Aviation Week & Space Technology

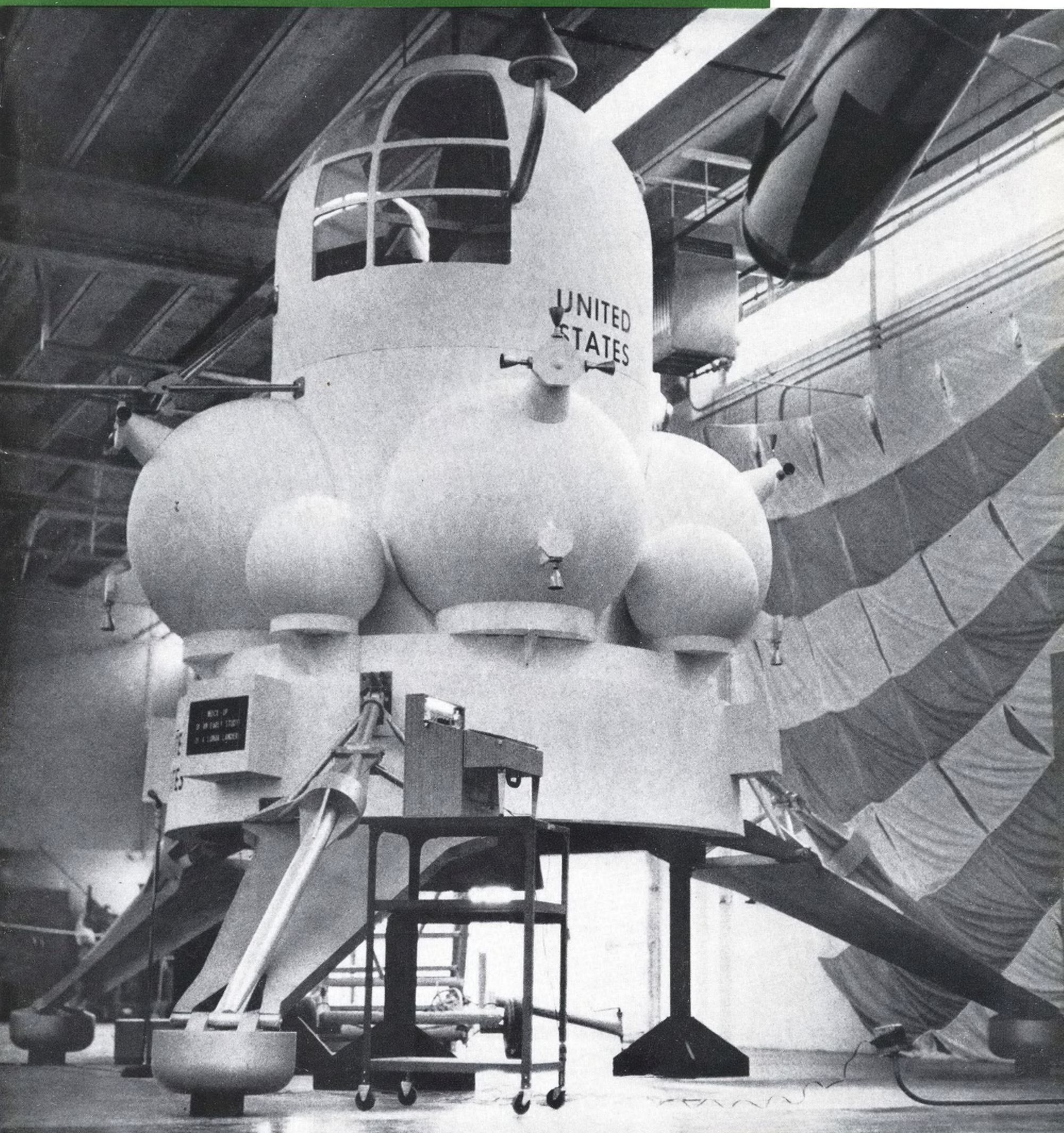
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October 1, 1962

Larger Space Role Proposed For Loran-C

Lunar Excursion Module



From conception to demonstration at AGN . . .



ML-1: WORLD'S FIRST FULLY MOBILE NUCLEAR POWER PLANT

Aerojet-General Nucleonics is engaged in one of the most challenging projects ever assigned to an organization specializing in reactor activities. The project: conceive, build and demonstrate a nuclear power plant powerful enough to supply 400 kw of electricity continuously for a year without refueling ...compact enough to be transported by truck-trailer, flatcar, or cargo plane...simple enough to be operated by a small crew of trained Army enlisted men...tough enough to withstand shock, vibration, pressure, and environmental extremes... and safe enough to be picked up and transported to a new site within hours after shutdown. One of the final steps, generation of electricity by the demonstration ML-1, is imminent.

The ML-1 is the smallest (40 tons) and hottest (1200°F. outlet temperature) nuclear power plant ever to produce electricity, and is the only plant in which the reactor is coupled directly to closed-cycle, high-speed turbo machinery. It is gas-cooled, and fueled with $BeO\text{-}UO_2$.

Full responsibility for the ML-1 project was assigned by the Atomic Energy Commission to AGN under the Army Gas-Cooled Reactor Systems Program. During management of the program, AGN has gained broad experience in all phases of lightweight, gas-cooled nuclear power plant design and production. AGN management skills, high-temperature reactor technology, test experience, and project personnel also are being applied to studies of advanced ground power plants, space power systems, and nuclear ram-jets.

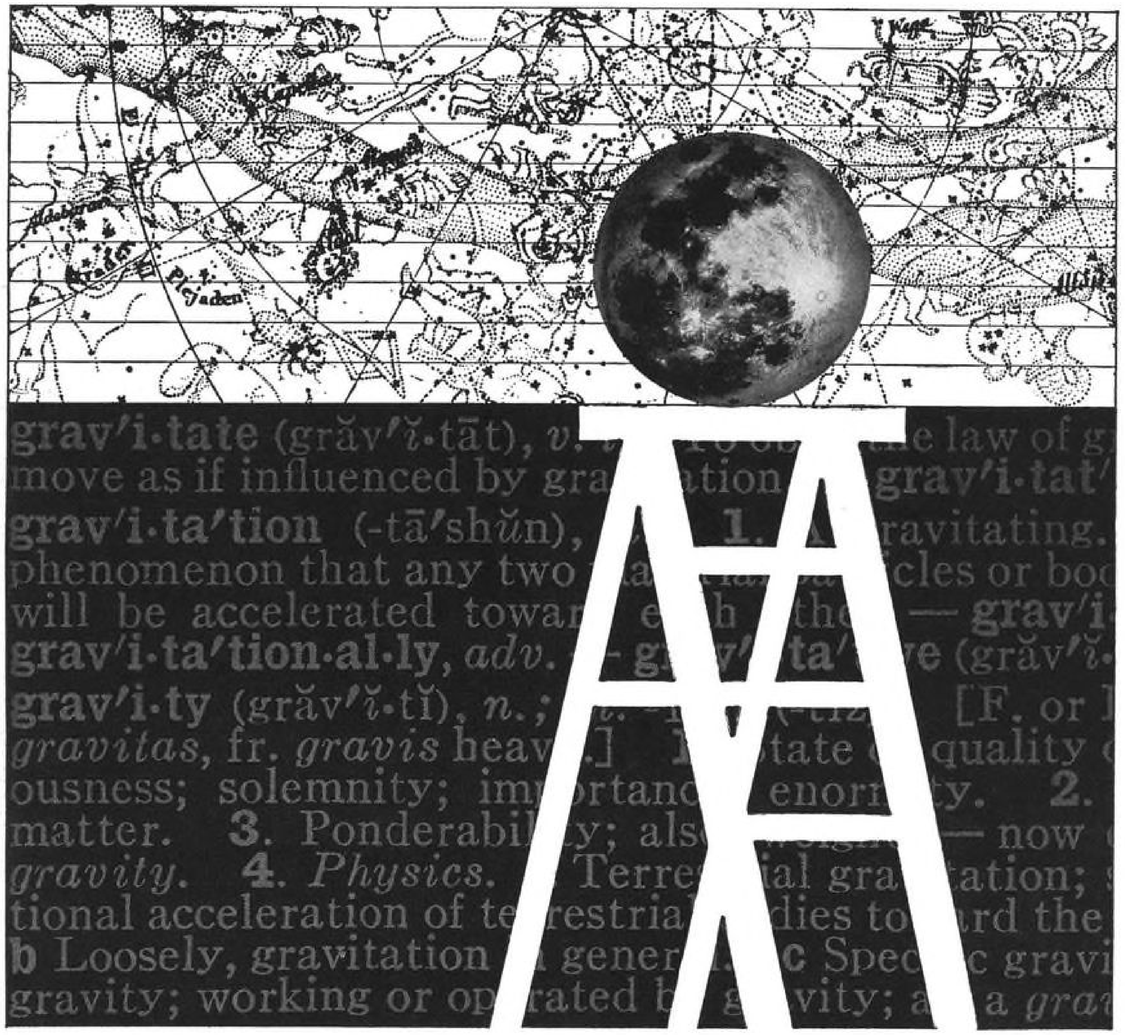
ML-1 is a joint project of the U. S. Atomic Energy Commission and the U. S. Army Corps of Engineers



Aerojet-General Nucleonics is located on a 500 acre site in the San Ramon Valley near Livermore, California

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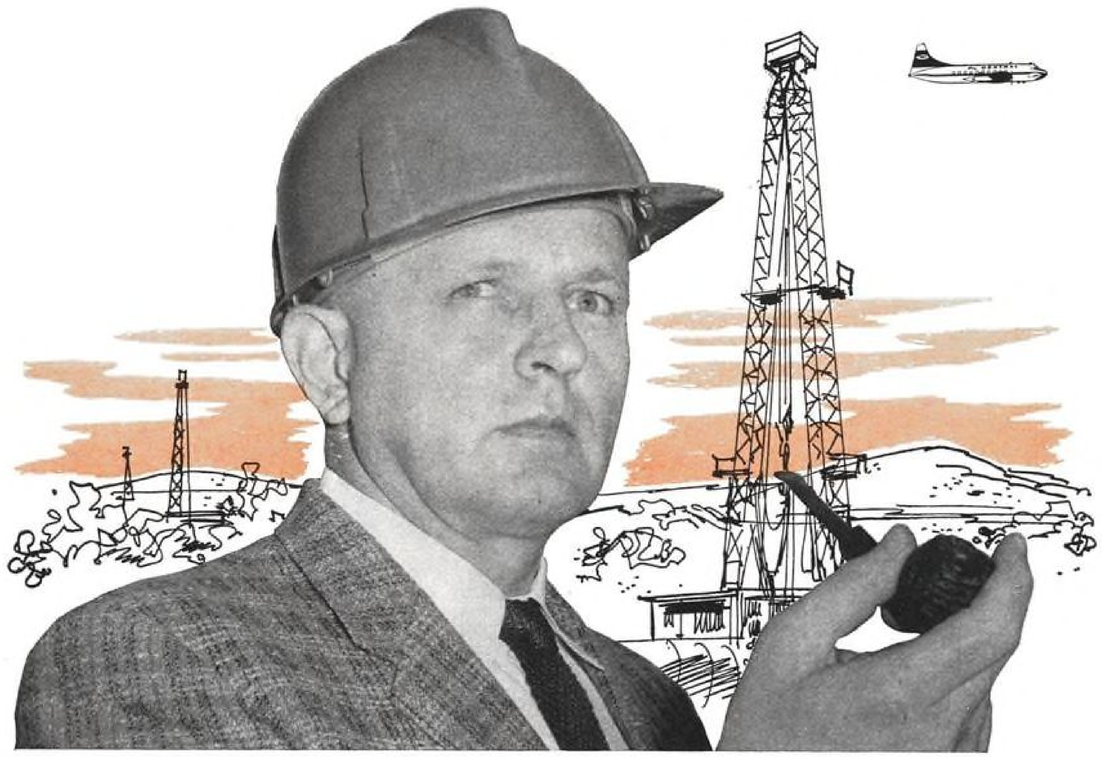
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Oct. 8-10—18th Annual National Electronics Conference & Exhibition, McCormick Place, Chicago, Ill.

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. 12-13—Symposium on Photography of Electronic Display, Shoreham Hotel, Washington, D.C. Sponsors: Society of Photographic Scientists & Engineers, National Bureau of Standards.

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: IAS; U. S. Navy. (Classified Secret)

Oct. 15-18—International Symposium on Space Phenomena and Measurement, Statler-Hilton, Detroit, Mich. Ninth Annual Meeting: IRE, NASA, AEC.

Oct. 15-18—17th Annual Instrument-Automation Conference & Exhibit, Instrument Society of America, Coliseum and Hotel New Yorker, New York, N. Y.

(Continued on page 7)

AVIATION WEEK and Space Technology

October 1, 1962
Vol. 77, No. 14

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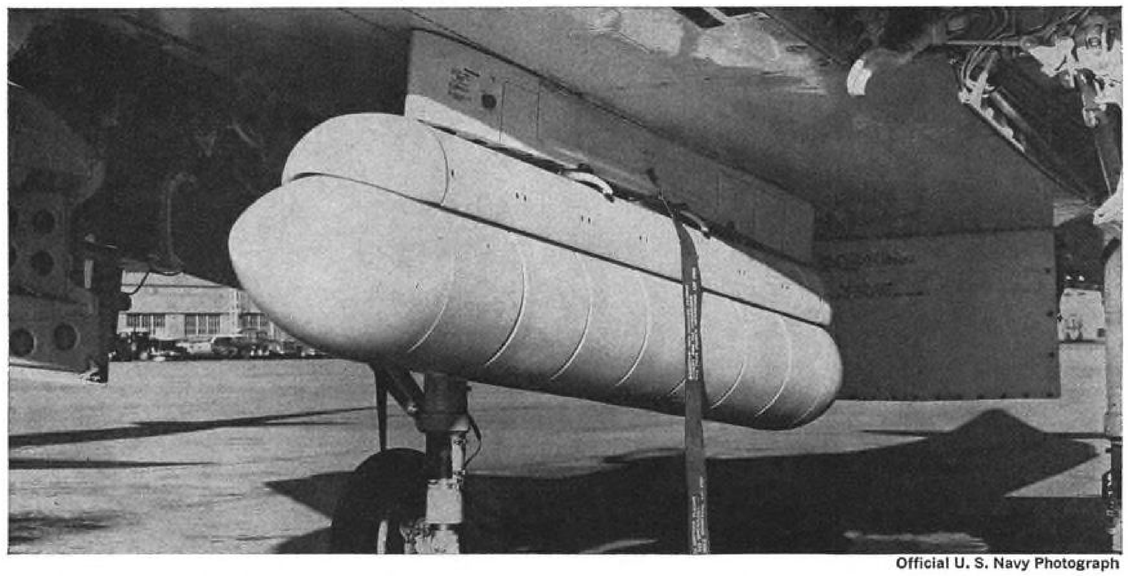
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limited warfare capability



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While public attention is focused on outstanding developments in ICBMs, atomic devices, earth satellites and other major programs, national defense must still be concerned with disabling the enemy's foot soldier; his weapons, his transportation—the tools of so-called "limited warfare."

One current program of Pacific Division, Houston Fearless Corporation, deals with this vital aspect of our nation's defense; a versatile, airborne, antipersonnel weapon system designated "Gladeye." Working in close cooperation with the U. S. Navy, Bureau of Weapons, and U. S. Naval Ordnance Test Station, China Lake, Calif., Pacific Division designed, developed and is producing this system.

This is another example of Pacific Division's advanced systems engineering and production capability. Other projects include propellant-actuated emergency escape systems, canopy actuators, launchers and stores ejectors.

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AEROSPACE CALENDAR

(Continued from page 5)

Oct. 16-17—Symposium on Inertial Guidance Test, Holloman AFB, N. M. Sponsor: Air Force Missile Development Center.

Oct. 16-18—Rochester Institute of Technology's Seminar on Noise in Electronic Systems, Midtown Tower Hotel, Rochester, N. Y.

Oct. 18-19—Second National Conference on Planning & Designing Urban Helicopter Facilities. Institute of Aerospace Sciences Bldg., Los Angeles, Calif. Sponsor: Los Angeles Chamber of Commerce.

Oct. 18-19—Sixth Annual Display, Aerospace Electrical Society, San Diego, Calif.

Oct. 22-23—Joint Meeting, Canadian Aeronautical Institute—Institute of the Aerospace Sciences, King Edward Sheraton Hotel, Toronto, Canada.

Oct. 22-24—East Coast Conference on Aerospace and Navigational Electronics, Institute of Radio Engineers, Emerson Hotel, Baltimore, Md.

Oct. 24-26—Annual Meeting & Exposition, Society for Experimental Stress Analysis, Hotel Schroeder, Milwaukee, Wis.

Oct. 25-27—1962 Electron Devices Meeting, Institute of Radio Engineers, Sheraton Park Hotel, Washington, D. C.

Oct. 26-27—17th Midwest Quality Control Conference, American Society for Quality Control, Denver Hilton Hotel, Denver.

Oct. 29—Fourth Annual Western Technical Conference, American Institute of Electrical Engineers, Biltmore Hotel, Los Angeles, Calif.

Oct. 29-30—Aerospace Fluid Power Conference, Pick-Fort Shelby Hotel, Detroit, Mich. Sponsor: Aerospace Division, Vickers, Inc.

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.

Oct. 29-Nov. 2—World Metal Show & National Metal Congress, American Society for Metals, Coliseum and Hotel Biltmore, New York, N. Y.

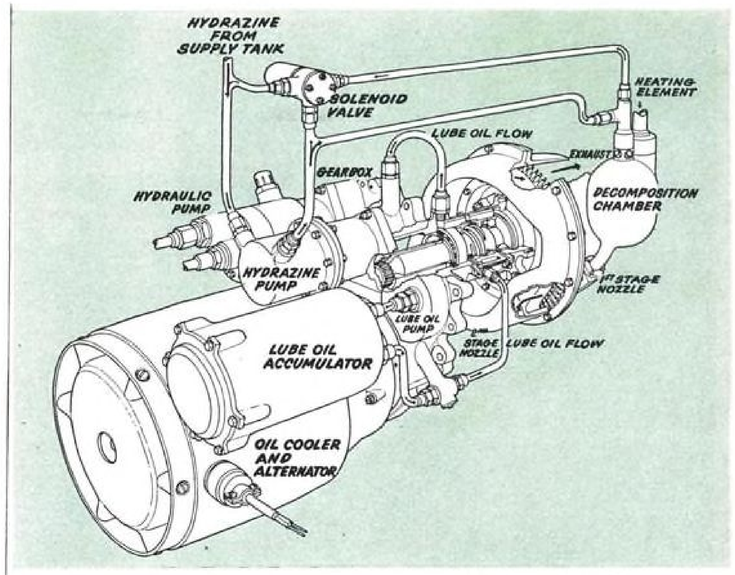
Oct. 29-Nov. 2—International Symposium, "Basic Environmental Problems of Man in Space." UNESCO House, Paris, France. Sponsors: International Astronautical Federation; International Academy of Astronautics.

Oct. 30—Supersonic Commercial Transport Metals Symposium, Metallurgical Society, Statler-Hilton Hotel, New York, N. Y.

Oct. 30-31—National Conference on Spaceborne Computer Engineering, IRE, Disneyland Hotel, Anaheim, Calif.

Oct. 30-Nov. 1—Eighth Tri-Service Conference, Armour Research Foundation, Chicago, Ill. Sponsors: U. S. Army, Navy and Air Force.

Nov. 13-18—17th Annual Meeting and Space Flight Exposition, American Rocket Society, Pan Pacific Auditorium, Los Angeles, Calif.



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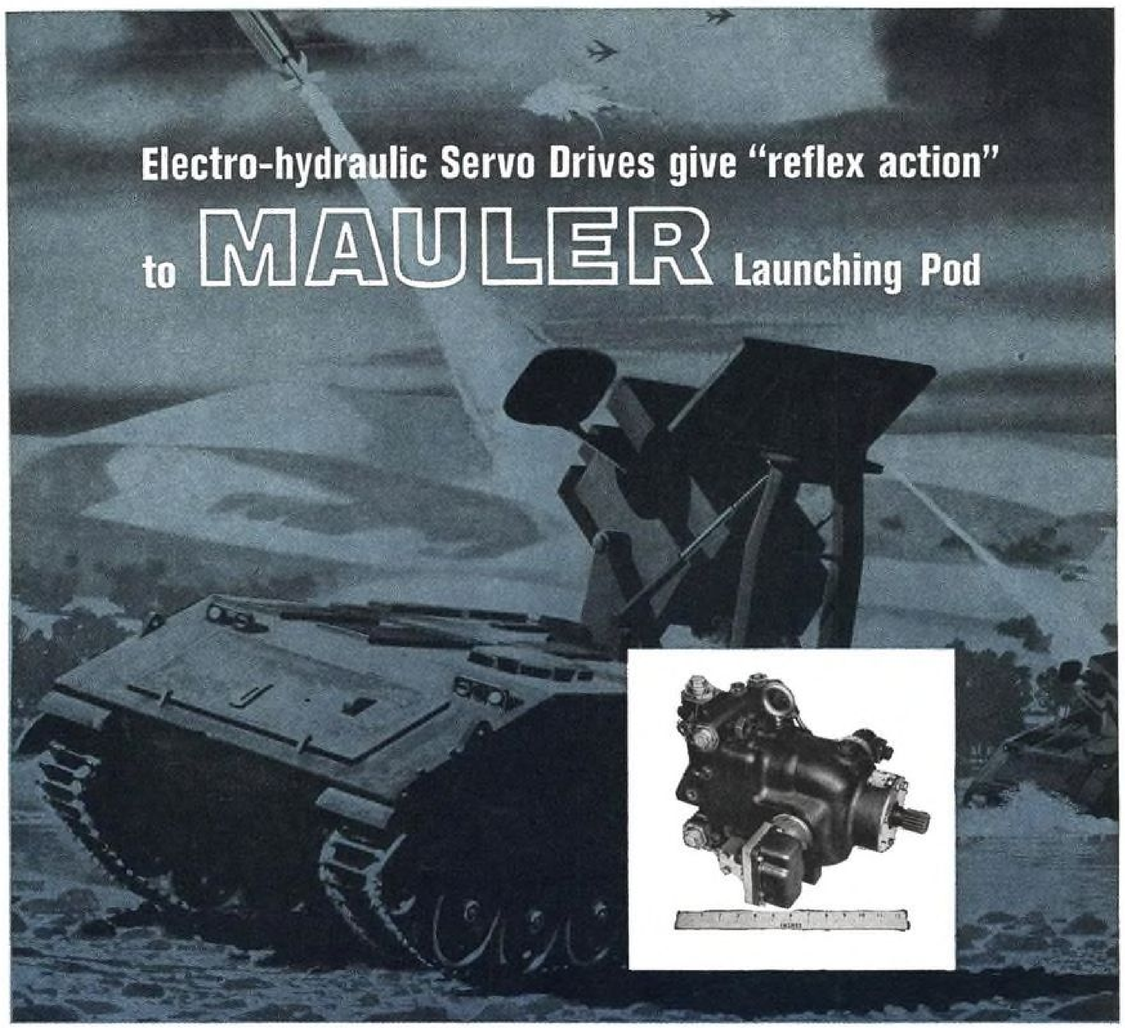
Under U.S. Air Force contract, Sundstrand Aviation-Denver has designed, developed, and tested a Space Power System fueled by hydrazine. It offers indefinite storability and instant restarts limited only by fuel. (Available with an electric heating element for starting or small oxidizer tank for hypergolic start.) ■ Both models utilize high performance, open cycle, monopropellant fueled turbomachinery. Both accomplish the objective of efficient conversion of chemical energy to electrical and hydraulic power. Normal rated output is 10 kva at 0.85 power factor (electrical) and 14 gpm at 2700 psig (hydraulic.) Either unit may operate on its own fuel supply, or on residual booster fuel at normal tank pressure. Each incorporates components required to convert the low pressure hydrazine to required decomposition chamber pressures. Four special Sundstrand design features give unique capabilities: ■ 1. A light, reliable hydrazine pump which injects the fuel into the decomposition chamber. ■ 2. Special, ball bearing, high-speed assembly, capable of withstanding extreme thermal gradients of the turbine shaft. ■ 3. Incorporation of a unique two-stage, single-disc turbine, wherein the thermal energy is efficiently converted to mechanical shaft power. ■ 4. An integrated lubrication system, capable of sustained operation in zero-gravity environment. ■ This Sundstrand SPS is adaptable to many space power applications, such as vehicle re-entry or orbital rendezvous operations where high power outputs are needed for relatively short durations. ■ Simply request, on your business stationery, further details concerning this, or the other space power systems which Sundstrand has under development. If you would like to work with or on the Sundstrand engineering team, finding practical solutions to challenging space power problems, write to: Personnel Director,

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Split-second response . . . deadly accuracy — these were the requirements! To position the launcher for the Army's fast-firing, fast-moving battlefield missile system called *MAULER, only a quick and precise power drive would do. FMC Corporation, which is developing the weapon pod, *found* that kind of drive in electro-hydraulic servo systems engineered and produced by Vickers Incorporated.

Vickers design approach to the required "reflex action" system was based on an unrivaled manufacturing experience (production of over 100,000 electro-hydraulic servo-pumps, for example) and broad servo-system engineering experience dating back to the beginning of World War II.

While the MAULER launching pod servo-pump package represents a custom-built system, it is essentially a combination of standard Vickers components tailored to provide optimum performance for FMC's specialized applications.

Here, then, is the unique advantage offered by Vickers Incorporated to any potential user of electro-hydraulic servo systems: extensive design capabilities coupled with a *broad line of existing hardware* including servo-pumps, servo-motors, valves and related components.

Check these advantages Vickers electro-hydraulic servo drives offer designers...

Rapid Acceleration (to 30°/sec.²) On one massive, tracking radar, Vickers servo drives provide accelerations of 30°/sec.² for inertias up to 7,480,000 lb. in. sec.²

High Grain — Accurate Response On another series of complex missile-tracking radars, Vickers closed-loop drives afford Velocity Constants over 100 sec.⁻¹

Low Weight-Volume/HP Ratios Weights and volumes of Vickers servo drives favor the antenna designer. For example, a 25 HP transmission has a weight to HP ratio of 8 lbs./HP and an envelope ratio of 0.24 cu. ft./HP.

Small Error Signals Move Large Masses On many antennas, error signal excitations as low as 0.10 milliwatts precisely and instantly control torques up to 4,500,000 inch pounds.

*Mauler is being developed for the United States Army by General Dynamics/Pomona.

If you would like to know more about the multiple advantages of hydraulics for ground support equipment, call your nearest Vickers district office or write to the Marine and Ordnance Department, Waterbury 20, Connecticut.

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COVER: Early concept of a lunar excursion module to be used in the Apollo manned lunar mission to land two men on the moon's surface was displayed by the Manned Spacecraft Center during President Kennedy's recent visit (AW Sept. 24, p. 32). This model was built by North American Aviation, which has the prime Apollo spacecraft contract. Contract for development of the operational module will be awarded soon.

PICTURE CREDITS
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EDITORIAL

Retrospect

Part of the function of this magazine, and this page in particular, is to alert various segments of the industry we serve to problems as soon as they are perceptible and occasionally to jar the industry into facing problems it would rather ignore. We find that the manufacturing portion of the industry seems to understand this type of comment and accepts it generally in the spirit in which it is written. However, the air transport industry, with some notable exceptions, has been enveloped in an aura of smug self-satisfaction that regards any criticism of its efforts, no matter how accurate or constructive, as lese majeste. This attitude of a large part of the air transport industry, particularly its official trumpeters, has not deterred us from taking a clinical approach to the industry's problems, nor will it. We will continue to politely decline the pleas of many airline people to help them sweep the industry's very acute problems under a rug of "gentlemanly conspiracy of silence" or to irrationally blame the government for all its ills.

The airline industry, most of all because of its daily abrasion on thousands of people, needs increased sensitivity to its public image and should concentrate hardest on projecting a feeling of mature, intelligent management, both to its stockholders and its passengers. This has been, as we predicted, a year of turmoil and changing trends in the air transport industry. We would be less than human if we did not take the opportunity that events now present to remind the wailing wall of airline management how many of the problems that they shrank from facing have now forcibly intruded into their operation, and how many of the problems we were implored to ignore have become the subject of drastic action by airline management.

Sales Staffs Shaken

For example, last winter (AW Feb. 5, p. 21), in an editorial entitled "Airline Sales Problems," we were so bold as to suggest that the energy expended in airline wailing about the overcapacity problem created by the jet transport could be better applied to a major revision of its sales philosophy and methods, both of which were rendered obsolete by the technical revolution of the jet. We even suggested that some airline sales experts had been lulled into a false regard for their own ability by the sharply rising trend of population and economic activity during the past two decades, contrasted with only a moderate increase in seating capacity. The major increase in seat capacity introduced by the jet transport issued a clear ultimatum—sell a lot more seats, or else. We received some pretty anguished cries over this comment from airlines sales personnel, including some vice presidents of major airlines. We think it significant that several of the loudest protesters against our exhortation to airline sales organizations to modernize for the jet age have been involved in the series of major shakeups of airlines sales staffs that has characterized the latter half of this year.

Safety is another issue that we warned could no longer be cloaked in a conspiracy of silence or muddled with meaningless statistics showing only a fraction of a person was killed per hundred million passenger miles flown. Our prediction that this outmoded approach to safety would no longer suffice in the jet age was confirmed by Sir Hudson Fysh, chairman of Qantas Airlines and retiring president of the International Air Transport Assn. and other speakers at its recent annual general meeting in Dublin (AW Sept. 17, pp. 21 and 38). The airlines are finally beginning to realize they must tackle this problem in a much more realistic manner, both internally and externally.

Passenger service is another subject that we have been harping on, much to some airline managements' annoyance. Here again some airlines have faced the problem and made some drastic innovations to simplify the routine of air travel for the passenger. Astonishingly enough they are finding the passengers flocking to their banner in larger quantities than ever and the empty seat problem becomes something for other airlines to worry about. But this message has not penetrated the air transport industry to nearly the depth it must before real progress can be made in this direction. Too many airlines still think more champagne, orchids for the ladies, or a newly designed overnight bag is the answer to passenger attraction. Traveling by air, whether on a short haul in piston equipment or on an intercontinental jet swoosh, is still far too complicated a procedure for the travelers to make them look forward to it as a pleasure.

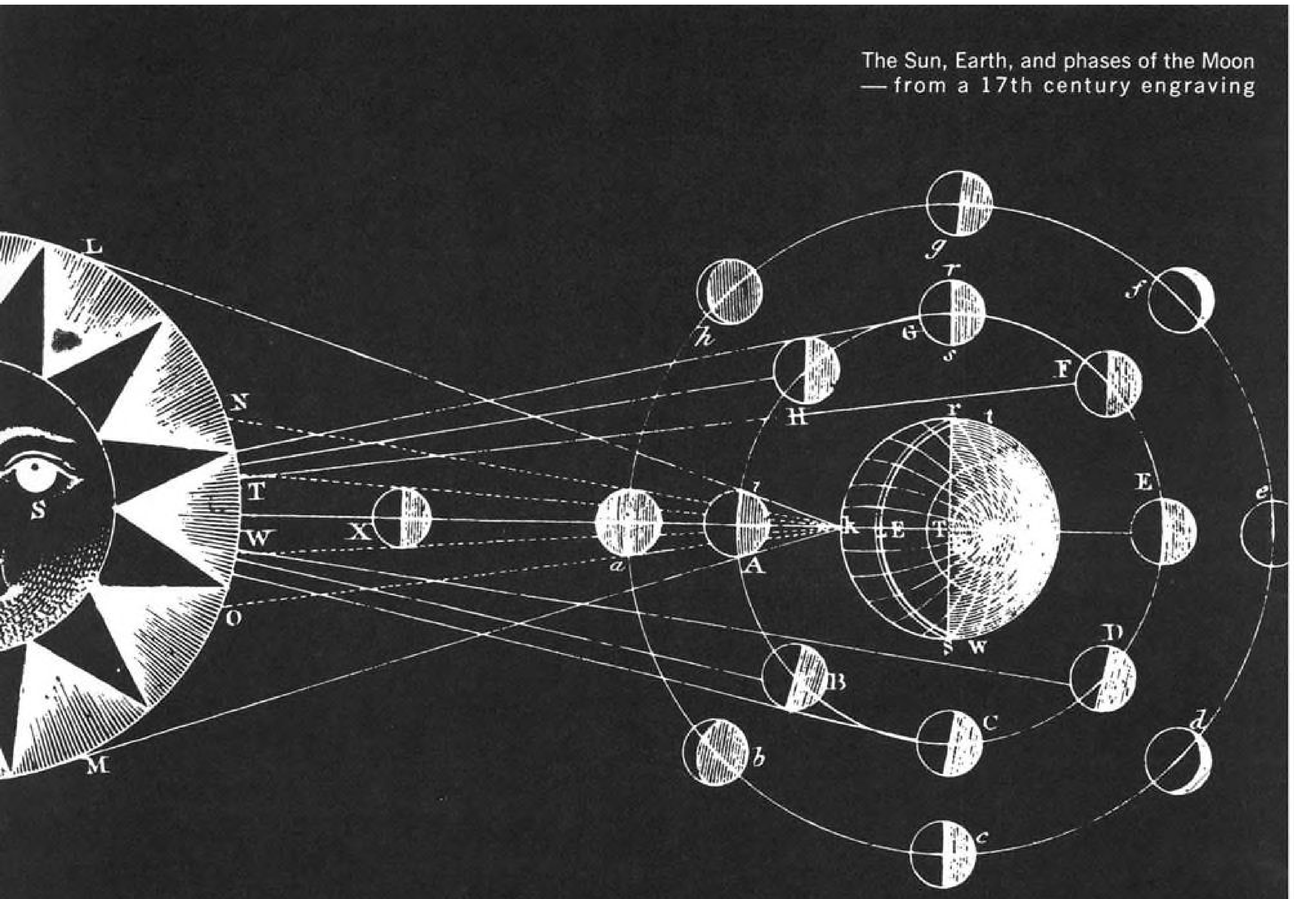
Applause for Lounges

Some time, the airlines are going to have to step firmly into airport terminal building design to halt the current trend of making passengers walk a significant portion of their total stage length simply to reach an aircraft. Whatever other critical jeers the Dulles International Airport mobile lounges may draw, they will surely be applauded by footsore passengers arriving exhausted from marathons on concrete at other airports. Has any responsible airline official ever considered the simple solution to the twin problems of adequate ramp space and passengers' sore feet long used in Europe with airport buses?

The increasing tempo of the world's economic and social life is creating a rapidly expanding demand for the services that airlines, thanks to their jet equipment, can now supply. The airlines problem is to supply it on terms that will attract the customer and not on terms that are simply a convenience for outmoded executive thinking.

Thus we deliberately cock an editorial snoot at our airline critics of the past few years and challenge them to add up the score as to who was more accurate in predicting the problems and changing trends in the industry. In the meantime, we will continue to do our editorial best, both in reporting these changing times in air transport on our news pages as accurately as is humanly possible and in trying to diagnose their portent on this page as a service to both the air transport industry and its passengers.

—Robert Hotz



The Sun, Earth, and phases of the Moon
— from a 17th century engraving

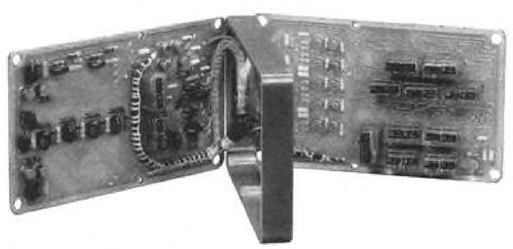
NEW DIMENSIONS IN SPACE

From early theories on space geometry, man's knowledge progressed to a finer appreciation of the universe and the challenging problems in its exploration.

Texas Instruments is applying its capabilities to an important part of the challenge — the problems of data acquisition, transmission, recovery, and display.

One of the newest technologies being brought to maturity in the Apparatus division is the expanded application of semiconductor network circuitry to space exploration equipment. TI's approach improves reliability and simplifies circuitry — effectively extending equipment capability without increasing volume.

For more information write Marketing department—47.



Here is one example: This seven-ounce PCM digital data signal conditioner has the semiconductor network equivalent of 2,215 components. Logic is performed by *Solid Circuit** semiconductor networks — 102 of them. This equipment has already been delivered to the Department of Physics and Astronomy at the State University of Iowa for an EGO satellite experiment.

* *Trademark of Texas Instruments Incorporated*

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WHO'S WHERE

In the Front Office

Lt. Gen. Donald L. Putt (USAF, ret.), a director, Granger Associates, Palo Alto, Calif. Gen. Putt is president of United Technology Corp.

William Lawrence, executive vice president, Laboratory For Electronics, Inc., Boston, Mass.; formerly he was general manager of General Dynamics' Military Products and Information Technology Divisions.

Carl W. Burroughs, Jr., vice president, Contracts and Service Division, Simmonds Precision Products, Inc., Tarrytown, N. Y.

Stanley A. Wainer, vice president-finance and secretary, Wyle Laboratories, El Segundo, Calif.

Edward A. Malling, vice president-marketing, Titeflex, Inc., Springfield, Mass., a division of Atlas Corp., and **Robert O. Cooling,** vice president-engineering.

Victor C. White, vice president and director of administration, Microdot, Inc., South Pasadena, Calif.

J. N. Martin, vice president-passenger sales, Trans World Airlines, Inc.

G. Ralph Bartolme, vice president and secretary-treasurer, Voi-Shan Industries, Inc., Pasadena, Calif.

Dr. Herbert F. Mitchell, Jr., vice president-advanced systems development, The Teleregister Corp., Stamford, Conn.

Capt. Fermon A. Stone, vice president-flight operations, Eastern Air Lines, Inc., and **Capt. Van Gale Rowland** and **Richard D. Eiland,** deputy vice presidents-flight operations.

Honors and Elections

Sen. George A. Smathers (D.-Fla.) has been named recipient of the Air Traffic Control Assn.'s Air Safety Award for legislative leadership in air safety.

Harold A. Wheeler, vice president and director of Hazeltine Corp. and founder and president of Wheeler Laboratories, Inc., a subsidiary, has been appointed a member of the Defense Science Board by the Secretary of Defense.

Changes

General Dynamics/Fort Worth (Tex.) Division has announced the following appointments: **W. T. Alvis,** director-contracts, pricing and planning; **R. L. Johnson,** director-flight and quality assurance; **J. J. Minton,** manager-program planning; **D. W. Johnson,** manager-contracts; **V. E. Prahl,** manager-flight, safety and reliability.

Thomas A. Callaghan, Jr., international programs manager, Aeronutronic Division of Ford Motor Co., with offices in Washington, D.C. **William S. Henry, Jr.,** succeeds Mr. Callaghan as manager of Aeronutronic's Eastern regional office.

A. L. Bethel, manager, Systems Department, Westinghouse Astronuclear Laboratory, Large, Pa.

Stanley M. Smolensky, deputy director of launch vehicles and propulsion, National Aeronautics and Space Administration's Manned Space Flight Office. Mr. Smolensky formerly was a Thiokol Chemical Corp., Washington representative.

INDUSTRY OBSERVER

► Army Ordnance Missile Command has selected four companies to conduct studies on its Hardsite program in a swing from its original plan to request bids for several three-month studies (AW Sept. 24, p. 23). Douglas, Lockheed, Martin and North American have been chosen to do the studies at $200,000 each.

► **Fairchild Camera and Radio Corp. of America are leading contenders for development of the visual instrumentation subsystem scheduled to be the camera payload for the Surveyor orbiter. Present NASA thinking favors going ahead with five 1,800-2,000-lb. Surveyor orbiters to be boosted into lunar orbit by the Atlas-Centaur. Alternative would have been to substitute limited-performance, 800-lb. Surveyors, boosted by Atlas-Agena B launchers, to get earlier shots in the series (AW July 23, p. 22).**

► Czech aircraft design team is developing a piston-engined, tilt-wing V/STOL aircraft aimed at both military and civilian applications. Work began about one year ago, and airplane may make its first flight late next year. Another design team is building an agricultural airplane, primarily for export to Soviet-bloc countries, which is expected to make its first flight early next year.

► **Proposals are due today for continued development of a low-cost odometric (distance-measuring) navigation system for the ground launching vehicle of the Army's surface-to-surface Mauler missile. System is to enable remote command post to ascertain location of launcher with high precision. It was previously under development by Belock Instrument Corp. for General Dynamics/Pomona, prime contractor for the Army tactical missile.**

► Rome Air Development Center plans a program to develop automatic means for comparison of two aerial photographs taken of the same area at different times. Purpose is to detect changes occurring since first photo was taken. Qualified companies must contact RADC by Oct. 1.

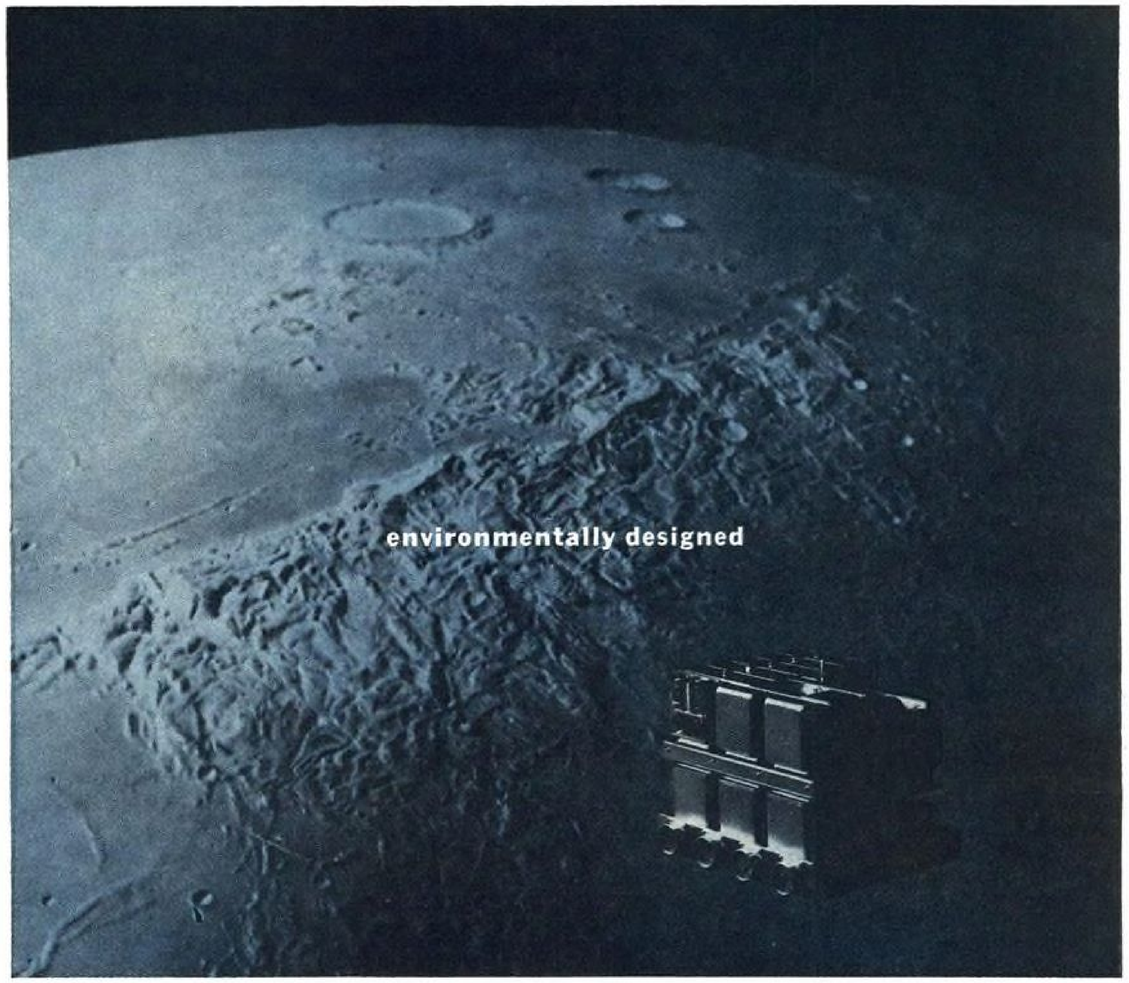
► **Advanced polycarbutene solid propellant being developed for Hughes GAR-9 missile by Lockheed Propulsion Co. (AW Sept. 17, p. 23) is expected to show specific impulse of 245 sec. and to withstand temperature cycling from 140F to −75F. Propellant was used in recent demonstration firing of Lockheed's 120-in. solid rocket motor.**

► USAF's Special Air Warfare Center has taken delivery on a pair of Cessna T-37B aircraft for evaluation of their limited-war capabilities. Planes are armed with four Sidewinders or other weapons including .50-cal. machine guns in underwing pods, 14 rounds of 2.75-in. dia. folding-fin aircraft rockets, or two 500-lb. bombs. Center also is evaluating the twin-engined Helio Model 500, designated U-5, as a STOL personnel carrier.

► **Some top NASA scientists believe that work on nuclear systems for space power and propulsion should be stopped temporarily in order to concentrate on some of the detailed problems still unsolved. They list radiators and liquid metals as two specific subjects demanding much more knowledge as a basis for further systems development.**

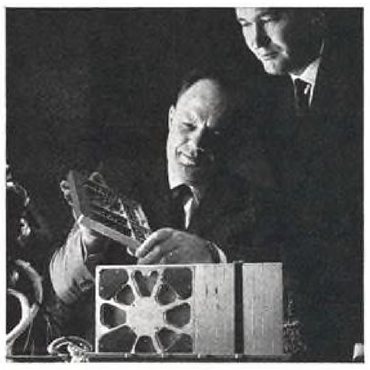
► Russian hydrofoil vessel development includes the use of a water jet for propulsion, replacing the conventional screw propeller. A new 30-passenger hydrofoil boat will be powered this way, and is expected to reach speeds of about 50 kt. Russians says the new boat will be able to cruise in shallow water and narrow channels.

► **Army is showing increased interest in Doppler navigation systems for its helicopters. Unexpectedly large number of Army helicopters were forced to land during recent maneuvers in the Carolinas after pilots became lost on night VFR (Visual Flight Rules) flights. Doppler systems are used for navigational aids on Navy helicopters such as the Kaman HU2K-1.**



...to survive in space: the moon and a Librascope computer

Shown metaphorically floating in circumlunar space is the first computer specifically designed to guide an exploratory instrument package to a soft landing on the moon. It is one of a line of Librascope computers designed to perform in space vehicles and missiles. The premium demand for minimum weight is met with



a variety of general-purpose digital computers. These computers are designed with maximum simplicity, commensurate with functional requirements and operate in their environment with highest reliability and long life. In space as well as at sea and in the air, Librascope computers pace man's expanding mind.

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Washington Roundup

Lunar Bug Decision

Politics and technical kibitzing are complicating selection of a contractor to build the manned lunar excursion module, or lunar bug, for the Apollo mission. Grumman and Martin led in the technical evaluation forwarded from the Manned Spacecraft Center at Houston, Tex., to James E. Webb, National Aeronautics and Space Administration chief, on Sept. 25. But most of the eight bidders have good "hard-luck stories," and the Kennedy Administration is paying closer attention than ever to contract awards because of the closeness of the November elections (see p. 16). Winner will be announced by Oct. 15.

Evaluation team was to brief Webb last weekend so NASA could be ready to make a formal presentation to the President's Science Advisory Committee on Oct. 2. Main reason for PSAC's interest is that Chairman Jerome Wiesner and his technical adviser, Nicholas Golovin, still are opposed to the lunar rendezvous method which NASA chose for getting to the moon (AW Sept. 17, p. 26). Because of this opposition, NASA had Space Technology Laboratories and McDonnell Aircraft conduct studies on direct ascent to the moon, using a two-man Apollo capsule boosted by a Saturn C-5 (AW July 16, p. 32). Conclusion of the studies: the mission would have only a marginal chance of success.

Critical Centaur Choice

Decision on the future of the troubled Atlas Centaur launch vehicle program rested with the top echelon at NASA last week after a sharp debate that pitted NASA's Space Sciences Office against its Marshall Space Flight Center. Marshall contends that the vehicle's troubles are so extensive that it should be removed from the space sciences program and made into a liquid hydrogen test vehicle, at least until three or four test flights can show whether it would be useful later on. Marshall said the Saturn C-1—which is already fully committed to Apollo development flights through about 1965—could take on the 10 lunar and planetary missions now scheduled for Centaur. Space Sciences Office wants the schedule to stay pretty much as it is. NASA re-evaluated Centaur after the House space sciences subcommittee said NASA should determine whether the program "constitutes a good investment of additional time, money and talent."

Russia launched Cosmos 9 at an inclination of 65 deg. to the equator on Sept. 27. Only two other Cosmos satellites have flown at that inclination. The last was Cosmos 7, which immediately preceded the flights of Vostoks 3 and 4 and apparently was used to assure that radiation along that path would not harm cosmonauts. Apogee of Cosmos 9 is 220 mi.; perigee, 187, and period, 90 min.

Chinese Nuclear Tests

Communist China has admitted publicly that it is working on nuclear weapons. A Communist broadcast to Tokyo quoted Deputy Premier Chen I as saying his country is engaged in large-scale nuclear experiments but that it could not reveal when it would conduct nuclear tests.

By late last week, Soviet Russia had conducted 17 tests since Aug. 5 that Atomic Energy Commission commented on specifically, plus enough others that AEC refers to the series as "intensive." The Aug. 5 test had a yield of 30 megatons, AEC said. Second and third largest shots up to Sept. 25 were in the multi-megaton range; five more were of several megatons; two were described as having yields of "a few megatons." On Sept. 27, Russia exploded a device that AEC said had a yield of less than 30 megatons.

At least 60 aerospace firms have located offices and company representatives in Houston to serve as liaison with the Manned Spacecraft Center. Another 20 to 25 companies have indicated that they plan to open offices there and at least one—Raytheon—has said it plans to establish an electronics laboratory in the area. Apollo manned lunar landing project being run from Houston now involves about 6,000 firms and more than 180,000 industry personnel, MSC Director Robert Gilruth told President Kennedy on the chief executive's recent visit.

Selected Short Subjects

Air Force has unofficially recommended to defense contractors a way to avoid submitting films for security review and having them returned with only the title and credits approved. It suggests that anyone who plans a film that will have to be reviewed should send three copies of the script through the usual channels for approval before committing the film to production.

President Kennedy apparently has no more luck at getting information from Assistant Secretary of Defense for Public Affairs Arthur Sylvester than reporters do. A questioner asked the President at a White House conference last week how reporters could obtain copies of the Mar. 23 space secrecy directive (AW May 28, p. 30), which deals with release of military satellite information. The President said he would ask Sylvester about it. The questioner said he had already done that. The President replied: "Fine. I will talk to him, with no success, I am sure."

—Washington Staff

Kennedy May Enter Dispute Over Solids

NASA, Defense split over how far Defense should go in developing large motors; Nova vehicle involved.

Washington—Defense Department and the civilian space agency were struggling to reach agreement late last week on a large solid fuel rocket motor development program that has become so controversial President Kennedy may be asked to settle it.

Basic issue is just how far Defense is obligated to go in developing large solids, under existing agreements. Defense leaders have contended they are only required to develop large solid technology, while National Aeronautics and Space Administration leaders claim the military is obligated actually to build and test-fire a 260-in.-dia. motor, which has become an active competitor for the Nova launch vehicle first stage.

Several members of Congress have been maintaining that Defense is not putting enough emphasis on large solids. Rep. David S. King (D.-Utah), a member of the House Science and Astronautics Committee who shares this view, told AVIATION WEEK that the Defense-NASA dispute is so fundamental to the national space program that he was going to urge President Kennedy to enter the dispute.

Rep. King's appeal to the President is likely to receive sympathetic treatment, partly because the entire large solids issue has heavy political overtones. Rep. King himself is in a tough fight with Republican Sen. Wallace F. Bennett for a Utah Senate seat. President Kennedy is very much interested in that race and therefore is inclined to help Rep. King any way he can. Getting Defense to spend a good part of the $40 million Congress authorized this year for large solids would be a great help to Rep. King's senatorial campaign, especially if some money went to Thiokol's Utah facilities before election day.

'Breach of Faith'

"It is a breach of faith with Congress for Defense to refuse to spend the money authorized for large solids," Rep. King said. "Any time we decide to turn to solid fuels for space propulsion we can within three years leap-frog the Russians."

In NASA itself, some leaders are urging Administrator James E. Webb to embark on a solid program if Defense does not conduct one extensive enough to fulfill the space agency's requirements. NASA may tell Congress it needs nearly $100 million for a large solid demonstration program if an agreement cannot be reached with Defense.

Point of dispute is interpretation of the roles and responsibilities contained in the Defense-NASA national launch vehicle program agreement of May 8, 1961. This agreement gave responsibility for development of large solid motors to the Defense Department, with the proviso that Defense be responsive to NASA requirements.

Defense has felt its responsibility is restricted to developing the technology for large solids. NASA is insisting that the program include the static firing demonstration of a flight-weight, 260-in.-dia. motor, including flyable nozzle, igniter and thrust vector control system.

Although NASA has been cold to the development of large solid motors in the past (AW Apr. 9, p. 33), the agency has re-examined potential Nova missions and proposed configurations and has revised its thinking on solids to the point where it now feels a demonstration firing is necessary before it can select the ultimate Nova vehicle.

The large solid program has reached its present status because of these developments:

- **Selection of lunar orbit** rendezvous technique for the Apollo manned lunar landing mission. If the direct ascent method had been chosen, NASA was prepared to equip Nova with a booster powered by 12 F-1 engines. Lunar orbit rendezvous will use the Saturn C-5—a cluster of five F-1s—and the decision to give top priority to this technique carried with it a two-year deferment in Nova development (AW July 9, p. 25).

In its re-examination of Nova, doubts have arisen within NASA on the wisdom of clustering as many as 12 massive engines in a single stage. In addition, it now appears that 13 or 14 F-1s may be needed for the minimum Nova mission, which is 500,000 lb. in earth orbit and 200,000 lb. in escape.

One informed official feels the Nova competition will ultimately narrow to a choice between solid propellants and plug nozzles in order to avoid the inherent lack of reliability in large numbers of engines in clusters.

- **Titan 3,** basically a Titan 2 core with two 120-in.-dia. solid propellant rockets strapped to its sides. The top priority which Defense Department and Air Force are placing on this vehicle, being designed as the X-20 (Dyna-Soar) launcher, has led to fears within NASA that money earmarked for the 156-in.-dia. and 260-in.-dia. motors would be diverted to Titan 3. This fear has been confirmed to Congress by the Pentagon (AW July 9, p. 17).

Air Force, which is backing the NASA solid propellant development program, feels a demonstration firing of a basic case and propellant of a 260-in. motor will cost less than the $40 million earmarked for solid motors larger than 120 in. However, a completely flyable system with flight subsystems will cost an estimated $100 million.

Defense Secretary Robert S. McNamara and Webb were to attempt to iron out their differences late last week and to come up with the basis for a mutual program. If they are successful, industry can expect to receive proposal requests for the program sometime in mid-October. Air Force Systems Command has had specifications ready for several months.

Nova Configuration

NASA had hoped to select a Nova configuration before the end of the year (AW Sept. 24, p. 34), but now admits that it cannot do so until the 260-in. solid motor is demonstrated. Because Air Force will do the actual development work on the motor—unless NASA pushes for a program of its own—NASA and Air Force have been in the unusual position of being on the same side in a disagreement with the Defense Department.

There is a strong possibility that no matter who manages the program, additional funds will be required in order to conduct a demonstration firing next year. Although NASA considers the 260-in. program its top priority solid propulsion development, the agency admits that the Nova configuration is highly competitive, and large solid development could be ended following the firing demonstration. Because the Defense Department-NASA agreement on launch vehicles gives responsibility for solid rockets to Defense, NASA has been given only $7.9 million for the program in Fiscal 1963.

Solid propellant proponents, meanwhile, are heartened by what they consider adaptability of a large solid booster for manned missions. Long burning times, in the order of 120 sec., will reduce maximum dynamic pressure to 1,000 psf. or less, and maximum g-loads to 4.8 to 5. Work is progressing on abort sensing and implementation systems, using pressures, accelerations and case temperatures as sensing points, and on astronaut control of booster thrust with secondary injection or movable fins.

Stricom Weapons Requirements Outlined

Las Vegas—Deficiencies in the U.S. arsenal of weapons on hand to cope with limited war were outlined here by Army Gen. Paul D. Adams, commander of U.S. Strike Command, and Brig. Gen. Gilbert L. Pritchard, commandant of USAF's Special Air Warfare Center, Eglin AFB, Fla.

Stricom's greatest need, according to Gen. Adams, is a cheap, reliable anti-tank missile. This weapon, he said, should contain a homing device. It should lend itself to either air-to-ground or ground-to-ground operations and be light enough that a soldier could carry it into the field and "fire it from the case it came in," Gen. Adams said.

Even more important is the more distant goal of lightening all combat equipment assigned to Stricom units, Gen. Adams said at the Air Force Assn. meeting here. On a related subject, he urged that more troop carrier aircraft be assigned to Tactical Air Command, over which Stricom has limited jurisdiction.

Air Force's "training role" in counter-insurgency operations would be aided if it could press into service a boundary layer control system that would enable existing aircraft to use shorter, unimproved landing strips, Gen. Pritchard said. But such a system should not be the end product of a prolonged development program; "The need is now," he said.

Another less tangible need cited by Gen. Pritchard is a "sound, usable doctrine" that would define the respective roles of USAF's Air Commandos and Army's Special Warfare Forces in dealing with counter-insurgency.

Aerospace Plane May Give Way To Booster, X-20 Type Vehicle

By David H. Hoffman

Las Vegas—Air Force concept of a single-unit Aerospace Plane may be scaled down in favor of a two-stage vehicle consisting of a recoverable booster and a spacecraft similar to the USAF-Boeing X-20 (Dyna-Soar) that would contain its own powerplant.

Shift in Air Force emphasis was suggested here by Gen. Bernard A. Schriever, commander of Air Force Systems Command, who said that "advanced feasibility studies" describing such a two-stage vehicle were in progress. According to Gen. Schriever, Aerospace Plane has never been more than an idea proposed to orbit and recover pilots in a single vehicle.

"We're now thinking of a two-stage booster that still would provide re-usable hardware," Gen. Schriever said.

Another judgment that could simplify the technical task of designing and building Aerospace Plane was voiced here by Air Force Secretary Eugene M. Zuckert. The "dual-vehicle orbital experiment of the Soviets," he said, indicates the U. S. should concentrate its defensive efforts in the "near orbital stage of space," not farther out.

"One possible instrument of security that might be useful at this level in space may be found in extending the X-15 and X-20 technology, leading to craft which could operate from surface to orbit and back, and perform defense missions at the edge of the atmosphere. Another might be the permanently manned orbital space station designed for military purposes."

In a speech coordinated beforehand with the White House (AW Sept. 24, p. 25), Zuckert stressed that while National Aeronautics and Space Administration's experience would help USAF acquire competence in manned orbital flight, hardware to support the military's space role must meet military standards of "cost effectiveness and repetitive use." For this reason, Air Force must seek "re-usable or less expensive mechanisms for getting into space, whether by use of recoverable first stage boosters or by employment of airborne launch platforms," according to Zuckert.

Running through Zuckert's speech was the theme of using space hardware repetitively to conserve funds.

On a closely related topic, Dr. Arthur Kantrowitz, director of Avco-Everett Research Laboratory, made a strong plea for a broad-based U. S. effort to develop the technology of manned orbital assembly. Criticizing what he called neglect in this area, Kantrowitz said that the lifting capability of current U. S. boosters should be exploited quickly to assemble a space station before Russia does. Kantrowitz outlined similar views for AVIATION WEEK last Sept. 4, (p. 60).

If the U. S. had been as "cautious" in developing the ICBM as it is now on manned orbital assembly projects, "we would not have an ICBM today," Kantrowitz said.

Opinion was split here on whether, in fact, a space gap or just a booster gap exists between the U. S. and the USSR. On this point, Kantrowitz said that if the Russians are close to mastering the techniques of orbital rendezvous, "soon they will be able to place larger payloads in orbit than we can with any of the boosters we are even thinking about. And that, my friends, is a gap."

To stress "the cliche" that all the U. S. lacks in the space race is big boosters damages the national space program, Kantrowitz said. "It stops us from using those we now have."

Had the U. S. concentrated on manned orbital assembly projects three or four years ago, he said, there would be no talk of booster gaps today. Even if such work was begun now, the U. S. could have 200,000 to 300,000-lb. payloads in low earth orbit by 1964, he said. The combination of manned orbital assembly and U. S. mass production would enable this country to outdistance the USSR, he said.

Vostok Rendezvous Study

Varna, Bulgaria—Study of "group flight and rendezvous techniques" was a primary objective of the flights of Vostoks 3 and 4, Soviet Cosmonaut Gherman Titov said here last week. He said the two capsules were within 3.1 mi. of one another at one point shortly after the launch of Vostok 4, and that the cosmonauts were in visual as well as radio contact with one another.

In an unscheduled appearance at the 13th International Astronautical Congress, Maj. Titov placed the total thrust of the booster system used to launch Vostoks at 1.32 million lb. Speaking in Russian, Maj. Titov described the launch vehicle as "a multi-stage system." His interpreter, however, translated this into English as a "four-stage" unit.

Vostok Estimates Change

Las Vegas—Space authorities in the U. S. are revising their public estimates of the distance that separated the Soviet Union's Vostoks 3 and 4 in orbit (AW Aug. 20, p. 26). According to Dr. Arthur Kantrowitz, director of Avco-Everett Research Laboratory, the two Russian capsules came within 1.87 mi. of each other shortly after launch.

Official North American Air Defense Command (NORAD) analysis of the flight is that the cosmonauts "approximated a space rendezvous pattern" while criss-crossing the U. S. mainland a total of 70 times.

NASA said last week it can no longer comment on its estimate of the distance between the Vostoks, although refined figures within the agency have now reduced the earlier 75-100 mi. estimate (AW Aug. 27, p. 36) to 12 mi.



BEECH MODEL 120 is powered by two 917-shp. Turbomeca Bastan 6 turboprop engines. Eight-place aircraft, which will sell for less than $500,000, will be offered in four configurations. Construction employs multi-spar wing and fail-safe design throughout airframe.

Beech Shows Full-Size Model 120 Mockup

By Erwin J. Bulban

Wichita, Kan.—Beech Aircraft Corp. opened its marketing program on the new eight-place, twin-turboprop-powered Model 120 executive transport last week with formal unveiling of a detailed, all-metal, full-size mockup here.

A week earlier, Beech briefed about 50 distributors and their key personnel on the new airplane.

Mockup is one of the most detailed ever constructed, closely duplicating the airplane as it will be built, down to placement of stringers, bulkheads, installation of systems and cockpit equipment, including actual instruments. The aircraft's cabin is completely furnished.

Current proposal is to keep the mockup in Wichita in a specially designed display area adjacent to the plant. This will provide prospective customers, with a maximum opportunity to study the aircraft in detail with full factory and management support through late this year. This schedule probably will preclude exhibiting the full-scale mockup elsewhere.

Building of the detailed mockup has paid a dividend to Beech engineers and workmen associated with the project by providing valuable experience that can be used in designing experimental tooling to construct the actual prototype. This is cutting considerable time from the drawing board-to-production cycle. It also provides first-hand knowledge of some fabrication problems that cannot readily be foreseen.

First flight was originally scheduled for early 1964 and deliveries of certificated production aircraft to customers was set for 1965. However, the fabrication experience gained through building the mockup may cause these dates to be moved ahead somewhat.

Powered by two 917-shp. Turbomeca Bastan 6 turboprop engines, the new Beech Model 120 will sell for less than $500,000 fully equipped with cabin furnishing and electronics. With several thousand hours of flight experience already behind it, the Bastan 6 is undergoing an additional 10-hr.-daily service program.

Initially, this powerplant may have time-to-overhaul of 750 to 1,000 hr. It is also expected that, following the usual procedure of basing overhaul time on service experience, the Bastan 6 will eventually reach 2,000 hr. service between overhauls.

Beech engineers based the Model 120 design on providing an airframe that will be capable of meeting Federal Aviation Agency requirements for certification under Civil Air Regulations Part 3, with a 3.2 load factor. Structure life is considered as infinite. Construction employs a multi-spar wing and fail-safe design in the entire airframe.

Model 120 is being considered for marketing in four configurations—varying in furnishings and equipment installations—based on a standard empty weight of 6,673 lb., and a maximum gross weight of 12,603 lb.

Payload-range capabilities will vary, considering provision for sufficient fuel to include usual allowances for the mission and adding IFR reserves of 200-mi. diversion plus 45 min. But the optimum configuration, with a full complement of six passengers and two crew members, provides for a 1,500-mi. nonstop range with these fuel reserves at a 325-mph. true airspeed cruise at 25,000 ft.

Estimated gross weight performance also includes a two-engine rate of climb from sea level of 2,200 fpm. With one engine out, climb rate is still 610 fpm. To clear a 50-ft. obstacle at sea level will require 2,700 ft. from start of takeoff roll. Landing distance over a 50-ft. obstacle at sea level with approximately 12,000 lb. weight will be a little more than 2,700 ft.

Blue Streak Delivery

London—De Havilland Blue Streak space launcher vehicle, first to complete full ground checkout and static-firing program at Spadeadam test grounds, will be shipped to Australia in November by sea.

Rocket, selected as first stage in European launcher development scheme, will be fired for the first time next year from the Woomera Range. Second and third stages are being developed by France and West Germany.

Latest static firing at Spadeadam, using the vehicle's two Rolls-Royce engines, lasted 40 sec. and produced a total of 275,000-lb. thrust. Capability will be increased to 300,000 lb. W. H. Stephens, nominated as technical director of European Launcher Development Organization (ELDO), said present plans call for 10 firings of complete three stage vehicles at Woomera.

AIA-Rocket Society Controversy Growing Over Technical Displays

New York — Controversy between American Rocket Society and the Aerospace Industries Assn. over displays at technical meetings is coming to a head as the date of the society's annual meeting approaches.

Basis for the argument is a pair of resolutions adopted by the AIA last November. First of these requests member companies ". . . to avoid the costly exhibition of company products" at technical society meetings.

Second resolution ". . . deplores the multiplicity of exhibitions of defense products . . ." and ". . . recommends to its [AIA's] members that participation in exhibitions, in the United States, not endorsed by the AIA, or formally requested by DOD or NASA, be eliminated, or reduced to the maximum extent possible."

Wording of both resolutions would not prohibit participation by a company which argues that it has reduced its participation to the maximum extent possible or that its exhibit is not costly. At least 24 top AIA companies have bought display space at the ARS meeting in the Pan-Pacific Auditorium, Los Angeles, Nov. 13-18.

ARS is trying to convince some of the holdout companies that their participation in the display portion of the meeting is not only justifiable but a very desirable adjunct to the meeting.

New this year to the ARS meeting is the concept of the "technical display," used not as a simple show case or ornate image for a company, but rather as a supplement to the technical papers which form the main reason for convening the meeting.

In response to some criticism of displays at last year's Space Flight Report to the Nation in New York, the society decided to encourage the technical display as one means of providing supplementary information not easily presented by the author of a technical paper.

Most of these technical displays are now planned as lectures and demonstrations. They are not necessarily costly. One company's booth will have folding chairs and a blackboard for the lecturer. Others will use the same basic setup, with charts or models included for the demonstration. Some elaborate and perhaps expensive displays have been planned for the meeting.

This kind of approach to a display, ARS says, is a valuable aid to the easy and rapid transfer of technical knowledge.

Among the displays planned for this year's meeting: Series by United Technology Corp. on the latest concepts in solid-rocket motor technology, Space Technology Laboratories demonstrations of the Orbiting Geophysical Observatory, descriptions of payloads for Rangers 6 through 10 by Radio Corp. of America, Republic Aviation Corp.'s lectures on Project Fire and a suit developed for the Apollo program, Martin-Marietta lecture on Titan 3 (System 624A), and a Saturn S-4 progress report by Douglas Aircraft.

House Group Backs Defense Supply Unit

Washington—Effectiveness of the newly-established Defense Supply Agency will be tested most significantly by the way it manages aeronautical spare parts, the House Government Operations Military Operations Subcommittee said in a report to Congress on the agency.

"The aeronautical supplies and repair parts commodity group is probably the key issue which must be decided in order to define the future size, scope and utility of the Defense Supply Agency," the subcommittee said in a report endorsing the centralized supply agency that was established by Defense Secretary Robert S. McNamara on Nov. 6, 1961.

Defense is studying the 500,000 items included in the military's inventory of aeronautical parts to determine which ones should be bought by the DSA and then distributed as needed to the individual services. General Accounting Office long has maintained that centralized procurement of these parts would save money.

The subcommittee endorsed DSA's caution in entering the aeronautical parts field. "The potential DSA role could provide great savings but also very dangerous margins for error," the report said. The subcommittee theorized that DSA was approaching the task "gingerly" because of the apprehensiveness of the individual services toward the expanding role of the supply agency. Report on a pilot study of aeronautical spare parts supply is expected to be given to Defense Secretary McNamara this month.

In contrast to an Aug. 13 report of a special House armed services subcommittee, the military operations subcommittee said the establishment of DSA "should not be viewed with alarm, in terms of the controversies of the past, as a fourth service of supply. . . . The committee supports a sustained aggressive effort of the DSA to acquire new responsibilities and to develop improved management methods for common supplies and services . . . [DSA] can become the first agency able to provide reasonably accurate data for optimum allocation of the common supply and service resources upon which all military components will levy competing requirements."

The armed services subcommittee had decried the Defense Department's centralization trend. The subcommittee said that this trend could lead to a fourth service.

In appearances before several congressional committees, McNamara has said DSA will save millions of dollars each year—$27.7 million in Fiscal 1963 alone. The subcommittee report detailed how Defense arrived at this estimate of savings. Defense asked each service to estimate how much their supply activities would cost in Fiscal 1963 by using customary methods. The services estimated the cost at $205.4 million.

Defense then estimated DSA could do the job for $177.7 million, or $27.7 million less.

Rear Adm. Joseph M. Lyle, DSA deputy director, told the subcommittee May 14 that the estimate was based on using 3,000 fewer people for supply activities. In its report, the subcommittee said the estimates are subject to uncertainty, adding "in the head count of personnel allocation, there are many difficulties which are not apparent from the examination of rosters and personnel strengths."

Mississippi Test Site Development Detailed

Washington—First construction phase of National Aeronautics and Space Administration's Mississippi Test Facility will include stands to static test booster and second stages of the Saturn C-5 launch vehicle.

Development plan, announced Sept. 26 by NASA, involves construction of about 15 mi. of canals at the facility so that barges can deliver stages directly to test stands. The 141,500-acre test site is 35 mi. from NASA's Michoud manufacturing plant, where the stages will be assembled.

The $200-million first construction phase calls for completion of the first of two North American S-2 pads in early 1965, and the first of two Boeing S-1C stands in mid-1965. Each test stand will have two firing positions, and the S-2 and S-1C complexes will be separated by 6,000 ft.

The test facility (AW Mar. 26, p. 54) will be used to static test stages of the Nova launch vehicle as well as the Saturn C-5.

U.S. Watches for Possible Cuban IRBMs

By Larry Booda

Washington—Pentagon strategists consider the present arms buildup in Cuba the first step toward eventual construction of intermediate-range ballistic missile emplacements.

They point out that the defensive nature of armaments arriving from Soviet Russia is aimed at preventing aerial photographic reconnaissance, not at preparation to fend off an invasion, although they could be used to repel invasion.

If this information source is shut off, then the construction of missile sites could begin in secrecy, they assert. After becoming operational, these missiles, if given a 1,200 naut. mi. capability, could hit targets as far away as Boston, Detroit, Chicago, Omaha, Kansas City, Wichita, Oklahoma City, Amarillo and El Paso.

Reconnaissance Missions

Although daily photographic reconnaissance missions are being flown over Cuba, it was dramatically demonstrated early this month that missile emplacements can appear overnight. Twelve surface-to-air missile (SAM) sites were spotted in the Havana area one day that had not been observed the day before.

Official estimates of total armaments and technical personnel, in addition to the SAM missiles, that have arrived in Cuba from Russia include:

- **MiG fighter aircraft.** There are about 70 MiGs now in operation. About 40 are MiG-17s and most of the remainder are MiG-19s. At least one MiG-21 is flying and 8 to 10 more are being assembled. Last March, State Department said there also were about a dozen Il-14 twin-engine transports and some helicopters, piston-engine trainers and small single-engine transports, plus some 50 to 75 MiGs. AVIATION WEEK reported later (June 18, p. 25) that the totals were 60 MiGs, of which 20 were MiG-19s; 24 Mil-4 helicopters, 20 An-2 utility planes and 8 Il-14 transports.
- **Small arms and military** transport equipment. Heavy shipments from Russia began arriving late in July and have been continuing since then.
- **Soviet technical assistance** personnel, both military and civil. The total is approaching 6,000, and large numbers are still arriving. Most have arrived aboard passenger ships, but some have come by air.

The strategists readily admit that the present fighters probably would have little effect in stopping reconnaissance missions over Cuba at supersonic speeds and altitudes of 55,000 ft. and above. However, the SAMs, which resemble the Army's Nike family of surface-to-air missiles, could pose a much more serious threat.

Cuban personnel could be trained with both types of defensive weapons, with the aim of later replacing present equipment with new models capable of higher performance.

- **Motor torpedo boats** armed with 10-mi. range missiles. Ten have been sighted.
- **Shore-to-sea missiles** with a range of 20 to 30 mi. One emplacement has been located at Banes on the north shore, on the opposite side of the island from Guantanamo Bay.

Cuban Premier Fidel Castro announced last week that Cuba will build a "fishing port" for Russia. Havana Radio later said the $12-million port will be built inside fortified Havana Bay and will include a radio station and special gear for loading and unloading "all types of equipment." It could become a base for Soviet missile-armed submarines and for the heavily instrumented Soviet fishing trawlers that are being utilized for electronic monitoring along U.S. East Coast military installations.

Russian deliveries of equipment and supplies to Cuba began in the summer of 1961, following the abortive invasion attempt in April of that year. Early this year there was a lull in the deliveries, which continued until late July.

Between then and Aug. 8, eight Soviet ships were observed sailing into Cuban ports. From then until about Aug. 20, the number rose to 20 cargo vessels and 10 passenger ships. As of mid-September, the total number of ships had approached 70.

Most of the cargoes have gone to the port of Havana, which is on the north coast 160 naut. mi. from the island's western tip. Ships have also gone into the harbors of Santiago de Cuba, on the south coast 95 naut. mi. west of the eastern tip of Cuba and 40 naut. mi. west of the U.S. Naval Base at Guantanamo Bay and Cienfuegos on the south coast 115 naut. mi. east of Havana.

Most of the equipment carried in the cargo vessels consisted of transportation vehicles, electronics vans and construction equipment. The vans were configured to carry radar, communications and generator equipment, such as would be used by coastal and air defense units. Large crates apparently contained the SAM missiles and their launchers.

Ten motor torpedo boats (MTB) were part of the cargo. It is believed that their principal use will be coastal patrol, armed with missiles.

There have been contradictory reports on the nature of the Soviet military personnel in Cuba. Some reports stated they were combat troops in uniform. Informed sources state that they are a mixture of military and civilian technicians sent to help the Cubans learn to operate the Soviet equipment. There is no solid information to indicate that any were combat troops.

Adding to the confusion was the appearance of what refugees called Chinese Communists. The same official sources say that oriental-appearing personnel seen leaving ships and working in rural areas are Russian Uzbecks, who are experts in rice and other agricultural crops. The Uzbecks are oriental in appearance. The other orientals are part of the 40,000 Chinese who were living in Cuba, mostly in Havana, when the Castro government gained power, plus a few Chinese Communists sent to indoctrinate them in communism.

Air Space Violation

One of the touchiest points in dealing with Cuba is violation of air space over the island, which lies astride the Caribbean area, measuring 615 naut. mi. from east to west, 85 naut. mi. wide toward its eastern end and 25 naut. mi. wide at Havana, toward the western end.

The existence of the U.S. Naval Base at Guantanamo Bay on the south shore 55 naut. mi. from the easternmost point of Cuba provides the basis for some of the complaints. Guantanamo Bay is a fleet training base, and as such, has two airfields which intermittently house the aircraft of attack and anti-submarine carriers. The newest airfield, at Leeward Point flanking the western side of the harbor entrance, is a jet airfield.

Air traffic procedures in and out of Guantanamo Bay stress meticulous avoidance of Cuban territory, even though one end of the jet runway comes very close to the boundary line.

The United States has leased Guantanamo Bay from the Republic of Cuba since 1903. Another lease was signed in 1934 assigning a perpetual lease to the U.S. The reservation consists of 28,817 acres, of which 9,000 are water.

International air routes over Cuba are controlled by international agreement. Many different airlines use them, with traffic flying to and from the U.S. to the Caribbean, Central America and South America areas. Intrusions of aircraft other than those under air route control have been the cause of numerous complaints by Cuba.

Officially, the U.S. denies violation of Cuban airspace. However, it has been learned that reconnaissance missions are being flown regularly over Cuba by Air Force and Navy aircraft, including the U-2, with an altitude capability of over 80,000 ft. Continuous analysis by photographic interpreters provides a day-by-day picture of happenings on the island.

Aerial photography has grown in sophistication so that good results can be obtained without overflying a target area. In the case of Cuba, aircraft could fly at 15 naut. mi. or more off the coast and take oblique photographs. From U-2 or other fighter altitudes the oblique angle would be small. Prints could be made from the negatives using rectification lenses. These prints then could be interpreted as stereo pairs to gain depth perception.

The terrain of Cuba is excellent for aerial photographic reconnaissance. Much of the central part of the island is mountainous. Some parts of the mountains are heavily wooded, but for the most part they are almost bare, with cactus as the principal growth. The lowlands are agriculturally productive and swampy in some regions. Rainfall is moderate, and the semitropical climate lends itself to all-year crop planting.

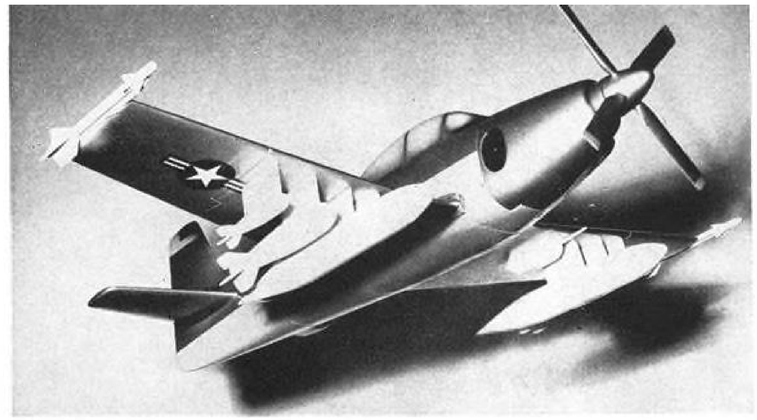
Military analysts say that the best locations for IRBM sites are the mountainous regions, although they could be located in the lowlands. In either case, construction of the sites would leave a scar on the bare terrain or result in bare spots in woods or fields. A sophisticated approach to this construction would include camouflage to fool aerial cameras.

An informed defense source said last week that the Cuban arms buildup is not a serious threat to the U.S. Relatively, he said, the buildup is great because Cuba had little to begin with. A far greater danger, he asserted, is the situation in Berlin where Soviet-bloc arms are a real threat.

In addition to Soviet ships, a large number of ships from noncommunist nations are carrying a variety of exchange goods into Cuban ports. Many of these ships have been leased to these nations by the U.S. Some are under charter to communist-bloc nations. The official approach to this problem has been to say that, in light of our own trade boycott, we do not like our friends trading with Cuba and using our own ships, but we will not use coercion to cut it off.

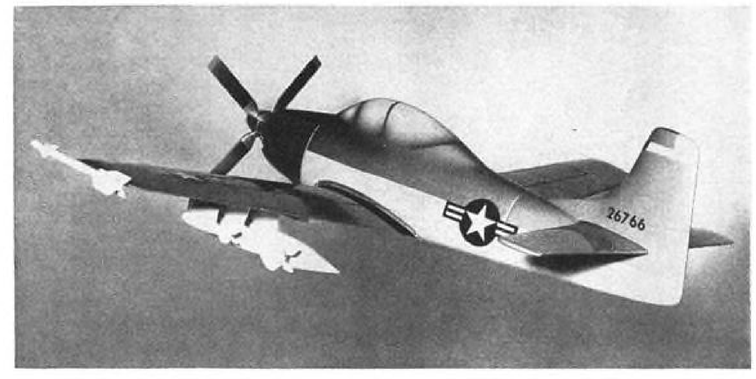
The North Atlantic Treaty nations trading with Cuba accounted for $32 million in imports from Cuba in 1961 and $85 million in exports to Cuba during the same year. Leaders in this trade were the United Kingdom, West Germany, France, Canada and The Netherlands. Reports for the current year indicate a drastic reduction in this trade.

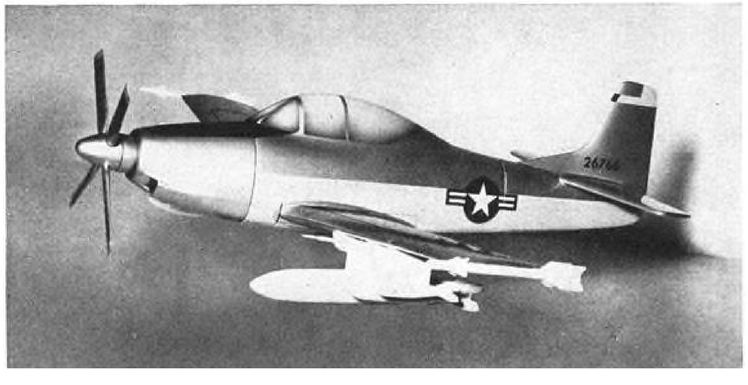
Goods represented in this trade were machinery, chemicals, industrial raw materials, animal fats and sulphur.



Model Shows Configuration of RS-28

First photos of North American RS-28 (reconnaissance-strike) show model of turboprop-powered version of T-28, one of which will be converted into new configuration by North American's Columbus (Ohio) Division and is expected to fly by Jan. 1, 1963. RS-28 (initially designated RA-28—reconnaissance-attack) will be powered by a 2,450-shp. Lycoming T55 turning an 11.5-ft.-dia. Aeroproducts propeller and will be capable of carrying up to 4,000 lb. of various external stores, including wingtip-mounted Sidewinder missiles. Two .50-cal. machine guns are carried in underwing pods and auxiliary fuel tanks, napalm, rockets or bombs can be fitted to wing pylons. RS-28 maximum speed is calculated at 313 kt., cruise speed varies from 180 kt. to 240 kt. depending upon mission and loading. Rate of climb is calculated at 5,130 fpm. Takeoff gross weight loaded is 15,350 lb., weight empty is 7,078 lb. Normal internal fuel is planned at 460 gal., with external tanks up to 680 gal. may be carried. Ferry range with external tankage is up to 2,400 naut. mi., typical reconnaissance-strike missions are calculated at approximately 200-naut.-mi. radius. Dimensions include wingspan of 40.6 ft., length of 35.7 ft., height 12.7 ft. Company already has converted 147 T-28 trainers to T-28D limited warfare reconnaissance-attack aircraft and calculates that approximately 526 T-28s are now available for use in this role, either piston-powered T-28D or turboprop-powered RS-28 configuration. U.S. Army is currently evaluating several T-28Bs for limited warfare. USAF operates T-28Ds in Tactical Air Command's Special Air Warfare Center, Eglin AFB, Fla. (AW June 25, p. 74).





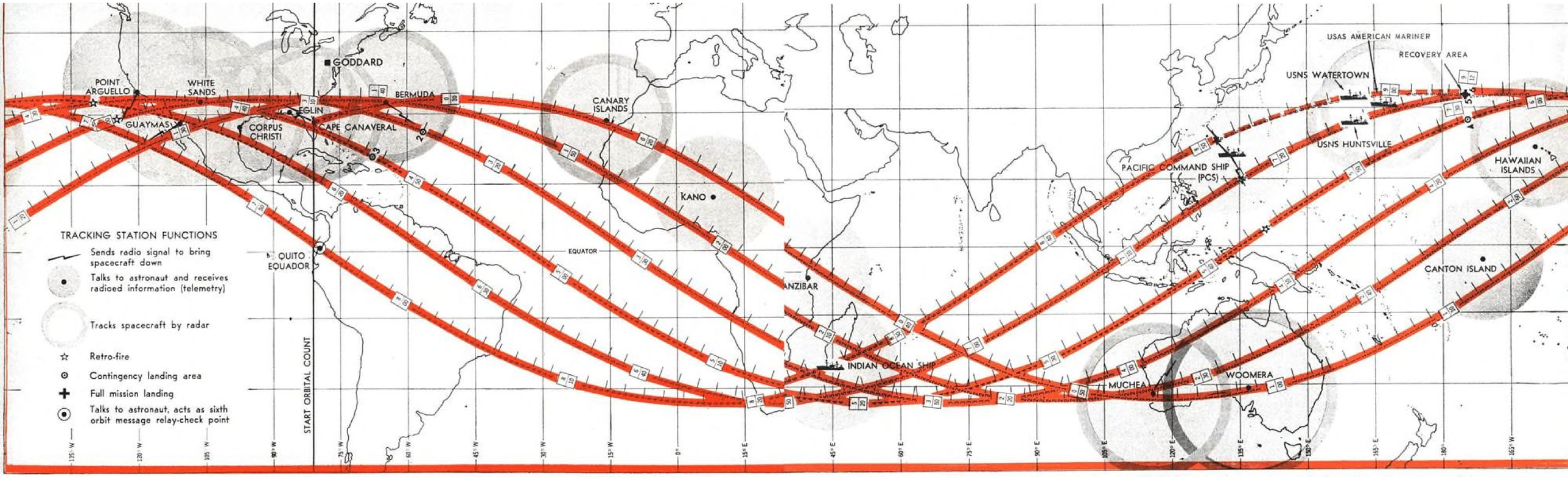


CHART SHOWS ORBITAL PATHS for Mercury Atlas-8 mission and positions of the Mercury tracking stations and ships. Pacific command ship is the Rose Knot. Boxes on orbital tracks show times after launch. MA-8 flight is placing major emphasis on the astronaut as a pilot.



ASTRONAUT SCHIRRA is on weight and balance scales during preflight checks for the MA-8 spacecraft.

Mercury's Future Hinges on MA-8 Flight

By Edward H. Kolcum

Washington—Mercury Atlas-8 will be the first engineering test flight in the U. S. manned space flight program and will determine the future course of Project Mercury. The performance of Cdr. Walter M. Schirra, Jr., could cut in half the scheduled number of flights.

National Aeronautics and Space Administration looks on MA-8 as its first opportunity to more thoroughly understand the engineering systems which later could be adapted to Gemini and Apollo spacecraft. Of primary interest are the attitude reference systems—automatic, periscope and window—and use of consumables. Earlier manned orbital flights of Marine Lt. Col. John H. Glenn, Jr., and Lt. Cdr. Scott Carpenter had so many scheduled tasks and procedures that these pilots were able to make only cursory assessments of engineering systems.

If Schirra's six-orbit mission is fully successful, it will be followed in February or March by a one-day flight. Prime pilot candidate is USAF Maj. Gordon Cooper, MA-8 backup pilot and the only eligible astronaut who has not flown.

Present Mercury schedule calls for two six-orbit and four one-day missions, but a successful MA-8 mission, followed by two 24-hr. flights could end the program in late 1963, when first manned Gemini mission is scheduled.

Late last week, Cdr. Schirra's flight was on the Atlantic Missile Range schedule for Oct. 3 following a five-day delay caused by a faulty valve in the reaction control system. Launch time is between 7-9 a.m. (EST) to provide at least three hours of daylight search time in the six-orbit recovery area, which is 275 mi. northeast of Midway in the Pacific Ocean.

Schirra has been undergoing exhaustive instructions on capsule systems designed to make him as familiar with them as are project engineers. During his first two orbits, Schirra will establish in detail how all systems are functioning. His program, which has been developed by Richard Day of Manned Spacecraft Center, also calls for nearly a full orbit on the automatic control system. Glenn and Carpenter used this system only minutes at a time.

By performing engineering tasks like this, Schirra will provide direct information on power and fuel usage rates. The number of scientific observations compared with those of Glenn and Carpenter are being minimized.

Schirra's spacecraft, which he has named Sigma 7, is McDonnell Aircraft Corp.'s production capsule No. 16 and is essentially the same as those flown earlier (AW Sept. 24, p. 29). Launch vehicle is General Dynamics/Astronautics Atlas Model 113-D. Other mission highlights are:

- **Network of 21 stations,** including five ships and the 16-station Mercury net (see map). Rose Knot, the Pacific Command Ship, can command retrorocket firing.
- **Primary recovery method** will be by destroyer. Sixteen contingency control teams from U. S. and Australia will be located around the world.
- **Food and water** to be carried includes 3,000 calories of semi-solid, bite-sized food wrapped in edible material, and six pounds of water.
- **Scientific experiments** (AW Aug. 27, p. 30) include flare visibility determination over Woomera, Australia, electric lamp visibility over Durban, South Africa, and color photography with a 35 mm. hand-held camera.

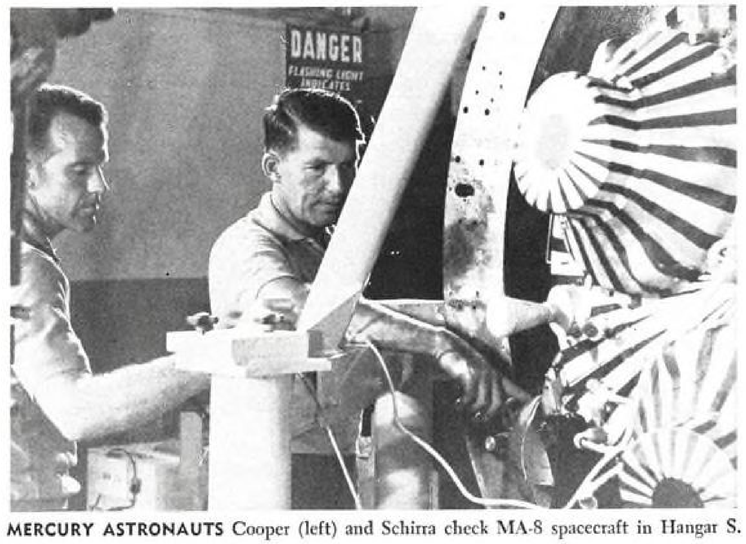
Passive experiments include evaluation of heat protection materials around the capsule neck, and a radiation-sensitive emulsion study to determine the number of cosmic ray strikes. Latter test was flown in both Glenn and Carpenter capsules (AW Sept. 17, p. 32).

Heat shield materials have been supplied by Avco Corp., NASA's Langley Research Center, McDonnell Aircraft Corp., Emerson Electric, Ling-Temco-Vought and General Electric. The two GE samples are an elastomeric material, which is a rubber foam embedded in plastic honeycomb, and an epoxy resin material called Series 500.

Atlas Sensing Points

Washington—Abort sensing and implementation system on Project Mercury Atlas launch vehicles measures critical angular and pressure values which will indicate an impending malfunction in the vehicle during pre-staging, staging and post-staging.

Sensing points are primary and backup pitch, yaw and roll rates, oxygen tank pressure, oxygen fuel tank differential pressure, manifold pressure for both booster engines, sustainer fuel manifold pressure, sustainer pressure and primary voltage.



MERCURY ASTRONAUTS Cooper (left) and Schirra check MA-8 spacecraft in Hangar S.

Telstar Finds Unusually High Radiation

By Philip J. Klass

Bell System's Telstar communication satellite is encountering about 10 times as many high-energy electrons as had been expected, at least one-third of them with energies higher than one million electron volts (mev), according to data obtained from the satellite's radiation detectors.

The energetic electrons, encountered at altitudes of 1,200 to 3,500 mi.—Telstar's apogee—have a peak omnidirectional flux of about one billion per cubic centimeter per second at energies above 0.2 mev, according to Bell Telephone Laboratories scientists.

The higher than expected density of energetic electrons has been attributed to the U. S. high-altitude Starfish nuclear detonation last July 9. The Atomic Energy Commission recently disclosed that Starfish occurred at an altitude of about 250 mi. and had a yield of 1.4 megatons.

Meager Knowledge

But because of the relatively meager knowledge of the energy levels and density of energetic particles in the natural Van Allen belt and their variation due to natural causes, scientists are reluctant to draw firm conclusions at this time. The radiation measurements which Telstar can make are relatively crude, since it was not designed primarily for this purpose. But because it is practically the only orbiting source of radiation data now operating, its data is proving extremely useful.

Telstar is continuing to perform its intended mission to permit communications experiments, despite an apparent failure of an auxiliary circuit within the satellite. Telstar carries two sets of command receivers and decoders, one of which serves as a standby. Upon command from the ground, the malfunctioning circuit is supposed to check to determine if both receivers and decoders are in operable condition. The failure means that scientists can no longer tell if both receivers and decoders are functioning properly, but otherwise it has no adverse effect, BTL said.

Although both high-energy electrons and protons degrade the performance of solar cells, the radiation resistant N-on-P type cells shielded with sapphire covers used on Telstar are most vulnerable to the protons with energies above 15 mev.

Telstar has reported peak proton densities of 20,000/cu.cm./sec. at energies of 22-32 mev, comparable to data obtained from previous satellite radiation measurements. But the density appears to fall off sharply at higher altitudes. From the data obtained, BTL scientists estimate that the high-energy proton density of 6,000 mi. altitude—one suggested altitude for communication satellites—is only 1/100th the peak density at low altitudes.

Available Data

It is not possible, however, to estimate the level of energetic electrons at 6,000 mi. altitude from available Telstar data, BTL said. The current uncertainty over the extent of man-made radiation resulting from the Starfish test emphasizes the relatively meager fine-grained data which has been obtained on the natural Van Allen radiation to date.

A recent report issued jointly by the Atomic Energy Commission, NASA and Defense Department says that the peak flux, which was reported by Telstar, is about 10 times the maximum ever observed in the outer Van Allen belt and a factor of 100 above the usual maximum conditions there. "But the intensities in the natural belt are even less well known than are the characteristics of the new belt of artificially injected electrons," the report said.

These figures may be low by a factor of two, or high by a factor of two to four, the report pointed out.

The expected lifetime of the man-made radiation depends in large part on its altitude and the atmospheric density. Atmospheric density varies by a factor of 10 from daytime to night, and is believed to vary by a factor of about 200 over a five-year interval between maximum and minimum solar activity, the report points out.

The greater number of stored man-made electrons are expected to have a lifetime that is comparable to electrons making up the natural Van Allen belt, the report said. These lifetimes are believed to be many years, with a half-life of 20 years being representative of electrons whose altitude is about 1,600 mi. at the equator, it said.

In the more than two months that Telstar has been in orbit, its solar cells have had their power output cut by about 15% as a result of radiation damage and other causes, BTL said. However, this is within the range of degradation for which allowance was made in the satellite design.

Degradation Rate

The rate of degradation is expected to decrease in the future, and the cells are now expected to be delivering about 68% of their original power output at the end of two years. The satellite was designed to operate satisfactorily with up to 50% loss of original power.

Satellite temperature is as expected, BTL said. The skin temperature varies from 5F to 50F while the inside temperature ranges between 65F and 75F. Internal temperature is controlled by automatic devices which increase or decrease satellite heat radiation to space.

Theory on New Radiation

Washington—Failure of the magnetic fields generated by the hot plasma of the Starfish high-altitude nuclear blast last July 9 and of earth's magnetic field to contain the explosion's fission products, which allowed intense streams of electrons and protons to shoot into space, is being suggested to explain the unexpected long-term intensification of the natural Van Allen radiation belt.

The instability of the plasma-generated magnetic fields is similar to problems encountered in efforts to achieve magnetic containment for controlled fusion power.

This theory also would explain why Starfish failed to produce the anticipated widespread blackout of radio communications. The energetic electrons in the plasma, which were expected to be contained and returned to the ionosphere to greatly intensify its ionization, were largely lost into space. Effectiveness of thermonuclear blasts to knock out radio communications now appears to be limited to lower-altitude explosions, which may help explain recently announced plans to conduct future tests at lower altitudes and lower yields.

Radiation Test Shots

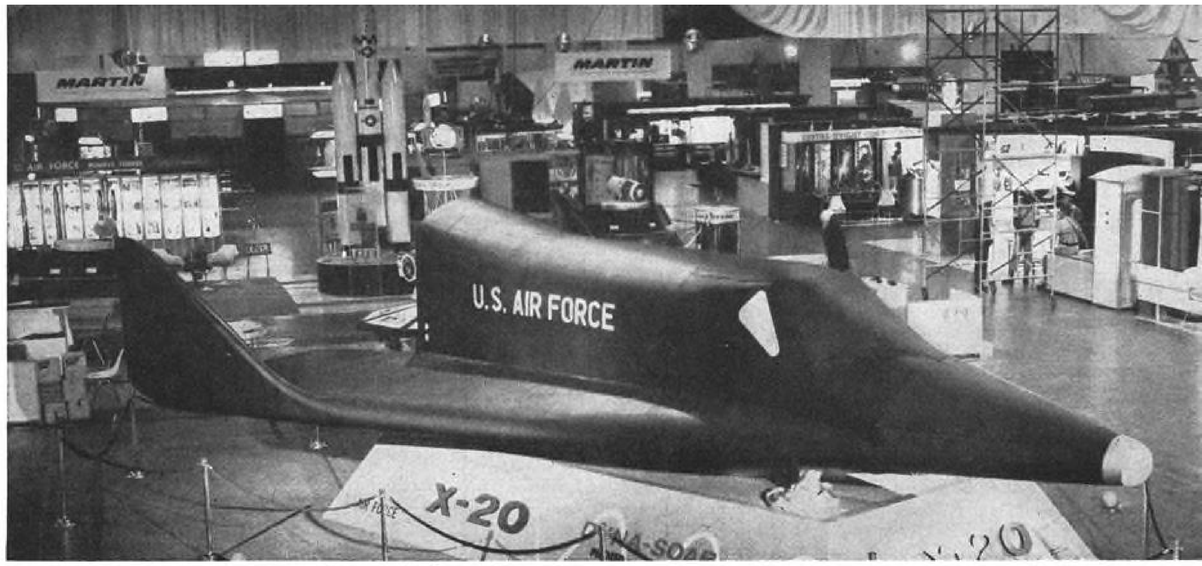
Santa Monica—U. S. will launch five satellites and a probe before the end of the year into the artificial radiation belt created by the July 9 high altitude nuclear detonation.

Special payloads are a probe, to be launched by an Argo D-4 from either Point Arguello, Calif., or Wallops Island, Va., and the S-3B satellite, to be launched by a Delta from Cape Canaveral (AW Sept. 17, p. 26).

Anna 1-B geodetic satellite will be modified as a result of the new belt to include 10 solar cell experiments using quartz and sapphire coverings. Slight modification also will be made to Relay solar cells to measure degradation.

The S-3A energetic particles satellite, scheduled for launch this week, and a military satellite also will measure the belt.

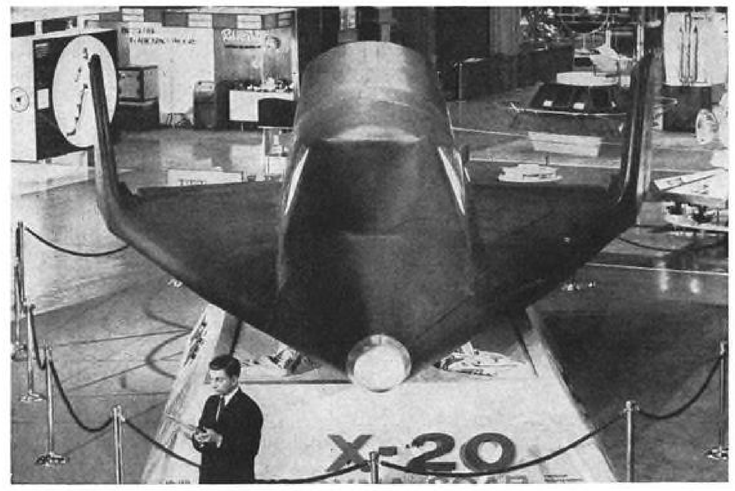
The S-3B satellite has a backup, designated S-3C. Series is unofficially called Serb—study of enhanced radiation belt.

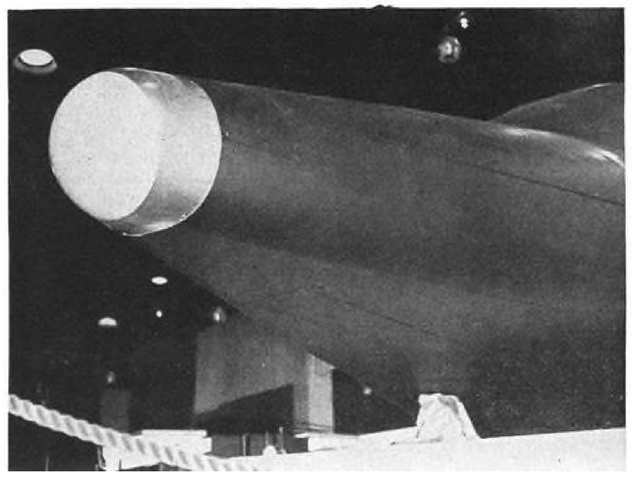


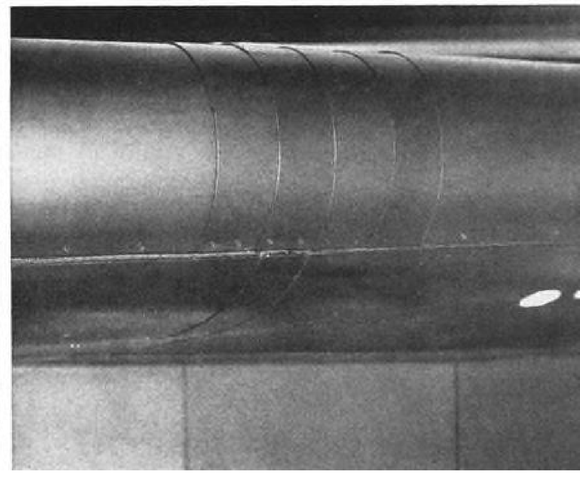
Full-scale mockup of Boeing X-20 Dyna-Soar, displayed at Air Force Assn. convention in Las Vegas (see p. 17), is 35 ft. long, 20 ft. wide and 8 ft. high. Actual orbital space vehicle will weigh 10,000 to 15,000 lb. and carry one astronaut. Re-entry heating may run as high as 4,000F, concentrated on the flat undersurface, wing leading edges and nose.

X-20 Features Unique Heat-Resistant Design

Construction techniques and black paint scheme of the X-20 are designed to provide radiation-cooling of the vehicle during re-entry. Nose-cap (below, left) is of ceramic material and a heat-resistant radiation conductive shield is fitted over the forward windshield. It remains in position until after re-entry is completed, then is jettisoned to allow the pilot forward visibility for landing. Fuselage skin will be of numerous small panels which will have gaps of up to one-eighth inch between them. Gaps will allow skin to contract or expand as temperature changes rapidly. Wing leading edge will be "shingled" (below, right) to help overcome temperature problems. Note use of flexible gap-filing material in the spanwise-gap of the leading edge to maintain aerodynamic contour of the airfoil. Trailing edges of the wing and rudder are blunt, with the rudder trailing edge cross section approximately four inches thick. X-20 is single-seat vehicle.







U.S. Topside Sounder Delayed

Los Angeles—Launch of the Scout-boosted S-48 topside sounder, originally scheduled for late this year, has been delayed to give engineers an opportunity to switch to a more radiation resistant type of solar cells, the N-on-P cell. These are expected to give the National Aeronautics and Space Administration satellite (AW June 20, 1960, p. 235) better protection from the intensified Van Allen radiation belt (AW Sept. 17, p. 32).

Plans are to launch S-48 from Pt. Arguello at an undecided date in 1963 into a 1,000-km. circular orbit inclined by 80 deg. from the equator. This inclination would place the satellite into a near polar orbit.

The satellite will carry a 90-lb. payload with six transmitters whose signals radiate into the ionosphere on six different frequencies—2.85, 3.72, 4.60, 5.47, 6.82 and 8.57 mc. Signals returned to the satellite will then be telemetered to ground and are expected to provide a profile of the electron density of the F_2 layer of the atmosphere.

The satellite will have three dipole antennas in the plane normal to its spin axis. Each pole will be 30 ft. in length when extended. Lifetime goal of the payload is six months to one year.

National Bureau of Standards Central Radio Propagation Laboratory and Airborne Instruments Laboratory jointly prepared the experiment, with NBS designing the experiment and AIL developing the hardware.

Canadian Satellite to Measure Electron Density of Ionosphere

By Barry Miller

Los Angeles—Canadian satellite Alouette, designed to measure distribution and seasonal variations in the electron density of the ionosphere from above its peak level of ionization was expected to be sent into a near-polar orbit by an Air Force Thor/Agena B booster combination late last week. A scheduled Wednesday night launch from Pt. Arguello, Calif., was postponed temporarily because of last-minute uncertainty about operation of the vehicle destruct system.

Electron density profile (electron density magnitude at varying altitudes) which is expected to evolve from experiments conducted by the 320-lb. Alouette-designated S-27—and a subsequent American satellite—S-48—will have wide effects in such diverse areas as long-range radio communications, detection of ICBM warheads and nuclear detonations, communications with re-entering space vehicles and electronic countermeasures.

Both the Canadian satellite, which was a joint Canadian-National Aeronautics and Space Administration undertaking, and the American S-48 are part of Goddard Space Flight Center's program in topside sounders—experiments which attempt to explore the ionosphere from above its peak, so-called F_2 layer, rather than from vertical incidence type ground-launched rocket probes commonly employed to date. The F_2 layer extends from about 180 to 600 mi. altitude.

NASA has scheduled only single S-27 and S-48 shots, but two flight models plus a flight-qualified prototype of each sounder have been built and are possible backups in the event of launch failures or payload malfunctions.

Canada volunteered to join in NASA's topside sounder program over three years ago, prompted by its concern over frequent disruptions in long-range communications due to temporary solar-phenomena-induced degradation in the reflecting properties of the ionosphere. It is striving to find ways of avoiding the effects of these disturbances in the future.

The topside sounder technique (AW June 20, 1960, p. 235) has the advantage of securing, for lengthy periods of time, electron density measurements as a function of altitude over widely dispersed geographical areas by radiating comparatively low-frequency radio signals which will not penetrate the ionosphere below, but be reflected back to the orbiting satellite. From the delays in signal returns, which will be telemetered back to data collection stations on the ground, this electron density profile can be calculated. By its nature and lifetime, the satellite sounder permits profiles to be made as a function of time, seasons, latitudes and magnetic disturbances.

Under the joint arrangement with NASA, Canadian Defense Research Telecommunications Establishment built the S-27 satellite, supplied three of its four experiments, the fourth provided by Canada's National Research Council, while NASA made the launch vehicle available, assisted in satellite design and fabrication, and provided its Minitrack stations for tracking and telemetry reception. In addition, Canada's defense research board built three telemetry stations in Canada and two other stations, readied for the S-27 experiments, were operated by Great Britain in Singapore and in the South Atlantic.

Both Alouette and S-48 were scheduled to be placed into identical, near circular, 600-stat.-mi. altitude orbits inclined by 80 deg. from the equator. Their 105-min. periods will bring them over the polar and auroral zones of particular interest to the Canadians.

Two sounders are designed to supplement, rather than duplicate, one another. Alouette was intended to concentrate on the polar and auroral zones while S-48's measurements will be along the 75 deg. west meridian.

Spheroid-shaped Canadian Alouette, so-named for a high-flying Canadian lark, was equipped with a miniaturized swept frequency transmitter to broadcast 100 microsecond pulses at the rate of 67 pulses per second on a carrier frequency of 1.6 to 11.5 mc. swept at a 1-mc. rate. Time-delayed returns, as a function of the sounding frequency, were to be telemetered back to earth.

Simultaneously with the topside soundings, eight ionospheric sounding stations in Canada, three of them built specially for the S-27 sounder, and other stations outside Canada plan to bounce signals off the underside of the ionosphere using more powerful versions of the swept frequency transmitter carried on the satellite. Thus, scientists hope to secure profiles from above and below.

Alouette design employs a single transmitter with a second backup transmitter available on command should a failure occur in the primary unit. The satellite also carried a 1.36- to 1.37-mc. beacon, two telemetry transmitters and receivers. It was designed for a maximum lifetime of one year.

S-48 will employ a fixed frequency sounding system, transmitting its high frequency (HF) signal pulses on six fixed frequencies. The U. S. system will have a fast profile acquisition rate (sampling 10 times per second) but a low resolution as it will not cover the number of frequencies Alouette will. S-27 will have a slower sampling rate—one sample every 15 sec. on a given frequency.

This Alouette shot is the first international spacecraft designed and built by a nation other than the U. S. or Russia and will be NASA's first try at orbiting a satellite from the West Coast.

Alouette was to carry three additional experiments besides the sounder. These are to measure galactic noise from space and radio noise produced by the ionosphere and to observe cosmic rays.

Two unusual antennas which unwind from drum containers to lengths of 150 and 75 ft. from dipole tip to tip were designed for the experiment by the Canadians.

Lockheed Deadlocked With IAM

Los Angeles — Lockheed Aircraft Corp. late last week was deadlocked with the International Assn. of Machinists on whether to allow its employes to vote for or against a union shop.

Lockheed thus became the last major aerospace company in this area to hold the line against what IAM and the United Auto Workers call the "principle of union security."

North American, General Dynamics, Douglas and Ryan Aeronautical in San Diego have acceded to the two unions (AW Sept. 24, p. 39). In Douglas' case, however, workers will form an agency shop in which union membership is not compulsory, but those who do not join must pay dues. The Douglas contract with IAM and UAW runs three years.

Officials of Lockheed and the IAM last week were in Washington negotiating economic items still in dispute. But the possibilities for compromise on the union shop question appeared to be few.

Union spokesmen, meanwhile, were charging that Lockheed was "disappointed" when the IAM decided not to go through with a strike scheduled Sept. 24. The company, they said, hoped to exploit the natural public sympathy against interfering with the defense effort to defeat the union.

About 25,000 Lockheed workers represented by the IAM are continuing to work here under their previous contract with the company. However, they are free to strike on five days' notice, and there were indications last week that IAM would schedule another strike vote shortly if the question of the union shop was not resolved.

United Auto Workers and North American announced agreement Sept. 24 on a three-year contract, which was to be ratified yesterday by the union's membership. Under its terms, members of the UAW's bargaining unit will vote Oct. 19 on a union shop.

NAA contract also provides for a wage increase of 5 to 8 cents per hour for the first year, an increase of 6 to 8 cents per hour the second year, and 6 to 9 cents per hour for the third year.

Meanwhile, in East Coast aerospace labor developments, Westinghouse workers who walked off their jobs last Monday at the company's Defense Center in Baltimore, returned to their jobs Thursday. They resumed work after Westinghouse obtained a court injunction ordering Local 1805 of the International Brotherhood of Electrical Workers to remove its picket lines.

Strike, involving 1,900 maintenance and production workers, stemmed from a dispute over the status of about 40 maintenance workers from the Air Arm and Electronics plants, who had been combined into a single work force. IBEW contended the men—members of Local 130 of the International Union of Electrical, Radio and Machine Workers of America—should come under its jurisdiction. Westinghouse said the matter was for the National Labor Relations Board to decide.

RAM Launch Fails

Washington—Attempt to obtain data on the radio blackout caused by ionization effect on re-entry bodies failed Sept. 22, when a three-stage radio attenuation measurement (RAM) vehicle lost thrust 11 sec. after second-stage ignition. Launch was from Wallops Island, Va.

The 175-lb. payload was designed to transmit signals over a variety of frequencies in the X, UHF, and HF bands during an ascent trajectory to a peak of 300,000 ft. This was the third flight of the RAM vehicle (AW July 2, p. 227).

Navy Reveals Details Of CH-53A Helicopter

Washington—Sikorsky CH-53A assault helicopter, which will be developed for use by the Marine Corps, will have a speed capability of 200 mph. and a gross normal weight of 33,267 lb., the Navy said last week in revealing additional details of the aircraft which won a Marine Corps competition late in August (AW Sept. 3, p. 24).

Carrying a payload of four tons at normal gross weight, the aircraft will be able to perform a military mission of 230 mi. The full payload would be carried on the 115-mi. trip out and two tons on the return trip. In an overload condition, the CH-53A will be able to carry nine tons on shorter missions.

The aircraft, developed using the technology of the S-64 flying crane, will be able to carry 30 combat-equipped troops or 63 in a high-density seating.

The cabin is 30 ft. long, 6.5 ft. high and 7.5 ft. wide. Length of the aircraft is 87.5 ft. and width 72 ft. It can be compressed for stowage aboard ship to 56.75 ft. long and 15.5 ft. wide.

An internal hydraulic cargo loading system will permit high speed loading through the rear doors, by way of a ramp and floor roller system. There will also be an external cargo pickup system. Within the four-ton limit, the aircraft could carry two Jeeps or two Hawk missiles, along with associated cable, reels and console control, or a 104 mm. howitzer with carriage.

Hovering ceiling is 7,600 ft. out of ground effect. A water-tight hull will permit emergency flotation. Powerplants are two General Electric T64-6s.

NASA School Grants

Washington—Five universities will share $6.4 million in National Aeronautics and Space Administration grants to build laboratories to be devoted to space science research. Grants are the first by NASA for facilities construction under the agency's grants and contracts program (AW July 2, p. 357).

Schools receiving facilities grants are University of California at Berkeley, $1.99 million; University of Chicago, $1.78 million; Rensselaer Polytechnic Institute, $1.5 million; State University of Iowa, $610,000 and Stanford $535,000.

News Digest

First de Havilland Caribou STOL transport for European registry has been delivered to Sweden.

Mariner 2 spacecraft was expected to be 5,664,717 mi. from the earth at 2 p.m. EDT today, traveling at 6,717 mph. as it continued to pick up speed from the attraction of the sun on its journey toward an encounter with the planet Venus. Scientific and engineering telemetry data arriving at Jet Propulsion Laboratory through late last week indicated that all spacecraft systems are operating satisfactorily.

Central African Airways, airline of Northern Rhodesia and Nyasaland, last week bought two BAC 111s.

Winner of Air Force 1962 Fighter Weapons Meet at Nellis AFB, Nev. was Capt. Charles E. Tofferi, 479th Tactical Fighter Wing, George AFB, Calif. Tofferi scored 19,018 out of a possible 24,000 points flying the only F-104 against a field of 13 F-100s, F-105s.

Lockheed Aircraft Corp. has acquired an 80-acre site adjacent to the University of Alabama Research Institute in Huntsville, Ala. for a building to house Lockheed personnel working with NASA officials on joint space projects.

USAF has named Col. Guy M. Townsend, first military pilot to fly the B-36, B-47 and B-52 bombers, to head the team of contractor and service technicians formed to test the North American XB-70 after its scheduled delivery later this year. Al White, North American chief pilot, is scheduled to fly the XB-70 first, followed by USAF Lt. Col. Joseph F. Cotton, chief USAF XB-70 test pilot, and Maj. Fitzhugh Fulton.

Israel will buy Army-Raytheon Hawk low-level anti-aircraft missiles from the U. S.

Foreign Airlines Hail New U.S. Attitude

White House study urges more liberal approach; secrecy arouses dissension among American carriers.

By L. L. Doty

London—Foreign flag carriers are elated over the philosophy contained in current White House study on international air transportation, first disclosed by AVIATION WEEK (Sept. 10, p. 53). Details of the study, which will be the basis of a revised U.S. policy in that field, are likely to amplify that elation.

Unfortunately, indications are that the White House will follow its normal routine and withhold the full text of the study. The informal secrecy attached to the work has already stirred some industry dissension, with a major U.S. carrier charging that a principal competitor has seen the study while it has not.

Final recommendations to the President on the course the U. S. should follow in establishing an international air transport policy will be made by a White House steering committee, headed by N. E. Halaby, Federal Aviation Agency administrator.

These recommendations will be based on the proposals developed in the study, which was conducted by private consulting firms. Whether the steering committee will apply all the details of the study in formulating a proposed policy cannot yet be determined.

Basic Measures

However, these are some of the basic measures the study recommends as guidelines in directing U.S. international air transport policies:

- **Economics should serve** as the sole criteria in the operation of international air services by U. S. carriers. All decisions in the future on route patterns, capacity and traffic rights should be based on economic rationality.
- **U. S. carriers should concentrate** on high-density markets. This recommendation is based on the theory that U. S. airlines are specialists in the production of mass transportation, but relatively weak in performing the highly-personalized type of service needed in developing low-density traffic markets.
- **Lower fares should be adopted** in high-density areas, particularly in the North Atlantic market. The study suggests that high fares restrain the expansion of markets, hide inefficient operations and force load factors downward, which, in turn, cause carriers to steer away from experimentation with promotional fares. These recommendations appear to conform with the pattern of fare structures the International Air Transport Assn. traffic conference is seeking to develop at its meeting in Chandler, Ariz. (AW Sept. 23, p. 43).
- **Carriers and the government** should recognize the wide difference between cargo and passenger services.
- **International air transportation** should not be considered as a factor in U. S. foreign affairs, except in cases where U. S. foreign economic relations may play a part.
- **U. S. should avoid** adoption of any principles of protectionism. U. S. policy should be based on economic liberality and no attempt should be made to control capacity or schedules of foreign flag competitors.
- **Determination of how many** U. S. carriers should serve a given foreign port should rest with the Civil Aeronautics Board. The study recommends that the adoption of "multiple designation" or "chosen instrument" on any route or series of routes should be decided on the merits of each case.

Foreign flag carriers will be particularly satisfied with the recommendation that the U. S. drop its attempts to impose capacity restrictions on air carriers serving U.S. ports. The trend toward pooling and mergers, coupled with the rapid growth of personal income in Europe, has given major European carriers confidence that they can now compete with U. S. airlines on a freedom-of-the-skies basis, whereas they once felt some protection against U. S. competitive power was necessary.

On the other hand, U. S. airlines for the past few years have held that they have been in financial jeopardy because of a steady loss of traffic to foreign competitors in such areas as the North Atlantic and South America, and have sought some protection against these inroads.

The White House study not only urges that drives for such protection be halted, but recommends that the U. S. no longer consider share-of-the-market as a factor in the development of U. S. international air transportation and proposes that expansion of the international travel market serve as the chief goal of U. S. airlines.

The White House study also backs at least a portion of the recommendations included in a CAB staff study of North Atlantic routes (AW May 28, p. 38), which most foreign flag carriers found agreeable.

The Board staff study recommended that U. S. carriers serving the North Atlantic focus their attention on such high-density traffic markets as London, Frankfurt, Paris and Rome. This coincides with the White House study's advice that U. S. airlines should operate as specialists in big markets.

The White House study is, of course, silent as to how these markets should be divided among U. S. airlines. The Board study urged that Pan American serve London and Frankfurt and that TWA serve Paris and Rome.

Fare Reduction Suggestion

The White House study's suggestion that fares be reduced in high-density traffic areas will evoke a mixed reaction from foreign flag carriers. Smaller airlines will rebel against this proposal, but at least four larger European airlines will favor it.

Implicit in the study is the suggestion that international air transportation is not as essential to U. S. foreign policy as many airline and government officials have led themselves to believe. The recommendation that international air transportation be treated entirely as an economic enterprise may be interpreted by some—who have consistently maintained that the airlines are flag carriers in the pure sense of the phrase—as relegating the industry to a lower stature than it deserves.

If this is true, U. S. international carriers will be at a disadvantage in competing with foreign flag carriers which bear the full support and backing of their governments, and which are viewed as a prestige symbol of the nations they represent.

Essentially, the White House study recommends that U. S. airlines take full advantage of their basic capabilities in competing with foreign flag airlines. These include the ability to operate efficiently at low costs, provide mass transportation in high-density markets on a wide scale and produce a good product at a low charge to the customer.

Giant Il-62 Transport Rolled Out

Moscow—Soviet aircraft designer Serge Ilyushin rolled out his giant Il-62 jet airliner last week for inspection by Nikita Khrushchev and other top Communist officials and turned it over to Aeroflot for the beginning of flight testing. The Il-62 is probably the largest jet-powered airliner in the world, dwarfing the Russian Tu-114 turboprop transport, British VC.10 and largest version of the Boeing 707.

The Il-62 has a fuselage 168 ft. long, carrying 182 passenger seats, a moderately-swept wing and a T-shaped empennage, with the horizontal stabilizer mounted atop the vertical fin (see drawing AW Mar. 19, p. 43). It has four 23,000-lb.-thrust bypass turbojets mounted in two nacelles on each side of the rear fuselage. Engines were designed by N. D. Kusnetsov, who also designed some of the turboprop engines on early Il-18 transports. The Il-62 is designed for a 560 mph. (900 km./hr.) cruise speed over a Moscow-New York nonstop run with standard fuel reserves.

The Il-62 is Russia's first transport design with aft-mounted engines, although the Blinder Mach 2 bomber (AW July 17, 1961, p. 61) had appeared previously with this design feature. Andrei Tupolev is also building an aft-engine version of his Tu-124 medium-range jet transport.

ATA Appeals to Press to Reduce 'False Alarms' on Airline Strikes

By Robert H. Cook

Washington—Air Transport Assn. has appealed directly to all press media for a better understanding of the Railway Labor Act as a means of reducing the volume of "false alarm" strike threats which ATA claims take a heavy toll of industry revenues every year.

ATA, which represents U. S. trunklines, contends that press, radio and television news outlets have become "unwitting pawns" of unions in their negotiations with the airlines.

The group has compiled a study of the "threat" techniques which it said have been used by the Transport Workers Union against American Airlines over a period of 15 years. Part of the study includes a series of clips taken from New York and Tulsa newspapers which ATA feels illustrates the ability of a union to keep an airline under "constant pressure" by creating the impression that a strike is imminent.

Examples cited by the ATA concerned only American and the TWU, but the association said such "scare psychology" has been used with equal effect by the Air Line Pilots Assn. and the Flight Engineers International Assn.

ATA has distributed copies of this study to all airline public relations representatives, plus an estimated 150 labor columnists and reporters in all news media. Along with the study packet is a memorandum outlining the four major steps—negotiation, mediation, arbitration and emergency board provisions—which can be employed in various combinations under the collective bargaining provisions of the Railway Labor Act.

ATA hopes that use of the memorandum by the press may reduce the number of headlines and hurried broadcasts which it says results in mass cancellations of reservations by passengers convinced that the airline involved in the labor dispute will not operate.

Trans World Airlines estimates its loss from strike threats has run as high as $2 million in a single month. Eastern said losses for the week prior to the latest FEIA strike exceeded $1 million, while its Air Shuttle service—which requires no reservations—showed a 20% decrease in traffic. The reservation cancellation rate during the week, plus a lack of advance bookings, indicated that an attempt to continue operations under such uncertain conditions might result in a revenue loss approaching $400,000 a day, the airline said.

By accepting the strike, rather than suffer the revenue lost through passenger uncertainty, the airline partly offset a $23.4-million operating loss between June 23 and Sept. 23 with a $15-million contribution from other members of the Mutual Aid Pact.

TWU's position is that while it is well aware that "so-called threats" of work stoppages or strike have injured the airlines' earning powers, the terms of the Railway Labor Act are being used as an industry weapon to stretch contract negotiations to a point where a final settlement requires the appointment of a presidential emergency board.

"The air carriers and their labor relations officials, either by instructions from the ATA, or of their own choosing, through their manipulations of the Railway Labor Act, the Department of Labor and the White House, have created this problem and their high-powered public relations experts cannot saddle the Transport Workers Union with the responsibility for their own losses," a TWU official said.

Legal recognition that at least one major trunk carrier has used the Railway Labor Act as a weapon against the union, rather than as a collective bargaining guide, is contained in a U.S. District Court refusal to grant Pan American World Airways an injunction against TWU last August, the union said.

Judge John F. Dooling, Jr., refused the injunction on grounds that the airline "failed to perform its obligation" under the terms of the Railway Labor Act. He emphasized that the Act is "rooted in negotiation . . . with provisions for mediation and emergency intervention not to be made optional ingredients of the collective bargaining process at the choice of either party.

"The parties must negotiate unrestrictedly without reference to these provisions and their concommittant statutory stays of change. Certainly at some point a party to negotiation met with obduracy can and should appeal for mediation and for emergency relief. But no party can plan its negotiation so as to incorporate mediation and emergency stages on the road to agreement . . . certainly not in the confidence that if it does so, an injunction will implement its technique of negotiation," Judge Dooling ruled.

Labor Disputes Settled

Washington—Trans World Airlines settled its crew complement dispute last week with the Flight Engineers International Assn. and Southern Airways began recalling pilots after a contract agreement ended their 28-month strike.

Terms of the TWA contract with the Flight Engineers International Assn. were not disclosed pending a ratification by union members, but they are understood to follow the recommendations of the Feinsinger Commission for three-man crew operation of the turbojets, with a pilot-qualified engineer position. Wage increases of about 3% were indicated, plus a maximum severance pay of $39,000 for each FEIA member refusing to take or qualify for pilot training (AW June 25, p. 45).

Southern, which reopened bargaining sessions with the Air Line Pilots Assn., under a direct order from the Civil Aeronautics Board (AW Sept. 3, p. 34), returned all 139 strikers to the seniority positions they held at the time of the walkout and agreed to general wage and working condition provisions similar to those offered prior to the strike. Non-union pilots employed during the strike will be placed at the bottom of the ALPA seniority list. Training and check-out for the returning pilots is expected to be completed by Dec. 1.

Board Urges Permanent Adoption Of No-Show Penalties by Airlines

Washington—Permanent adoption of the airlines' no-show plan has been urged by the Civil Aeronautics Board after a detailed analysis of the experiment's first three months of operation (AW July 9, p. 28).

Initial success of the plan, which assesses penalties ranging from $5 to $40 against passengers failing to appear for flights and a like amount against airlines which fail to provide a seat to holders of reservations, has caused the Board to advise trunk carriers that they approve a renewal of the plan beyond its present expiration date of Oct. 31.

The Board, while emphasizing that the industry still needs to improve reservation procedures and to further impress on travelers their responsibility to meet reservation obligations, pointed out that no-shows in the May, June and July period dropped from 9.8 to 6.9%. Total seats lost through no-shows decreased for the airlines least affected by the Eastern strike and remained constant for the balance of the industry.

Passengers seeking refunds under the plan amounted to little more than 0.1% of all passengers carried by the airlines in the three-month period.

Out-of-pocket costs of administering the plan were more than met by total collections, so that passengers are "apparently paying more attention to their reservations" and the significant reduction in no-shows indicates to some extent that airline reservation procedures have improved, the Board said.

The CAB analysis showed that the cost to the airlines for administering the plan dropped from $122,881 in May to $82,110 by the end of July.

Oversale penalty payments totaling $30,392 were made in July to 1,476 passengers, as compared with $21,980 paid out to 1,082 passengers for this purpose in May. An additional $32,693 was refunded in July to 1,526 no-show passengers who offered valid reasons for missing their flights. Much of this refund was accounted for by an amendment to the plan, permitting a 30-min. extension beyond the scheduled flight departure for ticket holders delayed en route to the airport.

The Board noted that the airlines mailed a total of 16,919 no-show bills totaling $338,047 in July, but only succeeded in collecting $9,428. The CAB said that it has received many complaints about these bills, many of which appeared "erroneous."

This would seem to account for the low percentage of bill collections by mail, so that any comparison between the carriers' actual mail collections and their billings cannot be considered a reliable indicator of the success or failure of the entire no-show plan, the Board said.

Deducting all administrative expenses, plus refunds to no-show passengers and payments to overbooked travelers, the airlines had a net profit of $50,869 from the plan in July, according to CAB figures. Board statisticians added that Eastern Air Lines did not report June and July figures because of its strike, and Northeast submitted an incomplete report because of the strike.

U. S. Probes Ditching Of Tiger Constellation

Washington — Civil Aeronautics Board last week began an investigation of the ditching of a Flying Tiger Line Lockheed 1049H Constellation in high seas Sept. 23 approximately 500 mi. west of the Irish coast. Of the 76 persons aboard, 48 were rescued.

Ditching occurred at 6:13 p.m. EDT at 54.03 deg. north latitude and 24.05 deg. west longitude, after loss of three engines. The aircraft was operating as a military charter flight out of McGuire AFB carrying military personnel and their dependents to Frankfurt, Germany. It departed Gander, Newfoundland, after refueling, at 1:09 p.m.

According to the CAB, the plane lost the use of No. 3 engine, which was feathered, a "few hours later." Engine No. 1 was then lost and feathered and finally a "third engine" was lost, CAB said.

With the loss of the first engine, the plane diverted its course to Shannon, Ireland, but when the third engine went out, it was forced to ditch. At the time, winds of gale force were reported with waves up to 40 ft. high.

Two other flights in the area, a Military Air Transport Service C-118 (Douglas DC-6A) and a Riddle Airlines Douglas DC-7 had been diverted to escort the crippled Flying Tiger flight. When it ditched, the MATS C-118 had sufficient fuel to orbit the area for 5 hr. to guide surface vessels to the scene.

CAB said the Federal Aviation Agency conducted a renewal inspection of Flying Tiger during October and found the carrier capable of maintaining a safe operation. A MATS service and capability survey team recently conducted an inspection of the airline and found it to be satisfactory.

CAB Air Safety Investigator B. R. Allen has been placed in charge of the accident investigation. He will be assisted by John McWhorter of the CAB in operations factors and interrogation of crew and passengers. CAB investigator Bernard C. Doyle will analyze human factors aspects, including emergency evacuation procedures. CAB said the Constellation is reported to have a flying time of 15,791 hr.

The ditching was the second Flying Tiger accident this year. On Mar. 16, a Lockheed 1049H disappeared in the Pacific with 107 persons aboard during a night flight between Saigon and Manila.

CAB Asks Retention Of Low Cargo Rates

Washington—U. S. flag carriers attending the International Air Transport Assn. traffic conferences in Chandler, Ariz. (AW Sept. 24, p. 43) have been urged by the Civil Aeronautics Board to retain low cargo rates and expand the 17-day excursion fare to all seasons.

In a letter addressed to 14 U. S. air carriers, CAB Chairman Alan S. Boyd, made these recommendations to delegates attending the conferences, now in their second week:

- **Present cargo rate scales** should be retained and consideration should be given to additional weight break-points within the framework of general cargo rates. Boyd admitted that the lower rates introduced last year had failed to develop the cargo market materially and had resulted in a reduction of average revenue yield. He said, however, that this should not be construed as an indictment of the basic rating approach. The Board, he said, favors a declining scale of rates at successively higher volume requirements.
- **Specific commodity rates** should be adopted only when such rates can be applied to generate new business or attract new types of traffic.
- **Passenger group fares** on the North Atlantic have been found to be successful by the CAB and are helping to expand the North Atlantic market. Boyd recommended a continuance of these rates and urged the expansion of such fares to other areas.
- **CAB is opposed** to the group fare provision that no refunds may be made within 30 days prior to flight departure. Boyd said the CAB feels that forfeiture of the full round-trip fare is unduly "harsh" and suggested that a less stiff financial penalty would effectively deter cancellations.
- **Extension of the off-season** 17-day excursion fare to the on-season periods was recommended. Boyd said the Board had "no fixed opinion" as to the number of days such fares should be valid, but said the Board will support a period of approximately three weeks.

Eastern Implements Sales Group Change

By James R. Ashlock

New York—Elimination of geographical organization in favor of a single system arrangement, with direct authority between home office and field officials, has been adopted by Eastern Air Lines in revamping its sales group.

"This has meant a complete shakeup within our sales organization," said Malcolm A. MacIntyre, president of Eastern, in announcing the move.

The move, an outgrowth of Eastern's recovery from the strike of its flight engineers, abolishes such traditional airline positions as the district and division sales manager. Instead, there will be field managers in Eastern's areas of operation, each reporting directly to home office directors.

"Historically, airlines have been organized on a geographical setup," MacIntyre said. "But we are changing that now to a single, functional sales effort."

MacIntyre said planning toward the new organization was in effect before the flight engineers strike on June 23. The change is being implemented earlier than planned, he said, Eastern having decided to make it a part of the over-all comeback from the strike.

"As for that convulsion," MacIntyre said, referring to the crew complement issue which sparked the strike, "I think it is forever settled."

Primary Aim

He stressed that a primary aim of the reorganization is to draw the two functions of selling and serving customers into a more unified activity. He hopes this will result in fewer procedural snarls and less customer inconvenience.

"It is time we faced up to the irony of a passenger spending more time on the ground than he does in the air when going to a city 200 or 300 mi. away," MacIntyre said.

"Everyone now has airplanes that will travel 600 mph.," he said. "The effort now should be to reduce the over-all travel time."

One area where Eastern is concentrating is in reservations. MacIntyre said that through its central computer facility at Charlotte, S. C., which serves the carrier's entire system, reservations can now be made more quickly and accurately. At the same time, the facility has enabled Eastern to reduce its reservations personnel staff by almost 50% in one year.

Eastern seeks further elimination of reservations through expansion of services like its Air Shuttle and Air Bus.

"About 17% of our total business now travels without reservations," MacIntyre said. "This should reach 20% by the end of the year, and I hope 30-35% in a year or so."

To speed up ground service, MacIntyre said, Eastern is experimenting with the idea of establishing parking lots exclusively for Eastern customers, with shuttle bus service to terminals.

"We opened one at Boston just before the strike," he said, "and response has been such that we must expand it soon."

MacIntyre said the "streamlining" of the airline should result in considerable cost saving through reduction of personnel and procedures. Eastern has already cut its personnel force to 14,000 compared with 17,000 prior to the strike.

The airline has also reduced service to certain low-revenue points, providing only one or two flights daily where it flew four or five before the strike.

"This resulted mainly from the retirement of our 39 Martin twin-engine aircraft," MacIntyre said. "Incidentally, we've already sold 12 of those airplanes.

"To make up for Martins, we've increased the utilization of our Convair twin-engine planes and our Electras," he added. "This has resulted in further cost savings."

MacIntyre said he believes the answer to the industry's financial problems rests in providing better service, reducing costs and also stepping up market research aimed at attracting new business.

There is a need, he feels, for more carrier cooperation in advertising the advantages of air travel, particularly safety and travel costs.

MacIntyre said he did not believe the over-capacity problem could be solved by a mutual agreement among carriers to reduce flight frequencies.

"I can conceive of some situations so severe that such a move would be practical," he said. "But I believe elimination of competition would be a better approach."

Eastern's reorganization, and its subsequent reduction of personnel, are not calculated toward the carrier's proposed merger with American Airlines, MacIntyre said. Nor is it a companion gesture to recent changeovers in American's sales force (AW Sept. 24, p. 45), he added.

"We did inform American of what we are doing," he said, "and there was no dissent."

MacIntyre said he was still optimistic of federal approval of the Eastern-American merger. The timetable as he sees it will bring a Civil Aeronautics Board examiner's decision early in October, arguments before the CAB in late October, and a final decision before year's end.

Revamping of sales and services will not bring any major elimination of figures at Eastern's top level beyond those that have already occurred, MacIntyre said. William L. Morrisette, Jr., former vice president of sales and advertising, resigned Sept. 1 (AW Sept. 10, p. 39). Maurice B. Westphal, former assistant vice president and general sales manager who recently became an assistant to MacIntyre, has plans to leave Eastern soon.

The new organization finds sales and customer services combined into a single function. Coupled with this is an expansion of Eastern's community relations activities, with former division and district senior sales managers being shifted to positions of community relations directors.

Over-all director of the new organization is Robert L. Turner, with the title of senior executive vice president. Turner was formerly executive vice president of transportation services.

Four Vice Presidents

Four executive vice presidents reporting to Turner are Frank Sharpe, sales and service; Maurice Lethbridge, staff services; Thomas E. Creighton, finance; and John Halliburton, administrative services. In addition, the vice presidents of maintenance, flight operations, public and industrial relations also report directly to Turner.

Under Sharpe will be all functions of sales, customer services and advertising. MacIntyre said the combining of these groups "conforms to logical hand-in-hand process of obtaining and serving customers."

Separate directors will manage the programs of agency sales, interline sales, commercial sales, group sales and cargo sales, directly supervising field managers. Advertising and sales promotion will also be home office positions, developing programs to be executed by the directors who control field sales activities.

There will be no single directing official at any Eastern service point. Station managers will oversee ground services and operations, but all other activities will be handled by the various field managers, responsible only to the directors in the home office.

Significant in the change is Eastern's abolition of sales quotas, or revenue goals, for individual salesmen and stations. MacIntyre said this had proven unrealistic, considering the size and pace of the industry today. Quotas hereafter will be awarded an over-all sales group, such as agency or interline sales.

Slick Plans Door-to-Door Air Cargo System;Resumes Common Carriage

New York—Slick Corp. is proposing further expansion outside the airline field as part of a "self-subsidization" plan for supporting such innovations as its air-truck fare plan now before the Civil Aeronautics Board or its re-entry into common carriage in a combined military-civil operation.

A year ago, Slick acquired the Illinois Shade Co. with an annual gross of about $4 million. Now it has reached preliminary agreement with the Martin-Marietta Corp. to acquire through stock exchange the Pulverizing Machinery Co., of Summit, N. J., a Martin-Marietta division. The latter company is grossing about $4½ million annually.

Both Illinois Shade and Pulverizing Machinery have a good sales and earnings history and good management, D. W. Rentzel, Slick Corp. president, said. "We are simply acquiring another breadwinner," he said, "that will contribute earnings to the company. We concluded a long time ago that no one was going to subsidize air cargo, so we decided to subsidize ourselves."

Slick will return to common carriage today after a six-year absence with inauguration of its combined military-commercial cargo operation.

The system will mean replacement of a Douglas DC-4 on one of its six Navy Quicktrans routes with a Lockheed 1049H Super Constellation.

By doubling the 20,000-lb. cargo capacity of the DC-4, Slick will be able to sell 20,000 lb. of cargo space on the route serving Boston, Hartford, New York (Idlewild), Indianapolis, Dallas-Ft. Worth and San Francisco, and still provide 20,000 lb. for the military. A daily flight each way is planned.

Rentzel said the system, if successful, could be extended to other military routes to serve Chicago, St. Louis and Los Angeles. By next spring, when all four of Slick's Canadair CL-44s are delivered, turboprop service in common carriage is expected to begin. Slick's two CL-44s now in service are handling military charters in the Far East.

Navy favors the proposed system, Rentzel said, because it offers the possibility of better service at lower cost to the military.

To develop common carriage, Rentzel is seeking to break the air cargo dilemma by creating an air-truck system providing door-to-door service on a through bill at competitive costs. Air cargo, he said, has faced the problem of having too little volume to permit reducing costs and not being able to attract volume without lowering costs.

With the non-airline acquisitions as a base, Slick has filed with CAB a proposal that would offer a second-morning delivery on its air-truck, plan at rates one-third less than first-class rates. This, in effect, introduces current second-class rates, which now provide such reductions on a five-day deferred service basis, into a two-day cycle.

"I'd like to see an air service eventually that is a bridge between six or eight trucking companies," Rentzel said. "Our future is in the slower service than the major airlines and their packaged freight, but perhaps more competitive with surface carriers."

Slick is proposing a joint venture, preferably with one or two truck lines in each city, on its reopened common carriage route, Rentzel said. Nothing in the law would prevent control of a truck line by Slick, Rentzel believes, but the aim is toward joint effort.

Standardized containerization is an essential part of the plan, Rentzel said, and Slick is working with several manufacturers and truckers on this problem. To provide a low-cost service requires that the customer do his own packaging, thus holding down handling expense on the part of the carrier.

Handling costs of less-than-carload freight have forced the railroads to raise rates up to eight times that of carload freight, Rentzel said. The result has been to drive the railroads, the lowest cost cargo handler, practically out of the less-than-carload freight business.

The container, Rentzel said, is, in effect, a boxcar which can be picked up at the shipper's door and delivered to the consignee the same way and with the same economy that the railroads can handle a shipper-loaded box car.

Slick Turbofan Order

Slick Corp. is negotiating with the Boeing Co. and Douglas Aircraft Co. on an order for two turbofan-powered cargo transports—either Boeing 707-320Cs or Douglas DC-8Fs. Outcome of congressional debate on a guaranteed loan for cargo aircraft will be a major factor in a go-ahead on the orders, but Slick hopes to make a decision in 30 days.

Hughes Ordered to Appear Oct. 29

New York—Howard Hughes has been ordered to appear in the Los Angeles U. S. District Court on Oct. 29 to have his deposition taken in the $115-million Trans World Airlines-Hughes Tool Co. anti-trust suit in progress here.

Judge Charles M. Metzner said he would permit Hughes to appeal for further delay on Oct. 22. A spokesman for Chester C. Davis, Hughes' attorney here, was unable to say whether Hughes would ask for the delay.

In another development, Judy McPhail, a receptionist for Davis, served TWA Board Chairman Ernest R. Breech with a subpoena while he was flying over New York state at 8:30 p. m. Sept. 19 aboard an American Airlines Boston-Detroit flight.

The subpoena calls for an answer within 20 days after service to Hughes Tool's $366-million counter-claim against TWA. Breech was named a defendant in the counter-claim for his role in TWA's jet financing while he served as one of three voting trustees from Dec. 1960, to Jan. 1962 (AW Feb. 19, p. 47). He is expected to ask that the subpoena be disallowed because it was served "over" a state rather than "in" a state having jurisdiction over the suit.

In Judge Metzner's Sept. 21 ruling on the Hughes appearance, he deferred ruling on the TWA charge that Davis' authorization from Hughes to accept the subpoena in his behalf was a forgery (AW Sept. 10, p. 39). At a hearing on Sept. 19, Davis told the court that even if Hughes did not sign the authorization himself, it was nonetheless binding.

Other points treated in Judge Metzner's Sept. 21 ruling were:

• **Possible sanctions** against Hughes Tool. The Special Master, appointed by the court to supervise the depositions, ruled Sept. 15 that Davis' authorization to accept the subpoena for Hughes was valid, regardless of TWA's forgery claim. He gave Hughes until Sept. 21 to reject this interpretation. If Hughes tries to deny the validity of the subpoena after Sept. 21, the Special Master said he would enter a $115-million judgment against Hughes Tool and strike its answer to TWA's claim from the record. Metzner said that since he hadn't heard from Hughes to the contrary, he assumed Hughes had accepted the interpretation.

• **Pre-trial conference** to define the facts and issues of the case. Judge Metzner said he would allow the parties to move for a pre-trial conference in an effort to expedite the case. Davis has taken depositions from three TWA witnesses over a period from last January to Sept. 21 with 20 more witnesses to go. The Special Master said on Sept. 15, in reference to the Tillinghast deposition —which ran nearly 7,000 pages—that he still didn't know what the "ultimate facts" were that TWA was using to establish its allegations.

Amery Rejects U.K. Route Award Appeals

By Herbert J. Coleman

London—Nineteen appeals against route awards granted to two British independent airlines (AW Sept. 10, p. 81) have been rejected by Aviation Minister Julian Amery, thus increasing competition for state-owned British European Airways.

Immediate effect was a BEA prediction that more capacity meant more empty seats and less hope for a decrease in fares. From the independent camp, British United Airways expressed satisfaction with the results, but Cunard Eagle Airways was sharply critical.

Said Cunard Eagle's Chairman Harold Bamberg:

"It is pathetic that we have had to wait for two years since introduction of the [Air Transport Licensing] Act and now find that the minister's decisions give us enough work for two or three airplanes at the most. . . It is a complete farce and the word competition hardly fits the case."

The minister confirmed these routes:

• **British United Airways**—Nine routes consisting of London-Paris twice daily, Amsterdam, Genoa, Milan, Athens, Basle, Barcelona, Palma and Lisbon-Madrid. License for service between London and Zurich was revoked.

• **Cunard Eagle Airways**—Six routes consisting of London to Glasgow, Edinburgh, Belfast, Dublin, Copenhagen via Stockholm and Liverpool to Dublin. License for service between London and Geneva was revoked, and Cunard Eagle's appeal against refusal of licenses between London and Manchester, London and Liverpool and Manchester and Dublin was refused.

Amery acted after inspecting recommendations of the appeals commissioner, Sir Arthur Hutchinson. He modified Cunard Eagle's license to serve London-Venice to specify the use of Viscounts.

If a larger airplane, such as a Bristol Britannia, is used, the trip will count as two journeys.

The London-Venice route is directly competitive with BEA but Amery ruled that scope for growth of tourist traffic is large enough to justify a summer service by Cunard Eagle.

Bamberg's reaction was largely the result of the London-Glasgow ruling, in which Cunard Eagle had plans for inauguration of high density, no-frill services for businessmen making the round trip in a single day.

Under the Amery ruling, Cunard Eagle gets seven flights a week, or one round trip per day. The airline will thus compete with 59 flights weekly offered by BEA, and its main objection is to the limitation in frequencies. BEA can increase its frequencies, if required.

Because of the limitation, Cunard Eagle will be forced to keep an idle airplane in Glasgow most of the day, or reschedule it to another run to keep utilization time up, with all the attendant operational complications this will involve.

At present, the company is evaluating the potential of the seven-flight weekly service and the possibility exists that it will ask for cancellation of the licenses, although officials refuse to comment of this. Because of Cunard Eagle's reaction, speculation also has been renewed that the airline will merge its domestic and European facilities with British United and continue the airline with its new tieup with British Overseas Airways Corp. on North Atlantic services.

Reason for the minister's revocation of the London-Zurich license was his reluctance to ask the Swiss government to accept a third British operator on the route. The cities are now served by both BEA and BOAC. Same reasoning applied to London-Geneva service, now a prime BEA route.

Meanwhile, British United last week said its subsidiary companies, Jersey Airlines and Silver City Airways, will operate a domestic network in the United Kingdom, with routes connecting with the Continent, under the new name of British United (C.I.) Airways. (C.I. stands for Channel Islands.)

Two airlines were acquired earlier this year by British United, and Silver City's car-ferry division was integrated with British United's Channel Air Bridge under the name of British United Air Ferries.

BUA officials said three new routes are being planned, and applications for approval will be made soon to the Air Transport Licensing Board. They are: Leeds to Amsterdam, London-Gatwick to Blackpool, the British vacation center, and Coventry to Dublin.

Current British United (C. I.) Airways' domestic routes link the Channel Islands with London-Gatwick, Bournemouth, Southampton, Manchester, Blackpool, Dublin, Cork, Glasgow, Edinburgh, Coventry, Exeter and Plymouth. Isle of Man connections are with Belfast, Birmingham, Blackpool, Glasgow, Edinburgh, Carlisle, Newcastle and Leeds, and Blackpool with Newcastle, Leeds, Dublin and Belfast.

Continental services connect the Channel Islands with Paris, Dinard, St. Brieuc, Quimper and Amsterdam; London-Gatwick with Brittany; Exeter with Paris; Bournemouth with Brittany and Paris; Southampton with Brittany; Newcastle with Amsterdam and Dusseldorf, and Blackpool with Ostend.

New fleet includes four Handley Page Dart Heralds, plus two more on order, 14 Douglas DC-3s, and two de Havilland Herons. Bristol 170s, operating in the north of England, will be withdrawn from service.

British United (C. I.) Airways will be headquartered in the Jersey Islands, under direction of M. L. Thomas, founder of Jersey Airlines. R. V. Baker, former director of Silver City, will be responsible for all activities outside the Channel Islands.



Trident Flies to Dublin

First flight of the de Havilland Trident three-jet transport outside the United Kingdom was made to Dublin Airport, carrying a group of airline executives to the annual general meeting of International Air Transport Assn. (AW Sept. 17, p. 38). Aircraft is one of three now in flight test and certification program at de Havilland's production facility at Hatfield.

AIRLINE OBSERVER

► Watch for a new move by the U. S. to sign with Iceland a bilateral air transport agreement which will apply Bermuda principles. Present agreement between the two countries is patterned after the original Chicago Convention format and makes no provisions for consultations on fares and rates. U. S. has similar agreements with Ireland and Czechoslovakia. State Department feels that incorporation of Bermuda principles in agreement with Iceland will be a major step toward bringing fares of Icelandic Airlines up to levels of International Air Transport Assn. members. Both Aer Lingus and Czechoslovenske Airlines are members of IATA.

► **Local service airlines flew 161.2 million revenue passenger miles in August, a 26.5% increase over the same month last year. Load factor for the month was 45.7 compared to 43.2% in August, 1961. For the first eight months of 1962, revenue passenger miles rose 19.9%. Load factor for the period was 42.7% as contrasted to 41.6% in the same eight-month period of 1961.**

► British European Airways feels that it may be successfully penetrating the auto travel market. Recent traffic figures indicate that BEA's six busiest routes were all within Britain. London-Glasgow total of 362,000 passengers was the top revenue producer last year and exceeded that of the airline's London-Paris route.

► **Time-between-overhauls (TBO) for Rolls-Royce Tyne turboprop engines on Canadair CL-44 all-cargo aircraft has been increased to 1,200 hr. Tyne operators expect TBO to reach 2,000 hr. by early 1963.**

► French aircraft industry officials continue to grumble about use of a Douglas DC-6B transport as a presidential aircraft. Recent trip to West Germany by President deGaulle in his DC-6B revived the old complaint. French Transport Union issued a communique claiming his use of the Douglas aircraft rather than a Sud Caravelle proves the government's indifference to French aircraft products.

► **United Air Lines last month began replacing the central section boom or main spar on its Vickers Viscount turboprop transports. Completion of project on all 47 Viscounts will require an estimated two years. United also has installed an interior telephone in the Viscounts' nose wheel well to provide improved communications between flight crews and ground servicemen.**

► Undercutting of air fares, a major issue at last month's International Air Transport Assn. annual general meeting (AW Sept. 17, p. 38), was brought to the attention of the recent International Civil Aviation Organization assembly in Rome with recommendations that governments take steps to ensure that published tariffs are fully observed by their national carriers.

► **Negotiations of the proposed merger between Trans World Airlines and Pan American World Airways have been slowed slightly by differences over terms, although both parties are still deeply interested in the possibility. Initially, Pan Am felt it could emerge with the best deal in view of TWA's financial problems. But TWA's improved business through the summer, particularly on the North Atlantic, has made it seek better merger terms.**

► Air Transport Assn. has advised 20,000 high school principals and guidance directors to caution students against spending needless time and money on special training schools for airline jobs. ATA said that airlines provide training in most jobs at no cost to the employe and that, except for a few specialized jobs, no special preparation is required beyond a good general education.

► **Federal Aviation Agency has awarded a $10-million contract to Texas Instruments, Inc., for 66 airport surveillance radar systems. Radars will be installed at continental and overseas USAF bases in a major step toward standardization of civil and military air traffic control systems. Total of 23 ASR systems will be installed, maintained and operated by FAA. The remainder will be jointly installed by the Air Force and Texas Instruments and will be operated and maintained by the Air Force.**

SHORTLINES

► **Airframe overhaul** time on United Air Lines' Boeing 720 transports has been extended to 4,000 hr.

► **Bonanza Air Lines** carried 40,164 passengers in August, the first time in its history it passed the 40,000 mark in a single month.

► **Continental Air Lines** has filed a tariff with the Civil Aeronautics Board calling for a 20% rate reduction for military groups of 25 or more beginning Oct. 19.

► **Delta Air Lines** reported a net income of $2.3 million for August on revenues of $20.7 million, a 65% increase over the $12.5 million for August, 1961.

► **National Airlines,** which flew 152 extra sections in August due to the Eastern Air Lines strike, reported a net profit of $1,345,000 for the month, compared with $132,000 for August, 1961. Operating revenues were $10.9 million, a $3.8 million increase over the same month last year. August load factor was 66% compared with 55% for the previous August.

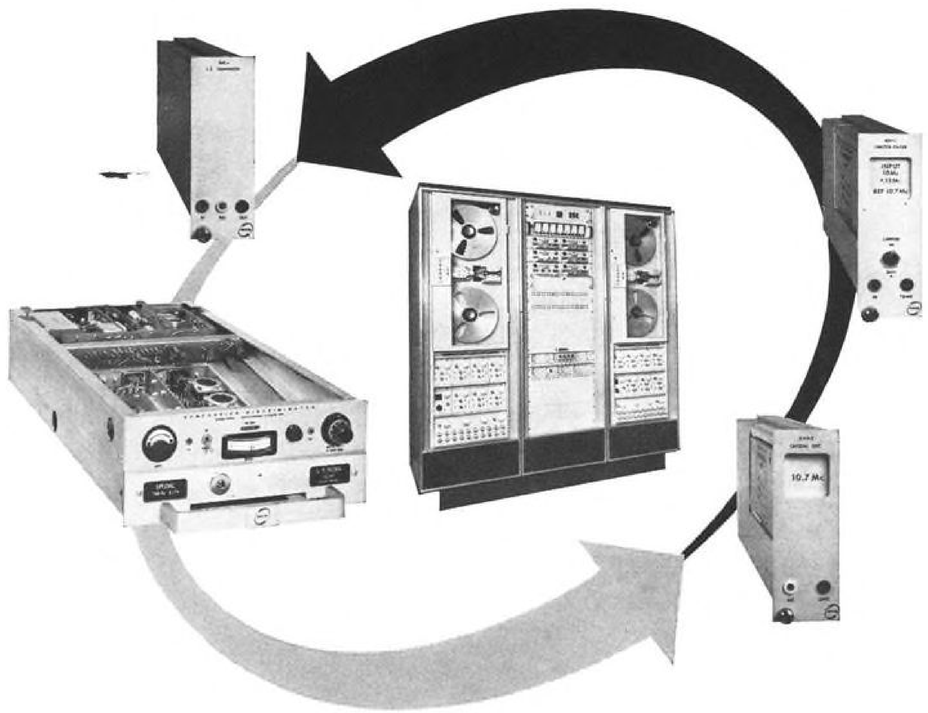
► **Northwest Airlines** reported a net profit of $1.6 million for August, compared with $1 million net earnings reported in the same period last year. Gross revenues for the period increased 30%.

► **Pacific Northern Airlines** credited improved business conditions and increased tourist travel in Alaska as reasons for its record 24,772 passengers carried in August. The 648,882 cargo ton miles handled by the airline during the month also established a new record.

► **Round-the-world** travel has increased 113% since jet transports were introduced in October, 1958, according to Pan American World Airways. The carrier estimates that 50,000 persons will make the trip this year.

► **TAG Airlines** has increased flight schedules between downtown Cleveland and downtown Detroit to 28 departures and arrivals daily. During the first six months of 1962, passenger traffic on the route increased 29%.

► **Trans World Airlines** has asked CAB to approve a special Christmas holiday fare reduction of 51% per round trip jet economy group travel by U. S. military personnel and their dependents stationed overseas.



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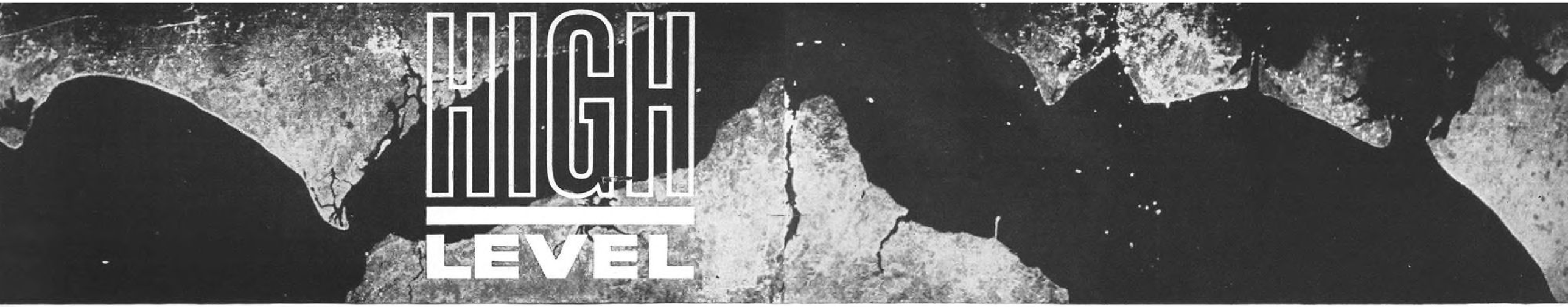
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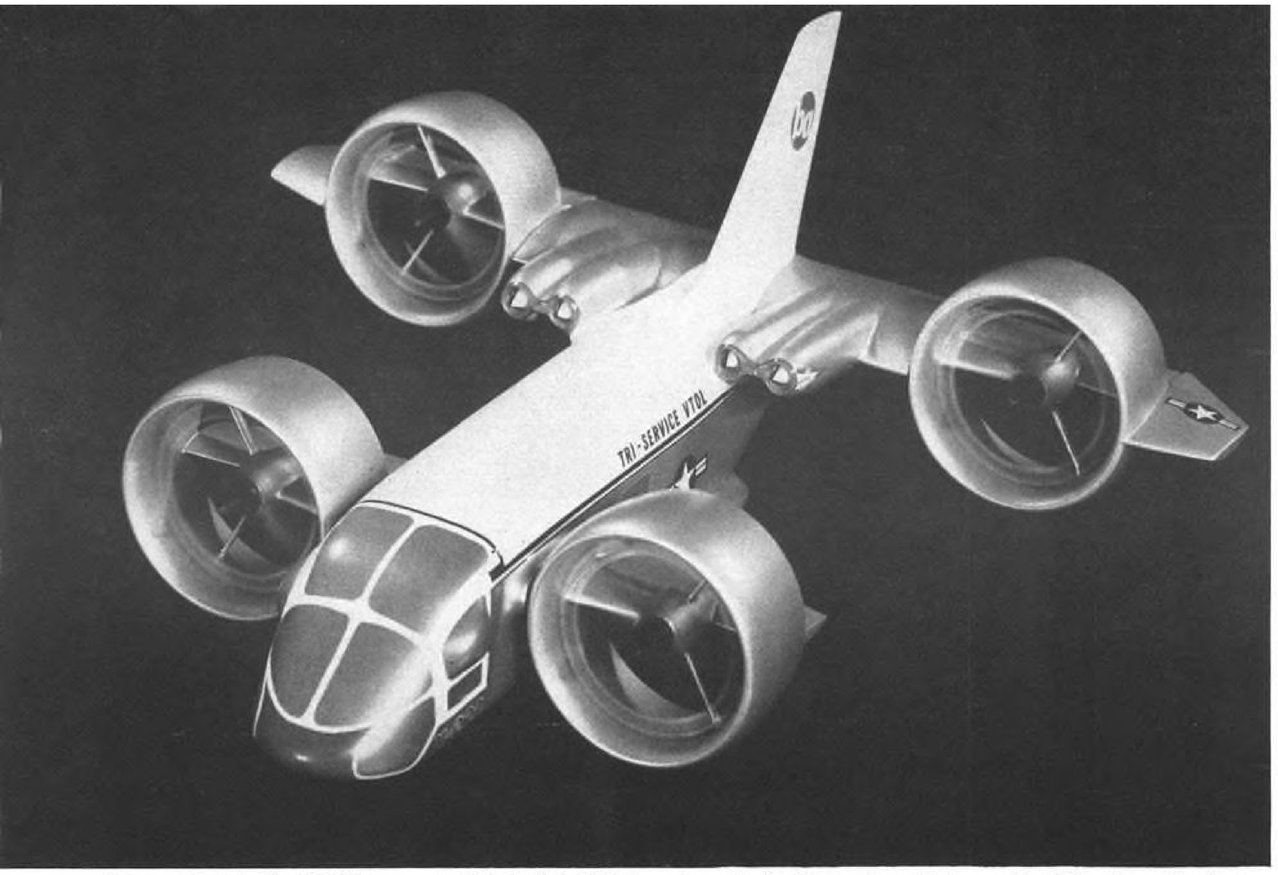
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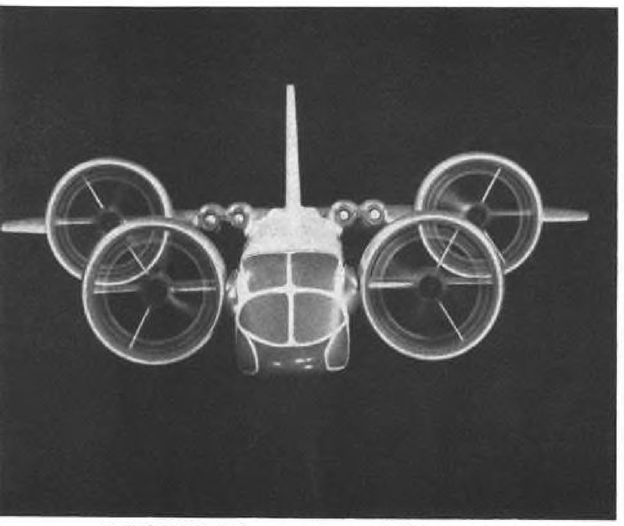
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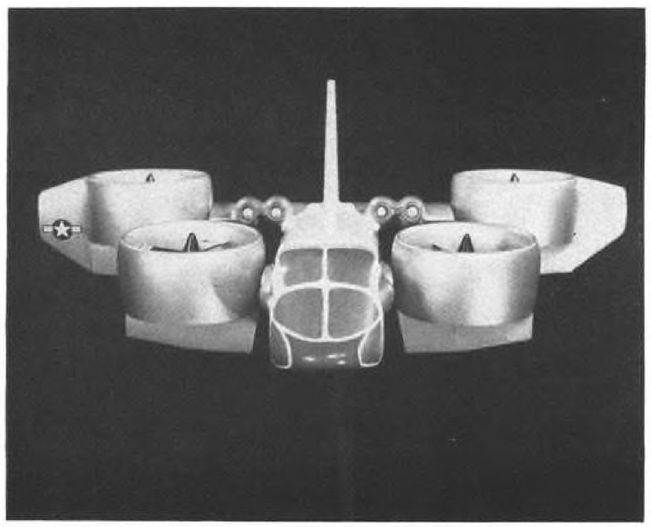




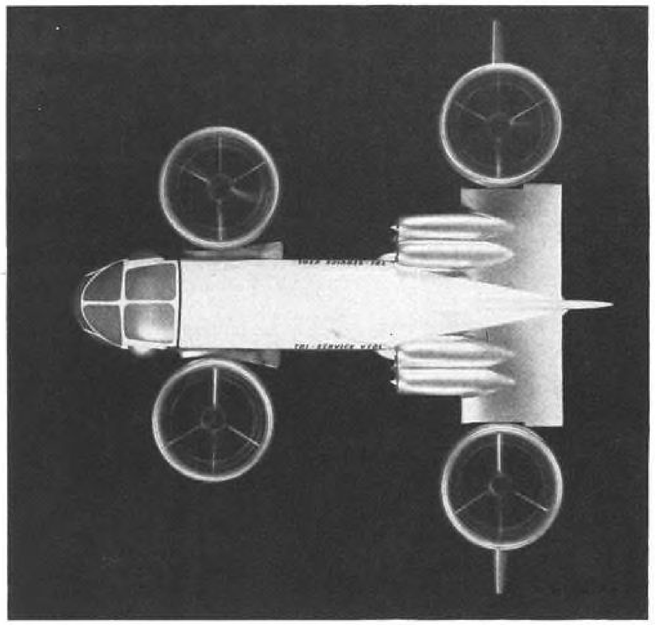
Jet-powered, ducted-fan, VTOL transport will be built by Bell Aerosystems Co. for Navy under contract exceeding $16 million. Aircraft is being developed as the Navy-managed portion of the tri-service VTOL program. Bell D-2127 is powered by four General Electric T58 turboshaft engines (AW Apr. 9, p. 27) and will have a crew of two. Payload will be 1,200 lb. or six passengers.

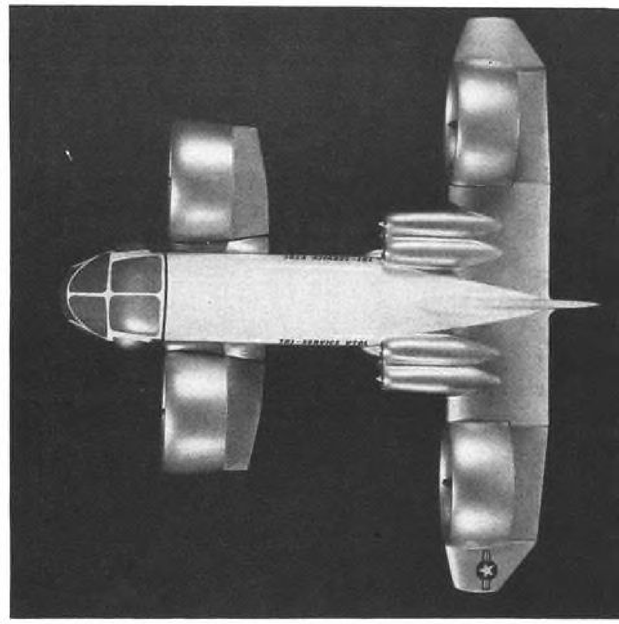
Bell Aerosystems Designing Navy VTOL Transport



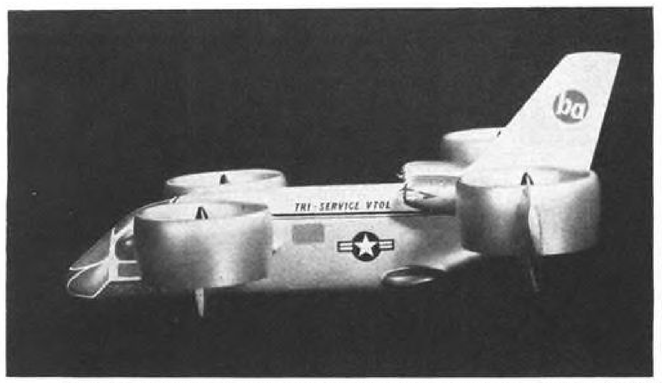


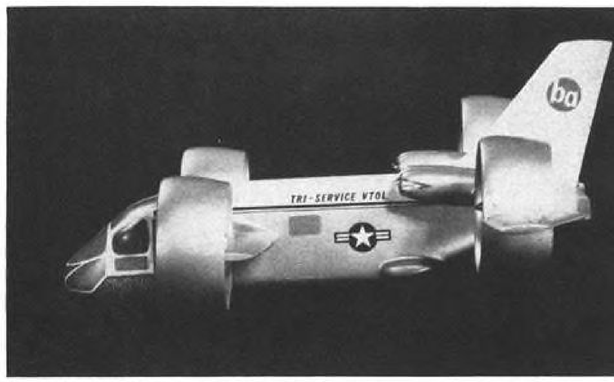
Bell D-2127 will have a wingspan of 39.2 ft. and will be 36.3 ft. long and 16.3 ft. high. Weight will be about 15,000 lb. Top speed is expected to be 350 mph. Engines are interconnected so that failure of one engine will not affect stability of the aircraft.



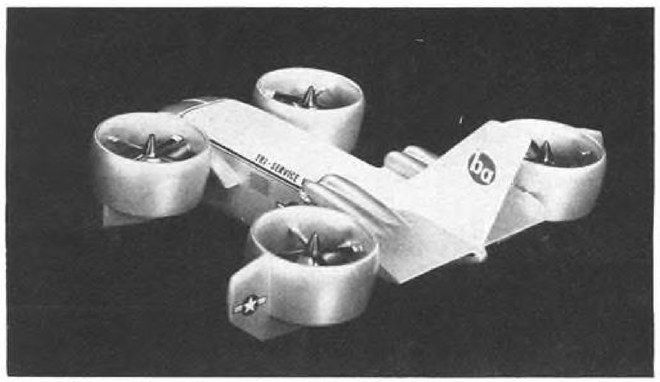


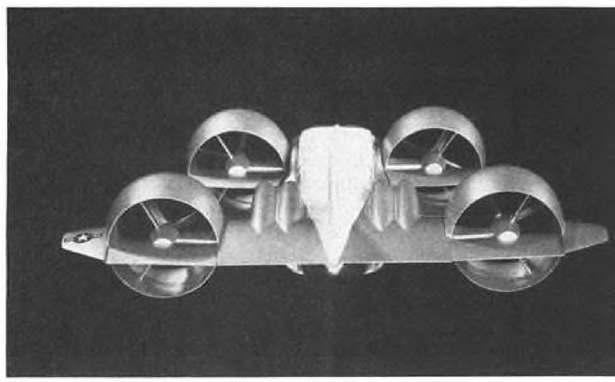
Ducted propeller units rotate to a vertical position to provide lift for hover and takeoff and return to a normal position for forward flight.



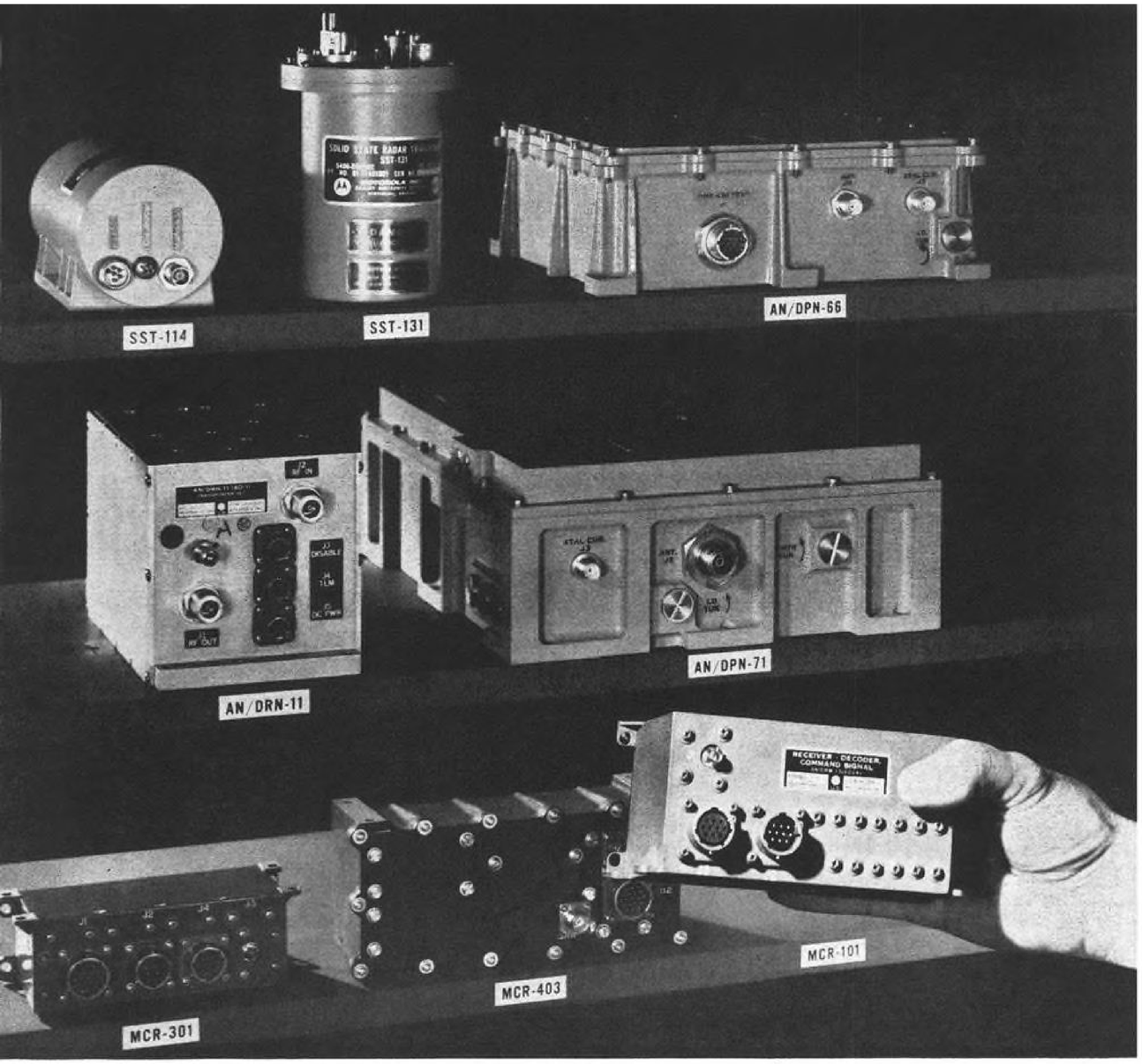


Cockpit has been designed around helicopter concepts to provide visibility for hovering and vertical takeoff capability.





Aft propeller units were extended outboard to prevent flow interference with forward units. Plane will be used as Navy research vehicle.



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A complete line of command receivers and radar transponders is now available from Motorola for off-the-shelf delivery. Designed and built to meet the control and tracking requirements of a wide variety of missiles, rockets, drones, manned aircraft and space vehicles, this compact instrumentation is setting new standards of performance and reliability. Motorola Command Receivers satisfy the most rigid physical and electrical specifications, and are constructed for ease of installation with a maximum saving in space and weight. These extremely reliable receiver-decoder units are being used or specified for command and destruct functions in most of today's second generation missiles. If you are interested in complete performance specifications on any of Motorola's qualified command receivers or transponders, write to our Instrumentation Products Group today.

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MCR-100 Series Radio Command Receiver
Channels: 10. Sensitivity: 5 μV
Range: 406-450mc. Weight: 2 lbs. 15 oz. (max.)

MCR-300 Series Radio Command Receiver
Channels: 3. Sensitivity: 5 μV
Range: 406-450mc. Weight: 2 lbs. (max.)

MCR-400 Series Radio Command Receiver
Channels: 4. Sensitivity: 5 μV
Range: 406-450mc. Weight: 3 lbs. 13 oz. (max.)

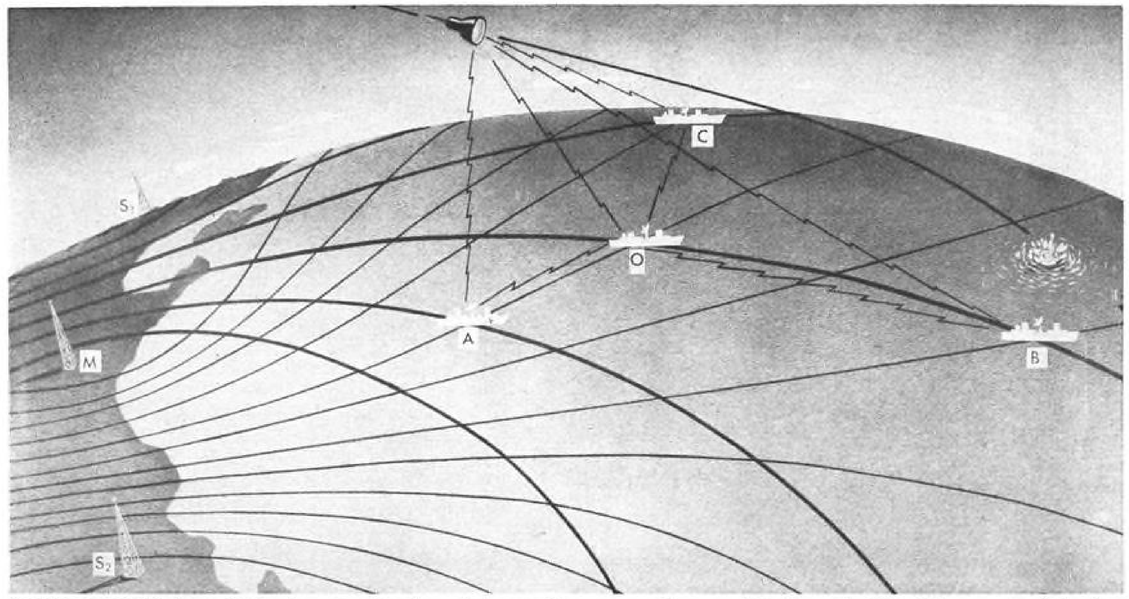
AN/DPN-66 Superheterodyne Transponder
Power: 500 watts. Sensitivity: −70dbm
Size: 200 cu. in. Weight: 10.8 lbs.

SST-131 Microminiature Superheterodyne Transponder
Power: 400 watts. Sensitivity: −65dbm
Size: 40 cu. in. Weight: 3 lbs.

AN/DPN-71 High Power Superheterodyne Transponder
Power: 20 Kilowatts. Sensitivity: −75dbm
Size: 0.3 cu. ft. Weight: 28 lbs.

SST-114 Subminiature Crystal Video Transponder
Power: 50 watts. Sensitivity: −42dbm
Size: 55 cu. in. Weight: 3.5 lbs.

AN/DRN-11 UDOP (UHF Doppler) Transponder
Power: 3 watts. Sensitivity: 5 μV
Range: Input 430-470mcs (Output 2x) Weight: 10.5 lbs.



LORAN-C SYSTEM for predicting impact point of re-entering satellite or manned spacecraft is shown in this artist's concept of the situation. Transmitting stations at left—one master and two slaves—generate the hyperboloidal surfaces whose ground traces are shown as solid lines. From these surfaces, the four tracking ships determine their positions. Arrival-time differences in the signal from the re-entering vehicle are used to compute the position of the vehicle with respect to the four ships and therefore with respect to a fixed reference. Continuous position data is used to compute and predict the trajectory, and—by extrapolation—to predict the impact point.

Loran-C Extension Proposed for Tracking

By David A. Anderton

New York—Sperry Gyroscope Co. engineers are proposing an extension of the Loran-C navigational system to enable more accurate prediction of impact points for ballistic missiles and manned spacecraft.

The long-range navigational aid would be used to determine positions of ships and aircraft in the recovery area with greater accuracy than that now available from standard dead-reckoning or inertial navigation techniques. It would be combined with a microwave tracking system to predict the trajectory of the re-entering vehicle. Finally, the Loran-C system would provide a common base for correlation of all the received position data.

Combination of these three techniques would enable predictions of impact points to be accurate within a few hundred feet, say Sperry senior engineers Paul Morenz and Winslow Palmer.

Acquisition of accurate position and velocity data for missiles and space vehicles is one of the major problems facing both users and operators of national and service ranges (AW Mar. 26, p. 68). This data is needed for every point along the vehicle's flight path, but assumes particular importance at launch, orbital injection, re-entry and impact. Most installations do not meet current requirements; proposals for future installations hardly meet current requirements; and future requirements for the precision and accuracy of this kind of data seem almost impossible to meet.

A complicating factor is that ship-based instrumentation must be used frequently for impact-area work. Current land-based installations now cover only short-range missiles, for example, and are essentially useless for long-range missile work or for recovery of space vehicles. Added to the basic inadequacies of the instrumentation is the fact that the position of the carrying ship can not now be determined to much better than a half-mile, one way or another, and consequently all trajectory data has to be modified by an assumed accuracy for ship's position.

One current requirement, stated by Dr. G. S. Blevins, formerly of Pan American World Airways' Guided Missile Range Operations at Patrick AFB, Fla., is that ship-based instruments must locate the ship itself within 500 ft. or less.

Results of a test evaluation of Loran-C as a ship navigation aid, made by an independent consulting firm, Jansky and Bailey, Inc., for the Office of Naval Research, showed position errors of that order of magnitude. The firm analyzed the operation of a Loran-C monitor station 550 mi. from the nearest, and about 900 mi. from the farthest, transmitter.

The results indicated that a ship in that area could expect 95% of its position fixes to be within 800 ft. of the exact geographical position.

Other Loran-C navigation networks, installed in the Mediterranean and Norwegian sea areas, and on islands in the north and central Pacific Ocean, are being used by Polaris-firing submarines for accurate positioning of launch sites. The subs establish the launch point for each enemy target by using the Loran-C system. They would navigate to those points, using their ship's inertial navigation systems (SINS), in the event of hostilities (AW Oct. 23, 1961, p. 19).

Work on installation of the Loran-C system as a time-signal synchronizer is progressing, although slowly, at the Atlantic Missile Range. Plans have been made to install systems at Cape Canaveral, Antigua and Ascension Islands, and at Pretoria, in South Africa, but budgetary problems on this and other range-instrumentation systems have de-

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layed the full installation and operation of the system.

Time correlation of events along a tracking network, which is of importance in the reduction of all parametric data, is currently accurate to about 100 microseconds. Dr. Blevins suggested last March that an order-of-magnitude improvement was needed to reduce that inaccuracy to about 10 microseconds. Sperry says the Loran-C system can provide synchronization of time events to 0.1 microsecond, with a worst possible time error through the system of 0.88 microsecond.

Logical Development

Range operators believe the Loran-C system represents a logical line of development for long-range, accurate metric data acquisition. But they point out that fairly large sums of money are involved. They explained that early range requirements called for metric data that could be satisfactorily taken with inertial techniques. Shots were few and far between, and there was no pressure on to develop high-speed, extremely accurate data-taking instrumentation. As the range grew and requirements increased, it always seemed cheaper to add another cross-checking system with optical or celestial navigation or radar fixes than to do the whole range over and go to a complete long-range electronic navigational system.

But now there is some opinion among range operators that the time is ripe for a change to such a system as Loran-C.

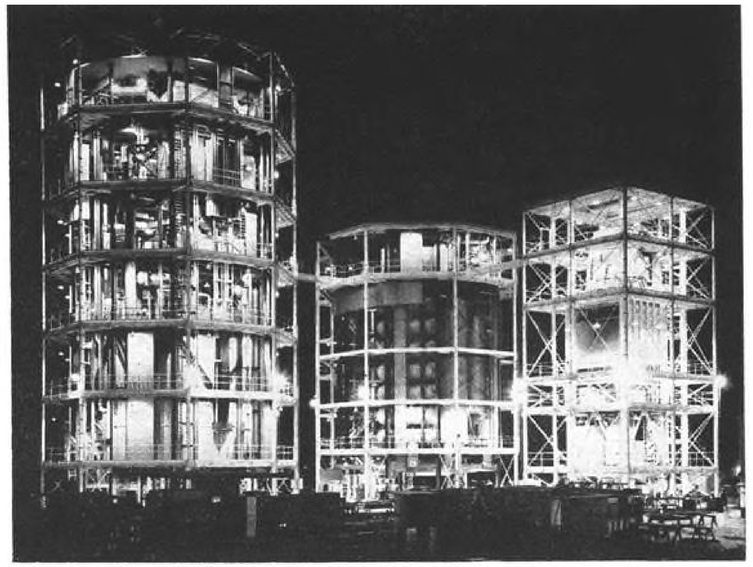
Loran-C systems currently in use as navigation aids cover the northern and western Atlantic Ocean, the Mediterranean, the area around the Hawaiian Islands, the north Pacific and the Aleutian chain. They operate in the low-frequency band with a carrier frequency of 100 kc. Using peak radiated powers between 100 and 300 kw., the ground-wave range is in excess of 1,000 mi.

The Sperry proposal for a recovery and tracking team is built around four ships, each equipped with a Loran-C receiver, a tracking receiver, an atomic clock and communication facilities for transmitting data to a control center or one of the ships.

Ship Positions

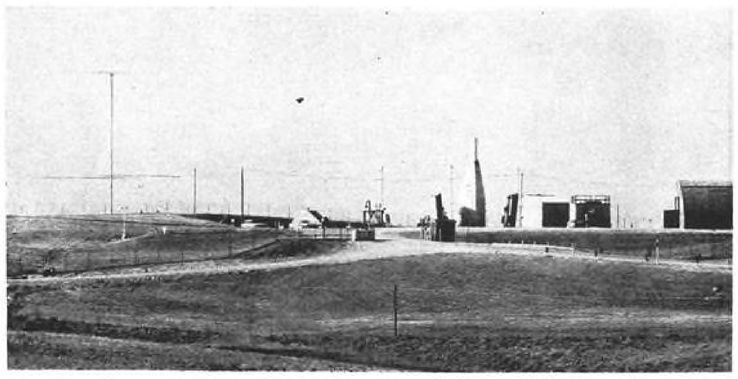
The ships would establish their positions from land-based Loran-C stations at distances up to 1,000 mi. away. With these positions known, the atomic clock time could be advanced for each ship to synchronize with the time of arrival of signals from the central Loran-C station, so that all clocks would read a common central-station time.

The re-entering vehicle would carry a transmitter operating in the VHF 30-300 mc. range. The proper VHF frequency would be chosen to get

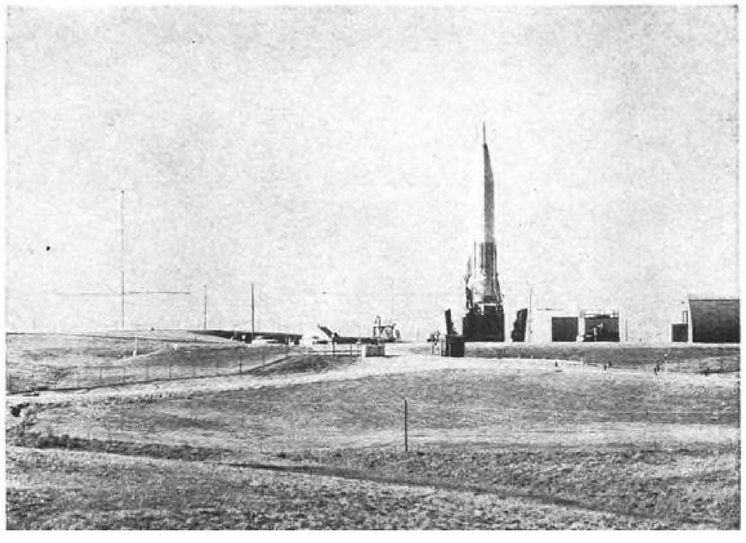


Full-scale mockup of Atlas F silo launcher at General Dynamics/Astronautics shows top and bottom silo segments, l. and c., and elevator system.

Atlas F Tested on Silo Launch Platform



Atlas F undergoes dual propellant loading test at Schilling AFB, Kan. Above, missile begins to emerge from underground silo, with stainless steel skin covered by frost caused by liquid oxygen. Below, launch platform is locked in launch position. Atlas "boils off" as some oxygen is vented before the missile is lowered again. Most of the oxygen is pumped back into storage tanks in the silo.



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General Electric is your only source for three classes of molybdenum sheet with specified reproducible mechanical properties. Made by the powder metallurgy process from pure molybdenum metal, they are available in thicknesses from 0.005 through 0.1875 inches and widths through 24 inches. All three classes are made from the same high quality 99.9% pure molybdenum metal. Planned variations in processing result in three classes of finished material, each suited for a general area of application depending on such factors as mechanical properties, tolerances, finish and flatness.

This means you can now select the class best suited to the needs and requirements of your application and be assured that the sheet you order next month or next year will be the same as you order tomorrow. You specify and buy the quality your application demands! G-E engineers will help you choose the best suited for your use. The three classes are defined below.

CLASS 100—Highly engineered, precision-rolled molybdenum sheet with specified reproducible mechanical properties. Processed for optimum strength and ductility characteristics at room temperature. Recommended for demanding application requirements such as difficult deep drawing and severe die forming. Available in widths from 1/8 through 12 inches.

CLASS 200—General purpose molybdenum sheet offered with specified reproducible mechanical properties. Recommended for less demanding applications where the more highly defined mechanical properties of Class 100 are not needed. Available in widths from 1/8 through 24 inches.

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General Electric's three classes of molybdenum sheet are described in Product Data Sheet 2400-d. Write for it today.

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General Electric scientists and engineers have developed new processes for rolling tungsten and molybdenum into reproducible sheet and plate, up to two feet wide. A bank of new rolling mills has been designed specifically for the flat rolling of refractory metals. Now fully installed and operating, they give General Electric unique capabilities in the supply of tungsten and moly in widths up to two feet. Where can you use wide refractory metals in your designs? Write now for complete data.

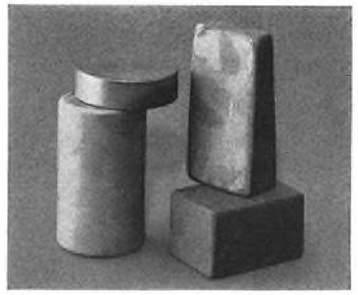
CAPSULE SPECS FOR FLAT ROLLED PRODUCTS

PRODUCT	FORM	TYPE	PURITY	AVAILABILITY
Molybdenum, unalloyed	Foil	Powder metallurgy	Molybdenum—99.9% min.	Thicknesses—0.001 through 0.004 in. Widths—⅛ through 7 in. Lengths—up to 8 ft.
		Vacuum arc-cast		
	Sheet	Powder metallurgy Classes 100, 200, 300		Thicknesses—0.005 through 0.1875 in. Widths—⅛ through 24 in. Lengths—up to 8 ft.
		Vacuum arc-cast		
	Plate	Powder Metallurgy		Thicknesses—0.188 through 0.800 in. Widths—1 through 24 in. Lengths—up to 8 ft.
		Vacuum arc-cast		
Molybdenum, alloyed with 0.5% titanium	Sheet	Vacuum arc-cast	Molybdenum—99.3% min. Titanium—0.40 to 0.55% Carbon—0.01 to 0.04%	Thicknesses—0.005 through 0.1875 in. Widths—⅛ through 24 in. Lengths—up to 8 ft.
	Plate			Thicknesses—0.188 through 0.800 in. Widths—1 through 24 in. Lengths—up to 8 ft.
Tungsten, unalloyed	Sheet	Powder metallurgy	Tungsten—99.9% min.	Thicknesses—0.005 through 0.1875 in. Widths—⅛ through 24 in. Lengths—up to 8 ft.
	Plate			Thicknesses—0.188 through 0.800 in. Widths—⅛ through 24 in. Lengths—up to 8 ft.

GENERAL ELECTRIC TUNGSTEN/MOLYBDENUM

pressed and sintered products . . .

BASIC FORMS—Sintered moly rounds up to 12″ diameter, tungsten to 9″ diameter. Minimum density for tungsten: 92%, for moly: 95%. Other basic forms of tungsten and moly can also be made: squares, wedges and rectangles. Maximum cross section is that which can be inscribed in a 12″ circle. Lengths go up to 50 inches depending on cross section dimensions.



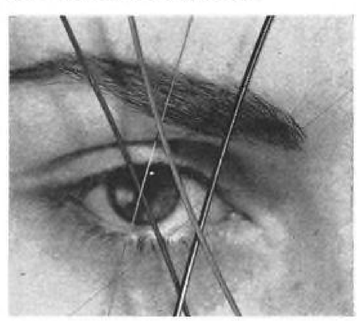
PREFORMS—General Electric engineers are ready to provide infinite assistance to help you use a tungsten or moly preform in your high temperature applications. For direct machining or forging, the preform approach may be best for you for utility and more efficient use of metal. Let our engineers tailor moly and tungsten to your specific shape.

powder, wire and rod products . . .

METAL POWDER—Tungsten and molybdenum metal powders of 99.9% minimum purity are available from General Electric for almost any application requiring these metals in powder form. They are produced by the hydrogen reduction of high purity compounds produced by chemical purification of tungsten ore and molybdenum trioxide. Integration of manufacturing steps back to these basic starting materials is a key to high quality.

Hydrogen-reduced tungsten metal powder is available in a wide range of sizes. For example, you can get it with an average particle diameter (as measured on the Fisher Sub Sieve Sizer) of less than one micron and all the way up to 50 microns! Granular tungsten metal powder can be made to any reasonable sieve size. Carbide . . . infiltrated electrical contacts . . . plasma spraying . . . these are applications well handled by G-E tungsten powder. Want a high pressed green strength powder where your pressing pressure is limited or you can't use a binder or you must have resistance to breakage or abrasion? General Electric has one that's tops! Is your application such that a tailor-made powder is required? General Electric can probably custom produce one for you.

Molybdenum metal powder is available from stock in the size range from 3½ through 6½ microns by the Fisher Sub Sieve Sizer. Finer or coarser sizes can be custom made. G-E moly metal powder has found wide acceptance for use in plasma spraying, pressing and many other applications. What's your application for this refractory metal?



WIRE AND ROD—Tungsten and molybdenum in the form of wire and rod are basic products of General Electric. With an historic background of supplying wire for our own electric lamp filaments and parts, General Electric is well equipped to supply wire and rod in almost every size and surface finish.

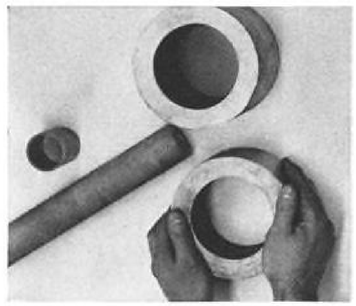
Tungsten, offered in self contained coils or on spools, is available as wire in sizes from 0.0002″ through 0.100″ in diameter. A General Electric first, 3-D alloy wire (tungsten/3% rhenium), is available for critical jobs in lamps and electronic tubes. Tungsten rod is supplied in straight lengths in sizes from 0.040″ through 1.000″ in a cleaned finish and through 0.970″ in a ground finish for automotive contacts, seals through hard glass, fasteners and other interesting applications. Tungsten rod in the form of electrodes for tungsten inert gas (TIG) welding are G-E products, too.

Molybdenum wire is supplied in the diameter range from 0.0012″ through 0.250″. This product is "drawn" molybdenum with a circular cross section and is shipped in self contained coils or on spools. Moly rod, shipped in straight lengths, is supplied in diameters from 0.030″ through 1.250″ in either a cleaned or ground finish. Glass-melting electrodes in the popular 1¼″ diameter size are offered, too!

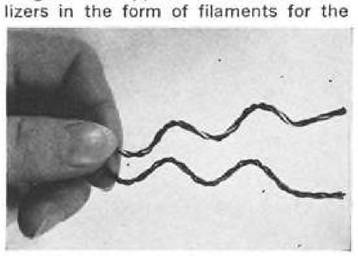
PRODUCT POSSIBILITIES EXTEND TO ∞



THICK-WALL TUBES AND CRUCIBLES General Electric can make straight, longitudinal holes down the center of PS Moly or PS Tungsten as tiny as ¼ inch. Tubes are available in O.D. sizes up to 12 inches. Maximum I.D. for any pressed tube is three-quarters of the O.D. Thinner walls may be available by machining. Lengths to 50 inches depending on diameter. PS tubes are used as furnace susceptors, electrodes in vacuum arc melting, missile hardware and other applications. General Electric's unique hydrostatic pressing technique lends itself to crucible forms, available in O.D.'s up to 12″.



VACUUM METALLIZING WIRE AND FILAMENTS—General Electric tungsten has an important role in the vacuum metallizing industry. It is an electric heat source for evaporating metals in high vacuum. General Electric "Long-Grain" tungsten is supplied to vacuum metallizers in the form of filaments for the



metallizer who prefers to buy his tungsten ready-to-use, or in the form of stranded wire for users who prefer to make their own filaments. General Electric offers this kind of tungsten in the form of regular strand, open strand and aluminum core strand for optimum results in metallizing. If you vacuum metallize, be sure to specify General Electric tungsten! Write for the tungsten metallizing wire and filament catalog.

IMPORTANT PHYSICAL PROPERTIES OF TUNGSTEN AND MOLYBDENUM

	TUNGSTEN	MOLYBDENUM
chemical symbol	W	Mo
atomic number	74	42
atomic weight	183.92	95.95
melting point	6170°F (3410°C)	4730°F (2610°C)
density, g/cc	19.3 (19.17 for wire)	10.2 (10.14 for wire)
thermal conductivity, cal/sq cm/cm/sec/°C	0.245 at 1727°C	0.159 at 1627°C
electrical resistivity, microhm-cm	5.48 at 0°C, 90.40 at 2727°C	5.2 a 0°C, 81.4 at 2622°C
modulus of elasticity	50,000,000 psi	47,000,000 psi
specific heat, cal/gram-atom at 20°C	6.25	6.24
lattice type	body centered cubic	body centered cubic

Write today on your company letterhead for a useful Tungsten/Moly Conversion and Weight Slide-Rule Calculator (free) and complete product data files on tungsten and molybdenum. Write to General Electric Co., Lamp Metals and Components Department, 21800 Tungsten Road, Cleveland 17, Ohio.

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through the ionosphere. These signals, transmitted from the re-entry vehicle, would be received on the four ships. Arrival time of the signals would be related to the common time base, coded along with the ship's position, and radioed to a control center for the recovery operation. In the control center a computer would calculate the successive positions of the re-entry body and establish a predicted trajectory and impact point.

Possible Errors

Any system is only as good as its inaccuracies permit it to be. The Loran-C system has several possible sources of error which could be contributing factors to the final position or prediction error.

Loran-C is a hyperbolic system, in which positions are defined by the intersections of several hyperboloidal surfaces which in turn are defined by the arrival-time differences of signals from more than one transmitter. In the re-entry situation, the problem is reversed; the hyperboloidal surfaces are defined by the arrival time at the four ships stations of a single signal coming from the re-entering body.

The accuracy of the position determined from that data depends on the accuracy of the signal time and the way that timing changes with position changes. Sensitivity of the signal timing to position changes depends on the angle subtended by the lines of sight between the tracking stations and the re-entry vehicle. If the vehicle were to be overhead at an elevation about equal to the base-line distances involved, the sensitivity would be reduced by a factor of about two compared with the best sensitivity claimed of about two microseconds per 1,000-ft. change in position.

If the vehicle is at the maximum range of 1,000 mi., the sensitivity would be reduced by a factor of 10 or 20, depending on the length of baseline and the direction of approach.

Surface Displacement

Since each of the position-fixing surfaces is subject to this same uncertainty, the displacement of a single surface causes a much larger displacement of an indicated position, depending on the acuteness of the intersection angle. Sperry says that in regions of good accuracy the uncertainty of position would be about three to ten times the displacement equivalent to the timing uncertainty; this will increase to 50 to 100 times the timing error at the limit of coverage.

Because of the variation of electrical properties of the atmosphere, the distance corresponding to a given signal delay will have an error of at best one part in 100,000. The ionosphere further retards a signal, depending on the frequency of the signal.

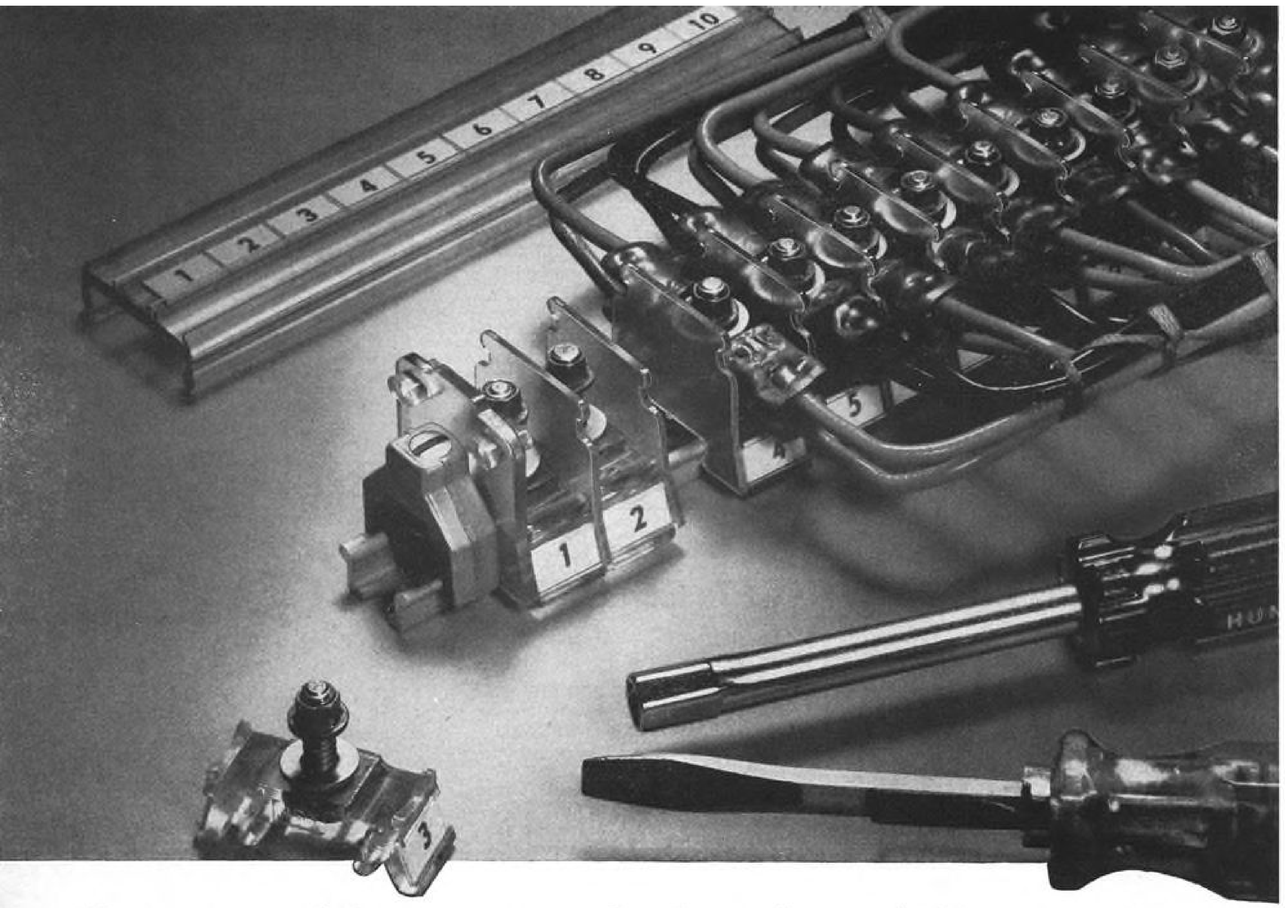
These uncertainties can be corrected with the best data available, and result in a propagation velocity determination which is correct to perhaps one part in 20,000.

Position Uncertainty

This latter uncertainty plus the error due to the uncertainty in determining the intersection of the hyperboloidal surfaces determine the over-all position uncertainty. In the case of a re-entry vehicle directly overhead, the total position error could be expected to be about 200 ft. At 1,000 mi. range of the re-entry vehicle, the position error would be on the order of three miles.

Sperry engineers make one more extension to the Loran-C system in their proposal, which would make its principles applicable to more accurate deep-space tracking. Some current thought is directed toward linking the Atlantic and Pacific Loran-C chains for time measurements.

If this were done, then a common time base with microsecond accuracy would be available across a distance approaching one earth diameter. The advantages that would result from such a large baseline for deep-space tracking are obvious.



all you need is two standard tools and 10 seconds

to remove or replace any circuit in new modular-design

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New JOYBLOCKS are built around an incredibly simple idea: easily-replaceable modular units. Every JOYBLOCK is an assembly of individual terminal bases which snap on and off a supporting rail. You can remove or replace any circuit you desire without disturbing other circuits, without dismantling and reassembling the entire block.

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Expandable. To add more circuits, just loosen and extend end retainers, and snap the desired number of additional terminal bases onto the rail.

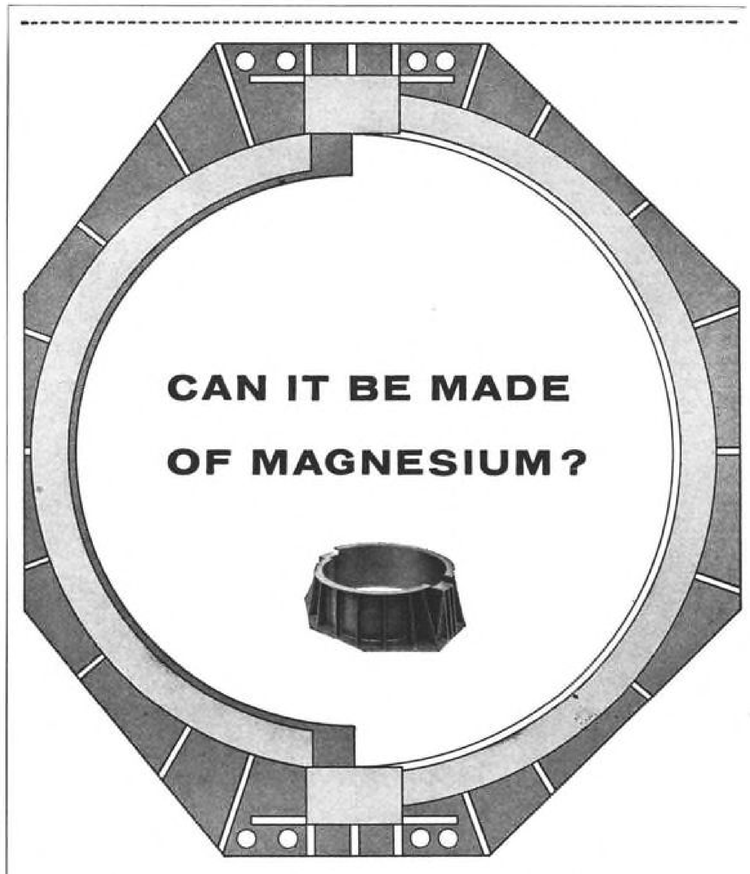
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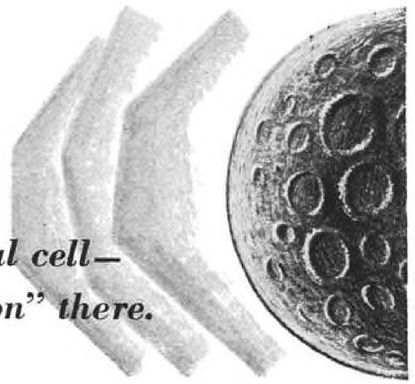
It can at Lavelle. Lavelle specialists know magnesium . . . how to weld it, form it, control it to produce precision missile and aerospace components that meet critical specifications, exacting performance requirements. Major contractors rely on Lavelle for sheet metal craftsmanship . . . in magnesium, titanium, nickel, aluminum, stainless steel and other alloys. Write for brochure detailing Lavelle quality controlled services: Engineering / Production Planning / Sheet Metal Forming Welding / Machining / Metal Finishing.

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When it Comes to Colonizing the Moon...

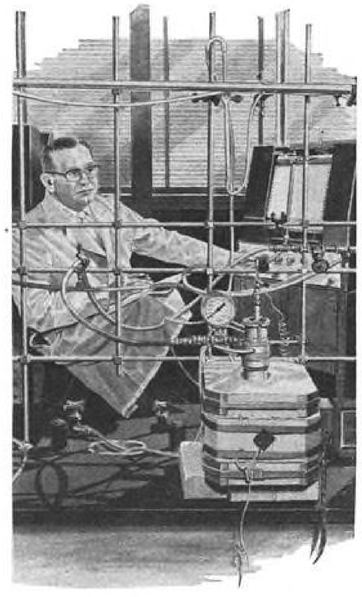


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Studies of nuclear power system design.

Study and preliminary design of advanced power systems for space and terrestrial use.

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PRODUCTION BRIEFING

Martin Co.'s Research Institute for Advanced Study, Baltimore, Md., will study the effects of intense light on photosynthesis in support of Air Force's research in the field of spacecraft life support systems. Work is sponsored by a $62,436 contract from Air Force's Aerospace Medical Division.

Bendix Corp.'s Pioneer-Central Division, Davenport, Iowa, has received a $287,000 contract from the Boeing Co. for design and manufacture of electronic instruments which will measure the amount of cryogenic fluid in the hydrogen and oxygen tanks of Air Force's X-20 (Dyna-Soar) space glider. Boeing also awarded a $127,000 contract to Cosmodyne Corp., Hawthorne, Calif., for controls to maintain constant pressure in the X-20's environmental oxygen tanks.

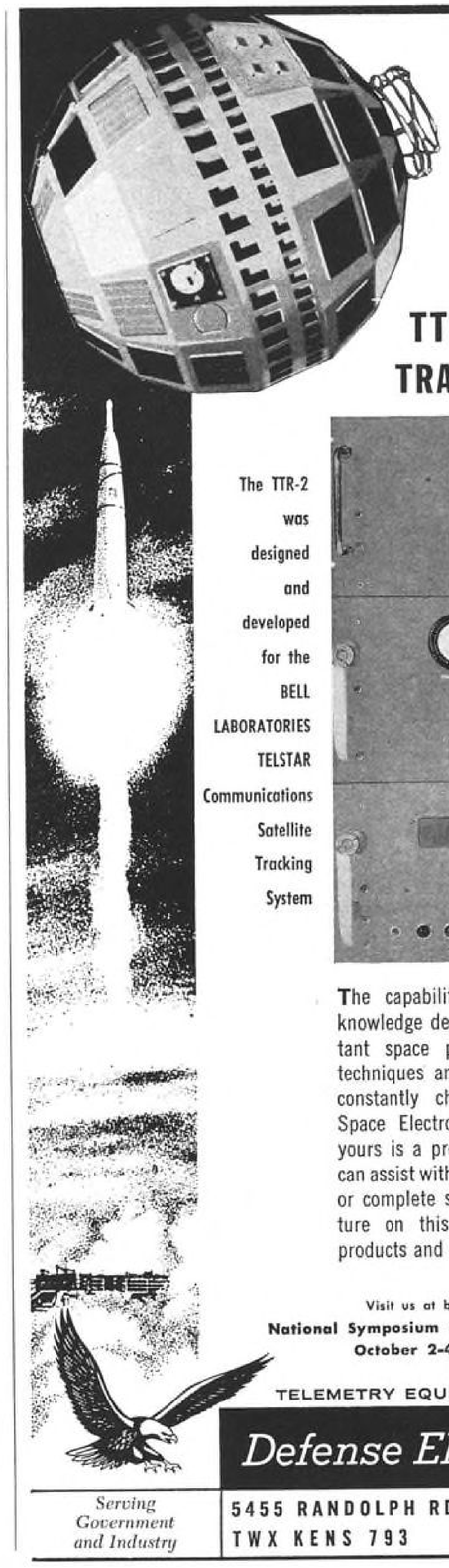
Moog Servocontrols, Inc., East Aurora, N. Y., will develop steering controls for the S-4 stage of the Saturn booster under an $850,000 contract from Douglas Aircraft Corp. Contract calls for servoactuators which will electrohydraulically move the S-4 stage engines.

Kellert Aircraft Corp., Willow Grove, Pa., has received a $228,712 contract from Navy's Bureau of Weapons for continued study of the effects of downwash on the operation of VTOL aircraft. Aircraft shapes representing the XC-142 tri-service VTOL assault transport will be used.

Cessna Aircraft Co., Wichita, Kan., has been awarded a $425,000 contract by Army's Transportation Materiel Command for five CH-1C helicopters, which will be used in the Military Assistance Program. Deliveries will start in December, 1962.

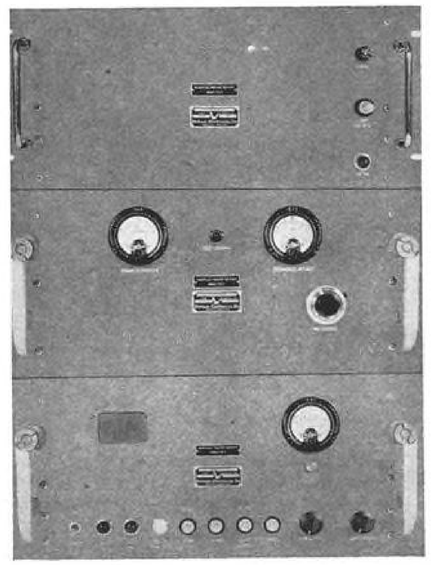
Beckman Instruments, Inc., will build a miniaturized carbon dioxide warning system for Project Mercury spacecraft under an $88,000 contract from the National Aeronautics and Space Administration. Devices will consist of four-ounce carbon dioxide sensors and solid-state amplifiers which will monitor carbon dioxide buildup in the spacecraft.

Monogram Precision Industries, Inc., Culver City, Calif., has received a $300,000 contract from Webcor, Inc., Chicago, to build frame, drum and cover assemblies for the receiving and transmitting phases of the compact radar systems used on the Navy's carrier-based A4D fighter-bombers.



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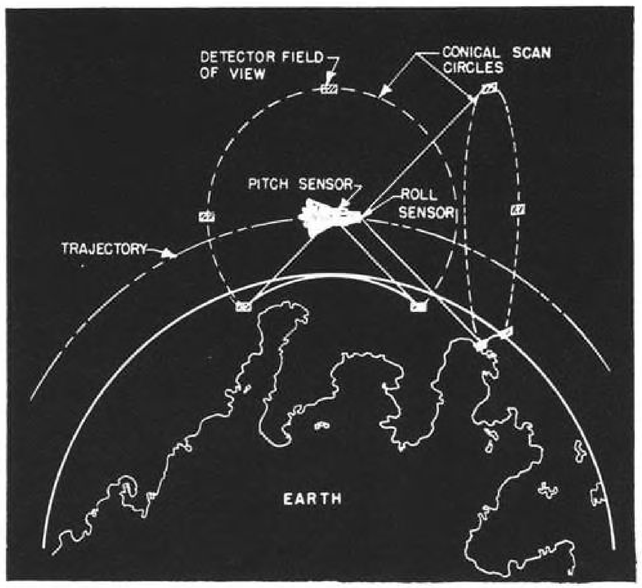
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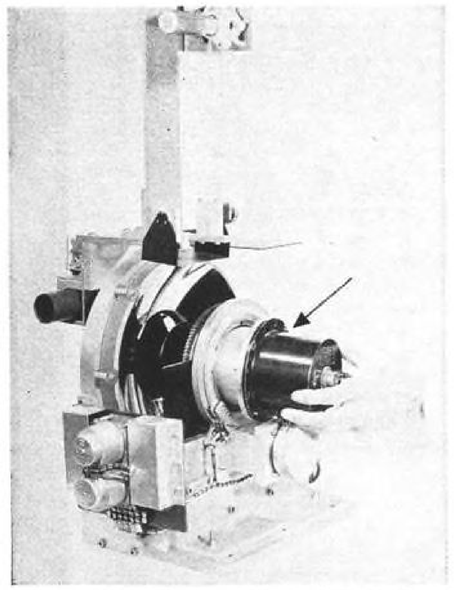
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TWO INFRARED HORIZON SENSORS in Mercury capsule determine direction to center of the earth to provide vertical attitude reference by measuring the thermal boundaries of the earth about pitch and roll axis. The 3-lb. horizon sensor, produced by Barnes Engineering, is shown (right) installed in test fixture which simulates earth.

Infrared Sensors in Space–Part 2:

Cold Clouds Troubling Horizon Sensors

By Philip J. Klass

Washington—Infrared horizon sensors, used to provide earth-attitude reference and stabilization both for manned and unmanned satellites, have encountered trouble from an unexpected phenomenon—clouds at extremely high altitudes which appear cold rather than warm. At lower altitudes, clouds reflect sunlight and therefore have a warm appearance in the infrared spectrum.

Cold cloud problem appears easier to resolve than the one of detecting ICBMs, which is delaying the Midas early warning satellite program (AW Sept. 24, p. 54). Simple modification has greatly eased the problem for the Mercury capsule sensors and improved fixes are under development.

But spurious cold cloud effects do not appear to be the explanation for the large error in pitch axis reference reported by Cdr. Scott Carpenter during the Mercury MA-7 mission. In fact, an extensive investigation by the National Aeronautics and Space Administration, by McDonnell Aircraft and by Barnes Engineering, which supplies the Mercury horizon sensors, has so far failed to pinpoint the basic cause.

Major cause of early delays in the NASA Nimbus meteorological satellite has been problems with the infrared horizon sensors used for attitude stabilization. These, too, have been attributed to effects of spurious radiation from clouds. However, General Electric says it has redesigned the system to get around the difficulty.

Infrared horizon sensors for spacecraft have been developed or are under development by several companies. Barnes Engineering, one of the pioneers in this field, is supplying horizon sensors to Lockheed for use in attitude stabilization of Agena vehicles in all USAF military satellite programs, in addition to the Mercury capsule units. Barnes also is supplying infrared horizon sensors for stabilization of the Satellite Inspector (Saint) vehicle under development by Radio Corp. of America.

Horizon sensors for the two-man Gemini space capsule and the Orbiting Geophysical Observatory will be supplied by Advanced Technology Laboratories, Mountain View, Calif. The horizon sensor for the Nimbus is being developed by General Electric's Missile and Space Division. Martin-Baltimore is producing a horizon sensor under NASA contract for undisclosed use.

Functionally speaking, the infrared horizon sensor might more appropriately be termed a "vertical sensor" since that is its purpose—to establish the direction from the spacecraft to the center of the earth.

Two or more infrared sensors normally are used to establish the attitude of the satellite with respect to the thermal outline of the earth, after which the center can be determined by simple geometry or equivalent. Because the earth is warm, with an average temperature of 280K (45F) in the moderate zones, it should provide a well-defined thermal outline against cool space.

Once the direction to the center of the earth (local vertical) has been established, a signal is available which can be used to operate gas jets or other control mechanisms to stabilize the satellite attitude with respect to vertical.

Or the signals can be used to orient a vertical gyro, as in the Mercury capsules, in much the same way that a small pendulum is used in a conventional aircraft vertical gyro to prevent drift and keep it aligned to the vertical. A pendulum or other accelerometer can not be used for this purpose in a satellite because the whole vehicle is in a zero-g condition.

In the Mercury capsule, two separate infrared horizon scanners are used, one for the pitch-axis reference and the other for roll-axis reference, both

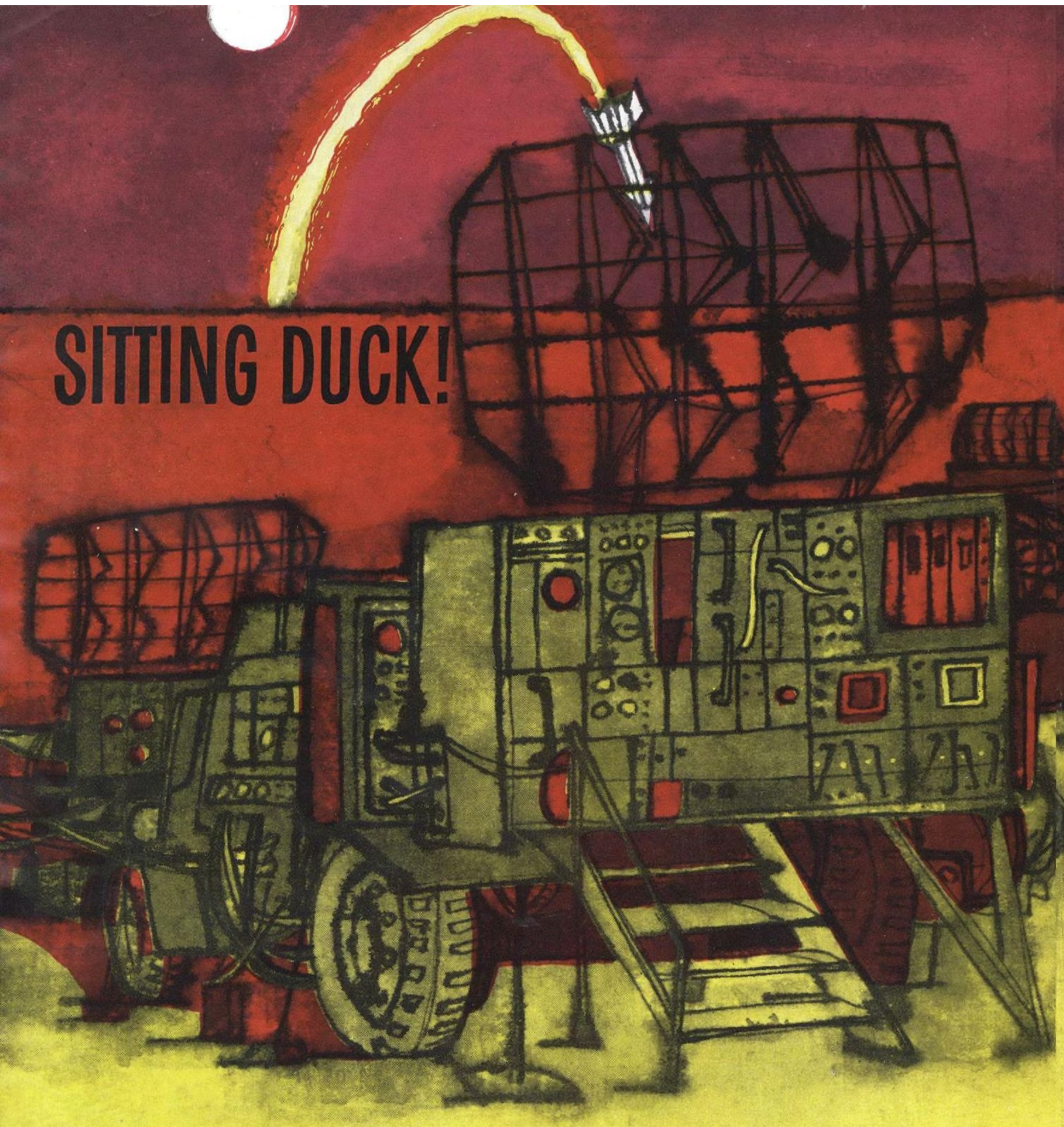


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mounted in the nose of the capsule. Each of the 3-lb. horizon sensors contains an infrared detector, optics which give the detector a 2 x 8 deg. field of view and a motor-driven scanning prism which causes the field of view to go through a conical scan at 30 rps.

The infrared detector "looks" out ahead (or behind) the capsule for roll-axis reference while the pitch-axis scanner looks out to the side. When the capsule attitude is such that the sensors can see the earth, the infrared radiation impinging on the detector increases sharply as it scans the edge of the warm earth. It should remain at this high level until the detector scans past the earth and again looks into space, at which time the signal should drop sharply.

Thermal Boundaries

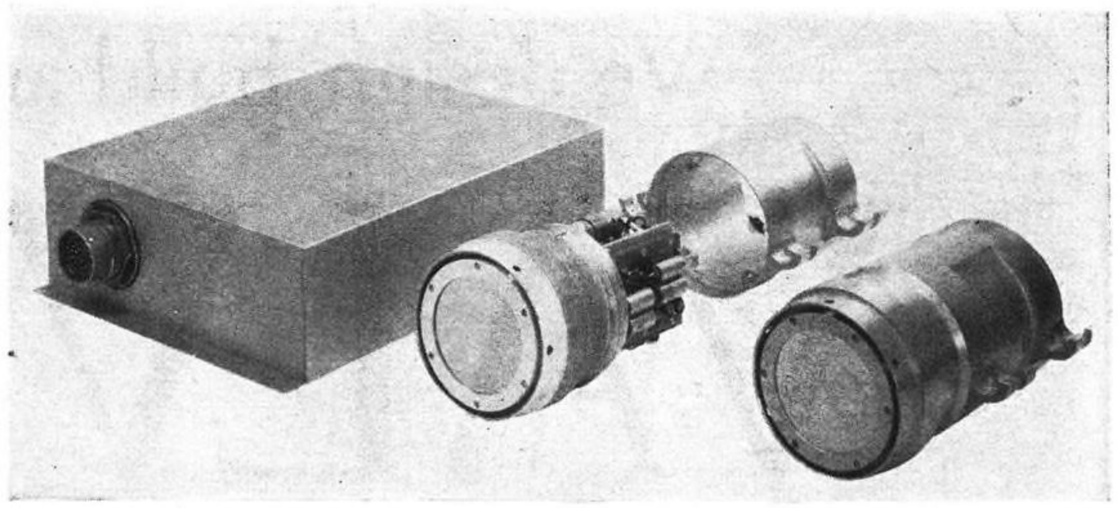
By this means one horizon sensor determines the thermal boundaries of the earth about the capsule's pitch axis while the other sensor does the same about the roll axis. This determines the angle which the earth subtends along each of the two axes. Bisecting this angle establishes the vertical, i.e., earth center.

If the earth emits sufficiently high radiation over the scanned surface, this angle bisection can be accomplished conveniently by thermal-electrical means. Specifically, gating circuits into which the infrared detector signal feeds can be set to trigger when the signal reaches a predetermined threshold, considerably above the energy level when the detector is looking at cold space. Clipping is used to cut off energy which is significantly greater in intensity than the threshold value.

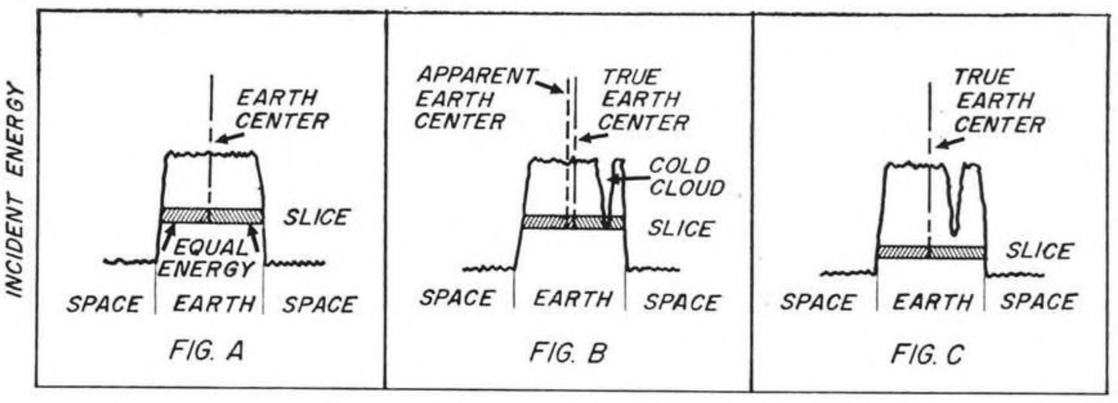
The result is a "slice sample" of the energy received by the detector between two specific energy levels across the spectrum bandpass of the system. (See Fig. A.) By locating the point along the slice, corresponding to position of scan across the earth, where the energy in one segment of the slice equals the energy of the other, the position of the vertical is established.

The technique, which Barnes uses in its horizon sensor for Mercury, is relatively insensitive to reflected sunlight because its germanium optics filter out most of the sunlight energy which occurs at wavelengths shorter than about 1.8 microns.

During the first orbital flight of an unmanned Mercury capsule, telemetry data showed that the horizon scanners were not performing properly during intervals. This led to an investigation that first suggested that the apparent radiation temperature of very high altitude clouds, as seen by the horizon scanner, was as low as 170K. This temperature was considerably colder than had been expected.



AGENA HORIZON SENSORS, similar to those used in Mercury, are used in Air Force's Discoverer program, presumably for earth orientation of Midas and Samos satellites.



EXPLANATION OF HORIZON SENSOR cold-cloud problems and subsequent cure: Earth center is determined by dividing sample slice into two segments that contain equal amount of infrared energy (A). But passing over very cold cloud causes energy dip which penetrates slice, creating false vertical (B). Lowering slice threshold eases the problem (C).

When the spacecraft passes over such high, cold clouds, the energy level received by the infrared detector falls drastically, almost as if the scanner were looking at cold space instead of at the warm earth. If, under these conditions, the received energy falls below the level of the slice, it upsets the balance, and the technique used to bisect the earth's subtended angle gives an erroneous indication of the vertical. (See Fig. B.)

Quick Fix

As a quick fix for this problem, Barnes decided to lower the energy level, or threshold, of the slice sample so that sharp dips produced as the satellite passed over cold clouds would not drop low enough to penetrate the slice and thereby upset the thermal balance. (See Fig. C.)

Where previously the slice threshold level had been set at about 50% of the normal radiation level emitted by the earth, the value was dropped to about 25%, according to Eric M. Wormser, vice president and general manager of Barnes Defense & Space Division.

The improved horizon sensors were first flown in the MA-5 orbital mission (with chimpanzee astronaut) to evaluate the fix. During the flight, the outputs of the two scanners were recorded continuously during five eight-minute intervals. And during one of these eight-minute periods, photographs were made through the capsule periscope of the earth horizon at 10-sec. intervals to provide a means for evaluating sensor performance.

Subsequent analysis showed that when passing over high cold clouds, the energy impinging on the detector often fell to less than 50% of normal value and occasionally dropped to as low as 5-10% of normal value. The photos also suggest that usually these high, cold clouds are associated with severe weather disturbances, such as hurricanes.

Transient Effect

Under most conditions, the cold cloud effect has only a small transient effect on the performance of a satellite attitude stabilization or reference system, causing it to align briefly to a slightly erroneous vertical.

In the Mercury capsule, the vertical (attitude) gyro is slaved to the horizon sensor determined vertical at a maximum rate of about seven deg. per minute. That is, if the horizon sensors are misled by cold clouds into establishing a false vertical, the vertical gyro can only move toward this false vertical at seven deg. per minute. Unless the satellite is over such cold clouds

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for an extended interval, they should not introduce a significant error into the attitude gyro indication.

Analysis of the MA-5 photos shows that when the horizon sensors are not disturbed by cold clouds, they can determine direction of earth vertical to within one deg. or less, Barnes says.

The improved horizon sensors, with lower (25%) slice threshold, were used in the first manned Mercury mission (MA-6) without reported difficulties. However, during the injection phase of the subsequent MA-7 flight, telemetered data indicated a discrepancy of approximately 20 deg. between the pitch axis vertical of the Atlas booster gyros and the capsule's pitch-axis control system. Since the booster gyros served as reference for injection, which was successful, it is assumed that the error was in the pitch-axis scanner of the capsule. The only independent reference is the radar tracking data which, in subsequent analysis, appears to confirm correctness of booster gyros.

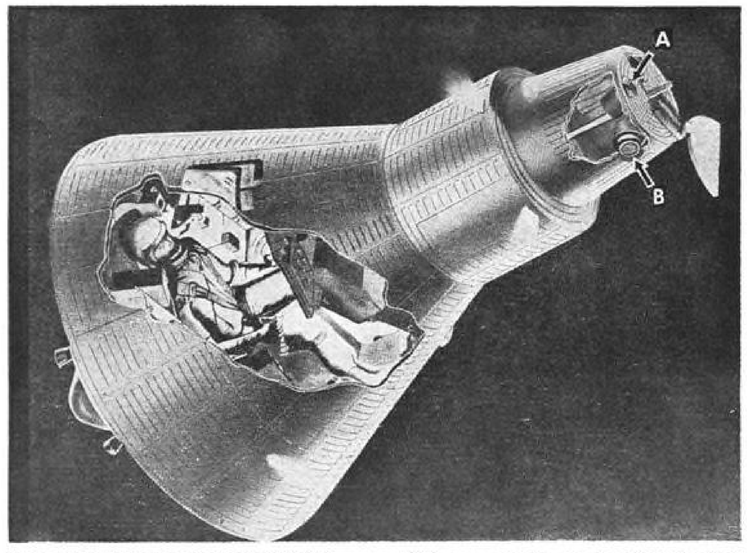
During the second orbit, while in contact with the Indian Ocean ship, Carpenter reported "the gyros do not seem to be indicating properly." But he then quickly added: "And that is not correct either. The gyros are . . . are okay; but on ASCS [Automatic Stabilization and Control System] standby. It may be an orientation problem. I'll orient visually and . . . see if that will help out the ASCS problem." At this point the Capsule Communicator on the ground raised a question about the astronaut's blood pressure and his attention was diverted from the gyro reference problem.

It was not until later in the second orbit, while in contact with the Hawaii station, that the Capsule Communicator returned to the problem: "Would like for you to return your gyros to normal [slaved to horizon sensors] and see what kind of indication we have: whether or not your window view agrees with your gyros." (The window has a scribe mark which should align with the earth horizon when the capsule is in the correct 34-deg. nose-down pitch attitude for firing the retrorockets.)

Before Carpenter could make this check, his attention was diverted by the white luminescent particles which Col. John Glenn had reported seeing during the MA-6 mission. By this time the capsule was approaching California where a decision had to be made on whether to go for a third orbit, so interest shifted to the astronaut's blood pressure and his capsule oxygen and fuel supplies.

The problem did not come under scrutiny again until the capsule was over Hawaii on the third pass and Carpenter was beginning his re-entry checklist run-down. When ASCS is operating properly, it can be used to automatically place the capsule in the required 34-deg. nose-down pitch attitude required to initiate the re-entry phase of the mission.

With only six minutes to go before retrofire, Carpenter reported "I have an ASCS problem here. I think ASCS is not operating properly. . ." About 30 sec. before retrofire, Carpenter reported "I don't have agreement with ASCS in the window. . ." indicating that the



TWO INFRARED HORIZON SENSORS in nose of Mercury capsule scan to determine thermal outline of warm earth against cold space to locate center of earth. This is used to keep capsule attitude gyros correctly aligned.

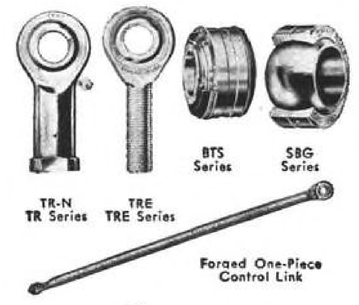
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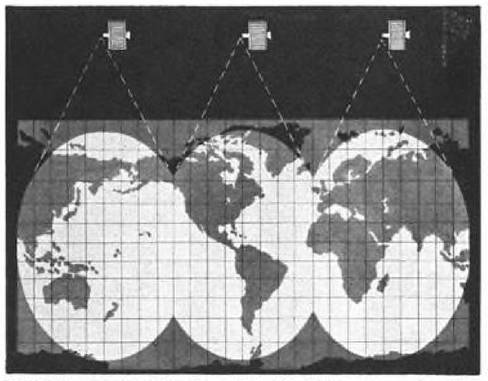
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Getting set for space, Syncom I will be launched by NASA soon. Aboard will be Hughes-built components such as this advanced traveling wave tube. Capable of amplifying weak signals so they may be relayed from the satellite back to earth, these tubes are tested to meet almost incredible standards of performance and reliability in compact, lightweight packages.



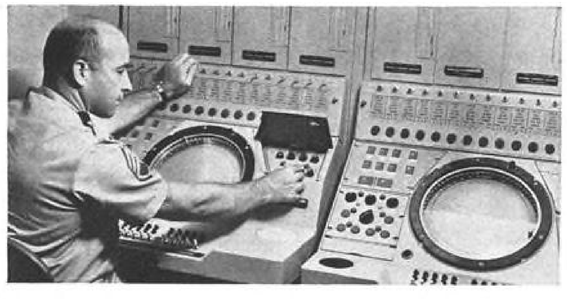


New 3-D radar to read the enemy's mind



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Hughes Display and Computer Systems keep pace with the increased capability of Hughes 3-D radar. Integrated into complete air or truck-transported air defense systems they enable today's commanders to "read the enemy's mind"—by supplying them with evaluations of threats as well as automating the assignment of weapons and targets for counter actions.

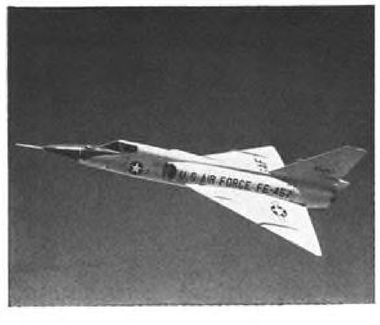


Mark of the Falcon's claw

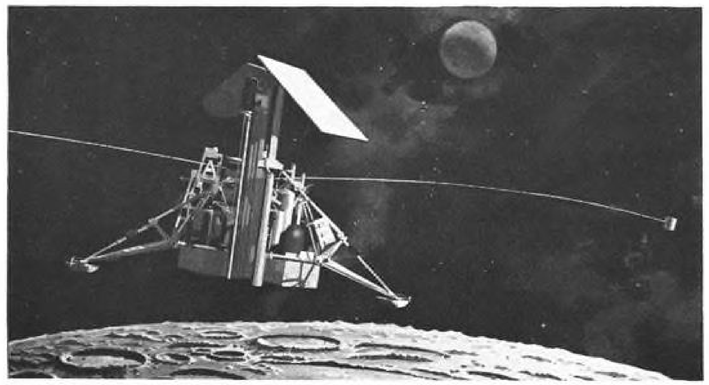


Falcon Fin Marks on the metal target prove the bulls-eye accuracy of this infrared heat-seeking air-to-air missile. In test after test, Falcons fired from long distances sensed the infrared radiated by such targets (heated to simulate the exhaust from a jet tailpipe) scoring bulls-eyes.

The F-106 realizes potential Hughes engineers saw 14 years ago for an integrated missile/electronic control/aircraft weapons system. Hughes has produced more than 33,000 infrared and radar guided Falcons, together with over 16,000 "seek, find and kill" electronic airborne weapons control systems. Today, Hughes design and development capability is being applied to meet new and even more advanced tactical fighter mission needs.



A Surveyor to take the measure of the moon



Before our Astronauts can land on the moon, we must know more about what they will encounter. The Hughes Surveyor, designed to "soft land" about 150 lbs. of scientific instruments on the moon, will gather, analyse and transmit vital lunar data back to earth. Even now, Surveyor test vehicles are being dropped on various surfaces to be sure they successfully "soft land" their precious cargos. For once on the moon, Surveyor's TV cameras will be capable of sending high-quality pictures of the earth *back* to earth. This moon-to-earth TV network will also give scientists pictures of the lunar surface and will enable them to watch Surveyor at work: drilling into the lunar surface and making chemical analyses, measuring geophysical characteristics, the magnetic and radiation fields. The National Aeronautics and Space Administration is scheduled to launch seven Hughes Surveyors which are being built under the technical direction of California Institute of Technology Jet Propulsion Laboratory.

How do you define capability?

One way is to see it as potential—a dynamic total of human knowledge and experience combined with facilities built to make these skills most productive.

At Hughes this potential is built on sound strengths: 15 years of continuing scientific achievement; facilities covering 5.3 million square feet; over 100,000 man-years of systems experience; the abilities of 28,000 people—including 5,300 engineers and scientists who have found an environment uniquely suited to the development of their own potential—where skill and imagination can find full expression.

At Hughes these factors mesh together into a functioning unity—with *total* capability. The several examples on these pages are just a few examples of Hughes accomplishments in helping to create a new world with electronics.

Creating a new world with electronics

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RTV-102 is useful as an adhesive or sealant for metal fabrication. Will not sag on vertical or overhead surfaces.

RTV-102 is an excellent adhesive for most materials. It is the only type of adhesive completely suitable for silicone rubber.

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GENERAL ELECTRIC

automatic control had not properly aligned the capsule in pitch.

Carpenter finally bypassed the automatic control system and used his manual controls to align capsule attitude, using the window scribe mark as a reference.

Intensive studies of the telemetered and tape recorder data made aboard the capsule, as well as later discussions with Carpenter, indicate that the 20-deg. pitch error apparently existed throughout the mission, but that the roll-axis sensor appeared to function properly. These studies have been made by NASA, McDonnell and Barnes.

MA-7 Difficulties

The magnitude of the error, its continuous existence and the proper operation of the roll-axis sensor indicate the MA-7 difficulties were not due to cold cloud radiation, according to Donald Ehlers, Barnes project engineer.

Any conclusive post-mortem is difficult because the nose package containing the horizon scanners is ejected during re-entry and not recovered.

Barnes' studies of the circuitry show three possible random component failures which might have caused the large pitch error. These range from a 10:1 loss of gain in one transistor to a specific capacitor becoming extremely leaky.

McDonnell has investigated the possibility that aerodynamic heating of the capsule nose during launch, immediately after the escape tower is jettisoned, might have leaked into the lens cover for the pitch scanner. This trouble was experienced earlier, but was thought to have been corrected by means of thermal insulation. Although no evidence has been found to indicate that this was the cause, additional insulation may be added in MA-8 as a precautionary measure.

Sensor Recovery

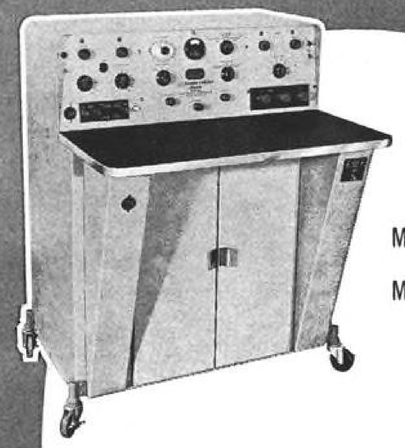
A spokesman at NASA's Manned Space Flight Center, Houston, says that provisions may be added to the nose pack for the MA-8 to permit recovery of the horizon sensors for a detailed post-mortem if the fault should occur again.

But the consensus of the investigation by NASA, Barnes and McDonnell on the MA-7 troubles is: "cause unknown."

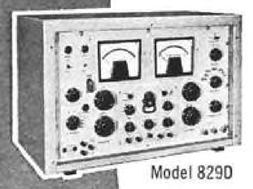
However, a NASA spokesman at Houston told AVIATION WEEK that the MA-8 mission profile will call for the astronaut to make performance checks on the ASCS and horizon sensors early in the mission, using visual references of the earth as viewed through the periscope and window.

Additionally, the mission profile will call for the astronaut to initiate his retrofire preparations much earlier in the

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The advantages gained by calibrating and standardizing electrical measuring instruments using self-contained, console type standards are impossible to duplicate using individual components. Their ease of operation, long term stability, accuracy, wide current and voltage ranges, and built-in safety provisions yield economies which result in substantial cost savings over older methods of calibration.

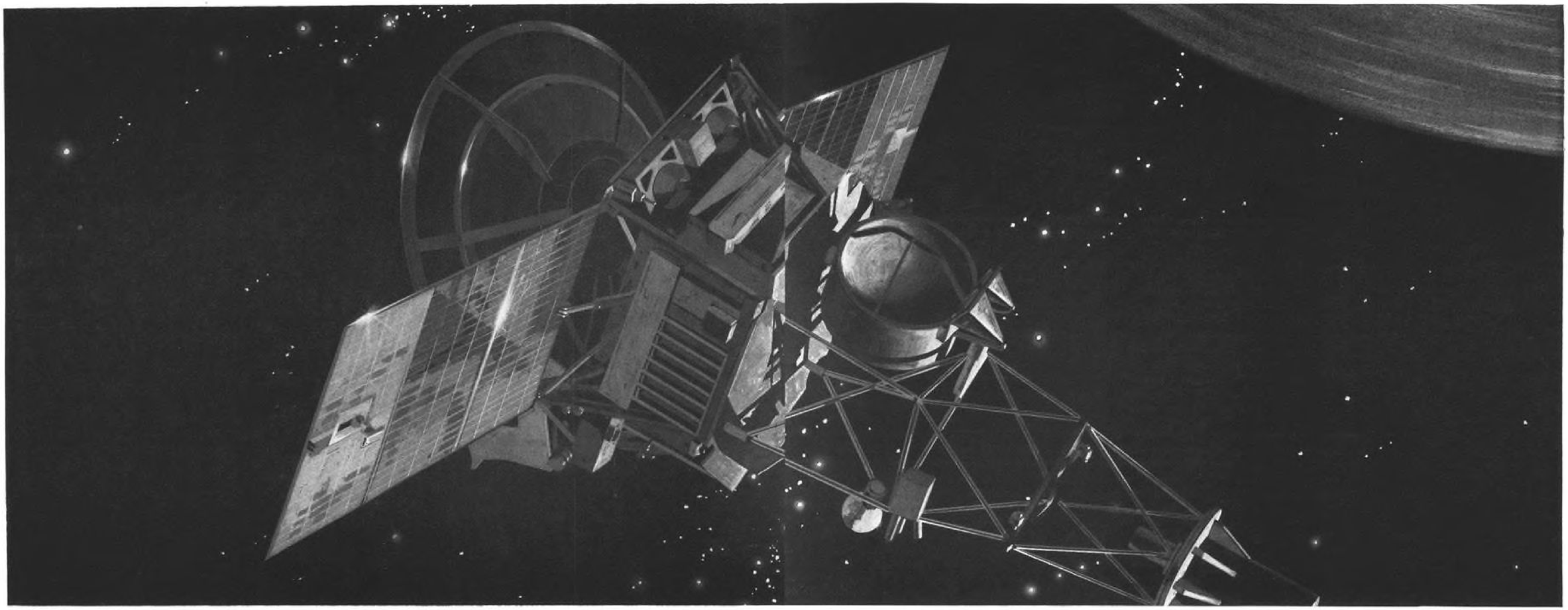
Since development of the original self-contained instrument calibration standard for the U. S. Navy in 1947, RFL has produced many variations and offers the world's widest selection of such equipment. Choice of direct-comparison, regulated-power-supply and AC-DC transfer methods with accuracies to meet all commercial and military requirements for working or reference standards is available. Some of the models currently in production are illustrated. They can be seen at the factory or by arrangement with field representatives in most states and 20 overseas countries.

Performance warranty is unequivocal. Calibration certificates for every current and voltage range, on all models, are supplied. Accuracy is traceable to primary standards at the National Bureau of Standards.

SEND FOR TECH. DATA

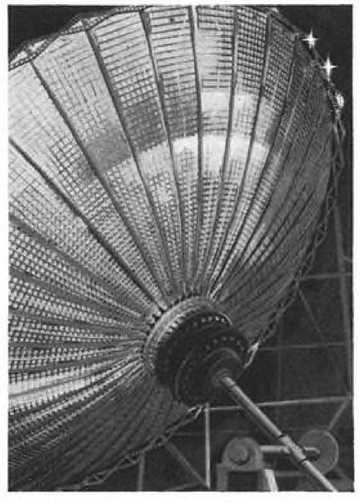
For additional information, including application data, write or phone DE 4-3100. Demonstrations available by local representatives.

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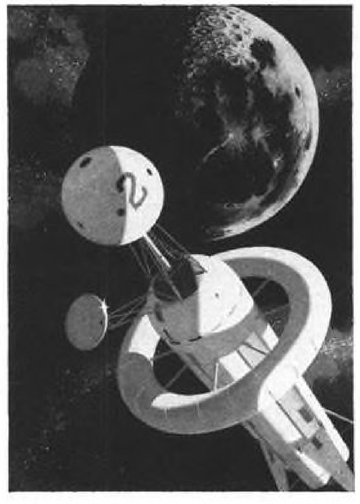




HIGH-ALTITUDE *radar altimeters for the Saturn launch vehicle, lunar landing spacecraft, and high-speed hydrofoil ships are among the advanced electronic guidance and communications systems now being created by Ryan Electronics.*



FOLDING SOLAR MIRRORS *can provide a source of power for space vehicles. This model, 10 feet in diameter, was completely engineered and fabricated in just a few months by Ryan's engineers and highly skilled metallurgists.*



MAGIC LINK *between space vehicles and earth is the Antenna which makes possible two-way communication. Lightweight, precision Space Antennae, capable of withstanding both launch and space environments, are being developed by Ryan.*

How to power Venus-bound space probes?

Ryan Aerospace is producing lightweight solar panels which will support thousands of tiny photoelectric cells to harness the sun's energy in space. The cells will generate the electrical power needed for the controls, experimental and communications systems of Venus space probes and earth satellites.

With broad experience in systems management, Ryan engineers are developing power systems, communications systems, and advanced space structures to meet the requirements of space vehicle programs. These capabilities are geared to *fast reaction time* in keeping with the demands of planetary orbits and sudden shifts in program schedules.

Flexible, fast-moving Ryan is also making significant contributions in the areas of V/STOL aircraft, Doppler sensing and navigation systems, and Flex Wing applications. And Ryan is the world's largest producer of jet target systems for the Armed Services.

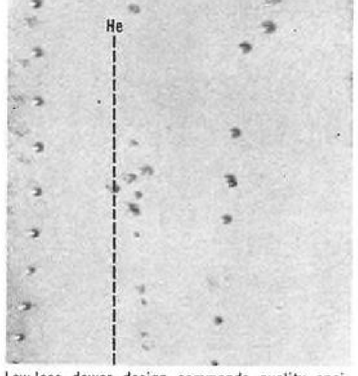
Your inquiry is invited concerning the total capability of Ryan Aerospace and Ryan Electronics in space age design, development and fabrication.

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CRYOGENICS

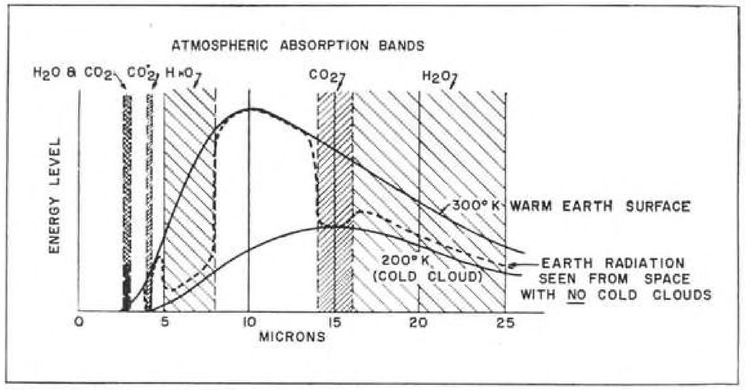
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Low-loss dewar design commands quality engineering. Ratings of some Cryenco high efficiency helium dewars show only a 1% boil-off loss per day at helium's -452°F. temperature—designed without liquid nitrogen shielding. Most of these Cryenco dewars are standard production units. These include liquid nitrogen mobile dispensing dewars with only .26% nitrogen loss per day, and in-plant liquid hydrogen trailer dewars with 1% hydrogen loss per day. Cryenco also makes a complete line of cryogenic hardware — liquefiers, refrigerators, cryovalves, tanks, cold traps, transfer lines, cryostats and biostats. All Cryenco equipment is designed to free your physicists and engineers for fundamental work. Write for quotation on your specific requirement, as well as full details on Cryenco's low-temperature capabilities and experience.



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INFRARED ENERGY EMITTED by warm earth (top solid curve) is heavily attenuated by carbon dioxide and water vapor in atmosphere at wavelengths shown, so that energy from earth seen by satellite horizon sensors appears as shown in dotted line when there is no cloud cover. Extremely cold, high-altitude clouds have infrared emission characteristic similar to black body with temperature of 200K (lower solid curve). Present satellite horizon sensors obtain most of their radiation at shorter wavelengths through windows (unshaded areas), which means they experience a sharp drop in energy level when passing over cold clouds (large difference between dotted and lower solid curve). More advanced horizon sensors now under development will operate in the 14-16 micron region, heavy carbon-dioxide absorption band, where there is relatively little difference between energy level of attenuated warm-earth radiation and that emitted by extremely cold, high-altitude clouds, to prevent errors now experienced.

mission to provide time to resolve any difficulties which may turn up and avoid the "cliff-hanger" experience of the MA-7, with its subsequent overshoot of the intended recovery area.

Although Barnes has modified its original horizon sensor design to enable it to scan across clouds which are as much as 80% colder than the earth without adverse effects, it is exploring more advanced techniques for future designs.

One new technique is based on designing the sensor optics to operate at longer (cooler) wavelengths. In the 15 micron band, for example, carbon dioxide in the atmosphere absorbs radiation of this wavelength from the earth and sunlight, then re-radiates it. A sensor operating in the 14-16 micron band should then see the earth profile by virtue of the infrared radiation from the carbon dioxide shell which encloses the earth.

In this strong carbon dioxide absorption region, it is believed that the earth will appear to have a nearly uniform temperature of about 200-220K, corresponding to the top of the troposphere.

Because the sensor is sensitive only in the cooler portion of the infrared spectrum, the cold clouds should cause only minor variations in the energy level impinging on the detector. By bisecting the angle formed by the earth's carbon dioxide shell, it should be possible to determine the local vertical, as with the present scanner.

The AF Cambridge Research Laboratories have taken a similar approach and are working on a narrow-band infrared detector with sensitivity centered in this same region.

Admittedly, there will be less contrast between the atmosphere and space at this cooler wavelength, but it should be sufficient for satisfactory operation, Wormser believes. One problem area in the design of a longer-wavelength scanner is to obtain optical components with good transmission efficiency in the 14-16 micron band which can also withstand the hostile space environment. Another problem area is obtaining efficient infrared filters to exclude longer wavelengths beyond this band. However, Barnes reports that it is making encouraging progress.

(This is the concluding article in a two-part series. First part appeared in AVIATION WEEK, *Sept. 24, p. 54.)*

GE, Toshiba to Form Electronics Company

Tokyo—General Electric Co. and Tokyo Shibaura Electric Co., Ltd., (Toshiba) will form a new electronics company to build and repair ground radar systems and accessories for Japan's Self-Defense Agency.

Formal application was made recently to the Japanese Ministry of International Trade and Industry for permission to form the new company, which will be called TESCO (Toshiba Electronics System Co.). It will be capitalized at $600,000, with Toshiba investing 60% and GE 40%.

TESCO is being formed to meet increasing demands from the Self-Defense Agency for production and overhaul of AN/FPS-6 and -8 ground radar systems, range calculators and photo-electric sighting devices.

FILTER CENTER

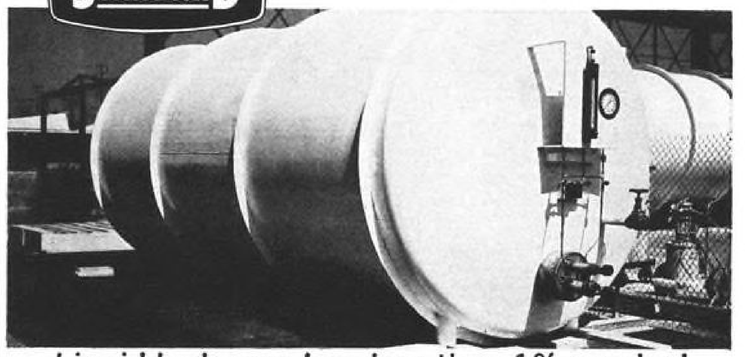
▶ **New High Intensity Laser**—New type helium-neon gas laser which operates by direct excitation (electric discharge) at a wavelength of 3.39 microns the longest wavelength yet reported except for cesium laser, has been "discovered inadvertently" by scientists at Spectra-Physics, Inc., Mountain View, Calif. Company says new laser produces more power and has a higher gain per unit length than any other infrared laser yet discovered. Power outputs of 10 mw. have been obtained from a discharge tube 115 cm. long by 9 mm. in diameter. By suitable selection of reflecting mirrors, laser can be made to emit visible light only, infrared, or combination of both. When both occur, the infrared laser operation has a significant effect on the visible lasing action, Spectra-Physics reports.

▶ **Higher Laser Efficiency Predicted**—Efficiency of lasers in converting excitation (pumping) energy into useful output, which currently runs less than 3%, can be expected to rise to 10-20% in a few years and ultimately perhaps to 50% or higher, according to Dr. C. H. Townes, who discovered maser action. However, such efficiencies will not necessarily be obtained with lasers that also have high power output and short-duration pulses, according to Townes. Townes, currently Provost at MIT, made the forecasts in a Pentagon seminar sponsored by ARPA.

▶ **Plasma Frequency Sensor Reported**—Technique which permits direct measurement of the plasma frequency of an ionized medium, from which electron density can be calculated, has been developed by Upper Air Research Laboratory of the University of Utah under sponsorship of Air Force Cambridge Research Laboratories. Technique, outlined in a report authored by O. C. Haycock and K. D. Baker, uses dipole antenna mounted on re-entry vehicle which is excited by a low-level radio-frequency source whose frequency can be varied. Antenna voltage and current are compared with phase as frequency is varied. When the two are in phase, the exciting frequency is the plasma frequency.

▶ **New Type Strain Transducer**—An extremely sensitive strain transducer, which experiences a thousand-fold change in resistance when subjected to a stress of a few thousand dynes, using a recently discovered characteristic of shallow semiconductor P-N junctions, was reported by W. Rindner and Raymond Nelson of Raytheon. Sensitivity is largely determined by junction depth and increases as depth decreases.

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WHY WAIT?



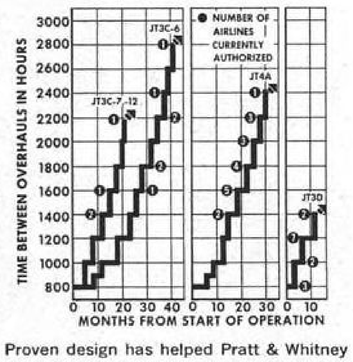
The JetStar is here now. In world-wide service with corporate fleets and the U. S. Air Force. Jet fast. Over-the-weather altitude. Crew and 8 passengers.

LOCKHEED JETSTAR *the compact utility jet*

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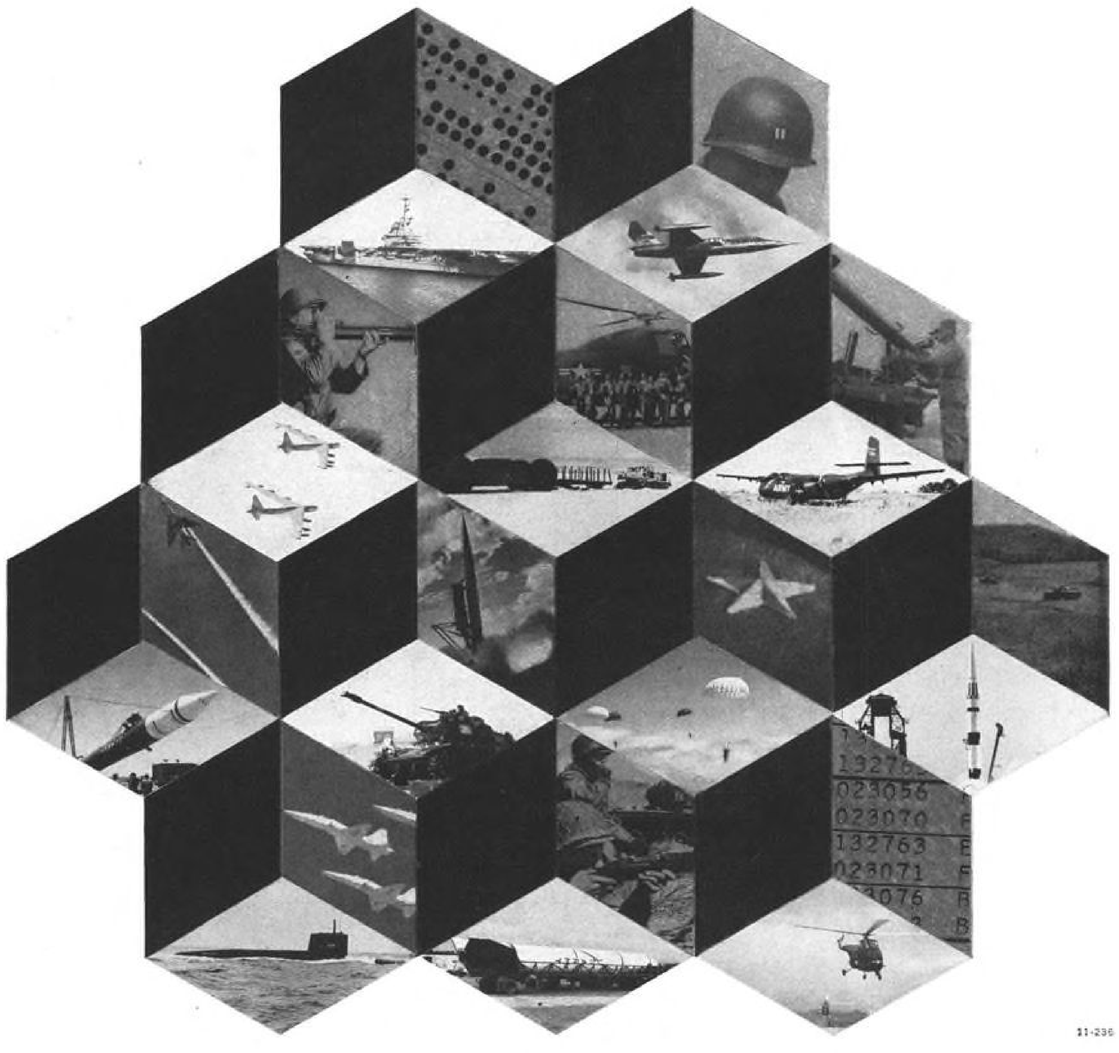
The information behind such decisions is incredibly complex. In volume, in variables, in interrelationships. And each decision itself may affect world-wide or continental forces and events. In making operational decisions, today's commanders and governmental leaders use systems which provide information processing assistance. Developing these huge man-machine systems is the work of scientists, engineers, and computer programmers at System Development Corporation. Their concern is system development, not hardware development. They consider the interaction and effect of men, doctrine, tradition, training; of organizations, chains-of-command and chains-of-succession; of communications, traffic centers, command posts, computers and displays. Their work begins with system analysis. It continues through system synthesis, computer instruction, system training, system evaluation—and then in adapting the system to the changing needs of its users. Throughout they strive to optimize man-computer relationships and also carry on research into future systems. Human Factors Scientists, Operations Research Scientists, Systems-Oriented Engineers and Computer Programmers interested in joining this expanding field are invited to write Dr. H. A. Best, SDC, 2432 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C.; Lexington, Massachusetts; Paramus, New Jersey; and Dayton, Ohio. "An equal opportunity employer."

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11-236

Electronic Data Systems Surge Predicted

By Donald E. Fink

New York—Increase in dollar value of the electronic information systems market from $3.5 billion in 1963 to about $5.5 billion by 1967 was predicted here recently at a military marketing symposium held in conjunction with the Electronic Industries Assn.'s fall conference.

Prediction was made by a five-member panel, which presented a market forecast extrapolated from government budget hearing figures, EIA files and electronics company projections. Moderator was Harold Rapaport, vice president of International Electric Corp. Panel members were Dr. R. Pfefferkorn, Martin Co.; Abraham Katz, Radio Corp. of America; Harry Keit, International Electric Corp., and William Orchard-Hays, vice president of CEIR, Inc.

Five-Year Period

Purpose of the symposium was to define the general area of information systems and their command and control applications, discuss major components of information systems and predict their market value over the next five years. A ten-year interval was considered, but it was dropped because the projection became too indistinct.

While numerous factors will influence growth of the information systems market, three main assumptions were listed as basic to the panel's projection:

- **Continuation** of the present international state of tension.
- **Continued emphasis** on development of communication satellites.
- **Substantial increase** in military aerospace communications needs.

Largest total market and the biggest rate of increase were forecast for the aerospace communications field, with the 1963 market estimated at $934 million. Of this, $400 million was tabbed for military applications, with the remainder being accounted for by expenditures from government agencies such as Federal Aviation Agency and National Aeronautics and Space Administration.

By 1967, the panel predicted, this market potential will have increased to $2.075 billion, of which $1.1 billion will be for military applications.

Largest single market listed was military expenditures for command and control systems. This was estimated at $800 million in 1963 of a total military and non-military market of $810 million. By 1967, it will have increased to $1 billion of a total $1.03 billion market.

Command and control systems, were termed keys to successful management of vast programs, such as the U.S.'s satellite communication and control program and the military's world-wide command setup.

Indicating increased emphasis on Army mobility over the next five years, the panel predicted greater Army requirements for mobile command and control systems, now used primarily by Navy and Marine Corps. Army expenditures for fixed systems are expected to decrease during the same period, while expenditures for mobile systems increase until Army becomes their biggest user (AW Sept. 24, p. 65).

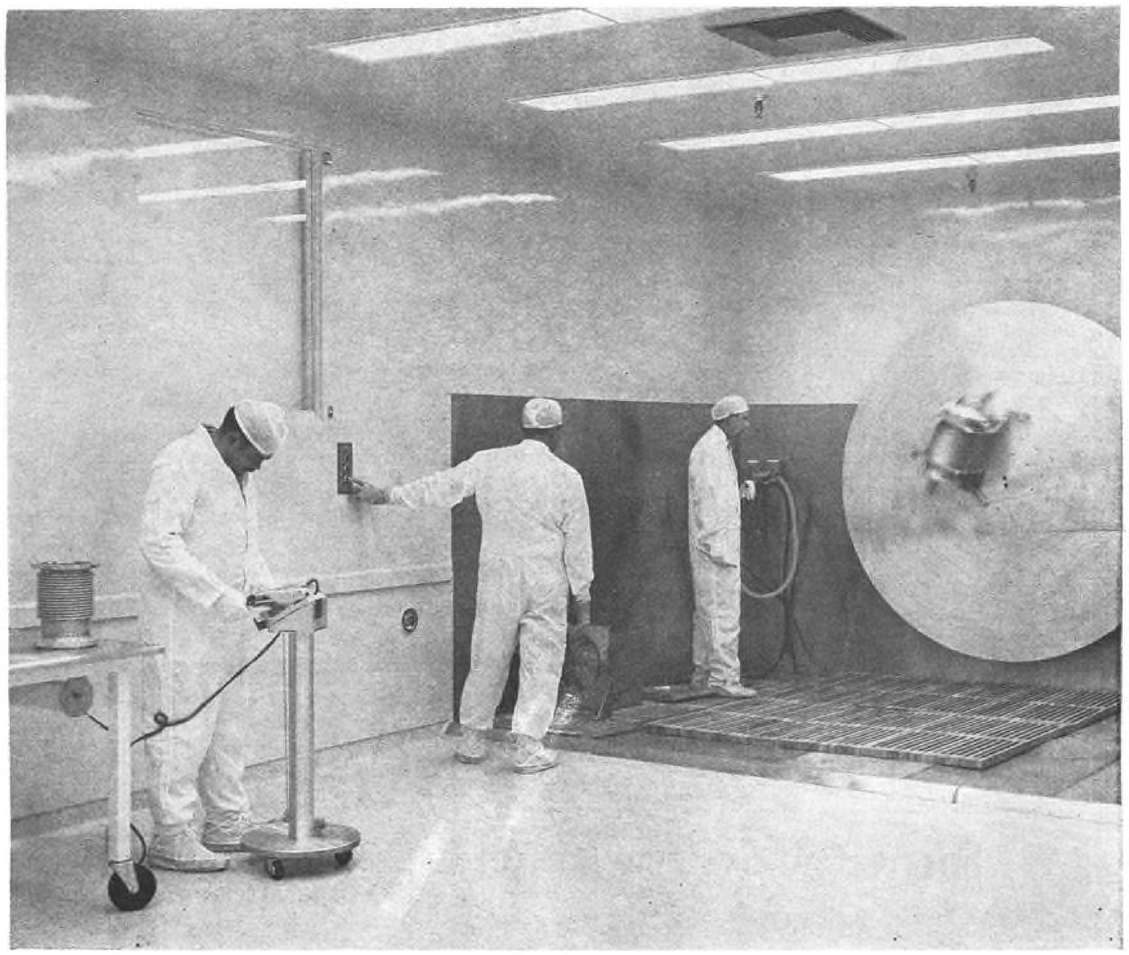
Critical Areas

During the discussion of major information systems components, it was pointed out that data transmission state-of-the-art has not kept pace with developments in related fields. Five major areas in which need for advancement will become critical in the near future include pulse techniques, power-versus-weight, antenna efficiency, receiver sensitivity and noise reduction. The market in data transmission equip-

Information Systems Market Expected Growth

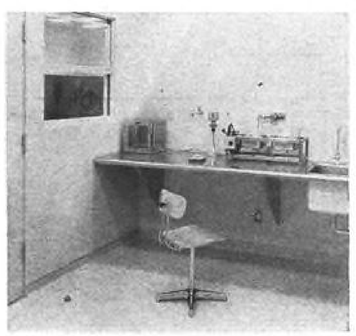
(in millions of dollars)

		1963	1964	1965	1966	1967
COMMAND AND CONTROL	Military	800	850	900	950	1,000
	Non-Mil.	10	30	30	30	30
	Both	810	880	930	980	1,030
MANAGEMENT CONTROL	Military	300	300	300	275	275
	Non-Mil.	33	53	53	56	56
	Both	333	353	353	331	331
AIR TRAFFIC CONTROL	Military	100	100	120	120	130
	Non-Mil.	125	125	150	150	170
	Both	225	225	270	270	300
AEROSPACE COMMUNICATION	Military	400	500	650	850	1,100
	Non-Mil.	534	885	975	975	975
	Both	934	1,385	1,625	1,825	2,075
SURVEILLANCE AND INTELLIGENCE	Military	572	631	681	711	721
	Non-Mil.	44	54	49	45	42
	Both	616	685	730	756	763
GENERAL SUPPORT	Military	390	444	471	531	555
	Non-Mil.	61	81	81	81	78
	Both	451	525	552	612	633
INFORMATION MANAGEMENT	Military	10	20	25	50	75
	Non-Mil.	10	15	20	20	20
	Both	20	35	45	70	95
RESEARCH AND DEVELOPMENT	Military	50	60	72	86	102
	Non-Mil.	87	108	130	147	147
	Both	137	168	202	233	249
GRAND TOTALS	Military	2,622	2,905	3,219	3,573	3,958
	Non-Mil.	904	1,351	1,488	1,504	1,518
	Both	3,526	4,256	4,707	5,077	5,476



Solar LOX cleaning facilities assure "surgical cleanliness" for cryogenic systems

Solar-built cryogenic and hydrocarbon systems for the nation's most sophisticated aerospace projects are cleaned and packaged in the company's newly-expanded LOX cleaning facilities.



Designed to NASA standards, the LOX cleaning area is typical of Solar's modern, complete aerospace facilities. In it, the newest methods are used to assure the required "surgical cleanliness" of missile parts.

The Solar LOX cleaning facility is fully equipped for hydrocarbon or alkaline cleaning methods. The clean room itself is pressurized and has an air supply system that delivers 3500 cu ft per minute, filtered at .5 micron and below.

Throughout the cleaning process, Solar maintains rigid safety and quality controls to assure that all standards are met or bettered.

A special assembly area, where cleaned parts and assemblies are protected from contamination, is an integral part of the facility. For more information about Solar's complete LOX cleaning facilities or unique capabilities, write Solar, Dept. K-167, San Diego 12, Calif.

SOLAR
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ment alone, estimated at $1.1 billion for 1963, is expected to reach $2.3 billion by 1967.

It also was predicted that producers of data transmission equipment will face increasing competition during the period because of the wide range of equipment which will be developed and increased selectivity by users. The larger companies will have the advantage, since they will be able to produce a wider range of equipment. Smaller companies will be pushed further into the ranks of subcontractors, according to the panel.

In the field of display components for information systems, it was pointed out that military expenditures account for 75-80% of the present market. The non-military market was termed unstable, both in technology and user requirements, since concentration in the past has been predicated on special military needs.

Extent of FAA utilization of control display devices, for example, is uncertain at present, but future needs to meet increased traffic control loads hold potential for a large market. The control display market, estimated at $197.5 million for 1963, is expected to reach $551.6 million by 1967.

"Softwear", the term applied to programed utilization of an information system, was another area requiring advancement. Methods of assembling data to be fed into the system and quality control of the input have not kept pace with the increasing efficiency of the equipment components of the systems, thereby reducing the over-all efficiency.

Terming the softwear market a mass of unsatisfied demand, the panel concluded that the immediate future will see a large demand for training programs which will produce more technical writers and highly skilled systems operators. The demand for the training programs is expected to taper off in the latter part of the five-year period.

Test System Bids

Eighteen companies are expected to bid for a contract to develop a general purpose automatic test system designed for overhaul depot use to check out and trouble-shoot three widely used Air Force airborne communication and navigation equipments—the AN/ARC-34 UHF communications set, the AN/ARN-21 Tacan navigation receiver and the AN/APN-105 Doppler radar navigation system. Delivery of the first prototype equipment is to be within 18 months after contract is signed. Procurement is being conducted by the Middletown Air Materiel Area, Olmsted AFB, Pa.

ACTION MEMO

FROM: Value Analysis Manager

TO: J.M.H. Dept 77-31

These Cherrylock features mean lower installation cost. We should save money in purchasing and manufacturing-fewer rivets to buy and stock – less chance of installing the wrong grip. We authorize an immediate evaluation.

H&C



Only the New Cherrylock Aircraft Rivets Give you ALL these advantages...

- ★ Positive Mechanically Locked Stem
- ★ Flush Fracture (No Stem Trimming)
- ★ Strong Clinch
- ★ Wide Grip Range
- ★ Positive Hole Fill

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.

Cherry Rivet Division
Santa Ana, Calif.

SEE OUR SPECIFICATIONS IN THE MICRAFILM CATALOG VSMF

Townsend Company
ESTABLISHED 1816 • BEAVER FALLS, PA. • A textron COMPANY

In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario



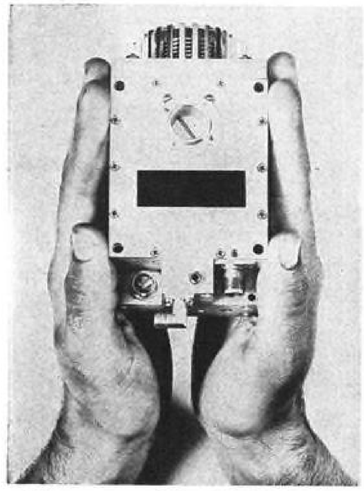
ECM

Modern electronic countermeasures are an important deterrent and intelligence tool for the military services. "Ferreting" ECM systems—for the detection, location and analysis of foreign electromagnetic radiation associated with radar, missile command and communications—are a demonstrated capability of Babcock's Military Products Division, where operational ferreting systems are in production for the Navy. Babcock's skilled team, with an established reputation for providing field-ready reliability in a wide range of military-qualified electronic systems and components, is conducting advanced research and development to provide solutions to new problems in ECM.

MILITARY PRODUCTS DIVISION **BABCOCK**

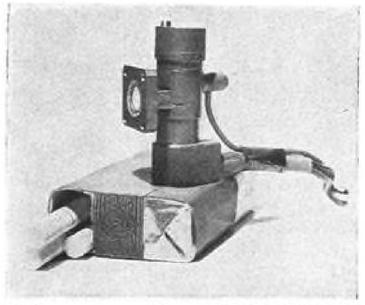
BABCOCK ELECTRONICS CORP.
1640 Monrovia Avenue, Costa Mesa, California

NEW AVIONIC PRODUCTS



• **Telemetry amplifier,** Model P-30A, a miniature VHF cavity amplifier providing 25 w. output at an operating plate efficiency of 65%, is conduction cooled and suitable for space and missile applications, ground-based VHF transmitters or special RF equipment. Amplifier occupies 21.7 cu. in., weighs 16.5 oz., has minimum bandwidth of 2 mc. in operating frequency range from 216 to 260 mc. It is designed for −20 to +85C temperature range, and will withstand 15g throughout 30 to 2,000 cycle range.

Manufacturer: Resdel Engineering Corp., 990 S. Fair Oaks Ave., Pasadena, Calif.



• **Microwave oscillator,** Model SRK-291, a K-band reflex kylstron suitable for use as a pump source for parametric amplifiers, delivers 80 mw. min. power and is mechanically tunable over the 1500 mc. range from 23 to 24.5 gc. Miniature tube weighs 3½ oz., is rugged and has low temperature coefficient to enable it to offer stable operation in airborne and ground installations. Manufacturer: Sperry Electronic Tube Division, Sperry Rand Corp., Gainesville, Fla.

• **Subminiature turbulence gage,** Model 2503, a piezoelectric transducer which resolves dynamic pressures in air, gas or liquid from 0.01 to 10 psi. while ignoring static loads. Sensitivity is 130 mv./psi., with frequency response from 2 cps. to 10 kc.

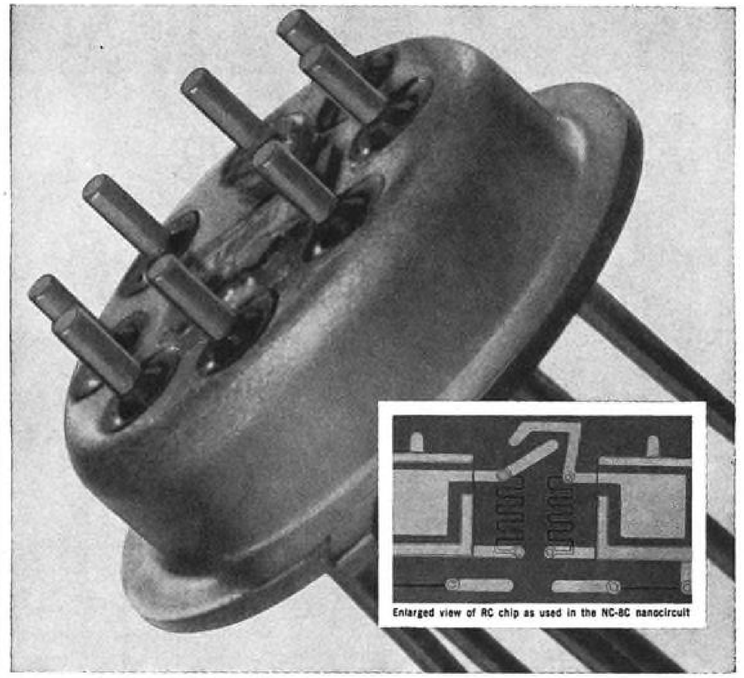
Transducer measures 0.388 in. dia. x 0.255 in. long, weighs 3 grams excluding cable.

Manufacturer: Endevco Corp., 801 So. Arroyo Parkway, Pasadena, Calif.

• **Subminiature repeat-cycle timers,** Series 4,400 for d.c. use and Series 25,400 for 400 cps. application, are available with cycle times of 5 sec. to 25 min. in the d.c. model and 12 sec. to 90 min. in the a.c. version. Up to 10 switches can be provided. Single-switch models measure 2⅛ in. long, while an eight-switch unit measures 4⅞ in. Single-switch model weighs 6½ oz. Normal operating range is −55C to 85C, but timers are available for 125C operation. Device is designed to operate under 10g vibration, 5-500 cps., or more on special order.

Manufacturer: A. W. Haydon Co., 232 North Elm St., Waterbury 20, Conn.

Nanocircuit of the Month

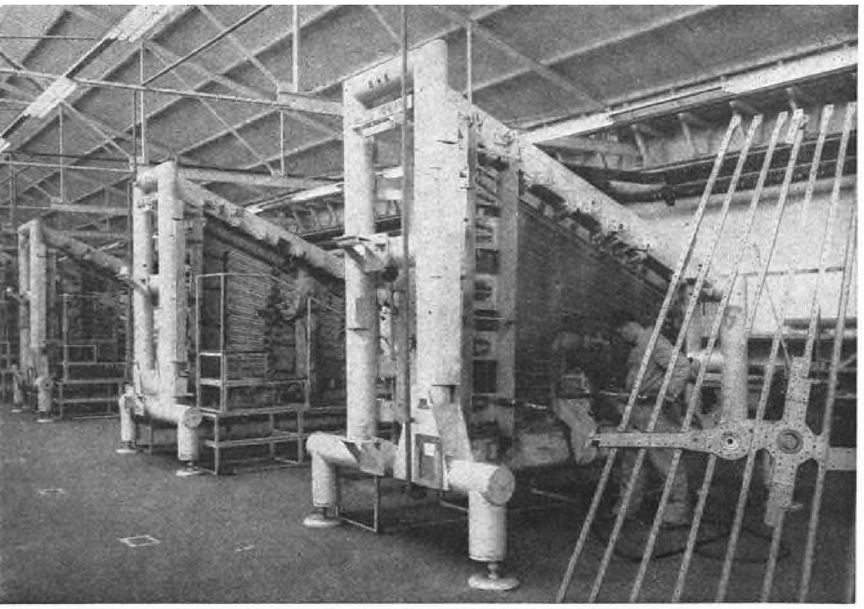


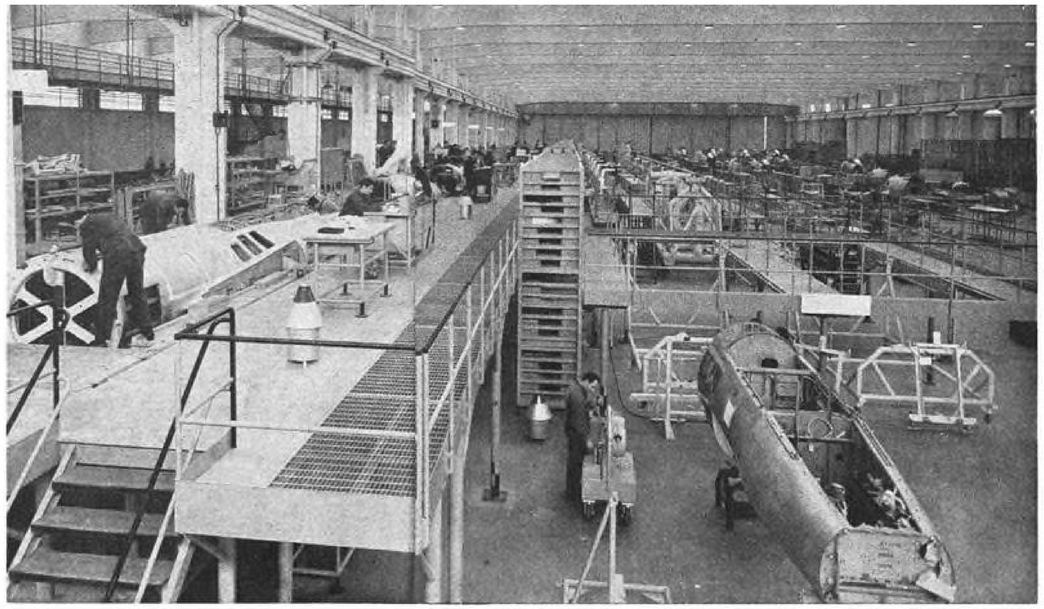
Flip-Flop for Satellite Communications

Performance to 20 MC. Operable over the full MIL range from −55° to +125° C.

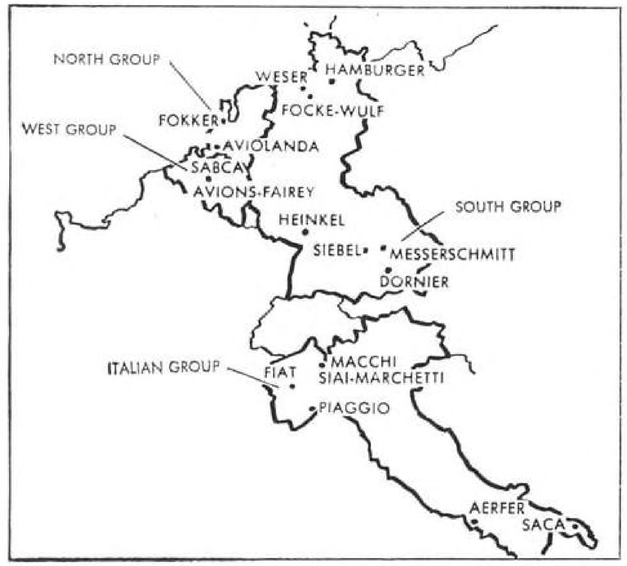
This is the next step in the evolution of nanocircuitry. General Instrument developed the concept of the multi-chip nanocircuit for maximum flexibility and performance. Now General Instrument offers the same performance with partial integration of the resistors, capacitors, diodes and transistors. A complete line of General Instrument Nanocircuits is immediately available in a variety of package configurations. For more information, call your nearest sales office, franchised distributor or write to Nanocircuits, General Instrument Semiconductor Division, 600 John Street, Hicksville, Long Island, N. Y.

GENERAL INSTRUMENT
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General Instrument Corporation





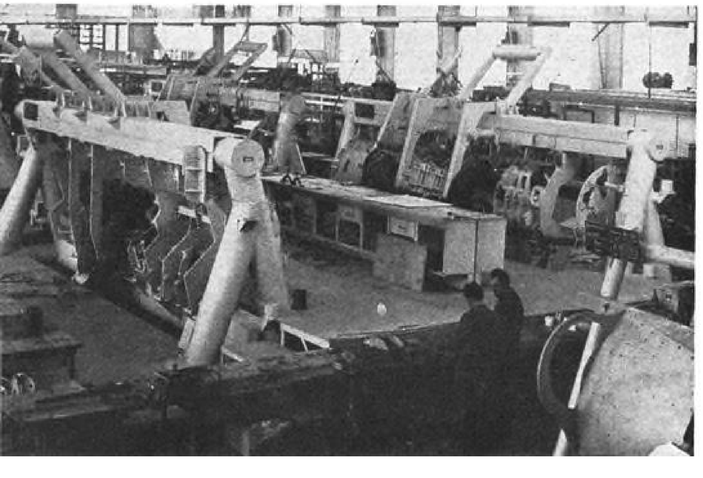
Wing sections are fabricated at Ernst Heinkel Flugzeugbau in Speyer, above, left. Heinkel will make wings, tip tanks and tail sections for 210 aircraft. Center, final assembly of 200 fuselages is done along an elevated line at Fiat for the Italian Group.



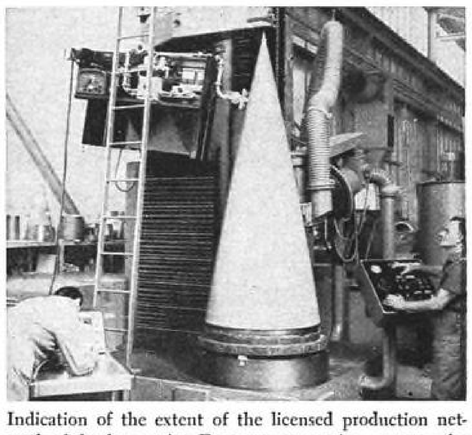
Map shows geographical spread over Europe of the four-nation F-104G airframe production and consequent problems of coordination and logistics support. Engine and avionics manufacturers and suppliers are not included.



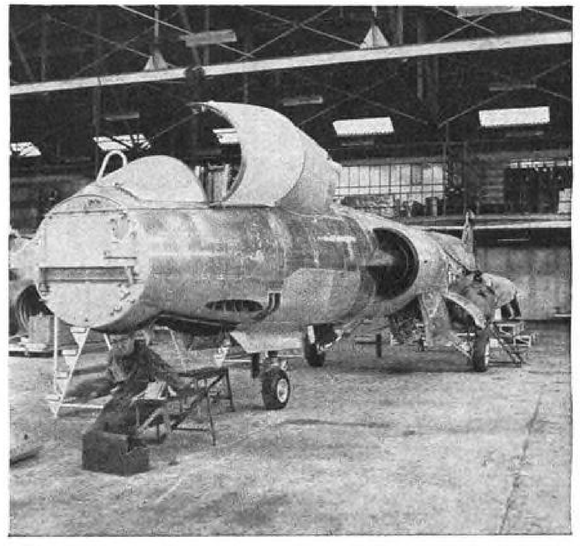
Fuselage sections fabricated by Dornier, Heinkel and Siebel are joined to forward sections at Messerschmitt's Augsburg facility, above. Below are jigs and tooling for the midfuselage section at Dornier in Munich.

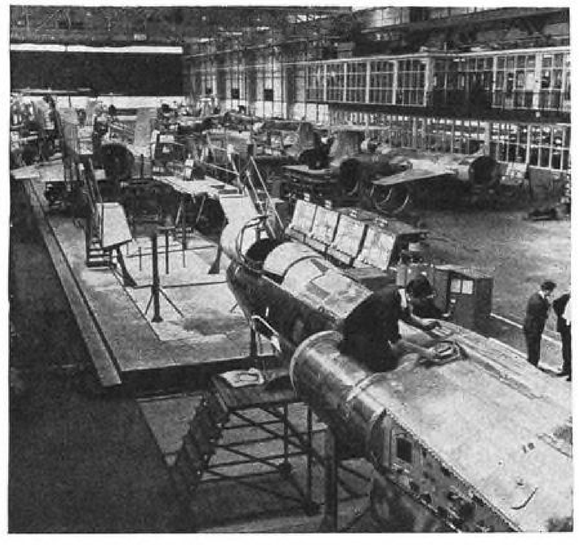


European F-104G Production Increases



Indication of the extent of the licensed production network of the four-nation European consortium program for the Lockheed F-104G is indicated by pictures of various production facilities. Individual companies are relying heavily on efforts of others in their respective groups to achieve progress in airframe and engine production. Originally limited to assembling U. S.-supplied parts, various European manufacturers now are turning out all-European airframes at an increasing rate. A total of 233 airframes will have been completed by consortium members before the end of the year as compared with an original schedule of 240 (AW Aug. 6, p. 55). Airframe production is expected to be on schedule sometime next year, with the last of 949 European aircraft being completed in 1965. First European-assembled F-104G was rolled out last fall. Above, an F-104G radome nose section for the Southern Group is given its final acceptance check at the Siebelwerke plant in Donauworth, West Germany.





Fuselage manufactured by Avions Fairey in Belgium is ready for wings and tail, above left. Right, fuselage sections move down twin lines at the Fokker plant near Amsterdam. Below, final assembly of Southern Group aircraft is done by Messerschmitt at Manching.



MegopaK Exotic?

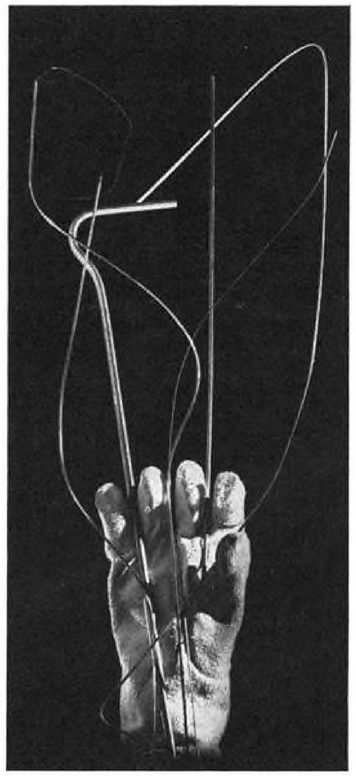
Only by association. Because of their speedy response and flexibility, MegopaK temperature sensors are being used in some of the most advanced scientific projects of our time. Modern industry, research, space age and atomic projects are using MegopaK sensors, and using them! To meet the demand, we now offer some 76,000 different combinations of MegopaK components from factory stock.

• •

You see, a **MegopaK** unit is a very precise and practical thermocouple, consisting of mineral-insulated thermocouple wires, solidly compacted within a corrosion-resistant metal sheath. It has exactly what it takes to sense reaction and process temperatures: high response speed, simplicity of construction, long useful life, small diameter (1/16" and even smaller on special order) and measurement ranges up to 3000°F. It can be had in lengths up to 50 feet. One of its greatest advantages is flexibility; it can be bent on the job to measure in spots that bulkier and rigidly - mounted sensors couldn't begin to reach.

• •

A **MegopaK** thermocouple is in a class by itself. For instance, the original sensor in an atomic reactor gave so much trouble that the user determined to replace it with the very best temperature measuring device that money could buy. After exhaustive consideration of everything available, he selected a **MegopaK** assembly, and reports complete



satisfaction now that it's at work.

Again, a leading builder of spacecraft considers **MegopaK** thermocouples "most important" (his words) to the success of this highly critical application.

• •

The **MegopaK** assembly is a typical Honeywell "family" achievement. Developed at our Corporate Research Center at Hopkins, Minn., it received the early attention of some of the world's leading authorities in thermocouple metallurgy and insulating materials. It is manufactured under spick-and-span conditions at a new facility in Philadelphia. Strictly controlled processing and specially-designed equipment make it possible to compact the assembly tightly with no unevenness in resistance or distortion of the wires. Finally, the completed **MegopaK** unit is 100% inspected at 500 V d.c. to make sure that every inch meets the highest possible standards.

Naturally, all this attention to detail is reflected in the price. You could probably find something that looks like a **MegopaK** sensor for considerably less money. It all depends on how much reliability and precision you're willing to pay for.

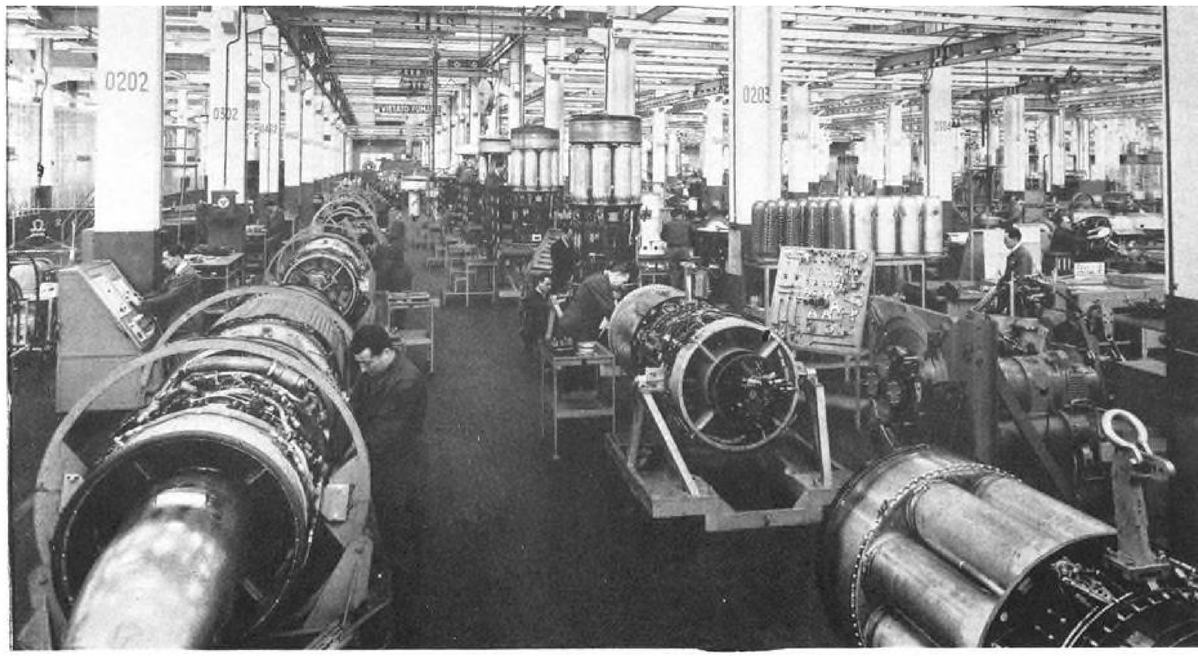
• •

Whether you are interested in measurement across the entire temperature spectrum, or only a narrow segment of it, you'll find that the best-known name in temperature measurement and control can be of distinct help to you. We'll gladly put our long and varied experience at your disposal in selecting sensors, instruments and data handling equipment. If you like, we'll install them for you, and guarantee they'll work. Talk over your needs with your nearest Honeywell field engineer, or write A. E. Finn, MINNEAPOLIS-HONEYWELL, Wayne & Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ont.

Honeywell

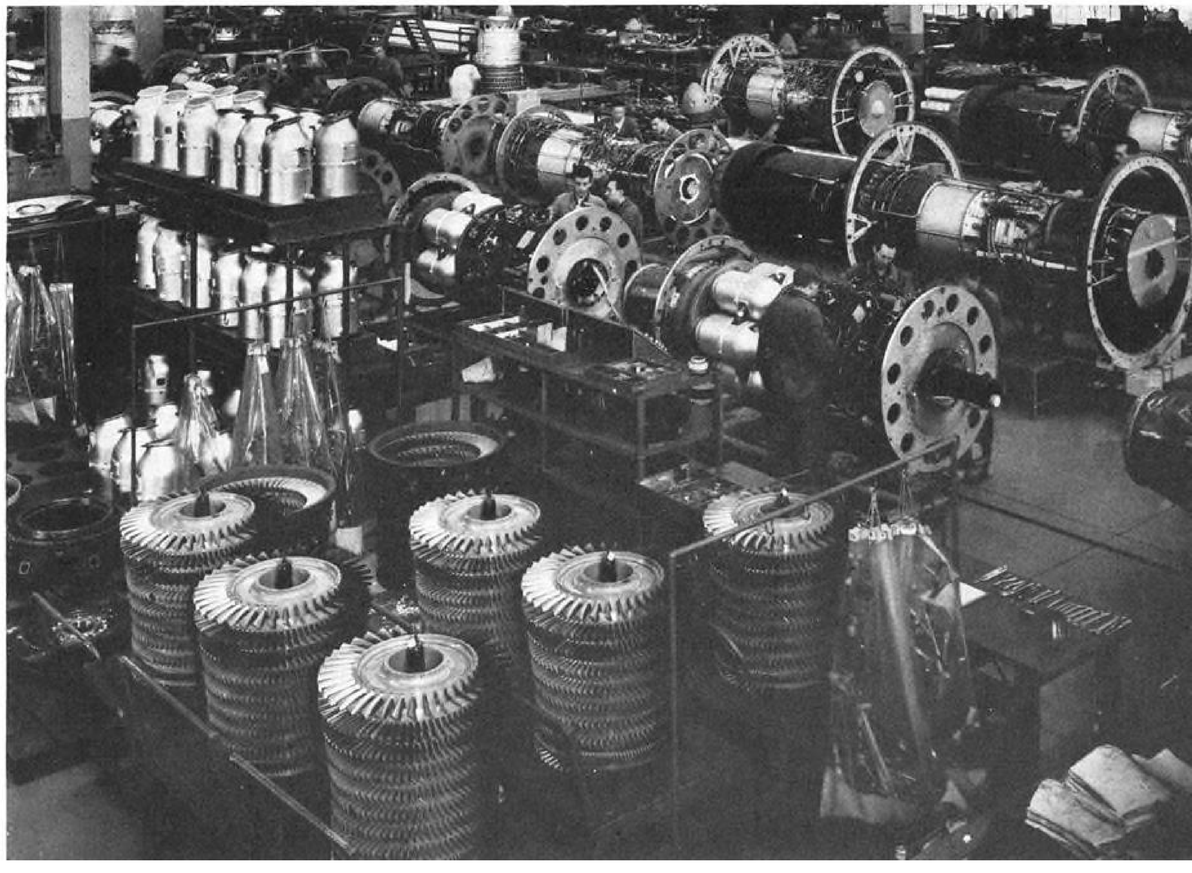
First in Control

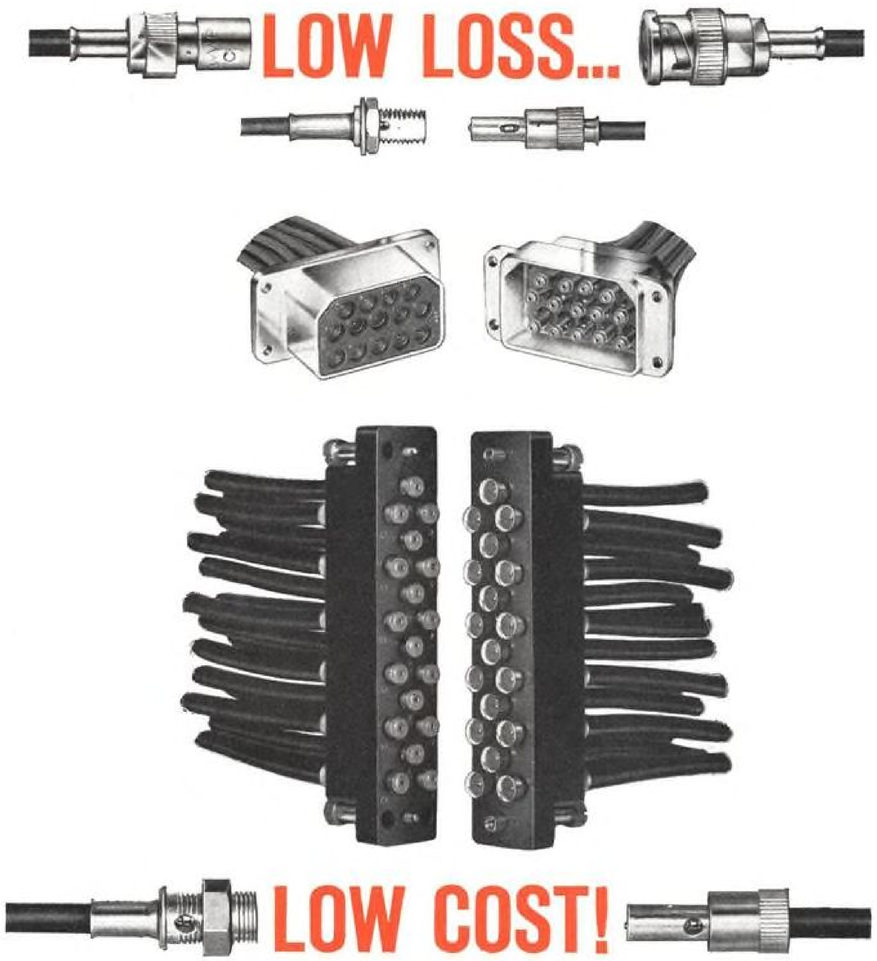
HONEYWELL INTERNATIONAL Sales and service offices in principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



J79 Engines Produced in Europe for F104s

Three European firms, BMW Triebwerkbau of Germany, Belgian FN Works and Fiat of Italy, are producing components and assembling complete General Electric J79-11A turbojet engines to power European-built F-104G fighters. Fiat, above, with Alfa Romeo as co-producer, manufactures stator and rotor blades and will assemble 262 complete engines. BMW, below, maintains a twin assembly line at its main plant near Munich. Company currently is producing 18 engines per month and will assemble 632. Belgian FN will assemble 334. Approximately 20% of the components are from General Electric stocks in the United States.





JUST ONE CRIMP DOES IT!
With all COAXICON* connectors you get simultaneous, one-crimp termination of inner conductor, outer braid and cable support. This exclusive AMP feature results in a more than 50% saving in applied costs over other solderless coaxial connector assemblies . . . even more when compared to those applied by solder. The contacts are pre-assembled, furnished ready for attachment. This means no assembly costs resulting from time loss and production slow-ups. Add to this the low initial cost (priced lower than comparable coaxial equipment) and you have the most economical coaxial connections on the market . . . by far!

PERFORMANCE
Price is nice, but what about quality? Test reports confirm minimum discontinuity up to 500 megacycles. At 500 megacycles impedance mismatch is only 1.06 to 1.09. And with the plus feature of AMP's matching tool and terminal technique, you further insure reliability by eliminating human error, hit-or-miss connections, cold solder joints.

THE STANDARD OF EXCELLENCE
.000030" non-porous gold over .000030" nickel contact plating is standard with AMP. This, combined with cantilever-beam contact retention springs, assures you of maximum conductivity, uniform contact pressures, longer insertion/extraction life.

Choose from a wide range of COAXICON connectors—single-in-line, bayonet and threaded nut types; multiple, in a wide variety of configurations, including coax and pin and socket mixes. Standard, miniature and sub-miniature contact sizes will handle a primary dielectric insulation range of .040" to .146".

Just add up the advantages: speed of application, lower initial and applied costs, low noise level, superior plating, wide selection. Then, put an AMP end to your coaxial connection problems. Get the complete story today!

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INCORPORATED
Harrisburg, Pennsylvania

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • Mexico • West Germany

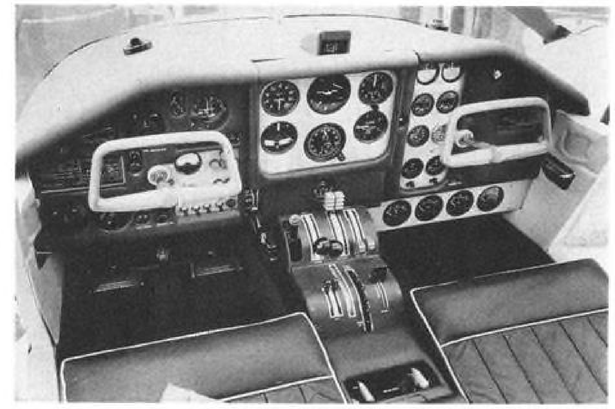
*Trademark of AMP INCORPORATED



Flight view of Beagle M.218 executive twin emphasizes roomy cabin and swept tail. Aircraft is about 63% glass-fiber reinforced plastic. Span is 37 ft. and length is 25 ft. 5 in. Gross weight is 3,200 lb. M.218 is aimed primarily at the European market.

Plastic Used in Beagle M.218 Twin Construction

Beagle M.218, newest executive twin to be produced by the British, is powered by two Rolls-Royce Continental O-300 engines of 145 hp. each. Primary load structure is a basic T-shape and the aircraft makes extensive use of glass-fiber reinforced plastics. The entire upper fuselage from the tailfin to the windshield is a single plastic unit, as are slotted flaps. Beagle says plastic sections are 50% stronger than required by Air Registration Board. Fuel capacity is 38 Imp. gal. in wing tanks outboard of the engines and fuel can be crossfed from the cockpit. Flight instruments are centered on the panel with engine instruments on the right and radios on the left. Main quadrant contains throttles, pitch and mixture controls. Cruise speed at 10,000 ft. is 160 mph. and maximum recommended cruise at 5,100 ft. is 175 mph. at 75% power. Maximum range with 500 lb. payload is 1,000 mi.







Engineered Environment

The British harvest mouse has her own solution to the baby sitting problem. She seals her helpless and hairless young inside a baseball shaped nest suspended among wheat stalks. The nest is high, dry and warm, yet well ventilated.

If environmental protection is important to your weapons system, American Air Filter can help. We have proved the ability to provide Aerospace Ground Support air conditioning systems in accordance with MIL-R-27542, GM 07-59-2617A, S-133-2, and other stringent specifications.

Recent project experience includes Minuteman, Atlas, Nike Zeus and Pershing. We are geared to military needs and the design challenge of modern systems—from research through prototype to full scale production and installation.

Inquire: Defense Products Division, *American Air Filter Co., Inc., 310 Third Street, Rock Island, Illinois, Phone 788-9311.*

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COMPLETE SYSTEMS CAPABILITY
- Heating
- Ventilating
- Air Filtering
- Refrigeration
- Humidity Control

ENGINEERED ENVIRONMENTAL SYSTEMS



PIPER CHEROKEE B will be offered in four models, ranging in price from $12,900 to $15,900. Plane is powered by a Lycoming O-360 engine.

Piper Displays New Model of Cherokee

Piper Cherokee B, powered with a 180-hp. Lycoming O-360 engine and designed to compete with the Cessna 172 and Beech Musketeer, was announced last week by Piper at its international sales meeting in Hollywood Beach, Fla.

Increase in power, along with other changes, allows the Cherokee B an increase of up to 250 lb. in gross weight over the Cherokee 150 and permits a top speed of 150 mph.

Cruise speed, Piper says, is 141 mph. at 75% power at 7,000 ft. Fuel capacity of 50 gal. is carried in two 25-gal. wing tanks and gives the aircraft a normal cruising range of 750 mi.

Cherokee B will be offered in four models, ranging in price from $12,000 to $15,900.

The engine is installed on Dynafocal mounts to reduce vibration and an alternator has replaced the generator in the electrical system. Piper says the Cherokee B is the first low-cost airplane to have an alternator, which permits battery charging at engine idling speeds.

Gross weight of the Cherokee B is 2,400 lb. Useful load ranges to 1,175 lb. depending on the version of the aircraft and the amount of optional equipment.

All-metal aircraft retains the lines of earlier Cherokee models, except that wheel speed fairings are standard equipment on all models. Wing tips, nose cowl and empennage tips are made of glass fiber or plastic in order to resist dents.

Tricycle landing gear has a 10-ft. tread and all legs have air-oil oleo shock struts and use the same 6.00 x 6 tires.

The aircraft also is available in seven different color combinations. The Cherokee B is in production at Piper's Vero Beach, Fla., factory.

Cherokee B

Engine	Lycoming O-360-A2A 180 hp. at 2,700 rpm.
Gross weight	2,400 lb.
Empty weight (standard model)	1,225 lb.
Useful load (standard model)	1,175 lb.
Wing span	30 ft.
Wing area	160 sq. ft.
Length	23.3 ft.
Height	7.3 ft.
Power loading	13.3 lb./hp.
Wing loading	15 psf.
Baggage capacity	125 lb.
Fuel capacity	50 gal.
Wheel base	6.2 ft.
Wheel tread	10 ft.

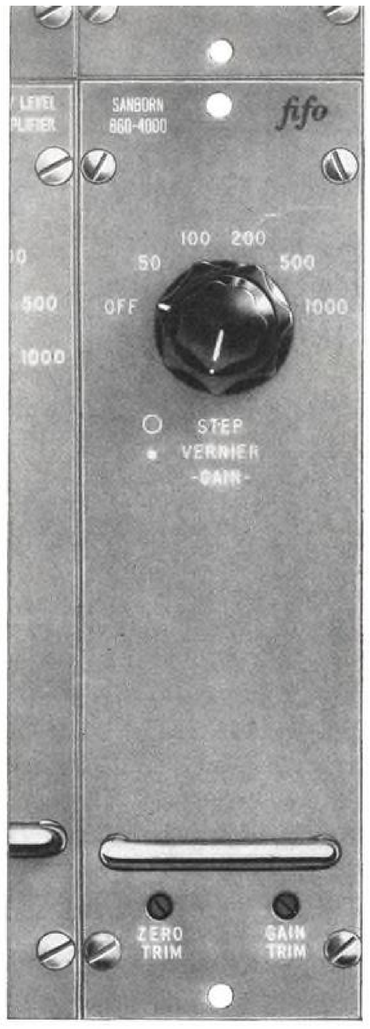
Performance

Top speed	150 mph.
Cruise speed, 75% power, 7,000 ft.	141 mph.
Stall speed, flaps down	57 mph.
Takeoff run	775 ft.
Landing roll, flaps down	600 ft.
Rate of climb	720 fpm.
Cruise range, 75% power	705 mi.
55% power	750 mi.

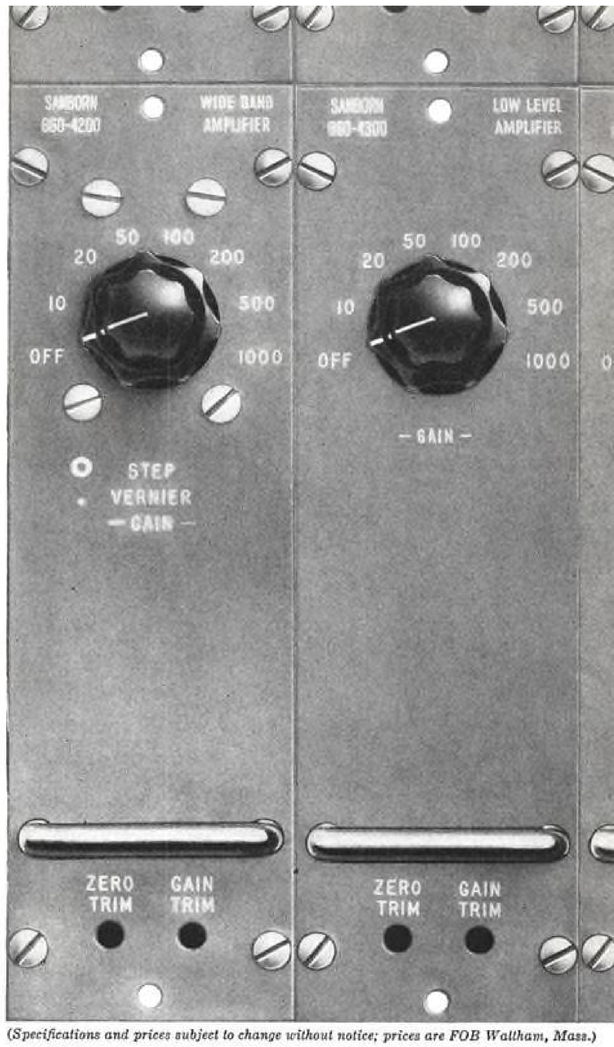
Piper Ending Policy Of Annual Changes

Piper Aircraft Corp. has discontinued its policy of annual model changes, Howard Piper, vice president-research and development, has announced. In the future, models will be changed only when sufficient modifications have accumulated to make such a change worthwhile.

Meanwhile, changes and improvements will be made from time to time if found desirable without changing the model designation, Piper said.



(Three types available now — more on the way)



Sanborn data amplifiers

(Specifications and prices subject to change without notice; prices are FOB Waltham, Mass.)

Match amplifier characteristics much more closely to your over-all *system* requirements — and pay for only the performance you need — by choosing from these newly-developed, all solid-state DC data amplifiers now available from Sanborn. Ask your local Sanborn Sales-Engineering Representative for complete specifications, application help and a copy of the Industrial Division Catalog — or write the Main Office in Waltham.

• • • • •

Wide Band, Floating Input—Floating Output "FIFO"

Bandwidth DC to 3 db down at 10 KC • Input isolated from output • Max. gain 1000, smooth gain covers intermediate ranges or switch out for calibrated gains of 1000 to 50 • Input impedance 100 meg. min. at DC, output impedance 60 ohms • Output capability ±10 V at 10 ma • Common mode rejection (1000 ohms in either input lead) 160 db at DC, 120 db at 60 cps • Linearity ±0.1% of 10 V full-scale at DC • Recovery from 500% overload is 300μsec to 1% of f.s. output • Recovery from 20 V overload is 1 millisecond to 1% of f.s. output • Model 860-4000 "FIFO", $825. Model 860-4000P (grounded output ±5 V at ±100 ma, impedance less than 1 ohm), $900.

DC—50 KC, 3-Terminal Floating Amplifier

Gain 1000 to 10 in 1, 2, 5 ratios; does not phase invert • Input impedance 100 meg. at DC • Output ±10 V ±100 ma, impedance less than 0.2 ohm • Linearity ±0.01% of 10 V output • Gain stability ±0.01% at DC at constant ambient for 40 hours • Model 860-4200, including internal power supply, $650.

Narrow Band, Floating Input — Floating Output

Bandwidth DC to 3 db down at 100 cps • Optional plug-in output filters to limit bandwidth • Floating input isolated from floating output • Gain 1000 to 10; fixed step attenuator, gain trim and zero trim controls • Input impedance 300,000 ohms min., output impedance 75 ohms • Output ±5 V, ±2.5 ma • Linearity ±0.05% of 5 V output • Recovers from ±10 V overload in 200 ms • Common mode rejection (1000 ohms in either input lead) 130 db at 60 cps • Model 860-4300, $425.

INDUSTRIAL DIVISION
SANBORN COMPANY
175 Wyman Street, Waltham 54, Massachusetts
A SUBSIDIARY OF HEWLETT-PACKARD COMPANY

Information About Hose Made of Teflon From The People Who Invented It

No. 2 in a series

ORIENTATION AND HOSE OF TEFLON

One of the many important parameters that a knowledgeable manufacturer of Teflon* hose tubing controls is the orientation of the building blocks of the resin, often called crystallites. It is generally understood that the specific technique of extrusion has influence over the degree of orientation of the particles; not so common is the knowledge that the subsequent manufacturing steps, sintering, etc., are far more important than extrusion for controlling properties of the tubing.

Recently spiral extrusion techniques have been advocated as a method of improving hose tubing. Counter-rotation of male and female dies during extrusion produces two spirally oriented layers of particles. However, Teflon tubing structure is determined at the micro level, and the post-extrusion processing steps exert greater influence in this area than specific arrangements of bands of particles. In other words, two-directional orientation (two massive bands of oriented particles), by itself, is still far from true "random orientation" of the little building blocks.

Maximum randomizing during the manufacturing operations provides the highest level of performance in terms of flex life, fatigue resistance and all the other desirable mechanical attributes of good tubing. The freedom from spiral delamination, cleavage planes and circumferential fracturing afforded by maximum randomizing is not easily attained. Although this implies that manufacturing operations are critical, such is not the case, since the control of the manufacturing process, although strict, is relatively routine after knowledge and understanding of the product have been achieved.

First recognized and defined by Resistoflex when they originated hose of Teflon nine years ago, sintering and post treatment have emerged as the dominant levers of control in the manufacture of quality aerospace Teflon hose. They have proved to be two of the valuable tools which keep our hose out in front as the standard of the aerospace industry.

Resistoflex markets its hose made of Teflon under the trade name Fluoroflex which is a Resistoflex T.M. *Du Pont T.M.

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RELIABILITY

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FINANCIAL

Financial Briefs

Hewlett-Packard Co. reported net earnings of $5,024,000 for the nine months ended July 31, on sales amounting to $80,154,000. Comparable figures for the same period in 1961 were $4,302,000 net earnings on sales totaling $63,416,000.

Ryan Aeronautical Co. showed a net income of $2,156,054 for the first three quarters of the company's fiscal year. Net sales were $52,738,136. Figures represent a decrease from comparable period in 1961, when net income of $2,176,159 was reported on net sales of $67,848,487.

Garrett Corp. reported net earnings of $5 million on $205 million in consolidated sales for its fiscal year ended June 30. Last year's net earnings were $1,450,000 on consolidated sales of $190 million.

Marshall Industries showed net earnings of $293,883 on consolidated revenues of $9,828,414 for the company's fiscal year ended May 31. Figures for a comparable period in 1961 were net earnings of $123,662 on consolidated revenues of $4,646,296.

Missile Systems Corp. reported earnings of $326,772 on net sales and other income of $1,106,524 for the three-month period ended July 31. Income for the same period in 1961 was $151,039 on sales of $1,969,258.

Laboratory For Electronics, Inc., had net earnings of $31,000 on sales of $15,363,000 during the first quarter of the company's fiscal year.

International Telephone and Telegraph Corp. reported earnings of $18.9 million on sales and revenues of $517 million for the first half of 1962. Comparable 1961 earnings were $17 million on sales and revenues of $431.5 million. Order backlog on June 30 this year was $775 million compared with $686 million on the same date last year.

Fairchild Stratos Corp. reports $1.5 million earned on sales of $35.8 million for the first six months of 1962. Same period last year showed $1.6 million earned on sales of $39.7 million.

General Precision Equipment Corp. showed a net income of nearly $1.9 million for the first six months of 1962—compared with nearly $2.5 million for the same period last year. Sales for the

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PROBLEMATICAL RECREATIONS 138



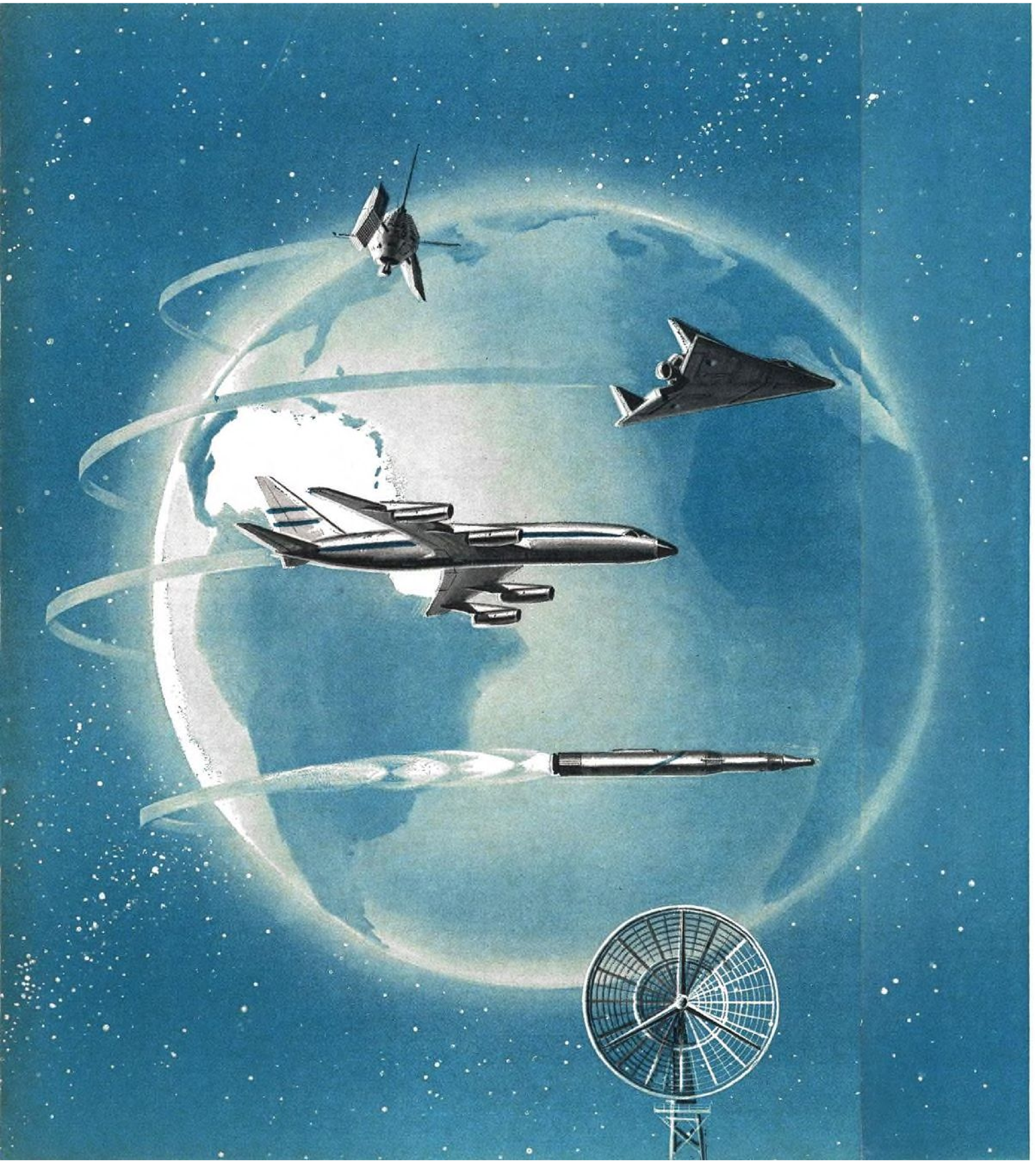
At the local yachting club they were checking over their equipment in preparation for the coming season. Woodson, a mathematically minded member, remarked that the two sails on his boat shared a curious property: the area of each in yards was equal to its perimeter in yards. Both sails, it should be mentioned, were of the usual right triangular shape and were of different dimensions. What must have been their areas? — *Contributed*

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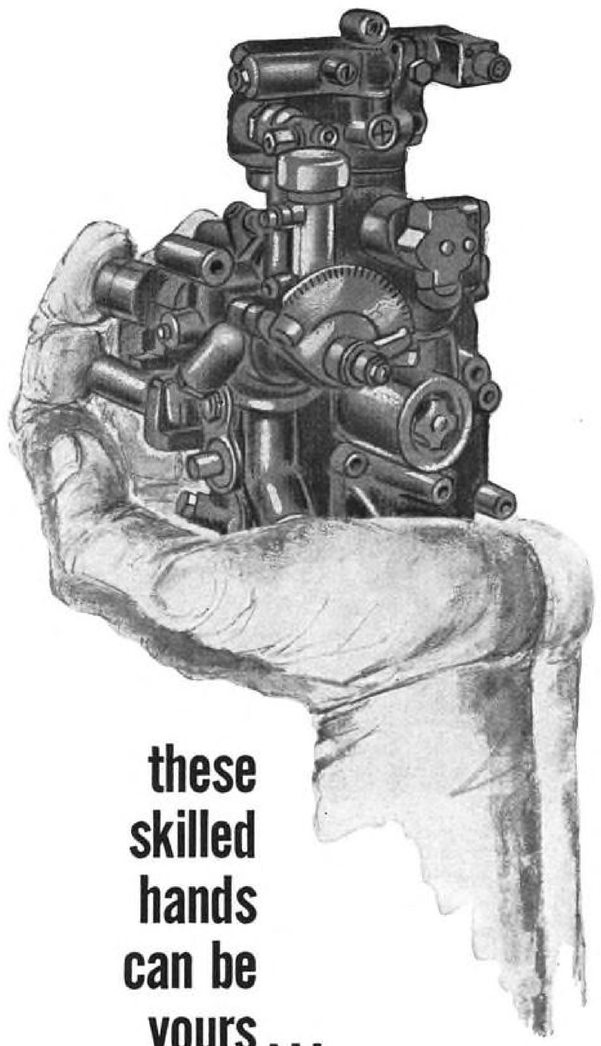
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A-31-A

Division of

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1962 period were $108 million compared with $119 million for the same period last year.

Aeroquip Corp. sales for the nine-month period ended June 30 were $43.9 million, with earnings of $2.5 million. Same period last year showed sales of $35.3 million accompanied by earnings of $1.1 million.

Westinghouse Air Brake Co., and subsidiaries, showed consolidated net earnings of $4.01 million on sales of $93.5 million during the first six months of 1962. First half of 1961 showed earnings of $4.05 million on sales of $85.2 million.

American Bosch Arma Corp. reported earnings of $1.5 million during the first half of 1962 compared with earnings of $1.2 million for the first half of 1961. Sales for the two periods were $64.1 million this year compared with $71.1 million for last year.

Royal Industries, Inc., of Pasadena, Calif., showed net earnings of $161,598 on sales of $8.7 million for the six months ended June 30. Same period last year showed $31,048 earned on sales of $5.2 million.

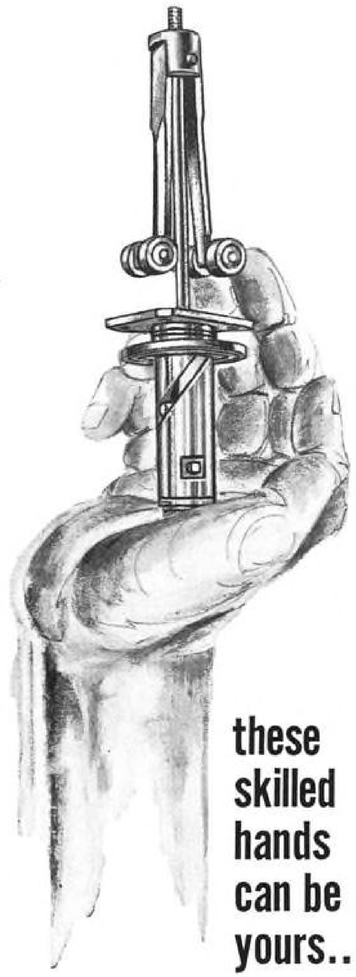
Litton Industries reported a 58% gain in sales and a 59% increase in earnings for the fiscal year ended July 31. Sales totaled $394 million and earnings of more than $16 million. Last year's sales were $250 million, with earnings of $10.1 million.

United ElectroDynamics, Inc., of Pasadena, Calif., earned $75,970 on sales of $7.1 million for the first half of 1962. Last year's earnings for the comparable period were $61,527 on sales of $5.3 million.

Greer Hydraulics, Inc., of Los Angeles, reported earnings of $80,749 on sales of $2.4 million during the first half of 1962. Figures for the same period last year were $126,356 earned on sales of $2.3 million.

Sperry Rand Corp. showed a net income of $3.46 million on sales of $280.8 million for the quarter ended June 30. Last year's totals for the same period included net income of $4.29 million on sales of $265.8 million. Backlog of defense orders stood at $630 million on June 30.

Piasecki Aircraft Corp. reported earnings of $177,948 on sales of $3.5 million for the fiscal year ended June 30. Comparative-period 1961 figures, included earnings of $79,833 on sales of $1.6 million. Order backlog on June 30 totaled nearly $5 million.



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Mergers and Acquisitions

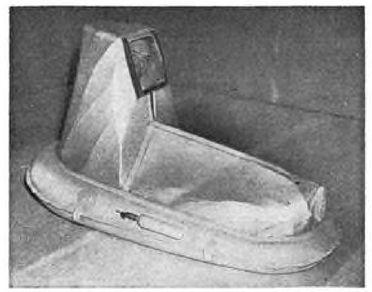
General American Transportation Corp., of Chicago, has bought American Machine & Foundry Co.'s Mechanics Research Division of Niles, Ill. The MRD division is engaged in advanced research and development for defense and industry and will continue this work for General American Transportation. AMF said the sale was in line with plans to concentrate its Government Products Group research and development around Greenwich-Stamford, Conn.

Vibration Mounting Controls, of Corona, N. Y., has acquired Comar Products, a fabricator of rubber products. The new facilities are being used to make silicone rubber shock mounts, including shock mounts for missile shipping containers.

Accessory Products Co., Whittier, Calif., a division of Textron, Inc., has acquired Fuel Engineering and Castalloy Co., of Torrance. Fuel Engineering manufactures heat exchangers, fired heaters and cryogenic devices.

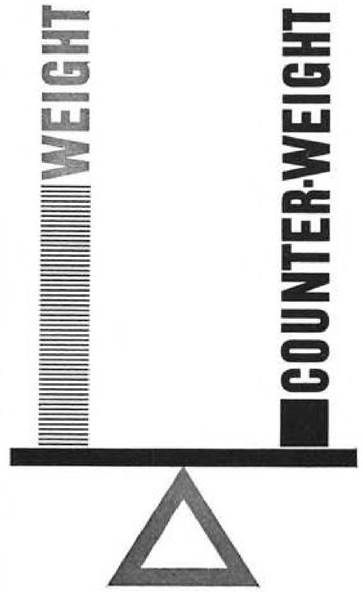
Delta Microwave Corp., of Clifton, N. J., a manufacturer of precision cast microwave components, has been acquired by Hitchiner Manufacturing Co., Inc., of Milford, N. H. Delta will be operated as a wholly owned subsidiary and retain its present management.

Burroughs Corp., of Detroit, has acquired Strand Engineering Co., of Ann Arbor, Mich. Strand is an electronics research and engineering company specializing in data display systems. Strand, formerly owned by Datronics Engineers, Inc., will be operated as a Michigan unit of Burroughs Laboratories.



Raft-Sleeping Bag

Combination life raft-sleeping bag developed by Air Cruisers Division of Garrett Corp. for USAF has a radar reflective inflatable canopy which covers the occupant while in a sitting position. A CO_2 cylinder inflates raft while the canopy is inflated by mouth.



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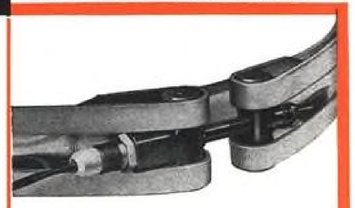
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ROD OR CABLE SEPARATOR
Used to separate a rod or cable under tension. Eliminates need for guillotine mechanism or fracture ring method. Capable of carrying full tensile allowables of the rod or cable.



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Provides combustion energies for the initiation of mechanisms for separation or ejection systems as well as explosively actuated components. Is certified to comply with AFMTC Ordnance Standards, 1 amp, 1 watt, no-fire, for Radiation Hazards.



PIN PULLER
Allows release of pin or rod without need to sever or fragment high tensile strength material.

DOD Support for Components Promised

Encouragement of component and subsystem development is one approach contemplated by Department of Defense Research and Engineering to improve future weapons system management and cut cost overruns.

"Well-proven technology is inherently more reliable, it performs better, its costs are easier to forecast than is the case for a completely new development," Dr. Harold Brown, director of defense research and engineering, told the National Advanced Technology Management Conference at Seattle.

"We intend to push component and subsystem development hard without requiring that they be attached to a formally stated military system requirement, so long as the technology contributed to a broad base which might be used in a variety of ways."

Cost overruns, Dr. Brown said, must be met and research and development programs have tended to be the source of replacement. These same areas are where the technological future is defined, he said, and are the source of many new components and subsystems.

"We intend to keep them healthy," he said, "and to minimize budget fluctuations of the past. I am always impressed by the fact that so many of our crash programs in the past had to use components and subsystems originally intended for other projects."

Industry can help, Dr. Brown said, by pushing the state-of-the-art in component and subsystems and by submitting proposals that employ proven and reliable components and subsystems which are realistically priced.

Dr. Brown emphasized that the weapon system itself must match a clearly foreseeable military need, but development of the system should not begin until most of the technology is reasonably well proven.

Other criteria laid down by Dr. Brown for future system development:

- **Adaptability to realistic** and reliable command and control systems.
- **Survivability and reliability** in their estimated operational environments.
- **Consistency** with a viable arms control system, should one be reached, particularly in event of a violation.

More effective use of resources was a repeated theme in Dr. Brown's speech. Too many of industry's best people are tied up in proposal making, sales talks and the like, Dr. Brown said, but he added that government must make improvements also. With increased use of incentive-type contracts, he said, programs must be better defined, better requests for proposals must be made, results must be better evaluated and projects managed more sensibly.

Dr. Brown called for the research and development community to alert Defense Department to significant changes in technology.

"There is a great deal of wasted effort in the many proposals that come to us from industry," he said, "that satisfy old requirements that were once valid but today aren't of much use. I would hope that by following more carefully the purposes which this equipment is designed to satisfy, you could anticipate which projects we will be—or should be—interested in and which we will not or should not."

Often, Dr. Brown said, there will be the tendency in managing technology to extrapolate the uses of new equipment by analogies from the past.

"While over-optimistic in the short run on applications of known use," he said, "we tend to be over-conservative on the developments in the long run. Usually we have not asked the right questions and thus have failed to see the interactions of new technologies in areas different from those for which they were developed.

"Thus, there are a number of functions which we are pretty sure can be carried out in an improved way using space—communications, meteorology, navigation. There may be others, but the tendency to carry over earthbound ideas has led to some suggested military space applications that appear unlikely to provide much advantage—for example, bombardment systems."

Besides technical manpower limitations on R&D efforts, Dr. Brown also discussed other constraints, such as the impact on the nation's economy and aerospace industrial base of Defense R&D decisions.

"There is a third factor that influences our decisions," he said, "and that is the cumulative effect of similar decisions made in the past. It is always difficult to stop or redirect an on-going program. Usually it is also quite expensive.

"By and large then, while the size of our total budget is large the effective size of our disposable budget is much smaller. Most of the time we are deciding on the reallocations of a small fraction of our resources during a given year, or even in future years. A $100-million shift in a $2-billion service budget means quite a dislocation.

"We try to deal rationally with these margins, but when a big system shows a cost overrun of something like 500%, then the entire operation is thrown out of balance and attempts at rational allocation become rather difficult.

A complementary approach was taken at the same meeting by Defense Comptroller Charles J. Hitch, who also asserted DOD's intention to finance exploratory development of critically needed techniques and components, especially pacing items in future systems.

"While we can afford to be fairly liberal," Hitch said, "as indeed we are, in our application of funds to basic and applied research, and even to the areas of exploratory and advanced development, we must weigh very carefully our commitments to engineering development where hundreds of millions and indeed billions of dollars may be involved in a single program."

Hitch described DOD's new budgeting techniques that call for use of the category of total obligational authority, which is the full cost of an annual increment of a program regardless of the year in which funds are authorized, appropriated or spent. Exceptions are certain Air Force missiles now incrementally funded, but beginning in Fiscal 1964, Hitch said, all programs will be fully funded.

"Both the program books," Hitch said, "i.e., program elements and resource categories, and the budget books, i.e., the appropriation accounts, will be kept in terms of total obligational authority programed and obligations incurred. These two fiscal

Management Planning

Defense Department believes the increase and acceleration of the defense program begun last year has put DOD in a position to move very cautiously in initiation of any new major weapon system developments, according to Defense Comptroller Charles J. Hitch. Possibly in answer to criticism of delays in new program decisions (AW Aug. 27, p. 26), Hitch said:

"To the greatest extent possible we want to do our thinking and planning before we start bending metal. Pencils and paper, and even computer time, are a lot cheaper than the scrapping of useless hardware.

"We hope that by a more thorough and complete study and assessment of the facets of each new development—prior to major commitments—we can reduce the number of such projects which might otherwise have to be reoriented, stretched out or terminated."

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measures will be the connecting links between the appropriation accounts (budget) and the programs. In addition, the budget books or appropriation accounts will also be kept in terms of new obligational authority (NOA) and expenditures as heretofore.

"In order to simplify the relationship between the program structure and the budget structure, we are trying to align the resource summaries or annexes of the major programs with the subdivisions of the appropriation accounts so that, to the maximum practicable extent, the two structures will be compatible. This has . . . been accomplished in the research and development area . . .

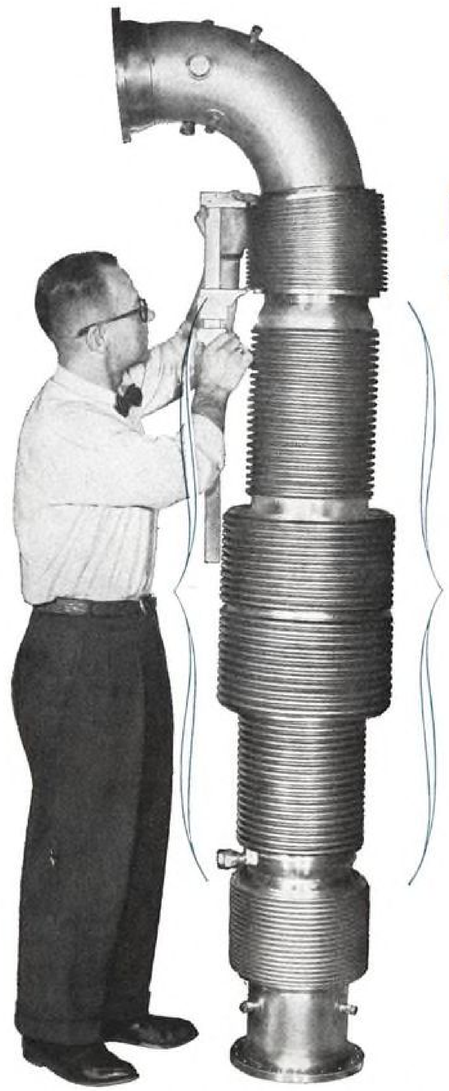
"As you know, there are four principal Research, Development, Test and Evaluation appropriations, one each for the Army, Navy, Air Force, and one for the Defense Agencies.

"The four principal RDT&E appropriations have been broken down into a total of about 340 subactivities which are identical in both the budget structure and the program structure. These 340 subactivities are aggregations of some 1,600 technical projects, which, in turn, are aggregations of something on the order of 15,000 technical tasks from which stem the tens of thousands of . . . contracts and job orders financed each year by the RDT&E . . .

"You will recognize that the key point for fiscal control, both for budgeting and programing purposes, is the RDT&E subactivity. We have established individual funding levels for each of the 340-odd subactivities for FY-1963. Any change from these amounts in excess of $2 million must be specifically approved by the Office of the Secretary of Defense, and amounts not approved, or deferred for obligation, may not be obligated for any purpose without such specific approval. We will, of course, also account for obligations incurred against each of these 340 subactivity amounts.

"A similar effort is now being made in the military construction and procurement areas. If we can successfully align all the resource categories supporting the programs with the contents of the appropriation accounts in the same manner as we have in the RDT&E area, fiscal control over both the program and the budget can be achieved in a single integrated system. And as long as the resource categories are accurately related to the program elements, fiscal control over the execution of both the program and the budget can be exercised simultaneously.

"In the case of program elements, our reporting and controls are being designed primarily to relate physical performance—i.e., progress in achieving the objectives of each program—to total cost to complete the development . . . and the annual cost of operating it."



This 8" flexible ducting unit is designed to supply fuel or LOX to the outboard engines of the Saturn C-1 booster. The compensator corrugated bellows elements (shown bracketed) provide axial stroke of ±50% of their live length. The top and bottom flexible elements, which are internally restrained gimbal joints, permit angular motion in any plane; thus, this assembly is capable of angular, offset, and axial motion.

Another first from Flexonics . . .

Flexible ducting length changes, but volume and pressure stay constant!

Developed by Flexonics for the Saturn C-1 vehicle, the unusual flexible ducting section shown here is an R&D unit designed to deliver fuel or LOX to the gimbaled outboard engines. As these engines move in response to guidance mechanisms, the fuel and LOX lines must provide for change of unit length, between engine and tank, up to 14".

Problem: Design and build flexible ducting for this application so that whatever the engine position, whatever the length of duct, the volume of the system remains constant. *Why?* Because volume change could cause pressure change, and this in turn would cause unsymmetrical loading on fuel and LOX pumps. Consistent engine performance depends on uniform supply of fuel and LOX to the pumps.

Flexonics engineers, working with engineers of the George C. Marshall Space Flight Center of National Aeronautics and Space Administration, Huntsville, Alabama, were equal to this challenge.

This arrangement of concentric bellows permits an axial stroke of ±50% of the live length of the compensator flex. The internal connection of the compensator flex provides for pressure compensation; during motion, the equal and opposite movement of the flex maintains a constant volume in the duct, in a plane of motion.

The use of this combination of compensator and gimbals eliminates any end thrust due to internal pressure. As a result, any flange loading on the pump is then due only to acceleration forces.

The Flexonics pressure-volume-compensated flexible connector now is fully developed and proved. Its unique principle is ready to be adapted to *your* missile or rocket ducting application. No need to look further than the one manufacturer now qualified to supply flexible ducting assemblies and systems for NASA's mighty Saturn.

FREE MODEL shows volume-compensating principle of Flexonics Pressure-Volume Compensator

We've prepared a simple cardboard model that demonstrates the volume-compensating principle of this unique ducting element. Mail the coupon for your copy.

A-475

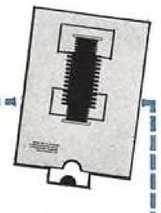
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Please send my FREE model of the Flexonics Pressure-Volume Compensator.

ACCENT ON VALUE

...not a bad sentiment for a job, either

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.

But there's no reason why this program should be limited to products. For years General Electric, and its Defense Systems Department, have placed the "Accent on Value" on professional positions as well. For example:

ACCENT ON PROGRAM DIVERSIFICATION — To briefly identify some of the program areas — **AWCS 412-L,** now in advanced development phase, will span entire continents. Its potential is global air weapons control. **MISTRAM** is a revolutionary precision trajectory measurement system with important ramifications in space vehicle terminal guidance. **NUDETS (477-L)** will be a national network of nuclear detection and measurement devices. **MISSILE AND SPACE VEHICLE GUIDANCE** is the logical extension of our engineers' pioneering work in developing the ATLAS Radio-Command Guidance System, currently used for booster guidance on the majority of America's space shots, including Project Mercury.

ACCENT ON TECHNICAL SUPPORT — The tools to get the job done. Among them, a computer facility of 7 general-purpose machines, ranging in size, speed and capability from modest to the fastest, large-scale equipment commercially available. This is augmented further by DSD's specially-designed GEESE facility — a custom mating of special-purpose digital equipment with an analog capacity of 550 amplifiers.

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Forward your resume in strict confidence to Mr. P. W. Christos, Div. 64-WN, Defense Systems Dept., General Electric, Northern Lights Office Bldg., Syracuse, N. Y.

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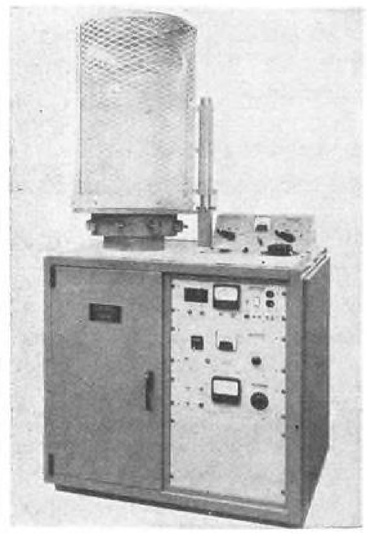
FILTER DESIGN SPECIALISTS
To assist control system designers in synthesizing compensating filters for advanced space vehicles and to conduct research in advanced methods of filter synthesis. M.S. in electrical engineering and related experience preferred.

SPACE VEHICLE DYNAMICISTS
To investigate the dynamics of large space boosters and payloads as they affect vehicle design. Body bending, propellant sloshing, spacecraft docking, and loading dynamics are among subjects to be studied. Flutter analysis experience and an M.S. in mechanical engineering or physics are preferred.

Write for complete information (include resume of background) to: F. V. Edmonds, Dept. 21, Missile and Space Systems Division, Douglas Aircraft Company, Inc., 3000 Ocean Park Blvd., Santa Monica, California. An equal opportunity employer.

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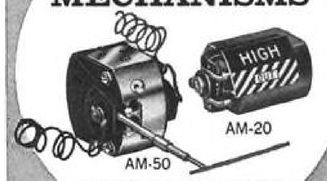
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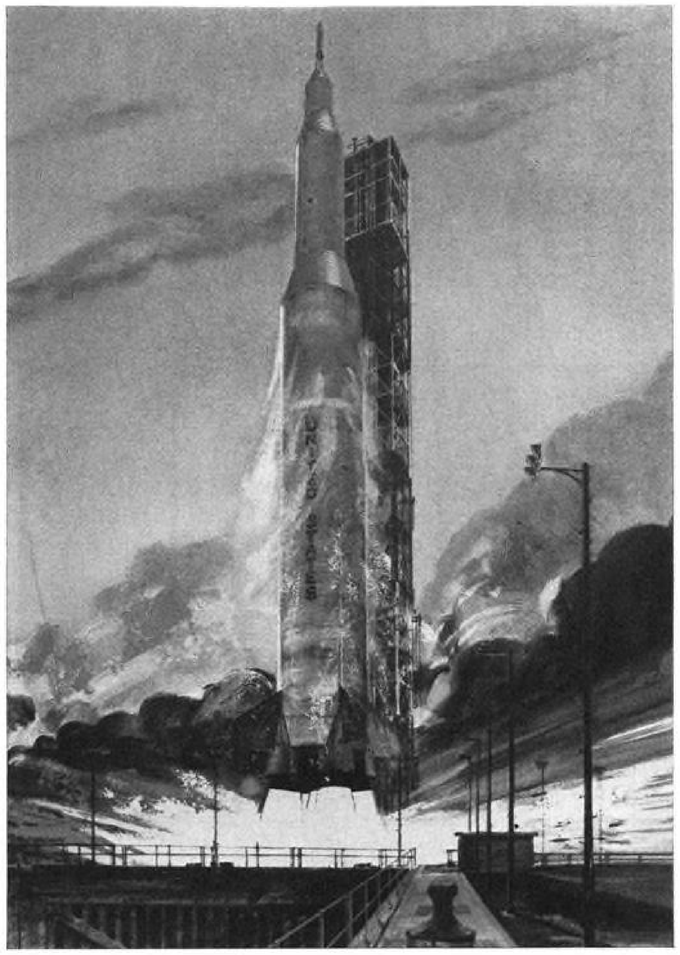
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BOEING

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Firm Name and Address	Base Pay 40 hr/Wk	Dates Employed Month/Year
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2. Position & Duties		
3. Position & Duties		
4. Position & Duties		

REFERENCES. Give full names, occupations and addresses. Professional (previous supervisor preferred):

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2._____

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1._____

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LIST TYPE OF WORK PREFERRED UPON EMPLOYMENT:

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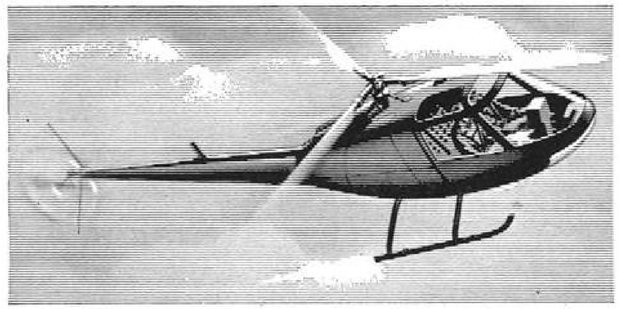
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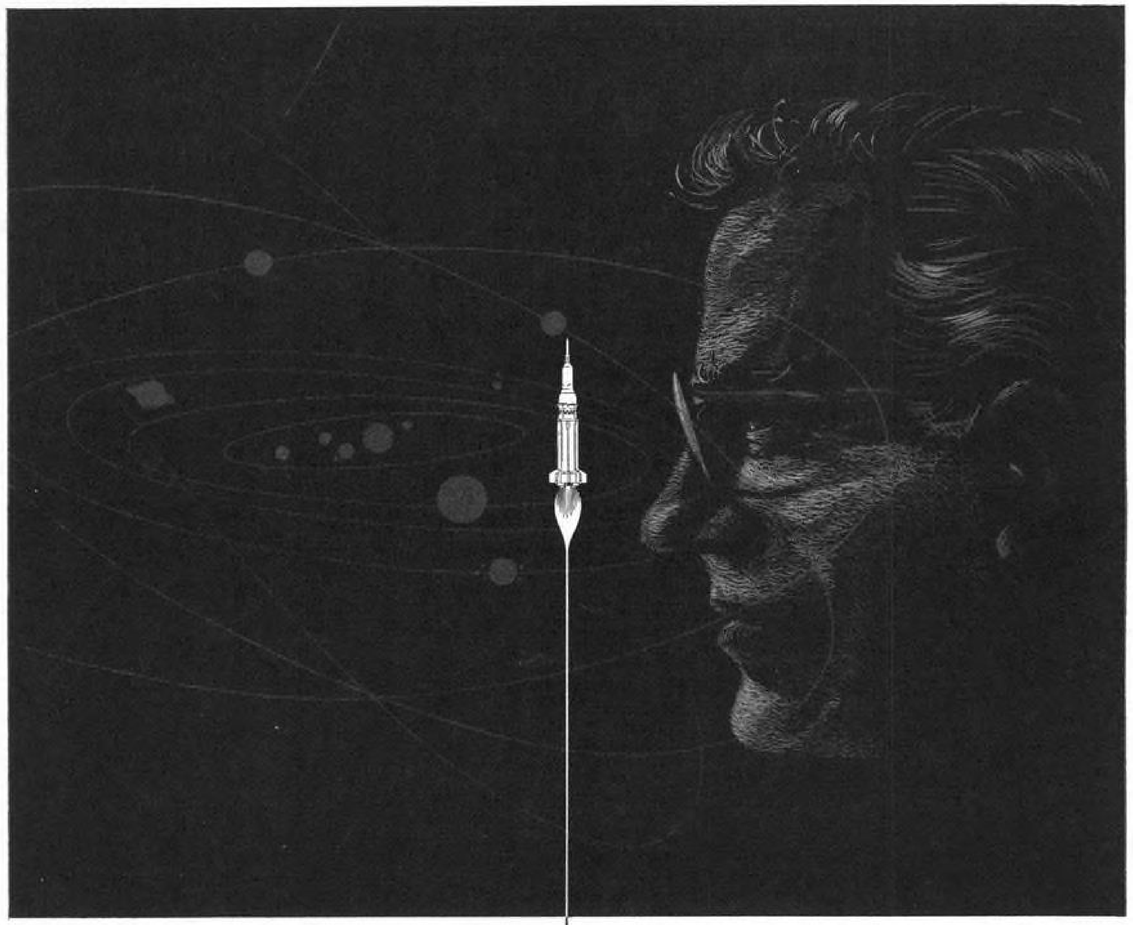
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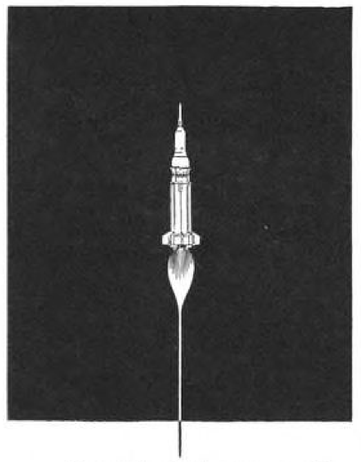
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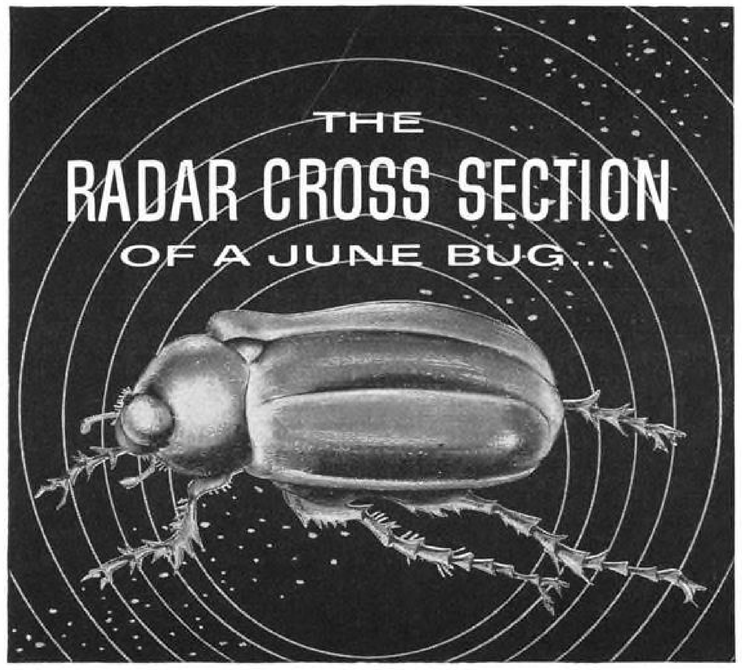
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(Continued on page 100)



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Lockheed California Co. 97
Minneapolis Honeywell, Aero Division 94
National Trailer Convoy, Inc. 100
Port of New York Authority 100
Pratt & Whitney Aircraft 99

Growth opportunities for communications engineers

Expanding activity at Hughes Communications Division is concerned with the definition and solution of global civilian and military communications requirements of the 1965-75 era. Immediate professional assignments exist for qualified Communications Engineers in the following project areas:

- SYNCOM I & II Studies
- 480L USAF Air Communication System Studies
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- Manpack Transceiver
- Air/Ground Digital Data Communication Systems
- Tactical Vocoder & Speech Processing Equipment
- Combat Area Communication Systems
- Microwave Synthesizers and Millimeter Wave Communication Equipment
- LASER Communications
- High-Power Transmitters
- Modem Developments
- Secure Data & Command Systems

If you are qualified by interest and experience, hold an accredited degree and U.S. Citizenship and would like to associate with one of Southern California's largest and fastest-growing aerospace firms, we would like to talk with you.

Please airmail your resumé or call Southern California (collect). Contact:

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LETTERS

Minuteman Materials

We here at Haveg Industries, who are closely associated with the manufacture of materials and components for the Minuteman missile, read with great interest your article on the first stage (AW Aug. 27, p. 54).

We are very proud of our association with Thiokol and their subcontractors in supplying these materials and components. We would, therefore, like to point out that the exit cones for most of the first-stage Minuteman missiles have been made with SIL-TEMP supplied by the SIL-TEMP Division of Haveg Industries. SIL-TEMP is our trade name for silica fabric just as Refrasil is the trade name for our competitor's silica fabric. We hope that you will publish this information for the benefit of your many readers who, perhaps, are aware of the widespread use of SIL-TEMP in the first stage Minuteman.

Incidentally, SIL-TEMP is also widely used in both the second stage Minuteman and the third stage Minuteman. Furthermore, it is being used extensively in the external insulation such as that used in the nose cones of the Minuteman.

JOHN M. WARD
Vice President
Haveg Corp.
Wilmington, Del.

Pioneer Tracking

In your otherwise informative article on the flight of Mariner R-2 in the Sept. 3 issue of AVIATION WEEK (p. 18) you ascribed the successful tracking of Pioneer 5 out to a range of 22.5 million mi. to the JPL Goldstone installation. Pioneer 5, designed, built, launched, and tracked by Space Technology Laboratories (not JPL), was tracked exclusively in the final weeks by the STL Able network tracking station, making use of the British 250-ft. radio astronomy antenna at Jodrell Bank. The 85-ft. antenna system at Goldstone and that at Millstone Hill cooperated very helpfully during the initial days of the Pioneer 5 flight, but the entire tracking, telemetry, and command activities were carried out by the four-station STL global space tracking network.

If Mariner R-2 maintains its communication link until November, the record of Pioneer 5 will be challenged for the first time in more than two years, but until then the 22.5 million mi. TTC link, maintained at Jodrell Bank by STL, still stands as the deepest penetration of space.

E. R. SPANGLER
Space Technology Laboratories, Inc.
Redondo Beach, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Space Waste

The ad writers weave a gay picture
Of glories for workers on space,
The industry scrambles for talent
To be first to the moon in the race.

Their blurbs are so very exciting,
Their climate is second to none,
Working conditions delightful,
Each day is eight hours of fun.

So the question to me is apparent,
If it's true that they want engineers,
Then why don't they answer our queries
And suppress our bewildering fears?

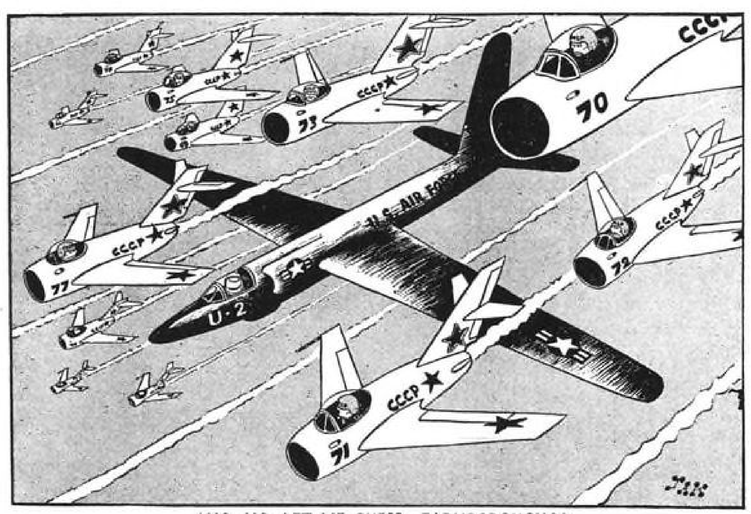
We have typed resumes by the dozen
Applications are now our forte,
School records went into the brochure
But again, there's no letter today!

Maybe NASA's not loosing the purse strings
Or the Air Force is up in the air,
Did the one-twenty booster get side-tracked
And the space weapon cupboard is bare?

If I headed some personnel office
The first change that there surely would be,
Is to send an immediate answer
To some worthy applicant: Me!

It's all getting a little bit boring
And frustration's the theme of my song,
If they want to have Russians eat space dust
Then why do they take so damn long?

(Name withheld by request.)
Engineer's Wife



'NO, NO, LET ME GUESS—FARNBOROUGH?'
London Evening Standard

Sea GEMs

The comments in your Industry Observer of Aug. 20 (p. 23) on the operation of GEMs at sea are, for some particular cases, true. However, we feel that such generalized statements are misleading when presented in such a brief and unqualified manner. In the interest of, and in defense of GEMs, we would therefore like to add the following comments.

The problem of certain combinations of waves producing oscillations of the craft, particularly when the frequency of encounter equals the natural frequency of the craft, have been understood for two years. Methods of improving the stability, such as damping control or of reducing the impact loading by careful hull design or flexible lower structures, have been developed and incorporated in the present generation of GEMs.

The fact that some part of the craft may touch the water is in itself not serious since the accelerations and loads are usually small. Nevertheless, it is accepted in the design of GEMs that there may be a very occasional hard contact of the craft with the water and, therefore, bow designs have been developed to reduce the loads to a minimum and structures designed to cope with any load conditions which may occur.

The problem of salt spray ingestion causing a loss of power is no longer a serious problem since methods of water separation from the engine "breathing" air have been developed. We are confident that there will be no loss of power due to this phenomenon on the Bell SKMR-1.

The problems of the design of the very large ocean GEM have not been completely evaluated at the present time. However, Bell Aerosystems Co. can confidently predict for the near future operational GEMs in the range of 30 to 300 tons, operating at heights from one to six feet over waves of up to 10 ft. for use in coastal and sheltered waters as high-speed short and medium range ferries.

JOHN B. CHAPLIN
Chief of GEM Programs
Advanced Design Department
Bell Aerosystems Co.
Division of Bell Aerospace Corp.
Buffalo, N. Y.

advanced
PRECISION COMPUTING RESOLVERS
for
Cascaded Resolver Systems

SIZE 8 FEEDBACK WINDING RESOLVERS

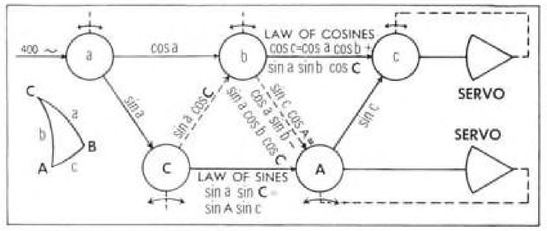


These resolvers are designed for use with transistorized "booster" amplifiers in cascaded chains.

Chains of precision size 8, winding compensated resolvers accurately solve the trigonometry of coordinate translation, rotation and conversion.

A chain of five resolvers is typically employed to solve for an unknown side and angle of oblique spherical triangles.

Individual resolvers exhibit functional errors of less than 0.1% and axis perpendicularity errors of ±5′ max. In combination with the CPPC RESOLVERAMP, the closed loop phase shift is 0.00° ±0.01° and the transformation ratio is 1.0000 ±.0005. The residual null voltage is 1 mv/v max. over a range of 10V, 400 ~.

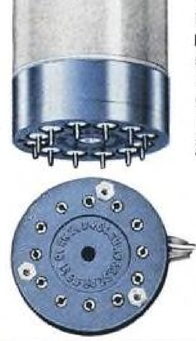


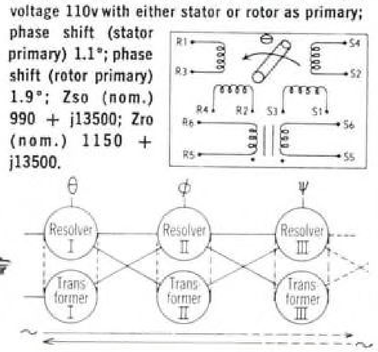
SIZE 11 "BOOSTERLESS" RESOLVERS FOR SERVICE IN REVERSIBLE CHAINS



The frame of these size 11 computing resolvers also houses a matching transformer which simulates a pair of resolver windings at maximum coupling. In a reversible chain of alternately interconnected resolvers (only partially diagrammed), the excitation may be applied to either end of the chain and the outputs taken from the other end.

Quick disconnect allows ease in harnessing. Accuracy: ±5′ of arc or less; winding perp. ±5′. Electrical characteristics: Input to EITHER rotor or stator. Input voltage 115v 1600 ~; output voltage 110v with either stator or rotor as primary; phase shift (stator primary) 1.1°; phase shift (rotor primary) 1.9°; Zso (nom.) 990 + j13500; Zro (nom.) 1150 + j13500.





SIZE 11 RESOLVER TRIMMED FOR ZERO PHASE SHIFT CONTAINS ALL COMPENSATION IN 2¼" LENGTH



The YZC-11-E-1 precision computing resolver has been developed for use in a cascaded, amplifierless resolver system at 900~.

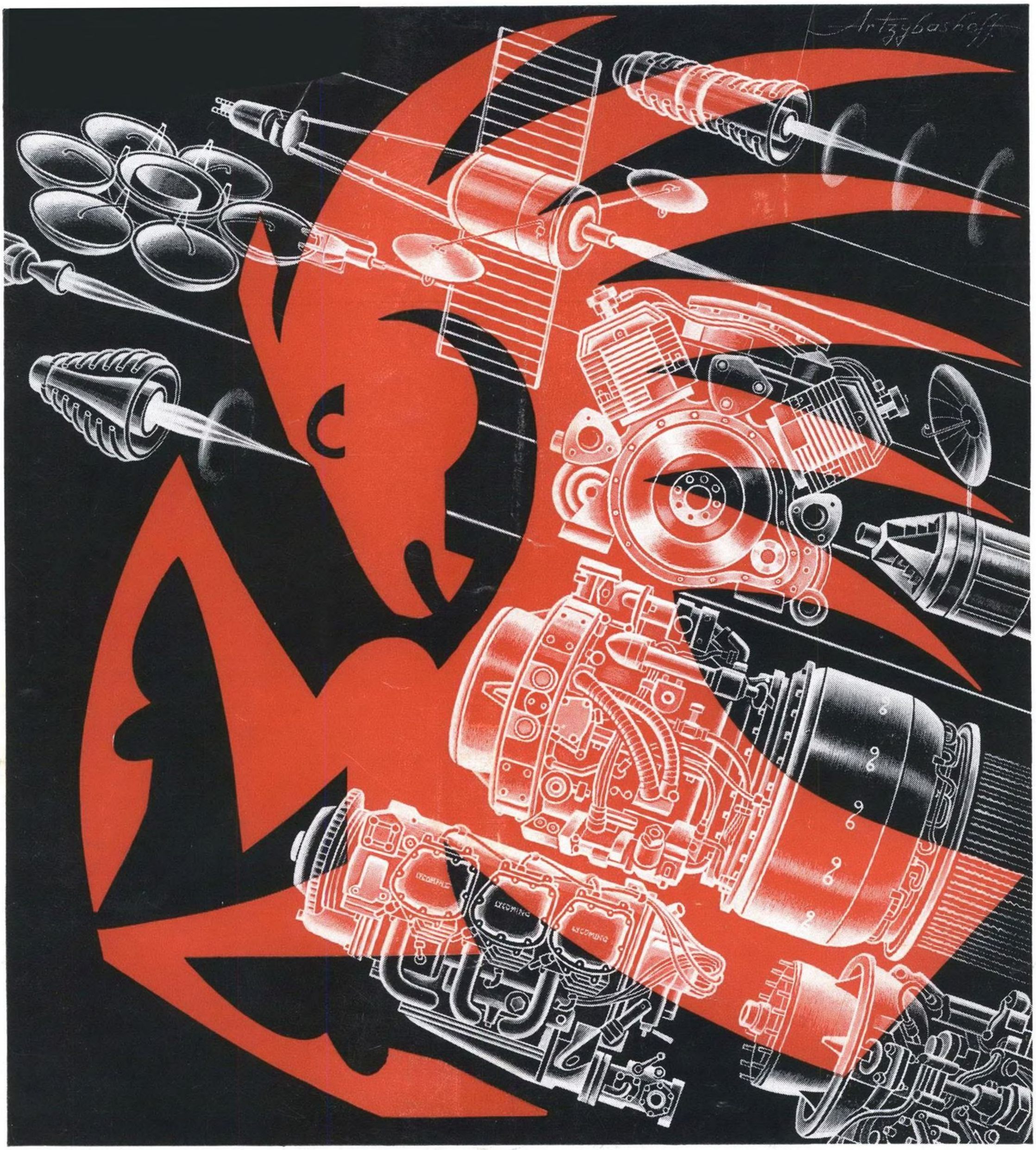
These units have been trimmed to provide zero phase shift and compensated for transformation ratio stability, under temperature, when working into their iterative impedance.

Accuracy: Functional error .1% or less; winding perp. ±5′. Electrical characteristics: Input voltage (stator) 40v900 ~; output voltage (rotor) 33.2v; phase shift 0; max. null voltage 1 mv/v.

Also ready for delivery is an equivalent, compatible pancake resolver. By its use, differential information from an inertial platform may be obtained and introduced into the system.

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