Aviation Week & Space Technology

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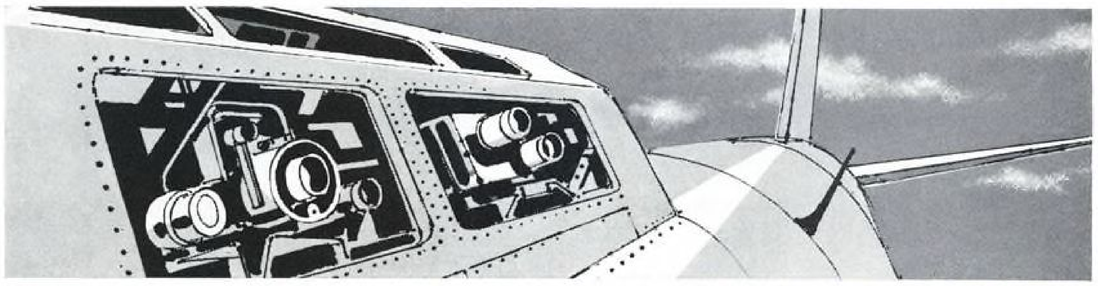
A McGraw-Hill Publication

February 18, 1963

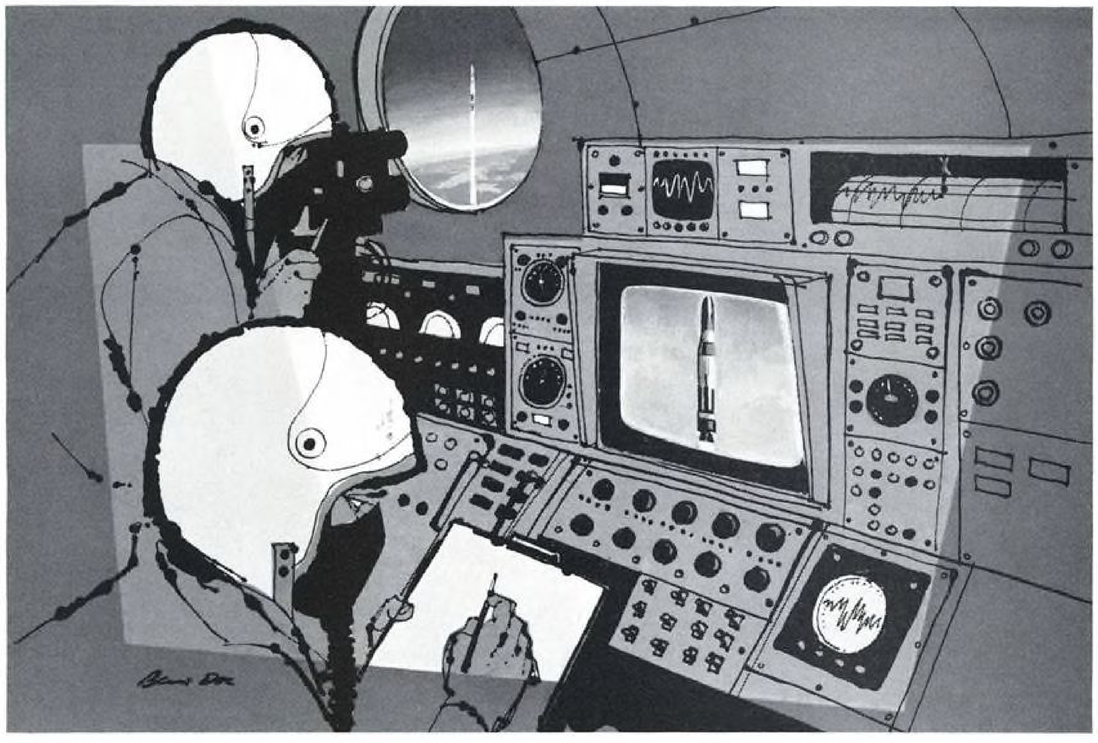
NEW PHOTOS:

Soviet Aircraft, Missiles in Cuba

Navy/Goodyear Subroc Firing



AN EIGHT-MILE HIGH RESEARCH LABORATORY



Operating at over 40,000 feet in a specially modified KC-135 jet aircraft, a team of "flying physicists" from Aerojet-General's Astrionics Division is conducting a series of unique experiments in the study of ballistic missiles. Their purpose: to obtain highly reliable data on the radiation characteristics of missiles in flight... data which provides design parameters for future warning and deterrent systems. Their research tools: infrared trackers, radiometers, spectrometers, and spatial measurement devices. These studies, known as Project RAMP ...Radiation Airborne Measurement Program...are a joint Advanced Research Projects Agency/Air Force Aeronautical Systems Division project. ■ Astrionics Research has been active in radiation physics for over eighteen years. Its scope of activities encompasses radiation physics, systems research, space physics, and computing sciences. Areas of special interest are advanced detection, tracking, and guidance systems, with applications ranging from surface warfare devices to infrared satellite surveillance systems.

AEROJET GENERAL TIRE GENERAL ASTRIONICS DIVISION/AZUSA, CALIFORNIA

Engineers, scientists: investigate outstanding opportunities at Aerojet-General®

HIGH CLAMP-UP MEETS MACH 2 STRUCTURE NEEDS

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Faster the speed, more varied the mission . . . the more critical are the structural requirements. Such is the Navy's newest all-weather, nuclear weapons carrying aircraft...the carrier-based A3J Vigilante.

Because of their excellent residual preload characteristics, Hi-Loks were selected for use throughout the A3J primary structure. The unique Hi-Lok torque-off feature produces a high, uniform clamp-up of high tensile sheet materials in *all* grip conditions. The installation method is smooth and quiet.

Inexpensive, lightweight, Hi-Lok tooling reduces worker fatigue and avoids the need for heavy squeezers or bulky pull-type equipment and their limitations in close quarters. In open areas, Hi-Loks can be installed at speeds up to 45 per minute.

Write or contact us for Hi-Lok technical and specification data.

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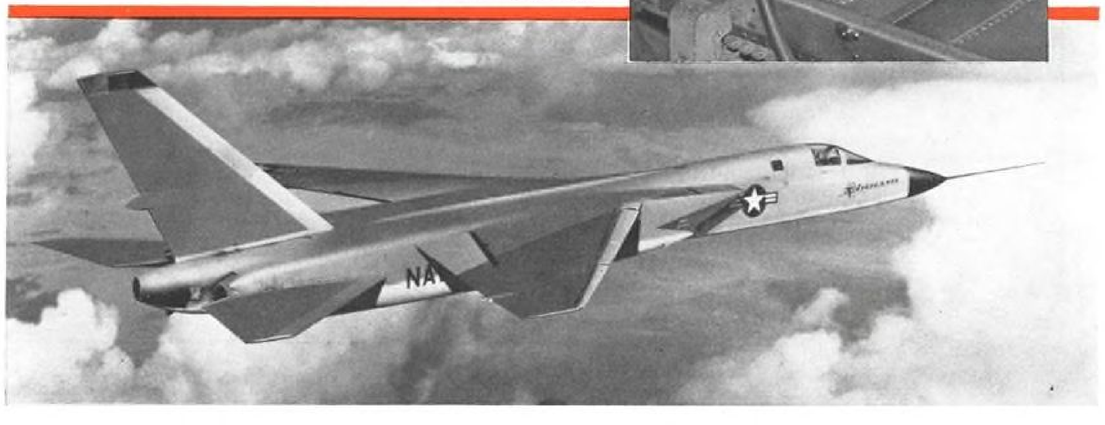
ABOVE In strength and temperature areas, the A3J uses stainless steel Hi-Lok pins (125,000 psi shear or 220,000 psi tensile) with shanks made to .0005 tolerance; with stainless steel collars, these Hi-Loks can be used to 800°F. Other primary structure uses alloy steel Hi-Lok pins (95,000 psi shear or 160,000-180,000 psi tensile) with shanks made to .001 min. as well as head heights to ±.001 tolerance.

RIGHT Here Hi-Loks are being installed in the A3J rear fuselage with Hi-Lok right angle tooling adapted to a Ratchet Wrench Motor. Other Hi-Lok adaptor tooling is available in straight, extended and offset styles to overcome difficult or tight clearance conditions resulting from the unusual structural configurations of high performance airframes such as the Vigilante.

TRADEMARK REGISTERED. U.S. PATENTS 2,882,773, 2,927,491 AND 2,940,495. OTHER U.S. AND FOREIGN PATENTS GRANTED AND PENDING.



Look into

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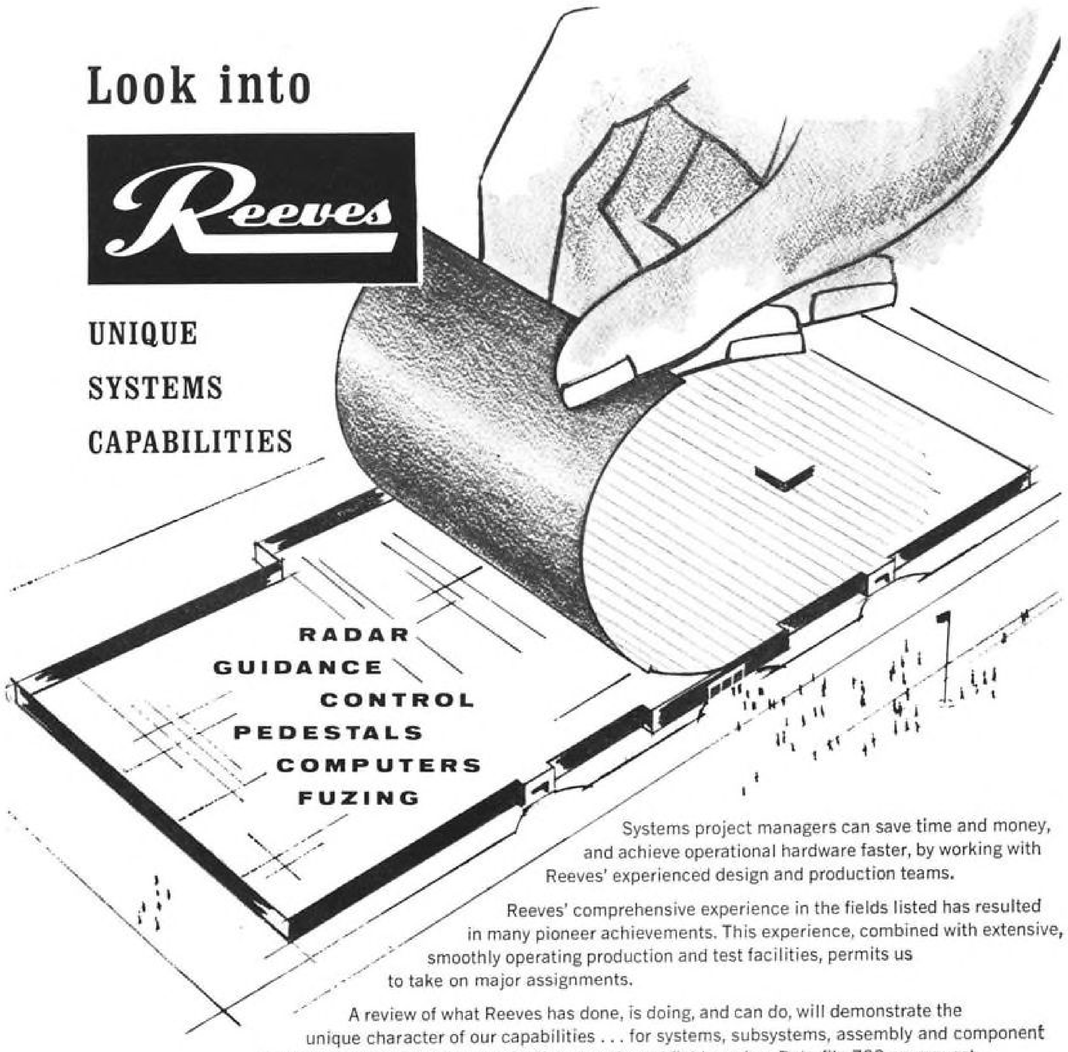
SYSTEMS
CAPABILITIES



Systems project managers can save time and money, and achieve operational hardware faster, by working with Reeves' experienced design and production teams.

Reeves' comprehensive experience in the fields listed has resulted in many pioneer achievements. This experience, combined with extensive, smoothly operating production and test facilities, permits us to take on major assignments.

A review of what Reeves has done, is doing, and can do, will demonstrate the unique character of our capabilities . . . for systems, subsystems, assembly and component development, engineering, production, supply and field service. Data file 702 on request.

FOR EXAMPLE: PEDESTALS

A major contribution to today's most sophisticated radar, tracking, and range systems are the ultra-high precision antenna pedestals developed by Reeves . . . the most advanced pedestals now available. They include 10-second accuracy 2- and 3-axis radar pedestals; optical pedestals, with angular accuracies of 5 seconds of arc, capable of sustaining a 250,000 lb. load; and air-transportable pedestals with accuracy of ±0.5 degrees in both axes.

Pedestal and related system problems are readily solved through our experienced, up-to-the-minute engineering and production capabilities.

Qualified engineers who are seeking rewarding opportunities for their talents in this and related fields are invited to get in touch with us.

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Reeves *Systems* engineering...management...production...field services

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AEROSPACE CALENDAR

Feb. 26-Mar. 1—19th Annual Technical Conference, Society of Plastics Engineers, Statler Hilton Hotel, Los Angeles, Calif.

Feb. 28-Mar. 1—Government Contracts Briefing Conference, Sheraton Hotel, Philadelphia, Pa. Sponsors: Federal Bar Assn.; Bureau of National Affairs.

Mar. 3-7—Seventh Annual Hydraulics, Gas Turbine, Aviation and Space Meeting, American Society of Mechanical Engineers, Statler Hilton Hotel, Los Angeles.

Mar. 4-5—Space Age Technology Measurement Symposium, Stanford Research Institute, Palo Alto, Calif.

Mar. 4-10—Third Inter-American Symposium of Astronautics, Ibirapuera Park, Sao Paulo, Brazil.

Mar. 6-7—Disc File Symposium, Hollywood Thunderbird Inn, Hollywood, Calif. Sponsor: Informatics, Inc.

Mar. 6-8—Annual Meeting, American Ordnance Assn.'s Packaging Division, Brookley AFB, Ala. Host: Air Force Packaging Laboratories, Mobile Air Materiel Area.

Mar. 7-8—National Propulsion Meeting, AIAA/NASA Lewis Research Center, Hotel Carter, Cleveland. (Classified).

Mar. 11-13—Electric Propulsion Conference, American Inst. of Aeronautics and Astronautics (AIAA), Broadmoor Hotel, Colorado Springs, Colo.

Mar. 15-16—Pacific Computer Conference, Institute of Electronic and Electrical Engineers, California Institute of Technology, Pasadena, Calif.

Mar. 18-20—Space Flight Testing Conference, American Institute of Aeronautics

(*Continued on page 7*)

AVIATION WEEK & Space Technology

February 18, 1963
Vol. 78, No. 7

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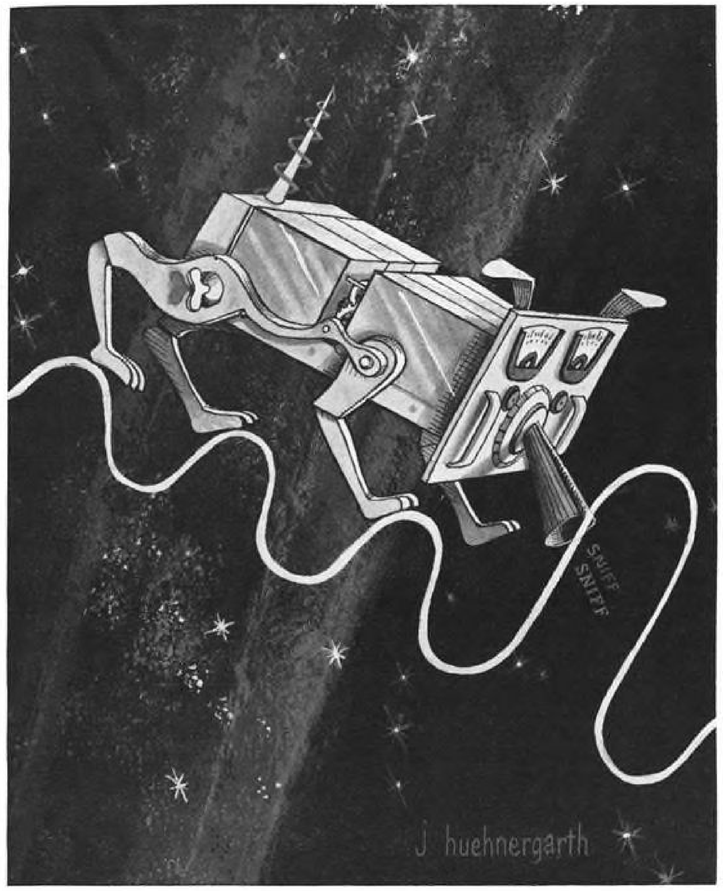

NEMS-CLARKE MODULE
Searches and locks carrier to –145 dbm

When missile and satellite signals are the hardest to find, and hold, this new PCM/PM Module is at its best. It is a phase lock tracking demodulator with anti-sideband lock-out. It searches, tracks and locks onto a carrier signal as low as –145 dbm and will maintain the lock at –150 dbm. AGC of this equipment has been maintained for signal strength lower than locking threshold. Ultra linear phase detector guarantees low distortion reception with a signal modulation as high as 1.4 radians. These new units demodulate either true phase or amplitude modulated signals.

The module is designed to plug into Nems-Clarke 1455-1456A receivers as well as the 1037 deep space probe receiver.

Specifications:

Operation Modes . . . . . Automatic, Manual
Automatic Sweep Range . . . . ±5 kc min of VCO center frequency
Manual Sweep Range . . . . . ±15 kc of nominal VCO frequency 5,445.00 kc
Tracking Loop Bandwith . . . . . 20 & 60 cps (selectable from front panel)
Tracking Loop Sensitivity . . . . . Minimum: –150 dbm (Maintain lock), –140 dbm (Automatic search & Lock)

For further information, write: Dept. 550
Vitro Electronics, 919 Jesup-Blair Drive,
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A graphic demonstration of the high-temperature strength of TD Nickel. The best superalloys now used in high-temperature service failed under similar test conditions.

Du Pont TD Nickel permits continuous operation of equipment and components up to 2400° F

Du Pont TD Nickel is a new alloy composed of 98% nickel and 2% (by volume) thoria. This unique dispersion imparts useful—and stable—mechanical properties to nickel at temperatures up to 2400°F.

For example, TD Nickel has an ultimate tensile strength of 10,000 psi at 2400°F—approximately 90% of the melting point of nickel. Relative to many nickel or cobalt base superalloys, TD Nickel has *superior mechanical properties* in the 1800°-2400°F range. TD Nickel also retains the *desirable physical properties* of pure nickel.

Yet, TD Nickel *is workable* in normal atmospheres...can be cold-drawn, rolled, forged, machined, sheared...*using standard metalworking techniques.*

Your present—and future—equipment and/or components may well benefit from the unique combination of properties available only in Du Pont TD Nickel.

Commercial Quantities Available—Commercial quantities of ½", ¾" and 1" diameter bar stock TD Nickel are available. Strip, sheet forms and tube hollows will be in production in the near future.

For complete descriptive data on Du Pont TD Nickel and its properties, use the coupon or write on your company letterhead. Please list the particular interest you have.

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Please forward technical data on Du Pont TD Nickel. I am interested in evaluating TD Nickel for:

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Better Things for Better Living ...through Chemistry — DU PONT

AEROSPACE CALENDAR

(*Continued from page 5*)

and Astronautics (AIAA), Cocoa Beach, Fla.

Mar. 18-21—1963 Western Metal Exposition and Congress, Pan-Pacific Auditorium/Ambassador Hotel, Los Angeles.

Mar. 18-22—Spring National Convention, Society for Nondestructive Testing, Ambassador Hotel, Los Angeles, Calif.

Mar. 19-21—Second Air Force-sponsored Symposium on Bionics, Biltmore Hotel, Dayton, Ohio.

Mar. 22—Sixth Annual Dr. Robert H. Goddard Memorial Dinner, Sheraton-Park Hotel, Washington, D. C. Sponsor: National Rocket Club.

Mar. 25-28—International Convention, Institute of Electrical and Electronics Engineers, Waldorf-Astoria and Coliseum, New York, N. Y.

Mar. 28-29—Fifth International Symposium on Electron Beam Technology, Hotel Sheraton Plaza, Cambridge, Mass. Sponsor: Alloyd Electronics Corp.

Apr. 1-3—Launch and Space Vehicle Shell Structures Conference, American Institute of Aeronautics and Astronautics, El Mirador Hotel, Palm Springs, Calif.

Apr. 2-3—Eighth Annual Business Aircraft Safety Seminar, Flight Safety Foundation, Barbizon Plaza, New York, N. Y.

Apr. 2-5—Spring Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 10—1963 National Value Engineering Conference. For information: Dr. David Miller, coordinator of special programs, Los Angeles State College, 5151 State College Dr., Los Angeles 32, Calif.

Apr. 10-11—Fourth Symposium on Engineering Aspects of Magnetohydrodynamics, University of California, Berkeley.

Apr. 16-18—National Meeting, Aerospace Industries Assn.'s Export Committee, Bolling AFB Officers Club, Washington, D. C.

Apr. 16-18—Optical Masers Symposium, United Engineering Center, New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Institute of Electrical and Electronics Engineers; American Optical Society; Armed Services.

Apr. 16-19—1963 USAF Aerospace Fluids and Lubricants Conference (unclassified), San Antonio, Tex. Managed by Southwest Research Institute.

Apr. 17-19—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Statler Hilton Hotel, Los Angeles, Calif.

Apr. 17-19—International Nonlinear Magnetics (INTERMAG) Conference. Institute of Electrical and Electronics Engineers, Shoreham Hotel, Washington.

Apr. 17-19—Southwestern Conference and Electronic Show, Institute of Electrical and Electronics Engineers, Dallas Memorial Auditorium, Dallas, Tex.

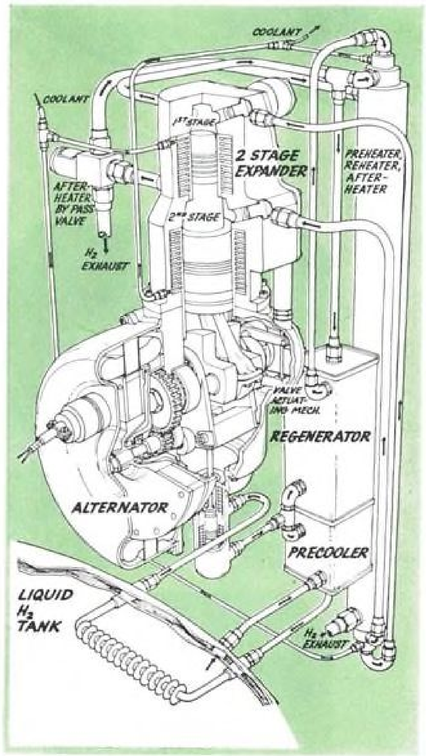
Apr. 17-19—Technical Meeting: Nuclear Materials for Space Applications, American Nuclear Society, Netherland Hilton Hotel, Cincinnati, Ohio.

Apr. 22-23—Annual Meeting, National Aeronautical Services Assn., Washington, D. C.

Apr. 22-24—Second Manned Space Flight

(*Continued on page 9*)

A RELIABLE SPACE POWER AND THERMAL CONTROL SYSTEM FOR LUNAR EXPLORATION



THE CRYHOCYCLE-R is one space power system now in the advanced test phase at Sundstrand Aviation - Denver. This system is unique in that it eliminates the problems of radiator development, orientation and protection, and the high weight of water evaporative cooling systems. Normally wasted energy (even the metabolic heat of the astronauts) is recovered and used. The working fluid, hydrogen, is heated both between stages and in the cylinders, significantly reducing the specific propellant consumption and providing simultaneous power generation and thermal control. ■ Because it provides both power and cooling, independent of the vehicle's external environment, the CRYHOCYCLE-R permits the development of a single lunar vehicle for exploration of any part of the moon, and at any time of the lunar day or night. ■ Because it operates on cryogenic propellants (and can utilize "boil-off") it also has many advantages for parking and rendezvous applications. ■ For an over-all picture of Sundstrand's broad experience in chemical and solar dynamic space power systems, send a request to our Applications Engineering Department on your business stationery. ■ If you would like to work on the Sundstrand engineering team finding practical solutions to challenging space problems, write to: Personnel Director,

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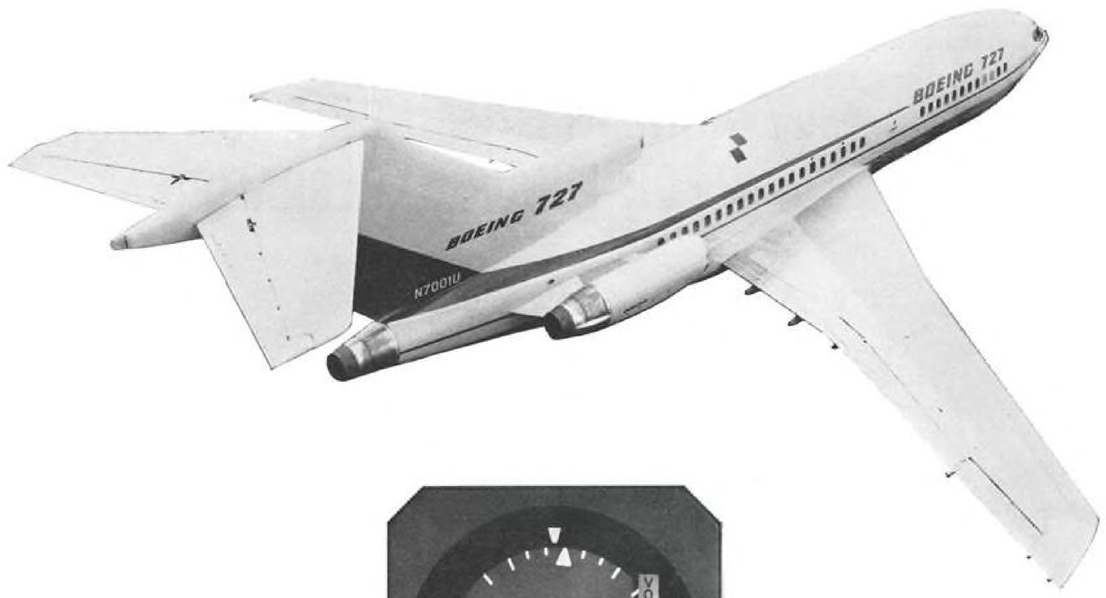

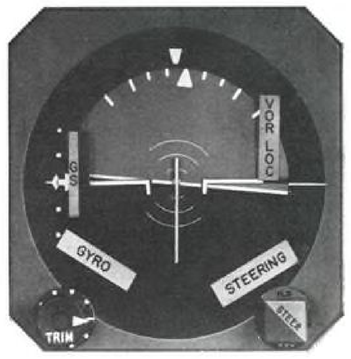

American and Eastern Pilots will fly this picture on the 727

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AEROSPACE CALENDAR

(Continued from page 7)

Symposium, AIAA/NASA, Marriott Hotel, Dallas, Tex.

Apr. 22-24—Third Annual San Diego Symposium for Biomedical Engineering, Del Webb's Oceanhouse, San Diego, Calif.

Apr. 23-25—Hypersonic Ramjets Conference, AIAA/ASME, Naval Ordnance Laboratory, White Oak, Md.

Apr. 29-30—1963 Spring Meeting, Western States Section/The Combustion Institute, Vacation Village Motel, San Diego, Calif. Sponsor: General Dynamics/Astronautics.

Apr. 29-May 2—34th Annual Scientific Meeting, Aerospace Medical Assn., Statler Hilton Hotel, Los Angeles, Calif.

Apr. 29-May 2—22nd Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton-Jefferson Hotel, St. Louis, Mo.

Apr. 29-May 3—Annual Conference, Society of Photographic Scientists and Engineers, Ambassador Hotel, Atlantic City, N. J. Cosponsor: Army Research Office.

May 1-3—19th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 2—Bioastronautics Conference, AIAA/Aerospace Medical Assn., Los Angeles, Calif.

May 2-3—Fourth National Symposium on Human Factors in Electronics, Institute of Electrical and Electronics Engineers, Marriott Twin Bridges Motel, Washington, D. C.

May 2-5—International Travel Fair and Flying Display, Biggin Hill Airport, Kent, England.

May 5-8—1963 Annual Conference, American Assn. of Airport Executives, Galt Ocean Mile, Beach Club and Coral Ridge Hotels, Fort Lauderdale, Fla.

May 6-8—Aerospace Reliability and Maintainability Meeting, AIAA/ASME/SAE, Washington, D. C.

May 7-9—Electronic Components Conference, Institute of Electrical and Electronics Engineers, Marriott Twin Bridges Motel, Washington.

May 13-15—National Aerospace Electronics Conference, Institute of Electrical and Electronics Engineers (IEEE)/AIAA, Dayton, Ohio.

May 15-17—Connecticut General Flight Forum's Second National Symposium on Air Transportation, Hartford, Conn.

May 20-22—National Symposium on Microwave Theory and Techniques, Institute of Electrical and Electronics Engineers, Miramar Hotel, Santa Monica, Calif.

May 20-22—National Telemetering Conference, Hilton Hotel, Albuquerque, N. M.

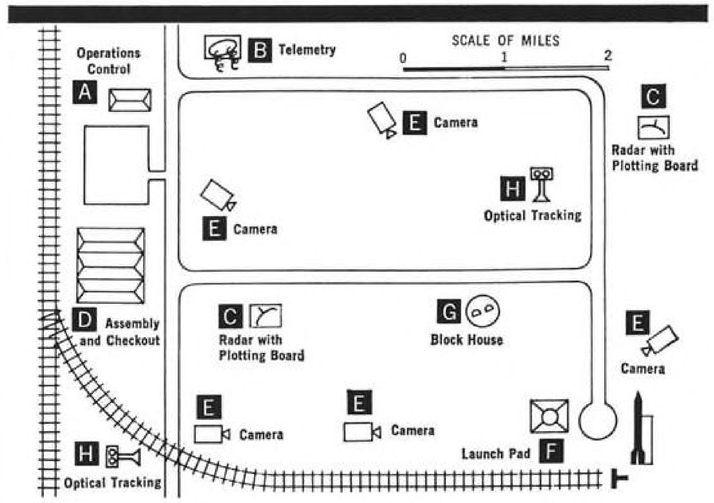
May 21-23—Spring Joint Computer Conference, American Federation of Information Processing Societies, Cobo Hall, Detroit, Mich.

May 27-28—Seventh National Conference on Product Engineering & Production, Institute of Electrical and Electronics Engineers, Continental Hotel, Cambridge, Mass.

June 7-16—25th French International Air Show, Le Bourget, Paris, France.

June 17-20—Summer Meeting, American Institute of Aeronautics and Astronautics (AIAA), Hotel Ambassador, Los Angeles.

Could you design a TIMING SYSTEM for this installation?



EECO "off-the-shelf systems" answer all time code requirements for test facilities

How would you use EECO timing equipment to design a "do-it-yourself" timing system for this hypothetical space vehicle launching facility?

Problem: See if you can match the timing system components listed below with the probable requirements of the testing and data recording sites shown in the map of an imaginary launching facility.

Assume existence of land lines connecting all locations.

See answer printed upside down at bottom of this ad for one workable timing system plan.

1. EECO 811 Time Code Generator. Generates all 4 IRIG formats or IRIG formats in combination with NASA or AMR codes.

2. EECO 30783 Control Bit Scanner Inserts up to 27 control bits into IRIG time formats to identify test numbers and runs, or to control external equipment.

3. EECO 860 Neon Distribution Amplifier. Provides timing signals to camera neon lamps. Includes neon "keep alive" voltage and current metering.

4. EECO 863 AC Line Driver for transmitting modulated time codes and sine wave signals over land line or telephone distribution systems to remote sites for tape units, time displays, other timing terminal equipment.

5. EECO 861 Relay Driver. Provides relay contact closures to plotting boards, pen recorders, or other high-current loads, locally or to remote sites.

6. EECO 864 DC Line Driver. Distributes pulse rates and level shift time codes over land lines to operate oscillographs, pen recorders, other DC loads locally or at remote sites.

7. EECO 865 Parallel Input Time Display. Supplements display on the EECO 811, within 500 feet of primary location. Wall-mounted or rack-mounted.

8. EECO 866 Serial Input Time Display. For remote display of generated time. Can drive several EECO 865's from one EECO 866 at the remote site.

What we're driving at: you can do it just as effectively in reality by using your choice of EECO's mutually compatible timing system components — to create your own "off-the-shelf system"!

By using EECO components, you get the convenience and economy of standardized, compatible, all-solid-state, off-the-shelf components. All standard time code formats available. Frequency stability 5 parts in 10^9/day.

System design consultation by the leading developers of timing and synchronization instrumentation is available to help solve your problem. No obligation, of course.

This is one practical way to solve it—what's yours?

A—1,2,3,4,5,6,7 • B—4,7,8 • C—Receives EECO 861 and EECO 864 signals • D—4,5,6,7,8 • E—Receives EECO 860 signals • F—8 • G—3,7,8 • H—Receives EECO 860, EECO 863, or EECO 864 signals.

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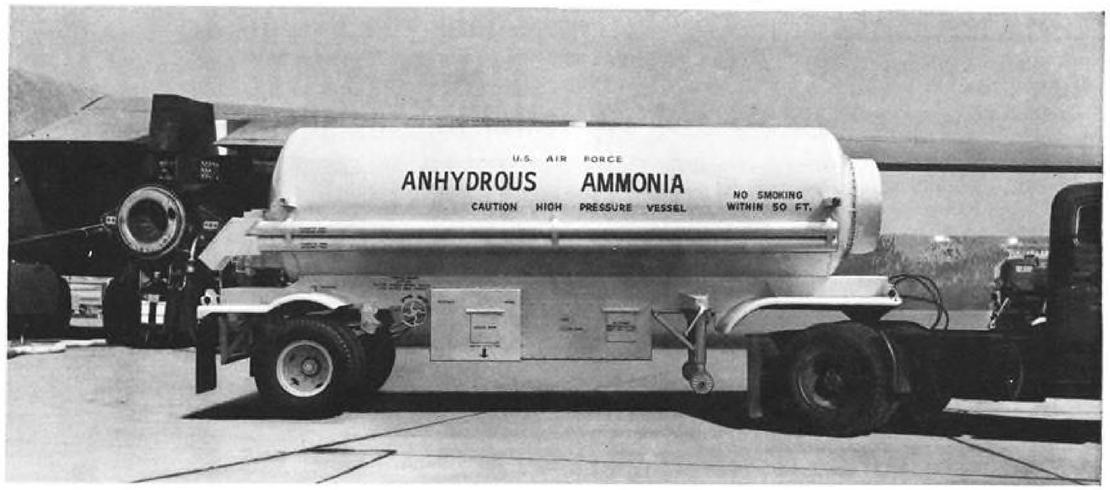

FRUEHAUF'S VAST RESOURCES ARE KEYED TO SPACE AGE NEEDS

Fruehauf's vast resources for the designing and producing of space age equipment have provided a wide range of military products . . . from standard and custom vans, shelters and trailers to advanced aerospace ground handling equipment. On both prime and subcontracts, Fruehauf's engineering know-how has consistently demonstrated its capacity for handling the toughest problems—swiftly, efficiently.

Fruehauf capability played an important part in the celebrated flight of the X-15 . . . the world's first man-controlled winged space flight. Fruehauf supplied North American Aviation, working under the National Aeronautics and Space Administration, with Anhydrous Ammonia Tank Trailers for fueling the X-15 prior to take-off. Fruehauf also provided lox tanks for servicing the X-15 from the B-52 mother ship while in flight.

For additional facts on Fruehauf's capability for designing, researching, developing and producing military and space age equipment of all kinds, send for your free copy of "Fruehauf G.S.E.–Military and Missile."

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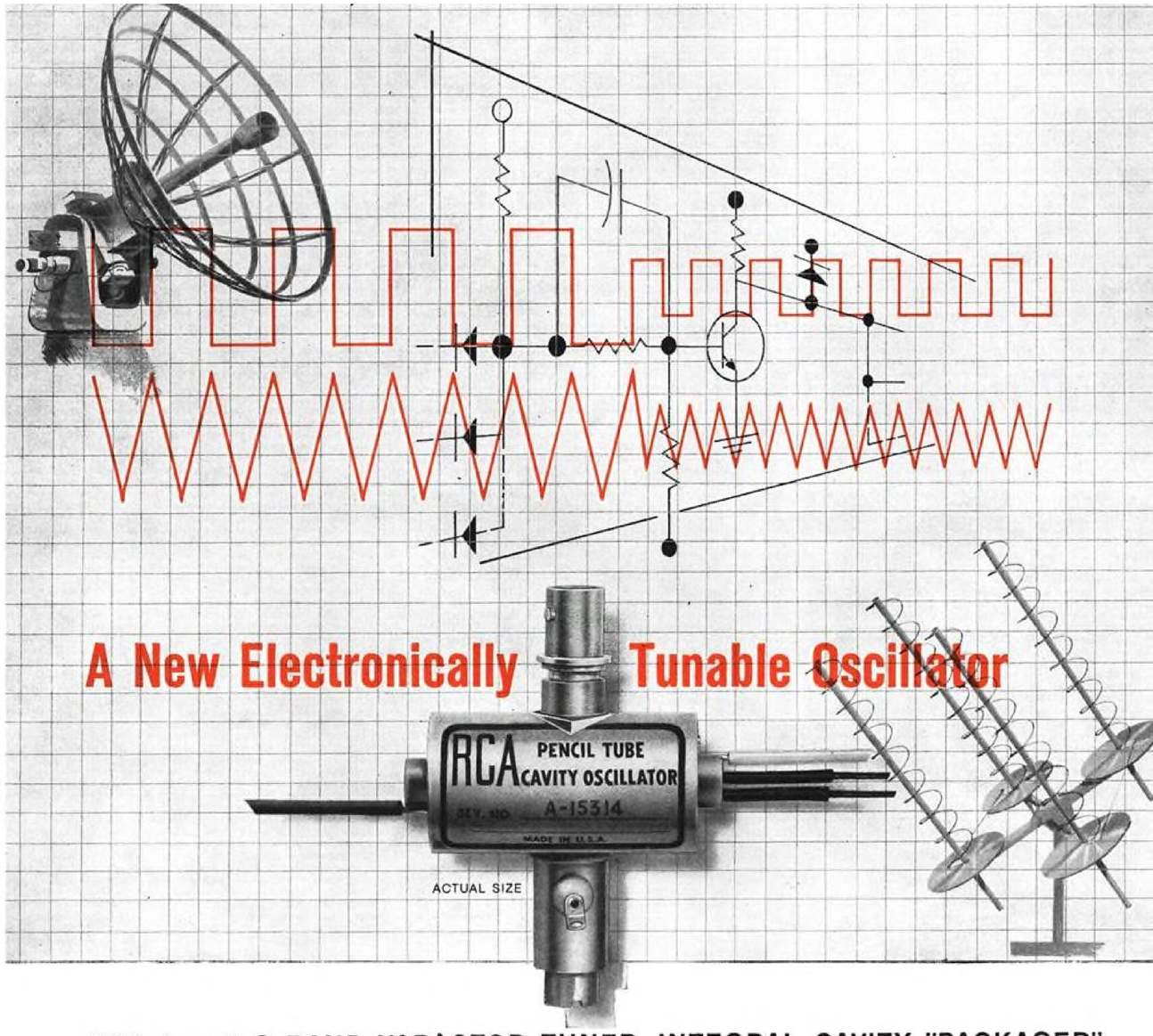

RCA L and S BAND VARACTOR-TUNED INTEGRAL-CAVITY "PACKAGED" MICROWAVE DEVICES MORE VERSATILE AND EFFICIENT THAN KLYSTRONS

RCA's new varactor-tuned integral-cavity pencil tube, A15314, operating at 1880 Mc, makes possible electronic frequency control in applications such as radar beacons, proximity devices, area surveillance equipment and telemetering devices, as well as in local oscillators and signal sources.

The cavity can be mechanically tuned between 1865 Mc and 1895 Mc and electronically tuned ± 10 Mc from any preset frequency within this range. Tuning sensitivity is approximately 1 Mc/volt. Power output over the tuning range is 200 mw minimum.

The integral packaging of the varactor with the cavity makes possible either electronic frequency control or frequency-modulated output. As such, the device has many advantages over klystrons including: better frequency stability in an FM system under conditions of varying heater and plate voltages and ambient temperature changes. Further advantages are lower input power, higher efficiency, longer life, and lower cost.

For additional information see chart at right. Detailed specifications and application information are available by writing: Manager, Microwave Marketing, RCA Electron Tube Division, Harrison, N. J.

General Data—RCA-A15314

Electrical		
Heater Voltage	6.0 ± 5%	volts
Heater Current	160	ma
Maximum DC Plate Voltage	150	volts
Maximum DC Plate Current	35	ma
Minimum Varactor Voltage	0	volts
Typical Operation—Frequency Modulated Oscillator		
DC Plate Voltage	125	volts
DC Plate Current	35	ma
Varactor Bias	—10	volts
Peak-to-Peak Modulating Voltage	20	volts
Center Frequency	1880	Mc
Peak Frequency Modulation	±10	Mc
Minimum Power Output	200	mw

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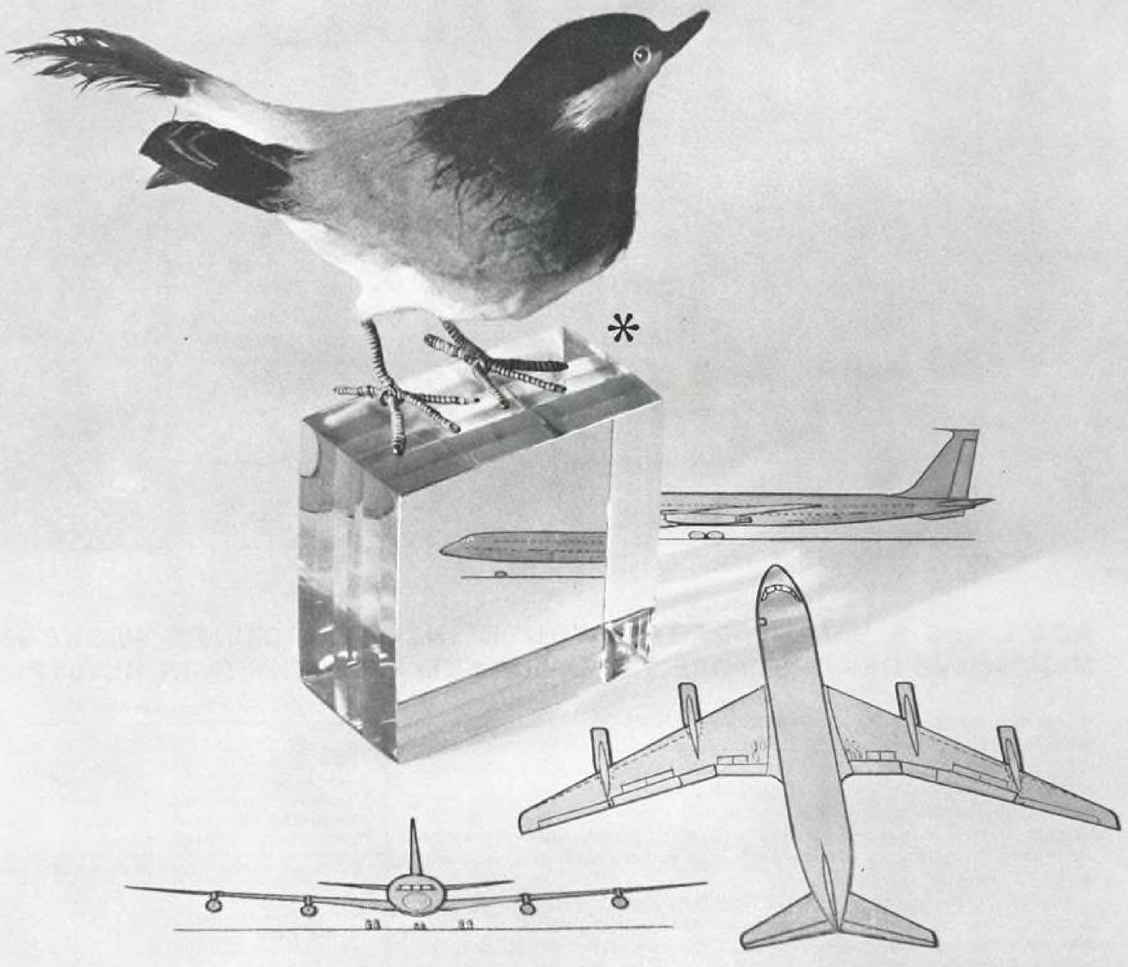

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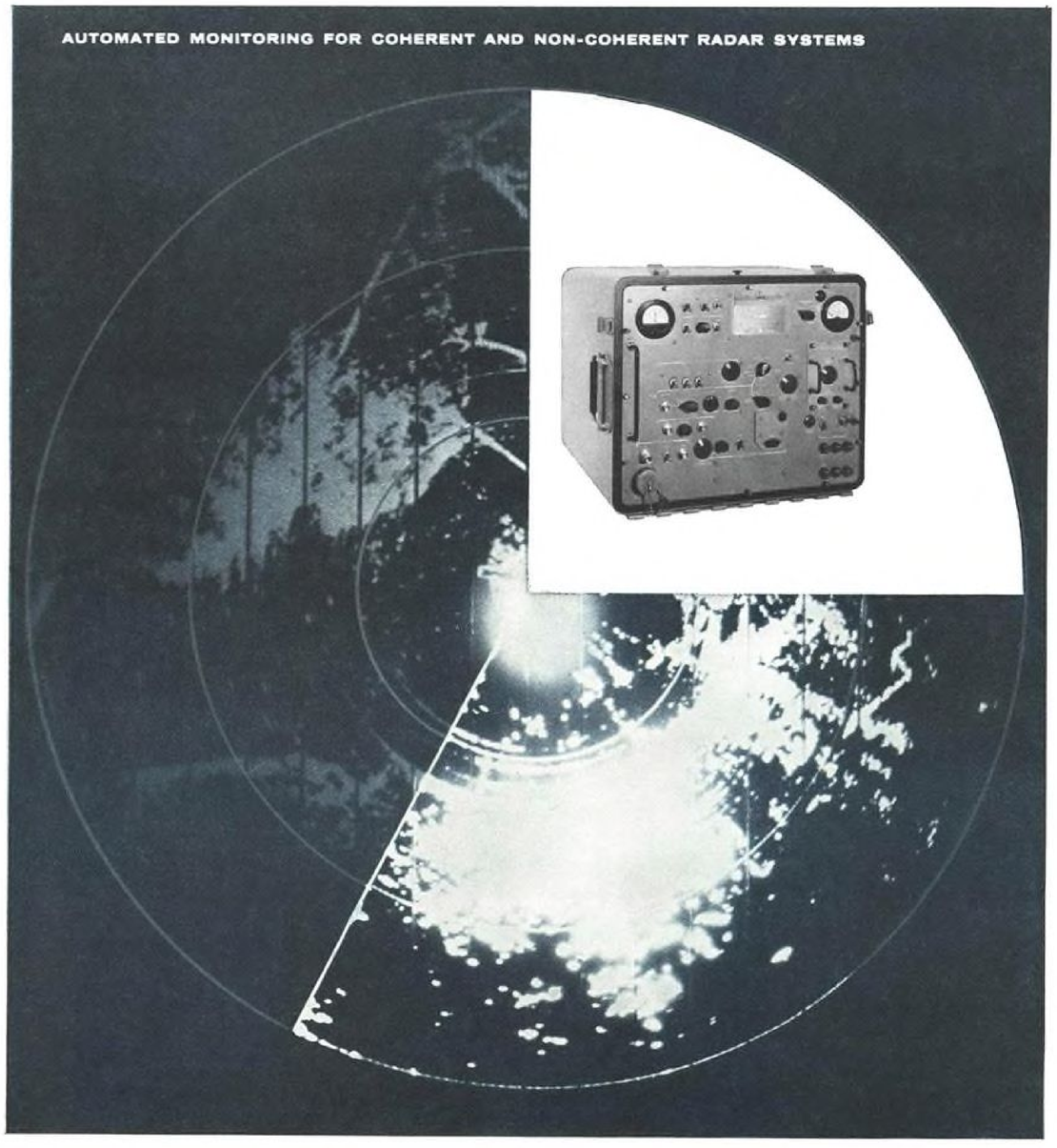

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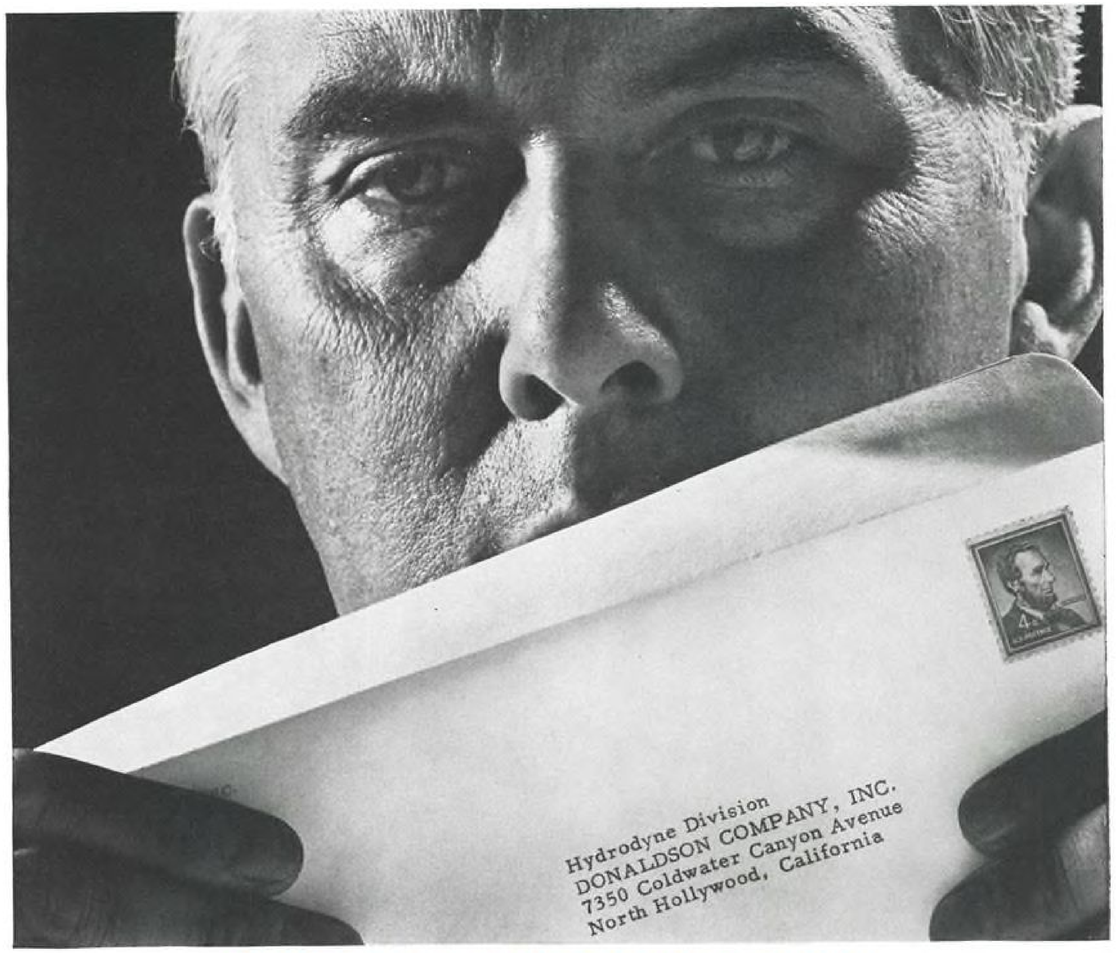

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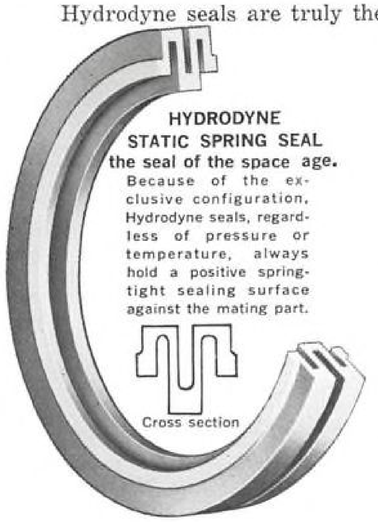

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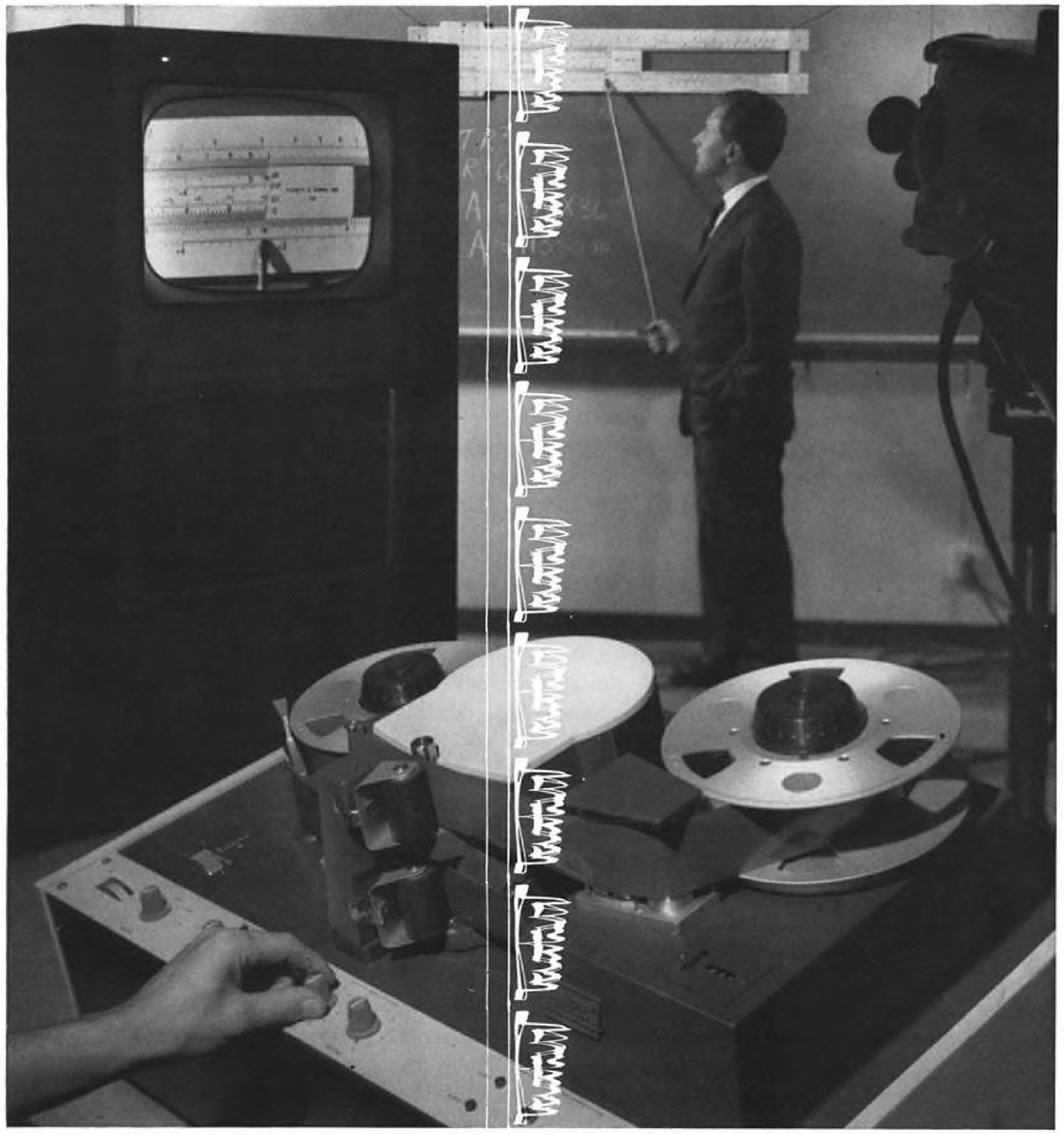

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MO-243

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COVER: Navy/Goodyear Subroc anti-submarine missile emerges from the ocean during recent test firings off the Pacific Coast. First photo shows test missile's general configuration. Missile is being developed by Naval Ordnance Laboratory, Silver Spring, Md., and Goodyear Aircraft Corp. It is designed to be fired from a submarine's torpedo tubes, surface and fly toward the target submarine, then re-enter the ocean to destroy the target. The test missile shown on cover was launched from an underwater launch platform.

PICTURE CREDITS
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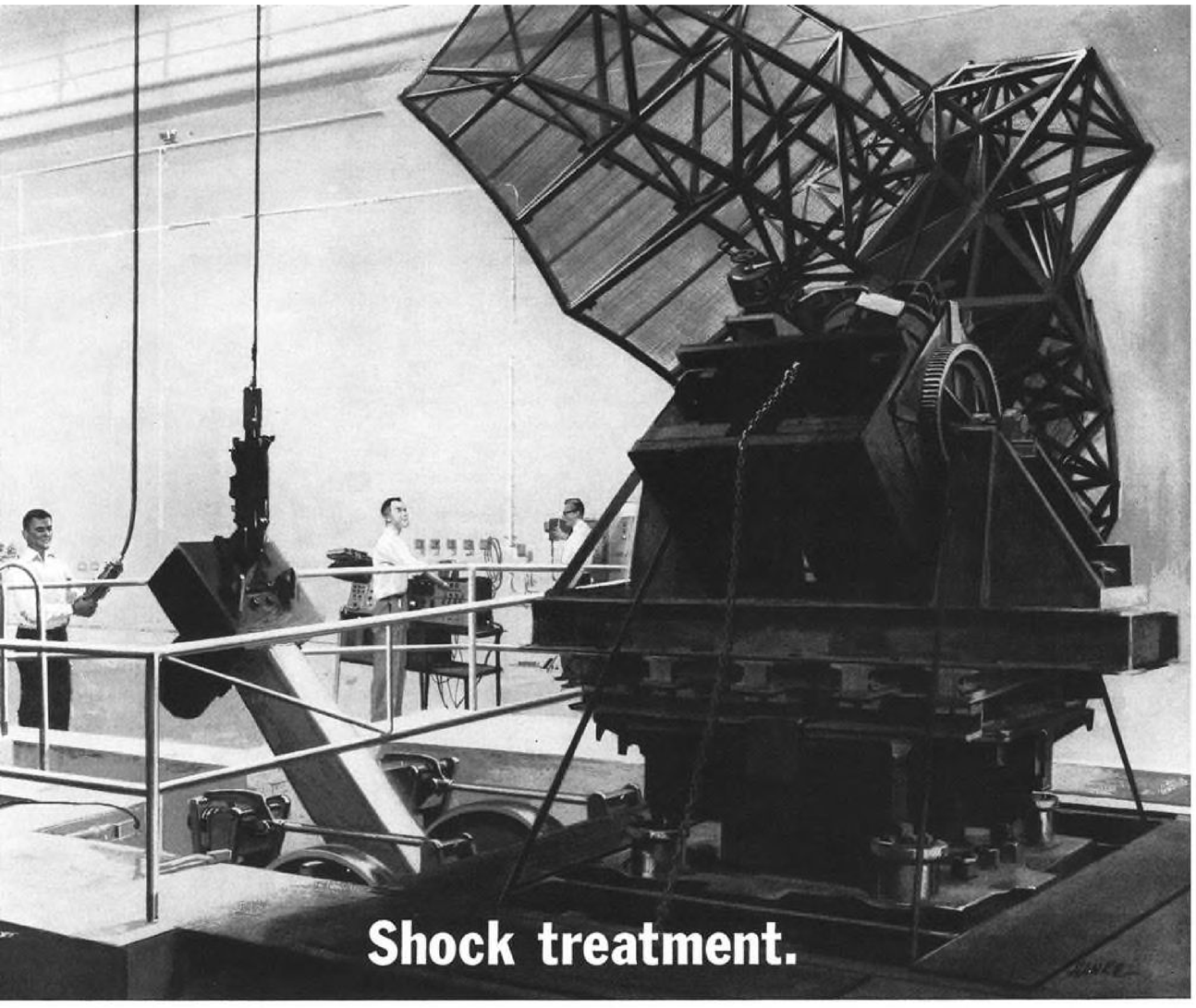

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For complete details write for a copy of Lockheed's test facilities brochure, "Environment in the Laboratory . . . a service to industry."

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EDITORIAL

NASA Needs A Watchdog

With the national space program scheduled to spend about $50 billion of the taxpayers' hard-earned money during the next decade, it is time that Congress created a permanent watchdog over the National Aeronautics and Space Administration. This would ensure that this agency adequately pursues the national goals set for it, and disburses the substantial sums of public money it appears likely to get with a reasonable degree of efficiency. The need for a congressional watchdog for NASA does not imply that there is anything basically wrong with this agency, its present course, or the capability of its key personnel. The point is simply that any publicly financed program of the magnitude of the national space program needs constant surveillance by a responsible outside group to keep it from straying both technically and morally.

The national space program is still so relatively new that most of the congressional effort in this field has rightly been devoted to getting NASA organized, funded and moving. But with the multi-billion dollar budget provided NASA last year, an additional billion and a half earmarked for military space activities, and a total NASA-Defense Dept. space budget request of over $7 billion for Fiscal 1964, it is high time that Congress set up adequate machinery for continued analytical surveillance of space agency activities.

It is unfortunate that at the very time the need for this activity is growing acute, the chairman of the House Science and Astronautics Committee, Rep. George Miller (D.-Calif.), appears ready to turn the clock back to the dismal days when the late Overton Brooks curtailed this committee's effectiveness (AW Feb. 1, 1960, p. 21).

McCormack's Key Role

For a variety of reasons, the House space group has played the key role in congressional space policy. This is in contrast to most major policy matters, in which the Senate committee is the vital force. Dominance of the House space group stems from the original wise and vigorous leadership provided in its early days by Rep. John McCormack, now House Speaker. It also stems from the relatively young and enthusiastic membership from both parties on this committee, in contrast to the apathetic approach from its Senate counterpart, composed primarily of older men too heavily committed in other important fields. Under the initial leadership of Rep. Miller, who succeeded to the chair after Mr. Brook's death, the House space group blossomed into productive activity. This was primarily because able subcommittee chairmen were appointed and they acted vigorously in their assigned areas to achieve many things that the cumbersome former policy of operating only as a committee of the whole, under the dictatorial domination of the chairman, could never accomplish.

The record of the subcommittees during 1962 was outstanding, both in achieving the first really effective review of the entire NASA program authorizations and in delving into special areas where fuzzy management patterns were impairing technical progress such as the Centaur, Advent and Anna programs.

Chairman Miller recognized the unwieldy procedure of having the 25-man committee function as a whole in trying to cover the broad scope of the entire NASA program, and broke it down into four subcommittees, each of which could devote intensive effort to a major portion of NASA's activities. These subcommittees basically followed the agency's own organizational division into manned space flight, space sciences, advanced research and technology and applications, tracking and data acquisition.

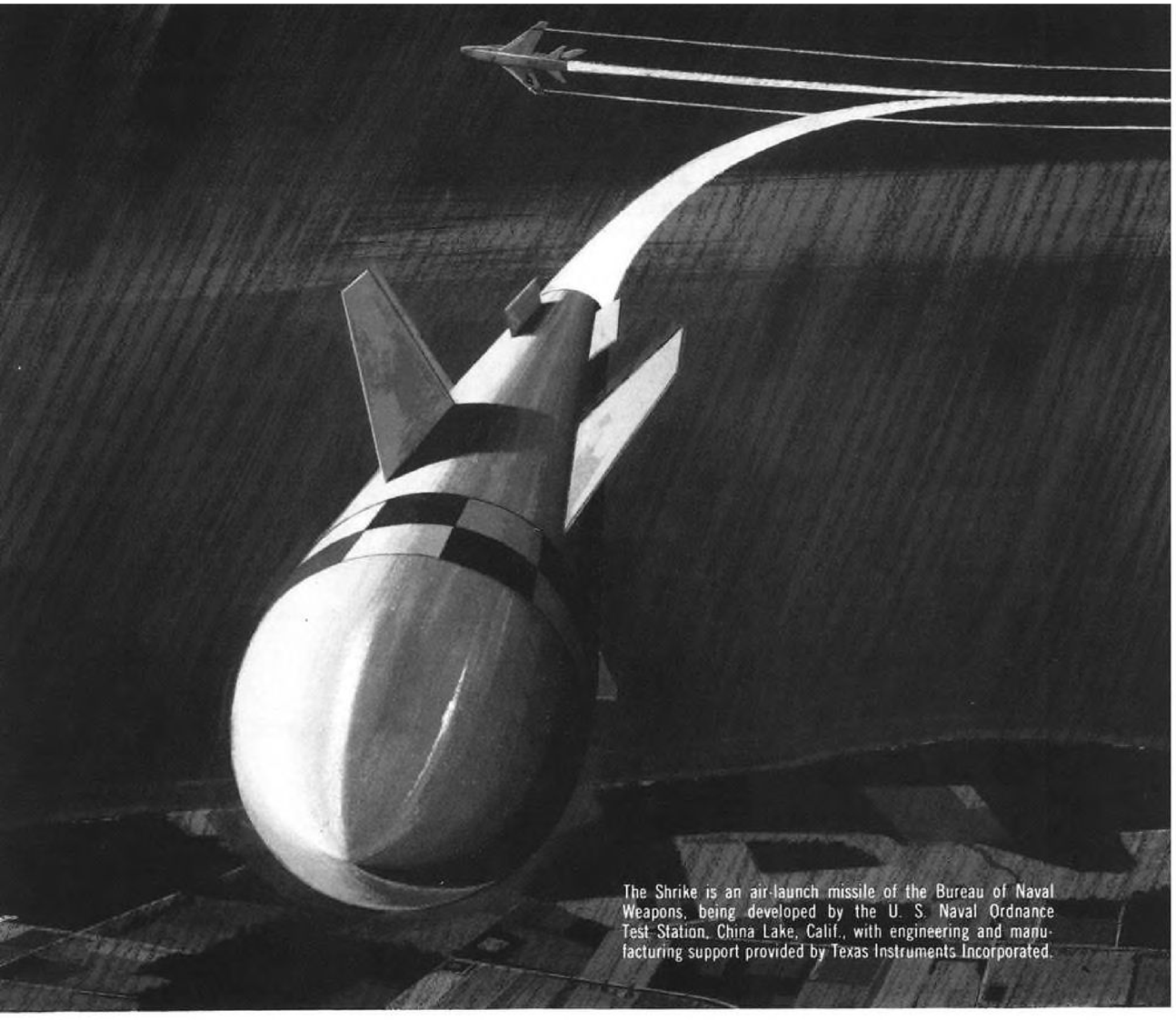
These subcommittees reacted enthusiastically to their task and produced a 3,000-page record that represents a comprehensive review of NASA's current program. In addition, they untangled some complicated NASA-Pentagon knots on project Anna and Cape Canaveral. They exposed the futility of the Prospector lunar exploration program, with its timetable slipped beyond that of the Apollo manned lunar effort, and found that NASA had better use for the $163 million requested last year for the solid-fueled Nova.

Puzzling Decision

With this record of constructive activity behind his subcommittee pattern, it is difficult to understand why Chairman Miller now wants to abandon this organizational pattern and allot only a single subcommittee to handle all of NASA, while assigning two other subcommittees to handle the National Bureau of Standards and the National Science Foundation. Neither of these two organizations has anything approaching the scope or national concern of NASA, nor do they really require this much attention from the House group.

It may appear that what could be dismissed as a minor organizational matter in a House committee is hardly significant in the over-all national space program. However, this is the year that the space program is going to face its toughest battle for funds on Capitol Hill. This is the year that NASA will have few spectacular space performances to bolster its support, as did the successful Mercury shots last year. This is the year when it will need a skillful combination of explanatory support from the House space committee, both to the rest of Congress and the taxpaying public, and critical analysis of some of its less successful programs, aimed at improving their management and convincing the legislators and public that NASA is not recklessly squandering the huge sums it requests. This kind of job is not likely to be done by the Senate space committee, nor is it likely to be done well by a House committee that is devoting only a small portion of its enthusiastic membership to the NASA programs. If the House committee fumbles the NASA ball during this Congress, it will be a setback for the national space program as well as the taxpayers who are relying on their group to function as an alert and intelligent watchdog of its space dollars.

—Robert Hotz



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new war-club for nation's arsenal

The Navy's Shrike missile is the first of a new breed of weapons designed specifically to increase air-to-surface striking power. Shrike will provide a new attack capability against heavily defended tactical target areas, combined with increased protection for the Navy's pilots and aircraft under operational conditions. Texas Instruments is the prime contractor for the guidance and control sections of the Shrike missile, applying skills in electronics and aerodynamics. TI contributes to the development of this high-performance weapon more than 20 years' experience in recognizing and solving tactical performance problems. ■ In addition to its systems management capabilities, TI possesses a unique combination of proved skills in many areas of endeavor. Expanding from a broad research base, TI interweaves its various technologies to provide a continuous flow of improved products and services for its customers. *Write Department 48.*

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WHO'S WHERE

In the Front Office

Dan A. Kimball, board chairman, Aerojet-General Corp., Azusa, Calif., succeeding **Arthur H. Rude**, retiring. **William E. Zisch** succeeds Mr. Kimball as president.

Robert Proctor, a director, Lockheed Aircraft Corp., Burbank, Calif., succeeding **Carl B. Squier**, now honorary director. Mr. Proctor, a Boston attorney, was special assistant to the late Robert E. Gross during World War 2.

Robert E. Lewis, president and director of Perkin-Elmer Corp., elected a director of Benrus Watch Co., Inc., New York.

Mark Shepherd, Jr., executive vice president, and **S. T. Harris**, senior vice president, elected directors of Texas Instruments, Inc., Dallas, Tex.

Andrew J. Unetic, vice president and general manager of Bourns Instrument Div., elected a director of Kinetics Corp., Solana Beach, Calif.

Satish Chandra, chairman, Indian Airlines Corp., succeeding **V. Shankar.**

John C. Brogan, chairman, Chicago Helicopter Airways, and **C. W. Moore**, president-treasurer.

W. J. Cheesman, group manager-telecommunications, International Telephone and Telegraph Corp. Mr. Cheesman will head the ITT Kellogg Telecommunications Div., and will continue as president of ITT Canada, Ltd.

Lt. Col. Joseph E. Boland (USAF, ret.), special assistant to William B. Bergen, president of the Martin Co., Baltimore, Md.

William H. Wall, vice president-administration, Lear Siegler, Inc.'s Astro Structures Div., El Segundo, Calif.

Donald T. Atkinson, executive vice president and general manager, McKiernan-Terry Div. of Litton Industries' RADCOM group, Dover, N. J.

Dr. E. M. Pritchard, general manager, Military Systems Div., and vice president of Lockheed Electronics Co., Plainfield, N. J.

Thomas D. Bryant, a vice president, Librascope Div. of General Precision's Information Systems Group, Glendale, Calif.

R. L. Mangold, vice president-sales planning, United Air Lines, Inc.

Blair H. Thompson, a vice president, Sparton Corp., Jackson, Mich.

Dynalectron Corp., Washington, D. C., has elected the following division managers as corporate vice presidents: **Daniel R. Bannister**, Aerospace Operations Div., and **J. Forrest Bigelow**, Mattern Div. (Chicago, Ill.); **Robert M. Conway**, Paradyn Div. (Pt. Mugu, Calif.); **John M. Macdonald**, Stepper Motors Div. (Gardena, Calif.); **Wesley A. Peterson**, Instrument & Electronics Div. (San Leandro, Calif.); **Edgar A. Stege**, Land-Air Div. (Holloman AFB, N. M.). Also: **John F. Carter**, manager of the Cheyenne (Wyo.) Div., now an assistant vice president of the corporation.

Vice Adm. Charles Wellborn, Jr. (USN, ret.) has been appointed a senior research executive and assistant to the president of Hudson Institute, Harmon-on-Hudson, N. Y. Until his retirement Jan. 31, Adm. Wellborn was the chief military adviser to the U. S. United Nations delegation.

(*Continued on page 124*)

INDUSTRY OBSERVER

► Army Missile Command and Bell Telephone Laboratories, as Nike Zeus system prime technical directors, are reviewing proposals for the development of the Sprint high-acceleration, anti-ICBM missile. Proposals under review came from Douglas Aircraft, Martin/Orlando and North American/Columbus. Selection of missile contractor is scheduled to be announced Apr. 1, but large volume of material submitted may extend the deadline.

► **Contractor selection for construction of two Apollo fixed-base mission simulators is approximately four to six weeks away. National Aeronautics and Space Administration currently is evaluating proposals following bidders' briefing by North American Aviation last December.**

► Russian space scientists have told U. S. delegates at scientific meetings that they believe it will not be possible to continue to use the current Russian pressurized suits and still get the required mobility for space-task performance. Suits are pressurized with mixed gas to 7.5 psi. They also believe Russian cosmonauts should have a 100% oxygen atmosphere inside if they are to venture outside the spacecraft in flight. This would avoid the delay caused by the necessity to pre-breathe 100% oxygen before leaving a less-than-100% oxygen environment for space.

► **Air Force Systems Command's Aerospace Medical Division is considering addition of an extensive lunar-surface simulation facility covering as much as three acres at its Brooks AFB, Tex., research complex.**

► Proposals for investigating feasibility of split scatter shields for nuclear auxiliary power applications in spacecraft are being evaluated by Air Force Aeronautical Systems Division. Concept is to split the shield configuration into individual sections and scatter radiation into space instead of capturing and absorbing it. Scatter shielding promises reductions in weight, heating and secondary radiation effects.

► **Development of two prototype earth sensors for stabilization systems of earth-orbiting satellites will be sponsored by NASA. Sensors will have to accommodate variations in orbital altitude from 10,500 to 26,500 mi., have a three-year operating lifetime, and 90% reliability.**

► Navy Electronics Laboratory, San Diego, is planning a study of optimum modulation techniques for electromagnetic communication links for fleet service from 1970 to 1980. Propagation methods to be studied will relate to active and passive satellite relay, ionospheric reflection, troposcatter, meteor-burst, ground-wave, and line-of-sight techniques. Analysis will also be made of major technical problems foreseen for the post-1980 period. Industry will submit proposals for the study effort by Mar. 1.

► **Apollo command module will use two-position seats to offset spacecraft's normal center-of-gravity travel and to aid maneuverability on re-entry.**

► Air Force Space Systems Division plans a 12-month military space systems tradeoff analysis to determine comparative advantages of using decoys, hardening, or maneuvering to protect a satellite from enemy countermeasures. Satellite involved in the proposed study is not identified but probably is the Samos reconnaissance spacecraft. To be qualified to submit bid, a company must be located within 150 mi. of Los Angeles International Airport and not be a manufacturer of military space hardware.

► **Navy is ready to support production of an underwater search vehicle for locating and identifying sunken objects, including nose cones and radioactive debris. Vehicle would incorporate TV scanning capability, buoyancy control, and its own propulsion system, but normally would be towed. Ability to detonate objects also would be included.**

► Defense Dept. plans to continue purchases of Boeing KC-135A tankers for USAF through Fiscal 1968, with $33 million for their procurement included in the Fiscal 1964 budget.

Space Flight Simulators — LINK Still Leads the Way

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Washington Roundup

Nuclear Policy Qualms

Congressional leaders are starting to express some gnawing doubts about the Kennedy Administration's decision to resign itself to a nuclear standoff between the U.S. and Russia (AW Feb. 4, p. 25). First detailed protest from Congress is likely to be a Republican policy statement attacking this defense strategy.

Rep. Gerald R. Ford, Jr., ranking Republican on the House defense appropriations subcommittee and a party leader, told AVIATION WEEK & SPACE TECHNOLOGY that Defense Secretary Robert S. McNamara's eloquent testimony in closed sessions has failed to dispel fears about settling for a nuclear stalemate. Air Force leaders, including Secretary Eugene M. Zuckert, have been quietly making the rounds on Capitol Hill to express their own concern about the Administration's nuclear policy.

"We have the full and complete ability to destroy the Soviet Union and win any war today," Rep. Ford said. "But I am still worried about the situation five years from now. There is no doubt the Administration believes we have reached the mutual deterrence period now and has exerted insufficient effort to lick the problem—to push ahead with new programs which promise to maintain U.S. superiority."

The Michigan legislator claimed this could be done within the present military budget total by slowing the buildup of conventional forces. The Administration has gone overboard on conventional forces, which by themselves never will be sizable enough to stop Russia's anyway, he said. Rep. Ford attacked the "conservative attitude" in the Defense Dept. "I firmly believe we've got the military scientists to lick the problem of continuing our total superiority," he said. "But there's this mental attitude."

NATO Burden Telling

House defense appropriations subcommittee, during closed hearings on the military budget, expressed further irritation with the failure of U.S. allies to pay for more of the cost of defending the West. McNamara was asked to submit a detailed statement showing the contributions of North Atlantic Treaty Organization nations, along with comments on whether they were doing their rightful share. A Senate group headed by Majority Leader Mike Mansfield toured Europe recently and issued a report recommending the U.S. make "the present costly level of our military commitment in western Europe contingent upon a substantial increase in the western European commitment to NATO."

Army Secretary Cyrus R. Vance and Comptroller Charles J. Hitch are considered at the forefront of likely successors to Roswell L. Gilpatric, deputy secretary of defense, who will leave his post this summer or fall.

GAO Centaur Probe

Centaur program is being investigated by 14 staffers from the General Accounting Office to determine whether government money was wasted. The report promises to be highly critical of the National Aeronautics and Space Administration and will recommend management reforms at a time when the space agency's budget is meeting increased resistance in Congress. The GAO investigation was requested by the House space sciences subcommittee after hearings last year on the NASA-General Dynamics/Astronautics Centaur project.

Chairman John L. McClellan has given high priority to his Senate investigations subcommittee probe of the F-111 (TFX) tactical fighter contract award which went to the General Dynamics-Grumman team rather than Boeing. He says it will be the first major probe this session. But staffers working on the investigation see little chance of open hearings because of the proprietary data involved. They also fear the closed hearings will boil down to a battle between experts, with little chance of senators being able to cut through the technical underbrush.

Joint Congressional Atomic Energy Committee next month will review Project Vela and other methods of detecting nuclear explosions as part of its analysis of the feasibility of a test ban agreement with Russia.

More Advent Problems

Defense Dept.'s Advent communication satellite program is in trouble again with Congress. Several lawmakers who have examined the program contend that Advent, as now designed, will not have the special military equipment which justified its funding and will have less over-all capability than Telstar.

European participation in a world-wide commercial communications satellite system is being planned by an ad hoc committee representing Belgium, Britain, France, Germany, Italy, Norway, Denmark, Sweden and Switzerland. Committee will work with the U.S. Communications Satellite Corp. (AW Feb. 4, p. 31).

Sen. William Proxmire, who last year decried the scramble by states for defense contracts, last week announced he had requested "a full-scale inventory" of his state's research and industrial abilities to handle federal defense contracts in order to "help me and others fight Wisconsin's case in Washington."

—Washington Staff

Army to Seek Attack Helicopter Proposals

Modification of existing airframe sought as part of service's $27-million aircraft weapons program.

By George C. Wilson

Washington—Army soon will ask industry for attack helicopter proposals as part of its controversial armed aircraft program, which is being emphasized to the point where it is expected to get one-third of the service's aircraft research funds in Fiscal 1964.

Lt. Gen. Dwight E. Beach, Army chief of research and development, disclosed before the current series of House Armed Services Committee posture hearings that the Army is asking for $27 million in new funds for Fiscal 1964 to advance its aircraft weapons program, with $4 million of that amount earmarked for development of an attack helicopter, built around an existing airframe. It would carry armament designed to clear the way for airborne assault troops.

Between now and the beginning of the new fiscal year, July 1, the Army intends to obtain $3 million through reprograming to start immediately on the development of an attack helicopter. One timetable being discussed calls for asking for industry proposals this month or early March. Helicopter companies would have 30 days to prepare the proposals and the Army would evaluate them over the following 30 days, meaning a contract could be awarded in May.

The Army has asked industry for information on stresses that would be experienced by helicopters maneuvering in attack patterns. This information apparently will be used to help draft the specifications for an attack helicopter.

The Army hopes to obtain an attack helicopter by modifying an existing airframe rather than building a new one. Bell Helicopter Co. has been working on an attack helicopter, called the Warrior which is a version of its UH-1 Iroquois. It reportedly would have a stub wing forward and could cruise at 180 mph. Kaman Aircraft Corp. also is interested in modifying its Navy UH-2A Seasprite for the Army's attack role.

Army Aircraft R&D
FY1964

Weapon development	$23,000,000
Armed attack helicopter	4,000,000
Air mobility techniques	13,000,000
Heavy lift helicopter	3,500,000
Helicopter propulsion experiments	3,000,000
Light observation helicopter	100,000
Bell UH-1 Iroquois testing	200,000
Vertol CH-47A Chinook evaluation	3,300,000
Grumman OV-1B Mohawk testing	100,000
de Havilland Caribou 2	5,400,000
New surveillance aircraft	10,000,000
V/STOL evaluation	10,000,000
Gas turbine engines	1,500,000
Safety, maintenance, off-loading	5,000,000
Total new obligational authority	$82,100,000

No funds were earmarked for the attack helicopter in the Army's Fiscal 1963 aircraft research budget. With the $3 million obtained through reprograming and the $4 million it seeks for Fiscal 1964, Army could purchase several prototype attack helicopters. Size of the ultimate buy is far from settled, but estimates run to 1,000 aircraft.

Gen. Beach told the House Armed Services Committee that "in the weapons helicopter program a helicopter will, for the first time, be designed around existing components as a pure fire support aircraft. Such a vehicle is required to support transport helicopters in combat operations not favorable for fixed wing aircraft. Plans call for development of prototypes by 1965 as an interim aircraft aimed at fulfilling this requirement."

Despite the variables in the attack helicopter program, the Army's research budget shows that Defense Secretary Robert S. McNamara has pushed aside Air Force objections for the moment and decided to let the Army accelerate its armed aircraft plans. Air Force backers in Congress, such as Sen. Barry Goldwater (R.-Ariz.), are already protesting (see box). They feel armed Army aircraft intrude upon the Air Force's tactical responsibilities.

In justifying the $23 million for weapons research, Gen. Beach told Congress the program would continue the effort to provide Army aircraft "with a capability for suppression of enemy ground fire as well as an inherent highly mobile limited offensive capability. Such a capability is critically required during the vulnerable takeoff and landing phases of air mobile operations."

At present, Gen. Beach said, the armament program "consists primarily of available ground weapons jury-rigged to existing helicopters and fixed wing aircraft. In the future a more compatible combination of airframes and weapons, as well as more effective weapons systems, will be provided." The effort will attempt to improve upon the armament being used on helicopters in Vietnam and will explore further the possibilities of weapon systems for fixed-wing aircraft such as the Grumman OV-1B Mohawk. This research will intensify debate on whether it is better to arm helicopters or slow-speed, fixed-wing aircraft.

All told, the Army is asking Congress for $82.1 million in new funds for aircraft research and development in Fiscal 1964 (see accompanying chart). The $27 million for attack helicopter and armament amounts to 32.9% of that total. Other highlights of the Army's Fiscal 1964 aircraft research budget:

• **Heavy lift helicopter.** Gen. Beach said the Army hopes to develop by 1970 a helicopter capable of lifting from 12 to 20 tons of troops and equipment. One concept being explored is landing pods of troops from helicopters. He said the Sikorsky S-64 Skycrane "is a potential interim solution." He said the S-64 would be evaluated in Fiscal 1964 and 1965 "as part of the program analysis leading to possible initiation of development in Fiscal 1966" of the desired heavy lift helicopter.

• **Helicopter propulsion experiments.** This program includes further tests of the Hughes Tool Co. Aircraft Div. hot cycle system which drives the rotors with engine exhaust gas. The gas is discharged at the rotor tips after being piped through the mast and rotor blades. This design eliminates heavy transmission and other gear boxes. A flying testbed is scheduled to be fabricated in Fiscal 1964.

The Hiller Aircraft Corp. concept of driving rotors with the thrust developed by turbojet engines mounted on the ends of rotor blades will also be tested. Gen. Beach said the size of the turbojet engines makes this concept most suitable for large helicopters that could carry more than 15 tons. The design would eliminate the need for heavy transmissions and gear boxes.

• **Other helicopters.** A total of $3.6 million in new money would be spent to continue work on the Bell UH-1 Iroquois, Vertol CH-47A Chinook and the light observation helicopter being developed by Bell, Hughes and Hiller. Gen. Beach said further testing will determine the type classification for the Chinook (AW Feb. 4, p. 84).

• **Air mobility techniques.** Gen. Beach said this program will include evaluation of advanced propulsion systems and helicopter performance, development of aircraft design load criteria and "studying proposed solutions to specific Army aviation problems."

• **Grumman OV-1B Mohawk,** de Havilland Caribou 2. Mohawk will undergo further testing. Caribou 2, with a fuselage enlarged to carry the Army-Martin Pershing missile, will become available in Fiscal 1965.

• **New surveillance aircraft.** Evaluation of V/STOL concepts and aircraft will continue, including the Lockheed Hummingbird XV-4A, General Electric-Ryan fan-in-wing XV-5A and British Hawker P.1127. Gen. Beach said selection in Fiscal 1965 of one of these types "will lead to an operational date of Fiscal 1969 for the first generation VTOL surveillance aircraft."

• **V/STOL evaluation.** Army plans to select a new VTOL transport configuration by Fiscal 1965, Gen. Beach said. The aircraft by 1973 might replace both the Caribou and Chinook. Leading candidate for the VTOL transport role is the Vought-Hiller-Ryan XC-142 tilt wing, also being evaluated by the Air Force and Navy. Gen. Beach said the first flight of this aircraft is scheduled for April, 1964.

• **Safety, maintenance, off-loading.** This program features development of safety devices for the aircraft and pilot; maintenance equipment that is rugged, simple and light; systems for air delivering loads from low altitude with more accuracy and less vulnerability.

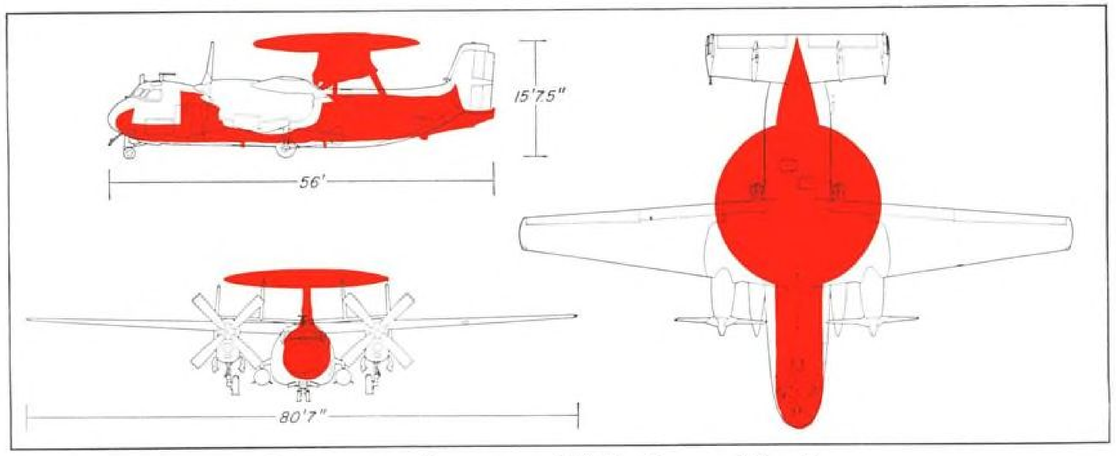
Vance's Aviation Views

Washington—"Army takes the basic view that the integration of aviation in the ground combat environment is a logical step in the evolution of mobility," Army Secretary Cyrus R. Vance recently told Congress, in answer to protests about his service's expanding aviation role.

"All aviation that operates continually in the ground soldier's environment should be responsive to his immediate command and should therefore be organic to the Army," Vance said. "The Army plans neither to organize an Army Air Corps nor to duplicate tactical air support missions that are the responsibility of the Air Force."

Objective of the board headed by Army Lt. Gen. Hamilton H. Howze, Vance said, "was to take a bold new look at land warfare mobility with a view to substituting air mobility systems employing the Army helicopter and Army light fixed-wing aircraft to replace, in part, and augment the traditional ground systems of the truck, ground fire support and the armored combat vehicle wherever analysis might show that such substitution improved the Army's combat effectiveness."

Vance's views were given to the House Armed Services Committee, which is continuing its military posture hearings this week. Sen. Barry Goldwater (R.-Ariz.), a reserve USAF major general, said earlier this month that the Howze board recommendations would give Air Force functions to the Army. He said this "makes about as much sense to me as a plan for the Air Force to organize ground battalions" (AW Feb. 11, p. 37).



Grumman Proposes W2F Cargo Version

C-2A carrier onboard delivery version of the E-2A (W2F-1) radar patrol plane is being developed by Grumman Aircraft Engineering Corp. for use as a Navy and Marine Corps utility transport and funds are being sought by the Navy in Fiscal 1964 (AW Feb. 4, p. 28). C-2A will utilize the wing, tail surfaces, engines and landing gear of the E-2A, but will have a newly designed fuselage without the electronics gear and radar antennas. Rear cargo door-ramp installation will permit fast loading of bulky cargo and will be compatible with Air Force's 463L pallet-loading system. Tanks suspended on fuselage are 450-gal. capacity and may be adapted for aerial refueling operations. Engines are Allison T56-A-8 turboprops, rated at 4,050 shp. Color indicates configuration of E-2A.

New MA-9 Date

Cape Canaveral, Fla.—New launch date of May 14 for the Mercury Atlas-9 launch has been tentatively established by the National Aeronautics and Space Administration. Original launch date of Apr. 2 was postponed (AW Feb. 11, p. 35) when a decision was made to rewire the autopilot canisters in the Atlas booster.

Astronaut Gordon L. Cooper announced recently that he may gradually decompress his Mercury spacecraft's internal pressure toward the end of his orbital flight in a test of the Mercury suit emergency pressurization system. Suit is considered a back-up to the primary cabin pressurization system of the McDonnell-built capsule. The pilot also intimated that the MA-9 flight may last beyond 22 orbits, or 34 hr., if all life support systems appear to be sufficient at that time for continued flight.

Aid for Short Bros.

London—Short Brothers & Harland, the Northern Ireland airframe manufacturer, will receive up to $28 million in government aid to complete its orders for Belfast turboprop transports and the Short Seacat missile.

Major share—$21 million—will come from the British government, according to Minister of Aviation Julian Amery. Remainder will be provided by the government of Northern Ireland.

Amery said a condition of the grant will be that at the end of the company's financial year in which the last of the 10 Belfasts ordered by the Royal Air Force are delivered, the firm's financial position will be reviewed again. The grant is subject to repayment.

Company is 80% owned by the British government. Last June, Short Brothers Chairman C. E. Wrangham warned that the firm would be out of business by 1965 unless more orders for the Belfast were received (AW June 25, p. 27).

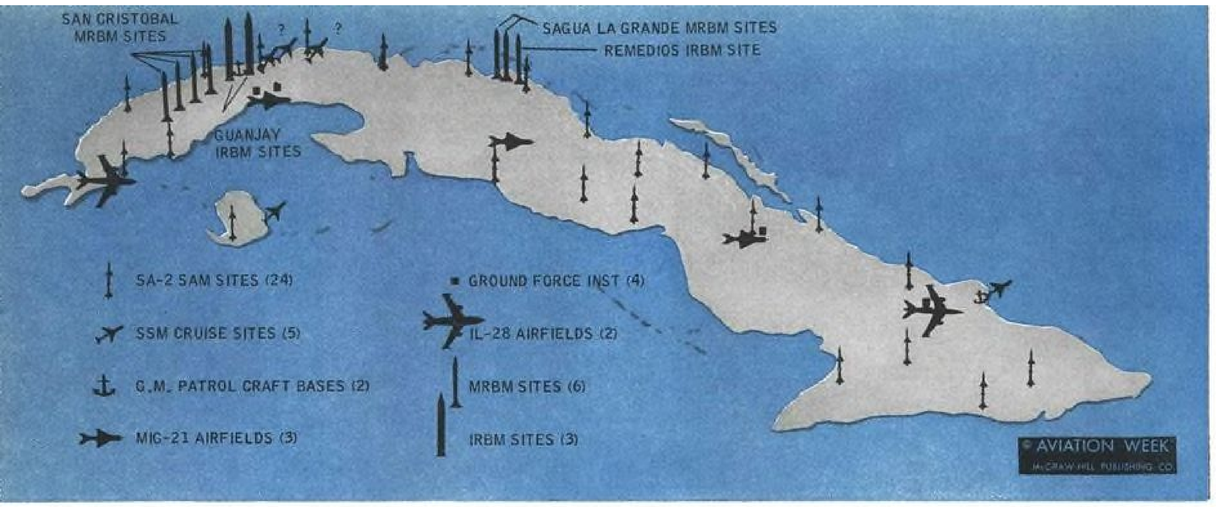
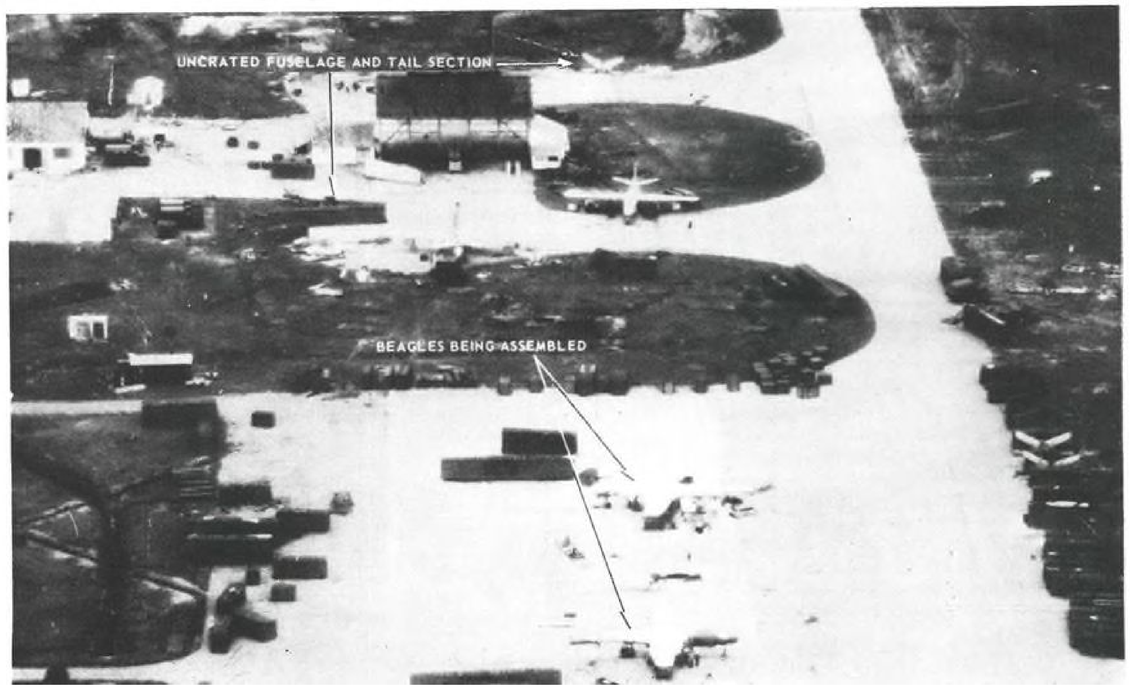


Chart shows maximum Soviet buildup in Cuba before the Soviets began dismantling their IRBM and MRBM sites on the island.

Twenty-four surface-to-air missile sites are still in Cuba and completely cover the island. Locations of the installations are pinpointed.

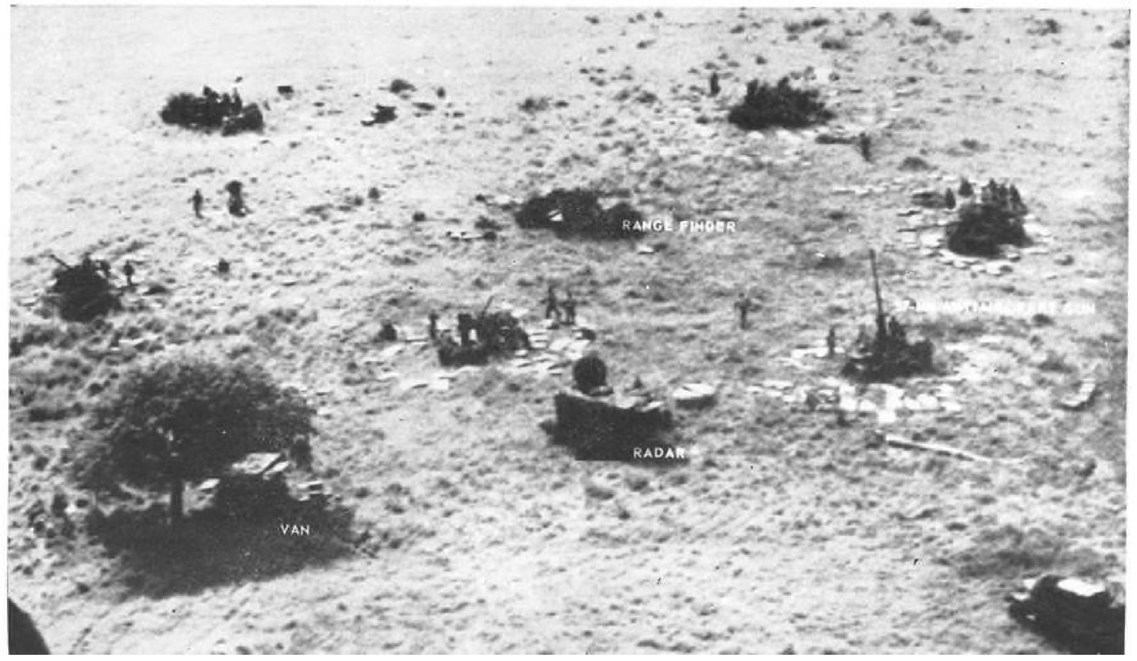
Recon Photos Reveal Soviet Anti-Aircraft Buildup in Cuba

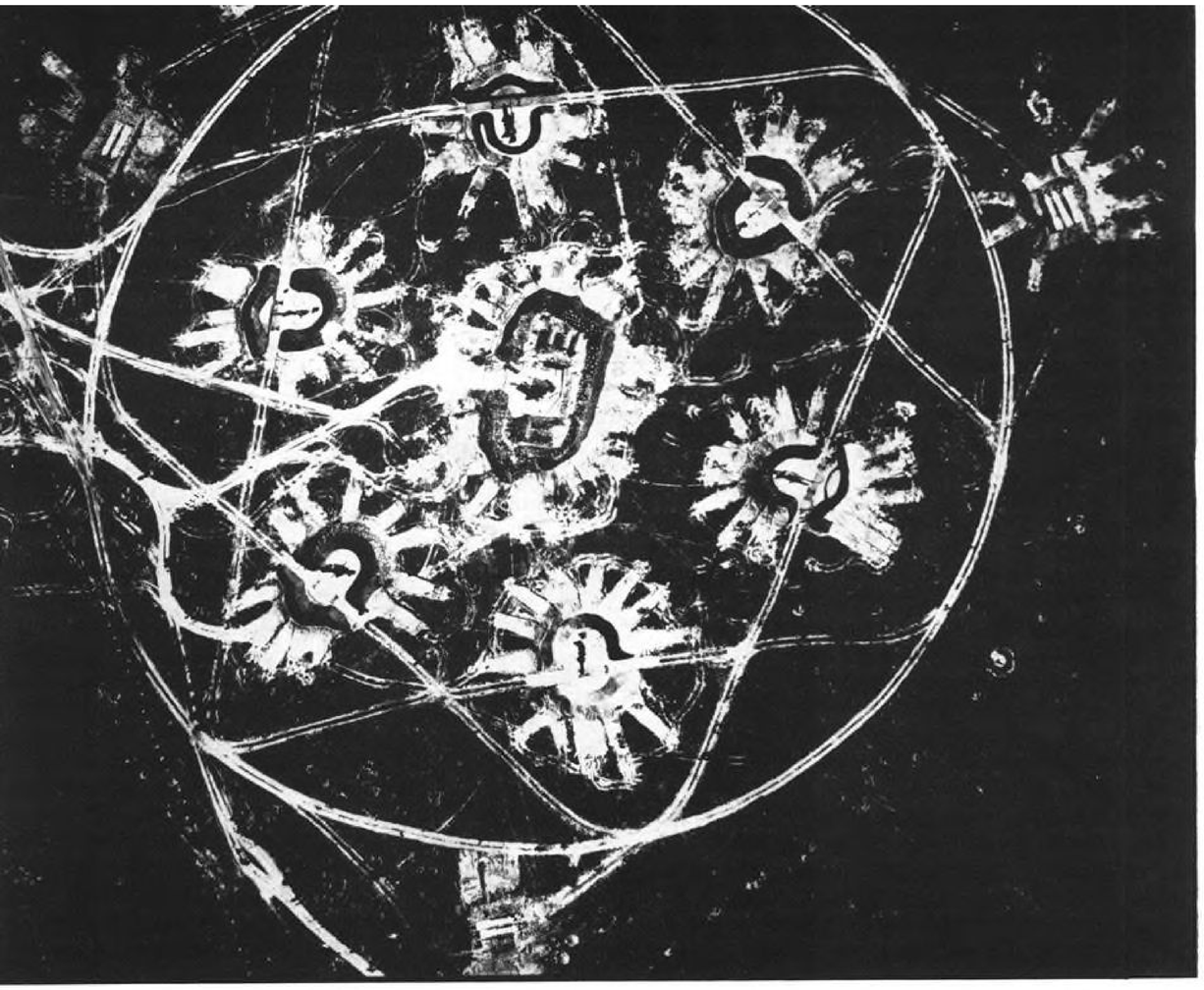
Soviet MiG-21 supersonic interceptors are shown fitted with Sidewinder type air-to-air missiles on Cuban Santa Clara airfield. Note camouflaged tarpaulins on some aircraft (above). Russian Il-28 Beagle bombers are photographed during assembly on San Julian airfield in Cuba. Note crated empennages and jet engines.



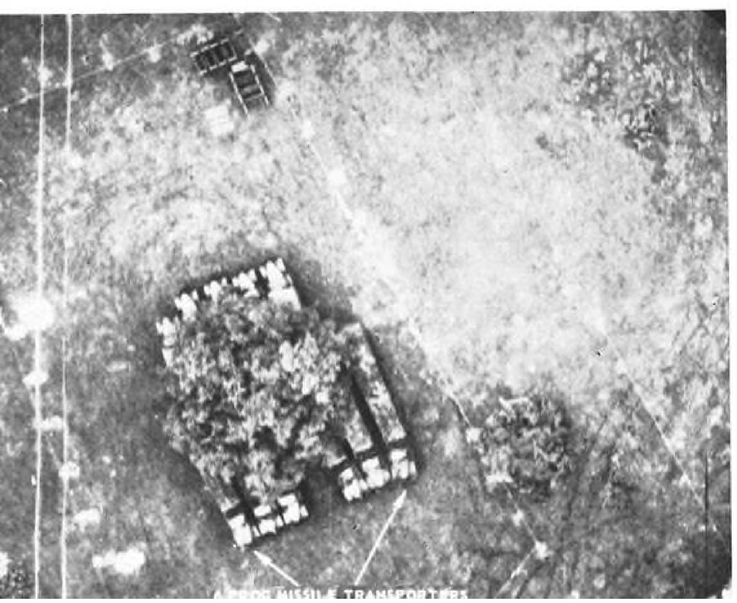
Russian gunners, below, scramble for their 57-mm. anti-aircraft guns too late to catch U. S. photo-reconnaissance plane that took this picture on Oct. 27, 1962 and continued on to photograph San Cristobal MRBM sites. (See other photos pp. 30-31, 54-57.) Soviets quickly responded to beginning of U. S. low-level photo flights on Oct. 23 by moving light flak units such as that shown below into positions to defend the missile sites. They proved ineffective against the 600-mph. runs of the photo planes at altitudes of 500 to 1,000 ft. Soviets also attempted to camouflage missile sites and equipment after low-level photo runs began.

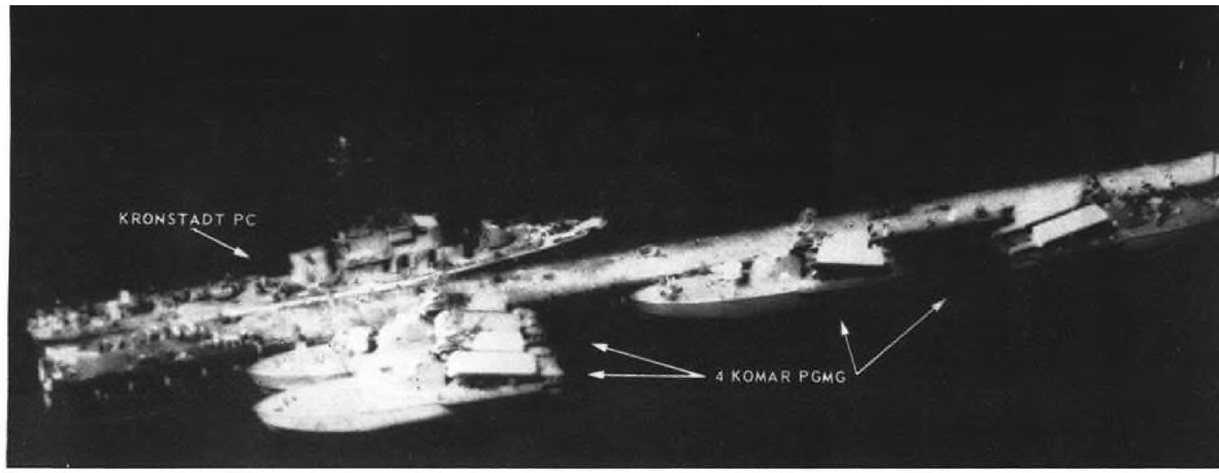
First Soviet MiG-21 Fishbed interceptor is caught, above, in flight by U. S. reconnaissance plane Oct. 18 at Santa Clara. Note shadow of aircraft on ground and centerline of runway between the climbing aircraft and its shadow.



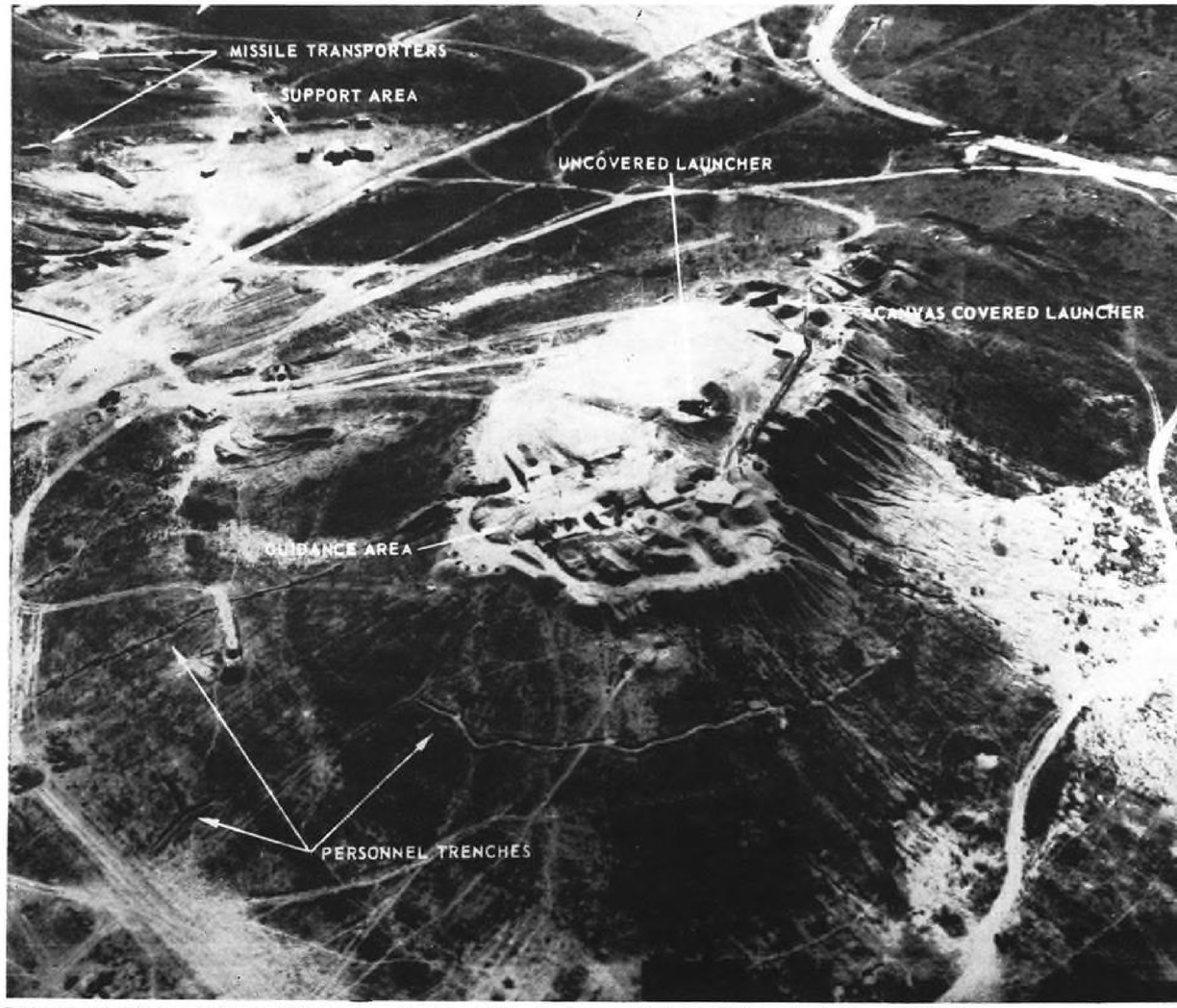


Soviet SA-2 Guideline missile site is shown above as photographed by a U. S. reconnaissance plane at La Coloma on Nov. 10. Note central revetment containing radar and fire control equipment and six missile firing pads in U-shaped revetments connected by access roads. Mobile FROG missiles are concealed under a tree near Remedios (lower left). Similar to U. S. Honest Johns, these 25-mi.-range missiles are used by Soviet troops. Insignia of Soviet armored unit (diamond shape) and elite guards (circle and flag) in Cuba are shown (lower right) in flower and stone patterns outside their headquarters on the outskirts of Havana.





Soviet Komar patrol boats equipped with a pair of missile launchers each are shown at dockside near Banes, Cuba. Missiles launched from the Komar-class boats have a range of about 15 mi. and are designed primarily as an anti-shipping weapon. Eight more Komar boats have been spotted in Cuba.



Soviet coastal defense missile site at Siguanea on the Isle of Pines is shown as photographed on a low-level pass by U. S. reconnaissance plane. These cruise-type missiles are launched from a 30-ft. inclined rail (note center revetment) and have a range of about 40 naut. mi. Four other of these sites have been photographed in Cuba at Banes and protecting the approaches to Havana.

U.S. to Select Orbiting Lab or Lunar Base

By Edward H. Kolcum

Washington—U. S. will decide within the next year whether a permanent orbiting laboratory or a lunar station will be the next manned space flight program. The decision will be based primarily on the results of a series of studies being conducted by the National Aeronautics and Space Administration and industry (see box).

Dr. Hugh L. Dryden, deputy NASA administrator, announced the alternatives here last week during the second NASA-Industry Conference, in which 36 NASA spokesmen told industry representatives of problem areas and potential markets. Dryden emphasized that the manned flight program which will follow the Apollo lunar landing will be a national policy decision and will be designed to meet national needs. Preliminary action leading to hardware development may begin as early as this fall, he said.

Whichever program is selected will entail companion projects in launch vehicles and supply and re-supply spacecraft, he said. These ferry vehicles could be adaptations of the X-20 (Dyna-Soar), Gemini or Apollo spacecraft or entirely new systems.

Dr. Dryden did not reveal a timetable for the post-Apollo mission, but he indicated that NASA is seeking a long-duration laboratory with sufficient room to conduct scientific measurements. This would eliminate Gemini and Apollo as space stations, but they could be used as resupply vehicles.

Both Dr. Dryden and Dr. Joseph F. Shea, manned space flight deputy director for systems, said that manned planetary expeditions represent another prime candidate for manned space flight missions. Dr. Shea said Mars is the most likely choice, but any landing attempt must be made by 1975 or delayed until after 1981. Flyby and orbiter missions, however, are possible at more frequent times, he said. Six-year interval starting in 1975 will be characterized by high solar activity.

Dr. Shea, whose office manages studies of advanced manned flight missions, said primary emphasis of the studies is on lunar logistics systems, lunar bases, space stations and manned planetary missions. He said two configurations have emerged from logistic system studies:

- **Lunar excursion module** modification, known as the LEM truck (AW Feb. 11, p. 36). In this concept, the ascent engine would be replaced by a cargo platform, and a payload of 5,000-6,500 lb. could be landed.
- **Logistics spacecraft** launched directly to the moon by a Saturn 5 vehicle, which could provide a payload of 25,-000-30,000 lb. This would be a two-stage vehicle, using a Rocketdyne J-2 engine to place the spacecraft into a lunar orbit, and another hydrogen-oxygen stage for descent and landing on the lunar surface.

Stay time up to about seven days on the moon in the Apollo mission is possible by increasing the consumable payload by about 100 lb. per day, Shea said. He said that some type of lunar crawler, with a 200-mi. range will increase the exploration capability.

The lunar excursion bug in the Apollo mission will be equipped with 215 lb. of scientific instruments, and will carry 80 lb. of samples, exposed film and records back to the orbiting command module.

Studies indicate that a semi-permanent lunar base for 12 men would require an initial supply cache of 240,-000 lbs., plus 8,500 lb. per month of operation, Dr. Shea said.

A major NASA endeavor is to establish man's tolerance for extended periods of weightlessness, Dr. Shea said. He feels that if a man can tolerate three months in earth orbit, he can tolerate a 12-month planetary mission. NASA is now studying ways of flying three-month missions with Gemini or Apollo spacecraft, but a major uncertainty is whether either provides enough room to conduct experiments like inflight analyses of blood and urine.

One estimate is that 3,000 cu. ft. will be required, and since this volume is eight times that of the Apollo command module, NASA may have to go to a space station to obtain the data needed, Shea said. NASA's Langley Research Center has developed a concept for a four-man, 2,500-cu.-ft. station, launched unmanned by a Saturn 1 vehicle. The crew would rendezvous with the station in orbit, using Gemini as a ferry vehicle launched by Titan 2. Resupply vehicle would be launched by an Atlas Agena B.

The NASA-Industry Conference was keyed not only to the potential market for aerospace companies outlined by Dryden and Shea, but also to specific areas where NASA is soliciting industry help in solving problems. James E. Webb, NASA administrator, said the agency is making certain that single contractors do not become dominant in major areas of competence. It was for this reason, he said, that NASA established the Michoud plant as a government installation to keep the competition open for future launch vehicle stages, rather than to have big booster stages built at contractor plants.

NASA is insisting that prime contractors seek out superior subcontractors of proven performance, "rather than risk failure or increased costs by trying to develop internal or new sources of competence . . . The prime contractor cannot reject available outside skills simply to keep the business within his own organization or pattern of supplies," Webb said.

George M. Low, director of manned spacecraft and flight missions, listed specific problems in manned flight "for which we would welcome solutions." He said acceptable solutions have been found in most cases, but that NASA is looking for better solutions. Because of the tight developmental cycle in Gemini and Apollo, he said, technical improvements may not be available for these systems but will contribute to follow-on manned space projects.

Low said technical improvements are needed in these areas:

- **Electronics:** lower-weight power supplies; communications during re-entry; speech compression techniques; micro-miniaturized equipment and bio-instrumentation, and smaller and more reliable tape recorders.
- **Thermal systems:** heat exchangers and insulating materials; reliable sensors that can operate at high temperatures (5,000R); surface coatings for space suits and spacecraft; techniques for cooling electronic equipment in space, and ablative material for rocket nozzles.
- **Structures:** impact and vibration attenuation systems; higher elasticity without degrading strength or weight, and welding techniques to reduce spacecraft leakage.
- **Personal equipment:** non-leaking pressure-sealing zippers; rotating suit disconnects; pressure compensating joints for pressure suits, and methods of increasing maneuverability outside the spacecraft.

Improvements also are needed in practical maintenance techniques for space equipment, better land recovery systems and more reliable time delay pyrotechnic devices.

Known and anticipated problems associated with the launch vehicles in the manned flight program were discussed by Milton W. Rosen, director of launch vehicles and propulsion in the manned flight office. The problems are shielding against meteoroids, theory and design of flanges and flange connections, response of liquids in missile containers, quality evaluation of thick welds, improved leak detectors, multicell tank manufacturing technology, application of dielectric materials for use at cryogenic temperatures, improvement of digital encoder accuracy and sensitivity, honeycomb bulkhead fabrication, and low temperature information.

NASA also is looking for higher reliability in vehicle support equipment, Rosen said, and is considering the use of solid state switching devices. Problems also exist in recognizing electromagnetic interference, and in the improvement of cables and connectors. Use of flat printed cables is under study to provide higher reliability and reduce costs.

In the area of propellant storage and transfer, NASA is seeking better subcooling systems and densifying techniques for liquid hydrogen, better pumping systems for high pressure gas, methods for transferring propellants in space, and leak detection in space, Rosen said. Other launch vehicle areas for which industry aid was solicited included digital transducers to measure temperature and pressure, improved automatic checkout systems, acoustic measuring devices of greater frequency range than now exists, ways to vertically transport large launch vehicles, handling, erection and clustering techniques for large solid propellant boosters, and launch pad flame deflectors for large solids.

John L. Sloop, director of propulsion and power generation in the Advanced Research and Technology Office, said the greatest single problem in rocket engine development is combustion oscillations. This problem is being experienced with the Rocketdyne F-1 1.5 million-lb. thrust engine (AW Feb. 4, p. 26).

Sloop said the next generation chemical engine after F-1 probably will be in the 24-million-lb. thrust class. In order to avoid massive problems associated with scaling-up existing engines, the agency is studying high pressure feed systems, and the use of multiple combustors which feed into a single nozzle. Both hydrogen and kerosene propellants are being studied for the multiple combustor application.

Major problems anticipated for the next generation chemical engine are learning how to make better pumps and turbines to produce high pressures, how to devise flow components to handle high pressure fluids, how to ignite and burn propellants stably at high pressure, and how to keep the engine cool under the high heat load, Sloop said.

NASA also is interested in more efficient and cheaper solar cells. Among those that appear promising are photovoltaic cells made of thin films, he said.

Harold B. Finger, manager of the NASA-Atomic Energy Commission space nuclear propulsion office and director of NASA nuclear programs, reported on a flight program designed to provide data on the effects of zero-gravity exposure on liquid metal boiling, and condensing heat transfer. Program is known as Meca, for mercury evaporation and condenser apparatus. 1,000-lb. payload will contain mercury fluid and Snap-8 boiler and condenser components. It will be launched from Wallops Island by two vehicle configurations. The first is a Thiokol Pollux with two Thiokol Recruit assist rockets as the booster, and a second stage powered by a Hercules-Alleganv Ballistic Laboratory X-259 motor. The other vehicle, called a Wasp, is boosted by a Thiokol Castor with the X-259 second stage. These vehicles will provide about 8 min. of zero-gravity flight.

Finger said the nuclear test stage, Rift, will require the largest flight tank ever constructed for liquid hydrogen. The stage, to be powered by the Nerva

NASA Future Flight Systems Studies

Washington—Indication of future manned space flight systems is provided in a summary list of recently-approved National Aeronautics and Space Administration studies of future flight systems distributed at the second NASA-Industry Conference here last week. The studies are in these areas:

- **Space stations: eight separate studies, aimed at defining electrical power systems designs, operations and supply requirements, environmental control and life support requirements and configurations of both rotating and zero-gravity stations. Also on the list are preliminary design and program definitions for both a five-to-six man Apollo resupply vehicle and a lifting body spacecraft to support a 12-man space station. Final study in this area concerns assembly, maintenance, checkout and repair techniques for launching vehicles from an orbiting station.**
- **Vehicles and propulsion: eight studies to define advanced nuclear systems, a nuclear orbit-to-orbit ferry vehicle and analyses of post-1970 medium vehicles (Saturn 1-class), based on two-stage aircraft-rocket concepts; large (Saturn 5-class) vehicles emphasizing re-useable boosters, and very large vehicles to define a Nova vehicle. Study area also includes definition of a solid-propellant Nova-class booster able to lift up to 1 million lb. into orbit, using the Aerojet M-1 second stage. Facilities are being studied for Nova launch, and for launching large solid-fueled boosters.**
- **Lunar base: seven studies, to define a lunar construction effort to support a lunar research facility, post-Apollo lunar transportation systems, characteristics of a high-energy chemical orbital launch re-supply vehicle, transportation system requirements for a lunar base, power requirements for the base and roving vehicle propulsion, and detailed engineering design for an earth-based system simulating the environment of the moon.**
- **Planetary missions: five studies to arrive at system concepts for a manned Mars landing, trajectories for Mars missions, electric propulsion ferry vehicles for manned planetary missions, a machine model for a planetary transportation system, and concepts to use Nova for early manned expeditions to Mars and Venus.**

Re-entry Communications

Washington—New technique for eliminating communications blackout during re-entry has been demonstrated under simulated re-entry conditions by National Aeronautics and Space Administration's Langley Research Center.

Technique involves water injected into the ionized flow field when communications are required. A flight experiment to verify these results is planned soon, according to Dr. Albert J. Kelley, chief of the electronics and control directorate.

In presenting the directorate's requirements at the NASA-Industry Conference here last week, Kelley cited several technical areas where increased research is needed, including rendezvous sensors, horizon sensors and digital transducers. The NASA official said the agency's Project Scanner, using vertical probe rockets with relatively crude instruments, suggests that ultra-violet horizon sensors may be superior to infrared sensors. Flights with improved instrumentation are planned during the coming year.

Another area which NASA intends to emphasize is the development of transducers and sensors that provide output signals in digital format without analog to digital conversion devices, Kelley said.

Ranger Power Supply

Electro-Optical Systems, Pasadena, has been selected by NASA's Jet Propulsion Laboratory to develop the power supply for the Ranger series of spacecraft 10-14, to be used for continued television surveillance of the moon.

Launch of the entire series is expected to be completed in 1964, and there is a possibility of adding 10 more Rangers for various lunar missions, including hard-landing of a survivable balsa capsule containing a seismometer, as contained in the unsuccessful Ranger 3, 4 and 5 missions.

Meanwhile, Ranger 6 is scheduled to undergo a destructive testing cycle at JPL for incorporation of possible improvements to Rangers 7-9, for launch this year, and also to succeeding series of Ranger 10-14.

nuclear engine, is to have a 396 in. dia., and be 1,039 in. high. Stage weight is 200,000 lb., including 156,000 lb. of propellant.

Dr. Richard B. Morrison, director of launch vehicles and propulsion in the Space Sciences Office, gave these average cost figures for vehicles used in science programs: Centaur, $10 million; Atlas Agena B, $7.5 million; Thor Agena B, $5.6 million; Thor Delta, $2.5 million, and Scout, $1 million.

Milton B. Ames, director of space vehicles in the advanced research and technology office, described NASA's research program aimed at obtaining better spacecraft. He said the agency is considering an advanced satellite program to determine potential hazards of micrometeoroids in cislunar space and near the moon.

Ames said that radically new configurations may result from research into spacecraft concepts for advanced manned earth-orbital, lunar and planetary spacecraft. He also summarized these areas of advanced spacecraft design criteria research:

• **Aerothermodynamics:** Atmospheric entry heating, spacecraft configurations and performance, landing and recovery, launch vehicle aerothermodynamics and acoustic noise propagation.

• **Environmental factors** and technology: high energy radiation effects and shielding, meteoroid environment and impact hazard, thermal radiation and temperature control, high vacuum technology and zero-gravity fluid behavior.

• **Structures** which simultaneously provide strength, stiffness, tolerance to high temperatures and integrity against all space hazards while remaining reasonably lightweight.

Edgar M. Cortright, deputy director of space sciences, said the challenge to industry can be categorized in the broad areas of improving reliability, long lead times and schedule slippages, and high costs and cost overruns.

Charles H. Zimmerman, director of aeronautics, said the agency's in-house capabilities require industry support for aeronautics in the areas of supersonic and hypersonic advanced propulsion concepts, engine noise, operations research and development of research equipment to aid in the study of all-weather capabilities and visual displays.

In the hypersonic cruise vehicle area (AW Feb. 11, p. 26), Zimmerman said NASA's initial work indicates that air-breathing vehicles appear promising, at least up to Mach 10 to 12. Ramjets seem most promising from Mach 3-4 to orbital velocity—Mach 25—he said. Supersonic-burning ramjets are efficient in the Mach 6-25 velocity range, and subsonic ramjets up to Mach 8.

A. M. Andrus, acting chief of communications satellite technology, said the agency is seeking improvements in reliability, antenna technology, transmitter and receiver technology, modulation methods, passive stabilization techniques and passive structures with improved scatter characteristics and frequency utilization. The agency also plans detailed studies to determine which of the communication satellite systems are cheapest and most reliable.

In antennas, NASA will study all-electric beam shaping and steering techniques, Andrus said. In transmitters, direct RF-RF frequency conversion without frequency amplification will be explored. Spacecraft receivers will be studied to reduce the present typical 12-14 db. noise level, and improvement of ground receiver bandwidth of phase-lock systems beyond the 3 mc. level also is sought.

Dr. William K. Widger, Jr., chief of operational meteorological satellites, said the industrial market in weather satellites does not lie in completely new and different spacecraft from Tiros and Nimbus, but rather in general improvements in these areas:

• **Supporting research** to develop such systems as image orthicon cameras, which take pictures of clouds at night; high resolution electrostatic tape recorders with more efficient storage; improved infrared and radiation spectrometer sensors; sensors which operate in the sferic, passive microwave and radar spectra; improved controls, power, recording and command subsystems.

• **Sensory concepts:** improvements for measuring cloud, atmospheric heat and radiation balance parameters, temperature, composition, winds, pressure, density, precipitation areas, sea surface conditions, index of refraction and altitudes of significant atmospheric layers.

• **Improved data handling,** storage, reduction and readout equipment.

Dr. Widger said several special experiments will be carried on future Tiros research spacecraft. Among them will be a 15-micron radiometer to provide data for Nimbus horizon scanner development, automatic picture transmission, equipment to provide television and infrared data in the polar latitudes, and cameras to view the earth disk from 300-3,000-mi. orbits and from orbit with a 22,300-mi. perigee.

Canada Buys Vertol 107s

Canada has ordered 12 Vertol 107 twin-engine helicopters for the Canadian Army. They are similar to 107s now being built for the Royal Canadian Air Force.

The Canadian Army will use them for transport of troops and equipment. The Army designation will be the CH-113A. RCAF version is the CH-113.

The aircraft's tandem rotors are powered by two General Electric T58-8Bs.

Syncom Launch

Cape Canaveral—Ground tracking stations lost contact with the Syncom synchronous communications satellite, Feb. 14, during the spacecraft's transfer from an elliptical to a circular orbit.

National Aeronautics and Space Administration believes that the satellite's spin axis may have been misaligned during the firing of the 900-lb. thrust, 13-in.-dia. Thiokol solid propellant motor. This motor, mounted inside the Hughes Aircraft Co.-built spacecraft, was fired at 5:42 a.m., 307 min. after launch of Syncom from here. At motor burnout, however, ground stations discovered that all telemetry and beacon signals had ceased. The satellite (AW Feb. 11, p. 64) failed to obey all ground stations commands. NASA said that it would continue to make attempts to reestablish contact with the satellite.

Syncom had been launched at 12:35 a.m., EST, Feb. 14 by a three-stage Delta vehicle.

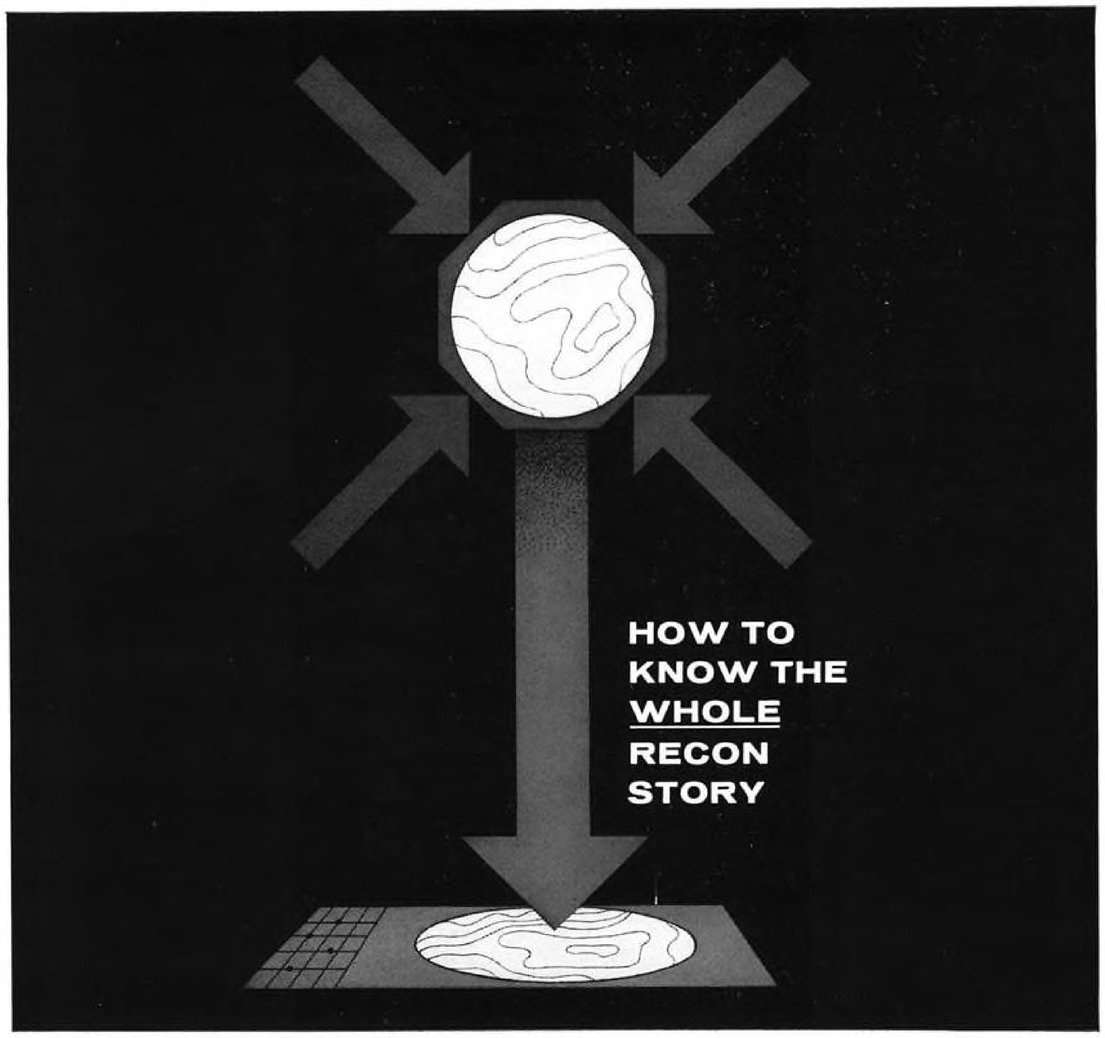
Expansion of NASA Tracking Net Planned

Washington—National Aeronautics and Space Administration's $349-million Fiscal 1964 budget request for expansion and improvement of its world-wide tracking and data acquisition network—double the amount appropriated for the same purpose this year—is intended to meet the needs of the Gemini and early Apollo orbital missions. Major improvements include:

• **Manned space flight network:** New ground station will be installed at Carnarvon, northwest Australia, to handle variable orbital inclinations planned for Gemini missions. This station, plus seven others in the network, will be outfitted with pulse code modulation (PCM) telemetry, new acquisition antennas and digital command systems. New unified S-band system will be installed at these eight stations.

• **Deep space network** will have 85-ft. dia. antennas installed in Australia and in Southern Europe, providing two such antennas at 120-deg. displaced longitudes around the globe so that more than one deep space probe can be tracked at one time. A 210-ft. dia. antenna will be installed at NASA's Goldstone, Calif., facility, the first of three planned for a global network.

• **Earth satellite network:** Automatic tracking antennas with diameters of 40 ft. will be installed in Chile, Peru and South Africa, and 85-ft. antennas will go in at Australia, Alaska, Newfoundland and North Carolina to enable the network to handle large amounts of data expected from orbiting astronomical and geophysical observatories.



High resolution photos are just part of the reconnaissance job. Photos must also be tied-in precisely to geography and numerous other critical conditions that surround surveillance from high-performance aircraft. Through this match, the whole recon story begins to take shape. To handle the important job of high-speed data annotation in flight, Fairchild Stratos has developed compact, light-weight computation and display devices which provide permanent data records on each image in easily read alpha-numeric format. When coupled to Fairchild Stratos data link, the "whole" recon story can be remotely viewed in "real time". High speed annotation techniques are but one outgrowth of the years of experience that have made Fairchild Stratos the leading supplier of equipment for reconnaissance and surveillance needs. For more information, contact our Director of Customer Relations.

When there's a need to know: Fairchild Stratos-Electronic Systems Division capabilities are best reflected in an integrated approach to data requirements. Extensive experience in acquisition, processing, transmission and display has given FS-ESD engineers a particularly sensitive awareness of both final information needs and the many subsystems required to answer them. • *For knowledgeable engineers interested in career opportunities in advanced data techniques, may we suggest a note to our Director of Industrial Relations for the brochure "Grow Your Own Future". FS-ESD, an equal opportunity employer.*

FAIRCHILD STRATOS
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COMPASSIONATE HUNTER

LEACH HERITAGE OF THE AIR—24

For a long time, the Adriatic Sea was the private domain of the Austro-Hungarian fleet. Then, in the Fall of 1916, Allied submarines crept in to menace the enemy shipping. And the Central Powers were powerless against them.

In an urgent move, the fleet set up a seaplane station at Kumbor, Austria. On September 15, 1916, their move paid off.

On that day, a submarine was spotted off the coast of Cattaro, Austria, skulking 30 feet below the surface on a Northwest course. The Kumbor station was immediately notified and two seaplanes took off on the hunt.

One Austrian Lohner Flying Boat was piloted by Sub-lieutenant Walter Zelezny, the other by his commander, Lieutenant Konjovic. Each seaplane had one observer.

Zelezny's biplane bird had a six-cylinder, watercooled, 160 HP engine and a maximum speed of 82 MPH. It carried two 110-pound depth charges and four 25-pound bombs. The depth charges were set to explode 30 feet below the sea's surface.

The shadowy prey Zelezny and Konjovic were hunting was a French Laubeuf type called the Foucault. She displaced about 400 tons on the water, 550 tons submerged. Just over 167 feet long, she cruised at 15 knots up, 11 knots under, and carried six 18-inch torpedoes in external launching rigs.

Zelezny flew to the area where the Foucault was last sighted. After a half hour of circle-searching, his observer, Baron von Klimburg, spotted the target. Zelezny dove his seaplane down to 600 feet, pulled out right above the unsuspecting sub, aimed carefully, and dropped his depth charges.

Both charges exploded 20 feet to starboard of the Foucault—one at the stern, one at the bow. When the sea calmed down a bit, Zelezny circled back to find the telltale signs of sinking. The Foucault was gone. Only a few patches of oil inked the sea. He was sure he had missed.

But he was dead wrong. The two depth charges wrenched the long fish just like the first tug of an angler's line. The Foucault's two officers and 27 crewmen thought they had struck a mine. Water gushed into the sub. She rolled to one side and sank quickly into the deep.

The Frenchmen didn't know how deep. The depth gauge showed 250 feet—as low as it could show. The outside pressure was unbearable. The batteries began to give off their noxious fumes. The men waited to die.

Then, after 30-minute years, the hand on the gauge moved. From 250 feet to 200 to 150 . . . 100 . . . 50 . . . 10 . . . 6 . . . 4 . . . 3 . . . 2 . . . 1 . . . ZERO! The electric pumps had miraculously lifted the Foucault out of her watery crypt!

As the submarine sliced up from the sea, her commander ordered the crew to abandon ship. He shook each man's hand as one by one they dropped to the narrow deck. Twenty-nine men stood on the fatally-wounded Foucault, alive but lost in the vastness of the sea.

Suddenly, two seaplanes appeared in the sky. Zelezny and Konjovic were as surprised to see the sub as the crew was surprised to see them.

The 2nd Officer opened up on Zelezny's low-flying seaplane with a small deck machine gun. Zelezny returned the fire with a small bomb that exploded and swept some of the crew into the sea. Then the Foucault shook, raised her bow to the sky and disappeared.

Thrilled with victory, Zelezny and Konjovic landed their seaplanes and floated into the midst of the frightened sailors. They pulled the wet, cold crew onto the wing floats and hull. Every single man was saved!

Soon an Austrian torpedo boat arrived on the scene and took the 27 crewmen prisoner. The two seaplanes, each with one Allied officer held prisoner, returned triumphantly to Kumbor.

Zelezny received many telegrams and letters of congratulations. The one he remembers best was a letter from his father who wrote:

"I am very pleased with your success, especially as no mother will cry following the sinking of the French submarine and your rescue of all the crew."

Amen.

There were some good pilots on the other side, too.

Yes, they and the pilots on our side contributed much to the growth of the world's aerospace industry. Of course, they couldn't even imagine today's sophisticated equipment.

What is Leach doing in today's space age?

Many things. For example, they are a leader in the miniature tape recorder field. This Leach Recorder/Reproducer

is now on many U.S. satellites. It withstands launch, reentry, and radiation belts . . . plays back data when and where it's needed.

Leach makes relays, too, don't they?

Leach has been building precision relays for the aviation industry since 1919. They've stayed the leader in this field with reliable time delay relays, solid state relays, balanced armature relays, and subminiature crystal can relays like this one.

Where are they located?

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Apollo-Saturn Crawler Due in Late 1964

Cape Canaveral—Marion Power and Shovel Co. of Marion, Ohio, was selected last week by the National Aeronautics and Space Administration to design and manufacture the crawler-transporter (AW Feb. 4, p. 26) which will transfer the completely-assembled Apollo-Saturn vehicle from NASA's assembly area to the launch stand.

Marion, which will negotiate a cost-plus-incentive-fee contract with NASA's launch operations center here, was one of two companies to submit bids for the crawler. Bucyrus-Erie Co. of Milwaukee, Wis., was the other. Twenty-two firms had been invited by NASA to bid (AW Dec. 24, p. 21). Present NASA plans call for manufacture of two crawlers, expected to cost between $4 and $5 million each. First vehicle will be delivered for testing in 1964.

Crawler is envisioned as a platform about 130 ft. long, 115 ft. wide and 20 ft. tall and weighing about 5.5 million lb. Locomotion will be provided by four electric-driven caterpillar tractors each driving a pair of steel-link caterpillar treads. Each of the tractors will be powered by two 2,802-hp. Diesel generators. Platform will rest on the crawler on two hydraulic cylinders located at each tractor.

In another Apollo development, Raytheon Corp. last week received a $15-million contract to provide industrial support, onboard computers and ground equipment for Massachusetts Institute of Technology for the Apollo system.

Soviets Ask Pullback

Soviets last week began what appeared to be a move to take tactical advantage of the concern within Western Europe that the U.S. may, in fact, be planning some form of nuclear disengagement. At the re-convened 17-nation disarmament conference, Soviet First Deputy Foreign Minister Vasil Kuznetsov proposed that the nuclear powers:

- ". . . dismantle the foreign bases for submarines carrying nuclear and rocket weapons and . . . renounce the use of foreign ports for such submarines."
- ". . . withdraw from foreign ports the aircraft carriers having on board planes armed with nuclear weapons."
- ". . . dismantle strategic rocket installations in foreign territories and . . . take away rockets of 1,500 km. range and over, and the nuclear warheads to fit them with, to their national territory."
- ". . . withdraw the strategic aircraft designed for delivering nuclear bombs to target, as well as these nuclear bombs from foreign bases to within their national boundaries."

House Unit to Probe NASA Fund Shifts

By Alfred P. Alibrando

Washington—House space committee intends to find out why the National Aeronautics and Space Administration has reprogramed more than $125 million within the past few months for construction of facilities. The reprogramed funds came from other authorized construction projects and research and development programs.

Chairman George Miller (D.-Calif.) and Rep. Joseph Karth (D.-Minn.), chairman of the space sciences subcommittee, expressed growing concern over NASA's reprograming of funds.

Since late last year, NASA has made more than 40 fund transfers involving well over $125 million. It was this large number of transfers and the large amount of money that brought the matter to the attention of committee members.

Most of the reprograming notices sent to Congress by NASA deal with transfer of research and development funds to construction activities. Other types of transfers—reprograming of research and development money from project to project within a program—do not require such notification. For instance, research and development funds appropriated for manned flight programs may be shifted from Project Mercury to Gemini or Apollo without notification to Congress. This kind of reprograming also will be questioned by committee members.

These are the larger reprograming actions taken this year, and the purposes for which the funds were transferred:

- **Mission Control Center** at Manned Spacecraft Center, Houston—$16.9 million.
- **Saturn S-4B stage test** facilities at Sacramento and Santa Monica—$18.5 million.
- **Apollo spacecraft development** facilities at North American Aviation, Inc., Downey, Calif.—$7.6 million.
- **New test facilities** and modification of existing facilities at White Sands, N. M.—$10.4 million.
- **Saturn S-2 stage test** facilities at Downey and Santa Susana, Calif.—$11.2 million.
- **Engine test stand** at the Nuclear Rocket Development Station, Nev.—$7.5 million.
- **Improvement of Highway** No. 95 serving the Nuclear Rocket Development Station—$4.5 million.
- **Mississippi Test Facility** Saturn vehicle development center—$24.3 million.
- **Work on Saturn pads** No. 34 and 37 at the Atlantic Missile Range—$2.6 million.
- **Modifications to engineering,** fabrication and office space at Michoud big booster plant, New Orleans—$20 million.
- **Meteorology radar facility** at the Atlantic Missile Range—$2.3 million.
- **Construction of rail** facilities to and on Merritt Island at AMR—$2.2 million.
- **Tracking station** in northwest Australia—$2 million.

Major transfers in the latter part of 1962 included:

- **University research** facilities—$6.4 million.
- **Applied science laboratory** at the Goddard Space Flight Center—$2 million.
- **Scout launch** facilities—$1.5 million.
- **Saturn C-5 test stand**—$1.2 million.

Chairman Miller has expressed more concern over the reprograming of funds by NASA than any of the areas the committee will investigate.

"We want to know why the money wasn't spent for the purposes the NASA people said it was going to be used for," he said. "I'm not saying funds are being misused or wasted. But since we are asking the nation to accept our judgment on the NASA program, we are going to have to be reassured that it is being managed properly."

Ten days ago, Rep. Olin E. Teague, (D.-Tex.), chairman of the manned space flight subcommittee, Rep. Karth and other members of the committee visited the Manned Spacecraft Center at Houston.

"We had a rundown on what funds had been authorized in the manned flight program and asked about actual expenditure of funds," said Rep. Karth. "We found that expenditures didn't match the authorizations or appropriations and it was difficult to get answers on financial matters."

Rep. Teague also is concerned with the transfer of funds, but said he believes part of the problem is preparation of budgets two years in advance by an agency that is developing new programs where costs change rapidly.

"The process on the Hill is also at fault," said Rep. Teague. "We work from a printed bill that is prepared some time before it is passed by Congress. I don't see why we can't work from a draft and make what changes are necessary before the bill leaves the committee."

NASA's authorization received unanimous approval in the House last year, thanks largely to the missionary work of members of the House space committee and public enthusiasm generated by the Mercury Atlas-6 flight. Key members of the committee feel that any indication of poor management on NASA's part will damage this support.

Rep. Karth said he was sympathetic with the need for reprograming of funds in NASA's early years.

Gemini Planning Unit

Washington—Defense Dept.-National Aeronautics and Space Administration Gemini Planning Board held an organizational meeting Feb. 8. The board was established to assure a flow of information from both agencies on experiment planning, operational flights and in-flight tests and analysis and dissemination of flight results.

Co-chairmen of the board are Dr. Brockway McMillan, assistant Air Force Secretary for Research and Development, and Dr. Robert C. Seamans, Jr., associate NASA administrator. Defense members are Dr. L. L. Kavanau, special assistant for space, office of defense research and engineering, and Gen. Bernard A. Schriever, commander of Air Force Systems Command. NASA members are Adm. W. F. Boone, deputy associate administrator for defense affairs, and Brainerd Holmes, director of manned space flight.

COIN Agreement

Washington—Navy and the Office of the Secretary of Defense appeared near agreement last week on how to pursue the counter-insurgency (COIN) aircraft program (AW Feb. 11, p. 35). If agreement is reached this week, requests for proposals are expected to be sent to industry about Apr. 1.

Present plan is to build three prototypes, one fabricated from glass fiber and two from aluminum alloys. It will be recognized that considerable airframe redesign will be necessary in construction of the glass fiber aircraft.

The 3,500-lb. aircraft would be powered by two 575-hp. turboprop engines, for a total of 1,150 hp. for the entire aircraft, instead of 1,150 hp. for each engine as originally reported (AW Dec. 24, p. 15).

The secretary's office has maintained that speed is necessary in developing and producing an aircraft for use by national forces of such countries as South Vietnam. The Navy's view has been that a logical development order should be followed. The compromise agreement will result in a program resembling the Army's light observation helicopter (LOH) program, in which three companies are building prototypes before a final decision is reached.

"I could understand it then, when programs were not well-defined," he said. "But they have been in business more than five years and their programs are pretty well set. We should be able to expect better management."

NASA has broad reprograming authority. The Space Act, as amended in 1961, permits the agency to transfer 3% of funds appropriated for salaries and expenses and 3% of funds appropriated for research and development to use for construction of facilities.

In addition, the act permits the agency to transfer without restriction money appropriated for research and development to use for construction of research and development facilities. However, research and development funds may not be used to acquire land.

Other provisions of the act permit NASA to use up to $30 million appropriated for specific construction projects "to construct, expand, or modify laboratories and other installations at any location."

House space committee will start "posture" hearings in about a week. Purpose of these hearings is to find out where the U. S. stands in space science, what has been accomplished in the last year and where programs have slipped.

Chairman Miller said NASA's authorization hearings would be handled by three subcommittees instead of four. The subcommittee on advanced research and technology, headed last year by former Rep. Victor Anfuso, will be eliminated and the area it covered will be handled by Rep. Karth's space sciences subcommittee. Other two subcommittees are Rep. Teague's manned flight subcommittee and Rep. Ken Hechler's subcommittee on applications, tracking and data acquisition.

Rep. Miller has indicated to committee members that after the authorization hearings, the three subcommittees on NASA will be formed into a single subcommittee for that agency. This prospect worries some committee members who feel that a single subcommittee would be less effective in examining problem areas in the space program.

Some committee members also would like more scientific, engineering and technical competency on the staff. They fear that if the committee does not do a more vigorous job in examining NASA's budget requests, other committees, such as the House committee on government operations, may do so.

Areas which the House space committee will examine most closely now include the F-1 combustion instability problem (AW Feb. 4, p. 26), and the decision to accomplish a manned landing on the moon late in this decade using the lunar orbiting rendezvous technique rather than the earth orbiting rendezvous method (AW Jan. 28, p. 30).

U.S.-Soviet Agreement Possible On War Definition, Enthoven Says

Washington—U. S. and Russian agreement on the difference between nuclear and non-nuclear war is possible, according to Dr. Alain Enthoven, deputy assistant secretary of defense for systems analysis.

"There is and will remain an important distinction, a 'fire break' if you like . . . a recognizable qualitative distinction that both combatants can recognize and agree upon, if they want to agree upon one," he said.

In a lengthy speech cleared with highest Administration officials, delivered to the Loyola University Forum on National Affairs in Los Angeles Feb. 3, Dr. Enthoven made a painstaking examination of U. S. weapons policy.

In the nuclear age, the combatants will have a very powerful incentive to agree upon this distinction and limitation, he said, "because if they do not there does not appear to be another easily recognizable limitation on weapons—no other obvious 'fire break'—all the way up the destructive spectrum to large-scale thermonuclear war."

Dr. Enthoven hinted that there are small nuclear weapons whose yield is less than the biggest conventional explosive weapons. This point has been used to argue that there can be no distinction between the two, he said. He disagreed with this thesis, maintaining that the difference can be defined and agreed on.

Massive thermonuclear attack to improve the military position of a nation will become illogical as both sides acquire protected forces such as Minuteman and Polaris, he said. "The destructive power of their uncontrolled use should give all participants a strong incentive to find ways of avoiding it," he declared.

Dr. Enthoven also tied defense logic to Christian logic:

"According to Christian doctrine, the use of force to repress evil can be justifiable under certain conditions, including the following: first, the use of force must have a reasonable chance of success; second, if successful, it must offer a better situation than the one that would prevail in the absence of the use of force; third, the force that is used must be proportional to the objectives being sought (or the evil being repressed) . . . fourth, the force must be used with the intention of sparing noncombatants and with a reasonable prospect of actually doing so."

These were Dr. Enthoven's major points:

- **Force must be used** in a controlled and deliberate way to achieve precisely the objectives being sought. The policy of total war and unconditional surrender must be replaced by a policy of conflict with limits. "Our use of military force must be command guided, not inertially guided," he said.
- **Nuclear weapons** are indispensable, but at the same time the non-nuclear forces of the U. S. and its allies must be strengthened to the point where they can meet any threat. "Without conventional forces, our choice, when faced with aggression may be 'red or dead;' conventional forces help to deter aggression, and if deterrence fails, they can give us the opportunity to fight to stay alive and free."
- **Nuclear war may come.** In this event the loss of many lives could be prevented by fallout shelters. An enemy nuclear bomb could explode upwind from a heavily populated area and cause as many casualties as a direct overhead burst, he said.
- **Nuclear war can and must** be controlled.

Dr. Enthoven emphasized that the President has many instruments he can use to maintain the U. S. position in international affairs. In addition to military force, there are diplomacy, economic policy, foreign economic and military assistance, alliances and other activities that contribute to national security.

In supporting the buildup of conventional forces, he said: "There are many situations in which the use of nuclear weapons would be inappropriate. For the same reasons that a sledge hammer does not make a good fly swatter, nuclear weapons are not a good substitute for non-nuclear forces against a wide range of military threats. Even if they could be used to apply the minimum force required to achieve our objectives, their use would risk triggering escalation to a more and unnecessarily destructive level of conflict.

"A nation or an alliance which maintains a strong nuclear posture combined with weak conventional forces thereby puts itself at a great disadvantage in the confrontation with another power that has both strong nuclear and strong conventional forces . . . Because nuclear war is so destructive, the use of nuclear weapons must be reserved only for the most desperate circumstances. But if the nuclears have to be reserved for vital issues, the side with the strong conventional forces is likely to be able to have its way on all issues less than vital. The side without adequate conventional forces will have no means for effective resistance in such confrontations."

Long-Endurance, Subsonic Aircraft Studies Are Revived by Air Force

By Larry Booda

Washington—Air Force has revived studies of a long-endurance subsonic aircraft that could act as an aerial command post, ballistic missile carrier, long range air-to-air missile launcher or electronic intelligence and electronic countermeasures aircraft.

The studies are being carried out under the project name Dromedary. In the late 1950s, a similar concept was carried through the study phase under the name CAMAL (continuous airborne missile launcher and low level), utilizing nuclear power for propulsion. This program progressed to the point where approval was sought for construction of two nuclear-powered prototypes but approval was denied.

As now proposed, the Dromedary aircraft would be powered by turboprop engines of advanced design whose fuel consumption would be lower than those now in use. Efficiency would be further enhanced by extensive use of boundary layer control to improve wing lift.

Dromedary would have an endurance of 120 hr. unrefueled. It would have at least two crews to alternate watches. It would be no bigger than present-day aircraft such as the B-52, and could operate from much smaller runways.

Air Force officers are somewhat optimistic about the Dromedary because the studies have not been disapproved. In the past two years the Office of the Secretary of Defense has put the lid on many Air Force studies. Air Force has been permitted to reinstate Dromedary with modest funding, but there has been no overt encouragement.

Defense Dept. officials like the idea because it offers a variety of ways to use the aircraft, especially as an airborne command post. Defense Secretary Robert S. McNamara has emphasized the need for survivable posts to direct operations after a nuclear attack, including airborne posts, ships at sea, submarines and underground posts. At present, Strategic Air Command Boeing C-135 aircraft are on continuous airborne alert.

These jet aircraft, defense analysis experts say, are too expensive to operate as command posts, from the standpoint of fuel cost, maintenance and overhaul. In addition, they cannot remain airborne for a long period of time without aerial refueling.

As an economical ballistic missile launching platform, these Defense Dept. officials say, Dromedary is much more attractive than the B-52 bomber, which is expensive to operate.

Now that the B-52-launched Skybolt has been canceled, the Air Force is looking for ways to keep manned aircraft in nuclear deterrent forces. Dromedary may be the answer.

In addition to launching ballistic missiles, Dromedary would be able to defend itself from aerial attack with air-to-air missiles of extended range. In this respect the aircraft would resemble Navy's canceled Missileer aircraft. The Missileer would have defended the fleet from aerial attack with 200-mi. Eagle missiles.

But the Dromedary would be so much more versatile than the Missileer that it has a good chance of approval for development.

As a ballistic missile launcher, Dromedary would operate at altitudes where the engines would be most efficient. As an electronic countermeasures and electronic intelligence aircraft, it would have to go to higher altitudes to survey enemy borders by the line of sight paths taken by many electromagnetic devices such as radar and VHF and UHF military communications networks.

The possibility of developing an aircraft powered by petroleum fuels that could remain airborne for 120 hr. has come from steady improvements in the technology of turbine engines and improved lifting qualities of aircraft wings.

The original CAMAL concept grew out of the Air Force's nuclear-powered aircraft (ANP) effort, which had an on-again-off-again history beginning in 1946. By 1958 the Air Force was well under way with plans to build the subsonic aircraft needed to carry the nuclear powerplant. Its basic mission was to provide continuous airborne alert.

The CAMAL project actually went as far as an industry airframe competition which was won by Convair in 1959 (AW Dec. 19, 1959, p. 56). The approval of the defense secretary was necessary before a low funded program could be initiated, however. Dr. Herbert York, who was then director of Defense Research and Engineering, opposed the plan, saying that a militarily useful aircraft would have to be supersonic. Donald A. Quarles, then deputy secretary of defense, sided with the Air Force, but he died May 8, 1959, before actually signing the formal document approving the project. Subsequent moves by Defense Dept. officials stalled the program and it was dropped along with the ANP program in 1961.

Two companies, in addition to Convair (now General Dynamics/Convair) have been identified with the past and current studies. Lockheed Aircraft Corp. envisioned the CAMAL as an aircraft that would be no bigger than current SAC aircraft, but with the range capability to reach the enemy heartland carrying a greater payload, and the capability to operate three or more times as many hours per year. Altitude capabilities would have been the same. Endurance would have been one week.

Northrop Corp. has done considerable work on boundary layer control (BLC), which would be one of the key points of the Dromedary concept. Northrop studies and applied research represent a jump ahead in principles now being employed.

There are several engine possibilities. Regeneration is one new turboprop development that permits dramatically-lowered specific fuel consumption—from 0.5 lb./hp./hr. to 0.3 lb./hp./hr. Both Allison and Pratt & Whitney have tried methods in which the engine is encased in a rotating drum, which acts as a heat exchanger to preheat the air going into the engine. Curtiss-Wright uses a liquid metal heat exchanger.

In a variation of this, AiResearch recaptures some of the exhaust gases, which still bear a substantial proportion of unburned oxygen, and feeds them back through the engine inlet, raising the temperature of the inlet mixture.

All of these systems, which are of no value to turbojets or turbofans, permit the specific fuel consumption to remain about the same regardless of altitude.

Air Force officers say that if approval were given to build Dromedary prototypes after a definition phase, development time would be about three years.

Midas Reduced to Experimental Status

Washington—Midas early warning satellite, originally scheduled to become operational by 1964, has been reduced to the status of an experimental program effort because of serious problems that have raised doubts as to its basic feasibility.

This is the second of three major Air Force military satellite programs to be sharply curtailed because of technological problems. Several months ago USAF voluntarily proposed a drastic cut-back in its satellite inspector (Saint) program.

Troubles with the Midas stem from an overly-ambitious program schedule which did not permit sufficient measurements of background infrared radiation of the earth against which ICBM rocket plume had to be detected, and from overly complex satellite design that caused frequent malfunctions in orbit (AW Sept. 24, p. 54).

France Puts New Strain on NATO But Is Expected to Aid Arms Output

By Cecil Brownlow

Paris—Question of the future direction, cohesion and effectiveness of the North Atlantic Treaty Organization, as well as the political and industrial influence of the U.S. within western Europe, is being brought to a head as France pushes its own national plans with their resultant strain upon the alliance.

Momentarily on the defensive as a result of the reactions of its veto of Great Britain as a Common Market partner and its rejection of the U.S.-proposed multilateral nuclear force, France is becoming more bitter toward U.S. policies concerning NATO and the European Economic Community.

Non-French NATO officials here generally agree that France's eventual goal under President Charles de Gaulle is to remove or severely dampen American influence inside western Europe, partially as an offshoot of its dream of creating a third force counterbalance between the U.S. and USSR.

Officials working closely with the problem, however, believe that France for the moment will continue to work with NATO where cooperation coincides with its best interests.

Despite the virtual dismissal of NATO as a spent force in some top French quarters, there are indications that France will maintain active collaboration in such areas as the multination production programs for the Raytheon Hawk anti-aircraft missile and similar projects already under way.

Neither is France expected to pull out of tentative plans for a NATO production program for the General Dynamics/Pomona Redeye infantry surface-to-air defensive missile or a projected multilateral project for an advanced anti-tank missile system.

Observers do expect, however, that France's decision to curb U.S. investments inside the Common Market area if possible—and certainly within France—will have an adverse effect upon the over-all activities of American aerospace companies despite assurances to the contrary (AW Feb. 11, p. 79).

One optimistic sign is the fact that France apparently has refrained thus far from attempting to pressure other European nations with which it has influence to follow its lead and remain aloof from the U.S. nuclear plan.

"That's one move they haven't made," one official said "and until they do, there's no real indication that they are completely ready to get out of NATO."

The U.S., another official adds, also has not yet played its trump card in its efforts to persuade France to play a positive rather than a devisive role within NATO—i.e., the withdrawal of American guarantees of a strategic nuclear protection of western Europe against Soviet threats. "De Gaulle," he adds, "would certainly have threatened [the U.S.] with this by now if the situation were reversed."

French officials, some of whom contend that the U.S. already is beginning a nuclear disengagement from Europe, say the U.S. will never unilaterally launch its atomic striking force against the Soviet Union in defense of the Continent when it knows such a move would mean immediate devastation for large sectors of its own country.

No U.S. President, they add, could or would make such a move unless the American continent faced an immediate and direct threat, and they regard President Kennedy's emphasis upon the buildup of conventional forces plus a withdrawal of some U.S. tactical nuclear units from the frontline areas of West Germany, coupled with the plannned removal of Jupiter IRBMs from Italy and Turkey (AW Feb. 4, p. 33), as a tacit admission of this.

U.S. has emphasized that the conventional buildup is designed to give it a choice, or at least a delay while it assesses the seriousness of Soviet intentions, before resorting to nuclear force. A French spokesman counters that "We don't want you to have a choice. When you do, we know what it will be. You won't protect Europe with your nuclear force."

Drawback of tactical nuclear units in West Germany is designed to fit the new U.S. policy and prevent the units from being overrun while the seriousness of the Soviet threat is gaged. American officials add that it in no way alters U.S. commitments.

U.S. officials also contend that the removal of the Jupiter sites from Turkey and Italy this spring was decided upon because the missiles were "largely obsolescent" when they were stationed in Europe and should be removed once Polaris fleet ballistic missile submarines begin operating in the Mediterranean Sea.

French and some other European officials, however, tend to regard the move as a withdrawal. The U.S., they say, was committed to launch the nuclear-armed Jupiters in the event of an atomic attack against Turkey or Italy, thus providing these two countries with at least a marginal deterrent. There is no such commitment, they add, for the sea-based Polaris.

Other spokesmen deny that either the Turkish or the Italian government is officially concerned over any theoretical loss of deterrence. A greater immediate worry, they say, is the number of local employes who will lose their jobs—about 3,000 in Italy.

One probable reason for France's professed doubt over U.S. intent is the fact, as stated by some spokesmen, that it would use its own nuclear force only if France itself were under an atomic attack or an immediate and positive threat of one.

Planned force of 50 Mirage 4 supersonic bombers and other nuclear-equipped units have one prime objective—to provide a national deterrent capable, if necessary, of destroying up to five Russian cities in the hopes that the conquest of France is not worth such an expenditure to the leaders of the Soviet Union.

News Digest

Iberia Air Lines of Spain last week resumed service into Havana on its Madrid-Mexico City operation. Service will be conducted on a bi-monthly basis. Havana stop was discontinued last October during the Cuban missile crisis.

Air Force was scheduled to break ground last week in a formal ceremony at Cape Canaveral for the initial steps in construction of the Titan-3 Integrated Transfer Launch Facility (ITL).

Navy Lockheed Polaris A-3X missile was successfully launched from a land pad at Cape Canaveral, Fla., Feb. 11. Flight was the second consecutive success for this 2,500-mi. range missile.

British Hawker P.1127 made the first vertical jet aircraft takeoff and landing on an aircraft carrier recently. Flights were made from the HMS Ark Royal in the English Channel.

Space Technology Laboratories was selected by Air Force's Space Systems Division recently to supply the space-to-ground communications subsystem which is to form the basis of the future Air Force command system for controlling many types of military satellites simultaneously (AW Sept. 10, p. 35).

NASA has simplified Saturn designations. Saturn C-1 is now known as Saturn 1; C-1B is known as Saturn 1B, and the C-5 is called Saturn 5.

Northwest Airlines Boeing 707-720B crashed 7 min. after takeoff from Miami, Fla., Feb. 12, killing all 43 persons aboard.

Trunkline 1962 Profit May Top $25 Million

Early reports indicate figure could reach $27.5 million, compared with loss of $34 million in 1961.

Washington—First financial reports for 1962 indicate that most trunkline carriers will show a substantial improvement in net earnings for the year, and that the industry will surpass the $25 million net profit forecast by AVIATION WEEK & SPACE TECHNOLOGY (Nov. 19, p. 41).

Chances now appear strong that the industry will report a net profit of approximately $27.5 million for 1962, compared with a net loss of $34 million in 1961. At the same time, Pan American World Airways, which is not included in the trunkline compilation, has reported a net income of $14.5 million for the year, a 62.6% increase over the net profit of $8.9 million reported in 1961.

Three carriers—Eastern, Northeast and Trans World Airlines—will show losses for 1962, but the total deficit of the three will be considerably less than their total losses in 1961. TWA, for example, is expected to cut its 1961 deficit of $14.7 million to about $5.5 million in 1962.

Biggest gain will be shown by Delta Air Lines. With revenues totaling close to $200 million as the result of increased traffic volume generated by its recently acquired southern transcontinental route, Delta will show net earnings of about $13.1 million for the 1962 calendar year. Delta reports formally to its stockholders on a fiscal year basis.

National Airlines, which also reports on a fiscal year ending June 30, has formally reported a $3.4-million net profit for the first six months of Fiscal 1962, compared with a net income of $227,110 in the same six months of the preceding year. It is estimated from Civil Aeronautics Board Form 41s that National's profit for Calendar Year 1962 will be $7.4 million.

American Airlines has reported a net profit of $7 million for 1962, compared with $8.5 million in 1961. The 1962 profit includes $1.7 million from the disposal of property and equipment and the 1961 profit includes $1.2 million from the same source.

Earnings for both years reflect adoption of a policy of accounting for leased jet engines as if they had been owned since they were placed into service. Earnings for 1962 reflect accelerated depreciation on Douglas DC-7 piston aircraft.

American's revenues totaled $463 million for 1962, an increase of 10% over the $421.3 million for 1961. Total expenses for 1962 were $457.6 million, compared with $414 million the previous year. Revenue passenger miles increased 8% in 1962 compared with 1961.

Braniff Airways' 1962 net earnings were $2.4 million, equal to 82 cents per share, an increase of 90% over the $1.2 million and 43 cents per share in 1961. Included in the net figure is a net credit of $204,600 resulting from the application of investment credit provisions of the 1962 Revenue Act.

Braniff's total revenues reached $94.5 million, an increase of 6% over 1961 revenues. Gross expenses totaled $90.1 million, a slight 3.7% increase over 1961's expense level. Pre-tax operating income was $4.3 million.

A 1962 net profit of $1.7 million has been reported by Continental Air Lines on gross sales of $66.2 million. Total operating expenses for 1962 totaled $61.1 million, compared with $58 million in 1961. Operating income for the year was $5 million.

In announcing year-end results, Continental said its break-even load factor now stood at 42.2%, a marked drop from the 43.5% for 1961 and the lowest in the trunkline industry. During the last six months of 1962, National reduced its break-even load factor from 53% to 46%.

United Air Lines has reported a net profit of $7.7 million for 1962, including a $1.3 million gain from the sale of aircraft. Net earnings in 1961 totaled $3.7 million and included $1.7 million from the sale of aircraft.

Total net profit for 1962 is equivalent to $1.36 per common share, based on the average number of shares outstanding after providing for preferred stock dividends. Earnings and gain in 1961 amounted to 70 cents per common share.

According to estimates developed by AVIATION WEEK & SPACE TECHNOLOGY from the CAB Form 41s, United Air Lines will show an increase in revenues from $517 million in 1961 to $563 million last year. Under the same formula, Western Air Lines, which as of late last week had issued no public reports, will show a net profit of $3.3 million.

Figures drawn from the CAB Form 41s, however, are subject to drastic revision since accounting procedures required by the CAB vary widely from those used in reports to stockholders. Such bookkeeping adjustments as tax write-offs and depreciation are treated differently under CAB standards than they are under normally-accepted accounting procedures.

Northwest Airlines will report a net profit of $7.2 million on gross revenues of $150 million. The airline's net earnings for 1961 were $3.6 million.

Air Union Revision Circulated

Paris—Revised version of the Air Union charter agreement drafted by the French government is now being circulated on a diplomatic level among the other nations concerned—West Germany, Italy and Belgium.

Changes, incorporated before the French government gave formal approval for Air France's entry into the consortium, were described as minor but reportedly center around provisions for the purchase of common equipment on the part of the four carriers.

France, it is believed, hopes to make provisions of the agreement dealing with the purchase of common equipment more binding on the other three carriers involved—Lufthansa West German Airlines, Alitalia and Sabena Belgian World Airlines. It is a foregone conclusion that Air France will order the Sud-British Aircraft Corp. Mach 2.2 supersonic transport, but France fears other members might want to delay purchases in order to buy a faster, longer-range American aircraft when and if it appears.

Meanwhile, KLM Royal Dutch Airlines' application for re-entry into Air Union is not expected to be seriously considered until a final draft of the charter agreement can be approved by the four present members, and officials here agree that this could be a lengthy process.

Pan American's total revenues were $501.4 million for 1962, the first time in the company's history that revenues have exceeded the $500-million mark. Accruals to the reserve for self-insurance in 1962 proved, at year-end, to be in excess of requirements and were restored to earnings.

Revenue ton miles cost was 44.1 cents compared with 49.1 cents in 1961, a reflection of increased daily utilization of jet equipment. Passenger revenues increased 9.4% over 1961 and freight revenues rose 12.1%.

Total profits that will be reported by the eight trunklines with net earnings in 1962 are expected to reach $49.9 million. All figures are unaudited results, but the audited results are not expected to vary to any great degree. The estimated loss of $22.3 million by the three remaining carriers is, however, subject to adjustment. Last minute bookkeeping changes could improve this figure, and the total loss figure does not include the some $15 million in mutual aid funds received by Eastern as a result of the flight engineers strike in 1962. This amount is reflected in final reports of the contributing airlines.

Five carriers—Braniff, Continental, Delta, National and Northwest—which raised violent objections to statements by American and Eastern that the industry is "sick" (AW Dec. 10, p. 38), reported a total net profit of $31.7 million for 1962. Close to half that amount, however, is represented by Delta's $13.1 million profit.

Traffic figures for January reveal that 1963 has started well for some carriers, but has been discouraging for at least four trunklines. Revenue passenger miles for the month showed an industry gain of 5% over the same month last year but two airlines, Eastern and Braniff, experienced a decline.

American registered a slight 0.9% improvement in traffic and Northeast showed only a 3.5% improvement. Significant increases were reported by Continental, Delta, National, Northwest and Western.

First-class traffic during January continued its downward trend with all 11 trunk carriers showing a decided dip in this category. Western's first-class traffic plummeted 44% and Continental's dropped 35%. Both Northwest and TWA experienced a 21% decline.

By contrast, coach revenue passenger miles showed marked improvement. Coach traffic for all 11 trunklines rose 18% compared with an industry decrease of 16% in first-class traffic. Continental's coach revenue passenger miles soared to a 49% increase over the previous January and Western's rose 40%.

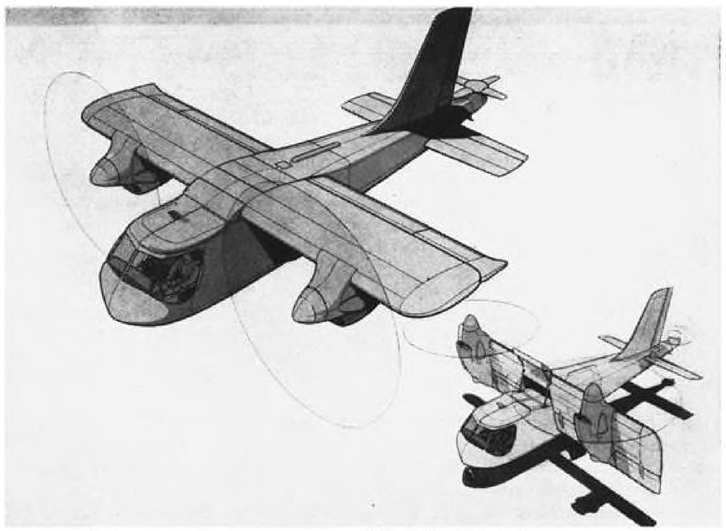
Delta's coach traffic climbed 39%, Northwest 33%, TWA 22%, Braniff and National 20% each, Northeast 16%, American and United 13% and Eastern 0.7%.

Only Northeast was able to show a gain in its over-all load factor. Five carriers—Eastern, TWA, United, Continental and Northwest—had monthly load factors below the 50% mark. Highest load factor was Delta with 58%, down 1%, from the level reached in January, 1961. American was second with a 53.5% load factor, but this was 5.5% under last January's figure.

Available coach seat miles for the industry rose 24.4%, with Western and Delta having the biggest gain in this area. First-class available seat miles for the group dropped 4.1%.

The danger point has been the low level hit in recent months in first-class load factors. In January, Northwest's load factor fell to 32% from the 40% reached last January. Continental's first-class load factor was 39.7%, compared with 47% in the same periods, while National experienced a decline to 39.8% from 46.6%. Delta was best in this category with 48.7% load factor.

Recent activities of the 11 trunklines are reflected in their common stock listings on the New York Stock Exchange. Braniff, Continental, Delta, National, Northwest and Western late last week were selling near 1962-1963 highs.



Canadair Proposes V/STOL Transport

Canadair, Ltd.'s, twin-engine CL-84 V/STOL transport, shown in artist's concept, is designed for variety of military roles (AW Jan. 28, p. 35) and possible commercial applications. Wing tilts through 90 deg. for vertical flight, with longitudinal control provided by small tail rotor. Two prototypes will be built under a recently authorized program with Canadair investing $2.5 million and the Canadian government $7.5 million.

United Moves to Halt Representation Vote

Washington—United Air Lines filed suit against the National Mediation Board last week in a last-ditch attempt to block an NMB representation election that could lead to union organization of 12,700 United employes by the Brotherhood of Railway Clerks (AW Feb. 11, p. 41).

United attorneys requested a preliminary injunction from the U. S. District Court here to stop the pending election sought by the railway union. United is contesting NMB election procedures and ballot forms.

United contends that the variety of work performed by the 12,700 employes, 3,000 of whom are members of the International Assn. of Machinists, makes it impractical to classify them under NMB rules as a single "class or craft" requiring representation by only one union. It has asked the court to prevent NMB from either holding the election or naming a union representative for the group, unless the Board first permits United to participate in a hearing on the class and craft determination. NMB earlier refused to hold such a hearing.

NMB should also be ordered to change its present ballot forms, because they fail to provide any means by which employes can vote against union representation, the attorneys said. In the present case, a minority of the 12,700 employes being balloted could successfully win union representation since any ballots cast blank, or with the notation of "no union representation" would be ruled invalid by the NMB.

Airlines Start Attack on New U.S. Policy

By L. L. Doty

Washington—U.S. international airlines last week took major steps toward the organization of a campaign designed to sidetrack the proposed White House policy on international air transportation (AW Feb. 11, p. 38).

As of late last week, the five carriers that had been briefed on the policy by the Federal Aviation Agency and Civil Aeronautics Board in an unusual meeting earlier this month, were in general agreement that the policy, as it now stands, can have damaging effects on the competitive posture of U.S. airlines operating overseas. There was some disagreement among the carriers on minor points.

Top officials of Trans World Airlines and Pan American World Airways are taking the lead in attacking the policy on grounds that it will be detrimental to the merger plans of the two carriers.

Indications now are that top government officials—including several at cabinet level—have committed themselves to supporting the proposed merger of Pan American and TWA.

Opposition is found in the second-echelon group, including those who drafted the policy.

The campaign will be directed against this group as a first step toward bringing about revisions in the policy that will make it more acceptable to the airlines. One of the principal reasons that the policy has been kept under security wraps has been a concern of the policy makers that the airlines would muster forces to attack it.

The airlines have been denied a right to participate fully in the development of the policy and any consultations held with the industry have been conducted on a highly restricted basis. It was only after a disclosure that representatives of the State Dept., Civil Aeronautics Board and the Federal Aviation Agency were planning to discuss the policy with six foreign governments before revealing its contents to U.S. carriers that the government bowed to industry demands that the airlines be permitted to review it.

After the briefing of the five carriers, held behind closed doors, the heads of the airlines present were obviously angry. Charles Tillinghast, president of TWA, and Juan Trippe, president of Pan American, were particularly annoyed.

TWA-Pan American drive to fight the policy and win support for a merger moved into high gear last week. At least one congressman and one senator, both Democrats, have expressed an intention to support the merger in response to the two airlines' campaign.

Here are the chief points the airlines are planning to adopt in their attack on the policy, although a formal position has not been fully approved by all airlines involved:

- **Policy puts the U.S.** airlines at a disadvantage in competing with foreign flag carriers serving the U.S. The industry believes that to compete effectively, the U.S. cannot be hampered by a foreign relations policy that restricts normal activities in a free enterprise function.
- **Standards established** in the new policy are contrary to those set by the Congress in the passing of the Federal Aviation Act of 1958.
- **Indifference by the policy** makers toward the part played by the U.S. airline industry in the balance of payments—the flow of dollars from the U.S. to foreign countries—has raised strong objections from the carriers. This issue will undoubtedly win the unanimous support of the airlines in the fight against the policy. Airlines will hold that any weakening of their competitive relationship with foreign carriers will only compound the current U.S. unfavorable balance of trade.
- **Airlines will take** strong issue with attempts to redefine sixth freedom traffic. In addition, they will argue the necessity for some form of control over capacity and schedule frequency offered foreign carriers in their operations to and from the U.S. The policy proposes that the status quo on capacity be maintained until traffic volume catches up with seat miles offered.
- **Caution should be exercised** in the policy's position in support of lower fares, according to the airlines. The industry feels that U.S. airlines have been leaders in the promotion of lower fares, but that rate reductions cannot be brought about too rapidly until it is adequately determined what effect the reductions will have on revenues.
- **Policy makers proposal** of a regional concept for air cargo operations has the full support of Seaboard World Airlines, since this carrier has long advocated such a program. Other airlines, however, will warn that any experiments in cargo operations could become permanent functions. On this basis, they will argue, it would be a wise policy to make no binding commitments on cargo operations until this form of traffic is more firmly established.

First-Class Revenue Drop Spurs Support for Single-Class Service

Washington—United Air Lines' proposed one-class service is drawing increased support from carriers critical of the complex of coach and discount fares which have diluted the industry's first-class revenues.

Success of the idea, many airlines feel, will assure its adoption by several other carriers who now believe that an increase in coach fares is the only practical method of increasing revenues during the present period of continued coach growth. Revenue spread between coach and first class now stands at 20-25%, and past industry attempts to reduce this gap by at least 5% have been consistently rejected by the Civil Aeronautics Board.

Basically the United proposal is a 5% more costly coach service, with better seating and service accommodations. Effective Mar. 10, the service will be inaugurated between Chicago and San Francisco. Ticket cost, minus tax, will be $111, as compared with a present coach fare of $105 and a first-class fare of $135.

Significantly, United did not place the new service on the highly competitive Chicago-Los Angeles route where it would face the combined lower-fare coach competition of American, Continental and Trans World Airlines. Both Continental and TWA have rejected United's proposal.

However, American has announced that it will provide a similar one-class service in the San Francisco market at the existing coach fare of $105 (see p. 52).

First public support for the single-class philosophy came last week from National Airlines President Lewis B. Maytag, Jr. He criticized the present fare structure as often "cut throat and absurd," and predicted that the variety of possible low fare combinations may affect every existing fare and eventually depress revenues in the entire industry.

Eastern Air Lines also joined the growing opposition to low promotional fares in an objection filed last week against a new summer excursion fare requested by Northeast Airlines for Florida.

"We, like the CAB, hoped lower fares would broaden the travel market and give equal or greater profits," the airline stated. "The results have been disappointing," Eastern said.

Boeing 727 transport made its first flight on Feb. 9. Aircraft took off from Renton (Wash.) Municipal Airport and landed at Paine Field, Wash., 20 mi. north of Seattle. Plane was airborne 2 hr. 1 min. Aircraft's performance and handling characteristics were investigated.

Boeing 727 Transport Makes First Flight

Aircraft is powered by three Pratt & Whitney JT8D turbofan engines, each rated at 14,000-lb. takeoff thrust. Two are pod-mounted on either side of the aft fuselage and the third is faired into the tail cone. During test flight, 727 weighed 130,000 lb.

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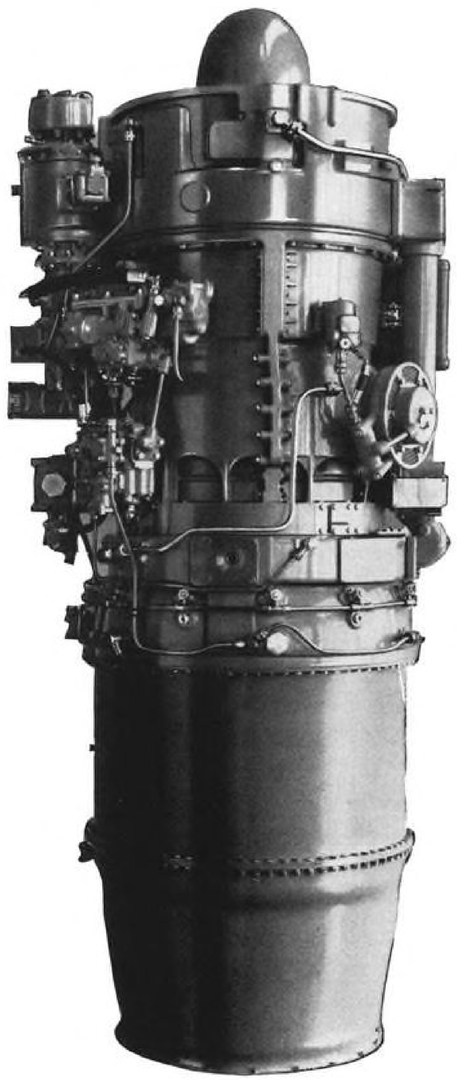
Airline Income and Expenses—November 1962

(IN THOUSANDS OF DOLLARS)

	OPERATING REVENUES						Total Operating Expense	Net Profit (or Loss)
	Passenger	Cargo	Other Non-Mail	U.S. & For. Mail	Federal Subsidy	Total		
DOMESTIC TRUNKS								
American	31,324	3,483	122	884	.....	35,813	36,888	(461)
Braniff	5,907	411	204	190	.....	6,712	6,657	(28)
Continental	4,642	293	170	116	.....	5,221	5,198	(105)
Delta	14,109	1,021	204	358	.....	15,692	13,750	766
Eastern	19,982	1,176	276	459	.....	21,893	25,913	(3,934)
National	6,676	549	184	152	.....	7,561	7,104	142
Northeast	3,082	130	94	32	.....	3,338	4,307	(1,100)
Northwest	6,479	640	111	221	.....	7,451	7,758	(247)
Trans World	21,852	1,690	8	585	.....	24,135	26,000	(4,026)
United	37,599	3,472	939	1,455	.....	43,465	45,474	(1,389)
Western	5,624	233	79	102	.....	6,038	6,074	(67)
Trunk Total	**157,276**	**13,098**	**2,391**	**4,554**	.....	**177,319**	**185,123**	**(10,449)**
INTERNATIONAL								
American	518	55	25	8	.....	606	574	7
Braniff	539	71	20	45	.....	675	1,047	(188)
Caribair	396	27	10	3	.....	436	419	5
Delta	174	16	1	.....	.....	191	323	(63)
Eastern	1,936	203	(1)	60	.....	2,198	2,445	(289)
Mackey	165	5	9	.....	.....	179	161	8
Northwest	2,320	399	220	972	.....	3,911	3,184	286
Panagra	1,148	333	113	123	.....	1,717	1,775	13
Pan American	24,973	5,229	3,672	3,985	.....	37,859	40,159	(861)
South Pacific	40	1	13	1	.....	55	95	(49)
Trans Caribbean	200	28	1,045	1	.....	1,274	975	98
Trans World	5,034	865	81	1,226	.....	7,206	7,879	104
United	1,890	115	49	115	.....	2,169	1,880	89
Western	523	11	3	5	.....	542	367	79
International Total	**39,856**	**7,358**	**5,260**	**6,544**	.....	**59,018**	**61,283**	**(761)**
LOCAL SERVICE								
Allegheny	1,336	90	8	29	534	1,997	1,891	2
Bonanza	682	21	5	4	268	980	836	56
Central	437	34	14	17	413	915	899	5
Frontier	714	53	21	15	631	1,434	1,341	37
Lake Central	500	40	33	11	342	926	885	25
Mohawk	1,575	83	57	20	388	2,123	1,905	81
North Central	1,285	93	35	37	728	2,178	2,143	2
Ozark	936	71	10	19	368	1,404	1,337	26
Pacific	649	23	10	17	366	1,065	989	23
Piedmont	1,081	58	13	24	400	1,576	1,638	(31)
Southern	672	35	31	30	482	1,250	1,181	26
Trans-Texas	520	38	26	16	386	986	964	8
West Coast	494	21	15	10	440	980	883	33
Local Service Total	**10,881**	**660**	**278**	**249**	**5,746**	**17,814**	**16,892**	**293**
ALASKA & HAWAIIAN								
Alaska Airlines	260	33	515	50	177	1,035	988	3
Alaska Coastal	105	17	6	15	110	253	263	(14)
Aloha	342	7	6	2	.....	357	410	(84)
Cordova	18	9	9	8	49	93	99	(7)
Hawaiian	435	92	4	4	.....	535	637	(116)
Kodiak	11	3	3	1	6	24	25	(1)
No. Consolidated	65	40	10	66	148	329	254	(29)
Pacific Northern	506	149	17	101	97	870	1,173	(171)
Reeve Aleutian				Not Available				
Western Alaska	3	1	1	.....	19	24	27	(4)
Wien Alaska	64	40	108	87	215	514	479	13
Ala. & Hawaiian Total	**1,809**	**391**	**679**	**334**	**821**	**4,034**	**4,355**	**(352)**
HELICOPTERS								
Chicago				Not Available				
Los Angeles	48	15	1	9	126	199	236	(35)
New York	167	7	4	2	135	315	389	(88)
Helicopter Total	**215**	**22**	**5**	**11**	**261**	**514**	**625**	**(123)**
CARGO & OTHER								
Aerovias				Not Available				
Avalon				Not Available				
Flying Tiger	.....	4,062	(11)	.....	.....	4,051	3,804	7
Riddle				Not Available				
Seaboard	.....	856	1,235	327	.....	2,418	2,065	202
Slick	.....	.....	2,175	.....	.....	2,175	2,008	38
Cargo, Etc. Total	.....	**4,918**	**3,399**	**327**	.....	**8,644**	**7,877**	**247**
Industry Total	**210,037**	**26,447**	**12,012**	**12,019**	**6,828**	**267,343**	**276,155**	**(11,145)**



Tough guy

The toughest proving ground for any aero-engine is in trainer aircraft, where the Bristol Siddeley Viper gas turbine made its reputation. In seven years Viper-powered trainers have entered service in six Air Forces of the world. Add to this the fact that Vipers have also featured in nine other types of aircraft including executives, research aircraft and fighters and you have world-wide proof of ruggedness and reliability.

The sheer simplicity of the Bristol Siddeley Viper is the basic reason for its reliability and ease of handling. It has also been a major feature in the rapid development of the engine from its original rating of 1,575 lb. The latest version, the Viper 20, is rated at 3,000 lb thrust and powers the de Havilland DH 125 and the Piaggio/Douglas PD 808 executive jets. The engine is now under development to even higher thrusts.

An extensive service organisation exists for the benefit of the operators of Bristol Siddeley engines and full servicing facilities are available throughout the Americas.

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TWA Will Seek Hughes Default Order

By James R. Ashlock

New York—Default judgment in favor of Trans World Airlines in its $115-million suit against the Hughes Tool Co. will be requested by the airline this week as a result of Howard R. Hughes' failure to appear last Monday for pre-trial interrogation (AW Feb. 11, p. 39).

Attorneys for the airline said they would also file for "dismissal with prejudice" of Hughes' $385-million counterclaim against TWA management officials and the carrier's financial backers. If granted by the court, a dismissal with prejudice would prevent counterclaim from being reopened.

Besides asking for monetary compensation, TWA's suit also seeks divestiture of Hughes' 78.2% of controlling stock in the airline. The carrier's lawyers were confident last week that because Hughes had entered into a willful default, TWA stood to receive everything it was asking for.

However, Hughes' lawyers said that any adverse judgment will be carried on to the Circuit Court of Appeals, and to the U. S. Supreme Court if necessary. Thus, without ever having come to trial, the case could still drag out for many months.

U. S. District Court for the Southern District of New York was notified on the Friday before Hughes' scheduled appearance that he would not appear in Los Angeles, as ordered.

Chester C. Davis, Hughes' lawyer, told Judge John Metzner in New York that he was stopping his pre-trial activities in the case, and thus there was no need for Hughes to appear.

Attorneys for TWA and its lending institutions said this did not alter their own rights to question Hughes, and that unless his failure to appear constituted a default, they wanted the subpoena on him enforced.

Judge Metzner then told the plaintiffs that he would entertain their motion for a default, and also a motion to dismiss Hughes' counterclaims. He told TWA it could choose its own date for filing the default motion.

Davis said he was told by Hughes Tool to announce that Hughes would not appear, adding that the company "does so with full awareness of the sanctions the court may place upon it."

He said his client still maintained that the case did not belong in the courts, but came within the jurisdiction of the Civil Aeronautics Board. Davis had earlier been denied a motion to Metzner to dismiss the TWA suit on this ground (AW Feb. 4, p. 47).

Legal sources emphasize that aside from Hughes wanting to continue the obscurity he has maintained for six years, he had an even more valid reason for wanting to stop the litigation. This was protection of the financial records of Hughes Tool Co.

In pressing its anti-trust charges that Hughes damaged TWA by dictating the carrier's acquisition of aircraft, TWA obtained a court order that Hughes produce the tool company's financial and tax records. These records have never been disclosed, since the company is wholly owned by Hughes and is not subject to the federal requirement for annual financial statements.

Sources connected with the tool company say that the market it serves, that of oil production equipment, is highly competitive. It has become even more so since the expiration of patents on Hughes Tool's drill bits, which for years were used almost exclusively throughout the free world.

Tool company officials say that Hughes' competitors would gain a substantial advantage through public disclosure of the firm's financial records. Hughes will take any chance, even default of the case, to avoid this.

End of the pre-trial examinations has spurred speculation that a settlement may be upcoming, but TWA's lawyers say that matters have gone too far to accept anything other than their full claims.

Only settlement discussion to arise came soon after TWA filed its suit. The tool company proposed an arrangement whereby TWA would take a consignment of Convair 880, 880M and 990 aircraft that Hughes had contracted to buy. In exchange, Hughes would supply the airline with funds, believed to be $100 million, through a purchase of debentures.

But TWA's new management, headed by Ernest R. Breech, elected to press its claims in hopes of eventually erasing any chance of Hughes regaining control of the airline.

Still pending is Davis' application to the Civil Aeronautics Board asking for an investigation into the relationship between TWA and its creditors on one hand and Pan American World Airways on the other.

Davis had two aims in making this move. One was to clear up the question of whether the TWA-Hughes dispute belongs before the courts or the CAB. The other was to formalize charges that the proposed TWA-Pan American merger might be a "monopolistic conspiracy" fostered by the lending institutions, TWA's management and Pan American without regard to Hughes' interest.

TWA and Pan American last week reiterated to the CAB their desire to hold a stockholder vote on the merger within 60 days after public hearings on the proposal. CAB's Bureau of Economic Counsel has twice rejected a delay of the vote, insisting it precede any CAB action primarily because of uncertainty over Hughes' reaction should TWA vote his stock.

TWA insisted that there was no need for the CAB to delay for this reason. The airline said it has unquestionable right to vote the stock, and that the CAB should expedite its procedures so that public hearings can be held within a reasonable time.

Flying Tiger Debt

New York—Contract agreement with Canadair, Ltd., which restricts further debt obligation until a major part of the loan on CL-44 aircraft has been paid, is delaying Flying Tiger Line's move to purchase two DC-8F freighters from Douglas Aircraft.

Flying Tiger has already announced its intention to buy DC-8Fs (AW Dec. 17, 1962, p. 39), but the contract remains unsigned. The airline is seeking some modification of the Canadair contract that would clear the way for the DC-8F deal.

Likelihood of turbojet freighter acquisition by its competitors, plus Military Air Transport Service's announcement that pure-jet operators will be favored for military personnel charters, are pressure points behind Flying Tiger's desire for the DC-8F. Carrier now operates 10 CL-44s.

MATS Requirement

Washington—Military Air Transport Service last week announced that bidders on all future MATS airlift contracts will be required to provide turbine-powered aircraft.

Out of 13 international routes, domestic cargo and supplemental carriers now providing this service, only two are not equipped with turbine aircraft, MATS said, and these two are currently negotiating for new equipment.

No new carriers will be solicited for bidding, MATS said. Fiscal 1964 contracts will be awarded through current options held by the 13 airlines.

Military requirements alone should not be the basis for purchase of new or additional turbine engine aircraft, MATS warned. Expansion of the airline's civilian business should be the first consideration, MATS said.

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The F-104 is unique in this age of specialization. It will tackle just about any job you hand it, and do it well. Best of all, it is a proven airplane that can be delivered quickly. **Lockheed F-104**

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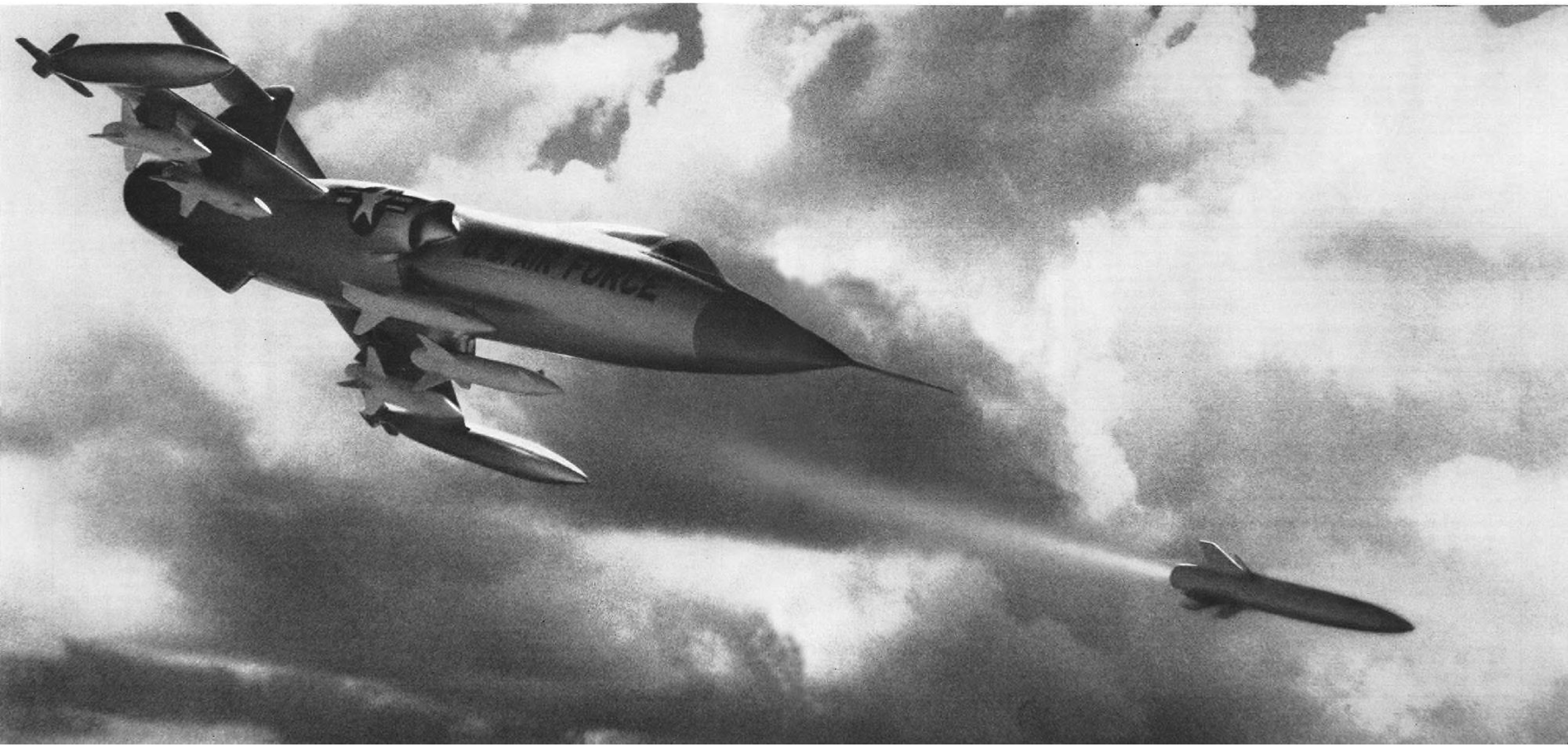

AIRLINE OBSERVER

► American Airlines will inaugurate Convair 990 turbofan transport service between Chicago and San Francisco in early March to oppose the single-class service United Air Lines will initiate on that route Mar. 10. American feels the 3-2 seating in the 990's coach section and regular coach fares of $105, versus $111 on single-class flights, can compete effectively against United. TWA will also maintain its two daily Convair 880 schedules on the segment, and may add more.

► Hawaiian Airlines and Aloha Airlines will oppose the unlimited travel, fixed 90-day fare for foreign travelers in the U. S. proposed by the 13 local service airlines (AW Feb. 11, p. 47). Possibility is strong, however, that the two Hawaiian carriers may modify their position by establishing a novelty fare that would promote travel to the islands from the Orient.

► Russia has increased the strategic importance of Aeroflot's trans-Siberian An-10 flights by ordering regular stops at Blagoveshchensk, which is located just across the Amur River from Communist China. Other intermediate points on the An-10s' Moscow-Khabarovsk run are Sverdlovsk, Novosibirsk and Irkutsk.

► Agency of International Development (AID) has provided $5 million for the construction by the Federal Aviation Agency of a 1,900-mi. airway from Ankara to Karachi via Tehran. Project is being undertaken through the Central Treaty Organization. CENTO members are Britain, Turkey, Iran and Pakistan, but the U. S. is participating in the airways project as a member of the organization's economic committee. FAA will provide the air traffic control and navigation equipment with the AID funds, and installation will be handled by Turkey, Iran and Pakistan.

► Prague-Havana route operated by CSA, the Czechoslovakian airline, completed its first year of weekly flights on Feb. 3. Havana Radio claims that more than 6,000 passengers, including 1,000 tourists, used the service.

► American Airlines will withhold widespread promotion of its new Convair 990A aircraft until about mid-1963. This will provide time for delivery of all five 990As, plus modification of some of the present 990s to incorporate the improved performance of the A models. Pattern is the same followed by American when it converted its Boeing 707s to turbofan engines.

► San Francisco Helicopter Airlines has purchased three Sikorsky S-62 turbojet helicopters which it has been leasing from the manufacturer since it began operating in 1961 (AW June 5, 1961, p. 52). Financing of the $1-million purchase was made through the Bank of America.

► Air Transport Assn. has completed a traffic survey of Florida-bound motorists and found that 48% "strongly favored" air travel in general, 22% "moderately favored" it while 23% had "no particular feeling." Five per cent "did not favor" and two per cent "strongly disfavored." Total of 65% said they had flown before, but 88% said they had not considered any means of travel for the Florida trip other than the private automobile. ATA also found that the motorists traveled in small groups, have higher-than-average incomes and traveled long distances—69% came from areas west of the Mississippi and north of Ohio.

► Domestic trunkline traffic showed signs of recovery in January with a 5% gain in revenue passenger miles for the month compared with the same period last year. It was the biggest percentage gain shown since September, when a 6.3% increase was registered. Available seat miles, however, rose 12.5% to compound the industry's excess capacity problem. Load factor for the 11 trunklines dropped to a dangerously-low 53% as a result.

► Eastern Air Lines last week asked the CAB to investigate the entire promotional fare situation and set a firm policy on the trend toward numerous types of fare discounts. Eastern said that its experiments with a 20% discount on Air-Shuttle fares during off-peak hours had failed in its purpose of drawing passengers away from peak traffic periods.

SHORTLINES

► **Aeroflot** is emphasizing the difficulties involved in maintaining its newly inaugurated scheduled nonstop Tu-114 service between Moscow and Havana. On the first few of the "regular" flights on the 6,769-mi. run, the large, double-decked Tupolev turboprop transport carried as few as 25 passengers eastbound. Apparently none of the flights is carrying a load close to the 170-passenger capacity of the aircraft.

► **Air express** revenues totaled $58.4 million in 1962, a 12.4% increase over revenues earned in 1961.

► **American Airlines** has filed a tariff with the Civil Aeronautics Board calling for a half-fare family plan on all first-class flights every day except Sunday. Current family plan provides a one-third discount for all family members except the family head when traveling together, and is in effect only from Monday noon to Thursday noon.

► **Best estimates** now place a CAB decision in the American-Eastern merger case no earlier than June. Oral arguments in the case start this week.

► **British Overseas Airways Corp.** will resume twice-weekly Boeing 707 service between Hong Kong and Sydney beginning in April. Service on the route was suspended last summer.

► **Eastern Air Lines** has contracted for Southern Airways to handle all Eastern ground operations at Dothan and Muscle Shoals, Ala. Under the plan, Southern will perform all ticket selling, passenger services and cargo handling for Eastern's two daily flights through these stations.

► **Federal Aviation Agency** is conducting tests to increase the range of communications between ground stations and airborne aircraft. Test facility has been installed at Barnstable, Mass., and includes a large, high-gain antenna 110 ft. high and 100 ft. wide, and a 4-kw. transmitter.

► **Kuwait Airways** has joined the International Air Transport Assn., bringing total IATA membership to 93 airlines.

► **National Airlines** flew 134.6 million revenue passenger miles in January, an increase of 12.8 million—or 10.5%—over the same month of 1962.

► **Pan American World Airways** will schedule 204 transatlantic flights each week during the 1963 summer season. Total of 438,000 seats will be provided each week during the peak season.

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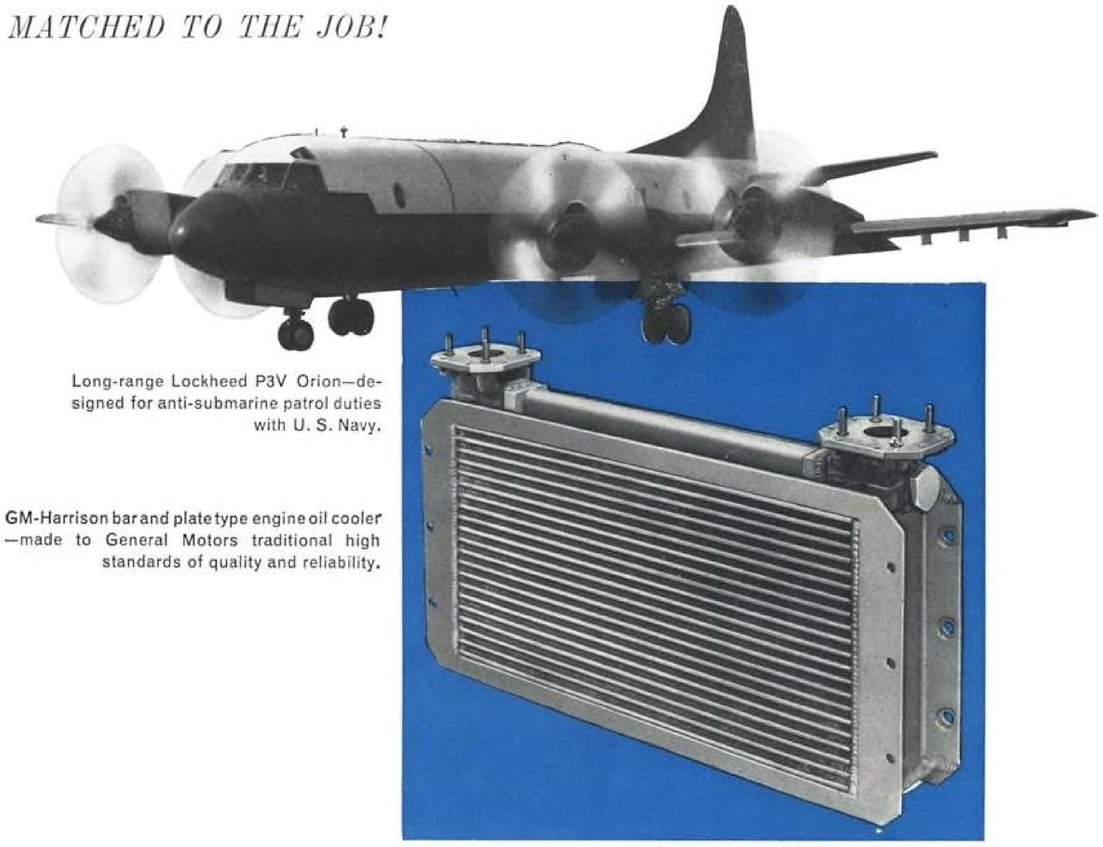

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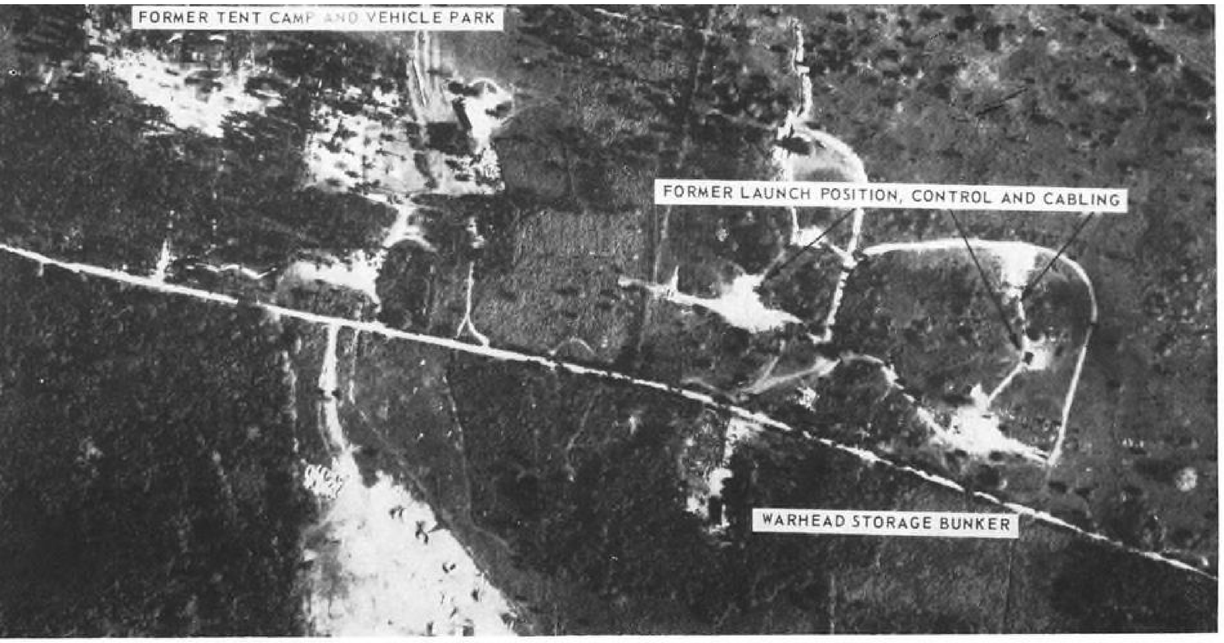
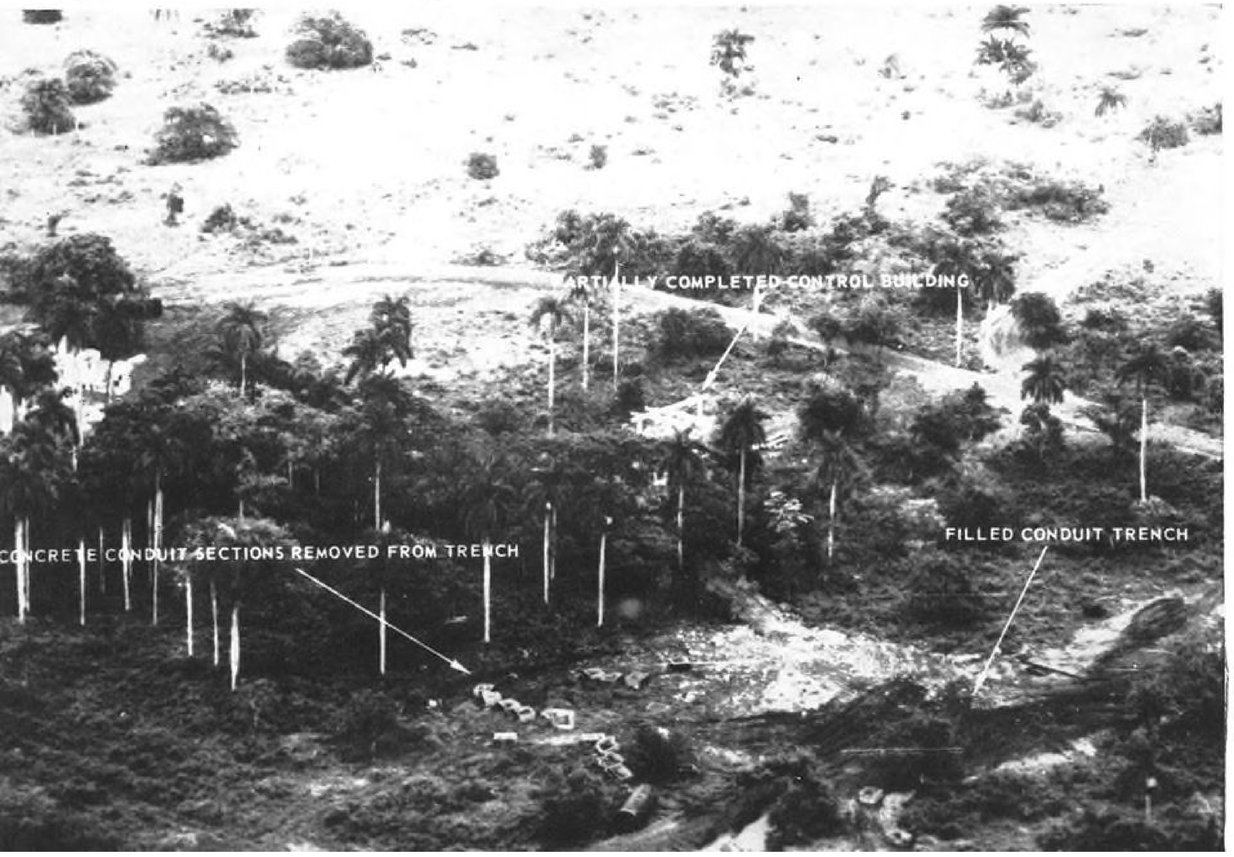
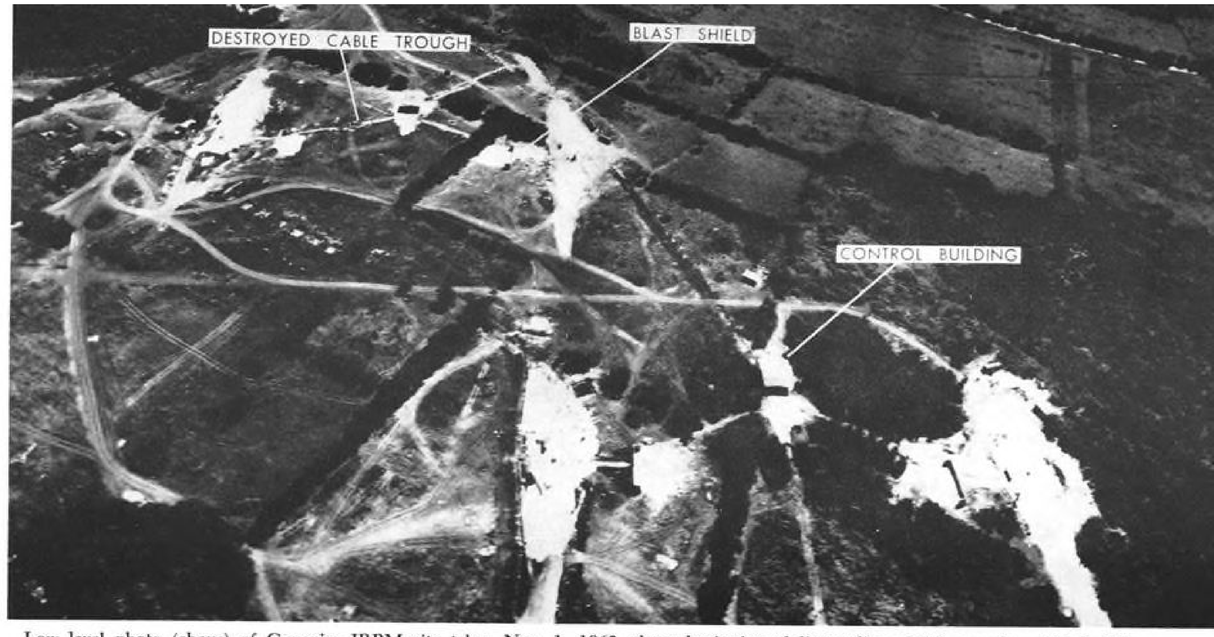


High-altitude photo (above) of Remedios IRBM site on Jan. 20, 1963, shows it deserted with concrete launch pads broken up, control and guidance system cable trenches filled in and no sign of any activity at the site. U. S. maintains regular high altitude photo-reconnaissance on entire island of Cuba as a substitute for on-site inspection originally demanded for the Soviet missile complexes.

New Defense Department Photos Show Rapid Disassembly of Soviet Missile Sites in Cuba

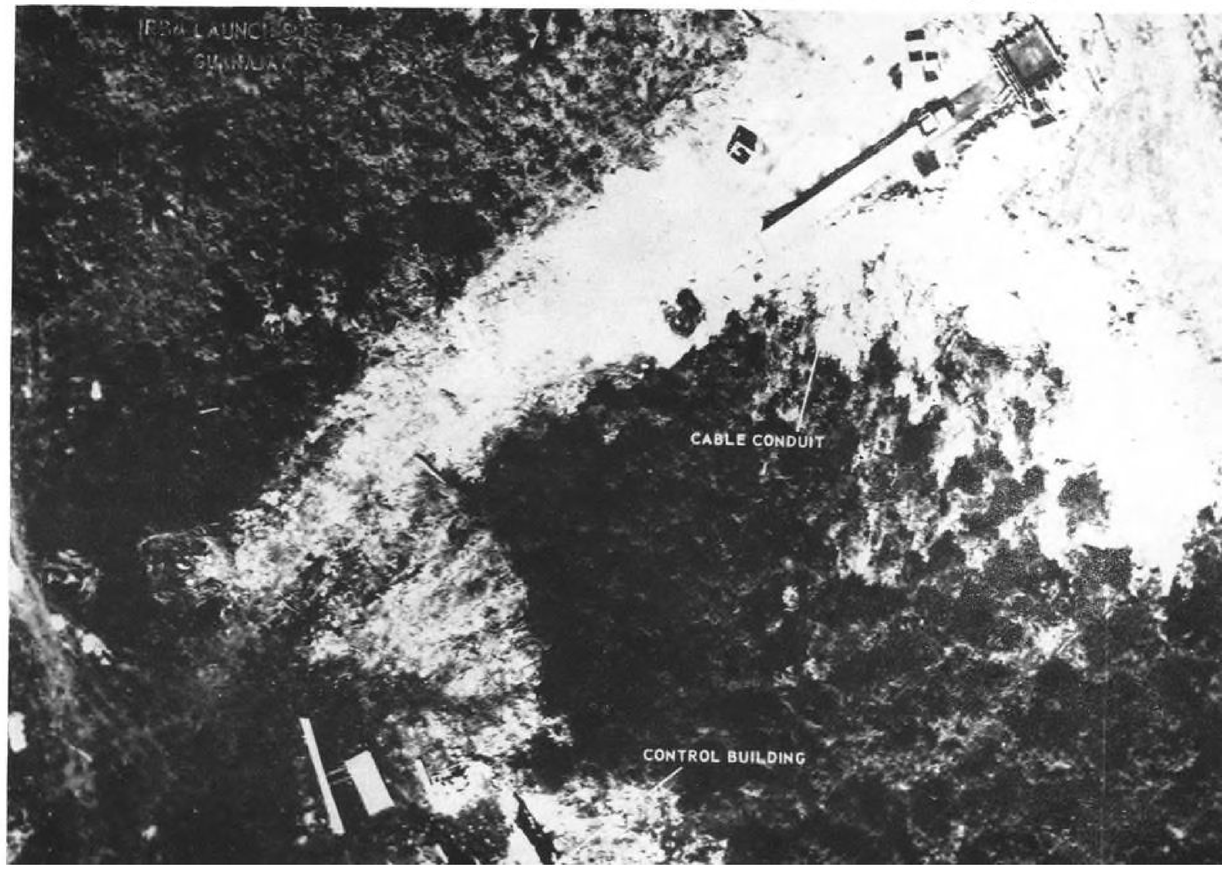
Low level oblique photo (below) of Remedios IRBM base taken Nov. 9, 1962, shows a broken and bulldozed concrete launch pad with power cable trenches filled in. Note the prefabricated concrete hollow blocks used as liners for the cable trenches.

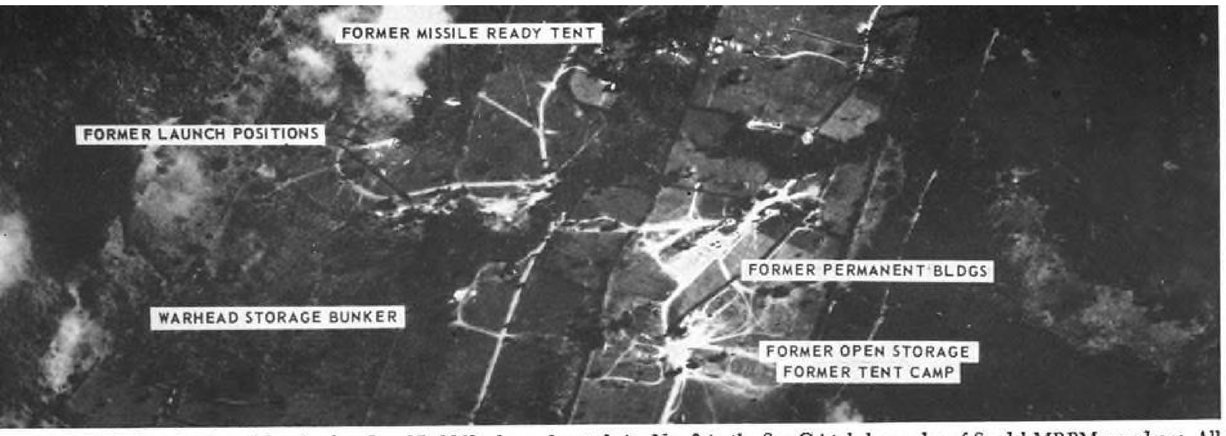




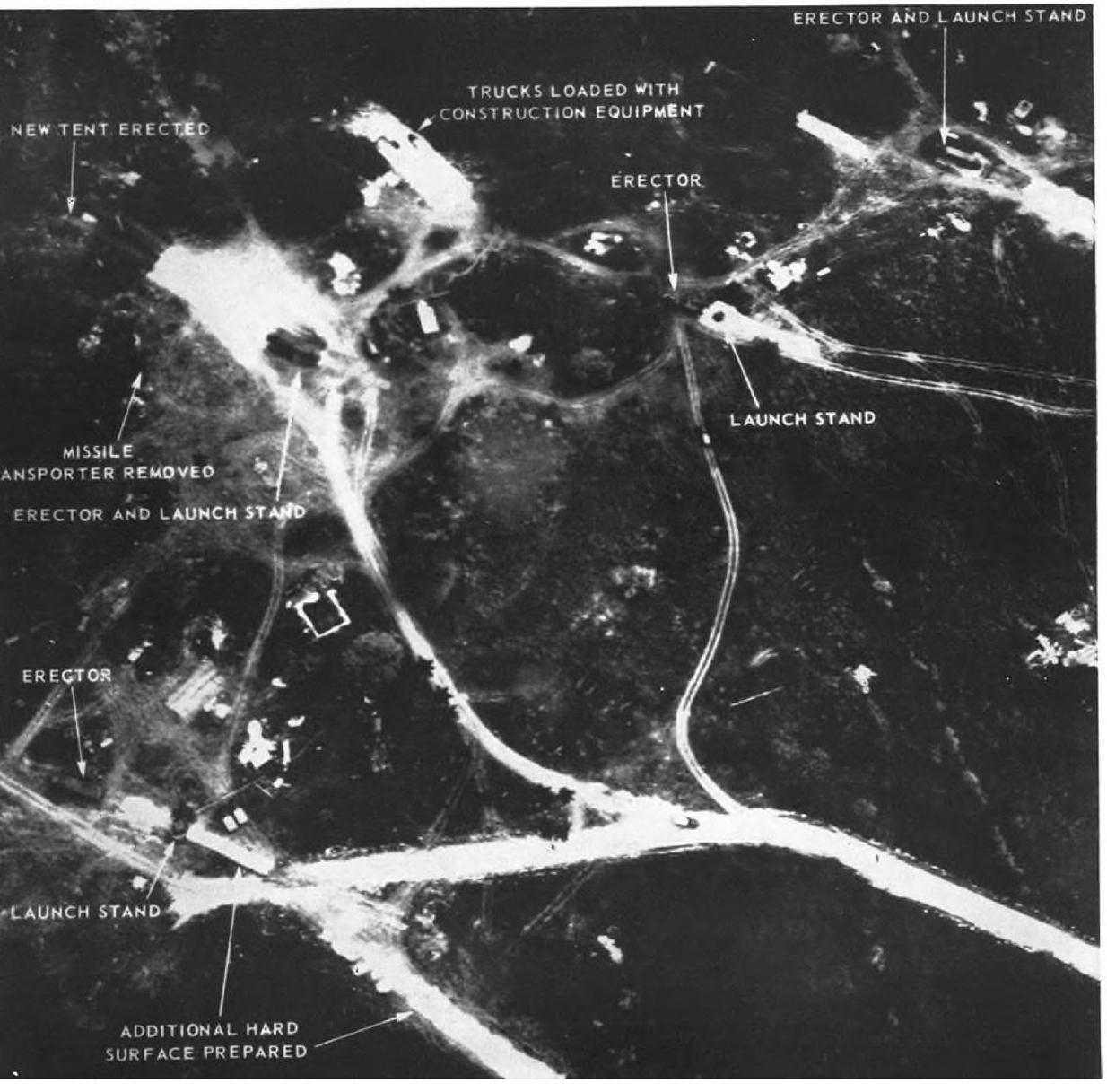
Low level photo (above) of Guanajay IRBM site taken Nov. 1, 1962, shows beginning of dismantling of this complex which had been nearing completion. Work has been halted on all construction. Concrete launch pads are being broken up by high compression drills and cable trenches are being filled in after cables have been removed. Note blast shields for fueling vehicles near each IRBM launch pad and completed launch control building designed to handle launchings on two pads.

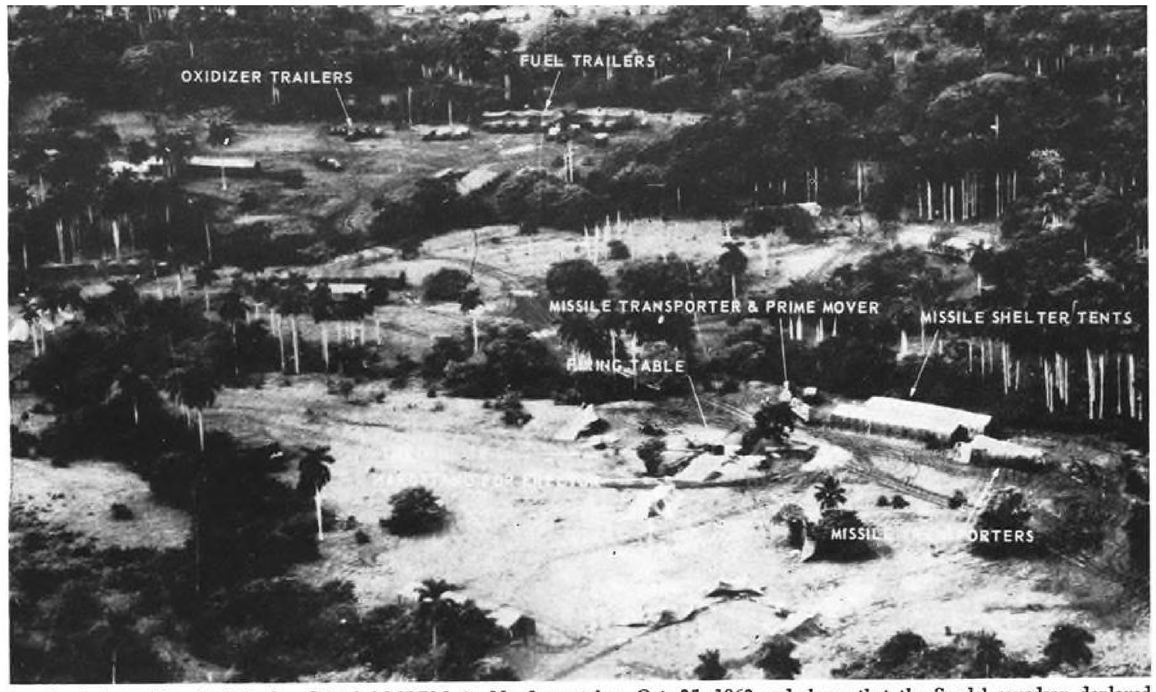
Medium level photo on one of the two Guanajay IRBM sites taken Nov. 1, 1962, shows construction still proceeding on launch pad complex. Note deep concrete forms, upper right, for pouring pad base and partially completed control building, foreground.



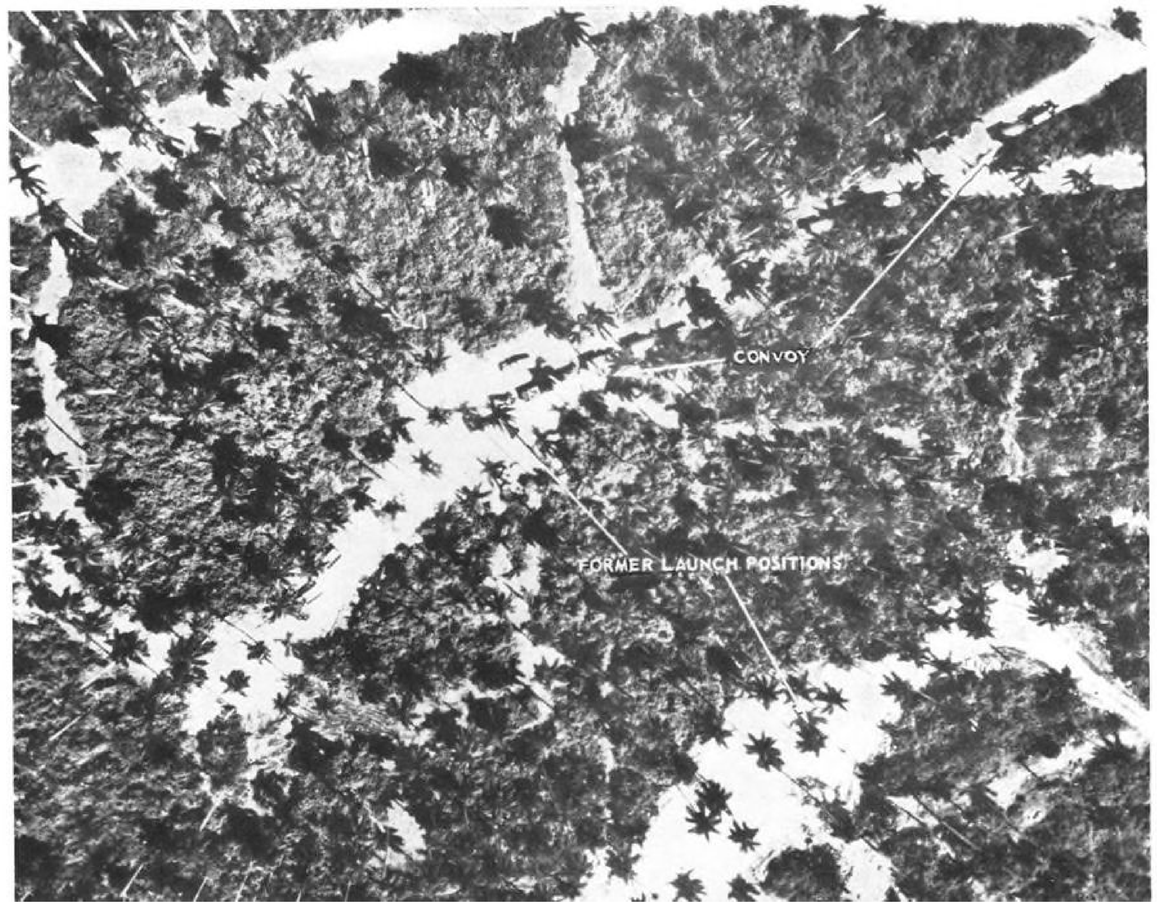


High altitude photo (above) taken Jan. 27, 1963, shows deserted site No. 3 in the San Cristobal complex of Sandal MRBM squadrons. All missile and support equipment has been removed, only foundations of barrack buildings remain and no signs of any recent activity are evident. Low-level photo (below) of Site No. 4 in San Cristobal complex taken on Oct. 29 shows Sandal MRBM squadron in state of full operational readiness in a well prepared launching site. Four launching pad hardstands are equipped with missile erectors and firing stands. Trucks loaded with construction equipment indicate work is still continuing to improve the site.





Low level photo (above) of the San Cristobal MRBM site No. 1 was taken Oct. 25, 1962 and shows that the Sandal squadron deployed here has reached operational readiness with its equipment and launching pads camouflaged under canvas tarpaulins. Launch pad in foreground gives good detail on how Sandal mobile-support equipment is deployed around the launch pads. U. S. photo-reconnaissance plane catches the last Soviet convoy moving out of its former Sandal launch site at Sagua La Grande (below). Picture was taken Nov. 1, 1962 and shows the deserted launch pads with the final convoy of support vehicles departing down the access road from the launch pad in the center of the photo. Missile convoys were followed on their journey to debarkation ports by U. S. photo surveillance several times daily until all 42 MRBMs and their related equipment were shown departing on Soviet ships from Cuban ports.



EXIT
HEAT

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Manual X-20A Boost Control Simulated

By Erwin J. Bulban

San Antonio—Simulated flight control operations in a centrifuge have shown that pilot trainees for the USAF/Boeing X-20A space glider can manually control the Dyna-Soar's boost stage and insert the vehicle into its proper orbital injection window.

Centrifuge operations were conducted at the Naval Air Development Station in Johnsville, Pa. A report on the results was delivered recently by Lt. Col. Burt Rowen, assistant for bioastronautics to the Dyna-Soar program director, during the USAF School of Aerospace Medicine's annual lecture series at Brooks AFB here.

Tests, carried out as part of the student pilots' training, included use of the X-20A space suit, pressurized (5 psi.) and unpressurized.

Wearing the suit in either condition did not decrease the occupant's efficiency, Rowen said.

Tests were additional proof of the effectiveness of the David Clark Co., Inc., spacesuit, which is now a firm part of the X-20A program. The Clark garment is one-piece and uses zipper closures, with separate gloves fastened at about mid-arm.

Separate gloves were chosen to obviate the necessity of discarding the entire garment should damage to the gloves be discovered while suiting up. Gloves also ease suiting procedure. Astronaut normally would not remove the glove portions during flight. Conventional flight boots also are used.

Helmet Design

Helmet design has not yet been finalized. Dyna-Soar program personnel are aiming for a configuration that will be fixed to the suit to provide zero torque on the pilot's head when he makes head movements. The design would also incorporate a fixed face plate, which on the current model would provide 110 deg. lateral vision, 8 deg. upward and 70 deg. downward vision.

Design makes for a large headgear which the pilots consider somewhat oversized. Helmet has demonstrated approximately 20-30 db. better sound attenuation than the helmet used on the A/P22-S suit.

X-20A suit also incorporates flotation capability not provided in the A/P22-S garment.

Dyna-Soar environmental control system (ECS) will provide a 46.5% oxygen and 53.5% nitrogen atmosphere for suit ventilation, pressurization and temperature control. The same gas mixture will be provided for cockpit pressure and ventilation. This mixed-gas ECS was selected in preference to a 100% oxygen system because it supports combustion less readily and is considered safer. Relative humidity will be controlled by a molecular sieve absorber in the cockpit, which will not be connected to the pilot's suit. Suit ventilation will be at the rate of 13 cu. ft./min.

Cockpit Pressure

ECS is so designed that an intermittent failure in the electrical system will not interrupt pilot breathing or pressurization gas supply. Design cockpit leak rate is .168 lb./min. With a .250 lb./min. pressurization supply, there is a constant leak rate allowing CO_2 to be dumped overboard.

Structure and cockpit cooling during re-entry will be handled by a circulating glycol/water system and the design calls for cockpit temperature throughout the mission to range from +35F to +160F even though parts of the spacecraft may heat up to 4,000F.

Ejection seat will be designed to function during subsonic flight. Since the X-20A structure is designed for +3.5g to −1g stress and thus is more susceptible to impact damage than a conventional jet fighter, the pilot will eject whenever landing on a prepared skid strip is not feasible.

Seat will be adjustable from two degrees forward of vertical, which the pilot will use while the X-20A system is in the vertical position prior to launch, to 13 deg. aft of vertical for horizontal flight. It is power-driven throughout the 15-deg. adjustment and can be set by the pilot at any angle in that range. Seat is designed and built by Weber Aircraft Co. and will undergo ejection testing on the high-speed track at Holloman AFB in Fiscal 1964.

Tests of the parachute system, including the seat survival kit and rescue beacon radio, are scheduled for this April at El Centro, Calif.

Seat will have a chaff supply which will disperse at ejection to provide a radar fix. A sofar bomb will also be fitted to detonate at a predetermined depth after a water landing.

New RCA rescue beacon radio will have five watt output, providing a signal over a 175 naut. mi. range at 20,000 ft.

In addition, the X-20A will generate a special signal in real-time telemetry if the pilot should eject.

Items scheduled for air-to-ground telemetry transmission will include blood pressure, respiratory rate and volume, electrocardiogram, pilot skin tem-

NASA Begins Biochemical Fuel Cell Program

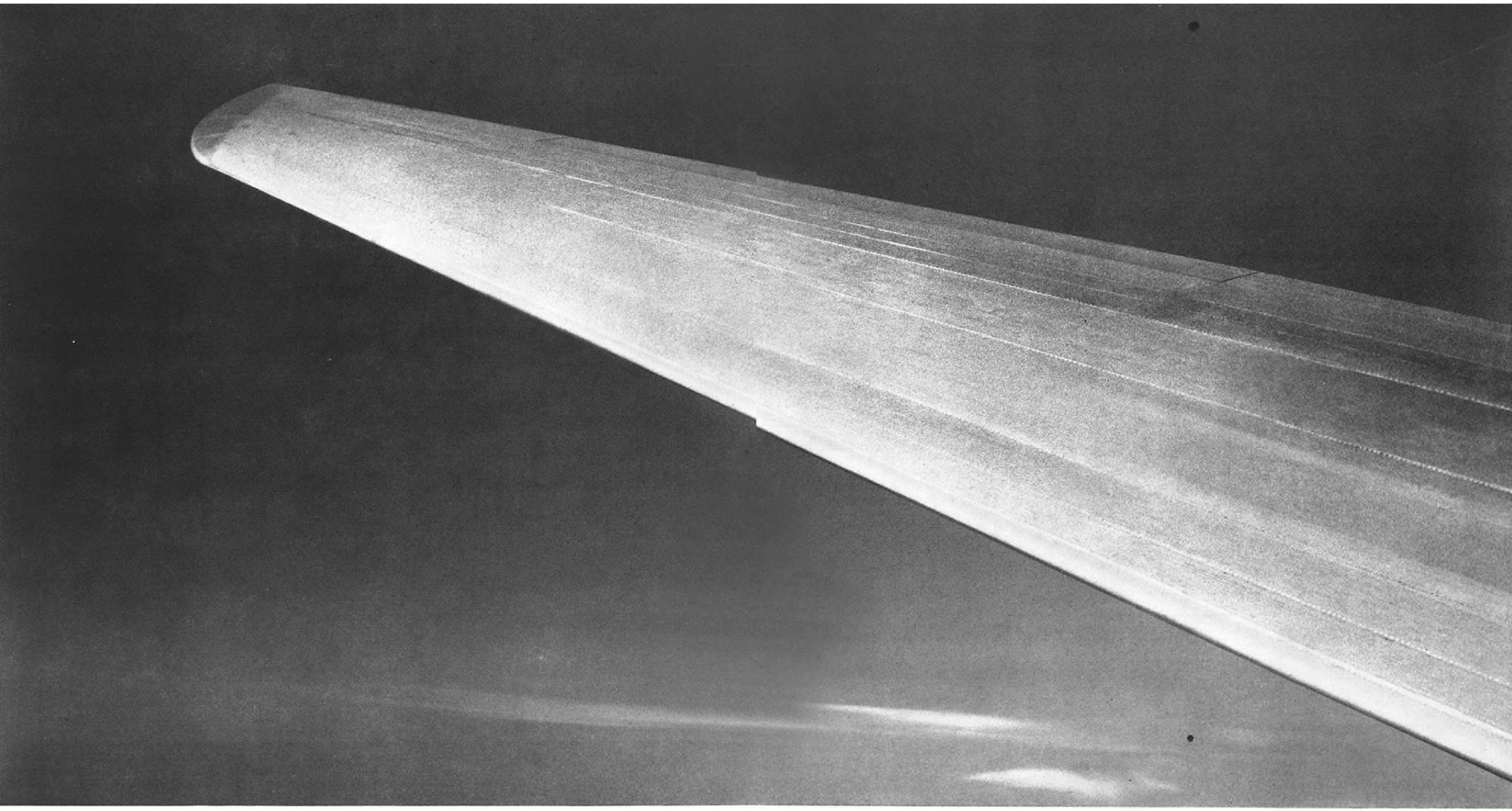
Los Angeles—Exploratory research program in biochemical fuel cells aimed at determining whether useful electrical power can be derived from human waste during long-term space missions will be initiated within the next several weeks by National Aeronautics and Space Administration.

Contracts totaling about $250,000 were being negotiated with three local avionics companies:

- Aeronutronic Div. of Ford Motor Co. will conduct a basic study of the electrochemistry of the reactants of human waste, urine and feces.
- Magna Products, a subsidiary of Thompson Ramo Wooldridge will empirically prepare a fuel cell using organic materials, such as urine and feces, to see if it is feasible to convert human waste to electrical energy. Magna has been conducting research in biochemical fuel cells under Navy sponsorship.
- Marquardt Corp. will try to devise an entirely new approach to the biochemical fuel cell and construct the necessary hardware for the experiment.

The three companies will exchange information on the progress of their efforts under NASA direction to insure useful cross-fertilization of ideas. A fourth effort, sponsored by NASA's Office of Advanced Research & Technology and under way at General Electric's Missile & Space Dept., will also be closely correlated with the three new biochemical fuel cell activities. General Electric's contract deals with waste management.

NASA feels that the need for the application of energy conversion from human waste, should this technique prove practical for space, would not materialize before the long-duration space missions of the post 1970s, according to Walter C. Scott, head of NASA's space power technology program. Scott reported on the program at the recent National Winter Convention on Military Electronics held here.



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To overcome this problem, Northrop has conducted a 14-year research program, and has developed a system called Laminar Flow Control. Row after row of paper-thin slots are put in the wings of an airplane. At the base of these slots are pinsize holes. A pumping system inhales the boundary layer air through the slots and holes and expels it to the rear. Swoosh! Eighty percent of the friction drag from boundary turbulence is gone.

Laminar Flow Control will make it possible to extend the range, endurance, or payload of large aircraft by 50% or more – with no increase in fuel consumption. Best of all, perhaps, is that it can be added at very nominal cost. And this initial cost is quickly recovered by economies of operation.

Laminar Flow Control is being applied by Northrop to two U.S. Air Force jet aircraft, which will be designated X-21's. These will be flown in 1963 to demonstrate the new technology. Results of these tests should radically alter the fundamental concepts of large plane design, economics, and missions. **NORTHROP**

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perature, suit pressure, suit ventilation flow rate (normally 1 cu. ft./min.), oxygen pressure, nitrogen pressure, cockpit pressure (7 psi.), cockpit temperature and ionizing radiation.

Bioastronautics support responsibility has been delegated to USAF Flight Test Center at Edwards AFB, under Dyna-Soar System Project Office supervision. General medical support director will be Col. Raymond Yerg.

Dyna-Soar program probably will require some major modification in the present ground tracking system, partly due to the fact that since it is a military-sponsored program, it may not be possible to utilize some NASA stations which have been sited overseas on the basis of that agency's civilian and scientific character.

Sources close to the project say that Dyna-Soar will utilize super high-frequency communications to overcome the blackout caused by formation of a plasma sheath around space vehicles during re-entry. Reason for attacking the communications blackout is that Dyna-Soar's re-entry profile would result in loss of communications using conventional systems for about 20 min. This is four times as long as has been experienced in the Mercury program, and is considered intolerable by USAF. These super high frequencies will require modification to existing range stations. Cost estimates are expected to be provided by Pacific Missile Range Mar. 21.

Structural drawings for the X-20A have been released to the shops. First airframe is scheduled to go to Wright-Patterson AFB. No boiler-plate configurations are planned; flights of even unmanned versions will be as close to piloted flight configurations as possible.

Only one unmanned orbital flight is scheduled. This will utilize the system's Minneapolis-Honeywell inertial guidance system. After re-entry, a Sperry drone control system adapted from the USAF's QF-104 target drone program will capture the Dyna-Soar for landing at Edwards AFB.

Components and systems testing already is under way. Minneapolis-Honeywell recently began flight tests of the X-20A inertial guidance system in a McDonnell F-101 over the Eglin Gulf Test Range; rocket sled tests of this system will be done at Holloman AFB. Guidance system has been improved by increasing the capacity of its memory drum.

Another F-101 is testing the side-stick controller at Edwards AFB and RCA communications gear also will undergo flight trials at Edwards AFB.

Nose-cap accomplished successful full-scale tests in December by Chance Vought. Nose-cap development back-up has been provided by Boeing. Cockpit geometry and equipment layout has been determined for single-orbit missions. Multi-orbit missions, which would utilize relight capability of the liquid-fueled trans-stage motor to circularize orbit, would require additional equipment.

X-20A has considerable capacity for stowage of additional expendables needed for multi-orbit missions. These could be placed in the transition stage —located between airframe and trans-stage.

Others would be located in the 75-cu.-ft. capacity payload compartment.

Soviet Optical Observation Program

Moscow—Program of optical observation of Soviet and American satellites has been drafted and is being carried out by the academies of sciences of seven Soviet bloc countries, according to Tass.

Dr. Alla Masevich, vice chairman of the Soviet Astronomical Council said that at present there are 90 optical tracking stations functioning on territory of the USSR. In 10 months of 1962, they carried out 47,600 observations of 11 Soviet and 12 American satellites. About 14,600 observations concerned Echo 1, according to the Soviet scientist.

Soviet bloc observation programs include USSR, Czechoslovakia, Poland, Bulgaria, Hungary, East Germany, and Mongolia. Czechoslovakia's time service will act as the single time service for all stations of the European Communist bloc, Masevich said. New stations for photographic observation of satellites will be established in Hungary, Mongolia, and the Far Eastern regions of the Soviet Union. This year stations of Hungary, East Germany, USSR and Czechoslovakia will carry out joint visual observations of Soviet satellites in the Cosmos series.

New stations are to determine changes in perigee height within short time periods. This work was described as "highly interesting" for the study of brief variations of atmospheric density at altitudes of 200,000-250,000 km.

Tass said the program of simultaneous photographic observations of the American balloon satellite Echo 1 had been worked out and would be implemented by a group of stations in the USSR, Czechoslovakia and Poland. "Dr. Masevich stressed that purpose of this program was to determine coordinates of both the satellite and of tracking stations," Tass said.

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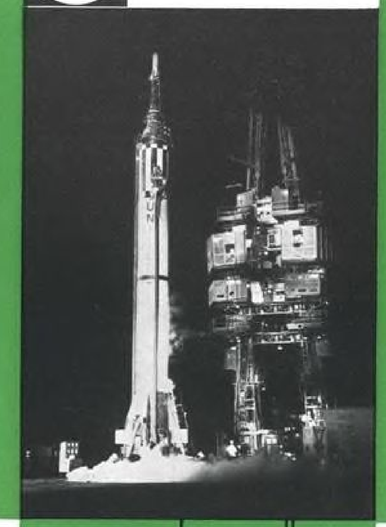

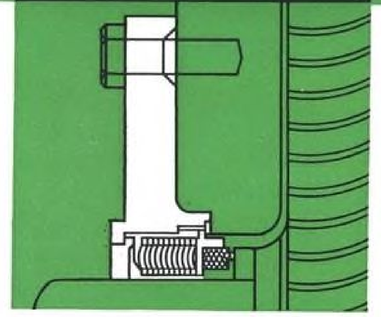

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$30-Million Space Test Facility To Allow Apollo Mission Simulation

Houston—Crews of Apollo and larger spacecraft will simulate operation of those vehicles and their personal equipment in a lunar mission environment in a $30-million test facility (AW Feb. 4, p. 55) to be built at National Aeronautics and Space Administration's Manned Spacecraft Center here.

Two environmental chambers within the facility will be built by a company selected in a bidding competition expected to begin late this month or in early March. Award will amount to about $4 million.

Facility will permit rotation of the space vehicle during mission simulation in a chamber to duplicate effects of solar radiation on the surface of the spacecraft. It also will enable crewmen in space suits to exit from the spacecraft and simulate lunar surface exploration, under conditions closely resembling an actual mission, to evaluate procedures and equipment.

Since the facility will expose humans to this hostile environment, it must be man-rated with control systems of extreme reliability to ensure their safety. An emergency recovery procedure will involve changing chamber atmosphere from a test environment approximating 10^{-5} in. Hg. to moderate altitude in about 30 sec., with provision for an airlock so that rescue personnel can enter the chamber to assist test subjects.

The 56,000-sq.-ft. facility will consist of a chamber building, administration structure and pumping building.

Chamber building, a two-level, relatively simple construction structure, will house two environmental chambers. One is the main vessel, 65 ft. in diameter and 120 ft. tall, domed top and bottom, with an opening in the side approximately 40 ft. in diameter for inserting or removing large test spacecraft up to 75 ft. long. The second vessel will be 35 ft. in diameter and 43 ft. tall, with a removable lid for loading Apollo command modules or other elements of the spacecraft system.

Cooling will be acomplished by pumping liquid nitrogen into cryogenic panels surrounding the chamber walls. Solar radiation will be handled by a system of Radio Corp. of America carbon-arc modules beaming their light into the chambers to radiate about 140 watts/sq. ft. on the test vehicle's sides. Approximately 24 to 30 hr. will be required to develop the lunar vacuum atmosphere in the large chamber. Design calls for maintaining these environments for mission lengths of 14 to 30 days.

Biomedical and environmental control system consoles will be monitored from a building connected to both the chamber and administration buildings.

Administration building, a 25,000-sq.-ft., two-story structure, will contain facilities for suiting up astronauts and test personnel similar to those in Hangar S at Cape Canaveral. Since the facility will have capabilities for simulating complete Apollo mission profiles from takeoff, data handling will be on a real-time basis, with voice and instrumentation data flowing constantly from within the chamber to personnel monitoring the tests.

Bechtel Corp., San Francisco, is acting as consultant to Manned Spacecraft Center in planning the facilities and preparing specifications for bidding. State-of-the-art is stressed in chamber equipment to hold down costs and maintain reasonable delivery schedules. Initial operation of the facility is being considered for late 1964, with full operation in early 1965.

Life Support System Proposals Are Asked

Washington—Space agency last week asked 18 firms to submit proposals for development of a life support system which could sustain four men from six to 12 months (AW Jan. 14, p. 28).

National Aeronautics and Space Administration's Langley Research Center sent requests for proposals to the Boeing Co.; Ling-Temco-Vought; General American Transportation Corp.; General Electric Corp.; Martin Co.; North American Aviation, Inc., Space Information Div., Downey, Calif.; North American Aviation, Inc., Los Angeles Div.; Republic Aviation, Inc.; Northrop Space Laboratories; Aerojet General Corp.; Garrett Corp.; Atlantic Research Corp.; Unified Science, Inc.; General Dynamics Corp., and the Bendix Corp.

Proposals for the space station-type life support system are due at the Langley Research Center by Feb. 26. Contract will cover research, design, construction and testing of a system that will provide a shirt-sleeve environment for up to 12 months, with resupply at 60 and 90 day intervals.

Other specifications include a demand of 2 lb. of oxygen per man per day, provided at a pressure between 10 and 14.7 lb. psi. (pressure on earth at sea level), storage of human wastes, removal of carbon dioxide and humidity from a 2,600 cubic foot cabin, and reclamation of oxygen and water.

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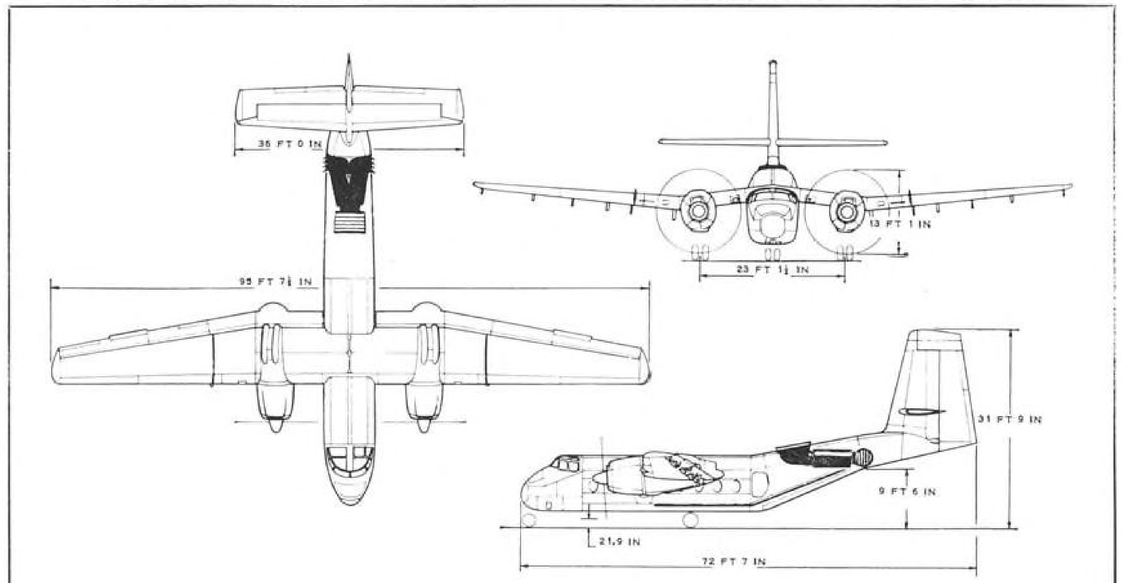

TWIN-JET REVERSIBLE THRUST package under development by de Havilland Aircraft of Canada is expected to give the Caribou utility transport a STOL capability of 600 ft. over a 50-ft. obstacle. Placement of the two J85s and thrust nozzles in upswept portion of empennage is shown. Reversible-thrust concept is outgrowth of de Havilland and Canadian Defense Research Board program.

Caribou Reverse Thrust for STOL Studied

By Donald E. Fink

TWIN-ENGINE OTTER CONFIGURATION is stage three of a STOL study using a single J85 reverse thrust engine. Two PT6 turboprops will give the Otter STOL capabilities of 400 ft. with 40 mph. approach speeds.

STAGE TWO OF STOL OTTER program marked first use of the reverse-thrust package, but with standard main engine. J85 intake is on top of fuselage at wing root.

Toronto—Twin-jet reversible thrust package, designed to improve the STOL capability of the DHC-4 Caribou utility transport by providing extra power for takeoff and reverse thrust for steep approaches and short landing rolls, is under development by de Havilland Aircraft of Canada.

Reversible-thrust concept is the outgrowth of a STOL research program which has been jointly funded by de Havilland and the Canadian Defense Research Board since 1956. Feasibility of using a jet engine for in-flight reverse thrust has been tested with a single General Electric J85 2,450-lb.-thrust engine mounted in the cargo compartment of a DHC-3 Otter.

Caribou package will be mounted in the upswept portion of the empennage, which will allow overhead clearance for the upward-swinging rear cargo door. Package will consist of:

- **Two J85 engines,** which will be canted out toward thrust deflection ports in each side of the fuselage.
- **Dorsal air intake** set flush on the forward portion of the empennage and feeding into a common intake plenum.
- **Standard J85 thrust diverter** to deflect the thrust from either engine to opposite exhaust port if one engine fails.
- **Vaned exhaust nozzles** which will

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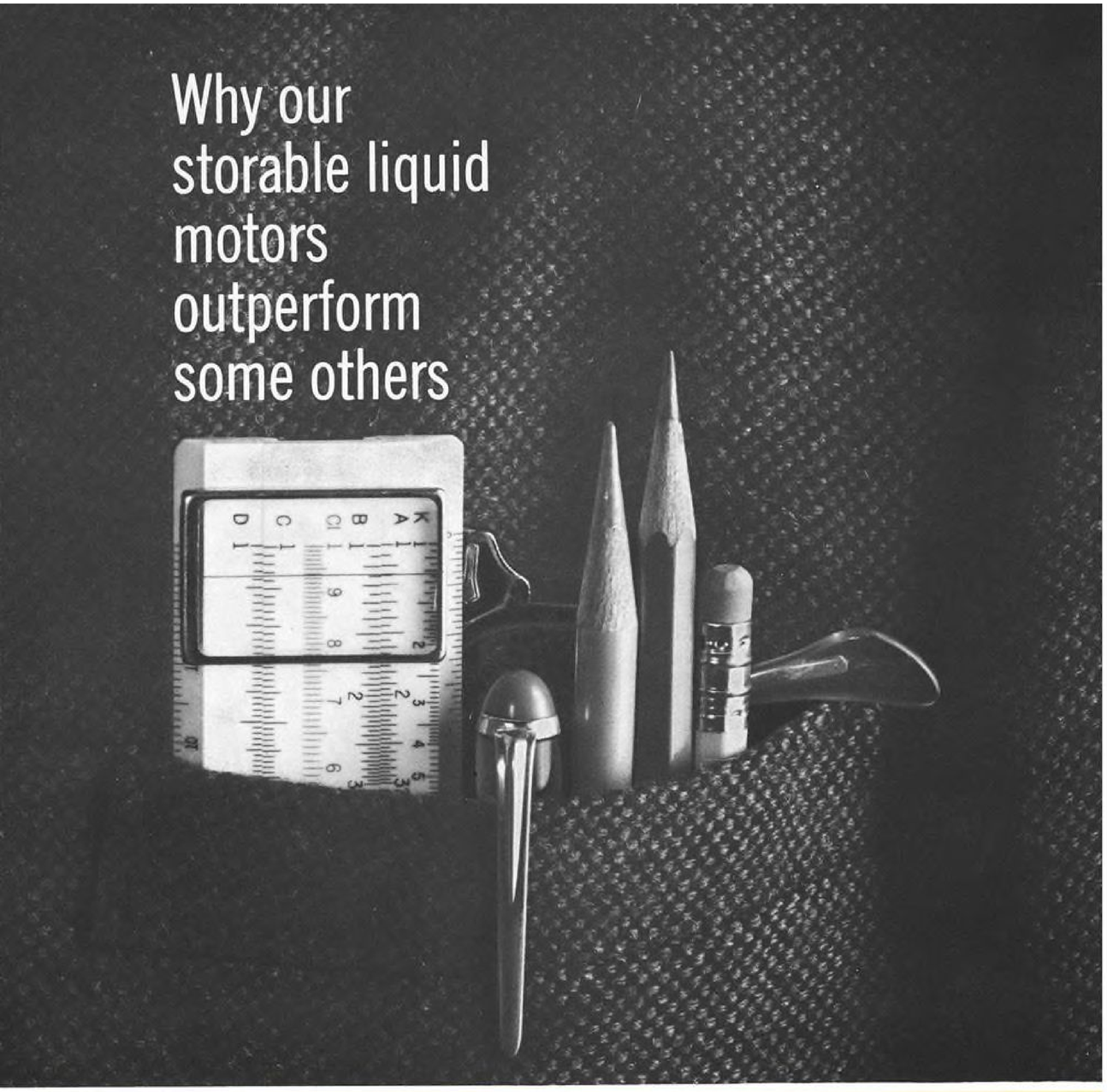

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permit rearward deflection of thrust for takeoff and forward deflection to control the rate of descent on steep approaches and for added breaking power at touchdown.

Takeoff and landing capabilities of 600 ft. over 50-ft. obstacles are anticipated in zero-wind conditions and at full gross weight of 28,500 lb. Steep approaches and short landing rolls will be made by using constant power settings on the main engines and varying the reverse thrust to regulate the rate and angle of descent. Full reverse thrust plus reverse propeller thrust will be used to shorten the landing roll.

Standard Caribou full-span, double slotted flaps and large tail surface area are expected to provide sufficient maneuverability and control during the slow, steep landing approach. Airflow over the control surfaces also can be improved during approach by increasing the main engine power settings and balancing the increased pull with reverse thrust to keep the approach speed down.

Boundary layer control studies also are being conducted, but BLC will not be used until control surface performance in the standard slipstream has been fully explored.

No major airframe modifications will be required to install the reversible thrust package, but extra JP-4 jet fuel tanks will be needed on the Caribou 1, which is powered by two Pratt & Whitney R-2000-7M2 piston engines. An integrated fuel system will be possible on the larger Caribou 2, now under development (AW July 23, p. 26), since it will be powered by two T-64-GE-1 2,850 shp. turboprop engines.

Funding for the Caribou program will be split between de Havilland and the Defense Research Board. De Havilland proposals currently are under study by the board, and a decision to begin the program is expected within the next few weeks.

De Havilland's Caribou 1 prototype probably will serve as the first testbed. U. S. Army also is reported interested in the reversible thrust package for possible application to its Caribou fleet.

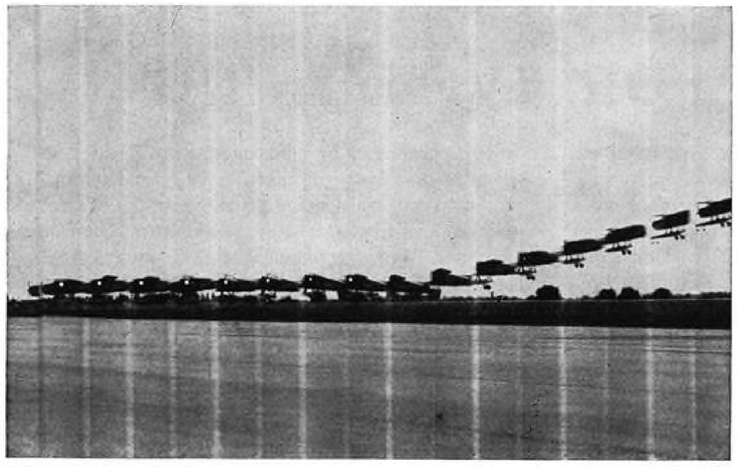
Otter J85 test-bed was first flown with its standard Pratt & Whitney R1340 piston engine, but now has been converted to a twin-engine configuration with Pratt & Whitney PT6 turboprop engines faired into the leading edges of each wing (AW Oct. 15, p. 23).

The engines, rented from Pratt & Whitney, are pre-production models and produce only 400 shp. De Havilland engineers plan to exchange them later in the program for improved PT6s which will produce 600 shp. on a standard hot day.

STOL performance on the single-engine Otter was doubled with the J85 installation. Normal Otter landing distance is 1,000 ft. over a 50-ft. obstacle in zero-wind conditions and with a maximum gross weight of 8,000 lb.

Average landing distance for the J85-equipped Otter under the same conditions was 496 ft., with approach speed of 42 mph. Ground contact was made about 210 ft. from the 50-ft. obstacle and approach angles varied from 18 to 20 deg. The shortest landing achieved was 376 ft. Takeoffs over a 50-ft. obstacle within 500 ft. posed no problem with the added boost from the J85.

Otter's engine placement and aft fuselage section were standard, but the tailplane was a modified configuration developed for an earlier STOL version which used large "bat wing" flaps to study the vectored slipstream approach to STOL operations. The twin-engine



TYPICAL STOL PERFORMANCE of single-engine Otter with reverse thrust J85 is shown in this split-frame photo sequence. Light at wing root flashes at touchdown. Steep approach and short landing roll are made possible with the reserve thrust.

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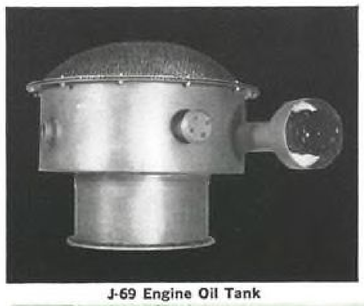
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version is the third configuration using the same Otter airframe.

Buffet zone created on the first version by the large flaps necessitated redesigning the horizontal stabilizer to give it a positive dihedral and raise it above the disturbed airflow (see photo below). The vertical stabilizer was then lengthened to balance the tailplane and improve its efficiency at low speeds. Boundary layer control also was employed by slotting the tail surfaces to channel airflow over them.

Slow flight performance of the vectored-slipstream Otter was improved with the new flap configuration, and stable flight was maintained at speeds approaching 50 mph.

Normal Otter stalling speed at maximum gross weight is in the 60 to 65 mph. range.

The vectored-slipstream studies comprised stage one of a three-stage program. When de Havilland engineers felt they had gathered sufficient data on the behavior of control surface airflow, they decided to explore the use of a reverse-thrust engine which would give the pilot positive control of the rate and angle of descent and permit accurate spot landings.

Basic vectored-slipstream concept has been continued, however, since control at the low approach speeds with the J85 version is maintained by generating sufficient airflow over the Otter's standard control surfaces with the propeller slipstream.

The same basic configuration was kept on the Otter when the J85 was installed, but the boundary layer control was abandoned since the reverse thrust component permitted higher main engine power settings to improve slipstream airflow over the control surfaces.

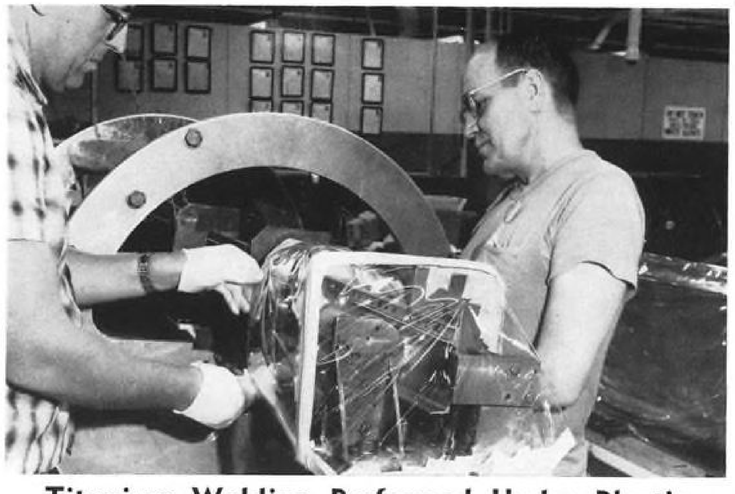
Landing gear on the STOL Otter is an adaptation of a standard float attachment, which was chosen for the first version as the easiest means of building a tricycle gear. This was done to shift the aircraft to a flying position on the runway and take best advantage of the vectored slipstream and ground effect. The configuration was kept on the second and third versions because it proved to be rugged and inexpensive.

The J85 engine in the reverse thrust versions of the Otter is set on the cargo compartment floor. The air intake is flush in the top of the fuselage just behind the wing root. The thrust deflection ports protrude from each side of the fuselage at floor level.

Thrust from the J85 is deflected equally to the two ports, which channel it into exhaust baffles parallel to the fuselage. An outer semi-cylindrical shell, resembling a sliding breadbox cover, is used to regulate the direction of exhaust flow from each port. For takeoff, the shells are rotated forward to cover the front exhaust openings and the thrust is deflected rearward.

On approach for landing, the main power setting is established and the exhaust port shells are rotated backward to deflect the thrust forward and create drag. The thrust is then regulated to prevent excessive buildup of speed during steep approaches. If added power is needed quickly, the shells can be rotated forward to give an immediate forward thrust component. At touchdown full reverse thrust is used to shorten the landing roll.

Caribou nozzle design has not been fully developed, but it probably will employ deflector vanes similar to those



Titanium Welding Performed Under Plastic

Low-cost method of blanketing titanium under inert gas during welding, developed by North American Aviation, consists of sealing part to be welded in 10-gage plastic sheeting, sealing the edges with masking tape and purging with argon.

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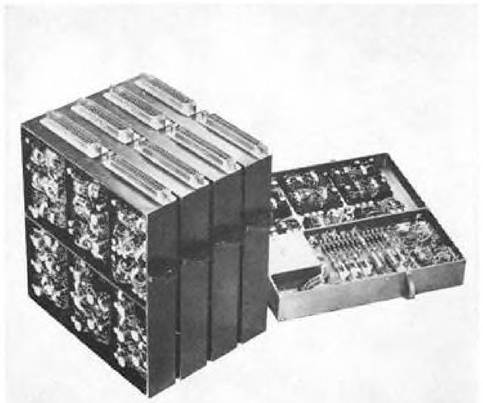
Computer Control Company performs successfully on Mariner II Program

Spaceborne Data Conditioning System handles over 5 million bits of scientific information on 109 day flight to Venus

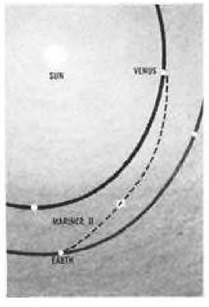


Spaceborne Data Conditioning System aboard Mariner II typifies Computer Control's ability to satisfy stringent size, power, reliability and delivery specifications for logic design, circuit and module development, fabrication and packaging. This fast real-time sampling, processing and control system gathered information from scientific instruments aboard the spacecraft and prepared data for transmission to earth. In addition, it controlled: (1) the scan of instruments sweeping Venus' surface, (2) calibration operation checkout, and (3), time sharing of scientific and engineering data in the telemetry system. Design to delivery: three months.

For over 10 years, Computer Control Company has designed, developed and delivered a wide range of special purpose digital systems for such applications as signal enhancement, information storage and retrieval, data conversion, digital positioning, industrial control, coordinate conversion. With this background and technical competence, 3C is equipped to supply specialized digital support systems for aerospace and ground environments.

Coordinate Conversion Computer at Goldstone positions antennas tracking Mariner II and other space vehicles

3C real-time Coordinate Conversion Computer at West Coast site continually positions 85-foot parabolic antennas to track orbiting satellites, as well as Mariner and other space probe vehicles. The antennas, computer and a microwave link form the closed loop system that tracked Mariner's 182-million mile journey through space. A similar system has been developed by 3C as part of an airborne tracking system designed to photograph missiles during re-entry.



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Simulation of space vehicle conditions, and associated instrumentation for spacecraft checkout requires high-speed data processing. The 3C DDP computer is designed to solve complex engineering problems involving real-time digital control techniques, simulation, data acquisition and reduction. In tandem with the 3C Digital Resolver — dual arithmetic unit — the system provides on-line solution of algebraic and transcendental functions. The DDP is particularly adaptable for real-time simulation in specialized hybrid digital-analog aerospace systems.

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used on the British Hawker P.1127 VTOL strike fighter.

Twin-engine Otter bears even less resemblance to the standard aircraft than the earlier configurations. The engines are enclosed in streamlined cowlings with the standard PT6 plenum intakes on the bottom. They turn three-bladed, aluminum Hartzell propellers with 8½-ft. blades. The propellers, which can be feathered but have no reverse pitch capability, are the largest ever used on the PT6 engine.

Nose engine compartment has been replaced with an elongated nose compartment which houses instruments for recording flight data and helps balance the aircraft. The wing is standard and was strengthened only at the root section to allow for the added weight of the engines.

Twin-engine conversion of the Otter, which will use the same J85 reverse-thrust package, was completed in about three months. Flight tests are scheduled to begin this month.

Decision was made to go to a twin-engine configuration to study further the effect of an improved slipstream on the control surfaces. The J85 installation in the standard engine configuration proved the feasibility of the reverse-thrust concept, but with limited forward power and slipstream generation capability, full potential of the J85 could not be explored.

Twin-engine Otter is expected to reduce the landing distance to an average of about 400 ft. with an increased maximum gross weight. Boundary layer will be explored again, later in the program, using bleed air from the jet engine to improve control surface efficiency further.

De Havilland engineers stress that the Otter conversions are strictly research and development projects and are not intended to produce an Otter STOL conversion package for widespread use.

Publication Planned For Scientific Reports

Washington—Institute of the Aerospace Sciences and Documentation, Inc., will abstract and index 40,000 scientific articles during 1963 in a program calling for publication of abstracts each week.

IAS will abstract 20,000 reports and publish them as International Aerospace Abstracts to be issued on alternate weeks. Documentation, Inc., effort, under a National Aeronautics and Space Administration contract, involves abstracting 20,000 articles and alternate week publication as Scientific and Technical Aerospace Reports, which will be called "Star."

Cumulative indexes will be issued quarterly by both publications.

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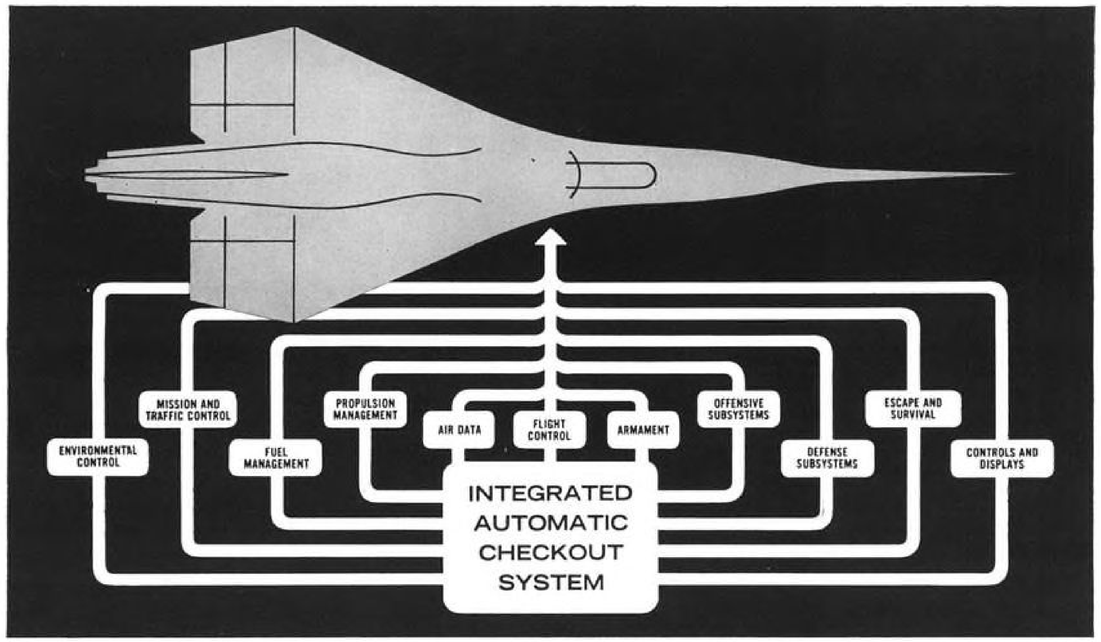
Will future Avionic Systems be maintenance liabilities?



All basic integrated avionic subsystems could logically be maintained with integrated maintenance equipment. This maintenance method would result in considerably more military operational capability per defense dollar.

Is industry meeting its responsibility to simplify avionic maintenance?

Industry's present method of designing military avionic systems has resulted in high-performance weapon systems with excessive maintenance requirements—from 60 to 150 maintenance man-hours for every flying hour. Since only a fully operationally ready weapon system is an effective one, this extensive downtime is a liability. It must be corrected before the weapon systems of the future are designed.

It is an industry responsibility to design weapon systems that provide a maximum state of readiness with a minimum of maintenance cost. To accomplish this, environmental orientation must be instilled into R&D management. These key steps should be followed:

(1) Establish avionics system management to provide unified technical direction and control integration and packaging of avionic subsystems so that they will function efficiently in concert with one another.

(2) Design avionics systems for maintainability. During the initial design phase, maintainability of the system should be given equal consideration with mission performance and operational environment. Maintainability should also rank with reliability as a factor in equipment design. Avionics system management would assure that:

- simple designs are used to reduce maintenance complexity
- built-in maintainability augments reliability
- concurrent design of the support equipment is compatible with the basic concepts of maintainability and operability

(3) Take advantage of technological advances to reduce the need for extensive electronic maintenance by providing high-performance avionics systems with greater reliability and maintainability.(See examples below on RF Fault Detection, Self-Repairing Circuitry and Micro Ace.)

We believe these concepts will prevent the complex electronic weapon systems of the future from becoming maintenance liabilities. Our experience in standardizing both manual and automatic maintenance equipment for different types of supersonic fighters—in addition to allied technological advances and management of military systems—firmly supports this conviction.

For more information on avionic systems maintenance, write Honeywell, Department 671-J, Minneapolis 40, Minnesota.

Radio frequency fault detection at Honeywell

A Honeywell-discovered method of detecting potential circuit failures will provide higher reliability for Honeywell-supplied systems for the Gemini and Apollo Spacecraft. The method has already been proven on the assembly line of Honeywell's F-104 Flight Control System.

Termed "Radio Frequency Fault Detection," the method provides a significant improvement in product reliability by locating potential failures that even X-ray tests would pass as perfect. The slightest imperfection in the electrical circuits generates an RF noise easily detected at approximately 25 Mc on an RF receiver. The test may be applied to entire systems as well as subsystems and components.

A Honeywell F-104 Flight Control System subassembly card is shown being tested by the RF Fault Detection method. The oscilloscope shows an intermittent RF noise produced by a faulty diode in the card.

Airborne computer monitors spacecraft systems in flight

Present-day checkout and maintenance equipment will not be practical for the spacecraft electronic systems of the future. A small, simplified unit carried aboard the craft will be needed.

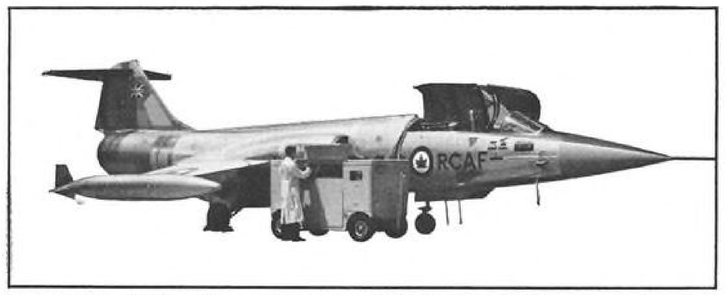
Such a computer, called Micro Ace (Microminiature Automatic Checkout Equipment), is being developed under a Honeywell-sponsored program which already has resulted in circuit designs capable of monitoring and isolating faulty components in a spacecraft's electronic system. The computer will permit astronauts to monitor systems and predict an impending failure far enough in advance so that faulty components can be replaced before the mission is affected.

Self-repairing circuitry may provide automatic repair of space systems

Honeywell is researching two ways of inducing circuitry to repair itself.

The first involves coating electronic circuitry with a special alloy. A small temperature rise at any break would cause the alloy to melt and flow into the break.

The second method (shown above) seeks to control the direction and growth of metallic whiskers (of the type that sometimes form on capacitor plates and produce short circuits) to effect a repair.



Honeywell's Automatic Analyzers provide standardization in performing avionic systems analysis and fault isolation on the Canadian CF-104 (above); U.S. Air Force F-101B; Royal Air Force Lightning; Canadian CF-101; German F-104G; Japanese F-104J; and NASA/U.S. Air Force X-15.

This advertisement is paid for by Honeywell, not from government funds. It is particularly addressed to companies seeking help in areas where Honeywell experience can be most useful.

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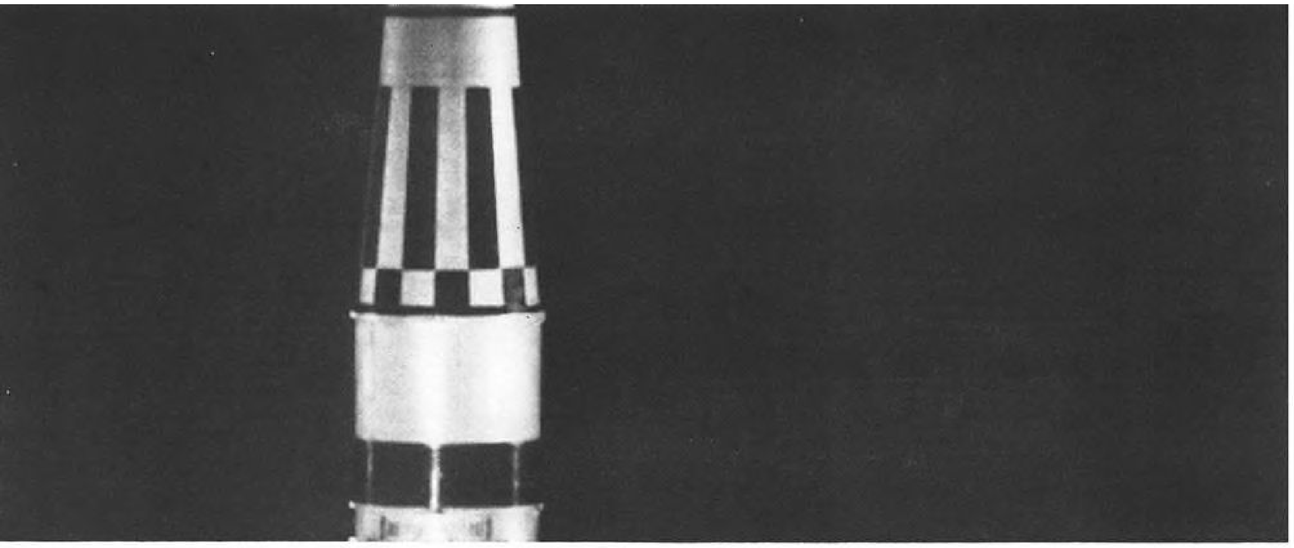

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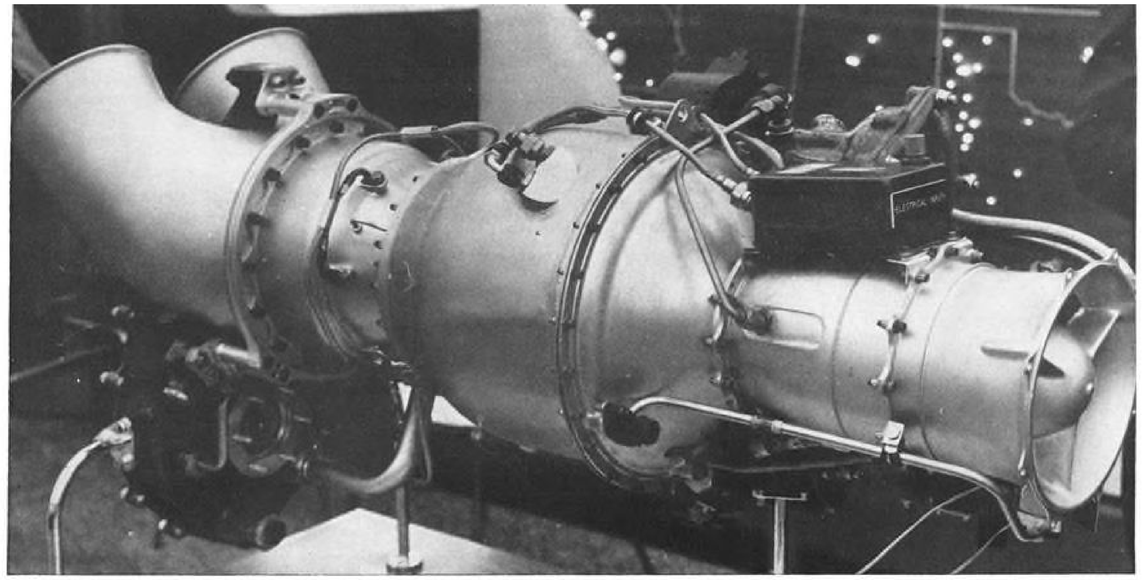


CONTINENTAL T65-T-1 turboshaft engine, due for its 150-hr. PFRT in October, has a flat 250-hp. military rating to 11,000 ft.

Continental T65 Passes 50-hr. PFRT

By David A. Anderton

Detroit—Continental Aviation and Engineering Corp.'s T65-T-1 turboshaft engine has passed its 50-hr. Preliminary Flight Rating Test (PFRT) and is scheduled to complete the 150-hr. PFRT this October.

The T65 has a military, or 30-min., rating of 250 shp. and is being developed as the alternate engine to Allison's T63 for the Army's light observation helicopter (LOH) program. Competitive evaluation of both engines is scheduled for next year.

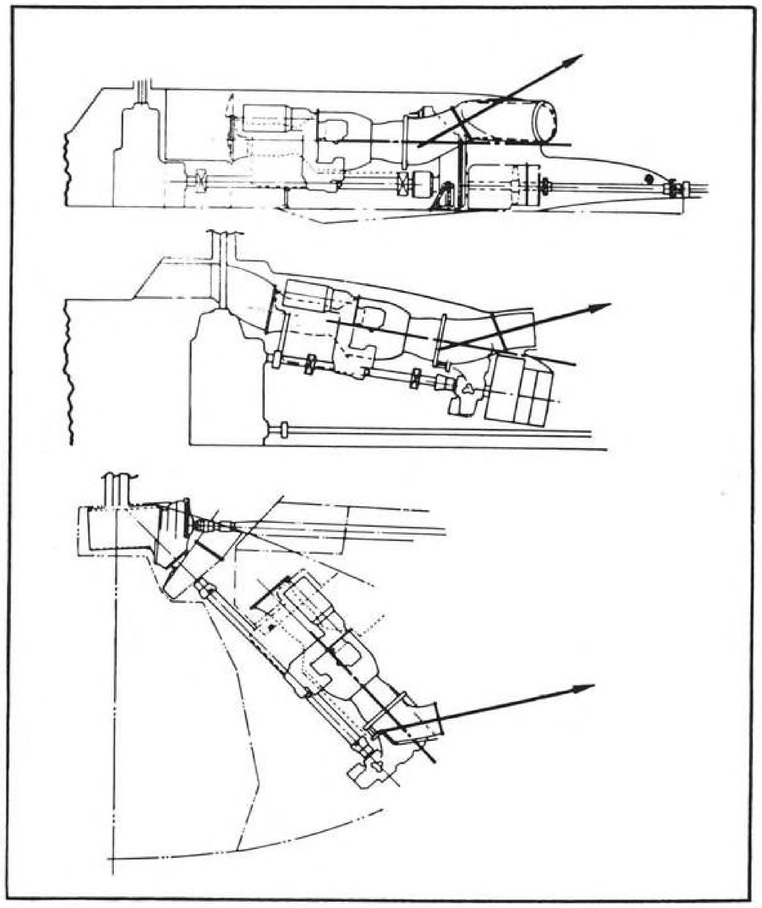
Development of the T65 is being financed by U. S. Army, under a contract between Continental and the U.S. Air Force which is responsible for monitoring the project.

The engine was designed to meet specifications of both the military and the Federal Aviation Agency, and the company has applied for a type certificate for the engine.

Time schedule for the T65 development was so short that no new aerodynamic development work could be planned. Instead, the Continental design team drew on its background and that of Societe Turbomeca, French aircraft engine firm, with whom CAEC has licensing agreements.

Geometric scaling of many of the major engine components has been credited by Continental as the shortcut that helped them meet the time schedule.

Layout of the T65 follows the familiar pattern developed by Turbomeca and Continental. Design point was chosen as 305 shp. at sea level so that the engine could be flat-rated at a con-



T65 INSTALLATION position and exhaust angles are shown for the three LOH competitors: Bell OH-4A configuration, top, Hiller OH-5A, center, and Hughes OH-6A at bottom.

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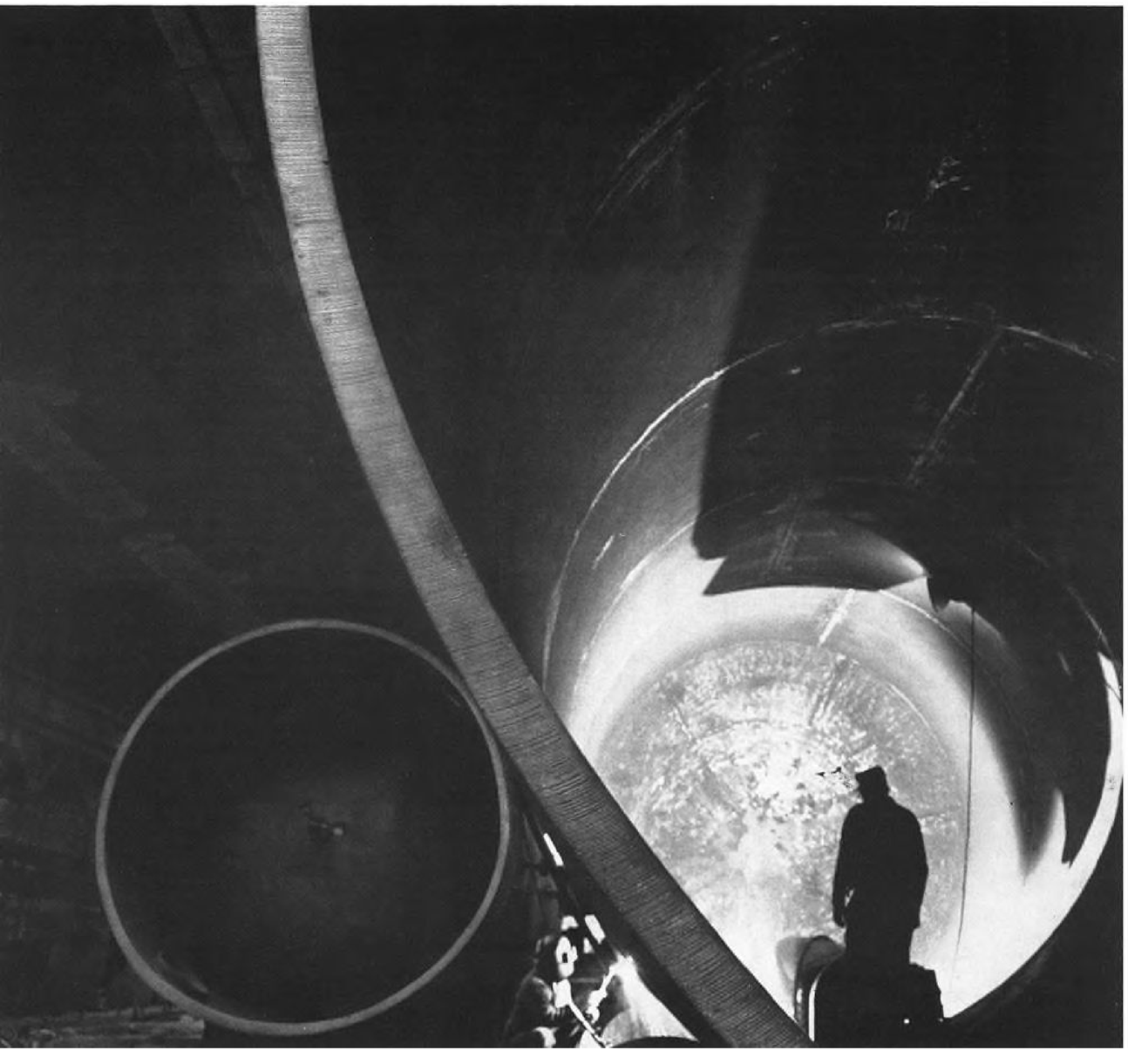

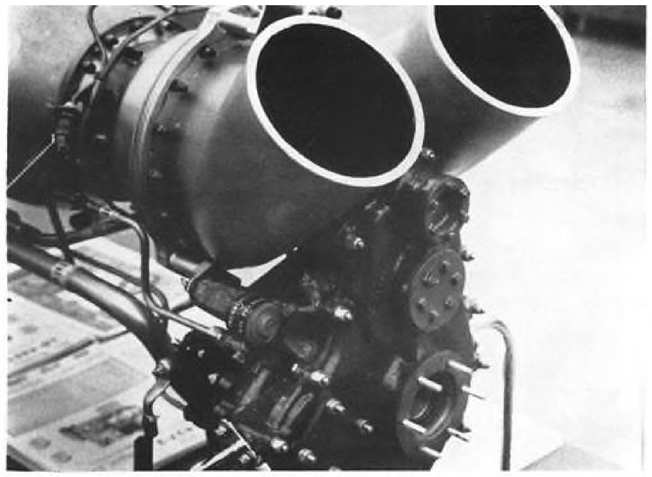

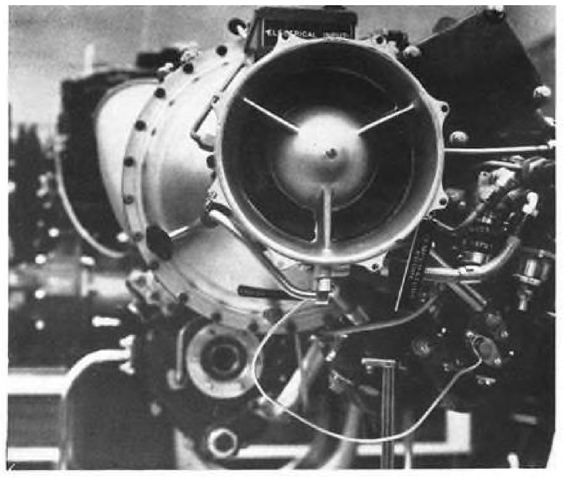

EXHAUST OUTLETS OF THE T65, left, are circular in section and angled at 45 deg. upward from engine centerline. Intake, right, is a single-entry modified bellmouth type. Engine has five power takeoff points for accessory drives, including one spare takeoff.

stant 250-hp. value up to 11,000 ft. This flat-rating of the engine also meant that it could deliver the full 250-shp. at sea level on hot days.

Air intake is a single-entry modified-bellmouth type. The engine air passes first through a single-stage, transonic axial-flow compressor and then through a single-stage centrifugal compressor before entering the annular combustor. Fuel is injected by a rotating fuel slinger.

Hot gases leave the combustion chamber and expand through a two-stage axial-flow turbine which drives the compressor by direct coupling. The exhaust then passes through a single-stage, axial-flow free power turbine which drives the output shaft through reduction gears.

Final discharge of the exhaust is through a pair of outlets angled 45 deg. upward from the engine centerline. Outlet nozzles are circular in section.

Power takeoff is at the rear of the engine; centerline of the takeoff is 7.57 in. below the centerline of the engine's rotating parts. Maximum envelope length of the T65 is 38.69 in., and the maximum width of the engine is 18.25 in. Over-all height is 19.06 in.

Weight of the powerplant is 130 lb. This figure includes the fuel pump and control, the lubricating-oil pump and filter, the ignition coil, leads and plugs, the thermocouples and their harness, and the usual engine lines and fittings.

Standard accessory drives include those for power-turbine and gas-genera-

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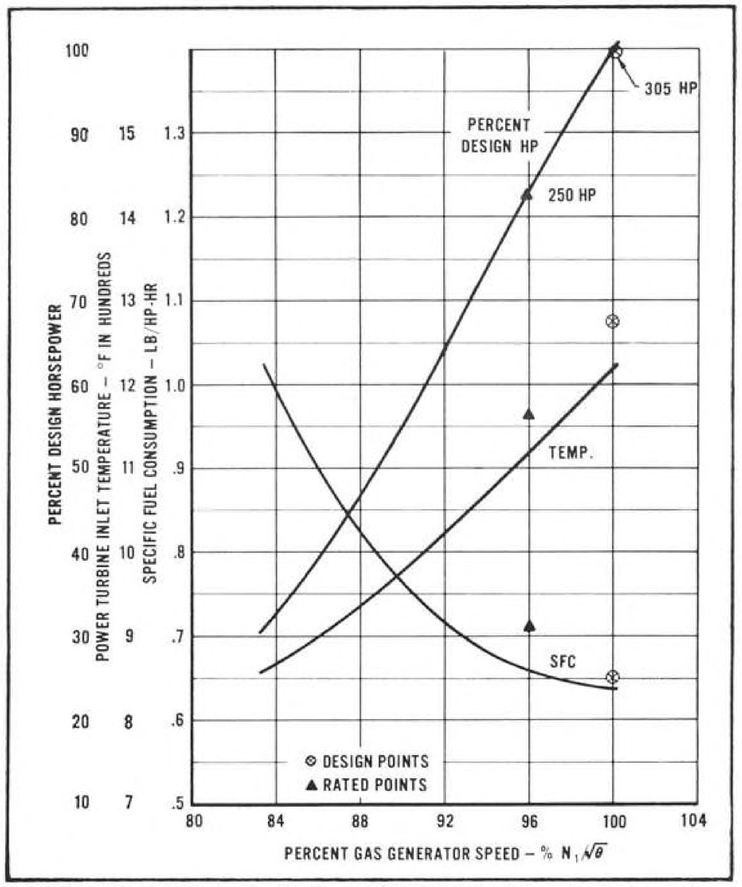

PERFORMANCE CHART for the Continental T65-T-1 turboshaft engine is shown above.

tor tachometers, the starter-generator, an auxiliary power takeoff, and also a spare.

Engine output shaft speed is 6,000 rpm.

By combining compressor bleed and flexible acceleration fuel scheduling, the designers were able to give the T65 a two-second response time from flight idle to maximum power output. Tradeoff of the bleed valve for reduced cost is possible, says Continental, but there is a "moderate sacrifice" in fuel consumption if it is done.

LOH Requirements

Accessories are grouped on one side in order to match the requirements of all three helicopters in the LOH program.

But Continental complains that the bulk and weight of the accessories and the drive assembly seem to be out of proportion to the engine.

The power-producing section of the T65 weighs only about 75 lb., while the accessories and their drive weigh 40 lb. With another 30 lb. added for reduction gearing, the importance of future weight reduction in these ancillary equipments is underlined.

Control system of the T65 uses a three-dimensional cam, permitting full freedom for scheduling the acceleration fuel flow as a function of speed, inlet air temperature and compressor exit pressure.

Military Need

Continental began the design of the engine in August, 1961, on the basis of a known military need, according to the company.

Requests for proposals were issued by USAF and Army in December, 1961, and CAEC submitted its proposed design the following month. The first experimental assembly ran as a complete engine in March, 1962, and during the same month, the Army selected the engine as its LOH alternate powerplant (AW Mar. 19, p. 39).

T65 had demonstrated both its design weight and performance by June last year.

First of the PFRT runs on the engine was made within 16 months after design began.

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Textron Forecasts Rise in Defense Sales

New York—Defense segment of Textron, Inc.'s, six basic manufacturing areas is forecast to rise to 34% of total company sales in 1963, largely due to increased helicopter business of Bell Helicopter Corp.

This forecast is based partly on a 50% increase in Bell Helicopter sales over 1962, resulting from Army UH-1B and UH-1B Iroquois deliveries, and orders for the Marine UH-1E version.

Commercial helicopter business is growing slowly, Textron Executive Vice President Harvey Gaylord told the New York Society of Security Analysts. Charter operators, a very weak area 10 years ago, have developed into a $55-60 million annual business, he said, with strong individual operators with large fleets. Commercial helicopter sales have not yet hit the steep part of their potential growth curve, Gaylord said, and he predicted a 10% annual average short-term increase.

Bell has no basic position in the large helicopter field, Gaylord said, and does not intend to gain one. Future objectives rather will be to consolidate the company's strong position in the small and medium size class.

Gaylord, who answered questions on Textron's defense business as part of an over-all presentation by Rupert C. Thompson, Jr., Textron chairman, added that all Textron defense operations were forecasting increased sales in 1963.

Total 1963 sales for Textron were estimated by Thompson at $600 million and he said the defense area is where the company's biggest growth potential lies. He also broke down the sales proportions for the company's six basic areas:

	1961	1962	1963 (est.)
Agrochemical	6	13	12
Automotive	18	17	15
Consumer	17	14	13
Defense	29	27	34
Industrial	15	16	15
Textile	15	13	11

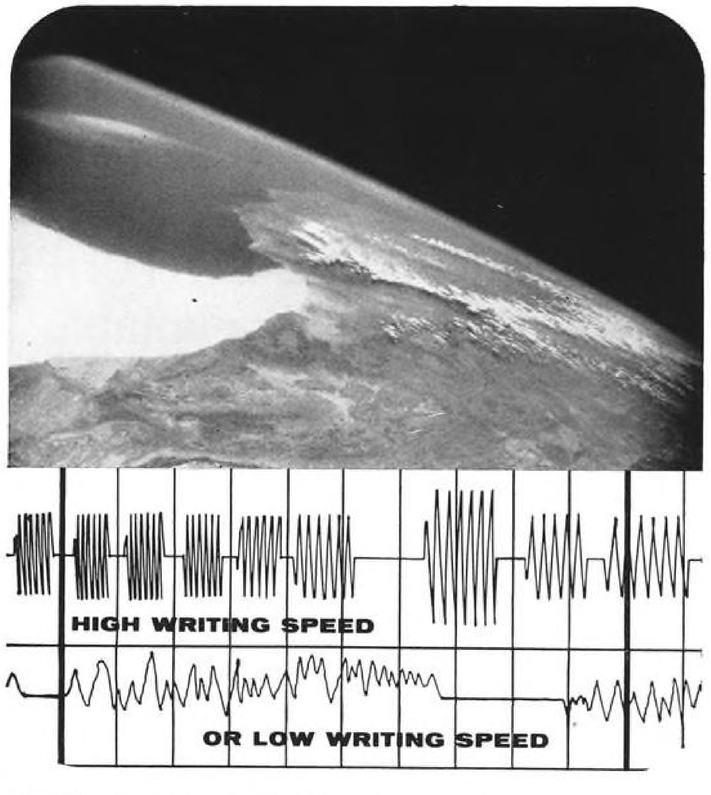
Profit contribution by each segment is approximately the same, although slightly lower in the traditionally low profit margin area of defense and textiles. Net earnings in 1963 should hold to about the same proportion as 1962—approximately 2.7% of sales of $550 million or $15 million after taxes. That would indicate approximately $16 million is expected in 1963.

Textron is attempting to increase margins through an organized campaign in the divisions in which results are reported quarterly. A fair return on equity—the money invested by the stockholder—is the main long-term objective, not margin on sales, Thompson said, but a short-range conservative goal as to sales margin would be 6%.

Textron's diversification plan, begun 10 years ago, was aimed at a 20% division of sales for each of what was then five groups. Shifts in this balance have occurred because of sales gains by such groups as defense, and none of the divisions has lost ground on a dollar basis, Thompson said.

Textron is most concerned with refining operation of the companies it has, but will consider acquisitions, probably those that would supplement existing product lines. Other points made:

• **Textron Electronics,** which is 75% owned by Textron, operated at a $1.4



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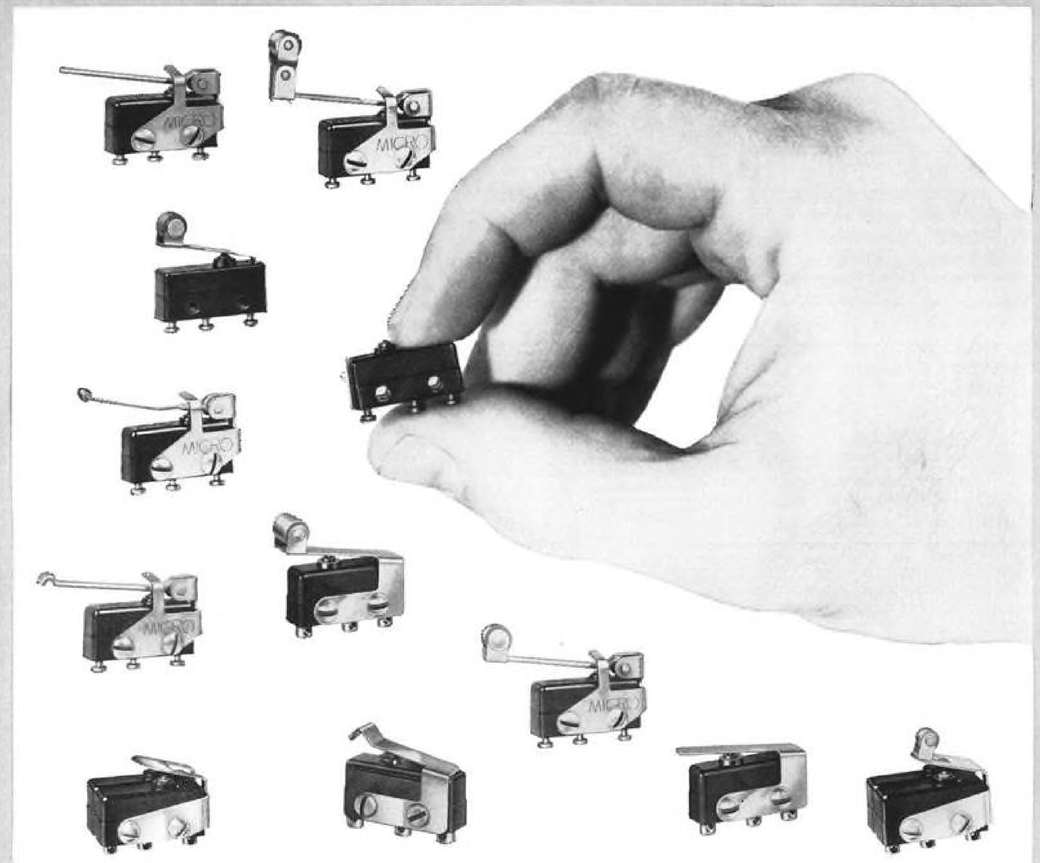

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Where space and weight limitations are critical, MICRO SWITCH "SM" subminiature switches bring a combination of compact size, reliable precision operation and broad range of actuators, assemblies and variations to meet a wide variety of design requirements.

Long, reliable life. Wide temperature ranges: −100° to +180° F. SPDT contact arrangement. Catalog listings also include types with extra long life and extra high temperature characteristics, gold contacts for low energy circuits, and bifurcated contacts—to name a few.

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million profit in 1962 after showing a loss of $800,000 in 1961. Sales volume of $28-30 million is forecast for 1963, and a profit is expected.

• **Name change** to better reflect the company's broadened interests outside the textile field has been considered. But the ideal name proved difficult to find, and it appeared to be easier to change the image of the Textron name that already is well known than to find and establish a new one.

PRODUCTION BRIEFING

Cluster of six Pratt & Whitney RL-10A3 engines was fired for the first time in a full-duration test at the Douglas Sacramento facility. This cluster will power the S-4 Saturn second stage being manufactured by Douglas.

Marshall Space Flight Center has issued invitations to bid on construction of a Saturn C-5 dynamic test stand to be located at Marshall.

Republic Aviation Corp. has been awarded a $136,640 contract to study over-all systems requirements for the NASA synchronous meteorological satellite (SMS), formerly called Aeros. Republic was one of 12 companies bidding for the study.

North American Aviation will build wind tunnel models of a swept wing airliner and an air inlet for supersonic studies by the National Aeronautics and Space Administration, under two $85,000 contracts.

Radio Corp. of America has been awarded a $3,690,000 contract from National Aeronautics and Space Administration's Manned Spacecraft Center for development of a solar simulation system to be used in environmental testing of the Apollo spacecraft. System will use carbon arcs to simulate the sun's radiation intensity.

Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc., is studying methods of detecting or preventing the placing of nuclear weapons in orbit under a $345,000 contract from the U.S. Arms Control and Disarmament Agency. Scheduled for completion in 1963, the study will assess existing verification techniques in terms of future arms control and disarmament needs.

United Control Corp., Redmond, Wash., has received contracts from Lockheed Missiles and Space Co. totaling $650,000 for development and production of programing and sensing devices for use in the Polaris A-3 missile.

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for 707's and Electra's

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The *Hardman Three - 2 Luxury Seat* is available new, or factory modified from your various Hardman models. Tooled for prompt delivery at considerable savings in price.

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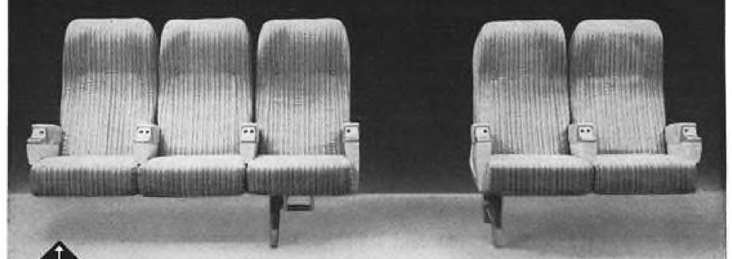

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PROBLEMATICAL RECREATIONS 158

The integers 1, 3, 8, N have the property that the product of any two when added to unity yields a square. What is N?

—Contributed

A number of positions of a challenging nature are presently available at our Guidance and Control Systems Division for engineers experienced in gyro development and gimbal system engineering. If you would like to contribute to the design of inertial systems components, and inertial technology generally, direct a résumé to Mr. J. T. Lacy. Applicants may expect immediate consideration.

ANSWER TO LAST WEEK'S PROBLEM: In order for two similar triangles to have two sides the same, the sides must be of the form pm^3, $pm^2 n$ and $pm n^2$ for the first triangle and $pm^2 n$, $pm n^2$ and pn^3 for the corresponding sides of the second. The difference between the two sides not common to the two triangles is, therefore, $p(m^3 - n^3)$. The only solution of $p(m^3 - n^3) = 387$ in positive integers is $p = 1$, $m = 8$, $n = 5$. The triangles, therefore, have sides of 512, 320, 200, and 320, 200, 125.

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(Photo 2¼ times actual size)

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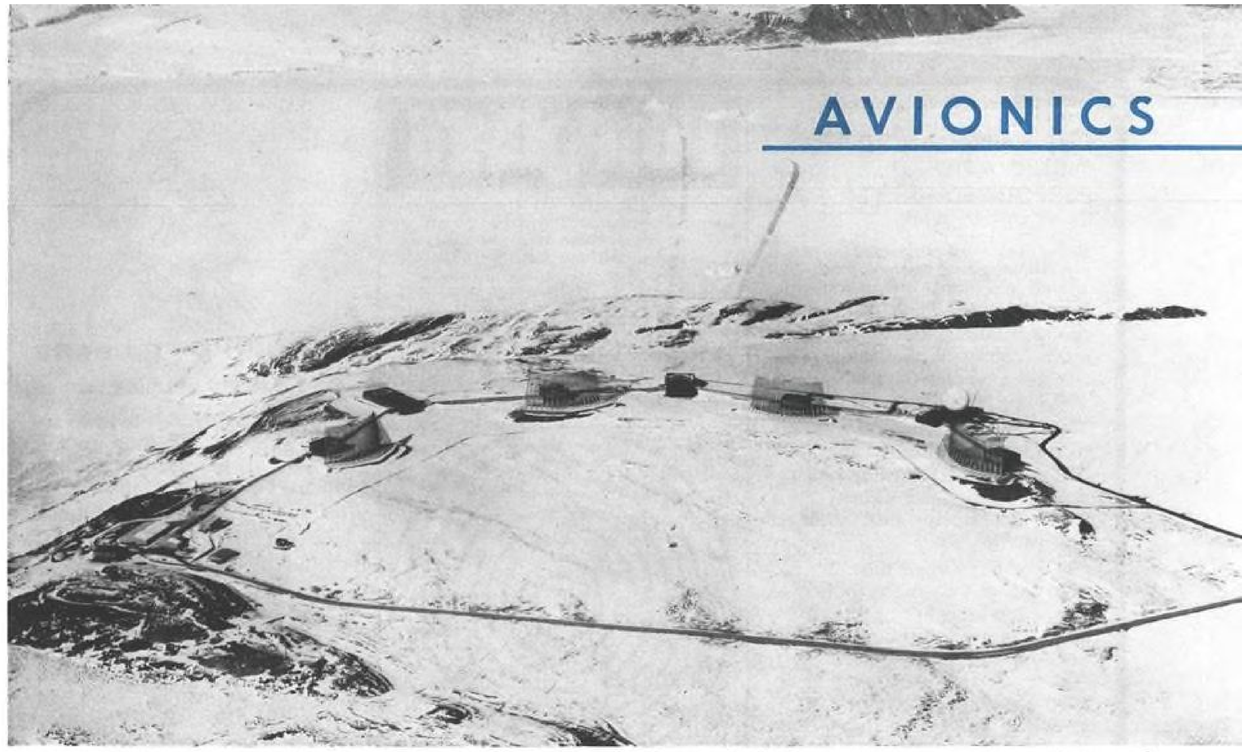

SPADATS SPACE SURVEILLANCE SYSTEM obtains satellite sighting data from hundreds of sensors but leans heavily on sightings made by Ballistic Missile Early Warning System radars in the Arctic and similar radars elsewhere. White dome in photo (right) is the tracking radar recently installed at Thule, Greenland BMEWS station. New British BMEWS will have three such radars which will be used both for surveillance and tracking. British BMEWS will become operational this summer.

Spadats Network Relies on Varied Sensors

By Philip J. Klass

Ent AFB, Colo.—In the five years since Sputnik 1 initiated the space age, the North American Air Defense Command (Norad) has assembled an effective space surveillance network using a variety of sensors, many of which were never designed for such purpose. The network is known by the acronym of Spadats—Space Detection and Tracking System.

For example, the Air Defense Command's Ballistic Missile Early Warning System (BMEWS) radars in Greenland and Alaska, in addition to their intended role, are primary sources of data on Soviet and U.S. satellites.

Other BMEWS type tracking and/or surveillance radars at Laredo, Tex., Trinidad, Shemya, Aleutian Islands and at the Radio Corp. of America Moorestown, N. J. plant also play key roles. Unmentioned by Norad officials are classified sensors such as the BMEWS type radar in Turkey and those established for Discoverer, Midas and Samos satellite programs.

Navy's Space Surveillance System (Navspasur), the electromagnetic fence which stretches across the southern part of the U. S., is another key Spadats sensor for detecting and obtaining fixes on non-cooperative satellites which pass over the U. S. (AW Nov. 26, p. 52).

Other principal sensors include the Smithsonian Astrophysical Observatory's Baker-Nunn telescopic camera network, particularly the installations at Cold Lake, Canada, Oslo, Norway and Edwards AFB, Calif. For U. S. launched satellites, the National Aeronautics and Space Administration's Minitrack network is a vital input, as well as the Atlantic and Pacific Missile Ranges.

Canadian government's Prince Albert Laboratory radar, damaged by fire several years ago, soon will become a sensor for Spadats. Nike Zeus radars installed in the Pacific for tests on the ICBM defense system also are used to detect and track satellites when their regular workload permits.

Periodically reports are received from some of the hundreds of independent scientists or universities around the globe, many of them operating with relatively inexpensive sensors. The total of sensors feeding data into Spadats is around 670, Norad officials say.

During the month of December, Spadats obtained 159,000 individual satellite sightings, equivalent to one every 17 sec. around the clock.

Norad officials acknowledge the desirability of having additional sensors which would enable it to detect and track Soviet satellites more quickly regardless of their launch site or inclination. But generally they say that Spadats suffers from too much data, not from too little. The pressing need is to be able to process incoming data more rapidly, to more quickly identify and establish orbital parameters for new Soviet spacecraft.

Opinion here is divided over the liklihood that the USSR would attempt to put thermonuclear weapons into orbit. But until such time as the U. S. has the ability to inspect Soviet satellites, there is full agreement that we must rely upon keeping a precise catalog of unknown satellites to watch for any sudden build-up which would suggest a hostile move from space.

Spadats obtain satellite sighting data from three classes of sensors, of which only the first is under Norad's operational control:

- **Spadats sensors,** consisting principally of Air Defense Command's Spacetrack

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62 SECOND MAZE: *Synchronize your watches: you have exactly 62 seconds to get from A to Z. 3, 2, 1 . . . GO!*

FINK* RATE GYRO

Squeals on Gemini Booster Systems

Translation: Giannini rate gyros will be used on the Gemini launch vehicle. Each gyro package will detect excessive rate of change in the launch vehicle's attitude and activate an abort system through the modified TITAN II's malfunction detection system.

If—NASA forbid—a Gemini launch goes sour, there'll be at least two men glad that Martin-Baltimore put Giannini on the team to squeal on any malfunctioning booster systems or components.

**FINK: Dates from 1892 Homestead Strike; guard, detective, informer, squealer, or stool pigeon.*

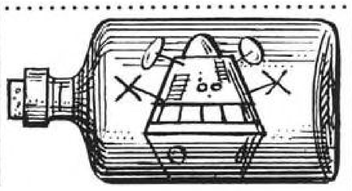
GIANNINI'S AIRBORNE STICK-SHAKER

Multi-engine aircraft used to vibrate when approaching a stall. Now, the big new jets can fly right into one. No vibration; no warning. Just all of a sudden, you're in the Twilight Zone.

Giannini's engineers went to work on the problem by discarding the old warning standards: airspeed and stagnation point sensing. Instead, they concentrated on the true parameters of jet stall: angle of attack and flap setting. That's how our stick-shaker Stall Warning was born.

Today, a Giannini-equipped jet makes no unscheduled VTOL's because of a special electronic/electromechanical system that constantly monitors the lift-determining factors of flap setting and angle of attack. When the stall point is approached, the system shakes the control columns, approximating the old aerodynamic warning vibration.

For details, ask a Cargomaster pilot. Better yet, ask Giannini.



MULTIPLE SPECS ARE FOR THE BIRDS

Pressure transducers about 1″ in diameter and 1.6″ long are fairly easy to find. Some are hermetically sealed. Some take 35 G vibrations. Some have dynamic error bands down around 1%.

However, big birds like Saturn or Thor Delta need all of these in a single package. That's why a certain leading transducer manufacturer, located in Duarte, California, has found an ingenious way to make a small, light, accurate, vibration resistant, hermetically sealed potentiometer output pressure transducer that withstands corrosive media and has a range of 0 to 10 psia minimum to 0 to 350 psia maximum. As a result of this accomplishment, you'll find about 16-dozen of these multiple-spec beauties on every Saturn booster.

If you're interested, the name of the company responsible for this measurement *tour de force* and complete specifications on their 451319 pressure transducer will be supplied on request.

SATELLITE STATUS BOARD at North American Air Defense Command's Space Detection and Tracking System Operations Control Center, Colorado Springs, displays tracking information on all man-made objects in earth orbit. Closed-circuit television pipes information to central display area at Norad Combat Operations Center.

network, Navy's Spasur and the Cold Lake telescopic camera operated by the Royal Canadian Air Force.

• **Other military sensors,** which have primary missions other than Spadats, such as the Atlantic and Pacific missile ranges and the radar in Turkey used for intelligence purposes (AW Oct. 21, 1957, p. 26).

• **Non-military sensors,** such as NASA's Minitrack network, the Smithsonian camera network, and university/scientific facilities.

The relationship of ADC's spacetrack network, consisting entirely of Air Force sensors, to Spadats is the same as the Air Defense Command's relationship to Norad. At times it is difficult for an outsider to distinguish the lines of demarcation because Air Force "blue suiters" predominate. The situation further is complicated by the fact that the Spacetrack computation center calculates orbital parameters for both Spadats and Norad.

Responsibility for operating Spacetrack, for providing the bulk of the Spadats service, for operating BMEWS and other major radar sensors is assigned to the 9th Aerospace Defense Division (ADD) of the Air Defense Command, under Col. Robert W. Waltz. Col. Harold G. Lund is vice commander.

The 9th ADD was organized in July, 1961, when the Spacetrack function was made an operational one and transferred from the USAF's Electronic Systems Division, Hanscom Field, Mass. The principal elements of the 9th Aerospace Defense Division, the first Air Force group to be assigned an operational mission in space, include:

• **71st Surveillance Wing,** under Col. Robert L. Harriger, is responsible for operating the BMEWS stations in Alaska and Greenland and has a detachment in Britain for initial operation of the third station at Fylingdales.

• **2nd Surveillance Squadron,** recently formed but not scheduled to become operational until July, will be responsible for operating other major Air Force sensors, such as the radars at Laredo, Shemya and Moorestown.

• **1st Aerospace Surveillance & Control Squadron,** under Col. Robert Miller, is responsible for operation of terminal data processing and display facilities for ADC's Spacetrack Center, for Norad's Spadats Center as well as for BMEWS ballistic missile defense function. Additionally, the 1st is responsible for terminal display of the output of the national bomb alarm system, developed by Western Union, and will have a similar role in the nuclear blast detection network, known as Nudets.

The 1st Aerospace Surveillance and Control Squadron's space surveillance responsibilities are to accept data on the thousands of incoming satellite sightings, convert it, where required, into a standard format suitable for processing by a Philco 2000 computer to maintain a running inventory of every object in space. An equally important function is to calculate the time when every satellite will pass within range of each major sensor in the network and its azimuth/elevation angle for that location during the pass to enable each sensor to quickly acquire and track the satellite.

Additionally, the Spacetrack Center here prepares a general bulletin giving orbital parameters on all unclassified satellites for use by non-USAF facilities. These do not give specific "look-angle" information for each of the hundreds of non-USAF sensors, but it is relatively easy for scientists at any location to calculate equivalent information from these general bulletins which usually cover a two-week advance prediction of satellite parameters.

Satellite sighting data from the two

BMEWS Confidence High

Ent AFB, Colo.—Soviet Union in launching the space race unwittingly strengthened U. S. defenses against a surprise ICBM attack. The hundreds of satellites and other objects in orbit which regularly penetrate Ballistic Missile Early Warning System radar beams serve to exercise the system almost continuously and to build confidence in the credibility of its warning.

Performance and reliability of the BMEWS system has been "outstanding," according to Air Defense Command officials here. This tribute is significant because the facilities were designed and installed on a crash-program basis.

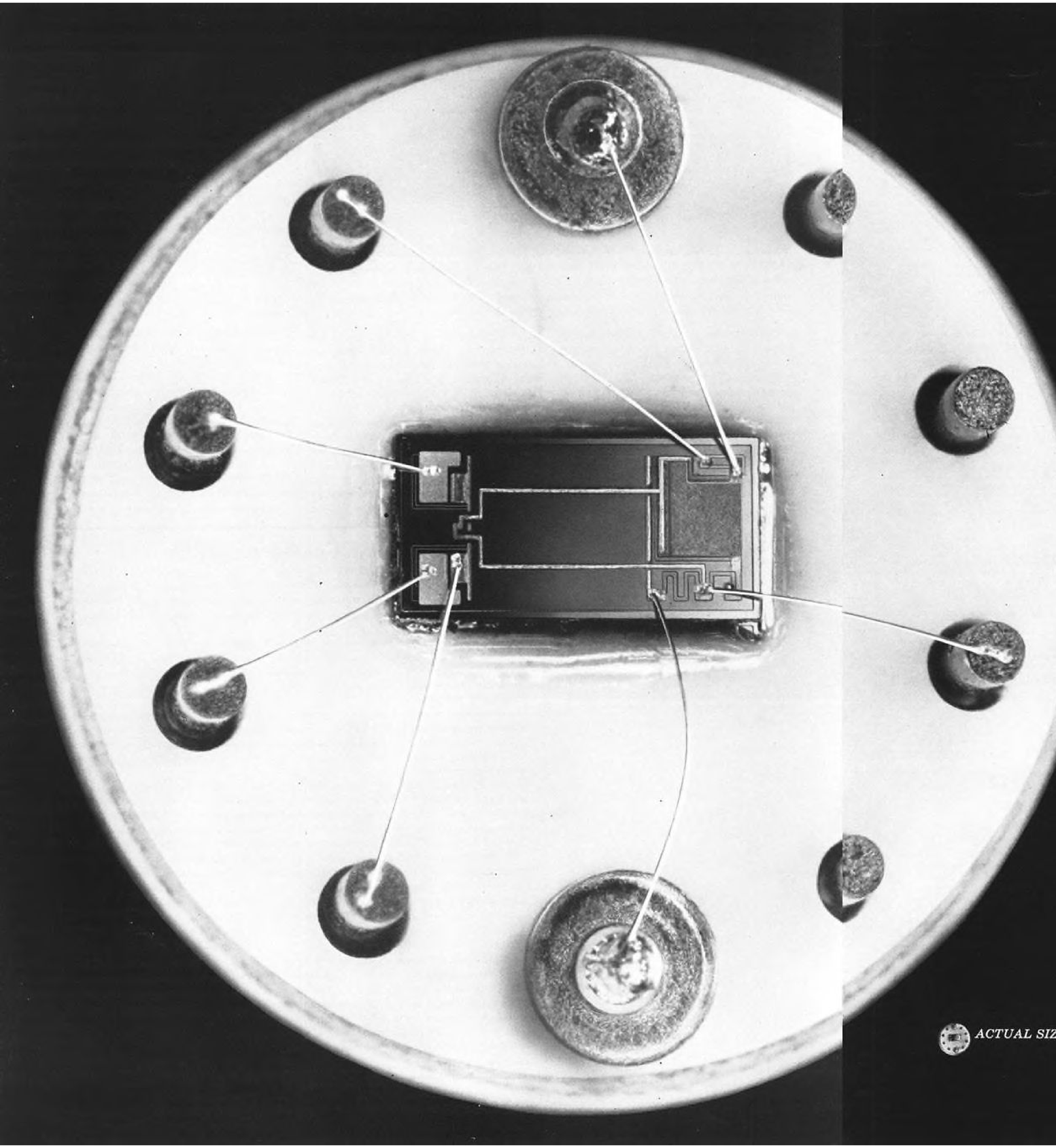
Except for the false alarm which occurred in October, 1961, shortly after the Greenland station went into operation, when signals bounced off the moon and the computer was not programed to disregard such echos, the system has performed without incident. Its ability to detect enemy countermeasures has been improved.

Two geographically dispersed digital data link circuits which connect the Alaska and Greenland stations with Norad's combat operations center here are continuously monitored to assure circuit continuity and operation. Once every 24 hr. the system is given a complete operational check-out by means of taped programs, simulating an enemy ICBM attack, which are introduced at the two existing BMEWS sites. These check the system performance except for the radar transmitters and receivers which remain operational during the test. If an attack were detected during the test, the system automatically reverts to its operational status.

Radar echos received at each station are processed at the site to discriminate between ballistic targets and non-threats such as satellites, meteorites, aurora and the moon. Any target which qualifies as a threat is instantly displayed here on a huge projected map of the northern hemisphere, as well as at Strategic Air Command Headquarters and at the War Room in the Pentagon.

Norad and SAC displays show the approximate area from which each ICBM has been launched and its estimated area of impact as well as the time of impact for each warhead. A small display console here at the Norad center continuously shows the operational status of every element of the two BMEWS stations, including such things as the presence of echos from aurora or enemy countermeasures.

The duty officer here, a member of the 1st Aerospace Surveillance and Control Squadron, can pick up a telephone and instantly talk to either Arctic station via dual voice circuits, one using submarine cable, the other tropospheric scatter radio communications. For secure communications, there are two encrypted teletype circuits.



SCIENTISTS AND ENGINEERS: Today's electronic systems for military and space programs demand smaller, lighter weight equipments with lower power consumption and the highest order of reliability. These needs have forced a marriage of the best features of advanced semiconductor and thin film integrated circuit techniques, and resulted in such functional electronic blocks as the tiny compatible circuit shown at left.

This is but one example of how Motorola scientists and engineers are enhancing their leadership position in integrated electronics.

To implement dynamic integrated circuit applications programs jointly funded with each of the three services, NASA and other government agencies, we can offer immediate opportunities to both systems and equipment design engineers experienced in the following areas:

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Integrated circuits...key to improved reliability

Specification of design constraints imposed by integrated circuits, trade-off analyses for integrated electronic implementation, and electronic systems specification and optimization, microminiature transistor circuit design, special solid state and semiconductor device utilization, computer-aided circuit design, and subminiature packaging techniques, including thermal considerations or basic training in the solid state sciences.

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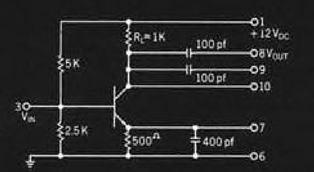
ACTUAL SIZE 120 mc RF high frequency linear amplifier integrated circuit custom built by Motorola's Semiconductor Products Division.



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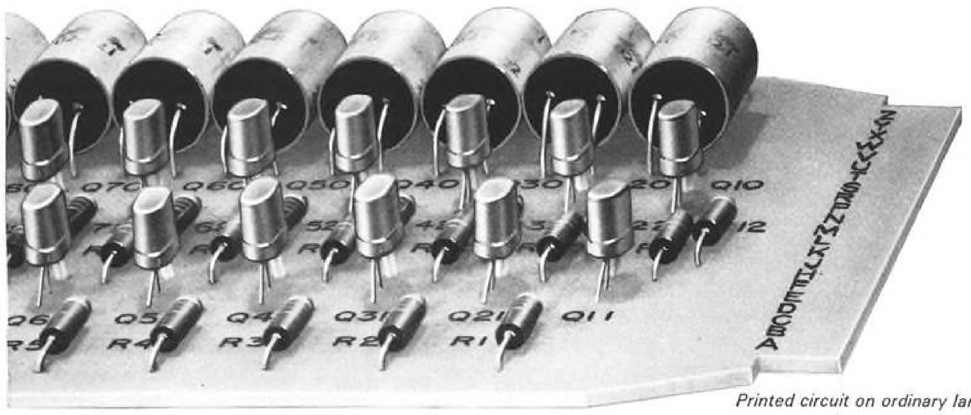
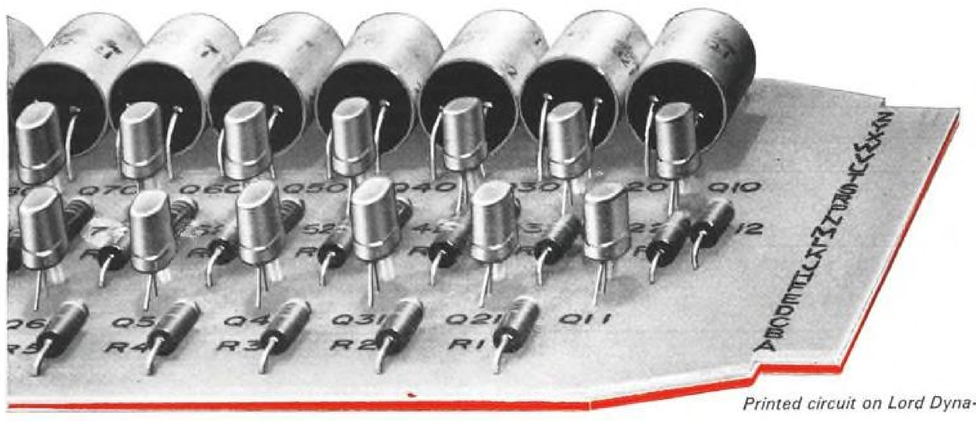


Printed circuit on ordinary laminated board



Printed circuit on Lord Dyna-damp® board

The difference is reliability
The reason is Lord Dyna-damp®

We don't make printed circuits. But we do add reliability to them with Dyna-damp laminates. ■ The circuits shown here—visual twins except for the damping layer—are far different in performance. Random vibration tests by a leading electronics firm showed that Lord Dyna-damp boards reduce the acceleration response level on the components by a factor of 5 or more. ■ The reason for this superiority is Dyna-damp's integral damping medium which dissipates vibratory energy and controls resonant response. The result is built-in reliability. ■ To add this kind of reliability to your printed circuits, contact: Lord Manufacturing Company, Erie, Pa. Field Engineering Offices in principal cities. In Canada: Railway & Power Engineering Corp., Ltd.

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BMEWS stations is provided by the Norad display information processor (DIP) here which actuates a punched-tape machine. From other major Spacetrack sensors, the data comes in to a communications center by teletype, sometimes encrypted. Sightings from foreign scientists or universities may come in by mail. About 90% of the data, fortunately, comes into the center here either in a form standardized by Norad, or other standard which can be easily converted to punch cards and then converted to magnetic tape for introduction into the Philco data processor.

Each observation for every satellite is fed into the computer memory, which can store up to 500 observations for each spacecraft, according to Lt. Col. D. F. Newton, director of the Spacetrack Center. When the mean deviation between these recent sightings differs by a prescribed amount from the last calculated orbital parameters for the particular satellite, the computer calculates new orbital parameters which are then stored for comparison with subsequent sightings.

Judgment Required

Approximately 90% of the satellite sightings correlate well with the stored inventory. It is the remaining 10% that occupy the attention of the Air Force mathematicians and analysts in the Spacetrack Center. These uncorrelated sightings may signal the launch of a new Soviet satellite, or they may indicate the decay of a satellite that has been in orbit.

With relatively meager data on the density of the atmosphere, which can vary by a factor of 10:1 from day to night, with even greater variations during the course of a year, it is difficult to program a computer to accurately predict the satellite's parameters as it nears the end of its life in orbit.

Thus, considerable human judgment becomes necessary in order to associate decaying objects with previously catalogued satellites.

Data Processor

To Norad and ADC officers accustomed to the fully automatic data input and processing provided by the SAGE air defense system and by BMEWS, the considerable amount of manual data handling and conversion required in Spacetrack and Spadats with consequent delays, represents a shortcoming of the present system.

This, added to delays in detecting some Soviet launches due to limitations in present sensor coverage, could result in nearly an hour's delay between launch and the time that orbital parameters are established.

Plans are under way to procure an automatic data processor which will accept incoming data from major sensors in teletype format and automatically prepare it for insertion into the Spacetrack computer. Current plans call for it to be installed and operational by early next year. Data from Navy's Spasur, formerly obtained in analog form and telephoned or teletyped to Spadats from Dahlgren, Va., is being automated for more rapid processing by the Navy and hopefully the data can be transmitted in a form suitable for direct insertion into the Spacetrack computer.

BMEWS Computer

The BMEWS target identification computers originally were designed to discriminate between objects having ballistic and non-ballistic trajectories, rejecting the latter and concerning themselves only with ballistic missiles (AW Mar. 6, 1961, p. 70).

While all targets which penetrate one of the two BMEWS beams, called a "Q-point," are reported automatically to Norad, and passed along to the Spacetrack Center, these Arctic radars could be made into more useful space surveillance sensors if another computer were installed at the radar sites, designed specifically to calculate satellite data, according to Lt. Col. S. J. Wicker, chief of Norad's Spadats Operations Div. Norad has recommended that a new computer be installed at the

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WRIGHT SPERRY
SIZE 8 STEPPER MOTOR
Provides Torque @ 90° In Excess of 1 oz. in.

Vastly increases pulse potential

MECHANICAL DATA

Rotor Inertia	.65 Gm-Cm²
Temp. Range, Ambient	−55°C to +125°C
Duty	Continuous
Diameter	.750 in
Length	1.048 in. max.
Weight	2.0 oz. average
Breakaway Torque	.15 oz.-in.
Torque @ 90 degrees	Up to 1.15 oz.-in.
Rotation	Reversible

ELECTRICAL DATA
(Unit Stabilized)

Voltage D. C.	28. Volts
D. C. Resistance	127.0 ohms
Power (Stall)	5.2 W
Input Current (Stall)	.190 A

Millions of pulse operations without failure are obtainable because the step motor employs magnetic detenting, thus eliminating shock loading and wear on mechanical detent mechanisms.

Shaft rotation for both clockwise and counterclockwise may be attained depending on the programmer. Increments of the resulting shaft rotation are 45, 90, 180 or 360 depending on the programmer. Synchronous stepping rates attainable are determined by load inertia, logic, and pulse wave form.

Recommended applications include:

- Pulse counter—high speed
- Digital to analog converter
- Self-checking digital readout
- Tape and film driver and positioner
- Positioning servo motor (digital-positioner)
- Industrial process control
- Machine tool actuator and positioner

Ask for Stepper Motor Data 842

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DIVISION OF SPERRY RAND CORPORATION
DURHAM, NORTH CAROLINA
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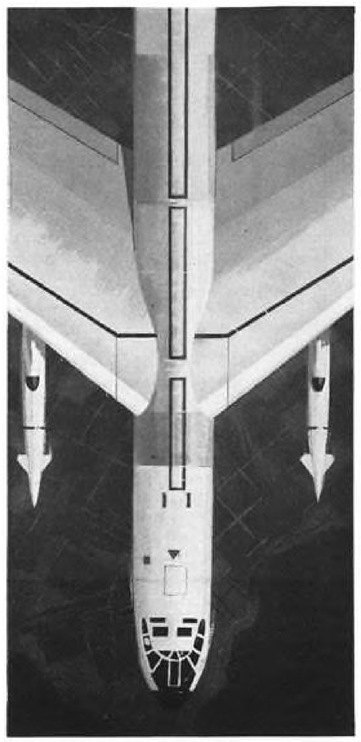
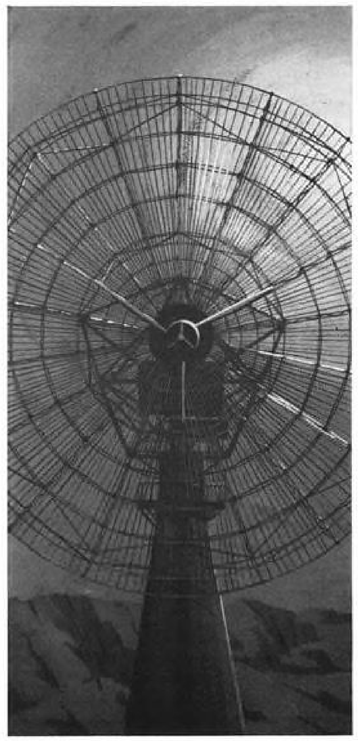
BRAKE SHOE'S AEROSPACE DIVISION IS PROVIDING THE ADVANCED PRODUCTS AND SYSTEMS DEMANDED BY AN EVER-WIDENING TECHNOLOGY. The Aerospace Division of American Brake Shoe offers a wide range of compatible hydraulic and electronic products. These products, coupled with the proven ability to imaginatively combine them into sophisticated systems, provides a single responsibility source for power and control of hydraulics for land, sea, air, and space. The Aerospace Division backs this capability with a full staff of factory-trained field engineers ready to serve you in principal U. S. cities, as well as in Canada and Europe. General Offices: 3151 West Fifth St., Oxnard, Calif. • Europe: Aerohydraul, GmbH, Wiesbaden-Biebrich, West Germany • Canada: Jarry Hydraulics Ltd., Montreal, P.Q. **AEROSPACE DIVISION / AMERICAN BRAKE SHOE COMPANY**

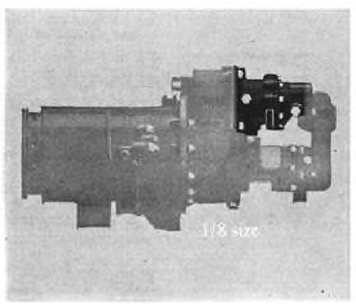


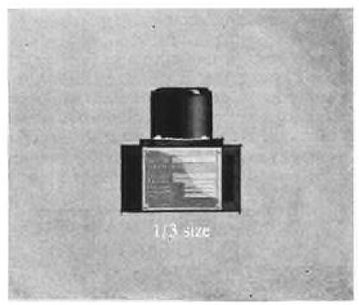
A Kellogg pump, a product of the Aerospace Division of American Brake Shoe, is an important part of the Garrett-AiResearch constant-speed drive—an efficient power source for aircraft cabin air compressors.

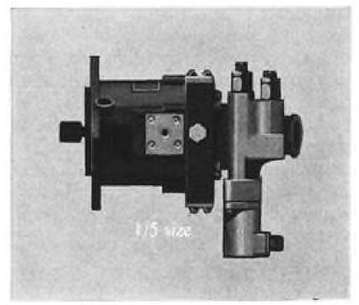


Atchley servovalves, with their exclusive JET-PIPE operation, pass contaminants as large as 200 microns without malfunction. Specified for their reliability in air- and spacecraft and for such specialized functions as driving huge antennas.

The Kellogg AP6VSC-6 pump, a single-stage, cam-actuated unit, is standard equipment on high-performance military aircraft and the Saturn I missile. The US Army's Chinook helicopter, produced by Boeing's Vertol Division, uses this pump as well as landing gear from Brake Shoe's Canadian subsidiary, Jarry Hydraulics, Ltd.







BMEWS sites to give them this added space surveillance capability.

Norad, in requirements submitted to the Joint Chiefs of Staff also has recommended that the capability of the present Spadats network be extended outward in range beyond the present near-earth orbit altitudes.

Current inventory of satellites and other detectable objects in space totals about 260, and the figure is increasing rapidly. To handle the increased work load, ADC plans to install a computer with greater storage capacity operating at higher computation speeds.

The Spacetrack center set up at Electronic Systems Division, Hanscom Field, when the network was first established as a research and development operation, continues to operate as a back-up facility for the center here at Colorado Springs.

FILTER CENTER

► **Space Charge Limited Triode**—Thin film space charge limited triode (AW Feb. 4, p. 69) with a gain-bandwidth product of about 5 mc. has been designed and operated by the Semiconductor Div. of Hughes Aircraft Co., the company reported last week. Device has a transconductance in excess of 1,000 micromhos, a gate resistance greater than a megohm and exhibits sharp triode characteristics as a function of gate voltage.

► **Lunar Mapping System**—Preliminary design of a camera, film developer system and a film readout system that could be used to map the moon from a lunar orbiting spacecraft will be conducted by Space Technology Laboratories for National Aeronautics and Space Administration. Film could have superior resolution but has been ignored in many possible space applications because of additional weight required for film processing. The study also will explore payload requirements.

► **Target Ranging in Space**—Air Force's Space Systems Div. soon will investigate passive techniques for determining range and range rate of uncooperative space vehicles at distances up to 250 mi. and beyond 1,000 mi. The ranging system is to be space based. Program probably will look at all types of electromagnetic radiation as a starting point.

► **Laser From Chemical Reactions**—Army is contemplating a contract award to Republic Aviation for an investigation of laser action (coherent generation of light) based on chemical reactions.

► **Linear Microcircuit Has High Gain**—Details of a linear semiconductor micro-

FOUR MAJOR NEW PROGRAMS ASSIGNED MITRE

Qualified Scientists and Engineers Are Needed Now!

1 **AEROSPACE COMMUNICATIONS:** Development of an advanced intercontinental communications capability has just been assigned to MITRE by the Air Force. Conceived by MITRE's Technical Staff, the new program will involve space technology as well as accompanying ground environment. Engineers and scientists are needed now to help direct this major program. In addition to design, work will include test and system acquisition. Wanted are people with broad backgrounds in space electronics and technical management.

2 **NUCLEAR DETECTION:** MITRE has recently been assigned the task of providing the Air Force with system design of NUDETS — the 477 L Nuclear Detection and Reporting System. The system detects, locates and reports nuclear detonations that occur within specified geographical areas. Needed are qualified physicists and engineers with experience in nuclear, electronic and optical fields.

3 **POST ATTACK Command and Control (PACCS):** The Air Force has recently assigned MITRE the task of being a system engineer for the PACCS Program, a Post Attack Command and Control System. This system will enable the Commander-in-Chief, Strategic Air Command, to improve control of his forces in the event that a nuclear attack destroys or seriously degrades his normal facilities. To accomplish the role of system engineer and to provide technical support, computer people are now needed to help design the system; to write sub-system specifications; and to carry the system through advanced development stages.

4 **U. S. STRIKE COMMAND:** MITRE scientists are now completing a functional analysis of command operations, working directly with the Army and Air Force staff officers. More men are needed to write specifications for computer programs and to conduct laboratory design verification studies of logistics, intelligence, targeting, communications and other functions involved in joint task force operations. Needed are systems-oriented designers with a good understanding of military operations.

Minimum requirements, B.S., or M.S., or Ph.D. in these disciplines: electronics, physics, and mathematics. MITRE is located in pleasant, suburban Boston. Rewards are competitive. Write, in confidence, to Vice President — Technical Operations, The MITRE Corporation, P.O. Box 208H. Bedford, Massachusetts.

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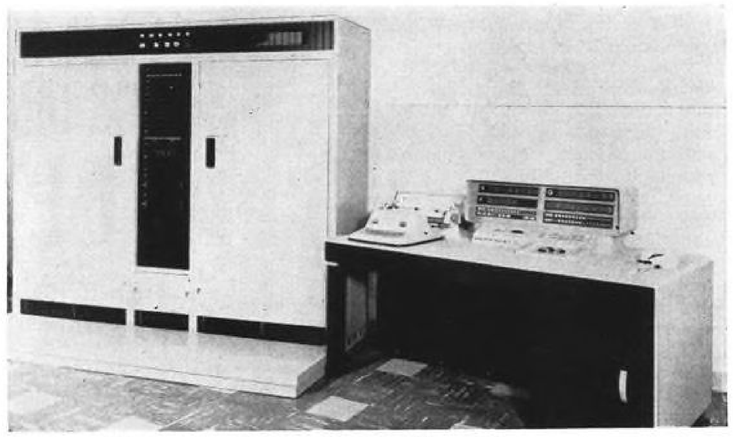
circuit amplifier which has a minimum voltage gain of 13,000 and is being used as a memory sense amplifier with the film memory of a small Univac digital computer (AW Dec. 24, p. 43) were revealed by Signetics Corp. The Mountain View, Calif., company has made dozens of these devices from Remington Rand design within an eight-week period. Packaged in three separate quarter-inch square glass kovar packages, each amplifier consists of five stages—a differential amplifier, three stages of voltage amplification and inversion, and an emitter follower and output gating circuit. The amplifier comprises the equivalent of 42 discrete components including nine transistors, five diodes and four 300 picofarad capacitors. Output rise and fall times are less than 50 nanoseconds.

► **Hybrid Microcircuit Effort Planned**—Program to investigate problems in depositing thin-film resistors and capacitors on a silicon substrate which has active elements already fabricated on the crystal is planned by Army Electronics Materiel Agency, Ft. Monmouth, N. J. Request for proposals is expected about Feb. 12.

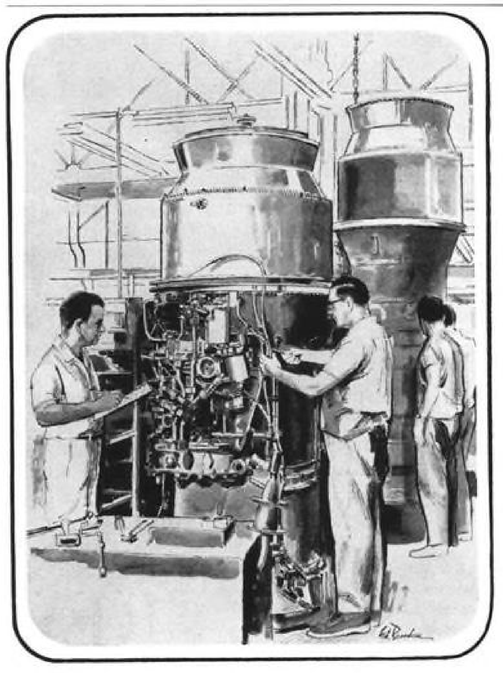
► **Cryogenic Laser to Be Studied**—Nine-month research to investigate solid-state laser configurations which will permit their operation at cryogenic temperatures is planned by Army Electronics Materiel Agency. Request for proposals is expected about Feb. 15.

► **High Laser Efficiencies Predicted**—Use of gallium-arsenide diode lasers as pump source for other types of laser crystals may yield over-all efficiencies as high as 85%, according to Sperry Rand Research Center scientists. High current density of gallium-arsenide laser has so far limited it to relatively low average power levels, while efficiency of other types of lasers is limited by broadband energy emitted by available flash tubes, much of which is wasted. Narrow-band radiation emitted by crystals of gallium-



Syncom Data Reduction Computer

General purpose Hughes Aircraft Co. digital computer will aid in reducing data returned by NASA's Syncom satellite. Computer, designated H-330, provides 16 bi-directional channels of automated buffered input and output and has varied data word lengths of 24, 30, 36 and 48 bits. Memory cycle time is 1.8 microsec. with 0.7 microsec. access time.



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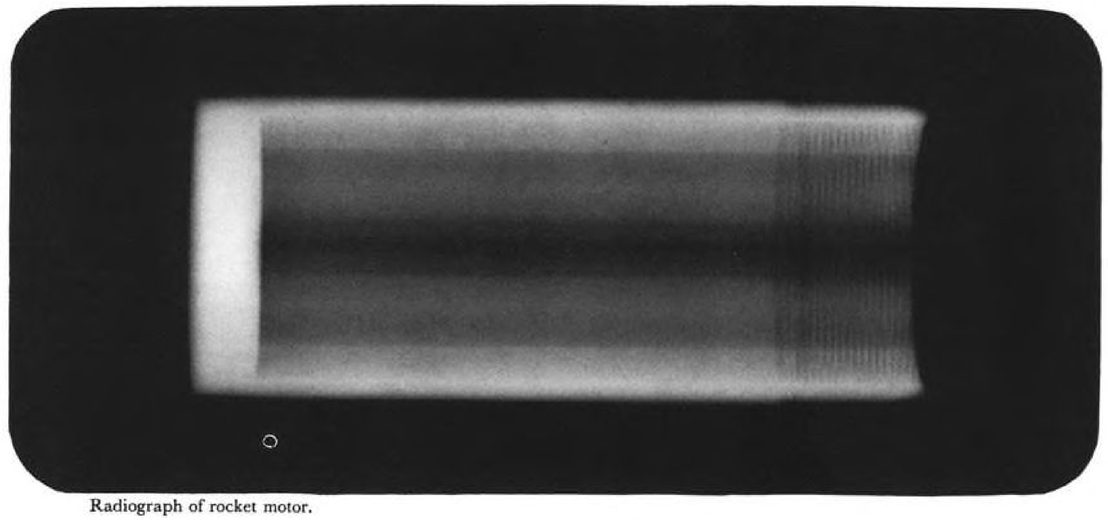

Radiograph of rocket motor.

Frank R. Carvell, right, general manager B. F. Goodrich Aerospace and Defense Products Division, Rialto, California, and David Y. Miller, product engineer, examine a radiograph of a rocket motor containing new high-energy composition of Nitro C — rubber solid propellant.

Now . . . Ready Pack in ROLLS and SHEETS KODAK Industrial X-ray Film, Types AA and M, in listed sizes.

- No darkroom loading—film sealed in a lighttight envelope.
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Radiography assures Better Rocket Performance

Sound propellant determines how well a rocket motor performs. B. F. Goodrich radiographs motors to show everything is in order.

B. F. Goodrich, Aerospace and Defense Products Division, has made a specialty of smaller rocket motors such as the Loki and the Sidewinder. They produce highly sophisticated, high-energy materials for propulsion.

In the final assembly the motors are radiographed to see that igniter, O-rings, gaskets and all component parts are in their proper places. And propellant is radiographed to see that there are no separations, voids, cracks, or imperfections.

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arsenide and gallium-indium-arsenide in the region of 8,700 to 9,000 angstroms is suitable for pumping crystals of disprosium-doped calcium fluoride and neodymium-doped calcium tungstate, Sperry tests indicate.

► **Soviets Show Bionics Interest**—Soviet press reports its cybernetics specialists have begun studies in bionics including animal experiments. U. S. Air Force-sponsored Bionics Symposium will be held Mar. 19-21 at Hotel Biltmore in Dayton. Registration forms and program can be obtained by writing: Bionics Symposium 1963, ASCFA, Wright-Patterson AFB, Ohio.

► **Transient Radiation Test Facility**—Air Force Nuclear Effects Radiation Laboratory, Kirtland AFB, N.M., is using a 600 kv. pulse X-ray system to study transient effects of radiation on avionic components. Extremely high-intensity transients occur immediately after a nuclear blast. The X-ray generator is a modified Marx Surge type which can produce high-energy electrons of about 600 kv., equivalent to 100 million roentgens per second at the face of the generating tube.

► **Transistor Sales Level Off**—Latest report on transistor sales for first 11 months of 1962 suggests that market has begun to level off in terms of units sold, for the first time since industry was born. Dollar volume had leveled off more than a year ago, but until recently unit sales had continued to climb. Sales for each of last four months remained at roughly 20 million units. Unit sales for 1962 are expected to be about 25% above 1961, with dollar volume slightly under 1961.

► **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Microwave Associates, Inc.,** Burlington, Mass., will develop a microwave beam plasma power amplifier, utilizing interaction between an electron beam and a gaseous plasma, under $493,000 contract from Advanced Research Projects Agency.

• **Radiation, Inc.,** Melbourne, Fla., will build nine digital command decoders for National Aeronautics and Space Administration's manned space flight tracking network, to be used to transmit command signals to Gemini spacecraft to aid in rendezvous experiments.

• **Philco Corp.,** Communications and Electronics Div., Philadelphia, will develop electronic file data conversion system to electronically read printed documents and convert text to magnetic tape format under $750,000 contract from Rome Air Development Center.

QUALIFIED CAPABILITY:
- EXPLODING BRIDGEWIRE SYSTEMS
- 1 AMP — 1 WATT EE DEVICES
- WELDED, HERMETICALLY SEALED STAINLESS STEEL COMPONENTS
- STANDARD ORDNANCE DEVICES

PROVEN PERFORMANCE:
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- MICRO-ROCKETS
- COOL GAS GENERATORS

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TODAY

EXPLOSIVE ORDNANCE

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From McCORMICK-SELPH, CONTROLLED EXPLOSIVE ENERGY SYSTEMS:

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TO CONTROL/TO ACCELERATE/
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TO INFLATE/TO ACTUATE/
TO IGNITE/TO PULL/TO PUSH

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TO MEET TODAY'S REQUIREMENTS... McCormick-Selph offers you 12 years of experience, complete facilities, and a broad range of qualified explosive ordnance devices now in use in every major space-age program.

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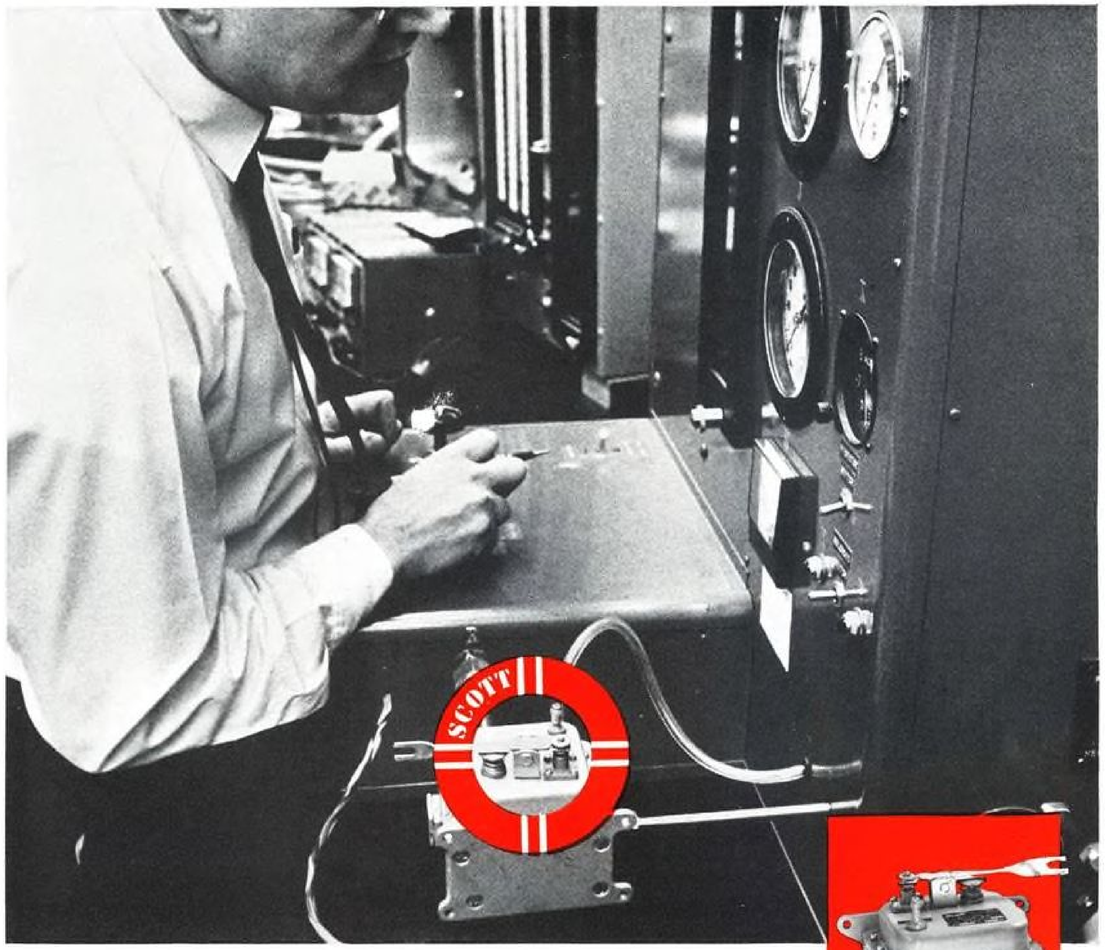


The LIFEGUARD of the future on schedule today at SCOTT

Passenger safety is a never-ending challenge at Scott. This Automatic Passenger Oxygen Flow Control Unit (Composite Regulator), undergoing exhaustive tests at Scott research laboratories, has been selected as standard equipment on the Boeing 727 jet. It automatically activates and controls oxygen flow to the passenger emergency oxygen system, replacing as many as seven previously required components including: pressure reduction, automatic turn-on and altitude flow control, activation surge, and turn-off.

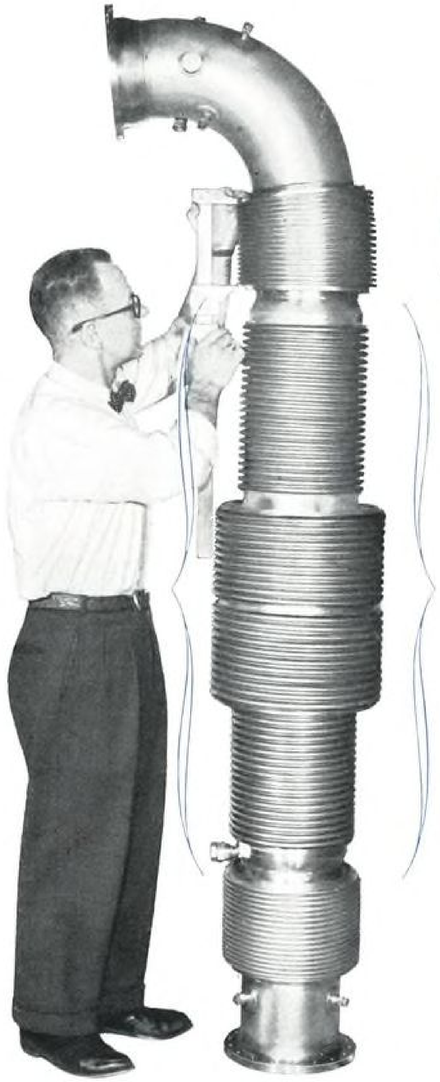
The new Scott Composite Regulator is automatically actuated at cabin altitudes of approximately 14,000 feet, and turns off again automatically at cabin altitudes of between 8,000 and 10,000 feet. The unit can be manually reset to "off" position at any altitude in between, while still retaining the automatic features. As an added safety feature, the Regulator supplies a momentary surge immediately after activation of approximately 80 psi, lasting about 10 seconds. This assures immediate filling and pressurization of the distribution system and positive actuation of mask presentation devices. After this initial surge, pressure is maintained at required levels, automatically controlled in response to system flow requirements and changing cabin pressure.

In addition to its many versatile features, the Scott Composite Regulator offers significant advantages in reduced weight, better efficiency, lower maintenance costs, and increased configuration flexibility.

For more information on the Scott Composite Regulator and how it can help you solve aerospace design and engineering problems write, phone, or wire:

SCOTT AVIATION CORPORATION DEPT. B-23, LANCASTER, NEW YORK

Export: Southern Oxygen Company, 3 West 57th Street, New York 19, New York. **West Coast Office:** Fulton-Ventura Bldg., 13273 Ventura Blvd., Studio City, California. **Great Britain Affiliate:** The Walter Kidde Company, Ltd.



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.

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.

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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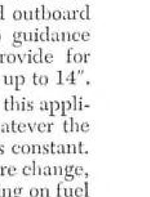

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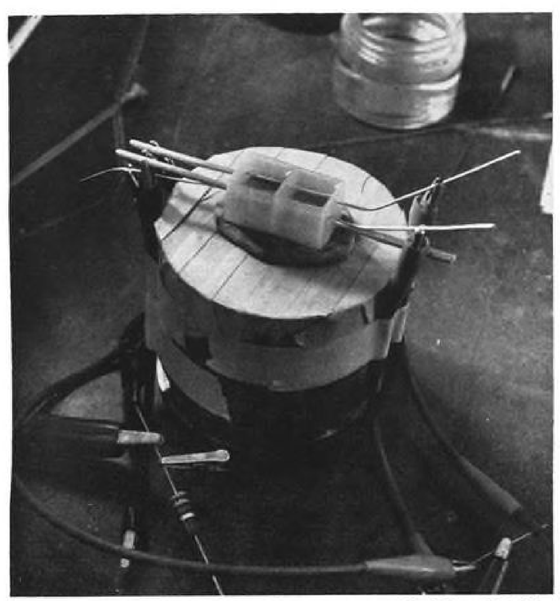
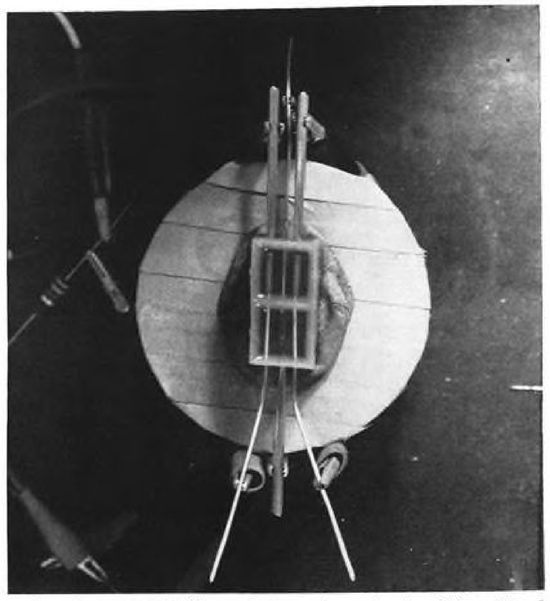
Please send my FREE model of the Flexonics Pressure-Volume Compensator.

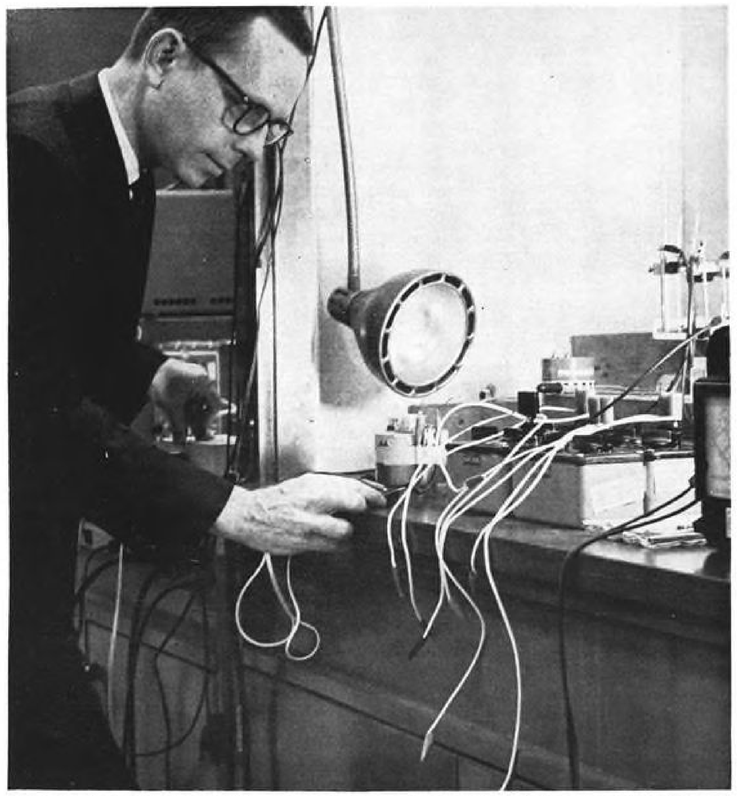




ELECTROCHEMICAL MODEL of human nerve cell (left and right), based on demonstrated likeness between iron wires in nitric acid and animal nerves, shows important computer property of inhibition. Cell elements are iron wires, supported by silver wires in nitric acid.

Electrochemical Nerve Cells Under Study

By Barry Miller



SPACE GENERAL PHYSICIST makes adjustments in electrochemical nerve cell experiment.

El Monte, Calif.—Feasibility of realizing a logically complete computer function with an inorganic electrochemical model of a human nerve cell was demonstrated here recently at Space General Corp.

This demonstration of the action of inhibition with an electrochemical nerve cell is regarded as an important early milestone in a difficult progression of research steps aimed at ultimately making possible a radical advance in computer technology.

Eventually, scientists here hope to duplicate or imitate in the laboratory the operation of the human brain. This involves building a device using electrochemical neurons, or artificial nerve cells analogous to what cells in the cerebral cortex are thought to be, having the capacity and the diminutive size of the human brain. Such a machine will be trained or conditioned by trial and error, according to Robert A. Stewart, a physicist and director of the effort.

In concept, this machine would differ from other self-learning devices, such as Perceptron (AW July 4, 1960, p. 72; Apr. 24, 1962, p. 69), in that the instructor or operator would not have access to individual cells or their responses. Instead, training would be accomplished by checking the response of the machine to a given stimulus, then moderately shocking it to prevent it from

We are heavily involved in exotic instrumentation.

A case in point is life support.

In our work to sustain human life in earth orbit, deep space and other hostile environments, we must draw upon the best capabilities to conceive, design and produce a unique array of life support systems and instrumentation.

The knowledge and experience we have accumulated in the fabrication of breathing oxygen pressure control and supply equipment over the past 30-odd years has led, in turn, to these current developments: supercritical cryogenic atmosphere supply systems; pressure control equipment; temperature and humidity control devices; toxic gas removal units and steam turbine air blowers. Systems designed and manufactured by us are in aerospace flight use as well as in toxic, radioactive, underwater and other hostile environments that utilize many combinations of our design, development and production abilities.

In addition to life support, we are involved in cryogenics, propellant measurement and control, precision special-purpose electronics. We would be pleased to help you solve your particular instrumentation problems; just write us at Dept. APR in Davenport, Iowa.

Pioneer-Central Division

THE Bendix CORPORATION

responding in a similar manner under the same circumstances.

Stewart believes he has found the key to this difficult job of training or conditioning, although he has not yet conducted definitive experiments to verify it.

McCulloch-Pitts Neuron

Recently, he and his co-workers built and successfully demonstrated an electrochemical version of the simplest form of what is called a McCulloch-Pitts neuron, the accepted picture of what the human neuron actually does and so-named for Dr. Warren S. McCulloch, a psychologist and medical doctor, and a former co-worker at Massachusetts Institute of Technology, W. H. Pitts.

This cell has a multiple number of elements (three in the units built here). As in a standard inhibitor circuit, when one input is fired, it causes the output to fire.

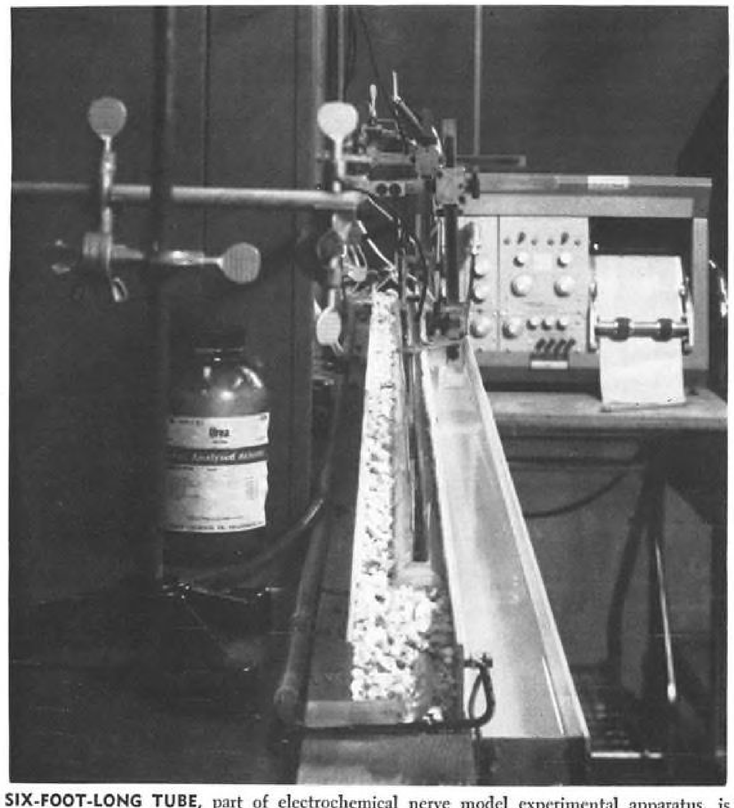
But in the event that two elements are fired, the third does not fire or effectively is inhibited from firing. This type of inhibition action is a logically complete and logically sufficient function for computer action, Stewart points out. This would mean that action of this type might be the basis for the logic section of a computer.

Space General's work in electrochemical neurons is being funded by the Bionics and Computer Branch, Electronic Technology Laboratory, Air Force's Aeronautical Systems Division. It began previously under company funding and is predated by theoretical and experimental work conducted by Stewart while still a graduate student some years ago.

Earlier Experiments

The basis for these activities rests on suggestions made early in this century that visible waves created when iron wire is immersed in nitric acid are similar to nerve impulses. These suggestions were followed about the time of World War 1 by experiments conducted by the American physiologist R. S. Lillie.

He definitely showed that iron wires in the acid exhibited a series of electrical characteristics similar to those of nerve impulses. (Information on nerves rests primarily on knowledge of the



SIX-FOOT-LONG TUBE, part of electrochemical nerve model experimental apparatus, is used for studying traveling waves set up by metal wires in an acid. Scientists hope to duplicate or imitate the operation of the human brain, which involves building a device using electrochemical neurons having the capacity and the diminutive size of the brain.

Coating problems on launcher arms, launchers, flame deflectors, flame buckets

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squid and peripheral human and animal nerves, not on the cortex itself).

Among Lillie's findings on wires which so closely parallel nerves are the following:

• **Stimulation threshold**—Iron wires have a threshold of excitation, which when exceeded will cause the wire to fire.

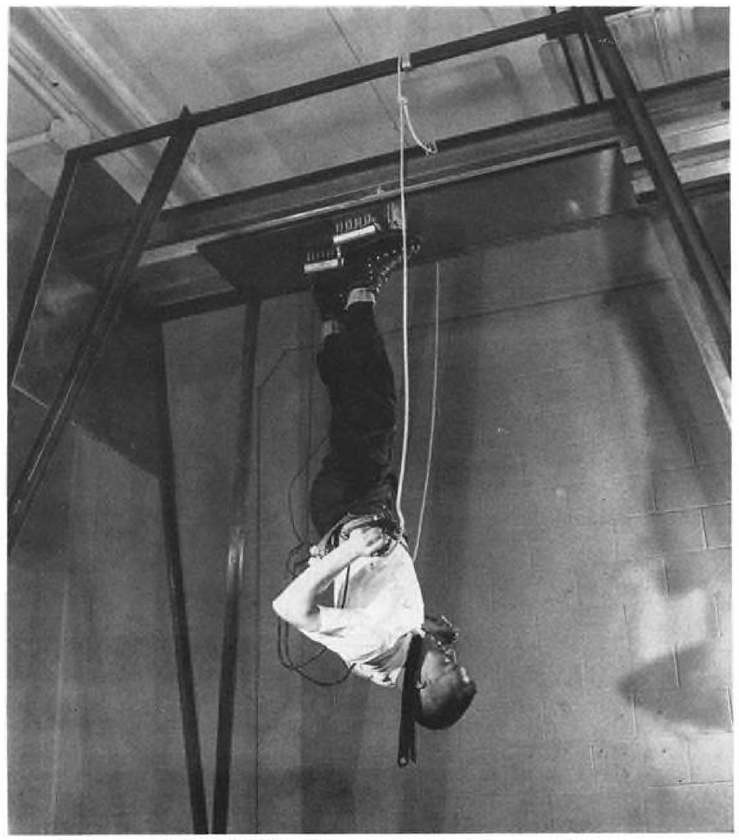
• **Threshold dependability**—The threshold level for a rested nerve is quite dependable, but the nerve is subject to fatigue or can undergo a period of refractoriness. The refractory period divides in two—an absolute refractory period when the nerve appears dead and a relative refractory interval during which the nerve may still be fired although the stimulus must be greater.

• **Subthreshold integration**—If a nerve is stimulated by a pulse of insufficient magnitude to excite it, and again stimulated, the two exciting pulses will add together if they occur closely together and should the superimposed magnitude exceed the threshold level, the nerve will fire. Similarly, Lillie found this phenomenon of subthreshold integration holds true for iron wires.

• **Rheobase**—Rheobase is the minimum repeated stimulation (magnitude) at which subthreshold integration will not take place.

• **Propagation speed**—The speeds of waves down the wires were found to be roughly in the same range as those of nerve impulses in animals, about two or three feet per second. There appears to be an approximate relationship between the size of the wire and the speed of the wave, probably due to an increase in conductance with increases in cross sectional area of the wire. Speed of propagation of the waves was found to be greater on myelinated wires or nerves, those that are covered with jointed fatty jackets.

• **Action and membrane potential**—A potential was found to exist between



'On-Off' Permanent Magnet

Subject is demonstrating a new permanent-magnet system developed at Westinghouse Research Laboratories. Permanent magnets attached to his shoes clamp his feet securely to a steel beam. But like no other permanent magnets, they can, in effect, be turned "on" and "off." The man can free his foot, take a step, then clamp it tight again. The magnets need no constant source of electric power as do conventional electromagnets, yet they are as easily controlled, according to Westinghouse.

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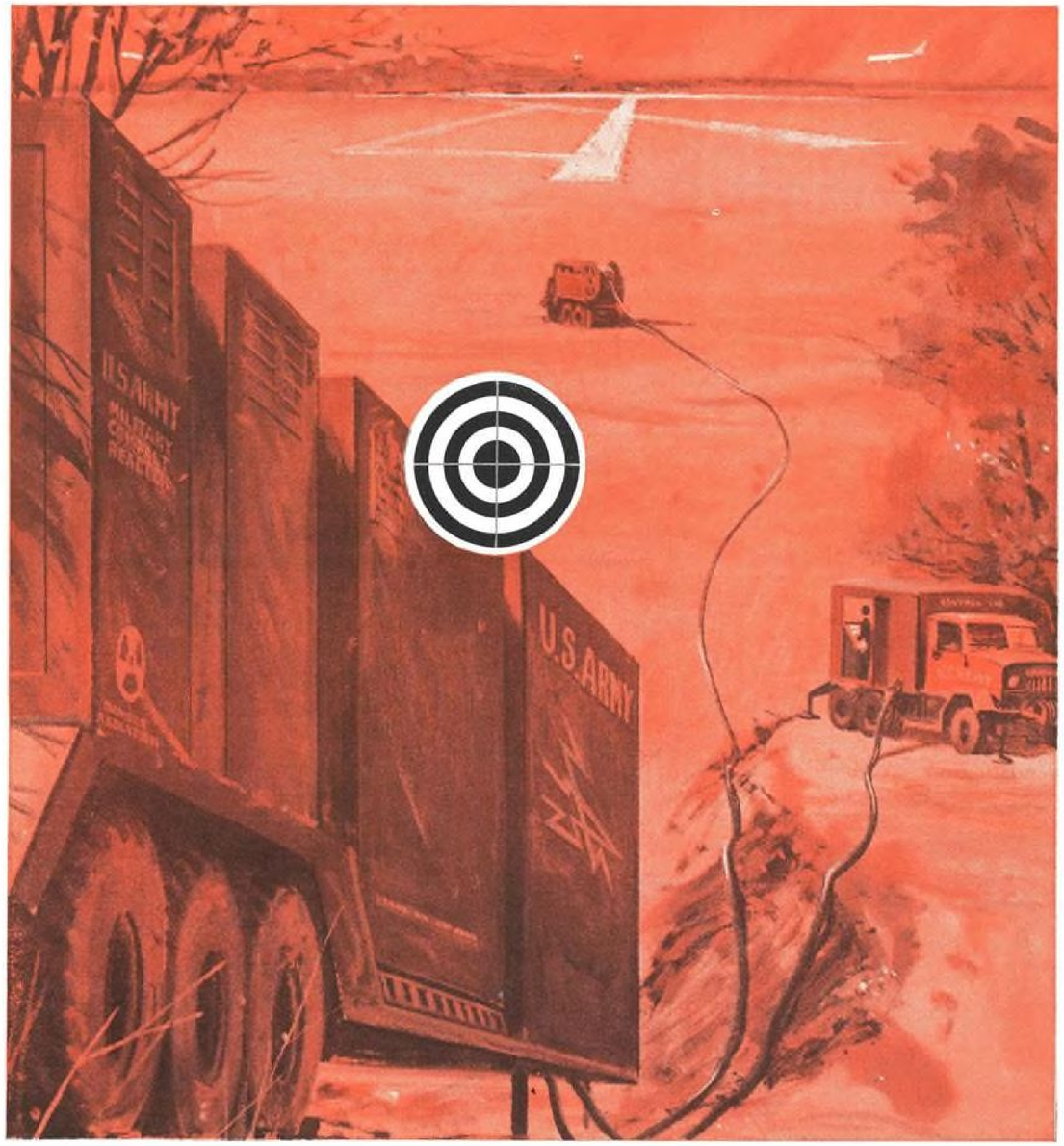

on target with MCR—the Military Compact Reactor being developed by Allison for the Atomic Energy Commission. Lightweight and extremely mobile, it will generate 3000 kw. of electricity. The AEC selected Allison as prime contractor "on the basis of company capability to carry out the entire project." That kind of capability is also working in a creative environment on advanced turbo prop and turbo shaft engines, Minuteman rocket cases and many other aerospace and nuclear projects, all of which are on target.

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30th Inventory of Aerospace Power Issue

March 11, 1963

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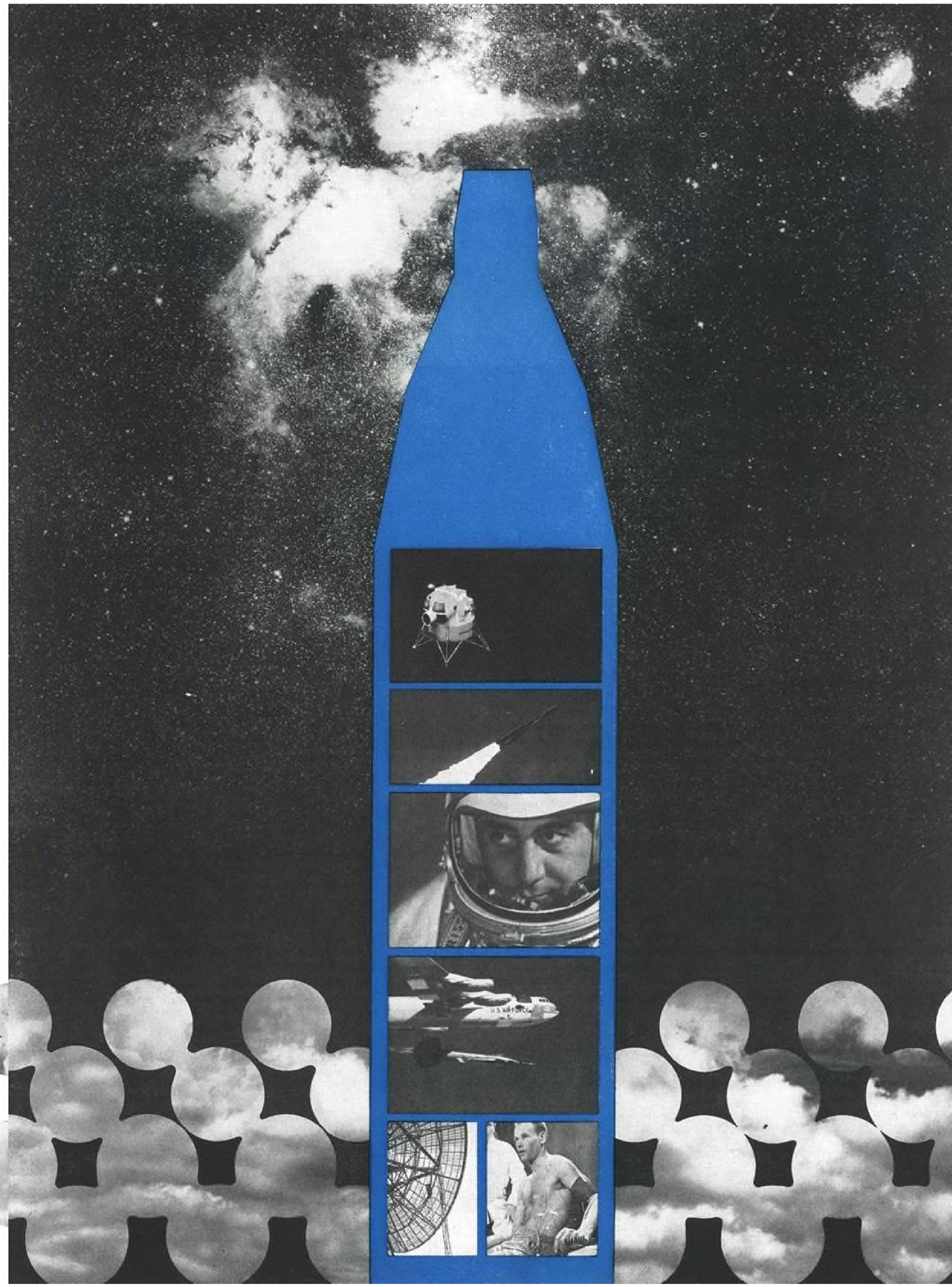

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the inside and outside wires, a potential referred to as membrane potential. Action potential is voltage measured along the nerve as the pulse goes by, thus changing during firing of the pulse.

• **Recovery time**—Recovery times of wires were found to be considerably greater than those of nerves, 15 min. as against about five milliseconds, this being the only major quantitative difference between nerves and wires. Rise and fall times and refractory period were on the order of a few milliseconds.

Since Lillie's time, other materials were found to exhibit similar effects. But this unusual analogy between nerves and iron wires, falling as it does between the practical interest of the physiologist and the computer engineer was largely ignored over the years.

Now, Space General has picked up and furthered this work, bringing the electrochemical artificial neuron to this point:

• **Sustained circulating waves**—The company has sustained a wave pattern in a closed circular wire for a period of five minutes and believes this can be extended for days, ultimately longer with proper materials. This offers the possibility of a reverberating or circulating memory.

Physiologists believe, Stewart says, that closed paths are associated with memory but there is uncertainty about the duration of circulation and how extensive or exclusive this type of memory is in the brain. Prior to his experiments, 0.1 sec. was the longest duration of a sustaining wave. Besides circulating waves which are set up when one of the two oppositely directed waves traveling about the circular wire is suppressed, a standing wave, like an electromagnetic standing wave, can be generated if one of the two counter directed waves is not suppressed.

• **Interactions**—Previously, work with iron wires was done on single wires, but Space General has excited wires and coupled two with a third, the coupling achieved without metallic contacts. Thus, coupling and interaction at a distance have been demonstrated.

In the neurons built and tested here, and shown in accompanying photographs, none of the three iron wires contact one another. The polyethylene cell pictured is partitioned in the center thus insulating wires from one another. The electrolyte is nitric acid. The electrochemical action of silver wires, which are the supporting unjacketed wires (the iron wires being covered with oxide coatings to simulate nerve membrane) and the iron tends to assist wave action, making wave recovery time faster. But this action is independent of the dynamic electrochemical wave action.

• **Moderators**—A wide range of behavior can be produced in wires by the use of different metals, the magnitude and direction of circulating currents can be controlled by different materials. Moderators, so-called for their ability to alter speed, wave recovery time, etc., can be other metals in combination with iron. These would be inert, good conductors, non-corrosive, non-propagators and inactive. They would be additional elements in any computer scheme.

• **Conditioning**—A drop in membrane resistance, which occurs when a nerve fires, is regarded by Stewart as the key to conditioning a network of electrochemical artificial neurons. This drop has been measured as a factor of 50 reduction in the squid. He has measured the drop in iron wires, and although it does not equal the drop in the squid's nervous system it is sizable and may rise with proper selection of materials.

Thus, by properly shocking an array of wire cells it may be possible to get as much as a 50 fold increase in current density. A shock in a properly localized area of active nerve cells might be the basis for conditioning the machine and bringing it to a stable mode of behavior.

The type of computing machine that Stewart envisions as eventually emerging from this activity would dwarf any now known. It would have parts packing

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G-E thick-wall tubes are now being used as furnace susceptors, heat shields, crucibles (G.E. closes the bottom), consumable electrodes in vacuum arc melting, and as parts in missile hardware. These tubes await the ingenious designs now shaping up on your drawing board. For detailed information on moly and tungsten tubes, write for Product Data Sheets 1700a, 2600a, 2600b. General Electric Co., Lamp Metals & Components Dept. AW-32, 21800 Tungsten Road, Cleveland 17, Ohio.

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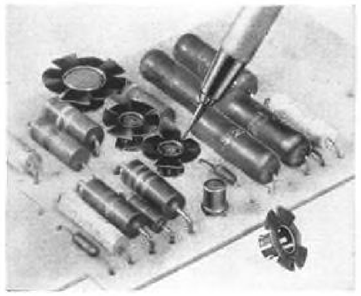
densities on the order of ten billion to a trillion parts per cubic foot.

To achieve so radical a jump, Stewart says, will require fundamental advances in manufacturing assembly so that none of the parts need be individually handled. Each cell might be on the order of molecular dimensions, but a first try would use small pellets possibly 10 mils in diameter, about twice the size of a small ball bearing now being made in Europe.

Pellets of various types—iron, conductors, moderators and insulators—would be combined and homogeneously mixed in a container, the electrolyte added and then sealed. Wires could be attached to its periphery for input stimuli and outputs. Then, the mixture would be conditioned by a conventional computer in a trial and error process.

NEW AVIONIC PRODUCTS

• **Transistor heat-dissipator,** known as Fan-Top, to fit TO-18 can, reportedly reduces junction temperature by up to

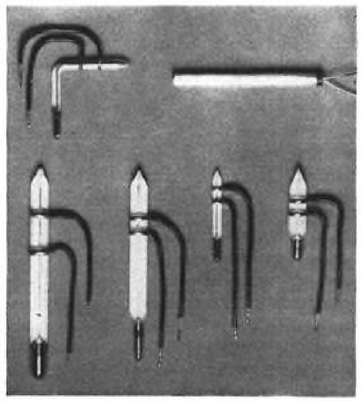


25%. Angled fan segments induce turbulence and thereby increase convection efficiency when forced air cooling is used. Devices are available from stock. Manufacturer: International Electronic Research Corp., 135 West Magnolia Blvd., Burbank, Calif.

• **Variable frequency synthesizer,** Model 5100A, provides precise frequencies from 50 cps. to 50 mc. in increments as

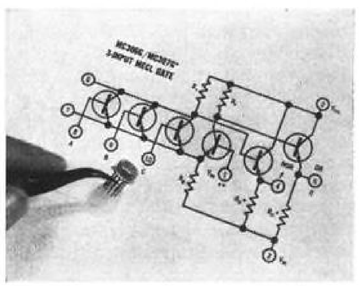
small as 0.01 cps. Synthesizer has 10 columns of pushbuttons arranged in decimal to permit rapid selection of desired frequency. Output voltage is 1 v. into 50 ohm resistive load. Base frequencies for synthesizer are provided by companion unit, Model 5110A, which has stability of three parts in one billion per day. Manufacturer: Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto, Calif.

• **Miniature mercury thermostats,** for precise control over temperature range of 0C to 100C, have two or more wire contacts inserted in mercury column to

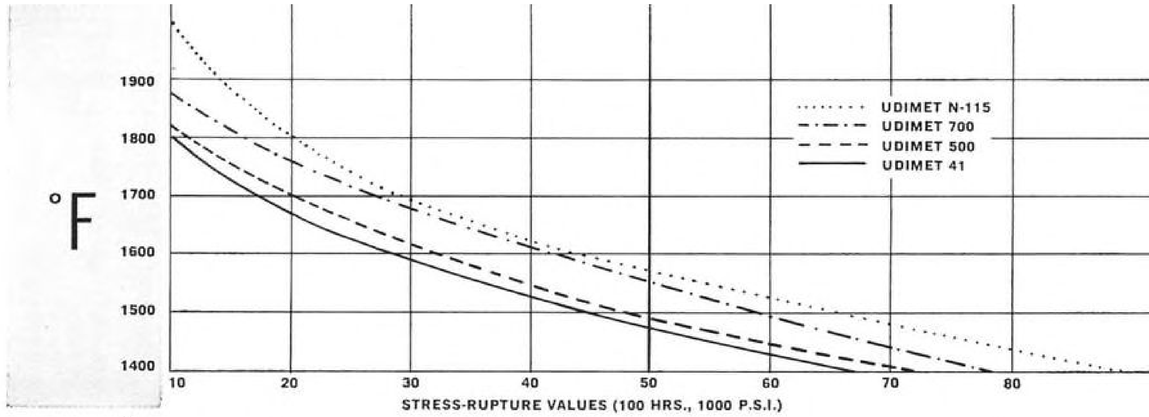


provide electric signal. Controlled temperatures can be obtained and held within 0.05C, according to manufacturer. Devices are available in variety of sizes and configurations. Manufacturer: Philadelphia Scientific Glass Co., Perkasie, Pa.

• **High-speed logic gate** with propagation delay of only four nanoseconds, consists of six epitaxial-planar transistors and four to six resistors packaged in single TO-5 transistor can with 10 output leads. Type MC306G is a four-transistor three-input gate circuit with



two transistors used as emitter-follower output stages. Type MC307G is similar but omits two output resistors to reduce power dissipation where logic operations are performed at the output of the circuits. Prices range from $60-$75, depending on quantity. Manufacturer: Motorola Semiconductor Products Inc., P.O. Box 955, Phoenix 1.



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High Temperature Alloys	SELECTOR TABLE
UDIMET N-115	Strongest superalloy for high temperature applications ranging upward to 1850° F. Especially recommended for forged blades in jet aircraft and missile components.
UDIMET 700	Strong superalloy for service from 1400 to 1800° F. Presently used in operational gas turbines as bucket material and in advanced jet engines for turbine wheels.
UDIMET 520	An alloy similar to UDIMET 500 in performance, with a service temperature range from 1400 to 1700° F, but superior in forgeability. Especially recommended for large and complex forgings.
UDIMET 500	Superalloy for service from 1400 to 1700° F with superior stress rupture performance at the higher end of the temperature range. Used for turbine buckets and small integral gas turbines.
UDIMET 41	An alloy for service from 1400 to 1700° F, produced in large quantities in bar and sheet form. Extensive use in fabricated sheet parts. High tensile strength properties combined with moderate stress rupture behavior when suitably heat treated.
WASPALOY	First metal to be vacuum induction melted, this traditional superalloy used for service from 1200 to 1600° F. Proven in hundreds of jet engines as turbine bucket material. Now being used for discs and other heavy forgings in jet engines of advanced design. Also suitable for forged castings and fabricated sheet parts.
M-252	An alloy for service from 1200 to 1600° F. Used for gas turbine buckets.
UDIMET 718	A weldable, age-hardened alloy with exceptionally high yield strength up to 1400° F for use in sheet form as well as large forged shapes. Normal service temperature from 1000° to 1400° F. Used for injector domes in liquid rocket engines.
UDIMET 200	An alloy widely used in discs and other heavy forgings for operational engines. Superior forgeability. Normal service temperature from 1000 to 1500° F.
Ultra High Strength Steel	
UDIMET B-250 UDIMET B-300	Super-strength steels with exceptional ductility and notch toughness at room and subzero temperatures. Strength maintained to 600° F. Excellent formability in the soft condition.

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FAA to Test Simplified Cockpit Layout

By David A. Brown

First in a series of prototype light aircraft cockpit layouts to be developed by Federal Aviation Agency's Project Little Guy will begin static simulation tests within two weeks in Washington.

Cockpit has been jointly developed by FAA and Matrix Corp. of Philadelphia, study contractor to FAA. Static simulation work, which includes fitting the prototype into a fuselage to check general arrangement, control location, etc., will be done at Matrix's Washington facility.

Dynamic simulation will begin about April with a modified general aviation trainer-simulator at FAA's National Aviation Facilities Experimental Center (NAFEC), Atlantic City, N. J. Contract for the simulator was to be signed with Link Div. of General Precision, Inc., this week.

Work is part of a program to develop light aircraft systems which will relieve the non-professional pilot of much of the mental work of flying the plane (AW Oct. 15, p. 117).

Cockpit must meet these requirements:

• **Significantly reduce the time** needed to learn to fly. Ultimate goal would be for a person to learn in 5-6 hr. of air time.

• **Allow pilot** to maintain proficiency with a minimum of time and work.

• **Increase the safety factor** by making flying simpler and by designing systems for a specific general aviation function.

Current thinking is that a number of problems have developed because systems originally designed for military or commercial purposes have been adapted for general aviation use. Red cockpit lighting, for example, originally was developed to allow military crews to keep their eyes dark-adapted while flying night combat missions. Red lights were used despite the fact that they are more difficult to see.

Project Little Guy will consider the entire aircraft to be a modular transportation system, according to Dr. Douglas Courtney, executive vice president of Matrix Corp., and is attempting to design subsystems which can be treated as building blocks for economy reasons.

Thus a pilot who flew largely on weekends for pleasure would be able to have only those subsystems which were needed in basic flight regimes. Other modules could be added if he began to fly more extensively.

Dr. Courtney said this modular concept had been followed only by avionics manufacturers to any significant degree, but that Project Little Guy hopes to expand use of the concept to include the instrument and navigation systems as well.

First prototype cockpit has a large pictorial navigation display centered on the instrument panel. The display consists of a moving dot which is superimposed on a map of the area being traversed.

Multi-colored, five-inch attitude display with a green "earth" portion and a blue "sky" area is located in front of the pilot. By making the attitude display rectangular rather than round, it was possible to eliminate the traditional miniature airplane for horizon reference and still retain accurate attitude reference.

Immediately above the attitude display is a horizontal linear speed indicator.

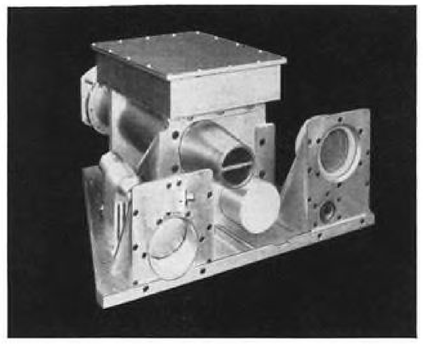
Below the attitude display is a heading display, a disk in a horizontal plane which indicates the aircraft's direction as well as the relative position of any other heading.

For instance, if the pilot were maintaining a course of 90 deg. and wanted to turn to 200 deg., heading indicator would pictorially show him that a right turn of 110 deg. would bring him to the desired heading. Heading indicator also has a heading command button which, in the present layout, causes a digital indicator to show a predetermined desired heading.

To the right of the attitude display is a linear vertical scale altimeter, which is calibrated to 20,000 ft. Window, approximately 4 in. deep by 1 in. wide, shows aircraft altitude at the center of

Beech Musketeer Delivered in Britain

First Beechcraft Model 23 Musketeer sold in Britain, 15th off production line, was delivered at Gatwick Airport recently. Airplane uses Lycoming 160-hp. engine, has 135-mph. cruise speed, can carry 4 passengers. Maximum range is 900 mi. It has dual controls, full instrumentation with engine-driven vacuum system, autopilot, standard radio gear (AW July 16, p. 66).



In the NASA-Goddard Orbiting Solar Observatory launched recently, radiation shield of Mallory 1000 is used in instruments which measure solar radiation. Part of instrument package is shown here.

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We can supply any of these materials as slabs, bars or rounds. And if you'd like shielding material that you can "pour" into cavities, we can supply them as near perfect spheres of uniform size, in diameters from a few thousandths to ¼". And for neutron shielding, we can incorporate boron into our materials with interesting results.

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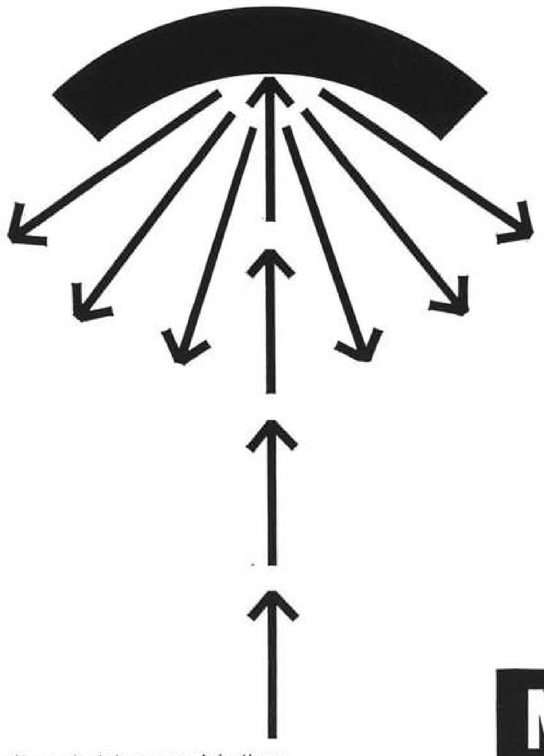

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the visible scale, with a 2,500-ft. range above and below the aircraft also visible to the pilot. Thus, if the aircraft were at 7,000 ft., that number would be centered in the vertical window. At the top of the window would be 9,500 ft. and at the bottom would be 4,500 ft.

Immediately below the linear altitude indicator is a digital altitude indicator for quick altitude checks.

To the right of the linear altitude window is a vertical speed indicator set on the same scale as the linear altitude indicator. VSI needle not only shows the rate of climb or descent, but points to the altitude, on the linear altitude indicator, which the aircraft will reach in one minute.

Thus, if the airplane is climbing at 500 fpm. from 5,000 ft., the VSI needle would point to 5,500 ft. on the altitude indicator and to 500 fpm. rate of climb on its own scale.

Altitude command knobs control warning indicators for desired and minimum altitudes.

To the right side of the panel is a digital ground speed indicator which, at present, is designed to work with Vortac stations, but still is under study and may evolve into a more or less sophisticated instrument.

Engine operating instruments—engine speed, manifold pressure and fuel mixture—have been converted to vertical linear gages and are above the controls which regulate them. Manifold pressure gage is above the throttle, engine speed indicator above the propeller pitch control and fuel mixture indicator above the mixture control.

Command Indices

Command buttons have been provided to position indices which show optimum engine settings for any given flight phase. A pilot preparing to take off, for example, would press the take-off button and the indices would position themselves opposite the values on the engine operating gages optimum for that phase of flight. Pilot then would advance the engine controls until the linear indicators were aligned with the command indices in order to take off.

For climb or cruise, the pilot would press the proper button to position the indices for that flight regime, then align the engine operating gage indicators with them.

Engine status instruments—temperature, oil pressure, fuel indicator, etc.—have been separated from the other engine instruments and placed on the right side of the panel. Fuel indicator shows flight time remaining at the current rate of fuel consumption.

Series of malfunction warning lights has been positioned across the top of the panel, adjacent to the pilot's line of sight when he is looking through the windshield.

Landing gear level has been moved from the conventional position immediately adjacent to the flap control and placed at the top of the panel.

Space has been provided for a light aircraft autopilot.

First cockpit prototype has conventional aircraft controls. Simplified and integrated controls, another Project Little Guy aim, will be included on later cockpit layouts. Contract for development work in this area is being negotiated with a New Jersey company.

Among other systems Project Little Guy will investigate is a low-cost, integrated nav-com system. Specifications are being prepared for submission to industry.

FAA and Matrix Corp. have completed a study of the entire Project Little Guy mission and a report should be ready late this week.

Mission analysis of current instrument flight rule (IFR) requirements, which will have a bearing on the project's work, has been submitted by Matrix to FAA and is included in the report.

Findings of a series of mission analysis IFR flights in light aircraft by FAA and Matrix Corp. personnel and a Matrix study of previous military and commercial work in the field also are in the report.

Colin G. Simpson, FAA chief of Project Little Guy, said that while the project should simplify visual flight rule work for pilots, long-range goal of the project is to bring IFR capability within the range of the average, non-professional pilot.

Not directly a phase of Project Little Guy, but working in conjunction with it, is another FAA project to devise a "speed limiter" for high-performance light aircraft.

Device would prevent an aircraft in IFR weather from exceeding predetermined speed or acceleration limits and also would aid stability without harming the aircraft's ability to hold a given course.

Request for proposals was issued recently by FAA's Aircraft Development Service and several have been received from industry. No study or development contracts have yet been let.

Mystere 20 Engines

Three Pratt & Whitney JT12 turbojet engines have been shipped to Generale Aeronautique Marcel Dassault for installation in the French manufacturer's Mystere 20 nine-passenger executive transport.

Aircraft, jointly developed by Dassault and Sud Aviation, is scheduled to fly in the spring. It is designed for a top speed of 540 mph. and a maximum range, without reserves, of 2,000 mi.

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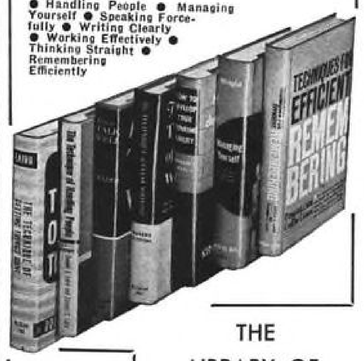

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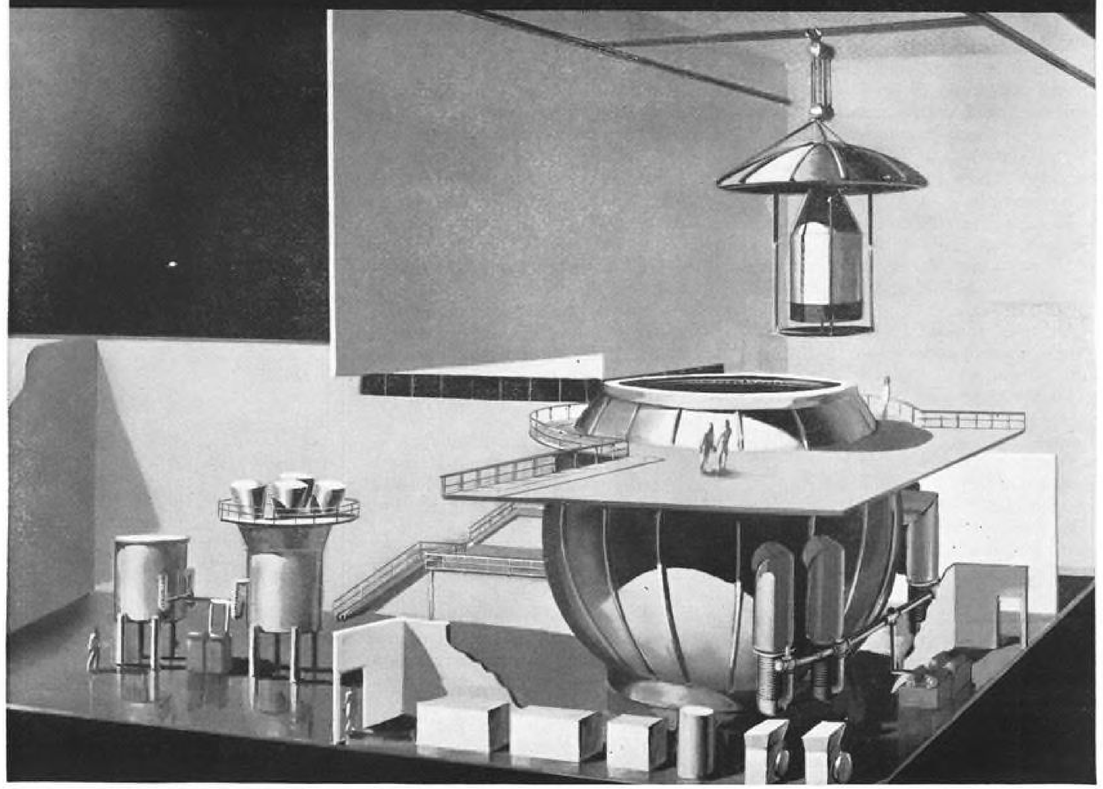
STOKES NAMED PRIME CONTRACTOR FOR NEW DOUGLAS SPACE FACILITIES



Artist's concept of Douglas Aircraft Environmental Test Center. Sketch shows test model of vehicle attached to lid and being lowered into 39' Stokes chamber. To the left are two Stokes "5 x 5s." One is shown with the solar simulator now being designed for it.

The Stokes Space System Department has been named prime contractor for the design and installation of three new space environment simulation chambers, key elements in Douglas Aircraft Corporation's privately financed Space Systems Center at Huntington Beach, California. The largest and most technically advanced space-test laboratory on the West Coast, the Center will be an integral part of Douglas' Missile and Space System Division.

The largest chamber, 39 ft. in diameter, will be capable of testing fully assembled vehicles scheduled for manned flight. It will be used in the Saturn program, and in the development of lunar and planetary probe vehicles. The Stokes systems will represent the most advanced state-of-the-art on completion, and are designed for updating to even higher simulation parameters in the future. Stokes units similar to these are now achieving vacuums in the 10^{-10} Torr. range. High-speed cryopumping on all three chambers at 20°K will assure the attainment of true orbital vacuums, even under high gas loads. Stokes has assigned CryoVac, Inc. the design, fabrication and installation of cryogenic systems, and named Pittsburgh-Des Moines Steel Company to furnish and erect the large steel sphere.

A deciding factor in the selection of the prime contractor was Stokes' experience in designing and building large, first-of-a-kind space test facilities, such as those installed at G.E.'s Space Technology Center. Another was Stokes' related background in space vacuum and cryogenics, as represented by General Electric's and Goddard's SES and DTC systems. To this experience, Stokes adds its long and successful history in the development of large-scale industrial equipment utilizing ultra-high vacuum, thorough engineering design and coordination, fabrication facilities, and field erection service . . . an integrated, start-to-finish capability unique in the entire area of space environment simulation. **Space Systems Department, F. J. Stokes Corporation, 5500 Tabor Road, Philadelphia 20, Pa.**

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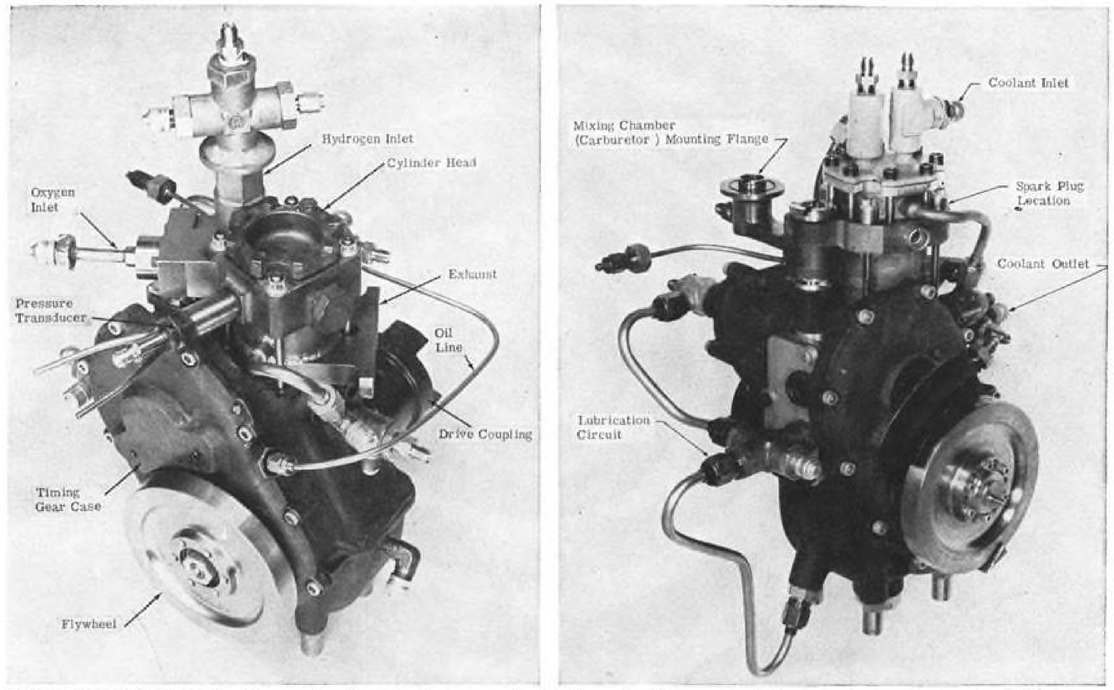


TWO HYDROGEN-FUELED piston engines built by Vickers under Air Force feasibility contract to determine a potential for driving space power systems are shown above. Oxygen injection version (left) proved successful during tests. Main difficulty encountered was oxygen leakage into cylinder through mechanically actuated oxygen injector. Carbureted version (right) was discarded after engine demonstrated continued tendency to miss and flashback into the hydrogen-oxygen mixing chamber.

Piston Engine Space Powerplant Designed

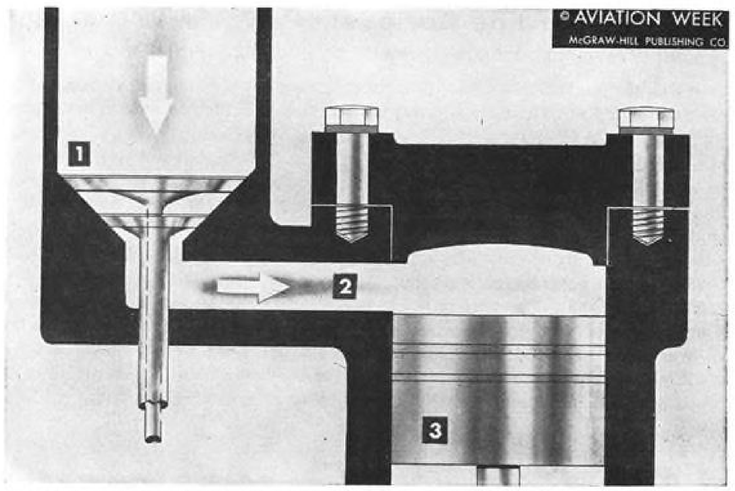
By Ward Wright

Internal combustion engines using hydrogen and oxygen as propellants to drive space power systems are being developed by Vickers Aero Hydraulics Division, Torrance, Calif.

Vickers is working on a complete electrical generating system, driven by an internal combustion piston engine utilizing hydrogen and oxygen boil-off as propellants, under a $197,000 technology advancement contract from National Aeronautics and Space Administration's Lewis Research Center in Cleveland.

System will be in the 3-kw. range, powered by a 5-hp. one-cylinder powerplant of about 3 cu. in. piston displacement. Contract calls for evaluation of the complete system including alternator, regenerative heat exchanger, inlet gas compressor and power controls.

Engine will operate on the two-stroke cycle and have a specific propellant consumption of about 2 lb. per. hp. hr. Contract is scheduled for completion this month, with a strong possibility of a follow-on contract to produce a work-



SCHEMATIC DRAWING illustrates principle of dual concentric valve power control used on Vickers' hydrogen-oxygen internal combustion test engine built under Air Force contract. Hydrogen gas at greater than combustion chamber pressure is ported over dual concentric valves (1) to aid sealing when valves are closed. Variable admission effect is achieved by fixing timing of either upper or lower valve and varying timing of the other, or, by varying timing of both valves simultaneously. Hydrogen is admitted to clearance volume (2) when piston (3) is at top dead center. Oxygen injector is not shown.

Said Gaspard de Coriolis: *"A particle which is subject to no forces in a rotating coordinate system experiences a radial acceleration and a tangential acceleration."*

It was around 1840 that Coriolis discovered what has since become known as the Coriolis Effect. He noticed objects above the earth tend to rotate relative to the earth's rotation . . . to the right in the northern hemisphere, to the left in the southern.

The Coriolis Effect is in force in outer space, too. If a space vehicle is rotated in order to establish artificial gravity, the necessarily short radius of the rotation causes a Coriolis force. This creates orientation problems for a human occupant. To eliminate this difficulty, a scientist at Lockheed Missiles and Space Division conceived the idea of connecting the vehicle to an auxiliary fuel tank by a half-mile-long cable. Thus, if the whole system is then rotated at a reduced speed around its center of mass gravity, the longer radius greatly minimizes the Coriolis force. Right now—on the drawing boards at Lockheed—is an enormously advanced space vehicle system which utilizes this concept, in addition to many others.

Fortunately, natural laws are about the only restrictions which circumscribe scientists and engineers at Lockheed Missiles & Space Company. The climate in Sunnyvale and Palo Alto, on the San Francisco Peninsula, is close to perfection. The creative atmosphere—the opportunity to work on such important projects as the AGENA Satellite series, the POLARIS FBM, or even more advanced concepts such as the space system cited above—is the dream of the creative engineer.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-11B, 599 North Mathilda Ave., Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required. An Equal Opportunity Employer.

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ing breadboard internal combustion space power system for NASA.

Vickers has been promoting the hydrogen-oxygen internal combustion space power system as a competitor to the fuel cell for missions from 100-hr. to one-month's duration, particularly lunar landing.

Booster weight on earth needed to carry a 1,510 lb. hydrogen-oxygen internal combustion space power system capable of a 2 kw. constant load through its mission, that is, its booster weight penalty, would total 441,000 lb., according to Vicker's figures.

Figures apply to a 14-day lunar landing mission which would include a seven-day lunar stay.

Comparable fuel cell system would have a 529,000 lb. booster weight penalty for the same mission even though the system weighed 1,420 lb. Weight of both systems assumes redundant components for equal reliability and includes weight of propellant tankage and heat exchangers.

Reason for the discrepancy is the higher propellant weight—1,310 lb.—for the internal combustion system compared with the fuel cell's 670 lb. propellant weight. The internal combustion system would consume more of its total weight than the fuel cell, leaving a lower weight to be boosted for the return trip.

Vickers says internal combustion piston engines for space power systems have these inherent advantages:

• **Availability with minimum effort** through use of existing technology.

• **Low weight.** Hydrogen-oxygen piston engines have a good specific propellant consumption combined with the lowest fixed weight of any space power system currently under development.

• **Versatility.** Piston engines allow great design flexibility and can be incorporated into a space power system in several ways. Vickers engineers say. Engines can be used to furnish hydraulic and electrical power in addition to driving power tools aboard spacecraft. With the aid of self-contained fuel tanks, piston engines could be used to operate portable tools on the lunar surface, the company feels.

Normand E. Morgan, Vickers space power systems group supervisor, outlined experiments with hydrogen-oxygen internal combustion engines under Air Force contract.

Two water-cooled test engines were used. One—called the oxygen injection engine—admitted hydrogen through a poppet valve, with the oxygen injected directly into the cylinder. The other—designated the "carbureted" engine—combined the gases in an external mixing chamber prior to their being fed into the cylinder.

Of the two, only the oxygen injection

mechanical & structural engineers for aerospace vehicle projects

Rapid expansion of Hughes Space Systems Division is creating attractive openings of long-range importance for Mechanical and Structural Engineers. Projects include: MMRBM—Mobile Mid-Range Ballistic Missile (Integration, Assembly & Checkout), TFX (N) Electronics, SURVEYOR (lunar spacecraft), SYNCOM (communications satellite), BAMBI . . . and many other aerospace vehicle systems. Excellent working environment includes well-equipped laboratories, air-conditioned, private and semi-private offices. ☐ Hughes Space Systems Division in Culver City is just two miles from the Pacific Ocean—away from the smog and high-density traffic areas. ☐ Immediate openings exist for qualified Junior and Senior Engineers in the following:

STRUCTURAL DESIGN ENGINEERS: For structural engineering and board design of missile and spacecraft. Some positions involve component packaging, installation or integration of spacecraft components and assemblies.

ELECTRO-MECHANICAL ENGINEERS: Positions involve design of spacecraft harness and cabling, design of shielding, working from schematics, supervision of drawing preparation, vendor liaison.

SR. MECHANICAL ENGINEER: Position requires broad background in design of missile or aircraft type structures and components, proposal writing, estimating, programming, military specifications, procedures and requirements and the supervision of large design groups.

WEIGHTS ENGINEERS: For weight and balance analysis of missile and space vehicle designs. Familiarity is required with weight and balance equipment for analyzing physical characteristics of units and total vehicles.

TEST ENGINEERS: Positions involve unit environmental and structural dynamic testing of spacecraft parts. Required is ability to establish test requirements; plan, direct and perform developmental, qualification and reliability tests of structures and components; reduction of test data and preparation of test reports.

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Compressing Real-Time Human Effectiveness

—one approach is to roll back two boundaries of the command and control data problem: the amount of information that can be reliably gathered and stored . . . and the amount that can be presented to the human decision-maker in real-time without exceeding the threshold of human saturation.

An illustration of this double-barreled systems approach may be seen in the Strategic Air Command Control System 465-L, for which ITT International Electric Corporation is Prime Contractor.

Data enters the 465-L network from Remote Communication Centrals all over the world. Each RCC can accommodate as many as 1,500 messages per hour by means of up to 32 input/output devices. All messages transmitted within the System are automatically routed, recorded, and error-checked by Data Transmission Control Centers located at each SAC Headquarters. Information flows into the Data Processing Central, where a high-speed computer compares events reported by RCC's with plans stored in its memory. The DPC will automatically alert the SAC staff to any significant deviation between actual and planned events.

At the critical man/465-L interface, assimilation of the vast quantities of information funneling into SAC command centers has been greatly enhanced by a recent ITT development — **data presentation in color.** Operating at speeds that appeared incredible only a short time ago, the new display system enables computer outputs to be converted to alpha-numeric form . . . photographed . . . developed and projected onto 16 large control center screens in as many as 7 colors in a matter of seconds.

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version proved a practical power source.

Oxygen injection version admitted hydrogen through dual concentric poppet valves—two valves, parallel with the axis of the bore, mounted one atop the other with the upper valve's stem descending through the hollow stem of the lower valve.

Both valves shared a common 45-deg. tapered seat and were located to the side of the cylinder barrel, as in a conventional L-head automotive engine.

Unlike an automotive engine inlet, gas was ported into the cylinder over the top of the valve rather than beneath it. In this way inlet gas at greater than combustion chamber pressure is prevented from opening the valve and forcing its way into the cylinder.

By varying the phase of the concentric valves in relation to each other, a variable admission effect was achieved. In the test engine phase, changes were made by stopping the engine and manually adjusting the relative valve timing.

Flight system using this power control method might employ a helical spline or planetary gear system to vary the valve phase while the engine was running, Morgan said. Oxygen ratio was controlled by regulating pressure.

In the NASA program, other power control techniques, including throttling, are being studied, Morgan said.

Engine does not have a true compression stroke in the sense of a hydrocarbon-fueled two-stroke engine. Instead, the hydrogen—already under pressure—is admitted to clearance volume between the piston at top center and the confines of the cylinder head.

In a flight system, the vacuum of space would scavenge the cylinder through the exhaust port. In the test engine, atmospheric pressure allowed traces of residual exhaust gas to remain in the cylinder and be compressed on the upstroke, thereby reducing the efficiency.

Ignition was achieved by a spark plug until the engine warmed after which propellant charge burned spontaneously as the oxygen was admitted to the hot cylinder.

Main design problem involved the oxygen injector, which tended to leak during tests. Oxygen leaking into the cylinder at times caused constant burning which raised heat, wasted propellants and did not add to power.

To increase efficiency, the cylinder head was insulated from the barrel by a low-heat conductivity seal and allowed to run hot. Piston was designed with minimum contact between dome and skirt to block heat transfer.

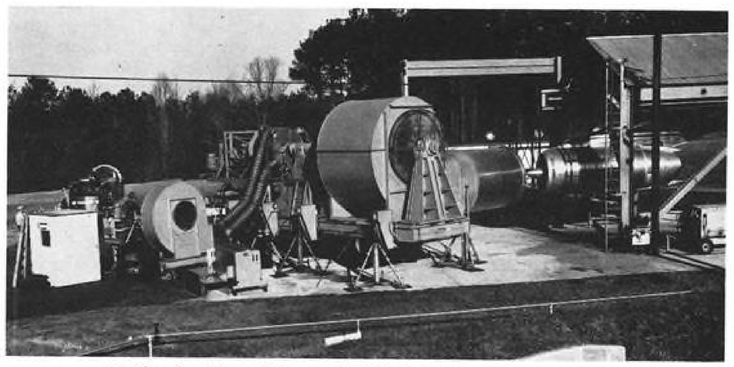
Specific propellant consumption ranged from 2.2 lb. to 3.3. lb. per hp. hr., with ambient temperature inlet gas admitted at an oxygen to hydrogen ratio of 0.9 to 1. Morgan said these consumptions better those of turbines at the 2- to 6-hp. levels developed during the tests.

Specific propellant consumption can be further lowered to 1.2 lb. per hp. hr. by regenerating the inlet gas to 400F, Morgan said. Lower inlet gas velocity due to increased temperature will cut the pressure loss at the valves and again lower the consumption to about 1.0 lb. per hp. hr.

Oxygen to hydrogen ratio increase to 2 to 1 will raise exhaust gas temperature to allow inlet gas regeneration to 900F, which should drop the specific propellant consumption to about 0.8 lb. per hp. hr., Morgan said.

Carbureted engine required constant electrical ignition and would not fire at oxygen to hydrogen ratios of less than 1.8 to 1. Ratios of 2.3 to 1 were required to approximate smooth running.

Engine developed hot-spots, causing pre-ignition and flashback into the mixing chamber. Uncontrolled combustion characteristics caused Vickers to drop the design.



Wind Machine TF33-P-7 Turbofan

Lockheed-built portable wind machine, which can generate cross-winds of 155 mph., is being used to demonstrate inlet recovery features during simulated stalls of the Pratt & Whitney TF33-P-7 turbofan engine which will power the C-141 transport.

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WHO'S WHERE

(Continued from page 23)

Honors and Elections

Dr. Walter J. Hesse, program manager of nucleonic systems for Ling-Temco-Vought's Chance Vought Corp., has been appointed a permanent member of scientific advisory group for the House of Representatives' Committee of Science and Astronautics.

J. C. Weadock, executive vice president of Chesapeake & Potomac Airways, Inc., has been elected president of the Helicopter Assn. of America.

Brig. Gen. Willard W. Millikan, commander of the District of Columbia's Air National Guard, has been named chairman of the Air National Guard Council of the Air Force Assn. Gen. Millikan is the senior representative for Northrop Corp.'s Norair Div. in Washington, D. C.

Changes

Col. Dale D. Davis, USAF, has been named Program Manager of the Federal Aviation Agency's Supersonic Transport Program Div. succeeding **Col. Lucian S. Rochte, Jr.,** now assigned to the Office of Manned Space Flight, Air Force Systems Command, Andrews AFB, Washington, D. C. Also: **Richard B. Leng,** Director of the FAA's Installation and Materiel Service.

Albert P. Smith, manager of engineering, United AeroSpace Division of United Electrodynamics, Inc., Pasadena, Calif.

Vernon L. Grose, director of reliability technology, Northrop Corp.'s Ventura Div., Van Nuys, Calif.

Lee W. Randolph, chief of the newly formed RF Systems Development Section, California Institute of Technology Jet Propulsion Laboratory, Pasadena, Calif.

Chester G. Bowers, deputy director, Airports Service, Federal Aviation Agency succeeding **George R. Borsari,** now chief, Obstruction Evaluation Branch, Air Traffic Service, FAA.

Frank R. Herud, assistant chief engineer for advanced development-rockets, Textron's Bell Aerosystems Co., Buffalo, N. Y. **Arnold R. Kimball** succeeds Mr. Herud as manager of rockets marketing.

Dimitry D. Viner, chief of flight operations, Sikorsky Aircraft Div. of United Aircraft Corp., Stratford, Conn. **Robert S. Decker** succeeds Mr. Viner as chief test pilot.

Fulton Monsees, manager of procurement, American Electronics, Inc., Fullerton, Calif.

William D. Smythe, manager-intermediate systems, General Electric Co.'s Computer Dept., Phoenix, Ariz., succeeding **William G. Baucum,** now manager of GE's Information Processing Center, Chicago, Ill.

Alexander F. Brewer, assistant director of electronics, Space Technology Laboratories, Inc., Redondo Beach, Calif., a subsidiary of Thompson Ramo Wooldridge.

William J. McClenahan, product manager, Microwave Div., Eitel-McCullough, Inc., San Carlos, Calif.

Warren C. Dunn, manager-military and aviation sales, Scott Aviation Corp., Lancaster, N. Y.

weapon system operations analysis

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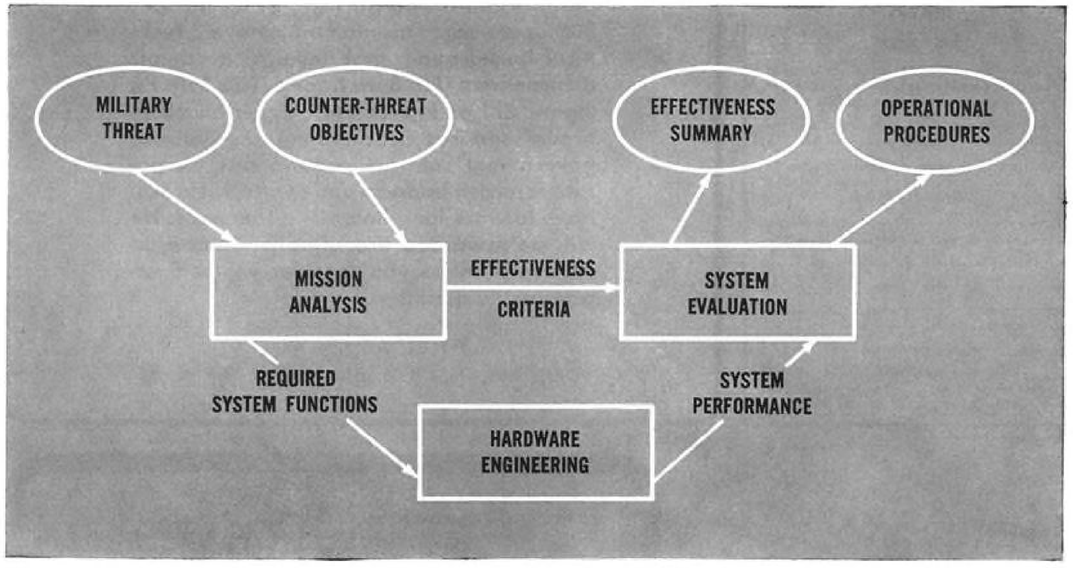

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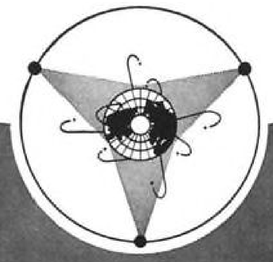

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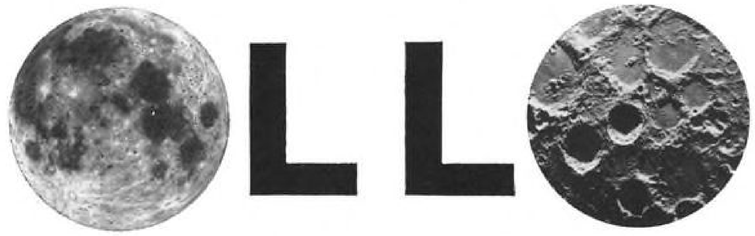

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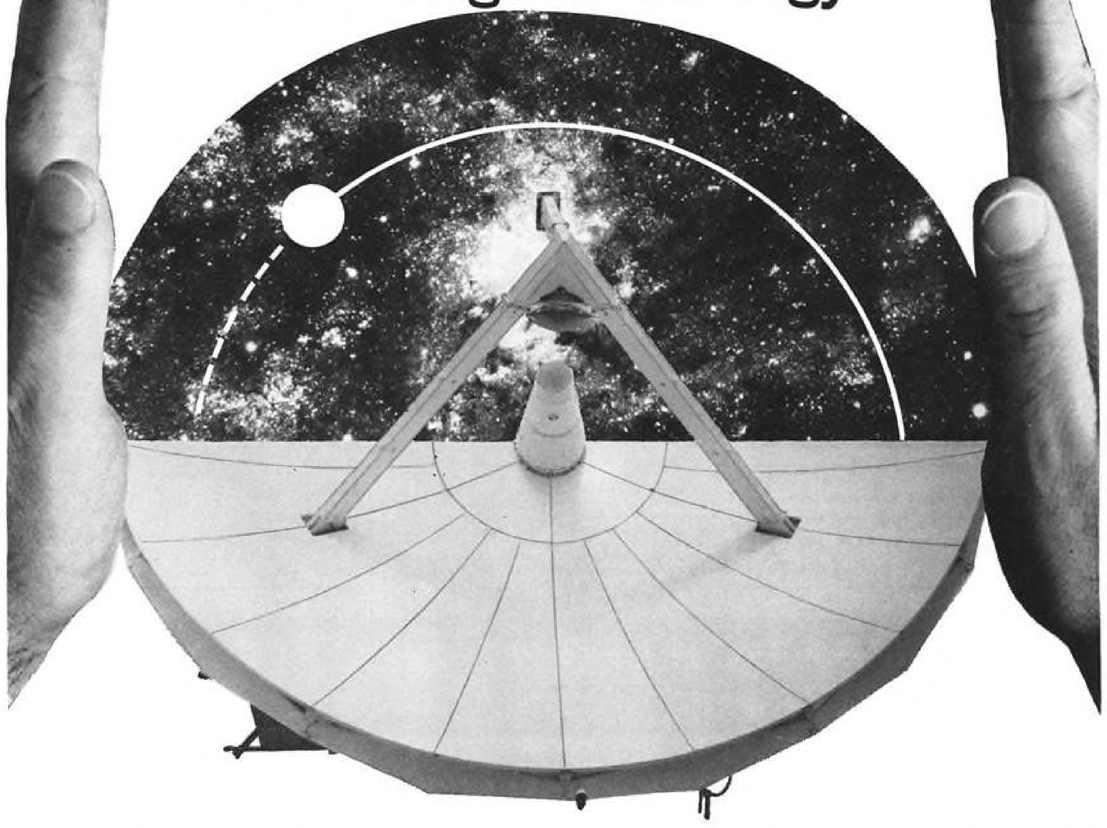

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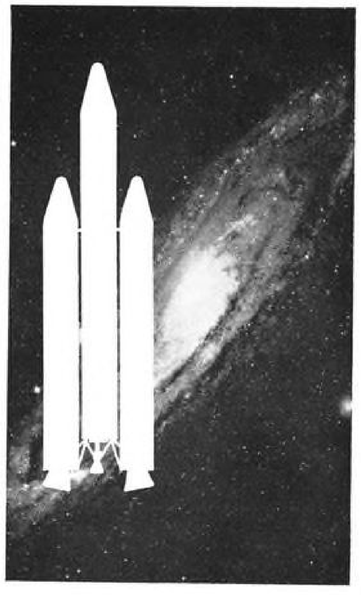


LETTERS

Soaring Contributions

I read with interest the article entitled "Antonov Scores Soviet Sports Authorities" in the Business Flying section of the Dec. 24 issue of AVIATION WEEK (p. 72), wherein O. K. Antonov takes the Soviets to task for backing out of the coming World Gliding Championships, which will be held in Argentina in February.

In the latter portion of the article, it is mentioned that the USSR has not been represented in previous World Championships. This is not correct, since a Russian team of four pilots was entered in the 1958 World Gliding Championships which were held in Leszno, Poland. It was not a really serious attempt, for they flew borrowed Polish equipment and finished well down in the standing.

The American situation is the reverse of that in the USSR. Here the decision to compete is made by the Soaring Society of America—the soaring enthusiasts' nonprofit membership organization that governs soaring in the U.S.A., representing the FAI through the NAA. Also, whereas the Russian gliding movement is a government project, here in the U.S.A. it is a private, sporting venture.

At the present time, the Soaring Society of America is conducting a fund drive to raise funds to enable them to send a team to the Championships in Argentina.

Any support you can give this effort would be most appreciated.

PAUL A. SCHWEIZER
Team Captain
The Soaring Society of America, Inc.
Elmira, N. Y.

Foggy Terminology

Generally speaking, I have a very high regard for the accuracy of AVIATION WEEK articles on various aircraft, but I would like to draw your attention to the loose manner in which the term "all weather" is used.

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.

Many aircraft manufacturers are now using this expression to indicate that their aircraft can fly in any type of weather, but this is not always factual.

To me "all weather" means what it says: not just the ability of an aircraft to fly under IFR conditions, but also rain, hail, ice crystals, icing conditions, etc.

For example, several military aircraft have been stated to be "designed to meet all weather requirements" but have no ice protection of engine intakes, windshields, or other vital areas of the aircraft—neither have these aircraft been demonstrated as being able to fly in icing conditions to CAR4b or Mil spec requirements.

As an avid reader of your magazine, I would like to see a much fuller description of "all weather" systems on specific aircraft in future technical descriptions and I hope that in spite of space limitations this will be possible.

GORDON E. WATKINS
Director-Technical Sales
The Sierracin Corp.
Burbank, Calif.

Insurance and Safety

Much has been said in your Letters column about insurance policies with respect to flight safety. Because there seems to be continued confusion between these per se unrelated subjects, I offer my views for comparison as follows:

1. The average wage earner makes during his life time probably $250,000. Those using airlines regularly have, very likely, a much higher total income. Consequently, a life insurance (policy) in that amount is more than justified, and by no means a minimum.

2. Aside from intentionally acquired insurance protection, most people who are professionally and socially active obtain life insurance automatically as soon as they join an engineering institute, an automobile club, a credit union, a bridge club and other aggregations of our modern society, not to mention the most substantial life insurance protection normally provided by the respective employer.

3. Such an individual pays, directly or indirectly, several premiums toward several protections, and his or her survivors are entitled to as many benefits as have been rightfully acquired.

4. Only unskilled or hasty criminals may purchase insurance shortly prior to a flight. Those having some talent will probably buy it long before the trip from various sources to preclude detection.

5. It seems to be absurd to limit the amount of protection required or desired by a citizen on the part of the airlines, as much as it were ridiculous to restrict the sale of airline tickets by insurance companies. One has nothing to do with the other.

6. Accident protection of the respective nature appears to be an obligation of the airlines. If they cannot accomplish this duty, they should call on the local police for help without impairing the rights of respectable citizens in this free country of ours.

RUDOLF STEINER
Van Nuys, Calif.

Satellite Identity

Re: The inquiry made by L. D. Braida (AW Dec. 24, p. 94) concerning the identity of satellite 1962 Alpha phi.

In the satellite situation report issued by the Smithsonian Astrophysical Observatory for the date 1200 Z (e.i. Greenwich time) 18 September 1962, the following notations are to be found:

International name ..... A-phi 1
Code name ..... unannounced
Source ..... unknown
Launch date ..... 10 Sept. 62
Status ..... unknown

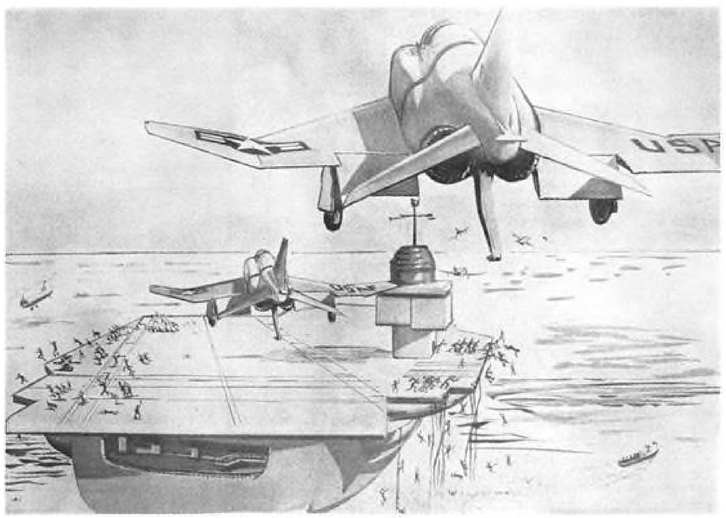
International name ..... A-phi 2
Code name ..... unannounced
Source ..... unknown
Launch date ..... 10 Sept. 62
Status ..... unknown

International name ..... A-phi 3
Code name ..... unannounced
Source ..... unknown
Launch date ..... 10 Sept. 62
Status ..... unknown

(Note that the A is a shorthand notation for Alpha.)

Since the information does not appear in the UN registry—as stated by AVIATION WEEK in the Dec. 24 issue—one is tempted to ask, "doth the right hand knoweth what the left hand doeth?" Or, censorship is a funny thing. It makes some people—or agencies—look like jackasses!!

SAUNDERS B. KRAMER
Sunnyvale, Calif.



BI-SERVICE COOPERATION IN ACTION

Clifton Precision announces 4 major improvements in Servo Motor performance

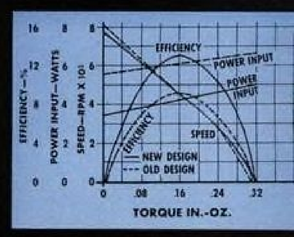
Greater EFFICIENCY

Higher TORQUE/INERTIA RATIO

Lower STARTING VOLTAGE

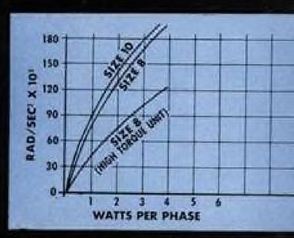
Less heat vulnerable MATERIALS

These motors provide more torque for considerably less power input. This results in a more efficient motor as well as a cooler running motor.



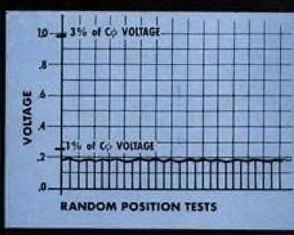
Acceleration is increased to 160,000 rad/sec² at between 2 and 3 watts/phase. Up to 200,000 rad/sec² is possible under certain conditions.

This is such an improvement that in certain motor-generator requirements, a new CPPC servo motor will now suffice.

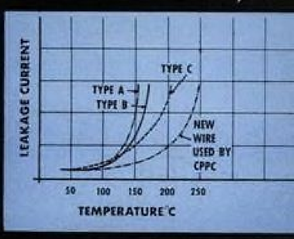


Whereas starting voltages have been specified at 3% of control phase voltage, we can now guarantee 1% and a great deal more uniformity.

Furthermore, starting voltage of these motors has been exhaustively tested so that all starting characteristics can be accurately predicted.



New slot and magnet wire insulation allow much less current leakage at high temperatures. In addition, new lubricants and new impregnation enable these motors to withstand 200°C plus. Solderless connections are now incorporated in our servo motor line (all connections are welded).



For full information: Sales Dept. 5050 State Rd., Drexel Hill, Pa. MAdison 2-1000, TWX 215 623-6068—or our Representatives.

Be sure to see and discuss these motors in our suite, Barbizon-Plaza Hotel at the IEEE Convention, New York City, March 25-28.

CLIFTON PRECISION PRODUCTS CO., INC.

cppc

Clifton Heights, Pa.
Colorado Springs, Colo.

FEB. 19 1963

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