Aviation Week & Space Technology

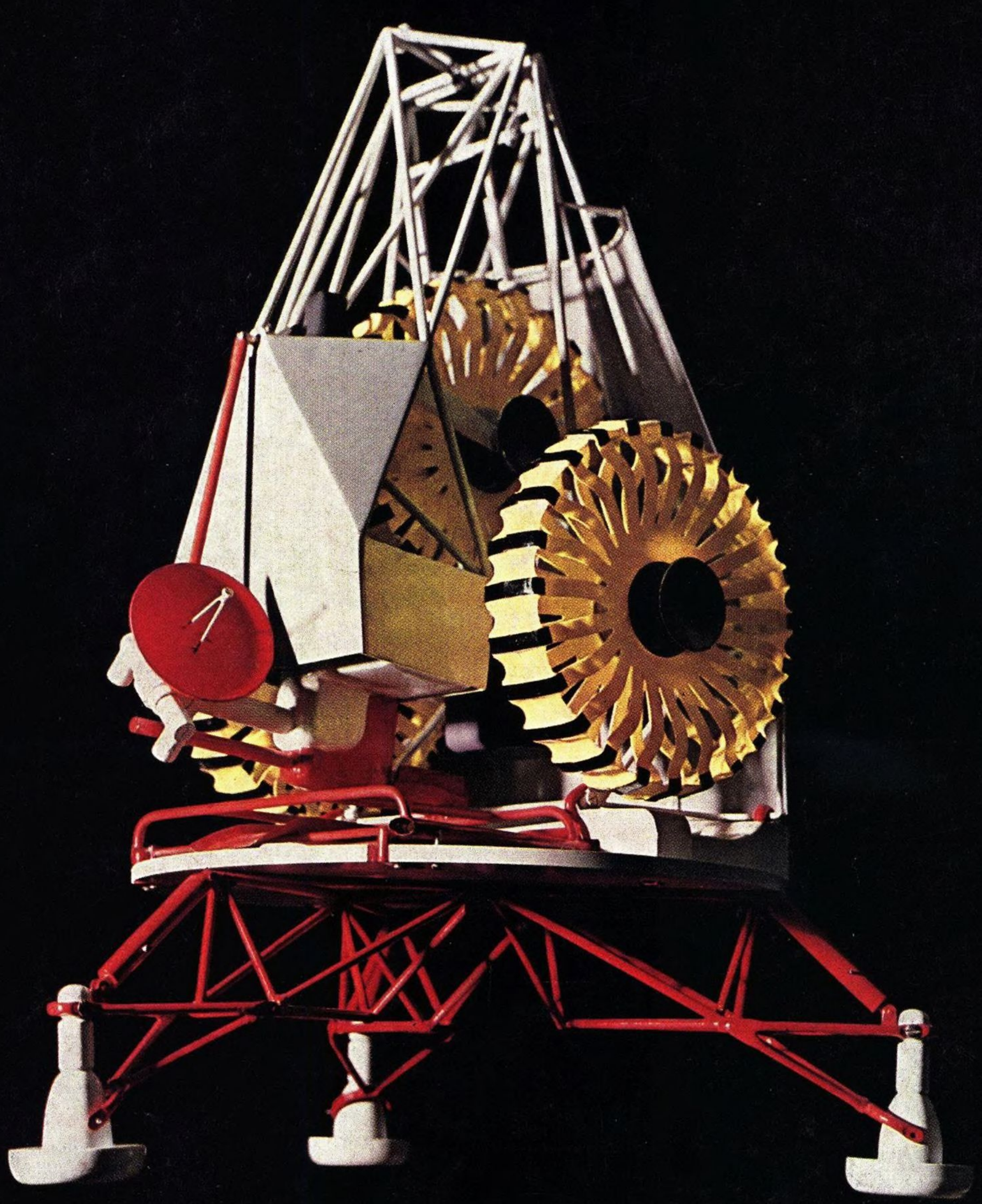
75 Cents

A McGraw-Hill Publication

June 4, 1962

USAF Shaping Techniques For Cost Forecasts

Bendix Lunar Vehicle



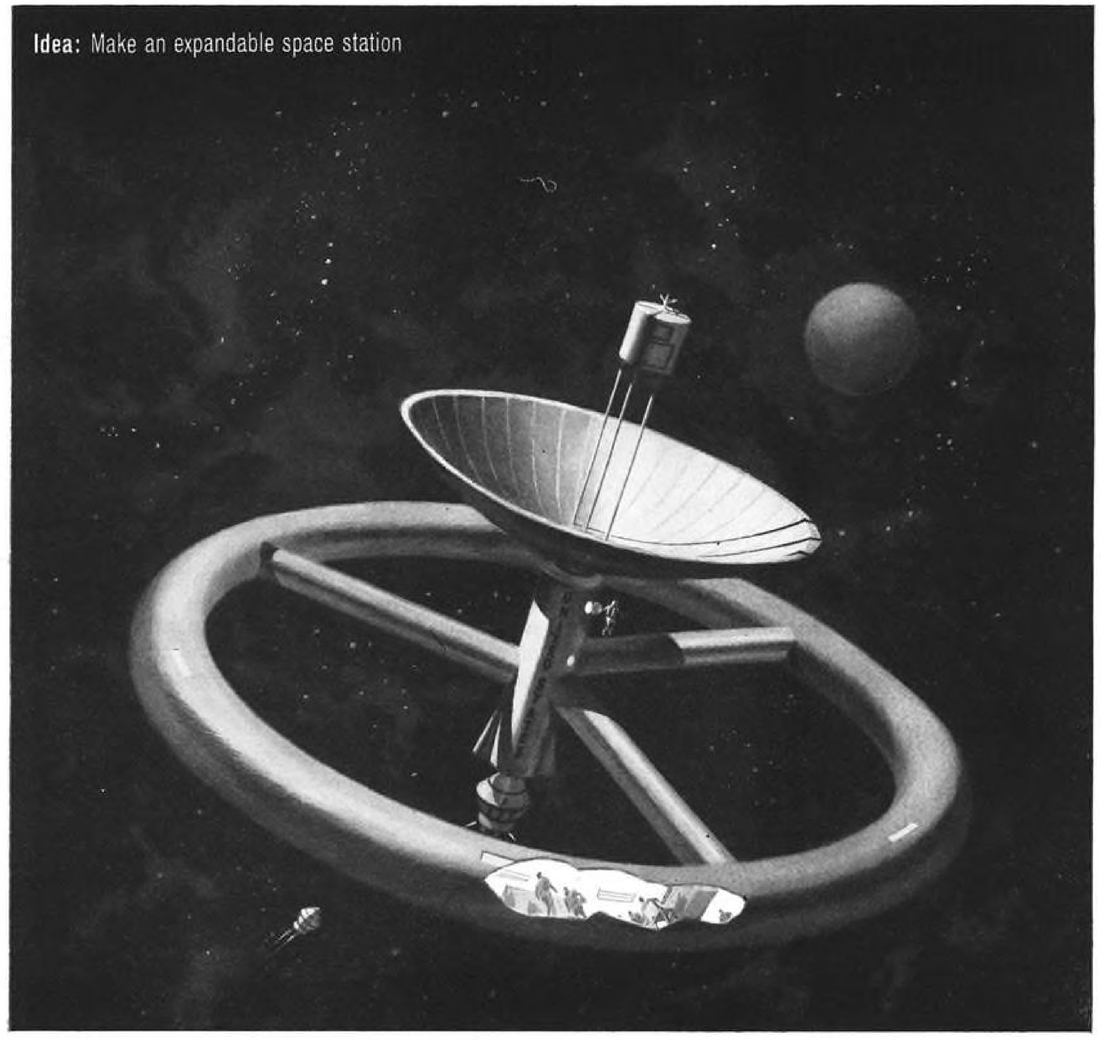
Volumes of Performance from Voi-Shan

Voi-Shan is noted for its ability to manufacture high-performance bolts, nuts and other precision fastening devices for the aircraft/missile industry. It is the nation's pioneer in Titanium bolt manufacturing and has worked with such exotic materials as Beryllium, Zirconium, and Columbium. Other exotic materials such as Tantalum and Tungsten are constantly being experimented with for their potential use as high-performance fasteners.

The table shown, is representative of Voi-Shan's range of experience in the manufacture of high-strength and high-temperature bolts. Write for descriptive literature on these and other Voi-Shan quality products.

Material	Room Temperature Minimum Ultimate Tensile Strengths (Typical)	Typical Temperature Usage Range	Typical Head Configurations
Mo +1/2% Ti	116,000 psi	−425 to 2500°F	100° Flat Head, Internal or External Hex or External 12 point Wrenching
Alloy Steel	160,000 psi	−100 to 550°F	
A-286 Corrosion Resistant Steel	160,000 psi	−425 to 1200°F	
Inconel X	165,000 psi	−425 to 1400°F	
M-252	170,000 psi	−425 to 1400°F	Threads: MIL-S-7742 (Class 3A)
Alloy Steel	180,000 psi	−100 to 550°F	
René 41	180,000 psi	−425 to 1600°F	100° Flat Head, Internal or External Hex or External 12 point Wrenching
K-Monel	180,000 psi	−425 to 1000°F	
Waspaloy	180,000 psi	−425 to 1400°F	
Udimet 500	195,000 psi	−425 to 1600°F	Threads: MIL-S-7742 MIL-S-8879 (Class 3A)
A-286 Corrosion Resistant Steel	200,000 psi	−425 to 1200°F	
PH 15-7 Mo	220,000 psi	−300 to 1000°F	
Hy-Tuf	220,000 psi	−100 to 550°F	Internal or External Hex or External 12 point Wrenching Threads: MIL-S-8879 (Class 3A)
Various	220,000 psi	−100 to 900°F	
5% Chrome	260,000 psi	−100 to 900°F	
Die Steels	280,000 psi	−100 to 900°F	

VOI-SHAN MANUFACTURING COMPANY A Division of Voi-Shan Industries, Inc. 8463 HIGUERA STREET, CULVER CITY, CALIFORNIA



LAND, SEA, AIR OR SPACE...TALENT THAT BUILDS BETTER DEFENSE SYSTEMS

This may well be America's space station of the future. It's an *expandable* structure, made of fabric—a concept pioneered by Goodyear Aircraft Corp. (GAC). It promises to solve aerodynamic, weight, volume, and erection problems looming in the path of advanced space projects.

Today, it permits the gathering of actual operating experience before "giant" boosters become available. Reason: It fits in a small package atop a rocket's nose... is lighter than proposed metal stations. And, it can be automatically erected in space, has overload recovery capabilities that let it shrug off sudden stresses.

Tomorrow, large stations, 100 feet and more in diameter, will simulate earth living conditions *(including gravity)*, while retaining a zero "G" hub for experimentation and rendezvous docking.

Right now space station models at GAC are being outfitted for human factors studies. NASA is using a GAC-fabricated station for the same purpose. These stations are typical of our capabilities in land, sea, air or space defense systems.

If *now* is when we can be of service to you in advanced systems and technology—aerospace support equipment—electronic subsystems—lightweight structures—or missile requirements, write:
Goodyear Aircraft Corporation, Dept. 914AR, Akron 15, Ohio, or Litchfield Park, Arizona.

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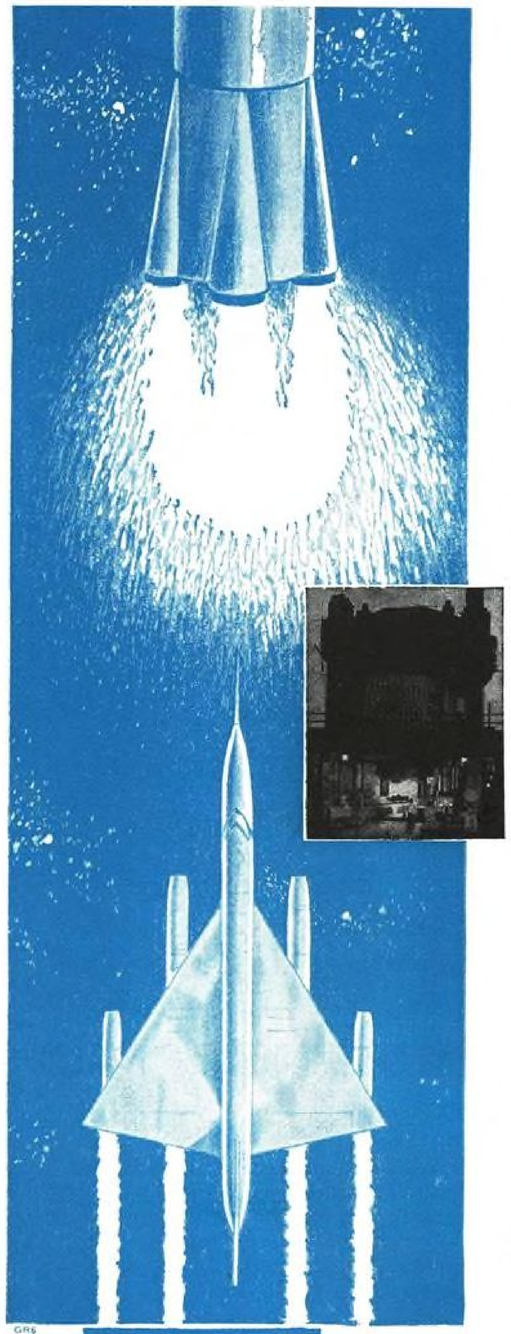

Forging a metal spectrum for any flight environment

Whether design criteria be Mach 2 or escape velocity — the part a wing spar or rocket motor nozzle — most of the significant advances in forging conventional, exotic and refractory materials come from Wyman-Gordon. Here, technical breakthroughs in size, complexity and strength-to-weight ratios of forged airframe hardware and propulsion components have materially raised performance ceilings for every type of vehicle — global bomber to deep space probe capsule. Always impatient with state-of-the-art concepts, Wyman-Gordon engineers and metallurgists constantly explore ways to bring hitherto "unforgeable" metals and alloys into operational use — broadening the spectrum of ultimate-performance materials available for advanced vehicle designs. Consultation on your project requirements can help achieve better correlation of materials to service environment.

CURRENTLY FORGING THESE AERO-SPACE MATERIALS

Aluminum	Beryllium
Titanium	Molybdenum
Magnesium	Tantalum
Columbium	Zirconium
Hafnium	Tungsten
Inco 718	René 41
Astroloy	Waspaloy
Stainless steels	Vacuum-melt alloys
Nickel-base alloys	Iron-base, high-temperature alloys
High-strength die steels	20-27 Nickel steels

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WYMAN-GORDON

Forgings of Aluminum, Magnesium, Steel, Titanium and Beryllium, Molybdenum, Columbium and other uncommon materials

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AEROSPACE CALENDAR

June 11-13—Sixth National Conference, National Aviation Education Council, Seattle, Wash.

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

June 13-16—Annual Meeting, National Society of Professional Engineers, French Lick Sheraton Hotel, French Lick, Ind.

June 17-22—Summer General Meeting, American Institute of Electrical Engineers, Denver Hilton Hotel, Denver, Colo.

June 18-19—Vacuum Metallurgy Conference, American Vacuum Society, New York University, New York, N. Y.

June 18-Aug. 10—Advanced Subject Matter Institute on Nuclear Rocket Propulsion, University of Florida, Gainesville, Fla. Sponsor: National Science Foundation.

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

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

June 20-22—Annual Convention, Airline Ground Transportation Assn., Barclay Hotel, New York, N. Y.

June 24-29—Annual Meeting, American Society for Testing and Materials, Statler Hilton Hotel, New York, N. Y.

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

June 25-30—Symposium on Electromagnetic Theory & Antennas, Copenhagen, Den-

(*Continued on page 7*)

AVIATION WEEK and Space Technology

June 4, 1962

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Here's the most accurate and reliable time/delay/switch ever designed for manual operation! The new miniature AGASWITCH is activated at a touch of the button ... delay is controlled by the patented AGASTAT® *pneumatic* timing head. Once started, the cycle continues to completion with high-accuracy repeatability, regardless of electrical or environmental variations.

AGASWITCH is supplied with fixed delays or any of five adjustable ranges covering a total span from .03 to 180 seconds. One to four pole switch models are available, with capacities to 10 amps at 28vdc or 115vac, both resistive. In standard units the switch transfers when the button is pressed, timing starts when button is released, and the switch returns to its initial position at the end of the delay period.

An exclusive "positive cycle" action can also be supplied, in which the switch transfers and timing starts simultaneously when the button is pressed, and no interruption of the timing cycle is possible until the switch returns to its initial position.

Hermetically sealed (MIL Spec) as well as unsealed models are immediately available from AGASTAT—leader in time delay instrumentation for over 30 years. Write Dept. A1-16, for specifications or engineering assistance on your specific requirements.

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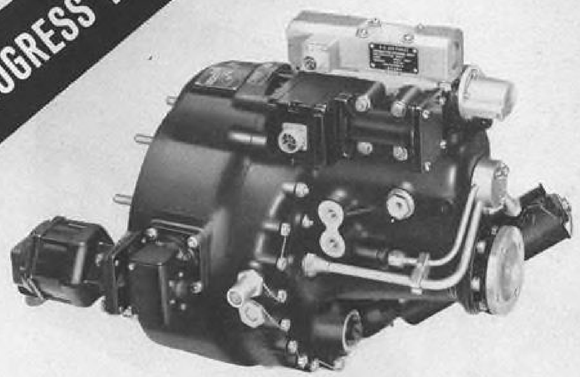

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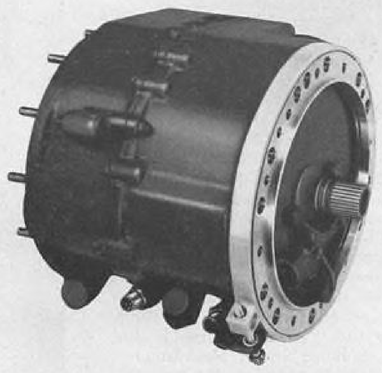

1962

Another milestone in Constant Speed Drive design

It has been 16 years since Sundstrand Constant Speed Drives opened the way to 400-cycle a-c electrical systems for aircraft, with the first drive installation on the B-36 bomber. Since that time, over 35,000 Constant Speed Drive units have been delivered for use on hundreds of first line military and commercial aircraft . . . bombers, fighters, reconnaissance aircraft, tankers, ASW planes, interceptors, and commercial jetliners. As the leading supplier of Constant Speed Drives for the aircraft industry, Sundstrand Aviation maintained this leadership through continuous state-of-the-art advancement.

During this period of changing requirements and accelerated development, there have been many Sundstrand firsts . . . first automatic paralleling system, first precise system frequency control, first magnetic trim head for governors, first Constant Speed Drive for commercial aircraft, first 60 KVA drive, and first 120 KVA drive.

Now Sundstrand can point to another milestone in the progressive improvement in Constant Speed Drive design . . . the 2500 series drive. This is the first Constant Speed Drive to enter service with an initial service time between overhaul guaranteed at 2500 hours. The 2500 series drive is a completely new concept in hydromechanical mechanisms that incorporates simple, proven commercial components. The key innovation in this new drive design is geared differential that divides the power between the hydraulic units and the mechanical power train, permitting significant reduction in the size of the hydraulic units. The hydraulic components are hydrostatically balanced, and this design makes possible the use of high-capacity, standard bearings, providing a major increase in life and reliability. In addition, the utilization of smaller components makes possible higher efficiency, as well as a smaller, lighter weight package.

Once again, Sundstrand Aviation is first in new design innovation in Constant Speed Drives. This could very well be as important a development in Constant Speed Drives as that first B-36 drive that brought a-c power to aircraft.

The new 2500 series drives not only provide great improvement in drive life, improved performance, and increased reliability, but offer easier servicing and more economical drive overhaul as well. The first of this new series of geared differential drives will soon be flying aboard the Boeing 727. Others have been accepted for military application. If you have a requirement for Constant Speed Drives, you should investigate this new drive design . . . the 2500 series drive.

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AEROSPACE CALENDAR

(Continued from page 5)

mark. Sponsors: Technical University of Denmark; International Scientific Radio Union.

June 26-28—Aviation Conference, American Society of Mechanical Engineers, University of Maryland, College Park, Md.

June 26-28—203rd National Meeting, American Meteorological Society, University of Alaska, Fairbanks, Alaska.

June 26-29—Third International Symposium on Rarefied Gas Dynamics, University of Paris, Paris, France. Sponsors: AFOSR; ONR; NASA. (Open meeting.)

June 27-28—Ninth Annual Symposium on Computers and Data Processing by the University of Denver's Denver Research Institute, Elkhorn Lodge, Estes Park.

June 27-29—Joint Automatic Control Conference, Institute of Radio Engineers, New York University, New York, N.Y.

June 28-29—Fourth National Symposium on Radio Frequency Interference, Institute of Radio Engineers, Town House, San Francisco, Calif.

July 7-11—16th Annual All-Woman Transcontinental Air Race from Oakland, Calif., to Wilmington, Del.

July 12-13—12th General Assembly, NATO Advisory Group for Aeronautical Research and Development, Paris, France.

July 17-19—Lunar Missions Meeting, American Rocket Society, Pick Carter and Statler Hilton Hotels, Cleveland, Ohio.

July 24-Aug. 2—National Soaring Championships, El Mirage, Calif. For information: National Soaring Championships, P.O. Box 997, Victorville, Calif.

Aug. 1-5—Experimental Aircraft Assn. Fly-In, Rockford Airport, Rockford, Ill.

Aug. 8-10—1962 Standards Laboratory Conference, National Bureau of Standards' Boulder Laboratories, Boulder, Colo.

Aug. 10-11—IAS National Specialists Meeting, Man-Machine Competition, Olympic Hotel, Seattle, Wash.

Aug. 13-16—Pacific Energy Conversion Conference, Fairmont Hotel, San Francisco.

Aug. 13-16—Seventh Symposium on Ballistic Missile and Space Technology, U. S. Air Force Academy, Colorado Springs, Colo. Sponsors: USAF; Aerospace Corp.

Aug. 14-16—Cryogenic Engineering Conference, University of California of Los Angeles, Los Angeles, Calif.

Aug. 14-16—International Conference on Precision Electromagnetic Measurements, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

Aug. 15-17—Nuclear Propulsion Conference, Monterey, Calif. Joint Meeting: Institute of the Aerospace Sciences; American Rocket Society; American Nuclear Society.

Aug. 15-17—Third International Electronic Circuit Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 19-25—Annual Meeting and Conference, Airport Operators Council, Princess Kaiulani Hotel, Honolulu, Hawaii.

Aug. 21-24—Western Electronics Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.

Aug. 21-Sept. 17—14th Session, Interna-

(Continued on page 9)

ACTION MEMO

FROM: Production Manager

TO: J.M.H. Dept. 76-38

Let's get on this evaluation now! We can save Money by eliminating stem trimming costs. It's a better rivet anyway.

E.B.B.

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

These features lower installed costs and save money

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

Now you can get a locked spindle flush-fracturing rivet that is not critical in grip, has an excellent sheet clamp-up, and a practical grip range.

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Cherry Rivet Division

Santa Ana, Calif.

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R-165

*DUPONT T.M.

AEROSPACE CALENDAR

(*Continued from page 7*)

tional Civil Aviation Organization Assembly, Rome, Italy.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

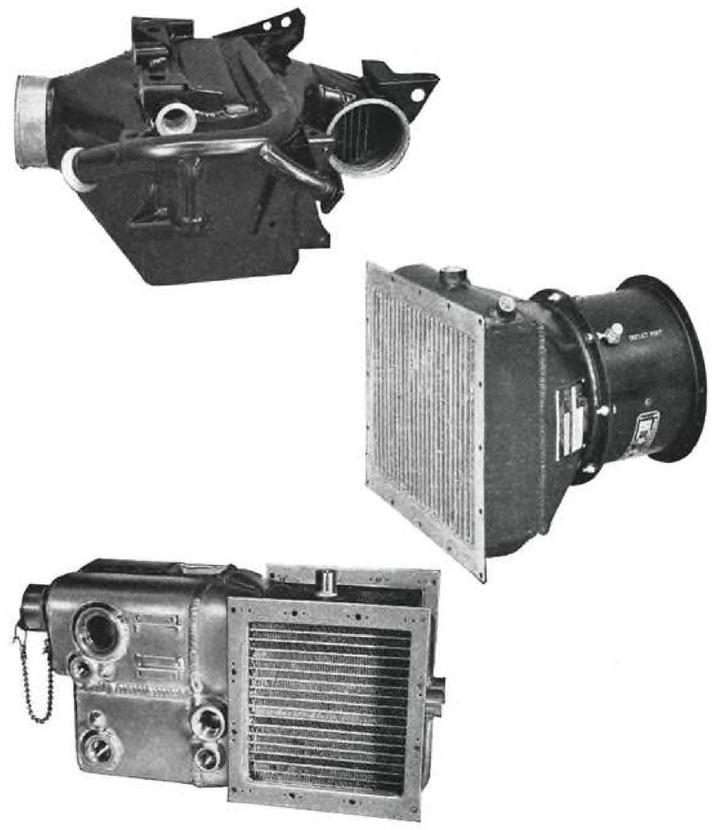
Sept. 19-22—Second International Agricultural Aviation Congress, National Superior Agronomy School, Grignon, France.

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

Sept. 25-28—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.

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

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



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Check with Janitrol the next time you want an oil cooler or heat exchanger. The biggest reason is reliability. The ability to produce production units with the same high quality of the prototype begins with our ability to form foil-thin sheets of stainless steel, titanium and aluminum. We use new techniques for creating optimum heat transfer surface AND structural strength in a wide variety of ways. We make heat exchangers and heat transfer systems for liquid/liquid, liquid/air, and air/air for both high temperature and cryogenic applications.

Ask Janitrol for a proposal when you need heat exchanger reliability on your aircraft, missile, ground support, or electronics cooling project. Request Bulletin JA-141 from Janitrol Aero Division, Midland-Ross Corporation, 4200 Surface Road, Columbus 4, Ohio.

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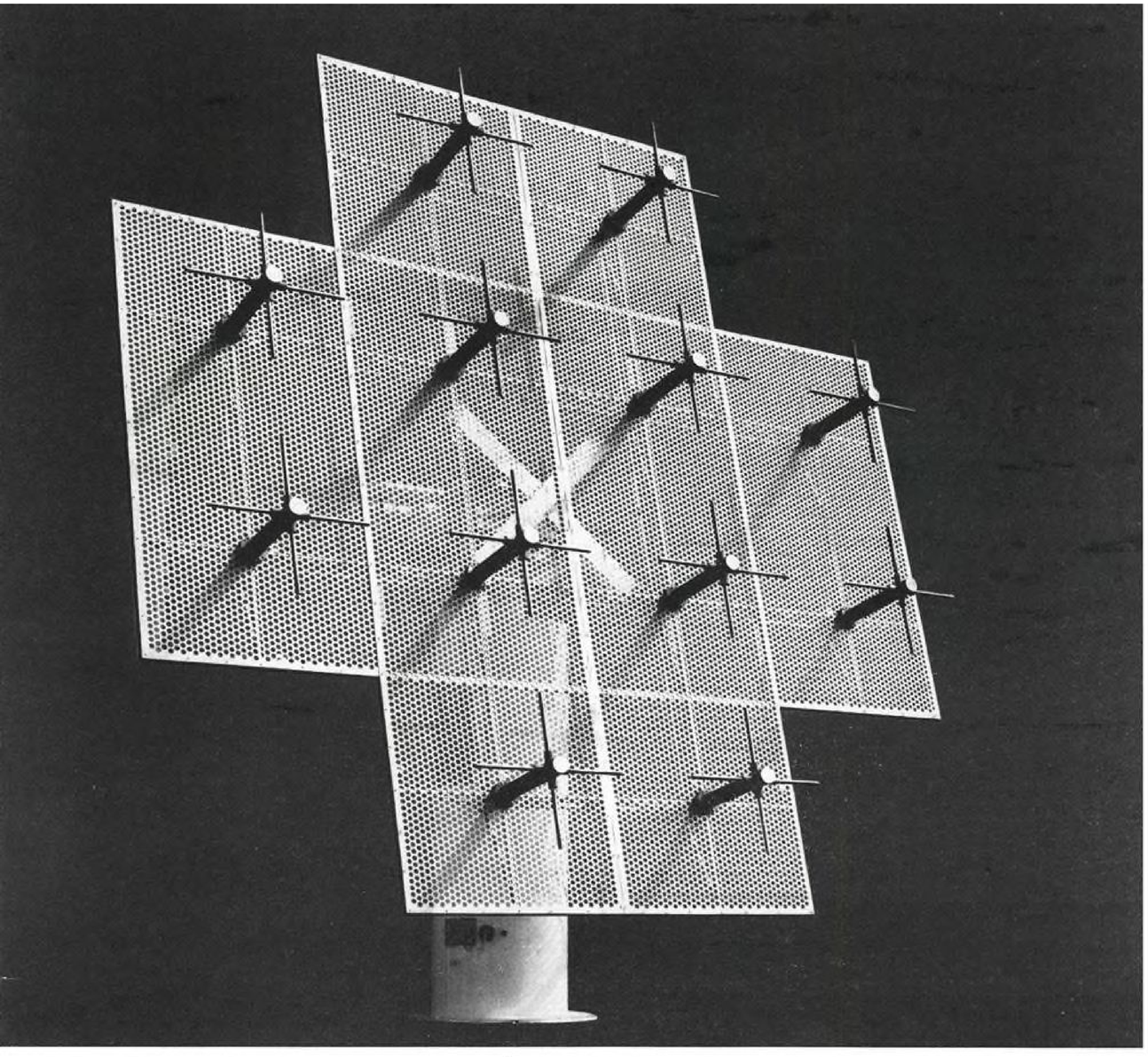

Specifications / Telemetry Antennas

The above dipole array is one of a family of high-performance tracking and acquisition antennas covering various telemetry frequency bands including 215-260 Mc and 370-410 Mc. These arrays have integral hybrids and provide both sum pattern and difference pattern outputs. Either manual or automatic self-tracking systems can be mechanized with complete polarization diversity . . . right and left circular, horizontal and vertical linear. Light weight and flat configuration results in lower mass moments and inertias, allowing use of smaller mounts and less complicated servo systems.

ARRAY NO. 1
Medium Gain Array *(above)*
PERFORMANCE

Frequency Range:	215 Mc - 260 Mc
Gain:	17.5 db
Sidelobes:	26 db (Principal planes) 17 db (Diagonal planes)
Null Depth:	35 db
Weight:	225 lbs.
Size:	12′x 12′x 1.5′
Beamwidth:	22.5 deg.

ARRAY NO. 2
High Gain Array
PERFORMANCE

Frequency Range:	215 Mc - 260 Mc
Gain:	21 db
Sidelobes:	20 db (All planes)
Null Depth:	35 db
Weight:	425 lbs.
Size:	18′x 18′x 1.5′
Beamwidth:	14 deg.

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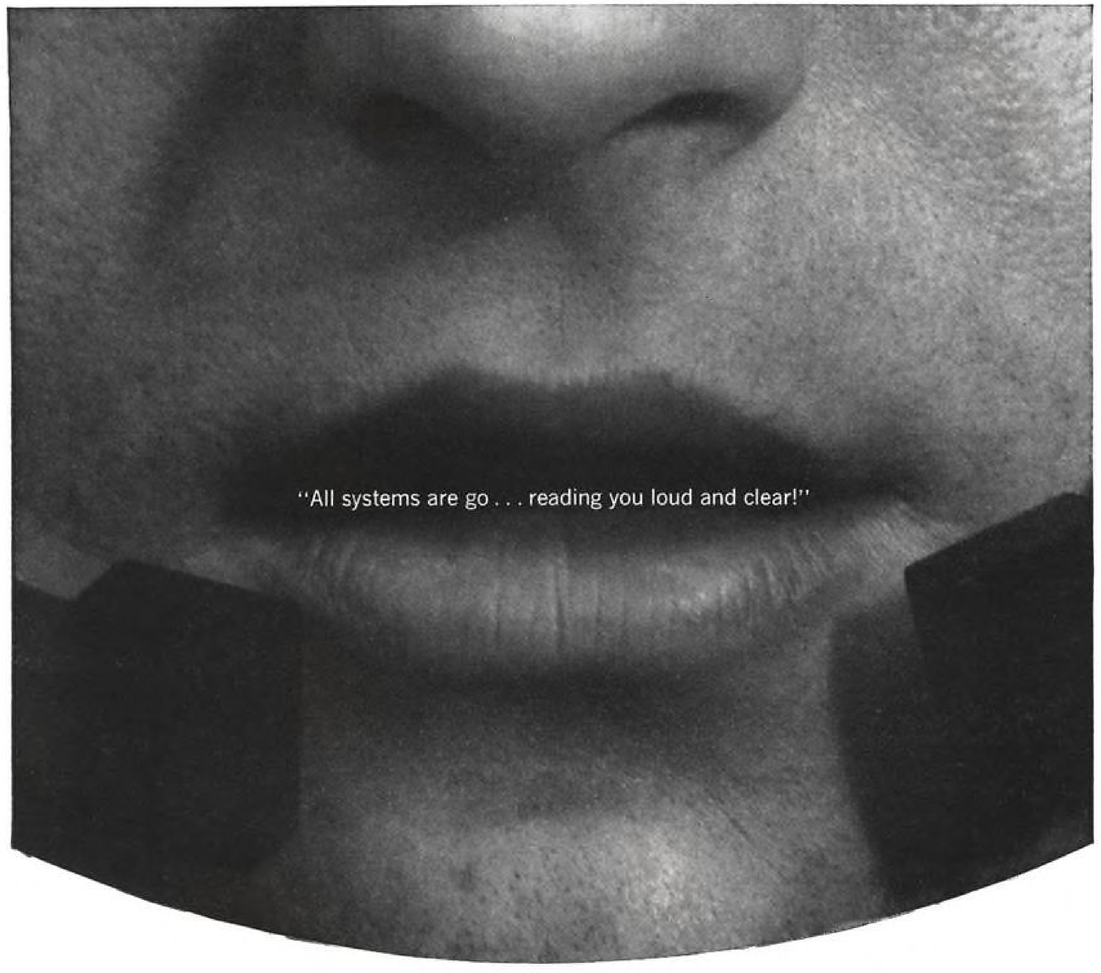

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Your Company: Collins, whose equipment transmitted the voices of Alan Shepherd, Gus Grissom, and John Glenn, from space. Collins designs, develops, and produces systems essential to every phase of manned space capsules. Prelaunch . . . launch . . . flight . . . re-entry . . . recovery. Collins is the link between earth and space in both human and electrical language.

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In fact, a long roll-call of projects . . . Corporal, Redstone, Jupiter, Bomarc, Titan, Atlas . . . repeatedly demonstrated the high quality and dependability of Anaconda stainless steel hose assemblies. For handling thermal expansion and contraction caused by temperature variations from —453°F to 1500°F, or taking up misalignment or offset, Anaconda produces stainless steel assemblies up to 48″ I.D.

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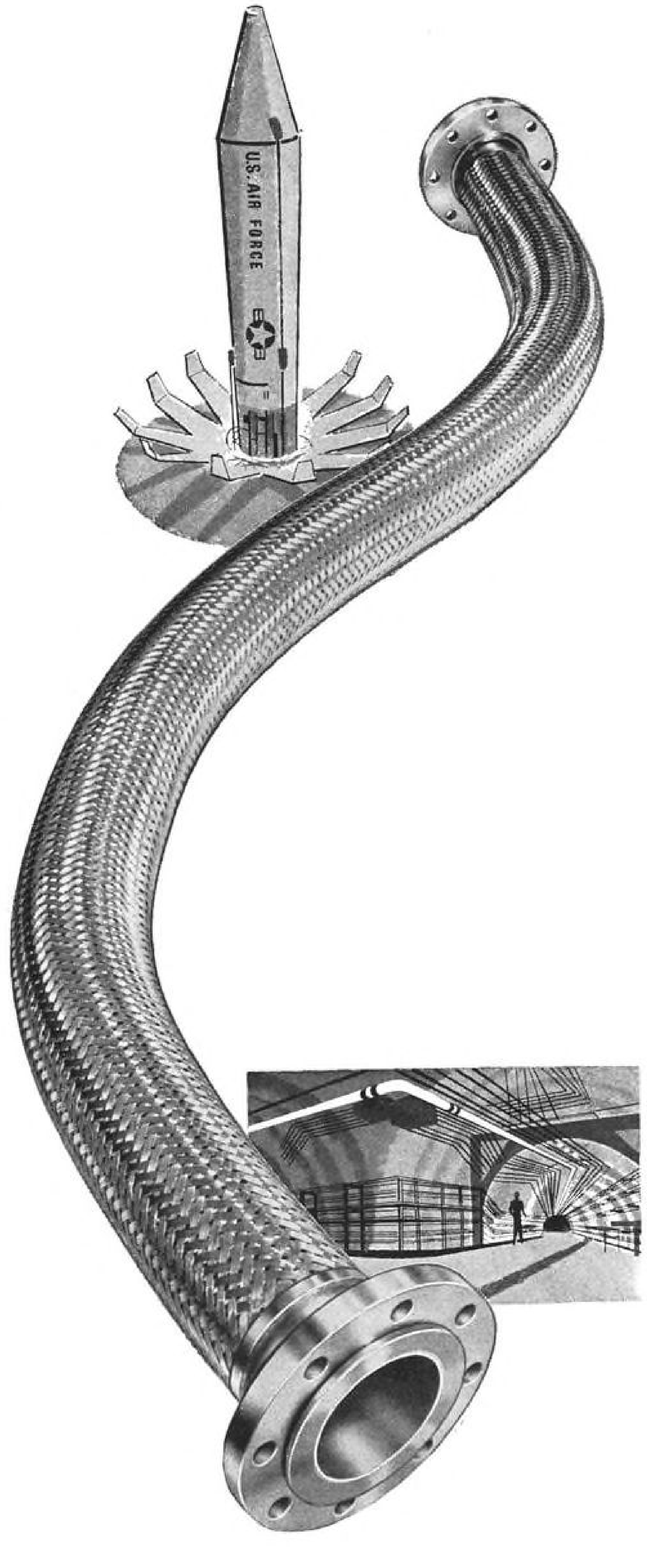

The helicopter parts Rohr can't build

Except for pilot, engine, and instrumentation, Rohr's capability in the fabrication of helicopter components is complete. It's a current capability based on broad experience gained from the manufacture of more than 93,000 adhesive bonded assemblies for aircraft, rockets and rotorcraft over the past seven years. Materials formed include honeycomb sandwich panels, metal-to-metal panels, and fiberglass laminates . . . with face materials of stainless steel, aluminum, magnesium, and fiberglass in combination with aluminum, steel, fiberglass and foam core materials. Rohr techniques have been developed to form an impressive variety of component shapes and sizes. Facility supported tools can provide adhesive bonded panels up to 15 x 30 feet, and Rohr "unitized" tools permit an even greater scope of manufacture. For answers to specific questions please write Marketing Mgr., Dept. 116, Rohr Corp., Chula Vista, Calif.

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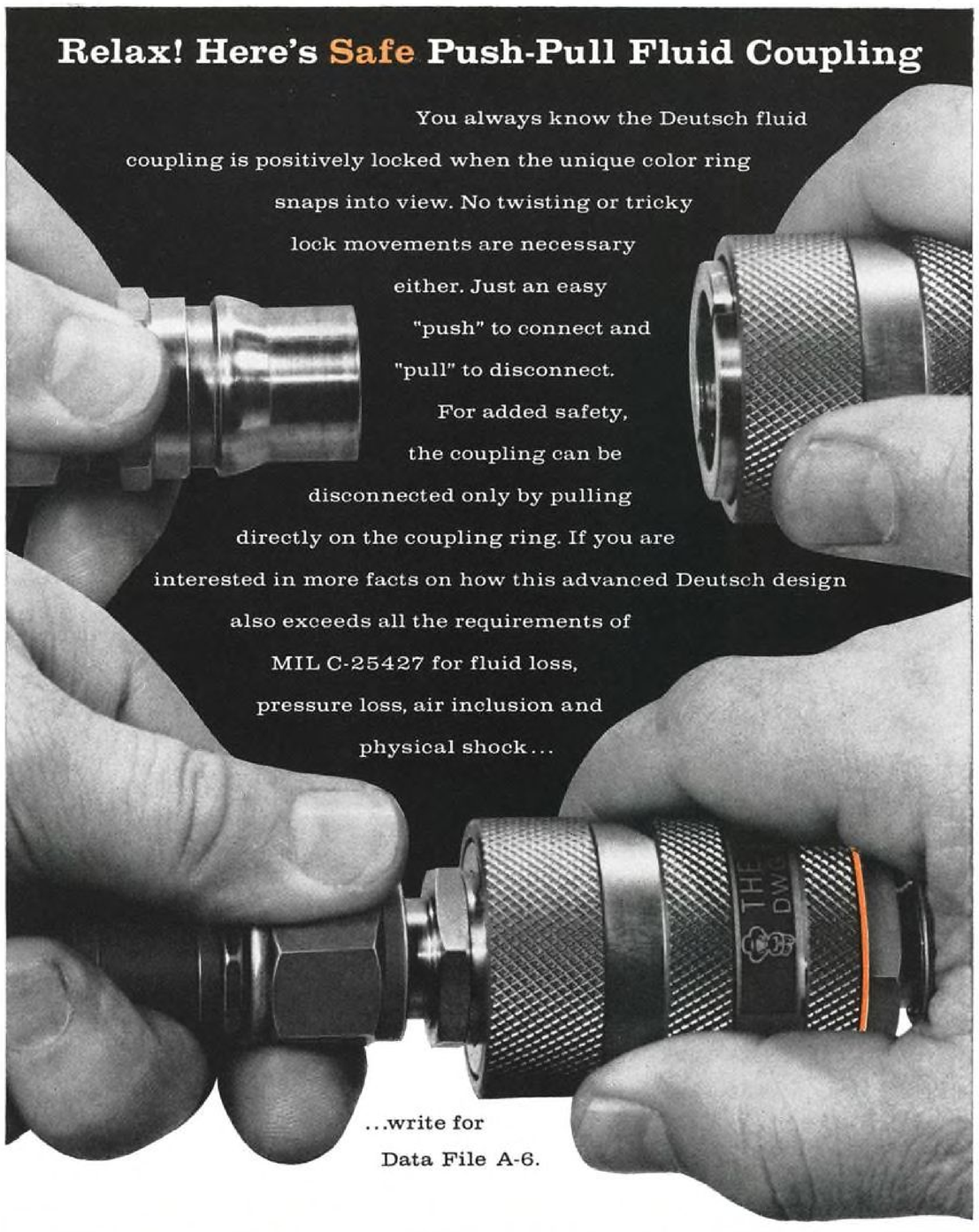

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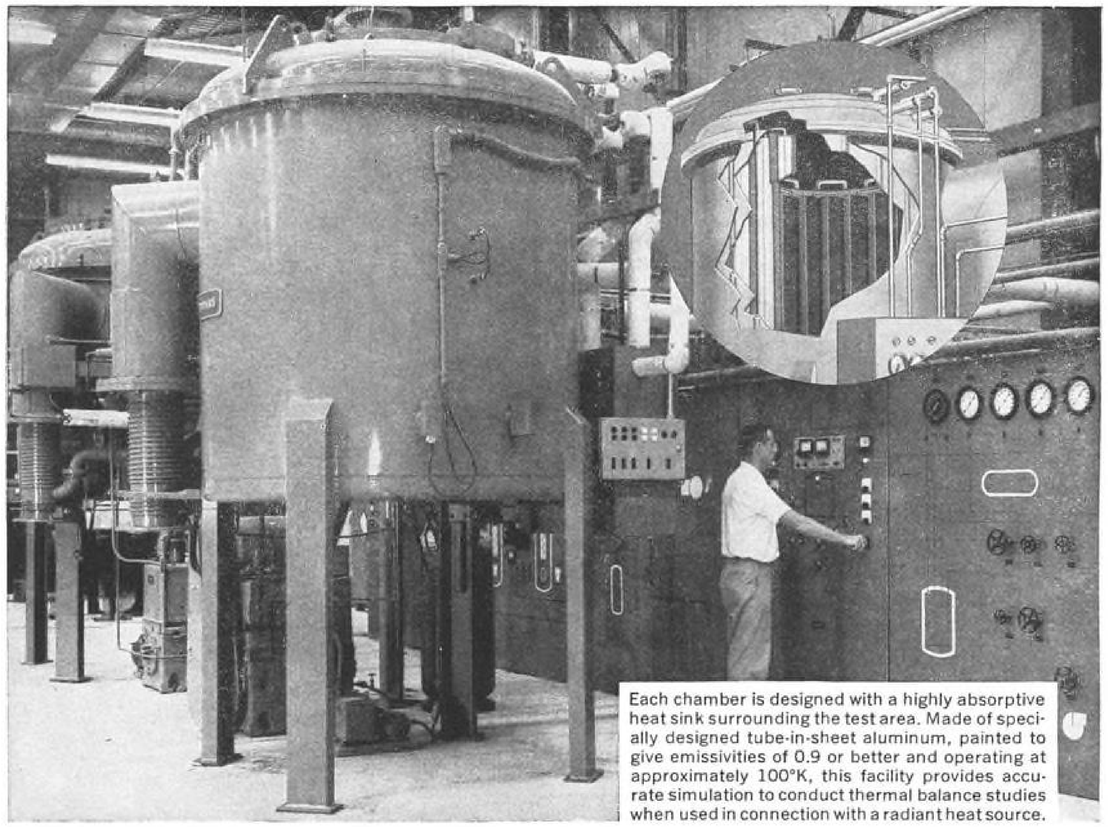

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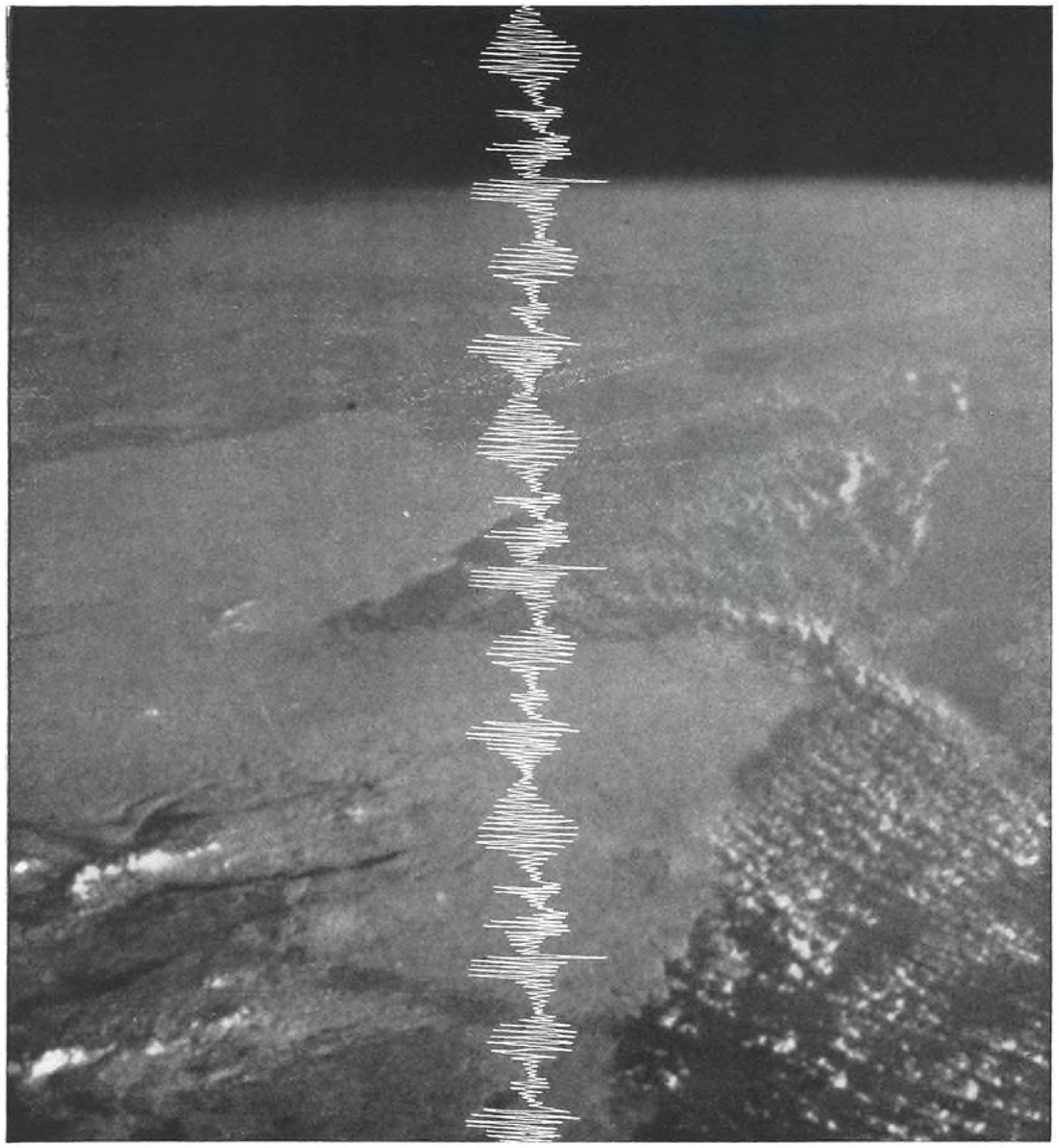

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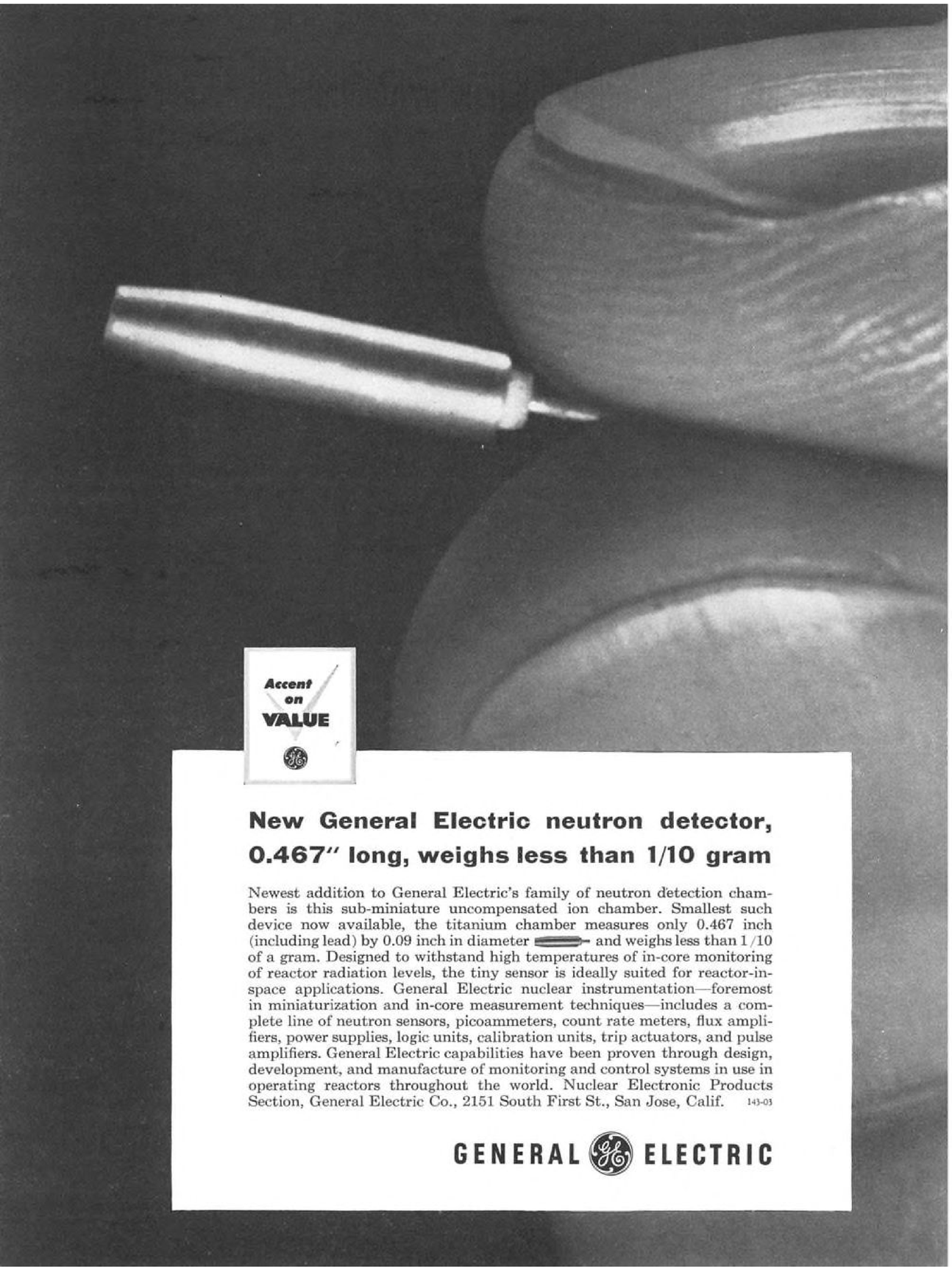

New General Electric neutron detector, 0.467" long, weighs less than 1/10 gram

Newest addition to General Electric's family of neutron detection chambers is this sub-miniature uncompensated ion chamber. Smallest such device now available, the titanium chamber measures only 0.467 inch (including lead) by 0.09 inch in diameter and weighs less than 1/10 of a gram. Designed to withstand high temperatures of in-core monitoring of reactor radiation levels, the tiny sensor is ideally suited for reactor-in-space applications. General Electric nuclear instrumentation—foremost in miniaturization and in-core measurement techniques—includes a complete line of neutron sensors, picoammeters, count rate meters, flux amplifiers, power supplies, logic units, calibration units, trip actuators, and pulse amplifiers. General Electric capabilities have been proven through design, development, and manufacture of monitoring and control systems in use in operating reactors throughout the world. Nuclear Electronic Products Section, General Electric Co., 2151 South First St., San Jose, Calif. 143-03

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MA-8 May Expand to Six Orbits..... 26
▶ Six orbits believed limit of present Mercury capsule's endurance; Carpenter's flight confirmed as over-all success.

CAB Alerted to Faulty Traffic Estimates..... 38
▶ Board, airlines learning that continually over-optimistic forecasts cause many carrier problems.

Bendix Continues Own Lunar Rover Study..... 54
▶ Despite failure of Prospector or alternate program to develop, Bendix investigating several roving lunar vehicle concepts.

SPACE TECHNOLOGY
MA-8 May Expand to Six Orbits..... 26
Cosmos 5 Orbited 30
Nimbus Launch Delayed..... 32
Nuclear Tests in Space..... 33
USAF Manned Saint Studies..... 34
F-1 Engine Reaches Full Thrust..... 36
Static Firing of Saturn S-4 Stage Due 36
Bendix Studies Lunar Rovers..... 54

AERONAUTICAL ENGINEERING
Allied Pilots Flight Test F-104G..... 30
JC-130As Fill Missile Range Gap..... 87
BLC B-66 to Fly in January..... 94
Paratroops Dropped From YHU-1D... 101
Focke-Wulf to Develop V/STOL Airliner 103
New Aerospace Products 123
Production Briefing 97

AVIONICS
DESC Begins New Electronic Parts Role 59
Filter Center 71

FINANCIAL
USAF Contracts 91
New Offerings 107

BUSINESS FLYING
Jet Commander to Fly This Year.... 119

AIR TRANSPORT
Airline Traffic Estimates Scored..... 38
Rehearing Ordered in Major Route Case 38
Continental Crash Linked to Bomb... 39
LACSA Control Terms Upheld..... 43
Second Trident Makes Flight..... 43
Southern to Resume ALPA Talks..... 43
Pakistan Line Plans Helicopter Service 44
MATS 1962 Dollar Obligations..... 45
Airline Traffic—February 1962..... 47
Airline Observer 50
Shortlines 50

MANAGEMENT
FAA, DOD DC-3 Replacement Plans... 31
Support Transport Stalled..... 31
DOD, NASA Space Coordination..... 32
GAO Widens Helicopter Study Role... 33
Gilpatric to Head DOD-Industry Unit. 34
DOD Promises Procurement Changes. 35
Guerrilla War Aircraft 35
JCS Orders War Terms Changed..... 37
McNamara Outlines Defense Studies. 37
Gen. Gerhart to Command Norad.... 37
Aircraft Shifts Cited in Merger..... 39
USAF Begins to Improve Forecasts... 76
Some Contractor Reporting to Be Cut 77
Industry Observer 23
Who's Where 23
Washington Roundup 25
News Digest 37

Aerospace Calendar 5
Letters 134

EDITORIAL
Proof of the Pudding..... 21

COVER: Bendix Corp.'s Systems Division has designed and constructed this 1/10th scale model of an unmanned, nuclear-powered roving lunar vehicle. Model shown is mobile but not self-powered. It is designed to fold into the nose cone of a three-stage launch vehicle, consisting of the two-stage Saturn C-1 configuration topped with the liquid-hydrogen Centaur upper stage. Vehicle would weigh 1,756 lb. For other photos and details, see p. 54.

PICTURE CREDITS
Cover—Henry McAllister, Bendix Corp.; pp. 26-30—NASA; 43—De Havilland; 44—Aviation Week; 54, 55—Bendix; 76—USAF; 94, 95—Garrett Corp.; 101, 117, Bell Helicopter; 103, 104—Focke-Wulf; 104 (bottom)—Aeronutronic Div. of Ford; 119, 121—Aero Commander.

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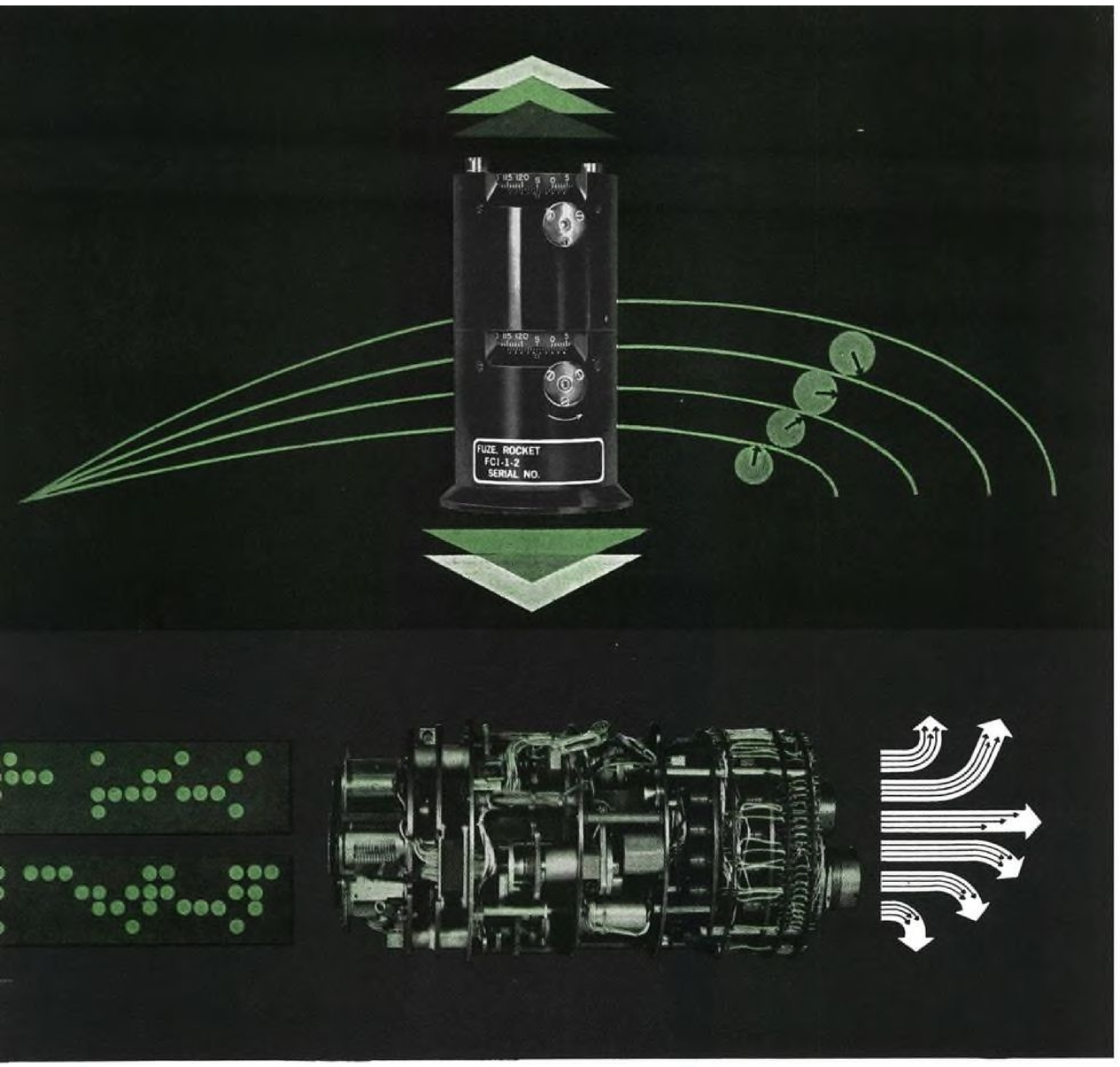

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EDITORIAL

Proof of the Pudding

Another pre-dawn vigil in the salt-moist, purple-velvet gloom of Cape Canaveral. Dawn breaks reluctantly, with the sun paled to a silver disk by thin wafers of overcast reinforced by fog and smoke from brush fires on the Florida mainland. On Pad 14 MA-7 proceeds through a flawless countdown with the Atlas 107D booster mated to the Aurora 7 Mercury capsule encasing Astronaut Scott Carpenter. From the press site a mile away, the gantry and missile on Pad 14 are invisible in the white fog blanket as the countdown whirls on to T — 11—eleven minutes short of the launch time of 7 a.m. EST—and then holds as the rising sun slowly burns off the fog. For 44 min., MA-7 holds its breath, awaiting the vagaries of the weather as the fog shroud plays strip-tease with the gantry and the sun wins its struggle with the mist.

The countdown resumes down to that breathless zero as the Atlas, now shining silver in the sun and venting white lox clouds below its lonely black capsule, stands silhouetted on the horizon. A tiny flash of igniters, two spurts of flame from the verniers and the initial bright orange flash as the two boosters and the sustainer rockets come to life. Three interminable seconds of hold-down on the pad as thrust builds up to full power and this incredible flight vehicle leaps free, rising slowly and awesomely toward the waiting clouds.

Seconds later, while the MA-7 missile and capsule are nearing the first cloud layer and the fiery orange rocket plumes are trailing like a comet's tail, the first pulsing roar of their power hits the press site with gut-trembling force. The missile, capsule and flame vanish into the first thin overcast, pop out again and then disappear once more into the second cloud layer. Emerging above these clouds, the fiery orange flame has paled to a cold gas glow, but the rockets still thunder their visceral message. White contrails break from the diminishing missile, obscuring the flame, and then suddenly stop as though a cut-off switch had been thrown. The flame becomes visible again against the gray sky, flickering in the same rhythm of its roar until 1 min. and 17 sec. after liftoff it vanishes from the naked eye and Scott Carpenter is hurtling toward his orbital injection point, observed only by the invisible fingers of telemetry, radar and the USAF television telescope.

Some 5 min. after liftoff, while the dust and exhaust steam is still slowly settling around Pad 14, Aurora 7 threads this orbital eye with incredible precision over Bermuda, about 500 mi. away and 99 mi. aloft. Less than 15 min. after liftoff, while observers are still trying to digest the emotional and intellectual impact of what they have just seen, Scott Carpenter is communicating with the Canary Islands and his capsule is coming up on the African coast, as the United States' second man in orbit settles down to the routine of his three trips around the world. Nothing during the rest of that sunbaked morning, not even the hour of re-entry suspense, can compare with the 2-min. of final countdown and launch.

No matter how many times you have seen an Atlas roar off the Cape with a warhead configuration or payload of inanimate instruments atop its silver shape, it is a vastly different sensation to see it go with the black blunt Mercury capsule atop and a man inside. It drives home, perhaps as nothing else can, the sheer audacity of man's determination to break out of his atmospheric envelope to explore the universe. It makes credible the incredible combination of courage and technical skill that has already brought us to this point, where man can ride this comet atop 360,000 fiery horses and control performance with more precision than the Wright brothers were able to manage over the sand dunes of Kitty Hawk in their first faltering steps into the air.

For Scott Carpenter's successful three orbital mission in Aurora 7 put a major stamp of approval on the entire concept of the Mercury program and the design, construction and operation of its equipment. During the MA-7 shot, the countdown on both booster and capsule was literally flawless—not a single technical problem and the only hold because of local weather. The Mercury capsule systems operated well during the entire flight, with the possible exception of the automatic recovery sequence. But a simple manual override by the pilot deployed the chutes properly. The design changes introduced in MA-7 as a result of John Glenn's first orbital flight were amply confirmed. The successful launch and precise injection into orbit of MA-7 by the Atlas is another startling measure of progress. This was the fourth successful orbital injection of a Mercury capsule by an Atlas. It represents the fruition of a painstaking program by General Dynamics/Astronautics, Air Force Systems Command's Space Systems Division, NASA and all of the subcontractors and equipment suppliers in the Atlas program, to transform this bird from a military weapon with statistical reliability acceptable for combat to a man-rated space booster with the perfect reliability that can be the only acceptable standard for manned space flight.

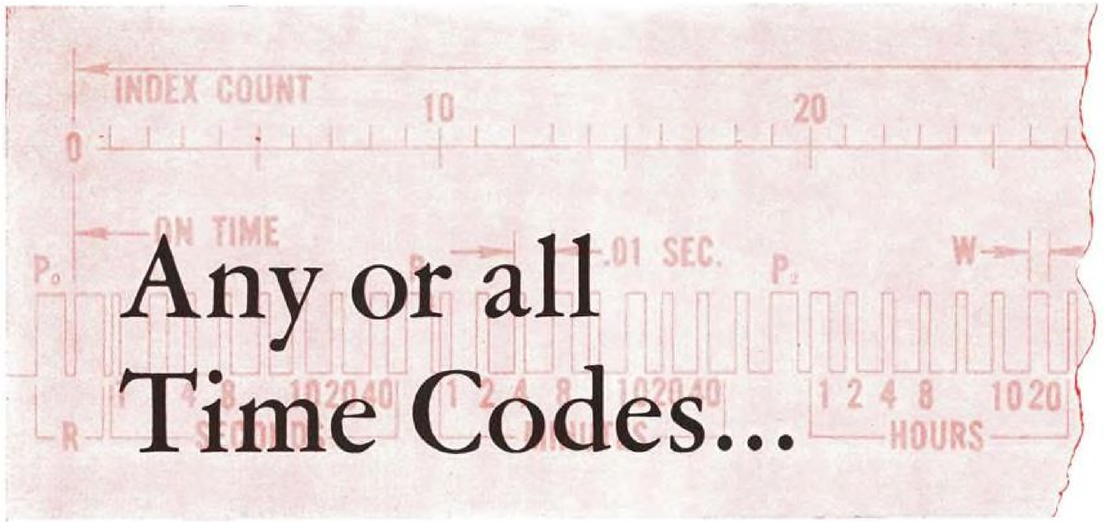
While MA-6 was devoted primarily to proving the feasibility of manned orbital flight, MA-7 proved just how much work a man can do during space flight. From the detailed record that is still unfolding, it is evident that Scott Carpenter was a busy working pilot in Aurora 7, gathering the data required by his assigned tasks and leaving himself little time for philosophical reflection or extraneous radio chit-chat. In addition to proving himself as a space pilot, Scott Carpenter also proved to be a master of handling the self-appointed critics' wing of the press site corps with a combination of blunt candor and razor-edge humor that could become a classic example of intellectual judo in a "Meet the Press"-type free for all.

It is also worth noting, since it seems to have escaped some daily chroniclers, that most of the flight research done by Scott Carpenter during MA-7 was related directly to the additional knowledge required, not only for advanced Mercury flights such as the six and 18-orbit missions, but also for the two-man Gemini capsule aimed at developing orbital rendezvous techniques, and the three-man Apollo mission to the moon.

The manned space flight program, while it may provide prime television entertainment and magazine serials as by-products, is basically a technically sound scientific program to extend man's frontier of knowledge, not only about his spatial environment, but about himself.

Scott Carpenter and his Mercury support team on MA-7 took another basic step forward in man's long journey toward the stars. It may sound corny, but it's true.

—Robert Hotz



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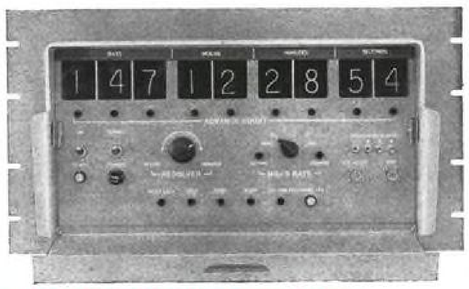

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WHO'S WHERE

In the Front Office

John B. Lawson, general manager, Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., succeeding **Gerald J. Lynch,** retiring. Also: **Dr. Donal B. Duncan,** assistant general manager-operations.

Dr. John P. Nash, a vice president, Lockheed Missiles & Space Co., Sunnyvale, Calif. Dr. Nash continues as director of the Research and Engineering Laboratories.

George Rappaport, president and chief executive officer, Warnecke Electron Tubes, Inc., Des Plaines, Ill. Warnecke is jointly owned by Compagnie Generale de Telegraphie Sans Fil, Paris, France, and The Hallicrafters Co., Chicago.

E. W. Pappenfus, vice president-engineering, Granger Associates, Palo Alto, Calif.

Dr. Glenn L. Musser, president, HRB-Singer, Inc., State College, Pa., a subsidiary of The Singer Manufacturing Co., succeeding **Dr. John L. McLucas,** now Deputy Director of Defense Research and Engineering, Tactical Warfare Program, the Pentagon.

Frank J. Hoyne, president and general manager, Mechanics Universal Joint Division of Borg-Warner Corp., Rockford, Ill., succeeding **Frank W. Rickard,** now chairman and chief executive officer.

Monte L. Marks, president, Owen Laboratories, Inc., Pasadena, Calif., succeeding **Robert P. Owen,** who assumes responsibilities for all engineering and new products development. Also: **Warren H. Paap,** director of marketing.

George E. Spaulding, Jr., president, Consolidated Vacuum Corp., Rochester, N. Y., a subsidiary of Consolidated Electrodynamics/Bell & Howell.

A. P. Stuhrman, a corporate vice president, Bourns, Inc., Riverside, Calif. Mr. Stuhrman continues as manager of the Trimpot Division.

Dr. John L. Sprague, a senior vice president, Sprague Electric Co., North Adams, Mass., and co-director of the company's engineering laboratories.

Robert L. Jannen, vice president-sales and marketing, Leach Corp., Compton, Calif.

Clarence D. Martin, Jr., Under Secretary of Commerce for Transportation, will serve as chairman of the Department of Commerce inter-agency group which will formulate policies on transportation mergers. Other members: **Kermit Gordon,** Council of Economic Advisers; **James J. Reynolds,** Assistant Secretary of Labor for Labor Management Relations; **Lee Loevinger,** Assistant Attorney General, Anti-trust Division, Department of Justice. **Joseph J. Saunders,** Chief of the Public Counsel Section, Department of Justice, will serve as alternate to Mr. Loevinger.

Honors and Elections

Charles F. Horne has been elected president of the Electronic Industries Assn. Mr. Horne is a senior vice president of General Dynamics Corp., and president of General Dynamics/Pomona and General Dynamics/Electronics.

INDUSTRY OBSERVER

► Bell Aerosystems Corp. soon will begin construction of a manned lunar landing simulator to be test-flown by NASA Flight Research Center at Edwards AFB, Calif. The machine, which resembles a flying footstool with the pilot seated on top, will be powered by a General Electric CF700 aft-fan engine developing 4,500 lb. thrust. Program, which will cost $5 million, will establish piloting techniques for lunar landings. Manned Spacecraft Center, Houston, Tex., recently released $300,000 in initial funding.

► **Rand Corp. will perform a study of low-acceleration space transportation systems to predict desirable and attainable characteristics of electric propulsion-powered spacecraft, for NASA's Marshall Space Flight Center.**

► Requirement for a new close-support aircraft with vertical takeoff capability is being framed now by U.S. military services. Aircraft would differ from currently planned NATO VTOL fighter, but would meet operational requirements of U.S. and European forces.

► **First launch attempt for NASA's S-49 EGO (Eccentric-orbiting Geophysical Observatory), first of the series of geophysical satellites, has slipped from the original schedule of March, 1963 to July next year. EGO will be launched by an Atlas/Agena B. It is planned to establish an orbit with a 150 naut. mi. perigee and a 60,000-naut. mi. apogee.**

► First attempt to launch Scout advanced first stage, designated Aerojet Algol 2A, will be made in July from Wallops Island by NASA technicians. The 2A has a 66-sec. burning time compared with 40 sec. for the standard Scout first stage designated Algol 1S. Thrust of each is 115,000 lb.

► **NASA is conducting a feasibility study of launching Scout payloads into a polar orbit from Wallops Island. Trajectory would follow usual flight path out over the Atlantic for the early portion, and then dog-leg onto the polar orbit course during third- or fourth-stage burning.**

► Navy has evinced interest in Ling-Temco-Vought studies of a sea-launched version of nuclear-ramjet-powered supersonic low-altitude missile (SLAM) and is conducting in-house studies, although it has not yet funded any program with Vought. With vehicle configuration fairly well defined and proof of feasibility of powerplant and guidance system in hand, SLAM activity now is concentrated on development of total technology involving marriage of warhead, guidance, stability and control into a weapon system.

► **Army has asked USAF Aeronautical Systems Division to develop an all-weather troop emergency airdrop capability for the C-141 Star-Lifter turbofan transport, now under development by Lockheed Georgia Division. Army is seeking future capability to drop troops into a rugged area of "brush fire" conflict, such as Laos, from on-the-deck altitudes at speeds of 100 to 200 kt. under zero-zero weather conditions. Terrain avoidance equipment and precise navigation techniques will be required aboard the C-141 in such an operation.**

► French manufacturer Henry Potez is developing a new version of the Fouga Magister trainer, redesignated CM-170-3 and powered by paired Turbomeca Marbore 6 engines. Airplane will have improved canopy, wraparound windshield and additional fuel capacity. Potez said it will be offered to Western-bloc air forces as a follow-on to the present Magisters, powered by Marbore 2 engines, of which about 1,000 have been sold.

► **Army is evaluating Grumman AO-1 Mohawk battlefield observation aircraft as a fighter-bomber armed with a wide variety of rockets, bombs and guns. Move is attributed to disappointment about the outcome of interim strike fighter competition last year.**

► Aeronautical Systems Division is seeking industry sources for research and development program in solid-state devices capable of operating at X-band frequencies and beyond. One program objective calls for a solid-state signal generator at millimeter wavelengths.

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Such is the case, we suggest, with UNION CARBIDE's improved fusible silicone rubber compounds—a product of ten years research and development—and now available in a broad range of hardness, tensile, elongation, and tack.

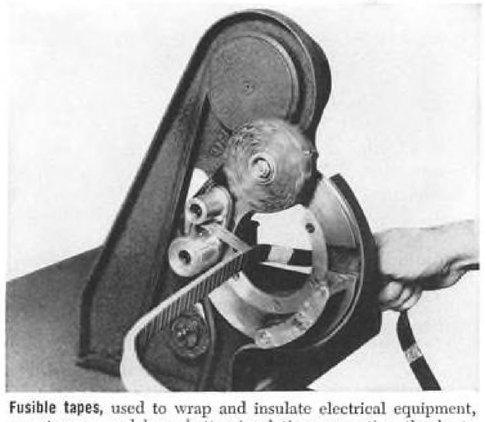
FUSES UPON CONTACT

The outstanding characteristic of parts or tapes made from fusible silicone rubber is that, while they look and feel like regular silicone rubber, they "grab" or adhere to other fusible rubber surfaces upon contact—*and in a few hours the pieces fuse together into a homogeneous mass.* (A short heating will speed up the process, but is not required.) Fusible silicone rubber is not sticky; it adheres only to itself, not to other surfaces. It is not an adhesive, not a paste—parts or tapes made of it are fully cured and possess excellent mechanical and electrical properties (along with the temperature stability and chemical resistance for which silicone rubber is noted). They can be worked and handled like other parts or tapes; but when you need them to adhere to each other, they do so immediately.

And, of special interest to both you and the fabricator, UNION CARBIDE's new fusible base can be compounded to make up many different fusible elastomers that can be tailored to meet your individual requirements. Moreover, it is the easiest handling silicone rubber known—it can be processed by any conventional forming technique (molding, extruding, calendering) to make the form *you* want.

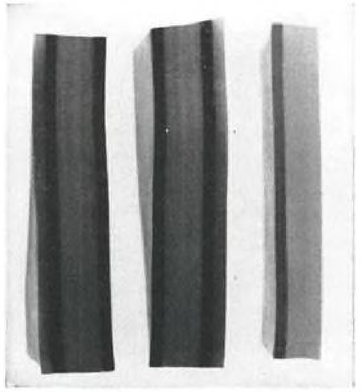
NEW PRODUCT APPLICATIONS

Development of the new base is an extension of the fusible concept pioneered by UNION CARBIDE. To date, the best known use of fusible rubber has been in tapes for insulating stator coils on electric motors. In addition, it has found application as a protective covering for vacuum tubes... for "on-the-spot" splicing of plastic insulated cables which connect the ground consoles to missiles . . . as overwrapping to protect the tail cone of solid-fuel rockets from back blast and damaging particles . . . as an overwrap to protect the insulation on nuclear cable used in an atomic energy plant from degradation caused by radiation and weather.



Fusible tapes, used to wrap and insulate electrical equipment, are stronger and have better insulating properties, thanks to fusible silicone rubber. Here, fusible tape is machine wrapped onto a stator coil.

With these uses in mind, we believe that the inherent advantages found in fusible compounds will suggest other product applications to the design engineer. They may provide a clue to new uses, or you may wish to talk it over with your fabricator and get his ideas about the feasibility of fusible rubber for a new molded or extruded product.



These slabs of fully cured fusible silicone rubber (colored light and dark for identification) fused together after they were piled up for one hour at room temperature.

SEND FOR FREE SAMPLE

In any case, to help you get acquainted with the extraordinary advantages and product design opportunities of fusible silicone rubber compounds, UNION CARBIDE offers you a free roll of tape. For yours, just write on your company letterhead to Silicones Division, Union Carbide Corporation, Dept. F16-9201, 30-20 Thomson Avenue, Long Island City 1, N. Y.

If you want to explore the whys and hows of product development with UNION CARBIDE fusible silicone rubber compounds, your UNION CARBIDE Silicones Man stands ready with sound technical advice.

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In Canada: Union Carbide Canada Ltd., Bakelite Division, Toronto 12.

UNION CARBIDE

SILICONES

Washington Roundup

Rendezvous Decision

Major decision on whether the U.S. will try rendezvous in earth orbit or near the moon for the Apollo manned mission will be made before the end of this month (AW Apr. 16, p. 32).

National Aeronautics and Space Administration's Manned Spacecraft Center is among those supporting the lunar orbit rendezvous, a technique proposed by John Houbolt of the Langley Research Center. (AW Nov. 6, p. 54). Plan calls for using one Saturn C-5 to put the Apollo spacecraft in lunar orbit. A one-man vehicle then would be dropped from the spacecraft onto the moon's surface. The small vehicle later would rejoin the Apollo and return to earth.

A form of earth orbital rendezvous is favored by the Marshall Spaceflight Center. (AW Mar. 19, p. 78). A stage derived from the Saturn S-4B filled with liquid oxygen would be launched first into a 140-mi. earth orbit. The rest of the Apollo vehicle would be launched later into a 261-mi. orbit. A Saturn C-5 would be used for each launching. The unmanned tanker vehicle would be propelled into a minimum energy transfer ellipse to rendezvous with the Apollo. Once the tanker and spacecraft were joined, the vehicle would proceed to its lunar landing. The vehicle would have enough power to return the spacecraft to earth.

Backers contend the lunar orbit mission is simpler and thus more certain of success. Advocates of the earth orbital technique counter that their way has fewer unknowns and permits checkout in orbit before the crew is committed to lunar flight. Brainerd Holmes, manned space flight director, will make the final decision.

Badgers to Red China

Russia is helping Red China modernize its air force by sending it twin-jet, swept-wing Tu-16 Badger bombers to replace the 700 straight-wing, Il-28 Beagle bombers. Although the Badgers are reaching China at a slow rate, they represent a major increase in Chicom offensive capability, particularly if fitted with the drone missile versions of the MiG-17 supersonic fighters (AW Mar. 12, p. 275). China-based Badgers could reach all major U.S. western Pacific bases, including those in Japan, The Philippines, Okinawa and Southeast Asia.

State Department, in a special report to Congress, said Soviet airplanes sent abroad as part of Russia's foreign aid program often are unsafe and more expensive to operate and maintain than comparable Western aircraft. "Cabin pressurization is faulty, takeoff speeds too slow and landing speed too fast. Soviet Il-18s have frequently crashed and eventually had to be grounded," State said.

Pentagon Gumshoes

Defense Department's crackdown on security leaks includes trailing individual reporters to learn where they obtain their information (AW May 21, p. 26). Defense Secretary Robert McNamara recently told the Joint Chiefs of Staff that a Pentagon correspondent for a major metropolitan daily had been followed as he visited Air Force offices. The Secretary evidently did not realize the reporter mainly was distributing complimentary copies of his new book.

The reporter eventually discovered he had been trailed and met with McNamara to discuss it. The Defense Secretary promised the practice would not be repeated and subsequently asked the Joint Chiefs to cooperate with the reporter. At least one other military correspondent for a major newspaper has been followed the same way but does not know about it.

Rep. Olin Teague, second ranking Democrat on the House space committee, is continuing his own campaign against the release of space information he considers valuable to Russia (AW May 28, p. 30). He met recently with McGeorge Bundy, presidential assistant for national security affairs, to discuss the space secrecy question and is expected to meet soon with State and Defense officials. These discussions probably will lead to a meeting with President Kennedy.

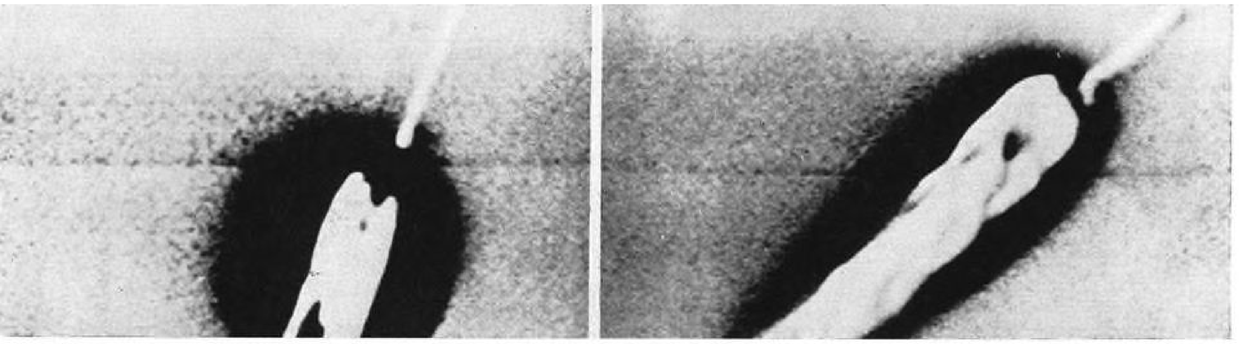
Foreign Airline Bills

House Transportation and Aeronautics Subcommittee opens hearings June 12 on international air transportation, but no full-fledged investigation of the problem is intended. Instead, the subcommittee will confine itself largely to taking testimony on three bills to give the Civil Aeronautics Board greater authority to regulate foreign air carrier traffic into the U.S. The Senate aviation subcommittee is showing a similar lack of interest in any broad investigation of international air traffic problems, partly because so few carriers responded to its questionnaire on the subject.

Watch for General Services Administration announcement within the next few weeks of a contract with Hughes Tool Co. formally ending government involvement with the HK-1, the giant plywood "Spruce Goose" seaplane built during World War 2 as an anti-submarine weapon. GSA wants to withdraw from the project, not extend it as recently reported elsewhere.

Plethora of project names prompted this protest on a Pentagon bulletin board: "Project AWESOME, for All Weather Surveillance, Old Mother Earth."

—Washington Staff



EXHAUST PATTERN of the Atlas booster that powered the MA-7 capsule into orbit begins to expand at high altitude as the booster becomes discernible in the exhaust as the booster programs further over (right, p. 26). Burning continues in booster stage after separation (pho

Next Astronaut May Spend 3 of 6 Orbits

Expanded mission would require few major changes; data continues to confirm over-all success of MA-7.

By Edward H. Kolcum

Washington—Expansion of the Mercury mission to six orbits—three of them in drifting flight—gained momentum last week as analyses of data from the Aurora 7 flight of Lt. Cdr. Scott Carpenter continued to confirm the overall success of the second U.S. manned three-orbit mission.

Detailed studies concluded recently indicate that six orbits is the limit of capability for the existing capsule configuraton, although a seven-orbit mission had been under serious study (AW May 28, p. 26).

A six-orbit mission will require no significant mechanical changes in the capsule and addition of only small quantities of consumable stores. The only major changes from the three-orbit profile are in the flight plan and in recovery force deployment.

Capsule will be allowed to drift free for three complete orbits. This will be done to conserve fuel because the automatic stabilization and control system will be made inoperative. Cdr. Carpenter, who conducted the first experiments in drifting flight, experienced no difficulty and said he would have been happy to continue drifting flight for four or five more orbits.

In order to conserve battery power, systems to be used intermittently in the six-orbit mission will be energized only when they are needed, rather than continuously as was done in the three-orbit flights. Data has not been fully reduced from the Mercury Atlas-7 (MA-7) mission of Cdr. Carpenter, but the MA-6 capsule used only 27.8% of available main and standby battery power.

Environmental oxygen presents no problem for a longer mission. The MA-6's oxygen consumption rate was 0.13 lb./hr. for the 4 hr. 56 min. of his flight.

The six-orbit recovery area will be northeast of Midway Island, which means that considerably more contingency aircraft will be needed than in the Atlantic Ocean recovery system. Pacific Fleet destrover and helicopter elements have already completed training for Mercury recovery, and the Navy foresees no problem in conducting Mercury recovery operations there.

Purpose of the advance to six orbits is to fill an aeromedical void, at a minor modification cost, between the present three-orbit profile and the 18-orbit Mercury missions scheduled to start next year. NASA will base its decision for the MA-8 flight on detailed analysis of MA-7 data, which will be completed by the end of this month.

Six orbits will provide about 531 min. of weightless flight for the astronaut, and an early opportunity to assess the effects of extended zero gravity on pilot performance. Onset of the nausea experienced by Soviet Maj. Gherman Titov in his 17-orbit flight in August, 1961, came at the start of the sixth orbit, after he had been weightless about 455 min. Although U. S. officials are confident that Titov is prone to inner ear sickness and the condition is not general, they are anxious to verify this belief before starting the 18-orbit Mercury program.

Because the six-orbit mission will be designed primarily for biomedical data, the number of scientific experiments calling for large fuel expenditures will be reduced. Mission objectives will be primarily to determine how the pilot reacts during longer weightless flight, and how the subsystems are affected by the extended zero gravity environment.

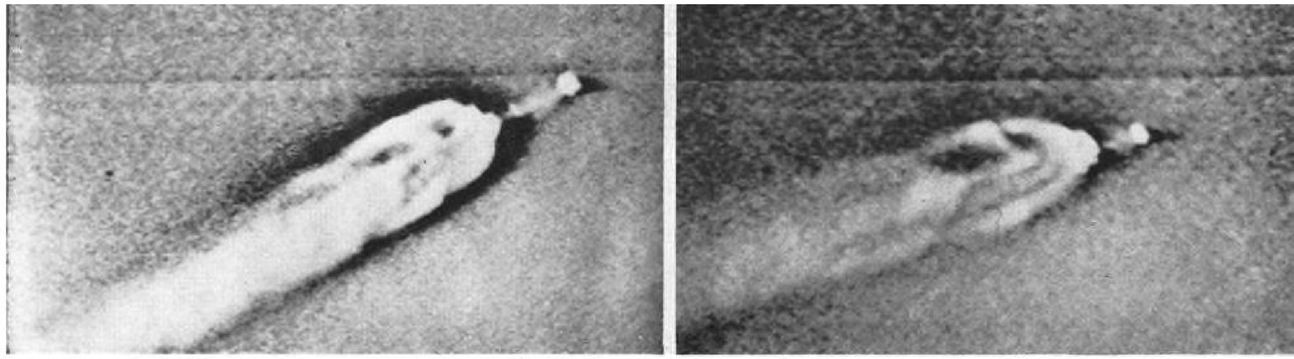
The six-orbit flight was to receive serious consideration for the mission if sufficient confirming data were obtained in the MA-7 flight (AW May 28, p. 26). By this yardstick, National Aeronautics and Space Administration is ready to proceed with detailed planning for the expanded mission. Carpenter's problems with MA-7 now appear to have been primarily in operating technique, rather than with capsule systems performance.

Walter C. Williams, associate director of the Manned Spacecraft Center and operations director for Mercury flights, said that both Atlas booster and Aurora 7 capsule systems operations were flawless.

Cdr. Carpenter's problems were a 250-mi. overshoot of his planned impact point; extremely high control system fuel consumption; an uncomfortably warm suit environment; and a failure of his attitude gyros to agree with the horizon he saw through his window.

Marine Lt. Col. John H. Glenn, Jr., pilot of the MA-6 capsule, landed near the planned impact point, but he too exhausted his control system fuel, and reported that his gyro reference system did not coincide with his visual observation.

Carpenter appeared to be less tired than Glenn immediately following the flight. A transmission from the Hawaii tracking station indicated that Cdr. Carpenter was "a tired and confused astronaut" just prior to the critical retrorocket firing sequence. But both Carpenter and aeromedical monitors discredit this observation. Proof of his awareness and strength was demon-



programs over. Programing begins after the vehicle passes through the area of maximum dynamic pressure at about 35,000 ft. Shock pattern tos, p. 27. Sustainer engine is smaller white circle at extreme right. Booster cutoff occurred at 130 sec. after ignition at 200,000 ft.

in Drift Flight

strated in his ability to leave the capsule through the neck—a technique which requires both strength and agility.

Carpenter could have blown the capsule emergency escape hatch, but this would have resulted in the vehicle shipping water and sinking. He decided to leave the hard way, which involves pushing the instrument panel aside, removing a pressure bulkhead, and climbing through the narrow capsule neck.

Two vital signs caused some immediate concern to aeromedical monitors during the flight, but detailed analysis is expected to find fault with the sensors, rather than the astronaut.

Carpenter's blood pressure, normally 120/70, rose in telemetry readings to 140 in the systolic range, while the diastolic varied between 60 and 70 mm. of Hg. Monitors feel that high systolic reading, along with a constant diastolic, mean the blood pressure cuff was loose.

The other vital sign which caused initial concern was body temperature, taken during the flight with a rectal thermometer. Carpenter's temperature rose from 100.4F to 102.4F in a period of 30 min. The rise was more pronounced than if he had been in a sweat box, and it was felt that the reading itself was faulty.

The astronaut was uncomfortable for about 90 min. during his flight starting with the second orbit, during which time he manipulated the suit water flow control valve and arrived at a satisfactory setting. The setting apparently was erroneous at launch, and between other pilot tasks, it took the entire second orbit to rectify this condition.

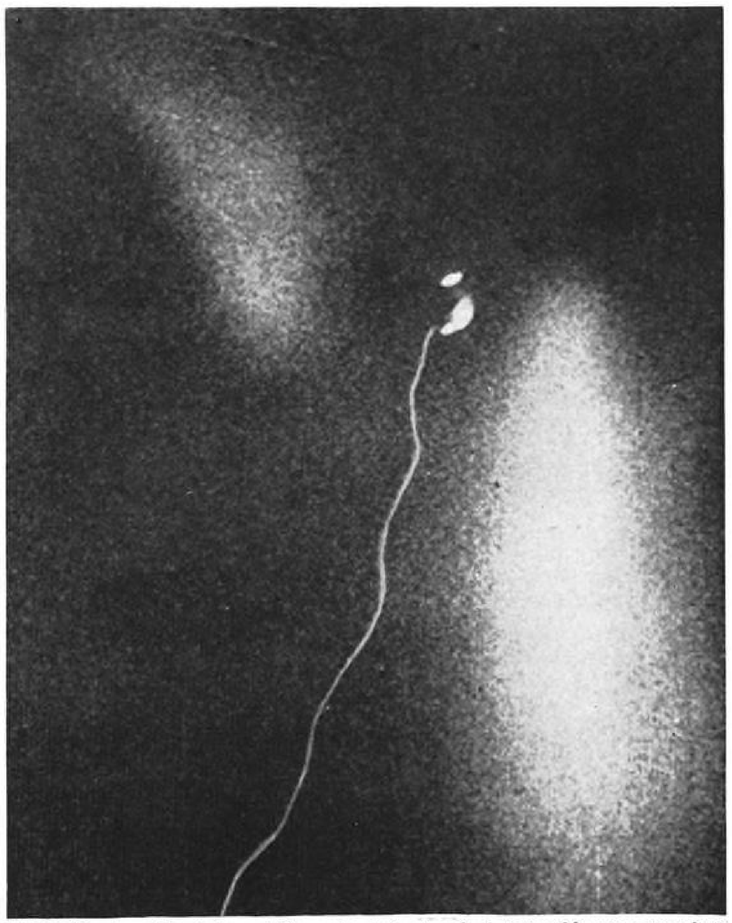
The continually warm suit probably contributed to the fact that Carpenter lost 7 lb. during his flight, from a pre-launch weight of 154 lb. to a post-launch weight of 147 lb. Col. Glenn lost 5 lb., 5 oz. during his mission, much of it after landing when suit inlet temperature rose by 15 deg. in 15 min.

The fact that Cdr. Carpenter overshot

DISTINCT LIST of Mercury capsule is evident as Astronaut Scott Carpenter awaits rescue. Carpenter landed at 12:41 p.m. EST May 24, approximately 250 mi. downrange from planned impact point (AW May 28, p. 26).

CARPENTER AND PARAMEDIC float in rafts. Paramedic team parachuted from a Douglas SC-54. Capsule is supported by inflated collar. Carpenter was rescued by a Sikorsky HSS-2.

TWO PARTICLES glow brilliantly as they float past Aurora 7 space capsule in orbit. Sun is at lower left. Carpenter took photo with a 35-mm. hand camera.



BALLOON released by Astronaut Carpenter trails at end of slack cable connecting it to Mercury capsule. Carpenter described balloon as a small sphere with two ears, and noted it oscillated randomly. Cable was slack at times and taut others, also in random pattern.

his impact point might have been caused by a less-than-normal impulse imparted by the retrorockets, or by a late retro ignition. Carpenter insisted that his retro attitude maneuver was performed as scheduled.

"The control task," he said, "is not difficult—the retros were aligned very well."

It was thought initially by controllers at the Mercury Control Center that the Aurora 7 capsule was aligned at 24-26 deg. to the local horizontal, rather than at the correct 34-deg. Solid propellant retrograde rockets are designed to ripple-fire, burning 10 sec., with a 5-sec. delay between ignitions. They have a nominal thrust of 1,000 lb. each. Telemetry signals indicate the rocket firing sequence began 5 sec. late.

Col. Glenn, at the time of retrofire over California, said, "It feels like I'm going back to Hawaii." Cdr. Carpenter said he did not have the same sensation of a "healthy kick in the back."

"I didn't get that. I also read prior to re-entry only 0.5g on the accelerometer. This is not as much as we suspected," Carpenter said.

Carpenter's excessive fuel consumption resulted from improper energy management, which the astronaut explained with candor:

"The fuel consumption was not the fault of the capsule, only the fault of an impatient man . . . I had sufficient fuel. I managed it improperly."

Fuel-Consuming Maneuvers

Carpenter made a large number of maneuvers and attitude corrections during the first two orbits of his flight, primarily in following the extensive program he was assigned for his flight. Considerable amounts of attitude control fuel were expended to orient the capsule to photograph the Atlas launch vehicle after separation, to roll the capsule around 180 deg. to photograph the ground, to observe the balloon experiment, and to conduct the zero gravity experiment.

The balloon experiment was a 30-in. Mylar sphere, with gores of different colors, designed to determine which colors are best seen in space. Although the sphere inflated only about one-third, Carpenter reported fluorescent orange and silver are easiest colors to see. Potentiometer readings were also taken on the nylon cord—part of which survived re-entry—to determine aerodynamic drag.

The zero gravity experiment used a clear flask containing green-colored water with a standpipe. Carpenter observed the water rise in the standpipe by capillary action, as expected by a majority of scientists.

Fuel consumption caused by extended maneuvers to perform all the flight tasks was further accelerated during re-entry when Carpenter failed to shut down his manual control system when he switched to the fly-by-wire mode. As a result he consumed hydrogen peroxide from both manual and automatic tanks for about four minutes. Automatic Stabilization and Control System (ASCS) and fly-by-wire control systems are fueled from the automatic propellant tanks. The manual proportional and rate stabilization systems receive fuel from the manual system tanks.

Re-entry Fuel Consumption

Carpenter used only 1% of his automatic fuel to control oscillations during re-entry on the fly-by-wire system. At the start of re-entry, his indicators showed 15% automatic and 7% manual fuel remaining, but he said during re-entry in a voice transmission that the manual system was "empty and ineffective."

He added that the auxiliary damping system, part of ASCS, "did a beautiful job. . . ."

Gyro problem experienced by both Glenn and Carpenter is thought by NASA engineers to be a simple matter of pilot procedure caused by impatience for the gyros to come around to scanner limits after a violent maneuver. Both pilots reported several times during their flights that the gyro indicators did not agree with what they saw.

NASA hopes in future flights to develop techniques of caging and shutting down the gyro systems so they will not be affected for long periods by violent maneuvers.

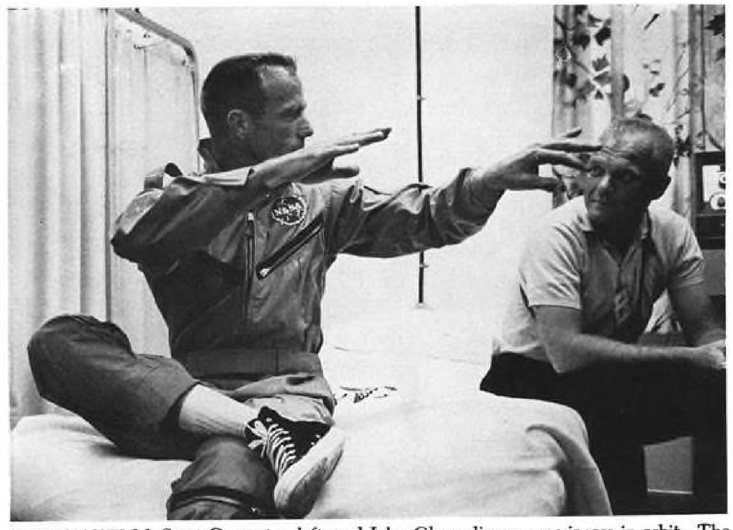
Like Col. Glenn, Cdr. Carpenter will suggest specific equipment which can be removed from the capsule in favor of increasing reliance on the pilot. Although he has not yet specified them, the 300-lb. periscope system has been discussed as a candidate for removal. Aurora 7 did not carry the earth path indicator, probably on the suggestion of Col. Glenn.

Heavy Work Load

Although the pilot work load was extremely heavy during MA-7, Cdr. Carpenter feels space pilots should be kept busy at all times, and it is apparent that NASA will continue to set pilot tasks somewhat beyond the limits of what can be performed.

Cdr. Carpenter said the capsule "was a jewel throughout the flight, with some minor exceptions," which he later identified as pitch in the ASCS. He later traced this condition to gyros that were not "trustworthy."

He said launch was much smoother than he expected, and he was impressed with the immediate silence that followed separation of the capsule from the launch vehicle. He had a momentary sensation of floating at zero-g onset. But like Col. Glenn, he finds weightlessness a pleasant sensation. Cdr. Car-



ASTRONAUTS M. Scott Carpenter, left, and John Glenn discuss experiences in orbit. The two were the first Americans to orbit the earth. Glenn's flight was Feb. 20.

NASA TECHNICIANS study the recovered Aurora 7 capsule in Hangar S at Cape Canaveral. Effects of re-entry heating are evident on small flag painted on capsule and on Aurora 7 emblem (bottom right).

CYCLONIC FLOW pattern is etched by clouds over an unidentified area along MA-7 flight path. Photo was taken by Cdr. Carpenter with a 35 mm. hand camera.

ATLAS lifts off pad to begin MA-7 flight.

penter said the only time he was comfortable in his pressure suit was during weightlessness, when he was "more comfortable in this restrictive suit than I would be at home . . . on the bed."

Carpenter feels he has brought back good intensity measurements on stars, particularly as they pass through the haze layer and their occlusion through the layer. He reported also that his flight will result in data on the layer itself, including its distance from the earth and time required to pass through.

He had a different analysis of the Glenn Effect particles than did Col. Glenn. Carpenter traced them to frost. He said when he rapped the side of the capsule, the particles flew off. "It appeared to me that the capsule must be covered with frost," Carpenter said.

He said some of the particles were bright, and some were silhouetted, some were luminous and some were gray. The particles, which he said look like snowflakes, varied in size from 1/16-in. to 0.5 in.

From his observations, Cdr. Carpenter believes the earth will look like a bright blue ring in the sky when viewed from the moon.

At the time of retrofire, a cloud of smoke which smelled like hot copper appeared over Cdr. Carpenter's shoulder, and quickly dispersed. The astronaut was unable to explain this phenomenon.

Cdr. Carpenter deployed his drogue recovery parachute at a 26,000 ft. altitude to damp oscillations which had built up to an estimated 270 deg. by that time. The reaction control jet fuel was exhausted and the capsule was "beginning to get small end down," he said. The drogue normally will deploy automatically at 21,000 ft. altitude.

Although the Mercury capsule is inherently stable above supersonic velocities, it is necessary to induce a roll of about four cycles per min. to maintain stability at subsonic speeds. Carpenter was unable to provide this roll when his fuel was gone.

He operated the recovery parachute manually at an altitude of 9,500 ft., 500 ft. lower than it should have deployed automatically. The actual descent and impact were described as normal in all respects.

Cosmos 5 Orbited For Space Research

Moscow—Soviet Union launched the fifth in a new series of scientifically instrumented earth satellites May 28. Preliminary data indicated that the satellite, Cosmos 5, had an orbit period of 102.75 min. with an inclination of 49 deg. 4 min. to the equator.

Perigee is 203 km. (126 mi.) and apogee 1,600 km. (994 mi.). Path of this satellite differs little from its planned orbit, according to Tass, the Soviet news agency.

Instrumentation installed on Cosmos 5 is designed for continuation of space research in accordance with the satellite program announced Mar. 16 by the Soviets (AW Mar. 26, p. 24).

Tass said Cosmos 5 carried scientific instrumentation plus a multi-channel radio telemetry system and radio devices for measuring trajectory. There also is a shortwave transmitter operating on a wavelength of 20.008 mc. Radio telemetry information received from the satellite shows that the entire on-board equipment is functioning smoothly, Tass said.

Telemetry information and data on reception of radio signals from a beacon transmitter are coming in at the coordinating and computing center. As with previous launchings in the latest series, there was no detail about payload size or type of launch vehicle.

U.S., Allied Pilots Flight-Test F-104G

Los Angeles—Category 2 flight tests on the Lockheed F-104G, involving pilots and engineers from the U. S., Canada, Germany, The Netherlands, Belgium and Italy, have been completed at Edwards AFB, Calif. Category 3 final tests are to begin later this year in Norvenich, Germany.

Begun a year ago, the Category 2 tests started simultaneously with Category 1 at the Lockheed facility in Palmdale, Calif. Under Air Force regulation, Category 1, 2 and 3 tests are conducted by the contractor, Air Force Flight Test Center and the using organization respectively.

Defense, FAA to Study DC-3 Replacement

By David H. Hoffman

Washington — Federal Aviation Agency and Defense Department will attempt to design a single low-cost, rugged aircraft that could replace more than 1,500 aging transports now operated by the U. S. government and world airlines—an aircraft market worth about $1 billion.

The economic threat posed by promising short-haul transports developed in Europe and the hesitation of U. S. industry to invest heavily in a DC-3 replacement program (AW May 21, p. 42) are prime incentives for the joint effort. On the civil side, a major goal is to save at least part of the $65-million subsidy that is paid to local service carriers.

Should FAA and Defense agree on a common set of specifications for such a transport, the DC-3, the DC-4, the twin-engine Convair series and the Martin 404 are among the aircraft it could replace.

All except the Martin are operated by both the military and U. S. commercial airlines.

Potential Market

Considering only DC-3s and their military counterpart, the C-47, independent agencies of the U. S. government, the Defense Department and members of the Assn. of Local Transport Airlines represent a potential market for 750 to 1,000 aircraft, FAA believes. In exploiting this market, manufacturers should concentrate on simple, unsophisticated designs, FAA Administrator N. E. Halaby suggested last week in testimony before the Senate aviation subcommittee.

According to Halaby, it might prove wise to stop insisting on a pressurized transport because most short-haul flying is at altitudes of less than 8,000 ft. He also urged greater emphasis on "proven, straightforward controls and instrumentation," and on standardization so that every aircraft does not resemble a unique organism.

Staff studies ordered by Sen. A. S. Mike Monroney (D.-Okla.), subcommittee chairman, indicate that 999 DC-3s still are being operated commercially in foreign countries—including 293 in Asia, 389 in Latin America, 86 in the Near East, 81 in Africa and 150 in Europe. If a U. S. military requirement for 350 aircraft and a feederline requirement for 250 are added to these, there exists a market for 1,599 DC-3 replacements.

At $500,000 per aircraft—the industry target price set by Civil Aeronautics Board Chairman Alan Boyd—this equals an $800-million market. And Sen. Monroney's figures are somewhat more conservative than those recited by FAA Administrator Halaby during his appearance before the subcommittee.

Thus, if FAA's minimum estimate of the U. S. market for a profitable short-range transport—750 aircraft—is added to Sen. Monroney's minimum estimate of how many such aircraft ultimately can be sold abroad—999 aircraft—total sales will approximate $875 million. According to Sen. Monroney, an aircraft market of this magnitude does not now exist in any other field of international aviation.

Lack of Agreement

Finding a replacement for the DC-3 has stymied industry for almost 15 years and developments during the past few months indicate that the airlines, Defense Department, CAB and FAA have not yet agreed on how the problem should best be tackled.

Halaby told the subcommittee: "I must quite frankly admit that, at the moment, I do not know its specifications. Secondly, I do not know its cost, nor its market potential. Finally, I am not at all sure that a new aircraft, by itself, will assure a profitable, subsidy-free local service air transportation system. I suspect that more is required."

On the positive side, FAA is requesting from ALTA and CAB their recommended, formal specifications for such a transport. Within ALTA, a committee is at work trying to develop data on desired operating costs, dimensions and performance. CAB Chairman Boyd has challenged industry to design a 24-passenger aircraft costing not more than $500,000 fully equipped and capable of operating from 4,000-ft. runways over stage lengths of from 50 to 150 mi. And FAA is embarking on the study program with Defense.

Meanwhile, FAA's new Aircraft Development Service is conducting a feasibility study of the aircraft's characteristics, its market potential, its possible military use, propulsion system and design.

Findings should be ready for presentation during the next session of Congress, Halaby said.

Referring to the Potez 840, Breguet 941, Fokker F-28 and other European short-range transports that could corner the market before the U. S. gets started on its own program, Halaby said "we cannot deny the airlines more efficient aircraft simply because they are not made in the U. S." Rather than erect new tariff barriers against these products, "we should seek to outdo them," he added.

But even if U. S. industry comes up with an efficient transport with direct operating costs 20% lower than those of the DC-3, it could lower the present subsidy bill only by about $19.4 million, assuming that revenue intake and indirect cost outlay remained static, Halaby said.

Development of such an aircraft in conjunction with the military could result in an over-designed, all-purpose, all-geography product capable of operating at high and low altitudes, in the Arctic and in the desert, Halaby said. His strong implication was that an aircraft incorporating this design philosophy could not be operated at a profit by commercial carriers.

Loan Guarantee

The question at issue before the subcommittee was whether legislation guaranteeing loans of up to $5 million to local service carriers should be extended for five years. An amendment would make the all-cargo carriers eligible for these guarantees. FAA recommended that the legislation be extended for a three-year period, when, it said, aircraft tailored to the needs of local carriers may be on hand and the act may require re-evaluation.

Although Halaby insisted he did not oppose extending the guarantees to all-cargo carriers, he said that it was questionable whether a "line can be meaningfully drawn between them and other carriers, whether their inclusion will give us any really significant improvement in the nation's emergency airlift capability, and whether the bill can be expected to spur development of any new cargo aircraft."

Support Aircraft Impasse

Washington—Prospect was dim last week that Air Force, Navy and Army could agree on what aircraft to procure for military mission support outside the U. S. by the July 1 deadline that has been imposed by Defense Secretary Robert S. McNamara.

Air Force has backed the Lockheed C-140 four-jet aircraft. Navy is fighting for the Grumman Gulfstream, while the Army supports the Fairchild F-27 for a large transport and the Piper Aztec or Cessna 310 for light transport.

At this point, conferees have had trouble even in reaching agreement on a definition for mission support. Director of Defense Research and Engineering is expected to enter the picture to act as a referee in order to meet the July 1 deadline.

Corresponding DOD-NASA Units To Coordinate Space Programs

By Larry Booda

Washington—Six manned space flight directorates of the Air Force Systems Command and six similar National Aeronautics and Space Administration groups will be formed soon at NASA headquarters here to coordinate the national space effort, according to plans completed last week.

Brainerd Holmes, NASA's director of manned space flight, will represent that agency. Maj. Gen. Osmond J. Ritland will represent AFSC, the agent of the Department of Defense, with the title of deputy to the commander for manned space flight as predicted by AVIATION WEEK (Jan. 22, p. 25). Until recently he was commander of the AFSC Space Systems Division.

Earlier plans for a separate office to fulfill the liaison function were scrapped in favor of the directorates arrangement.

As now planned, the organization lacks a clear-cut line of authority. Rather, there will be two lines of authority stemming from Holmes and Ritland down through the directorates. Although located at NASA headquarters, neither AFSC nor the NASA directors will have unilateral decision power.

Working level problems that cannot be solved will presumably be referred to the next higher level, where two opposite numbers will attempt to reach agreement. Especially difficult problems will be resolved by Holmes and Gen. Ritland themselves. From past experience, it can be presumed that some differences may have to be decided even higher, through interagency mediation.

At present the NASA-AFSC cooperative effort is being implemented by means of more than 50 agreements, some of which are of long standing. These were mostly working level agreements which served their purpose in the past when there was little emphasis on the space effort.

After President John F. Kennedy placed a national priority on reaching the moon last year, it soon became apparent that a more formal arrangement would be needed as the space effort expanded radically. NASA is dependent principally on the Air Force and to a lesser extent on the Navy and Army for research and development, launch, space medicine and other facilities.

Active planning for centralizing contact between NASA and AFSC began late last year, when Gen. Ritland was assigned the Defense portion of the task by Gen. Bernard Schriever, AFSC commander, and Col. Donald H. Heaton, USAF, who has been assigned to NASA since January, 1959, was appointed to represent Holmes. Heaton is scheduled to return to Air Force duty in the near future. NASA's Directorate of Manned Space Flight was formed last Nov. 1. It is divided into these six subordinate directorates: launch vehicles and propulsion, spacecraft and flight missions, systems, aerospace medicine, program review and resources management and integration and checkout.

Gen. Ritland is now selecting the Air Force directors and those who will serve under them. Four of the Air Force directorates will have the same names as the NASA groups. The other two will be called systems engineering, in place of NASA's systems directorate, and checkout and ground support equipment, instead of NASA's integration and checkout.

In addition to the six directorates listed above, Ritland will have four additional groups located with him at AFSC headquarters at Andrews AFB, Md.: military space programs, space programs and technology, NASA programs and space support resources.

It is planned to have Navy and Army representatives scattered among the directorates whose interests involve those services.

The general description of the mission of the AFSC Deputy for Manned Space Flight includes the planning, programing and coordination of USAF resources necessary to support specific NASA projects and programs. He will be responsible for contacts with NASA, management arrangements and coordination with that agency for projects and programs of both agencies. The interface will provide for support in both directions.

The directorates of launch vehicles and propulsion will concentrate on the development of engines and stage vehicles. An example of cooperation in this area which has progressed almost to the development funding phase, is the 624A Standardized Space Launching System—formerly Titan 3 (AW May 28, p. 29). The already-developed Titan 2 booster is to be mated with solid propellant boosters not yet developed. A transfer stage would propel payloads into desired orbits.

In this instance the Air Force is the greatest contributor to the system and will continue to act as the principal manager. At present many launch facilities used for space purposes have been developed by the military services, but NASA is building its own launching pads at Cape Canaveral, Fla., and the Pacific Missile Range areas in California, which will eventually serve most of its purposes. The Atlantic Missile Range, with its tracking and communications facilities, is operated by USAF and Pacific Missile Range by Navy.

Both NASA and the military services operate test facilities for propulsion. There will also be coordination with company-owned test facilities through the launch vehicle and propulsion directorates. The directorates for spacecraft and flight missions will concentrate on development of spacecraft, coordination of world-wide tracking networks and use of ground facilities.

Mission descriptions do not mention that the flight mission and spacecraft coordination will deal almost entirely with NASA projects. Gen. Ritland has retained a directorate for military space programs at AFSC headquarters. Some military projects are using military-developed vehicles whose operations have been secret and depend on military tracking and recovery networks.

Directorates for systems will concentrate on analyzing what approaches will be used in space missions and will work on system integration relating to specific missions. This will also be the contact point for transmission of future resource requirements. Design practices and reliability will also be the responsibility of this group, as well as human factors, communications and tracking.

Aerospace medicine directorates will combine the efforts in this area, including research and development, operations and future plans. Planning group's task is that of supporting the operating groups in planning, programing, budgeting, scheduling of resources. Integration and checkout directorates will control analysis, guidance and direction of reliability, maintainability and ground support standardization for space missions. Responsibility extends to checkout equipment for specific programs.

Nimbus Delay

Inability of the infrared horizon sensors in the attitude control system of the Nimbus meteorological satellite to distinguish clearly between cloud cover and a true horizon has caused the first launch date to slip from the end of this year to the second quarter of 1963 (AW Jan. 22, p. 54).

Original specifications required the sensors and the control system to align Nimbus within 1 deg. of a local vertical (AW July 10, p. 77). NASA and General Electric program personnel now are talking about "several degrees" accuracy.

Substitution of an Atlas Agena for the planned Thor Agena launch vehicle, or increasing the power of the Thor Agena, is being considered as the weight of the full-system Nimbus approaches 700 lb.

GAO Broadens Role in Helicopter Study

By George C. Wilson

Washington — General Accounting Office raised some fundamental questions by declaring last week that the Air Force cost the taxpayers "at least $9.5 million" additional by developing Kaman Aircraft Corp. H-43B helicopters rather than purchasing Bell Helicopter Co. HU-1As already in advanced development.

GAO took the unusual step of evaluating the two helicopters as "similar" and claimed that the Secretary of Defense should have prevented the duplication of effort. Defense countered that cost and availability of the HU-1As were considered, but "operational factors were the deciding element" in deciding to procure the H-43Bs.

Some military and industry officials regarded the GAO report as an expansion of the agency's scope of interest. They also noted with concern that GAO officials consulted with Bell in writing the report, thereby obtaining information about Kaman from a competing company. Joseph Campbell, GAO head, told AVIATION WEEK the helicopter report did not represent any departure from past policy. Another GAO spokesman said similar comparisons have been made in the past about military clothing and fire-fighting equipment.

But comparing two types of aircraft and making an evaluation certainly requires more technical analysis than GAO usually undertakes in writing its reports. The report also represents an insight into two opposing points of view on the cost vs. performance question which is at the heart of many of the budget deliberations now underway in the Pentagon.

These were GAO's principal findings and conclusions in its helicopter report, recently submitted to Congress:

• **Initial procurement.** Air Force procurement director on June 5, 1957, told the Air Force Air Materiel Command at Dayton, Ohio, that the Kaman HOK-1 (later designated H-43B) had been selected as the helicopter best suited for local base rescues. On Oct. 31, 1957, Air Force signed a $1-million contract with Kaman for 18 reciprocating engine and 116 turbine engine helicopters. Subsequent contracts obligated $61 million for these 134 helicopters. The reciprocating engine helicopter—H-43A—was essentially the same as the one Kaman developed for the Navy, but the turbine engine version — H-43B — was, according to GAO, "a completely new aircraft for all intents and purposes since it incorporated a turbine engine and had a larger body."

GAO criticized the Air Force for starting procurement of the Kaman helicopters in 1957—two years after it had awarded a contract to Bell for a general purpose turbine engine helicopter for the Army. Despite a favorable Air Force evaluation report in 1957 on the performance of the Bell prototype of the HU-1A, and an admission in the same year that the HU-1A would fulfill Air Force rescue needs, the service persisted in procuring the Kaman H-43s, GAO said.

GAO said Air Force's "sole justification" for proceeding with the H-43s was the claim those helicopters could be procured "more quickly and cheaply" than the HU-1A. "Our review disclosed, however," GAO said, that "on the basis of information then available the Air Force had no sound justification" for this contention.

• **Defense Department role.** GAO said Air Force proceeded in its procurement of H-43Bs despite Defense Department requests to withhold action. GAO said Defense eventually "was forced to reluctantly approve" the procurement because of the cost of cancelling the contract. Paul D. Foote, then assistant secretary of defense for research and engineering, requested the Secretary of Air Force by memorandum on Sept. 19, 1957, to defer procurement of the H-43B, but GAO found no response.

GAO concluded that the "Department of Defense failed to take firm and authoritative action to prevent the Air Force from proceeding with development and procurement of the H-43B helicopter under circumstances in which the reasonably prudent exercise of management responsibilities would have required that the Air Force be directed to procure the existing Army helicopter, and, that as a result, the government incurred additional costs of at least $9.5 million."

• **Extra costs.** GAO said that as of Sept. 30, 1961, the 134 H-43As and H-43Bs cost—exclusive of spare engines and parts—$55.2 million while GAO estimated the same number of HU-1As would have cost $40.1 million, a difference of $15.1 million. After taking into account the savings made by concurrent production at Kaman of the Navy and Air Force helicopters, GAO said the "estimated minimum additional costs" of procuring the H-43s was $9.5 million.

GAO added that procurement of the Bell helicopter also would have saved "an indeterminate" amount of money because of such factors as the simplified logistical support which would result from using one rather than two types of helicopters and elimination of the extensive flight testing of the H-43B.

Thomas D. Morris, assistant secretary of defense for installations and logistics, said the H-43 "offered certain bonus operational features that made it a more suitable aircraft for the crash rescue mission" than the HU-1A helicopter. Morris said advantages included: ability to fly in rugged, forested areas close to the ground because of its fixed rudder-like tail, as compared with the HU-1A tail rotor which could get tangled in underbrush and cause loss of control; higher altitude capability; synchropter rotor design which develops a down-wash distribution which helps control flames and the foam blanket and cools the rescue team; superior downwind hover capability.

Morris said "the judgment of the selection agencies appears to have been justified by the outstanding performance of the H-43 helicopter in an operational role in the Air Force." He cited rescues made by H-43s and the two altitude records claimed by the H-43B —one of 29,846 ft. on Dec. 9, 1959, and another of 26,365 ft. with a 2,205 lb. payload on May 25, 1961. Morris conceded there were differences of opinion about the H-43 procurement but said "in the light of the information available at the time of decision, the actions taken appeared to be the most reasonable in the interest of the Department of Defense."

In its report, GAO recommended that the Secretary of Defense exercise his management responsibility fully by preventing military departments from signing contracts "for the development of a major item" without his advance approval. Morris said that although he could not accept the conclusions of the helicopter report, "we do fully recognize and support the principle" of the Secretary of Defense exercising his authority to prevent duplication, "especially where non-tactical items are involved."

Nuclear Tests in Space

Washington—Nuclear weapons lifted into space by Thor boosters were scheduled to be fired late last week in the vicinity of Johnston Island in the Pacific.

A joint Atomic Energy Commission-Defense Department announcement said plans are to explode the devices at 30 mi., 200 mi. and 500 mi. altitudes which would place them below, in and above the ionosphere. The highest and lowest shots will have yields of below a megaton, while the 200 mi. shot will be over a megaton (AW May 7, p. 26).

USAF Starts Manned Saint Studies

Air Force's Space Systems Division has selected a group of industry contractors to conduct a series of three-month studies of vehicle designs, missions and sensors for a manned satellite inspector, loosely referred to as a "manned 621A" or "Manned Saint" program.

The designation 621A applies to the Air Force's unmanned satellite inspector, previously referred to by the code name Saint, and designed to rendezvous with and inspect potentially hostile earth satellites. In view of recent Department of Defense reluctance to identify its space programs by code names, the new program may well be called 621B (AW May 21, p. 26).

Six aerospace and avionics companies, numbering among them those most closely associated with the nation's manned space flight programs, including the prime contractors on Mercury, Dyna-Soar and Apollo, were notified late last month that the Air Force would start negotiating with them for contracts, which may run about $50,000 each, for three-month studies of manned satellite inspectors.

Prior to notification, there hadn't been any formal indication that a study program of this nature and magnitude was in the offing and the awards are being made without an industry competition and to the apparent surprise of the selected companies.

Four companies are scheduled to conduct vehicle configuration studies. They are the Boeing Co., Lockheed California Co., McDonnell Aircraft and North American's Space and Information Systems Division.

In addition, Hughes Aircraft Co. and Raytheon Co. will be asked to conduct three-month studies of sensors required by the military space inspector. These sensor studies by the two avionics companies will parallel sensor investigations that will be carried out by the four spaceframe manufacturers and their avionic subcontractors as part of the over-all system study efforts.

Award of these study contracts by the Air Force may be one means by which the Department of Defense intends to implement its intentions, as mentioned last month by Deputy Secretary of Defense Roswell L. Gilpatric, of giving increasing attention through the remainder of the year to the military role in space. Gilpatric made his remarks at an Air Force Systems Command management conference in Monterey, Calif. (AW May 7, p. 29).

Besides its inspection mission, the manned version of Saint to be investigated by the Air Force and its contractors may be able to destroy potentially hostile satellites and defend itself and unarmed American satellites from hostile actions, according to industry speculation.

Boeing, Lockheed Burbank and North American are known to have conducted intensive studies of manned military offensive and defensive space systems during the past several years. Boeing ran detailed studies over a year ago of such missions as bombing and reconnaissance under its partially Air Force funded Boss (Wedge) program (AW Apr. 10, p. 26). The Boeing Boss/Wedge efforts centered about follow-on versions of Dyna-Soar.

Recently, Lockheed Burbank is understood to have devoted a sizable study effort to an orbital interceptor in addition to its partly funded work on Aerospace Plane and an accelerated preproposal effort on the Apollo lunar landing module.

North American has been championing manned military space systems for months (AW Jan. 29, p. 33) as an outgrowth of its global surveillance system studies among others. It had developed a system concept, known as Cosmos, of an orbital defensive weapon system to be deployed against hostile satellite-based offensive weapon systems.

Similarly, the Air Force's Systems Command through its Space Systems Division has investigated a multi-purpose winged space vehicle which it called Saint 2 (AW Sept 25, p. 93), although the vehicle was envisaged to have far broader capabilities than simply satellite inspection.

Over the past six months or more, Space Systems Division has considered several possible anti-satellite (defensive) studies. It presently is evaluating industry proposals for a parametric anti-satellite study. This will be a feasibility study to determine all necessary anti-satellite parameters, such as types of weapons needed, ranges involved, etc.

The disposition of several proposed SSD planning studies, one for an orbital weapon system, another for an orbital defense system remains in doubt. The manned Saint studies may supplant the defense system, which was also expected to be manned.

Air Force may also keep alive studies of orbital weapons, or so called "bombs in orbit" systems, originally studied under study requirements 79821—advanced earth orbital weapon system (high orbit) and 79822—advanced earth orbital weapon system (high orbit).

The planning study, parametric study and advanced development objective are different techniques by which Air Force conducts advanced studies and they differ largely in the source of funding.

Gilpatric Will Head Defense-Industry Unit

Washington—Defense Industry Advisory Council, whose members will be Defense officials and representatives of firms doing business with the Defense Department, will be formed soon, Deputy Defense Secretary Roswell Gilpatric announced last week. Gilpatric will serve as chairman.

The council will serve as a forum for the Defense Department to present its logistics management objectives, outline its problems and detail what it has already done to produce weapon and other military systems more economically.

It will also allow industry to present its suggestions and constructive criticisms to high Defense officials in the area of logistics management. Studies made by both Defense and industry will be reviewed.

Gilpatric said that ideally the group would consist of about 15 members, but that it may grow to 25. Industry members will all be company executives and in most instances will represent industrial associations such as the Aerospace Industries Assn., the Electronics Industries Assn., the National Security Industry Assn. and the American Ordnance Assn.

Gilpatric outlined the following areas which need study, but did not limit the council to them:

- **Development of more** centralized procurement where the requirements of the services are identical.
- **Over 40%** of defense contracts which are non-competitive, and how to control them in the public interest.
- **Procurement contracts** in which the prime contractors simply serve as agents of the government in managing subcontracts. Several recent major system contracts have made it mandatory to subcontract 50% or more of the work.
- **Trend away from** mass production types of contracts to research and development types, with a minor portion of the funds spent on production.
- **Imbalance of orders** favoring some companies while sharply cutting those to other companies due to shifts in technical emphasis.

Last fall Defense began to search for a focal point for its contact with industry, because Defense officials were spending an inordinate amount of time talking to representatives of industrial associations and individual company officials (AW Dec. 4, p. 30).

The Defense Department-sponsored Logistics Management Institute will serve as the secretariat for the council. The institute was formed last fall to study what and how much Defense should buy, and how to buy it most economically and efficiently.

Defense Pledges Profit Changes to Senate

By Katherine Johnsen

Washington—Defense Department last week promised action to make changes in three procurement areas which the Senate's Permanent Investigating Subcommittee has charged have led to excessive profits by weapon systems contractors.

At the final subcommittee session, which ended a month of hearings, Thomas D. Morris, assistant secretary of defense for installations and logistics, declared that "we are in basic accord with the key objectives which have been highlighted by this subcommittee." These are:

- **"Break-out"** of prime weapon system contracts—direct procurement by the government of subsystems and sub-subsystems—as early as possible. Sen. John McClellan (D.-Ark.), subcommittee chairman, has claimed that by direct procurement—particularly in the Nike program—the government could have saved money by eliminating the profits of prime and major subcontractors.
- **Establishment** of realistic target costs as a prerequisite for contracts in which the contractor is given an incentive bonus for reducing these costs. Evidence presented during the hearings by the subcommittee staff and General Accounting Office indicated that contractors are inclined first to pad costs for their own protection and then to achieve bonus incentive payments for performance below these costs (AW May 28, p. 36).
- **Setting of profits** for the prime contractor on the work of subcontractors which will truly reflect the contractor's own effort. McClellan has charged "arbitrary mark-ups" and "profits on profits" were made by prime contractors which reflected no effort on their part (AW Apr. 16, p. 33).

Standard Profit Rate

Morris said that there has been a tendency to give prime contractors a standard profit rate on subcontracts. He said a re-examination has been started to achieve "a more precise measurement and analysis" of the contractor's contribution, allowing a high profit rate in cases where the contractor assumes a substantial responsibility for subcontract work and a "minimal" profit on the procurement of standardized subcontract items.

McClellan applauded Defense Department's "attitude of wanting to improve." He said that the contractors under the three weapon systems investigated—Nike, Atlas, and Bomarc—had also given the subcommittee and its staff fine cooperation.

Morris and Maj. Gen. W. A. Davis, commander of USAF's Aeronautical Systems Division, firmly defended incentive type contracting as preferable to the cost-plus-fixed-fee type of contracting.

Although the profits to contractors under incentive contracts may be greater, Gen. Davis stressed, the final price to the government is less because of reductions in costs.

USAF Study

He said that an Air Force study of contracts settled over the past three years showed a consistent tendency of cost over-runs on cost-plus-fixed-fee contracts and cost under-runs on incentive type contracts. On 730 cost-plus-fixed-fee contracts amounting to $2.2 billion, there were cost over-runs totaling $149 million, he reported. There were cost under-runs of $142 million on 161 incentive type contracts totaling $4.2 billion, he added.

Gen. Davis reported that Air Force is now in the process of establishing a formal procedure for "an after-the-fact assessment" of costs on incentive contracts. This is to assure that contractors do not reap incentive bonuses on under-runs of costs which were misjudged in the first place.

Under a new Defense Department policy on development contracts—where costs are not known with accuracy—only a fraction of the incentive to the contractor will hinge on cost, Morris told the subcommittee. In a typical missile contract, he said, one-half the incentive would be based on performance factors—range, payload, accuracy, reliability—and one-third would be based on time of completion. This would leave only one-third the incentive based on cost reductions.

This contrasts with the past policy of going to straight cost-reduction incentives during the development phase of a program.

As the missile moves into production, the weight given on cost reduction as an incentive would be increased, Morris said.

Boeing's Case

R. W. Tharrington, assistant general manager of the Aerospace Division of Boeing Co., defended Boeing's costs and profits on the 12-year, $1.6-billion Bomarc program with these observations to the subcommittee:

- **Company's total profit** of $124 million amounted to 7.6% of sales, before taxes, or only 3.6% after taxes.
- **With respect to "profit pyramiding,"** the total gross profit paid to all tiers of the entire subcontract structure administered by Boeing approximated $63 million. This, with Boeing's $124-million profit, totaled $187 million, or 11.4% of sales before taxes.
- **All but $90 million** of the $187 million will be repaid in taxes, leaving the total profit payment by the government on the $1.6-billion Bomarc program at approximately 5.5%.

Tharrington pointed out that Boeing made cost reductions to the government on four Bomarc incentive contracts of $95 million—or more than the $90 million profits paid by the government on the program.

Subcontractor Testimony

The subcommittee was critical of one of these incentive contracts on which there was a 32% under-run and on which Boeing earned a 14.5% profit. Testimony was presented by subcontractors—International Telephone & Telegraph Corp., Westinghouse Electric Corp., Lear, Inc.—that Boeing had overestimated their costs by millions of dol-

Guerrilla War Aircraft

Washington—Joint Chiefs of Staff, with the approval of Defense Secretary Robert S. McNamara, has ordered the Air Force to write an operational requirement for a low-speed, low-altitude aircraft which would be effective in guerrilla warfare where targets are difficult for pilots to spot. Aim is to have some aircraft available in Southeast Asia at the end of the monsoon season by modifying aircraft currently in production.

The order was a direct result of studies begun on a high-priority basis in April after the Army and the Navy submitted position papers to the JCS stating the need for such an aircraft in what the Defense Department now calls "counter-insurgency" operations (AW Mar. 26, p. 13 and Apr. 23, p. 21).

Air Force passed the task of writing the requirement to its First Combat Applications Group at Eglin AFB, Fla.

To gain information on what is needed in such an aircraft the Air Force has hurriedly arranged with the Army to buy two Grumman AO-1 Mohawk twin-turboprop, two-place aircraft. These aircraft will be modified from their usual radar-infrared battlefield surveillance configuration to take tactical weapons such as bombs, machine guns, napalm and rockets.

Launching racks will be attached to strong points on the wings.

The operational requirements will be used as the basis for writing technical specifications prior to requesting proposals from industry.

lars in negotiating an initial target price with the government.

Gen. Davis commented that the subcommittee had singled out "the worst" contract and "the exception" in highlighting its point that incentive contracts are over-estimated in the first place.

Over a long period, Boeing's cost estimates "have come out pretty close," according to Gen. Davis. He said the Air Force has developed a great confidence in the company, and probably did not check the estimates in the particular contract in the detail that it would have checked the estimates of "some companies we know are way off all the time."

Cost Reductions

Tharrington disclosed that Boeing has recently started making incentive type contracts with its subcontractors, after McClellan criticized the company for justifying incentive bonuses for cost reductions to itself but not giving subcontractors the opportunity to earn such bonuses.

Sen. McClellan noted that ITT, Westinghouse, and Lear had volunteered cost reductions to Boeing without getting additional profit on the under-run.

Morris stressed long-range planning—two or three years in advance—as the key to the effective and early break-out of weapon systems. He said that each of the military departments is establishing target dates for their major systems at which time prime contractors will be required to furnish technical data necessary for direct procurement of subsystems by the government.

"We are stressing strict enforcement of contract provisions for timely delivery of technical data, which will provide for withholding of payments for non-delivery," Morris testified before the subcommittee.

He reported that a training program for senior project managers, who would take over management responsibilities now left with prime contractors, will be started in the near future by the Army and will later be extended to Air Force and Navy.

Examples Cited

Gen. Davis cited several examples to illustrate USAF's constant effort to increase direct government procurement and eliminate profits to prime contractors. Between Fiscal 1959 and Fiscal 1962, the percentage increase of direct government procurement to total flyaway cost on the following programs was presented by Gen. Davis as: on the Lockheed C-130B, from 25% to 33%; on the Northrop T-38, from 20% to 40%; on the North American T-39, from 17% to 29%; and on the Republic F-105, from 25% to 32%.

Static Firing of Saturn S-4 Stage Due Soon; Cold Tests Near End

Sacramento, Calif.—Static firing of the liquid hydrogen-fueled S-4 stage of the National Aeronautics and Space Administration Saturn C-1 launch vehicle is scheduled to begin at the Douglas Aircraft Co. facility here this week.

Company officials concede the schedule may slip as much as a week. First tests will be of a non-flyable battleship version. The two test stands in the facility include steam ejector pumps and diffuser ducts beneath the Pratt & Whitney RL-10A-3 engines to create a vacuum simulating starting conditions at an altitude of 13 mi. Douglas has a contract to produce 10 S-4 stages which will be acceptance tested on test stand 1. An all-systems test vehicle will be installed in test stand 2 and will remain there throughout the program for continuous evaluation of newly developed or modified systems. The all-systems test vehicle will be a prototype flight stage.

Cold flow tests to evaluate facilities which transfer liquid hydrogen and liquid oxygen, engine chill-down tests and tests of the altitude simulator system are nearing completion. Chill-down tests are necessary to measure the time required to bring the six RL-10A-3 engines to the low temperature required for start.

Hot tests of the battleship system will begin with runs at the maximum total thrust of 90,000 lb. Altitude simulator consists of a 31-ft. long diffuser tube around each of the six nozzles and extending downward. At the bottom ends of the diffusers are blowout caps to provide an exit for exhaust gases after ignition. The ejectors which create the initial vacuum are fed steam at high velocity from accumulators where it is stored at 250 psi. At engine ignition, the diffuser cap is blown off and the momentum of the exhaust gases maintains the altitude simulation. Used steam from the ejectors is exhausted out a battery of large periscope-like ducts high on the test stand.

Liquid hydrogen is transferred to the vehicle tank from a pair of 90,000-gal. spherical storage tanks at a rate of 2,000 gal. per min. through vacuum-jacketed pipes. The 35-ft. diameter storage tanks are double-walled and the 2.5-ft. space between the walls of each tank is evacuated of air and filled with 60,000 lb. of expanded volcanic silicate insulation. The tank design is expected to limit hydrogen boil-off to 0.13% per day.

Liquid oxygen storage capacity at the Douglas Sacramento facility is 42,000 gal. A single blockhouse controls the whole facility. A special handling device has been developed for removing engines in the crowded space between the diffusers and the S-4 structure. It consists of a "cookie sheet" and an inflatable diaphragm which are slipped into the one-inch gap between the diffuser and the engine nozzle lip. The diaphragm is inflated until the cookie sheet bears the weight of the engine which is then detached from its thrust mount. The diaphragm is deflated and the cookie sheet and engine slipped onto a dolly.

The S-4 test facility, originally used for static testing of Thor IRBMs, was re-equipped and the test stands enlarged at a cost of $2 million. The S-4 stage will be 41 ft. long, 18.5 ft. in diameter and will weigh 111,000 lb. when loaded with liquid hydrogen and liquid oxygen. The structure of the stage is made of aluminum alloy with waffle-patterned integral stiffening milled on the inside and surge baffles at the top of each tank. Unlike the Centaur hydrogen-fueled rocket, the insulation to limit hydrogen boil-off is on the inside of the S-4 tank and is a permanent part of the structure.

The dome-shaped common bulkhead betwen the liquid hydrogen and the liquid oxygen is also heavily insulated to prevent the colder hydrogen from freezing the oxygen. Spherical bottles of helium used to pressurize the propellant tanks are located within the hydrogen tank where the −423F temperature makes it possible to store a given weight of helium in a much smaller volume without excessive pressures.

The helium bottles are made of titanium which becomes 50% stronger when immersed in the cold liquid hydrogen. The pressurizing gas is so cold as it leaves the bottles that the system needs a helium heater and a warm restorage tank which are located at the base of the stage between the six engine thrust mounts. The heater is now being tested at the Sacramento facility.

F-1 Engine Reaches 1.5-Million-lb. Thrust

Full thrust of 1.5 million lb. was sustained for 151.8 sec. by the F-1 liquid-fueled rocket engine at Edwards AFB, Calif., for the first time May 26.

Developed by Rocketdyne Division of North American Aviation, Inc., the F-1 is slated for use in a cluster of five as the first stage of the C-5 advanced Saturn vehicle for NASA's Project Apollo. Rocketdyne said it was the longest known full-thrust, flight-duration run of an engine developing over one million pounds of thrust.

JCS Orders Improved Communication

Washington—Joint Chiefs of Staff has outlawed the use of such unpleasant terms as "reprisal" and "total nuclear war" in an order which appears in the new Dictionary of United States Military Terms for Joint Usage. JCS, in what it said was a move to "assist understanding and facilitate communication," issued the following list of taboo terms and their substitutes:

Not recommended for use	Recommended term
Accidental war	Accidental attack
All-out war	General war
Catalytic war	Catalytic attack
Central war	General war
Controlled reprisal	Controlled response
Controlled war	Limited war
Local war	Limited war
Nuclear equipoise	Nuclear stalemate
Partisan warfare	Guerrilla warfare
Peripheral war	Limited war
Pre-emptive war	Pre-emptive attack
Recuperation	Recovery and reconstitution
Spasm war	General war
Total nuclear war	General war
Total war	General war
Unlimited war	General war
Unpremeditated expansion of a war	Escalation
Unpremeditated war	Accidental attack

McNamara Outlines New Defense Studies

Washington—Defense policy that will emphasize multiple feasibility studies by research organizations and industry, rather than detailed weapon system proposals by competing companies that are costly in use of engineering talent and money, was confirmed last week by Defense Secretary Robert S. McNamara.

McNamara cited the mobile medium-range ballistic missile as an example in which weapon characteristics and alternatives are being decided after a series of studies (AW Apr. 2, p. 22). This approach to research and development was one of more than 60 unclassified study projects initiated by the Defense Secretary for completion between late June and March of 1963.

Another study is aimed at applying the 5-year force structure and finance programs developed last year into 5-year production programs for defense industries and research organizations.

Among the studies were:

- **Reduction of the complexity** and improvement of the reliability of Navy ships and weapon systems.
- **Use of aircraft** which are not included in the 5-year force plans—mostly non-combat aircraft—for proficiency and administrative flying.
- **Development of an effective** approach to determination of a weapon requirements for the North Atlantic Treaty Organization.
- **Development of a 5-year estimate** of Air Force personnel requirements based on changes in the Air Force structure, especially reduction in the numbers of bomber aircraft.
- **Analysis of support forces** overseas and how their cost can be reduced. McNamara suggested that more help from indigenous sources would be used. This was one of a number of studies aimed at stemming the gold flow from the U.S.
- **Composition and mission** of Army aviation.

Gen. Gerhart Named To Command Norad

Washington—Lt. Gen. John K. Gerhart, Deputy Chief of Staff for Plans and Programs at USAF Headquarters, has been nominated by President John F. Kennedy to be Commander-in-Chief of the North American Air Defense Command with the rank of General. He will relieve Gen. Laurence S. Kuter, who will retire July 31.

The nomination led to a widespread shift of Air Force general officers, involving both operational and materiel commands.

Lt. Gen. Mark E. Bradley, Jr., will become commander of the Air Force Logistics Command with the rank of General. At present he is Deputy Chief of Staff (DCS) for Systems and Logistics. He relieves Gen. William F. McKee, who was previously appointed as Vice Chief of Staff, USAF.

Gen. Bradley will be relieved by Maj. Gen. Thomas P. Gerrity, who at present is commander of the Ballistic Systems Division of the Air Force Systems Command. He will become a Lt. General.

Other appointments made include:

- **Lt. Gen. C. Strother,** to U.S. representative of the North Atlantic Treaty Organization's military committee and standing group, with the rank of General.
- **Maj. Gen. David A. Burchinal,** to DCS for Plans and Programs in place of Gen. Gerhart, with the rank of Lt. General.
- **Maj. Gen. William S. Stone,** to DCS for Personnel, with the rank of Lt. General.
- **Maj. Gen. Richard M. Montgomery,** to Vice Commander-in-Chief, U.S. Air Force in Europe, with the rank of Lt. General.
- **Maj. Gen. Harvey T. Alness,** to Director of the Weapon Systems Evaluation Group, with rank of Lt. General.
- **Lt. Gen. Gabriel P. Disoswav,** to DCS for Operations in place of Gen. Strother.
- **Lt. Gen. Edward J. Timberlake,** to Commander, Continental Air Command.

News Digest

Second successful three-stage launch of the Nike Zeus anti-missile missile over the Pacific Missile Range has been conducted at Pt. Mugu. The missile obeyed taped guidance signals from the target intercept computer on the ground.

Beech Aircraft Corp. will build nose landing gear doors and the honeycomb emergency exit doors for the Lockheed-Georgia C-141 transport. Earlier Beech won a contract for the flaps and ailerons for the same aircraft (AW May 21, p. 39).

Space General Corp. has been awarded a $300,000 Langley Research Center contract to build three inflatable paragliders—two of them flight models—which will be carried to 700,000 ft. altitude by modified Aerobee rockets. Dual flight objectives will be to study micrometeoroid flux and suitability of the system for a controllable recovery device.

Seaboard World Airlines last week purchased two additional Canadair CL-44 all-cargo transports to increase its fleet of the turboprop aircraft to seven. The aircraft will be placed in service in July and August and will permit carrier to operate 150 transatlantic flights per month.

United Aircraft and Flygmotor AB of Sweden have signed an agreement permitting licensed production in Sweden of several hundred Pratt & Whitney JT8D turbojet engines. Engines will power the Saab J37 aircraft, which the Swedish Royal Air Force is expected to order in quantity as a replacement for the Saab J35.

CAB Alerted to Faulty Traffic Estimates

Board, airlines learning that continually over-optimistic forecasts cause many carrier problems.

By Robert H. Cook

Washington—Failure of many airline markets to produce traffic volumes as high as those predicted by the carriers is causing the Civil Aeronautics Board to adopt a more realistic attitude toward traffic forecasts.

CAB staff analysts have long held that the customary method of basing forecasts on the assumption that past growth rates will automatically continue in the future have too often failed to adjust for abnormal past growth or possible changes in future travel patterns

To a large extent, they contend, today's traffic level in the Florida market has fallen far short of predictions made five years ago because neither the carriers nor the Board could foresee that lower fares and turbojet aircraft would combine to divert much of the area's expected traffic into other areas such as the Atlantic and Caribbean markets.

The most recent indication that CAB is paying more attention to this problem is contained in a staff report on the current Trans-Atlantic Route Renewal Case (AW May 28, p. 38), which notes that it is "imperative" that there be a reliable forecast of the size of the Atlantic market. The report considers the market's 27% growth rate in 1960 as "abnormal" in that it was probably brought about by jet stimulation and the introduction of special excursion fares. The sharp drop to a rate of only 7.8% last year was also considered unusual, reflecting a slow economic recovery along with a worsening international situation in Germany and France. The report's prediction for this year's growth rate was 22%, with a notation that the figure is based upon a stable economy, and that any political unrest in Europe could negate this prediction.

Over-optimistic traffic forecasts have been recognized by both the Board and the airlines as one of the industry's common weaknesses and were recently brought into sharp focus by Robert C. Lester, former Secretary to the CAB.

Rebutting criticism of the Board's past actions at an aviation symposium last year, Lester said: "The problem that CAB faced, it seems to me, over several years that they were awarding new competition, was not so much the applications that were in front of them, as these wonderful traffic forecasts that were in front of them.

"The bankers believed those forecasts and put lots of money on them. The CAB believed them and new competition was based on them. I think they had other reasons for certificating multiple competition than merely the optimistic forecasts, but this, it seems to me, is what has gotten us into trouble. . . over-optimism on how traffic would grow. I think this is true. . . that everyone was over-optimistic about what traffic would be today."

Despite a severe winter and strike problems which combined to affect traffic to Florida in 1960, most informed observers feel traffic totals for that year make a valid comparison to illustrate that predictions by both the airlines and CAB for 1958 traffic in the New York to Florida and Great Lakes Southeast Service Cases were over-optimistic.

Exhibits filed in the 1957 Great Lakes case show that Eastern Air Lines predicted it would carry 40,000 passengers a year between Buffalo and Miami, if granted the Florida route. CAB analysts estimated the entire route, including Pittsburgh, Cleveland and Akron, would produce 1,148,000 passengers a year by the end of 1958.

Total passengers carried in both directions over the entire route that year, as indicated by CAB figures, amounted to only 182,140 persons. Capital Airlines, with sole access to Buffalo, carried 26,070 passengers between there and Miami. Balance of the route, over which Eastern was the major competitor with Capital, produced a total of 89,210 passengers at Cleveland, 64,220 at Pittsburgh and 2,640 at Akron.

The Chicago and Detroit points in the same case were estimated by CAB to produce 1,893,398 and 1,250,000 passengers respectively by the end of 1958. Delta Air Lines, which won the Detroit-Miami route, predicted it would carry 114,180 passengers over the route by the end of 1958. The actual total in 1960 amounted to 99,770, according to the Board's 10% sample of origination and destination figures. The 1960 total of passengers carried between Chicago and Miami was 246,080.

In the New York-Miami Case, which resulted in Northeast Airlines being placed in competition with Eastern and National over the route, Northeast predicted it would carry 1,297,505 passengers by the end of 1958. Capital claimed the addition of Boston to the route would give it a total of 442,267 passengers and the CAB foresaw a traffic total of 3,265,427 passengers for the entire route from Boston, including Providence, Hartford, New York, Philadelphia, Washington, Jacksonville, Tampa and Miami.

CAB statistics show the New York-Miami traffic, in both directions, produced a passenger total for all carriers of 918,334 passengers.

Traffic experience resulting from route awards granted in 1959 in the Chicago-Twin Cities Case show a similar pattern of over-optimistic forecasts.

Capital Airlines was placed in competition with Northwest Airlines, in one portion of the case, and Northwest was granted a route with non-stop authority between Minneapolis and Milwaukee and the southern points of Atlanta, Tampa and Miami.

Capital economists forecast a total traffic of 329,269 passengers for both airlines over the Minneapolis and Milwaukee-Chicago route. The Board's 1960 statistics show a combined total for these points of 226,449.

The Board's forecast for total expected traffic along the route granted Northwest was 124,063 passengers. Examiner J. S. Keith, who made the forecast, noted in his initial decision that this volume was not enough to support more than one non-stop carrier on the route and further cautioned that the forecast "may not be realized."

Total traffic realized along this route for the cities of Minneapolis, Milwaukee, Atlanta, Tampa and Miami, amounted to only 85,200 passengers, according to the Board's 1960 figures.

Many industry observers now feel that the current wave of merger talks and proposals has been generated in large part by the inability of both airlines and the CAB to make more accurate forecasts. Over-optimism in traffic forecasting has gone hand-in-hand with overcapacity, many say, with the result that some carriers view merger as the only means out of their financial dilemma.

Rehearing Ordered in Major Route Case

Washington—Civil Aeronautics Board may be forced to reopen hearings on most of the Southern Transcontinental Service Case as a result of a U. S. Court of Appeals order directing a rehearing on the award of a Texas-to-Florida route to Eastern Air Lines.

Grounds for reversal of the Board's action, sought on an appeal filed by Braniff Airways, was that CAB failed to offer sufficient evidence to justify its contention that the route was needed by Eastern because of the airline's financial condition and competition from American, Trans World and United airlines, the court ruled.

The decision said that the CAB may also reopen the balance of the case in which other routes were granted National, Delta, Continental and American airlines, if it appears necessary or desirable to do so.

Reviewing the Board's decision, the court said: "The Board states that because of the worsening financial position of Eastern in the industry, the probable diversionary impact upon Eastern of the announced merger between United and Capital, the appreciable curtailment of Eastern's traffic opportunities during the past five years, as well as the disappointing lack of growth in the Florida market [see story], one of Eastern's richest, the public interest required the Texas-Florida route to be awarded to Eastern.

"We are asked to accept this judgment of the Board, but the basis on which it was reached consists of the conclusionary statement set forth above. These are not the sort of findings which enable us intelligently to pass upon the correctness of the judgment reached."

The court pointed out that the CAB offered "no real analysis" of the relation of Eastern to the other Big Four carriers, and that it failed to document or explain the claims of Eastern's "worsening financial condition."

"Braniff is denied a route it probably would have obtained except for its competitor's relative position with respect to other carriers," the court said. In the "interest of fairness" a more complete explanation of the Board's reasoning is required, the court said.

Braniff filed for three separate routes in the Southern Transcontinental Case and was chosen for the Texas-Florida route by a CAB examiner, whose initial decision on the route was later rejected by the full, five-member CAB.

Bomb Is Suspected in 707 Crash

Washington—Data from the flight recorder carried by the Continental Air Lines Boeing 707 which crashed in Iowa on May 22 indicates the jet was destroyed by a bomb explosion in its lavatory compartment and not by severe turbulence, as first suspected.

According to Civil Aeronautics Board Chairman Alan S. Boyd, wreckage shows that the right side wall of the aircraft's fuselage "blew straight out" as the result of a high velocity explosion. Rapid decompression of the cabin, he said, could not cause this to happen.

The body of one stewardess still strapped in her seat was found several miles from the aircraft's fuselage, and an autopsy showed it was riddled with what Boyd described as "shrapnel." All 45 on board were killed when the jet plunged to earth near Centerville, Iowa, on a flight from Chicago to Los Angeles (AW May 28, p. 37).

Appearing before the Senate aviation subcommittee headed by Sen. A. S. Mike Monroney (D.-Okla.), Boyd said the 707's flight recorder indicated the aircraft flew through turbulence for 40 min. prior to the crash. But during the 5 min. just before the moment the jet's blip was observed to disappear suddenly from an Air Force radar scope, it was flying in stable air, Boyd told the subcommittee.

Stressing that the tragedy was not caused by any structural defect in the airplane, Boyd said that powder burns containing a strong residue of sulphur were found on wreckage that came from the jet's right rear lavatory. This indicated that a dynamite-type explosive might have been used.

The jet, which had requested descent clearance, was thought to be cruising at its assigned altitude of 39,000 ft. when the device was detonated. Wreckage was strewn over a 100-mi.-long area, but most was concentrated within 3-5 mi. of the 707's fuselage.

Structural pieces disclosed that at the time of ground impact the pilot had extended the aircraft's landing gear. Some on board—presumably crew members—had donned emergency oxygen masks.

Weather radar on the 707 apparently operated satisfactorily during the flight hour preceding the crash. Acting on the basis of its cloud picture, the Continental pilot over-ruled an Air Force GCI (Ground Controlled Intercept) site technician and elected to deviate north, rather than south, of his course.

The 707's turbojets, snapped from their pylons, were discovered within a 1-to-3-mi. radius of the jet's fuselage. Its empennage was five miles from the point of maximum wreckage concentration. Vertical stabilizer and rudder were found 8.75 mi. out.

FAA Administrator N. E. Halaby told the subcommittee that there have been five instances of in-flight bombing in U. S. civil aviation history. But in none of these, he said, has the guilty party collected a penny of insurance money.

Boyd said he was "certain" the bomb was detonated in the 707's lavatory rather than in its baggage compartment. A passenger, therefore, had to carry the device on board the aircraft. Although more intensive autopsies are now in progress, there has been no evidence as yet of copper wire fragments of the type common in time bombs. A simple fuse or cap could have been employed.

Boyd and Halaby met last week and agreed upon a joint study to determine whether the government "had done everything it possibly could" to avert similar explosions in the future. One idea advanced by Sen. Monroney would involve training salesmen to sell insurance at airports and the elimination of coin-operated vending machines. Through a short question and answer session, such salesmen might be able to spot psychotics before they could board an aircraft, the senator said.

Because all evidence points toward an explosion as the accident's probable cause, Boyd said he could "see no useful purpose" in scheduling public hearings. The Board probably will elect to take depositions from those in a position to supply useful information in lieu of the hearing.

Aircraft Shifts Cited In Merger Hearings

Washington—Merger of Eastern Air Lines and American Airlines would reduce the problem of overcapacity by permitting the shift of aircraft fleets from one route to another according to seasonal demands, Melvin A. Brenner, American vice president, said last week at Civil Aeronautics Board hearings in the American-Eastern Merger Case.

The hearings, which are now entering their fourth week, have been devoted almost entirely to the operating plans that will be adopted if the merger is approved. As in past sessions, Delta Air Lines legal counsel, backed by Braniff Airways attorneys, continued to monopolize the cross-examination of American and Eastern witnesses.

Brenner, who spent a total of four days on the witness stand, said that because of the "seasonal swing of capacity," the merged carrier could meet its obligations with six fewer jet aircraft than would be required for the two airlines separately.

New Shell designed refueler "inspects" every drop of fuel it delivers—can pump 600 gpm to reduce fueling time

Shell has designed a new refueler that can pump 600 gallons of fuel per minute, "inspects" it for cleanliness and can shut itself off automatically to help assure outstanding quality. It even has a "gold-fish bowl" cab (see picture) for maximum visibility.

Read how its maneuverability, front-end refueling system and built-in elevator help make this vehicle exceptionally sate, efficient and simple to use.

THE picture on the left shows the business end of Shell's new 10,000-gallon refueling truck.

Airlines are happy with the new refueler because it helps them reduce costly ground time for their jets. Here's how: Each refueler can pump 600 gallons of jet fuel a minute. Working as a team, two units can refuel an aircraft—20,000 gallons—in 17 minutes.

The refueler's low silhouette lets it maneuver with ease into refueling position *between engine pods.*

The new Shell truck's cab even has a roof of glass, allowing the driver to position the truck swiftly and safely.

Front refueling for efficiency, safety

Refueling is done from the *front* of Shell's refueler. There is less chance of accidents.

The new truck even has an elevator (the pumping platform is hydraulically operated). This makes it easier to hook up refueling hoses to a plane. Each truck has a special filter-separator. It is designed to meet strict military specifications for fuel cleanliness—and the even stricter specifications imposed by Shell scientists themselves.

NOTE: Precautions are taken against dirt or moisture all along the line, whenever fuel is transferred from one container to another—from refinery to tank barge to storage tank to trucks to aircraft.

Checks and double checks to prevent accidents

It's highly unlikely that water could get into the new refueler. But if it should, this remarkable unit is designed to prevent it from getting into an airplane's tank. Each refueler has a highly sensitive *water slug* device. If it detects water in the fuel, a filter-water separator slug valve can stop the pump in *half a second.*

The "deadman's control" is another safety device. It allows operation by remote control, and gives the operator freedom to oversee the entire fueling operation from the best location. Should trouble occur, the "deadman's control" can also stop the pumps.

More automatic features

Pumping pressures are regulated automatically. The truck's brakes lock automatically when the pumping operation begins. They cannot release until pumping is finished and the hose is returned to its receptacle in the truck.

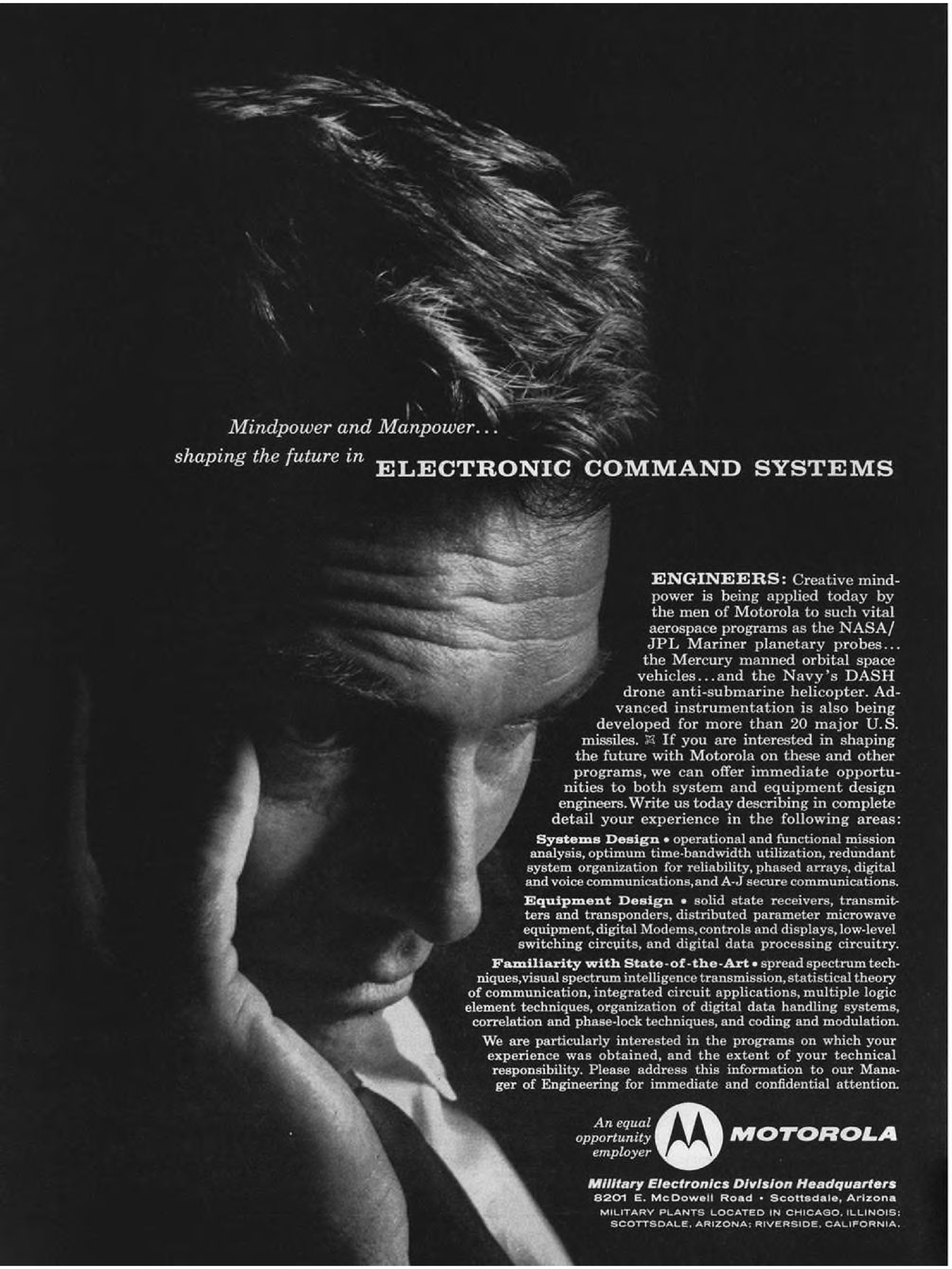
These are just a handful of the many features Shell has designed into this remarkable truck. They give you an idea of how much imagination and care Shell and its dealers invest to serve aviation better.

For full information on Shell's aviation products and services—including refueling developments—write: Shell Oil Company, 50 West 50th Street, New York 20, New York.

SHELL

Shell is the nation's leading supplier of commercial aviation fuel—and has been for more than a decade.

New Shell designed refueler, left, snuggles between the pods and under the wing of aircraft. Two of these refuelers operating simultaneously can refuel a jet in 17 minutes or under.



Second Trident Makes Maiden Flight

Second de Havilland Trident DH-121 three jet transport (foreground) made its maiden flight May 20, flying for 1 hr. 55 min. from the Hatfield, England, production plant airfield. First Trident has flown 115 hr. in 105 flights with program 10 hr. ahead of schedule. Airplane has flown at Mach .88 at 32,000 ft. in handling trials; Mach 0.9 flights will commence after completion of flutter trials. Company said preflight tests on Trident control simulator (AW May 14, p. 107) indicated low speed outboard ailerons would not be needed and flight testing has confirmed the finding; thus the ailerons will not be installed on production aircraft as originally planned. Other tests have included inflight operation of reverse thrust with no trim changes and no loss of lift.

Preliminary CAB Opinion Orders Southern to Resume ALPA Talks

Washington—Southern Airways will be ordered to resume bargaining with union pilots who struck the carrier two years ago or face action that could lead to the loss of its operating certificate, according to a tentative Civil Aeronautics Board finding.

Only questions at issue in the deadlock are whether non-union pilots employed by Southern should retain their seniority and whether those who struck should be subjected to disciplinary action. The demands of the carrier are "illegal" on each point, CAB said.

Chairman Alan S. Boyd, Vice Chairman Robert T. Murphy and Member G. Joseph Minetti—all Democrats—concurred in the decision, while the CAB's two Republicans, Chan Gurney and Whitney Gillilland, did not.

The Board's tentative finding, which reverses the Sept. 22, 1961, decision of Examiner William Cusick, was issued on May 25—four days before an ALPA board of directors meeting called to elect a new slate of union officers. Settlement of the Southern strike has been a major issue in pre-election campaigning within ALPA and incumbents seeking re-election can be expected to exploit the Board's announcement.

Although the strike began on June 5, 1960, negotiations between Southern and ALPA did not collapse until July 12. Strike-breaking pilots hired after the latter date must give way to ALPA members. "The seniority of strikers reinstated is to be unimpaired," CAB said, adding that Southern may discipline its employes as it sees fit but any such action is to be covered by statutory grievance procedures.

Unless Southern management begins another round of bargaining 30 days after CAB's final order, the Board said it would take "appropriate steps" under a section of the Federal Aviation Act that empowers it to modify, alter, suspend or revoke any airline's operating certificate. But Board action in this direction can be stayed by court appeal, and Southern President Frank W. Hulse has warned that he will make such an appeal if necessary.

Southern's demand that ALPA pilots take a place behind the non-union pilots on the airline's seniority list amounted to "unwarranted discrimination against the strikers," CAB said. On the subject of discipline, it held that Southern's stand would deprive employes of "their statutory right to submit grievances to an adjustment board."

The Atlanta-based local service carrier would not be bargaining in good faith if it continued to insist that these two demands be included in any strike settlement, CAB said.

The announcement of the tentative CAB finding, which came in the form of a press release, stated that this was not the Board's final decision. The final ruling will come "at a later date," the release said.

CAB Upholds Terms Of LACSA Control

Washington—Pan American World Airways' request for relief from the strict conditions Civil Aeronautics Board ordered in approving Pan American control of LACSA, the Costa Rican flag carrier (AW Feb. 5, p. 40), has been denied. CAB did however, leave the door open to future relief if it becomes necessary.

Pan American had said it might be left at a competitive disadvantage if other carriers reduced fares to meet those of LACSA and Pan American could not. CAB had prohibited Pan Am from using LACSA's lower fares as a reason for seeking fares less than International Air Transport Assn. minimums.

Pakistan Airlines Plans Helicopter Service

New York—Pakistan International Airlines is considering the purchase of three twin-turbine helicopters—either Boeing-Vertol 107s or Sikorsky S-61s—to begin a domestic passenger service initially in East Pakistan.

New York Airways has made a study of the prospective operation, and a technical assistance program under auspices of the State Department for initial operation of the service may be developed. This would follow the precedents of assistance provided by Trans World Airlines to Ethiopia and Saudi Arabia and by Pan American World Airways to Afghanistan.

Air Commodore M. Nur Khan, managing director of the Pakistan airline, said that government approval of the service, which requires both capital investment and subsidy, would be sought this year. Once government approval is obtained, he said, delivery of the helicopters would require about a year, permitting service to start in the latter half of 1963 or early 1964.

Eventually the helicopter service would be extended to inaccessible or mountainous regions of West Pakistan, but the geography of East Pakistan, cross hatched with streams and rivers making up the deltas of the Ganges and Brahmaputra rivers, and the lack of surface transportation because of the river barriers, give it a natural requirement for rotary wing operation.

Pakistan is considering two versions of the Sikorsky twin turbine transport, one, the S-61L long-fuselage development of the Navy HSS-2 in service with Los Angeles Airways, and the S-61N. The latter has the long fuselage, but retains the floats and water-tight hull of the basic Navy ship.

The Vertol 107-2, ordered by the Marine Corps as the HRB-1 and with greater payload capacity than the 107, is the 107 version under consideration. It also has sponsons and a water-tight fuselage. Emergency water capability is considered essential but roughness from river currents makes scheduled water-based operation impracticable, the survey said.

Other twin-turbine helicopters are in development in Europe, the survey said, but only these two are immediately available and suitable. Small single engine helicopters in the Bell 47 or Hiller 12E class were considered too small and too short ranged for the Pakistan requirement.

The medium class Sikorsky S-62A also was studied in the survey. Full payload and reserves would limit its range to less than 100 mi.

Cost of three Vertol 107s, including shipping, four spare engines, rotatable spares, a two year supply of consumable spares, and special tools adds to $3,040,404. Inclusion of training costs and ground communications stations brings total capital investment to $3,530,904.

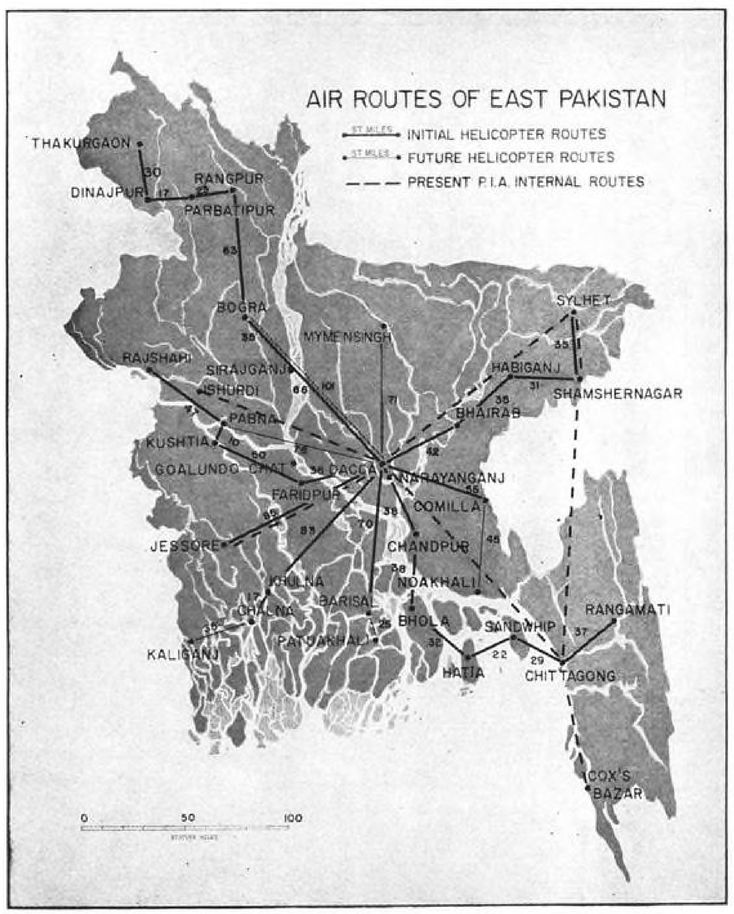
The Vertol helicopter is used for purposes of the study, but no recommendation is made between the two aircraft. Air Commodore Nur Khan visited both manufacturers late last month, but expressed no preference. Prices of both are about the same, he said, with the Sikorsky unit proposal the lower by about $15,000.

Annual revenues of $1,859,432, including $1,549,527 in passenger revenues and the balance in cargo, are estimated in the survey. An annual operational loss of $70,057 and a total annual subsidy of $263,006 after inclusion of overhead is forecast.

Foreign exchange requirements are estimated at $3,418,904 for the initial investment and $800,385 annually for fuel and spares. This is an important consideration for the Pakistani airline. International operations, conducted now by the airline with a leased Boeing 707 and Lockheed 1049 Super Constellations, enable the airline to earn back about 75% of its foreign exchange expenditure for equipment, Air Commodore Nur Khan said. Such earning potential is a key reason, rather than prestige, he said, for small-nation interest in establishment of an overseas airline.

This return compares with a domestic operation like the Pakistan rail system which also invests relatively large amounts in foreign equipment but which can earn little of it back in an all-internal operation.

The proposed helicopter service might bring a similar objection, but Pakistan airlines also bought Viscounts and Fokker Friendships for its internal routes. Delivery of the first Boeing 720B of three ordered by the airline has been made, and two more aircraft are scheduled for delivery later this year, all for use in international service.



EAST PAKISTAN air routes, present and proposed, center on Dacca.

DC-3 Phaseout

Domestically, the airline is preparing to phase out its DC-3 equipment and is operating F-27s both in East and West Pakistan. In East Pakistan, however, the airline has instituted a DC-3 Air-Bus service with fares 10% higher than rail travel.

It has been averaging 70-80% load factors and making money, even though Pakistanis have grown as discriminating in their preference for turbine-powered aircraft as travelers of other nations.

The proposed helicopter service, designed to provide a radial service from Dacca, East Pakistan's capital, to 25 areas of commercial importance or of extreme inaccessibility, would eliminate some F-27 or DC-3 service, but would feed Pakistan Airlines' fixed-wing traffic in other cases.

Helicopter routes are concentrated in the western half of the country, cut off from Dacca by unbridgeable rivers. There are no roads and no through railroads from Dacca to the northwestern, western and southwestern areas, and the cost to build them is considered prohibitive.

For a traveler to go from Dacca to Khulna to the southwest, he must first fly to Jessore and then make a three-hour 30-mi. bus or car trip.

If he goes on from Khulna to East Pakistan's second seaport, Chalna, it is a 15-mi. motor boat trip, since there is no road.

Comparison of helicopter and rail travel time and fare between these same two points shows:

- **Dacca-Jessore,** 18:57 hr., fare 60.75 rupees by rail; helicopter, 38 min. and fare 50 rupees.
- **Dacca-Khulna,** 21:20 hr. and fare 66.66 rupees by rail; helicopter, 37 min. and 50 rupees.

The survey contends that the helicopter service, operated city center to city center would be faster than the existing Dacca-Jessore F-27 service when time to airport is considered. At Dacca, ground time is longer than the 38 min. helicopter flying time, according to the survey.

Fare structure for the helicopter service averages 10.29 cents per mile, somewhat higher than fixed-wing fares, the survey said. The survey estimates a minimum of 200,000 passengers a year at this fare level and an over-all load factor of 77.8%. Direct operating cost per hour for the helicopter is estimated at $274 and ground, and indirect costs at $44 per hour.

Proposed Schedule

The proposed schedule in the survey calls for two ships flying and one in maintenance. Each operational ship would fly 8-9 hr. daily for a combined total of 2,218 scheduled aircraft miles daily.

Specific sites for heliports were not selected in the survey, but photographs of the terrain at each were included with the comment that plenty of suitable sites were available.

There are 12 airports, two abandoned airfields and 12 strips in East Pakistan, most built during World War 2. These are suitable for light aircraft generally, but their location away from cities makes them inconvenient and they are not well suited to heavier commercial aircraft. Airport costs in expanding fixed-wing service rather than opening a helicopter operation would be extremely high, the survey said.

MATS Fiscal Year 1962 Dollar Obligations

1 July 1961 through 31 January 1962

	Carrier	Total Volume Amount	Total Volume % of Total	Logair, Quick Trans and Fixed Amount	Logair, Quick Trans and Fixed % of Total	Expansion* Amount	Expansion* % of Total	Expansion* % Expansion to Fixed	Call† Amount	Call† % of Total
1	Riddle Airlines	$21,134,367	16.79	$15,845,810	18.24	$1,303,353	7.67	8.23	$3,985,205	18.08
2	Pan American	21,047,987	16.72	15,926,195	18.33	4,745,994	27.93	29.80	375,798	1.71
3	Flying Tiger Line	20,079,515	15.95	10,496,598	12.08	5,902,967	34.75	56.24	3,679,950	16.70
4	Slick Airways	14,760,948	11.72	9,081,775	10.45	2,588,182	15.23	28.50	3,090,981	14.02
5	World Airways	10,633,481	8.45	6,793,872	7.52	996,590	5.87	14.67	2,843,019	12.90
6	AAXICO Airlines	7,833,741	6.22	7,786,764	8.96	.....	.....	.....	46,977	0.21
7	Seaboard World Airlines	7,415,256	5.89	5,772,922	6.65	938,841	5.53	16.26	703,493	3.19
8	Capitol Airways	5,319,527	4.23	2,883,135	3.32	.....	.....	.....	2,436,392	11.05
9	Zantop	3,772,058	3.00	3,772,058	4.34	.....	.....	.....	.....	.....
10	Trans International	3,756,987	2.98	1,440,832	1.66	218,213	1.28	15.14	2,097,942	9.52
11	Overseas National	3,578,900	2.84	3,349,203	3.86	29,241	0.17	0.87	200,457	0.91
12	Southern Air Transport	2,350,309	1.87	2,338,362	2.69	.....	.....	.....	11,947	0.05
13	Northwest	1,648,435	1.31	1,380,982	1.59	267,454	1.57	19.37	.....	.....
14	U. S. Overseas	1,437,556	1.14	.....	.....	.....	.....	.....	1,437,556	6.52
15	Great Lakes	528,949	0.42	.....	.....	.....	.....	.....	528,949	2.40
16	California Hawaiian	356,449	0.28	.....	.....	.....	.....	.....	356,449	1.62
17	Alaska Airlines	228,090	0.18	.....	.....	.....	.....	.....	228,090	1.03
18	Trans Caribbean	17,133	0.01	.....	.....	.....	.....	.....	17,133	.08
		$125,899,688	100.00	$86,868,508	100.00	$16,990,835	100.00	.....	$22,040,338	100.00

* When MATS places an annual airlift contract up for bids, it requires that each carrier list not only the aircraft it will assign but also those it will make available should MATS require additional aircraft for airlift expansion.

† If MATS wishes to spread its aircraft procurement across a broader base than that fixed by contract awards and expansion clauses, it awards short-term "call contracts" to any airline which has signed a general "call" agreement with MATS. These contracts are generally for a one to three month duration.

Source: MATS Hq.
Scott Air Force Base, Illinois

Shown above: Scale model of new Boeing 727 short-to-medium range jetliner

Boeing 727 test program to cost $30,000,000

Requiring 865,000 man-hours, the test program for the new Boeing 727 will include the manufacture of two complete airframes solely for structural test purposes. The first airframe will be tested to destruction to prove its structural integrity and to determine the ultimate limits of its strength. The second will undergo 16 months of load tests simulating the repeated flight, maneuver, pressurization and landing loads a 727 would encounter in approximately 20 years of airline service.

The 727's systems—from cockpit to flight surfaces and including associated hydraulic systems—will undergo complete testing and evaluation in a full-scale mockup.

Meantime, some 4,500 hours of wind tunnel test time, and 250 flight hours on the 707 prototype applicable to the 727, have already been carried out. In addition, 727 components and systems common to the 707 and 720 have been "tested" in more than a million hours of Boeing jetliner operations.

Boeing 727s will bring airlines the unique benefits of design, test and manufacture by the world's most experienced builder of jetliners. So far, 127 Boeing 727s, America's first short-to-medium range jetliner, have been ordered by American Airlines, Eastern Air Lines, Lufthansa German Airlines, Trans World Airlines, and United Air Lines. Deliveries will begin late next year.

BOEING 727

Airline Traffic—February, 1962

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U.S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-All Revenue Load Factor %
DOMESTIC TRUNKS								
American	569,447	446,669	55.4	2,424,179	1,004,127	10,520,595	56,725,303	52.9
Braniff	180,744	84,071	53.5	449,205	161,411	914,056	9,580,552	44.1
Continental	101,272	65,207	44.6	295,245	105,390	653,776	7,307,328	37.7
Delta	300,443	194,205	58.9	765,046	331,693	1,840,302	21,604,669	50.0
Eastern	696,280	401,835	54.3	1,362,003	546,386	2,522,930	43,169,807	41.4
National	152,883	113,645	57.6	385,752	95,058	1,436,225	12,902,896	47.4
Northeast	111,915	67,970	59.2	148,419	49,071	283,040	6,996,753	48.9
Northwest	134,206	87,643	43.8	619,470	246,370	1,428,466	10,714,966	38.7
Trans World	342,420	301,312	50.0	1,568,542	687,638	4,343,920	35,485,510	42.1
United	800,907	498,498	50.2	3,627,554	1,068,363	8,588,725	61,009,424	45.9
Western	139,024	79,179	51.4	314,312	97,351	448,245	8,439,035	42.1
INTERNATIONAL								
American	9,557	11,128	71.3	6,032	319	187,732	1,383,806	73.8
Braniff	9,043	11,733	52.8	52,474	----	151,028	1,432,100	47.0
Caribbean Atlantic	49,013	3,500	67.2	2,307	----	17,488	348,844	68.6
Delta	941	1,199	33.6	771	----	10,862	137,314	31.0
Eastern	39,657	58,014	59.7	121,510	3,316	340,475	6,097,484	53.1
Mackey	10,908	1,899	41.5	----	217	7,101	194,387	35.5
Northwest	16,158	29,787	46.8	1,663,224	2,624	781,592	5,598,678	52.1
Pan American								
Alaska	2,826	2,805	24.1	43,201	1,479	177,255	516,197	31.4
Atlantic	99,230	123,933	45.1	2,829,912	----	6,464,064	22,354,631	40.6
Latin America	111,147	145,895	64.2	539,997	6,007	3,881,077	19,661,504	64.5
Pacific	37,564	159,170	64.4	3,481,952	11,742	3,847,606	23,719,655	62.1
Panagra	11,078	20,563	71.1	82,424	----	627,418	2,895,014	66.3
South Pacific	101	276	22.2	611	----	255	29,376	21.9
Trans Caribbean	8,443	12,837	63.6	----	639	3,178	133,422	63.6
Trans World	16,043	51,855	44.2	2,013,330	----	2,292,621	9,693,721	53.0
United	13,448	33,491	57.3	350,094	7,451	175,727	3,947,925	52.9
Western	6,237	9,349	74.5	8,253	----	29,477	999,811	63.3
LOCAL SERVICE								
Allegheny	59,433	12,654	39.5	25,272	36,216	71,581	1,341,767	42.7
Bonanza	30,021	7,667	56.2	6,915	2,963	14,556	760,321	57.2
Central	22,332	4,674	35.3	16,713	8,242	25,919	498,432	34.2
Frontier	25,043	6,771	34.1	20,780	9,896	55,031	736,693	36.7
Lake Central	30,585	4,818	38.1	9,942	20,811	18,233	509,454	39.6
Mohawk	66,858	13,576	47.8	25,594	30,733	43,664	1,393,507	46.6
North Central	73,330	12,856	39.8	39,649	41,701	53,049	1,355,742	41.0
Ozark	46,992	8,430	45.3	18,802	25,722	32,300	883,582	49.4
Pacific	31,529	7,411	46.2	13,751	3,922	9,816	735,020	46.8
Piedmont	37,005	7,665	40.2	14,027	15,920	24,289	788,091	41.6
Southern	32,495	6,000	32.0	22,368	18,049	25,581	640,700	34.9
Trans-Texas	27,264	6,388	34.0	18,873	11,081	36,973	678,377	34.5
West Coast	26,966	6,494	39.3	14,755	4,410	19,367	658,803	39.9
HAWAIIAN LINES								
Aloha	23,379	3,676	64.3	2,664	----	3,499	300,979	56.0
Hawaiian	31,969	4,858	58.7	4,679	----	151,235	545,931	60.8
CARGO LINES								
Aerovias Sud Americana	----	----	----	----	----	238,598	238,598	70.0
Flying Tiger	829	3,587	60.3	21,804	24,994	19,555,722	19,961,292	79.9
Riddle-Domestic	----	----	----	7,343	9,620	5,222,926	5,239,889	68.0
-Overseas	2,380	16,968	94.2	10,717	441	3,728,266	5,409,235	80.6
Seaboard World	188	752	98.9	735,840	----	4,369,372	5,187,971	63.6
Slick	404	1,893	63.8	1,893	----	6,903,007	7,079,596	85.6
HELICOPTER LINES								
Chicago Helicopter	230,894	4,002	41.7	20,479	126	----	402,408	35.9
Los Angeles	1,861	63	50.0	3,417	1,748	----	11,243	60.3
New York	7,822	161	53.9	180	497	388	16,402	55.0
ALASKA LINES								
Alaska Airlines	6,358	5,927	36.0	56,286	2,222	304,421	959,207	51.1
Alaska Coastal	3,612	370	57.8	3,680	----	3,666	44,909	59.9
Cordova	2,695	471	50.7	4,748	----	31,745	84,104	50.5
Ellis	3,276	180	49.9	1,756	----	1,967	22,203	61.6
Kodiak	595	518	42.3	518	----	608	4,657	46.6
Northern Consolidated	1,822	539	37.6	49,564	----	45,637	154,716	61.0
Pacific Northern	6,581	5,228	33.4	142,247	8,652	333,787	1,052,279	53.5
Reeve Aleutian	815	787	30.3	51,899	----	49,385	188,414	47.6
Western Alaska	410	19	47.5	727	----	793	3,304	51.9
Wien Alaska	2,233	586	27.0	59,727	----	68,195	188,397	37.7
Avalon	3,954	283	46.9	488	----	163[1]	27,581	48.1

[1] Includes excess baggage

TO THE TARGET...

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Eclipse-Pioneer Division

THE Bendix CORPORATION

WHERE IDEAS UNLOCK THE FUTURE

AIRLINE OBSERVER

► Iberia Airlines of Spain is reorganizing the middle and upper echelons of its management structure. General Julio Rubio, who was recently named acting chairman of the airline's board (AW Jan. 8, p. 36), will remain in the top post but a new management team under him is expected to consist of officers schooled in airline operations. Juan Viniegra, long-time member of Iberia's management, has been named secretary of the board and it now appears that he is slated to assume one of the top positions within the next two years.

► **NASA Flight Research Center, Edwards AFB, Calif. will receive a late model Convair B-58 on bailment from USAF for research in handling-qualities and traffic control problems relating to the supersonic transport. Federal Aviation Agency will work closely with NASA on the program. NASA requested the aircraft two years ago.**

► USAF Lockheed C-141 transport will incorporate "zero-ducting" on its four Pratt & Whitney TF33-P-7 turbofan engines to eliminate vibration damage to the engine exhaust pipe caused by bypass air from the fan. New design extends the fan ducting to a point even with the engine exhaust outlet, creating a cowling-within-a-cowling effect.

► **Airlines are still cool to the idea of an early introduction of a supersonic transport, but some top officials are showing new interest in a design proposal that will permit an aircraft to operate economically at subsonic speeds on medium-haul routes, such as New York-Chicago, as well as long-haul and intercontinental routes at supersonic speeds. The design applies the variable sweep wing principle.**

► Merger talks between Central Airlines and Ozark Air Lines are still in progress with agreement expected shortly. Meanwhile, Curtis L. Carlson, Minneapolis businessman, has joined Carl R. Pohlad (AW May 14, p. 40) in purchasing controlling interest in Central.

► **Federal Aviation Agency has awarded three additional contracts totaling $500,992 in the government-industry research program on supersonic transport technical problems (AW May 28, p. 28). Contracts went to Coordinating Research Council of New York, Southwest Research Institute of San Antonio and Hughes Aircraft.**

► Russia's Aeroflot appears to be having a serious load factor imbalance on its much-publicized, 55-min., Moscow-Leningrad shuttle operation. Aeroflot inaugurated this operation with 100-passenger, twin-jet Tu-104B transports in April, 1959. About 1,450,000 passengers were handled in the three-year period. Difficulty is that a million of these passengers flew from Leningrad to Moscow and only 450,000 from Moscow to Leningrad. Aeroflot has been running six Tu-104B round trips daily on the route during the winter. Flights will be stepped up to 15 round trips daily this summer.

► **Air-India has replaced its Lockheed Super Constellations with Boeing 707 jets on the Bombay-Delhi-Moscow run.**

► Passenger traffic on the North Atlantic increased 15.3% during April, compared with the same month last year, according to the International Air Transport Assn. Available seat miles rose 11.1% and the average passenger load factor for the month was 49.1%, an increase of 1.8% over the previous April.

► **Federal Aviation Agency plans to accept new air traffic controllers who can pass a special aptitude test developed by the agency regardless of whether they possess ATC experience. For the past three years, FAA has filled controller vacancies from a list of those who passed a 1959 civil service examination which made ATC experience a pre-requisite. In its Fiscal 1963 budget request, the agency has asked authority for about 1,000 additional ATC specialists.**

SHORTLINES

► **American Airlines'** Convair 990's will replace Boeing 707s on its 9:20 a.m. New York-Dallas-El Paso flights beginning June 3. On June 17, 990s will replace 707s on the 9 a.m. New York-Chicago-Phoenix flight.

► **Alitalia's** passenger traffic between the U.S. and Europe increased 53% in April over April, 1961, and 54% for the first quarter over the same period last year, the airline said.

► **Braniff Airways'** air freight volume reached 3.5 million ton miles during the first quarter of 1962—a 24% increase over the first quarter of 1961, the airline said.

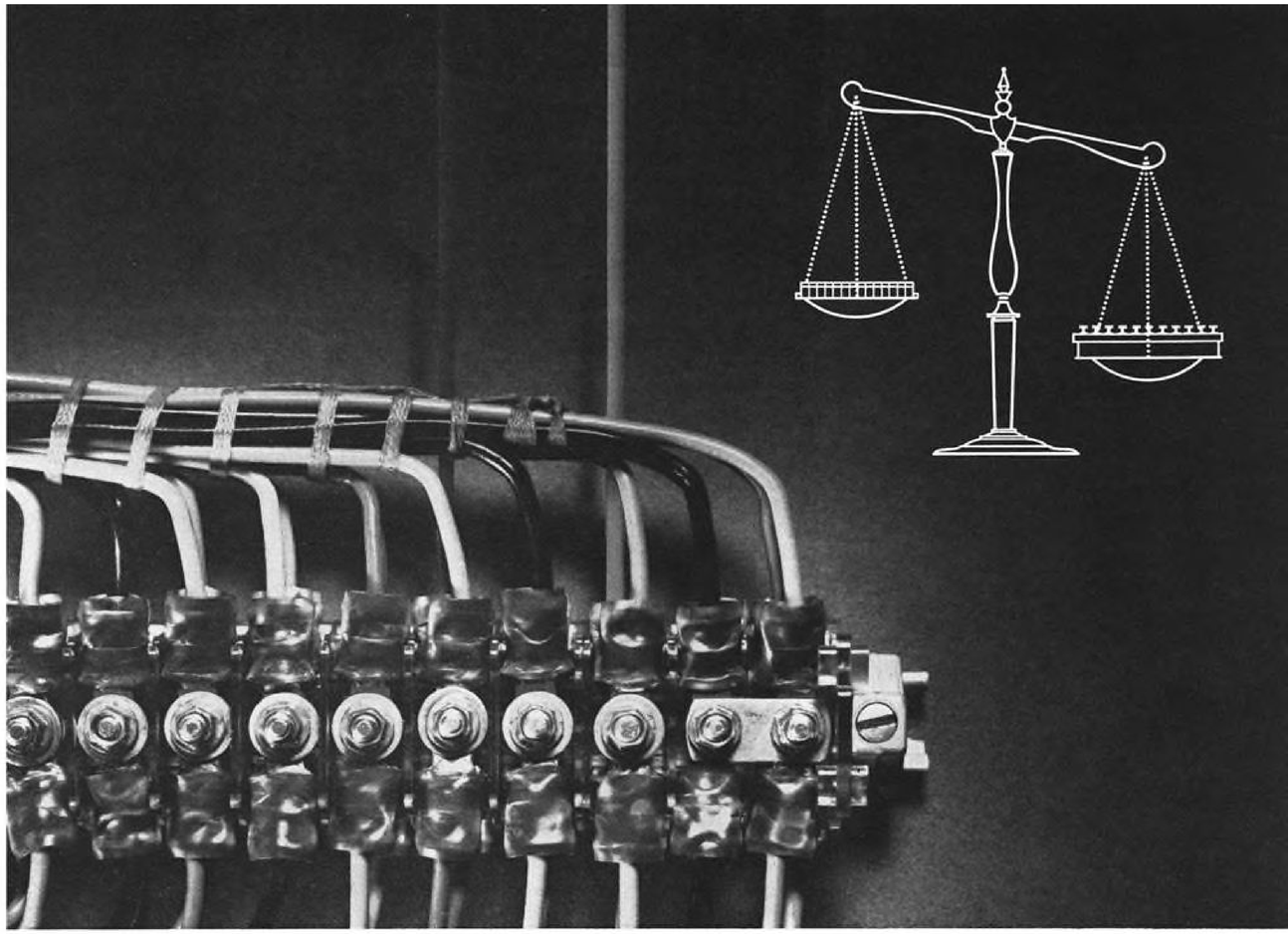
► **Civil Aeronautics Board** has suspended and is investigating Los Angeles-Las Vegas excursion fares proposed by Bonanza, Trans World, United and Western Airlines. Bonanza, TWA and Western fares would provide round-trip service for $26 subject to certain limitations. United's fare for the route would be $23. Bonanza's proposed $15.85 one-way night coach fare is also under suspension.

► **Delta Air Lines'** net income was $1.1 million for April compared with $764,000 for April, 1961. Sale of aircraft accounted for $261,000 of the total for this April, whereas the April, 1961 figure contained no revenue from this source, Delta said.

► **Mohawk Airlines'** Univac real-time computer system for confirming reservations and making up-to-date flight information available to its sales agents began operations late last month. The Univac system can confirm reservations in 4 sec. as opposed to 2-3 min. under the old procedure.

► **National Airlines'** net income for April totaled $1 million from operating revenues of $8.3 million. Net income and operating revenues for April, 1961, were $292,728 and $6.2 million respectively. The earnings bring profits for the first 10 months of Fiscal 1962 to $4 million, compared with a net loss of $5.6 million for the same period last year, the airline said.

► **Philippine Air Lines** will begin the first nonstop jet service between the U.S. and the Philippines on June 20. Initially, service will be one flight weekly between San Francisco and Manila. The airline will also operate four other flights weekly with DC-8 equipment between Manila and Hong Kong.



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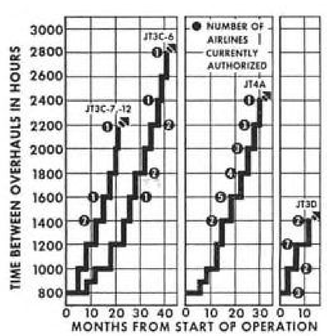

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DIVISION OF UNITED AIRCRAFT CORP.

EAST HARTFORD, CONN.

Bendix Continues Own Lunar Rover Study

By Barry Miller

Several concepts of roving lunar vehicles, unmanned and manned alike, are being investigated by Bendix Corp.'s Systems Division in anticipation of the need for such vehicles to support manned landings on the moon and ultimately to take part in planetary exploration.

Company designed and constructed a 1/10 scale model of an unmanned, nuclear-powered vehicle, optimized to achieve the maximum number of missions possible for a single vehicle within the imposing constraints of lunar soft landing capability expected over the next several years. The model is mobile, but not self-powered. As shown in accompanying photographs, this vehicle is designed to fold into a nose cone of a three-stage launch vehicle, consisting of the two-stage Saturn C-1 configuration with a liquid-hydrogen Centaur upper stage. The intended roving vehicle weight (1,756 lb.) and the soft-landing capability of the launch vehicle for which it was designed, place this model in the class of surface roving vehicles originally envisioned for the Prospector program (AW Oct. 2 p. 52).

In addition, plans for an entire family of roving vehicles which would be modular in design, providing them with growth capability paralleling what is expected from a space vehicle like the Apollo, have been worked out. This modular series of vehicles would use many of the basic subsystems and ideas, such as the traction technique, wheel design, navigation, guidance and control, and communications incorporated in the model built by Bendix.

Like a number of other companies, Bendix has been working on extraterrestrial vehicle designs for more than a year, devoting a total of 15 man-years to the effort, despite the failure of the Prospector or an alternate program to materialize and despite the disappointment, shared by a sizable group of other competitors, at the cancellation of an Air Force roving vehicle study program (AW Dec. 18, p. 56) after costly proposals had been submitted.

Bendix believes that roving lunar vehicles will play a vital role in the manned lunar program, possibly including participation in landing site selection for the Apollo program, although this mission is not now in the announced Apollo plans, according to R. G. Eisenhardt, manager of lunar and deep space programs for Bendix Systems in Ann Arbor, Mich.

Besides assisting in the search for and identification of landing sites, an unmanned vehicle could place beacons or other landing aids in place to aid Apollo landings.

Unmanned vehicle pictured here will measure 22 ft. in over-all length and 8 ft. in height when unfolded. It is designed for:

- **500 mi. range** with 90% reliability.
- **2,000 mi. range** with 50% reliability.
- **Payload capability** of 275 lb., sufficient for a selection of scientific experiments and equipment, including a soil drill which can penetrate lunar surface to a depth of 15 ft., a television camera, spectroscope and optical periscope.

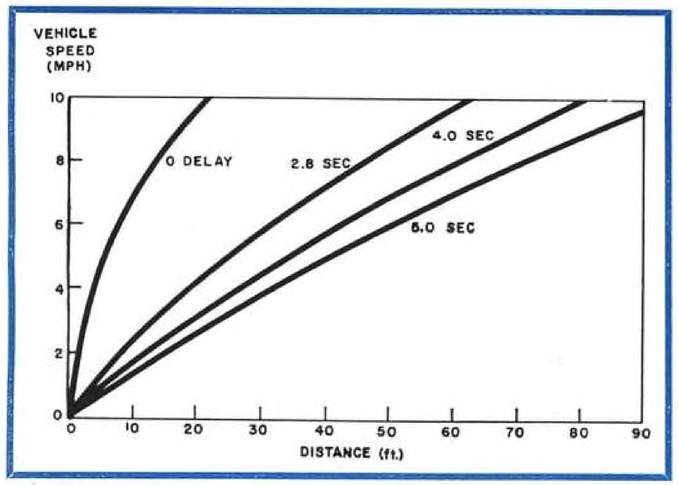
Vehicle employs three non-collapsible 5-ft.-dia. wheels as its basic means of locomotion, with the two rear wheels spaced 12 ft. apart. The wheels effectively are a mechanical effort to simulate a pneumatic wheel, which Eisenhardt says would be undesirable on the moon.

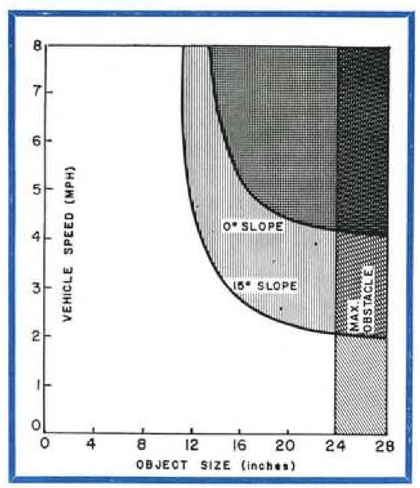
Each wheel is one foot wide, has tempered aluminum spokes and recessed stainless steel webbing which connects the spoke rims around the wheel's periphery. The spokes can deflect radially and tangentially.

In the design, it was desired to minimize locomotive power regardless of load and soil constant. To do this, it is necessary to keep the rolling resistance, a direct function of wheel width and bearing pressure (analogous to inflation pressure of a pneumatic wheel), relatively constant.

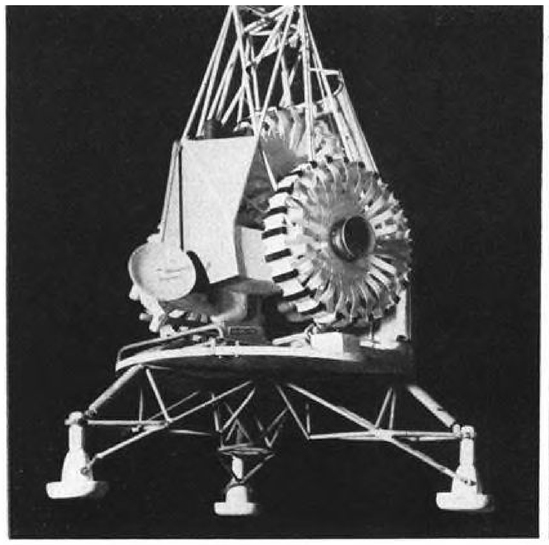
Width is maintained constant by design as the webbing offers no area for increase in width. This is somewhat akin to an automobile tire which under load does not widen at the tread but rather at the bulge along the sides of the tires and above the treads. With increasing load the contact area will increase in length, not in width. The depth of penetration, indicative of bearing pressure, does not increase.

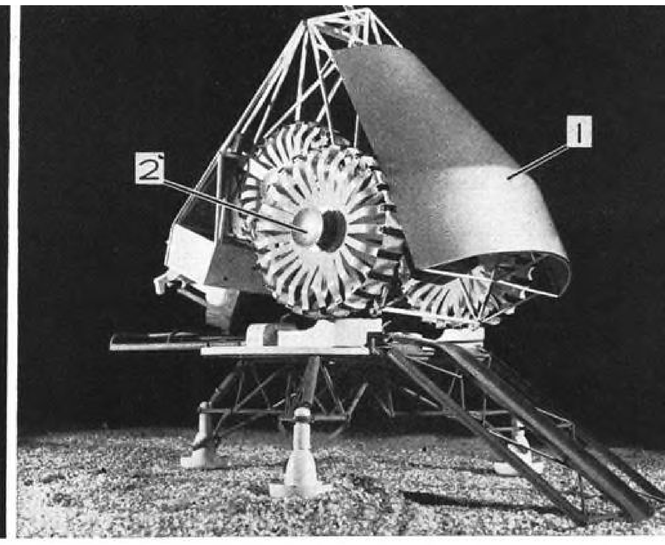
Each wheel has an integral drive unit,

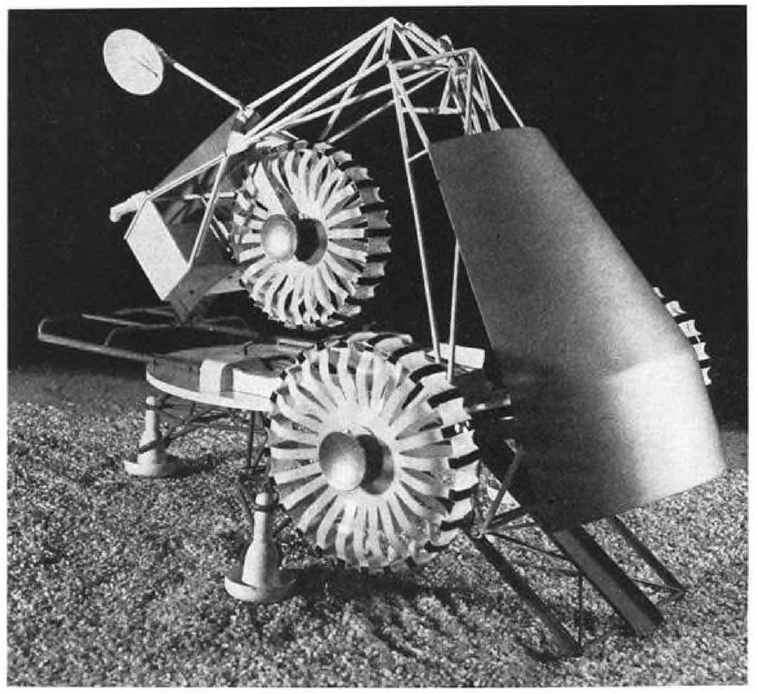




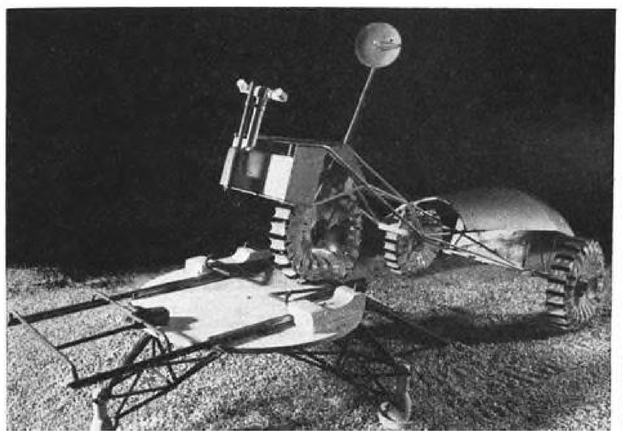
DISTANCE a roving lunar vehicle will travel before it is commanded to stop to avoid impending danger is shown at left over a range of speeds up to 10 mph. Family of curves allows for various delays associated with ground control loop, including round trip communications delay for signals sent between the vehicle and ground center, time required to reconstitute TV frame. Chart indicates that vehicle traveling at 6 mph., for example, takes over 50 ft. to stop under earth-based control. Dynamic stability limits for roving vehicles are shown at right in plot of vehicle speed as a function of obstacle size. Shaded areas block out limits of size of an obstacle which vehicle can traverse.

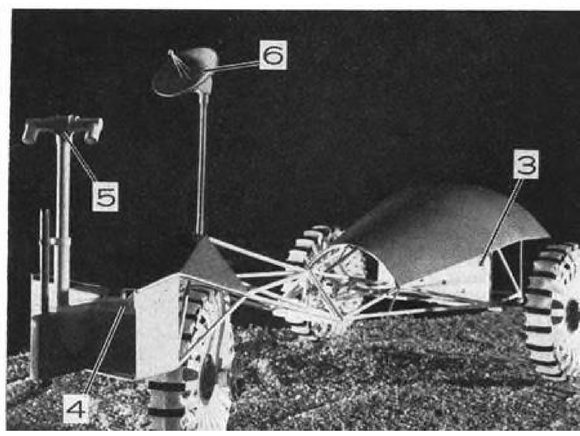


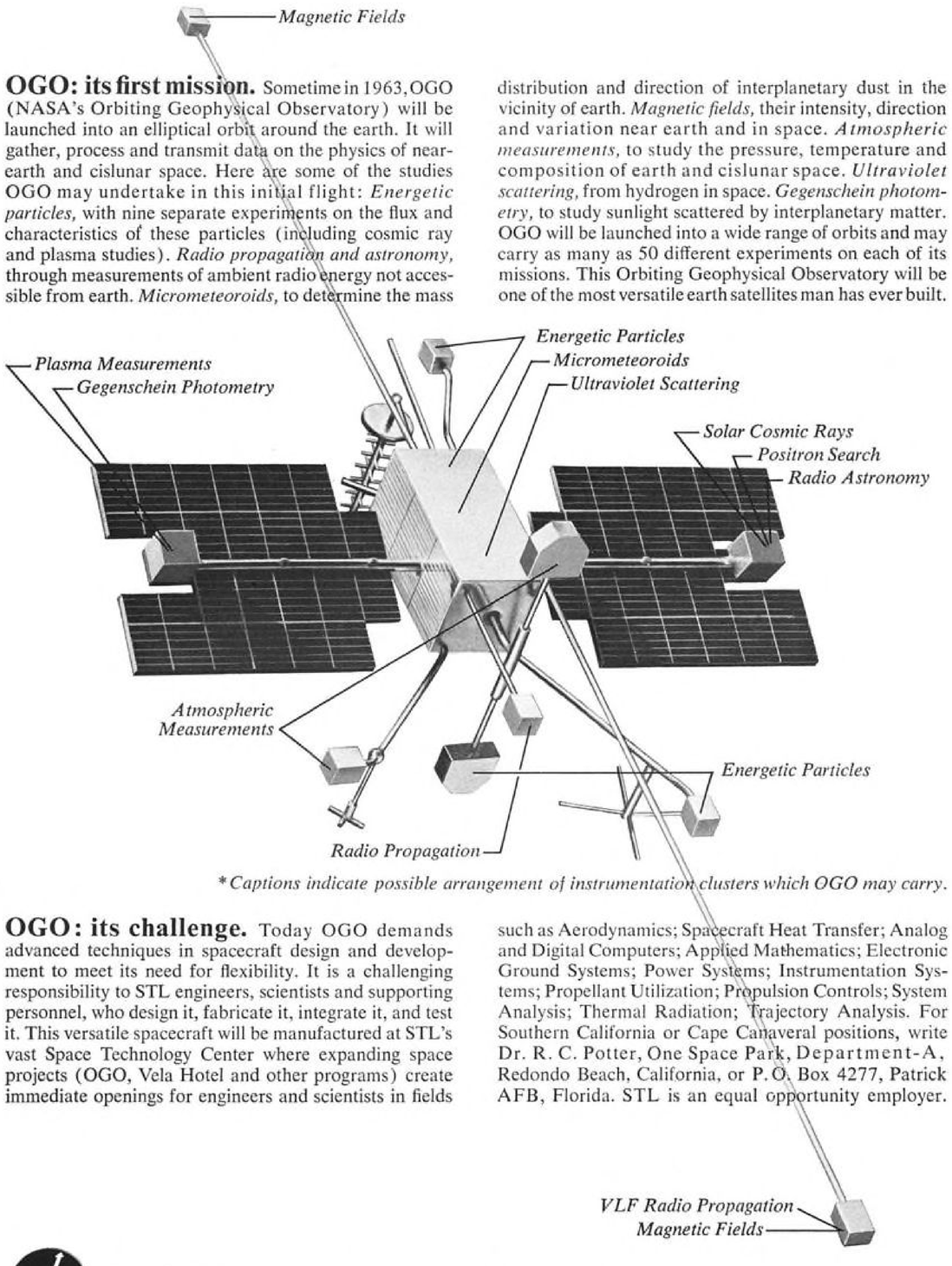




Nuclear-powered roving lunar vehicle model is shown unfolding in sequence from its launch configuration (above, left) to operating form. The 1,756 lb., three-wheel unmanned vehicle was designed for soft landing on the moon using a Saturn C-1 with a Centaur top stage. It has many design features, such as non-collapsible steel webbed wheels, which are being employed in conceptual designs of a family of modular roving vehicles proposed for Apollo support missions. Portions of vehicle in view include high-temperature radiator (1), local radiators which look like wheel hubs (2), shadow shield which obscures reactor (3) and an electronics package (4) at the opposite end of the 22-ft. vehicle from the reactor. Periscope (5) aids surface navigation and 16-deg. beamwidth antenna mounted on 2-ft.-long spring extended support (6) receives guidance commands from earth. Nuclear reactor system, similar to Snap 2, supplies 3 kilowatts of useful power and makes possible operation during the long lunar nights. Vehicle was designed by Bendix Systems Division, Ann Arbor, Mich., to fold into the nose cone of the three-stage launch vehicle. The model shown here is mobile but not self-powered and is 1/10 scale. Lunar rover would be designed for 500-mi. range with 90% reliability, and payload capacity of 275 lb.







OGO: its first mission. Sometime in 1963, OGO (NASA's Orbiting Geophysical Observatory) will be launched into an elliptical orbit around the earth. It will gather, process and transmit data on the physics of near-earth and cislunar space. Here are some of the studies OGO may undertake in this initial flight: *Energetic particles,* with nine separate experiments on the flux and characteristics of these particles (including cosmic ray and plasma studies). *Radio propagation and astronomy,* through measurements of ambient radio energy not accessible from earth. *Micrometeoroids,* to determine the mass distribution and direction of interplanetary dust in the vicinity of earth. *Magnetic fields,* their intensity, direction and variation near earth and in space. *Atmospheric measurements,* to study the pressure, temperature and composition of earth and cislunar space. *Ultraviolet scattering,* from hydrogen in space. *Gegenschein photometry,* to study sunlight scattered by interplanetary matter. OGO will be launched into a wide range of orbits and may carry as many as 50 different experiments on each of its missions. This Orbiting Geophysical Observatory will be one of the most versatile earth satellites man has ever built.

**Captions indicate possible arrangement of instrumentation clusters which OGO may carry.*

OGO: its challenge. Today OGO demands advanced techniques in spacecraft design and development to meet its need for flexibility. It is a challenging responsibility to STL engineers, scientists and supporting personnel, who design it, fabricate it, integrate it, and test it. This versatile spacecraft will be manufactured at STL's vast Space Technology Center where expanding space projects (OGO, Vela Hotel and other programs) create immediate openings for engineers and scientists in fields such as Aerodynamics; Spacecraft Heat Transfer; Analog and Digital Computers; Applied Mathematics; Electronic Ground Systems; Power Systems; Instrumentation Systems; Propellant Utilization; Propulsion Controls; System Analysis; Thermal Radiation; Trajectory Analysis. For Southern California or Cape Canaveral positions, write Dr. R. C. Potter, One Space Park, Department-A, Redondo Beach, California, or P. O. Box 4277, Patrick AFB, Florida. STL is an equal opportunity employer.

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a self-contained electrical motor and gear. The wheels have 3 forward speeds —5, 2½ and ¼ mph. with a 2:1 speed ratio making possible the 2½-mph. speed by switching poles of the drive motor and a 10:1 gear shift giving the ¼-mph. speed. There are also 3 reverse speeds.

The wheels are mechanically independent and self-disengaging. If the power actuator of the forward wheel fails, for example, the front wheel will automatically disengage and track. Locomotion can be provided by differential speeds of the rear wheels. Weight of the wheels is 26. lb. each, the drive system 12 lb.

Nuclear dynamic system similar to the Snap 2 system is the source of prime power for the vehicle, supplying about 3 kilowatts. Aside from favorable potential power density (power/lb.) compared with other possible power sources, the nuclear system offers attractive features for the unmanned vehicle. For instance, it eliminates long periods of forced inactivity, which would be imposed on solar cell-powered vehicles during the 14-earth-day lunar nights unless weight-consuming storage systems were available. This ability to operate through the lunar night effectively halves or at least shortens the vehicle hardware lifetime requirements.

Operation through the extremely cold lunar nights might also simplify temperature control of sensitive avionics gear. The vehicle is so configured as to allow for maximum separation, equivalent to the 22 ft. length of the vehicle, between the nuclear reactor, housed at the rear of the rover behind a shadow-shield, and the avionics gear at the front of the vehicle. The structure resembling a fender covering the rear portion of the vehicle is a high temperature radiator.

Structural members of the vehicle are tubular welded struts designed to minimize thermal expansion and held to as simple a configuration as possible. Interestingly, it is the launch rather than landing phase which places the most severe stresses on the vehicle.

In a launch configuration the vehicle is folded, hinged at one point in the center of the strutted assembly with the nose wheel folded in. The center axle has an extension so wheels can spread to simplify folding. The vehicle sets down on a landing bus. A ramp, down which the roving vehicle will descend, is blown out of the bus after landing. An actuator provides power for unfolding the vehicle, which rolls down the ramp, drawing part of its power initially from the bus. When it is fully extended and latched, the rover power supply is initiated.

In its modular vehicle approach, Bendix is suggesting a basic 2,350-lb. vehicle on which one-, two-, or three-man capsules can be mounted before launch or on the moon. The modular vehicle is similar to the model except that it would be a four-wheel unit scaling 2,350 lb. with its power supply, communications gear, guidance and control. The vehicle would have a gross weight of 6,000 lb.

The modular rover would be 12 ft. long, 6.8 ft. in diameter. Its basic configuration permits use of the vehicle for unmanned operation on the moon initially. A second vehicle of the same type, with a manned capsule added, might later be launched with higher confidence in its potential performance based on previous experience with the basic vehicle on the moon. Or the manned capsule might be landed on the moon where it could be assembled on a prelocated unmanned modular vehicle. In either case, human passengers would initially enter the capsule on the moon.

Manned capsule designs (not including the basic vehicle) proposed by Bendix are as follows:

- **One-man**—1,996 lb. at launch, 2,246 lb. with one man in the capsule. Dimensions of the capsule are 5 ft. dia., 3.8 ft. long with an inside volume of 75 cu. ft.
- **Two men**—2,532 lb. increased to 3,022 lb. with both passengers. Inside measurements are 6.3 ft. high, 3.5 ft. wide and 10 ft. in length. Inside volume is 175 cu. ft.
- **Three men**—Launching weight is 2,859 lb., increased to 3,609 lb. with the full three man complement. Inside dimensions are 6.3 ft. high, 5 ft. wide and 10 ft. long. Internal volume will be 249 cu. ft.

Possible missions for unmanned or manned roving vehicles, or both, could include emergency and normal transport of men, site selection and exploration, manned exploration, cargo transport, base construction and provision of shelter.

Problem of supplying sufficient shielding to protect men in a manned vehicle probably would rule out the use of the nuclear reactor in the manned version, in favor of fuel cells.

Basic subsystems common to the three wheel vehicle and the family of four wheel modular roving vehicles are expected to weigh a total of 225 lb., require 700 watts peak power.

Breakdown of these systems, their performance, weight and peak power, is:

- **Navigation**—¼-mi. accuracy, 25 lb., 20 watts.
- **Communications**—10^6 bits/sec. video, 55 lb., 310 watts.
- **Guidance and control**—3 sec. delay, 3 speeds forward/reverse, 20 lb.
- **Television**—Three stereo videcon units, 75 lb., 100 watts.
- **Environment control**—+86F to 122F, 50 lb. 250 watts.

To date, Bendix studies are entirely company funded.

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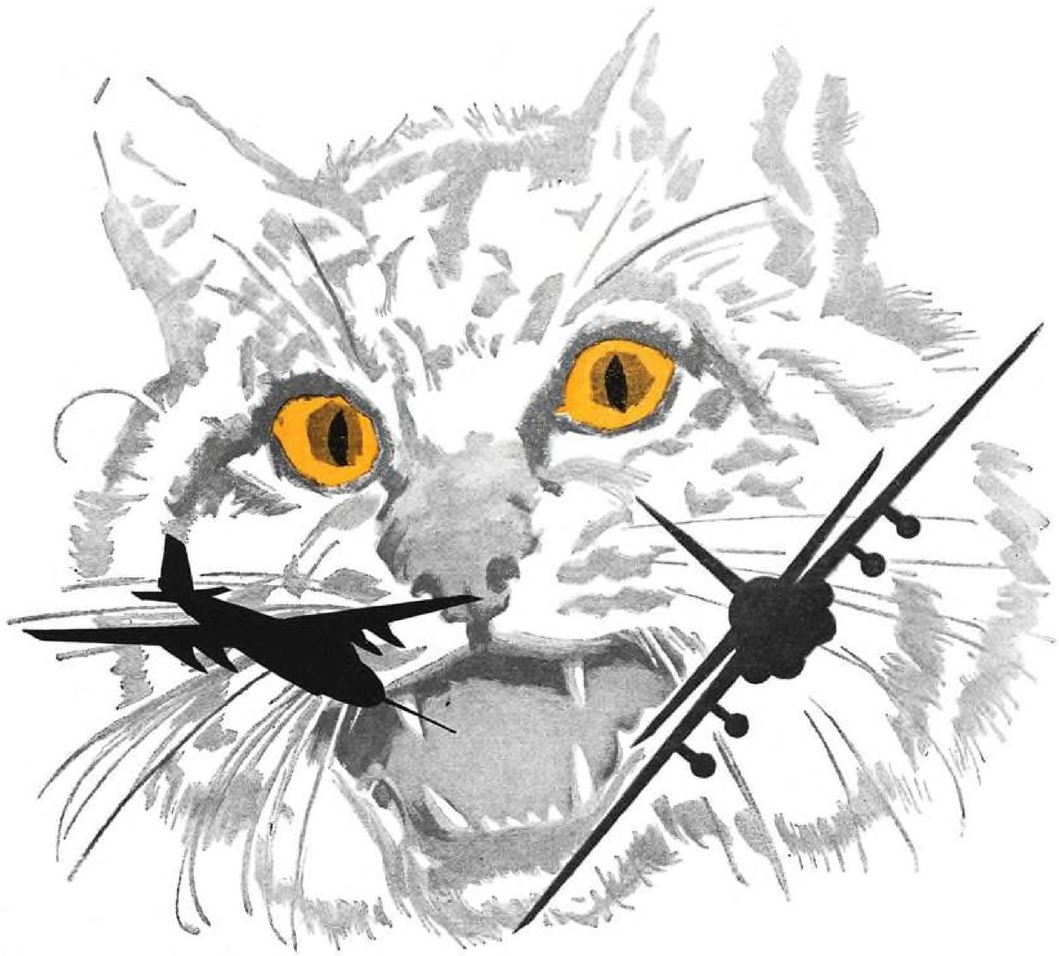

"Cat's Eyes" for the Navy's Intruder

NORDEN

The Grumman carrier-based A2F-1 Intruder is an elusive, low-flying aircraft that can follow a course around hills and other hazards as it swoops in toward its target. The pilot "sees" his course and target clearly even in midnight darkness . . . or in spite of severe weather conditions . . . by Norden's Search and Terrain Clearance Radar.

This system, serving as "cat's eyes" for the Intruder, provides an electronic display of information supplied by advanced sensory equipment. Two viewing screens in the cockpit enable the pilot to determine targets and geographical features. The aircraft automatically pursues the desired approach, discharges its weapons and leaves the target area. The pilot may easily alter course if the situation demands it.

This is just one of several important programs at Norden involving advanced television and radar systems. It is another Norden contribution in strengthening our nation's defense by EXTENDING MAN'S CAPABILITIES.

FOR ADDITIONAL INFORMATION ABOUT NORDEN SEARCH AND TERRAIN CLEARANCE RADAR SYSTEMS, WRITE:

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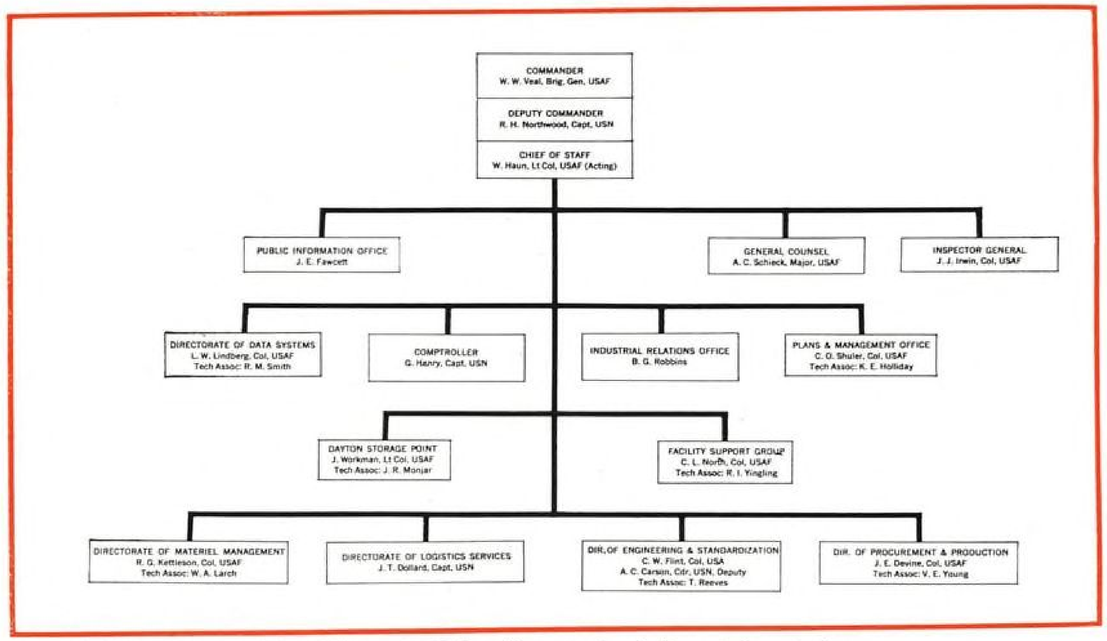

ORGANIZATION of the recently formed joint-service Defense Electronics Supply Center is shown in chart.

DESC Begins New Electronic Parts Role

By Philip J. Klass

Dayton, Ohio—The recently formed Defense Electronics Supply Center (DESC), which will buy and manage the distribution of most of the electronic components used for spare parts by all military services, totaling nearly a quarter of a billion dollars annually, will begin its operations July 1.

The new joint-service agency, one of nine joint supply centers under the Defense Supply Agency, will be responsible for the procurement and management of approximately one million different types of components by the time it is fully implemented in Fiscal 1964.

This figure represents 29% of the total in the entire Defense Department inventory and more than half of the number assigned to the whole Defense Supply Agency for management.

Cut in Items

One of the important objectives in setting up DESC is to slash the number of different items that must be procured and stocked. Present goal is to reduce the number of different items in the inventory by approximately one third, according to Brig. Gen. William W. Veal, USAF, DESC commander. (Capt. R. H. Northwood, USN, is deputy commander of DESC.)

For example, fixed resistors with 5% tolerance on their resistance values are more expensive than 10% tolerance units, which in turn are more expensive than 20% tolerance units. Normally, an equipment manufacturer uses the least expensive units suitable for the particular application, and replacement spare parts are supplied with the identical tolerance.

Cost Differential

But in large quantity procurement, the cost differential between different tolerances may be so small that the savings in stocking and handling costs might justify standardizing on 5% resistors, for example, for all replacement uses.

DESC has been assigned procurement and management responsibility for 20 types of electronic components in the Federal Group 59, including such items as vacuum tubes, circuit breakers, capacitors, resistors, relays, connectors, synchros, transformers and crystals. In addition, it is responsible for supply class 6145—electrical wire and cable.

Excluded from DESC responsibility are the following: reparable items, classified items, nuclear stores, high dollar value items and devices still undergoing development or refinement. These will be procured and managed, as in the past, by the individual services.

Vacuum tubes will be the first class to come under DESC responsibility, and by the end of this year the transfer from individual services is expected to be complete.

The final take-over dates for other types of components are scheduled as follows:

- **Mar. 31, 1963:** networks, fuses and circuit breakers.
- **June 30, 1963:** lugs, terminals, crystals, headsets, electrical hardware and supplies.
- **Sept. 30, 1963:** relays, solenoids, insulators, antenna and wave guides.
- **Dec. 31, 1963:** connectors, wire and cable.
- **Mar. 31, 1964:** coils, transformers, brushes and synchros.
- **June 30, 1964:** capacitors, switches, cables and cords.
- **Sept. 30, 1964:** resistors.

$500-Million Inventory

When the transfer is complete, DESC expects to be managing an inventory of nearly $500 million. Annual procurement to replenish this stock currently is estimated at $220 million, according to Gen. Veal.

The choice of Gentile AFB here in Dayton, site of the former Dayton Air Force Depot, as headquarters for the new Defense Electronic Supply Center, coupled with its dual-mission

Hercules can haul almost anything–almost anywhere

U.S. Air Force C-130B takes off from jungle clearing between Amazon and Andes for one-hour flight to Lima, Peru. Heavy freight must otherwise be hauled 7,000 roundabout miles by river, sea, and rail.

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Destination may be a crude landing strip freshly hacked out of the jungle. Or a snow field at the South Pole. Makes no difference. The Lockheed C-130 Hercules can land and take off on just about any reasonably flat, clear spot on the face of the earth — so it can take its vital cargo close to the action without delay.

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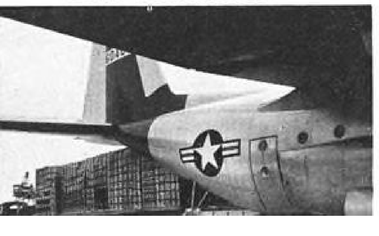
Loads from the rear



Carries 92 troops

Refuels fighters

Drops big equipment

Launches target drones

Lands on snow & ice

The great paradox of our time, perhaps of all time, is that peace depends on our capacity to fight a war. Thus the person who contributes to our military strength, contributes to the cause of world peace.

MITRE's contribution is the design of command and control systems to give our military commanders the means to detect attack and retaliate.

The men who design these systems must think in terms of war and military operations — weapons, logistics, communications, intelligence, ability to destroy and ability to survive. They must be able to predict and solve the problems of future military command within the reality of existing or predictable electronic capability.

We call this "Military Command Technology."

MITRE's specific assignment is the design, development, evaluation, and integration of several interrelated, constantly evolving systems. It encompasses Command Systems (such as NORAD); Control Systems (such as SAGE); Intelligence Systems (such as MIDAS); and Warning Systems (such as BMEWS).

The work involves important new areas of technology in such fields as communications, intelligence, space surveillance, survivability, computer applications, data processing and other electronic techniques.

MITRE is located in pleasant, suburban Boston. Requirements: B.S., M.S., or Ph.D. in these disciplines — electronics, physics, and mathematics. Rewards are competitive. Openings also available in Washington, D.C. and Colorado Springs, Colo.

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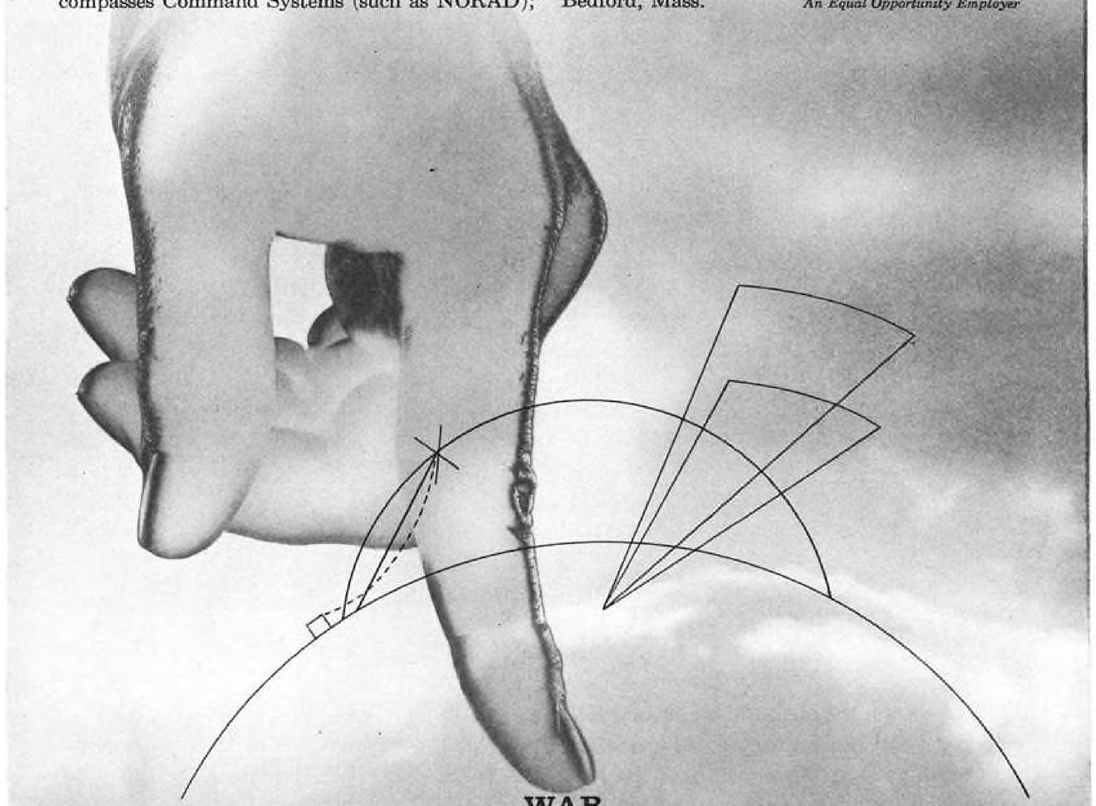

WAR

How would it be fought?
What would this nation's strategy be?
What kind of decisions would have to be made?
How would the commander command?
Who and what would survive?

MITRE is an independent, nonprofit corporation working with — not in competition with — industry. Formed under the sponsorship of the Massachusetts Institute of Technology, MITRE serves as Technical Advisor to the Air Force Electronic Systems Division, and is chartered to work for such other Government agencies as FAA.

task, has resulted in some confusion over DESC's role.

The principal role of DESC is to serve as a "wholesaler" of its assigned electronic components to eight distribution points operated by the individual services. In addition, DESC has taken over the storage/distribution function of the former Dayton Air Force Depot and serves as a "retailer" to distribute electronic components directly to hundreds of Air Force bases and maintenance facilities.

Employment Figures

The procurement-management function (National Inventory Control Point) is expected to involve about 3,500 employes, while the depot function (distributing directly to USAF bases and facilities) will involve about 2,000 employes. In addition, approximately 400 will be involved in operating the Dayton facility and in operating communication networks. Military personnel will make up an estimated 3% of the total, according to Gen. Veal.

Navy, Army and Marine Corps will use their existing distribution points for supply of electronic components. For example, a Navy base that needs vacuum tubes would place a requisition with its Oakland, Calif., Norfolk, Va., or Bayonne, N. J., supply points, while the Army will requisition from its Sacramento, Calif., Lexington, Ky., or Tobyhanna, Pa., facilities.

If the component is in stock, it will be supplied by that facility, which in turn will report the transaction to DESC headquarters for inventory control. If the requisitioned component is not available, the facility will notify DESC, which will then determine the closest distribution point which has the item in stock, and promptly dispatch instructions to ship the item.

The Marine Corps depots at Barstow, Calif., and Albany, Ga., will not be part of DESC, but they will replenish their stock by direct requisitions from DESC.

Inventory Management

As DESC takes over responsibility for management of different types of components, it assumes "ownership" for all such stocks, regardless of their location. Thus, it can draw on stocks in a nearby Navy distribution point to fill an Army requisition which cannot be supplied by the closest Army distribution point, for example. In this way, the complete inventory of the three services can be made available to any using facility.

By the time DESC is fully operational in 1964, the facility here expects that it will be processing an average of 25,000 individual transactions each day, including both its wholesaling and retailing operations, according to Gen. Veal.

BRIG. GEN. WILLIAM W. VEAL, commander of new Defense Electronic Supply Center (DESC), which begins operation July 1, formerly was commander of the Dayton Air Force Depot. Veal holds a B.S. degree in metallurgy from University of Toronto and an M.S. in industrial engineering from Georgia Institute of Technology.

To handle this vast amount of paper work speedily and accurately, DESC has installed an IBM 7080 computer and two IBM 1401s, which are used for input-output data processing. These machines will be used to maintain up-to-the-minute count of the millions of items in the inventory. The computers will be programed to automatically print out a list of those items whose supply or current consumption rate requires procurement action.

Direct Communications

Rapid, direct communications between DESC and individual service distribution points will be provided by the Air Force's Combat Logistics Network (Comlognet) and the Army's Switch Communication Automatic Network (Scan).

One of the most challenging opportunities for economy under the new set-up is to eliminate stocking of identical or functionally interchangeable components purchased by the individual services under different part numbers. This mission, assigned to the DESC Directorate of Logistics Services, under Capt. J. T. Dollard, USN, requires a detailed study of the thousands of different types of resistors, capacitors and other components now in the inventory to determine which can be culled out.

A recent study has revealed that the number of new types of components entering the inventory each year increases by about 20%, with negligible retirement of old components. Unless this trend can be halted, DESC faces the prospect of a four-fold increase in types of components every decade.

One reason for the rapid multiplication in types of components has been the inability of the military services to

PUMP PRIMERS

ARTHUR A. NICHOLS

VALUE ANALYSIS REPORT ON GEROTOR PUMPS

► The rather unusual qualities of the Gerotor pump which have kept it intimately associated with aircraft pumping applications from the days of the earliest superchargers for reciprocating engines, can best be summed up as *inherent adaptability* and *high reliability.*

► The Gerotor pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump—simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance at high altitudes and has low wear over a long service life. In addition, it is balanced and extremely quiet in operation.

► Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See Fig. 1.)

► Valveless design insures absence of mechanical troubles associated with the operating complexity and service and wear problems inherent in valve construction.

FIG. 1

► Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

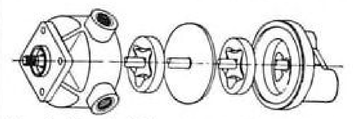

Fig. 2. Several fluid systems can be served economically by one multiple element pump arranged as shown in diagram.

► *Technical data is available and your inquiry is invited. Write:*

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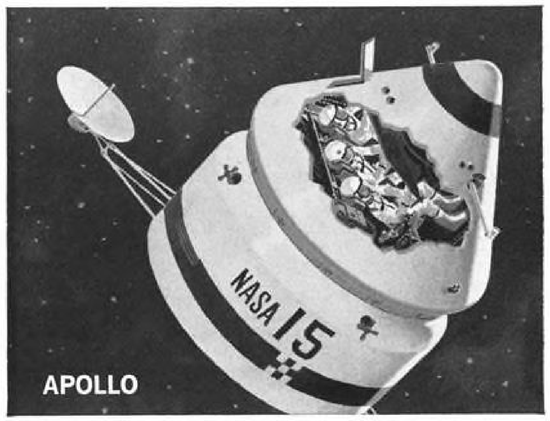
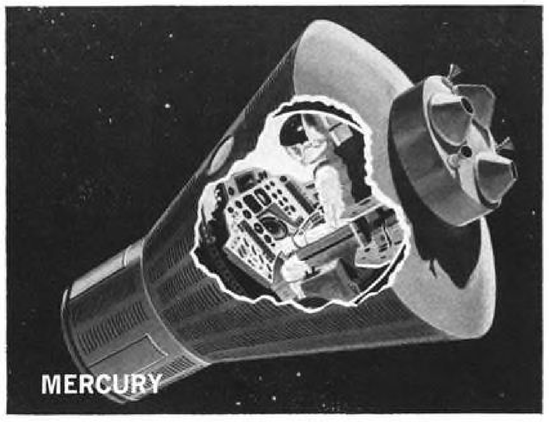
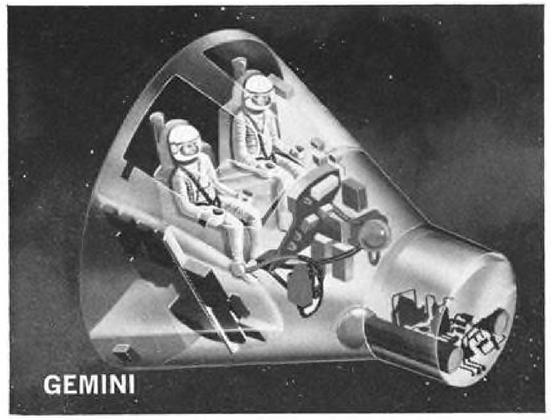
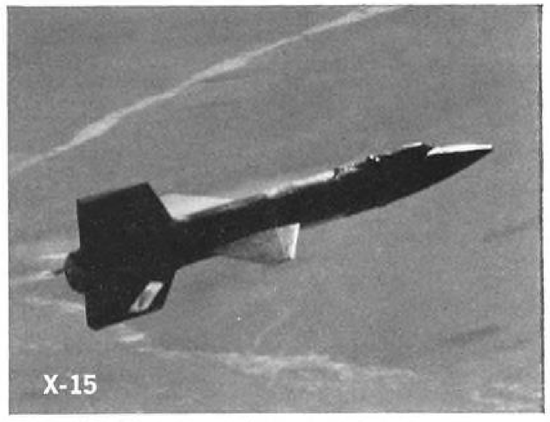
HONEYWELL TEAMS









HONEYWELL SYSTEMS help U.S. astronauts control these vehicles through critical maneuvers in space.

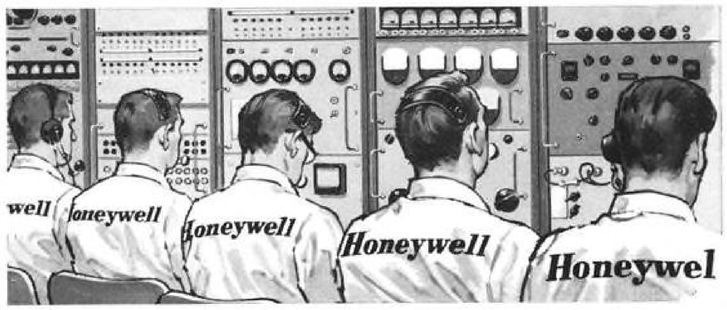
Honeywell support systems vital to mission success

Another Honeywell contribution to U. S. space programs is the launch-site checkout equipment that conducts prelaunch checks of the navigation, control and stabilization systems. This equipment saves valuable countdown time and helps assure mission success.

A Honeywell-sponsored development program is investigating concepts for capsule-borne automatic monitoring and checkout equipment that will help Apollo astronauts perform in-flight maintenance on all systems during their mission.

Honeywell's support equipment assignments on space programs are the result of long experience in the advanced technology of checkout systems for aircraft, missiles, spacecraft, research vehicles and high-thrust engines. In addition, Honeywell has built special-purpose airborne and ground-based digital computers for various support functions, including transmission and storage of tracking, command and in-flight performance data by radio, radar, infrared, sonar.

Honeywell also designs and builds simulators and trainers for satellites, spacecraft, submarines, nuclear reactors and nuclear power-plants.



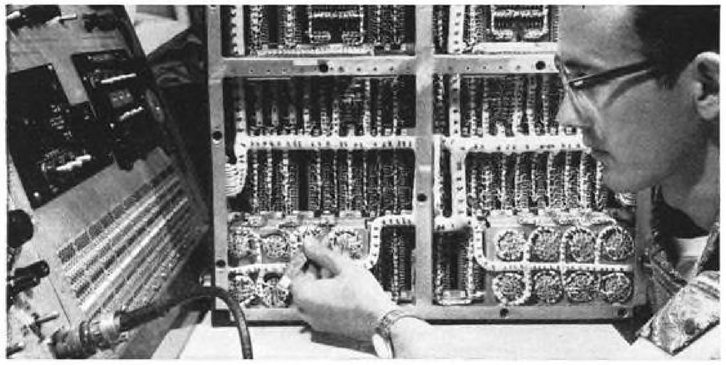
WITH MAN-IN-SPACE

When the multi-man Apollo spacecraft travels to the moon and back, Honeywell control, stabilization and display systems will be on board to help the astronauts perform the necessary critical space maneuvers along the way.

The Apollo mission will be an advanced phase in a carefully planned series of NASA-USAF manned space exploration projects by the United States in which Honeywell is playing a vital role. Each step is contributing new knowledge about the performance of man and machine in space —knowledge which every participant like Honeywell is applying to assure the success of subsequent steps.

Earlier steps in this series have included the pioneering NASA-USAF-Navy X-15 rocket-powered flights to the fringes of space and NASA's Mercury suborbital flights of astronauts Shepard and Grissom —and most recently, the three-orbit Mercury flight by John Glenn. Subsequent projects include the two-man NASA Gemini spacecraft for extended duration missions and orbital rendezvous tests, and the Apollo manned lunar spacecraft.

Previous Honeywell assignments on U.S. space programs have included inertial reference systems for Vanguard, Thor-Delta and Agena B as well as complete guidance and control systems for Scout and Blue Scout. Fifty-four U.S. satellites have been guided into orbit with the help of Honeywell precision inertial systems or components.



Honeywell X-15 system provides uniform aerospace flight control

Maintaining uniform control of a vehicle both in the atmosphere and in space calls for a control system that adjusts itself automatically to extremes of speed and altitude. Such a system is the Honeywell Adaptive Flight Control System now flying the X-15 aerospace research vehicle.

Honeywell also developed an airborne analyzer for the X-15 flight control system. Carried aboard the B-52 mothership, this system makes 78 separate preflight checks in less than three minutes immediately prior to X-15 launch.

Honeywell Mercury systems perform successfully on all shots

When the Mercury spacecraft separates from its booster, a Honeywell system stabilizes it and yaws it around to the normal orbiting position—heat shield first. During the mission the astronaut can maneuver the spacecraft manually, using Honeywell controls and displays. At a command from the astronaut, from the automatic sequences, or from the ground, the Honeywell automatic control system tips the spacecraft to the precise angle required for successful retrorocket firing and aligns the spacecraft for re-entry.

A Honeywell Attitude and Attitude Rate Indication System tells the Mercury astronaut when the spacecraft attitude is changing and how fast it is changing. A Honeywell Earth Path Indicator tells him where he is in relation to the earth's surface and where he will land should he initiate re-entry. A Honeywell Humidity Indicator keeps the astronaut informed of his cabin humidity. Honeywell systems have met all performance objectives on all 12 instrumented Mercury shots to date.

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Honeywell

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Engineers and Scientists: Investigate professional opportunities at Honeywell.

CARE AND FEEDING OF MISFIT BITS

(Or: Down to bedrock with EDP)

"Data," quoth one of our intrepid R&D Engineers in a moment of bemused relaxation, "are too often treated like a woman's foot!"

"The object," he elaborated, "seems to be to squeeze it into the smallest shoe available. It's axiomatic, of course, that *feet don't fit shoes. Vice versa. And data . . .* "—well, you know the rest.

Which is another way of saying that trying to solve a specialized data processing problem with a "standard" system will usually get you bunions . . . and a lot of wasted time and money. We frankly prefer to start with the data itself . . . and an unfettered mind. We've been doing it for something over 20 years, and you would find the results most interesting.*

Take, for instance, the Radar Data Processor we developed and produced for the 433-L Weather Observing and Forecasting Program. One big objective of this program is to generate composite radar displays of large storm systems. The idea is to get cloud intensity and height data from a hundred or so weather radar sets across the nation, and combine all this information at a single processing center.

Foregoing a treatise on the problems, let it suffice to say that a size 9 brown oxford data processor out of a box was "no fit" for the job. The unit as we produced it accepts the quantized grey levels of radar echoes from clouds . . . eliminates interference effects from practical consideration . . . and encodes the data in 7 intensity and 6 height levels. For each 5 by 5 nautical square mile area, maximum cloud intensity and the height of the highest cloud are stored in a magnetic core memory.

The radar unfortunately supplies its information in a spherical coordinate system, so we had to convert it for storage in rectangular coordinates, for ease of display. Conversion is accomplished with some interesting (see previous footnote) analog computation techniques. On command, stored data are transmitted either to a local display printer, or over phone lines to the central control station, or both.

There are also facilities for inserting code into outgoing messages, alarms to signal certain weather conditions, and internal test equipment for checking system performance. And there's a Telecoder with some unique capabilities that can be adapted for use wherever information on printed or punched tape has to be converted for serial transmission or readout. (If this is up your alley, write for Data Sheet 6-106.)

We'll gladly tell you more about what we've done, but we'd much rather talk about your current problem in converting data into "hard copy," telephone line signals or visual displays . . . or in developing specialized data handling systems or computer control centers. When can we get together? Data Processing and Display Systems Dept., Budd Electronics, 43-22 Queens St., Long Island City 1, New York.

*Term commonly used by R&D men in referring to their own accomplishments. Meaning: "Remarkably ingenious; nothing else quite like it."

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develop, obtain approval, and issue new component specifications in time to meet the needs of industry designers.

Recognizing this, the Defense Department has assigned the functions of the Armed Services Electro Standards Agency (ASESA), formerly responsible for coordinating military specifications, to the center here. Approximately 150 of the employes who worked in ASESA are being transferred to Dayton next month.

Issue Date Target

Col. C. W. Flint, USA, who heads the Directorate of Engineering & Standardization, to which this function is now assigned, says that DESC expects to be able to prepare and issue new military component specifications within six months before the work is started.

The individual military services will, as in the past, be responsible for drafting the initial specification, but DESC will be responsible for coordinating the proposed specification with the other services and with industry, and for pushing it through to a final version ready for issuance.

The speed-up in specification preparation is expected to result from the early use of working groups consisting of representatives of each of the services and from interested component manufacturers. This technique, first used on a trial run basis for vacuum tube and semiconductor specifications, will be applied to all other types of components starting next month, Flint told AVIATION WEEK.

Procurement Set-up

All procurement of DESC-assigned components will be handled from the Dayton facility, under the Directorate of Procurement and Production, headed by Col. J. E. Devine, USAF.

Approximately 80% of the procurement dollar volume is expected to be awarded through advertised bidding on a fixed-price contract. The remaining 20%, representing perhaps 75% of the total number of components procured, will involve contracts running less than $2,500 per individual award. These small individual contracts are negotiated by obtaining bids from three or more selected companies.

Management of the vast DESC inventory will be handled by the Directorate of Materiel Management, under Col. R. G. Kettleson, USAF.

The officers assigned to DESC will come from all the services. At present, Air Force officers make up 56% of the total, with Army officers representing 20%, Navy 19%, and Marine Corps 5%. Ultimate goal calls for increasing Army and Navy representation modestly with a corresponding reduction in Air Force officers.

Information from countless sources, staggering amounts of it. New information that changes from moment to moment, old information that must be retrieved from storage in seconds. Information of world importance. This is what command decisions are based on: This is what a new science-technology must cope with to help make command decisions possible. The science-technology of which we speak involves the development of far-reaching man-machine systems to provide information processing assistance for military and government leaders. The needs of this field have created a number of new positions at System Development Corporation. Our scientists, engineers and computer programmers applied this science-technology to help develop SAGE. We now apply it to our work on the SAC Control System and other command and control systems being developed. At SDC, our staff participates in key phases of system development; analysis, synthesis, computer instruction, system training and evaluation. If you are a Computer Programmer seeking the work we describe, please contact Mr. A. C. Granville, Jr., SDC, 2432 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C.; Lexington, Massachusetts; and Paramus, New Jersey. "An equal opportunity employer."

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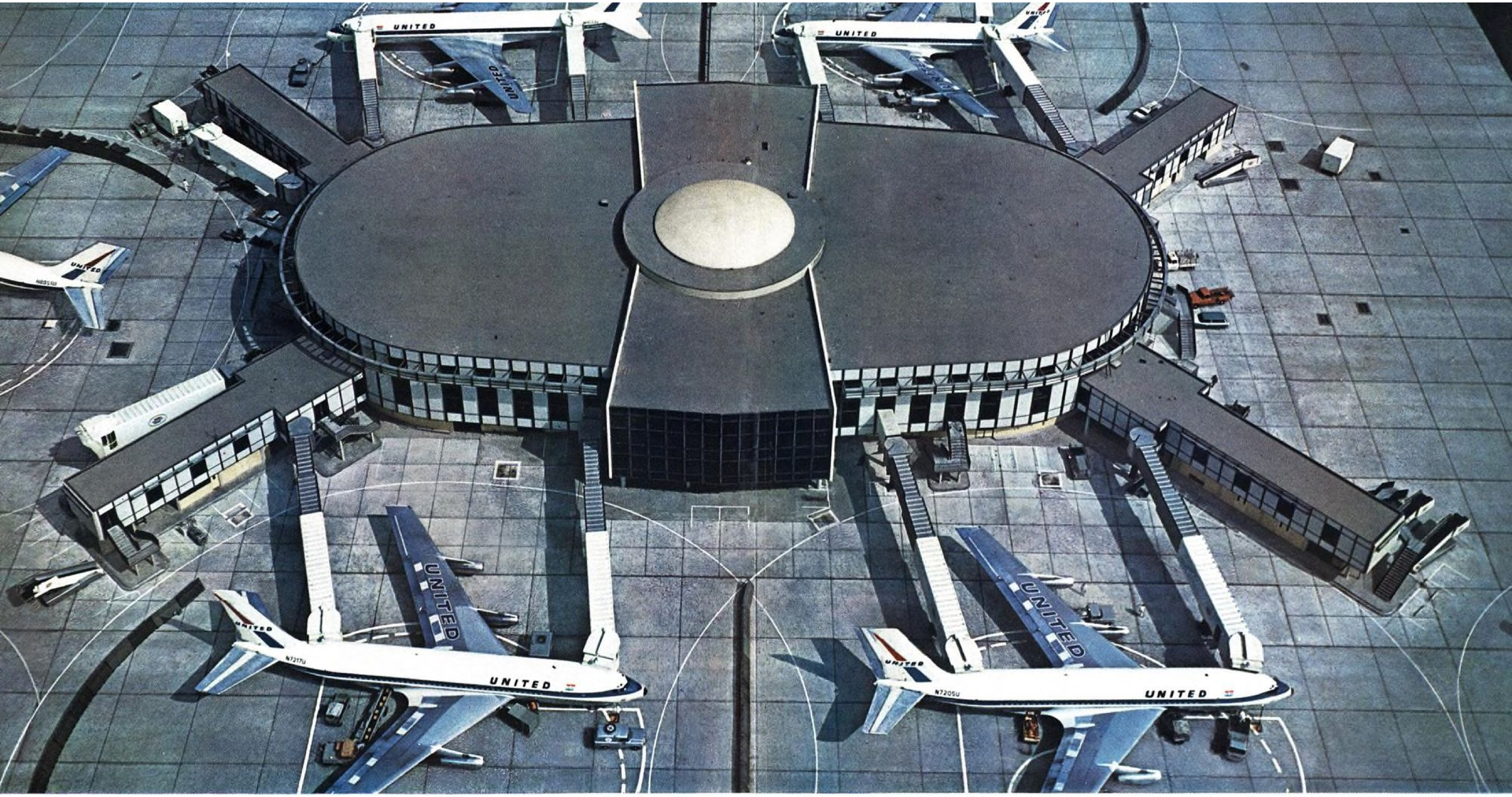

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FILTER CENTER

► **Ion Propulsion Study**—One-year study of ion neutralization in ion propulsion systems will be conducted for National Aeronautics and Space Administration by Litton Industries' Tube Division. Paper study will concentrate on interaction of ions and electrons. First flight of an ion engine, scheduled for late this year, is expected to help resolve differences within the industry over the nature and magnitude of the problem of neutralization of ion beams.

► **TV Dinners in Space?**—Feasibility and design study of a system for preserving frozen food for human consumption during aerospace missions up to 30 days in length without using electrical power will be conducted by Spacelabs, Inc., Van Nuys, Calif., for Air Force Systems Command's Aeronautical Systems Division under a $22,600 contract. The nine-month program will explore insulative techniques among others which may preserve frozen foods in a minimum of space and weight.

► **Implanted Microelectronic Telemetry**—North American's Space and Information Systems Division will fabricate a number of microelectronic telemetry systems and surgically implant them in the chests of monkeys in continuation of an Air Force Ballistic Systems Division program designed to obtain useful physiological data from monkeys with implanted sensors and telemetry, launched in nose cones of Atlas ballistic missiles. The research center of North American's Autonetics Division will assist in the program by preparing necessary deposited microcircuits (AW May 14, p. 95) for the program.

► **Soviets Plan 300-kw. Thermionic Units**—Plans to build nuclear-powered thermionic converters capable of generating 300 kw., for space vehicle use, have been reported by Soviet Union. First prototype nuclear-thermionic unit, designed to develop 30 kw., and using Curium 242 as a fuel, is scheduled to be built this year. Thermionic converter will use cesium vapor. A two-stage demonstration model thermionic converter, with first stage emitter operating at a temperature of 1,150C and the second stage at a temperature of 1,200C, has developed 0.35 watts, half from each stage. Another low-power demonstrator develops 4 watts at 4% efficiency when operating at 1,500C. Plutonium 238 is mentioned as an alternative fuel, or a combination of Curium and Nickel. With the latter, a power of 870 watts per cubic centime-

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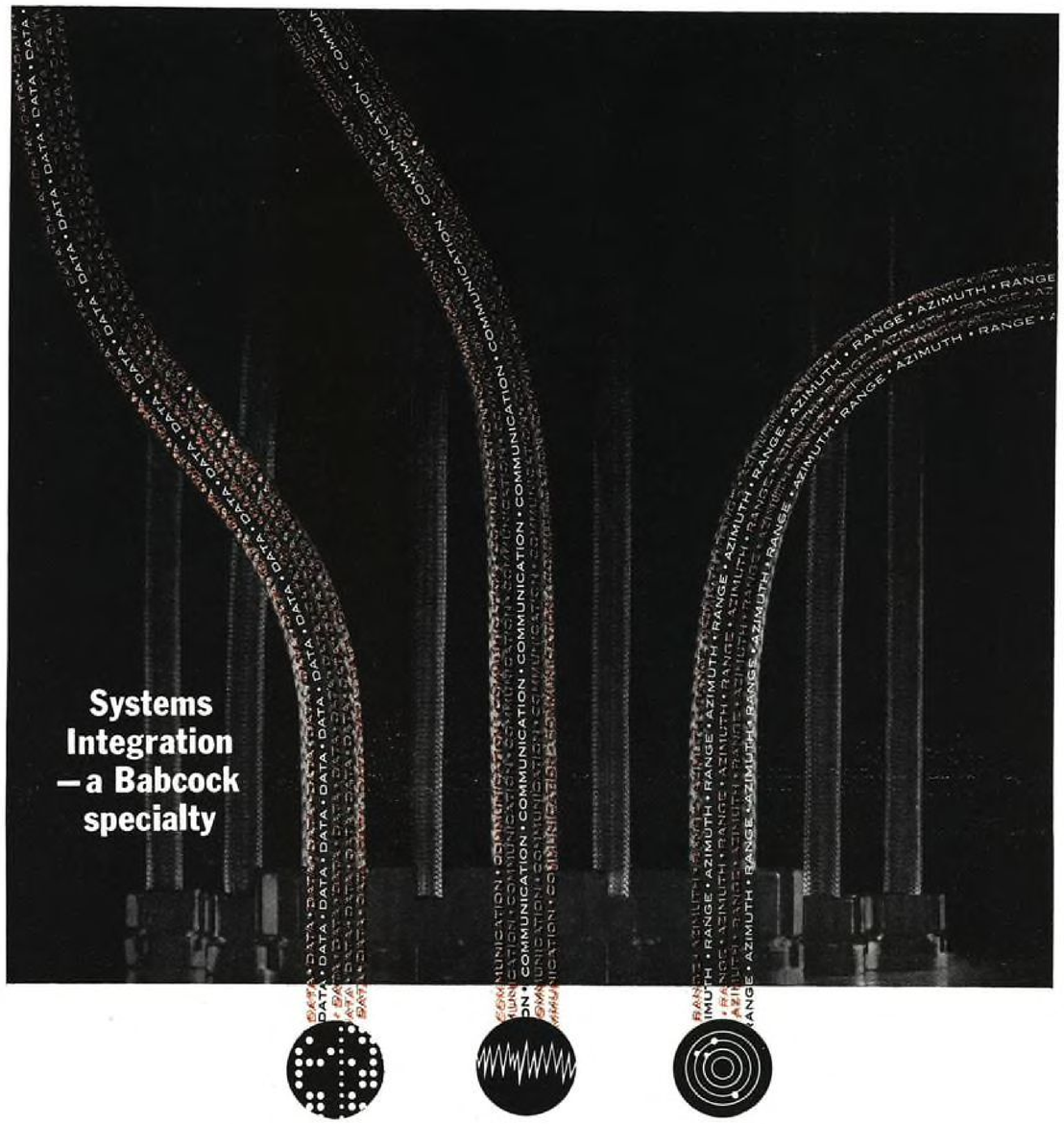

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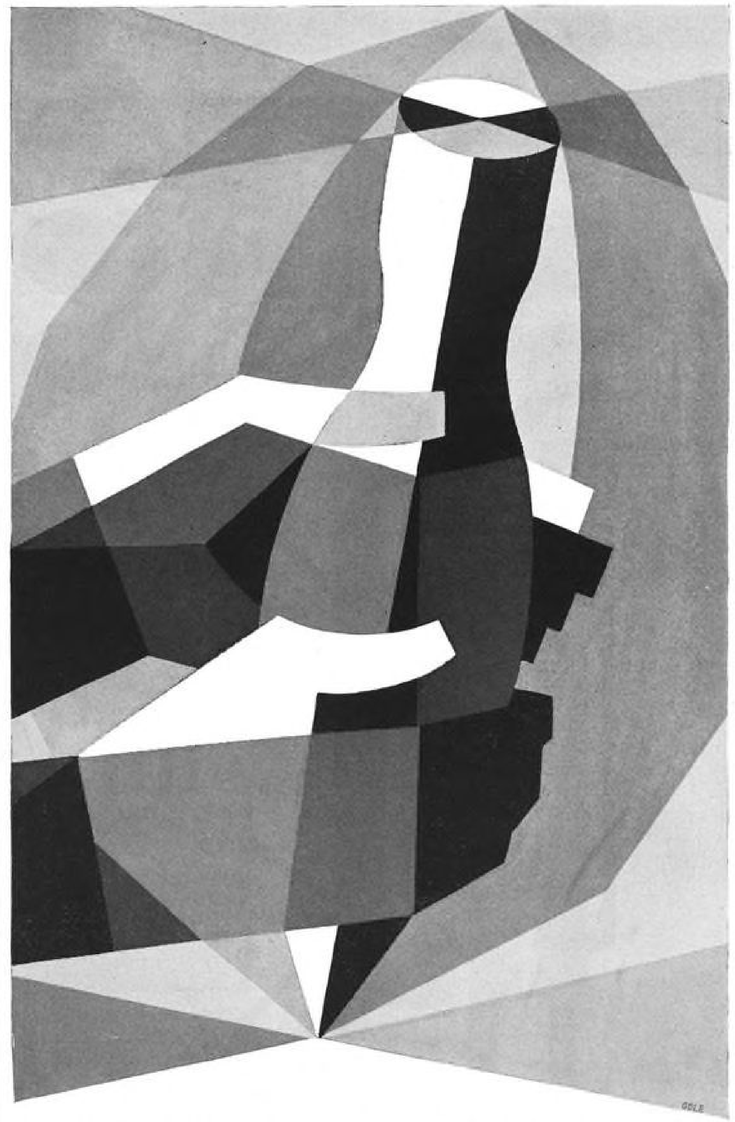
ter can be obtained, Soviet article says. Przeglad techniczny, No. 27, 1961; p. II.

► **Strapped-Down Inertial Guidance System Research**—Applied Research program to develop a strapped-down (no stable platform) inertial guidance system using two electrostatically suspended pendulous gyro accelerometers and two electrostatically suspended gyros, is planned shortly by Air Force's Aeronautical Systems Division. The proposed configuration is expected to reduce both mechanical complexity and the high computation rate required for strapped-down inertial systems.

► **Integrated Circuits for Non-Digital Applications**—Signs of what may develop into a major effort by semiconductor integrated circuit manufacturers to capture a large potential market for linear circuitry as used in communications, navigation and guidance equipment are beginning to appear. Fairchild Semiconductor has started a small effort to develop linear integrated circuits; Texas Instruments will be marketing a line of analog circuits and Signetics Corp. plans to introduce linear circuits, starting with an IF amplifier early next year. Because only a small number of each type of linear circuit is employed in any equipment as compared with the number of common circuits in a digital computer, the integrated circuit manufacturer's tooling and masking costs will probably be reflected in higher prices for individual linear circuits than for digital circuits for some time.

Laser Beam

Laser beam cutting hole in a diamond (right) in 200 microsec. generates temperatures of about 10,000F, giving indication of energy concentration in the laser beam. Holes produced by General Electric researchers are approximately 0.02 in. in diameter. Diamonds also can be cut and drilled with electron beam but operation must be carried out in a vacuum and requires longer time. Laser is not visible in photo above, being to left of focusing lens. Glass plate in center protects lens.



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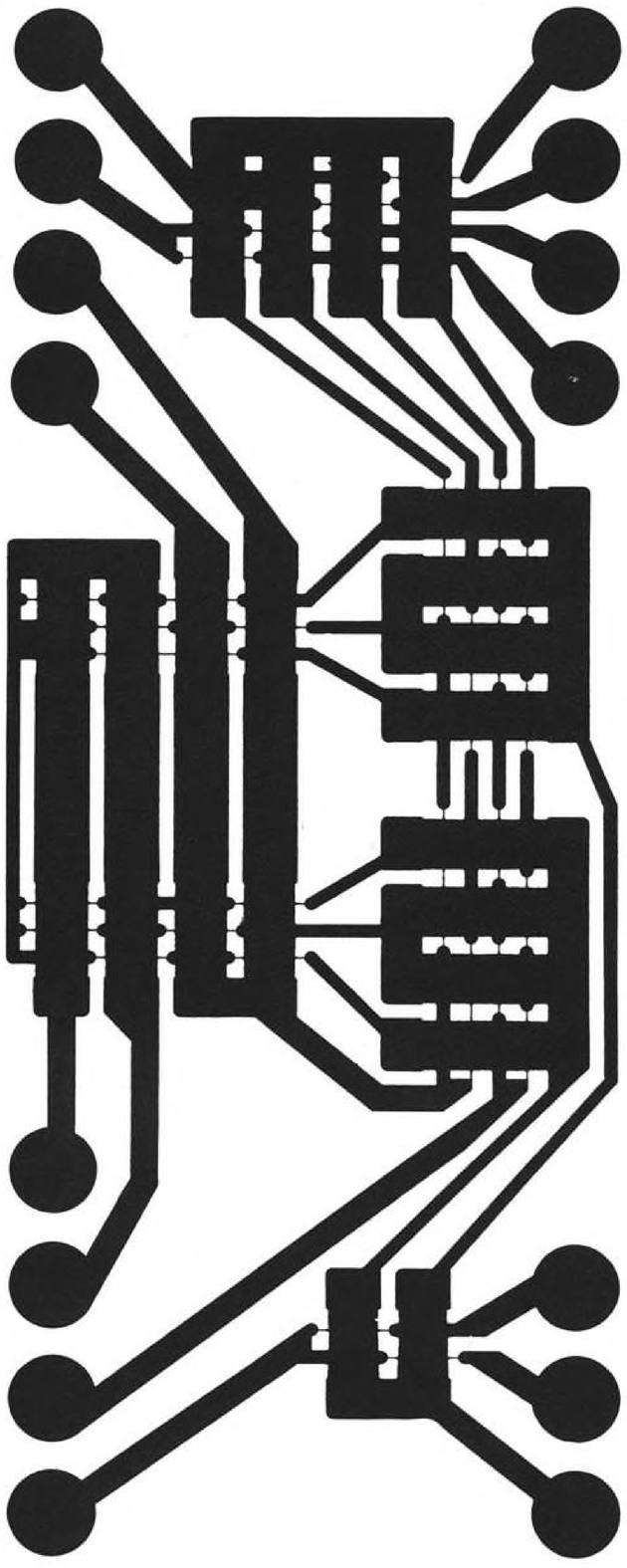


NEWS... OF DEFENSE TECHNOLOGIES

GUIDANCE

There are vast differences between the techniques required to guide missile flights and those needed for space ventures. Entirely different problems are presented in the tasks of guiding an air-to-air missile having a few thousand yards range, sending an ICBM to a target thousands of miles away, and boosting men and instruments to the frontiers of space. Experience in each is invaluable in satisfying new mission requirements.

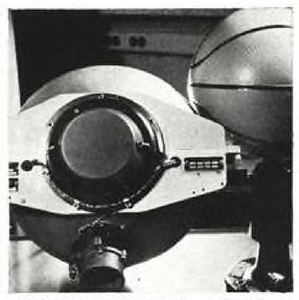
General Electric is producing infrared guidance for the Sidewinder, inertial guidance for the Polaris, and the radio-command system for Atlas ICBM's. It was this phenomenally accurate radio-command guidance that helped put the Mercury-Atlas into earth-orbit.

This wide range of guidance experience is enabling General Electric to apply new devices and techniques (such as electrostatic gyros and cryogenics) directly to existing problems, thus providing continuous and significant upgrading of guidance technologies and capabilities. Current activities include development of reference navigational systems for space and exploration of the best combinations of basic guidance forms for the sophisticated missiles and space vehicles of the future.

CRYOGENIC PROGRESS in inertial guidance is typified by this 32-gate logic element for smaller, faster, more reliable computers. Other current cryogenic work includes high-precision gyros and accelerometers.

ELECTROSTATIC GYROS are being developed to meet future requirements for accuracies up to 1000 times greater than those attainable with present gyros. Other advantages will be simplicity and long life.

STAR-FIELD TRACKER correlates a viewed star pattern against a stored reference map for spacecraft attitude control. This device may replace the inertial table as an attitude sensor because of its zero drift.



INERTIAL GUIDANCE for Polaris has been extremely successful. Designed by M.I.T. and produced by General Electric, the small MK 2 system will help to extend the range of the advanced Polaris missile to 2500 miles.

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USAF Drive Begins to Improve Forecasts

By William H. Gregory

Washington—Air Force and the Aerospace Industries Assn. are discussing revisions of standardized contractor cost reporting formats that are part of a USAF program to improve contractor and Air Force cost estimates.

Better cost estimating was one of the major points stressed at the Air Force Systems Command Management Conference at Monterey, Calif. (AW May 14, p. 26).

Besides better industry projections, Gen. Bernard A. Schriever, commander of the Systems Command, is insisting that AFSC develop its own in-house capability so that it need not rely exclusively on contractor estimates. One phase of this effort has been the training of Systems Command officers in such estimating techniques at a five-week course developed in cooperation with the Rand Corp., and 50 officers have completed the indoctrination program. Five more classes of 25 officers each are scheduled through June, 1963.

Another element of the cost estimating program, which is being emphasized along with the standardized contractor reporting format, is the development of new cost relationships. In today's research and development, low production environment, established tools and relationships such as learning curves and cost per airframe pound are no longer useful in many programs.

All major USAF commands are assisting in developing relationships as well in the areas of training, operations, maintenance and support so that these elements also are given full weight in estimating total system costs.

Feasibility tests were conducted on the Titan 2 and 465L, the Strategic Air Command control system, from this standpoint. Systems Command headquarters has carried out a cost analysis on Aerospace Plane. The 624A standardized space launching system also is undergoing careful review from a costing standpoint (AW May 21, p. 98).

Cost has not become an overriding consideration in weapon system programing, but its status now is equal to performance and schedule. Defense Department is making the term cost effectiveness a key one in decision making.

Cost relationships, and the related theory of cost sensitivity, are emerging as major tools in Systems Command's own approach. Cost sensitivity analysis is the identification of the elements of a system causing the greatest uncertainty in estimates, thus permitting concentration of effort on critical areas.

Establishment of cost relationships is regarded as especially important by Systems Command because, as rules of thumb based on experience, they tend to include allowances for such intangibles as administrative delays, changes and the like.

The Air Force believes it is in a better position than a contractor to develop such relationships because of its broad access to varied experience on all types of programs no single contractor could have. But one officer emphasized the necessity of moving quickly and energetically in obtaining the data. "Even on a program as recent as Atlas," he said, "all the data will be locked away in a file somewhere if we don't go after it now."

Progress in this area is not as far along as the contractor reporting format, but some tentative relationships have been suggested in the last two or three months by Systems Command's Directorate of Cost Analysis, and the directorate, headed by Col. Carl J. Reber, has been able to analyze the Fiscal 1963 and 1964 budgets and make suggestions in this light. Cost analysis offices have been established at Divisions and capability is being developed at the system program office level.

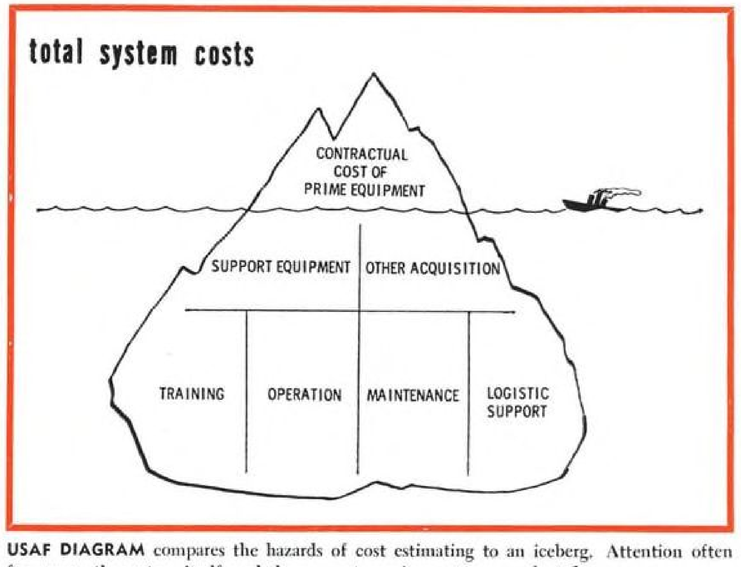
Still another effort is the plan to form a Budget Program Development Committee at each Systems Command division. This committee, including at least two general officers, would consider estimates of a program from three sources—an independent group, the contractor and the system program office.

Some effort has been made initially at Ballistic Systems Division with representatives of the Directorate of Cost Analysis sitting in as the independent group. There have been some wide variations in estimates—some as much as double. Causes include one frequently cited at Monterey as a problem area—variation in understanding by one group or another of what specific elements are to be included.

Standardizing formats for cost reporting thus is receiving strong attention from the USAF-AIA task group. Agreement has virtually been reached on the final form of the reports, a less complex format than first proposed by Systems Command, with the objective of having the system in use by this fall for preparation of the Fiscal 1964 budget.

The AIA group, a task force of the Government Reports Committee, with addition of an Electronic Industries Assn. and American Management Assn. representative each, has stressed two fundamental principles:

- **Contractor cost accounting** systems can provide the program-oriented data if the type of data is specified from the beginning, in the request for quotation stage. On the other hand, breaking out historical data from programs already under way is difficult for contractors, whose accounting systems are generally oriented along functional lines such as engineering, manufacturing, etc.
- **Accurate projections** by contractors



USAF DIAGRAM compares the hazards of cost estimating to an iceberg. Attention often focuses on the system itself, and the support requirements are neglected.

Some Contractor Reporting to Be Cut

Washington—Air Force Systems Command is developing a Gordian-knot solution to cut out unnecessary contractor reporting, a situation that Maj. Gen. Robert J. Friedman, Systems Command comptroller, says has been allowed to get out of hand.

The new system, Gen. Friedman said, would consist of specifying in one clause in a contract what specific reports will be required.

Then a "wipe-out" clause would be inserted also, he said, specifying that, regardless of references, if the report is not specifically listed in the contract it is not required.

How the problem has grown in an allied area was described at the recent Systems Command Management Conference at Monterey, Calif., (AW May 14, p. 26) by Marion G. Pritchard, of the AFSC's Directorate of Status Analysis.

"One data specification recently examined," he reported, "referenced 18 others which, in turn, referenced 93 others, and it is estimated that at least 500 are included in the next tier of reference."

Reporting requirements and data requirements are controversial ones with industry, but for different reasons. Progress reports bring industry complaint of overcomplexity and intrusion into industry management prerogatives. Engineering data, on the other hand, often involves the issue of proprietary rights. Both overlap, however, in the same way many of the specific problems touched on at Monterey intermeshed, and many of these fall into Gen. Friedman's area of financial management, which is interpreted in a broader fashion in Systems Command than in most USAF commands.

Gen. Friedman, for example, heads a review committee with responsibility to oversee translating into action and follow-up of the work of the entire Monterey meeting, not just financial areas.

A working group, headed by Col. J. C. Maxwell, assistant for management to Gen. Bernard A. Schriever, commander of Systems Command, will submit specific programs to the review group.

First concrete result from the meeting will be distribution of summaries of the papers at the sessions this month. These will be followed by periodic status reports on action taken on various recommendations.

Whether to hold another such meeting, attendance at which has become something of a status symbol since the first, will be left open until the end of this year, Gen. Friedman said.

In commenting to Aviation Week on aspects of the panel at which he acted as chairman—financial management—Gen. Friedman elaborated on some other significant areas for industry:

- Incremental financing, despite some criticism within government and industry, is regarded by Air Force as a particularly effective control tool—as an overrun preventive and to stimulate better contractor estimating and reporting.

Normally, incremental financing follows the pattern of providing the contractor at the beginning of the year with 65% of the annual funds available in the budget. As the program progresses, another 25% would be supplied, probably around the six-month time period. The final 10% would then be reserved for fine tuning at the end of the year.

If the Air Force is dissatisfied with contractor reporting, however, it can resort to what industry calls "spoon feeding"—for example, breaking the annual funding into 12-month increments and feeding them to a contractor in these amounts. Generally, this would be just enough to keep the contractor from having to seek short-term bank financing to keep the program going.

Contractors complain that funding on less than a 90-day basis is inefficient and adds cost, especially in the purchasing of materials, where quantity discounts are lost. Gen. Friedman responds that such punitive financing has to be used only rarely and that its effectiveness in improved contractor reporting has been clearly demonstrated.

Incremental financing should not be confused with holdbacks or with full program funding. The latter, which refers to fully funding every program in budget terms over its full life, is favored by Air Force.

Holdbacks were a Defense Department practice in the previous Administration to commit only a small fraction of a program's budgeted funds for its own bookkeeping and reporting reasons.

Beginning of the new fiscal year July 1 will provide a test of whether the Kennedy Administration will also follow this practice.

- Program Package concept is undergoing alteration through a new Program Action Control System which has been developed in the office of Defense Comptroller Charles J. Hitch, who espoused the original package concept.

The Program Action Control System, Gen. Friedman said, provides for continuous review of package programs once a five-year program base has been approved by the Secretary of Defense. All changes which exceed certain thresholds—in funds, quantity, quality, etc.—must have specific approval from the Office of the Secretary of Defense. A ballpark estimate for a threshold would be 5% of funding for a fiscal year or 10% of funding for a longer period.

Monthly reports on physical progress and fund status of key program elements will be submitted to the Secretary of Defense, and periodic updating submissions will be submitted at least twice a year, showing cumulative values of individual changes that fell below the threshold level.

Systems Command, to meet these requirements, must have a program-oriented, accurate, rapid and standardized reporting system, such as that envisioned in the new Systems Command formats (see story on p. 76).

- Cost estimating and reporting, even in research and development areas, can be improved over past performance, Gen. Friedman said. "We expect that a contractor should be somewhere near right in his forecast costs," he said, "and he ought to be able to explain the differences that do appear with other than a shrug."

One frequent contractor counter-complaint—that of too broad a work statement or lack of clear program definition—is a problem that is getting attention, and the multi-step procedure which provides for detailed cost study in the pre-contract signing stage is regarded as a feasible solution.

Hazards of price and wage increases are not regarded by Gen. Friedman as a real impediment to good estimating. "Even Secretary McNamara has said he would buy a 5-10% plus or minus error over the years," Gen. Friedman said, and he doubted whether inflation would have that large an impact.

David Novick of the Rand Corp. told the Monterey group that even on programs pushing into new state-of-the-art areas, there is usually enough historical data available to provide an 80% old and 20% new ratio—enough to permit accurate forecasting.

Gen. Friedman agreed with the Novick thesis in general, but added: "Whether it will be so easy or not remains to be seen. Fact gathering is a tremendous effort."

- Incentive contracting will require judgment in each individual case, and use of a historical percentage as a fee will not be feasible. On initial incentive programs, careful review at the secretarial level in both Air Force and DOD is to be expected, Gen. Friedman said. Cost-plus-fixed-fee contracts, under fire by both government and industry, still will be used, he said, though probably only in initial program stages.

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Then in the glass sealing department, relay headers are hermetically sealed to provide maximum resistance to breakdown.

Finally, assembly, adjustment and inspection are performed in electrostatically filtered "clean rooms".

GLASS SEALING DEPARTMENT

At present the Deutsch relay is available in seven case types and four header types, plus special configurations for printed circuit applications and other requirements.

But to obtain all the vital statistics, contact your local Deutschman, or write for a fact-filled spec sheet containing the names, numbers and characteristics of this winning relay team.

CLEAN ROOM ASSEMBLY

ADVANCED SPECIFICATION MINIATURE ELECTRICAL COMPONENTS

Write for Data File R-6

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rest on firm quantity and schedule requirements from USAF.

One specific problem area has developed in formats themselves. It involves projections of costs of technical manuals, a cost item that has brought questions from Congress as to the reason for the relative rise of software and drop in hardware bought by defense dollars.

The initial formats were published by Systems Command in October, 1961, under the title "Contractor Cost Study." Electronic Systems Division has used a skeletonized version of these formats for inclusion in RFQs as a form of pilot effort in several programs (AW May 14, p. 23).

Original study provided 15 formats, the first four of general application. These were:

- **Summary** of estimated and incurred costs on currently projected schedules for a complete weapon system or support system. On this form, called Format A, data from prior and current years as well as estimates through five fiscal years or to completion were to be provided for various specified cost elements.
- **Detailed estimate** and breakdown, labeled Format B, for each of the cost elements making up weapon or support system summarized in Format A.
- **Variance evaluation**—A comparison of estimates by the contractor for the current and previous fiscal year with explanations for the differences. This report was called Format A-1.
- **Financial management report** of planned commitment, expenditures and invoicing for the next 2½ fiscal years. This is a Defense Department requirement, DOD form 1097 or Format C in the Air Force proposal, which is a key requirement for USAF and DOD program progress evaluation. Air Force is especially insistent on high quality reporting on this form before it releases program funds (see box p. 77).

Various other reports follow, covering such areas as facilities and tooling, and including the technical manual format that is still a stumbling block.

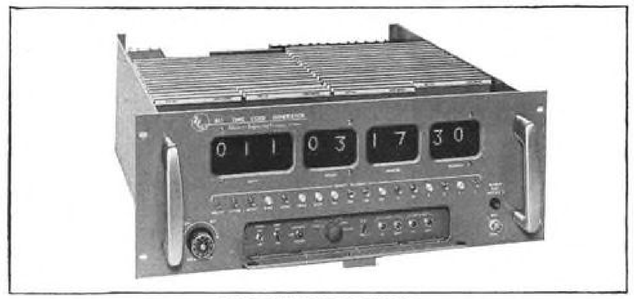
The AIA task group, headed by William Hummel of North American Aviation, who also heads the Government Reports Committee, responded with recommendations that in general simplified the system. USAF then responded early in May with new formats on which both parties have virtually agreed.

All four major formats remain in the list, which has grown to a total of 16, but there have been three significant additions and one deletion plus some reshuffling of titles. The three additions:

- **Program fund requirements** format, called Format A-2 and covering the five-year projection span, has been

FOR FOUR TIME

ALL FOUR IRIG FORMATS ON ONE COMPACT CHASSIS WITH EECO 811 TIME CODE GENERATOR



EECO 811 IRIG FORMATS

	A	B	C	D
Time Code Format	34 Bit BCD Code identifying days, hours, minutes, seconds and 1/10 seconds and a 17-bit binary code identifying time of day in seconds.	30 Bit BCD Code identifying days, hours, minutes, seconds and a 17-bit binary code identifying time of day in seconds.	23 Bit BCD Code identifying days, hours and minutes.	16 Bit BCD Code identifying days and hours.
Code Frame Length	0.1 second	1 second	1 minute	1 hour
Code Scan Rates	1000 pps	100 pps	2 pps	1 ppm
Code Carrier Frequency	10 kc	1 kc	1 kc or 100 cps (switch selection)	1 kc or 100 cps (switch selection)

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DAGE RGS-10 . . . . . "WATCHDOG" FOR THE ATLAS MISSILE

Television has assumed a variety of important roles in military communications: perhaps none is as essential as in the activation of missile sites for America's Atlas defense complex. *Dage RGS-10 television systems will soon be at every operational Atlas base across the nation.* They will be needed for observation of fueling, for training, surveillance and other key operations; the systems must perform under the most rugged environmental conditions possible for TV equipment. Why was the Dage RGS-10 system picked for this critical application?

Recently, the Air Force and the Astronautics Division of General Dynamics performed a series of tests on several closed circuit TV systems to determine which could take the constant punishment encountered in Atlas Systems support . . . and still produce sharp, clear pictures. *The Dage RGS-10 was the system that met all the following requirements:*

- Shock (MIL-E-5272B Proc. 2) and Vibration (MIL-E-5272B Proc. 1) Among other things, these two tests must prove that the camera can "take it" while directly mounted on aircraft or in missiles.
- Explosion Proof (MIL-E-5272B Proc. 2) Certified that the camera can contain an internal explosion of 100/130 octane aviation gasoline.
- Satisfactory operation at light levels of less than one foot-candle
- Satisfactory operation in temperatures from —30°F. to +160°F.
- Certified operation under noise levels of 150 db . . . permits direct, close range observation of rocket blasts.
- Insignificant radio interference

Here are a few other applications of Dage television systems:

Observation of explosive materials
Army Chemical Center—Maryland

Boresight tracking
Patrick Air Force Base—Florida

Hazardous test observation
Point Arguello—California

Rocket engine test observation
Red Stone Arsenal—Alabama

Missile Pad observation
NASA—Wallops Island, Virginia

Reactor observation
Hanford—Washington

Eyes for remote controlled tank
Fort Belvoir—Virginia

All-weather runway observation
Oceana Naval Air Station—Calif.

Other features of the Dage RGS-10 camera:

- 700 lines Horizontal Resolution at 10 mc Bandwidth
- Complete EIA synchronization and scanning exceeds FCC requirements for commercial telecasting
- Multiple camera systems, common or individual EIA sync generators
- Completely transistorized construction
- 17-Watt power requirement
- Unlimited altitude operation
- Optic system fully enclosed for complete protection
- 4-lens turret, zoom lens, pan and tilt, and remote focus available

The Dage Division of Thompson Ramo Wooldridge provides a wide range of cameras, controls, monitors and other equipment as well as complete systems engineering and field service. If you would like to learn more about the Dage RGS-10 and other Dage closed circuit systems and development capabilities . . .

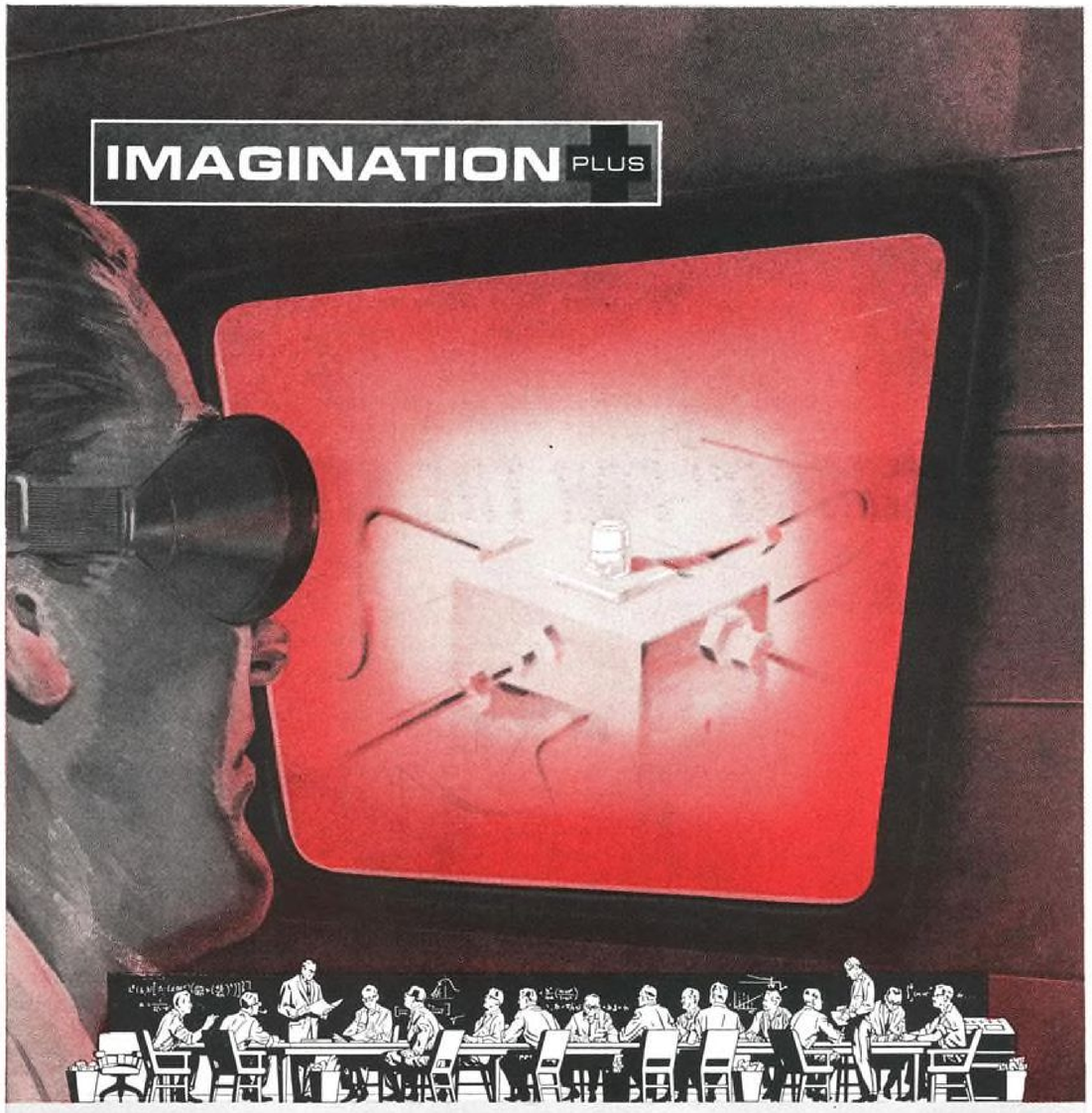
Contact the nearest Dage-TRW regional office—Atlanta, Washington, D.C., Los Angeles or Salt Lake City. (or)

Contact Dage Division Direct—Michigan City, Indiana. (or)

Check the Yellow Pages for your nearby Dage distributor.

TRW DAGE **Thompson Ramo Wooldridge Inc.**

Photos of USAF ICBM Courtesy of General Dynamics/Astronautics



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added, and covers generally the same cost elements as Format A.

• **Major hardware** cost information, labeled Format E, provides data on unit costs of prime mission equipment, tooling and start-up costs and lead time.

• **Command and control** systems only are to be covered in a cost element/task summary, labeled Format E-2, which includes such specialized gear as data acquisition and surveillance equipment, data processing equipment, presentation and display equipment, etc.

The major deletion:

• **Summary** of dollar distribution by the contractor, a report labeled Format D and covering contractor's outside purchases. This covers the politically sensitive small business and subcontracting areas, and includes those criticized at Monterey as social welfare programs in defense spending. Elements of this format, such as make-or-buy definition, now are part of the detailed estimates report or are shown in other formats.

Core of the entire format system, however, is the detailed estimates report—Format B—for here are laid down the detailed elements that are summarized in the other major reports.

In the original Air Force study, these elements were broken down into four main groups—Development, with five major sub-categories; Production for Operational Inventory, also five sub-categories; Development and Production, a category for items that fit in both of the first two but are not common to either one, with 10 sub-categories, and finally, Operational Support, with six sub-categories.

In addition, general and administrative costs and fee or profit were to be allocated to each of the four categories, and detailed within the categories, but not added in the totals for any of the four. As a total, however, it would be shown in the broader summaries.

Sub-categories, in turn, were further broken down into detail items. Under Development, for example, the first sub-category, Integration Engineering, listed four detail estimates including engineering labor and all other labor as separate items. Second sub-category, System Testing, was broken down into seven specific items which included mockups, instrumentation, etc.

An even more complex area, classed under the Development category, was the sub-category for Aerospace Ground Equipment. Ground Equipment was not only broken down into specific numbered items, such as development engineering, but into specific sub-items covering labor and other costs, and under some elements, such as Recurring Costs, into sub-sub-items.

The latest outline of detail elements, the one which is close to the final format, bears only a general resemblance to the original. Besides changing the organization logic, the new format also shows the effort made for simplification, with deletions or shifting and combining of elements in other formats.

Skybolt and Estimating

Better program definition is a major premise in improving cost estimation, and the Douglas Skybolt air-launched, solid propellant intercontinental ballistic missile is a prime example of the reason.

Gen. Bernard A. Schriever, commander of the Air Force Systems Command, told the command's Management Conference in Monterey, that the initial estimate for the Skybolt research and development phase came in at $180 million. Despite his skepticism, the estimate stuck. Actual R & D cost to date is $480 million.

Though General Schriever did not elaborate, part of the problem with Skybolt was in definition of what constituted R & D. Defense Department refused to approve any production funds until feasibility was clearly proven. Yet to meet the weapon system's critical operational readiness requirement, some Phase 1 and 2 concurrency was essential. The result was a broader Phase 1 program and increased costs.

Skybolt system feasibility can now be demonstrated and Fiscal 1963 funds are expected for production and tooling.

Two instead of four major categories now comprise the basic organization: Subsystem Cost and Costs Not Identifiable with a Specific Subsystem.

Subsystem cost is further divided into four main sub-categories: Research Development, Test and Engineering; Production for Operational Inventory; Operational Support, and Supplemental Costs, the latter essentially overhead and fee or profit.

The first two, RDT&E and Production for Operation Inventory, are the major ones, and they each are further broken down into the same detailed items: Program Plans and Management, Prime Mission Equipment, Aerospace Ground Equipment, Personnel and Training, Technical Data, Industrial Facilities, and Other.

In turn, these are broken down into such sub-items as engineering, testing, manufacturing, etc., where applicable, or in some cases, like Personnel and Training, stand alone.

The second major category, Costs Not Identifiable with Specific Subsystems, is divided into seven sub-categories, including integration engineering, system test, site activation, etc., but far fewer items are specified in further breakdown.

This category also includes a sub-category for overhead and fee. By including the overhead burden in only two places, once in each category, the new organization saves multiple listings for this item—listings that dipped down into the sub-item level in the original study.

In the technical manual area, the latest format under discussion has not changed greatly from the original one drawn by USAF. However, the types of manuals which are to be covered in the report are spelled out in much greater detail in the latest outline. Printing and distribution costs in the latest outline are not broken down by quantity and cost as initially planned, but are simply totaled as a single figure covering printing and distribution.

Another revision has occurred in the format for reporting modification costs, now titled Updating. Unlike the initial format, the latest version calls for costing comparisons for previous years and estimates, when applicable, for as many as six years in the future.

Estimates for costs of all changes which have been approved by the Configuration Control Board or which the contractor plans to submit and deems mandatory for safety or performance are to be included, and the contractor is encouraged to use his experience and judgment of possible change costs Category 2 testing may produce.

USAF feels industry response has been cooperative in reaching agreement on a final system. However, the basic conflict in the over-all reporting area was made quite plain at the Monterey conference. Two statements from this meeting illustrate the problem:

From Dudley E. Browne, Lockheed Aircraft Corp. vice president-finance—"A fourth area of conflicting management philosophies is found in our planning and reporting of costs. Industry experience supports the concept of planning, budgeting and reporting costs by organizational units . . . On the other side, through PERT (Program Evaluation and Review Technique) and PERT/Cost, the military's needs have been identified as requiring planning, budgeting and control of costs by event or activity . . . These conflicts are seemingly irreconcilable and, taken together, produce such voluminous detail as to indicate that these differences are unacceptable—though they will require the Wisdom of Solomon to balance."

And from Col. Eugene W. Phillips, deputy commander (comptroller) for aerospace systems—"The financial reports and forecasts required of contractors by the Air Force are minimum in number, scope and content. For the dollars involved, they are certainly reasonable and do not excel commercial requirements. The required data is well within the scope of knowledge needed by any efficient firm to conduct properly its affairs. Yet past experience has disclosed a serious lack of quality in many financial reports submitted to the Air Force . . ."

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AUXILIARY FUEL TANKS, of 450-gal. capacity each, and a special 12-gal. oil tank were added to Lockheed JC-130As in course of Temco modification to extend airplane's normal endurance on station on Atlantic Missile Range to some 12-13 hr.

Modified JC-130As Fill Missile Range Gap

Dallas, Tex. – Specially modified, long-endurance Lockheed JC-130A Hercules transports are joining the fleet of Atlantic Missile Range gap filler aircraft operated by the Air Force to cover re-entry phases of missile and space vehicle programs.

Primary mission of the eleven modified early production models of the C-130A, operated by the 6550th Support Wing (Range) under the command of Col. Henry Dittman out of the USAF Missile Test Center, Patrick AFB, Fla., is to collect telemetry information. Data will include terminal phases of missile and spacecraft shots from Cape Canaveral, including re-entry and impact.

Secondary purpose is to locate and mark returning nose cones, vehicles and other objects for retrieval by surface forces. The 6550th also employs seven Convair C-131s, two Douglas C-54s and two Martin B-57s in its support role, with the C-54s being phased out.

The last of the 11 JC-130As are going through the shops at Temco Aerosystems Division, Ling-Temco-Vought, Greenville, Tex., prior to delivery to Patrick.

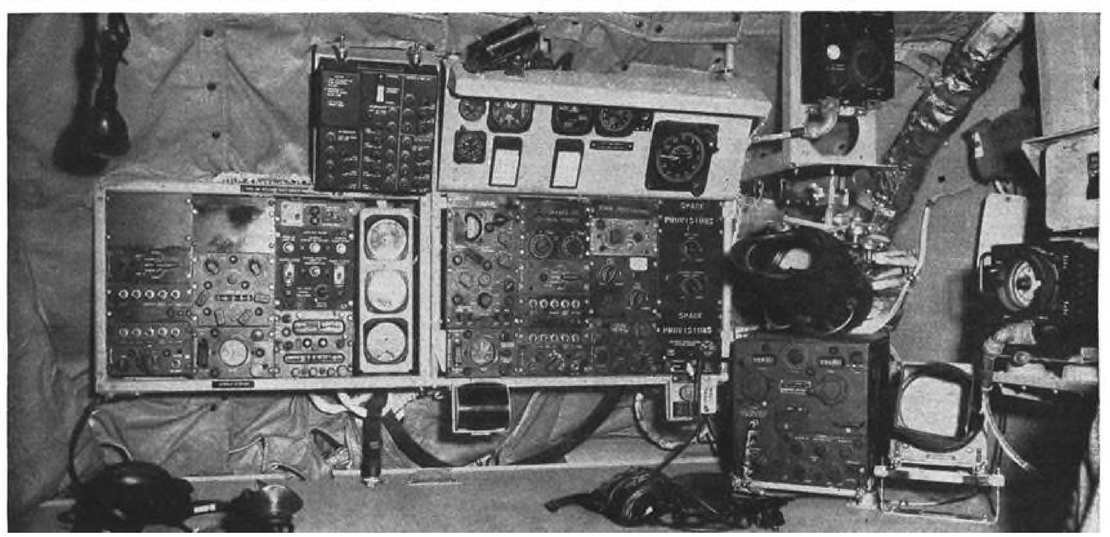
The 6550th flies about 700 hr. monthly supporting the various range users, including re-entry portions of Mercury and the Navy's Polaris firings.

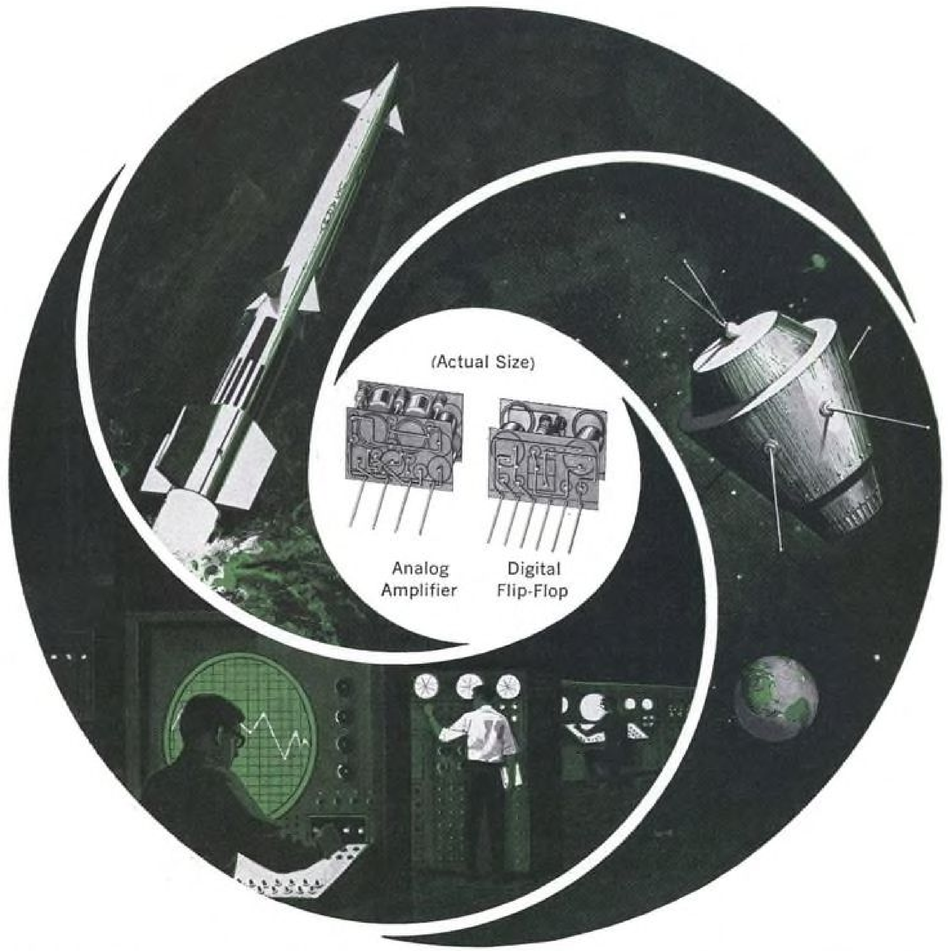
In the Mercury shots it has acquired the capsule electronically from parachute deployment to splash and provided relay of capsule UHF transmissions below the radio horizon of surface stations direct to a range station for passage to the control center at the Cape, while recording all conversations from chute deployment downward.

The squadron stages aircraft out of its home base at Patrick AFB, Antigua, B.W.I., Recife, Brazil, Ascension Island, and Johannesburg, Capetown and Durban, all in the Union of South Africa, and Mauritius Island, Indian Ocean, and in the case of Mercury shots, from Ramey AFB, P.R., utilizing from one to eight airplanes, depending on the mission.

The job is to collect and record vital

DOPPLER SYSTEM was added to JC-130A's navigator station and Temco redesigned former equipment layout to human engineering concept. Drift meter installation (lower left) also was added to standard equipment to aid position reckoning.





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telemetry data during re-entry and down to impact, covering areas that often are blanked out from surface ships and stations by limits imposed by the horizon—or sometimes, in the case of ships, because antenna stabilization problems due to sea state sometimes blank out reception at the surface. Mobility of airplanes and the ability to assume precise stations make them important "gap fillers" on important portions of the range system.

Mission Profile

Airplanes generally depart for their station anywhere from T—5 hr., arriving at station by T—15 min. Position holding in initial portion of mission is at approximately 25,000-ft. altitude, orbiting to maintain the best "look angle" for visual location of the splash.

The airplanes then descend to mark the target—nose cone, vehicle, or other object—with dye marker or buoys to facilitate surface recovery. In the case of manned shots, the aircraft carry Paramedics to provide immediate assistance after landing, if required.

The JC-130As have an endurance capability of 12-13 hr., several hours beyond their original range, as a result of installation of 450-gal. auxiliary fuel tanks and an additional 12-gal. oil tank.

The Temco contract for modifying the 11 airplanes, which totaled approximately $6 million, was awarded by the Aeronautical Systems Division of USAF Systems Command. Of the first six airplanes, two were especially equipped with additional telemetry equipment to provide special support to Polaris firings.

Temco evolved a prototype configuration to cover the rest of the airplanes and outfitted this airplane. On the remainder of the contract, it overhauled the airplanes and installed wiring.

Required racks, brackets and electronic equipment were installed by the 6550th at Patrick AFB utilizing the prototype and drawings as a guide.

A major installation in the airplanes is the separate instrumentation compartment, containing three Atlantic Missile Range equipment racks for telemetry, timing and recording equipment and search and location aids.

Adjacent to main instrumentation compartment another separate room was built, intended initially as an in-flight maintenance and repair facility for the on-board electronic gear. However, additional mission requirements have deleted this function, and the room is used now as an operating station.

Additional navigation aids have been installed, since the airplanes often operate over water areas where a minimum of navaid assistance is available. Additional equipment includes an APN-99 Doppler navigation system and a B-6A drift meter. In the course of reworking the aircraft interior, the navigator's standard equipment layout was revised to be more functional.

Communications modifications include installation of an ARC-58 single side band system, and the interphone system was revised to add eight more stations in the instrumentation compartments and a special crew rest area in the rear over the tail loading doors, which were fixed. Crew rest area consists of a three-tier bunk and table.

To aid in visual spotting of impacted objects, the standard side paratroop doors were modified so that after they are rolled overhead, similar-size doors with large transparent areas can be rolled down on the same tracks and locked in their place. This is done by the observers after the airplane leaves cabin pressurization altitude.

Antenna installations include incorporation of two retractable telemetry and direction finding antennas and domes under the belly, which provide for sufficient ground clearance during landings and takeoffs.

Antenna retraction is accomplished by the copilot. The mechanism includes warning lights and horn to warn against landing with gear and domes in down position.

HOLLEY VALVE "ROLLS" THE VZ-10 "HUMMINGBIRD"

ROLL CONTROL DEVICE HAS WIDE APPLICATION

The VZ-10 "Hummingbird", Lockheed's versatile, high-speed research VTOL aircraft now under construction for the U. S. Army, uses a Holley-developed "Roll Control" valve in each wing tip, to provide attitude control during vertical take-offs and landings and in hovering flight maneuvers.

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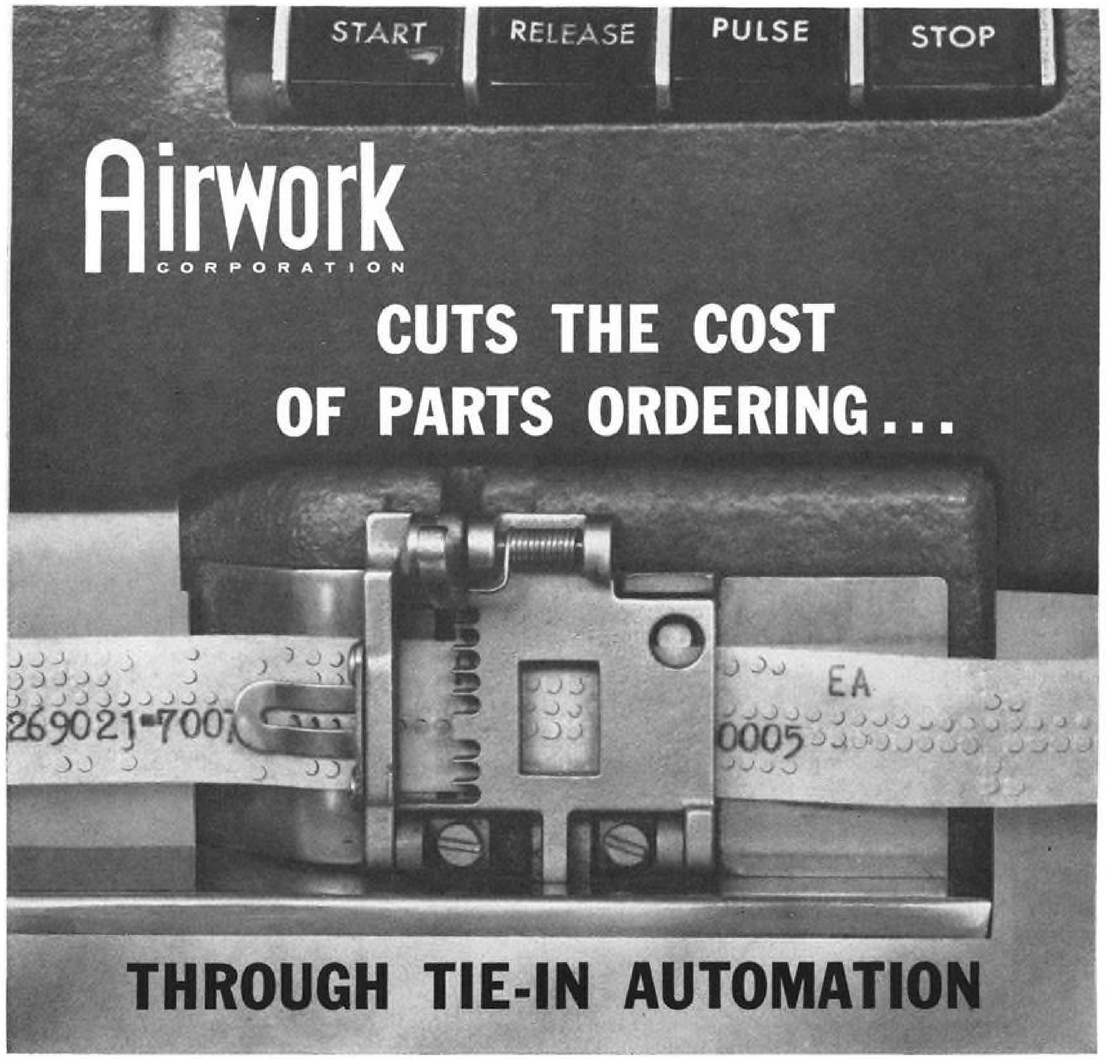

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USAF Contracts

Air Force Office of Scientific Research recently awarded the following grants and contracts totaling approximately $1.9 million to colleges, universities, non-profit research institutions and industrial laboratories.

GRANTS:

Purdue Research Foundation, Lafayette, Ind.—$90,000 for study of adaptive automatic control and learning systems theory.

New York University, New York, N. Y.—$54,669 for study of nonlinear theories of elasticity.

California Institute of Technology, Pasadena, Calif.—$49,958 for research work on non-linear problems in structural dynamics.

Northwestern University, Evanston, Ill.—$81,760 for study of thermophysical properties of plasmas.

University of Michigan, Ann Arbor, Mich.—$35,000 for research work on speech analysis.

University of Washington, Seattle, Wash.—$24,000 for further man-computer interface study.

Rockford Research Institute, Inc., Cambridge, Mass.—$23,677 for study of theory of artificial intelligence and information retrieval.

University of Montreal, Montreal, Canada—$21,313 to develop a symbolic shorthand system for medical documentation.

Tufts College, Bedford, Mass.—$19,800 for innovation in task-oriented communication.

University of Miami, Coral Gables, Fla.—$12,375 for research on interpolation with polynomials to boundary values.

University of Michigan, Ann Arbor, Mich.—$15,335 for study of singular integral equations with special reference to boundary value problems.

Arizona State University, Tempe, Ariz.—$18,505 for study of continued fractions and linear operators.

Yale University, New Haven, Conn.—$28,750 for research in algebras.

Northwestern University, Evanston, Ill.—$11,901 for study of Markov chains and sample function structure.

Stanford University, Stanford, Calif.—$31,850 for research on function spaces and algebras on groups.

University of California, Berkeley, Calif.—$36,800 for study of modern algebraic topology.

Polytechnic Institute of Brooklyn, Brooklyn, N. Y.—$66,617 for active and time-varying systems research and linear network studies.

Stanford University, Stanford, Calif.—$60,000 for study of optical and infrared masers and coherent plasma phenomena.

University of Minnesota, Minneapolis, Minn.—$17,000 for investigation of the helium 2 file and measurement of the velocity of propagation of ordinary sound in He^3 and He^4 gas at low temperatures.

Massachusetts Institute of Technology, Cambridge, Mass.—$50,000 for study of coherent light and radio optics.

Stanford University, Stanford, Calif.—$50,000 for research on electrodynamic problems of astrophysics.

Duke University, Durham, N. C.—$151,180 for research on microwave and radio-frequency spectroscopy.

University of California, Berkeley, Calif.—$75,000 for atomic and molecular beam research.

Michigan State University, East Lansing, Mich.—$10,400 for research on IR and microwave spectra or asymmetric top molecules.

University of Maryland, College Park, Md.—$40,000 for research on foundations of scattering theory and applications to physical problems.

University of California, Berkeley, Calif.—$40,000 for study of theoretical physics of elementary particles and their interactions.

Arizona State University, Tempe, Ariz.—$81,150 for research on magnetic susceptibility of rare earth oxides at low temperatures.

University of Louvain, Louvain, Belgium—$5,200 for research on kinematics of structures.

University of Oxford, Oxford, England—$17,465 for research in neuroendocrinology.

University of Marseilles, Marseilles, France—$10,275 for statistical analysis of the electro-encephalograph.

University of Pisa, Pisa, Italy—$9,174 for studies of behavior.

University of Stockholm, Stockholm, Sweden—$7,200 for study of long-range navigation in animals.

University of Madrid, Department of Crystalography, Madrid, Spain—$40,000 for study of thermal effects on crystal structure.

CONTRACTS:

Grumman Aircraft Engineering Corp., Bethpage, N. Y.—$44,361 for investigation of air vehicle flight path optimization.

Northrop Corp., Northrop Space Laboratories, Hawthorne, Calif.—$47,000 for study of plasma properties and momentum change.

Avco Corp., Everett Research Laboratory, Wilmington, Mass.—$332,629 for continuation of research on plasma propulsion.

Arthur D. Little, Inc., Cambridge, Mass.—$58,935 for study of rocket combustion instability.

General Motors Corp., Allison Div., Indianapolis, Ind.—$79,480 for continuation of research on rail type electromagnetic acceleration.

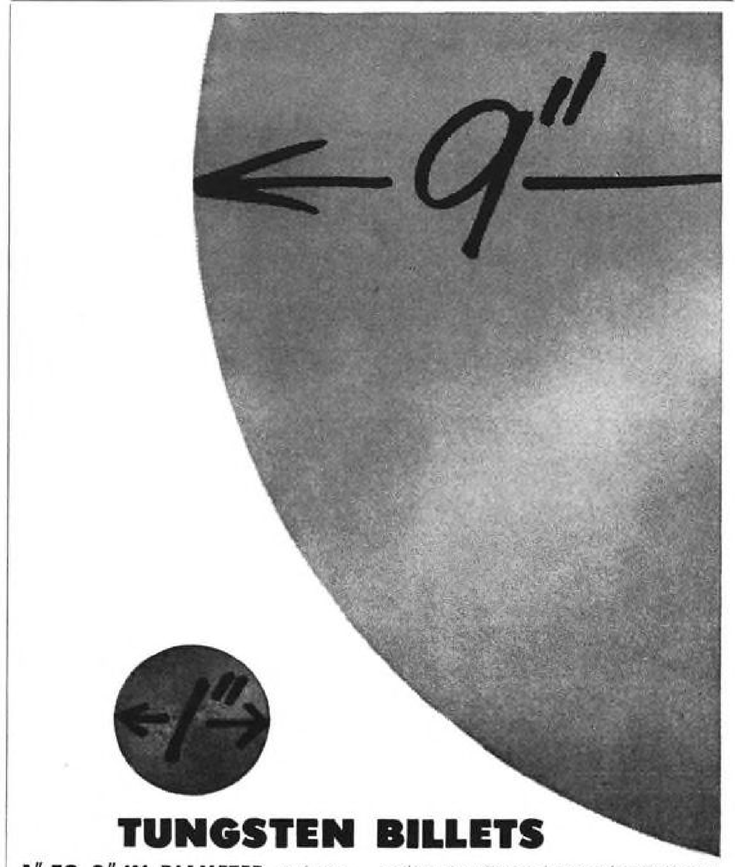
P.E.C. Corp., Boulder, Colo.—$5,993 for research on analytic number theory.

University of Michigan, Ann Arbor, Mich.—$20,000 for Vela Uniform advisory panel.

University of Saarbruecken, Heidelberg, Germany—$7,000 for investigation of bending rectangular plates supported at four points for optical application.

University of Naples, Naples, Italy—$11,500 for research on supersonic flow in three dimensional pointed bodies.

University of Rome, Rome, Italy—$29,600 for study of re-entry heat transfer.



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General Electric PS Tungsten also gives you the advantages of high purity (99.95% minimum) and high density (92% minimum). General Electric can supply you with PS Molybdenum, too. Write General Electric Co., Lamp Metals and Components Department AW-26, 21800 Tungsten Rd., Cleveland 17, Ohio.

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Now he is leaving this familiar environment and entering a realm where no life as we know it exists. It is an infinite realm. And it is more lonely than any wilderness man has ever encountered before.

It is outer space.

Already, man has taken the first steps into space. And in the coming years he will reach farther and farther into space, traveling thousands of miles, living for days and weeks and even months in an alien environment.

The success of these journeys is one of the greatest challenges in the history of American industry. It has given the word "reliability" a depth of meaning it has never known before.

Indeed, the reliability demands for space travel are staggering. To assure a 99.9% chance of return, a space traveler must have equipment whose mean-time-between-failures is 1000 times the expected length of the flight. This means that on an 8½-month trip to Mars the vehicle would have to be built to last more than 700 years.

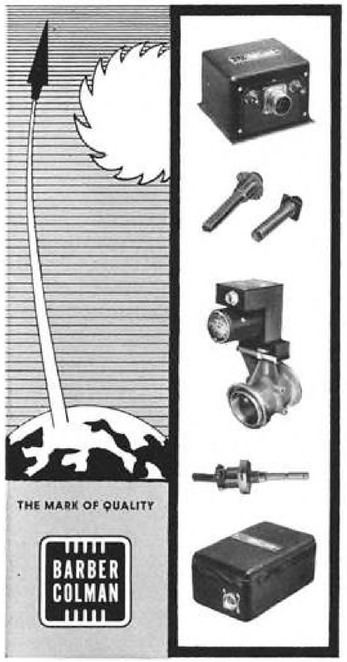
Certainly no one is more aware of these immense reliability requirements than the engineers and scientists of the aerospace industry. Time after time they are called on to assure reliability in systems that have not even been designed. And time after time the desired reliability has been there when needed.

These unrelenting efforts by the aerospace industry are helping the Free World's astronauts in their conquest of outer space. They are helping the loneliest men on the loneliest job in the world today.

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

Precise control for your selected* temperature

*high, low, or medium



Since the "thirties" and Boeing Clipper days, Barber-Colman temperature controls have made significant contributions to many of the nation's major commercial, military, and business aircraft.

In more recent years missiles and ground-support units, too, have incorporated precision temperature control systems by Barber-Colman. For example, temperatures in the Titan guidance platform are held to within a few hundredths of one degree with one of these systems.

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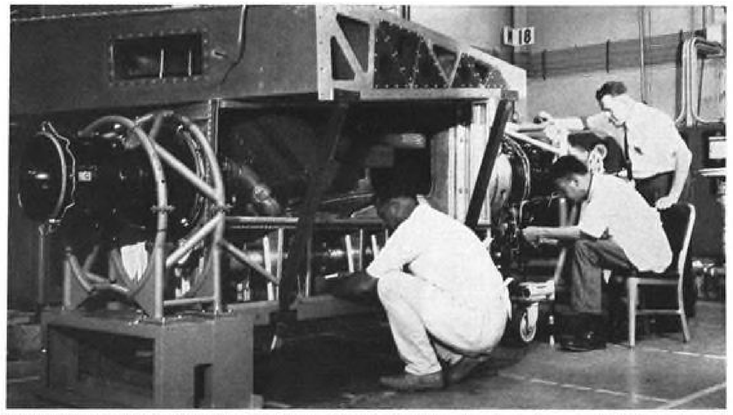


SUCTION TURBOPUMPS for Northrop Norair Division laminar flow control test aircraft are readied for first tests of the complete pumping system in the altitude chamber of Garrett Corp. AiResearch Div. at Phoenix, Ariz. The system is mounted under a wing section of the NB-66 test aircraft, an extensively modified Douglas B-66.

B-66 With Boundary Layer Control Slated to Make Flight in January

Phoenix, Ariz.—First tests of air pumping system for $30 million USAF program to flight-test Northrop experimental suction-type boundary layer control are now being conducted by Garrett Corp.'s AiResearch Division.

The experimental system, called Laminar Flow Control, is being developed by the Norair Division of Northrop Corp. (AW May 29, 1961, p. 61) and pump development is done under subcontract by AiResearch.

Program to modify and flight test two Douglas B-66 aircraft equipped with the LFC system has been funded with $25 million through the end of Fiscal 1962. First of the two aircraft, redesignated NB-66, will fly in January, 1963, and the second will fly in March, 1963. Flight test program to be conducted by Northrop is scheduled to end in August, 1963. An important part of the program is test of procedures and ground support equipment to avoid blockage of the very thin suction slots in the wing skin.

AiResearch pumping system tests are being conducted in an altitude chamber to simulated altitudes up to 45,000 ft. and with pump inlet temperatures between −20F and 200F. The air pumping system consists of two separate turbocompressors on each wing installed in series so that the low pressure compressor exhausts into the inlet of the high pressure compressor. The turbocompressors are designed to operate over a wide range of flow rates and inlet pressures to cope with fluctuations due to changes in speed, angle of attack, and altitude of the airplane.

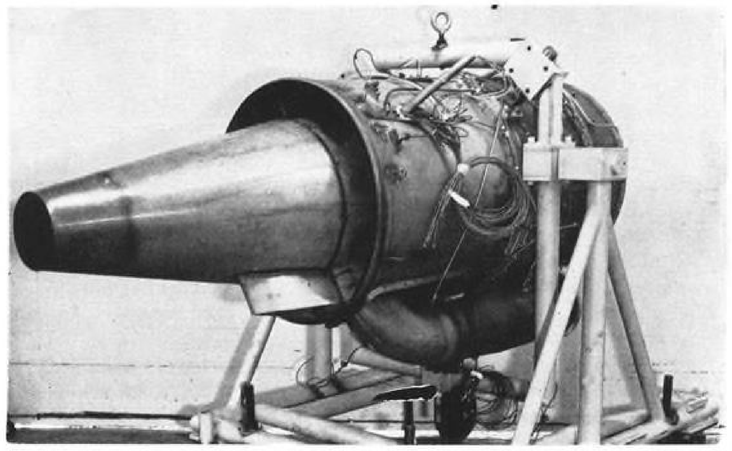
The low pressure compressor is powered by an air turbine running on bleed-air from the compressor stages of the two tail-mounted General Electric J79 engines and is to be controlled by the flight engineer by flapper valves in the air lines. Its maximum pressure ratio is 1.52 to 1 and its maximum flow rate is 27 lb./sec.

High-Pressure Compressor

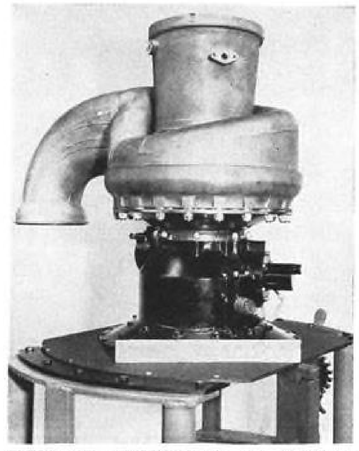
The high pressure compressor is powered by a bleed-and-burn turbine with a single combustor burning fuel from the propulsion system tanks in bleed-air from the propulsion engine compressors. The flight engineer controls compressor speed by throttling fuel flow. The high pressure compressor has a maximum pressure ratio of 1.67 to 1 and a maximum flow rate of 65 lb./sec. Air from relatively high pressure areas on the wing flows directly into the plenum chamber between low pressure exit and high pressure inlet.

AiResearch engineers say they expect no feedback problems from lack of synchronization between the two turbocompressors.

One suction pumping system will be in an aerodynamic capsule under the trailing edge of each wing of the NB-66 test aircraft. AiResearch engineers say performance of their system could be matched only by specially designed propulsion engines with free turbines driving separate LFC compressor stages. However, these would be much more costly and would lack flexibility of configuration.



HIGH-PRESSURE turbocompressor burns fuel from main tanks in air bled from compressor stages of propulsion engines in single combustor on lower right side. Bleed-and-burn turbine exhaust exit is at the apex of the tailcone.



BLEED-AIR TURBOPUMP for Northrop Norair Division NB-66 aircraft to test suction-type boundary layer control system is low pressure stage of AiResearch pumping system.

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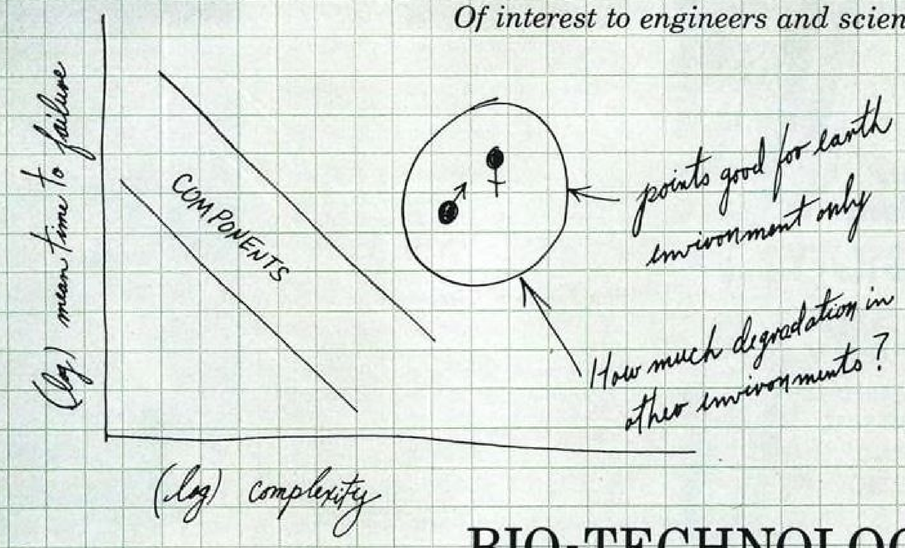
Of interest to engineers and scientists



BIO-TECHNOLOGY

...one of more than 500 R&D programs under way at Douglas

This Douglas program is studying areas related to man-machine and biological systems as:

- Psycho-physiological monitoring techniques for determining biological stability in normal and exotic ecological systems;
- Cybernetic and bionic principles for application to personnel subsystem support;
- Techniques for producing artificial environments and evaluating their biological effects;
- Learning and teaching machines, remote handling systems, and display and control techniques to support space operations.

Bio-technological devices will be constructed related to experimentation in the above fields. A considerable amount of work has already been accomplished on ecological problems associated with advanced space systems.

Of career interest to engineers and scientists

To further aerospace research and development, Douglas is investing millions of dollars to provide an environment most conducive to scientific and engineering achievement.

Present modern facilities will soon be augmented by an extensive new research-development-test complex. Included will be an advanced $3 million space chamber.

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PRODUCTION BRIEFING

Plans to build a $2-million, 200-seat planetarium with an 85-ft.-dia. dome and an associated space center on an island in Washington, D. C.'s Potomac River have been announced. The Japanese optical firm of Chivoda Kogakuseiko has offered a $100,000 star projector for the planetarium.

North American Aviation's Solid Rocket Division, McGregor, Tex., is producing ten 100,000-lb.-thrust Megaboom solid-propellant motors for USAF use at Holloman AFB, N. M., on a variety of sled track missions which will include tests of Minuteman ICBM guidance systems and pilot protective equipment used in high-speed aircraft ejection systems. Initial deliveries of the Megaboom motors will begin in June under a $190,000 USAF Systems Command contract.

General Dynamics/Pomona has received a $7,779,600 Army contract to conduct further research and development for the Mauler missile system.

Acoustica Associates, Inc., Los Angeles, has received a $500,000 follow-on contract from General Dynamics/Astronautics for site activation work on the Atlas F missile program. Contract calls for installation, test and check-out of propellant utilization systems and ground support at Atlas bases in the U. S.

Cannon Electric Co., Costa Mesa, Calif., will supply the Boeing Co. with high-temperature electrical connectors for use within the Dyna-Soar manned space glider under a contract exceeding $300,000.

Sperry Gyroscope Co., Great Neck, N. Y., has received a $900,000 contract from North American Aviation's Autonetics Division to produce stable platforms for the Minuteman ICBM's airborne guidance system.

Hughes Aircraft Co.'s Tucson, Ariz., facility will manufacture GAR-3A, GAR-4A and GAR-11A Falcon missiles with test systems under USAF Aeronautical Systems Division contracts totaling $24.6 million.

Custom Tool & Mfg. Co., Minneapolis subsidiary of Steel Improvement and Forge Co., has received four contracts totaling $2.1 million from Aerojet-General Corp. to produce propulsion system components for the Navy's Polaris missile. The contracts call for high precision machining, assembly, refractory coating and finishing of rocket engine nozzles and thrust vector control hardware.

Never before...all these features in ONE spray gun

Compare the Model 62 with the gun you're now using

1. New drop forged aluminum body for ruggedness.
2. Exclusive stainless steel material inserts for longer gun life.
3. New larger air passages for increased efficiency.
4. New contoured trigger, forged aluminum with hardened steel contact plate.

It's all new. The only gun available that incorporates all the features you've asked for in a spray gun.

Drop forged aluminum gun body... plated for extra protection. Ruggedly built to withstand abuse of production handling. Fluid passages are corrosion-resistant stainless steel . . . a Binks exclusive. Fluid threads also stainless steel. No seizing . . . no stripping. These features assure long gun life.

Newly designed air passages . . . extra large . . . give you more effective air pressure at the nozzle . . . better atomization with less pressure.

See the all new "62" at your local Binks distributor or jobber. We think you'll agree, it's the finest production spray gun available.

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This big bird lifts

Sikorsky's Skycrane is an aerial workhorse. It can pick up and deliver nine tons in single or multiple units of almost any size or shape.

Skycrane has a lift capacity four and one-half times greater than any other helicopter in commercial service. It is an off-highway hoist, tow, and crane that helps you set your sites anywhere.

Powered by two 4,050 hp Pratt & Whitney Aircraft JFTD-12 turbine engines, the S-64 can move men and material at speeds up to 145 knots or hover patiently to work overhead. Fitted with detachable pods, it transports field offices, tool sheds, kitchens, vehicles, and cargo of every description.

This busy bird can reduce the time, trouble, and expense of doing things anywhere in the world. To find out how the new Skycrane can give your project a lift, write today on your letterhead to Sikorsky Aircraft, Stratford, Connecticut.

Sikorsky Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION

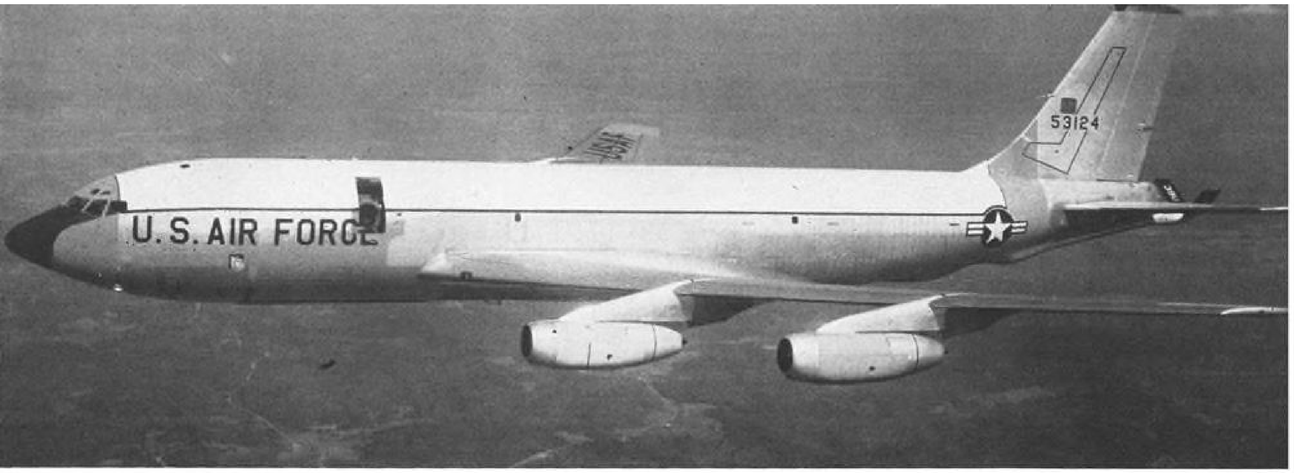
STRATFORD, CONNECTICUT

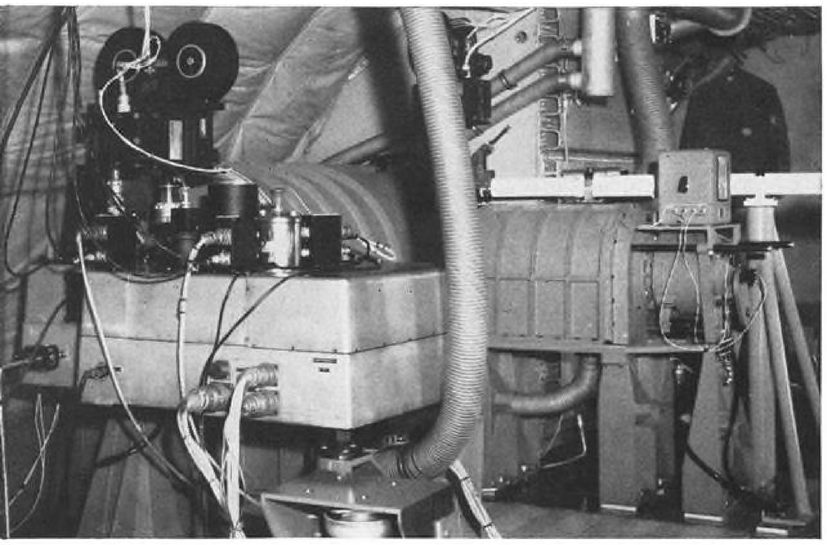
9 tons of almost anything

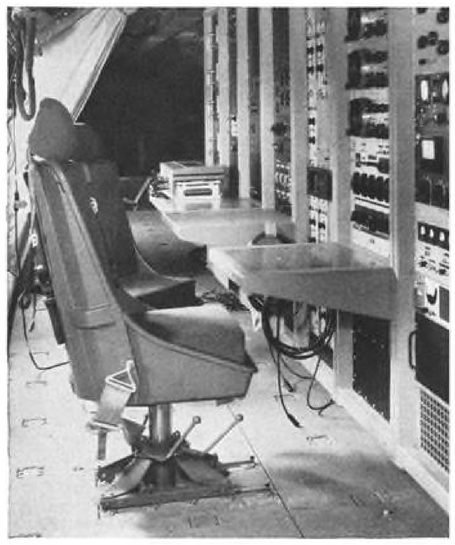
Maneuvering heavy loads up, over, and down, Sikorsky's S-64 Skycrane makes vertical logging a practical possibility.

Operating over any terrain, Skycrane can deliver men, machinery, and supplies direct to remote job sites with speed and safety.

Skycrane's mobility enables it to transport a variety of cargo containers or detachable pods at speeds up to 145 knots.







SKYSCRAPER, an airborne system to measure the ultraviolet, visible and infrared radiation emitted by a re-entering ballistic missile, passes its first functional test flight. The Bendix Systems Division is developing the system for Air Force Cambridge Research Laboratories under sponsorship of ARPA. Inserts show (L) internal optical instrumentation behind gimballed "eye" port forward of wing and (R) control, monitoring and recording equipment at the operator's console.

AIRBORNE INSTRUMENTATION, a key to development of advanced defense systems, is a major field of activity at Bendix Systems Division. Opportunities are open for experienced engineers in optical and microwave instrumentation, re-entry physics, data handling systems, aircraft installation, or flight test. Write or call our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division THE Bendix CORPORATION **WHERE IDEAS UNLOCK THE FUTURE**

Paratroopers drop from the cabin of a Bell YHU-1D, above and below left, during Army Phase E user trials by Airborne Service Test Division of Airborne Electronics and Special Warfare Board, Fort Bragg, N.C. Iroquois carried eight jumpers on both day and night missions.

Paratroops Dropped From YHU-1D During Trials

Water trailer, right, is attached to a hovering Iroquois during tests at Ft. Bragg. Trailer weighs 2,280 lb.

How to power Venus-bound space probes?

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

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

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

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

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

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

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

RYAN AEROSPACE

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA

Focke-Wulf to Develop V/STOL Airliner

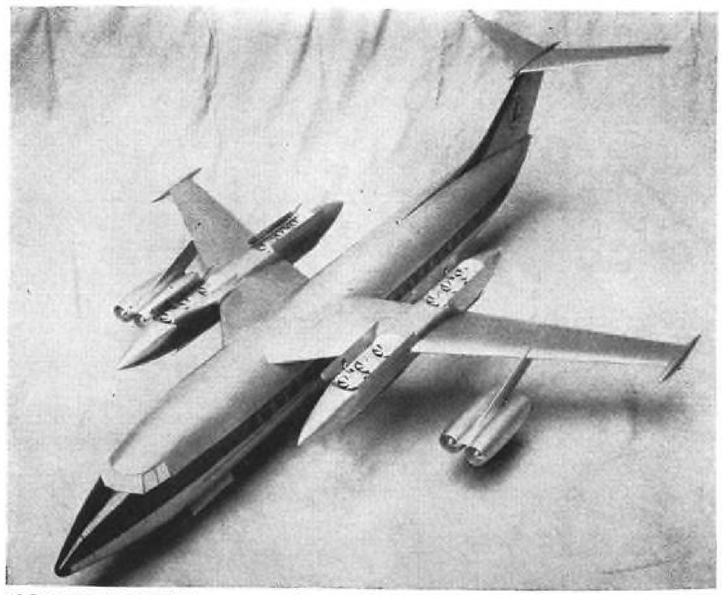
Hanover—Focke-Wulf has completed detail design work on its 85-passenger short-to-medium range V/STOL transport which it says it plans to carry through the development stage despite the apparent lack of government financial support.

Designated the FW 260, the high-swept-wing aircraft has a design cruise speed of Mach 0.85 over stage lengths from 300 to 1,200 mi. with a maximum payload of 24,000 lb. By decreasing the payload, range can be extended to a maximum of 2,000 mi., according to Focke-Wulf.

Vertical thrust is obtained from six 8,000-lb.-thrust Bristol Siddeley BS.59 lift fan engines in each of two wing pods plus augmentation from the deflected thrust of the aircraft's four largely conventional turbojet engines. Main powerplants, pylon-mounted in pairs beneath each wing, probably would be deflected thrust versions of the Rolls-Royce Spey.

Projected thrust for each engine is 9,100 lb.

The company says it decided upon the use of multiple lift engines rather than variable thrust powerplants such as the BS.53, which is employed in the gov-



FOCKE-WULF V/STOL transport design, the FW 260, incorporates six 8,000-lb.-thrust Bristol Siddeley BS.59 lift fan engines in each wing pod. Deflected thrust would be available from four conventional turbojets. Door panels on top and bottom of wing pods are closed during the aircraft's forward flight operations.

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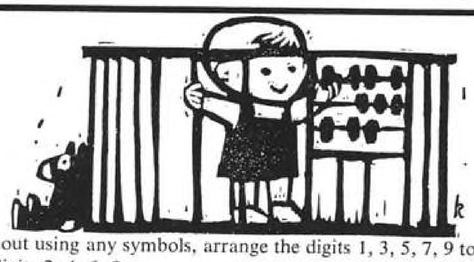
PROBLEMATICAL RECREATIONS 121



Without using any symbols, arrange the digits 1, 3, 5, 7, 9 to equal the digits 2, 4, 6, 8. — *Contributed*

In addition to our Maryland Division's advanced space electronics projects (e.g., satellite and high altitude rocket payloads) you will find such products as ionosphere recorders, nuclear tape recorder packages, and rodmeter systems, sea valves and other underwater devices. They're very large on antennas and microwave systems, too. For a complete list of Litton-Maryland's equipment and systems write to 4900 Calvert Road, College Park.

ANSWER TO LAST WEEK'S PROBLEM: Call one of them Smith. The other 5 can be placed in 2 categories: acquainted with Smith or unacquainted with Smith. One of these categories contains at least 3 individuals, say the first, i.e., A, B and C are acquainted with Smith. Now if any pair of them are acquainted, that pair and Smith are mutually acquainted, and if not, A, B and C are mutually unacquainted. The other case is handled symmetrically.

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Beverly Hills, California

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"Aircraft Quality" Temperature Sensors now available for Industrial Use.

Where environmental conditions require superior resistance to vibration, shock and working pressures to as much as 3500 p. s. i. g. while constant accuracy is a must, specify Lewis bulbs.

Many types are hermetically sealed and provided with AND 10066-12 S-3P receptacles for positive electrical connection, others have flexible lead connections with AN5539 terminals.

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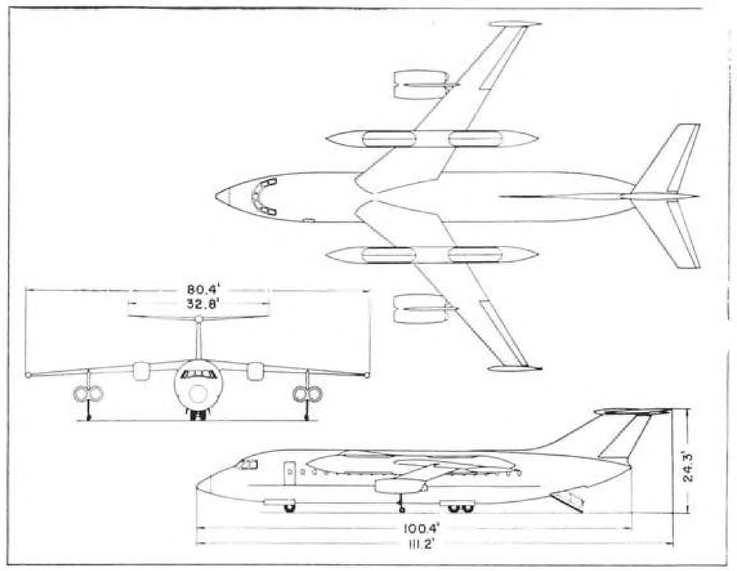

THREE-VIEW of FW 260 shows landing gear design, including use of outriggers beneath engine pylons, and rear stairway plus side door. T-tail unit has a boost control system.

ernment-supported Dornier Do.31 V/STOL transport program, because of the "greater security (through numbers) in case of power failure together with a favorable use of available space." A Focke-Wulf statement adds:

"This (high-wing pod) arrangement also . . . reduces vibration in the passenger cabin, provides smooth air flow to the power units and reduces to a minimum the ground effects on the nacelle."

Over-all length of the aircraft is 111.22 ft., slightly longer than the Sud Caravelle jet transport. Wing span is 80.38 ft. Cabin length, including galley and toilets, is 63 ft. The aircraft has twin nose wheels plus a bogey undercarriage mounted in tandem on the underside of the mid fuselage section. A retractable outrigger gear unit also is located beneath each engine pylon.

FW 260 Specifications

Over-all length	111.22 ft.
Aspect ratio	6.75
Wing area	957.6 sq. ft.
Wing span	80.38 ft.
Height off ground	24.27 ft.
Fuselage length	100.4 ft.
Fuselage width	11.32 ft.
Fuselage height	6.72 ft.
Cabin height	63 ft.
Empty weight	49,270 lb.
Useful load	24,000 lb.
Fuel incl. reserve	21,200 lb.
Max. take-off weight	99,200 lb.
Cruise speed	565.5 mph.
Cruise altitude	36,000 ft.
Range with 85 passengers	1,200 mi.
Max. range	2,000 mi.
Rate of climb to cruise altitude	18 min.

Ford Tests Air Cushion Vehicle

Tethered hover tests are conducted on 21 x 8 ft. air cushion vehicle built by Aeronutronic Division of Ford Motor Co. Two 310-hp. Continental aircraft engines ran at 25-50% full power during tests. Note wheels, which would be retracted on over-land runs and are utilized when the craft is stopped or parked.

Do you share his organized impatience?

Tomorrow isn't soon enough to suit him. He wants new answers and new applications now. By constantly challenging the state of the art he keeps it advancing.

If you share his itch for action, come to Northrop where action is a way of life. Work on projects ranging from space guidance and navigation to automatic checkout equipment, from computer design and world-wide communications to laminar flow control.

On the following pages you'll find some specific positions available now at Northrop Space Laboratories and the Norair Division. Look them over. One may be just the spot for you.

But even if you don't find your specialty listed—don't go away. We simply don't have room to mention all the opportunities to be found throughout Northrop's several divisions. If you're the kind of man who gets things done, there's bound to be a place for you at Northrop. Write to Dr. Alexander Weir at Northrop Corporation, Beverly Hills, California, and tell us about yourself. You will receive a prompt reply.

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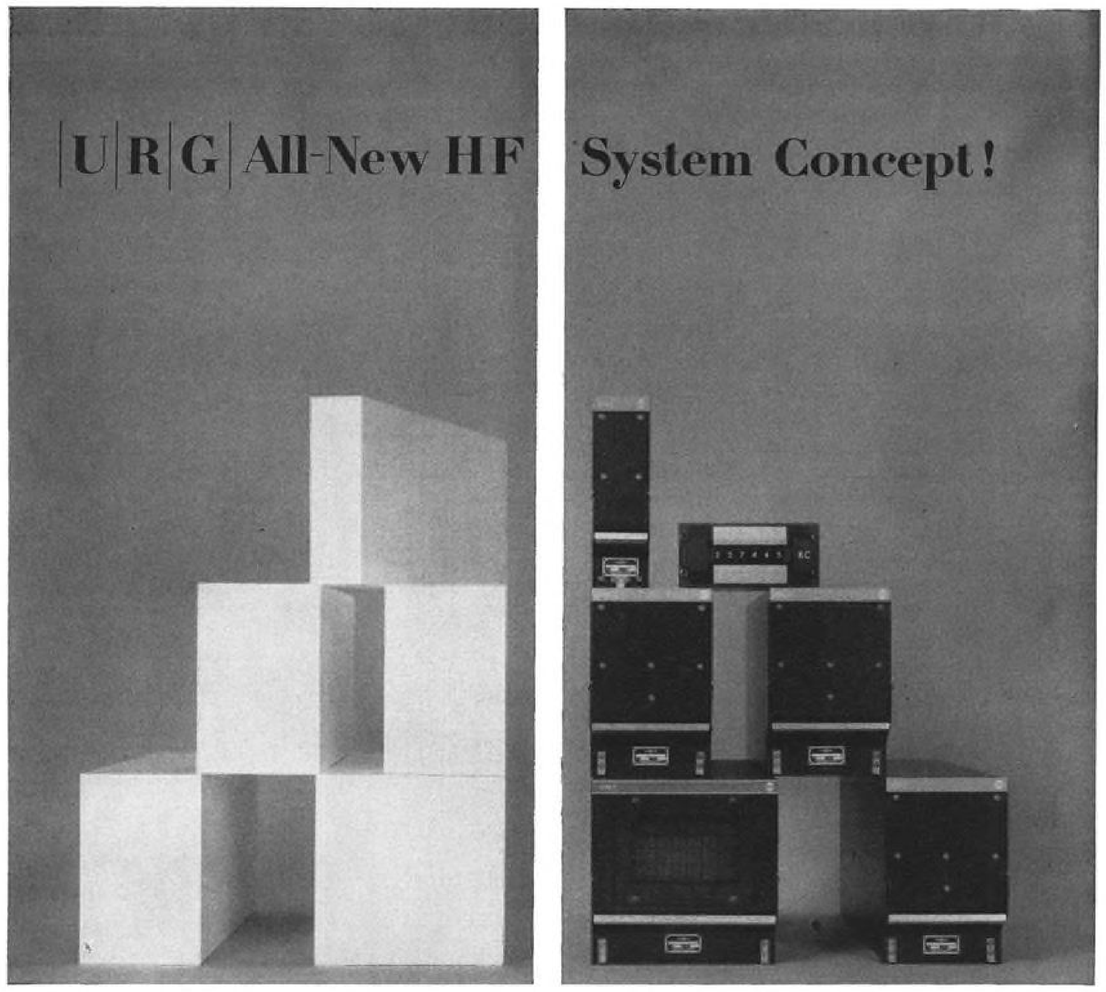

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COLLINS

FINANCIAL

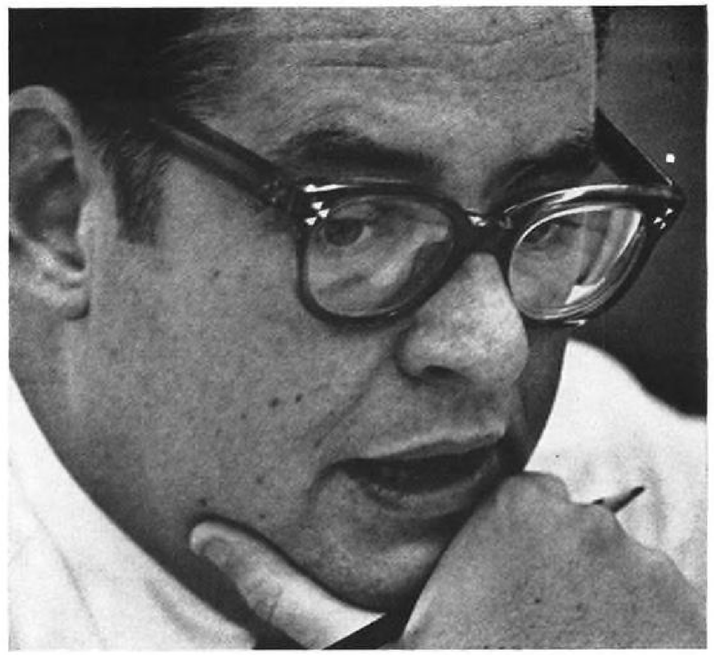
New Offerings

Doman Helicopters, Inc., Danbury, Conn., organized in 1945; until 1957 the company was primarily engaged in research, development and construction of experimental models and production of prototype helicopters. The resulting model, LZ-5, was type-certificated by the Federal Aviation Agency in 1955. Since 1957 the company has unsuccessfully attempted to secure military or commercial markets for its helicopters and to secure adequate financing; the company is not now and never has been engaged in any substantial manufacturing activities. Improvements to the LZ-5 type are said to have been in design since Jan. 1961, and with those improvements, the helicopter now proposed to be sold is known as the Doman-Ambrosini D-10B, for which the company has applied to the FAA for an amendment to its type certificate. The company was reorganized in 1960, and has continued its efforts largely through loans or the sale of stock or convertible obligations to management officials, employes and friends of the company. Through the fiscal year ended Sept. 30, 1961, consolidated losses were $5,715,076, of which the company estimates $3,500,000 is attributable to development of the D-10B helicopter; for the year ended on that date the net loss was $341,405, and the company is now insolvent.

The company has an agreement with an Italian manufacturer to produce the D-10B helicopter in Italy. However, the company will purchase in the U.S. or produce its own rotor blades and will purchase engines in the U.S. and expects to do final assembly work at its own plant and to handle sales itself.

Offering is 418,680 common shares for subscription by common stockholders at the rate of two new shares for each three shares held. Offering also includes 74,000 outstanding shares for public sale by the holders, and 189,201 shares by the company to certain creditors to reduce current liabilities. The company's proceeds will be used to obtain the amended type certification from the FAA; to obtain and train field service personnel; salaries for one year ($133,000); for an expanded sales program; for tooling in preparation for helicopter rotor blade production; for a deposit to procure delivery of engines; to assemble initial production models of the D-10B; to discharge existing obligations; for working capital and inventories. The company estimates that it will take up to eight months to obtain

Northrop Space Laboratories needs impatient men



At its inception, a new enterprise needs impatient men to mold it. Restless men whose minds won't fit the confines of older, more complacent organizations.

Northrop Space Laboratories is just such an enterprise . . . newly formed, free from preconceived ideas, with a broad range of programs planned in pure as well as applied science, and the enthusiastic support of the Northrop Corporation to carry them out. Men who join this group today will move upward with it, and give it direction through the years of growth ahead. Key openings are available for:

Solid state physicists, to conduct fundamental research on many-body problems as applied to an ultra high pressure program. The goals of this program are to study the electrical and physical behavior of materials under ultra high pressure, to investigate the origin, history and structure of the moon and planets, and to find ways to utilize their natural resources.

Scientists, to perform research in nuclear and radiochemistry, and to conceive and carry out investigations in the fields of activation analysis, dosimetry, gamma ray spectrometry, surface phenomena, and numerous other areas.

Structural engineers, to do stress analysis and optimize the design of advanced space structures.

A plasma physicist, to join our growing program in the measurement of plasma properties, spectroscopy, diagnostics, accelerators, and power conversion devices.

A mathematician-physicist, to concentrate on systems analysis and operations research applied to military and non-military space systems.

Physicists experienced in electro-optical imaging devices and laser theory; **engineering mathematicians** interested in detection theory, reconnaissance and tracking; **electronic engineers** who know their way around statistical communications theory and noise phenomena; for new and original work in satellite detection systems.

For more information about these and other opportunities, write to W. E. Propst, Space Personnel Office, 1111 East Broadway, Hawthorne, California. You will receive a prompt reply.

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TRONA® AMMONIUM PERCHLORATE, the work-horse oxidizer, is keeping abreast of the "shape of things to come" in future generations of solid fuel rocket motors. Broad-scale ammonium perchlorate research programs at the Henderson, Nevada plant of American Potash and Chemical Corporation have resulted in the development of new particle sizes and spheroidal shapes that may be necessary for tomorrow's superboosters. Objective? To provide the solid propellant industry with new types of ammonium perchlorate that enhance the possibility of increasing impulse through higher solids loading and improving propellant flow characteristics. American Potash, the nation's largest ammonium perchlorate producer, keeps abreast of changing requirements in solids, not only in product quality but in production capability as well. For the industry's most advanced ammonium perchlorate facilities, plus research and technical service, contact...

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certification from the FAA, 10 months to receive deliveries of airframes from the Italian manufacturer, and two additional months for transportation and final assembly by the company.

Assembly Products, Inc., Chesterland, Ohio, engaged in the manufacture of electro-mechanical and electronic devices for the measurement of electrical current and the control of equipment using electrical current. Offering is $1,250,000 of 5½% convertible subordinated debentures, due 1972. Of the proceeds, $355,000 will be used to pay a mortgage loan on present plant, and $300,000 for new plant and equipment.

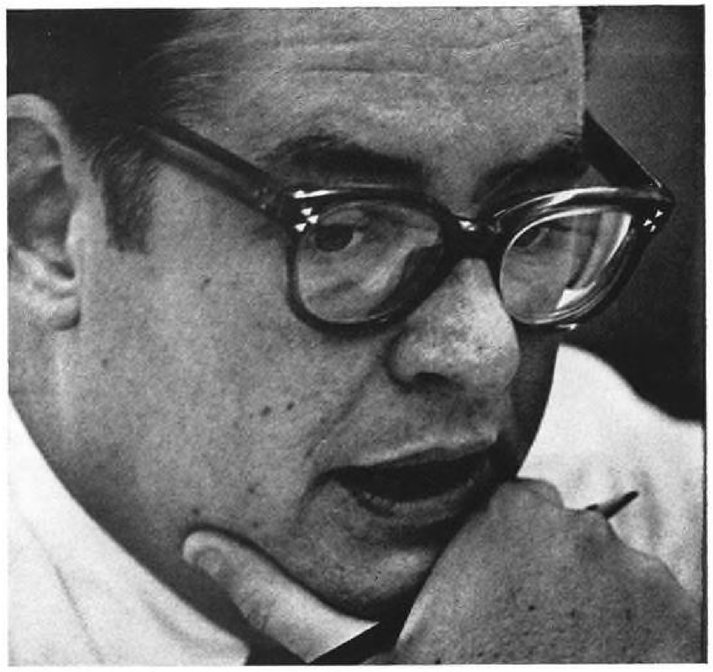
International Systems Research Corp., Plainview, N. Y., engaged principally as a prime contractor in the design, development and manufacture of mechanical, electro-mechanical and electronic equipment for government agencies and the military. Offering is 110,000 Class A common shares, and nine month warrants to purchase an additional 110,000 Class A shares at $4 per share; offering to be made in units, each consisting of one share and one warrant at $4 per unit. Of the proceeds, $100,000 will be used to purchase additional production facilities; $100,000 for additional research facilities; $70,000 to repay bank obligations.

Servotronics, Inc., Cheektowaga, N. Y., engaged in the design, development and manufacture of precision control components (electro-mechanical actuators and hydraulic and hot gas transducers) and associated products. Offering is 125,000 capital shares at $3 per share. Proceeds will be used to retire outstanding bank indebtedness and to purchase capital equipment.

Tactair Fluid Control Corp., Bridgeport, Pa., engaged in the manufacture of fluid control equipment for use in connection with missiles (excluding spacecraft), helicopters and aircraft, and in the production of automatic flight equipment for private and business aircraft, frequently referred to as automatic pilots, autopilots or flight-assist equipment. Offering is 90,000 outstanding common shares by John H. Stephens and Eugene K. Gray, president and senior vice president, respectively.

Solid State Products, Inc., Salem, Mass., engaged in the development and manufacture of semiconductor devices for use in military and industrial electronics and electrical equipment. Offering is 110,000 common shares. Of the proceeds, $600,000 will be used to finance, in part, the construction and equipping of a proposed new plant at Danvers, Mass.; another portion will be used to retire bank loans.

Wanted: Men with unmortgaged minds



Northrop-Norair needs men who can see with fresh eyes; men who owe no allegiance to accepted ideas. Headstrong men, impatient for tomorrow.

If the shoe fits, come to Norair—where new lines of investigation open all the time, and no new idea is ever out of bounds. Positions are immediately available for:

- Engineers in electronic checkout systems who have worked with advanced design and program development.
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- Engineers familiar with airframe structural analysis.
- Scientists specializing in infrared, optics, and electronic research.
- Engineers to work in data reduction.
- Scientists who know structures research and dynamics.
- Scientists who have done supersonic aerodynamic research.
- Scientists experienced in working with information and sensing systems, platforms, infrared, sensors, flight controls, airborne computing and data handling systems.
- Engineers familiar with programming, operations, and instrumentation for ballistic missile flight test.
- Reliability Engineers to assess the reliability and to optimize the configurations and mission profiles of space systems.
- Chemical Engineers to work on the development and applications of structural adhesives for aerospace vehicles.
- Metallurgical Engineers for research and development on materials and joining.

If you'd like more information about these opportunities and others soon to be available at Norair, write and tell us about yourself. Write Roy L. Pool, Engineering Center Personnel Office, 1001 E. Broadway, Hawthorne, California.

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National Aeronautics and Space Administration Issue

Today's most timely aerospace industry subject — The National Aeronautics and Space Administration — will be featured in AVIATION WEEK & SPACE TECHNOLOGY's July 2, 1962 issue.

This massive editorial effort will present, for the first time, a complete analysis in depth of NASA:

1. Current & future plans and programs
2. Expansion of operations & facilities
3. Budgets
4. Management changes
5. New procurement policies

. . . as well as a long-range forecast of NASA's future in our industry.

How to do business with the fastest expanding part of the aerospace market, scheduled to award contracts exceeding Three Billion Dollars in Fiscal 1963 is a subject that will command the attention of key buying influences and open the door to countless sales opportunities for thousands of manufacturers throughout the country. As an example, in the Mercury project alone over 4,000 sub-contractors participated. The NASA man-in-space program is projected toward a $20 to $30 billion total over the next decade.

AVIATION WEEK & SPACE TECHNOLOGY has achieved an international reputation for presentations of this type with the Systems Command Issue, "Forging Military Spacepower" (1961); the Strategic Air Command Issue, "SAC in Transition" (1960); the NASA Issue, "Next Decade in Space" (1959); and the Air Research and Development Command Issue, "Research for Space" (1958).

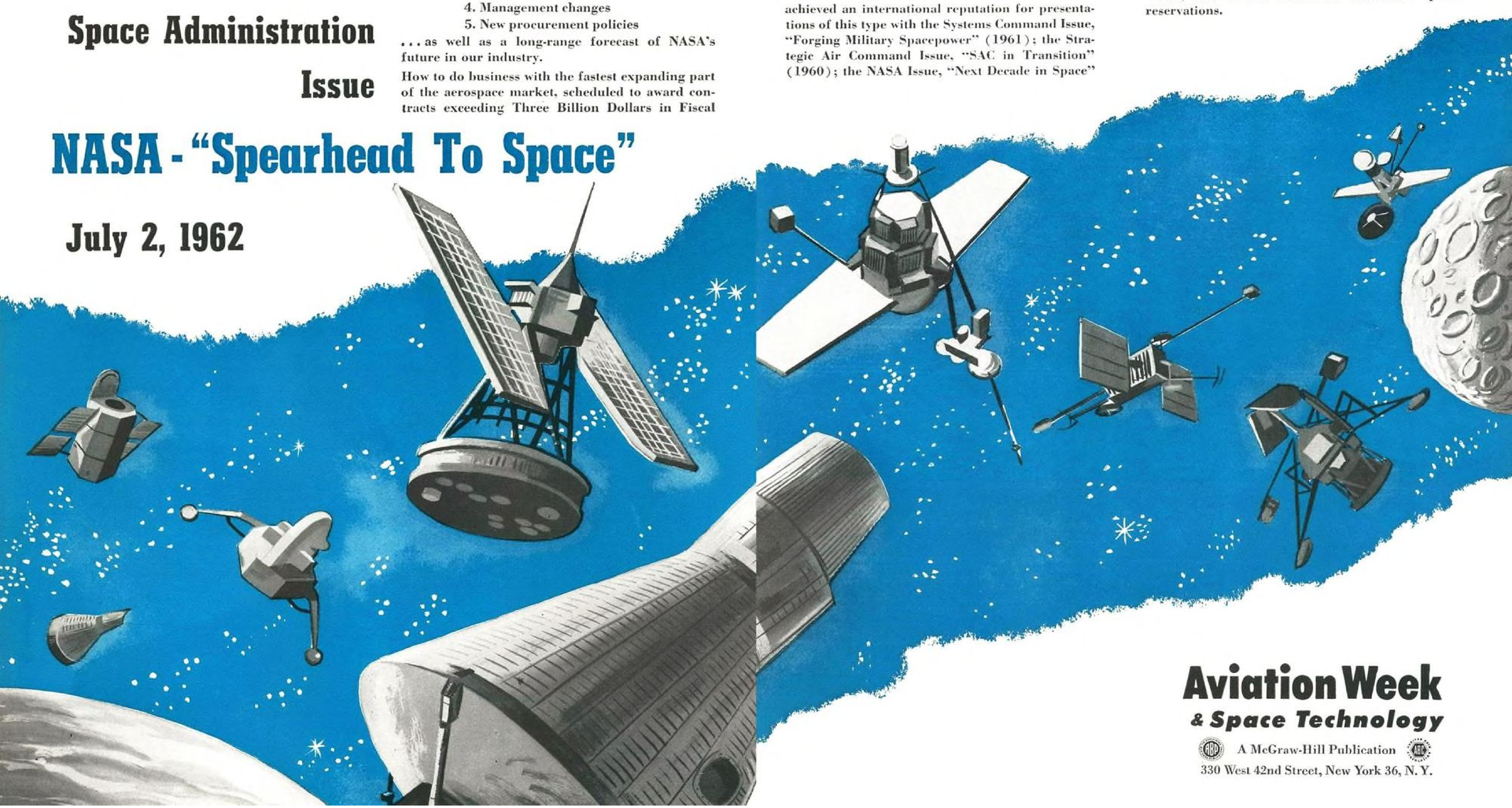
Teams of AVIATION WEEK & SPACE TECHNOLOGY editors are now carrying out assignments covering NASA operations and bases throughout the nation.

We urge your company's participation by advertising its products, capabilities and facilities in the most important aerospace issue of 1962.

Write, wire or call collect for immediate space reservations.

NASA - "Spearhead To Space"

July 2, 1962



Aviation Week
& Space Technology

A McGraw-Hill Publication

330 West 42nd Street, New York 36, N. Y.

Airlines Report Salaries, Expenses, Bonuses, Stock Holdings for 1961

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, 1961, as reported to the Civil Aeronautics Board:

Eastern Air Lines, Inc.—E. V. Rickenbacker, chairman of the board, $49,808 salary, $900 bonus and indirect compensation, $12,000 expenses, 24,549 shares of common stock; **M. A. MacIntyre,** president and director, $79,693 salary, $900 bonus and indirect compensation, $14,373 expenses, 102 shares of common stock; **R. L. Turner,** executive vice president and director, $34,169 salary, $300 bonus and indirect compensation, $5,105 expenses, 102 shares of common stock; **M. Lethbridge,** executive vice president, $24,497 salary, $2,324 expenses, 553 shares of common stock; **J. H. Halliburton,** executive vice president, $33,127 salary, $1,356 expenses, 600 shares of common stock; **T. E. Creighton,** executive vice president and secretary, $22,751 salary, $400 bonus and indirect compensation, $763 expenses, 3,500 shares of common stock; **W. Van Dusen,** vice president, $26,398 salary, $2,532 expenses, 1,516 shares of common stock; **W. L. Morrisette, Jr.,** vice president, $27,395 salary, $11,072 expenses, 208 shares of common stock; **J. O. Jarrard,** vice president, $24,207 salary, $1,289 expenses; **C. R. Springer,** vice president, $30,764 salary, $1,251 expenses; **A. L. Chabot,** vice president, $29,478 salary, $960 expenses, 1,062 shares of common stock; **F. Sharpe,** vice president, $21,590 salary, $1,341 expenses, 100 shares of common stock; **C. Froesch,** vice president, $25,321 salary, $1,076 expenses, 2,620 shares of common stock; **R. Ramspeck,** vice president, $19,923 salary, $6,387 expenses, 200 shares of common stock; **W. R. Winn, Jr.,** vice president (since Aug. 1, 1961), $9,168 salary, $470 expenses, 349 shares of common stock; **R. S. Lipp,** vice president, $16,772 salary, $137 expenses, 101 shares of common stock; **G. A. Smith,** vice president, $26,525 salary, $5,667 expenses, 1,532 shares of common stock; **J. H. Brock,** vice president, $25,321 salary, $5,252 expenses, 1,278 shares of common stock; **C. A. Wallen,** treasurer and assistant secretary, $15,278 salary, $420 expenses, six shares of common stock; **C. J. Simons,** $16,193 salary, $3,580 expenses, 34 shares of common stock; **R. F. Moore,** deputy vice president, $22,459 salary, $1,684 expenses; **M. B. Westphal,** assistant vice president, $19,923 salary, $4,161 expenses, 160 shares of common stock; **H. W. Cutshall,** assistant vice president, $16,935 salary, $3,599 expenses, 11 shares of common stock.

R. E. Baskind, assistant vice president, $15,939 salary, $1,770 expenses, 167 shares of common stock; **M. O. Byrd,** assistant vice president, $16,437 salary, $1,932 expenses, 55 shares of common stock; **L. O. Cameron,** assistant vice president, $18,529 salary, $3,278 expenses, 823 shares of common stock; **G. W. Channell,** assistant vice president, $15,939 salary, $2,193 expenses; **W. C. Gilbert,** assistant vice president, $16,935 salary, $1,555 expenses, 113 shares of common stock; **C. A. Glover, Jr.,** assistant vice president, $15,939 salary, $4,420 expenses, 244 shares of common stock, three shares of common stock in the name of others; **B. Griffith,** assistant vice president, $9,364 salary, $1,902 expenses; **J. A. Hamill, Jr.,** $13,004 salary, $183 expenses; **J. T. Hoffman, Jr.,** assistant vice president, $13,947 salary, $4,422 expenses, 116 shares of common stock; **H. Knapp,** assistant vice president, $12,454 salary, $4,450 expenses, 355 shares of common stock; **D. C. McRae,** assistant vice president, $17,475 salary, $590 expenses, 742 shares of common stock; **J. E. Reinke,** $15,540 salary, $5,399 expenses, 103 shares of common stock; **H. B. Shipman,** assistant vice president, $10,958 salary, $1,501 expenses, 170 shares of common stock; **D. L. Sinkler,** $14,943 salary, $5,941 expenses, 570 shares of common stock; **T. A. Sundem,** $15,939 salary, $2,327 expenses, 32 shares of common stock; **A. F. Tirrell,** assistant vice president, $13,947 salary, $4,323 expenses, 195 shares of common stock.

E. L. Williams, assistant vice president, $13,947 salary, $3,656 expenses, 223 shares of common stock; **F. E. Williams,** assistant vice president, $16,564 salary, $3,120 expenses, 378 shares of common stock; **E. E. Hahn,** assistant controller, $15,568 salary, $2,383 expenses, 57 shares of common stock; **J. C. Warlick,** assistant secretary, $11,143 salary, $515 expenses, 19 shares of common stock; **E. R. Cook,** director, $400 bonus and indirect compensation, 300 shares of common stock; **C. E. Daniel,** director, $300 bonus and indirect compensation, 2,030 shares of common stock; **P. M. Davis,** director, 3,091 shares of common stock; **J. A. Elkins, Jr.,** director, $300 bonus and indirect compensation, 312 shares of common stock; **E. S. Gambrell,** director, $800 bonus and indirect compensation, 33,121 shares of common stock; **C. H. Kellstadt,** director; **H. Knowlton,** director, $400 bonus and indirect compensation, 534 shares of common stock in the name of others; **P. E. Reinhold,** director, $800 bonus and indirect compensation, 1,658 shares of common stock, 6,367 shares of common stock in the name of others; **M. Smith,** director, $500 bonus and indirect compensation, 553 shares of common stock; **F. J. Turner,** director, $300 bonus and indirect compensation, 327 shares of common stock; **T. D. White,** director, $100 bonus and indirect compensation, 100 shares of common stock; **H. Woodward,** director, $900 bonus and indirect compensation, 500 shares of common stock.

The following firms were paid $5,000 or more for services during 1961: **Gambrell, Harlan, Russell, Moye and Richardson,** legal services, $245,204; **W. F. Parker,** legal services, $5,000; **C. Moon,** consulting services, $6,000; **Gus W. Campbell Associates,** consulting services, $17,824; **Basham, Ringe and Correo,** legal services, $9,700; **Price Waterhouse & Co.,** auditing, $34,675; **Wyatt, Grafton and Sloss,** legal services, $5,576; **Alexander Proudfoot Co.,** services, $54,080; **C. C. I. Div. of Communication Affiliates, Inc.,** services, $5,894; **T. F. Armstrong,** consultant, $14,850; **M. M. Frost,** consultant, $10,000.

Northwest Airlines

Northwest Airlines—D. W. Nyrop, president and director, $70,313 salary, $5,355 expenses, 14,900 shares of common stock; **F. C. Judd,** vice president-maintenance and engineering, $33,000 salary, $1,657 expenses, 905 shares of common stock; **E. T. Nunneley, Jr.,** vice president and general counsel, $38,000 salary, $2,179 expenses; **P. Benscoter,** vice president-transportation services, $24,267 salary, $2,045 expenses, 200 shares of common stock; **C. L. Stewart,** vice president-economic planning, $19,313 salary, $155 expenses, 200 shares of common stock; **A. E. Floan,** vice president and secretary, $22,000 salary, $991 expenses, five shares of common stock; **D. H. Hardesty,** vice president-finance and treasurer, $19,500 salary, $1,303 expenses, 710 shares of common stock; **M. J. Lapensky,** controller, $17,500 salary, $290 expenses; **F. J. Scott,** assistant secretary, $12,975 salary, $72 expenses, 500 shares of common stock; **D. Merrick,** assistant vice president-properties, $14,813 salary, $221 expenses, 100 shares of common stock; **R. A. Ebert,** vice president-personnel, $17,875 salary, $734 expenses, 20 shares of common stock, seven shares of preferred stock; **W. H. Huskins, Jr.,** vice president-Orient region, $8,986 salary, $2,450 bonus and indirect compensation, $595 expenses, and 25 shares of common stock; **R. J. Wright,** vice president-

CREATIVE OPPORTUNITIES WITH HONEYWELL IN FLORIDA

Presently engaged in expanding their modern space facilities for the fifth straight year, the Aeronautical Division in St. Petersburg, Florida offers unsurpassed technical opportunities to the imaginative engineer.

Continued advancement in the micro-miniaturization of airborne guidance systems demands the highest caliber of technical competence. The design flexibility illustrated on the adjacent page is only a sample of such adaptability. Now more than ever before, significant opportunities exist for those with the skill, experience, and imaginative foresight to move into still more sophisticated electronic endeavors.

Immediate and specific opportunities exist in the areas of:

- Computer design, development and fabrication
- Gyro and accelerometer development
- Platform design and development
- System analysis
- Circuit design
- Instrumentation
- Reliability
- Quality control
- Component application
- Subcontract administration
- Program management

To explore these openings, write in confidence to Mr. M. C. Keese, Manager, Professional Employment, Minneapolis-Honeywell Aeronautical Division, 13350 U.S. Highway 19, St. Petersburg, Florida.

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To investigate professional opportunities in other Honeywell facilities, send resume to H. F. Eckstrom, Minneapolis-Honeywell, Minneapolis 8, Minnesota.

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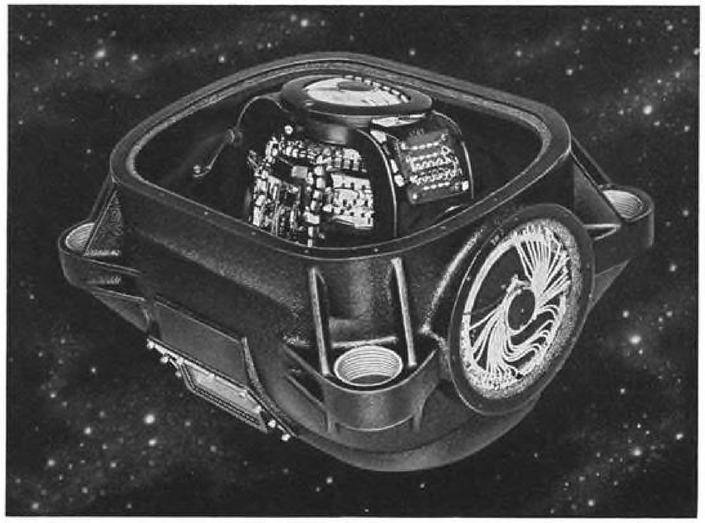

New miniature inertial platforms are adaptable to all system needs

The keynote of Honeywell's miniature inertial platform line is *adaptability*! A single basic design employs interchangeable components to provide navigational information and attitude stabilization for a wide variety of system applications.

A number of gimbal configurations, inertial sensor combinations, and digital or analog output devices can be combined to meet specific applications. Either three-gimbal or four-gimbal versions are available from the same basic production parts. This modular building block design permits quick assembly and eliminates problems of bearing alignment and other adjustments. Honeywell miniature platforms are used with any of several generations of Honeywell precision inertial floated gyros and accelerometers. This assures lower design and production costs, quick availability and proven reliability. The compact size (0. 5 cu. ft.) and low weight (28 lbs.) of Honeywell miniature inertial platforms have made them suitable for a wide variety of applications.

For more information on how Honeywell can design and/or manufacture inertial systems or components to your requirements, contact your nearest Honeywell Military Products Group representative. Or write or call Minneapolis-Honeywell Aeronautical Division, 13350 U.S. Highway 19, St. Petersburg, Florida. Phone HEmlock 5-1151.

Subminiature Inertial Platform Proven reliability in a small package. Only one-third the size and weight of conventional miniature platforms with no sacrifice in performance or dependability. Adaptable to many terrestrial, marine, aerospace navigation or stabilization requirements.

Honeywell

Military Products Group

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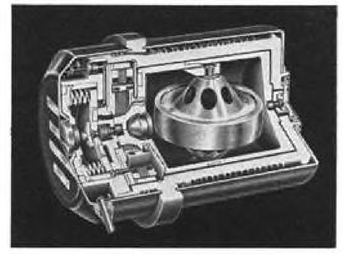
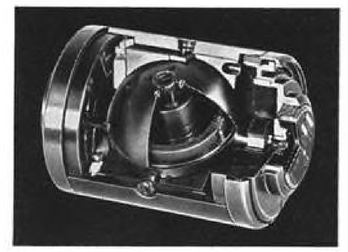
INERTIAL COMPONENT NEWS

Honeywell's experience in the design and manufacture of inertial components dates from the first MIT-designed floated gyros, the HIG 4, 5, and 6's. Since then Honeywell has produced more than 30,000 precision floated gyros. Sixty-three successful U.S. orbital shots have used Honeywell inertial components or systems.



BUILDING TO HONEYWELL DESIGN

Honeywell's experience in building inertial components of its own design includes the GG49, 8001, 87 and 159 Miniature Integrating Gyros (MIGS) and GG56, 116 and 137 accelerometers. These advanced floated inertial components, some featuring gas bearings and precision ceramics, are being supplied to such programs as Sergeant, SD-5 Drone, Scout, Centaur, and Agena.



BUILDING TO OTHERS' DESIGNS

Honeywell is the major supplier of gyros for the Navy's Polaris missile program. Honeywell is building these Inertial Rate Integrating Gyros (IRIG's) and Pendulous Integrating Gyros (PIG's) to MIT's design. Honeywell is also manufacturing to Autonetics' design, gyros for the Minuteman missile, the SIR Gyro for Westinghouse, and has delivered ABMA-designed gyros for use on Redstone.

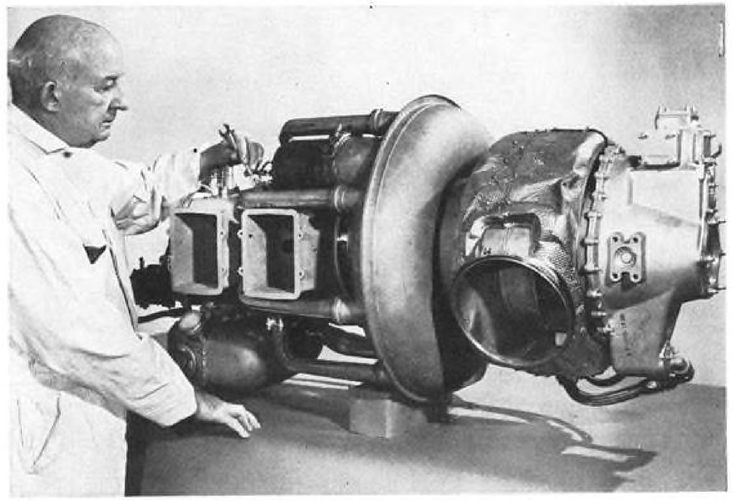
sales, $11,875 salary, $1,168 expenses; **C. Hunter**, chairman of the board, $25,000 bonus and indirect compensation, $1,825 expenses, 2,000 shares of common stock, 1,000 shares of preferred stock.

J. H. Binger, director, $1,080 expenses, 2,826 shares of common stock; **H. Case**, director, $1,021 expenses, 18,000 shares of common stock in the name of others, 10,000 shares of preferred stock in the name of others; **M. Fry**, director, $1,705 expenses, 2,600 shares of common stock, 13,000 shares of common stock in the name of others; **J. T. Johnson**, director, $1,154 expenses, 1,000 shares of common stock in the name of others; **M. S. Mackay**, director, $1,222 expenses, 2,000 shares of common stock; **C. B. Morgan**, director, $1,504 expenses; **A. Petteys**, director, $1,703 expenses, 15,000 shares of common stock, 5,000 shares of preferred stock, 6,000 shares of common stock in the name of others, 2,000 shares of preferred stock in the name of others; **C. F. Reavis**, director, $641 expenses, 3,500 shares of common stock, 1,167 shares of preferred stock; **A. G. Redpath**, director, $1,539 expenses, 1,000 shares of common stock; **W. Stern**, director, $9,600 bonus and indirect compensation, $2,212 expenses, 1,000 shares of common stock, 500 shares of preferred stock; **L. E. Wakefield, Jr.**, director, $1,182 expenses, 1,000 shares of common stock; **A. J. Weatherhead, Jr.**, director, $760 expenses, 1,550 shares of common stock.

The following firms were paid $5,000 or more for services rendered during 1961: **Alcorn, Bakewell & Smith**, legal service (Sept. 21, 1960-Apr. 1, 1961), $41,173; **Dorsey, Owen, Barber, Marquart & Windhorst**, legal services (July 16, 1960-Nov. 14, 1961), $57,865; **Ernst & Ernst**, accounting (June 30, 1960-July 27, 1961), $25,210; **Hodges, Reavis, McGrath & Downey**, legal services (July 1, 1960-Sept. 30, 1961), $42,712; **Jasper, Winner and Perina**, legal services, $10,013; **Klagsbrunn, Hanes and Irwin**, legal services (July 1, 1960-Sept. 30, 1961), $76,445; **C. Edward Leasure**, legal services, $46,860; **Mayo Clinic**, medical services (Dec. 1, 1960-Oct. 26, 1961), $21,970; **Miller, Canfield, Paddock & Stone**, legal services (Jan. 1, 1959-Dec. 12, 1961), $8,915; **Pogue and Neal**, legal services (July 1, 1960-June 19, 1961), $6,190; **White and Case**, legal services (July 1, 1960-May 8, 1961), $14,858.

Braniff Airways Inc.—**C. E. Beard**, president and director, $72,000 salary, $4,542 expenses, 21,600 shares of common stock; **J. W. Miller**, executive vice president (retired as officer Dec. 31), director, $48,000 salary, $1,827 expenses, 1,206 shares of common stock; **R. Brack**, senior vice president and director, $35,000 salary, $5,109 expenses, 300 shares of common stock; **R. V. Carleton**, senior vice president and director, $40,000 salary, $2,075 expenses, 4,000 shares of common stock; **C. G. Adams**, vice president, secretary (retired as officer Dec. 31, 1961) and director, $33,000 salary, $111 expenses, 6,759 shares of common stock; **F. J. Beisecker**, vice president-financial service, $19,500 salary, $390 expenses; **H. Boiding**, vice president-purchasing and stores, $21,500 salary, $186 expenses, four shares of common stock; **R. H. Burck**, vice president-traffic and sales, $18,000 salary, $6,556 expenses; **M. Harrison**, vice president-industrial relations, $25,200 salary, $665 expenses; **W. Henshel**, vice president-public relations, $23,200 salary, $1,984 expenses; **J. R. Horton**, vice president-maintenance and engineering, $20,000 salary, $517 expenses; **D. Hughes**, vice president-operations, $37,840 salary, $245 expenses; **T. Robertson**, vice president-economic planning, $14,900 salary, $1,835 expenses; **C. S. South**, vice president, $24,000 salary, $5,628 expenses; **R. C. Shrader**, vice president (retired as officer Dec. 31, 1961), director, $16,500 salary, 1,200 shares of common stock; **O. Crane**, treasurer, $16,600 salary, $619 expenses, 213 shares of common stock; **R. L. Barrier**, assistant vice president-budgets, $14,250 salary, 100 shares of common stock; **R. Frost**, assistant vice president-properties, $11,700 salary, 1,858 expenses.

V. A. Knopff, assistant vice president-executive projects, $14,000 salary, $850 expenses; **J. Serlie**, assistant vice president-flight dispatch, $14,400 salary, $42 expenses; **L. Eden**, assistant treasurer, $13,650 salary, $286 expenses; **V. Bowlware**, assistant secretary, $5,700 salary, 40 shares of common stock; **J. Seay**, assistant vice president-ground operations, $14,400 salary, $461 expenses, 242 shares of common stock; **F. Jones**, chairman of the board, $800 expenses, 2,132 shares of common stock; **G. Butler** director $800 expenses, 10,720 shares of common stock; **W. W. Flenniken**, director, $800 expenses, 339 shares of common stock; **J. E. Jonsson**, director, 251,543 shares of common stock; **T. N. Law**, $600 expenses, 130 shares of common stock; **A. Shivers**,



Boeing YT60 Helicopter Turbine Nears 50-hr. Test

Boeing YT60 (520-6) helicopter turbine will begin its 50-hr. Preliminary Flight Rating Test (PFRT) in September. Engine, latest in the company's T60 series, weighs 250 lb. and develops 550 hp. Specific fuel consumption of the engine is 0.65 lb. fuel per shaft horsepower hour. The engine is a descendant of the T60-BO-2 powerplant.

CREATIVE OPPORTUNITIES WITH HONEYWELL IN FLORIDA

Presently engaged in expanding their modern space facilities for the fifth straight year, the Aeronautical Division in St. Petersburg, Florida offers unsurpassed technical opportunities to the imaginative engineer.

Continued advancement in the micro-miniaturization of airborne guidance systems demands the highest caliber of technical competence. The design flexibility illustrated on the adjacent page is only a sample of such adaptability. Now more than ever before, significant opportunities exist for those with the skill, experience, and imaginative foresight to move into still more sophisticated electronic endeavors.

Immediate and specific opportunities exist in the areas of:

- Computer design, development and fabrication
- Gyro and accelerometer development
- Platform design and development
- System analysis
- Circuit design
- Instrumentation
- Reliability
- Quality control
- Component application
- Subcontract administration
- Program management

To explore these openings, write in confidence to Mr. M. C. Keese, Manager, Professional Employment, Minneapolis-Honeywell Aeronautical Division, 13350 U.S. Highway 19, St. Petersburg, Florida.

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To investigate professional opportunities in other Honeywell facilities, send resume to H. F. Eckstrom, Minneapolis-Honeywell, Minneapolis 8, Minnesota.

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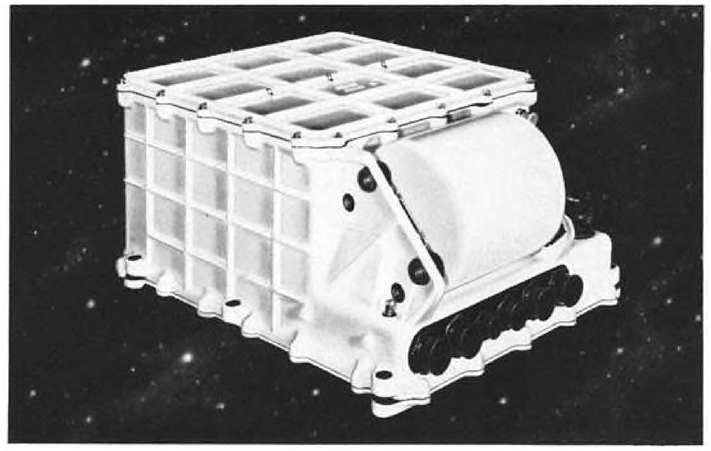


Standard building block assemblies permit custom designed computers

Honeywell, recognized navigation *systems* manufacturer, now offers you accurate, reliable inertial grade computers and components for space, terrestrial and marine applications. These new computers are designed around Honeywell's standard building block modules which permit wider flexibility in computer assembly to provide exactly the computer functions desired. They permit a higher degree of miniaturization and assure faster delivery and lower cost.

For example, Honeywell's versatile Aerospace computer (shown above) offers the largest capacity of any airborne computer. This rugged digital computer is available in radiation-cooled models for missile and orbital vehicle application, or air-cooled models for use in the atmosphere. Most of the required input-output equipment is already incorporated into the computer; special input-output equipment can be provided with a minimum of weight and volume. The Honeywell Aerospace computer offers wide environmental capability and high reliability.

In addition to computers, Honeywell can also supply computer components and will develop and build environmental whole number and/or incremental computers to meet your special requirements. Honeywell also has the experience and capability to build to another's design. Contact your Honeywell Military Products Group representative, or Minneapolis-Honeywell Aeronautical Division, St. Petersburg, Fla. HE 5-1151.

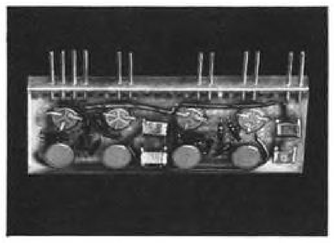
Honeywell Subminiature (PICO) Computer (in open position to show accessibility). Now being readied for production the PICO combines high computational capacity with low weight (18 lbs.), volume (0.38 cu. ft.) and power requirements (40 watts). Designed for advanced space missions, it is representative of the many computers in production or under development at Honeywell.

Honeywell

Military Products Group

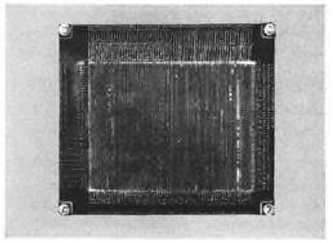
HONEYWELL INTERNATIONAL: Sales and service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

COMPUTER NEWS



WELDED MODULES UP RELIABILITY

Honeywell's computer building block modules are weld-assembled for maximum reliability. This welded-module construction permits higher capacity with packing density as great as 660,000 components per cubic foot. They can be assembled in varying combinations to suit your individual needs.



SOLID STATE MEMORY ART ADVANCED

In addition to its line of memory drums, Honeywell offers advanced solid state memories featuring Biax® cores. Especially suited to long term space requirements, these solid state memories feature random access in microseconds, low power requirements, and two-thirds weight reduction over comparable drum memories. No moving parts means high reliability, elimination of precession torques and greater shock and vibration resistance.

Unique Honeywell solid state memory design provides simplified electronics, non-destructive readout, and closed flux path for increased signal output with less noise.

Hughes

Provides you with an opportunity to enrich your background. For example: The Advanced Armaments Laboratory.

The steadily expanding Hughes Advanced Armaments Laboratory has numerous projects underway to challenge the imagination and heighten the potential of many engineers such as yourself. Advanced facilities provide the professional environment for creative thought. The warm Southern California climate makes life easier and more rewarding. Hughes offers this combination to enrich your life—opportunity, challenge, environment and climate.

Immediate positions are available in:

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Subsystem and Component Development

Help push forward the state of the art on projects in these challenging areas:

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CFAR Detection Devices & Displays
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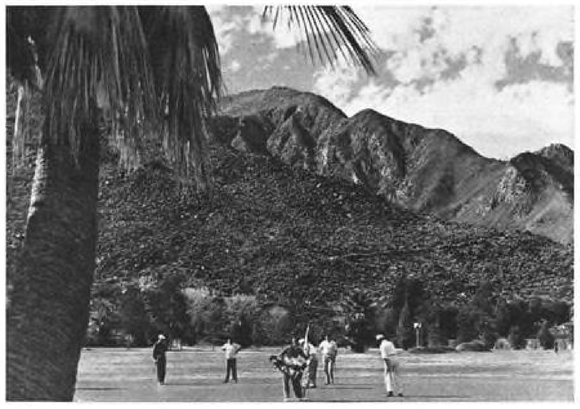
Advanced Weapon System Planning and Analysis
Planar Array Antennas for Missiles and Aircraft
Low Noise Parametric Amplifiers
Advanced TWT Research and Development
Solid State Computers



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Bell HUL-1M Flight Tested With T63-A-3 Engine

Bell Helicopter's HUL-1M helicopter, powered by an Allison T63-A-3 turbine engine, is now undergoing contractor flight testing. Performance tests have been made at altitudes up to 12,000 ft. and speeds of 105 mph.

director, $200 expenses, 700 shares of common stock; **J. H. Walker**, director, $800 expenses, 100 shares of common stock; **R. J. Whiteford**, director, $200 expenses, 1,120 shares of common stock.

Following firms were paid $5,000 or more for services rendered during 1961: **Whiteford, Hart, Carmody & Wilson**, legal services, $72,000; **Ernst & Ernst**, auditing, $10,989.

Allegheny Airlines, Inc.—H. A. Satterwhite, chairman of the board, $4,309 salary, $757 expenses, 12,975 shares of common stock; **L. O. Barnes**, president and director, $40,896 salary, $7,788 expenses, 28,200 shares of common stock, $3,000 debentures; **N. B. Fry, Jr.**, senior vice president and general manager (since Nov. 1, 1961) $21,228 salary, $1,757 expenses, 400 shares of common stock; **D. L. Miller**, senior vice president and director, $21,633 salary, $4,744 expenses, 602 shares of common stock, $2,500 debentures; **W. J. Short**, senior vice president-finance and administration (since Nov. 1, 1961), $25,000 salary, $2,320 expenses, 250 shares of common stock, $1,000 debentures; **E. I. Colodny**, vice president legal affairs and economic research, $19,500 salary, $1,473 expenses, $500 debentures; **R. G. Dinning**, vice president-flight operations, $18,230 salary, $1,835 expenses, 500 shares of common stock, $1,000 debentures; **R. J. Masiello**, vice president-maintenance and engineering, $18,248 salary; $1,376 expenses; **G. F. Gerth**, treasurer, $11,750 salary, $309 expenses, 200 shares of common stock, $500 debentures; **W. B. Thompson**, controller (since May 16, 1961), $8,515 salary, $162 expenses; **L. W. Stentzel**, secretary, $123 expenses, $1,500 debentures; **P. D. Brennan**, assistant secretary, $8,579 salary, $1,061 expenses, 3,600 shares of common.

W. D. Hay, controller, and assistant to vice president-finance (since May 15, 1961), $11,500 salary, $399 expenses, $500 debentures; **G. T. Bowmen**, director, $167 expenses, 15,100 shares of common stock, $25,000 debentures; **R. F. George**, director, $1,609 expenses, 53,100 shares of common stock, $85,000 debentures; **H. O. Hale**, director, $56 expenses, 1,500 shares of common stock, $3,000 debentures; **H. R. Hallowell**, director, $171 expenses, 4,000 shares of common stock; **R. M. Love**, director, $194 expenses, 2,000 shares of common stock; **P. V. Mattes**, director, $168 expenses, 5,000 shares of common stock, $10,000 debentures; **W. F. Rockwell, Jr.**, director, 15,000 shares of common stock; **C. Thom, Jr.**, $19 expenses, 2,000 shares of common stock, $2,000 debentures; **H. R. Sharp**, director (until June 27, 1961); **K. C. Glaser**, director (June 27, 1961-Sept. 7, 1961); **T. Hankey**, director (June 27, 1961-Aug. 18, 1961); **L. T. Ferguson**, acting vice president-sales and service (since Nov. 1, 1961), $10,310 salary, $391 expenses, 10 shares of common stock.

The following firms were paid $5,000 or more for services rendered during 1961: **Hale, Russell & Stentzel**, legal services, $57,524; **Van Sant Dugddale & Co.**, advertising, $304,263; **Peat, Marwick, Mitchell & Co.**, accounting and auditing, $5,475; **United Research, Inc.**, professional services, $10,610.

Northeast Airlines, Inc.—J. W. Austin, president, $42,483 salary, $3,842 expenses, 200 shares of common stock; **J. V. Auskelis**, assistant vice president-production, $11,571 salary, $411 expenses; **F. C. Barker**, assistant vice president-communications, $12,000 salary, $539 expenses; **A. A. Brennan**, assistant vice president-personnel, $13,875 salary, $826 expenses; **J. S. Daniels, Jr.**, assistant vice president-advertising and promotion, $14,796 salary, $475 expenses; **M. M. Deggroff**, vice president-general traffic manager, $15,420 salary, $1,867 expenses; **R. E. Fisher**, vice president-public relations, $6,875 salary, $1,698 expenses; **G. E. Gardner**, assistant chairman of the board, $14,400 salary; **T. L. Grace**, vice president-operations, $26,116 salary, $1,675 expenses; **H. Heard**, vice president-administration, $15,412 salary, $547 expenses; **R. P. Lane, Jr.**, vice president-finance and treasurer, $21,408 salary, $3,169 expenses; **W. W. Mies**, assistant vice president-quality control, $12,400 salary, $373 expenses, 100 shares of common stock; **M. W. Offutt 3rd**, assistant vice president-sales, $16,440 salary, $5,323 expenses; **E. O. Schroeder**, vice president-technical services, $26,116 salary, $841 expenses, 200 shares of common stock; **J. O. Urquhart**, assistant vice president-passenger service, $14,394 salary, $1,017 expenses; **A. S. Walker, Jr.**, vice president-ground operations, $14,796 salary, $619 expenses; **H. F. Zimmerman**, assistant vice president and controller, $14,384 salary, $65 expenses; **J. Cochran**, director; **P. F. Collins**, director; **J. F. Fitzgerald**, director; **H. E. Foley**, clerk of the corporation, 900 shares of common stock; **R. Irimescue**, director, $3,561 salary; **O. Johnston**, director; **D. Stretch**, chairman of the board, 600 shares of common stock; **E. Vidal**, director; **A. G. McMeninem**, director.

The following firms were paid $5,000 or more for services rendered during 1961. **J. Walter Thompson**, advertising, $1,105,362; **Airline Architectural Consultants**, architectural services, $19,196; **Lybrand, Ross Bros. & Montgomery**, auditing services, $29,414; **Foley, Hoag & Eliot**, legal services, $49,298; **Walton, Lantaff, Schroeder, Atkins, Carson & Wahl**, legal services, $5,842; **Systems Analysis & Research Corp.**, technical research, $34,945; **Simpson, Thatcher & Bartlett**, legal services, $18,508; **United Research, Inc.**, technical research, $13,563; **Advertising House, Inc.**, public relations, $6,820.

Piedmont Airlines—T. H. Davis, president and treasurer, $30,000 salary, $4,949 expenses, 147,153 shares of common stock, $50,000 debentures; **C. G. Brown, Jr.**, vice president, $16,512 salary, $1,720 expenses, 2,420 shares of common stock; **H. K. Saunders**, vice president, $19,512 salary, $1,176 expenses, 3,797 shares of common stock; **R. S. Northington**, vice president, $19,261 salary, $3,629 expenses, 6,710 shares of common stock; **M. F. Fare**, secretary and assistant treasurer, $14,016 salary, $1,968 expenses, 7,040 shares of common stock; **T. W. Morton**, assistant controller, $10,500 salary, $135 expenses, 220 shares of common stock; **J. R. Farley**, assistant secretary; **G. E. Anderson**, director, $150 bonus and indirect compensation, 110 shares of common stock; **E. L. Davis**, director, $150 bonus and indirect compensation, 8,839 shares of common stock; **E. L. Davis, Jr.**, director, $100 bonus and indirect compensation, 6,183 shares of common stock; **F. Dowd**, director, $100 bonus and indirect compensation, 1,100 shares of common stock; **R. W. Gardner**, director, $50 bonus and indirect compensation, 13,250 shares of common stock; **B. Gray**, director, 11,000 shares of common stock; **C. E. Norfleet**, director, 2,946 shares of common stock; **J. F. Watlington, Jr.**, director, 200 shares of common stock.

The following firms were paid $5,000 or more for services rendered during 1961: **Kilpatrick, Ballard & Beasley**, legal services, $25,697; **Liller, Neal, Battle, and Lindsey, Inc.**, advertising, $159,266; **Ernst & Ernst**, auditing, $9,475.

ACHPHENOMENON

The mind focuses upon the center cube, each face having required a distinct cut. Until that realization, the problem of proving that a minimum of six cuts is necessary to make twenty seven cubes out of one appears insurmountable. Insight, perception, Achphenomenon at work.

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MOCKUP of Aero Commander 1121 Jet Commander executive transport is making cross-country tour. Cabin is laid out in four-passenger configuration with buffet and lavatory. Mockup also shows layout of instrumentation and controls in pilot's compartment.

Jet Commander Slated to Fly This Year

By Erwin J. Bulban

Dallas, Tex.—Aero Commander, Inc., is making a vigorous sales push for its Model 1121 Jet Commander twin-jet executive transport (AW May 8, 1961, p. 92) by sending a full-scale, fully-furnished mockup on a cross-country tour.

By late last month, the company had 12 orders backed by deposits on its books for the aircraft and letters of intent for four more Jet Commanders.

Jet Commander Sales Manager Paul Blanton is supervising the trip, which opened here May 21 with a display of the mockup at Southwest Airmotive Corp., Love Field. Next scheduled stop was the Reading, Pa., Business Aircraft Forum, where the mockup was to be on view beginning June 1.

Aero Commander will show the mockup at the Marriott Motor Hotel, Washington, D. C. for several days starting June 12 and then take it to New York for a display beginning June 17.

The New York showing is planned for a location downtown in order to make it more readily available to business executives who might find a visit to an airport inconvenient.

Fabrication Work

Meantime, Aero Commander has fabrication of the first four test and demonstrator Jet Commanders well under way at its Norman, Okla., research and development facility. Concurrently, it is adding more production area and equipment to its facility at Bethany, Okla., where the fifth and following airplanes will be built.

Fuselage of the first airplane, which will be slated for water tank tests of pressurization and structural integrity, already is out of the jigs. The second airframe will be a flight test article to handle aerodynamics, performance and stability trials, and the third unit will be for systems certification tests, including fuel system, electronics and other equipment.

The fourth airplane will be a factory-owned demonstrator. Prototype first flight is planned for late fall of 1962 and delivery of the first production airplane for December, 1963. It is expected that production will be at a four-per-month rate in early 1964. Of the first 12 firm orders, four are from distributors.

1121 Specifications

Wing span	43.31 ft.
Length, over-all	48 ft.
Height, over-all	15.8 ft.
Cabin height (interior)	59 in.
Cabin width (interior)	57 in.
Passenger compartment length	101.75 in.
Lavatory compartment (length, width, height)	27 in. x 57 in. x 59 in.
Maximum gross weight	14,000 lb.
Empty weight (including equipment)	6,800 lb.
Cruise speed at 35,000 ft.	503 mph.
Cruise speed at 20,000 ft. or less	415 mph.
Maneuvering speed	234 mph.
Gear extension speed	288 mph.
Flap extension speed	173 mph.
Stall speed (clean)	112 mph.
Stall speed (landing configuration)	96 mph.

Considerable progress has been made in negotiations with components suppliers for the initial production block of 50 airplanes. A contract has been signed with General Electric for 100 CJ610-1 engines. That company also will be the major supplier of the airplane's electrical system, including starters, generators, alternators and circuit controls.

Goodyear will supply electrically-heated windshields and wheels, brakes and tires. AiResearch is fabricating the initial 50 sets of air conditioning-cabin pressurization systems. On the basis of recommendation from this supplier, the initial plan to have a separate compressor, driven by engine bleed air, has been dropped, and another system—similar to that used on the Sud Caravelle and General Dynamics 880 transports—will provide both air conditioning and pressurization directly from the engines through a system of valves, heat exchangers and air mixers.

Wing Components

Some wing components, including skins, are now going to Automation Industries, Tulsa, for chemical milling. Indications are that the airframe manufacturer gave up its earlier plans to have slab skins machine milled.

Suppliers of the electric boot de-icer systems for wings and tail, and electronics and seats have not been chosen. With the aircraft to be certificated

Can a Computer Recognize

MOON GEOGRAPHY?

• Cornell Aeronautical Laboratory's engineers and scientists are investigating concepts for computers which can be "taught" to recognize patterns, whether those patterns be airfields, missile sites — or even significant topographic features of the moon. In related areas, CAL is developing special purpose computers surprisingly small in size, yet faster for the task than the speediest general purpose computers in use today. These computers use novel delay line storage techniques to perform computations in real time.

As a research tool in our cognitive systems program, a special input facility for the IBM 704 digital computer has been developed, allowing photographic data to be inserted directly into the computer. This facility allows CAL engineers to implement and evaluate pattern recognition concepts at an early stage in the research program.

Other computer related science activities include analytical and experimental research in data processing techniques, adaptive control systems, and trajectory tracking techniques. Our scientists engaged in this research have education and experience in areas such as information theory, statistics, control systems, advanced programming, theory of automata and intelligent machines.

CORNELL AERONAUTICAL LABORATORY, INC.

of Cornell University, Buffalo 21, New York

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under Civil Air Regulations Part 4b and capable of operating to 40,000 ft., Aero Commander feels it will want to wait to utilize latest state-of-the-art in electronics equipment—including solid state circuitry. It is also interested in encouraging competition among seat suppliers for a new development in this equipment.

The company has instituted a Program Evaluation and Review Technique (PERT) for the 1121 project to monitor engineering, production and supply, utilizing an IBM 7090 computer to prepare bi-weekly detailed situation summaries.

Extensive study of engine location and air inlet design has been carried out with a scale model in a water tunnel using aluminum particles suspended in the liquid to study flow characteristics. Although Aero Commander does not consider these tests as being conclusive, spokesmen indicate that they are heartened by the fact that no major changes were indicated necessary by these studies.

$475,000 Price

The company still uses the figure of $475,000 as the price for the basic four-passenger configuration with standard interior and basic dual flight instrumentation and points out that contracts contain no escalation clauses. The contract also contains a performance guarantee.

In addition, the company will provide a comprehensive 12-month warranty.

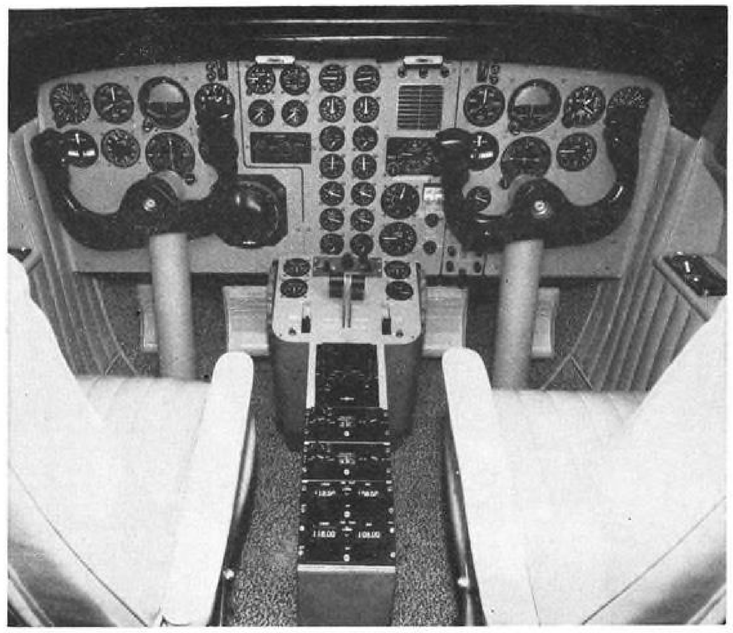
The CJ610-1 turbojets probably will start out with a 600-hr. minimum time between overhauls. General Electric probably will authorize five or six overhaul centers strategically located to handle engine work, and the program probably will include the lease of a replacement engine to the customer while his engine is being worked on at the overhaul center.

The CJ610-1 has a sea level thrust rating of 2,850 lb. and weighs 355 lb. The engine is 39.7 in. long and 17.7 in. in diameter.

Overhaul Cost

Cost of overhaul of two engines will be approximately $19,800. This data is included in Aero Commander operating computations for the Model 1121.

On the basis of operating the airplane 600 hr. annually with six passengers over 800 naut.-mi. stage lengths, seat-mile costs work out at 13.3 cents. On a 400-hr. utilization with six passengers over the same stage lengths, costs per seat-mile should be 17.4 cents. On 600-hr. annual utilization, total operating costs, including airplane parking fees, are $298 per flying hour, and on 400-hr. annual use, $387.90 per hour, the Aero Commander data indicates.



MODEL 1121 Jet Commander mockup has radar scope mounted on pilot's panel. Engine instruments are centered on panel. Throttle, speed brake and flap controls are on pedestal; radio equipment is on floor between seats. Oxygen regulator is on cabin wall arm rest.

JET COMMANDER MOCKUP has a four-passenger executive interior. Six-passenger executive configuration also is available. Cabin is equipped with a lavatory and galley. Height of the cabin interior is 59 in. Width inside is 57 in.

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But this is only about 20% of all the plant expansion recently completed. A second wing, finished in April, 1962, further increased total plant floorspace owned and leased to over 500,000 square feet.

In recent years, the Communication Products Department has built a healthy mix of industrial, commercial and military programs. Products represent a spectrum of communication systems—from tiny, personal two-way radios, to continent-spanning microwave radio relay networks. Now, by continuing to grow along virtually this entire front, the professional opportunities newly created carry a hard-to-find combination of two key career factors: rapid growth potential, *and near-optimum stability*.

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In the military sphere, we recently added a new program of great importance to the nation's security—developing the intersite communications link for Titan II operational bases... a system which must be *survivable and reliable*.

In our commercial areas, a number of new opportunities have been created by expansion of such programs as: a 600 channel, fully transistorized and miniaturized multiplex telephone carrier system; a 600 channel microwave radio relay system (also fully transistorized) embodying a heterodyne repeater, parametric and traveling wave tube amplifiers; compact, transistorized two-way FM mobile radio; highly miniaturized personal communication equipment; tropospheric scatter equipment with modulation techniques, designed specifically for thin route applications.

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Communication Equipment Advance Development
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2-Way Mobile Transmitter Design
2-Way Mobile Systems & Reliability Engineering
Military Sales Engineering
Mobile Radio Sales Engineering

■ Your letter or resume will receive careful attention and a prompt, personal reply. Write in confidence to Mr. W. J. Kelly, Div. 64-WW, Communication Products Department, General Electric, Mountain View Road, Lynchburg, Virginia.

• Lynchburg offers the advantages of a modern, progressive community located in the beautiful Blue Ridge area of Virginia, only four easy driving hours from Washington, D. C.

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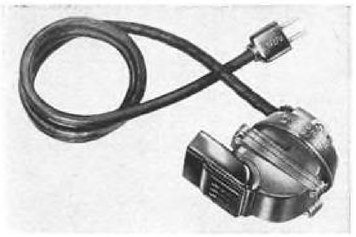
NEW AEROSPACE PRODUCTS

Oxygen Mask Microphone

Roanwell Model ROM-32(29) moving-coil microphone is designed to provide reliable communications through oxygen mask-attached system under high altitude and high ambient noise.



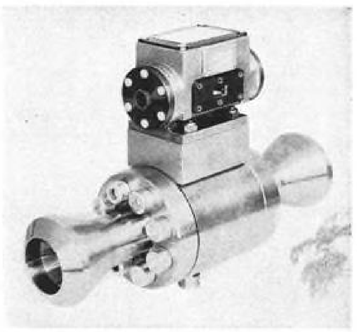
The manufacturer reports that the microphone can be used in both pressure-breathing and demand-oxygen masks. The microphone has been tested successfully to USAF specification Mil-M-9434B, and the unit's noise cancellation capability permits intelligible transmission in a 120 db. ambient noise field. Motor assembly is mounted in a plastic case and the mouthpiece is protected by a moisture barrier.

Frequency range is 200-5,000 cps., and output impedance is 6.3 ohms. Unit weighs 2.5 oz. and has an 18-in. cord with a miniature connector at each end.

Roanwell Corp., 180 Varick St., New York 14, N. Y.

High Pressure Helium Valve

Ultra-high pressure ball valve for helium gas service is available in manually and remotely controlled models. It is designed for applications requiring minimum pressure drop and bubble tight sealing at pressures of 6,000 psi. and over. The manufacturer says the valve has a low silhouette and size, with excellent flow and sealing characteristics.



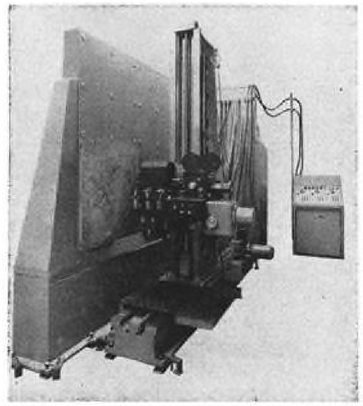
Sizes range from ¼ in. to 8 in. The valve is also available for use to accommodate shut-off or controlled flow requirements.

Flodyne Controls, Inc., 1701 Elizabeth Ave., E., Linden, N. J.

Celestial-Terrain Viewer

Viewing system can be used in space flight training to simulate the earth's terrain as it would appear on a spacecraft television screen during takeoff and re-entry or to simulate appearance of the skies during orbital flight.

System consists basically of a camera, camera positioner and optical unit, all of which are used in conjunction with a main console, three-dimensional terrain map and easel. The system is fully automatic and incorporates both animation and motion "freeze" techniques. The camera is positioned by punched tape commands to east-west and north-south coordinates and altitudes over the easel-mounted maps.



As pictures flow through the main recording system, descriptive information on each frame is entered on the film track beside the picture by a pattern projected from sub-miniature lamps.

The system also can be used to provide a simulated frame of reference by superimposing a theoretical horizontal line and one-point perspective grid on the filmed flight path.

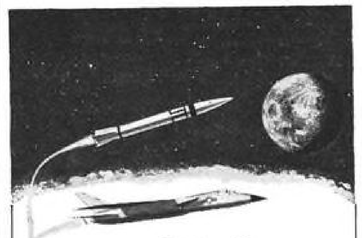
Kearfott Division, General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

Tape Transport

New device is designed to be applied to recording operations under high environmental mechanical shock conditions. The unit has no pinch rollers and provides tape-to-head contact at all times, the manufacturer says.

Typical applications are rocket sled tests, missile launch and re-entry operations, centrifuge tests, high performance aircraft and helicopter flights and shock effect testing. The unit uses ½-in. or 1-in. standard tape, with ¼-in. tape available if desired.

Weber Electronics, 3050 California St., Burbank, Calif.



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Columbus 16, Ohio
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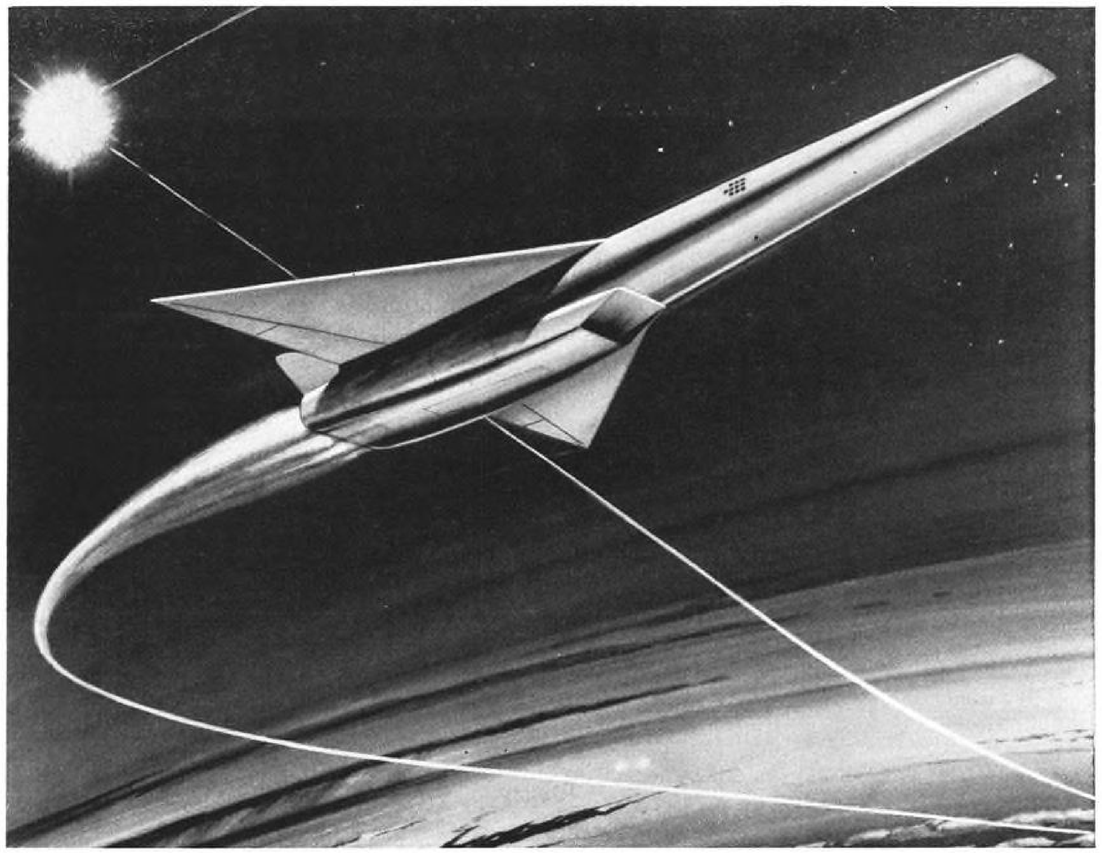

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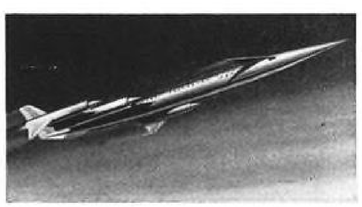


LOCKHEED *CALIFORNIA COMPANY*

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

WHO'S WHERE

(*Continued from page 23*)

Changes

Charles W. Hutton, assistant to the vice president-general manager of Douglas Aircraft Co.'s Missile and Space Systems Division, Santa Monica, Calif.

D. J. Cockeram, director of reactor development, and **R. O. Williams, Jr.,** director of nuclear operations, Compact Systems Division of Atomics International, Canoga Park, Calif., a division of North American Aviation, Inc.

Farar B. C. Martin, director of Federal Electric Corp.'s Early Warning Systems Division, Paramus, N. J.

Capt. L. J. Royall, system chief pilot, National Airlines.

Ivan Bekey, project engineer, Command and Control, Mobile Medium-Range Ballistic Missile (MMRBM) Program Office, Aerospace Corp., Los Angeles, Calif.

Richard H. Gilbert, chief pilot, Helicopter Air Lift, Chicago, Ill., a division of Butler Aviation Co.

Joseph W. Weichowski, Western Operations manager, Studebaker-Packard Corp.'s CTL Division, Santa Ana, Calif. Also: **Richard C. Kostner,** plant manager; **Sherman R. Rodgers,** manager-quality control.

Air Marshal Sir Paterson Fraser, Inspector-General of the Royal Air Force, U. K.

George Molchan, chief of procurement, Connecticut Advanced Nuclear Engineering Laboratory (CANEL), Middletown, Conn., of Pratt & Whitney Aircraft Division of United Aircraft Corp.

Richard B. Hook, manager, Neptune Meter Co.'s new Corporate Research Laboratory, Wallingford, Conn.

Allen V. Butterworth, head, Evaluation Studies Department, General Motors Defense Research Laboratories, Santa Barbara, Calif.

Chester E. Underwood, staff chemist, Inorganic and High Temperature Materials Research Division, Bjorksten Research Laboratories, Madison, Wis.

Dr. John W. Clark, manager, Nucleonics Division, Hughes Aircraft Co., Fullerton, Calif. Also: **Jonas R. Moore,** manager of the Division's new Marketing Department; **Joseph H. Beno,** manager of the new Remote Handling Systems Department.

Arnold A. Isford, product manager of the newly established Telemetry and Space Communications Department, Lockheed Electronics Co., Plainfield, N. J., and **Charles J. Gotthardt,** sales manager.

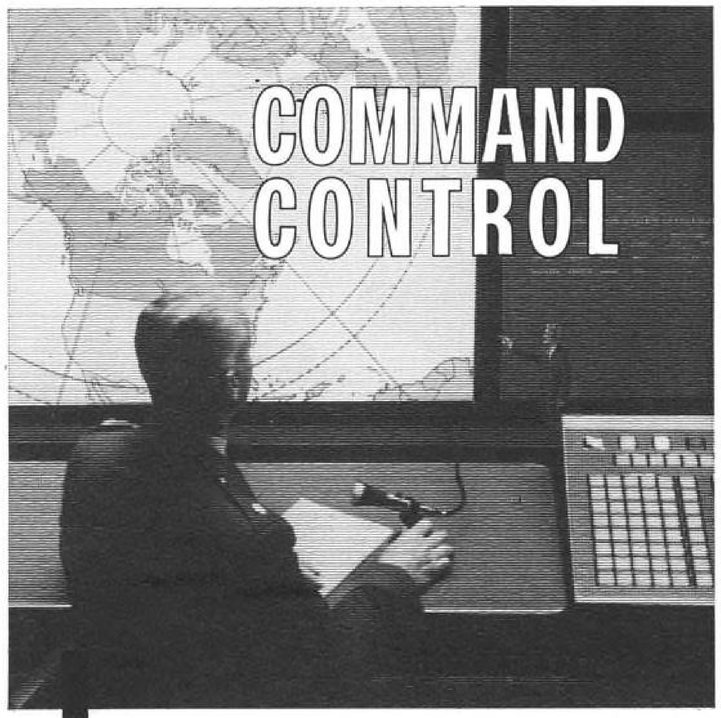
Dr. Charles L. Bernier, director, Armed Services Technical Information Agency, Washington, D. C.

Josef K. Hoenig, director of European operations for Textron's Bell Aerospace Corp., with offices in Paris, France.

Dr. L. L. Marton, chief of international relations, Office of the Director of the National Bureau of Standards, Washington, D. C. Also: **C. N. Coates,** program adviser, and **G. E. Auman,** assistant to the director.

Dr. David A. Kahn, systems associate, Melpar, Inc., Falls Church, Pa.

Samuel J. Wiegand, manager-service engineering, Federal Systems Marketing Department, Minneapolis-Honeywell's Electronic Data Processing Division, Wellesley, Mass.



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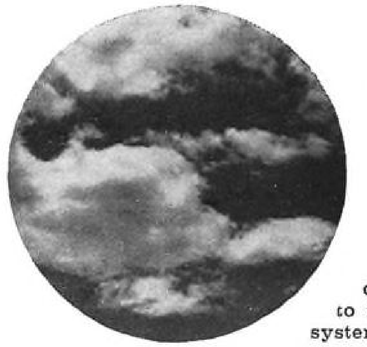
Commercial Pilot 1700 hrs., 36 married, S&MEL, Instrument, A&E. Resume on request. PW-9086, Aviation Week.

GRUMMAN PANORAMA...

The Mission



The mission, preoccupies the engineer designing vehicles and systems at Grumman. Their variety, applicable to four environments, provides multiple challenge to the systems oriented engineer. The broad spectrum includes:

• The detection, classification and destruction of enemy submarines (utilizing advanced electronic equipments in aircraft and high speed hydrofoil craft).

• The detection of impending enemy attacks far at sea in time for their interception by the fleets patrolling our defense perimeters ("Early Warning" carrier-based aircraft).

• The perception and destruction, in either brushfire or retaliatory nuclear war, of enemy targets completely obscured by night or weather conditions (employing long range sensitive "integrated display systems").

• The study of cosmic phenomena and aquisition of scientific information heretofore inaccessible, through advanced telemetry and television techniques (OAO-Orbiting Astronomical Observatory).

These diverse programs are creating a continued demand for the systems thinking engineer. Those who can make significant contributions are urged to explore these immediate openings.

ASW Systems Analyst—MS or BS in EE or Physics with a minimum of 5 years experience in airborne or surface anti-submarine systems desirable. Emphasis is placed on theory and application of sensors, data processing and control equipment when integrated with the launch vehicle and/or weapon, in a tactical environment. Familiarity with ASW doctrine desirable but not necessary. This endeavor is primarily a conceptual and overall systems approach type, which is particularly satisfying to the creative individual with an aptitude for practical application of scientific principles.

Structural Designers—BS in CE, ME or AE with a minimum of 5 years experience in layout and design of aircraft wing or fuselage structures and/or missile structures.

ECM Engineers—BSEE or BS in Physics with a minimum of 3 years' experience in the fields of radar systems, passive and/or active counter-measures systems, and ECCM systems. Work involves the development of ECM systems and the integration of ECM equipment with navigation and digital computer systems. Background in digital computers and programming is desirable but not essential.

Laboratory Equipment Engineers—BSEE with 5-10 years experience in laboratory test programs of airborne electronics equipment. A working knowledge is required in a majority of the fields of airborne communication radar, navigation and digital computers. Work will be conducted in our new Electronics Systems Center with the finest facilities and equipment available. Applicants must be willing to extend their technical capabilities to new challenging areas ranging from DC to microwaves.

Communications Systems Engineer—Electronic Engineers with thorough knowledge of communications techniques who wish to extend their technical background to new challenging areas. An important phase of this effort will be extensive laboratory development programs in our new Electronics Systems Center using the finest equipment and facilities. BSEE with a minimum of 3 years' experience.

Space Dynamicist—MS in Applied Mechanics or Applied Math and 4 or more years' experience in the analysis of flight dynamics with at least 2 years' experience in celestial mechanics. To investigate problems associated with cislunar flight, reentry dynamics and orbital transfer.

To arrange an immediate interview, SEND RESUME to Mr. W. Brown, Manager, Engineering Employment, GR-25

Grumman

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Write to Mr. George R. Hickman
Technical Employment Manager, Dept. 1F-1

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Guidance and controls

Space vehicle propulsion

Space systems dynamics

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P-9077 Aviation Week
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Five (5) years experience in thermodynamic analysis with emphasis on heat transfer and cycle studies, M.S. or Ph.D. desired.

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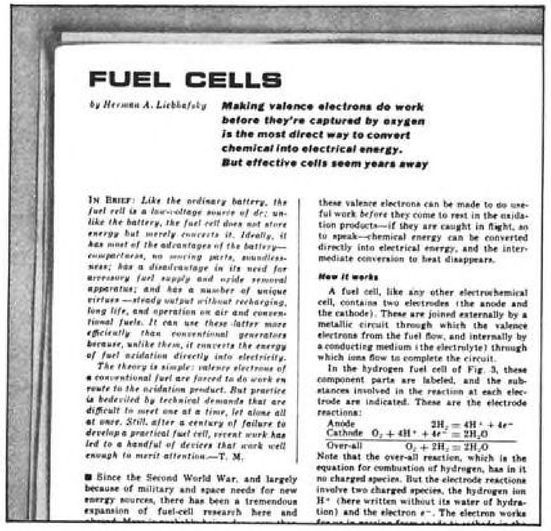
IBM asks basic questions in information retrieval

What is known?



FUEL CELLS

by Herman A. Liebhafsky

Making valence electrons do work before they're captured by oxygen is the most direct way to convert chemical into electrical energy. But effective cells seem years away

IN BRIEF: *Like the ordinary battery, the fuel cell is a low-voltage source of dc; unlike the battery, the fuel cell does not store energy but merely converts it. Ideally, it has most of the advantages of the battery—compactness, no moving parts, soundlessness; has a disadvantage in its need for necessary fuel supply and oxide removal apparatus; and has a number of unique virtues—steady output without recharging, long life, and operation on air and conventional fuels. It can use these latter more efficiently than conventional generators because, unlike them, it converts the energy of fuel oxidation directly into electricity.*

The theory is simple: valence electrons of a conventional fuel are forced to do work en route to the oxidation product. But practice is bedeviled by technical demands that are difficult to meet one at a time, let alone all at once. Still, after a century of failure to develop a practical fuel cell, recent work has led to a handful of devices that work well enough to merit attention.—T. M.

■ Since the Second World War, and largely because of military and space needs for new energy sources, there has been a tremendous expansion of fuel-cell research here and

these valence electrons can be made to do useful work *before* they come to rest in the oxidation products—if they are caught in flight, as to speak—chemical energy can be converted directly into electrical energy, and the intermediate conversion to heat disappears.

How it works

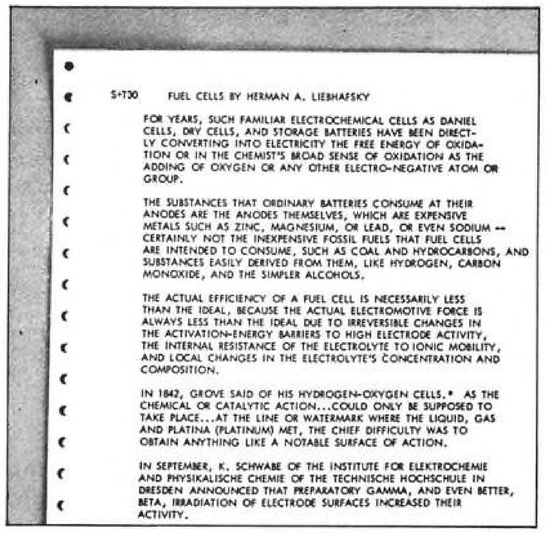
A fuel cell, like any other electrochemical cell, contains two electrodes (the anode and the cathode). These are joined externally by a metallic circuit through which the valence electrons from the fuel flow, and internally by a conducting medium (the electrolyte) through which ions flow to complete the circuit.

In the hydrogen fuel cell of Fig. 3, these component parts are labeled, and the substances involved in the reaction at each electrode are indicated. These are the electrode reactions:

Anode $2H_2 = 4H^+ + 4e^-$
Cathode $O_2 + 4H^+ + 4e^- = 2H_2O$
Over-all $O_2 + 2H_2 = 2H_2O$

Note that the over-all reaction, which is the equation for combustion of hydrogen, has in it no charged species. But the electrode reactions involve two charged species, the hydrogen ion H^+ (here written without its water of hydration) and the electron e^-. The electron works

This 4000-word article appeared in the January, 1962, issue of International Science and Technology. *To abstract the article, a document analyst would read it, define its purpose, and summarize its essential points.*



S-T30 FUEL CELLS BY HERMAN A. LIEBHAFSKY

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IN SEPTEMBER, K. SCHWABE OF THE INSTITUTE FOR ELEKTROCHEMIE AND PHYSIKALISCHE CHEMIE OF THE TECHNISCHE HOCHSCHULE IN DRESDEN ANNOUNCED THAT PREPARATORY GAMMA, AND EVEN BETTER, BETA, IRRADIATION OF ELECTRODE SURFACES INCREASED THEIR ACTIVITY.

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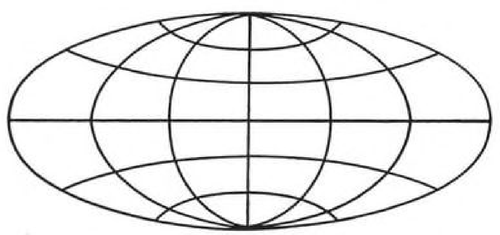

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, JUNE 4, 1962

AIRWORK CORPORATION 90
AMERICAN POTASH & CHEMICAL CORPORATION 108
AMPEX CORPORATION 17
ANACONDA METAL HOSE DIVISION, AMERICAN BRASS COMPANY 12
ASTRODATA, INC. 22
AVIATION WEEK & SPACE TECHNOLOGY 110-111

BABCOCK ELECTRONICS CORPORATION 72
BALDWIN-LIMA-HAMILTON CORPORATION, INDUSTRIAL EQUIPMENT DIVISION 86
BARBER-COLMAN COMPANY, AIRCRAFT & MISSILE PRODUCTS DIVISION 94
BELL AEROSYSTEMS COMPANY DIVISION OF BELL AEROSPACE CORPORATION ..... 3rd Cover
BELL HELICOPTER COMPANY DIVISION OF BELL AEROSPACE CORPORATION 70
BENDIX ECLIPSE-PIONEER DIVISION, THE BENDIX CORPORATION 48-49
BENDIX PACIFIC DIVISION, THE BENDIX CORPORATION 84
BENDIX SYSTEMS DIVISION, THE BENDIX CORPORATION 100
BINKS MANUFACTURING COMPANY 97
BOEING COMPANY, THE—DOMESTIC TRANSPORT DIVISION 46
BROOKS & PERKINS, INC. 73
BUDD ELECTRONICS, A DIVISION OF THE BUDD COMPANY, INC. 66

CHERRY RIVET DIVISION, TOWNSEND COMPANY 7
CHRISTIE ELECTRIC CORPORATION 103
COLLINS RADIO COMPANY, ... 11, 106
COLUMBUS, A DIVISION OF NORTH AMERICAN AVIATION, INC. 123
CORNELL AERONAUTICAL LABORATORY, INC. OF CORNELL UNIVERSITY 120, 121

DEUTSCH COMPANY, THE—ELECTRONIC COMPONENTS DIVISION 80
DEUTSCH COMPANY, THE—HYDRAULIC COMPONENTS DIVISION 14
DOUGLAS AIRCRAFT COMPANY, INC. 96

ELASTIC STOP NUT CORPORATION OF AMERICA, ELIZABETH DIVISION 5
ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA 81

FAIRCHILD CAMERA & INSTRUMENT CORPORATION, DEFENSE PRODUCTS DIVISION 20
FREBANK COMPANY 95

GARRETT CORPORATION, THE—AVIATION SERVICE COMPANY 15
GENERAL ELECTRIC COMPANY 122
GENERAL ELECTRIC COMPANY, DEFENSE ELECTRONICS DIVISION 74-75
GENERAL ELECTRIC COMPANY, LAMP METALS & COMPONENTS DEPARTMENT 91
GENERAL ELECTRIC COMPANY, NUCLEAR ELECTRONIC PRODUCTS SECTION 18
GOODYEAR AIRCRAFT CORPORATION, THE 3
GUIDANCE CONTROLS CORPORATION SUBSIDIARY OF WARNER ELECTRIC BRAKE & CLUTCH CO. 95

HOLLEY CARBURETOR COMPANY 89
HUGHES AIRCRAFT COMPANY 116

INTERNATIONAL BUSINESS MACHINES CORPORATION, DATA PROCESSING DIVISION 78-79
INTERNATIONAL ELECTRIC CORPORATION 125

JANITROL AERO DIVISION, MIDLAND-ROSS CORPORATION 9
JOY MANUFACTURING COMPANY 51

LEWIS ENGINEERING COMPANY, THE 104
LITTON INDUSTRIES, INC. 103
LITTON SYSTEMS, INC. 118
LOCKHEED CALIFORNIA COMPANY, A DIVISION OF LOCKHEED AIRCRAFT CORPORATION 124
LOCKHEED GEORGIA COMPANY, A DIVISION OF LOCKHEED AIRCRAFT CORPORATION 60-61, 133

McDONNELL AIRCRAFT CORPORATION ..... 4th Cover
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, AERONAUTICAL DIVISION 112-113, 114-115
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, MILITARY PRODUCTS GROUP 64-65
MITRE CORPORATION, THE 62
MOTOROLA, INC., MILITARY ELECTRONICS DIVISION 42

NICHOLS COMPANY, W. H. 63
NORTH AMERICAN AVIATION, INC. 92-93
NORTHROP CORPORATION 105, 107, 109

PARSONS COMPANY, THE RALPH M. 88

RANTEC CORPORATION 10
REEVES SOUNDCRAFT CORPORATION 8
ROHR CORPORATION 13
RYAN AERONAUTICAL COMPANY 102

SHELL OIL COMPANY 40-41
SILICONES DIVISION, UNION CARBIDE CORPORATION 24
SPACE TECHNOLOGY LABORATORIES DIVISION OF THOMPSON RAMO WOOLDRIDGE INC. 56
STEPHENS-ADAMSON MFG. COMPANY, SPHERCO BEARINGS DIVISION 57
STOKES CORPORATION, F. J., SPACE SYSTEMS DEPARTMENT 16
SUNDSTRAND AVIATION DIVISION OF SUNDSTRAND CORPORATION 6
SYSTEM DEVELOPMENT CORPORATION 67

THOMPSON RAMO WOOLDRIDGE INC., DAGE TELEVISION DIVISION 82-83
THOMSON INDUSTRIES, INC. 71

UNITED AIRCRAFT CORPORATION, NORDEN DIVISION 58
UNITED AIRCRAFT CORPORATION, PRATT & WHITNEY AIRCRAFT DIVISION 52-53
UNITED AIRCRAFT CORPORATION, SIKORSKY AIRCRAFT DIVISION 98-99
UNITED AIR LINES 68-69

VOI-SHAN MANUFACTURING COMPANY, A DIVISION OF VOI-SHAN INDUSTRIES, INC. 2nd Cover

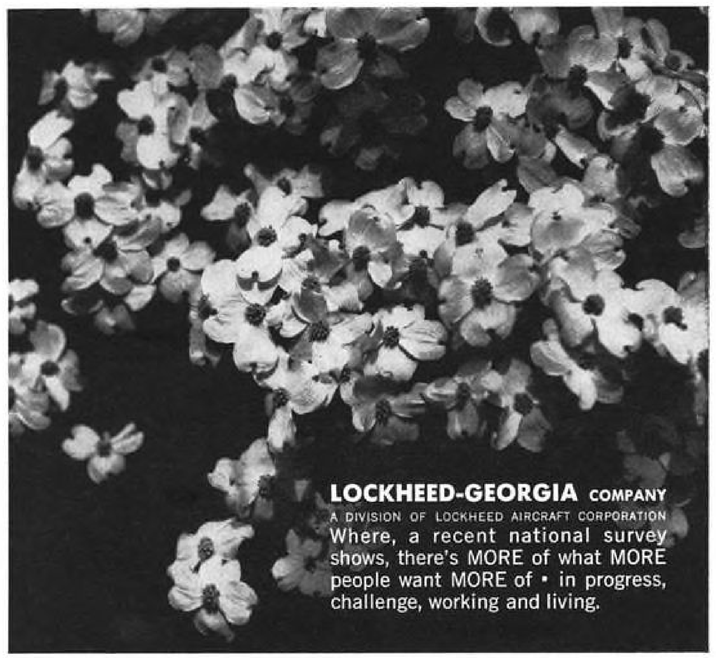
WARNER ELECTRIC BRAKE & CLUTCH COMPANY 95
WYMAN-GORDON COMPANY 4

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 126-131
EQUIPMENT (Used or Surplus New) For Sale 132

ADVERTISERS INDEX

AIR Corporation 132
Avco Research & Development 126
Berry Associates, Inc. 126
Grumman Aircraft Co. 127
Horan, William N. 132
IBM Corporation 129
Jansen, Al 132
Kearfott Division, General Precision Inc. 130
Lawrence Aviation Industries Inc. 132
Martin Orlando, A Div. of Marietta Corp. 126
Pratt & Whitney Aircraft 131
Republic Aviation Corporation 128, 130
Sun Oil Co. 132
Sundstrand Corp. 128
Thiokol Chemical Corporation 130
Trans-Global Airlines 132
University of Southern California 132
Zep Aero 132



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LETTERS

Pershing Credit

As a former member of the USAOMC, Redstone Arsenal, Ala., I read with interest your story on Pershing (AW Apr. 9, pp. 80-87), but feel that no credit was given to the originator of most of the concepts which are proving successful in the Pershing development program.

The successful rainy-night launching of a "near tactical" Army/Martin Pershing ballistic missile is a typical example of what the USAOMC Test and Evaluation Laboratory calls "operational suitability" testing, i.e., tests conducted during the final development phase to demonstrate that the missile system is capable of performing satisfactorily in the world-wide environments to which it will ultimately be exposed.

Actually the laboratory (formerly the ARGMA Test and Evaluation Laboratory) pioneered this type of testing as early as 1957.

The concept was successfully utilized during development of such systems as the Little John, Honest John, Light Antitank Weapon (LAW) and LaCrosse. It is currently being utilized on all missile systems being developed by or under the technical supervision of the USAOMC.

The T & E Lab to which I refer, and by which I was formerly employed from 1954 through 1961, is relatively obscure probably because it was willing to "stick its neck out" during the past several years by introducing concepts which are radical departures from the Army's so-called traditional rigidity. Operational suitability testing is part of an over-all missile system development test philosophy which the USAOMC Test Laboratory has been trying to sell since 1957.

Martin-Orlando was first introduced to the philosophy in 1957 during its development of the LaCrosse GM System under the technical supervision of ARGMA. The ARGMA T & E Lab was appointed test program manager and it is apparent that the Martin professionals learned their lessons well. Undoubtedly, this experience was transferred from LaCrosse to Pershing in 1958.

The over-all test philosophy to which I have frequently referred emphasizes:

- **Building reliability** into a system via the components and/or subsystems, hence the stringent code of quality control being followed in the Pershing flight test program.
- **Recognition that the system** is man-machine and the introduction of the typical, as opposed to the ideal, man into the development tests as early as practicable; hence, the training program which parallels the Pershing firing program, and the plans for gradual change over to Army firings under Martin monitoring and, eventually, to all Army shots.
- **Integrated testing** whereby engineer and service test agencies participate in development tests to the maximum extent possible thereby eliminating duplicate testing. In the case of LaCrosse, it has been conservatively estimated that some $2,500,000 was saved (25 test missiles at a cost of about $100,000 each) by utilizing the integrated test concept.

This is not a criticism of Martin-Orlando. The willingness of that division to participate in such a radical departure from accepted Army practice is commendable. LaCrosse is operational, and Pershing is well on the way toward that goal because the Martin professionals had the guts to try something new.

I like to think that the successful utilization of the concepts outlined herein, and particularly the integrated test concepts, prompted in part the recent Army reorganization with its U.S. Army Materiel Development and Logistic Command and its single Test and Evaluation Agency.

Before closing, let me correct one error which appears on p. 86 of your Pershing story. The service test program (one of the test regimes for the Pershing missile) is not the first user test run by Army. They have been conducted for as long as I can remember; this was the purpose of the USCONARC Boards (Infantry, Artillery, Armor, etc.).

GEORGE C. TRAVERS, JR.
Staff Engineer (Test)
Space and Missile Systems
Minneapolis-Honeywell Regulator Co.
Minneapolis, Minn.

(Thanks to reader Travers for a valuable footnote to AVIATION WEEK*'s story on the Martin Pershing. The intent of the reference to the service test program was to call it the first Army user test on the Pershing missile and not the first-ever such test on any Army weapon.—Ed.)*

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

FAA Certificating

The caption under the picture of a helicopter in the Apr. 23 issue of AVIATION WEEK (p. 25) stated the company "expects to receive Federal Aviation Agency certificate of airworthiness this year." Perhaps it was meant to state "type certificate," but whether or not it was it may be of interest to your readers to know more about these two kinds of certificates.

Just as all horses have four legs but all four-legged creatures are not horses, it can in a somewhat similar manner of speaking be said that to fly legally all type certificated aircraft must have an airworthiness certificate but all airworthiness certificated aircraft do not have to have a type certificate. Generally speaking, a type certificate is obtained after a comparatively long, expensive and rigorous test and analytical program which results in showing compliance with a particular set of Civil Air Regulations (e.g., CAR 6 for a normal category rotorcraft), whereas an airworthiness certificate involves comparatively less time and expense to get.

A type certificate is issued for a design (rather than for an existing aircraft); it (i.e., one type certificate) can cover a multitude of aircraft (e.g., all which may be built to conform with the type design), and it is never displayed in or on the aircraft. On the other hand, an airworthiness certificate is issued only for an existing aircraft; it applies only to one aircraft, and it must be displayed in or on the aircraft. It is possible to obtain a type certificate without having an actually existing aircraft which conforms to the type design; it is not possible to obtain an airworthiness certificate without having an actually existing aircraft. A type certificate is transferrable without the necessity to transfer any aircraft (if they should exist), or may be made available to a third party under licensing agreements and can represent a valuable asset. The airworthiness certificate is transferrable only with its individual aircraft, and generally does not represent as valuable an asset as a type certificate can be.

The above are only a few and perhaps over-simplified comments on this subject. Should any of your readers wish additional information they are cordially invited to contact their nearest FAA District Office or the writer.

WILLIAM OLEKSAK, Assistant Chief
Engineering and Manufacturing Branch
Idlewild Airport
Federal Aviation Agency
Eastern Region

*(*AVIATION WEEK*'s caption was correct, but readers may be interested in Mr. Oleksak's helpful offer.—Ed.)*

PB-20 Autopilot

The Eclipse-Pioneer Division of The Bendix Corp. will supply a modified PB-20 autopilot to the Nihon Aeroplane Manufacturing Co., Ltd., Tokyo, for use on the **YS-11 twin turboprop airplane.** This was reported incorrectly in your Apr. 20 issue of AVIATION WEEK (p. 75) as the Y5-11 twin turboprop 52-60 passenger helicopter.

While there may be a requirement for a helicopter of this size, to our knowledge there is nothing around to fill the bill. If there is, the PB-20 would also handle it as it has done in 23 different installations to date.

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REX R. HAMILTON
Ass't. Sales Manager-Systems
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*(*AVIATION WEEK & SPACE TECHNOLOGY *erred in the designation of the Japanese transport now under development. Reader Hamilton's description is correct.—Ed.)*

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ALS — All-weather, automatic Aircraft Landing System. This electronic "window in the sky" automatically guides planes to safe landings in foul weather, at night, even in heavy seas. Purchased by Navy for installation on 10 modern aircraft carriers.

AGENA ROCKET ENGINE — Stop-and-start engine for the Air Force and NASA satellite and space probe programs. It has put in orbit more payload than any other engine.

HIPERNAS — High Performance Navigation System. Designed for the U. S. Air Force, this self-compensating, pure inertial guidance system can pinpoint a long-range missile on target, or guide a satellite or space ship to any point in the universe.

STEERING GEAR FOR MERCURY ASTRONAUTS — Jet Reaction Controls, developed by Bell, control the roll, pitch and yaw of the Mercury capsule in space.

EETF — Electronic Environmental Test Facility at Ft. Huachuca, Arizona. Bell is operating the electronic phase of this program to analyze communications interference due to large volume of radio and electronic equipment being used in modern military operations.

HYDROSKIMMER — A novel vehicle that travels over water or land on a cushion of air. SKMR-1, contracted for by the U. S. Navy, is 62 feet long and weighs 22 tons. It carries a crew of three, a five-ton payload and travels at speeds in excess of 70 miles per hour.

BELL AEROSYSTEMS COMPANY • *Buffalo 5, N. Y.*
DIVISION OF BELL AEROSPACE CORPORATION

A textron COMPANY

JUN. 5 1962

PHANTOM II . . . THREE SERVICE FIGHTER

Never before has one aircraft so indelibly marked the pages of military aviation history. It is appropriate that the Phantom II will now serve three air arms of our nation.

This multiple mission fighter, designated F4H-1, is already in service as an air defense interceptor for the United States Navy. With the same designation, the Phantom II will soon be delivered to the United States Marines for close support and air superiority missions. Designated the F-110A and the RF-110 by the United States Air Force, this versatile aircraft is now being built to augment the tactical strike and reconnaissance capability of that service.

RECORD FLIGHTS OF THE PHANTOM II:

16 kilometer straightaway . . . . . 1606 mph
3 kilometer low altitude . . . . . 902 mph
100 kilometer closed course . . . . . 1390 mph
500 kilometer closed course . . . . . 1216 mph
Sustained altitude (level flight) . . . . . 66,443 feet
Los Angeles to New York . . . . . 170 minutes
Altitude . . . . . Over 100,000 feet

Time to Climb (in meters):

3,000 . . . . 34.52 seconds	15,000 . . . 114.54 seconds
6,000 . . . . 48.78 seconds	20,000 . . . 178.50 seconds
9,000 . . . . 61.62 seconds	25,000 . . . 230.44 seconds
12,000 . . . . 77.15 seconds	30,000 . . . 371.43 seconds

MCDONNELL

F4H and F-110A Fighter and Attack Aircraft • RF-110 Reconnaissance Aircraft •
Mercury, Gemini, Asset and Aeroballistic Spacecraft • Talos and Typhon Missile Airframes and Engines •
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Engineers and Scientists: Employment opportunities exist at McDonnell, prime contractor on projects in the national interest such as MERCURY, ASSET, GEMINI, and PHANTOM II. Equal Opportunity Employer. For information, write: Professional Placement, McDonnell, Dept. A 5 , Box 516, St. Louis 66, Mo.