Aviation Week & Space Technology

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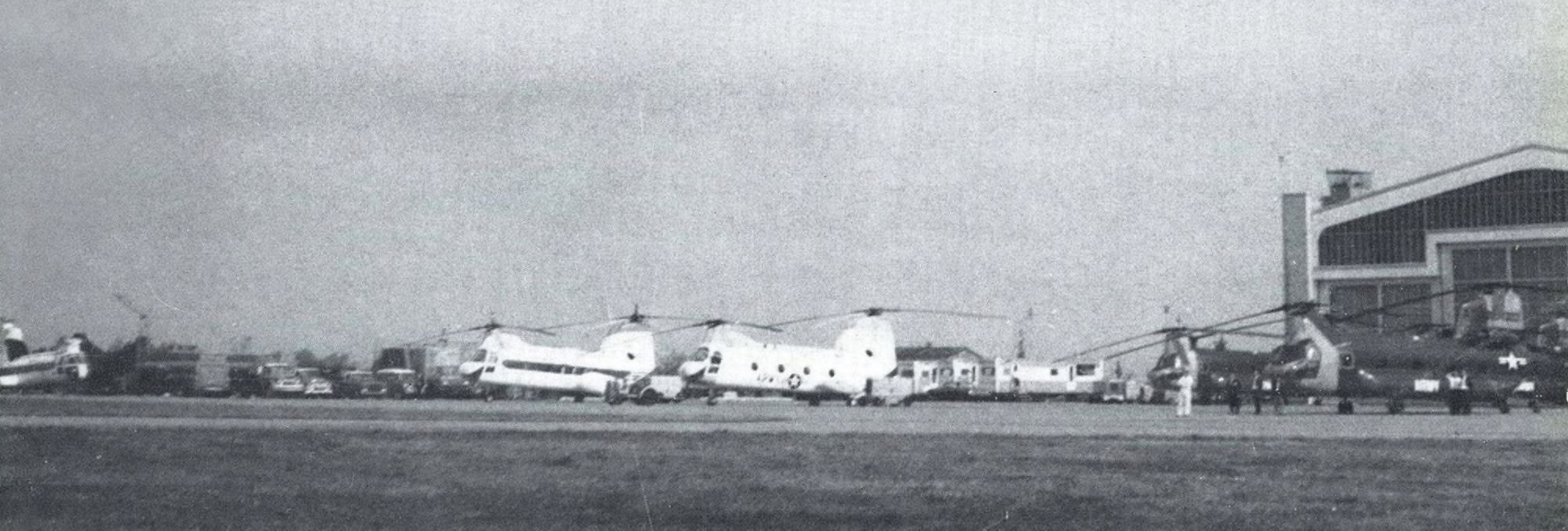
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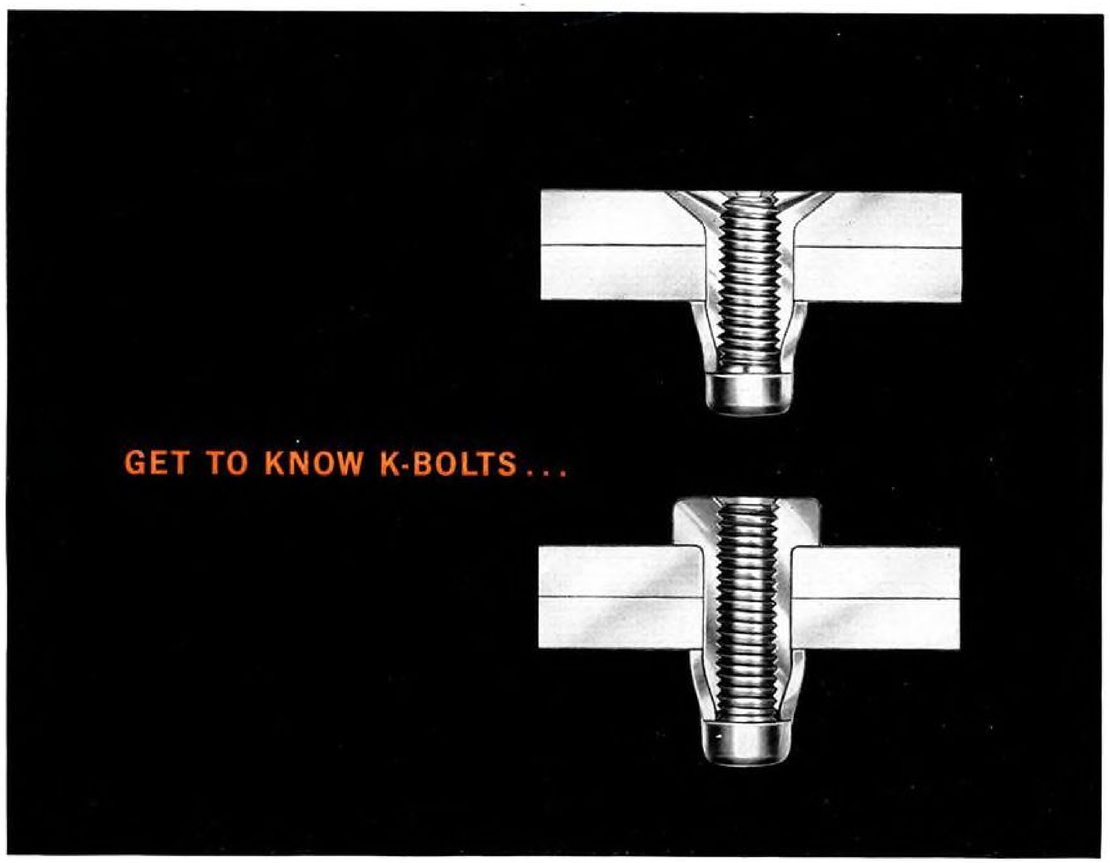
December 3, 1962

Improved Range, Power Planned For DH-125

Vertol/Marine CH-46A Assault Helicopter







K-BOLT the blind fastener with Kaylock® reliability

Here's the newest addition to Kaylock's line of quality fasteners

1—Has superior clamp-up characteristics

2—High resistance to vibration and fatigue

3—Easily installed from one side of work surface

4—Reduces assembly time and related costs

5—Standard in-stock installation tools are used

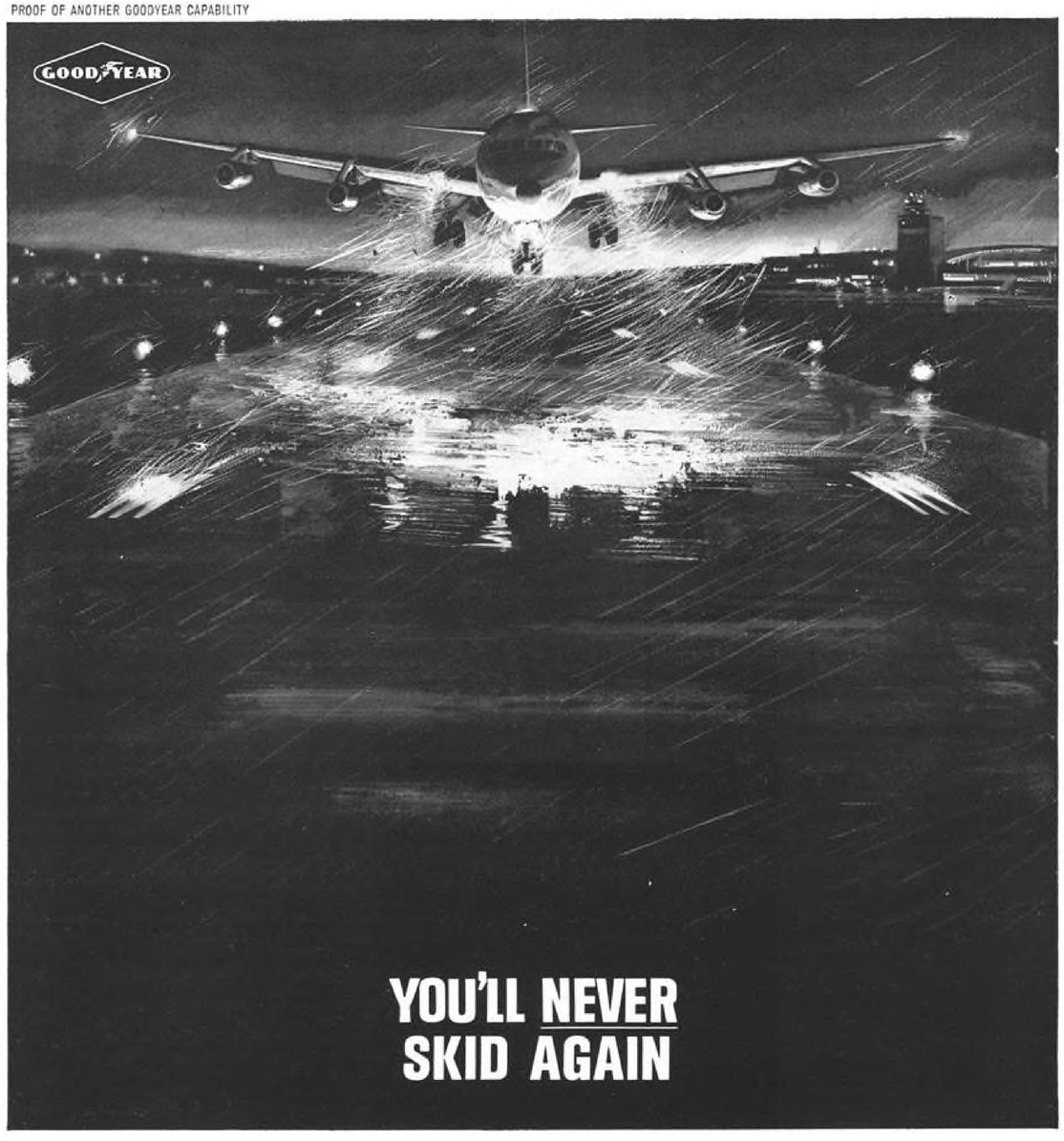
6—Conforms to proposed Aerospace specifications

Designed for structural applications, K-Bolt unit assemblies are available with Hex or Flush Heads, in nominal shank diameters. Write today for Bulletin 2622.

Kaylock®
first in all-metal self-locking fasteners

KAYNAR MFG. CO., INC., KAYLOCK DIVISION • Box 2001, Terminal Annex, Los Angeles 54, California

PROOF OF ANOTHER GOODYEAR CAPABILITY



with the Exclusive Goodyear Adaptive Brake-Pressure Control

AND HERE'S WHY: It automatically maintains brake pressure just below the skid point — instantaneously adapts the pressure of the brake to the coefficient of friction between the tires and any runway surface — constantly adjusts its own sensitivity to the runway condition changes throughout the landing. And it's not affected by over-pressurization of the braking system.

There are three great Goodyear Anti-Skid Systems:

Adaptive Brake Pressure Control is but the latest skid control system by Goodyear. Another Goodyear Anti-Skid System lets the pilot control braking pressure unless a skid threatens — then automatically "dumps" pressure until the skid condition is corrected. And the Skid Warning System* tells a pilot when a skid is imminent by a sharp "thumping" action on his foot that *demands* his immediate attention and permits the pilot to correct for skids by releasing brake pedal pressure.

Goodyear skid control systems are used on Republic's F-105D, Douglas' DC-7, Lockheed's JetStar and F-104, Convair's B-58, the Vickers Viscount and many other planes. For more information on these systems, write on your company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. **X-1715**, Akron 16, Ohio.

Lots of good things come from **GOODYEAR**

*Patents pending

ANOTHER IN A SERIES DEPTH MANAGEMENT IN ACTION

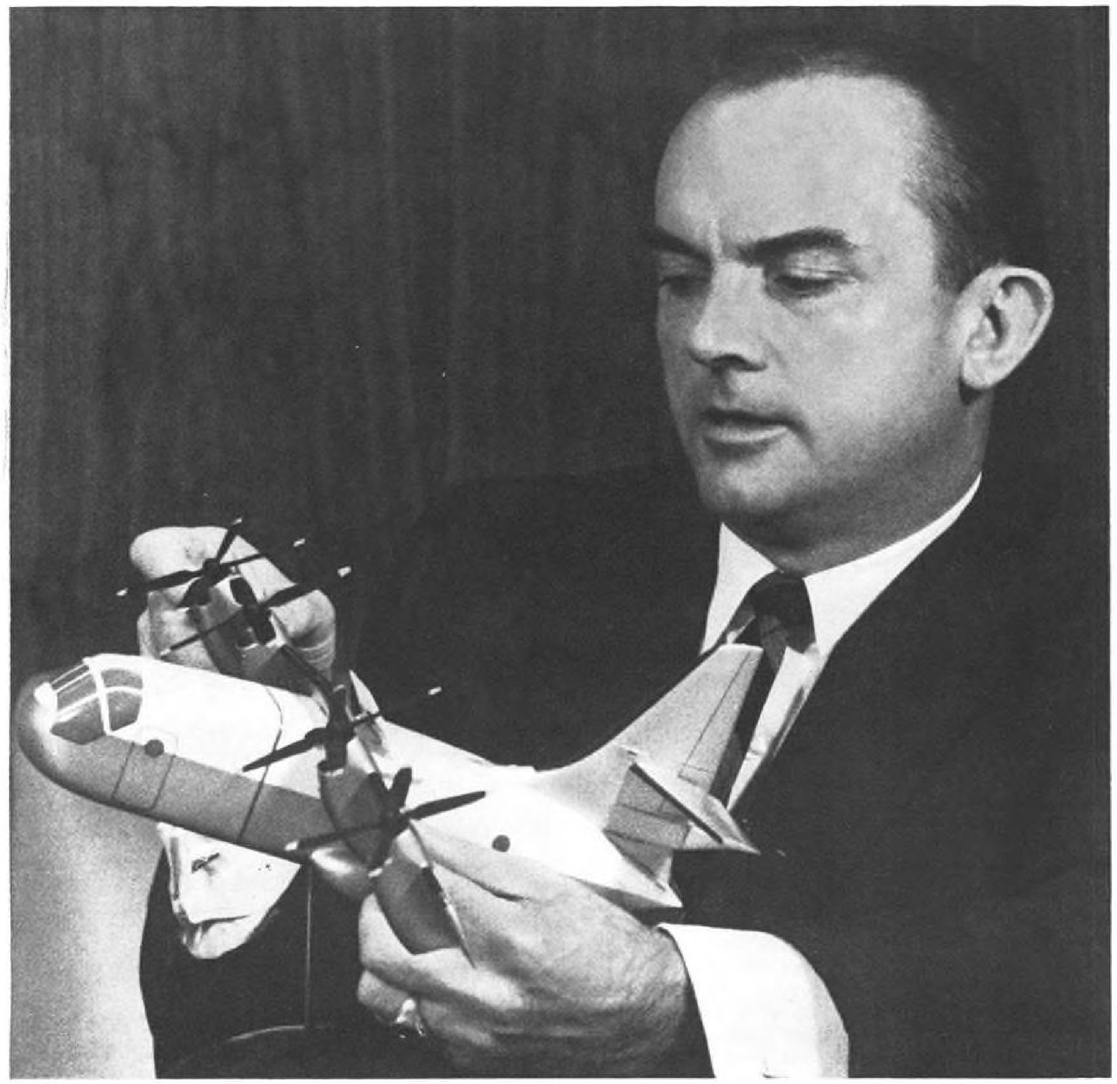
THE STORY BEHIND AN AMAZING NEW AIRCRAFT

The Army, Navy and Air Force will soon have a revolutionary new aircraft, Chance Vought's VTOL transport. The first of an entirely new generation, the VTOL — vertical take-off and landing aircraft — will combine the best features of both helicopters and airplanes. When wing and engines are tilted vertically, the VTOL will climb or land like a helicopter. When wing and engines are moved into conventional position, the transport will fly at a speed much faster than a helicopter's. The VTOL's flexibility will be especially effective for rapid transport of troops, equipment and supplies into unprepared areas under all weather conditions. Its potential is also great for use as a civilian local service aircraft.

Chance Vought, the aerospace arm of Ling-Temco-Vought, has the prime contract for development of an operational prototype VTOL. Teamed with Vought are two other famous names in aviation — Ryan Aeronautical Company and Hiller Corporation. LTV's efforts in this important program are guided by Paul Thayer — a dynamic executive who has grown through the ranks from test pilot to Chance Vought president, and whose leadership is a vital component in LTV's management in depth.

This caliber of management, linked with proved technical competence in aerospace, electronics, communications and consumer products, enables LTV to make important contributions to the security, prestige and the well being of our nation.

LING-TEMCO-VOUGHT, INC. LTV DALLAS, TEXAS



AEROSPACE CALENDAR

Dec. 10-11—First Annual Symposium on Unconventional Inertial Sensors (classified), Republic's Paul Moore Research & Development Center, Farmingdale, N. Y. Co-sponsors: Bureau of Naval Weapons & Republic Aviation Corp., in cooperation with AFSC Scientific and Technical Liaison Office.

Dec. 10-12—Conference on VTOL Aircraft, New York Academy of Sciences, Henry Hudson Hotel, New York, N. Y.

Dec. 17—First National Conference on the Utilization of Retired Military Personnel, Sheraton Park Hotel, Washington, D. C. Co-sponsors: Department of Labor; Air Force Assn.

Dec. 17-20—International Arms Control Symposium, University of Michigan, Ann Arbor, Mich. Co-sponsors: University of Michigan; Bendix Systems Division.

Dec. 26-31—Space Physics Meeting, American Rocket Society and American Assn. for Advancement of Science, Philadelphia, Pa.

Dec. 27—American Astronautical Society Symposium on Scientific Satellites-Mission and Design, Franklin Hall, Philadelphia.

Jan. 7-10—Millimeter and Submillimeter Conference, Institute of Radio Engineers, Cherry Plaza Hotel, Orlando, Fla.

Jan. 13-16—15th Annual Convention, Helicopter Assn. of America, Cabana Motor Hotel, Palo Alto, Calif.

Jan. 14-18—Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

(Continued on page 7)

AVIATION WEEK and Space Technology

December 3, 1962

Vol. 77, No. 23

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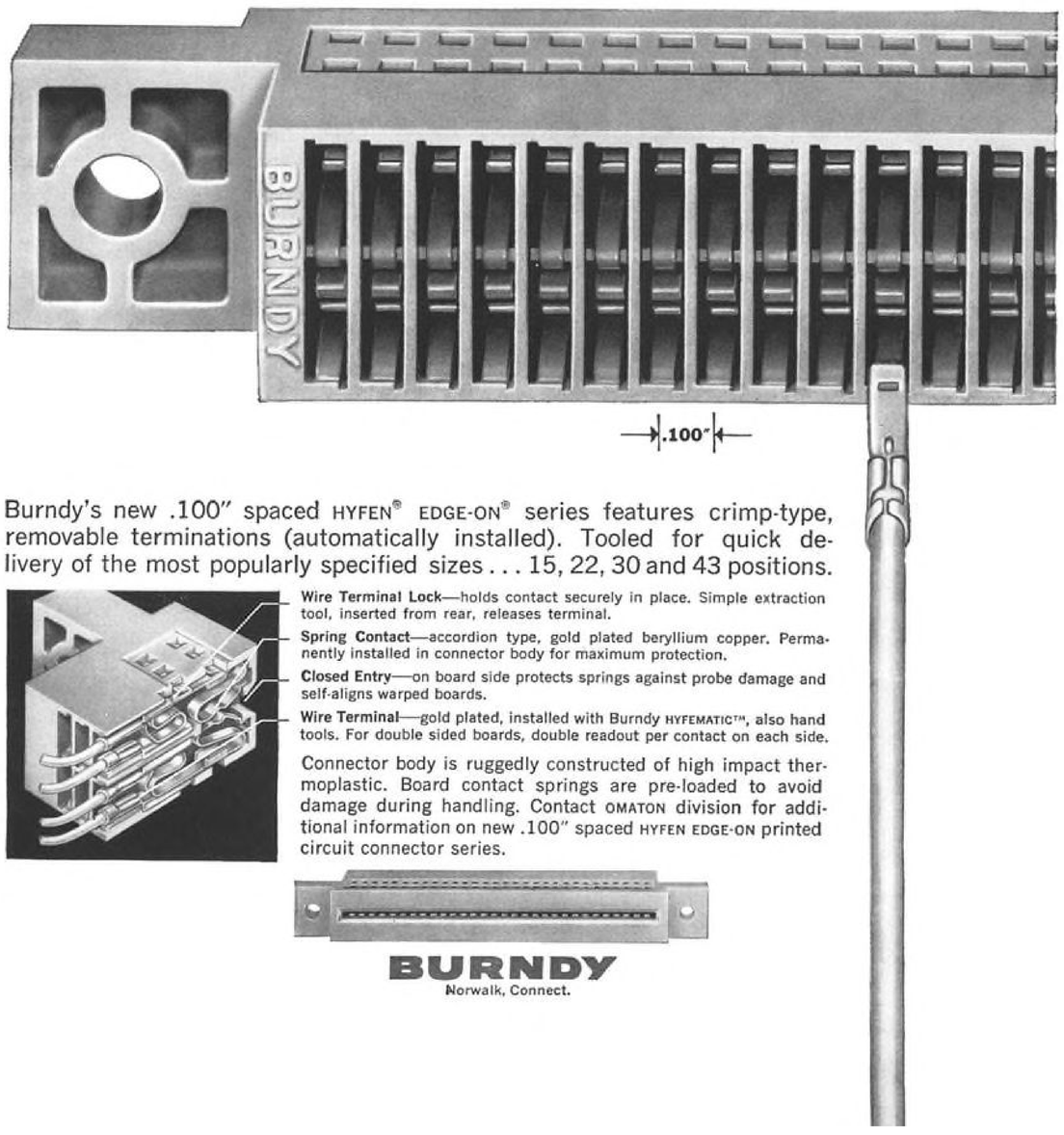
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Burndy's new .100" spaced HYFEN® EDGE-ON® series features crimp-type, removable terminations (automatically installed). Tooled for quick delivery of the most popularly specified sizes . . . 15, 22, 30 and 43 positions.

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Closed Entry—on board side protects springs against probe damage and self-aligns warped boards.

Wire Terminal—gold plated, installed with Burndy HYFEMATIC™, also hand tools. For double sided boards, double readout per contact on each side.

Connector body is ruggedly constructed of high impact thermoplastic. Board contact springs are pre-loaded to avoid damage during handling. Contact OMATON division for additional information on new .100" spaced HYFEN EDGE-ON printed circuit connector series.

BURNDY
Norwalk, Connect.

AEROSPACE CALENDAR

(*Continued from page 5*)

Jan. 15-17—Ninth Annual Meeting, American Astronautical Society, Statler Hilton Hotel, Los Angeles, Calif.

Jan. 21-23—31st Annual Meeting (including Wright Brothers Lecture), Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y.

Jan. 21-24—43rd Annual Meeting, American Meteorological Society, New York, N. Y.

Jan. 22-24—Ninth National Symposium on Reliability and Quality Control, Sheraton-Palace Hotel, San Francisco, Calif.

Jan. 28—Fifth Annual Army Aviation Contract Services Symposium, International Inn, Washington, D. C. Sponsor: National Aeronautical Services Assn.

Jan. 30-Feb. 1—Fourth Annual Solid Propellant Rocket Conference, American Rocket Society, Bellevue Stratford Hotel and The Franklin Institute, Philadelphia.

Jan. 30-Feb. 1—National Winter Convention on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Feb. 5-6—Symposium on Engineering for Major Scientific Programs, Georgia Institute of Technology, Atlanta, Ga.

Feb. 5-7—Advances in Metalworking Seminar, American Society of Tool and Manufacturing Engineers, Park Sheraton Hotel, New York, N. Y.

Feb. 6-7—59th Meeting, National Aerospace Standards Committee of the Aerospace Industries Assn., Ambassador Hotel, Los Angeles, Calif.

Feb. 11-15—Third International Symposium on Quantum Electronics, UNESCO Building, Paris, France. Sponsors: International Scientific Radio Union; Office of Naval Research; La Federation Nationale Des Industries Electroniques.

Feb. 12-13—Space Vehicle Thermal and Atmosphere Control Symposium, conducted by the Aeronautical Systems Division, Engineers Club, Dayton, Ohio. Sponsor: ASD's Flight Accessories Laboratory.

Feb. 20-22—1963 International Solid-State Circuits Conference, Philadelphia, Pa. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; University of Pennsylvania.

Mar. 7-8—Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio.

Mar. 11-13—Electric Propulsion Conference, American Rocket Society, Broadmoor Hotel, Colorado Springs, Colo.

Mar. 18-20—Space Flight Testing Conference, American Rocket Society and Institute of the Aerospace Sciences, Cocoa Beach, Fla.

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

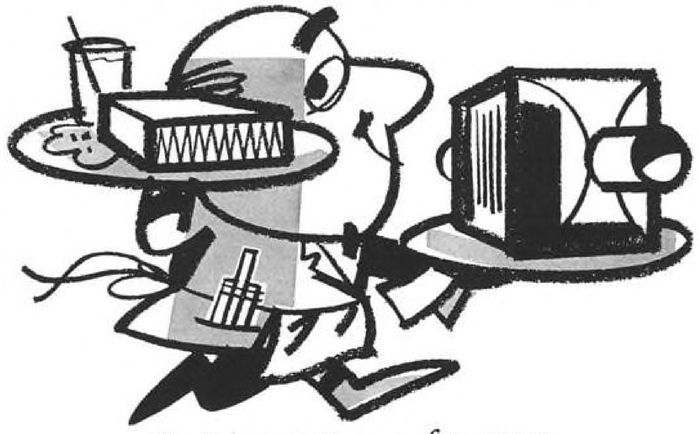
Mar. 19-21—Second Air Force-sponsored Symposium on Bionics, Biltmore Hotel, Dayton, Ohio.

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

Apr. 1-3—Fourth Annual Structures and Materials Conference, American Rocket Society and Institute of the Aerospace Sciences, El Mirado Hotel, Palm Springs.

(*Continued on page 9*)

HEAT EXCHANGERS IN A HURRY



(Or: A new slant on $q=\int u(t_h-t_c)dA$)

Heat exchanger design problems are reputed to make young men gray and older men balder. It thus gives us joy to report that Budd heat transfer engineers are today retaining whatever cranial adornment they started with. You can profit thereby.

Budd offers complete design, prototype and production services for plate-fin heat exchangers. We produce these compact, lightweight and highly efficient components by both dip-brazing and epoxy bonding . . . with aluminum, stainless steel, copper and other materials . . . in myriad configurations for missile cooling, intercoolers, oil coolers, air conditioning systems and other land, sea, air and space applications.

What's new about that? Just this:

To design the best heat exchanger for a given job, a number of complexly interrelated thermal variables . . . heat transfer rate, thermal conductance, transfer area, hot- and cold-side temperatures, etc. . . . are usually juggled around until the required heat transfer rate is attained.* During this labor, the designer must also find a way to satisfy such vital external requirements as size, weight, strength, reliability and cost.

We now announce, as modestly as possible under the circumstances, that Budd is applying new techniques that enable plate-fin component heat exchangers to be designed and produced *faster than ever before!*

This is not the result of an overnight inspiration. Our Environmental Control Systems Department has long been busy with a fresh and deep-probing investigation of analytical approaches to heat exchanger design. Their study was pointedly abetted by the experience, the knowledge of practical operating conditions, and the voluminous test data we've accumulated in over 20 years of designing and producing complete heat exchanger systems, as well as component exchangers and other types of environmental control systems.

Our new design method enables us to fix optimum exchanger relationships and values with surprising speed. In several recent cases, we've designed complex new exchangers *in a few hours!*

How do we do it? The details we guard. But we *can* say that design reliability as well as speed is assured by a pre-specified feedback checking technique. (In a moment of flamboyance, we tagged the new method "Feedback-Controlled Design." It may stick.) Other enticing information is contained in our heat exchanger bulletin, which we'll naturally send on request. (If you don't already belong to The Budd Electronics Chowder and Marching Society, be sure to ask for your membership credentials too.)

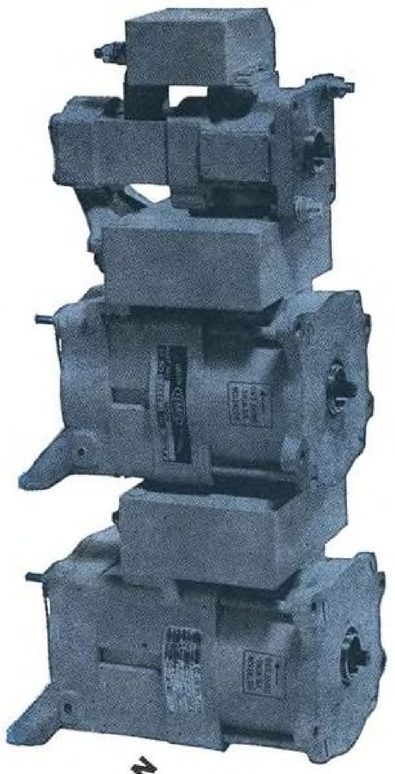
There is, of course, an eminently scientific way to verify our rather substantial claim—let us design and deliver your next exchanger. Why wait? Environmental Control Systems, Budd Electronics, 43-22 Queens St., Long Island City 1, N.Y.

*Simplified formula shown above. Also, in another usage: q=beverage consumption rate. A=total transfer area, beverage to blood stream. u=beverage conductance per ft² of A. t_b=torpidity, maximum allowable. t_c=torpidity, initial.

Budd ELECTRONICS
A DIVISION OF THE BUDD COMPANY, INC.

Data Processing & Display Systems
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EEMCO
MOTORS



THE THREE STAGES OF MINUTEMAN

depend upon three auxiliary power packages. Each is driven by a small-size big-output motor capable of delivering the order of reliability and performance demanded for Minuteman. They are products of Eemco Division of Electronic Specialty Co., which has been providing missile, space, and aircraft industries with custom motors, actuators, and starter-generators for 20 years. For complete, specific information on Eemco Minuteman-proved products, just write or call.



GENERAL REQUIREMENTS:

2 circuit radio noise filters for ungrounded return; Explosion-proof; Fluid resistant (MIL-H-5606 fluid); Air Ambient +32°F. to 325°F.; Sustained Acceleration: 25 g., perpendicular to mtg. flange; Shock: 100 g.; Temperature sensing element imbedded in stator windings; General environmental conditions per MIL-M-8609A, class B; Resistance to ground: 10 meg-ohms min.

Vibration—Sinusoidal and Gaussian random as follows:

5 to 50 cps	.6 g's RMS
50 to 2,000 cps	12 g's RMS
5 to 25 cps	0.1 g²/cps
25 to 50 cps	0.3 g²/cps
50 to 1,000 cps	0.6 g²/cps
1,000 to 2,000 cps	rolled off at 12db/octave from 1,000 cps value

SPECIFIC REQUIREMENTS:

D-1356 (First Stage)
Maximum Duty: 5.2 H.P., 12,500 RPM, 24 Volts, 208 Amps, 78% Efficiency.
5 Min. Duty: 3.6 H.P., 16,100 RPM, 28 Volts, 122 Amps, 78% Efficiency, Altitude—0 to 100,000 feet. Life: 100 cycles of 5 min. duty. Weight: 10.8 lbs., incl. filter.

D-1298 (Second Stage)
Maximum Duty: 4.37 H.P., 12,700 RPM, 24 Volts, 188 Amps, 76% Efficiency.
5 Min. Duty: 3.12 H.P., 16,900 RPM, 28 Volts, 113 Amps, 74% Efficiency, Altitude—0 to 300,000 feet. Life: 100 cycles of 5 min. duty. Weight: 9.1 lbs.

D-1302 (Third Stage)
Maximum Duty: 1.35 H.P., 14,500 RPM, 24 Volts, 63 Amps, 66% Efficiency.
5 Min. Duty: 1.13 H.P., 19,100 RPM, 28 Volts, 44 Amps, 68% Efficiency, Altitude—0 to 300,000 feet. Life: 100 cycles of 5 min. duty. Weight 4.1 lbs.

ELECTRONIC SPECIALTY CO., Eemco Division • 4612 W. Jefferson Blvd., Los Angeles 16, Calif. REpublic 3-0151

AEROSPACE CALENDAR

(*Continued from page 7*)

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

Apr. 15-17—Hypersonic Ramjets Conference, American Rocket Society and American Society of Mechanical Engineers, Naval Ordnance Laboratory, White Oak, Md.

Apr. 17-19—International Nonlinear Magnetics Conference, Shoreham Hotel, Washington, D. C. Sponsors: American Institute of Electrical Engineers; IRE.

Apr. 17-19—Southwestern Conference and Electronic Show, Institute of Radio 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 Symposium, Institute of the Aerospace Sciences in cooperation with NASA and AFSC, Dallas, Tex.

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

Apr. 24-26—Seventh Region Technical Conference, Institute of Radio Engineers, San Diego, Calif.

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

May 2—Bioastronautics Conference, American Rocket Society and Aerospace Medical Assn., Los Angeles, Calif.

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

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

May 13-15—National Aerospace Electronics Conference, Institute of Radio Engineers, 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 Radio Engineers, Miramar Hotel, Santa Monica, Calif.

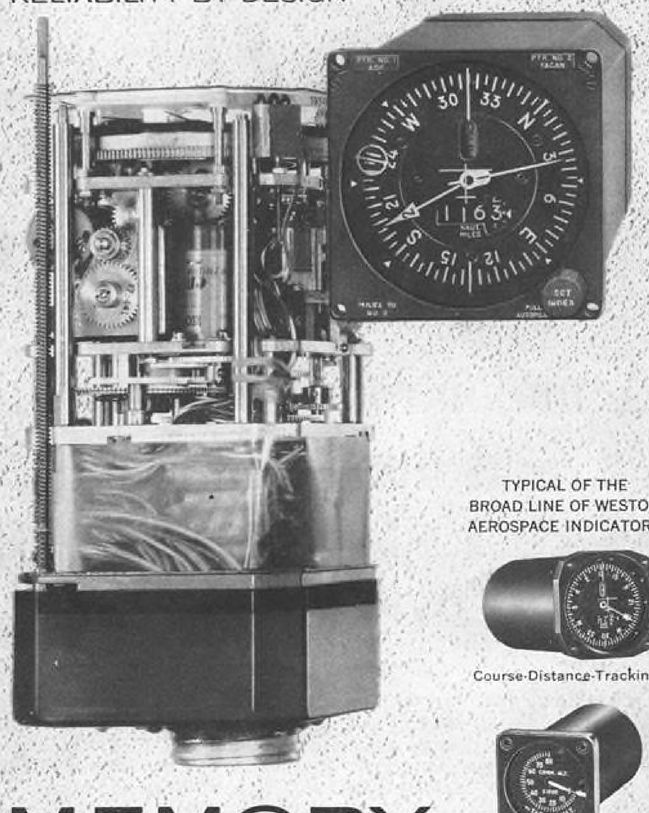
May 20-22—National Telemetering Conference, Hilton Hotel, Albuquerque, N. M.

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 Radio Engineers, Continental Hotel, Cambridge, Mass.

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

RELIABILITY BY DESIGN



TYPICAL OF THE BROAD LINE OF WESTON AEROSPACE INDICATORS



Course-Distance-Tracking



Command/Target Altitude

MEMORY

ONLY INSTRUMENT OF ITS KIND . . .
HAS INDEX FOR AUTOMATIC CONTROL

In outer space or at sea level, you can depend on Weston aerospace instruments for highest reliability and superior performance. The complex Bearing-Distance-Heading Indicator, for example, provides an accuracy of ± 0.5° on the card, and is equipped with an adjustable memory index for automatic flight control. Reliability is proved in rigid 1,000-hour MTBF tests* . . . rather than by time logged under normal flight conditions.

Weston's high performance standards are achieved through unexcelled packaging techniques and mechanical design, in-plant machining, and rigid quality control. In addition, Weston offers unparalleled engineering experience. We designed and built the original I.L.S. Indicators, and recently supplied nine of the 26 indicating instruments aboard each Mercury Capsule.

Take advantage of unusual Weston design and development capability. For more information, write Weston — producer of the most complete line of electrical aerospace instruments for manned flight. Dept. AW-48.

*Test Level H, Advisory Groups of Reliability of Electronic Equipment.



Situation Display



Bearing-Distance-Heading



Radar Altimeter

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Announces

CLEAR LAKE CITY

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Your company belongs next to NASA/Houston — at Clear Lake City. This 15,000-acre planned community flanks the Manned Spacecraft Center on three sides. Campus-like research and industrial areas will adjoin the MSC.

NASA/Houston recently announced acceleration of its $150 million construction program. By late 1963, operations will start concentrating at the Manned Spacecraft Center and at nearby Ellington AFB. Clear Lake City bridges these two NASA nerve centers.

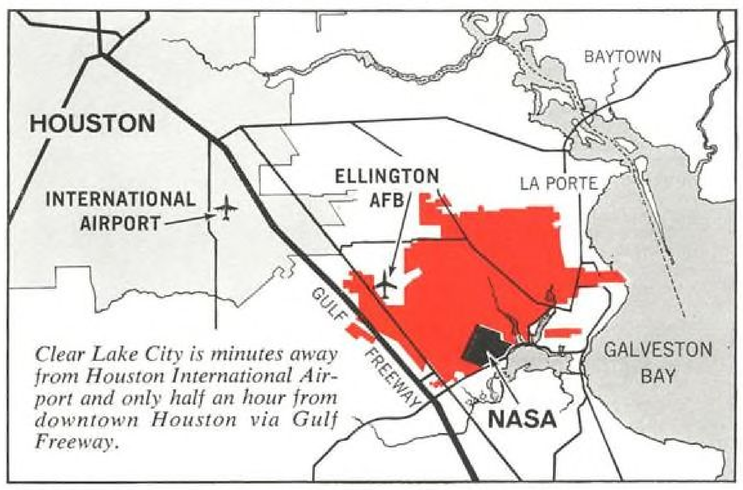
Clear Lake City Research Park occupies 1000 choice acres on NASA's northwest limits. The strategic location and meticulous planning of this park make it one of the most desirable R&D locations in the country. The Research Park will have extensive landscaping and underground utilities. Architectural controls will help achieve harmony without regimentation.

The Industrial Park, with identical improvements and controls, will adjoin the Research Park on the south. An Industrial District will be located in the northwest.

First class office space suited to technical representatives will be ready for occupancy next spring.

Clear Lake City will boast a fine motor hotel, apartment buildings, mobile home park, community center, shopping center, model homes and country club. The first nine holes of an 18-hole, four-season golf course will be playable in 1963.

Northeast of Clear Lake City, 7000 acres are to be developed for heavy industry by Humble Oil & Refining Company.



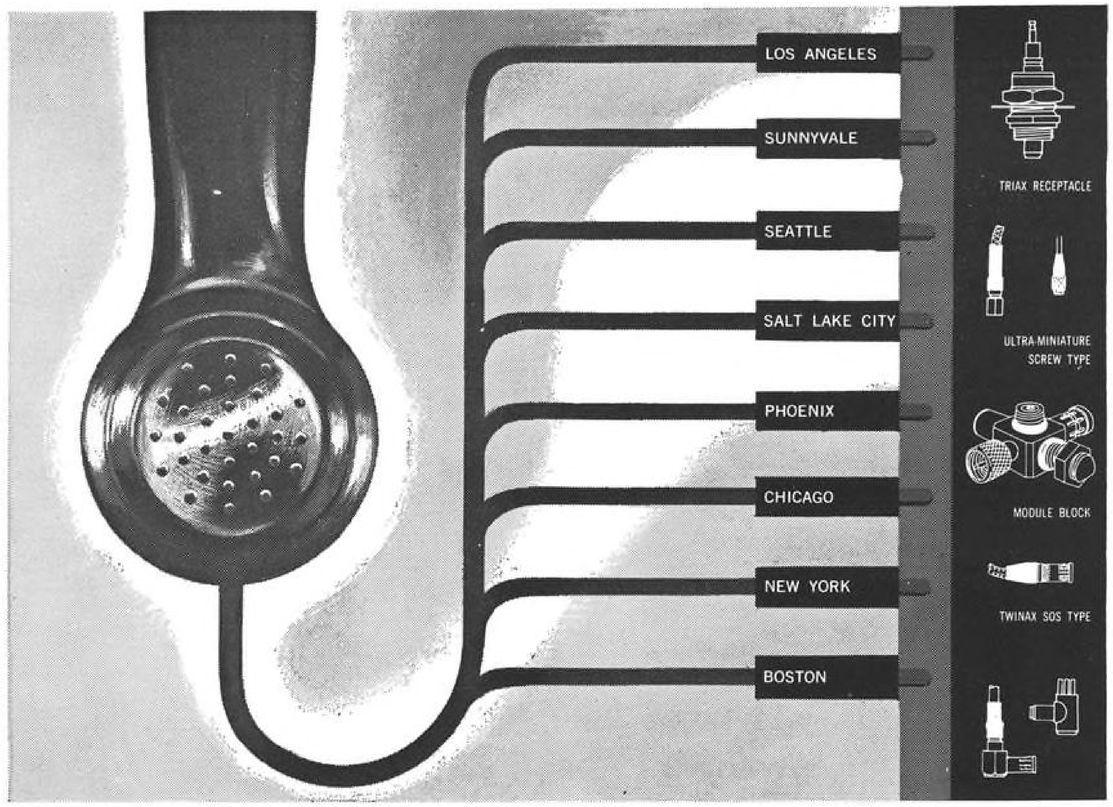
Clear Lake City is minutes away from Houston International Airport and only half an hour from downtown Houston via Gulf Freeway.

For detailed information, write or call W. Lawrence Prehn, Jr., Resident Manager, Commercial and Industrial Development, Del E. Webb Corporation, 900 Texas National Bank Building, Houston 2, Texas. Telephone CApitol 8-0781. Your inquiry will be treated in the strictest confidence.

Clear Lake City is a project of Del E. Webb Corporation for Friendswood Development Company.

DEL E. WEBB CORPORATION

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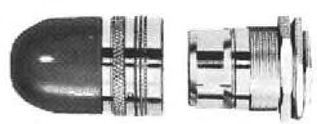
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Teaching Machine

Hughes 269A Helicopter combines all the features of the "perfect" trainer. Consider these facts:

1. Designed for learning ease—Pilots who have "flown them all" praise the 269A for its responsive controls, very high maneuverability, unusual stability, 360° visibility, high rotor clearance—overall compact size.

2. Costs less to buy, less to fly—First cost of the 269A—$22,500—is at least half that of previous helicopters. Commercial operators report all direct operating costs are as low as $10.55 per hour. (One operator reports a maintenance parts and labor record of just $3.25/hour through 475 flight hours!)

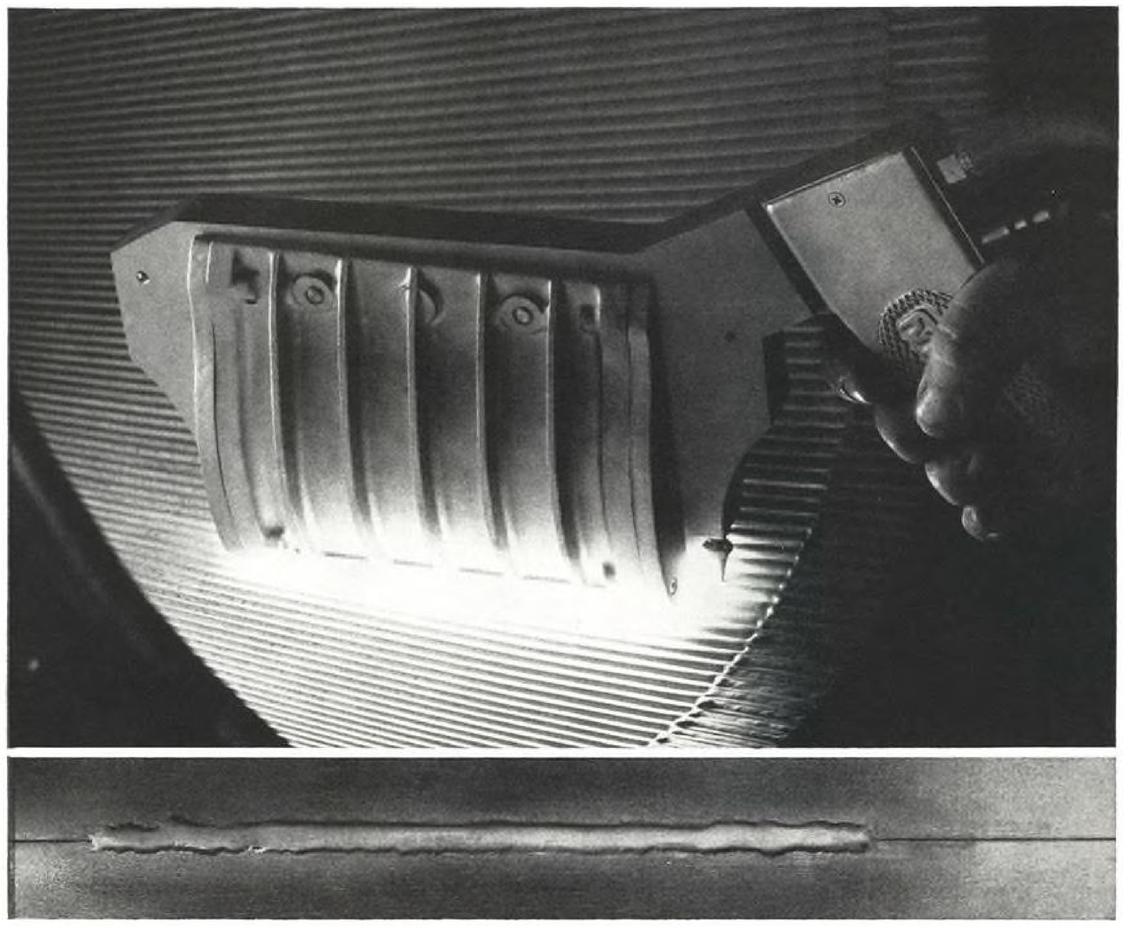
3. Proved in U.S. Army and Air Force evaluations—The HO-2 (Army designation for the 269A prototype) met or exceeded all guarantees for a light two-place helicopter. Reasons: The 269A's high power to weight ratio, small rotor diameter, rugged structure, overall simplicity, and integrity of design.

4. Minimum maintenance, maximum air time—The 269A delivers more "up time" because it spends less time in the shop. Example: Wearing parts in major components have a life of at least 1000 hours. Hughes records show a ratio of three hours of flight time to one hour of maintenance.

5. "Off the shelf" delivery—The Hughes 269A is now in full volume production at Hughes Tool Company/Aircraft Division facilities. A world-wide dealer network offers complete sales, service and training support.

6. Salient Specifications for the Hughes 269A. Rotor diameter—25'. Overall length—22'. Useful load—640 lbs. Powered by Lycoming 180 h.p. engine. Cruise speed—83 mph. Range—200 miles. Endurance—3 hours.

For more information on the 269A and its unusual capabilities as a trainer, please contact the Vice President, Marketing, **Hughes Tool Company,** Aircraft Division, Culver City, California.



VERSATILE INFRA-RED BRAZING TOOL HANDLES PRECISION WORK AT TEMPERATURES UP TO 2100°F.

Electric-powered and timer-controlled, Aerojet's new Aeroray Brazing Gun* offers far more control over hand brazing operations than ever before possible. Developed to perform delicate repairs to thin-walled sections (.010 - .020 inch) of missile thrust chambers, the gun focuses high density infra-red energy into a 5 inch line only .100 inch wide, delivering time-controlled temperatures up to 2100° F. ■ The Aeroray Brazing Gun has a power density output of 2400 watts per square inch, and can melt a braze alloy such as Coast #62 in less than 45 seconds. This speeds up brazing dramatically and permits use of inexpensive braze alloys. Just as important, close control of the heat output reduces discoloration and all but eliminates accidental burn damage to the part. ■ Made of aluminum, the Aeroray Brazing Gun weighs only 3 pounds. Operation is so simple unskilled personnel can be trained in about 15 minutes. Power requirement is 230 volts A.C. Heat is generated by a standard quartz lamp and focused by reflectors. Brazing takes place in an envelope of argon gas triggered through the gun. ■ Price of the complete Aeroray Brazing Gun (including timer), $975.00 plus shipping and handling. For more information, contact Aerojet-General® Corporation, P.O. Box 296—F, Dept. 50, Azusa, California.

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*PATENT APPLIED FOR



HERE IS A PROJECT THAT FOLDED.

In more ways than one.

The Hiller "CAMEL" may never log one second of air time. It is one of a number of exploratory projects which Hiller has sponsored over the years to make tomorrow's *flying* helicopters more useful and reliable.

In 1959 Hiller military requirements engineers teamed with Army combat experts to explore thoroughly the problem of transporting tactical helicopters into remote theaters of action, quickly and with minimum logistical support. The CAMEL was one of the results — a turbine helicopter with eight-minute foldability.

Company-financed research programs, like the CAMEL, often don't reach flight status; but their ideas do—in such aircraft as the Hiller Ten99 and U.S. Army HO-5 Light Observation Helicopter. Two of the world's most advanced rotorcraft.

U.S. ARMY HO-5

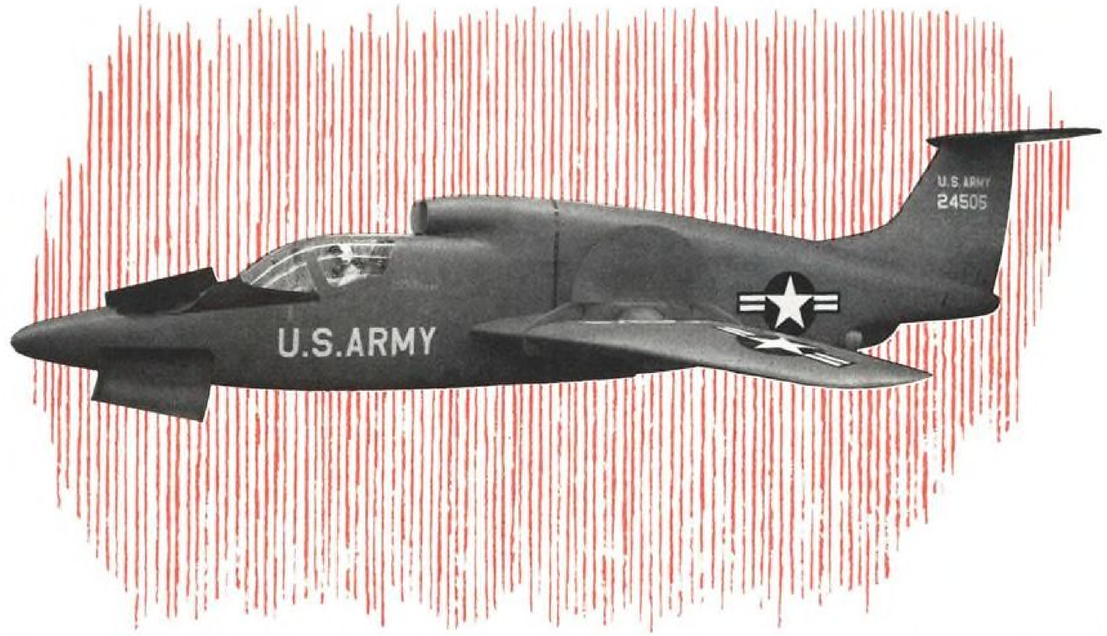


HILLER TEN99



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Army XV-5A* provides maximum range/payload

Scheduled to fly in mid-1963, the Army XV-5A* lift fan research aircraft will provide greater payload/range capability than any other high performance V/STOL system.

Now being designed and built by Ryan Aeronautical Company, under contract to General Electric, the XV-5A* aircraft will be powered by two J85 jet engines which drive submerged wing fans for vertical flight. This unique concept provides two to three times more lift, for a given amount of installed engine thrust, than any other high speed V/STOL design.

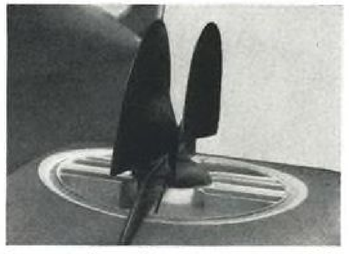
Result: Greater payload/range capability — less fuel consumption and need for logistic support. Because the lift fan system multiplies engine thrust by 300 percent, for vertical flight, XV-5A* engines can be sized for most efficient hovering and cruise conditions and do not have to be oversized to meet V/STOL flight requirements. These inherent and designed advantages give the XV-5A* performance which meets anticipated requirements for military missions.

* FORMERLY VZ-11

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA



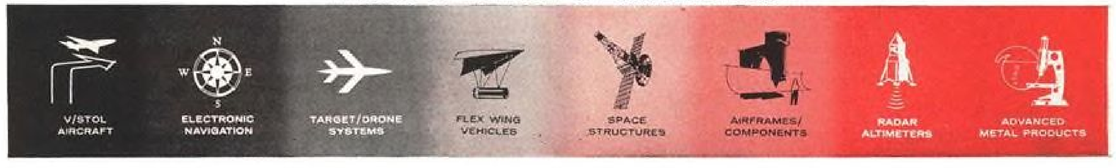
Conventional XV-5A* cockpit permits pilots to fly through transitions without moving hand or foot control positions.

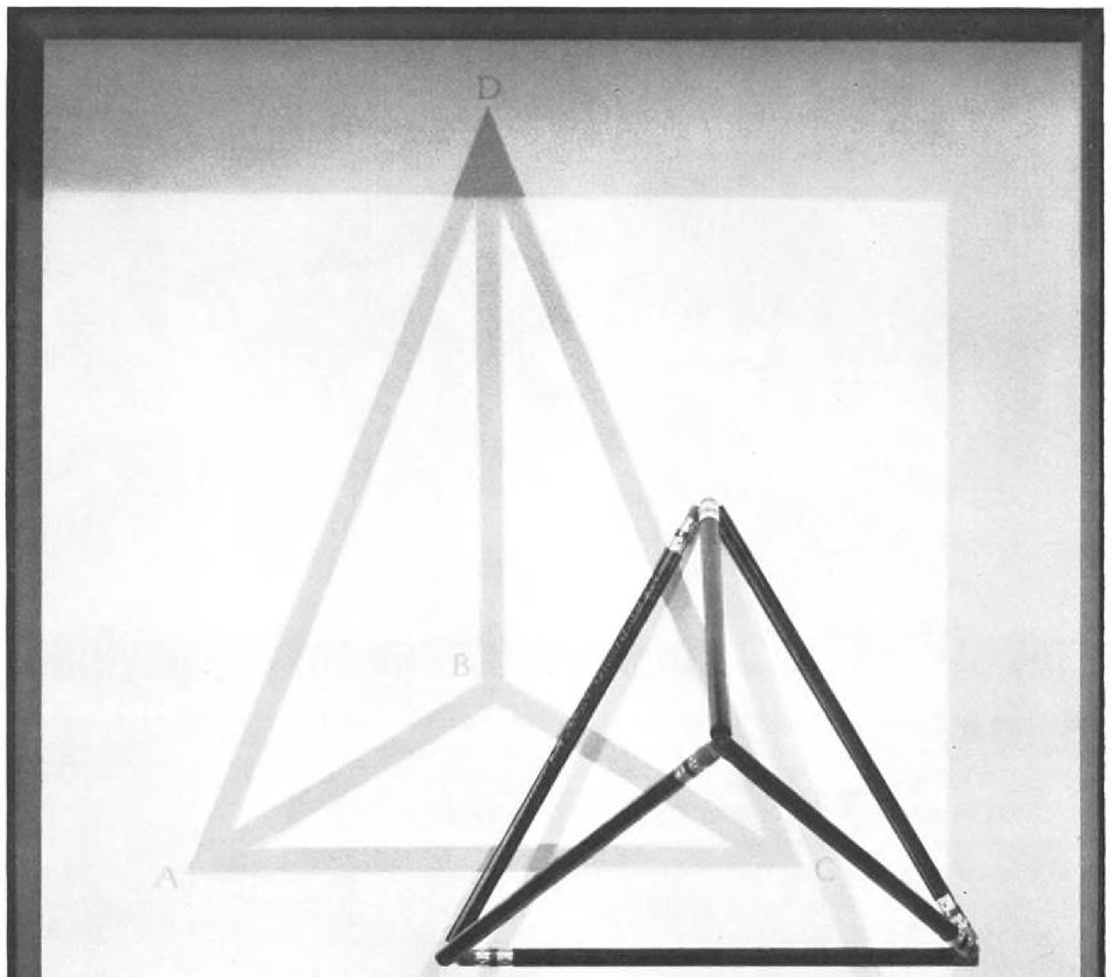


Low velocity and low temperature of lift fan efflux provide major advantages for operation from unprepared sites.

RYAN
AEROSPACE

RYAN'S SPECTRUM OF CAPABILITIES

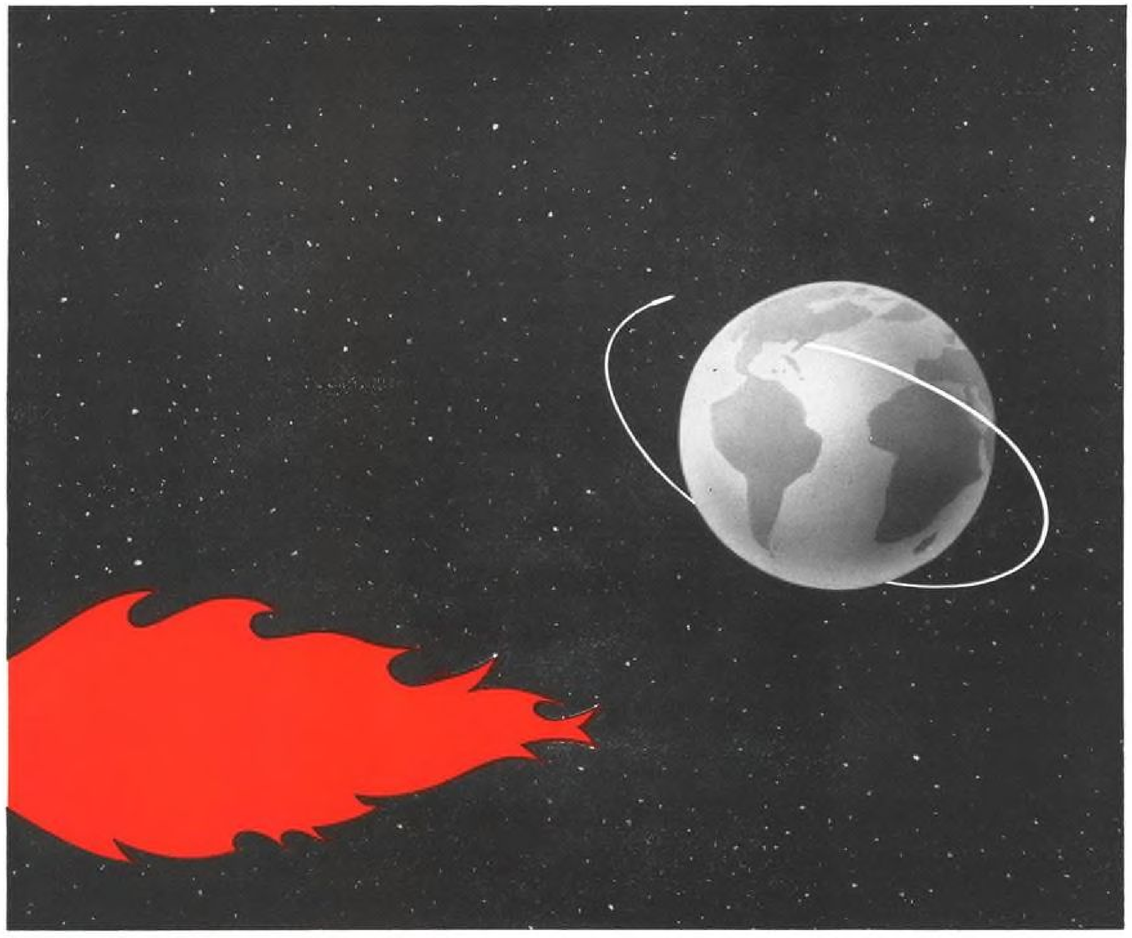




Achphenomenon

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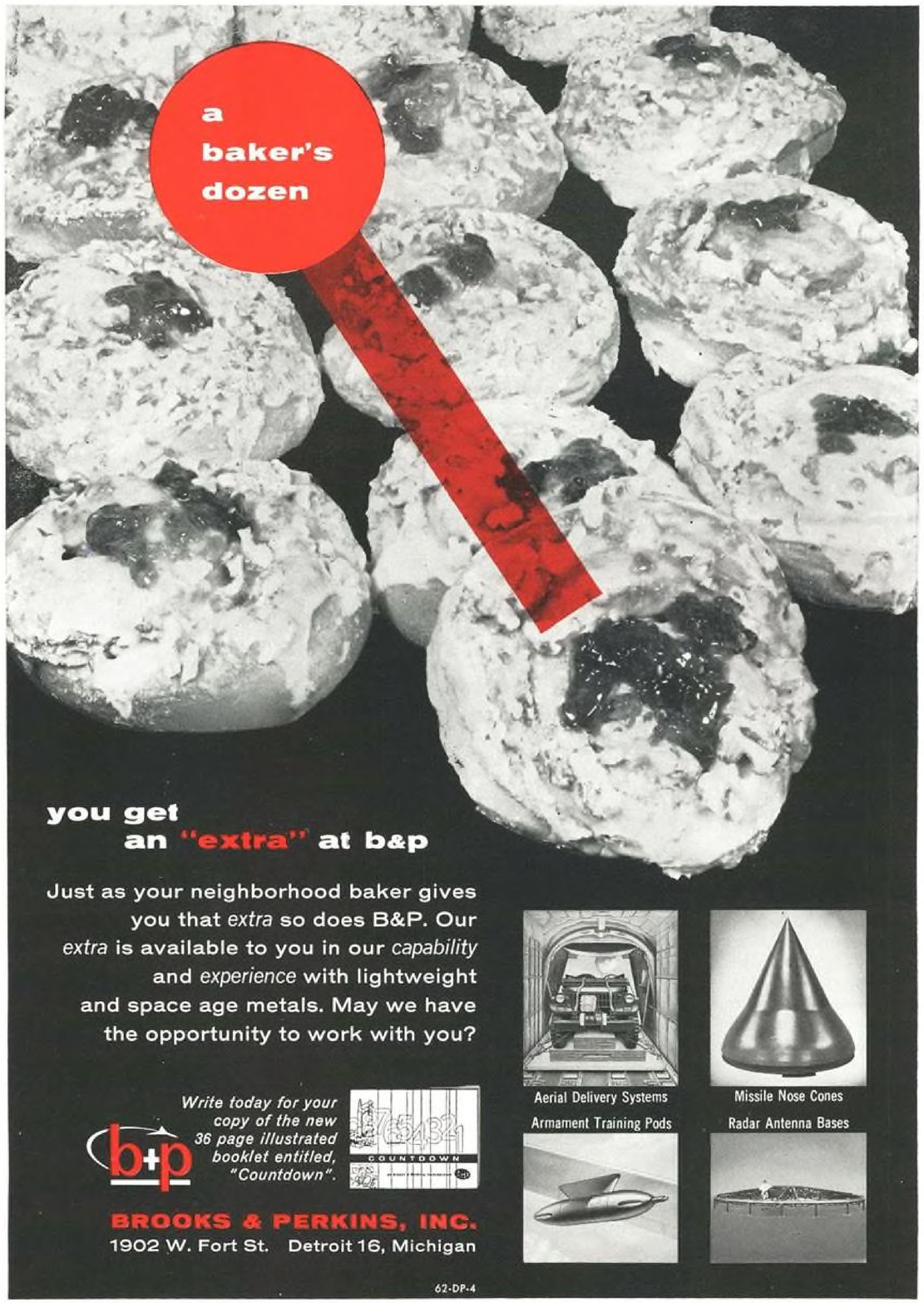
Many of today's important aerospace parts have successfully used Flame-Plated coatings—such as the combustion chamber of the Agena satellite rocket engine, aircraft valves, compressor blades, turbine engine seals, rocker arms, and many others. For many industrial parts, LINDE's "prescription" coatings have increased service life as much as 40 times!

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CONTENTS

SPACE TECHNOLOGY
ANALYSIS BY U. S. REVEALS SPUTNIK 4 FABRICATION 52
Mariner 2 Battery Operating at Top Design Limit 29
Spacecraft Center Management Reorganized 32
Sleeping Period Test Considered for MA-9 32
Lunar Reconnaissance Module Studied 33
NASA Soft-Lands Mercury Boilerplate 66
Model Martian Atmosphere Constructed 72

AIR TRANSPORT
CAB EXAMINER REJECTS AMERICAN-EASTERN MERGER 38
FAA Criticized on Air-Ground Data Link 40
British/French to Build SST Prototypes 41
SAS-Icelandic Battle Over Rates Intensifies 41
RAF-V/STOL Transport Competition 41
UAL Pilots Object to Minimums Training 43
Japan International, Honolulu Airports Underao Expansion 45
Bird Collision Cited in Viscount Crash 50
Airline Observer 47
Shortlines 47

AERONAUTICAL ENGINEERING
GENERAL DYNAMICS ASSEMBLING TFX SUBCONTRACTS 26
Canada Selects HSS-2s for ASW Mission 30
Token $50 Million Is Released by DOD for RS-70 32
Squadrons Cited for Cuban Photo Missions 34
New Aerospace Products 121

AVIONICS
COMPONENT FAILURES PREDICTED BY INFRARED 85
Telstar Silenced After Reliability Record 95
Filter Center 107
New Avionic Products 90

MANAGEMENT
LOCKHEED/IAM DISPUTE LEADS TO CONTRACT CURTAILMENT 27
Sen. Anderson Asks More Defense Work for New Mexico 28
India Policy Shift Opens Way to More Aid 33
U. S.-Russian Meetings Expected to Clarify Cuban Issues Further 35
Radio Frequency Allocation Drive Launched 36
New Procurement Rules Spur Incentives 117
Industry Observer 23
Who's Where 23

BUSINESS FLYING
MORE RANGE, POWER PLANNED FOR DH-125 110
U. S. Business & Utility Plane Shipments 113
Private Lines 113

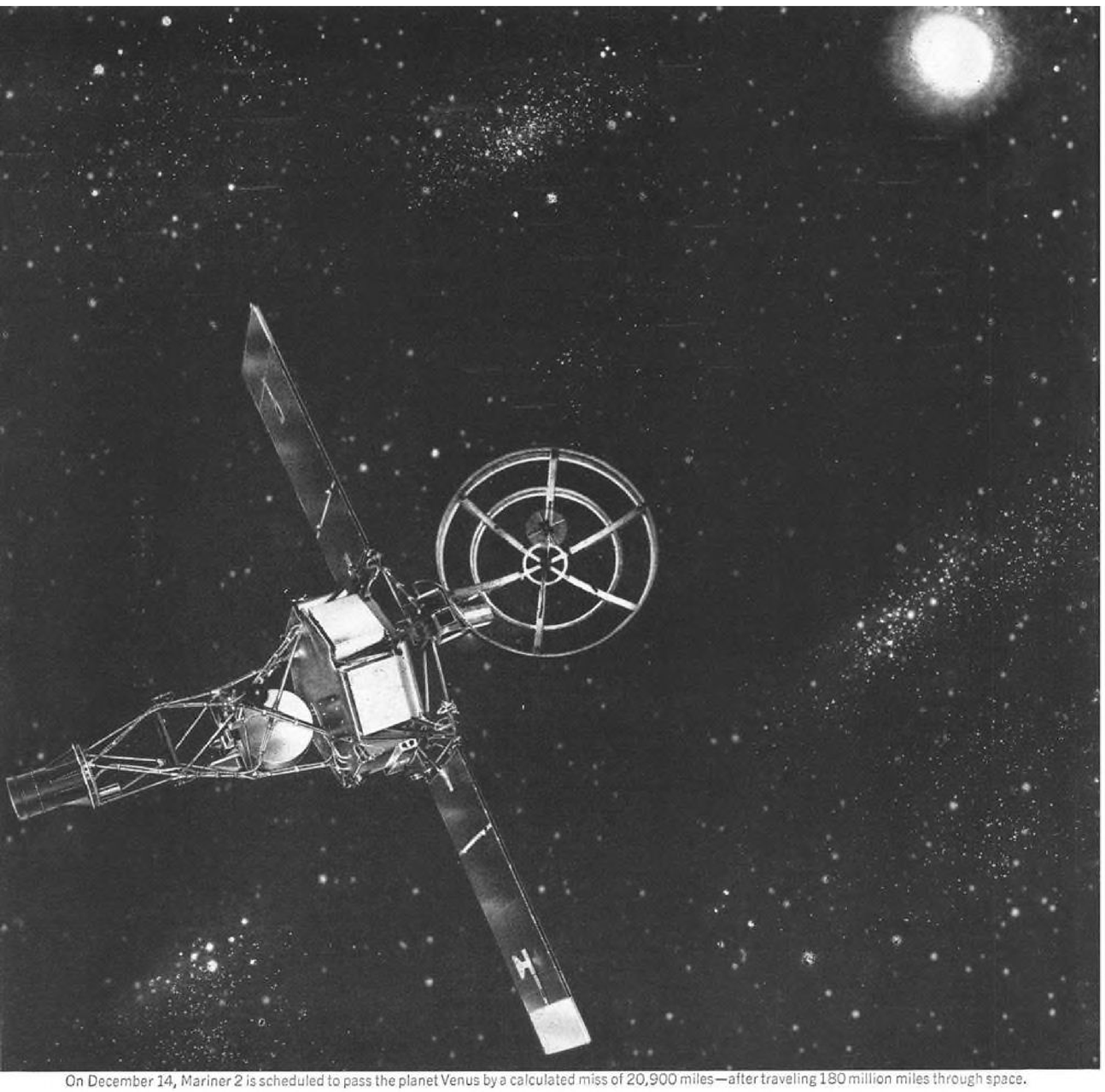
Washington Roundup 25
News Digest 37
Letters 134
Aerospace Calendar 5

EDITORIAL
The TFX Program 21

COVER: Marine CH-46A Sea Knight medium assault helicopter (HRB-1) is shown in flight over Being-Vertol's test facility at the Philadelphia International Airport. The helicopter is based on Vertol's 107 commercial helicopter design, but it has a hydraulically operated rear loading cargo ramp and configuration of the rear engine mounting and pylon is changed (AW Oct. 22, p. 30). Below the CH-46A is a Canadian 107, an Army HC-1A development helicopter for the CH-47A Chinook and three CH-47A test aircraft (far right).

PICTURE CREDITS

Cover—Robert Zultowski, Boeing-Vertol; 30—Sikorsky; 31—Sud Aviation; 34, 35—Wide World; 38—AP; 39—Boeing; 40, 110, 111—De Havilland; 45—(bot.) United Air Lines; 52, 53—Smithsonian Astrophysical Observatory; 52, (bot.), 80—Aviation Week; 55—General Dynamics; 59—Block Assoc.; 63—(top) Martin-Marietta, (bot.) Geophysics Corp.; 66—(top) Boeing (bot.) USAF; 71—NASA; 72, 73—(top) Grumman, (bot.) Rand Corp.; 77—Fairchild Stratos; 85-87—Raytheon; 95—Bell Telephone Labs; 113—J. Havard.



On December 14, Mariner 2 is scheduled to pass the planet Venus by a calculated miss of 20,900 miles—after traveling 180 million miles through space.

When you can't stop for spare parts

At the moment you read this, the Mariner 2 is millions of miles out in space and approaching its rendezvous with Venus. For the project to be a total success, nearly 14,000 electronic and electromechanical components must function perfectly during the entire 110 day voyage.

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EDITORIAL

The TFX Program

The largest potential procurement plum in the Kennedy Administration fell off the Pentagon tree last week to General Dynamics' Ft. Worth Division in partnership with Grumman Aircraft Engineering Corp. of Bethpage, Long Island, N. Y. with the award of the tactical fighter (TFX) development contract. The TFX is the only basic new weapon system that has been initiated in the 22 months since Robert Strange McNamara became Secretary of Defense and the final decision on it came some 10 months after Mr. McNamara's original deadline.

The TFX contest was certainly one of the most prolonged technical competitions in the postwar history of the Pentagon, dating back to an original USAF requirement of 1959 vintage. Those who have been responsible for most of the delays during the past year justify their indecision on the grounds that a far more realistic program has resulted, both technically and financially, as a result of a more thorough program definition before the contract award instead of afterward. We hope that time confirms their judgment, because the TFX appears destined to play an extremely important role in the type of fringe wars that seem likely to plague the world while nuclear deterrence remains effective.

It must have been an extremely difficult technical decision to pick a winner from the two finalists—the General Dynamics-Grumman partnership and the Boeing Co.—since both have long records of proven technical performance in the advanced technology of aviation. Primary design responsibility goes to the General Dynamics team—known more familiarly in the industry under the former Convair imprimatur—headed by Frank Davis and supported by J. T. "Bing" Cosby and Robert Widmer. This team proved the mettle of its technical management in developing the B-58 Hustler, the world's first Mach 2 bomber—a truly remarkable aircraft whose complete capabilities are still underestimated by Pentagon planners. It is ironic that the success of the B-58 as a routine Mach 2 performer has been more appreciated abroad, where it has encouraged the British and French to proceed solidly with their joint Mach 2.2 supersonic transport project (see p. 41). The significance of the B-58's 1961 performance in spanning the New York-Paris transatlantic gap in 3 hr. 19 min., cruising for a substantial period at Mach 2, was not lost on the Anglo-French planners. The B-58 development program also proved new concepts of weapon systems management that can be applied fruitfully to the TFX problem.

It was logical to expect that the Navy would insist on a contractor long experienced in its needs for the carrier-based version of the TFX, and hardly a surprise that Grumman fitted this requirement. The Navy and Grumman have been a successful operating team in naval aviation for more than three decades without a quaver in their mutual confidence.

If it has taken the TFX an extraordinarily long time to materialize as a firm program, it may be because it has changed its character several times along the way from its original goal as an all-purpose convertible Edsel to be used by USAF, Navy and Army, with only a change in paint to distinguish individual service requirements. In its present character as a basic variable geometry design built in two configurations, one to meet USAF requirements and the other suitable for Navy carrier-based operations, it reflects a far more realistic approach than in its original tri-service all-purpose conception. By utilizing one basic design and a high percentage of common components (about 80% at current estimates) major economies can be achieved over two separate design programs, each operated independently by a separate service. It may be that the current version of the TFX program represents the first realistic compromise between the over-simplified Detroit standardization of the automotive technology and the hand-tailored approach for each color of service paint by USAF and Navy. If so, real progress has been made in some areas of the Pentagon.

Underlying the whole TFX concept is one of the solid, basic technical explorations by the researchers of the old National Advisory Committee for Aeronautics (NACA) that did so much to keep this country the international leader in supersonic aircraft development. Without the fundamental research into the variable sweep wing and the detailed development of this principle by the Langley research laboratory group headed by John Stack, the current TFX concepts of both final competitors would have been impossible. Among Stack's able lieutenants in the Langley wind tunnels on this project were Thomas Toll, William Alford, Jr., and Edward Tolhamus and later John Swihart, Donald Baals and Mark Nichols. When Congress convenes again and begins carping over the Fiscal 1964 NASA budget for aeronautical research, the full story of the Langley contribution to the TFX program should be hammered home as an example of how these research and development investments eventually pay substantial dividends.

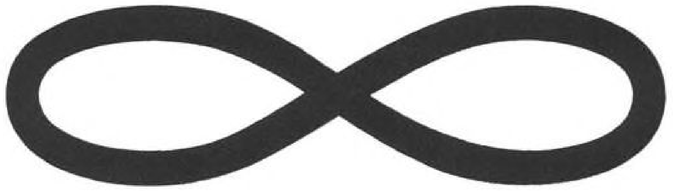
If the TFX development is successful, the proposed production program for 1,500 aircraft at a total cost of $4.9 billion would make it one of the most substantial "bread and butter" jobs in prospect. Convair and USAF are now organizing a vast subcontracting tier involving about half of the initial $1.1 billion development bill that will be the key to future TFX business in the vast production program, if it materializes in the scope now contemplated.

Thus the TFX program presents a technical and managerial challenge of vast proportions to the aerospace industry, the military managers and the Pentagon overseers. It is heartening to see that it is at last under way.

—Robert Hotz

We repeat--

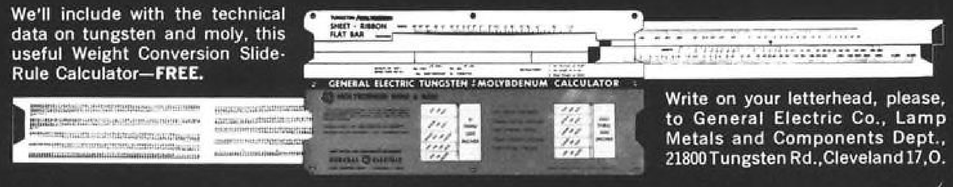
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WHO'S WHERE

In the Front Office

Gerald J. Lynch, board chairman, Menasco Manufacturing Co., Burbank, Calif. Mr. Lynch continues as president.

Lt. Gen. Donald L. Putt (USAF, ret.), a vice president of United Aircraft Corp. He will coordinate all West Coast activities of the company's operating divisions and subsidiaries. **Barnet R. Adelman** succeeds Gen. Putt as president of United Technology Corp., a subsidiary of UAC.

Lyle S. Garlock, a director of Melpar, Inc., Falls Church, Va. Mr. Garlock, formerly Assistant Secretary of the Air Force, is Eastern Air Lines' vice president-government and community relations.

W. A. Summers appointed a board member of Vickers-Armstrongs (Aircraft), Ltd.; he will be director-in-charge of the Hurn (England) factory. Mr. Summers continues as managing director of Hunting Aircraft.

Stanley J. Hardman, president, Hardman Tool and Engineering Co., Los Angeles.

Carl H. McBain, a vice president, Perkin-Elmer Corp., Norwalk, Conn., and director of marketing for the Instrument Division.

William T. Kirkpatrick, vice president-government products, Universal Match Corp. Mr. Kirkpatrick continues as executive vice president and general manager of Reflectone Electronics, Inc., Stamford, Conn., a subsidiary of Universal Match.

Dr. P. A. Clavier, vice president-director of Engineering Sciences, Plasmadyne Corp., Santa Ana, Calif., a Giannini scientific company, and **J. W. Winzler,** vice president, Components Division.

Dr. Harold R. Luxenberg, vice president-engineering, Houston Fearless Corp. Dr. Luxenberg continues as assistant general manager of the company's Westwood Division, Los Angeles, Calif.

Hazeltine Corp., Little Neck, N. Y., has announced the election of the following as senior vice presidents of Hazeltine Electronics Division: **J. W. Evans,** for marketing; **J. F. Willenbecher,** for operations; **Dr. R. K. Hellmann,** for engineering. Also: **S. M. Thomas,** elected senior vice president, Hazeltine International Division. Hazeltine Research Corp., a subsidiary of Hazeltine Corp., has elected **Donald Richman** and **Dr. V. J. Young** as vice presidents.

Capt. M. C. Wedge, vice president-flight operations, National Airlines, Inc., and **J. M. Wolgast,** vice president-maintenance.

Bliss M. Bushman, vice president-engineering, Consolidated Systems Corp., Monrovia, Calif., and **Alan B. Dallas,** vice president-field engineering.

Honors and Elections

Alfred C. Pinchak, of the California Institute of Technology, has received the American Rocket Society's Graduate Student Award for the best report submitted this year by a graduate student in the field of astronautics. **Ronald H. Winston,** of Harvard, and **Franklin J. Kosdon,** of MIT, received the Society's Undergraduate Student Award for their original paper on experimental research on a composite rocket fuel they developed.

(Continued on page 125)

INDUSTRY OBSERVER

► Proposals for a 12,000-mi. range "global" ballistic missile system were due last week from industry. Air Force's Ballistic Systems Division requested the proposals. The 156-in. solid-propellant rocket motor has been considered as a possible first-stage booster for this missile.

► **Tri-service transport V/STOL being developed by Vought, Hiller and Ryan team as the XC-142 is being proposed for antisubmarine warfare as one of several Navy missions under study. ASW version would include a torpedo bay big enough to carry two Mk.46 torpedoes. Planes would operate from carriers, would utilize folding wings, vertical tail and tail propeller boom plus a two-position landing gear. Weight penalty would be 1,056 lb. total.**

► Funds for Air Force Systems Command Space Systems Division's "manned" Saint program may be allotted in Fiscal 1964, but vehicles used for the initial satellite-intercept exercises would be unmanned. Both Samos reconnaissance satellite and Gemini are under consideration for loading with special equipment. Plans also contemplate use of Gemini with one man, with payload allotment for second astronaut being used for special equipment.

► **National Aeronautics and Space Administration may award sole-source propulsion system contract for its Apollo lunar excursion module (LEM). The system will use one main and one backup powerplant with ablative thrust chambers and storable liquid propellants. Development of main system should be responsibility of Grumman Aircraft Engineering Corp., LEM prime contractor, but question of whether Grumman or NASA would manage the backup system was still undecided as the two conducted LEM negotiations at Houston, Tex. Negotiations are expected to be completed before the end of the year.**

► Hypersonic re-entry glide vehicle designated Super-Asset has been proposed by McDonnell Aircraft Corp. to Air Force. Vehicle is designed for aerothermodynamic structural research in the upper atmosphere at speeds equivalent to escape velocities. It would be a follow-on to Project Asset (AW Nov. 26, p. 23) but would be substantially heavier and be capable of proving advanced Dyna-Soar or Apollo-class structures.

► **Army Missile Command may have to rely on a state-of-the-art solid propellant for its Sprint anti-missile missile because of the relatively tight schedule projected for the program. Alternative would have been a high-energy propellant envisioned by a program supported by Advanced Research Projects Agency (AW Nov. 12, p. 23). Competitors for the Sprint program include Douglas, North American-Columbus and Martin Orlando. Lockheed Missiles and Space Co. decided not to participate; after Lockheed dropped out, Boeing offered to participate but was refused by AMC.**

► Potential of the 156-in.-dia. solid-propellant rocket motor, generally regarded as bypassed in the emphasis on the 260-in. motor by USAF and NASA, still is being studied for a variety of missions by Aerospace Corp. for Air Force's Space Systems Division. One possibility: use the 156-in. motor as an advanced core for a Titan 3 type of configuration, and use four 120-in. motors instead of the two planned for Titan 3.

► **Third Saturn C-1 launch vehicle flight was marked by good data acquisition comparable to that of the first two flights. There were 12 losses and two partial losses out of 607 attempted in-flight measurements. Lost data included temperature and pressure readings on inboard engine No. 5, attributed to a broken connection between instrumentation and power source. Two partial-loss measurements showed high signal-to-noise ratio, but data appeared reducible. First Saturn carried 505 measurement points, with eight total and 11 partial losses of data. Second carried 526, lost four completely and four partially.**

► Electrostatic camera system which will be part of the operational Nimbus meteorological satellite will be flight tested on board Tiros 7 if the camera is ready by early next year. If not, it will be part of the Tiros 8 flight vehicle.



GAMMA RADIATION TESTS on Navy computer circuit cards are being conducted at the cobalt 60 irradiation facility at The University of Michigan. Shown above are circuit cards being inserted in the irradiation test cylinder. After the cards are in place, the cobalt 60 source is raised around the test cylinder. The waveform characteristics of the cards are photographed during irradiation to measure both gamma dose rate and total gamma dose effects.

ATTACK SURVIVAL of our Naval forces depends in part upon the ability of shipboard electronic systems to operate after nuclear attack. Using the facilities of The University of Michigan Phoenix Laboratory, Bendix engineers are measuring the effects of gamma radiation on typical shipboard electronic circuits. This is one of a spectrum of Bendix programs covering design of systems tolerant of ionizing radiation from weapons, from nuclear propulsion systems, from nuclear space power systems, and from both natural and induced space radiation. Engineers interested in applications of radiation effects techniques are invited to contact our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division

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Washington Roundup

Sylvester's Sunshine Kit

Arthur Sylvester's "good news kit" governing the release of information on military space launchings is only 12 days old but it has already drawn the fire of Chairman John E. Moss of the House Government Information Subcommittee.

News of military launchings is severely restricted by a secret directive, written last spring and since re-written, and signed by Deputy Secretary of Defense Roswell Gilpatric (AW May 21, p. 26). On Nov. 21, Sylvester, who is assistant secretary of defense for public affairs, distributed a "public affairs guidance" telling military information officers how to say a little bit about a launch without violating the Gilpatric directive. The guidance also encourages "all echelons" to forward non-launch information to his office for "consideration and public release" as long as it is "consistent with the protection of security information."

As for launches, if a vehicle gets safely out of sight and sound of ground observers, the fact that the launching has occurred, the type of booster, the launching agency and the launching site can be released. If the vehicle explodes or is intentionally destroyed on the pad or within sight or sound of observers, that fact can be revealed, plus the information that "an investigation is under way to determine the cause." If trouble occurs after the vehicle is out of sight and sound, however, information officers must apply the no-news-is-good-news philosophy and say nothing.

Rep. Moss pointed out in a speech Nov. 30 that all military launches, "whether they are for a military purpose or to gather information of a scientific nature, are covered by the blanket of secrecy," and said: "All information about the billions of dollars spent by the military in space research is channeled through the Pentagon's single public information voice." He said his committee will "do everything possible to promote a wide public discussion of this system for management of news about military space efforts." Presumably, this would include public hearings early in the next session of Congress.

Rep. Moss also said Rep. George Miller, chairman of the House space committee, "is just as concerned as I am about the growing secrecy surrounding military space activities. [He] has first-hand knowledge of the damage that excessive secrecy can do to our scientific space program."

U.S.-Soviet Space Pact

Three-part agreement on cooperative U.S.-Russian space projects, now at the White House, is expected to get President Kennedy's signature as soon as he feels the Cuban situation has eased sufficiently. Some space officials believed the President would discuss the agreement in his talk with Soviet First Deputy Premier Anastas Mikoyan here late last week (see p. 35).

Scientists hope the agreement can become effective before the end of the year, so Russia can prepare to bounce signals off the Echo 2 inflatable communications satellite, due for launch in March. Other experiments that have been agreed upon at the working-level deal with weather and geomagnetic survey satellites.

Committee on the Peaceful Uses of Outer Space is to report Dec. 3 to the United Nations General Assembly, and it is expected that the subcommittee report on legal aspects of space will be returned for further consideration. Agreement on the technical subcommittee report was unanimous, but the judiciary subcommittee report brought a sharp split along U.S. and Russian lines.

NASA Budget Status

Budget Bureau and the National Aeronautics and Space Administration have almost completed discussions on the Fiscal 1964 civilian space budget. NASA asked for $6.2 billion but the bureau is understood to have cut this back to $5.5 billion.

Of more immediate concern to some space-minded congressmen is NASA Administrator James E. Webb's reluctance to ask for additional money for the current space budget. Following White House instructions, Webb said the space pace could be maintained without a supplemental appropriation. The fact is that the Gemini and Apollo manned space programs have been slowed by money shortages (AW Nov. 26, p. 26). Some members of the House space committee will urge NASA to ask for more Fiscal 1963 funds in hearings early next year.

Leading contender for the job as manager of the Spur/Snap 50 auxiliary space power project is Col. Elwood M. Douthett, director of geophysics unit at Air Force's Cambridge Research Laboratory. The manager will work under the Atomic Energy Commission and coordinate Defense Dept. and NASA activities through special deputies (AW Sept. 17, p. 31).

Last two major satellite launches of 1962 by NASA are scheduled next week—the RCA Relay active communications satellite on Dec. 11 and the S-55B micrometeoroid satellite on Dec. 12. Relay will go from Cape Canaveral, Fla., and S-55B from Wallops Island, Va.

—Washington Staff

Assembling of TFX Subcontractors Begins

1,500 aircraft expected from $6 billion program; General Dynamics-Grumman team sorting work tasks.

Washington—General Dynamics/Ft. Worth last week took the first steps toward assembling subcontractors for development of the bi-service F-111 tactical fighter (TFX). General Dynamics, teamed with Grumman Aircraft Engineering Corp., was named winner Nov. 24 over the Boeing Co. of the final study competition in the $6 billion program.

Leading contenders as subcontractors are McDonnell Aircraft Corp. for the crew escape system, Litton Industries for some avionic components and General Electric for the central control system computer. General Dynamics has been told to funnel approximately 50% of the estimated $1.1 billion development effort to subcontractors.

The only subcontractors chosen so far are Hughes Aircraft Co., which will develop the air-to-air missile system for the F-111B Navy version, and Pratt & Whitney, which will furnish the JTF-10A-20 turbofan engines for both versions of the twin-engine aircraft.

Current Plans

Current plans call for production of 1,500 of the fighters at a cost of $3.3 million each, for a total of $4.95 billion exclusive of development costs.

General Dynamics will build 22 prototype airframes for developmental testing. The first is due to be delivered within 2½ years. All 22 will be fabricated at Ft. Worth. Four of these will be delivered to Grumman to be equipped as Navy versions.

Detailed determination of how the development tasks will be split between the two companies have not been made, but in general, Grumman will design, fabricate and install components peculiar to Navy requirements and will build some assemblies common to both versions. For example, Grumman will design and fabricate landing gear and the associated structure.

Initial phases of the testing program will involve both the Air Force and Navy so that the basic configuration can be proved. Specialized testing will follow. Both companies will work closely on the testing programs.

Most of the 22 aircraft can be used as trainers or operational aircraft after the development, test and evaluation phase is completed. At least one will be tested to destruction and others will stay in the experimental category.

The first meeting to review the General Dynamics-Grumman proposal, the division of labor, program milestones and the development, test and evaluation aspects of the program was held at the F-111 System Program Office at Air Force Aeronautical Systems Division, Wright-Patterson AFB, Ohio, on Nov. 27.

Selection of subcontractors other than Hughes and Pratt & Whitney will be made over a three-to-four-month period, during which the prime contract and principal subcontracts will be negotiated. General Dynamics held competitions on every subsystem or major component before submitting its proposed list of subcontractors.

A substantial portion of the development funds will go to Hughes for the long-range missile and its control system. Pratt & Whitney already is well along on development of the engine under a Navy contract that was awarded when the now-canceled Navy Missileer fighter was an active project. Some additional money will be needed to complete the work. The JTF10A-20 has been flown in a North American B-45 testbed since early this year (AW Apr. 2, p. 73).

TFX Origin

The TFX project began when Secretary of Defense Robert S. McNamara announced in January of 1961 that Air Force, Navy and Army tactical fighter requirements would be merged into what he then termed a tri-service project.

The industry competition began in September of 1961 and was narrowed to two firms early this year.

General Dynamics/Ft. Worth President Frank W. Davis and J. T. "Bing" Cosby, vice president for the F-111 program, are the principal contractor negotiators in the conference at ASD. Heading the service team is USAF Col. Charles A. Gayle, the system program director. He is assisted by Navy Capt. John T. Shepard.

Davis and Cosby said the F-111 is more nearly within the existing technology than was the B-58 Hustler when it was developed at Ft. Worth. During its development period, the B-58 required breakthroughs in its aerodynamics, temperature environment, structure, subsystems and powerplant. Much of what was learned on the B-58 in structure, fabrication techniques, production equipment, testing methods and subsystem integration techniques will be applied to the F-111.

One defense source said that after the second study competition was completed, the percentage of common components for the Air Force F-111A and the Navy F-111B had been boosted to 83. The requirement for common components was emphasized when the re-studies were initiated. As development proceeds, the percentage of common items is expected to increase.

Speed Range

The two-place F-111 will have a speed range from 80 kt. for landing when returning from a mission lightly loaded, to Mach 2.5 or more than 1,500 mph. at optimum altitude. This will be made possible by the use of a variable sweep wing.

Both civilian and military critics within the Defense Dept. have called the F-111 too expensive for what it can do. Cost effectiveness studies, however, have shown that it offsets its cost by being able to fly extremely long distances without the need for aerial refueling. It will thus eliminate the need for replacing TAC's aging fleet of tankers.

The F-111A will weigh about 60,000 lb. and will have a ferry range of 3,600 naut. mi. It will have large wheels for operations from rough airstrips. The F-111B will weigh about 55,000 lb. and will be able to operate from aircraft carriers.

The variable sweep wing is expected to have its first successful application in the F-111. If it does, much of the credit will go to a 20-man team of engineers who worked at the National Aeronautics and Space Administration's Langley Research Center under John Stack, now Republic's vice president for engineering.

The first work on variable sweep was done in Germany by Messerschmitt during World War 2. After the war, the old National Advisory Committee for Aeronautics initiated a program which resulted in the building of the Bell X-5 aircraft, which had a variable wing sweep from 20 deg. to 59 deg. It first flew in June, 1951. This was followed closely by the Navy's Grumman F10F-1, designed as a fighter. About the same time Dr. Barnes Wallis of Vickers, Ltd., in England started the Swallow supersonic transport aircraft research program. Much of the wind tunnel work on this project was done at Langley, supported largely by U.S. funds.

All these programs had one basic fault. When the wings were swept back from the forward position, the center of pressure shifted. To overcome this shift, it was necessary to provide for excessive elevator trim to keep the nose from pitching down. The designs also suffered from heavy and complex wing folding mechanisms. An attempt was made on the F10F to move the whole wing root forward as the wing swept back. This project was abandoned.

TAC Requirements

These original ideas depended on pivoting the wings inside the fuselage, at the wing root. In 1959, USAF Tactical Air Command, which has its headquarters at Langley AFB, Va., contacted Stack, stating its requirements for both low and high speeds and a supersonic capability just above the ground. Stack already had the nucleus of his team busy on the Swallow concept. He increased the effort on variable sweep concepts.

By 1960 the team had evolved a system, based on original work by Thomas A. Toll, in which the pivot point was placed out on the wing away from the fuselage. This eliminated the change in the center of pressure when the wing was swept. Two of the engineers who worked early in the Swallow project, William J. Alford, Jr., and Edward C. Tolhamus, applied for a patent on the principle in July, 1960. The patent, number 3053484, was awarded to them last Sept. 11. Their rights go to the government. Financial awards for their invention will be determined later.

Design Studies

The Air Force took the results of this work and went to industry, asking for studies on aircraft designs.

Proposals were received from three two-company teams and three individual companies in December of last year.

Last Jan. 30, General Dynamics-Grumman and Boeing were given until Apr. 30 to complete re-studies. Again on June 30, no final winner was chosen, and another 60-day re-study period was ordered. This was extended by 15 days. Between the time of that submission and the Nov. 24 announcement several re-evaluations took place within Defense Dept.

New Large Solid Plan

Washington—Agreement between Defense Dept. and the National Aeronautics and Space Administration on development of large solid rocket motors (AW Nov. 13, p. 38) will call for a feasibility demonstration of a cluster of four 276-in. dia. motors, each 120 ft. long and weighing 4 million lb. Each will deliver a thrust of 9 million lb. Nozzle diameter of each motor will be 7 ft.

SSD Withholding Lockheed Contracts

Los Angeles—Defense Dept., through Air Force's Space Systems Div., is withholding release of any contract to Lockheed Missiles and Space Co. and Lockheed-California Co. during the present labor dispute between Lockheed and the International Assn. of Machinists.

DOD previously had threatened to transfer business from Lockheed in the event of a strike (AW Nov. 26, p. 36) and also has ruled that any contracts going to Lockheed, or any expansion of a current contract, will have to have the approval of the appropriate military service secretary. This directive, supposedly effective Nov. 20, forms the basis for SSD's stand.

Policy apparently went into effect, at SSD on Nov. 26, two days before the walkout, which began at 12:01 a.m. Nov. 28. Strike was temporarily suspended Nov. 29.

Lockheed spokesman said the official stand of SSD was that no document of a contractual nature would be released to Lockheed and that this specifically included any document relating to funding of work under any oral agreement, letter contract or definitive contract.

At the time the prohibition went into effect, there were as many as 15 letter contracts with Lockheed Missile and Space Co. in various stages of negotiations.

While negotiations before the strike proceeded on contracts between Lockheed and SSD, it was understood that no contracts would be signed.

This action apparently was taken to protect government requirements in the event an alternate source of supply became necessary. Lockheed spokesmen expressed the opinion that there was no precedent for an action of this type with regard to any company in the history of the aerospace industry.

Strike against Lockheed Missile and Space Co. and Lockheed-California Co. was precipitated by refusal of the parent company to agree to an employe vote on the issue of a union shop. A two-thirds affirmative vote would have been neecssary by members of the relevant bargaining units.

Lockheed has contended that establishment of the union shop would mean that the company would have to discharge any employe who refused to join the union and said it would not agree to this condition.

Union shop vote, recommended by a presidential board, was accepted by three other California aerospace firms, North American Aviation and Ryan Aeronautical Co., both organized by the United Auto Workers and Convair Division of General Dynamics Corp., organized by the IAM. Union shop was voted down at all three firms.

President Kennedy last week appointed a three-man board of inquiry into the strike which was due to report to him today. The move was seen as first step toward an injunction under provisions of the Taft-Hartley Law. Thursday, Nov. 29, IAM agreed to a request from the federal government to end temporarily the strike and resume work under terms of previous contracts pending the committee's report today.

A union spokesman was reported as saying that the union would prefer seizure of the company by the government rather than an injunction. If an injunction is obtained, he said, the union would continue to work for a vote on the union shop proposal and would continue to strike after the required 80-day cooling off period.

Lockheed offered to increase base pay rates from 5 to 8 cents per hour for 1962, retroactive to July 23, 6 to 8 cents per hour for 1963 and 6 to 9 cents per hour for 1964. Union pressed for a vote on the union shop issue.

Negotiations between the two parties continued until about two hours before the strike began. Federal Mediation Service Director William Simkin attended the talks.

Locations affected by the IAM walkout included the Lockheed-California Co.'s division at Burbank and Lockheed Missile and Space Co. facilities at Sunnyvale, Van Nuys, Santa Cruz and Vandenberg AFB, all in California, Cape Canaveral, Fla., and in Hawaii. The Burbank facility, which manufactures F-104 and P3V-1 aircraft, has approximately 24,100 employes, of whom 16,500 are in the bargaining unit and 11,400 of these are union members.

Employes of the Lockheed Missile and Space Co. total 31,400, with 14,500 in the bargaining unit and 5,700 union members. IAM said that 2,577 new members had been acquired during the past three months and a number of additional applications for membership had been received.

Reports indicated that strike effects varied from department to department during the first day with Lockheed-California Co.'s manufacturing department reporting a 90% absenteeism and the financial activities associated with the bargaining unit reported only 52% absenteeism.

At Cape Canaveral, 155 members of the IAM employed by Lockheed were absent the first day and picket lines were formed. Also absent from work were 144 IAM members employed by Boeing Co. at the Florida site, who stayed away in sympathy.

Main effect on activities at Cape Canaveral was expected to be indirect as a result of work stoppages in Sunnyvale, where Polaris IRBMs and Agena space boosters are built.

Legislators Seeking to Acquire Key Space Role for New Mexico

By George C. Wilson

Washington—New Mexico lawmakers, under the leadership of politically powerful Sen. Clinton P. Anderson (D.-N. M.), are organizing their biggest campaign to date to make the White Sands Missile Range and Holloman AFB in their state the nation's aerospace landing and recovery site, as well as the final assembly area for such vehicles as the lunar excursion module.

Several political and economic factors brighten their chances of succeeding in the new Congress, especially since they will be claiming their approach is the most economical one, right at the time when the National Aeronautics and Space Administration is hard-pressed for funds (AW Nov. 26, p. 26). The main factors are:

• **Sen. Anderson,** second-ranking Democrat on the Senate Aeronautical and Space Sciences Committee, told AVIATION WEEK that persuading NASA to make more use of existing New Mexico facilities will be his number one objective in the new Congress. "Our space program is becoming so expensive," he said, "that before asking us for more money, NASA should be able to show it is interested in economizing by making use of existing facilities."

Sen. Anderson would become chairman of the Senate space committee if Sen. Robert S. Kerr (D.-Okla.) relinquished that chairmanship to head the Public Works Committee. The death of Sen. Dennis Chavez (D.-N. M.) puts Sen. Kerr in line for the Public Works chairmanship. But indications are Sen. Kerr will keep the space committee chairmanship. Sen. Anderson would like to exchange his chairmanship of the Interior and Insular Affairs Committee for the space committee job. One reason is that he succeeded in the last Congress in getting approval of the long-sought $221-million Navajo Indian and San Juan-Chama irrigation project for his state, and now wants to concentrate on space activities.

• **NASA has diverted** about $11 million from its research and Atlantic Missile Range accounts to the White Sands Missile Range. This gives the New Mexico congressional delegation a powerful wedge for broadening space activity in the state. Rep. Thomas G. Morris (D.-N. M.), a member of the House Science and Astronautics Committee, said the New Mexico delegation is united on this objective. The two New Mexico representatives run for election at large, so they, as well as the two senators, must work for the whole state rather than concentrate on their congressional districts.

On Oct. 30, NASA notified Congress it was transferring $1,617,000 from the Cape Canaveral construction account to White Sands, where the money will be used to build part of the test facilities for the Apollo spacecraft. General Dynamics/Convair Little Joe 2 solid rockets will launch boilerplate models of the Apollo spacecraft modules from White Sands to flight test configuration, systems hardware performance, structure and the launch escape system. The tests are scheduled to be made in Calendar 1963, 1964 and 1965.

Just before the Nov. 6 election, NASA notified Congress it was going to take $9,084,000 out of its research funds to build additional Apollo test facilities at White Sands. The breakdown: advance planning and design, $275,000; site development and utilities, $1,832,000; spacecraft preparation building, $1,434,000; test stands, fuel storage, transfer and test control facilities, $2,988,000; project control facility, $181,000; instrumentation, $2,072,000; design-engineering services, $302,000.

• **NASA and Defense Dept.** have reached agreement on the use of the White Sands Missile Range for the Apollo project. The agreements are regarded as precedent-setting for NASA's use of both White Sands and Holloman AFB. Defense Secretary Robert S. McNamara approved the agreements earlier this month and final approval is expected soon. One agreement covers an Apollo system development test area on the western boundary of White Sands, while the other document covers the Little Joe 2 tests within the range.

• **Effort is under way** to persuade Grumman Aircraft Engineering Corp. to use existing facilities at Holloman AFB for the final assembly of the lunar excursion module (LEM). Sen. Anderson said the idea is "still in the discussion stage," but he and other New Mexico leaders contend such a step would save millions of dollars. They point to the two existing hangars at Holloman suitable for LEM's assembly, and maintain it would cost about $5 million to duplicate them.

Activity at White Sands and Holloman declined as the U. S. shifted its emphasis from short-range missiles to the longer-ranged ones requiring more extensive ranges like those on the Atlantic and Pacific coasts. New Mexico leaders hope to revitalize White Sands and Holloman by making their state the nation's spacecraft landing area.

The case for using this complex was stated last year by the Holloman Section of the American Rocket Society, as well as by the senators and representatives from New Mexico. The ARS chapter said the White Sands-Holloman complex "is capable of playing a major role in the next 10 years of space exploration by providing the only existing land range either in the U. S. or easily available to the USA." Major claims:

• **Present range telemetry,** radar, tracking, communication, timing and computer links, with minor modifications, would fulfill the needs of landing glide-vehicles like Boeing's Dyna-Soar (X-20) and other space vehicles which will be landed on earth rather than on the sea. If necessary, the range can be surrounded up to 500 mi. in every direction by precisely located tracking stations, the ARS chapter said.

• **Alkali Flats** at White Sands will support more than four times the weight supported by the salt flats at Edwards AFB where the North American X-15 lands. Also, the ARS chapter claims cracking and caking does not occur on the alkali flats, that no runway there would require greater than a 15-deg. glide path angle from any direction and a zero angle from one direction is possible.

• **Range "will require** least modification," the chapter said, "has the highest experience factor in recovery of drones, has the highest probability of success and has by far the lowest cost of modification in the next decade of planned vehicle recoveries." It said that with Alkali Flats as primary target, the present range can act as a 5,500 sq. mi. secondary landing area and 4,500 sq. mi. additional is available as an emergency landing area.

• **Aeromedical Field Laboratory** together with medical facilities at the Lovelace Foundation, William Beaumont Army Hospital and atomic energy laboratories in New Mexico "form a unique combination to serve any animal or human occupants of re-entry vehicles with least lost time and danger to the occupants," the chapter said.

• **Range has excellent weather,** power, transportation, communications and is in a basin surrounded by mountains that block interference from strong radio transmitters.

Similarly, personnel of the Air Force Missile Development Center at Holloman and White Sands Missile Range drafted a proposal to make their complex the "National Aerospace Landing Site." According to the proposal, the complex "can meet any current or future NASA or Department of Defense space system recovery requirement . . ."

Although current plans call for using Edwards AFB for testing X-20 and Gemini, the New Mexico delegation is still hopeful of having those activities switched to White Sands.

Increasing Battery Temperature Is Last Big Mariner 2 Obstacle

Major problem remaining in the Mariner 2 Venus flyby mission is the survivability of the on-board battery package, which last week was operating at temperatures approaching the design limit.

Jet Propulsion Laboratory scientists were optimistic that the payload will continue to function through Dec. 14, when Mariner 2 enters the Venus encounter phase of its flight.

Uncertainties in the interplanetary space environment will cause the spacecraft to miss Venus by at least 300 mi. more than the previous estimate of 20,-900 mi. These uncertainties were described as the effect of solar pressure, the exact locations on earth of the three stations in the Deep Space Instrumentation Facility and the precise distance in the astronomical unit (AU).

Batteries were operating at a temperature of 113F last week, with the design limit set at 125F. JPL projected temperature at the time of Venus encounter is 129F. However, officials are hopeful because the spare flight battery was tested to destruction and survived heat loading up to 140F.

Solar panels also are hotter than had been anticipated, and by last week had reached 220F. They are designed to survive heat loads as high as 350F, and this system is not considered critical.

JPL has conducted extensive analyses of the AU using the radar bounce technique, and has computed the unit distance to be 92,751,070 mi. ±310 mi. At the time of Venus encounter—3 p.m. EST Dec. 14—JPL will conduct a two-way Doppler transmission with the spacecraft, and simultaneously will bounce a radar beam off Venus. With these two measurements, and data from radar bounce experiments JPL has been conducting since Oct. 1, the laboratory expects to reduce the ± quantity in the AU to zero.

The four interplanetary experiments, which measure cosmic dust density, characteristics of charged particles and characteristics of solar plasma, have been operating continuously since Nov. 8 (AW Nov. 19, p. 37). On Nov. 25, Mariner 2 set a long-distance tracking record by returning useful data from a distance of 22.5 million mi. to the Johannesburg, South Africa station.

Mariner 2 was launched from the Atlantic Missile Range Aug. 27. Venus encounter will occur after 110 days and 144 million mi. of space flight.

Soviet Mars Probe

Moscow—Soviet Union reported Nov. 27 that regular radio contact sessions have been held with the Mars 1 probe, and that telemetered data indicates onboard temperature and pressure are within design limits.

The probe was launched from a parking orbit Nov. 1 (AW Nov. 5, p. 42). In the most recent Russian report, Soviet News Agency Tass said temperature ranges between 75-80F, and that pressure is steady at 850 mm. of Hg.

Tass said that as of Nov. 28, the probe was 5,632,700 mi. from earth.

Scientific spokesmen at the Russian Embassy in Washington said they expect reports on the probe to be made every eight or nine days.

Previously announced USSR attempt at interplanetary flight was unsuccessful in Feb., 1961, when a Venus probe launched from Sputnik 8 failed to continue transmissions after 18 days of flight.

U. S. has said there have been at least five other unannounced Soviet attempts to send payloads to Venus and Mars (AW Sept. 17, p. 31).

Skybolt Pitches Down, Fails in Fifth Launch

Cape Canaveral—Fifth flight test of the USAF-Douglas Skybolt ended in failure here, Nov. 28, when the air-launched ballistic missile pitched down, instead of up, after being dropped from its B-52G mothership at an altitude of approximately 40,000 ft.

Pilot in the F-100F photographic chase plane was understood to have reported that the missile dropped normally after release from the plane and that ignition occurred, but that instead of pitching up and climbing along a ballistic trajectory, it instead flew in level flight for awhile and then suddenly pitched down toward the ocean. It was lost in heavy clouds and impact was not visually observed.

Range safety officer did not destroy the missile.

Flight was to have been the first full-fledged test of the Nortronics Division of Northrop stellar inertial guidance system, with the missile determining its relative position from star fixes and computing its trajectory to a preselected impact point out in the Atlantic Ocean. It was understood that the guidance system operated satisfactorily until the time of drop. Cause of the failure, the third in the program so far, was not immediately determinable, USAF said.

Skybolt's other tests were rated as partial successes, with no missile achieving all of its test objectives.

Rift, S-4B Facilities

Washington—National Aeronautics and Space Administration has decided to build and assemble the Lockheed Rift nuclear rocket test stage in a dirigible hangar at Moffett Field Naval Air Station, Calif., and to test the Douglas S-4B Saturn upper stage on a 1,600-acre tract near Sacramento, Calif.

NASA originally planned to produce Rift at the Michoud plant near New Orleans, but was forced to seek other facilities when the plant became fully occupied with Saturn S-1 and S-1C production. The hangar was obtained through an agreement with the Navy.

The hangar, which is near both NASA's Ames Research Center and Lockheed's Sunnyvale plant, will be renovated at an estimated cost of $10 million. The facility is 1,100 ft. long, 300 ft. wide and 195 ft. high. About 1,200 Lockheed employes will work on the stage there. Rift stage is 33 ft. in diameter and 88 ft. high.

The S-4B—a single Rocketdyne J-2 engine—will be tested at the Douglas Sacramento Field Station on property to be leased to the company by NASA. The agency will spend about $17 million to build two test stands, a blockhouse and related utilities, and will lease the facilities to Douglas. Stands are to be completed in 1964.

GE Industrial Park Planned for Daytona

General Electric Co. is developing plans for a 246-acre industrial park in Daytona Beach, Fla., which could eventually accommodate 18 buildings and 3,000 employes, most in the Apollo Support Dept.

The new department is a unit of the Command Systems Division (AW Nov. 19, p. 28) which will have its headquarters in Daytona Beach. The company will begin construction immediately on three buildings with 165,000 sq. ft. of space which will be assigned to the Apollo group. Eventually, the park will have 1 million sq. ft. of space.

Apollo group will provide checkout, reliability assessment and integration support for National Aeronautics and Space Administration in the Apollo project. Contract also calls for supply, installation and maintenance of launch control and checkout equipment, reliability performance assessment and technical staff services for the Apollo system.

Canada Selects HSS-2s for ASW Mission

By Donald E. Fink

Royal Canadian Navy has selected the Sikorsky HSS-2 twin-turbine helicopter as an all-weather replacement aircraft for its Sikorsky HO4S-3 (S-55) anti-submarine helicopter fleet.

Decision to buy HSS-2s is the first step toward building a modern anti-submarine task force which will employ fast destroyer escorts, each equipped with a helicopter platform on the fantail. Canadian navy has ordered eight HSS-2s.

Selection of the Sikorsky aircraft was made after a thorough study of numerous helicopters by the Canadian navy. Kaman HU2K was given serious consideration (AW May 15, 1961, p. 23), but the mission profile and requirement that both detection and weapons systems be mounted in the same helicopter exceeded the HU2K's performance capabilities. Boeing Vertol's 107 also was considered, but its tandem rotor configuration made it too large for operations from the small destroyer deck.

First HSS-2 is scheduled for delivery to the Canadian navy by the middle of next May. Second and third aircraft will be delivered by the end of June, and the remainder at the rate of one per month for the next five months.

Initial order is expected to exceed $12 million, not including the 1,250-shp. General Electric T58-8 turboshaft engines, electronic submarine detection gear and weapons system.

First three helicopters will be off the shelf deliveries from United Aircraft Corp.'s Sikorsky plant in Stratford, Conn. The remaining five will be assembled in United Aircraft's Canadian Pratt & Whitney plant near Montreal.

Total scope of the program has not been determined, but a Sikorsky spokesman said follow-on orders are expected, with an increasing amount of the manufacturing program being transferred to Canada. Requirement for the Canadian navy ASW fleet is estimated at 70 helicopters.

Configuration of the Canadian HSS-2 will not differ appreciably from the U. S. Navy version (AW Jan. 16, 1961, p. 52). These extras, however, will be included:

- **Automatic tail-folding device** to swing forward the rear portion of the tail empennage. This is folded manually on the U. S. version.
- **Winch-down device** which will permit operations from the small destroyer platforms, measuring about 35 ft. x 75 ft.

This equipment will not be ready for the first three deliveries, which will be rushed through to give the Canadian navy helicopters for a training program. Transition training for HO4S-3 pilots will be provided by Sikorsky instructors and U. S. Navy-trained Canadian instructors. U. S. Navy helicopter facilities probably also will be utilized.

When subsequent deliveries are made, the first three HSS-2s will be returned to Sikorsky for fitting of the folding device and the winching gear.

Canadian navy presently is operating its HO4S-3 anti-submarine fleet from the aircraft carrier HMCS Bonaventure. The decision to equip destroyer escorts with helicopters represents a modernization move to cope with new submarine capabilities and eventually will replace the carrier-based operations.

Size of the helicopter-equipped fleet has not been definitely fixed, according to a Canadian spokesman, but the program will be reviewed in the fall of 1963 after trials with the first HSS-2s are completed.

At that time, the number of follow-on orders from Sikorsky probably will be determined. In the meantime, seven of the HSS-2s will be assigned to the Bonaventure for crew training. The eighth will be used in extensive sea trials with a platform-equipped destroyer escort.

Operations from the small deck, which in bad weather probably will encounter severe pitch problems, dictated the inclusion of the automatic tailfolding device and the winch-down equipment.

Tail boom must fold to allow clearance in the small hangars which will adjoin the landing deck. The automatic folding device was chosen to eliminate hazards to shipboard personnel trying to fold the boom manually.

Increased safety of the automatic system is expected to offset the additional maintenance problems it may create.

Winch-down system, built by Fairey Aviation Co., Ltd., Halifax, Nova Scotia, will serve both to guide the helicopter to a landing on the small deck and to secure it immediately upon touchdown. Landing with the system is accomplished in these stages:

- **Helicopter pilot** approaches the rear of the ship, hovers about 40 to 50 ft. above the deck and reels out a light nylon line. A deck crewman attaches the winch-down cable to the line, which is reeled back up to the helicopter. It pulls a quick-attach probe into a housing in the bottom of the helicopter, just forward of the sonar dome. The helicopter is then ready for initial pull-down by a winch below the deck.
- **Pilot maintains** hover power on the helicopter as slack is taken up in the cable. The helicopter is pulled down to about 10 or 12 ft. above the deck. The winch has a slip clutch which cushions any shock caused by sudden updrafts on the helicopter and prevents airframe and cable strain.

Clutch has two winding speeds, one for the initial pull-down and the other for the final, slower pull to touchdown. The probe housing is equipped with a quick release device which can be triggered by the pilot and a tension release which automatically disengages when tension exceeds a specified limit. The second feature is used during takeoff to hold the helicopter on the deck until it has built up enough lift to leap clear.

- **As the helicopter** is winched down onto the deck, it must land within a circle about 4 ft. in diameter so that the cable, which runs down through a securing device in the deck, can pull the probe into it and lock it in place. This secures the helicopter to the deck.
- **Securing device** slides in a slot on the deck, enabling the deck crew to push the helicopter into its hangar without releasing the lock. Inside the hangar, the lock can be released if maintenance requirements call for the helicopter to be moved around or jacked up. For most operations, however, the securing device will be left locked.

For takeoff, the helicopter is pushed back out to the middle of the deck. The securing device holds it down until lift from the rotor blades exceeds the tension setting. The probe then pulls out and the helicopter lifts off. Tension setting in the probe housing can be varied to allow for different weather and launch conditions.

Canadian navy feels the HSS-2 is slightly larger than desirable but it is the smallest helicopter that could meet the requirements. HSS-2 features which helped sway the decision in its favor included:

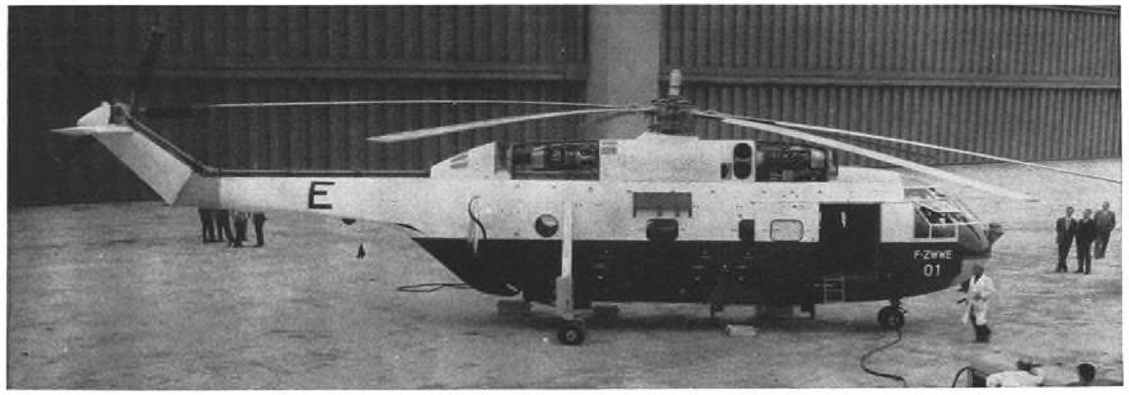
- **Automatic hover capability.**
- **All-weather, day-night capability.**
- **Sophisticated sonar** and integrated weapons systems.
- **High speed,** rated in excess of 200 mph.
- **Boat hull.**

HSS-2 will operate with a four-man crew—two pilots and two sonar operators. Normal operational weight will be approximately 17,000 lb. Ultimately, helicopter-equipped destroyer escorts will work in groups of six.

U. S. Navy ASW attack missions with the HSS-2 specify a 240-naut. mi. cruise at 132 kt. to target for dropping 840 lb. of weapons and return at optimum speed.



WINCH LANDING TECHNIQUE, which Canadian Navy will use to land HSS-2 anti-submarine helicopters on platform-equipped destroyer escorts, is tested near Sikorsky's Stratford, Conn., plant with HSS-2 in U. S. Navy markings. Helicopter pilot maintains hover power as the aircraft is winched down via a cable attached to the bottom of the fuselage.



Super Frelon Undergoes Testing of Turbines

First photo of Sud Aviation's SA 3210 Super Frelon 26-passenger heavy helicopter shows the aircraft during initial turbine run-up tests which began this month. Machine is first of two prototypes. Super Frelon is powered by three Turbomeca Turmo 3C turbines (AW July 23, p. 48). Main rotor has 62-ft. dia., fuselage is 55.7-ft. long. Gross weight is 37,730 lb., and cruising speed will be 118 kt.

Telstar Is Silenced By Circuit Problem

Washington—Malfunction in Telstar command circuitry, preventing ground stations from turning its transmitter-receiver on and off, has made the communication satellite inoperable, at least temporarily, after more than four months of near-perfect operation.

Ironically, the first evidence of the malfunction occurred less than a week after a Bell Telephone Laboratories symposium, which was held to report the reliability effort which had enabled Telstar to achieve a record operational lifetime for satellites of comparable complexity (see p. 95).

The satellite's telemetry transmitter is still functioning and reporting data on internal operating conditions and Van Allen radiation levels. When first signs of trouble were discovered—after 1,242 orbits—it was decided to leave the telemetry transmitter on permanently, since it draws only very small power, instead of turning it off when the satellite is not within range of a ground station.

Two months ago, a minor malfunction occurred in the command circuitry that did not affect performance of the Telstar's communication service, but which may have led to the current troubles. The satellite was outfitted with dual command receivers, either of which could perform the necessary on-off functions, with provisions for a ground station to shut down one command channel and check whether the other was still operating.

The earlier malfunction made it impossible at times to shut down one command channel.

The intensified Van Allen radiation produced by the U. S. high-altitude nuclear test July 9 has not significantly affected Telstar solar cells because they are radiation-resistant N-on-P types with sapphire shielding, but there is speculation that the intensified radiation may have damaged semiconductor devices in the command receivers.

At the time of failure, the command circuitry that remains energized continuously throughout the orbit had accumulated a total operating time of about 3,300 hr. The communications transmitter-receiver, which remains operable so far as is known, had achieved a total operating time of about 165 hr., according to Bell Telephone Laboratories.

DOD Designations On Pocket-Size Card

New aircraft designations put into effect by the Defense Dept., together with the previous designations, have been reprinted from Aviation Week & Space Technology on a folding card.

Folded, the card fits easily into a pocket; open it can be affixed to a desk top. The cards are available from Aviation Week at 25 cents each for 1-20 copies, 20 cents each for quantities of 20-50, and 15 cents each in quantities over 50. Send orders to:

Aviation Week Reprint Dept.
330 West 42nd St.
New York 36, N. Y.

Sleeping Period Test Considered for MA-9

Washington—Six scientific experiments, including an 8-hr. period for sleep, are being considered for the Mercury Atlas-9 mission to be flown in April by Maj. Gordon Cooper.

Mercury scientific selection panel will not make a final decision in the scientific payload for the capsule until after Jan. 1. Final flight configuration was to be decided Dec. 3.

In addition to the sleep period, experiments under consideration are:

- Fuel tankage, to determine the characteristics of attitude control fuel feed in a weightless environment. This experiment would be carried open loop and would not be connected to the attitude control system Maj. Cooper will use to change attitude.
- Night visibility, in which a small ball containing high intensity strobe lights would be ejected from the Mercury capsule. The ball would have a motor on board with which to make incremental velocity changes so that Maj. Cooper can gage the extent of his ability to see the lights.
- Drag balloon, to determine the behavior of an inflated sphere trailed on a line from the Mercury capsule. Similar experiment was conducted on Lt. Cdr. Scott Carpenter's MA-7 mission (AW May 28, p. 26).
- Television camera, which will be operated at a slower scan rate than commercial television, but could be converted to live, commercial television transmission during the flight. Objective of this experiment would be to test a system which could be used for rendezvous and docking maneuvers in Gemini and Apollo missions.
- Ultraviolet photography, an extension of similar experiments used on the earlier manned orbital flights.

Experiments will be selected on the basis of weight, space and power requirements and availability.

Token $50 Million Is Released By DOD for RS-70 Development

Washington—Token $50 million was allocated to Air Force last week by the Defense Dept. to be added to Fiscal 1963 funds for the North American RS-70 Mach 3 bomber project, making the total estimated program cost for three aircraft $1.35 billion through Fiscal 1965.

The move was generally interpreted as a Defense Dept. attempt to mollify congressional critics who were responsible for Congress' appropriating $191.6 million more than the $171 million requested by the Administration for the project for Fiscal 1963.

It was from this appropriation that the $50 million—which was earmarked for reconnaissance-strike component developments—came. This raises the total released to USAF by Defense Dept. for Fiscal 1963 from $171 million to $221 million.

Sen. Clair Engle (D.-Calif.) declared last week that he still was not satisfied that the program was moving fast enough. The $50 million, he said, was not adequate to assure development of a complete system. "All we will have will be a flying hull. Much more will be needed to make it complete."

Sen. Engle said he would recommend that hearings be held on the subject soon after Congress convenes in January, probably by the Preparedness Subcommittee of the Senate Armed Services Committee.

Although the aircraft program has been redesignated the RS-70 to reflect its reconnaissance-strike mission, the three aircraft of the original program still bear the XB-70 designation. The first aircraft is scheduled to make its first flight next March or April (AW Nov. 26, p. 35).

The third aircraft will incorporate a bomb-navigation system.

When congressional pressure was applied to Secretary of Defense Robert S. McNamara last March to proceed with research and development for the reconnaissance-strike version, he declared that $52 million "from other sources" would be added to Fiscal 1963 funds. This $52 million remained unexplained last week. Pentagon sources said there never was an actual transfer of funds, but that bits and pieces of research and development under separate programs which could be applied to the reconnaissance-strike mission were transferred to the RS-70 project.

Funding now breaks down this way: $800 million for Fiscal 1961 and prior years, $220 million for Fiscal 1962, $221 million for Fiscal 1963, $81 million for Fiscal 1964 and $29 million for Fiscal 1965.

The Air Force restudy of the RS-70 proposal, requested by Congress, was received by McNamara's office in increments between June 2 and Oct. 1. It is being used in making decisions on the future of the program.

Probe Role Is Urged For Naval Missiles

Washington—Use of Navy missiles as high-altitude, information-gathering probes was suggested last week by Rear Adm. Jack P. Monroe, Navy director of astronautics and ranges.

Adm. Monroe told the Washington Aero Club that existing missiles—Talos, Terrier, Tartar—could be made more versatile and useful if cameras, weather detecting and electronic gear were flown on them as well as warheads.

He also suggested use of carrier-based aircraft as "first stages for putting satellites in orbit."

Spacecraft Center Management Reorganized

Washington—Management structure of the space agency's Manned Spacecraft Center in Houston, Tex., will be reorganized under two deputy directors in January. Walter C. Williams, associate director, will become deputy director for mission requirements and flight operations and James C. Elms will become deputy director for development and programs.

The move has been under consideration by National Aeronautics and Space Administration for several weeks (AW Nov. 26, p. 25) and will become effective when Elms joins the agency next month. Elms, 46, is now director of space and electronics for Ford Aeronutronic Division.

Williams, 43, also becomes director of flight operations in the NASA Headquarters' Manned Space Flight Office, and in this post will report directly to Brainerd Holmes, manned space flight chief. Williams' responsibilities at the Manned Spacecraft Center include mission requirements, field test programs, flight operations and acting as the NASA representative in all negotiations with Defense Dept. for support.

Elms will be responsible for all spacecraft center development projects, including scheduling, engineering, supervisory and administrative support. He will be succeeded at Aeronutronic by Charles H. Sword, manager of contract administration.

In another organizational change, NASA appointed Dr. Eugene Shoemaker chairman of a newly-formed joint working group on coordination of manned and unmanned flight programs. Dr. Shoemaker recently joined NASA as assistant to the director of lunar and planetary programs after serving as chief of the Astrogeology Branch of the U. S. Geological Survey.

India Policy Shift Opens Way to More Aid

By Cecil Brownlow

New Delhi — Indian government, pressed by financial realities of building an effective defense force on an accelerated basis, is publicly abandoning its earlier position that it would accept no outright military aid from the West without one day paying at least a token fee, thus opening the door for an increased flow of American and British material.

Shift in public policy is believed by some observers here to be a possible forerunner of India becoming a virtual participant in the United States Mutual Aid Program, although the nation will try to maintain an outward position of political non-alignment.

One reported move under discussion would be inclusion of India among mutual aid nations scheduled to receive quantities of the Northrop F-5 (N-156F) fighter. F-5 can in a number of ways fit the Indian air force's urgent need for an advanced aircraft that can be used both as an interceptor and a close-support aircraft. Indian defense planners also have been openly interested in McDonnell F-4B (F4H).

First Step

First tentative step towards backing away from earlier policy was Indian acceptance on "loan" basis of twelve C-130 turboprop transports plus their flight, maintenance and logistics crews from USAFE's 32nd Air Division based at Evreux-Fauville, France. Twelve aircraft operating on "civilian" basis under formal Indian government jurisdiction began flying military equipment and supplies to forward areas early last week from New Delhi's Palam Airport. Twelve C-130s plus an additional lead aircraft were directed operationally during initial stages by 32nd commander, Col. Charles Howe.

Under United States-Indian agreement planes and crews will be returned to USAFE when they no longer are needed to ferry supplies to forward areas where the Indian army is facing Chinese troops still well inside the territory India claims. There will be no payment for use of the aircraft.

A second, more positive, step came later in the week when the government announced it had accepted a British offer to supply additional defense materials without charge. The new agreement, which British officials say may touch off another arms airlift from the United Kingdom, was agreed upon during a visit here by Duncan Sandys, Commonwealth relations secretary, and General Sir Richard Hull, chief of the Imperial General Staff.

At same time, a program similar in scope was being hammered out by an American survey team headed by Averell Harriman, assistant secretary of state for Far Eastern affairs. The American mission also included Assistant Secretary of Defense Paul Nitze and Gen. Paul D. Adams, commander of the combined Air Force-Army Strike Command.

Arrival of the C-130s also permitted resumption of regular passenger domestic air service within India, which had been at virtual and crippling standstill since mid-November. Aircraft of Indian Airlines Corp. had been pressed into Indian air force service. Most scheduled passenger service by Indian Airlines' fleet of Viscounts, DC-3s and Fokker F-27s had been restored by late last week and all routes were scheduled to be in operation by early this week.

Although C-130s are flying into forward areas with United States crews aboard, American officials here took pains to point out that the aircraft would not risk coming into direct contact with Communist Chinese forces. Ambassador John Kenneth Galbraith emphasized upon the aircrafts' arrival they were replacements for "civilian" planes. He added:

"They are not going into combat areas but they are flying military equipment and military personnel."

Arms Airlift

He said the aircraft will not be used for any air drops, either of personnel or equipment. As C-130s were arriving, the Royal Air Force was completing its second arms airlift operation into India with Blackburn Beverleys and Handley Page Hastings ferrying in supplies from Singapore and Britannias arriving from the British Isles. While the Britannias returned to England, the Beverleys and Hastings were kept on alert at Calcutta's Dum Dum Airport in event new fighting flared and it became necessary to evacuate still more British civilians from threatened border regions.

Beverleys and Hastings plus Indian air force aircraft had been used earlier to evacuate a large number of women and children from areas near the front in tea-growing Assam state.

Lunar Reconnaissance Module Studied

Pasadena, Calif.—National Aeronautics and Space Administration is giving serious attention to a lunar orbiting spacecraft, unofficially called the lunar reconnaissance module (LRM), for securing detailed views of the lunar surface as an aid in selecting suitable landing sites for the Apollo Lunar Excursion Module. Both unmanned and manned versions are under early study.

Ford Motor Co.'s Aeronutronic Division is conducting an extensive in-house, company-funded investigation of a manned LRM.

Within NASA, serious thought is being given to the use of a Lunar Excursion Module or a modified LEM for this purpose. Boost vehicle might be a Saturn C-1, or at a later date, the C-5.

LRM is viewed as a second-generation lunar orbiter, or a heavier, more capable successor to Jet Propulsion Laboratory's Surveyor lunar orbiter. It appears, however, that NASA's Manned Spacecraft Center may believe LRM could be made available by about the same date (1965) as the frequently delayed Surveyor orbiter. NASA and JPL are trying to decide on a timetable for the Surveyor orbiter, the progress of which has been marred by a number of false starts over the past two years (AW July 23, p. 22). Funds earmarked for the orbiter project in NASA's Fiscal 1963 budget have been diverted by NASA headquarters to other phases of the unmanned lunar and planetary program. Selection of an orbiter payload contractor, nearly two months overdue (AW Nov. 26, p. 31), apparently will be postponed indefinitely.

Part of the Surveyor orbiter delay is attributed to the uncertain development schedule and performance of the Atlas-Centaur boost vehicle. Consequently, the schedule has been delayed and NASA, which is experiencing severe funding shortages (AW Nov. 19, p. 26) has redirected orbiter money.

While the Surveyor orbiter is still scheduled to use the Atlas-Centaur, JPL and NASA Marshall Space Flight Center are studying a possible alternative, including a Titan-Centaur, which would increase the maximum orbiter payload by 300 or 400 lb. over the planned 1,800-2,000 lb. A Saturn C-1B-Agena combination, also under study, could increase maximum orbiter payload to 3,000 lb. but would triple the cost of the Atlas-Centaur.

Review of NASA's lunar orbiter requirements, in view of the needs of the Apollo program, is now being conducted in Washington by Dr. Eugene Shoemaker, who is now coordinating manned and unmanned space flight programs (see p. 32).

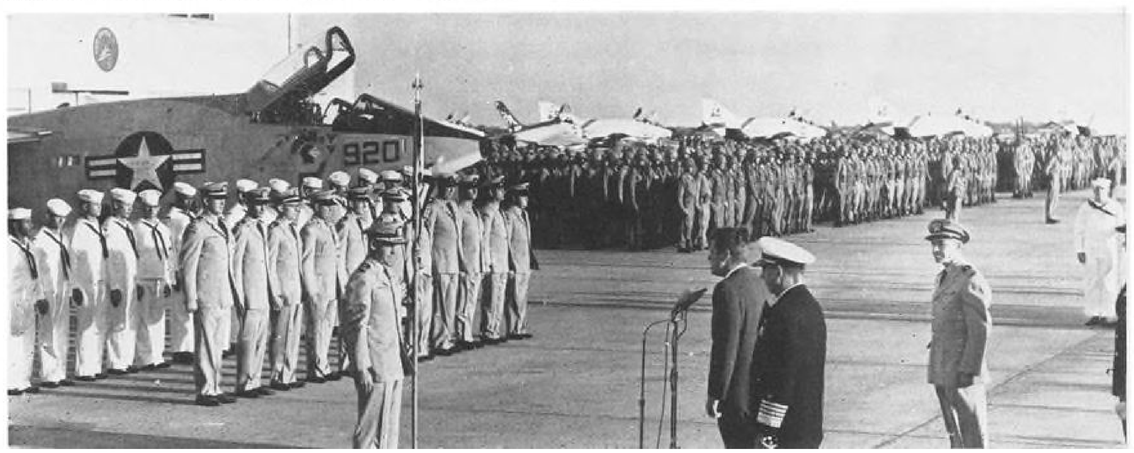


McDonnell RF-101 Voodoos used during low level photography of Cuban missile sites line the ramp at Homestead AFB, Fla., as President John F. Kennedy watches a flyby of other aircraft during his tour last week of bases that played major roles in the Cuban crisis. The President awarded Air Force Outstanding Unit Citations to the 363rd Tactical Reconnaissance Wing, whose RF-101s provided low-level photos of Cuban missile installations, and to the 4080th Strategic Wing, whose Lockheed U-2s took the photos Oct. 14 that provided conclusive proof of the missile buildup. Flyby at Homestead, where the Cuban war room was located, also included Naval aircraft (below, left to right), Douglas A3Ds, North American A3Js and Chance Vought F8Us. Also in the flyby were North American F-100s and Republic F-105s and F-84s that took part in Cuban air operations.

Squadrons Cited for Cuban Photo Missions



Navy unit commendation citations were awarded by President to Navy Light Photographic Squadron VFP-62 and Marine Light Photographic Squadron VMCJ-2 at the Boca Chica Naval Air Station, Fla. Cdr. William Ecker, commanding officer of the Navy squadron, holds the unit commendation flag in front of the squadron's F8U-1Ps that took part in the Cuban photo missions. In the background are a Douglas F4D and McDonnell F4Hs, behind the Marines in battle dress. Distinguished Flying Crosses have gone to 12 VFP-62 pilots, four VMCJ-2 pilots, 10 SAC pilots from 4080th and 16 TAC pilots from the 363rd.





LOW-LEVEL air defense was provided at Boca Chica NAS by Army Raytheon Hawks deployed around field's perimeter. President Kennedy is inspecting a Hawk emplacement.

U.S.-Russian Meetings Expected To Clarify Cuban Issues Further

Washington—Further resolution of U. S.-Russian problems over Cuba was expected to result from a meeting late last week between President John F. Kennedy and Soviet First Deputy Premier Anastas Mikoyan, top Kremlin trouble-shooter who spent 24 days on the Caribbean island.

Mikoyan met with U. S. officials at the United Nations several times last week and was to see them again following his meeting with the President on Nov. 29. Before the Kennedy-Mikoyan meeting, the U. S. still was insisting on on-site inspection of the now-dismantled Soviet missile bases in Cuba and some guarantee against any further introduction of Soviet offensive weapons into the Caribbean.

Defense Dept. last week began redeploying the air, sea and land forces concentrated in the southeastern U. S. and the Atlantic and Caribbean when Soviet bombers and medium-range and intermediate-range missiles were discovered there in mid-October.

By late last week, the U. S. had not announced detection of the actual removal of any Il-28 Beagle bombers, which Soviet Chairman Nikita Khrushchev said would be off the island by late December (AW Nov. 26, p. 33).

The President toured Ft. Stewart, Ga.; Homestead AFB, Fla., and Boca Chica Naval Air Station at Key West, Fla., last week and offered "a sincere 'well done' to all ranks." He also issued commendations to four Air Force, Navy and Marine photographic reconnaissance units for their aerial surveillance of Cuba (see p. 34).

On Dec. 7 the President is scheduled to visit Strategic Air Command headquarters at Offutt AFB, Omaha, Neb.; Atomic Energy Commission laboratories at Los Alamos, N. M.; and the Sandia Corp. and Air Force's Nuclear Effects Research Laboratory at Albuquerque, N. M. On Dec. 8, he will visit the Nuclear Rocket Development Station at Jackass Flats, Nev. The President last visited SAC headquarters in August, 1960. The White House said in connection with the Los Alamos and Jackass Flats visits that the President is particularly interested in Project Rover nuclear rocket work.

State Dept. last week suspended a requirement, begun during the Cuban crisis, that all officials report on their contacts and discussions with reporters (AW Nov. 26, p. 33). It said the requirement never was intended to halt the flow of news, and said it would be reinstated in the future "if it becomes necessary or advisable."

A similar Defense Dept. regulation (AW Nov. 5, p. 21) remained in effect late last week, but Defense Dept. on Nov. 21 withdrew its request that newsmen use what it called "voluntary restraints" in publishing information described in a 12-point "security guidance" (AW Oct. 29, p. 25). Defense Dept. said its order requiring the reporting of contacts with newsmen remained in effect even though State Dept.'s had been suspended.

Pastore Urges Rapid Nuclear Rocket Pace

Washington—U. S. supremacy in space depends on development of a nuclear rocket capability Sen. John O. Pastore (D.-R. I.), vice chairman of the Joint Congressional Atomic Energy Committee, told the Atomic Industrial Forum last week.

Sen. Pastore, who is scheduled to become chairman of the committee in January, said Russia has bigger chemically fueled rockets and this nation's "best chance to leapfrog the Soviets lies in the fastest possible development of nuclear power for use in space.

"It may be too late to develop nuclear rockets to share the first mission to the moon," he said, "but for further missions to the moon and other planets, nuclear power is a 'must.'"

Sen. Pastore was critical of government agencies for not making earlier and wider use of nuclear power systems for space vehicles. He pointed out that while solar cell power systems on several earth satellites and deep space probes have been damaged by radiation or experienced unexplained malfunctions, the 2.7 watt radioisotope Snap power device on Transit 4A has operated perfectly since its June 29, 1961, launch.

Industry representatives also urged the government to state more positively and specifically the need for nuclear rockets and power sources.

Dr. C. L. Kober, director of advanced technology of the Martin Co.'s Denver Division, said that "if a definite need can be established, the technical problems will be circumvented."

National Aeronautics and Space Administration's view is that missions should not be assigned until a nuclear rocket technology has been developed. NASA is trying to do that with its Nerva nuclear stage project.

Dr. Kober said a second goal should be to identify the point and manner of introducing nuclear rockets "to assure compatible and complementary relationships with established chemical rocket programs."

He suggested development of a Nova type of vehicle using a chemically fueled first stage, with four Aerojet M-1 engines producing a total thrust of 4 million lb., and a second, or sustainer, stage with a 2.5 million lb. thrust nuclear stage. Dr. Kober said promising applications for a large rocket with a nuclear stage are lunar shuttle flights and manned Mars exploration.

Dr. Jerome G. Morse, director of auxiliary power systems for Martin's Nuclear Division, told the forum studies show that active communications satellites will require nuclear power systems providing 60 to 300 watts, with a lifetime of 10 years.

U.S. Drafting Space Frequency Proposal

By Katherine Johnsen

Washington—U.S. is launching a drive to win international support for radio frequency allocations needed for operational meteorological, navigational, and communication satellite systems and for its Apollo lunar landing program and other space research projects.

A draft of U.S. proposals has been distributed by Federal Communications Commission for final review by government and private domestic frequency users and equipment manufacturers. Comments, which could result in detail changes, are due Dec. 14. Replies are due Jan. 9.

The proposals will be formally presented to a special conference of the International Telecommunication Union—the Extraordinary Administrative Radio Conference for Space Radiocommunication—scheduled to convene next fall in Geneva to allocate frequencies for space activities.

First Test

This meeting will be the first voting test of the priority that more than a hundred ITU member nations are willing to accord space projects. Members will be confronted with two major issues raised by the U.S. proposal:

- **Whether communication satellites** should be authorized to share about a third of the presently usable radio spectrum below 10,000 mc. already loaded with existing users.
- **Whether present users** should be shifted to other frequencies to give space research exclusive use of frequency bands scattered throughout the radio spectrum.

U.S. proposals for frequency allocations for operational meteorological and navigational space systems appear to have general international support. Compared with a communications satellite system, they will impose a light load on the spectrum and they do not raise the spectre of military application.

Spectrum Usage

Decisions on spectrum usage—within presently allocated bands—for space communications for aeronautical services, which will be required by advanced aircraft operating beyond the earth's atmosphere, would be delegated to International Civil Aviation Organization under a U.S. proposal. No additional frequencies would be made available to ICAO.

The 1959 ITU conference made the first frequencies available for space services at the urging of the U.S., supported by the USSR and Great Britain—the only other countries interested in space projects at the time. The 13 frequency bands allocated, with some reluctance, are on a shared and generally secondary basis, and are restricted to research. No provision was made in 1959 for operational space systems.

ITU members, which include virtually every country of the world except Communist China, have historically abided by ITU decisions on frequencies, regardless of political climate, for the reason that failure to do so could result in communication chaos for all.

U.S. proposals include:

- **Total of 2,975 mc.,** in four bands, for operational communication satellites on a shared basis with fixed and mobile services. Within the U.S., two of the bands, totaling 1,000 mc., are now being used by communications common carriers. One band of 700 mc. is assigned to private users, primarily utility and oil companies, and one band totaling 1,275 mc. is assigned military and civilian government services.
- **Five frequency bands,** totaling 122 mc. within the 10,000 mc. spectrum span, for space research on an exclusive basis. In addition, two bands in the higher portion of the presently allocated spectrum—in the 15,000 and 31,000 mc. bands—would be earmarked for exclusive space research to permit reliable communications during spacecraft reentry into the atmosphere where the plasma sheath blacks out lower frequencies.

The U.S. considers frequency exclusivity an absolute must for its Apollo and other space research projects. Interference from high-power radar, television, aeronautical services, or tropospheric scatter systems could completely cancel out space research transmissions.

Failure to obtain multilateral agreement on exclusivity at the coming ITU conference, according to FCC, would mean that endless bilateral agreements or understandings would be the only alternative to open the way for successful space experiments. Arrangements would be necessary with all countries with well-developed communications, including the USSR.

FCC also believes that under-developed nations will move in the direction of tropospheric scatter systems. These extend a line-of-sight transmission from about 30 to several hundred miles. They have an appeal for countries with rugged and undeveloped terrain: they permit city-to-city or town-to-town transmissions without the necessity of in-between maintenance of relay stations.

Space Research

On the need for space research exclusivity, the U.S. proposal explains:

"The U.S.A. recognizes the difficulty of displacing existing services in some of the bands proposed exclusively for space research . . . To minimize the problems created . . . it is acceptable, in so far as space research is concerned, to permit existing services to phase out their operations in these bands over a period of years . . . A maximum three-year period is suggested. The potential benefits to mankind from existing and planned space programs are so promising that the U.S.A. believes the research effort should not be jeopardized. The cost in spectrum space is minimal."

The proposal also notes:

"Research data lost due to interference are irretrievable. Such loss represents a direct waste of time, energy, talent and material resources. The very substantial commitments to space programs demand the prevention of interference because of the difficulty of identifying and locating sources of interference in sufficient time to prevent the loss of important scientific data.

"Space research experiments are designed to accumulate the maximum practicable amount of scientific information. The spacecraft used in these experiments necessarily utilize radio links with the earth as the only means of relaying information they acquire. Only a minimum portion of the available space and weight aboard a spacecraft can be apportioned to its radio equipment. This fact, plus reliability considerations, therefore require the radio links to be designed with minimum power in the spacecraft and, consequently, maximum receiver sensitivity at the earth stations. This, in turn, makes such radio links highly susceptible to interference when attempting to work to the full limit of their capability."

State Dept. officials, in campaigning to win international support of the U.S. proposals, are emphasizing the scientific progress and peaceful benefits promised by space research.

They are aiming to keep possible military use of space frequencies or military yields from space research out of the picture. They point out that frequency allocations proposed by the U.S. are not needed for military projects. These do not require wide participation and arrangements can be made bilaterally with allied nations. For example, a reconnaissance satellite could perform satisfactorily with only one read-out station in the mid-U.S. to receive photographic signals.

Among negotiators on the diplomatic front there is some annoyance with Defense Dept. publicity of its Advent military communications program and recruitment advertisements for the program by International Telephone & Telegraph Corp.

From the view of those charged with selling the U.S. proposals, this puts space communications as a military undertaking in the forefront and improperly confuses it with the President's program for a world-wide civilian system. State Dept. is hopeful that negotiations for communication satellite frequencies will not become entangled in controversy over the type of system to be operated—high, low, or medium orbit—to the detriment of any system.

The frequency allocations will not determine the type of system. Low, high, or medium orbit systems could use the same frequencies, depending on the power units inside the satellites.

The overriding objective at this point it is emphasized is to obtain the frequencies.

Three possible blocs as to the type of system could develop:

- **Random, low orbit.** The U.S. is not committed to a Telstar or Relay-type system. However, experts of National Aeronautics and Space Administration believe that this type of system will be the first to be operationally feasible.
- **High-altitude,** synchronous orbit. Alexsander Kakunin, USSR's vice minister of communications, has announced that Russia will launch synchronous orbit communications satellites in the near future (AW Sept. 24, p. 40). USSR's capability to do this is generally unquestioned in U.S. circles.
- **Medium-altitude,** equatorial orbit. This type of system, between the low and high altitude systems in technical sophistication, is being proposed by Great Britain. It would provide for communication among Commonwealth nations. This would be difficult and costly with a random, low-orbit system.

The number of countries that now have space communications projects—Great Britain, Japan, West Germany, and others—indicates that there will be substantial support for spectrum allocations for an operational system at next year's ITU meeting. Several European countries have already indicated agreement with the U.S. that about 3,000 mc. will be required. There are differences of opinion over which bands.

Preceding the Geneva ITU conference next year, ITU's technical advisory group, the International Radio Consultative Committee (CCIR), will consider technical aspects of spectrum use for space. CCIR is scheduled to meet in New Delhi in mid-January.

One CCIR study group will consider areas of the spectrum suitable for space communication and protection from interference required for space uses. Another study group will consider the impact of space services on terrestial services. CCIR's recommendations to ITU set the broad technical framework for frequency allocations.

UAC Title Changes

United Aircraft Corp. has given general managers of six divisions new titles of division presidents. They are: Leonard C. Mallet, Pratt & Whitney Aircraft; William E. Diefenderfer, Hamilton Standard; Lee S. Johnson, Sikorsky Aircraft; John N. Phillips, Norden; Charles M. Kearns, Jr., United Aircraft Corporate Systems Center, and Barnet R. Adelman, United Technology Center. Johnson, Mallet and Kearns will continue as vice presidents of United Aircraft Corp.

Space Radiation Facility

Washington—Atomic Energy Commission is requesting General Services Administration to transfer the Dawsonville, Ga., Nuclear Laboratory to AEC for use as a facility to assess radiation effects on space vehicle components for the National Aeronautics and Space Administration.

The laboratory was used by the Air Force as an irradiation testing facility in the aircraft nuclear propulsion program until this program was cancelled last year. The facility was declared surplus by USAF last August.

Lockheed Aircraft Corp., prime contractor for NASA's Rift nuclear rocket engine, operated the plant for USAF and will continue as operator under a lease agreement with AEC.

Air Force Will Study Ozone in Atmosphere

Washington—Air Force will launch 700 balloons in a year-long study of atmospheric ozone scheduled to begin in January.

Scientists at the USAF Cambridge Research Laboratories said the study will be the most thorough ever made. Objectives of the program are to learn why ozone concentrations in the lower atmosphere increase during winter and early spring in higher latitudes, reasons for vertical flux of ozone from the stratosphere into the troposphere and something of the storage time and mixing history of ozone as it passes through the troposphere to the earth's surface.

Although a minor constituent of the atmosphere, ozone distribution plays an important part in determining earth's heat balance and thermal structure of stratosphere and helps shield earth from direct solar ultraviolet radiation.

News Digest

Kollsman Instrument Corp. has won the Air Force competition to be prime contractor for the AN/USQ-28 geodetic survey and photo mapping system to be used in RC-135A jet aircraft. Kollsman initially will build two prototype systems for Aeronautical Systems Division. Subsequent production is expected to total about $50 million, company said.

Continental Aviation & Engineering Corp., Detroit, has been awarded an R&D contract for an off-the-shelf lift engine for the Air Force (AW Aug. 6, p. 23). Continental is hiring about 200 new engineers for the project. Follow-on work would be carried out at the firm's Toledo plant.

Aerojet-General Corp. will begin construction this month on the first of a series of solid rocket propellant plants on its 75,000-acre site near Miami, Fla. Initially, the plant will produce fuel for existing programs.

Airline Mutual Aid Pact members last week asked Civil Aeronautics Board approval of their agreements in a brief that agreed to give CAB full details of the pact. American, Braniff, Continental, Eastern, Northwest, Pan American, Trans World and United Air Lines said, however, that they would object to any conditions which might change the pact's effectiveness in paying a percentage of revenues to strikebound members.

Seventy-one companies were invited to bid on a contract to operate the computer facility of the National Aeronautics and Space Administration's Michoud fabrication plant. The facility, located at Slidell, La., will be operated on a two-shift basis. Computers there are IBM 7090 and 1401, Honeywell 800 and 400 and GE 225 units.

Army Missile B tactical weapon system, designed to replace the current Honest John and LaCrosse battlefield non-nuclear and nuclear systems, has been renamed "Lance." Chance Vought Corp. is the prime contractor.

Frank W. Lehan last week was named president of Space-General Corp., El Monte, Calif., succeeding James Fletcher, who moves up to chairman of the company's board of directors. Jack E. Froehlich will succeed Lehan as executive vice president. Space-General is a subsidiary of Aerojet-General Corp.

First operational Titan 2 storable liquid propellant intercontinental ballistic missile was delivered last week to the Air Force at Davis-Monthan AFB, Tuscon, Ariz.

Examiner's Rebuff Shakes Merger Hopes

Decision is the fourth setback for American-Eastern union; final rejection by CAB or White House seen.

By Robert H. Cook

Washington—Rejection of the proposed American-Eastern merger by a Civil Aeronautics Board examiner last week was the fourth consecutive setback for the plan, and increased the airline industry's feeling that the consolidation ultimately will be rejected by the Board or the White House, which must rule on the final decision.

Details of Examiner Ralph Wiser's decision follow closely and enlarge upon objections raised earlier by a House anti-trust subcommittee staff study (AW Apr. 2, p. 26), the Justice Dept. (AW Aug. 6, p. 43) and attorneys for the Board's Bureau of Economic Regulations.

The congressional study rejected the merger on grounds that it would create a monopolistic "super carrier," leaving the airline industry under the "domination of three goliaths"—American-Eastern, United and Trans World Airlines. Justice Dept. also emphasized the monopoly aspect and warned that approval would run counter to the desired "course of competition" set forth in President Kennedy's transportation message (AW Apr. 9, p. 42).

Key issues emphasized in Wiser's rejection, contained in a 73-page decision and 246-page appendix, followed this general pattern:

- **Merger would give** the combined carrier control over one-third of all domestic traffic and access to 76.8% of all domestic passengers. Along with United, the two airlines would control 60% of all domestic traffic.
- **Monopoly would be created** in the New England area, jeopardizing the existence of Northeast Airlines. Control would be particularly effective over the present Boston, New York, Washington routes and those connecting New York with Providence, Chicago, Indianapolis, Hartford, Baltimore and Louisville.
- **American-Eastern would gain** a southern transcontinental route in direct competition with Delta and National airlines.
- **Merged airline would divert** far more traffic from remaining competitors than their estimates indicate.
- **Operational savings claimed** by the two carriers through a merger are small, and much could be accomplished without a merger.
- **Financial strength** and past earnings history of neither American nor Eastern airlines justify the merger request of the two airlines on the grounds of business need.
- **Balance of the industry** feels that it has passed through the worst of its financial problems, caused primarily by the jet re-equipment program, and that future traffic growth will make mergers undesirable.

Both American and Eastern stated that they are confident the merger will still be approved, despite these setbacks. The case now goes before the five-member CAB, which is expected to take several months to reach a decision. Because of Eastern's service into Mexico and Bermuda, and American's route into Mexico, the Board's final decision will be subject to White House approval.

Considering the failure of the merger applicants to win support in any major documentation so far, and CAB's duty to maintain effective competition in the industry, most informed observers believe the Board may be forced to reject the merger on this basis:

- **United-Capital merger** was approved primarily to save the jobs of some 7,000 Capital employes who faced dismissal from a bankrupt company. It did not set an acceptable precedent for a merger between two carriers with the strength of American and Eastern.
- **Board Chairman** Alan S. Boyd's public encouragement of more mergers is not shared by all members. Boyd once indicated that CAB would establish "merger guidelines," but failed to do so.

On several occasions he emphasized a preference for mergers between one large and one small carrier or two small carriers, but has never stated his opinion on any merger agreement involving two of the "Big Four" trunklines.

- **Approval of the merger** would be contrary to the Board's customary method of promoting economic competition by strengthening smaller airlines to compete better with the larger.
- **CAB has taken** great care to protect Northeast through such measures as approving financial aid and control by Hughes Tool Co. Competition from an American-Eastern combine would prevent the smaller airline from regaining financial stability.
- **Neither American** nor Eastern were successful in winning a southern transcontinental route between Florida and California. Connection of existing routes operated by these airlines in that area would give them such a route, dividing the available traffic among three airlines and threatening the earning power of both Delta and National airlines. The latter have been showing a healthy profit along southern transcontinental route.

If the Board ignores Wiser's stand and approves the merger, it will set the stage for a revelation to what extent the Justice Dept. objections reflect those of Attorney General Robert Kennedy.

It will also reveal whether these views are shared by his brother, the President.

President's Statement

The President has stated that "chronic overcapacity and deficits" can eventually be ended in the airline industry by "vigorous competition and innovation" providing that Congress is "alert for any violations of existing laws against monopoly and predatory trade practices."

Supporting the President's stand, Justice Dept. has warned CAB that "little will be accomplished in the public interest by the bold moves recommended by the President to deal with the transportation problems if the greater freedom and diminished regulation that the President envisages are to be achieved by only a handful of surviving transport companies."

Wiser's decision reflected this concern in his statement that the merger should be denied because of its effect on the public.

Noting that the merger would "violently disarrange" the competitive balance among the airlines, Wiser said, "It would be a long step toward a three or four carrier industry. And when that came about, many of the same contentions as to elimination of duplicate facilities as presented here would be available to claim savings to justify complete monopoly."

Merger Impact

As an example of the impact of the merger on top markets, the examiner pointed out that American and Eastern carried 70% of the 1960 traffic in the top ranking market of Boston-New York. In the same year they accounted for 67% of the passenger volume between New York and Washington. Since then Eastern's shuttle service has been expanded and Northeast's participation in the market decreased 9.7% during the first quarter of this year. In the 14 leading markets in the Northeast, the two airlines carried 70% of the passengers, and in half of them, attracted from 87% to 97% of the total, he said.

The volume of traffic that the merger partners estimate they would divert



First Boeing 727 Transport Rolls Out at Renton Plant

First Boeing 727 short-to-medium range transport was rolled out of the company's Renton, Wash., plant last week as the latest of a 10-airplane family designed to fill every airline need from short to long-haul aircraft. Boeing has 131 orders for the three-engine jetliner, all of them from trunk airlines. Company so far has failed to crack the short-haul, local service market and Boeing officials admit some doubt as to whether or not the airplane will ever be sold in substantial numbers to local service operators. But they do foresee a market of 1,000 airplanes of the 727 type and hope to make between 350 and 450 sales to trunk and international airlines. Production of the airplane, which is powered by Pratt & Whitney JT8D-1 engines producing 14,000-lb. thrust, is scheduled to reach three a month by the end of 1963, and increase to a maximum of eight a month thereafter. Aircraft will carry 70-114 passengers, depending on interior configuration, over stage lengths of 150-2,000 mi. United Air Lines has ordered 40 of the planes, Eastern 40, Ansett-ANA 2, Trans-Australia 2, Lufthansa 12, American 25 and TWA 10. Cruise speed of the aircraft is 550-600 mph. and cruising altitudes 15,000-35,000. Wingspan is 108 ft. 7 in., length is 134 ft. 1 in. and height is 33 ft. 9 in. Landing weight is 131,000 lb. Passengers will enter and leave the aircraft by way of a side door forward and a ventral door aft of the cabin. Single galley midway in the cabin will provide for all passengers and will increase seat capacity.



from their remaining competition "is only a fraction of that which can be expected," Wiser said, since the combined carrier could be expected to provide a greater volume of service and would also benefit from a superior identity.

Emphasizing the power of identity, Wiser cited Braniff Airways' contention that while it has matched both flight frequencies and equipment against American in the Dallas-New York market, it received only 38% of the traffic in 1960, while American carried 56%. A similar disparity exists in the Dallas-Chicago market, primarily because of American's ability to attract more traffic from greater traffic sources and heavier advertising coverage, the airline said.

The examiner said it is likely the merged carrier would greatly expand its future services and there was nothing in the CAB record which would give a reasonable estimate of future diversion.

Wiser also cast strong doubt on the validity of American and Eastern claims that a merged company would produce annual expense savings of $54.9 million and capital savings of $100.7 million by 1965. Over 90% of the capital savings figure stems from the anticipated elimination of 10 Boeing 720 turbojets and 6 Boeing 727s from future fleet requirements. None of these aircraft will be acquired in the event of a merger, and Wiser added that the 10 Boeing 707s which Eastern estimates it will need are not now on order and have never been studied for purchase by the airline.

In disputing the carriers' contention that the merger is a business necessity, Wiser said American has consistently led the industry in load factors over the years and has experienced rates of return on investment well above the industry average. Eastern for years has been one of the strongest airlines, even though it has experienced losses over the past two years.

Eastern has a strong financial position along with a favorable cash flow and it may be expected that their financial problems are of a temporary nature, the examiner said. The favorable ratio of exchange of stock under the agreement indicates that American's owners consider Eastern's routes valuable, he said.

While the relative size of joining companies is not always the deciding factor, Wiser said, it "looms into great significance" in this case. For example, he said, the Electra was designed in consultation with both American and Eastern, and Lockheed originally agreed that they would get the entire first year's production of the turboprops. The agreement was later altered, but Wiser pointed out that a union of the two airlines would be in an even stronger position to demand aircraft delivery on a schedule that would give the airline a significant competitive advantage.

FAA Attitude Toward Data Link, ATC Development is Criticized

By Philip J. Klass

Washington—Federal Aviation Agency's unwillingness to join with Defense Dept. and industry in developing standards for an air-ground data link, for which both the Air Force and airlines see an operational need, was criticized here at the fall meeting of the Radio Technical Commission for Aeronautics.

The FAA also was criticized for an apparent lack of a sense of urgency in its efforts to improve the present air traffic control system and for its plan not to fund any new programs in airborne anti-collision systems (AW Oct. 22, p. 37).

A Defense Dept. spokesman disclosed that major procedural and technical problems must still be resolved before the air traffic control system design plan developed by the FAA will be satisfactory to the military.

Some of the points of military and airline dissatisfaction stem from basic policy decisions recommended a year ago in the Project Beacon report, prepared by a special study group headed by Richard R. Hough, vice president-engineering of AT&T.

The Project Beacon report recommended that the airborne radar transponder be used to provide aircraft identity and to report aircraft altitude automatically. This would eliminate any immediate need for an air-ground data link, the report concluded, and it recommended that FAA drop its work on data link systems.

USAF Col. F. K. Nichols, reading a prepared statement of Defense Dept. views on the FAA's proposed air traffic control system design developed to implement the Project Beacon recommendations, said "there are some complex issues yet to be worked out with regard to the . . . radar beacon . . . The military services have more than 20,000 IFF (radar) transponders in aircraft use. Any requirement that causes changes in the use, modification or replacement of these items . . . results in problems that reach staggering proportions."

The Defense Dept. has agreed to the national standards for the beacon, Nichols said, "but there has been no agreement . . . on an implementation plan nor for a plan for implementation of automatic altitude reporting on the beacon."

Nichols pointed out that military services have a considerable investment in aircraft equipped with air-ground data link. "Some arrangement needs to be made in the [air traffic control] system to account for our use of this technique," Nichols told the conference.

Robert J. Shank, deputy FAA administrator for development, said that the introduction of radar transponders providing automatic altitude reporting and aircraft identity should eliminate much of the burden on overloaded voice communication channels, eliminating any immediate need for data link.

This philosophy, coupled with the lukewarm view of the function performed by the Radio Technical Commission for Aeronautics expressed at last year's RTCA meeting by FAA Administrator N. E. Halaby, apparently explains the agency's refusal to participate in the preparation of basic standards for an air-ground data link by RTCA Special Committee 100.

Despite FAA's refusal to participate and make known its anticipated future requirements, the committee, after nearly a year of effort, has drawn up basic data link standards which appear acceptable to the Defense Dept., the airlines and to equipment manufacturers. The SC-100 data link standards will be issued publicly in the near future, USAF Lt. Col. H. F. X. Hession, chairman of the committee, reported.

Major R. E. Winters, Air Force Systems Command, said he now is hopeful that USAF will authorize the development of an air-ground data link for use by SAC, MATS and TAC aircraft.

The airlines see an important need for air-ground data link for company-to-aircraft communications to assure speedy transmission of information at all times without interrupting the crew when they are heavily burdened with cockpit duties, Air Transport Assn.'s Frank White said.

Shank told the RTCA that the FAA plans for improving the traffic control system call for installation of bright radar displays, to be followed by mosaic consoles which can display aircraft from several radars simultaneously to provide larger area coverage.

Later, FAA plans to install alphanumeric displays for use with the radar transponders, which will indicate identity and altitude of such aircraft blips on the scope. In congested terminal areas, track-while-scan equipment will be needed to automatically keep the altitude-identity information correlated with the appropriate radar blip.

ATA's Walter A. Jensen called upon the FAA to show a "greater sense of urgency in solving the traffic control problem." He also called for more information on the approximate cost of system innovations before the agency makes firm decisions to adopt them.

RAF V/STOL Transport Competition

London—Decision on a Royal Air Force replacement transport with V/STOL capabilities will not be made until early next year, Minister of Aviation Julian Amery said here last week.

Amery also said that reports that an American aircraft is likely to be chosen to replace the Blackburn Beverley and Handley Page Hastings transports are entirely speculative. His statement was in reference to negotiations to acquire a number of Lockheed BLC-130s which would be built in England under license.

He noted, however, that it would be quite reasonable that the RAF should try to develop a common requirement with the U. S. Air Force if possible. Other designs have been submitted by Bristol Aircraft, Gloster Whitworth and Short Brothers and Harland (AW Nov. 26, p. 37).

Decision on a production order for the Hawker P.1154, supersonic version of the P.1127 VTOL fighter (AW Sept. 17, p. 30) is pending completion of a project study, Amery said. Next step will be a development contract based on replacement for the Hawker Hunter and the de Havilland Sea Vixen.

British Approve Construction Of Supersonic Transport Prototypes

By Herbert J. Coleman

London—British government last week approved production of two Mach 2.2 supersonic transport prototypes and two pre-production aircraft in cooperation with the French at a cost of about $476 million, spread over eight years.

Decision to proceed with the airplane jointly on a 50-50 basis caps negotiations between Sud Aviation and British Aircraft Corp. which started more than a year ago when France first proposed a Super Caravelle version. Both companies have been involved in supersonic research since 1956.

First production airplane will be purchased by British Overseas Airways Corp., according to Minister of Aviation Julian Amery. He said production order will be placed by BOAC but that the government will underwrite the cost. Similar plan involving the medium-range aircraft probably will be followed by Air France.

The airplane will have a slender delta planform (AW Sept. 17, p. 34) and will be powered by four Bristol Siddeley Olympus 593 turbojet engines, the powerplant also being used in the British TSR-2 strike reconnaissance plane.

Each nation will assemble one prototype and one pre-production airplane. There will be no duplication of main production jigs and manufacture of various assemblies will be divided between France and Great Britain, with components transported to final assembly lines in either country.

Each company will be responsible for one general assembly line and for flight and acceptance tests of the aircraft it assembles.

Bristol Siddeley has prime responsibility for the engine itself, in collaboration with Societe Nationale d'Etude et de Construction de Moteurs d'Aviation (SNECMA).

French engine company will be responsible for the afterburning system, variable divergent-convergent ejector nozzles, thrust reversing and noise suppression. Afterburner probably is an advanced version of a SNECMA development for the Atar-9 axial flow engine which enables the pilot to control both engine and afterburner with a single lever. SNECMA work in this area has been fed into the Atar-9K, the powerplant for the Dassault Mirage 4 supersonic bomber.

Supersonic Olympus engine has been flying in an Avro Vulcan testbed since last February (AW Sept. 10, p. 26). Thrusts achieved have been in excess of 30,000 lb.

One prototype will be for long-range flights, and will be built by BAC at its Bristol Aircraft Corp. plant at Filton. The other, a medium-range version, will be built by Sud at Toulouse. Basic designs—170 ft. long fuselage and a 77 ft. wingspan—will be identical, with changes limited to fuel tankage and passenger seating configuration. Gross weight of the long-range version will be 250,000 lb.; medium-range airplane will weigh 200,000 lb.

Most construction will be of aluminum alloys with localized uses of titanium or stainless steel in areas subject to high temperature stresses. Both versions will incorporate a rectractable cover over the pilot's windshield during supersonic cruise, to reduce drag. Aircraft will accommodate about 100 passengers and the cabin will have the usual number of windows for an airplane of this size.

Cruise speed will be 1,450 mph. This will cut the London to New York flight time from approximately 7 hr. in the current generation of jets to 3 hr.

Entire joint venture will be directed by a board of directors, with positions of president and vice president rotated every two years between Great Britain and France. Board presently has as members: president, Gen. Andre Puget, president of Sud Aviation; vice president, Sir George Edwards, managing director of British Aircraft Corp.; technical director, Pierre Satre, technical director of Sud; deputy technical director, Dr. A. E. Russell, technical director of Bristol Aircraft; general manager and director of production, finance and contracts, J. F. Harper, managing director of Bristol Aircraft; deputy general manager, Louis Giusta, director general of Sud; co-sales director, Allan H. C. Greenwood, BAC aircraft sales manager, and J. W. Jakimiuk, Sud sales director; directors, B. C. Vallieres, managing director of General Aeronautique Marcel Dassault; and G. E. Knight, BAC commercial manager.

SAS-Icelandic Battle Over Rates Intensifies

Washington—International Air Transport Assn. carriers operating across the North Atlantic face a possible open rate situation on piston fares because of the intense competition between Scandinavian Airlines System and Icelandic Airlines.

Faced with the problem of competing against the lower fares of Icelandic, a non-IATA carrier, SAS officials are meeting with the governments of Denmark, Norway and Sweden to discuss a possible SAS veto of IATA's North Atlantic piston fares, informed sources said.

Icelandic, which operates a fleet of 4 Douglas DC-6Bs between New York, Iceland and the three major Scandinavian countries, contends that SAS has exaggerated the extent of the competition.

Total traffic carried on all of Icelandic's routes last year was only 52,000 passengers, rather than the 70,000 estimate made by SAS, the company said. Icelandic also claimed that SAS's estimate of its own traffic last year—80,000 passengers—represented traffic on only one of SAS's routes.

SAS also claims that most of Icelandic's passengers come from Scandinavian countries. Loss of this business to the smaller airline amounts to $7 million a year, SAS claims. The Scandinavian airline has 52 aircraft, including 11 Douglas DC-7s and a DC-6B.

Icelandic claims it carried only 8,700 passengers from Scandinavian nations, and that this market has been decreasing to a point where it accounts for about one-quarter of all Icelandic traffic.

TELSTAR & THE WORLD'S LARGEST AIRLINE



World's largest airline makes world's first reservation via Telstar!

Place: A reservations desk in the Air France reservations center at Idlewild Airport. There is an important difference in the phone call that is being received at this moment, however. It was placed at Air France headquarters in Paris, transmitted to the Telstar communications satellite in space, then back again to earth!

This historic "first" is one of many Air France has established. Other examples: first international passenger flight, Paris/London, in 1919; first flight with a passenger across the South Atlantic, in 1930; first jet passenger flight over the North Pole, Paris/Tokyo, in 1960; first airline to equip its entire Boeing 707 Intercontinental Jet fleet with Doppler radar, an automatic navigational system. And Air France was first to order a remarkable new communication system that now links its 41 offices in North America with over 500 offices around the world. Air France's network covers 201,-043 miles of unduplicated route miles, the largest of any airline in the world.

Maintenance and personnel training programs are other areas in which Air France strives for perfection. Pilots as well as crews constantly undergo refresher training. No other airline has higher standards for its personnel. Or for any phase of operations, in fact.

This kind of dedication to excellence has always been a hallmark of Air France, the world's largest airline, through 43 years of international flying experience.

AIR FRANCE
THE WORLD'S LARGEST AIRLINE

UAL Pilots Object to Minimums Training

By James R. Ashlock

New York—Refusal by some United Air Lines jet pilots to continue training toward 200-ft. ceiling and ½-mi. visibility conditions has not spread to other carriers.

United is seeking a court injunction (AW Nov. 26, p. 37) to block the refusal by 35% of its jet pilots to continue the training. Action came after 65% had already qualified to fly under the lower weather minimums.

Spokesmen for American Airlines, Pan American World Airways, Trans World Airlines and Northeast Airlines reported no pilot refusals to undergo certification training under the disputed conditions.

Pilot Resolution

United's pilots made their action formal in a resolution adopted by their master executive council of the Air Line Pilots Assn. Union headquarters endorsed the resolution and announced it to ALPA members on other airlines.

Federal Aviation Agency authorized the lower landing minimums for jets earlier this year, restricting them to international airports at New York, Los Angeles, London and Paris. Airlines anticipate their extension soon to San Francisco, Detroit and Chicago's O'Hare Field.

In qualifying to make approaches at the lower minimums, pilots are required to descend 100 ft. below the 200-ft. level. FAA believes this is a definite demonstration of proficiency and builds confidence.

United's pilots, however, claim that to go within 100 ft. of the surface on instruments is unnecessary and may be hazardous with large jet aircraft. Instrument landing system beam deviations and unreliability of altimeters at extremely low altitudes are cited by United's pilots, who also say they doubt the benefits of going to 100 ft. in training.

"They have no complaint with going to 200 ft., the prescribed minimum," said an ALPA spokesman, "but they feel 100 ft. is unnecessary and unsafe. Or, they'd be willing to demonstrate proficiency to 100 ft. in the flight simulator."

ALPA is compiling a list of near-accidents attributed to the training, one of which it says occurred at Denver. A DC-8, being flown with the autopilot coupled to the ILS, struck the runway prematurely. Impact, approximating 4g, caused some damage to the aircraft.

United officials said the incident was due apparently to a malfunction of the autopilot, and approaches involving coupling with the ILS have been discontinued on the DC-8 pending study and correction. The procedure is being continued on United's Boeing 720s. The 720s have a different type of autopilot.

No such incidents have been reported on other airlines conducting the training. American, which has 204 of its 253 jet captains certified for the lower minimums, said that only in one instance did an FAA check pilot require a captain to conduct an extra approach to attain certification.

Spokesmen for FAA also say they have encountered no criticism from pilots on other carriers about the training requirements. Northeast said all but a few of its captains had completed the training on the airline's Convair 880s.

Training procedures among the carriers involved differ according to cockpit instrumentation of their jets.

American, for example, is certified to make approaches under the new minimums only with the autopilot and ILS coupled. When making a manual approach, its jet captains are restricted to the former 300-ft., ¾-mi. visibility limitations.

"We spent $60,000 on a modification of the autopilot-ILS coupler on our Boeings, which makes the system exceptionally reliable for approaches under the lower minimum," said R. H. Sutherland, manager of special services for American.

Modification involves a computer and a memory circuit. Autopilot sets the aircraft in proper trim to follow the ILS gradient on landings. But when the plane passes the inner marker, where the ILS beam may begin to deviate because of the low altitude, the memory circuit takes over, maintaining the proper trim and glide angle.

Pilots have only to adjust the throttles to control speed.

"By relying on this system, we save close to a million dollars in training time to certify our captains for the new minimums," Sutherland said.

Further Modifications

American has not made the modification on its Convair 990s, which are still restricted to the 300-ft., ¾-mi. minimums. The airline expects to equip them for the lower limits about next April.

TWA has its pilots make the basic ILS manual approach, and also certifies them on flight director system approaches. On flight director, the pilot follows an aircraft silhouette that tracks the ILS beam.

Although TWA isn't certified for autopilot-ILS coupled approaches, it is training its crews for the procedure. On TWA's Convairs and Boeings, the pilot makes manual adjustments of autopilot sensitivity each 1,500 ft. of descent, correcting for ILS beam deviation. The American system does this automatically.

When crews have completed the training, TWA expects to seek the agency's certification for autopilot-ILS coupled approaches to the lower minimums.

Pan American, which has 190 pilots certified and is continuing training for the remainder of its captains, does not include approaches on autopilot, nor does Northeast.

Airline Request

FAA granted the lower jet minimums at airline request, after checking cockpit instrumentation of the carriers involved. The 200-ft., ½-mi. minimums, long standard for piston aircraft, would better assure jet schedule reliability in spite of weather, the airlines held.

One carrier estimates it would have been spared approximately 60 diversions from Los Angeles International Airport to the field at Ontario, Calif., in 1961 if the lower minimums had been in effect.

LOT Viscounts

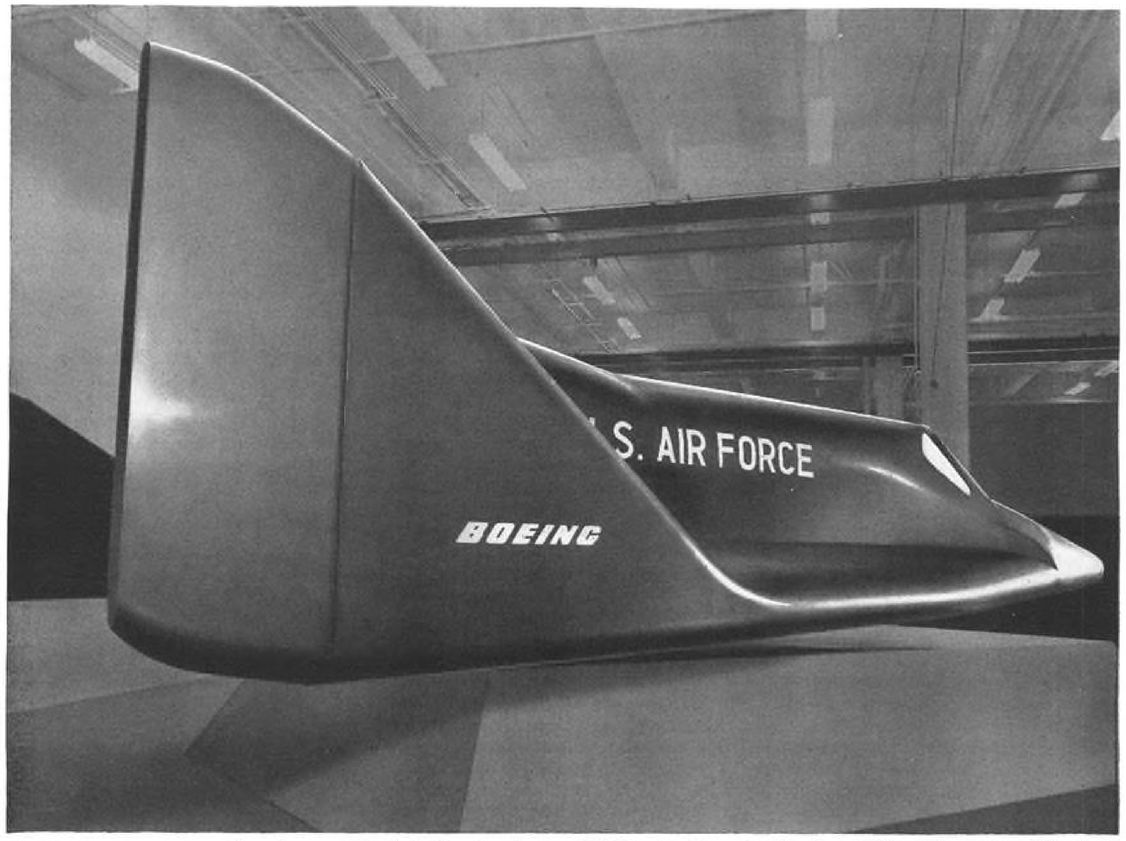
Geneva—LOT Polish Airlines is phasing out its four 40-passenger Convair 240s presently operating most of its services to West European centers and is replacing them with Vickers Viscount 800s.

Deadline for completion of the changeover is Apr. 1. Only remaining Convair 240 service then will probably be between Warsaw and Copenhagen, according to a LOT spokesman.

First of three Viscount 800s ordered in June from British Aircraft Corp. (AW Nov. 12, p. 45) began serving LOT's Warsaw to Rome via Vienna and Warsaw to Amsterdam via East Berlin routes on Dec. 1 on a twice-weekly round-trip basis.

Second Viscount will be introduced on the carrier's Warsaw to Paris via East Berlin and Warsaw to London via Amsterdam services on Jan. 13 once a week.

Third Viscount will be used beginning Apr. 1 to increase LOT's Warsaw via East Berlin to Amsterdam and London flights to three times weekly. It also will be flown on two once-weekly round-trip services between Warsaw and Brussels via East Berlin and Warsaw to Athens via Budapest and Belgrade.



X-20 DYNA-SOAR mockup shown at Boeing's Seattle plant. Combining speed of ballistic missile in space with airplane-like control in atmosphere, U. S. Air Force's Dyna-Soar will rocket into space atop giant booster, and orbit earth at speeds above 17,000 mph. Dyna-Soar's pilot will be able to fly glider back into atmosphere and land at airfield of his choice. Boeing is Dyna-Soar system contractor, responsible for manufacture of glider, integration of vehicle and booster, and assembly and test.

Capability has many faces at Boeing



U. S. NAVY'S first hydrofoil patrol craft, shown at launching. Boeing is prime contractor. Hydrofoil, 115 feet long, will "fly" on underwater wings at speeds of 40 to 50 knots.

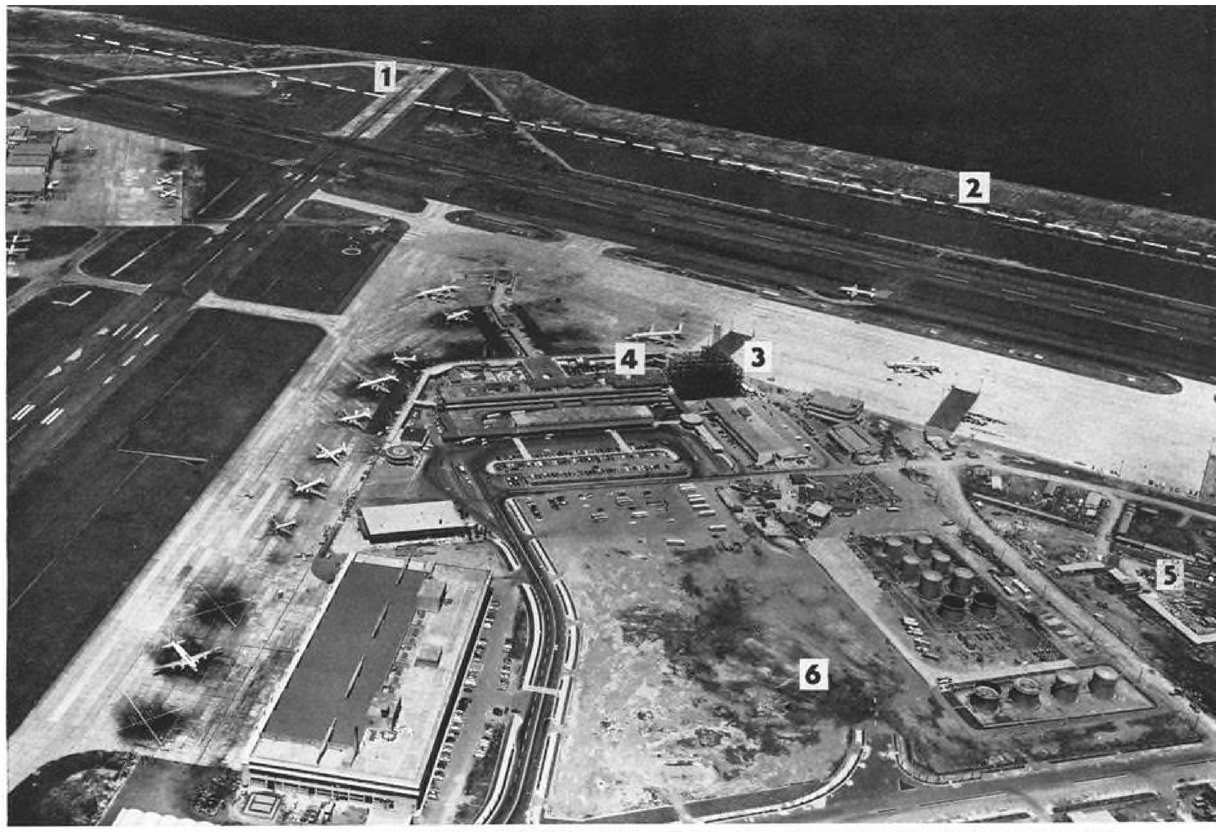


SPACE TWIST. Tests devised by Boeing scientists determine how much twist an astronaut, working weightless outside orbiting vehicle, could exert on a wrench. Instruments measure the efficiency of bracing techniques.



DASH. U. S. Navy's unmanned anti-submarine helicopter, DASH, will be operated by remote control from destroyers. Powered by 300-hp Boeing T50 gas turbine engine, DASH is designed and built by Gyrodyne Company of America. Boeing gas turbines are used in a wide variety of land, sea and air applications.

BOEING



Japanese Airport Program Enlarged; Honolulu Terminal Is Being Expanded

EXPANSION PROGRAM at Tokyo International Airport (Haneda) calls for runway extensions, including the eastern portion of Runway 4-22 now completed (1), and construction of a new 10,300 ft. runway (2) paralleling the existing 9,200 ft. northwest-southeast runway, which also is being extended at the southern end. A 10-story control tower is being erected (3), and expansion of the main terminal building is under way (4). A freight hangar and additional ramp space will be provided (5), and so will an enlarged parking area (6). A new expressway to Tokyo will provide a high-speed link to the city. Terminal building enlargement will cost $6-million and will double the building's available floor space. In addition to Tokyo-airport roadway, a contract is about to be granted for a monorail service to further speed traffic to and from downtown.

In addition to expansion of Tokyo International Airport (above), the Japanese Civil Aeronautics Bureau last week announced plans for a second Tokyo International Airport, about six times as large as the present facility at Haneda. Proposed airport will have five runways and is expected to be capable of handling four times as much traffic as Haneda. Cost of the new airport is calculated at $333 million and would be operating in 1971. Ministry already has asked for $42,000 to be budgeted against 1963 in order to find a suitable site. There is some speculation that parts of Tokyo Bay may be filled in to accommodate the new airport. Plan is to have two of the five runways, each 13,000-ft. long, completed in 1970. Construction on other three shorter runways will commence in 1971.

Honolulu Airport's new John Rogers Terminal (right), features a Y-shaped boarding finger and is five times larger than the old facilities at the airport. Two United DC-8s are seen in foreground, two Pan American Boeing 707s are in the background.





Watchdog for 4 nations

This is the Bristol/Ferranti Bloodhound surface-to-air guided missile, adopted by the United Kingdom, Australia, Sweden and Switzerland as an integral part of their defence systems. Bloodhound is powered by two Bristol Siddeley Thor ramjets which have proved their reliability during hundreds of test firings in the missile's development programme. Bristol Siddeley have more than twelve years experience in the design and development of ramjets and are the only European company to have a large ramjet engine in quantity production.

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BS Bristol Siddeley Engines Limited. Central Office: Mercury House, 195 Knightsbridge, London SW7.

SHORTLINES

► **Allegheny Airlines'** new daily round trip between Pittsburgh and Boston is to stop at Reading, Pa., providing the first direct service from that point to New England. The service was to begin Dec. 1 with the airline using Martin 202 equipment.

► **Communities** seeking airport construction or improvement funds under the Fiscal 1964 Federal Airport Aid Program must submit their requests to Federal Aviation Agency District Airport Engineer Offices no later than Feb. 15, 1963.

► **Delta Air Lines** plans to purchase a Collins Radio Co. data communication switching system to handle message traffic between the carrier's headquarters in Atlanta, Ga., and its operations throughout the U. S., the Caribbean and South America. Work on the system, known as Data Central, is to begin next month and be completed in the fall of 1963.

► **FAA has ended** the restrictions imposed during the Cuban crisis on all civil aircraft flying over the southern two-thirds of the Florida peninsula (AW Oct. 29, p. 40). The restrictions remain in effect over the Florida Keys and adjacent waters.

► **Flying Tiger Line** has expanded its transcontinental all-cargo service after acquiring two additional Canadair CL-44 turboprop freighters. The carrier has initiated a direct overnight flight from San Francisco to New York and daily nonstop service, eastbound and westbound between Los Angeles and New York.

Profit of $488,000 is reported by Seaboard World Airways for the first 10 months of the year, compared with a $3,886,000 loss in the comparable period of 1961. Revenues totaled $18,363,000 as against $16,579,000 in 1961. Nine months earnings for Seaboard this year were $68,000, rather than a $3.1 million loss as reported earlier in AVIATION WEEK (AW Nov. 26, p. 50). Sharp rise in net return is attributed to a $420,000 profit in October.

► **Trans Caribbean Airways** reported gross operating revenues of $8,378,413 for the first nine months of 1962, an increase of 81% over the figure for the same 1961 period. The carrier credited the increase to conversion to jet equipment.

AIRLINE OBSERVER

► Military Air Transport Service commercial airline contracts with 16 carriers reached an all-time high of $132.2 million during the past four months. Short-notice contracts for individual seats and planeload lots during that period nearly equalled the $137 million awarded the airlines for all of Fiscal 1962. The sudden increase was due to extraordinary military airlift requirements arising from such situations as the Cuban crisis and the arms airlift to India. Pan American World Airways had the largest contract, valued at $29.1 million, and Flying Tiger was second with $24.8 million.

► **British Overseas Airways Corp. load factor for the first half of this year is 2½% below the same 1961 period. Decrease is primarily on BOAC's eastern routes, down 5%, and southern routes, down 10%. Western route load factors are remaining about even with last year, BOAC reports.**

► High-flying birds have caused at least nine airline accidents in the past 10 years, according to Civil Aeronautics Board records, including the 1960 crash of an Eastern Air Lines Electra on takeoff from Boston. Ducks, seagulls and starlings caused most of the accidents. Migrating geese at altitudes of 4,500 ft. struck a North Central Airlines Convair 340 over Pierre, S. D. last October and a United DC-6 over Elgin, Ill., in March of last year.

► **No-shows are beginning to plague the Soviet airline Aeroflot, according to Sovetskaya Rossiya, a leading Russian newspaper. The publication in criticizing Moscow's Sheremetyevo Airport management, claimed that aircraft are being dispatched with empty seats after travelers have been told all space has been sold. Airport officials admit that "planes frequently fly empty," but explain that "there is a lack of coordination between city ticket offices and the airport reservations center. Seats are reserved but then aren't occupied."**

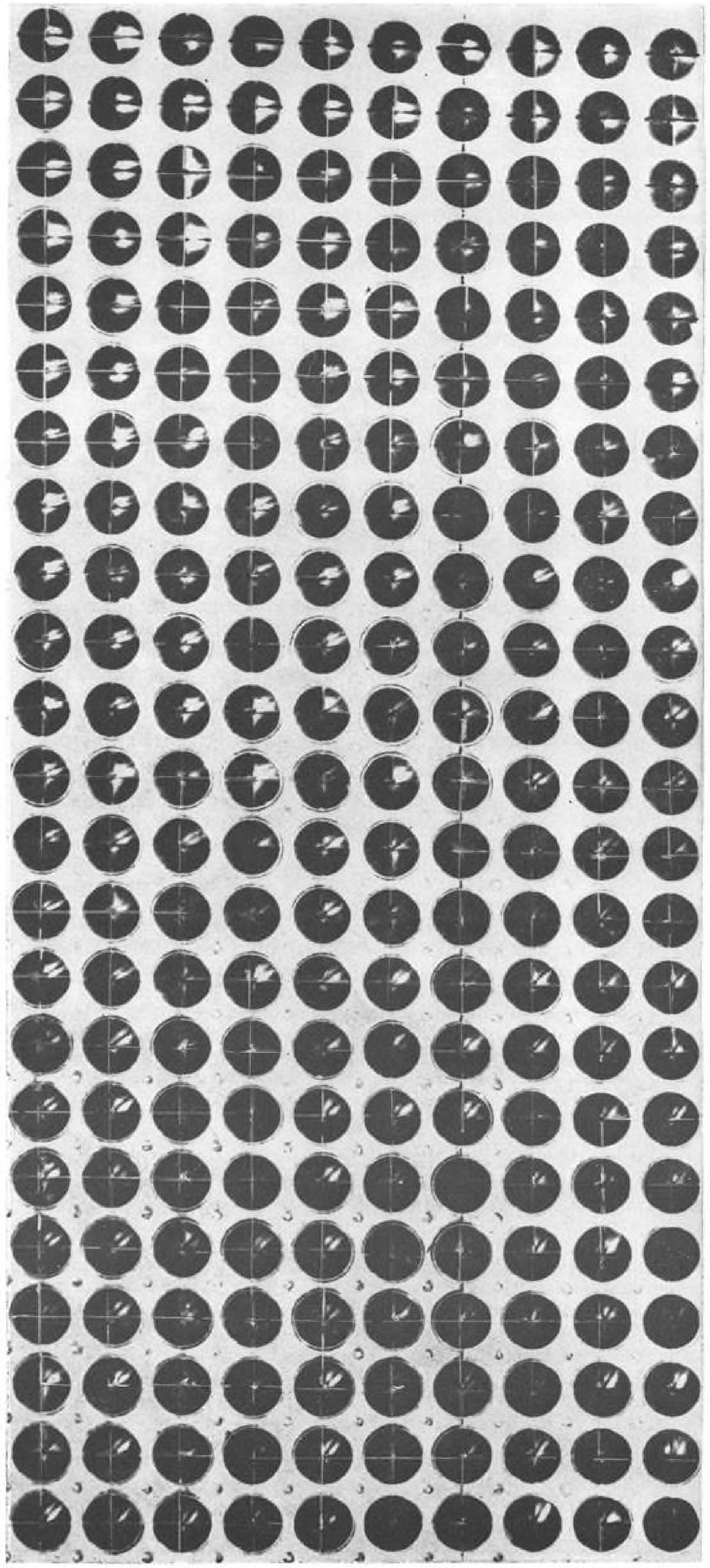
► Air Afrique, the airline combine of 11 former French possessions, has voted to purchase two DC-8 turbojets as part of a plan to expand its operations. A recent meeting of the airline's stockholders also discussed plans to reduce French participation in the company and eventual service into the U. S.

► **Improved thrust and fuel economy are being reported by operators of Convair 880 aircraft equipped with General Electric's modified CJ805-3A powerplants. Basic thrust rating of 11,200 lb. remains unchanged, but availability of design power and fuel consumption is assured by widening of stator spacing to admit more air, adjustment of fuel control to compensate for greater volume of air compressed, and a reduction of area of each sound suppressor lobe to between 35 and 35.2 sq. in. Engine power settings on the modified engine are now set by exhaust pressure ratio, rather than by revolutions per minute as on the unmodified CJ805-3.**

► VASP, the Brazilian airline, has purchased 10 Viscount 701 turboprop aircraft from British European Airways. Four other Viscounts have been sold to Cambrian Airways, a British independent partially owned by BEA.

► **British European Airways has asked the British Ministry of Aviation for permission to move its summer and winter London Viscount schedules from Gatwick airport to London-Heathrow on grounds that passengers object to the surface travel time to Gatwick. The Ministry is expected to reject the request to avoid traffic saturation at Heathrow.**

► Trans World Airlines will make the first commercial test of a Lockheed data recording system on one of its Boeing 707-120s. The device, which already has been evaluated on military aircraft, monitors aircraft performance in flight and makes a magnetic tape recording designed to pinpoint malfunctions.



ACCENT ON VALUE

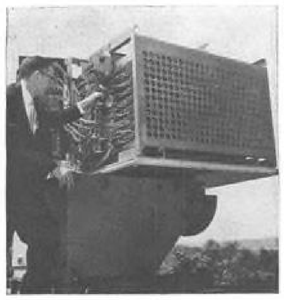
..... NEWS OF DEFENSE TECHNOLOGIES

RADAR

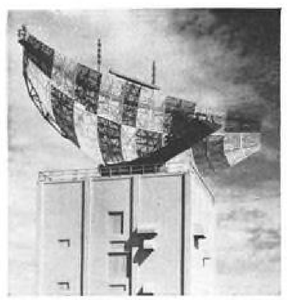
Sweeping advances in aerospace technology have caused radar targets to vary widely in size, range and altitude, speed and acceleration. Resulting radar design problems are further intensified by electronic jamming and the need for decoy discrimination, creating a continuous demand for increased capabilties.

General Electric has anticipated this challenge with steady improvements in transmitter and receiver performance, mechanical design, and signal processing. Low-noise parametric amplifiers and masers extend effective range while new pulse compression techniques improve target range discrimination. Antenna structures are built to increasingly closer tolerances for reduced side-lobes and precise angular positioning. Coherent integrators provide both velocity resolution and high signal-to-noise ratios, combining with side-lobe cancellers to diminish the effect of radio interference.

Such developments are reflected in a broad range of radars produced by General Electric and installed in virtually every major country in the Free World—radars that include the FPS-50 surveillance giant for the Air Force's BMEWS, the High Power Acquisition Radar (HIPAR) for the Army's Improved Nike-Hercules System, and the Marine Corps' high-mobility TPQ-10.



PHASED PLANAR ARRAY forms multiple scanning radar beams. G.E.'s even newer, more efficient MOSAR array scans the sky millions of times each second to generate at low cost as many independently steered receive beams as needed.



GROUNDBASED FPS-24 search radar is one of the largest and most modern radars in the Semi-Automatic Ground Environment (SAGE) air defense network. Designed for the U.S. Air Force, it will detect supersonic high-altitude aircraft at long range.



STABILIZED ANTENNA for the U.S. Navy's SPS-30 shipboard radar is actuated in roll and pitch by a unique dual ball-screw drive. The precision, electro-formed organ-pipe scanner permits long-range, high-accuracy search and height-finding capability.



OPTICAL PROCESSOR uses oil-film storage to analyze high-resolution radar returns in real time. Over one million integrations can be performed simultaneously by this processor to determine range, velocity, and acceleration for multiple targets.



AIRBORNE APS-96 will afford increased detection capabilities for fleet early warning as well as contribute to the control of intercept aircraft. This advanced radar is currently under flight test aboard the U.S. Navy Grumman-built Hawkeye.

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SYSTEMS PROGRESS



CHECKING THE POLARIS MISSILE

Designed to process data from 180 channels at one time, a CSC system is now in use at the Sunnyvale, California, thermostructural test facilities of the Lockheed Missiles & Space Division.

Measurements of strain and temperature, recorded at hundreds of points on a Polaris missile being tested, are changed to proportional analog voltages by transducers and processed by the system for digital recording on magnetic tape compatible for direct entry into an IBM 7090 computer. In addition to magnetic-tape recording, output is available in the form of IBM punched cards and X-Y plots. Monitoring is by bar graphs on a 17-inch oscilloscope and oscillograph recordings.

This Thermostructure Recording and Monitoring System is one of hundreds produced by CSC for data acquisition, reduction, conversion, presentation and analysis. In addition to analog and digital data handling systems, CSC designs, develops and manufactures systems for industrial control, electro-optical, pneumatic and hydraulic applications.

For details of CSC accomplishments in your area of interest, call your local engineering representative or write

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Collision With Swan May Have Caused United Viscount Crash

Investigators speculated last week that collision with a swan may have caused the Nov. 23 crash of a United Air Lines Viscount 10 mi. southwest of Baltimore, killing the 17 persons aboard.

Remains of a whistling swan, a high flying bird that weighs up to 14 lb., were found lodged in the left horizontal stabilizer of the aircraft. Similar damage was disclosed on the right stabilizer, leading Civil Aeronautics Board investigators to theorize that one or more birds struck the tail assembly.

Loss of control could have come from either damage to the control system, or an aerodynamic flutter that broke up the tail surfaces, investigators said.

Flight was en route from Newark, N. J., to Albany, Ga., with a scheduled stop at Washington. The pilot acknowledged preliminary instructions from Washington approach controllers, including a notation that other pilots had reported birds flying in the area at altitudes up to 6,000 ft.

Subsequent controller instructions directing a course change were not answered. Witnesses told of seeing the aircraft dive to earth at a sharp angle. There was no evidence of an inflight explosion, investigators said.

Aircraft's flight recorder was recovered and was being examined by the Bureau of Standards, seeking speed, altitude, heading and gravitational forces up to moment of ground impact.

Accident was the fourth in less than a week's time involving commercial transports, others occurring in Peru, Brazil and France.

Varig Airlines Boeing 707 crashed near Lima, Peru, Tuesday while en route from Porto Alegre, Brazil, to Los Angeles, with stops at Lima, Bogota, Panama and Mexico City. Ninety-seven persons aboard died.

Flight had crossed the Andes and made its last report to the Lima tower while at 12,000 ft., a short time before its scheduled 3:30 a.m. arrival. Early reports said the pilot also reported "This is an emergency." However, Varig officials said later in New York that no such report was made, and the emergency situation was declared at the airport only after the plane did not arrive and radio calls were unanswered.

Demolished aircraft was found on a bare hilltop 2,400-ft. high and 15 mi. south of Lima. Weather conditions at the airport were 1,800-ft. ceiling and eight mile visibility.

Wreckage was scattered over a 200-sq.-yd. area. Varig spokesmen said the flight recorder, located in a main gear wheel well, had still not been recovered by the day after the crash. Only a portion of vertical stabilizer was intact.

Civil Aeronautics Board sent Charles F. Collar, chief of the Southeastern CAB Region headquartered at Miami, to the scene. CAB interest stemming from the aircraft being built by a U. S. firm. Representatives of the Boeing Co. were assisting in the investigation.

Another South American crash occurred Monday when a VASP twin-engine airliner collided with a light plane over Sao Paulo state in Brazil, killing 23 persons.

In France, a Malev Hungarian airline Il-18 crashed Nov. 23 while making an instrument approach into Orly airport, Paris. Ceiling was roughly 150 ft. at the time, and the pilot of the Russian-built four-engine turboprop aircraft reportedly radioed, while on final approach, that he had doubts about landing conditions.

Orly radar technician warned the pilot that he was too low on approach, and the aircraft blip disappeared from the radar screen two minutes later. Aircraft struck the ground five miles from the runway, killing 21 persons aboard.

Joint Franco-Hungarian investigation team has begun an inquiry.

Supersonic Transport Decision Is Due Soon

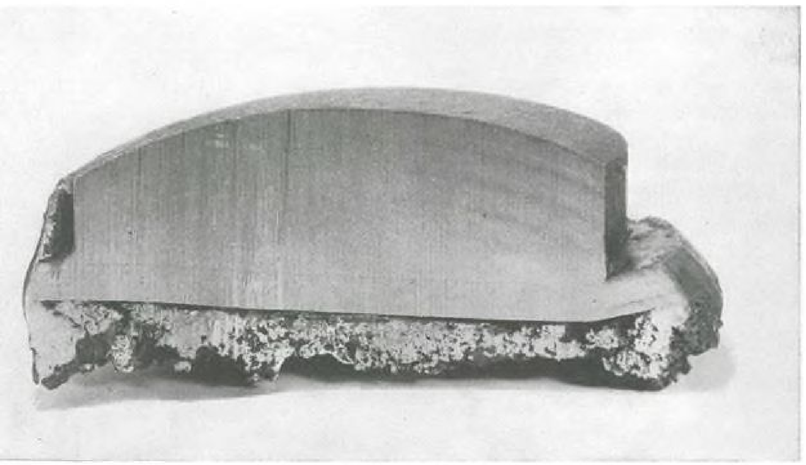
Washington — Federal Aviation Agency will submit its recommendations for a supersonic transport development program to the White House by the end of this month.

Administrator N. E. Halaby said that a firm decision on the design Mach number has not been made, but that he favors development of a steel and titanium combination airframe for an aircraft capable of flying at 2,000 mph.

Halaby indicated he may recommend a Mach 3 aircraft, instead of a Mach 2 design now being worked out by the British and French (see p. 41), in his recent statement that "we may not be the first, but we want to have the best." He estimated it will take at least 10 years to build the supersonic transport.

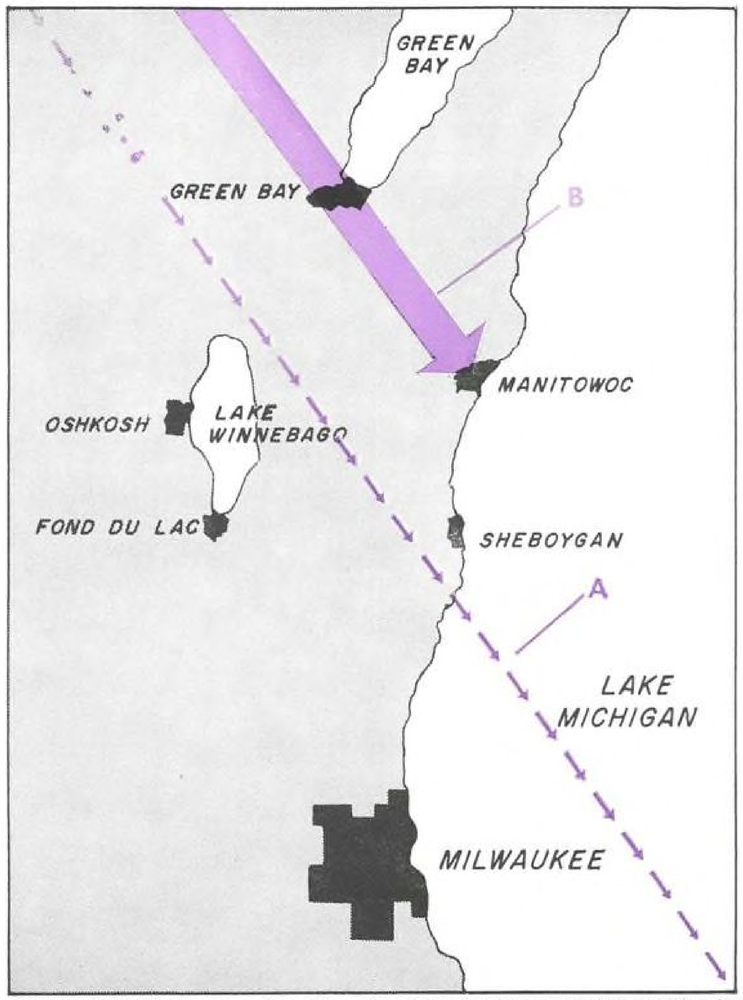
FAA has already spent $33 million on supersonic transport research, and Halaby estimates development costs will exceed $700 million before the first model can be sold, at an expected price of $15 million. He added that he will probably recommended that Congress appropriate the full development cost, since U. S. has subsidized civilian transportation projects, such as S. S. United States and nuclear ship Savannah.







SECTIONED FRAGMENT of Sputnik 4 satellite shows shape of ablated steel on underside (left), embedded nut and flanged bolt (right).



PATH A SHOWS observed track and formation of the six fragments tracked by Milwaukee observer. Path B indicates probable track of fragments recovered in Manitowoc.

U. S. Analysis

By Warren C. Wetmore

Cambridge, Mass. – Metallurgical analysis of fragments from the Soviet Sputnik 4 satellite which fell in Manitowoc, Wis., Sept. 5 revealed that they were composed of a conventional, medium-carbon steel, according to officials at the Smithsonian Astrophysical Observatory here.

Sputnik 4—said by the Soviet Union to be a test of the Russian life-support system later incorporated into the manned Vostok spacecraft—was launched on May 15, 1960, and designated 1960 Epsilon (AW May 23, 1960, p. 27).

Satellite, according to Soviet reports, carried a dummy cosmonaut in a pressurized cabin. It was programed for a controlled re-entry.

When the control system failed and the retrorockets fired in the wrong direction, the spacecraft was boosted into a higher orbit (AW May 30, 1960, p. 30). Following this error, the vehicle disintegrated into several pieces, the largest of which, thought to be the cabin, was designated 1960 Epsilon 1 (AW June 6, 1960, p. 30) and re-entered the earth's atmosphere on Sept. 5.

Recovered objects include heavily-ablated metallic spherules resembling ferrous meteorites, with diameters ranging from $\frac{1}{8}$ to $\frac{3}{8}$ in., and a disk-shaped object with a diameter of 7.9 in. and a thickness of 3.2 in. The latter, which weighed 20.9 lb. before a section was removed for analysis, has two distinct parts (see photos)—a short, solid cylinder with a diameter of 5.9 in. and a circular plate 0.39 in. thick.

The two are welded together around the perimeter of the cylinder, except for a 30-deg. arc. The plate appears to have been machined to a depth of approximately $\frac{1}{8}$ in. to accommodate the cylinder, and the interface between the two is extremely smooth. A metallurgist who examined the object at Massachusetts Institute of Technology termed the weld "very good."

Rounded top surface of the cylinder and the plate show evidence of ablation, although the cylinder has retained its sharp upper perimeter. The shoulder formed by the cylinder and plate is partially filled with resolidified steel, the appearance of which suggests that it flowed from the top surface during re-entry.

Irregular mass of ablated steel adheres to the underside of the plate and is bubbled and porous in appearance, as might be expected from the resolidification of molten steel. Composition of this part is identical to that of the unablated portion of the disk, except for a decrease in the concentration of some of the more volatile trace elements.

Over-all appearance of the disk lends credence to the Smithsonian supposition that it re-entered the atmosphere with the rounded cylinder foremost, but an MIT professor of aeronautics and astronautics said that in its present shape the object probably would be aerodynamically unstable, causing it to tumble during re-entry.

When the disk was sectioned for scientific analysis, a bolt was revealed embedded in the resolidified deposit on the bottom of the plate. The bolt—one end of which is threaded into a flanged nut—has metric-system dimensions, with 6-mm.-dia. and one thread per millimeter.





EDGE OF STEEL PLATE contains counter-bored bolt hole (left). Full view of fragment (right) indicates disk-like configuration.

Reveals Sputnik 4 Fabrication Techniques

The bolt has not undergone analysis, as was suggested by an MIT metallurgist, nor is there any plan to search for other objects that might be concealed by the ablated steel.

As yet, no positive identification has been made of the precise function of the disk-shaped object in the satellite. Dr. Charles A. Lundquist, Smithsonian assistant director-science, said that it may have been ballast or a part of the heat sink in the re-entry shield, which would explain its unusual massiveness.

Several Soviet scientists, including Mme. Alla Massavich, head of the Russian program for monitoring satellite re-entry, have been approached for an explanation of the disk, but to date none has been offered.



BEAD OF WELD joins steel cylinder and plate. Note shape and texture of resolidified steel which ablated from top of cylinder to fill part of shoulder.

Proof that the object had been above the atmosphere for a considerable length of time and was not a hoax was obtained by means of radiological tests conducted at Los Alamos Scientific Laboratory. A radioactive isotope, Argon 37, was detected in the test sample. This isotope was formed by bombardment with galactic cosmic rays and trapped particles in the Van Allen belts.

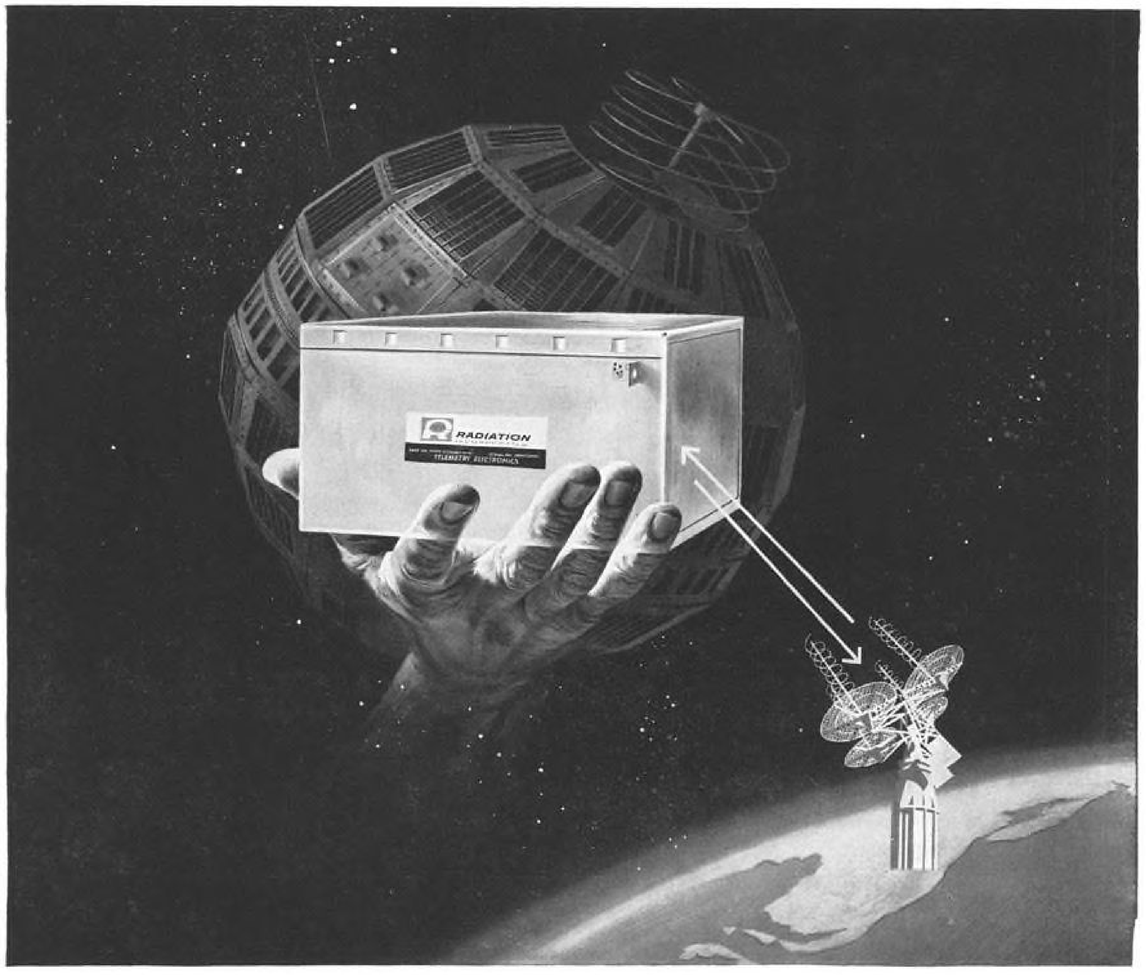
Test for tritium, a triple-heavy hydrogen isotope, was negative, but this was attributed to the fact that the substance probably flowed away during re-entry into the atmosphere.

Smithsonian officials ascribed the successful sequence of events—visual observation of re-entry, recovery of fragments and scientific investigation—to a combination of luck and enthusiastic support by members of their Moonwatch teams, field investigation personnel and scientific staff.

Moonwatch teams, which were organized in 1958 for the purpose of monitoring satellite re-entries, were alerted throughout the world following prediction by the North American Air Defense Command's Space Detection and Tracking System (Spadats) that Sputnik 4 would re-enter the atmosphere on or about Sept. 6. Re-entry ephemeris computed by Moonwatch headquarters indicated that the satellite would pass near zenith in the Milwaukee area during its final orbit at 4:58 a.m. local time.

Three trained observers on the Milwaukee team, equipped with theodolites, were waiting for the satellite. Two were stationed at the Milwaukee Observatory on the outskirts of the city, while a third was about 20 mi. away in downtown Milwaukee.

At 4:49 the downtown observer no-



AT RADIATION, IDEAS BECOME REALITY

Example: Telstar's 8 lb/112 channel PCM telemetry system

Bell System's Telstar's continuing success—in a space environment that intersects the Van Allen Belt—not only proves the feasibility of world satellite communications, but also the reliability of a new transmission technique. PCM telemetry has now won its spurs as the most advanced method of checking satellite performance.

Telstar's PCM system, built by Radiation-Melbourne for Bell Telephone Laboratories, weighs only 8 pounds, requires less than 450 milliwatts of power . . . yet provides 112 information channels with highest accuracy available today. Channel allocations: 16-voltage; 40-temperature; 9-current; 27-radiation experiments; 2-pressure; 10-solar aspect; and 8-relay status.

First analysis of Telstar's telemetry data—received by Radiation-designed and built command-tracking antennas—indicates the canister pressure is still above 5 lb./sq. in., showing that the canister has not been punctured; average temperature inside of 75°F; average skin temperature of 32°F; solar cells delivering 0.5 amp at 13.5 W; and a radiation-induced decrease in current output of 10% (±2) with 20 mils sapphire shielded semiconductors and 5% (±2) with 25 or 30 mils sapphire shielding.

This important new telemetry technique is only one of many advanced projects on which Radiation scientists are now working. If you like to explore advanced concepts, you'll find a stimulating and challenging environment at Radiation . . . where ideas become reality. Send your resume or write for more information. Personnel Director, Dept AW-12R, Radiation-Melbourne, Melbourne, Florida.

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ticed an incandescent star-like object low in the northwest sky.

The object appeared to separate into a number of pieces, and by the time the first fix—azimuth 340 deg., altitude 8 deg. above the horizon—was made, six separate pieces, glowing with an estimated astronomical magnitude of −6, were discernible moving rapidly southeast in a cruciform pattern with the largest body leading the formation.

Largest Object

Largest object was at an azimuth of 0 deg. (true north) and altitude of 12 deg. at 4:49:47 local time, as recorded by stopwatch and later compared with the National Bureau of Standards WWV radio time signal. By this time, only the leading object was visible. It was tracked out over Lake Michigan to azimuth 16 deg. and altitude 11 deg., where it finally became invisible.

Two team members at the observatory witnessed the event and corroborated the report of the downtown observer, although they were unable to obtain theodolite fixes.

Several persons along the re-entry path in northern Wisconsin observed the passage of the fragments, which ranged in number from five to more than 25 in the various accounts. While part of the discrepancy in the reported number of pieces can be attributed to confusion, it is likely that the smaller fragments dissipated their heat more rapidly than the larger ones during the passage through the lower regions of the atmosphere, so that the visible number of incandescent fragments decreased along the re-entry path.

Many witnesses believed they had observed the disintegration of the satellite, but their accounts generally placed this event at a low elevation, which indicates that their observations probably were affected by parallax.

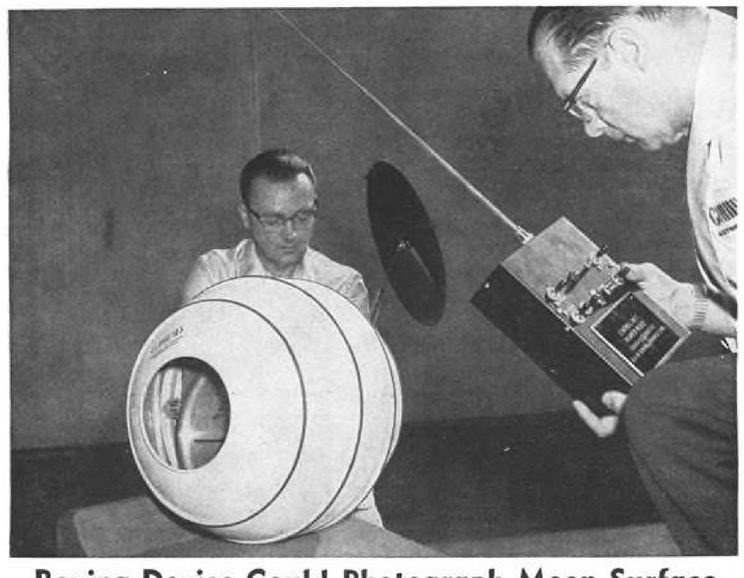
However, one Canadian reported that he saw the vehicle break up near zenith, which increases the likelihood that he witnessed the actual disintegration. There were several reports of a thunder-like noise in the direction from which the fragments came after they had passed; this was probably due to the shock wave created by hypersonic re-entry.

Impact point of the disk-shaped fragment was at the north side of an intersection in Manitowoc. Noise of the impact was heard by a woman asleep in a nearby house, but she could not see the fragments because of the darkness.

Impact in Street

Apparently the fragment had been decelerated to low subsonic velocity at the time of impact, for the impression it made in the street at the time of impact was only about three inches deep.

Two policemen patrolling the area at 5.30 a.m. noticed the fragment lying



Roving Device Could Photograph Moon Surface

Ball-like vehicle, designated "Roamer," has been developed by General Dynamics/Astronautics to roll over lunar surface taking television photos and executing other radio commands from earth. Device propels itself by displacing center of gravity or utilizing flywheel-clutch system that is powered by the sun. The vehicle could also analyze samples of the lunar surface and report its findings back to earth.

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GENERAL PRECISION BUILDS BOTH FACES OF A SPACE-INFORMATION SYSTEM

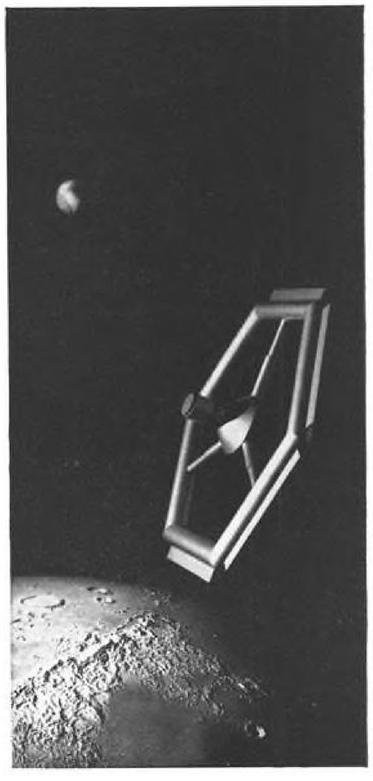


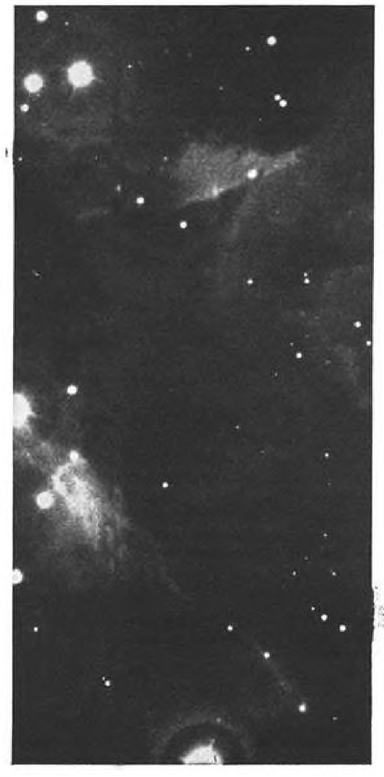


ON-BOARD SYSTEMS—A Librascope computer, the first designed to guide an exploratory instrument package to a soft landing on the moon, will be carried aloft inside NASA's Atlas-Centaur spacecraft. One of the smallest and lightest general-purpose digital computers available for today's space needs.



Like the ancient Roman deity Janus, Guardian of the Gates, a space-information system has two faces. □ One is the on-board subsystem that gathers space data and performs preliminary processing. The other is the ground-based subsystem that completes the processing and displays the desired information after transmission from the spacecraft. □ Only quarter-century-mature Librascope Division General Precision has so thoroughly demonstrated competence in producing *both* on-board space-vehicle computers and large-scale ground-based data processing systems,





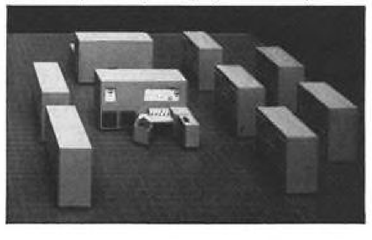
under military and space contracts, and in integrating complex information systems. □ Other divisions of General Precision aid in furnishing the depth of experience in space-environment sensing, astro-navigation, vehicle- and ground-systems displays, and simulation-system management. □ Send for the story of Librascope's 25 years in information systems and latest work on advanced computing techniques and equipment.

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G2-924



GROUND-BASED SYSTEMS—From 1963 on, U.S. global strategy will be supported by this Librascope multiple-computer system, a key part of USAF's 473L command-and-control system to be installed in the Pentagon. One of the many new large-scale Librascope computing system complexes.





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SAC-167	5400-5800	100	1.25	8	47	37.5
SAX-151	9000-9500	500	1.0	10	40	30
SAX-191	8830-9200	370	1.25	6	50	37.5

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For details on Sperry's broadband, high average power, phase linear, high pulse energy megawatt klystrons, write Section 172. Information about a wide selection of classified Sperry microwave tubes is available with proper security clearance and "need to know." Sperry is represented nationally by Cain & Co.

SPERRY ELECTRONIC TUBE DIVISION

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in the middle of the road, but in the faint early-morning light they mistook it for cardboard and ignored it. When they passed it again at 7 a.m. it appeared to be metallic, and they stopped and moved it to the side of the road, after finding that it was too hot to handle except for brief periods of time.

The unidentified fragment remained at the edge of the road until the afternoon, when police, acting on reports that there might be pieces of a satellite in the vicinity of Manitowoc, retrieved the object and carried it to police headquarters.

From there the object was taken to Milwaukee and flown to Cambridge for positive identification.

Additional Fragments

The search for additional fragments began several days later, when a Smithsonian field representative arrived in Manitowoc. A small piece had been found on a lawn about 125 ft. from the impact point. Further search along the line defined by the main impact point and the point where the smaller fragment was found yielded 15 small spherules on a roof about 20 ft. from the impact point and two small spherule clusters at a distance of about 500 ft. from the main impact.

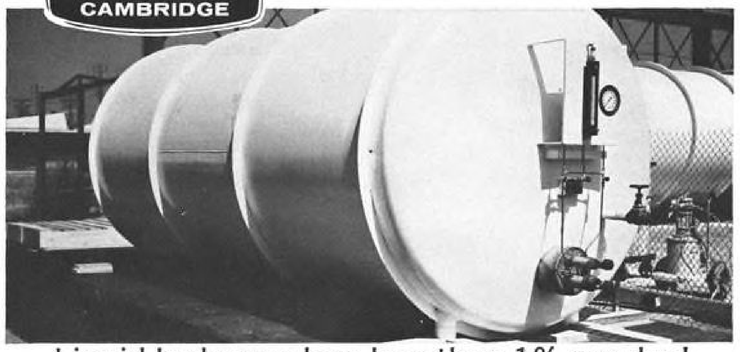
The largest body, seen leading the formation of fragments by the Milwaukee Moonwatch observers, is presumed to have fallen into Lake Michigan, which is less than 2,000 ft. from the impact point. Smithsonian officials



Satellite Spectrometer

First infrared radiation measurements of earth from satellite, to obtain data for Midas early warning satellite sensors, were made using this 6-lb. interferometer-type spectrometer by Air Force Cambridge Research Laboratories (AW Nov. 19, p. 23). Instrument, made by Block Associates, made measurements over band of 1.8 to 16 microns, in series of one-second exposures each covering diameter of about 50 mi. at the earth. Device has sensitivity which is 10,000 times that of conventional spectrometer, according to Block Associates. AFCRL plans to use device to make similar measurements in the ultraviolet and visible part of spectrum from a satelliite.

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PROBLEMATICAL RECREATIONS 147



A set of items sells for $1122.00, and another set of like items sells for $2210.00. What is the cost of each item?

—*Contributed*

Note to the practical minded: The Aero Automated Coordinatograph can rapidly repay its cost in direct labor and time savings. This solid state X and Y plotter is designed for automatically programmed plotting with .0025" accuracy. The Coordinatograph is speedy, too. Plots up to three inches per second, making it the fastest digital-type plotting device on the market. Our Aero Service Corporation Division will be delighted to demonstrate. For information write to them at 210 E. Courtland St., Philadelphia 20, Pennsylvania.

ANSWER TO LAST WEEK'S PROBLEM: No. Removing opposite corners leaves 32 squares of one color and 30 squares of another color. However, each domino covers one square of each color.

LITTON INDUSTRIES, INC.
Beverly Hills, California

Correction: Answer to #143 is 66⅔ yds. Sorry!





DOUBLE JEOPARDY: now the Navy must protect both targets against enemy subs

Today the U.S. Navy's anti-submarine warfare mission is more complex than ever before. Our shipping faces the threat of more than 500 potentially hostile conventional submarines (remember what enemy subs did to Allied shipping in World War II). And now our cities, even those far inland, face real danger from deep-running nuclear-powered subs that can launch long-range ballistic missiles from the ocean depths.

To help the Navy find better ways to detect, track, and destroy these undersea marauders, Lockheed-California scientists are studying underwater sound propagation and scattering, underwater electronics, hydrodynamics, underwater biological sounds, and scores of other subjects. An underwater tracking system, designed and built by Lockheed, measures distance and speed of vessels crossing lines of contact.

Also from Lockheed-California Company comes the Navy's new P3V-1 Orion sub-hunter-killer—the deadliest combination of men, electronics, and armament ever pitted against submarines.

Lockheed-California's Anti-Submarine Warfare & Ocean Systems Organization coordinates a corporation-wide effort that runs broad and deep—from the depths to the surface to the aerospace above.

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Reliability facilities like this test each AAF Minuteman component

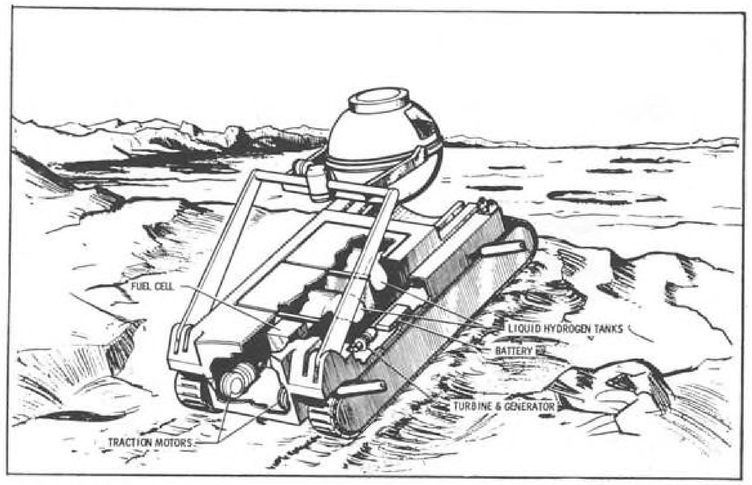
AAF Minuteman environmental system gets

328 hour warm-up for a long and lonely life

Deeply buried in isolated launch silos, the Minuteman missiles will strike back instantly, even under direct attack. This is well known. But how can each missile, with its sensitive guidance elements, remain always operational and ready? ■ Part of the answer is the Minuteman's environmental support system—prime contractor, American Air Filter Company Defense Group. ■ A system of heating, ventilating, air filtering, refrigeration, and humidity control may seem commonplace. Yet few firms even felt qualified to bid on this Minuteman assignment. The technical problems were staggering. The reliability of hundreds of missiles was at stake. Also the ability of remote control personnel to survive and retaliate. ■ AAF's capability for such a task had evolved out of four decades of pioneer engineering and large-scale production for military and civilian industry. ■ But even AAF engineers were surprised at the speed with which Minuteman's urgent schedule carried them beyond previous limits of the art of environmental control. ■ Component after component was redesigned, as AAF moved inevitably away from the idea of equipment *serving* the weapon—to create a necessarily *integral part* of the weapons system itself. ■ In completing its part of the system on schedule, AAF's Defense Group utilized its own production plants, plus resources of our Air Filter Division, Temper Air Group (Herman Nelson), Fiber Glass Group (Amer-glas), and other AAF divisions and subsidiaries. This corporate team offers scope, flexibility, and effective systems management capability. ■ *If environmental control is important to your project, send for AAF Bulletin D-164. Write Defense Products Group, American Air Filter Company, Inc., 310 Third Street, Rock Island, Illinois.*

AAF **American Air Filter**

BETTER AIR IS OUR BUSINESS



Moon Vehicle Power System Uses Hydrogen, Lithium

Artist's concept indicates key elements in new power system for moon vehicles, designed by Martin Marietta's Space Systems Division, Baltimore, Md. Hydrogen gas, produced by heating liquid hydrogen, drives turbine-generator to furnish electrical power for traction motors. Hydrogen then would be introduced into fuel cell to produce additional electricity for vehicle. Hydrogen combines with lithium in cell to produce lithium hydride for storage aboard the vehicle. Nuclear reactor refueling station could break down lithium hydride into components and process them for re-use by the vehicle.

said that the Navy is considering the use of divers for search and recovery operations.

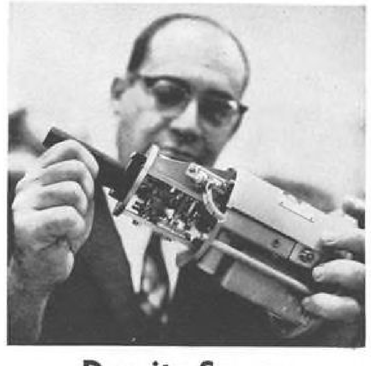
An attempt was made to return the fragment to the Soviet Union during a session of the United Nations Committee on Peaceful Uses of Outer Space on Sept. 14. P. D. Morozov, the Soviet delegate to the committee, refused to accept the object for his government, and labeled the move "a circus trick" intended to strengthen the U. S. position in the committee, which was working on rules for liability for injury or damage resulting from objects re-entering from orbit.

To date the Soviets have neither confirmed nor denied that the fragments were part of a Soviet satellite, Smithsonian officials said, and the incident received no coverage in the Soviet press.

However, it is likely that members of the Soviet scientific community are aware of it.

In addition to those mentioned, agencies and institutions which have examined the fragments include the National Aeronautics and Space Administration, Brookhaven National Laboratory, the Air Force Cambridge Research Laboratories, Department of Chemistry at the Carnegie Institute of Technology, and the Central Intelligence Agency.

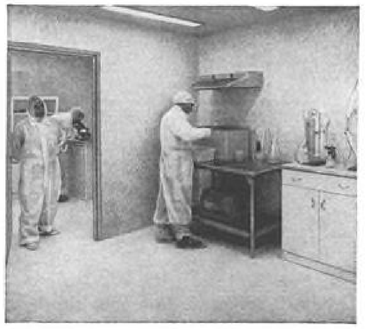
The final disposition of the disk-shaped fragment is undetermined at the present time, Smithsonian officials said, although the Soviets may claim it any time. Scientific investigations are continuing, and the fragment will be scientifically useful for several years because of the long half-lives of several of the radioactive isotopes, such as Manganese 54. Some Congressional interest has been shown in the return of the fragment to the Manitowoc museum adjacent to the impact point. Fragment is currently in the possession of the Smithsonian laboratories here.



Density Sensor

Ionospheric density sensor, developed by Geophysics Corp. of America under a National Aeronautics and Space Administration contract, weighs only 6 lb. and is designed to be a hitch-hiker on board a variety of rockets. Self-contained, it is programed and calibrated by a d.c. motor with six gears. Tip on the left connects to an electrode on the nose of the rocket which measures currents during flight through the ionosphere.

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STARLIGHT!

NO. 6 IN A SERIES OF SCIENCE-FICTION ORIGINALS CREATED EXPRESSLY FOR HOFFMAN ELECTRONICS CORPORATION



By Isaac Asimov

Arthur Trent heard them quite clearly. The tense, angry words shot out of his receiver.

"Trent! You can't get away. We will intersect your orbit in two hours and if you try to resist we will blow you out of space."

Trent smiled and said nothing. He had no weapons and no need to fight. In far less than two hours, the ship would make its Jump through hyperspace and they would never find him. He would have with him nearly a kilogram of Krillium, enough for the construction of the brain-paths of thousands of robots and worth some ten million credits on any world in the Galaxy—and no questions asked.

Old Brennmeyer had planned the whole thing. He had planned it for thirty years and more. It had been his life's work.

"It's the getaway, young man," he had said. "That's why I need you. You can lift a ship off the ground and out into space. I can't."

"Getting it into space is no good, Mr. Brennmeyer," Trent said, "we'll be caught in half a day."

"Not," said Brennmeyer, craftily, "if we make the Jump; not if we flash through hyperspace and end up light-years away."

"It would take half a day to plot the Jump and even if we could take the time, the police would alert all stellar systems."

"No, Trent, no." The old man's hand fell on his, clutching it in trembling excitement. "Not *all* stellar systems; only the dozen in our neighborhood. The Galaxy is big and the colonists of the last fifty thousand years have lost touch with each other."

He talked avidly, painting the picture. The Galaxy now was like the surface of man's original planet (Earth, they had called it) in prehistoric times. Man had been scattered over all the continents but each group had known only the area immediately surrounding itself.

"If we make the Jump at random," Brennmeyer said, "we would be anywhere, even fifty thousand light-years away, and there would be no more chance of finding us than of finding a pebble in a meteor swarm."

Trent shook his head, "And we don't find ourselves, either. We wouldn't have the foggiest way of getting to an inhabited planet."

Brennmeyer's quick-moving eyes inspected the surroundings. No one was near him, but his voice sank to a whisper anyway. "I've spent thirty years collecting data on every habitable planet in the Galaxy. I've searched all the old records. I've travelled thousand of light-years, farther than any space-pilot. And the location of every habitable planet is now in the memory store of the best computer in the world."

Trent lifted his eyebrows politely.

Brennmeyer said, "I design computers and I have the best.

"I've also plotted the exact location of every luminous star in the Galaxy, every star of spectral class F, B, A and O, and put that into the memory store. Once we've made the Jump the computer will scan the heavens spectroscopically and compare the results with the map of the Galaxy it contains. Once it finds the proper match, and sooner or later it will, the ship is located in space and it is then automatically guided through a second Jump to the neighborhood of the nearest inhabited planet."

"Sounds too complicated."

"It can't miss. All these years I've worked on it and it can't miss. I'll have ten years left yet to be a millionaire. But you're young; you'll be a millionaire much longer."

"When you Jump at random, you can end inside a star."

"Not one chance in a hundred trillion, Trent. We might also land so far from any luminous star that the computer can't find anything to match up against its program. We might find we've jumped only a light year or two and the police are still on our trail. The chances of that are smaller still. If you want to worry, worry that you might die of a heart attack at the moment of take-off. The chances for that are much higher."

"*You* might, Mr. Brennmeyer. You're older."

The old man shrugged. "I don't count. The computer will do everything automatically."

Trent nodded and remembered that. One midnight, when the ship was ready and Brennmeyer arrived with the Krillium in a briefcase (he had no difficulty for he was a greatly trusted man) Trent took the briefcase with one hand while his other moved quickly and surely.

A knife was still the best, just as quick as a molecular depolarizer, just as fatal, and much more quiet. Trent left the knife there with the body, complete with fingerprints. What was the difference? They wouldn't get him.

Deep in space now, with the police-cruisers in pursuit, he felt the gathering tension that always preceded a Jump. No physiologist could explain it, but every space-wise pilot knew what it felt like.

There was a momentary inside-out feeling as his ship and himself, for one moment of non-space and non-time, became non-matter and non-energy, then reassembled themselves instantaneously in another part of the Galaxy.

Trent smiled. He was still alive. No star was too close and there were thousands that were close enough. The sky was alive with stars and the pattern was so different that he knew the Jump had gone far. Some of those stars had to be spectral class F and better. The computer would have a nice rich pattern to match against its memory. It shouldn't take long.

He leaned back in comfort and watched the bright pattern of starlight move as the ship rotated slowly. A bright star came into view, a really bright one. It didn't seem more than a couple of light-years away and his pilot's sense told him it was a hot one; good and hot. The computer would use that as its base and match the pattern centered about it. Once again, he thought: It shouldn't take long.

But it did. The minutes passed. Then an hour. And still the computer clicked busily and its lights flashed.

Trent frowned. Why didn't it find the pattern? The pattern had to be there. Brennmeyer had showed him his long years of work. He *couldn't* have left out a star or recorded it in the wrong place.

Surely stars were born and died and moved through space while in being, but these changes were slow, slow. In a million years, the patterns that Brennmeyer had recorded couldn't—

A sudden panic clutched at Trent. NO! It *couldn't* be. The chances for it were even smaller than Jumping into a star's interior.

He waited for the bright star to come into view again and, with trembling hands, brought it into telescopic focus. He put in all the magnification he could, and around the bright speck of light was the tell-tale fog of turbulent gases caught, as it were, in mid-flight.

It was a nova!

From dim obscurity, the star had raised itself to bright luminosity,—perhaps only a month ago. It had graduated from a spectral class low enough to be ignored by the computer, to one that would be most certainly taken into account.

But the nova that existed in space didn't exist in the computer's memory store because Brennmeyer had not put it there. It had not existed when Brennmeyer was collecting his data—at least not as a luminous star.

"Don't count it," shrieked Trent. "Ignore it."

But he was shouting at automatic machinery that would match the nova-centered pattern against the Galactic pattern and find it nowhere and continue, nevertheless, to match and match and match for as long as its energy supply held out.

The air supply would run out much sooner. Trent's life would ebb away much sooner.

Helplessly, Trent slumped in his chair, watching the mocking pattern of star light and beginning the long and agonized wait for death.

—If he had only kept the knife.

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HOW SCIENCE FICTION BECOMES SCIENTIFIC FACT



Matching the feat of Trent's stellar navigation computer won't be easy, yet that's just the sort of thing we at Hoffman are working toward daily.

The serious business of military hide-and-seek, for example, is among our specialties—though our customers usually call it reconnaissance, surveillance or electronic warfare.

Lately, we completed a multi-million-dollar job as prime contractor on a major reconnaissance system. This involved leading an eight-company team, including people at Cornell, Stanford and Lockheed, to successful delivery of the prototype systems. It's been our recent privilege to develop advanced reconnaissance systems for all three branches of the Armed Forces.

Now our experts in this field have turned their minds toward similar systems in space—conceiving new ways to play hide-and-seek with unfriendly satellites and manned spacecraft.

No less spectacular than the navigation feat in "Starlight," when viewed as current accomplishment, is the performance of Hoffman TACAN in guiding an Air Force B-58 on its record-setting (1044.3 mph average) coast-to-coast round trip at altitudes to 50,000 ft. This, one of the more than 20,000 such airborne systems we've made in recent years, interrogated 64 VORTAC stations in the process of keeping this high-performance aircraft on course toward its record.

With Hoffman TACAN or new DME, any size military aircraft—from helicopters up through the latest Mach 3 bombers—can utilize VORTAC facilities to navigate with pin-point accuracy. Bearing and distance information provides running fix of aircraft's position.

Less down to earth: the minds of our men at Hoffman Science Center, high on a hill overlooking Santa Barbara, They are hard at work striving toward such things as a solar cell power system which would serve our country's first men on the moon, as well on developing Laser communications systems that will let these heroes report back to less venturesome souls on this planet. Real progress is being made in both areas, and we have every hope of broadening our contributions to this nation's space programs far beyond what we've been proud to provide so far.

Our business, you see, is converting science fiction into scientific fact. We're concentrating our efforts on those things we know most about. These broad areas of military electronics: communications, navigation, reconnaissance, surveillance, semiconductor devices and conversion of solar energy into electric power. If you have a problem that might relate to what we do, call us.

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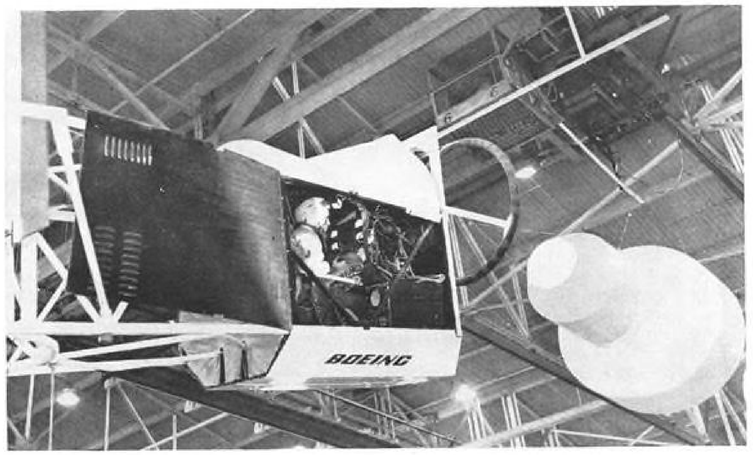
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Space Docking Simulated by Boeing

Simulated planetary exploration vehicle, left, is being guided by pilot to rendezvous with space ship in experiment carried out at the Boeing factory in Seattle. Pilot's controls are connected through an analog computer to an overhead crane which carries the space ship. Space ship's movements, made in response to pilot's control movements, simulate movement of the pilot's vehicle. The pilot's vehicle normally is enclosed. Pilot can control pitch, roll and yaw of his vehicle, according to Boeing.

NASA Soft-Lands Mercury Boilerplate

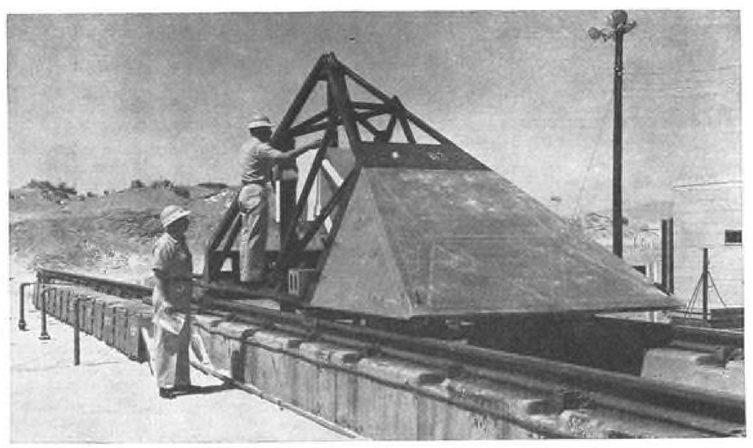
Boilerplate Mercury capsule has been successfully landed at Gary Army Air Field, near San Marcos, Tex., in demonstration of a soft-landing technique being studied by National Aeronautics and Space Administration's Manned Spacecraft Center for Future Manned Space Vehicles.

System under study utilizes a 63-ft.-dia. ring-sail parachute modified by the addition of a flap that permits steering the chute in desired directions and also varying the glide angle.

The Mercury boilerplate also was fitted with a landing retrorocket, providing 3.2g deceleration of approximately one-third second.

In the last of a series of four recent tests—previous three involved water landings—the spacecraft was dropped from a USAF Fairchild C-119 transport at 3,000 ft. over the air field.

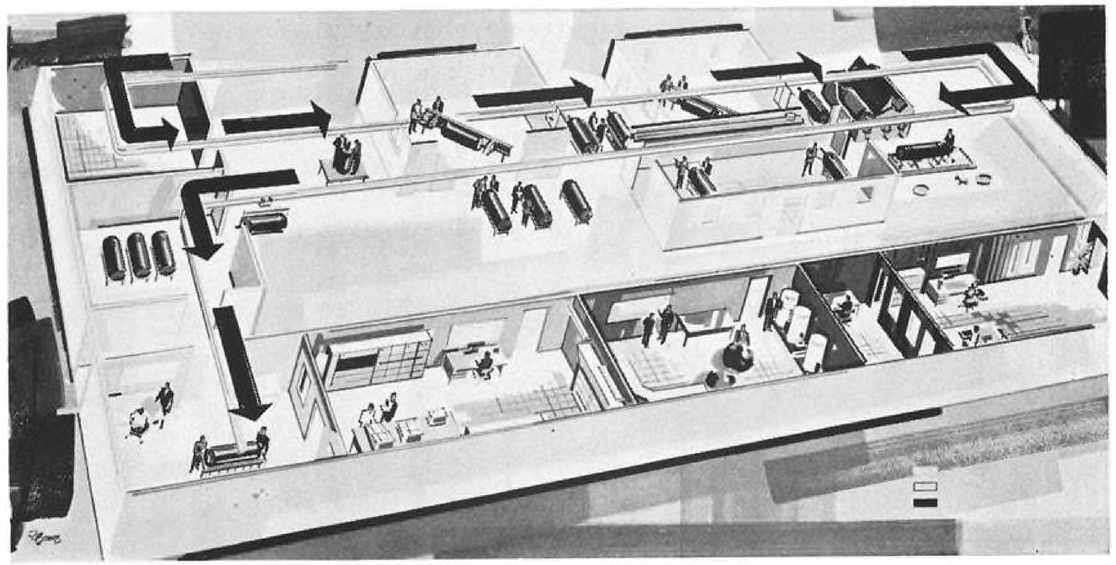
In the four drops conducted, maximum impact acceleration ranged from 3.2g to 8g and impact velocity has attained a maximum speed of 3 fps.



Dyna-Soar Landing Gear Tested

Dyna-Soar (X-20) landing gear is tested on a 3,000-lb. rocket sled mounted on a 35,000-ft. captive missile test track at Holloman Air Force Base, N. M. Sled is powered by solid-propellant boosters totaling 77,000 lb. thrust. Landing gear is scheduled for a total of 20 runs simulating several different types of landings.

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New filament winding facilities developed by BS&B allow assembly-line production rates and efficiency, yet maintain exacting tolerances and rigid quality control.

BS&B filament winding machines basically consist of hydraulic servo operated chamber rotation and glass resin supply systems. A preset programming controller establishes the geometry of the chamber windings. This system maintains exacting tolerances and insures repeatability and reliability. Assembly areas are dust-free. Temperatures and humidity are rigidly controlled. Detailed standard instructions insure quality which will meet the most exacting requirements.

The assembly line is carefully monitored by highly trained quality control personnel, insuring compliance to specification in every phase of the operation. The area represents a great military potential because production capacity can be doubled or tripled in a relatively short time. Operational Rocket motor cases that have been produced in quantity by BS&B include Third Stage Minuteman, Second Stage Polaris A2, Altair A5 and A6, First Stage Polaris A3, Second Stage Polaris A3, and the First Stage Minuteman.

Applying modern production methods is not new at BS&B. Over the years the company has successfully developed and applied modern manufacturing techniques for such diversified lines of products as oil and gas processing equipment, control valves, automative parts, automation systems and electronic instruments.

Want more information? Write BS&B, Industrial Air Park, Ardmore, Oklahoma.

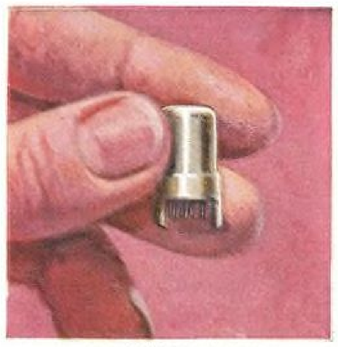
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RCA NUVISTOR ELECTRON TUBES help maintain the vital link between earth and space



RCA NUVISTOR TUBES
combine highly effective performance with extremely small size and light weight.

The astronaut's pulse and blood pressure vary with stresses of acceleration... his breathing becomes harder... his body temperature fluctuates a fraction of a degree.

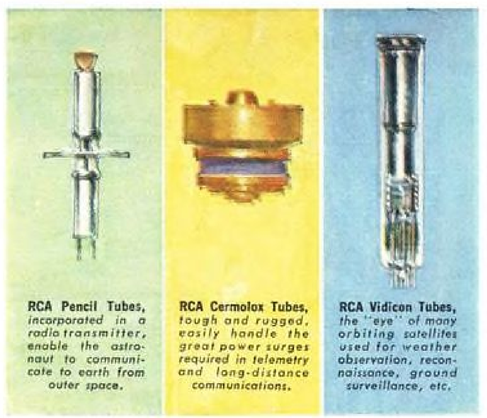
Infinitesimal changes in the void of space... yet each minute variation is perceived, recorded and analyzed at a tracking station a thousand miles distant. Such is the wonder of satellite telemetry in the space age. A key component in these incredibly complex systems is a new electron tube from RCA: the NUVISTOR. Scarcely larger than a pencil eraser, this tiny giant has the ruggedness, stamina, dependability, high performance and resistance to radiation that space-age jobs demand.

Because of NUVISTOR's extreme sensitivity and fidelity of response, nuvistorized circuits can detect and amplify—without distortion—signals reflecting the smallest changes in physical environment or condition... changes that might be lost or distorted by less sophisticated components.

RCA NUVISTORS—symbolizing today's trend of packing more and more electronic performance into less and less space—are at work in scientific marvels ranging from satellites and radiation counters to radar systems and home television sets. They are another product of RCA's unceasing effort to create new tubes for new uses—in home entertainment, in science, industry, medicine, and national defense.

RCA ELECTRON TUBE DIVISION

The Most Trusted Name in Electronics



RCA Pencil Tubes, *incorporated in a radio transmitter, enable the astronaut to communicate to earth from outer space.*

RCA Cermolox Tubes, *tough and rugged, easily handle the great power surges required in telemetry and long-distance communications.*

RCA Vidicon Tubes, *the "eye" of many orbiting satellites used for weather observation, reconnaissance, ground surveillance, etc.*

Ship BIG with the Argosy...

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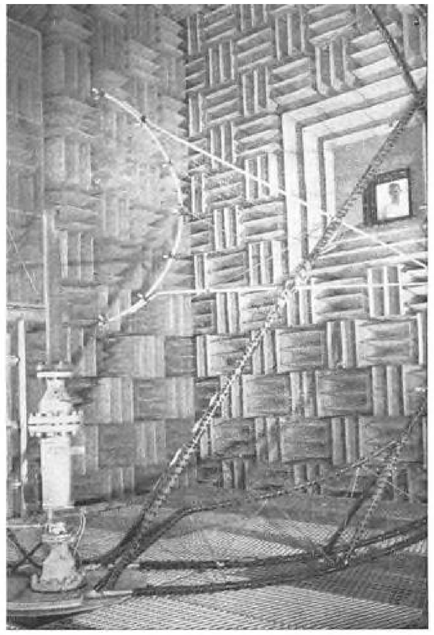
Capitol Airways, which operates Whitworth Gloster Argosy freighters to carry outsize and other military cargo on Logair routes in the U.S., now offers 28,000 lbs Argosy payload capacity for commercial charter. Consignments up to 8 ft. wide, 6 ft. high and 46 ft. long can be loaded at truck-bed height through full width doors at either end of the fuselage. With this easy handling, and jet delivery speed, Capitol can help you airship your outsize cargo and cut distribution costs on many products. Just call Bill Leonard, Capitol's V.P. Sales at Nashville, Tenn., ALpine 6-5115, or write Capitol Airways, Berry Field, Nashville, Tenn.

The Argosy is built by Whitworth Gloster Aircraft Ltd., Coventry, England for

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U.S. Enquiries to: Arthur Norden, 551 Fifth Avenue, New York 17, Tel: OXford 7-2890



Noise Laboratory

Noise Research Laboratory operated by National Aeronautics and Space Administration at Langley Research Center, Va., consists of cubical test cells with interior dimensions of approximately 27 ft. Cell is designed to study noise created by turbine or rocket engines, turbofan noise or compressor noise. Cell is equipped with a propane burner capable of producing hot jets with temperatures up to 1,500F absolute.

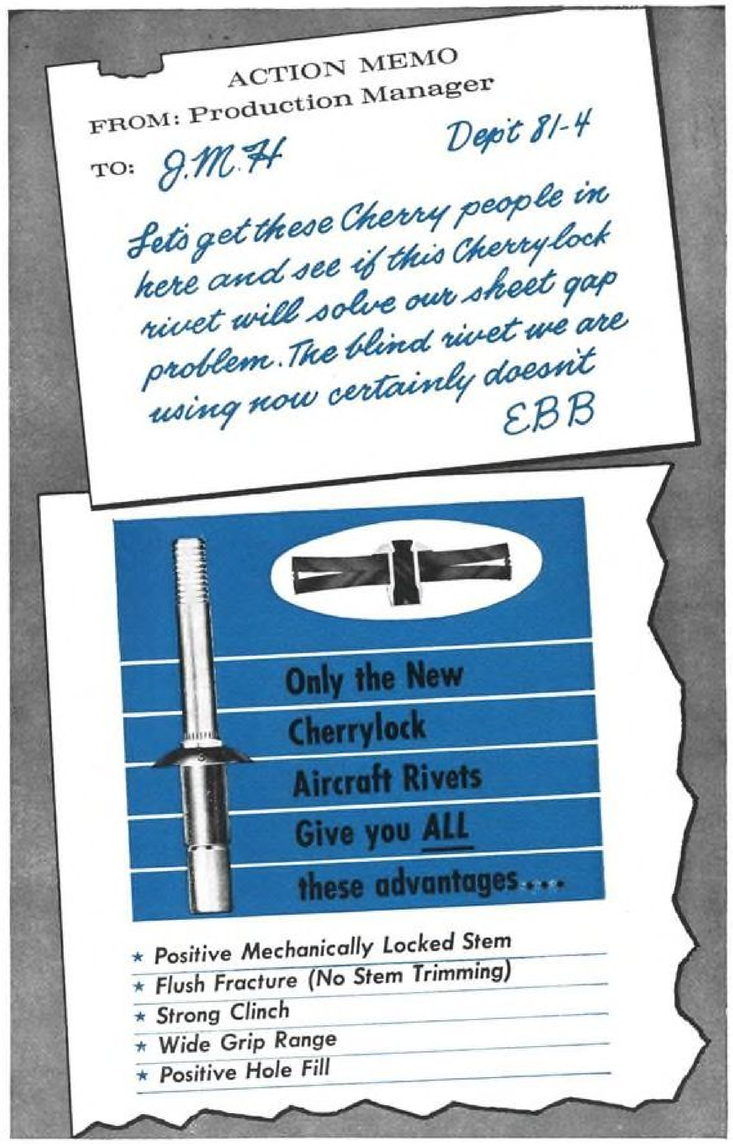
Combustion Chamber Shock Tests Begun

New York—Effects of combustion chamber shock waves, which result from unsteady combustion in liquid fuel rocket motors and cause thrust surges, are being explored by a Polytechnic Institute of Brooklyn research team.

Tests are being conducted at the Institute's Farmingdale, N. Y., Graduate Center and are funded by a $95,302 Air Force study grant. A 2-in. dia., 50-lb. thrust motor, fueled with JP-5A is used in the test firings.

Shock waves are introduced into the motor's combustion chamber with a small piston, which is actuated by a modified shotgun firing chamber using shells with the shot removed.

Piston movement creates a continuous shock wave in the combustion chamber and enables researchers to determine which wave frequencies build up and cause motor malfunction and which ones damp out. Preliminary test results indicate that fuel droplets are condensed by the shock waves. These disrupt the gas dynamics and cause thrust surges.

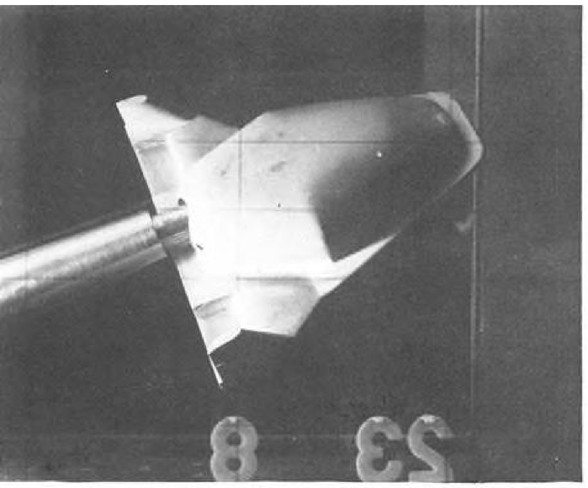


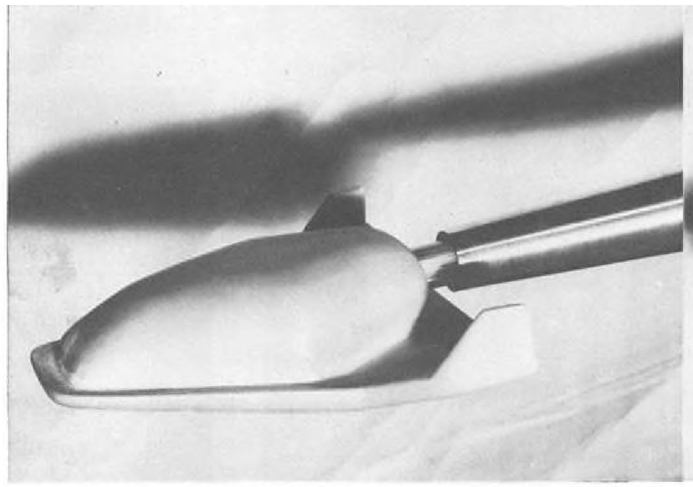
United States Patent No. 2931532. Qualifies under NAS Specification 1400 and meets Standard Pages NAS 1398 and 1399. For technical data on the Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

Cherry Rivet Division
Santa Ana, Calif.

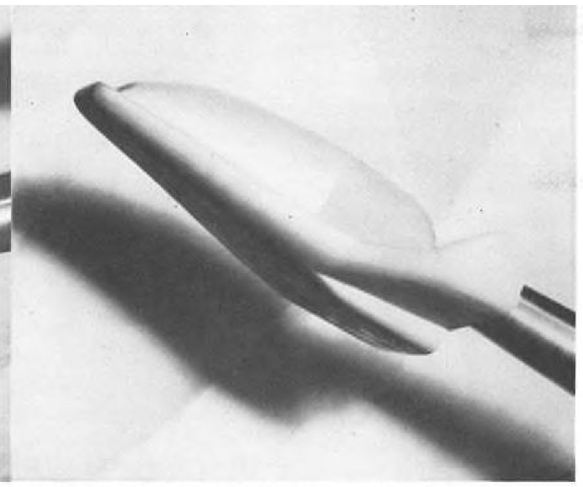
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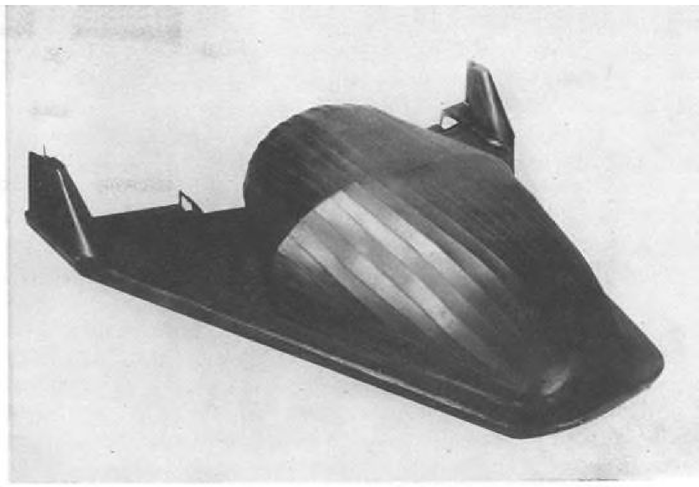
In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario





LEADING-EDGE CONTOUR GEOMETRY was used by Grumman for entry vehicle design. Vehicle has been wind-tunnel tested.





GRUMMAN BELIEVES that more study of the edge design concept may make it a useful tool in re-entry vehicle design.

Model Martian Atmosphere Constructed to Aid Planetary Exploration Vehicle Design

By C. M. Plattner

Philadelphia—Variety of analytical techniques for preliminary design of planetary entry vehicles, indicating widespread interest in future planetary exploration, were proposed here at a recent symposium on Dynamics of Manned Lifting Entry co-sponsored by General Electric Co.'s Space Sciences Laboratory and Air Force Office of Scientific Research.

Typical of the preliminary design research tools was an engineering model atmosphere of Mars, presented by Gerhard F. Schilling of The Rand Corp. It defines the upper and lower limits of pressure, temperature and density in the Martian atmosphere up to 150 km. in the middle and low altitudes.

The limits established are independent of time of day or season.

The proposed model is characterized, however, by a broad spread of probable values indicating the present scarcity of knowledge of the planet.

Usefulness of the engineering model atmosphere does not lie in the definition of absolute flight conditions expected but rather in the fact that actual conditions encountered can safely be expected to fall within the limits indicated. It is representative of the state-of-the-art efforts to formulate preliminary aerodynamic design tools for building a Martian entry vehicle with few accurate guide lines to go by.

In the past, model Martian atmospheres have been constructed mathematically giving limiting conditions for various atmospheric parameters. These are similar to ones constructed for earth's atmosphere before the advent of sounding rockets and satellites. But the wide latitude of environmental conditions on which the various model Martian atmospheres were based make a choice of any one of them more a matter of speculation than a scientifically sound decision.

The advantage of an engineering model Martian atmosphere is that the user is relieved of the requirement of making a preferential choice of certain specific conditions most likely to prevail at the time of entry.

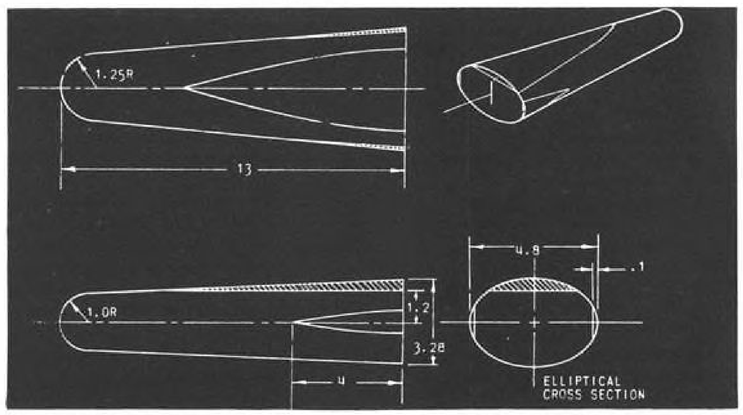
Construction of the engineering model atmosphere was based on the best known values for equatorial and polar radius, planetary mass, solar constant, columnar atmosphere mass, mean molecular mass and probable extremes of mean air temperature. Nitrogen was assumed to be the primary gas in the Martian atmosphere with possibly some carbon dioxide, nitrogen dioxide, argon and ozone also present.

As a preliminary design tool, according to Schilling, the actual conditions of the Martian atmosphere can safely be expected to fall within the limits given, permitting insertion of realistic tolerance requirements into design studies.

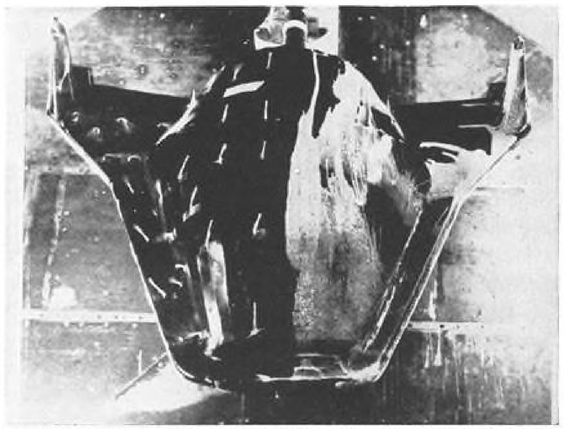
Schilling noted that entry into the Martian atmosphere would probably be easier than entering the atmospheres of either Venus or earth, based on Mars' relatively small planetary mass and gradual decrease of atmospheric density with altitude.

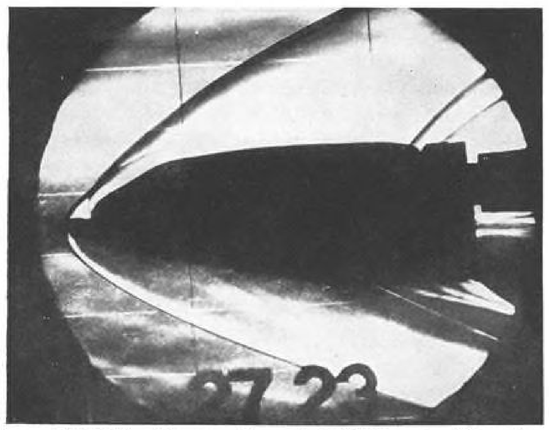
Contention that Mars would be the first planet to be explored rather than Venus (which is the planet closest to earth) was shared by many scientists at the symposium. Cloud cover on Venus has allowed observers to obtain only a small amount of basic information about the planet's atmosphere and surface.

Recent studies of microwave radiation received from Venus have indicated that possibly for the first time we are receiving information on environ-

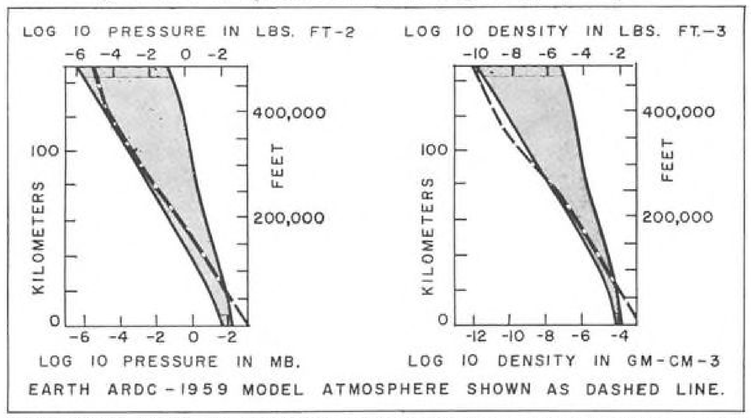


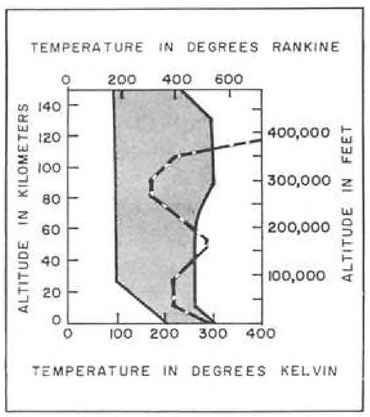
AIR FORCE SORTIE vehicle is designed to explore aerodynamic, aerothermodynamic and performance characteristics in the velocity range of 3,000 to 3,600 ft. per sec. Vehicle is looked on as the next step beyond Apollo and Dyna-Soar.





GRUMMAN'S BLUNT-EDGE ENTRY configuration is tested at subsonic speeds (left) and supersonic speeds (right) to gain information on flow and stability characteristics. Subsonic test was made at an angle of attack of 20 deg. Shock wave at right was produced at Mach 4 at low angle of attack during tests Grumman conducted at supersonic speeds.





ENGINEERING MODEL OF MARTIAN ATMOSPHERE shows projected pressure, density and temperature at various altitudes. Broad spread of probable values indicates scarcity of firm information about Martian atmosphere. Similar model atmosphere of earth, compiled in 1959, is shown as dashed line. Martian atmosphere was based on the best known values for equatorial and polar radius, planetary mass, solar constant, columnar atmosphere mass, mean molecular mass, and mean air temperature extremes.



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Moreover, Lockheed is involved in another important space application of nuclear energy: its use in nuclear electrical systems to operate auxiliary equipment, and eventually in electrical propulsion systems.

Nuclear space applications is but one of many areas being explored by Lockheed Missiles & Space Company. As one of the industrial leaders in current space investigations, many new positions are continually being opened for scientists and engineers of proved ability in all disciplines. And Lockheed's ideal location in Sunnyvale, on the beautiful San Francisco Peninsula, makes living as well as working invigorating and stimulating.

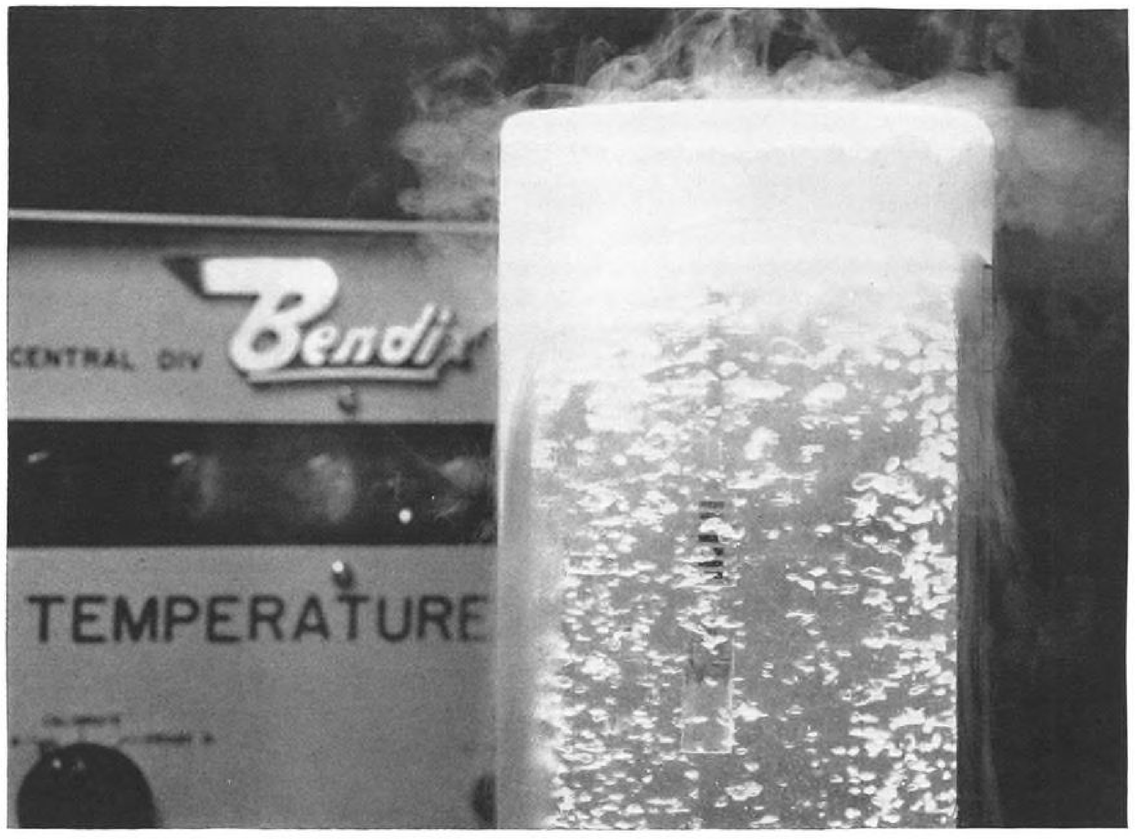
If you have proved ability and wish to work in a challenging environment, please write: Research & Development Staff, Dept. M-40A, 599 North Mathilda Avenue, Sunnyvale, California. Lockheed is an equal opportunity employer.

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mental conditions beneath the cloud cover. Analysis of the microwave radiation infers a surface temperature as high as 700K to 750K compared with former assumptions of 350K to 400K. Contrary theories, however, that the microwave radiation observed might be emitted from high altitudes in an ionosphere are not completely discounted.

There is little known about the Venusian cloud layer itself as there is about the surface it covers, Peter P. Wegener, Yale University professor and Rand Corp. consultant noted in a summary of attempts to explain the existence of the Venusian cloud layer.

Venusian Clouds

Cloud composition theories attempting to rationalize Venus' suspected high surface temperatures include a wind-driven, dust-laden troposphere with heat produced by wind shear proposed by E. J. Opik and a "greenhouse model" of the atmosphere with ice crystals making up a thin cloud layer proposed by C. Sagan.

Wegener told the symposium that with the present uncertainty of knowledge of Venus there was not enough basic information to provide reasonable aerodynamic predictions for the Venusian atmosphere. Mariner 2 space probe scheduled to pass by Venus Dec. 14 should yield considerable useful information during its microwave and infrared scan of the cloud-shielded planet.

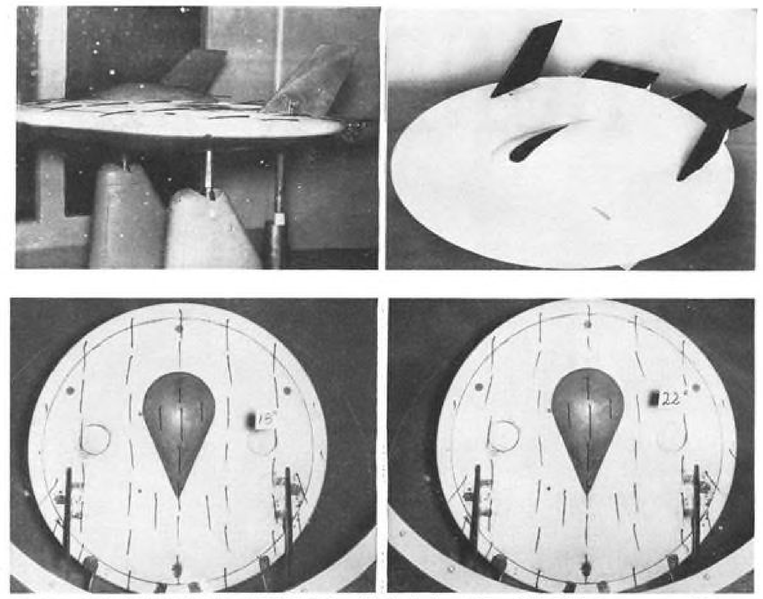
Characteristic results of attempts to calculate aerodynamic parameters for Martian and Venusian atmospheres were presented by Wegener. The calculations which had been performed under a joint Air Force-Jet Propulsion Laboratory contract resulted in discrepancies up to several orders of magnitude (one order of magnitude is defined as a factor of 10; two orders, 100, etc.). Discrepancies resulted from uncertainty of free molecular flow conditions and density.

The aerodynamic parameters considered were free stream Mach number, Reynolds number and Knudsen number and were calculated for an entry vehicle flying at varying altitudes in simplified model atmospheres of Venus and Mars.

Mars' Environment

In contrast to Venus, however, Mars will present an environment for flight that is hospitable, Wegener noted. There is general agreement on values of surface temperature in a range from 200K to 300K, and gravitational acceleration has been determined to lie between 14.2 and 15.3 ft./sec.^{2}. Similar values for Venus are less well known.

Vehicle sizing problems in a manned Venusian entry versus a manned Martian entry were pointed out in another symposium report presented by Peter Levine of Avco Corp. Calculations



LANDABLE, LENTICULAR RE-ENTRY vehicle designed by Fairchild Stratos would enter the atmosphere at a 60 deg. angle of attack and use its rounded bottom as a heat shield. Control after entry is by means of both vertical and horizontal aerodynamic control surfaces (upper right photo) which unfold after transition from hypersonic to supersonic speeds.

showed a manned Venus entry vehicle would weigh four times as much as a manned Martian entry vehicle. Levine considered a direct entry into the planetary atmosphere from earth at hyperbolic velocity, landing, takeoff with planetary rendezvous and earth re-entry. An ellipsoidal entry vehicle was chosen with a lift/drag ratio of .5 at 30 deg. angle of attack, 14.5 ft. in length and 14.5 ft. in maximum span for Martian entry.

Weight of the vehicle for a Venus trip was 200,000 lb. compared with 50,000 lb. for a Mars flight, but neither weight included the booster necessary to accelerate the vehicle to escape speed from earth launch. Weight of the earth re-entry vehicle was 10,000 lb. Large comparative weight of the Venus vehicle was dictated by take-off and rendezvous fuel requirements for the larger planet. Size of Venus vehicle was adjusted to 36 ft. in length to carry the extra fuel with a corresponding lift/drag ratio of .75. Same nose section was used as on the Martian entry vehicle.

Considerations met in weight sizing for the entry vehicles included enough fuel for soft touchdown with a landing module and launch back into orbit similar to Apollo lunar exploration flight plan.

Accurate determination of Mars' surface temperature and chemical composition of gases in Martian atmosphere would allow more exact model atmospheres to be constructed. Lack of knowledge of either parameter at present forces aerodynamicists to rely on best value model atmospheres to determine heating and such basic design criteria as viscosity, Mach number, Reynolds number and Knudsen number, or forces them to design for a wide range of probable values using an engineering model atmosphere.

Neither approach is completely satisfactory. The latter approach of designing within a wide range of probable values is more accurate but is not exact enough for anything beyond preliminary design work. Instrumented fly-by and impact probes are expected to provide information needed for specific design work. First U.S. Mars fly-by is not scheduled until 1964.

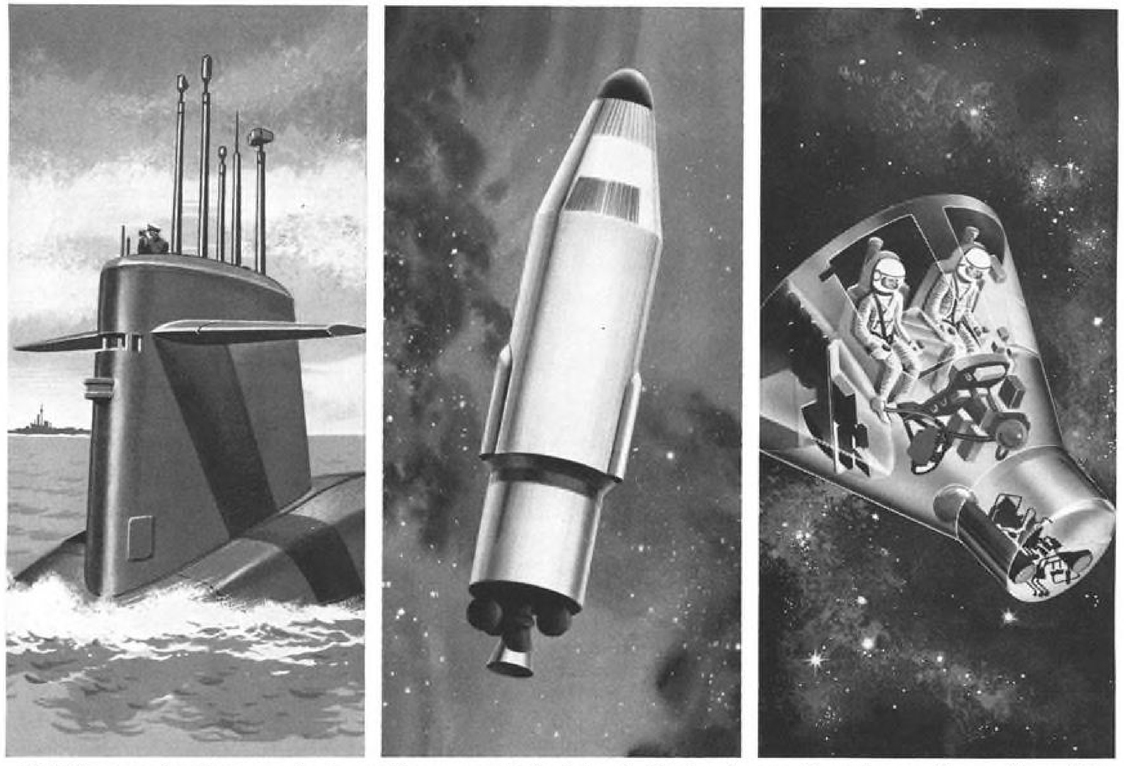
Extensive Work

Although state-of-the-art in interplanetary exploration does not call for a conceptual manned lifting/entry vehicle at this time, because of the lack of specific design parameters, results of research on different vehicle configurations presented at the symposium indicate extensive work in this area by industry and government.

Research vehicles and analytical design techniques reported at the symposium included:

• **Air Force superorbital re-entry vehicle** called SORTIE (Superorbital Re-entry Test Integrated Environment) designed as a test vehicle to explore aerodynamic, aerothermodynamic and performance characteristics in the velocity range of 3,000 to 36,000 ft. per sec. during re-

HONEYWELL SYSTEMS



Under the sea or in outer space, the demand for more sophisticated navigational systems continues to grow. Honeywell's goal: to advance the art and science of guidance and navigational equipment and continue to produce quality systems at the lowest costs.

CHOSEN FOR TOUGHEST NAVIGATION PROJECTS

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For tomorrow's systems capable of performing rendezvous-in-space maneuvers, Honeywell offers a wealth of experience in the development of navigation systems. Many of our nation's most demanding projects are using Honeywell-developed guidance and control systems: Gemini, SD-5 Drone, and X-20 (Dyna Soar). Honeywell is also building guidance systems for Polaris.

As space missions become more and more complex, the guidance equipment aboard the various vehicles must be capable of more complicated maneuvers. Systems are needed that do more and weigh less. Today's sophisticated systems must precisely measure everything that happens to a moving vehicle and guide and control it with precision on an exact course from one place to another, almost anywhere in the universe. All this must be done independently of any earth-based equipment. The need for accuracy is most vital. (A slight error can throw a vehicle thousands of miles off course.)

Honeywell has pioneered in all phases of design, development, fabrication, test and use of such inertial guidance and navigation systems and components. The tasks have been many and varied. They range from aerospace to terrestrial to marine navigation.

Currently, many advanced navigation systems are under development at Honeywell. New sub-miniature inertial platforms (one-third the size of conventional miniature platforms) are now being readied and offer complete capabilities with no sacrifice in performance or reliability. Companion sub-miniature computers and components are also being developed.

Honeywell navigation systems are adaptable to either analog or digital modes. They can incorporate star trackers, horizon scanners, infrared and other optical components where needed for special applications such as superaccurate missiles and deep-space missions.

In addition to complete systems, Honeywell can supply computers, computer components, inertial platforms, and inertial components built to your own or to Honeywell's design.

For more information on how Honeywell can assist you in the development and/or manufacture of navigation systems contact your nearest Honeywell Military Products Group representative, or Minneapolis-Honeywell, Aeronautical Division, 13350 U.S. Highway 19, St. Petersburg, Fla. Phone HEmlock 5-1151.
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X-20 (Dyna Soar) to be guided by Honeywell system

The Air Force's X-20 (Dyna Soar) program, presents challenging guidance and flight control problems. A Honeywell system will supply accurate navigation, guidance and pilot's display information from self-contained measurements and computations made within the glider. By means of this display, the pilot is able to evaluate the capability of the gliders reaching a given selected destination and, if necessary, can choose an alternate destination. The system will operate from launch until landing and provide uniform control of the craft through a vast range of speeds and altitudes.

Honeywell-developed guidance and/or flight control systems are also in use or slated for use on the X-15, Mercury, Gemini, and Apollo.



Honeywell project: exploring the art of celestial navigation

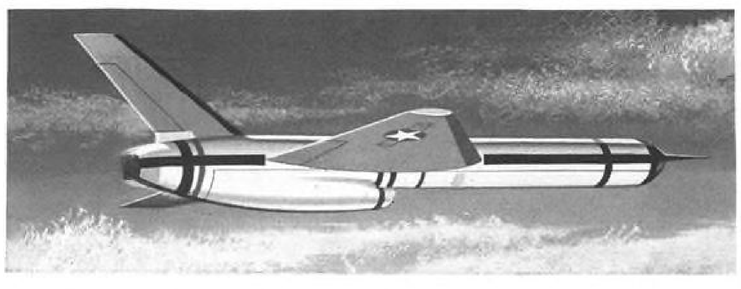
Optics is the key to the future in celestial navigation of space vehicles, and optical devices of many types and varied uses are being developed at Honeywell. One system being studied would actually track several planets by means of high-powered radar-like Laser devices. Range and range rate to the planets would be determined by the tracking devices and the information used to orient the vehicle on its proper course.

Consistent with celestial navigation system development, other far-reaching new ideas are being conceived and evaluated to maintain Honeywell's leadership in the navigation and guidance field.

Honeywell system guides Army SD-5 drone

For the Army SD-5 surveillance drone Honeywell designed, managed, and is manufacturing the inertial navigation system.This compact drone can find its way hundreds of miles behind enemy lines, locate battle-area targets and report back on its reconnaissance missions.

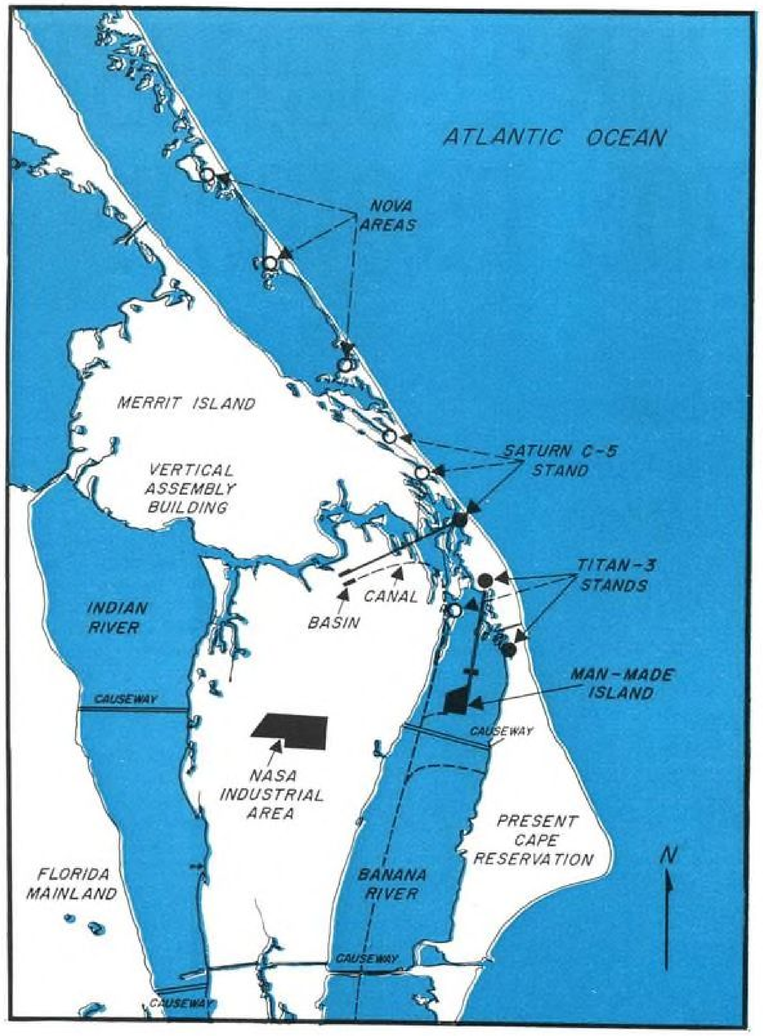
The system can guide the drone over several target areas in each flight without need for any radio or radar commands from the ground. After completion of its mission the Honeywell system guides the drone to its home base. The SD-5's terrestrial inertial navigation system is an all-digital type. And because the system is completely self-contained it is not subject to "jamming" or interference by enemy countermeasures.



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NASA Pinpoints C-5 Launch Stand

National Aeronautics and Space Administration has firmly sited the first Saturn C-5 launch stand and USAF is taking soil samples for siting two Titan 3 stands at Cape Canaveral, Fla. Marshy area selected for the first C-5 stand is about 11,000 ft. north of the second Titan 3 stand and now is being filled. Vertical assembly building, in which the complete Apollo-Saturn vehicle will be assembled and checked out (AW July 2, p. 127), will be sited on Merritt Island, 2,000 ft. south of Banana Creek and about 16,700 ft. from the first C-5 stand. Large basin alongside the vertical assembly building will be used to accept delivery of Saturn stages barged into the Cape via canals (broken line). Tracked transporter-launcher will move the Apollo-Saturn vehicle from the assembly building to launch site along roadways. Three C-5 stands now are definitely programed by NASA and a fourth may be added later. Distance between C-5 stands presently is planned to be about 8,700 ft. First of the Titan 3 stands now being surveyed by USAF will be just within the present northernmost boundary of the Cape reservation and the second pad will be just beyond the gate on False Cape. USAF had located the Titan 3 sites to within 1,000 ft. by late last week. Distance between the Titan 3 stands is expected to be 3,000-4,000 ft. Man-made island will be created in the Banana River for the Titan 3 program. Island will contain a vertical assembly building similar to that to be used in the Saturn C-5 program. A third Titan 3 site may be added later and would be located on Merritt Island. Nova areas have been identified by NASA to within 1 mi. Small black rectangle across road from man-made island to Titan launch sites is assembly area where solid propellant boosters will be added to Titan 2 core in order to form the Titan 3 missile.

entry into earth's atmosphere. The modified blunt, elliptical cone-shaped vehicle can be considered as the next step beyond Apollo and Dyna-Soar in developing a lifting entry vehicle. Vehicle has a maximum lift/drag ratio of 1.2 at 200,000 ft. receiving its lift from a flattened bottom surface and rounded top surface. Mach 5-19 tunnel tests confirmed preliminary design predictions of stability, although below Mach 3 experimental data started to vary as much as 20% from the predicted values.

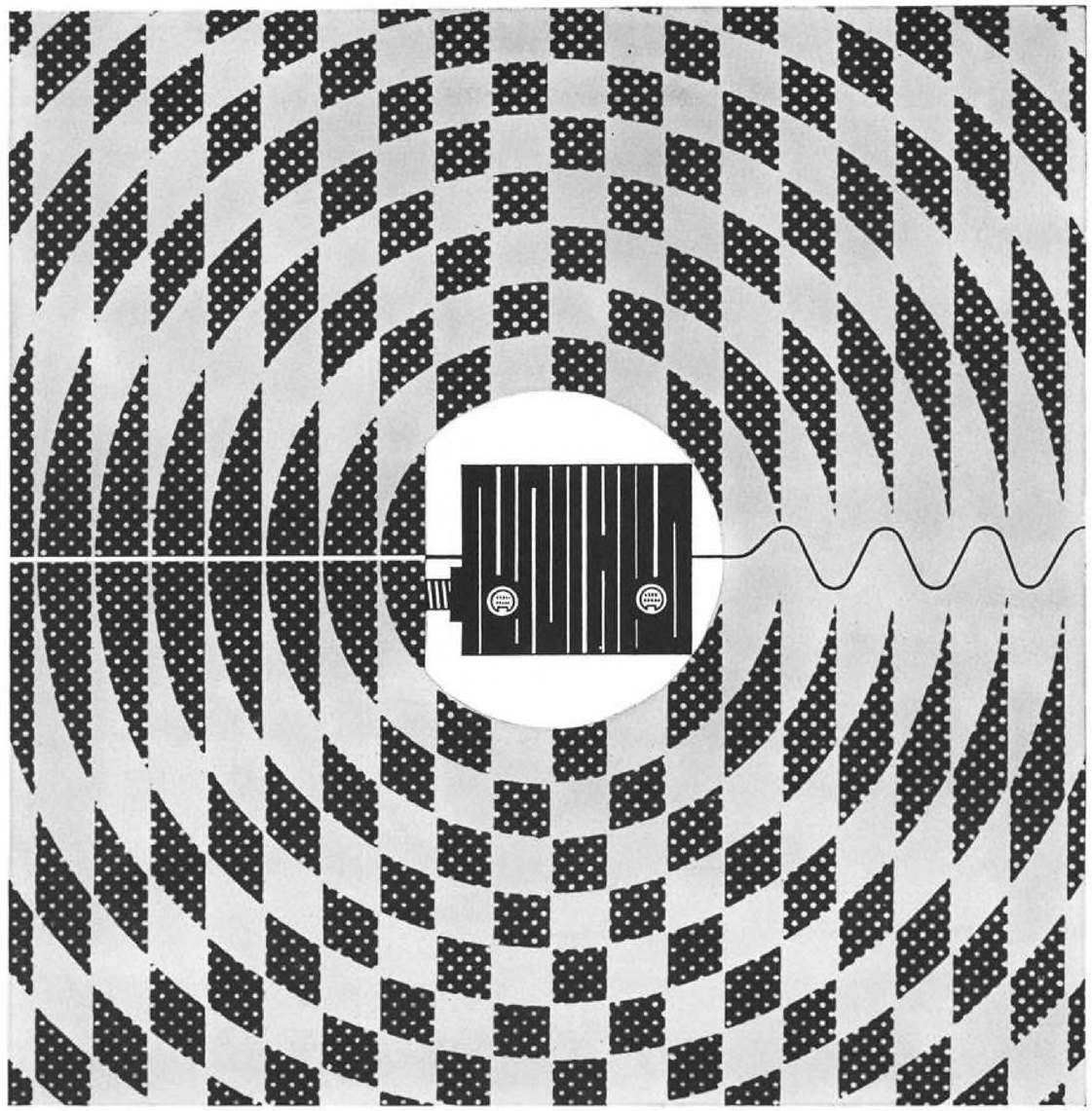
Actual flight testing of SORTIE vehicle, probably with an Atlas-Agena booster, is being considered by Air Force now (AW Nov. 5, p. 23).

• **Fairchild Stratos** proposed a landable disk (lenticular) re-entry vehicle which would enter an atmosphere at a 60 deg. angle of attack using its rounded bottom surface as a heat shield. Studies performed indicated a test model of the vehicle was stable at angles of attack ranging up to 23 deg. in low speed tunnel tests at Mach .22. Glide ratios for a trimmed subsonic configuration on the order of 5.5 were attained with stable flight characteristics at landing attitudes. Proposed aerodynamic control is by means of vertical and horizontal surfaces which are unfolded after transition from hypersonic to supersonic speeds during re-entry (AW Jan. 9, p. 50).

• **Grumman Aircraft Engineering Corp.,** using leading edge-contour geometry and orientation as principal design parameters, analyzed a flat-nosed, edged configuration with twin vertical aerodynamic surfaces and tested a model at hypersonic and subsonic speeds. At Mach 4, Grumman found edge-contour design can be useful in influencing yaw and roll characteristics at high angles of attack. They found at subsonic speeds that minor changes in upper side geometry modify the edge forces and vortex lift to give substantial yaw and roll forces at high angles of attack without involving fin properties.

Grumman indicated that more study of the edge design concept might make it an effective tool in the design of re-entry vehicles.

• **Method of analyzing** and predicting landing techniques of manned re-entry vehicles was offered by North American Aviation, Inc. as a result of its own analysis of X-15 landings. The technique evolved was felt to be applicable to other re-entry or entry vehicles since the X-15 actually experiences a re-entry into the earth's atmosphere on every flight, characterised by steep glide angle and high sink rate, touchdown speed, and approach speed. Landing analysis was divided into four phases: positioning, final approach, landing flare or pullout, and deceleration to vehicle touchdown.



HOW 6 TRANSISTORS CAN WORK
7 TIMES HARDER WITH ONLY HALF TRYING

(a report from Delco Radio)

Sound like a riddle? Well, it was . . . almost. Here's the story.

Delco Radio engineers wanted to build a precision static inverter that was smaller, simpler, lighter, more economical and considerably more powerful than previous models.

Research hit on the idea of current feedback. Following this principle, the engineers designed an amazing inverter using only 6 transistors. Transistor utilization is stepped up 7 times, yet the transistors work at less than 50% of their capacity, run cooler, last longer.

This new Delco 250 VA power supply converts 28 volts DC to 115 volts, 400 cps. Its circuits are a model of simplicity.

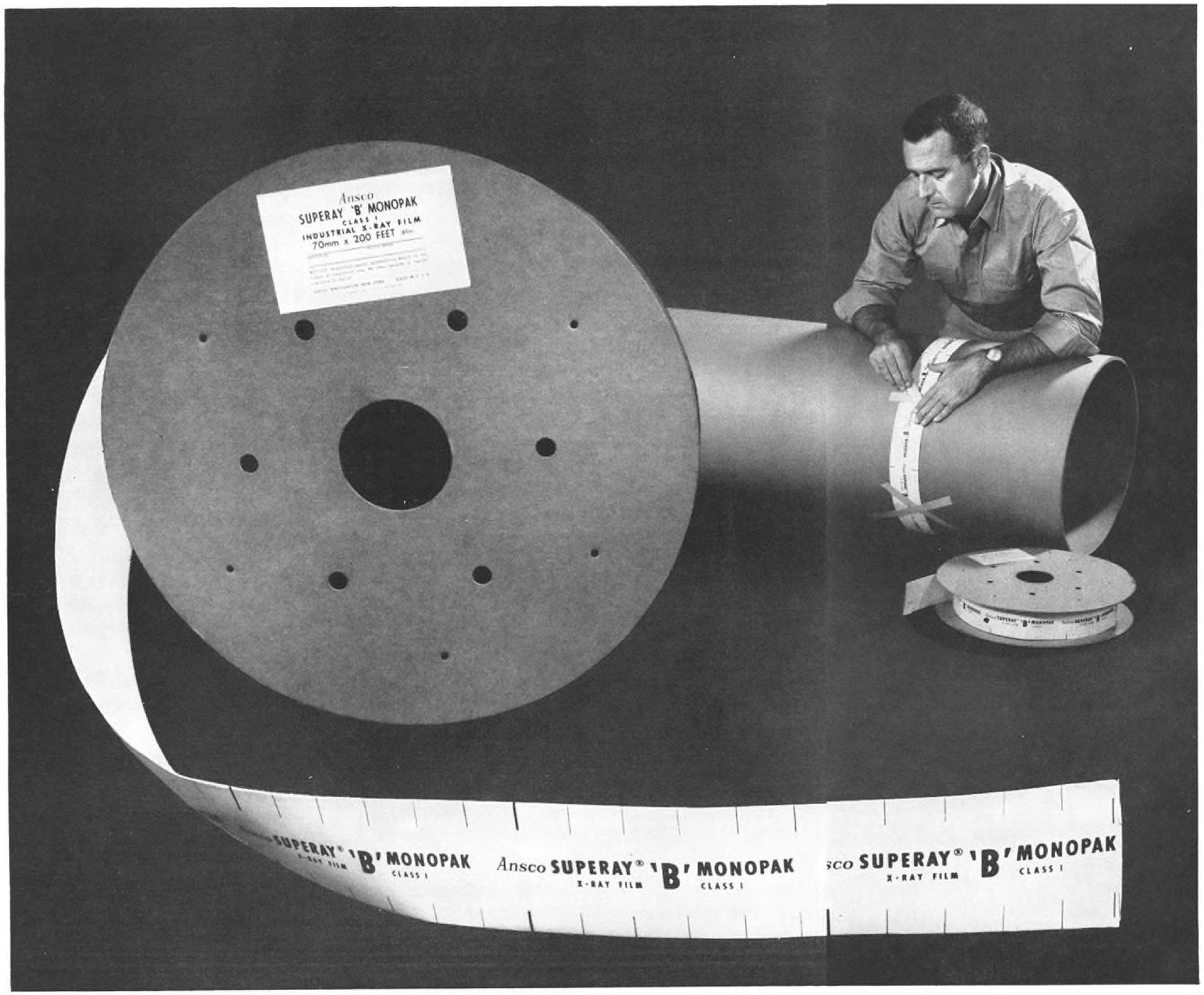
The unit is designed for continuous full-load operation at 71 degrees C. still air, yet weighs only 10 lbs., measures 6¼" x 7⅜" x 5". A minimum of components assures extra-high reliability.

The 250 VA Static Inverter is practical hardware today, awaiting your inquiry. Delco Radio may be able to solve your problem in miniaturization, modules, inverters or converters, too. Write to Delco Radio Military Sales Department, Kokomo, Indiana.

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MALLORY

Component Failures Predicted by Infrared

By Philip J. Klass

Boston—New technique developed by Raytheon shows promise of being able to spot potential component failures in a matter of minutes by measuring their infrared radiation intensity.

Limited evidence suggests that a 5-min. infrared examination may pinpoint transistors which will be the first to fail several thousand hours later, Raytheon's Dr. Riccardo Vanzetti reported here at recent Northeast Electronics Research and Engineering Meeting (Nerem).

Same technique can be used to monitor internal circuit operating conditions to detect discrepancies from design levels. It also has been used to locate the cause of a malfunction within an item of equipment, Vanzetti reported.

Technique is relatively inexpensive, non-destructive and fast. It is based on the long-established fact that the operating temperature of a component is a major factor affecting its reliability and longevity.

Infrared provides a method for measuring the temperature of each component while operating in a circuit without the inconvenience of attaching thermocouples or the risk of changing component temperature by the measurement process. The intensity of infrared radiation emitted by each component is proportional to the fourth power of its temperature.

Raytheon uses a commercially available radiometer, made by Barnes Engineering Co., with a 12-in. focal length Cassegrain optical system. It can detect differences in temperature as small as a few thousandths of a degree Centigrade, far more sensitive than required for the new technique, Vanzetti said.

Output of the radiometer is recorded on a conventional strip chart. When suitable calibration factors are applied, the output is a direct indication of the temperature of the component at which the radiometer is aimed.

Component temperature is important for itself and also as an indicator of how much current is flowing through the component. This adds to the usefulness of the technique for diagnostic purposes.

Radiometer can detect differences in component power dissipation as small as one milliwatt in resistors and transistors and as small as 100 microwatts in glass diodes, according to Vanzetti.

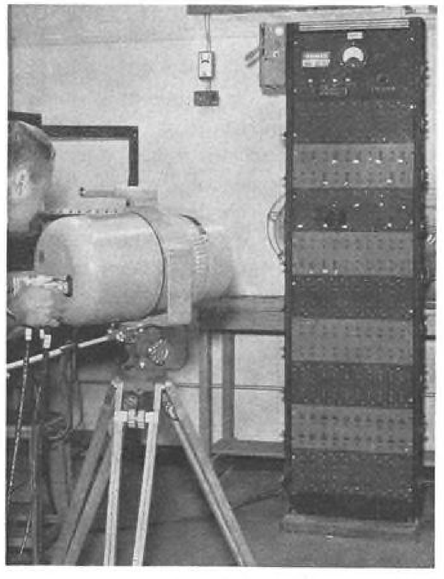
Seemingly identical components carrying identical currents and installed in the same environment should have approximately identical temperature rise rates and level off at roughly the same final temperature. But Raytheon tests show that this is not the case and that the differences may be an important clue to future component longevity.

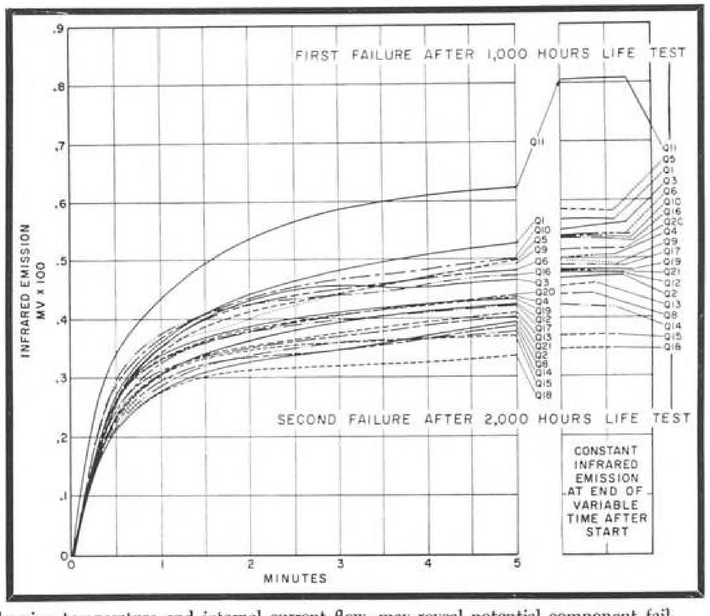
In one Raytheon test, 20 presumably identical 2N174 power transistors were placed on test with identical currents. A recording of their temperature rise after application of power was made with the radiometer. Within several minutes the temperature rise of all 20 units had leveled off.

But one of the 20 transistors showed a much more rapid rate of temperature rise and reached a higher final level than the others. It was the first transistor in the group to fail, after about 1,000 hr. of operation.

Another transistor, which had the lowest rate of rise and leveled off somewhat below the others, was the second unit to fail, after about 2,000 hr. The other 18 transistors operated at 4,000 hr. without failure.

Vanzetti acknowledges that it may be only a coincidence that the two transistors, one with an extremely low internal thermal resistance and the other with a very high thermal resistance, were the first and only transistors to fail. But if more extensive controlled tests now planned by Raytheon's semiconductor

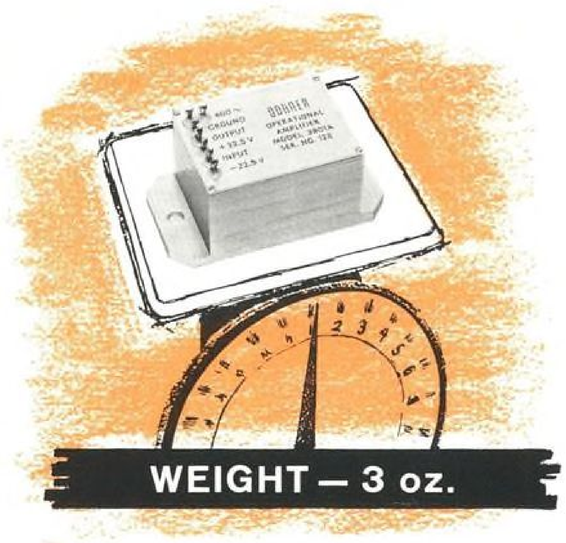




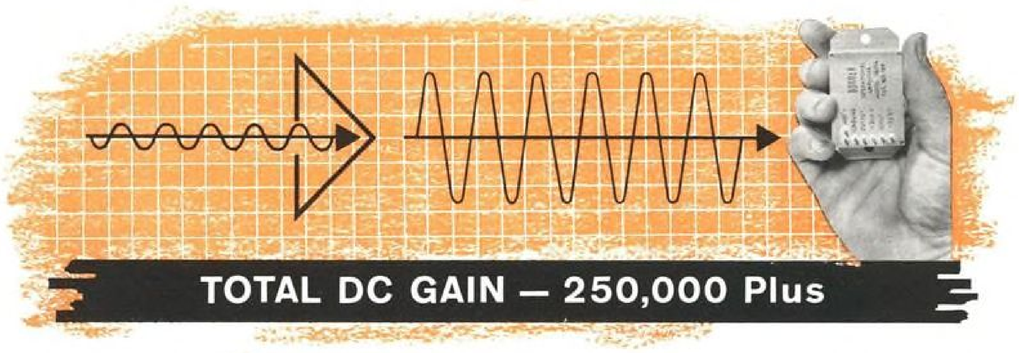
INFRARED MEASUREMENTS of components (left), showing temperature and internal current flow, may reveal potential component failures and provide check on circuit operation, according to Raytheon, which is exploring the technique. Temperature-versus-time measurements on group of 20 transistors followed by life tests disclosed that first device to fail was one with extremely rapid temperature rise (curve, right), followed by device with lowest temperature rise. None of others failed during 4,000 hr. operation.

Donner's New* Airborne Amplifier

*New is somewhat misleading. This rugged, reliable operational amplifier has actually been used for more than a year in critical missile applications. What is new is the package, which is smaller and now measures 2¼" wide, 3¾" long and ½" thick. It occupies only 2 cubic inches.



WEIGHT — 3 oz.



TOTAL DC GAIN — 250,000 Plus

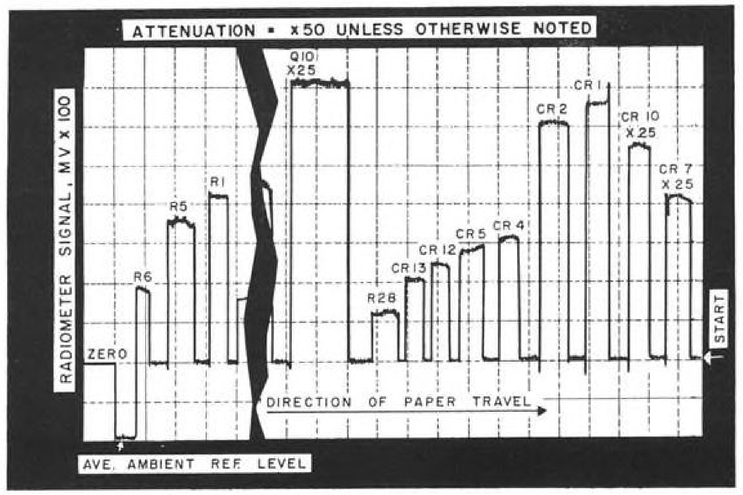


SHOCK — 100 g

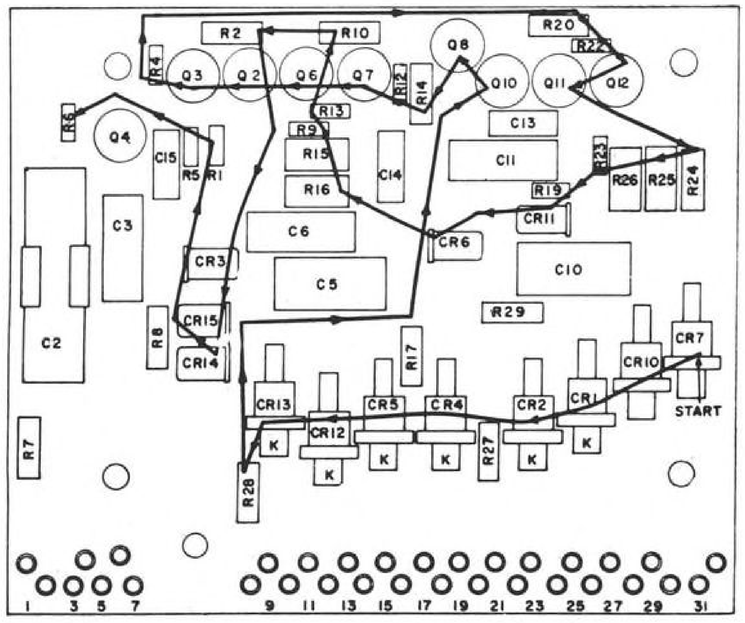
Using silicon transistors throughout, the Model 3801 sc (sc for small case) provides high gain, wide bandwidth and chopper stabilization paths over a broad range of ambient conditions. Standard model operates from 0° C to +55° C in relative humidity of 95%. Special versions cover −10° C to +80° C. The amplifier will withstand shock of 30 g and meet all specifications to 50,000 feet. Additional technical data is ready now. Call your Donner engineering representative or write us directly.

BRIEF SPECIFICATIONS OUTPUT ±10 volts at 4 milliamps load; ±20 volts at 2 milliamps load. TOTAL DC GAIN In excess of 250,000. FREQUENCY RESPONSE dc to 200 kcs. DRIFT REFERRED TO INPUT 1 millivolt/30° C change; ½ millivolt/24 hours with constant temperature. JUNCTION CURRENT 2 x 10^{-9} ampere for full output. POWER REQUIREMENTS ±28 volts dc (8 ma maximum drain) and 12 volts peak-to-peak center tapped, 400 cps (2 ma maximum drain). PRICE $450. Quantity discounts available.

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THERMAL PROFILE (top) obtained with infrared radiometer shows temperature and current flow through each component in a circuit board (bottom). Radiometer is trained on components in sequence shown at bottom, with corresponding radiometer readings shown on strip chart above. By comparing thermal profiles of identical units off production line, out-of-tolerance conditions and malfunctions can be spotted, Raytheon says.



department show similar results, the technique will be a powerful tool for weeding out potential failures with a low-cost test procedure in a matter of a few minutes.

New technique also is useful in evaluating potential reliability of different circuit designs. It is also useful for quality control of units coming off a production line.

For these applications, the radiometer is aimed at each component in the circuit in a prescribed sequence. The result is a strip chart recording which gives a thermal profile of every component in the circuit (see illustration, above).

The profile can be made in a matter of minutes.

By comparing the thermal infrared profiles of circuits which are designed to be identical it is possible to spot quickly any components whose temperatures exceed normal values. This indicates either a potentially faulty component or an adverse build-up of circuit tolerances causing certain components to operate beyond design

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Raytheon AD-50A
Analog-to-Digital Converter



The AD-50A Converter is another product of DATA-DESIGN,
Raytheon's Digital System Design Service

limits. Vanzetti cited a power supply which was redesigned in an attempt to eliminate field reliability problems due to excessive temperature, largely from transformer heat.

Before committing the new design to production, however, an infrared thermal profile was run on the original and the revised models. This revealed that while the redesign had drastically cut transformer temperature, a resistor and two transistors in the new model were now operating considerably hotter than in the original model, thereby inviting new reliability problems, Vanzetti reported.

As a result the power supply underwent another redesign.

Trouble-Shooting

Another use for the infrared thermal profiles is in trouble-shooting. Vanzetti cited a low-voltage regulated power supply which had malfunctioned for unknown reasons.

When a thermal profile was made, showing the relative current through each of its components, the circuit designer was able quickly to pinpoint the trouble as a faulty zener diode, according to Vanzetti.

The thermal profile of the power supply showed which components were operating far beyond original design limits and which were operating far below the design limits.

Vanzetti suggested that it might be possible to simulate a variety of different faults in an item of equipment and make an infrared thermal profile of the equipment under each condition, providing a "thermal fingerprint" for each type of fault. These could be stored in a computer-type memory as part of an automatic trouble-shooting equipment. The latter would make a thermal profile of any malfunctioning device, compare the profile with those stored in its memory, and thereby correlate the unknown fault with one identified in its memory.

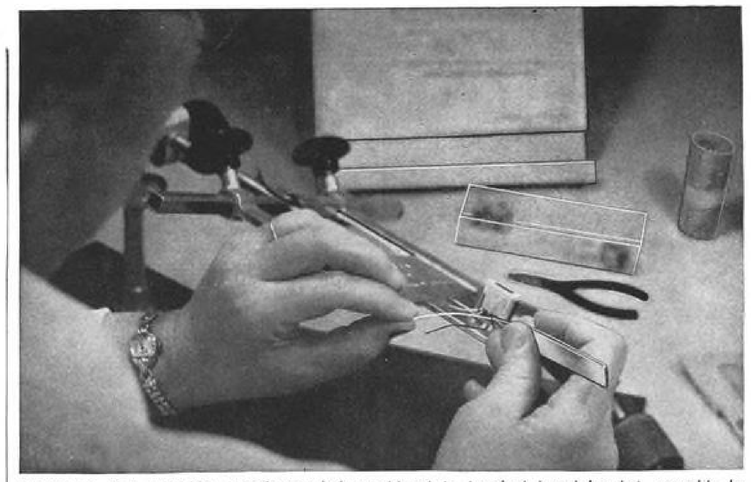
Microcircuitry Aid

Vanzetti pointed out that the technique may prove invaluable as industry turns to microcircuitry, where it is now impossible to make measurements within a circuit to determine the circuit's status.

With an infrared microscope, it is possible to measure current flow and power dissipation anywhere in the microcircuit to determine if all elements are performing properly.

Similar technique for thermal mapping of thin-film microcircuits was reported by Philco scientists during the recent Electron Devices Meeting which was conducted in Washington (see photos on p. 90).

Recently, Raytheon invited a num-



Minuteman high reliability transformer being soldered to terminal board bracket assembly by NASA-certified solderer.

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Wheeler's family of Minuteman high reliability transformers

That's a quick way to describe one of the most successful precision duplication achievements in the electronic field today . . . Wheeler's controlled-environment production of **identical** high reliability transformers. For instance, completely homogeneous transformers with an objective failure rate of .001% per thousand hours with a 60% confidence level are now being made for the U.S. Air Force Minuteman Missile. Dust, humidity, and temperature are regulated and monitored; exacting specifications and controls govern all processes from raw materials to packaging.

SPECIAL PRODUCTION METHODS — A special method of simultaneous multiple coil winding guarantees precisely the same number of turns and the same winding length on each coil, thus assuring accurate margin dimensions. This method permits a single insertion of inter-layer insulation in all the windings at once, greatly reducing possibility of contamination from handling many separate sheets of insulation. Improved anchoring of lead exits contributes to consistent production of identical units. Soldering is done by NASA-certified solderers to sustain highest quality.

EXACT REPEATABILITY ASSURED — Every operation in manufacturing, testing, and quality control is detailed in writing and carefully followed by every operator to achieve exact duplication. Documentation of each step immediately pinpoints any discrepancies.

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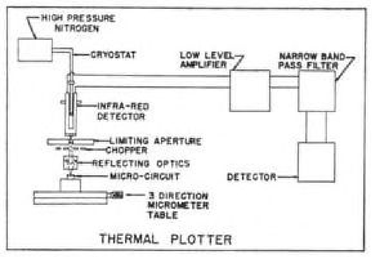
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3WH62

NEW AVIONIC PRODUCTS



THERMAL MAP of microcircuit (top) shows temperature profile and indicates hot spots which may cause later failure. Profile was obtained by new thermal plotter (bottom) developed by Philco Corp., which uses infrared scanner to measure microcircuit temperature. Technique is usable down to temperature of 50C and has 1.4 mil resolution. Method is rapid and non-destructive. Philco plans to market the thermal microcircuit plotter commercially.



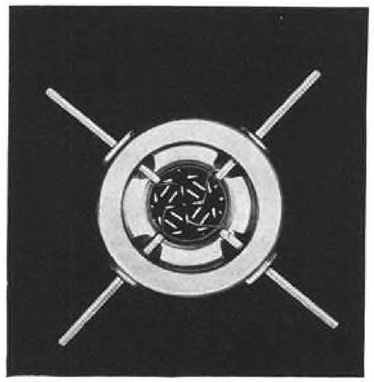
THERMAL PLOTTER

ber of avionics companies to attend a conference briefing on the new technique. Companies represented included AC Sparkplug Division of General Motors, Aerojet-General, Barnes Engineering, Boeing, General Dynamics, General Electric, International Business Machines Corp., Martin-Orlando, Remington Rand Univac Division and Space-General.

As an outgrowth of this meeting, an industry group known as the Infrared Techniques for Electronics Committee has been formed to exploit and conduct further investigations of the new technique. The committee is headed by E. F. Dertinger of Raytheon's Equipment Division, with Dr. Vanzetti as technical chairman.

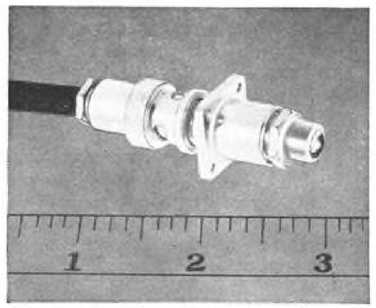
Merger Talks Terminate

Marquardt Corp. and Packard Bell Electronics Corp. announced last week that they had terminated discussions on a possible merger (AW Oct. 15, p. 32). Marquardt, primarily interested in Packard Bell's digital computer capability, reportedly was unwilling to accept other operations of the Los Angeles company.



• **Microminiature pressure transducer,** weighing only 3 grams, uses silicon piezo-electric bridge in flush diaphragm with no moving parts. The type APG-101 provides full-scale output of 300 mv., operates over range of 0-50 psig., has a natural frequency of 25 kc., hysteresis of 0.5% and is accurate to within 1% full scale, according to manufacturer: Amelco, Inc., Electron Devices Div., 341 Moffett Blvd., Mountain View, Calif.

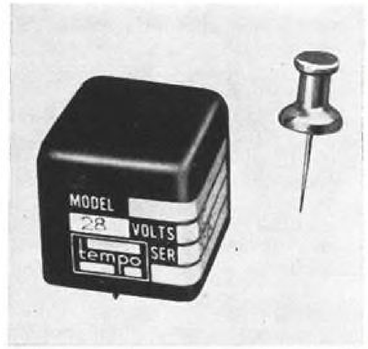
• **Laser power transducer,** for measuring thermal power from intense, transient sources such as lasers, flash lamps, rocket exhausts, is available with rise



time ranging from 0.1 to 10 microseconds, with sensitivities ranging from 0.1 to 10 mv./watt. For measuring short duration pulses, transducer can stand more than 100 kw./sq. cm. Manufacturer: Endevco Corp., 801 South Arroyo Parkway, Pasadena, Calif.

• **Butler beam forming matrix,** when connected to an N-element antenna array, provides N simultaneous, overlapping isolated beams, each pointing in a different direction and using the full projected antenna aperture. The Butler arrays are available both in narrow and broadband models at any operating center frequency between 0.5 and 8.0 gc. (kmc.). Adjacent beam isolation is quoted at 35 db. Application data is available in Bulletin No. 401. Manufacturer: Advanced Development Laboratories, Inc., Haines St., Nashua, N. H.

• **Miniature solid-state circuit breaker,** protective device for use in d.c. circuits, with no moving parts, detects and responds to overloads in a few microseconds. Device is available in current



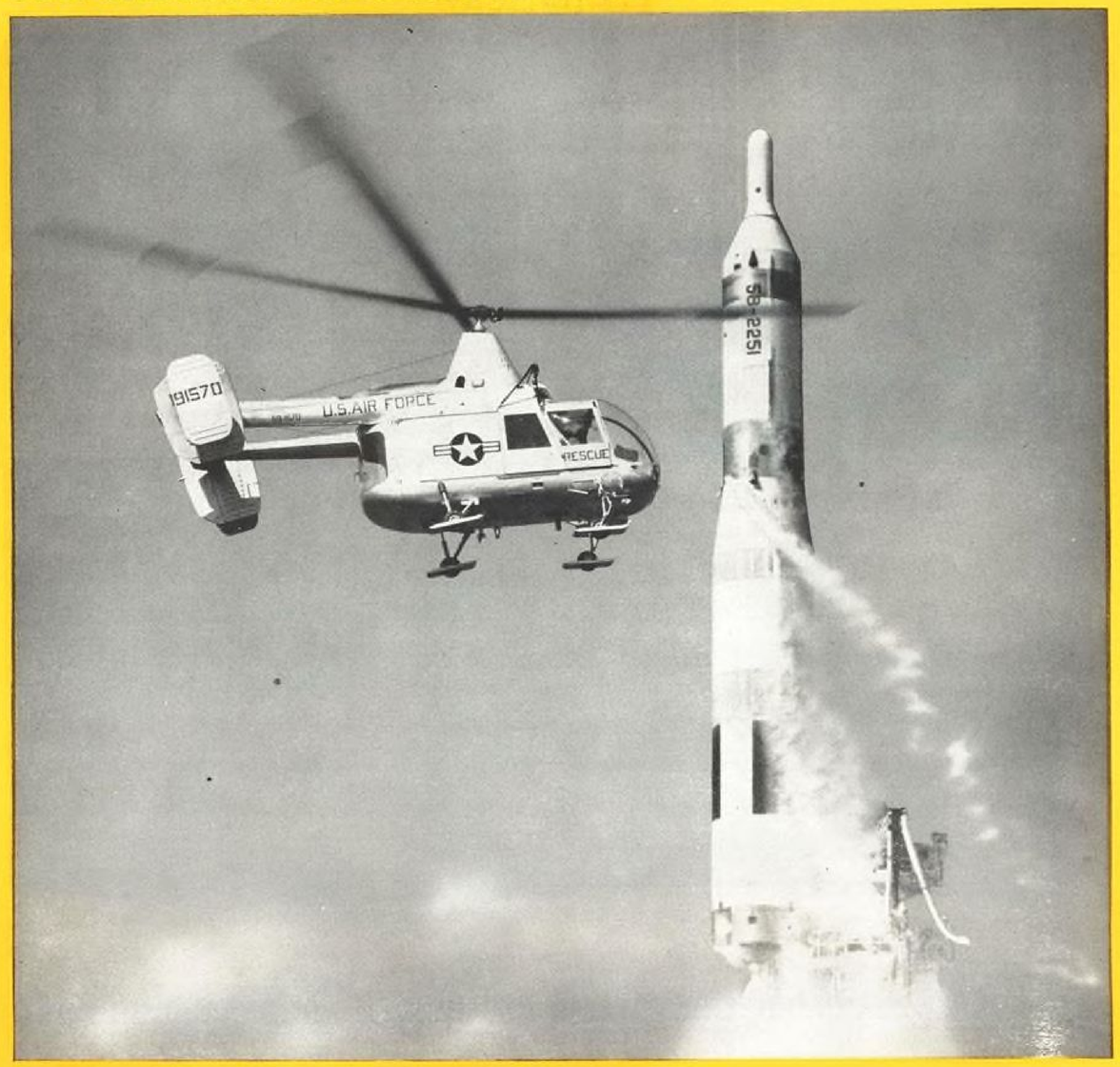
ratings up to 5 amp. at 6 to 28 v.d.c. for operation over temperature range of −55C to 125C. In current ratings up to 250 ma., device occupies only 0.32 cu. in. Breaker can be reset by remote momentary switch. Manufacturer: Tempo Instrument, Inc., East Bethpage Road, Plainview, L. I., N. Y.

• **Latching - type waveguide switch,** Model W51AH2L, designed for X-band operation, does not require continuous application of current to keep switch in open or closed position. A 30-millisecond pulse of 900 ma. current is



required to open switch and a 10 millisecond pulse of same amplitude is required to close it. Isolation is 55 db. minimum, insertion loss is 0.1 db. maximum and VSWR is 1.05:1 for any 10% band, according to manufacturer: Waveguide, Inc., 851 West 18th St., Costa Mesa, Calif.

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Kaman's HH-43B is purely and simply the helicopter which can provide maximum effectiveness of the Defense Program dollar . . . and it's in the ready inventory! ***Inventory Status****—USAF logistic support in being . . . hundreds of USAF pilots and mechanics qualified in type . . . In production with proven dynamic components . . .* ***Reliability****—Best record of safety and dependability of any USAF helicopter . . . lowest accident rate . . . holder of world's records for distance, altitude and payload . . . minimum maintenance . . . 1000-hour dynamic components . . .* ***Productivity****—Based on the factors of range, speed, payload and altitude, the HUSKIE can provide the most favorable ton/mile factor of any helicopter in its class . . .*

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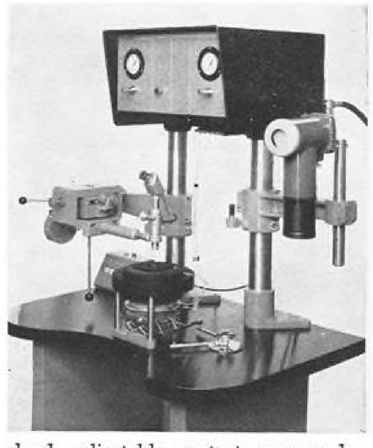
THE Bendix CORPORATION **Bendix Computer Division**

• **Memory plane & stack tester,** Model 2145A, is fully automatic system for making detailed analysis of operation of all types of coincident-current and



word-organized magnetic memories. System tests continuity and directions of access and sense wires and determines the composite sense output characteristics. It can generate a variety of programs for testing all phases of memory operation. Maximum scan capability of the system is a matrix of 128 x 128 cores, or an over-all total of up to 16,384 words. Manufacturer: Computer Instrumentation Corp., Route 38, Cherry Hill, N. J.

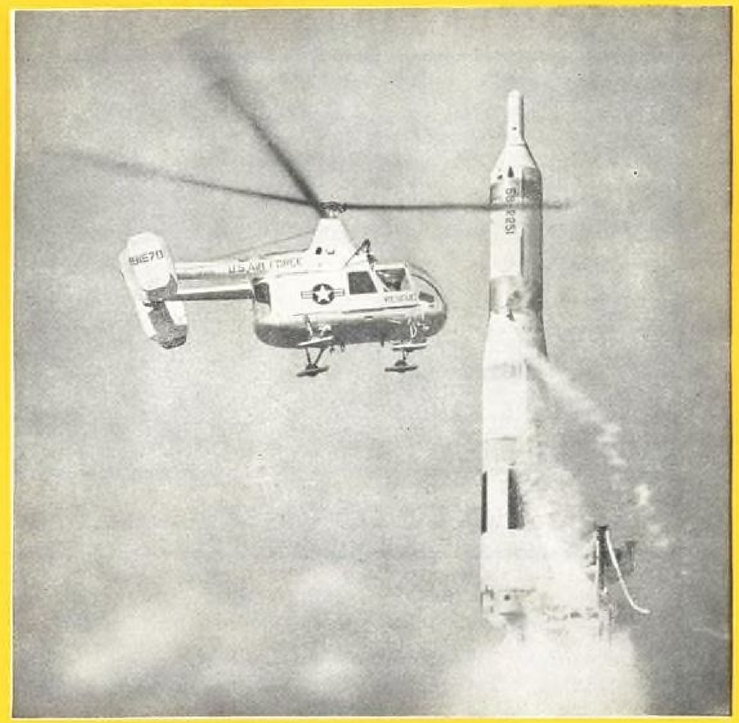
• **Microcircuit alignment machine,** for precision positioning of glass masks and wafers, provides self-aligning wafer



chuck, adjustable contact pressure between wafer and mask and a micromanipulation control. Bulletin No. 675 gives further details. Manufacturer: Kulicke and Soffa, 135 Commerce Drive, Industrial Park, Fort Washington, Pa.

• **Large laser crystals,** calcium tungstate-doped glass, are now available as rods in quarter-inch diameter up to five inches long and half-inch diameter up to four inches long. On special order the quarter-inch diameter crystals can be supplied in 10-in. lengths and the half-inch diameter crystals in lengths up to six inches. Manufacturer: Isomet

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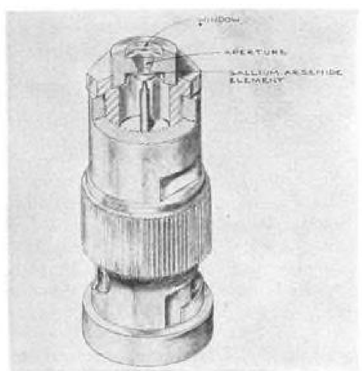
• **Sensitive photo-multiplier tube,** Type K-2276, has twice the sensitivity of previous models in the visible and near infrared part of spectrum, with peak



response in the 7,500 to 8,000 angstrom unit range. The 10-stage tube provides median amplification of 300,000, according to manufacturer. Tube measures 1¼ in. in diameter. Manufacturer: Electronic Tube Division, Allen B. DuMont Laboratories, Clifton, N.J.

• **Shock monitor system,** for use when transporting precision systems which can be damaged by excessive shock en route without external evidence of such damage. Device contains vertical and horizontal accelerometers which indicate shock levels above any preset value ranging from ½g to 100g. Manufacturer: Aerodyne Controls Corp., 90 Gazza Blvd., Farmingdale, N.Y.

• **Infrared emitting diode,** gallium-arsenide type GAE-402, emits radiation at nearly 9,000 angstroms wavelength. Radiated power output of 1 mw. can be obtained at room temperature or more than 25 mw. when diode is cooled to



77K. Diode is mounted in a UG-88/U type connector which permits modulation at microwave frequencies. Device is priced at $175 in sample quantities with delivery quoted at two weeks. Manufacturer: Philco Corp., Special Products Operation, Lansdale, Pa.

Telstar Silenced After Reliability Record

Murray Hill, N.J.—First major malfunction in Telstar developed in the command system, preventing ground stations from turning on the communication satellite's transmitter-receiver, less than a week after Bell Telephone Laboratories made a detailed report here on the techniques which had enabled it to set a reliability record for U.S. satellites of comparable complexity.

Despite the greatly increased Van Allen radiation produced by the July 9 Starfish high-altitude nuclear test, Telstar performance matched or exceeded original design objectives for more than four months, BTL reported here to 200 industry and government representatives.

The failure on Nov. 23 may be an outgrowth of an earlier intermittent malfunction, also in the command circuitry. Telstar contains dual command channels, the only redundancy employed, with provisions for ground stations to shut down one channel and check whether the other was operating properly. About two months ago an intermittent malfunction developed which made it impossible, at times, to shut down one command channel, but this did not affect the basic communications functions of Telstar.

In designing, building and delivering Telstar within 15 months of the date that a launch agreement was signed with the National Aeronautics and Space Administration, without prior experience in spacecraft design, BTL demonstrated a lesser-known aspect of its capability. While BTL is famed for its basic research which has produced such breakthroughs as the transistor and the laser, its capability in hardware design and prototype construction is not as well known outside the Bell System.

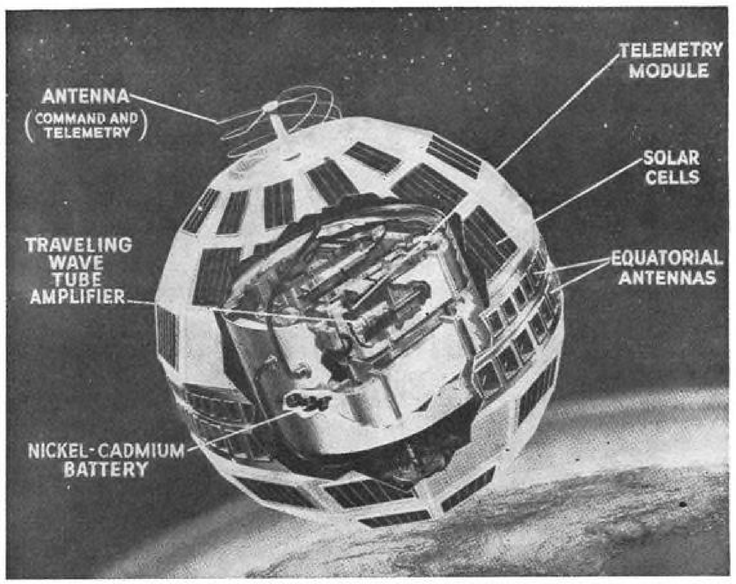
Reports delivered here by 12 BTL scientists indicate that Telstar owes its reliability to a well-planned systems approach with meticulous attention to small details which characterizes Bell System developments such as the submarine cable. However, Telstar required a broader spectrum of scientific disciplines than previous Murray Hill projects, according to one spokesman.

The systems engineering approach in making design decisions is typified by the choice of design for the traveling wave tube power amplifier used in the Telstar transmitter. Traveling wave tubes with comparable power levels are available which weigh less than the 6.75 lb. of the tube which BTL developed and used in its satellite.

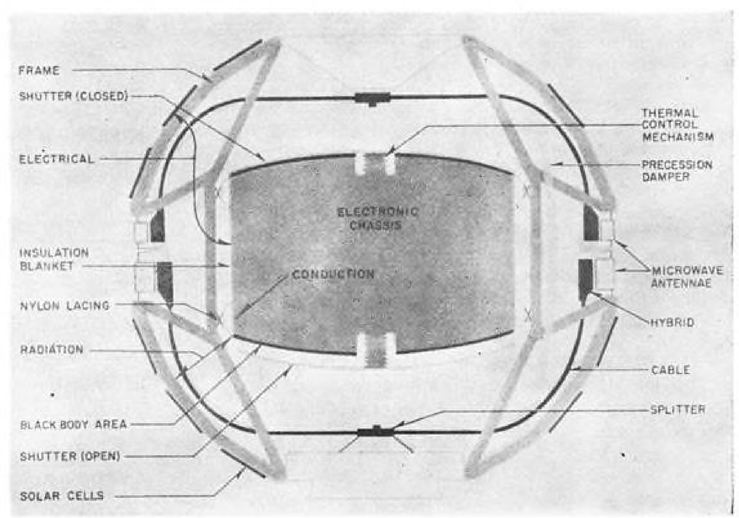
But these lighter weight tubes have considerably lower over-all efficiency than the 30% figure of the tube selected, according to D. A. Chrisholm. The BTL tube permitted the use of fewer solar cells and batteries with an over-all weight saving in the satellite.

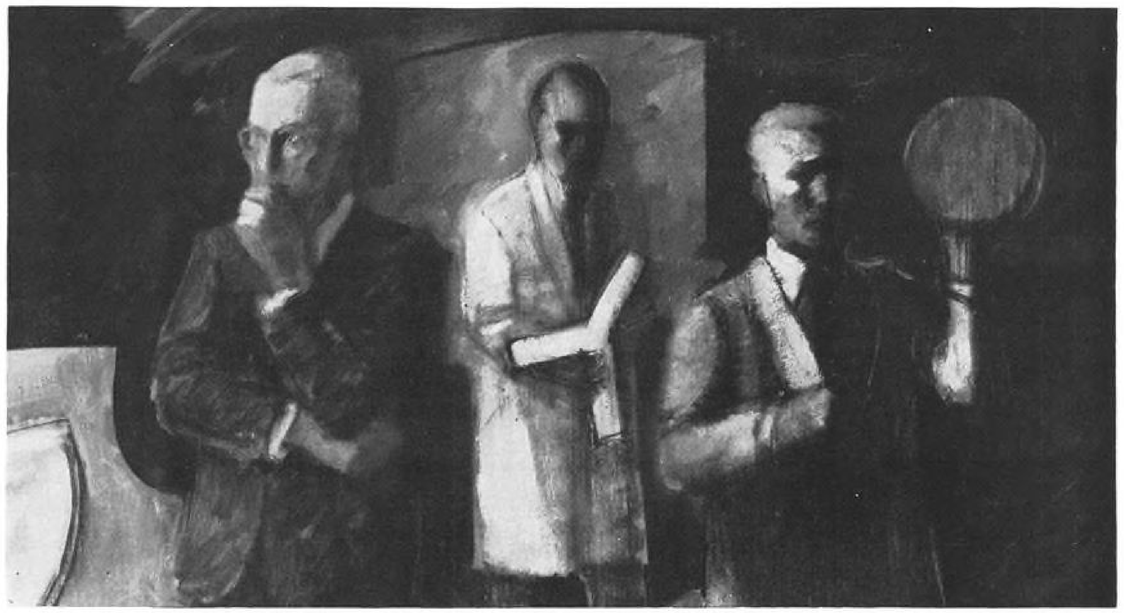
The 15-month Telstar timetable meant that commercially available or in-house available components had to be used wherever possible. But when early life tests on commercially available nickel-cadmium batteries showed a high failure rate due to leakage and other causes, suggesting a low probability of providing two years operation in orbit, BTL designed and built an improved cell and these are used on Telstar.

Where others have used dual (redundant) equipment design in an effort to achieve satellite reliability, BTL adopted a philosophy of non-redundant



TELSTAR PERFORMANCE was result of painstaking reliability effort, encompassing both components and system design. Details of program were reported at recent Bell Telephone Laboratories symposium. Major elements of Telstar are shown (top). Avionics payload in canister is suspended from nylon cable (bottom) to isolate from vibration. Payload temperature is maintained nearly constant by two diaphragms which automatically open (below) and close (top) actuated by pressure generated by thermally sensitive fluid.





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SYSTEMS ANALYSIS Analysis and simulation of complete nuclear power plants to develop reliable, unattended, completely automatic control and instrumentation systems including reactor kinetics, dynamics, hazards and reliability analysis.

REACTOR SHIELDING Experimental and analytical shielding techniques and materials development for both central station and compact power reactors.

STRESS ANALYSIS Experience in either thermal stress or dynamic stress resulting from shock and vibration loads in aircraft structures. Responsibilities will entail design support for compact nuclear power plants for space applications including review of all designs with respect to stresses resulting from thermo gradients and transients, static loadings, and vibrational and shock loadings.

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Contact: Mr. G. Y. Newton, Personnel Office, Atomics International, 8900 DeSoto Avenue, Canoga Park, Calif.

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design, relying instead upon ultra-conservative design and component selection. With a component count of 7,385 exclusive of solar cells and mechanical elements, and a design objective of two years of operational life in orbit with a 90% confidence level, components with failure rates averaging one per billion hours were needed, BTL analysis indicated.

To meet this objective, BTL designers tried wherever possible to limit their choice of types of components to those which were in high production where manufacturing techniques had been stabilized and extensive reliability data was available.

Sharp component derating was used in all applications. For example, capacitors were operated at no more than 50% of their rated voltage, resistors at no more than 50% of their power ratings and transistors at 10% or less of their rated power.

Resistor Selection

In selecting types of resistors used, designers avoided those that pushed a manufacturing technique near its upper limit. For instance, thin film resistors can be produced in values up to about one megohm, but for Telstar only units with values up to ¼ megohm were used, Henry A. Stone reported.

To minimize the possibility of a shift in Telstar performance due to vibration or shock during launch, adjustable devices involving moving parts were avoided wherever possible. For example, instead of using a potentiometer a series of fixed resistors was employed with the selection of resistance values used to trim up the circuit to the required performance.

Every component that went into the satellite underwent aging tests, averaging 15 weeks and longer where the Telstar 1 timetable permitted, to weed out early failures and to permit selection of components exhibiting stable and normal aging characteristics.

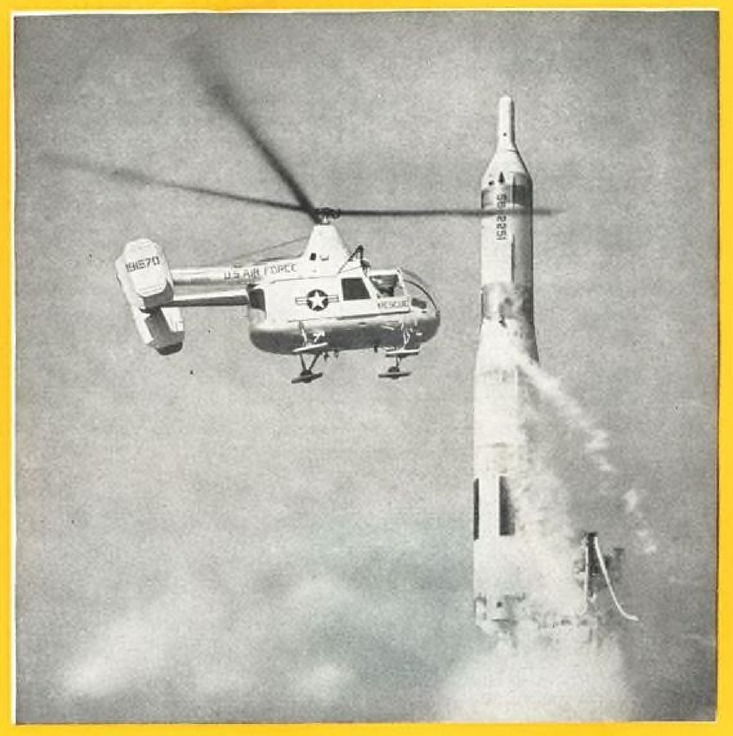
Component Screening

Any component whose characteristics after aging differed significantly from the norm for that type component, even when the difference might result in improved system performance initially, was rejected. For example, a resistor which aged less than the norm might exhibit this performance because of two intrinsic faults which temporarily compensate for one another but which in time would be the cause of a failure.

"We avoided the unknown even when the effect might appear to be benevolent," Stone said.

Oil-filled capacitors and those using liquid dielectric were ruled out because space radiation might produce gas bubbles and puncture the seal. The bulk

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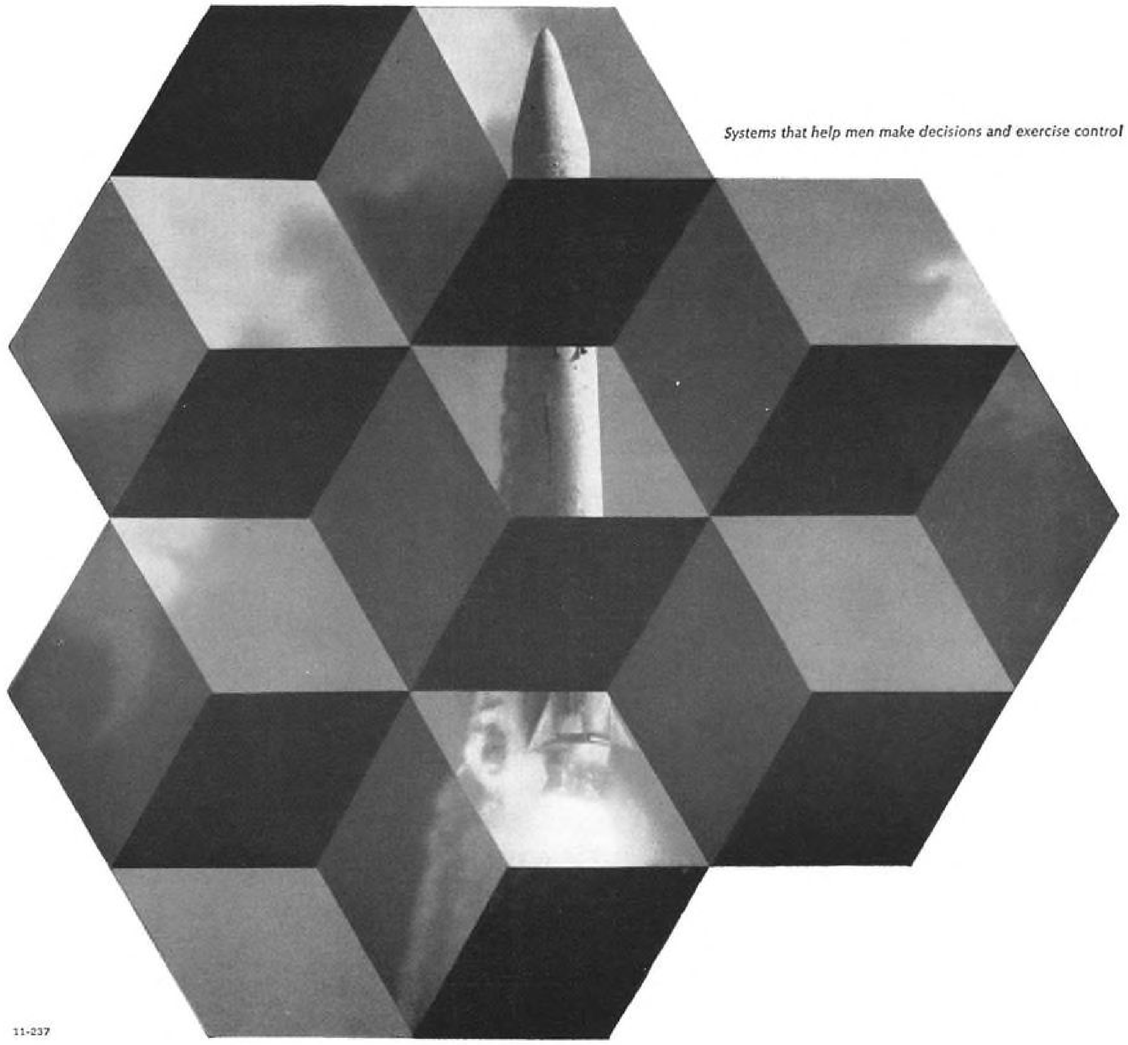
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11-237

of capacitor needs were filled by solid tantalum and ceramic types, with a few glass and Mylar units. All tantalum capacitors were subjected to X-ray inspection at the source to detect impurities which might cause failure.

Most of the semiconductor devices came from the Western Electric military semiconductor production line which is producing high-reliability types for Nike Zeus and other defense programs. Despite this, BTL selected only 40% of those put on aging tests as being suitable for Telstar use.

Design Tests

Prior to selecting the types of semiconductors to be used, BTL subjected them to design qualification tests which included shock tests of 2,000g for 0.2 ms. duration, centrifuge tests up to 10,000g and vibration tests of 100g at 80 cps. for devices mounted internally and 100-2,000 cps. for those mounted on the satellite skin.

Design qualification tests also included radiation vulnerability under proton, electron and gamma-ray exposure. These pointed to the need for conducting radiation tests during the subsequent screening process to select units for satellite use, D. S. Peck said. Radiation levels far below those required to cause body damage to a transistor can cause a significant increase in the collector reverse current, with a corresponding adverse effect on its current gain.

Two types of silicon transistors showed considerable degradation under the low-level radiation exposure and were therefore rejected for use. During the aging-screening tests, BTL selected transistors which exhibited the lowest reverse collector currents for use in the more critical circuits, Peck said.

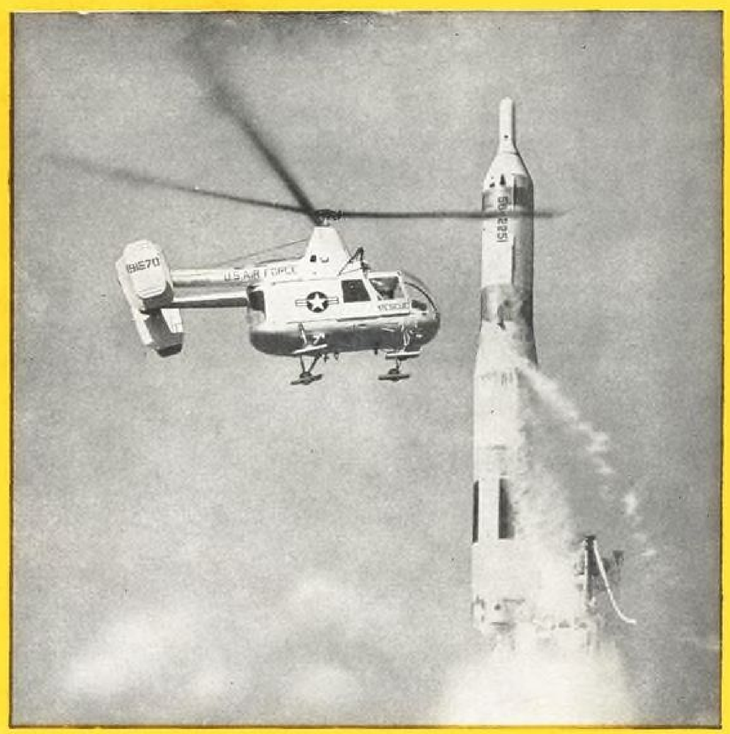
Battery Tests

Early BTL tests on a group of commercially available nickel-cadmium batteries disclosed that 30% of the group had significant leakage of the electrolyte. Although these cells might be suitable for an orbital lifetime of less than a year they were potentially a weak link in the two-year Telstar lifetime objective, L. F. Moose said. Additionally, there was considerable variation among cells in their capacity, according to Moose.

Recognizing that there was not sufficient time to develop a basically new cell, BTL launched a product improvement program in a field where it had no prior direct experience. A more reliable ceramic seal and improved brazing techniques were devised.

But this raised a new problem because the cell generates gases internally during recharge which in a leak-proof cell might produce explosive forces. The amount of gas generated can be

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☾♂♀ Left to right, above, astronomical symbols for the Moon, Mars, and Venus.

reduced if an excess of capacity is provided in the negative electrode. To assure this excess capacity, the positive and negative electrodes were assembled in matched pairs and the quantity of electrolyte added was carefully controlled according to the core weight.

The new cells were subjected to qualification tests, including 40g vibration from 5 to 2,000 cps. in two planes for 1½ hr. as well as to 30g acceleration in two planes for one-half hour, with no failures observed, D. C. Bomberger reported. A group of 122 cells were constructed and placed on screening test in November, 1961, with deep discharge and charge cycles to simulate orbital use. By April, 1962, another 391 of improved design were added to the test group.

The seven batteries used in Telstar were selected from the improved design group. Out of a total of 513 cells on test, the initial group for a year and the improved design for six months, there has been only one operational failure to date. This was a cell which developed a short circuit, according to Bomberger.

Using an extremely sensitive detection device (water-moistened P-H paper), minute leaks have been detected in all of the early design cells which have been on test for a year, but less than half of the improved design seals show any sign of leakage after six months of tests.

However, Bomberger emphasized that this leakage is so minute that it has not manifested itself adversely in battery performance. All cells are exhibiting their normal capacities and no excessive end-of-charge voltages are found. Despite the major improvement



Miniature Computer

Miniature general purpose digital computer, Model L-2010, with magnetic disk memory of 4,096 words, 30-bits in length, costs about $40,000. Addition, subtraction time is 78 microseconds, multiplication requires 0.156 to 2.42 milliseconds. Internal makeup permits direct or buffered communication with input, output devices. Librascope Division, General Precision, Inc.

HH-43B HUSKIE

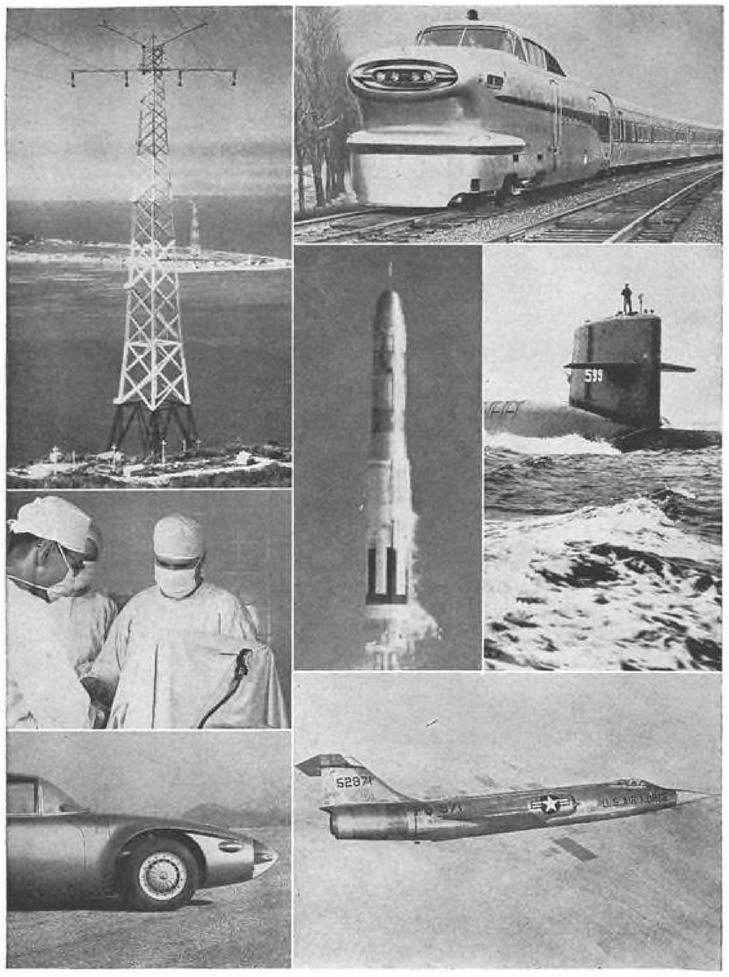


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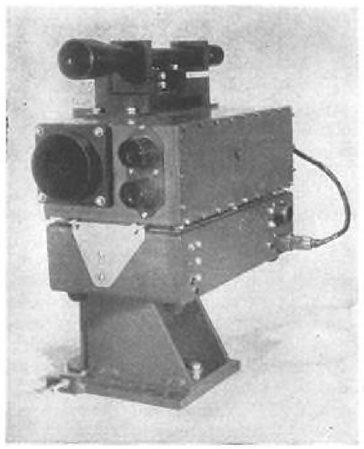
In almost every imaginable area of science and industry, you'll find that CEC multi-channel recording oscillographs measure up as the very finest measuring and recording instruments available. Their versatility, dependability and accuracy have made them the recognized standard of excellence for literally thousands of dynamic testing programs currently being carried out in all parts of the world. And, in addition to the broad variety of recording oscillographs, CEC also produces signal conditioning equipment and power supplies that represent the ultimate in reliability.

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Infrared Tracker

Martin infrared tracker (Mirtrak), can be used to guide short-range missile to its target. Missile would carry flashing infrared light source which is automatically tracked by Martin device, compared with pre-sighted direction of target to generate signals to correct missile trajectory. In production, Mirtrak is expected to weigh 15 lb., to have field of view of 20 deg. for acquisition, 1 deg. for tracking, with accuracy of 0.1 milliradian, equivalent to one foot at 10,000 ft. range. Power consumption is only 4 w. Device was developed by Martin Electronic Systems and Products Division, Baltimore.

in cell performance, Bomberger says that still better cells are needed to assure orbital lifetimes of five years or longer required for an operational communication satellite.

The BTL-developed traveling wave tube used in Telstar underwent 2,871 hr. of aging prior to being selected for its important mission. Telemetry data transmitted from Telstar during the first 1,000 orbits shows that helix and collector currents are remarkably stable. The anode current consumption has increased a few milliamperes, but this is an aging characteristic of all tubes which BTL life tested, D. A. Chrisholm reported.

The meticulous attention to detail applied in component selection was carried over into assembly of the satellite payload. Assembly of components into circuitry was carried out by specially selected operators in controlled environment rooms. After each circuit board was assembled, it was subjected to a very careful inspection by another operator with particular attention given to soldered joint quality. This procedure of inspection at every waypoint in the assembly is "extremely important," R. H. Shennum told the conference.

After each major subassembly was completed and had passed all electrical tests, it was placed in a mold into which polyurethane foam was poured to fill the voids, locking each component into position. The encapsulated subassembly then was subjected to mechanical vibration and shock tests during which its electrical performance was monitored.

The major encapsulated subassemblies were then installed in the internal metal canister, their operation electrically checked, and the canister then was filled with polyurethane foam, followed again by tests.

Insulating Blanket

The canister was enclosed in an insulating blanket, consisting of about 30 layers of Mylar aluminized on both sides and separated by glass-fiber spacers to minimize radiant heat transfer from the chassis to the satellite skin. The insulated canister then was placed in the satellite shell and suspended from its frame by means of nylon lacing which provided vibration isolation and minimized heat transfer to the skin by conduction.

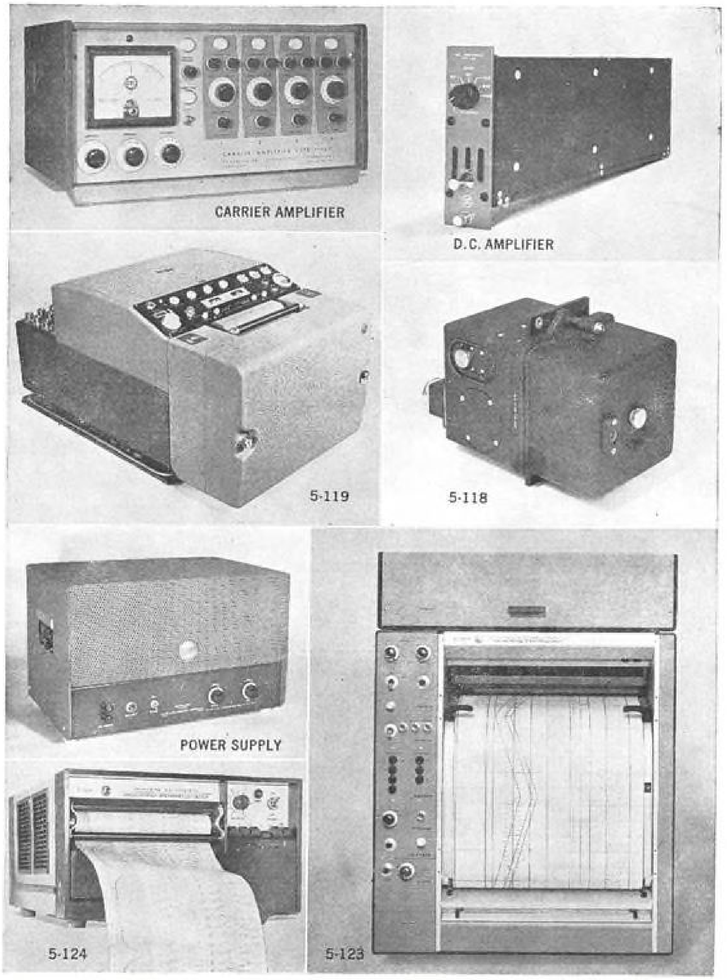
Temperature control of the canister is provided by two metal diaphragms, one above and one below the canister, which are spring-loaded closed. Internal pistons operated by pentane charge fluid, whose pressure varies with temperature, overcome the spring forces to open the covers. The design is such that when the canister temperature is 50F the diaphragms are fully closed and at 80F they are fully open, allowing internal heat to radiate to the satellite skin.

Telemetry data indicates that Telstar's payload reached an equilibrium temperature of 74F within the first day after launch, a figure which was within one degree of the calculated mean temperature, J. W. West reported. Since that time the temperature has dropped slightly because the satellite is spending more time in the earth's shadow. For the last several months the temperature of the satellite's payload has held within several degrees.

Dummy Satellites

To permit simultaneous development and test in several technical areas, BTL constructed a number of "dummy satellites," West indicated. One was used to develop and test the satellite antenna system, two were used to measure vibration levels for various shell components, while two more were used to check out the operation of the temperature control system.

In addition, two substantially complete Telstar satellites were constructed, one to serve as a mechanical development model and the other as an electrical development model. Finally, a prototype unit was built and subjected to a full range of environmental and op-



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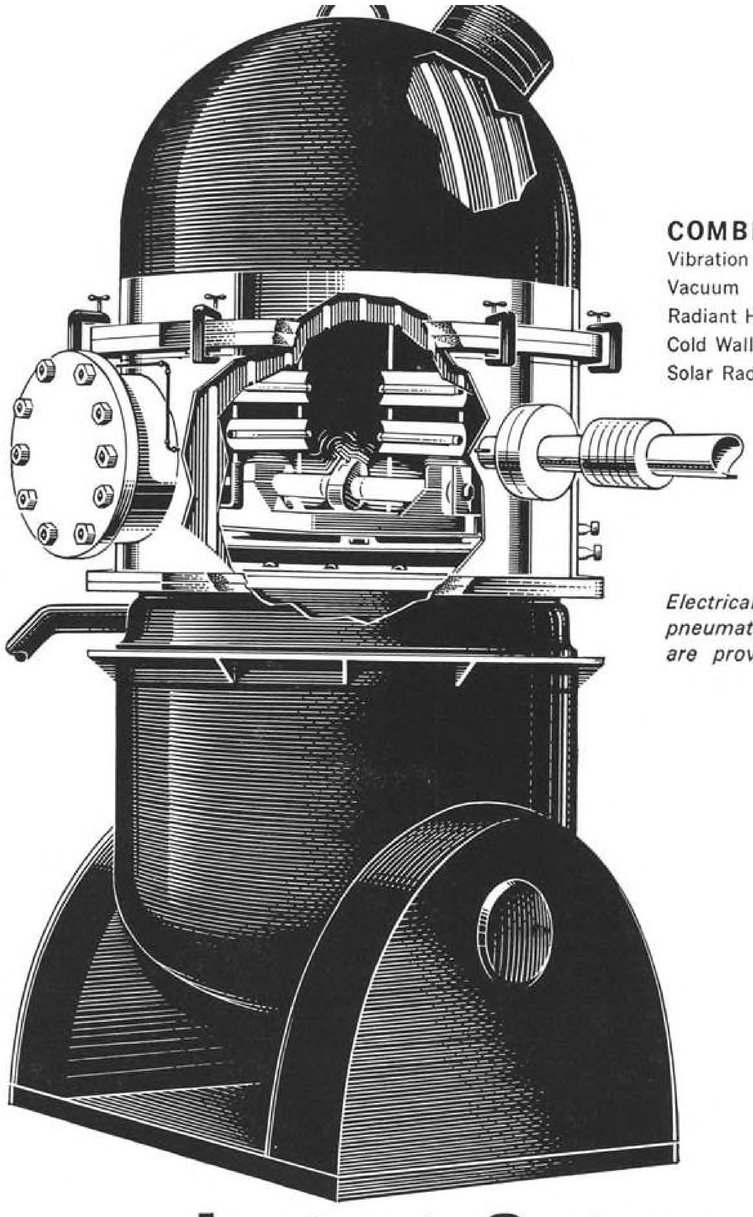
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In addition to the sophisticated simulator . . ⇨

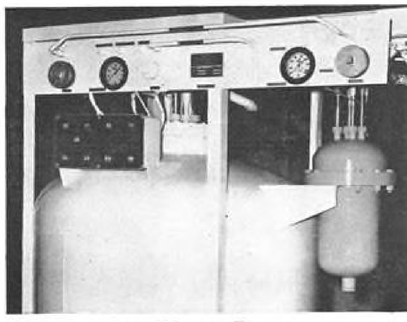
Other Beech Capabilities In Systems Management Include:



R & D . . .



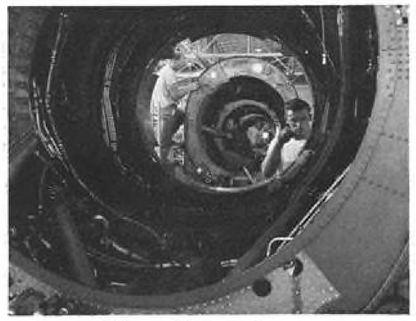
Propulsion . . .



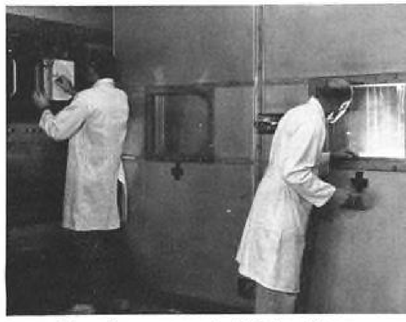
Auxiliary Power . . .



GSE . . .



Manufacturing . . .



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SERVO MOTORS		Stall Torque In. Oz.	No Load Speed RPM	Rotor Inertia GM-CM²
4 Pole	CM00129350	0.22	10,525	0.18
	CM00130450	0.33	10,525	0.18
6 Pole	CM00127350	0.19	7,300	0.46
	CM00128450	0.28	7,300	0.46
	CM00131350	0.22	7,000	0.18
	CM00132450	0.34	7,000	0.18

TACHOMETERS		Volts/1000 RPM	Signal/Noise	Linearity
Rate	CM00854 . . .	0.6	60:1	0.04%
Damping	CM00844 . . .	0.445	55:1	0.25%
High Signal to Noise Ratio	CM00834 . . .	1.1	110:1	0.25%
Temp. Comp. Integrating	CM00864 . . .	0.52	52:1	0.04%

Rounding out this line are Inertial and Viscous Damped Motors, Braked Motors, Stepper Motors, D.C. Tachometers and Alternators, Gearheads and naturally the best Size 8 Synchros and Resolvers available.

GENERAL PRECISION AEROSPACE

KEARFOTT DIVISION
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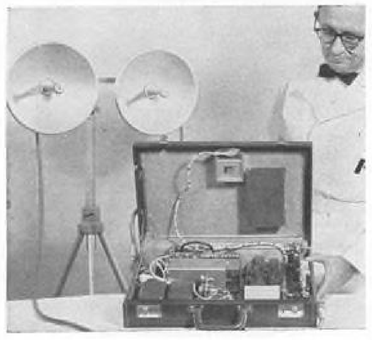
erational tests, followed by the first flight model.

The ability which Telstar's solar cells have demonstrated to withstand the intensified Van Allen radiation produced by the July 9 nuclear test reflects extensive effort which BTL put into design of satellite's power system.

The decision to break with tradition and use the newer, more radiation-resistant N-on-P type cells resulted in part from extensive radiation tests which BTL conducted using a Van de Graaff generator. These clearly indicated that the newer type, despite its initially lower power output, should exhibit significantly greater longevity in the presence of the natural Van Allen radiation, H. G. Gummel said.

Where most previous satellites have used fused quartz to shield solar cells against radiation and micrometeorite damage, BTL's investigation of many materials prompted the selection of sapphire in 30 mil thickness for its increased radiation protection. Because sapphire has inferior heat conduction characteristics, BTL had to devise an improved means for cooling the solar cells. This was accomplished using a solar cell mounting plate which transferred heat from the cells to the satellite shell by means of silver clips and platinum side strips, R. J. Nielsen said.

American Telephone & Telegraph Co. earlier had deferred plans to launch Telstar 2 because Telstar 1 was still operating and had carried out all of the originally planned experiments. If the recent Telstar 1 malfunction does not clear itself, the company will reconsider its earlier decision.



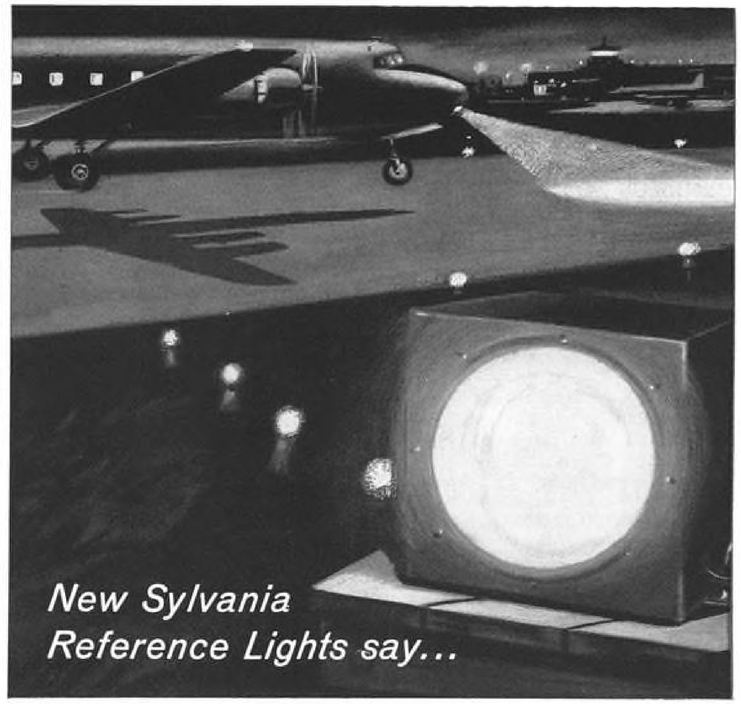
Spaceborne Radar

Spaceborne radar prototype, called Decor, an acronym for digital electronic continuous ranging, can measure range and velocity from distances of thousands of miles and velocities from thousands of feet per second to less than one foot per second, according to Fairchild Stratos-Electronic Systems Division. System measures phase-shift resulting from propagation time in digital manner, permitting maximum use of microcircuit construction techniques.

FILTER CENTER

► **Manned Spacecraft Center Competition Opens**—Industry proposals for the job of implementing Manned Spacecraft Center's Integrated Mission Control Center (IMCC) and integrating the Ground Operational Support Systems (GOSS) into IMCC are due at Houston, where IMCC will be located, on Dec. 7. The multi-million dollar manned control center is expected to be the hub of Apollo and rendezvous phases of Gemini missions, much as Mercury control center has been in the manned Mercury flights. Ten avionics companies invited to bid are Bendix Radio, General Electric, Hughes, International Business Machines, International Telephone & Telegraph, Lockheed Missiles & Space, Philco, Radio Corp. of America, Raytheon and Space Technology Laboratories. Philco's Government and Industrial Division, Palo Alto, Calif., which has been conducting NASA-funded studies of all phases of Apollo and Gemini ground control since last spring is reported to be one of the leading contenders. IBM previously (AW Oct. 22, p. 26) was selected as associate IMCC contractor for a central, real-time data processing facility and a separate competition for two mission simulators to be incorporated into IMCC will be held shortly (AW Nov. 12, p. 38). Besides the computer facility, IMCC will include communications, simulation, mission control and RF receiving and transmitting facilities. The implementation contractor will handle detailed systems design, equipment procurement, systems planning and integration and IMCC activation.

► **Electric Propulsion Application Detailed**—Satellite electric propulsion system employing nine cesium ion engines to be built by Hughes Research Laboratories for Lewis Research Center is expected to control attitude of advanced 24-hr. satellites to $\pm\frac{1}{2}$ deg., and their position to ± 0.1 deg. Each of the nine engines will have specific impulse of 4,500 sec. and the six attitude control engines will provide $\frac{1}{2}$ of a thousandth of a pound thrust and the three station keeping engines 1.5 thousandths of a pound. Average power required by the 42-lb. system will be 137 w. Power supply consisting of solar cells and batteries will weigh 78 lb. The system will have nine thrusting directions at four stations—two north-south and one east-west for station keeping and six for three-axis attitude control. Attitude control engines will employ unusual arrangement of linear strips, experimental versions of which recently were built by Hughes.



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Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

Air Force Weapons Meet Won By J79-Powered USAF Lockheed F-104

NELLIS AFB, Nev.—USAF Capt. Charles E. Tofferi, piloting a J79-powered Lockheed F-104, outperformed his nearest rival by 1700 points to win the individual competition in the USAF Weapons Meet held here recently.

Flying the lone J79-powered F-104 against 10 F-100's and three F-105's from various Fighter Wings, Capt. Tofferi scored an impressive 19,018 points out of a possible 24,000. Top pilots from the U.S., the European area, and the Pacific Command were entered in the competition.

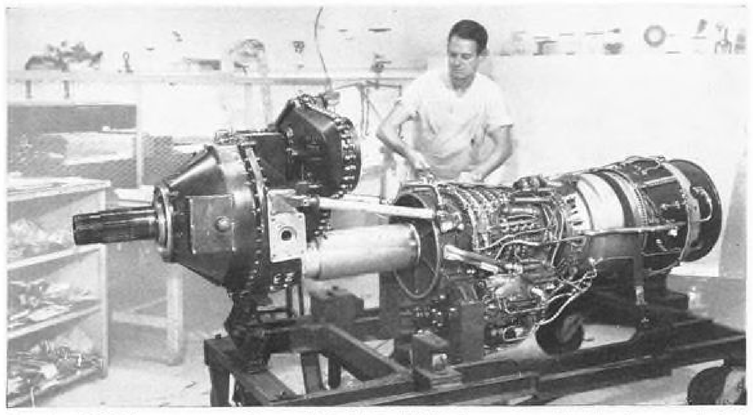
Operational with the USAF Tactical Air Command all over the world, the F-104 is now also slated for service with the air forces of 10 foreign nations, including Canada, West Germany, France, Italy, and Japan.

At one time, the F-104 held all eight world time-to-climb records—from 3000 to 30,000 meters. Today these time-to-climb records are held by the U.S. Navy's J79-powered McDonnell F-4B. The F-104 has also held the "triple crown" of world speed, altitude, and time-to-climb marks—the only aircraft ever to do so.

The F-104's record-breaking achievements have been formally recognized by several awards, including the Collier, Harmon, and General Electric trophies.



USAF Capt. Charles E. Tofferi, piloting a G-E J79-powered Lockheed F-104 Starfighter, won individual honors in USAF Weapons Meet at Nellis Air Force Base.



Rated at 2850 horsepower, General Electric's T64 turboprop engine has been selected by the U.S. Army to power its new STOL transport, the deHavilland Caribou II.

T64's to Power U.S. Army's Caribou II

LYNN, Mass.—Twin General Electric T64 turboprop engines have been selected by the U.S. Army to power the new deHavilland Caribou II STOL transport.

Scheduled for flight testing in early 1964, the Caribou II is a larger, improved-performance version of the piston-powered Caribou AC-1 now in service with the U.S. Army, Royal Canadian Air Force, and other Free World forces.

Initial orders for the Caribou II call for four aircraft. Final production decisions will await Army evaluation of the aircraft and will be dependent on military requirements.

A T64 engine flight test program on the Caribou AC-1 got underway in September 1961 and effectively demonstrated the potential of turbinizing the aircraft. During the program the T64 engines chalked up more than 350 hours operating time, 100 of them in the air. Included in these tests were evaluation of installation compatibility, one-engine-out flight performance, and in-flight starting. Engine-propeller compatibility and STOL characteristics were also studied. The Caribou II development program is already well advanced. It has included extensive design studies and wind tunnel analyses in addition to the engine flight-test work.

The Caribou II ultimately delivered to the Army will have greatly increased range and cruise speed over the conventional piston-powered Caribou. Work capacity will be doubled.

The cargo compartment of the new aircraft is compatible with the cargo space of the Army's Chinook helicopter to enable the two types of aircraft to work together in handling combat area payloads under rugged conditions. Payloads in the three- to five-ton range, which can include the Pershing missile, 105 mm. howitzer, or a ¾-ton truck, will be carried by the Caribou II.

Rated at 2850 horsepower, the T64 turboprop engine weighs 1136 pounds and has a specific fuel consumption of 0.49. The engine's present applications include the Vought-Hiller-Ryan XC-142A, Tri-service VTOL transport; Sikorsky CH-53A, U.S. Marine heavy assault transport helicopter; and Hughes hot-cycle helicopter.

Other potential T64 applications include military assault transport helicopters, medium transports, crane helicopters, close support aircraft, carrier-based anti-submarine warfare aircraft, and ground effect machines.

G-E Engine Flight Time Passes 36 Million Hours

CINCINNATI, Ohio—General Electric jet engines recently passed the 36 million flight-hour mark—more such time than has been accumulated by any other jet engine builder.

Of the total, more than 360,000 hours have been logged by G.E.'s J79 turbojet, whose operating record also includes 2500 hours of Mach 2 time.

These operating time milestones are part of a history that includes 36,000 production engines turned out by General Electric in the 20 years since the company produced the first U.S. jet engine in 1942.

Alfa Romeo Is Named J85/CJ610 Distributor For Italian Aviation

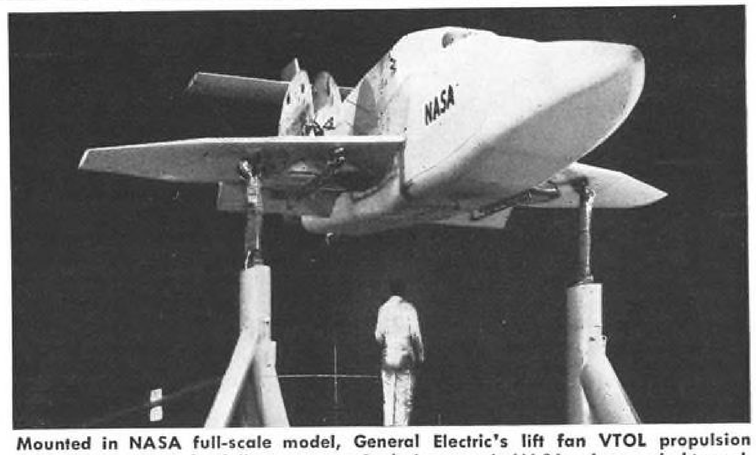
LYNN, Mass.—Alfa Romeo has been named distributor for General Electric J85/CJ610 turbojet engines in Italy, under terms of an agreement with G.E.'s Small Aircraft Engine Department.

As a distributor, Alfa Romeo is authorized to sell G.E.'s J85-5, -7, -13, and CJ610 engines to Italian private and government customers. Concurrent with the agreement, Alfa Romeo is undertaking a sales campaign in Italy for the CJ610 which began with a CJ610 demonstration at the Alfa Romeo plant at Pomigiliano d'Arco near Naples.

In recent years the J85/CJ610 engine series has been selected to power a number of new military and civil aircraft, many of which are expected to see increased service in Western Europe.

Typical of these is the Northrop F-5A fighter, to be supplied to allied nations by the U.S. Department of Defense under the Military Assistance Program. The F-5A is powered by twin J85-13 turbojets.

Other applications include the supersonic Northrop T-38A trainer, powered by twin J85's; Canadair's CT-114 trainer, using a single CJ610; McDonnell GAM-72 decoy missile, powered by a single J85; Fairchild C-123H transport with J85 boost engines; and four business aircraft powered by twin CJ610's—Aero Commander Model 1121, Lear Aircraft Model 23, Piaggio-Douglas PD-808, and Hamburger-Flugzeugbau 320.



Mounted in NASA full-scale model, General Electric's lift fan VTOL propulsion system was operated at full power recently during tests in NASA—Ames wind tunnel.

G-E Lift Fan System Runs At Full Power

MOFFETT FIELD, Calif.—General Electric's lift fan propulsion system for the Army's XV-5A V/STOL aircraft was run at full power here recently in a NASA full-scale wind tunnel model.

The tests were conducted in NASA's 40- by 80-foot wind tunnel at Ames Research Center as part of a continuing program to evaluate the lift fan V/STOL propulsion system.

The current NASA full-scale model is similar to the design configuration to be used for the U.S. Army's XV-5A lift fan V/STOL research aircraft (formerly designated the VZ-11). The XV-5A is being built by General Electric and Ryan Aeronautical Company.

During the NASA tests, wind tunnel speeds ranged from 0 to 120 knots. The lift fans operated at up to a full power rating of 2640 rpm. Results have confirmed the aerodynamic and configuration design of the lift fan V/STOL aircraft, bearing out previous wind tunnel tests using small-scale XV-5A models that were conducted by General Electric and Ryan.

Second phase of the current tests is scheduled for December when NASA will install a nose-mounted pitch fan in the full-scale model for evaluation of interaction effects between the nose-fan aircraft fuselage and propulsion equipment.

The NASA tests will provide data for flight testing of the XV-5A, scheduled for July, 1963. These flights will show how lift fan propulsion can most ably meet designers' requirements for many future VTOL aircraft. The system produces two to three times more lift than is available from the aircraft's jet engines alone. Thus, the basic engines can be sized for cruise conditions and still satisfy vertical lift requirements.

This advantage will make possible important savings in fuel consumption and logistics support, besides providing greater range and payload capabilities.

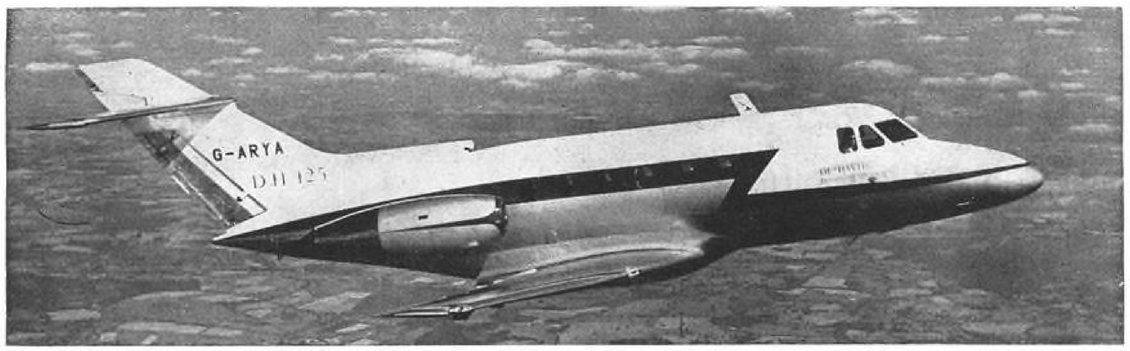


U.S. MARINE CORPS NEW MEDIUM ASSAULT HELICOPTER, the Boeing Vertol CH-46A, made its first official flight recently at Vertol's Philadelphia Flight Test Center. Powered by twin General Electric T58 engines, the CH-46A is a modified version of its civil Boeing counterpart, the Vertol 107—also powered by twin T58's. The new helicopter's primary mission is to transport assault forces into forward combat areas. The CH-46A cruises at 130 knots. The payload capacity for a 100 nautical mile radius mission is 17 combat-equipped troops or 4000 pounds of cargo.

FOR MORE INFORMATION

If you would like specific information on any one of these General Electric flight propulsion programs, write on your company or organization letterhead to: General Electric Company, Section 206-55, Schenectady 5, New York.

GENERAL ELECTRIC



WING OF THE DE HAVILLAND DH-125 is swept 20 deg. and is almost all fuel tankage. Flap hinges are external below the wing to save material and labor costs. Drag penalty is negligible, de Havilland says. A number of system components are mounted in wing fillets and the tail cone. Follow-on versions may have more powerful engines and a 150-gal. fuel tank in fuselage forward of wing root.

More Range, Power Planned for DH-125

By Herbert J. Coleman

Hatfield, England—De Havilland Aircraft designers are working on follow-on versions of the DH-125 executive jet that will extend its range and power.

Immediate future of the airplane is assured by an order for 22 from the Royal Air Force (AW Sept. 24, p. 113), one from Bristol Siddeley Engines for engine development and another from Knorr-Bremser, a German charter operator. Next move will be to improve thrust of the Bristol Siddeley Viper Mk. 520 powerplant and to design fuel tankage which will not affect the clean wing.

At the moment, and this is subject to change, the de Havilland design team is working on a tank mockup involving a 150-gal. unit which would be faired to the forward fuselage, ahead of the leading edge. Work was primarily sought by the Royal Air Force, which wants additional flight time available so the airplane may be used as a navigation and NASARR trainer.

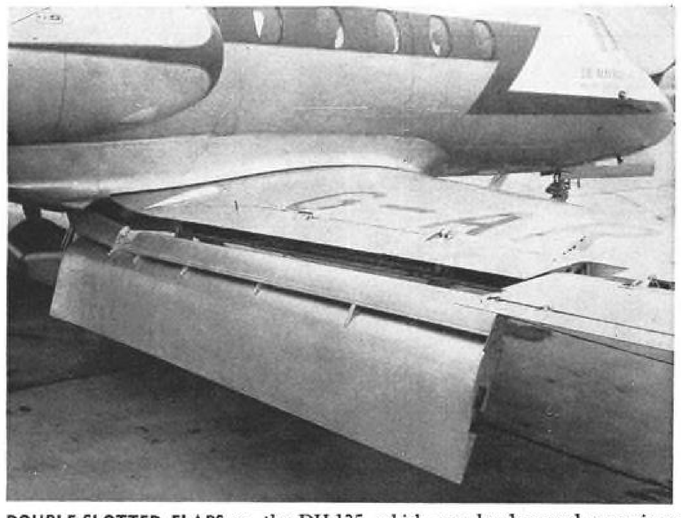
De Havilland is resisting such tankage installations as tip or slipper units on the wing. Final configuration will be a variation of the tank now being installed on the RAF mockup at Hatfield, England.

To broaden potential sales of the DH-125, de Havilland is working closely with Bristol Siddeley on an advanced version of the Viper, now rated at 3,000 lb. takeoff thrust. This engine is also specified for the Douglas-Piaggio Vespa jet, one of de Havilland's competitors.

The engine company's design effort is aimed at a version of the Viper which will produce 3,350 lb. thrust without reducing the overhaul time of about 600 hr. This version would increase DH-125 capabilities in hot weather countries and at high altitude airports.

To obtain higher thrust, Bristol Siddeley is studying use of new materials to increase the Mk. 520 Viper's 1,078K inlet temperature limit.

Since the DH-125 production version was laid down, there have been few major design changes. Top fin is now a fixed unit and a bullet-shaped fairing has been added to improve airflow at high cruise speeds. All production models will incorporate a larger front door which is curved and retracts inward to fit flush with the fuselage roof.





DOUBLE-SLOTTED FLAPS on the DH-125, which may be depressed a maximum of 70 deg., are hydraulically controlled. Slot is concealed by flap shroud when flaps are raised. Speed brake is on upper surface of wing. Bristol Siddeley Viper engines can be reached from ground level. Cowl panels surrounding the Viper engines are detachable for ease of maintenance.



PRODUCTION OF THE DE HAVILLAND DH-125 executive jet is under way at the company's Chester, England, facility. First airplane, which was demonstrated at the annual Farnborough Air Display, has been tufted for flow patterns during aerodynamic testing.

C. T. Wilkins, de Havilland's chief designer and a member of the board of directors, says the DH-125 guarantee calls for a fail-safe, trouble-free fuselage life of 10,000 flights—two flights daily, seven days a week for 15 years. Through the company's connection with the Hawker Siddeley Group, de Havilland will also develop an airplane and engine service backup network in various sections of the United States, which it considers its major market. Though this plan is based on the Viper, de Havilland has done considerable study of the General Electric CJ-610 for U. S. operators. Particular interest is in the 610's fan version, the CF-700.

First two DH-125s are being assembled at Hatfield, and the rest are being built at de Havilland's Chester production facility. Initial batch is 30.

At the same time, part of de Havilland's design team will continue to work on the proposed DH-126, a larger version aimed at the feeder-liner market. Decision on a go-ahead, as far as a prototype is concerned, is still in the future.

On the basis of flight tests, Wilkins feels that the DH-125 has met its design requirements, including:

- **Simplicity** in fuselage and wing design to cut costs and delivery prices, and to reduce maintenance problems.
- **Capability to carry** six to eight passengers for flights of up to 4 hr. on stages of 1,300 mi. or more, and to operate from short fields.

Decision to design an airplane with a cruise speed of 500 mph. avoided necessity for an extreme wing sweep and airfoil thinness and for the complexity involved in installing power controls. The wing contains fuel tanks, and each engine is fed from the tank on the same side to eliminate the need for in-flight switching. Cross-feed is available, however.

Wing, which is under the main fuselage structure and dished on the upper surface of the center section for mating to the belly, is built in a single section and is attached to the fuselage at five points. Tankage is provided from front to rear spar, and from tip to tip, divided into the two main compartments. Main spars extend from the center section to the wing tip, with a center spar extending about two-thirds of the semispan.

Upper wing surface consists of two continuous sheets of zinc-bearing aluminum alloy joined at the root to the center section cover plate. Skins are stiffened by spanwise stringers and reinforcing plates, Redux bonded to the under surface at the rib stations. Copper-bearing alloy is used for the bottom skin, which contains six manholes closed by load-carrying doors.

Fin and stabilizer are of conventional construction and both consist of box beams comprising two webs with the outer skins stiffened by stringers. Stabilizer is a continuous structure.

Main fuselage is a 6 ft. 4 in. diameter cylinder and has an unpressurized tail cone aft of the pressure dome. Canopy is similar to that of the de Havilland Trident three-jet transport. Skin is made of copper-bearing aluminum alloy with bonded stringers and with circumferential frames. To ensure low stress levels, designers used bonded reinforcing strips on the seam joints.

Window design, which also follows that of the Trident, calls for cutouts reinforced by a doubler plate and a heavy gage window pane. Window itself consists of two panes of Perspex. Each will carry pressurization loads alone.

Wilkins said the basic structure is designed on fail-safe principles by employing multiple load paths and bonded crack stoppers. Wherever these features have not been applicable, components have been designed of high tensile steel.

Flaps are double-slotted and extend for more than 55% of the wingspan and comprise 25% of the chord. Flap position is 15 deg. for takeoff and 50 deg. for landing. Speed brakes on the top and bottom surfaces of the wing form flap shrouds when retracted. For aerodynamic braking to reduce landing roll, 70 deg. of flap extension is available.

Tricycle landing gear is hydraulically operated and pilot has a nose wheel steering control. Twin wheels were incorporated in the design deliberately for use in rough ground conditions. The main wheels are staggered about 3 in. to allow them to fit smoothly into the wheel well and thus eliminate the need for cover doors, but the nose wheel, is covered by a door. Disk brakes are operated through Maxaret units to prevent wheel locking.

A DH-125 fuselage is now in the water tank at Hatfield for stress test cycling and measurement on the basic fuselage, and for cabin pressure tests. Pressure is provided by air bled from the last stage of the Viper engine com-

pressor and cooled before entering the cabin; minimum flow is 20 lb./min. Normal maximum pressure differential is 8.25 psi. Cooling is achieved by passing air through a heat exchanger mounted in tail cone and cooled by ram air. Used air is collected in an underfloor duct and dumped through a valve in the pressure dome.

Internal systems also have been kept simple. Hydraulic fluid is drawn by two pumps from a reservoir in the aft bay and pressure is controlled at 2,500-3,000 psi. by a cutout in the system. Two accumulators are incorporated in wheel braking circuits, one for normal operation of the system and the other acting as an emergency brake accumulator with a non-return valve to prevent discharging in the system.

Main electrical supply comes from two 28 v. 9 kw. starter generators which energize in parallel two d.c. bus bars. Rotary converter provides a.c. power. Two 24 v. batteries are carried in the nose section for system backup and for start power if an external power unit is not available.

De Havilland says engine changes can be accomplished in two hours. Each pod is divided into zones: Zone A has the forward intake section followed by the compressor section and auxiliary equipment. Next zone contains the combustion cans, the turbine section and a portion of the tailpipe, and the final zone is the detachable fairing at the end of the nozzle. A longitudinal firewall separates each engine from the mounting structure.

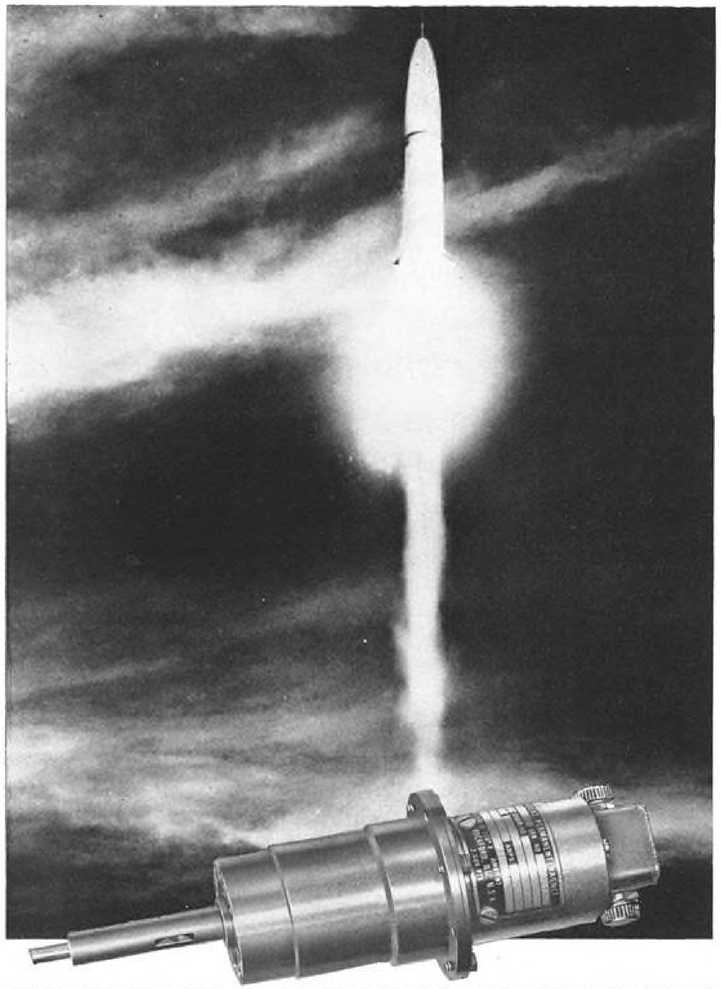
Cabin interiors are, at the present, being designed by de Havilland but an outside designer has been called in for consultation. De Havilland is doing considerable work in reinforced plastics for interior side walls and roof covering in order to save weight without reducing toughness. Cabin is 18 ft. 6 in. long and 5 ft. 10 in. wide. Recessed center aisle is clear of any wing structure and gives 5 ft. 9 in. of headroom.

Airplane, including radios, will sell for about $500,000.



Low-Cost ADF

Low-cost ADF unit, priced under $1,000 weighs 8 lb. and is fully transistorized. Power drain is 0.6 amp. Manufacturer is National Aeronautical Corp., Fort Washington, Pa.



HARMONIC DRIVE

High-torque electromechanical drive replaces hydraulics

Missile Servo Actuator: Harmonic Drive electromechanical servo actuator replaced hydraulics for advanced missile servo requirement, providing added reliability and excellent standby characteristics. It reduces input idling power demand to one-tenth, and provides high output torque and response in reduced size, weight, and complexity of components. Harmonic Drive ratio 104 : 1, rated torque 130 in-lb (capable of 1000 in-lb impact load), backlash below 2 min., weight (incl. motor) 1.45 lb, O.D. 1.625 in, length 5 in.

Do you have a problem Harmonic Drive can solve? — Available for your application: Hermetically-sealed configurations that achieve positive mechanical transmission of rotary or linear motion through a welded steel barrier . . . New extremes in static positional accuracy and rate constancy for instrumentation use . . . High efficiency, low backlash . . . Use as speed increaser or reducer . . . Sizes from sub-fractional to hundreds of horsepower.



SEND for new 32-page brochure on Harmonic Drive applications. Harmonic Drive Division, United Shoe Machinery Corporation, Beverly, Mass.; or 8438 San Fernando Road, Sun Valley, California.

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SIPA 251 Antilope Completes First Flight

SIPA 251 Antilope turboprop light aircraft recently made its first flight in France. Powerplant of the five-place aircraft is the 560 hp. Turbomeca Astazou engine. Aircraft will cruise at approximately 260 kt. and will operate over distances of 930 mi. Maximum speed is approximately 320 mph. and normal range about 1,150 mi. Gross weight is 3,300 lb. and empty weight is 1,670 lb. Antilope design originally was produced by the Italian firm of Procaer in Milan. SIPA, a private French firm, took over the design in June, 1961, and fit the aircraft with Astazou engine, in cooperation with the Italians. Estimated price is about $50,000 with standard equipment.

PRIVATE LINES

Federal Aviation Agency has prepared a guide booklet for state and local agencies that wish to acquire surplus personal property for public airport use. Personal property is defined as tractors, jeeps, snow plows, fire trucks, boundary lights, markers, winds tees and similar items. Copies of the booklet "Federal Surplus Personal Property for Public Airport Purposes" are available from the FAA Airports Service in Washington without charge.

Brantly Helicopter Corp. of Frederick, Okla., has unveiled its 1963 model two-place helicopter with a redesigned cabin which does not have the traditional "bug-eye" Plexiglas domes. Brantly says the cabin on the new model helicopter has improved visibility, is roomier and has adjustable seats. No major changes have been made in the dynamic components.

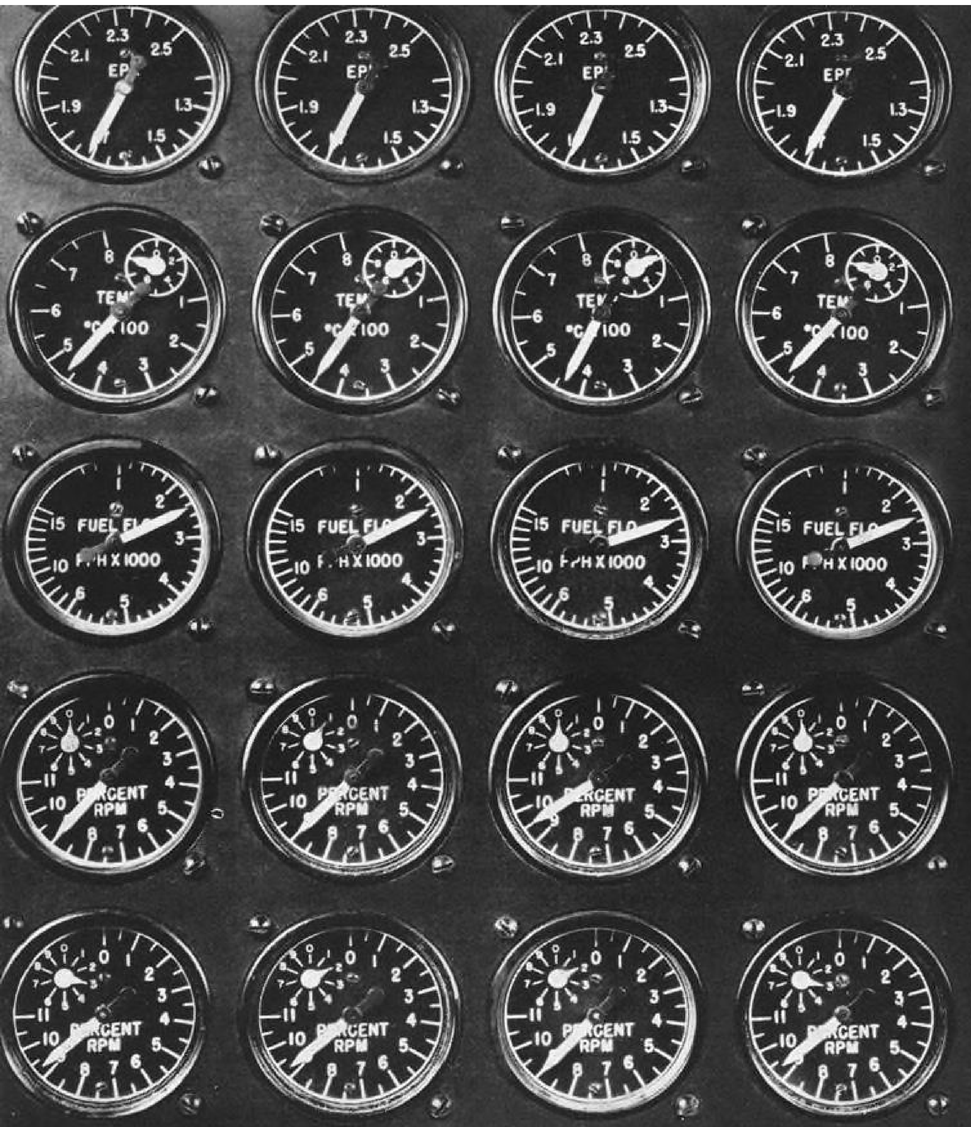
Aero Commander, Inc., Bethany, Okla., has opened an overseas sales office in Zurich, Switzerland. Office will handle sales and service requirements for Europe, Africa and the Near and Middle East. Floyd A. Atchison, international sales representative, will head the new office.

U. S. Business & Utility Plane Shipments

July 1962

Make & Model	No. of Units	Net Billings
Aero Commander 500A, B	5	
560F	2	$1,197,000
680F	5	
Beech Super 18	2	
33 Debonair	13	
35 Bonanza	17	
50 Twin-Bonanza	2	
55 Baron	12	$3,175,000
65 Queen Air	2	
80 Queen Air	8	
95 Travel Air	3	
Cessna 150	30	
172 Skyhawk	47	
175 Skylark	6	
182 Skylane	72	
185 Skywagon	21	$3,131,000
210	14	
310	14	
320 Skyknight	1	
Mooney Mark 20	38	$546,000
Piper PA-18-150 Super Cub	7	
PA-22-108 Colt	13	
PA-22-160 Tri-Pacer	1	
PA-23-160 Apache	2	
PA-23-250 Aztec	16	
PA-24-180 Comanche	4	$1,847,000
PA-24-250 Comanche	14	
PA-25-150 Pawnee	4	
PA-25-235 Pawnee	35	
PA-28-150 Cherokee	3	
PA-28-160 Cherokee	26	
Totals	444	$9,923,000

Note: This brings total shipments from the factories through July to 3,970 aircraft having a total net billing value of $82,057,000 compared to 4,138 aircraft having a net billing value totaling approximately $75,170,000 in the same period last year.



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Both of these cockpit displays convey the same information. The similarity ends there.

Round dials with their pointers have been the conventional cockpit display since airplanes first used instruments. Although highly refined over the years, they cannot be read with the speed and accuracy demanded by the operation of today's high performance aircraft. And they require more than their rightful share of panel space.

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They require much less panel space, too—55% less, in fact, as shown above in the one-to-one comparison between a vertical scale panel for the U.S. Air Force's new C-141 jet transports and the comparable presentations by conventional round dial indicators.

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Eclipse-Pioneer Division

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It is not as sophisticated as our electron microscope or our hypersonic shock tunnels, perhaps, but it is of use to physicist Tom Mee as he pursues a research program of his own choosing. In this program Mr. Mee is using Cornell Aeronautical Laboratory funds to study water surface behavior under controlled conditions. With a modified Doppler radar he is trying to identify primary back-scattering elements in the wave surface and determine their behavior as the scale of wave motion is changed. Waves generated at one end of a long tank spend themselves on a "beach" at the other end. The rake is used to shape the beach.

Unlike Mr. Mee's project, most of our 250-or-so projects have sponsors. But the fact that we are willing and able to support many of the research ideas of our technical staff with our own funds is one of our hidden strengths. It is one reason some of the best men in your field stay with us, and it has repeatedly paved the way to seven-league strides in science.

Some of the fields in which we are making strides today are computer sciences, applied physics, electronics, operations research, aerodynamic and applied hypersonic research, flight research, applied mechanics, vehicle dynamics and systems research. The coupon below will bring you an interesting briefing on this community of science.

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FINANCIAL

Financial Briefs

Boeing Co. reported net earnings of $21,579,000 for the first nine months of 1962 on sales of $1,268,365,000. Comparable figures for the first nine months of 1961 included net earnings of $26,073,000 on sales of $1,309,260,000.

Douglas Aircraft Co. earned $6,351,957 for the first nine months of Fiscal 1962 on sales totaling $552,758,652. Same period last year showed a profit of $4,485,938 on sales totaling $616,217,249.

Northrop Corp. had earnings of $9,051,323 for its Fiscal 1962 ended July 29 on sales of $347,460,547. This represents a 30% increase in sales and a profit increase of about $378,000 over Fiscal 1961.

Marquardt Corp. reports earnings of $1,319,360 on sales of $39,114,603 for the first 40 weeks of 1962. For the same period in 1961, the company reported sales of $34,955,315 and earnings, adjusted to exclude special credits, of $179,741.

Borg-Warner Corp. earned $19,934,599 for the first three quarters of 1962 on sales of $486,443,226. Figures represent a 52% increase over earnings for the same period last year of $13,112,628 and a 13% increase over the $431,214,690 sales reported a year ago.

Motorola, Inc., had earnings of $9,098,080 for the first nine months of 1962 on sales of $244,700,845, compared with earnings of $6,416,892 on sales of $207,703,769 for the same period in 1961.

Radio Corp. of America earned $34.3 million—or $1.88 per share—on sales of nearly $1.27 billion for the first nine months of 1962. Earnings for the same period last year were $23.8 million—or $1.29 per share—on sales of $1.09 billion. Third quarter 1962 profits were $10.3 million on sales of $411.6 million, or $0.56 per share. Third quarter 1961 showed $6.2 million earned on sales of $368.3 million, or $0.32 per share.

Sanders Associates, Inc., Nashua, N. H., had earnings of nearly $2.03 million—$1.40 per share—on sales of $41.8 million for fiscal year ended July 31. Last year's figures were $880,000 earned on sales of $21.4 million, or about $0.61 per share.

New Procurement Rules Spur Incentives

By George C. Wilson

Washington—Defense Dept. will issue regulations soon designed to increase the Renegotiation Board's tolerance for incentive-type contracts and to encourage the aerospace industry to find ways to economize in developing and producing military items.

The forthcoming additions to the Armed Service Procurement Regulations (ASPR), to be issued this month or early next year, are an important part of Defense Secretary Robert S. McNamara's general strategy for achieving the economy he has promised President Kennedy.

McNamara's basic contention is that the missile age requires the government and industry to enter into a new type partnership where there is more incentive for both sides to discard traditional methods and develop techniques which promise to save time and money.

But a formidable obstacle to this objective is the Renegotiation Board, the five-member body Congress installed as watchdog over military contractors. The board has the right to demand that contractors return excessive profits to the government. The board, the contractor and the Defense Dept. have often disagreed in the past on what constitutes excessive profits.

Cash Incentives

McNamara and his deputies fear the cash incentives they want to build into defense contracts may be regarded by the Renegotiation Board as excessive profits. This would ruin their strategy for winning the battle against rising costs in the Defense Dept. So the McNamara team—more than any of its predecessors—is trying to win over the Renegotiation Board to its way of thinking. The forthcoming ASPRs are part of this effort.

The regulations, now in final form, direct Defense Dept. personnel to keep the Renegotiation Board fully informed about their contracting actions as they go along, rather than after the fact. The rules instruct the procurement officers to furnish the board with such information as the contractor's record for delivering on schedule, how effectively he used facilities, capital funds allocated to the project, success in developing new materials that do the job at less cost, risks involved, and efforts to subcontract work to small businesses and labor surplus areas. In short, Defense Dept. wants to give the Renegotiation Board so much detail that it can evaluate the performance of the contractor itself instead of relying mainly on the financial figures afterward to reveal whether the profits were excessive.

In a recently published incentive contracting guide prepared for the Defense Dept. by Harbridge House, Inc., of Boston, procurement officials are told that the Renegotiation Board is not compelled to recover unusually large profits; that cash incentives placed into contracts will not necessarily be subjected to recovery procedures.

Defense Dept. leaders also refer to recent statements by Chairman Lawrence E. Hartwig, of the Renegotiation Board, indicating sympathy for incentive contracts. On Oct. 26, for example, Hartwig said that in deciding whether profits on a defense contract were excessive, the board must "consider all these complex factors so that (among other things) the producer who is most efficient, who is most integrated, who has made the greatest contribution to the defense effort and who has most capital at risk may keep more profit than the producer who satisfies these factors to a lesser extent."

Another impetus for the Defense Dept., Renegotiation Board and aerospace industry to reach an understanding on incentive contracts is the U. S. Tax Court practice of calculating profits by measuring them against "whole net worth." Examples are:

• **Tax Court on Jan. 10 ordered** the Boeing Co. to turn back $13 million of its profits on 1952 business. Judge Craydon G. Withey arrived at the figure by measuring the profits against what he called "whole net worth." The Renegotiation Board sought to recover $20 million. It said Boeing's profits of $56.7 million for 1952 were about 98% of its net book worth of $57.8. Judge Withey ruled that Boeing's engineering and manufacturing know-how were intangibles as valuable as the book worth. So he doubled the net book worth and reduced the claim to $13 million (AW Jan. 22, p. 32).

• **Tax Court on Oct. 25 directed** North American Aviation to refund $16.5 million as excess profits on government business for 1953 and 1954. Judge John E. Mulroney praised the work of North American but still calculated excess profits in the same manner as did Judge Withey, thus dealing a severe blow to the campaign to provide more cash incentives to aerospace contractors (AW Nov. 5, p. 41).

In short, the U. S. Tax Court has not seen fit to rule that superior work necessarily justifies superior profits. Consequently, as the use of incentive contracts broadens, DOD, Renegotiation Board and aerospace contractors most likely will try harder to reach an accommodation about profits among themselves rather than resort to the courts.

The McNamara team also intends to use cash rewards as the incentive to make contractors introduce money saving techniques. Defense Dept. officials call this value engineering. They will formalize their guidance to procurement officials by issuing ASPRs on how to build more value engineering into contracts.

Value engineering clauses will give the contractor a share of the savings gained by doing such things as simplifying designs and introducing materials which cost less without impairing quality. One idea under discussion in the Pentagon is to have the government pay the cost of a value engineering team assigned by the contractor full time on a project. After the government is reimbursed for financing the team, the savings the team effected would be split between the government and the contractor. One suggested formula is to repay the government's investment in the value engineering team five times over and then split the remainder of the savings 50-50.

Value Engineering

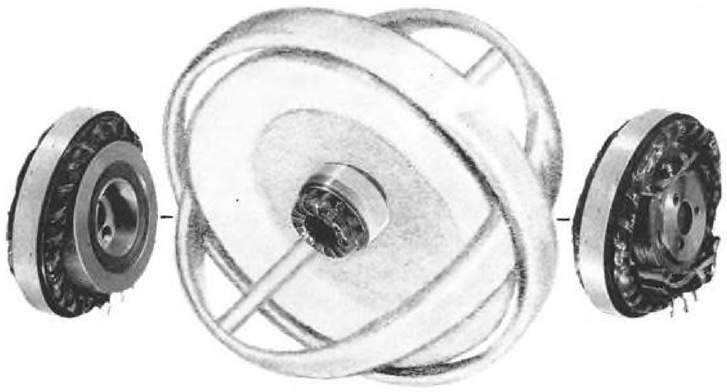
Thomas D. Morris, assistant secretary of defense for installations and logistics, is especially enthusiastic about the money-saving possibilities of value engineering. In the conference room adjoining his Pentagon office are displays of items which saved money through engineering or material changes. Morris told AVIATION WEEK that the Defense Dept. is determined to make value engineering more of a habit in industry.

Contractors interviewed about the Pentagon's value engineering campaign said it cannot succeed fully unless Defense Dept. finds a way to give faster approval to contractors' money saving ideas. Morris said this was a legitimate criticism, and said steps are being taken to give Defense Dept. personnel in the field more authority.

Some contractors also fear the proposed ASPR which would make money-saving techniques the property of the government. "Giving that away is giving away our guts," said one major aerospace contractor. Morris said such fears are based on misunderstanding, and pointed out that the Pentagon traditionally assumes the rights to technological advances made on its contracts.

The type of value engineering team Defense Dept. is trying to foster would include experts in engineering, materials and production. "The key both within the Defense Dept. and within the defense industry," Morris said, "is to organize to do the job of value engi-

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neering." He said goals must be set and specific value engineering projects identified. Value engineering should apply both to the development and production stages, Morris said.

The Martin Co.'s Orlando Division is one of the defense contractors which has set up a full-time value engineering team. George J. Parker, the division's administrative director, recently told a small business forum in Jacksonville, Fla., that "we are fast approaching the point where we cannot afford to defend ourselves." He said a concentrated value analysis program to save money was a must for the defense industry, adding "motivation is the key word in the success of any program."

Martin-Orlando has a five-member value analysis team working on the Bullpup air-to-ground missile. A company spokesman said the team decreased the cost of the missile by 70% between the time the first production model was finished in 1959 and now. Bullpup value analysis team includes engineers with manufacturing and design experience, material specialists, and finance and procurement officials.

Defense Dept. leaders frankly feel contractors often give the government less for its money than other customers. The recently published "Air Force Guide for Pricing" states this view in the form of a warning to procurement officials negotiating contracts: "It is not unusual for an otherwise highly competitive company to form a separate division for government work or segregate operations applicable to government work and thereby lose some of the obvious advantages noted in their competitive commercial operations."

Government Controls

In the immediate future, the economy effort will require more government controls as procurement officials try to write the Defense Dept.'s philosophy into contract clauses. But if the effort does succeed, there is a promise for less government control over the management of industry.

The newly-published incentive contracting guide says: "Without question, one of DOD's primary objectives in promoting the use of multiple incentive contracts is to improve the quality of industrial managerial control over the country's large development programs. In fact, under a properly written contract the amount of fee earned will depend directly on the contractor's ability to achieve this improvement—as evidenced by lower costs, earlier deliveries and/or higher quality performance.

"What will be required," the guide continues, "is more sensitivity in existing program control procedures and increased management interest in the information these procedures generate."

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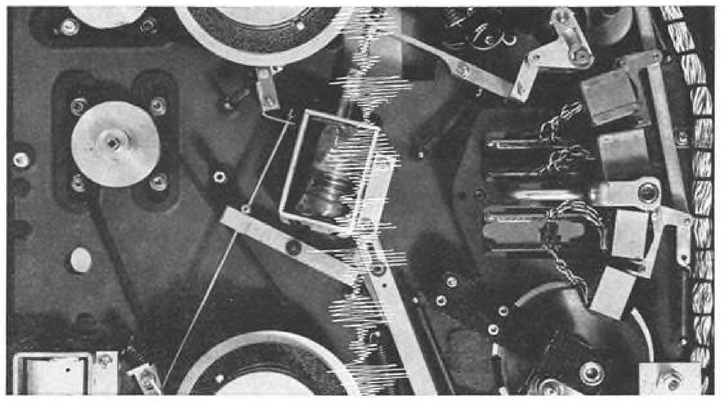
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system analysts

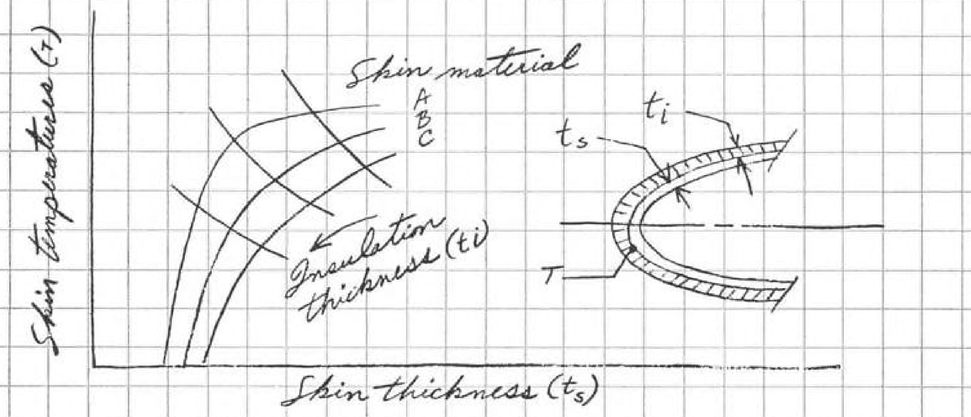
Senior System Analysts with BSEE, MSEE or Ph.D. experience in missile, space, or Undersea Warfare Systems including use of computers and systems work. Openings are in System Analysis, Advanced Studies and Proposal Activity.

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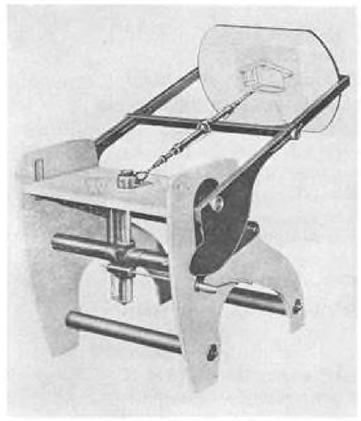
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NEW AEROSPACE PRODUCTS

Perspective Drawing Machine

Machine called "Perspex" permits rapid, automatic translation of engineering drawings into exact, optically correct geometrical perspective drawings, including the most complex exploded view drawings, the manufacturer says.

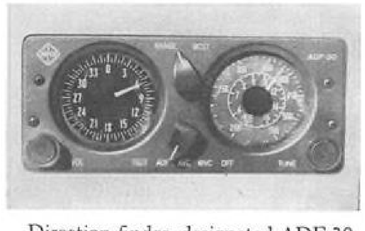


Perspex tests have demonstrated that 50 to 75% time savings are possible over other drawing methods, according to the manufacturer. Machine has three basic parts: horizontal working table adjustable for elevation, an outboard table upon which the perspective drawing is developed, and an extensible sight rod pivoted on its axis by a spherical bearing having an illuminated cross-hair viewer on the tracing end and a telescoping pencil at the drawing end. In operation, viewer is traced over the engineering drawing to operate the telescoping pencil bearing against the outboard table to produce a perspective drawing.

Lomart Perfected Devices, Inc., 980 Alabama Ave., Brooklyn 7, N. Y.

Automatic Direction Finder

Automatic direction finder which directs pilot toward any standard commercial broadcast, aeronautical or marine radio station weighs 8 lb., according to the manufacturer.



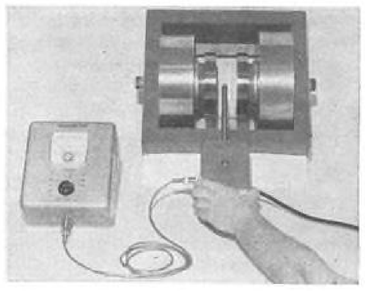
Direction finder, designated ADF-30, has low-drag sensing antenna mounted in a low-silhouette housing 2 in. deep. Sensor has no moving parts, seeks out the station electronically, and operates on the maximum signal of the station rather than the null. Manufacturer says this feature means signals are much less affected by thunderstorms or precipitation static. Unit is all-transistor and, with exception of the sensing unit, is a completely self-contained panel-mounted package measuring 6⅛ in. wide x 2⅞ in. high x 8 in. deep and using 0.54 amp.

National Aeronautical Corp., Fort Washington, Pa.

Precision Gaussmeter

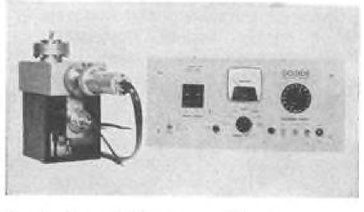
Device measures magnetic field precisely in eight ranges covering from zero to 100,000 gauss.

Gaussmeter is all-transistorized, direct reading and operates on the principle of rotating a wound wire coil at high speed by a precision synchronous motor. Output signal is directly proportional to the magnetic field and is read directly from a precision meter calibrated in gauss.



Homogeneous or inhomogeneous magnetic fields may be measured and temperature compensation is incorporated for increased precision.

Alpha Scientific Laboratories, Inc., P. O. Box 333, Berkeley 1, Calif.



Dual Speed Vacuum Pump

Dual speed high vacuum pump for electronic vacuum tube processing systems obtains pressures below 10^{-9} torr and has highest pumping speed for its size of any vacuum pump on the market, the manufacturer says.

Called BoostiVac Model 10-400, the pump combines cold cathode ion pumping with titanium evaporation to produce an interaction between pump discharge and evaporated film which is greater than the sum of the individual pumping actions. The new principle allows for faster pumpdown and higher vacuum during cathode conversions.

Unit operates entirely from electric power; no oils, water or refrigerants are required to produce a contaminant free vacuum in the 10^{-10} torr range, manufacturer says.

Ultek Corp., 920 Commercial St., Palo Alto, Calif.

Aerospace Lubricant

Tungsten disulfide dry powdered lubricant will remain stable in air in temperatures to 950F, has a low vaporization rate at higher temperatures, and remains stable in vacuums and inert atmospheres over 2,400F, the manufacturer says.

Tungsten disulfide has an average particle size of 1.5 microns and can lubricate at pressures as high as 400,000 psi., making it a suitable lubricant for a wide variety of electro-mechanical aerospace components operating in extreme temperatures and high vacuums, according to the manufacturer.

Bemol, Inc., 131 State St., Boston 9, Mass.

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Loads Analyst. To establish structural design criteria for advanced missiles and spacecraft. Should be capable of determining external airload and inertial force distributions.

Reliability Analyst. To perform statistical analysis of structural loads and strength properties for the purpose of establishing structural reliability criteria on a probability basis.

Stress Analyst. To perform advanced stress analysis of complex and redundant missile and spacecraft structures. Will be required to solve special problems in elasticity, plasticity, short time creep and structural stability.

Design. Experience is required in preliminary and final structural engineering and design, including preliminary stress analysis. A knowledge of the effects of extreme temperature environment and hard vacuum, plus a background in materials is desired.

Heat Transfer

Space Vehicle Heat Transfer. Basic knowledge of radiation conduction and convection heat transfer with application to thermal control of space vehicles is required. Knowledge of spectrally-selective radiation coating, super-insulations and thermal vacuum testing is of particular value.

Aerothermodynamicist. Experience in hypersonic real gas dynamics, heat transfer, ablation; re-entry vehicle design, detection; shock layer, wake and rocket exhaust ionization; and anti-missile system requirements will be most useful.

Equipment Installation

Packaging and Installation Engineer. To perform optimum packaging and installation design for missile and/or spacecraft units, considering amount and geometric shape of space available as well as weight and center of gravity distribution requirements. Must be capable of analyzing structural adequacy of unit under extreme environmental conditions.

Controls

Optical Devices. Design, development, procurement and test operations are involved. Considerable experience in the field of optical devices for space applications such as star, horizon, sun and moon trackers.

System Test. To plan and supervise the operations of a flight control system laboratory. Air bearing tables and a wide variety of optical mechanical and electrical equipment are involved.

Control System Analysis. Requires engineers at various levels of experience including senior men capable of taking over-all project responsibility in the synthesis and analysis of control systems.

Circuit Design and Development. Experience required in design and development of transistorized control system circuits, including electronic switching and modulation techniques.

If you are a graduate E.E., M.E., A.E. or physicist with experience applicable to the above openings, please airmail your resume to:

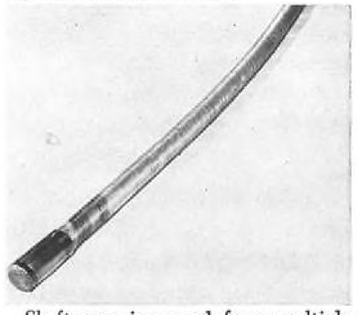
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Titanium flexible shaft cores for high temperature use in missiles and aircraft is lighter and as strong or stronger than comparable steel or stainless steel shafting, the manufacturer says.



Shaft core is wound from multiple layers of the titanium wire and covered with a casing which protects the core and acts as a bearing surface. Shafting applications include aircraft and missile controls, operation of various actuators and accessories at temperatures as high as 1,000F.

Stow Mfg. Co., 68 Shear St., Binghamton, N. Y.

Micro-miniature Welder

Unit performs micro-miniature welding, brazing, hard soldering, annealing and other metal joining operations with a hand-held torch emitting a flame 20/1,000 in. dia. and ⅜-in. long at 6,000F.

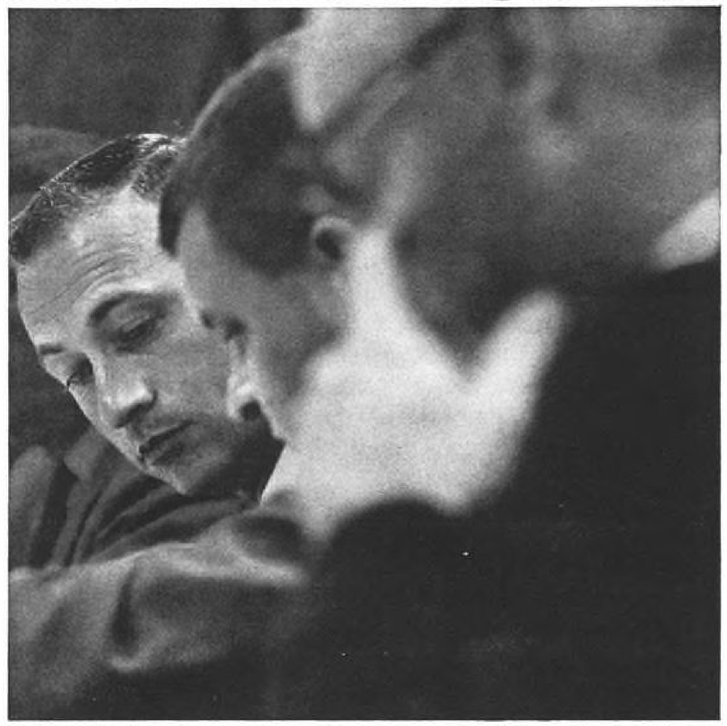


Welder breaks down distilled water electrochemically, with 110 v.a.c. and an electrolyte, into high purity hydrogen and oxygen fuel for torch. Gas stream is washed, filtered, dried and passed through a reducing agent, where it acquires a reducing atmosphere which envelopes and shields the flame and heated area so that parts remain free of scale, oxides, nitrides and other impurities, manufacturer says.

Flame emits little heat from its sides, making it ideal for working in formerly inaccessible areas in crowded instrument assemblies, closely assembled terminals on computer terminal blocks, etc.

Associated Precision Industries, 2743 N. Sheffield Ave., Chicago 14, Ill.

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Propulsion. Men with knowledge of the fundamental technologies to do research and development on solid, liquid, hybrid, and air-breathing systems.
Vehicle dynamics and control. For research and development in aerodynamics and flight controls as applied to VTOL vehicles, space trainer aircraft, and six-degree-of-freedom near-earth trajectory problems.
Electromagnetics. For studies in energy propagation and field theory pertinent to such areas as communications antennas, radar cross-sections, and plasma sheaths.
Fluid mechanics. For analyses of subsonic, supersonic and hypersonic flows.
Communications. To conduct analysis and integration of new concepts in telemetry command, detection, and tracking systems.
Experimental aerodynamics. To work with a group that will support theoretical aerodynamic research with experimental approaches and will initiate experimental research to fill voids in the theoretical techniques.
Operations research. To visualize complete weapons systems, and apply basic knowledge to new and diversified problems.
Guidance and controls. To conduct study and analysis of sensors and computers.
Systems research. To work on systems performance optimization.
Numerical analysis. To develop large-scale numerical procedures for aerodynamic design and flow field analysis.
Avionics. To work on the design, development, and analysis of avionics systems for airborne applications.
Reliability. To assess the reliability and optimize the configuration and mission profiles of space systems.
Chemical research. To work on the development and applications of structural adhesives for aerospace vehicles.
Metallurgical research. For research and development on materials and joining.

If you'd like more information about these opportunities and others that may be available, write to Roy L. Pool, Engineering Center Personnel Office, 1001 East Broadway, Hawthorne, California.

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The 300-foot microwave test tower, and radio telescope (used for satellite tracking, communications and space research) are two distinctive landmarks of ITT Federal Laboratories in Nutley. Here, modern facilities house 17 laboratories engaged in missile and space systems, avionics, communications, research in the physical sciences, and sophisticated electronic manufacturing operations. ■ Today's opportunities are especially well timed for the engineer seeking a significant career jump now, and a progressive series of professional assignments that will provide substantial growth impetus during the months and years to come.



We are most interested in talking with engineers offering backgrounds in any of the areas listed below.

PARTIAL LIST OF POSITIONS IMMEDIATELY AVAILABLE AS OF DECEMBER 1, 1962

COMMUNICATIONS

Mechanical Engineer, for antenna design and development. Experience in the field of satellite and missile communication antennas highly valued. Also experience in electronic equipment packaging, servo-systems and structural analysis. 5 years minimum experience.

EE; PhD desirable, with 4 years' experience in sophisticated microwave communications and tracking receivers using coherent detection and signal processing—frequency range, 1,000 mc through 10 kmc; power range, 1 through 50 kw. In addition, at least 2 years' background in communication systems design.



EE, experienced in microwave equipment design; prefer individual with post graduate courses in communications theory.

EE, with heavy design experience in high power amplifiers for communications; background in design of solid state control circuitry and amplifier circuitry in UHF through SHF ranges.

ME or EE, with at least 2 years' experience in electrical design and testing of multi-conductor, power, and communication cables and conductors to mil specs. If an ME, must be familiar with basic principles of electrical engineering such as attenuation, impedance, etc.



Project responsibility on microwave communications equipment development. Must be capable of supervising design of transistorized transmitters, receivers and modulators . . . able to handle all phases of proposal preparation.

BSEE or equivalent, with 5 to 10 years' experience in test equipment design and engineering re-design of equipment for manufacturing radio transmitters and receivers in UHF and VHF regions.

EE, with several years experience at major research organization, good background in solid state theory. Specific duties and responsibilities will involve research and theoretical studies on electron tunneling phenomenon in thin films, band structure of wide gap semiconductors.



Physicist, with good background in thermodynamics, high vacuum techniques, or solid state theory for work in thermionics. PhD preferred; MS minimum.

Senior Scientist, theoretically oriented, experienced in communication networks, troposcatter and line-of-sight radio communication and system analysis.

Data Processing Analysis Manager, with 4 to 8 years' experience, including analysis and programming on a large scale digital computer; knowledge of diagnostic, utility and executive programming; experienced in planning and leading groups of programmers and analysts. BS in Mathematics, Engineering or Physics.

EE, with 5 to 8 years' experience in design and applications of microwave antennas, transmission lines, duplexers, filters and other similar microwave components for tropo and line-of-sight systems.

AVIONICS

Managerial position, calls for 8 to 10 years' experience in the field of project management, demonstrated capability in management of the engineering and production aspects of large electronics systems contracts.

EE, with 4 to 5 years' experience in frequency control or communications field; background in frequency synthesis, HF and UHF communications.

EE, with 6 to 10 years' experience in the airborne electronic field, preferably commercial avionics; ability in the area of video circuitry or airborne communication or navigation equipments.



MISSILES AND SPACE

Senior position involves leadership of structural design group working on satellite and other space-borne payloads. Requires a minimum of 5 years' experience in space vehicle stress analysis.

Forward your resume in full confidence to Mr. W. Bieszard, Box 19-C, ITT-Federal Laboratories, 500 Washington Avenue, Nutley, New Jersey. An Equal Opportunity Employer.

ITT FEDERAL LABORATORIES

WHO'S WHERE

(*Continued from page 23*)

Honors and Elections

Willard W. Millikan has been elected president of the American Fighter Aces Assn, succeeding **James L. Brooks**, now board chairman. Mr. Millikan is a brigadier general in the USAF Air National Guard and is senior Washington, D. C., representative for Northrop Norair, a division of Northrop Corp. Mr. Brooks is director of customer relations for Autonetics, a division of North American Aviation, Inc.

J. W. Sparke, of the Royal Aircraft Establishment, has been awarded a John Scott Award for 1962 for his invention of the RAE Visual Glide Path Indicator.

H. D. Cameron, executive assistant to the president of Canadian Pacific Airlines, has been elected president of the Air Transport Assn. of Canada.

Dr. Marvin H. Gold, manager of the Propellant Chemicals Division of Aerojet-General Corp.'s Solid Rocket Plant, has received the Navy Meritorious Public Service Citation from the Office of Naval Research for his contributions to high energy rocket propulsion for advanced Polaris.

Capt. Alexander W. Wuerker (USCG, ret.) has been appointed the first full-time chairman of the Radio Technical Commission for Aeronautics, Washington, D. C., as of Jan. 1, succeeding **Dr. Arthur L. Lebel** of the Department of State.

Changes

H. E. Felix, chief engineer, Douglas Aircraft Co.'s Tulsa (Okla.) Division, and **H. G. Irwin**, assistant chief engineer.

William H. Hynes, director of estimating, Aerospace/Rockets Division, Textron's Bell Aerosystems Co., Buffalo, N. Y.

James S. Farrior, director of Lockheed Missiles & Space Co.'s Research and Engineering Center to be established at Huntsville, Ala. **Victor L. Marquis** will be administrator of the new Center.

Dr. David K. Priest, chief, Solid Mechanics and Mathematics Research, North American Aviation's Columbus (Ohio) Division.

Alvin M. Perlmutter, senior development engineer, North Atlantic Industries, Inc., Plainview, N. Y.

P. E. A. Talbot, chief executive of the newly established Jamaica, N. Y., office, Aviation Division of S. Smith and Sons (Canada) Ltd.

J. Ward Wright, manager, Huntsville (Ala.) district marketing office, Librascope Division of General Precision, Inc.

Beech Aircraft Corp. has announced the following managerial appointments within the Aerospace Division: **Darrell L. Schneider**, head of the Washington, D. C., office and also Eastern regional manager, with **Roy E. Adkins** as Eastern region marketing manager to coordinate Beech activities with NASA, and **Richard L. Mullen** as Eastern region marketing manager to coordinate Beech activities with the USN; **Royal S. Foote**, Southwest regional manager, Houston, Tex.; **T. Bruce Cooper**, Southeast regional manager, Huntsville, Ala.; **L. Sam White**, district manager, Western region, Los Angeles, Calif.

Anti-Submarine Warfare

Senior and intermediate-level engineers will find rewarding careers in responsible positions at Raytheon's ASW Center in the following areas:

UNDERWATER ACOUSTIC SYSTEMS

Will develop advanced underwater acoustic systems concepts of detection, classification, communications and tracking. Applicants must be specialists in communications theory or systems engineers with extensive experience in either sonar, radar, communications, or fire control theory.

WEAPONS SYSTEMS

Will engage in the analysis of weapons systems. Applicants must be specialists in operations research or have extensive experience as weapons systems engineers.

APPLIED RESEARCH

Must have extensive experience in any of these fields: propagation, matched filter theory, pattern recognition, statistical communication theory, underwater communications, statistical decision theory.

Please send resume to:

D. T. Anderson
Raytheon Company
Submarine Signal Operation
Portsmouth, Rhode Island

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by DICK RYON (BS Physics 1950), Project Leader, Data Instruments Department, Apparatus Division



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ADVANCED DESIGN RESEARCH (BS, MS, PhD). Studies for advanced rocket systems to establish system concepts and optimize preliminary design criteria.

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COMBUSTION RESEARCH (MS, PhD). Theoretical and applied studies of combustion process in rocket chamber under firing conditions.

GAS DYNAMICS (MS, PhD). Analytical and experimental studies of particle flow, nozzle efficiency, altitude performance parameters, thrust magnitude and vector control.

PROPELLANT RESEARCH (MS, PhD). Theoretical and experimental investigations of propellant detonability, bonding characteristics, propellant formulation, morphology and rheology of filled solid polymers and slurries, stress analysis.

STRESS ANALYSIS (BS, MS, PhD). Analysis of filament-wound pressure vessels and rocket motor components.

ENGINEERING SPECIALISTS (BS, MS, PhD). 8-10 years experience; analysis, heat transfer, systems analysis, missile ballistics, internal rocket ballistics, insulation, fluid dynamics.

INSTRUMENTATION (BS, MS). Design and develop instrumentation to obtain data from static firing tests, entire cycle from sensing devices on motor to data collecting mechanisms. Design and develop process instrumentation for production of propellants and component chemicals.

PROCESS ENGINEERING (BS, MS). Design improved material handling, molding, tooling and process equipment for propellant and rocket manufacturing.

TEST ENGINEERING (BS, MS). Build and analyze static firing test stands and associated hardware. Recommend range handling and operating equipment including environmental test.

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DATA REDUCTION (BS, MS). Prepare calculation systems for programming complex data into IBM 7074 computer.

STATISTICS (MS, PhD). Apply statistical methods to quality control, reliability, research test procedures and analyses of test data.

Write in confidence to: Mr. W. D. Linkenhoker, Dept. 2M-1

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THERMODYNAMICS—HEAT TRANSFER Investigations require the application of all modes of heat transfer in solids and in single and two phase fluids at pressures from space vacuum to hundreds of atmospheres, temperatures from cryogenic to those existing in highly performing flames. Products under study range from advanced gas turbines to liquid metal boilers.

MISSILE & SPACE VEHICLES Analyze mission and determine overall vehicle systems requirements; consider aerodynamic, thermodynamic, structural and guidance considerations as they affect selection of propulsion, propellant and guidance systems in order to establish basic structural and aerodynamic design.

SYSTEMS ENGINEERING Determine characteristics of energy conversion and power systems that are technically and economically feasible for development efforts. Duties include the analysis and evaluation of specific systems applications and participation in the pertinent analytic and experimental development program. (Connecticut only)

EXPERIMENTAL TEST Develop test procedures; direct parts fabrication, test rig assembly, instrumentation and facilities preparation; conduct test; analyze data; formulate test conclusions. Assignments are available in both air-breathing and non air-breathing programs ranging from current gas turbine engines to fuel cells.

MECHANICAL DESIGN Translate theoretical studies into workable hardware on a variety of complex, high precision energy conversion devices—both air-breathing and non air-breathing. Analytical ability necessary since the mechanical designer is expected to perform all but the most complex analyses.

STRUCTURES Analytical investigation, design and development of complex structures using conventional and unconventional materials and novel manufacturing processes. Object of this program is to develop improved lightweight, temperature-resistant structures for all types of energy conversion devices.

FLUID MECHANICS Analytical studies and design of fluid machinery for a variety of powerplants. Investigations range from the hydrodynamics of mixed flow, high head rise pumps to the separation of vapor and liquid phases in a reduced gravitational field.

PERFORMANCE ANALYSIS Analysis of gas turbine and fuel cell test data and test results with the objective of predicting trouble areas and recommending design changes necessary to improve performance characteristics. Strong aerodynamic, thermodynamic or combustion experience desirable.

AIR-BREATHING PROPULSION CONCEPTS EVALUATION Analytical evaluation of advanced propulsion systems concepts such as turbojets, turbofans and ram jets as they apply to subsonic, supersonic, hypersonic, V/STOL and marine vehicles. An advanced degree would be particularly desirable for these openings.

STRESS ANALYSIS—VIBRATIONS Analysis of structures subjected to both complex static loading and transient thermal loading, operating in an environment which is subject to vibratory loads. Requires strong applied mechanics background.

Many other openings at various experience levels are also available in important programs. If your specialty or field of interest is not listed here, write us—regardless.

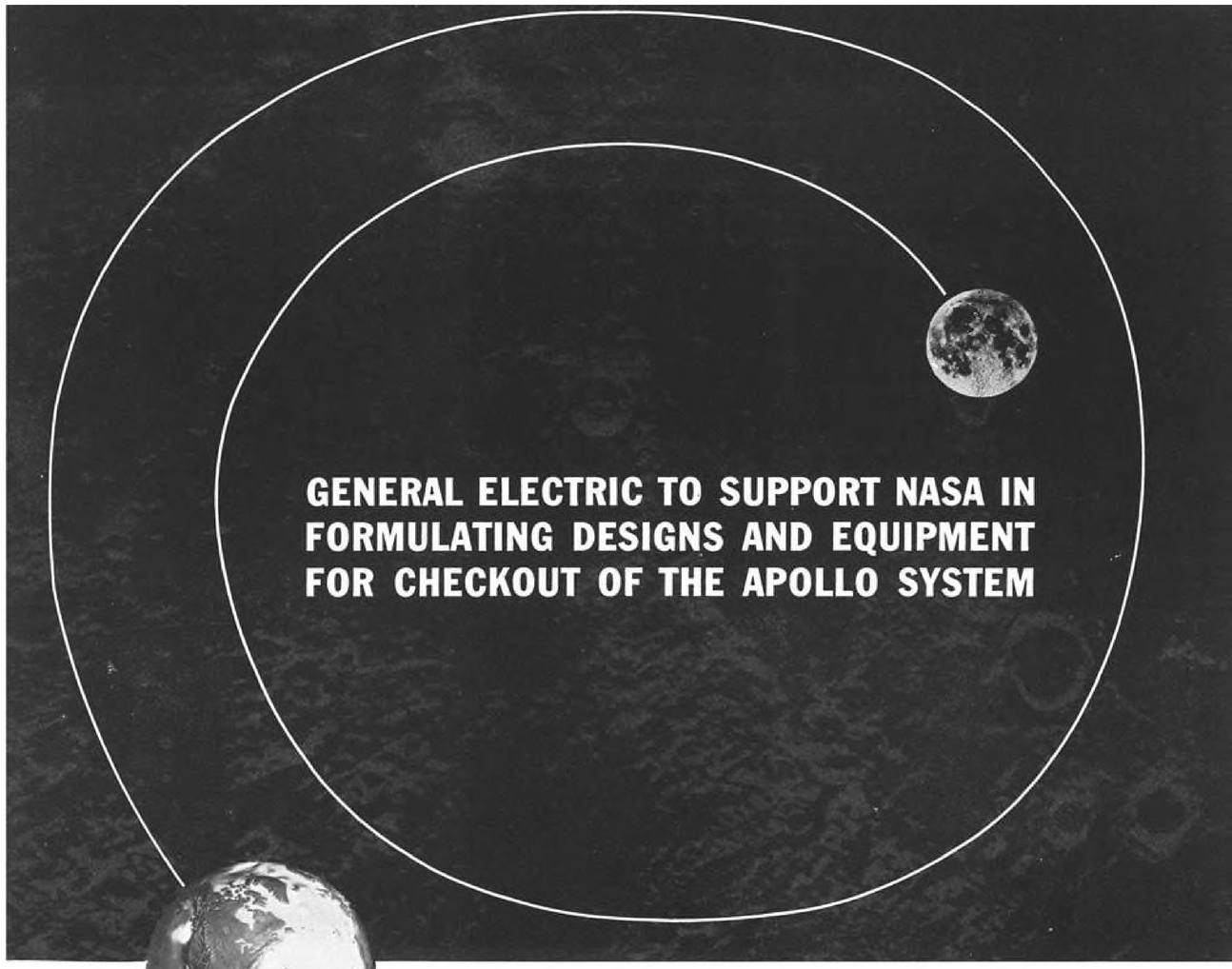
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CONTROL SYSTEMS & SIMULATION ENGINEERS
Supervisory and senior level positions for assignment to automatic feedback control systems, aerospace vehicles, automatic throttle systems, control systems for simulators and autopilots, closed circuit TV and circuit design. BS or advanced degree in EE plus 3 to 8 years analytical experience related to servo analysis involving hydraulic and electronic control systems, feedback theory, analog computers, simulators and autopilots.

SR. ENGINEERS & PROJECT MANAGERS
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Your inquiries are invited. Please send resume to Mr. T. C. Fritschi, Dept. 82.

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, DECEMBER 3, 1962

AEROJET-GENERAL CORPORATION 13
AEROTEST LABORATORIES, INC. 63
AIR FRANCE 42
AIR-MAZE DIVISION, ROCKWELL-STANDARD CORPORATION 66
AMERICAN AIR FILTER COMPANY, INC. DEFENSE PRODUCTS GROUP 62
AMPEX CORPORATION 119
ATOMICS INTERNATIONAL, A DIVISION OF NORTH AMERICAN AVIATION, INC. 96
AVNET ELECTRONICS CORPORATION 11

BEECH AIRCRAFT CORPORATION 104-105
BELLCOMM INC.—A.T.&T. 100
BENDIX COMPUTER DIVISION, THE BENDIX CORPORATION 92
BENDIX ECLIPSE-PIONEER DIVISION, THE BENDIX CORPORATION 114-115
BENDIX PACIFIC DIVISION, THE BENDIX CORPORATION 119
BENDIX PIONEER CENTRAL DIVISION, THE BENDIX CORPORATION 76
BENDIX SYSTEMS DIVISION, THE BENDIX CORPORATION 24
BLACK, SIVALS & BRYSON, INC. 67
BOEING COMPANY, THE 44
BRISTOL SIDDELEY ENGINES LIMITED 46
BROOKS & PERKINS, INC. 18
BRUSH INSTRUMENTS DIVISION, CLEVITE CORPORATION ..... 3rd Cover
BUDD ELECTRONICS, A DIVISION OF THE BUDD COMPANY, INC. 7
BURNDY CORPORATION 6

CHERRY RIVET DIVISION, TOWNSEND COMPANY 71
COLUMBUS, A DIVISION OF NORTH AMERICAN AVIATION, INC. 133
CONSOLIDATED ELECTRODYNAMICS CORPORATION 102, 103
CONSOLIDATED SYSTEMS CORPORATION 50
CORNELL AERONAUTICAL LABORATORY, INC. OF CORNELL UNIVERSITY 116

DEL E. WEBB CORPORATION 10
DELCO RADIO DIVISION, GENERAL MOTORS CORPORATION 81
DONNER DIVISION, SYSTRON-DONNER CORPORATION 86
DOUGLAS AIRCRAFT COMPANY, INC. 120

EDGEWATER STEEL COMPANY 5
ELECTRONIC SPECIALTY COMPANY, EEMCO DIVISION 8

FAIRCHILD SEMICONDUCTOR, A DIVISION OF FAIRCHILD CAMERA & INSTRUMENT CORPORATION 20

GENERAL ANILINE & FILM CORPORATION, ANSCO DIVISION 82-83
GENERAL ELECTRIC COMPANY, DEFENSE ELECTRONICS DIVISION 48-49
GENERAL ELECTRIC COMPANY, FLIGHT PROPULSION DIVISION 108-109
GENERAL ELECTRIC COMPANY, LAMP METALS & COMPONENTS DEPT. 22
GENERAL PRECISION, INC., KEARFOTT DIVISION 106
GENERAL PRECISION, INC., LIBRASCOPE DIVISION 56-57
GOODYEAR TIRE & RUBBER COMPANY, THE 3

HAWKER SIDDELEY AVIATION LIMITED 70
HILLER AIRCRAFT CORPORATION 14
HOFFMAN ELECTRONICS CORPORATION, MILITARY PRODUCTS DIVISION 64-65
HOUGH COMPANY, THE FRANK G. 94
HUGHES AIRCRAFT COMPANY 122
HUGHES TOOL COMPANY, AIRCRAFT DIVISION 12

INTERNATIONAL TELEPHONE & TELEGRAPH CORPORATION, FEDERAL LABORATORIES ... 124

KAMAN AIRCRAFT CORPORATION 91, 93, 97, 99, 101
KAYNAR MANUFACTURING COMPANY, INC., KAYLOCK DIVISION ..... 2nd Cover

LING-TEMCO-VOUGHT, INC. 4
LINDE COMPANY DIVISION OF UNION CARBIDE CORPORATION 17
LITTON INDUSTRIES, INC. 59
LITTON INDUSTRIES, INC., GUIDANCE & CONTROL SYSTEMS DIVISION 16
LOCKHEED AIRCRAFT CORPORATION 118, 121
LOCKHEED CALIFORNIA COMPANY DIVISION OF LOCKHEED AIRCRAFT CORPORATION ... 60-61
LOCKHEED MISSILES & SPACE COMPANY DIVISION OF LOCKHEED AIRCRAFT CORPORATION 74-75

MALLORY & COMPANY, INC., P. R. 84
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, MILITARY PRODUCTS GROUP 78-79
MOTOROLA, INC., MILITARY ELECTRONICS DIVISION 51

NORTHROP CORPORATION 123

RADIATION, INCORPORATED 54
RADIO CORPORATION OF AMERICA, ELECTRON TUBE DIVISION 68-69
RAYTHEON COMPANY 68, 125
RYAN AERONAUTICAL COMPANY 15

SPERRY ELECTFONIC TUBE DIVISION, SPERRY RAND CORPORATION 58
STANDARD STEEL CORPORATION 59
STEPHENS-ADAMSON MFG. CO., SPHERCO BEARINGS DIV. 55
SYLVANIA ELECTRIC PRODUCTS, INC., SPECIAL PRODUCTS 107
SYSTEM DEVELOPMENT CORPORATION 98

TAMAR ELECTRONICS INDUSTRIES, INC., WIANCKO ENGINEERING 87

UNITED SHOE MACHINERY CORPORATION, HARMONIC DRIVE DIVISION 112

VARIAN ASSOCIATES, TUBE DIVISION ..... 4th Cover

WESTON INSTRUMENTS DIVISION OF DAYSTROM, INCORPORATED 9
WHEELER ELECTRONIC COMPANY DIVISION OF SPERRY RAND CORPORATION 89
WRIGHT MACHINERY COMPANY DIVISION OF SPERRY RAND CORPORATION 118

CLASSIFIED ADVERTISING

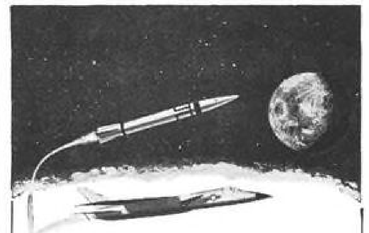
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 126-132

EQUIPMENT
(Used or Surplus New)
For Sale 132

ADVERTISERS INDEX

Allegany Ballistics Laboratory
Hercules Powder Co. 127
Atlantic Aviation Corp. 132
Avco 132
Bell Aerosystems Co., Div. of Bell Aerospace Corp. ... 130
Boreas Corp. 132
Executive Aircraft Service Inc. 132
General Electric DSD Apollo 129
Mobile Facility Engineering 132
Pan American Aviation 131
Pavex Inc. 132
Pratt & Whitney Aircraft 128
Radio Research Instrument Co. 130
Texas Instruments Incorporated
Apparatus Division Dept. 126
Zep Aero 132



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LETTERS

Doppler Discussion

I would like to answer Mr. Grafa's question (AW Oct. 29, p. 118) on the elimination of the navigation function by bringing the attention to the real source of error.

My qualifications are over 20 years as a flight navigator, 990 crossings of the North Atlantic and technical chairman of the Air Line Navigators Assn. Since Apr. 31, 1958, I have been working on Doppler equipped flights.

The real source of error is the Doppler's inability to fix the position of an aircraft at any time!

As he so well states, "A Doppler navigation system requires a heading input from an outside source . . ." [and] ". . . blaming the Doppler radar . . . is comparable to blaming a computer for wrong answers when the input data is erroneous." It is correct that the Doppler only gives out what is put in plus its own variable errors.

The ALNA has historically, from the first plan of TWA's purchasing the Boeing 707 jets, requested Doppler, Loran and ADF controls as aids to the navigator. The Doppler, as an aid to the navigator, is like the KIFIS system (Kollsman Integrated Flight Instrument System) to the pilots.

I believe people have been misled by TWA and FAA news releases about the navigators' position. Our main problem has been to be heard and then not have all the accurate statistics buried from the public. Our position is—the system as sold by TWA and FAA is another potential air tragedy.

Out of 258 flights reported up to Aug. 6, 1962, 30% were 30 or more miles off course. These are the result of Doppler, compass and pilot errors.

The "miles to go" is bad enough that some of the Captains got to updating the "miles to go" input every 10 deg. of longitude. This is only a Doppler error and no compass can be blamed.

The Doppler can be blamed for high maintenance rate, as reported to the FAA on Aug. 6 by the ALNA from TWA maintenance records.

TWA and FAA's claim of 10 mi. average off course distance is a dream for publication, but not factual. The record shows distances off course of 220 mi., 120 mi., 110 mi., 90 mi. and many more above 50 mi. off course.

The Doppler navigation system as used by TWA and FAA includes Doppler, Loran, and Polar Path fluxgate compasses.

TWA and FAA also claim no dual Doppler failures en route. July 18, 1962, Flight 801-18 both Dopplers went out—one out of Paris, number two before 10 deg. West; the professional navigator took over. June 22, 1962, Flight 700-21 both Dopplers were out over Torbay, Newfoundland to 33 deg. West, one hour and twenty-one minutes, the captain had the navigator take over before 50 deg. West.

Needless to say we are not being automated out of the profession, we are being "railroaded" out by short-sighted individuals. The public is unaware of the magnitude of navigational errors involved with this system. All the foreign carriers have turned this system down flat. FAA obviously has its strong doubts for it has now contracted some $282,000 to develop another non-fixing system.

F. A. Harland
Technical Chairman
Air Line Navigators Assn.
Glen Cove, N. Y.

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.

Passenger Perspective

Congratulations on your editorial "Retrospect" in the Oct. 1 AW! It is high time that this highly respected publication took a stand against the prevailing "Ceiling Zero" type of airline attitude that had its day in the '30s. When the airlines "come down to earth" with their airplanes and take the business of air transportation seriously, the industry will begin to prosper.

As a potential frequent air traveler, the airlines may be assured that I could (not) care less about the champagne, carpets, sexy "stewardii," the view from 35,000, and what the air speed indicator reads. What I do care about is spending a minimum of time, effort and money in getting from A to B!

The airlines may be impressed with the beauty and technological complexities of their aluminum "beasts," but to some of us with a practical mind they are just another noisy conveyance with one singularly attractive characteristic—the potential of saving the traveler time by bringing practically the whole world within hours of his reach.

J. E. Crommet
Tustin, Calif.

Single Travel Class

As a fairly frequent customer of the airlines and an individual interested in all aspects of aviation, I found it most refreshing to read United Air Lines President Mr. W. A. Patterson's remarks (AW Oct. 15, p. 21) relative to abolishing the class system in air travel. Why it was inaugurated has never been fully explained and perhaps never will. The fact that the public, government agencies and industry executives choose to bestow their business to the coach sections should be no mystery. Simple calculations readily verify that the extra fare required to go first class is not justified by the difference in service received. A single class of air travel, in my opinion, would stimulate the public to a much greater degree than the current practice of attempting to entice more people via the second class citizen approach.

Seating density in today's economy class of air travel is certainly not conducive to comfort. Denial of drinks serves no purpose, as those that don't drink would refuse and those that would accept have only a short time to wait until they arrive at their destinations. The fact that it is denied, however, only serves to emphasize the lack of service available. The reactions to the lack of meals would be the same as for drinks; however, the more economical meals now served in coach sections are sufficiently attractive to be offered as the standard on single class flights.

The public has, through its patronage, demonstrated to the airlines the type of service preferred. Room enough to sit without being cramped, an unpretentious meal and the opportunity to purchase a drink or two, if desired, would satisfy the majority of air travelers. Standardization of service would reduce airline expenses, and I would predict that this would bring increased prestige to the airline as well as to instill increased confidence in the public being served.

Lt. Col. Edmund S. Bloom
(USAF, ret.)
Littleton, Colo.

Below Cost Seats

I recently read another article in that the main theme was about the airlines crying about empty seats. Now I can see why they don't want to lose money; they are in the business to make money. So, why don't they come up with a family plan low priced enough to be attractive to the average wage earner? Such as, price it at a seat breakeven point or even below. It would be better to collect, say, $60 on a $100 seat rather than lose the entire $100.

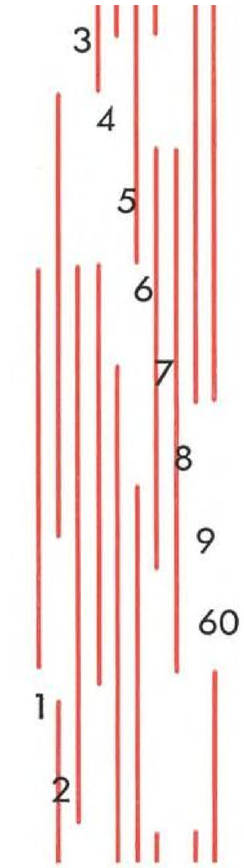
I am married, have a wife and four children, ages fourteen to four. Come vacation time I would stand and throw rocks at my car if I could afford to fly my family. The round trip fare where we go is in the neighborhood of $650 at present family plan rates. This definitely doesn't agree with some airline slogans "that now anyone can afford to fly." If this $650 could be cut to, say, $300 I would sign up tomorrow for my next five years' vacation trips.

In 1957 I flew from Seattle to Pierre, S.D. From Seattle the DC-6 was 70% loaded; at Denver I changed to a DC-3 that had 11 on board. At takeoff from Rapid City I had the entire airplane to myself; it was like having my own private airliner. The airline could have reduced that loss by letting those seats go to some families at reduced rates. Even if they lost money, it would not have been a total loss.

Last week I flew an Electra from L.A. to Salt Lake. At L.A. the plane was 75% loaded; after leaving Las Vegas it was about 55%. I don't know how many went on through to Minn.

I still think that airline brains can come up with a drastically reduced family plan that will help ease empty seat tantrums. Let's hear some more on this subject, and maybe some day we can all afford to fly.

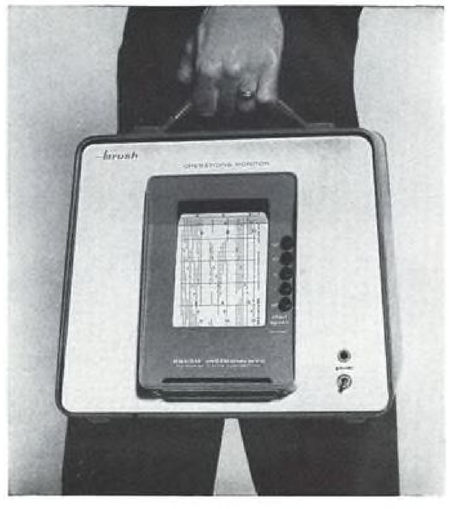
Bill Blake
Midvale, Utah

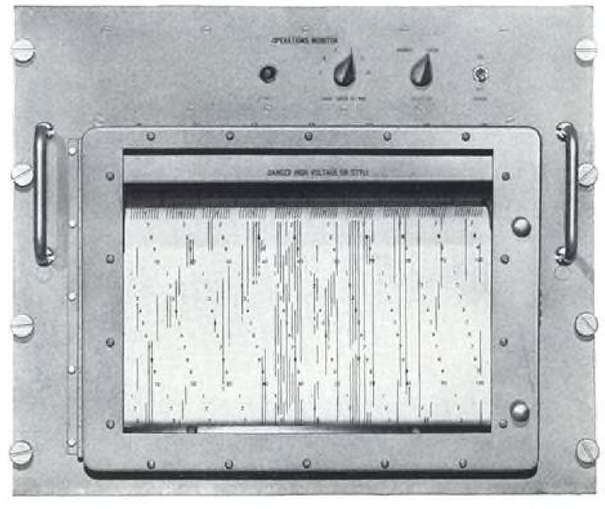


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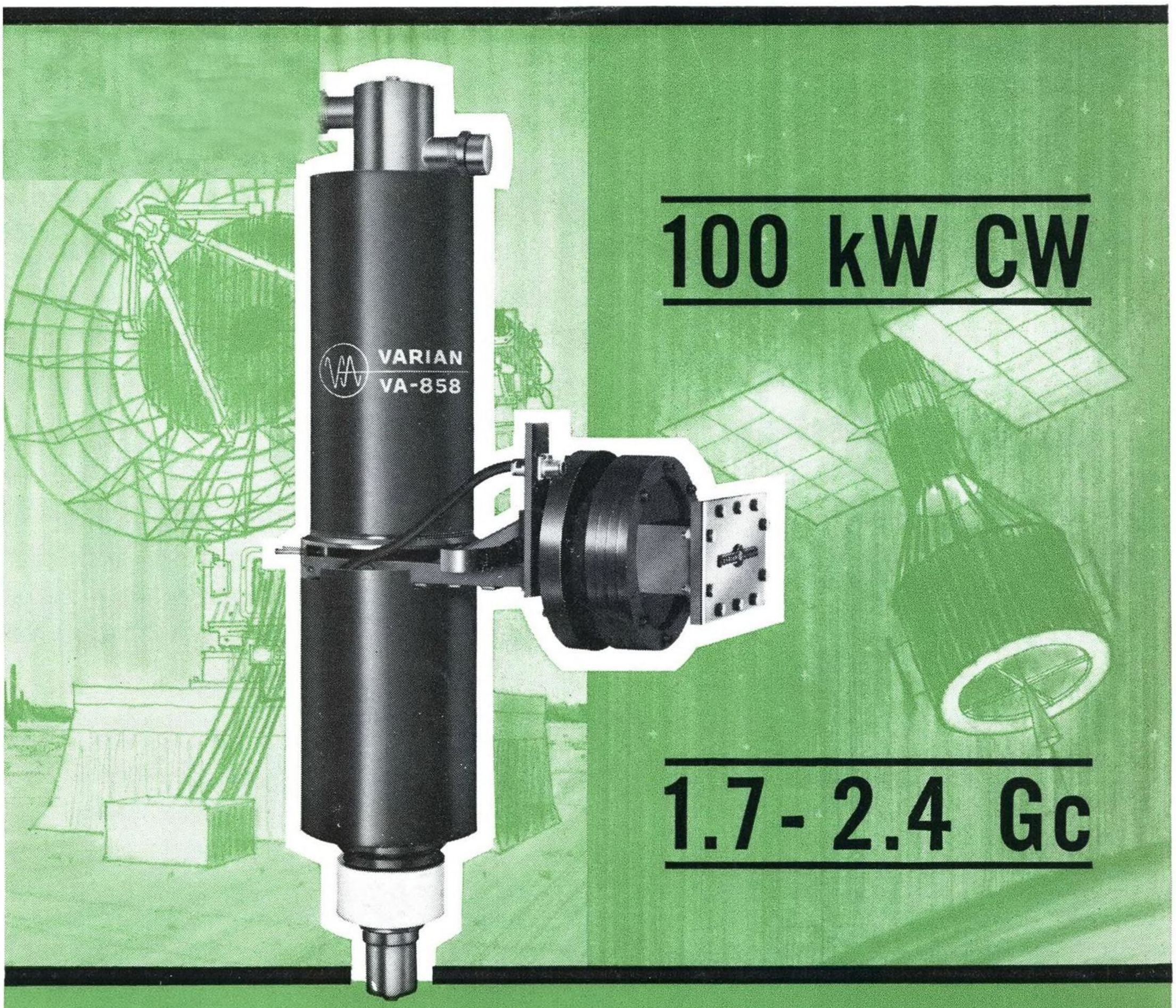
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