# Aviation Week and Space Technology

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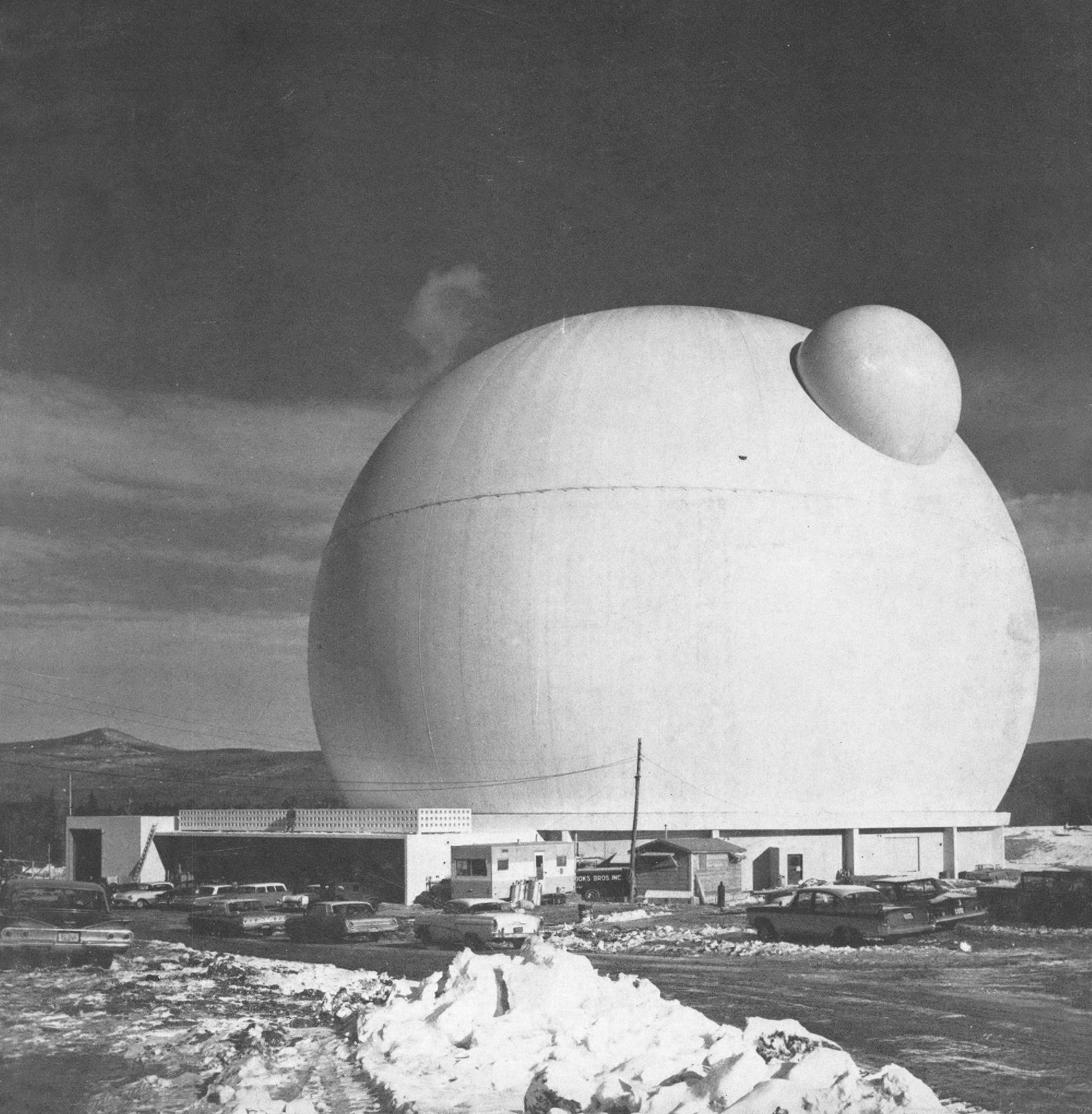
A McGraw-Hill Publication

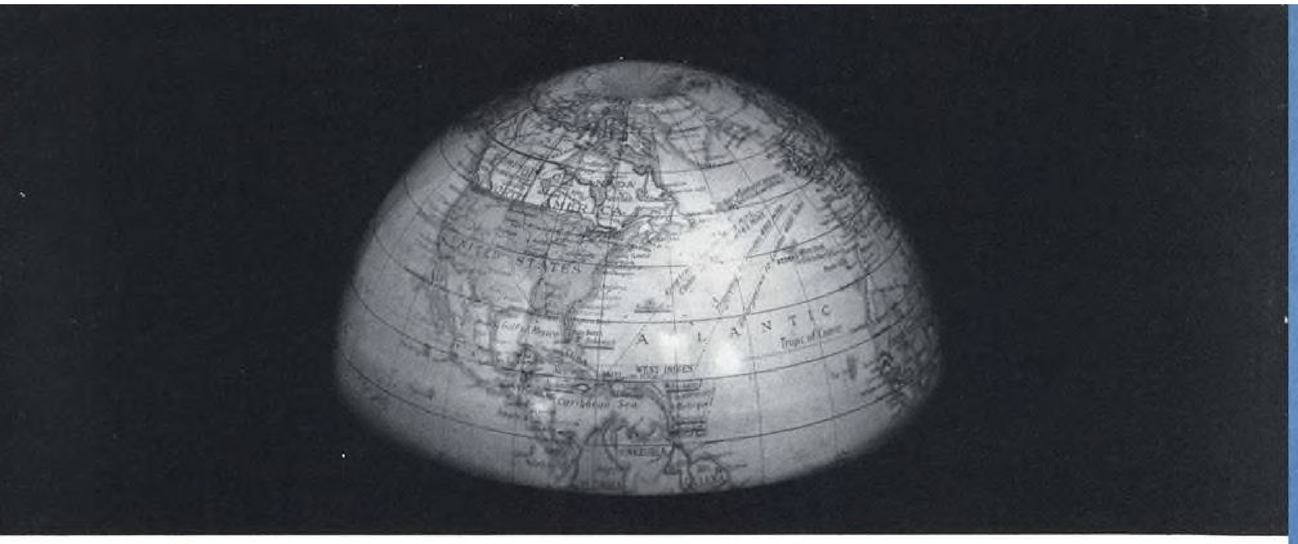
February 12, 1962


PILOT REPORT:

## AW 650 Argosy Cargo Transport

AT&T Telstar Comsat Station





# A WORLD OF FASTENERS BY VOI-SHAN

Voi-Shan Manufacturing Company offers a wide wide world of products in the fastening field to serve an ever growing variety of aircraft and missile fastening needs. ■ Available the world over, Voi-Shan products are now being supplied to customers throughout the entire United States, Canada, Europe and the Far East.

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To learn more about these and other quality Voi-Shan Fasteners, write on your letterhead to receive catalogs covering each item in specific technical detail, to keep the world of Voi-Shan at your fingertips.

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## VOI-SHAN MANUFACTURING COMPANY

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# BIGGER "EARS" FOR THE NAVY

**1 KILOWATT SEMICONDUCTOR AUDIO AMPLIFIERS TODAY**

**100 KILOWATT SEMICONDUCTOR AUDIO AMPLIFIERS TOMORROW**

Today, the Boston Division of Honeywell is delivering one kilowatt linear audio amplifiers for driving sonar transducers to the United States Navy Underwater Sound Laboratory.

Tomorrow, using a new basic technique for producing a-c and d-c at high power levels, Honeywell is designing semiconductor amplifiers capable of hundreds of kilowatts of audio power.

Employing transistors in the switching mode, Honeywell engineers have developed a feedback system of pulse width modulation (patent pending) which produces more accurate linear amplification than any conventional method.

The new technique can be used wherever low power a-c or d-c is to be amplified from a different a-c or d-c power source and wherever amplitude of voltage or current must be controlled.

A method of creating bigger "ears" for the Navy is typical of the inventive thinking of Honeywell's Military Products Group. In the electronics area exciting new ideas are being explored in high power solid state audio amplifiers. These amplifiers are an important contribution to Honeywell's expanding sonar systems capability.

Write for information on Honeywell's capabilities in the electronics area to Minneapolis-Honeywell, Boston Division, Dept. 2, 1400 Soldiers Field Road, Boston 35, Mass., or call your local Military Products Group Office. Sales and Service offices in all principal cities of the world.

Challenging career positions for Electro-Mechanical Design Engineers, Circuit Design Engineers and Physicists are now available in the Boston Division. Write to Personnel Department.

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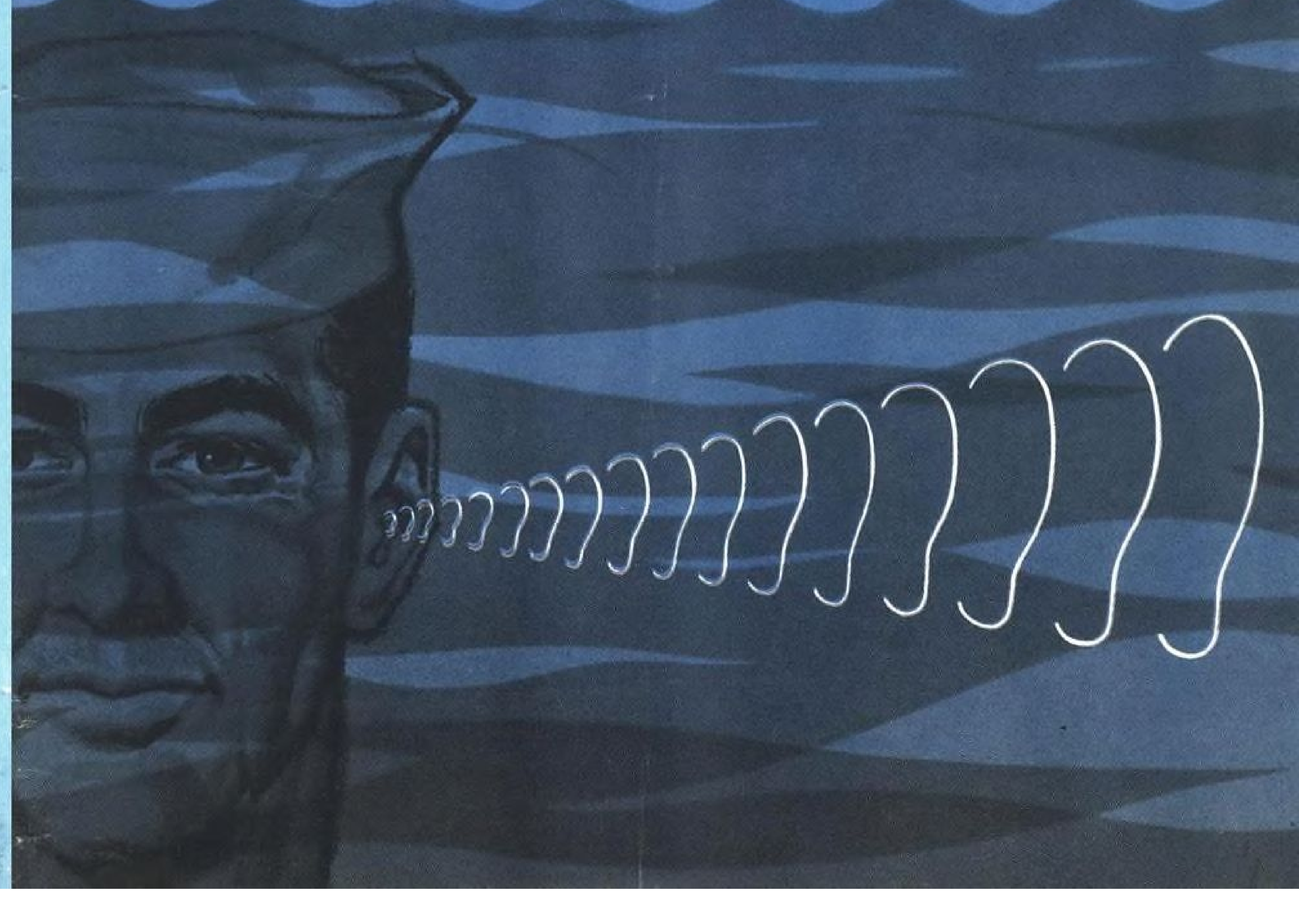
H HONEYWELL Military Products Group



# FORGING OUR SPEARHEADS IN SPACE

1 Titanium motor case parts totalling 2010 lbs.
2 ICBM heat sink cone; Copper, 1876 lbs.
3 Ported motor closure; 74 lbs., Aluminum.
4 Magnesium turbopump ring gear; 35 lbs.
5 Sustainer ring; 208 lbs., alloy steel.
6 Aluminum airframe ring splice; 53 lbs.
7 Missile blast cone; 237 lbs., carbon steel.
8 Stainless steel injector plate; 155 lbs.
9 Payload container; 10 lbs., Beryllium.
10 Super-strength steel head; 725 lbs.
11 Missile fin spar; 65 lbs., Aluminum.
12 Thrust cone; 613 lbs., alloy steel.
13 Power system part; 1300 lbs., Columbium.
14 Titanium igniter nozzle; 122 lbs.
15 Pressure bottle half; Titanium, 173 lbs.
16 Astroloy turbopump wheel; 170 lbs.
17 Heat shield backup; 134 lbs., Magnesium.
18 Airframe wind arm; 129 lbs., Aluminum.
19 Super-strength steel, 3100-lb. head.
20 Alloy-steel missile bulkhead; 130 lbs.
21 Tungsten nozzle throat insert; 115 lbs.
22 Aluminum sustainer thrust cone; 110 lbs.
23 Aft closure; 1600 lbs., super-strength steel.
24 Airframe rib spar; 95 lbs., Titanium.
25 Motor-case Titanium closure; 590 lbs.
26 Missile bulkhead; Aluminum, 89 lbs.
27 Beryllium guidance carrier ring; 23 lbs.
28 Booster turbowheel; Rene 41, 948 lbs.
29 Rocket spur gear; 18 lbs., Magnesium.
30 Magnesium satellite canister; 229 lbs.
31 IRBM Jetevator ring; 45 lbs., Molybdenum.
32 Missile motor Copper blast cone; 88 lbs.
33 IRBM spacer ring; 78 lbs., Tungsten.
34 Aluminum longeron for ICBM; 36 lbs.
35 Launching shoe; 26 lbs., alloy steel.
36 Columbium power system part; 1100 lbs.
37 Tungsten thrust-chamber throat; 32 lbs.
38 Glide vehicle component; Rene 41, 3 lbs.
39 Beryllium guidance main shaft; 9 lbs.
40 Launch vehicle domes; capability to 160°.

To call the roll of America's space efforts—in missiles, satellites, launch vehicles and spacecraft—is virtually to name the projects which rely on Wyman-Gordon forgings.

Specialization has made it so. For this is the one source whose pioneering in the sophisticated metal-forming requirements of flight dates from the dawn of our air age.

Thus Wyman-Gordon brings to today's space challenges a record of hot-working achievement and experience unduplicated in both environments.

This background considerably extends the scope of Wyman-Gordon forging services. Here, broad-spectrum capabilities in engineering, metallurgy and basic research are teamed with space-oriented facilities to forge vital components in all areas—payload, guidance, airframe, propulsion, auxiliary power and ground support.

Consultation can indicate how ultimate performance of your project's critical-mission hardware may benefit from Wyman-Gordon breakthroughs in forging exotic and refractory materials to new design parameters.

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## AEROSPACE CALENDAR

**Feb. 19-21**—Tracking & Command of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

**Feb. 22**—First Women's Space Symposium, Ambassador Hotel, Los Angeles, Calif.

**Feb. 23-24**—American Ordnance Assn.'s Container Section Meeting, Naval Ordnance Laboratory, Silver Spring, Md.

**Feb. 27**—Conference of aircraft operators and equipment manufacturers with the Federal Aviation Agency to specify airborne equipment requirements of Project Beacon report, Department of Labor Auditorium, Washington, D. C.

**Feb. 27-Mar. 1**—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: Society for Nondestructive Testing; Southwest Research Institute.

**Feb. 27-Mar. 1**—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

**Mar. 1-3**—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

**Mar. 5-8**—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

**Mar. 8-9**—Institute of the Aerospace Sciences' Propulsion Meeting (classified), Cleveland, Ohio.

**Mar. 14-16**—Electric Propulsion Conference,

(*Continued on page 7*)


AVIATION WEEK and Space Technology

February 12, 1962

Vol. 76, No. 7

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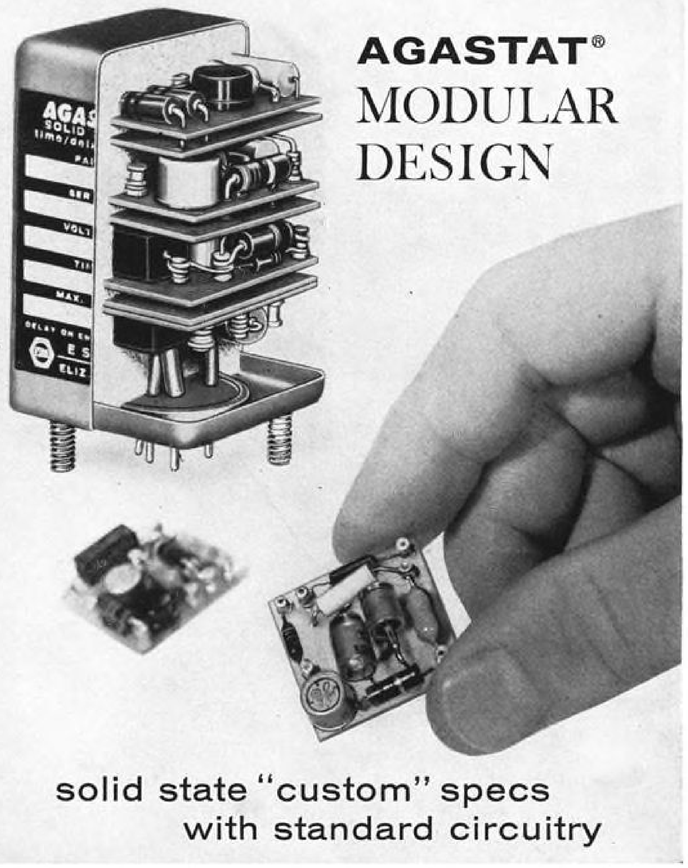

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New AGASTAT solid state time/delay/relays offer you greater reliability, wider timing ranges, and more design flexibility than has ever been available before in solid state relays. The unique "modular sandwich" construction simplifies production, speeds delivery of custom-made units.

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## AEROSPACE CALENDAR

(Continued from page 5)

American Rocket Society, Hotel Claremont, Berkeley, Calif.

**Mar. 16**—Annual Robert H. Goddard Memorial Symposium, "Torques and Attitude Sensing in Satellites," American Astronautical Society, Washington.

**Mar. 20-21**—University of Denver's Second National Symposium on Hypervelocity Techniques, Denver, Colo.

**Mar. 26-29**—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

**Mar. 28-29**—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

**Mar. 29-30**—Fourth Annual Electron Beam Symposium, Alloyd Electronics Corp., Cambridge, Mass.

**Apr. 1-4**—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

**Apr. 3-5**—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

**Apr. 3-6**—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

**Apr. 10-12**—Second Symposium on The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston. Sponsor: AF Cambridge Research Laboratories.

**Apr. 11-13**—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

**Apr. 11-13**—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Sheraton Chicago Hotel, Chicago, Ill.

**Apr. 12-13**—Eighth Annual Heat Transfer Conference, Oklahoma State University, Stillwater, Okla.

**Apr. 13**—Government Contracts Symposium, National Assn. of Professional Contracts Administrators, Ambassador Hotel, Los Angeles, Calif.

**Apr. 14-16**—Second Conference on Kinetics, Equilibria, and Performance of High Temperature Systems, University of California, Los Angeles, Calif. Sponsor: Western States Section/Combustion Institute.

**Apr. 16-18**—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

**Apr. 16-18**—Aerospace Systems Reliability Symposium, Institute of the Aerospace Sciences, Salt Lake City, Utah.

**Apr. 24-26**—Polytechnic Institute of Brooklyn's Symposium on the Mathematical Theory of Automata, United Engineering Center, New York, N. Y.

**Apr. 25-29**—Western Space Age Industries and Engineering Exposition, Cow Palace, San Francisco, Calif.

**Apr. 30-May 2**—Meeting on Manned Space Flight, Institute of the Aerospace Sciences, Hotel Chase, St. Louis, Mo.

**May 1-3**—Spring Joint Computer Conference, Fairmont Hotel, San Francisco.

(Continued on page 9)

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32-WATT P.E.P. OUTPUT LINEAR AMPLIFIER

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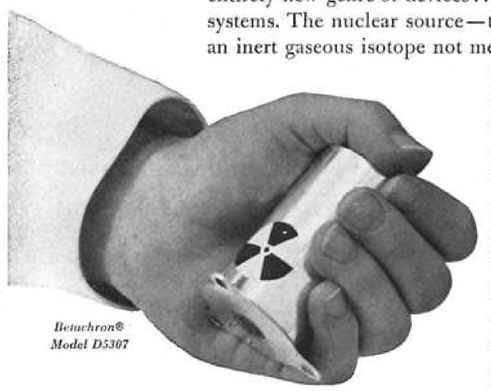
# STATUS REPORT ON SELF-POWERED AEROSPACE DEVICES

Nuclear-Powered Components: The availability of a miniature nuclear source has made possible an entirely new genre of devices . . . that of self-powered components for aerospace systems. The nuclear source—the Leesona Moos Krypton 85 Battery—contains an inert gaseous isotope not metabolized by the body and quickly dispersible in air should the battery be damaged. As a result, the battery is a very practical as well as reliable unit, delivering in excess of 10,000 volts, charging linearly to 1,000 volts, and having an operating life of over ten years.



*Betachron® Model D5307*

■—As would be expected, the advent of such a power source has been accompanied more recently by a new wave of components designed around it. Most of the new Leesona Moos components are aerospace-type transducers: small, lightweight, self-powered.

■—*Example I:* the Betachron® Model D5307. This is an acceleration-actuated delay timer which senses uniaxial acceleration, initiates a time delay when a certain predetermined g force has been reached, then delivers an electrical signal to the load. The time delay can be set for a minimum of 15 seconds and the maximum is limited only by duration of acceleration. Should the g level fall below the set value before the time delay is complete, the device automatically resets itself. With its highly reliable service life of 10 years, plus its unusual characteristics, the Betachron D5307 has found a number of aerospace system applications, such as data package release, parachute release, weapon sterilization, and actuation of satellite transmitters or other equipment.

■—*Example II:* The Ionoswitch™ System. This device senses altitude as a function of air density differential, initiates a time delay at the pre-set altitude, then delivers a capacitor discharge or closes a switch. It contains only one moving part and can be set for altitudes from 0 to 250,000 feet. The applications of the Ionoswitch Altitude Sensing System include stage destruct, stage separation, package release, re-entry body release, and other similar aerospace uses.

■—These are but two of a new group of self-powered aerospace devices. All are characterized by ruggedness; being unaffected by shock, vibration, or temperature cycling, and usable or storable for a period of more than 10 years, they offer a high order of reliability. Because the battery isotope is a beta emitter, only routine low-level-radioactivity handling is required. For data on these and many other novel aerospace components, both nuclear-powered and non-nuclear, write Leesona Moos Laboratories at Dept. 32.

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## AEROSPACE CALENDAR

(*Continued from page 7*)

**May 2-4**—18th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

**May 2-11**—International Space Research and Technology Exhibition, London, England. Sponsor: British Interplanetary Society.

**May 3-4**—First International Congress on Human Factors in Electronics, Institute of Radio Engineers, Lafayette Hotel, Long Beach, Calif.

**May 7-9**—Materials & Processing for Space Environments Symposium, Society of Aerospace Material and Process Engineers, Hotel Statler, St. Louis, Mo.

**May 7-11**—Annual Conference, Society of Photographic Scientists and Engineers, Somerset Hotel, Boston, Mass. Cosponsor: Air Force Cambridge Research Laboratories.

**May 8-10**—12th Annual Electronics Components Conference, Marriott Twin Bridges Motor Hotel, Washington, D. C.

**May 14-16**—National Aerospace Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

**May 14-16**—Joint Technical Society-Department of Defense Symposium on Thermionic Power Conversion, Antlers Hotel, Colorado Springs, Colo.

**May 14-17**—21st Annual National Conference, Society of Aeronautical Weight Engineers, Benjamin Franklin Hotel, Seattle.

**May 20-24**—Annual Conference, American Assn. of Airport Executives, Ambassador Hotel, Los Angeles, Calif.

**May 21-25**—Eighth Aerospace Instrumentation Symposium and National Telemetering Conference, Sheraton Park Hotel, Washington, D. C.

**May 22-24**—Conference on Self-Organizing Systems, Museum of Science and Industry, Chicago, Ill. Sponsors: Office of Naval Research; Armour Research Foundation.

**May 22-24**—National Microwave Theory & Techniques Symposium, Institute of Radio Engineers, Boulder, Colo.

**May 24-26**—Seventh Region Conference on Space Communications, Institute of Radio Engineers, Seattle, Wash.

**June 6-7**—Symposium on Standards for Filament-Wound Reinforced Plastics, Naval Ordnance Laboratory, Silver Spring, Md. Sponsors: U. S. Navy; American Society for Testing and Materials.

**June 8-9**—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

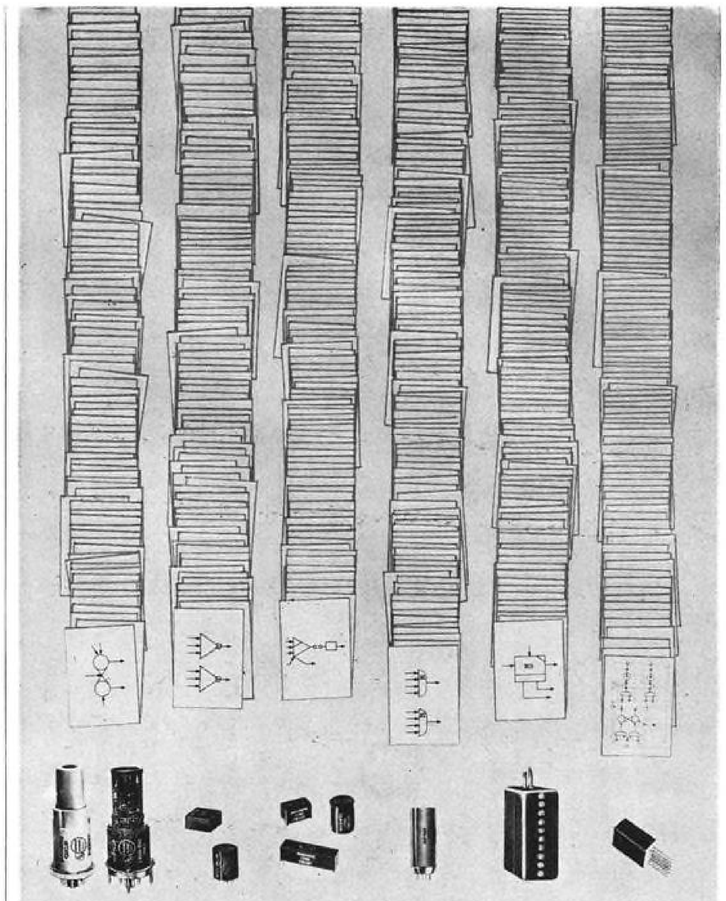
**June 13-15**—Annual Meeting, Heat Transfer and Fluid Mechanics Institute, University of Washington, Seattle, Wash.

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

**June 25-30**—Symposium on Electromagnetic Theory & Antennas, Copenhagen, Denmark. Sponsors: Technical University of Denmark; International Scientific Radio Union.

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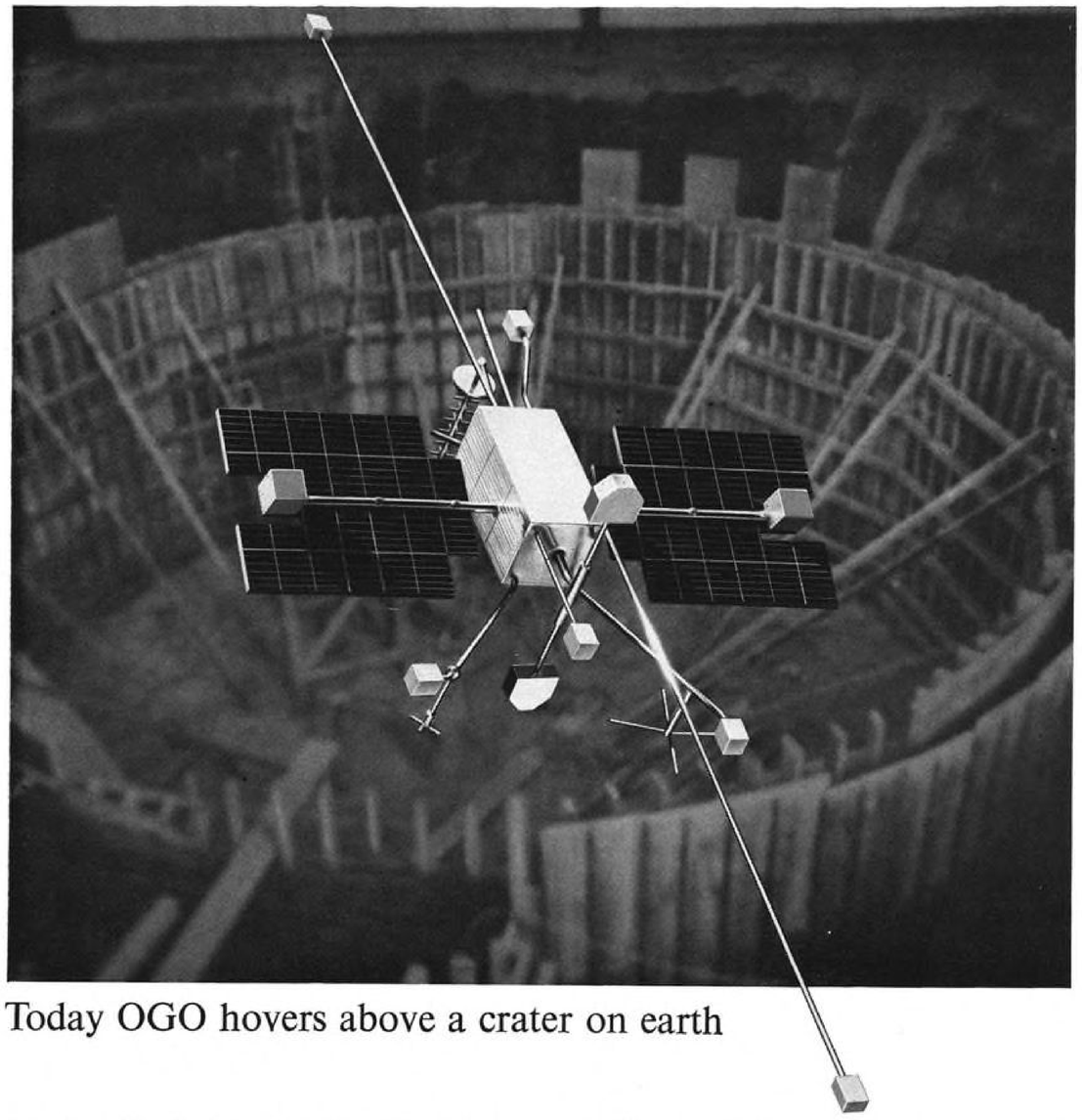

Today OGO hovers above a crater on earth

Soon a new space chamber 30 feet in diameter will fill this deepening bowl of earth. Here OGO (NASA's Orbiting Geophysical Observatory) will be subjected to conditions of solar heating, vacuum, and vehicle radiation to the cold of outer space. The new space chamber will be the sixth at STL. It will enable engineers and scientists working on OGO, Vela Hotel and other STL projects to test large, complete spacecraft as well as major subsystems. And along with other advanced facilities at STL's Space Technology Center, it will provide unusual scope for engineers and scientists to verify and apply new techniques in design, development and fabrication of spacecraft. STL's expanding space programs have created new opportunities for engineers and scientists in the following fields: Aerodynamics, spacecraft heat transfer; Communication Systems; Electronic Ground Systems; Power Systems; Propellant Utilization; Propulsion Controls; Reentry Body Evaluation; Systems Analysis; Thermal Radiation; and Trajectory Analysis. All qualified applicants are invited to write Dr. R. C. Potter, Manager of Professional Placement and Development, for opportunities with STL in Southern California or at Cape Canaveral. STL is an equal opportunity employer.

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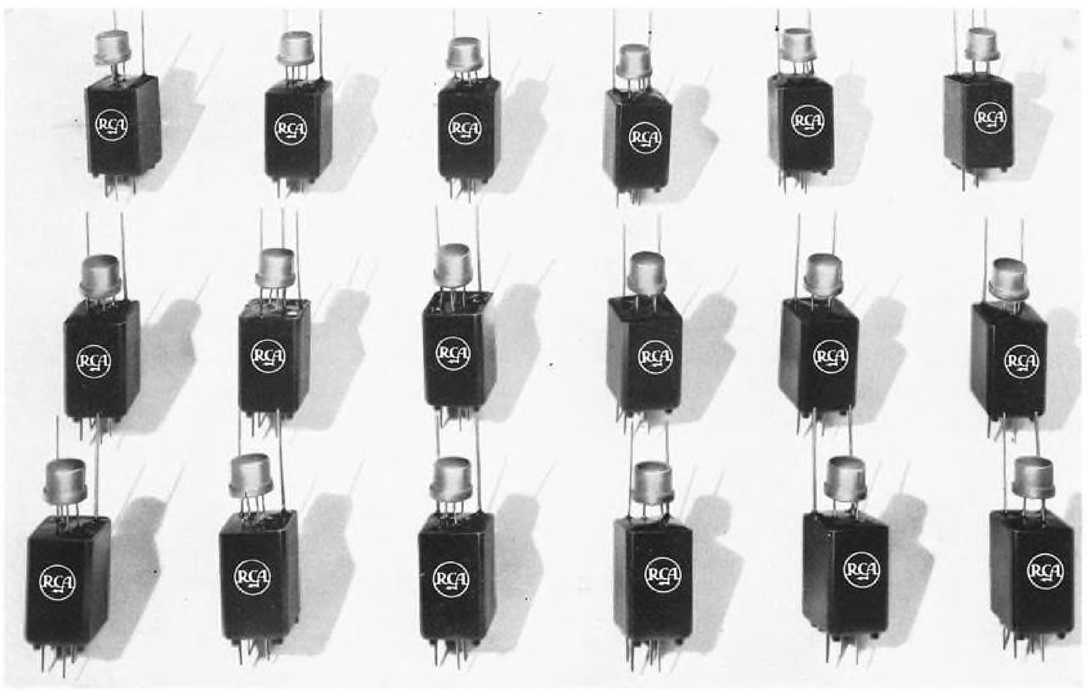

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● RCA microelectronics specialists are ready to work with you to design your Minimodule circuit package. Typical of the 40 types now in production are four RCA Minimodules for digital-computer applications. These high-performance units, built with RCA's experience in manufacturing hundreds of thousands of digital Minimodules, are available now, ready for mounting on standard printedcircuit boards. Order these RCA Minimodules now:

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RCA CP0919 . . . Minimodule Power-Gate Input Circuit
RCA CP0920 . . . Minimodule Power-Gate Output Circuit

● Call your RCA representative for information on the comprehensive line of RCA transistor-circuit Minimodules and RCA Micromodules. Or write RCA Semiconductor and Materials Division, Commercial Engineering Section B-112-NM, Somerville, N. J.

**RCA Minimodules** — miniature packaged circuits, utilizing conventional components and transistors—can be supplied in high volume, in the format you need, with terminal arrangements to meet your assembly requirements. (Minimodule shown at left, before encapsulation, 1½ times actual size. Units below are typical of wide variation in configurations available through RCA.)

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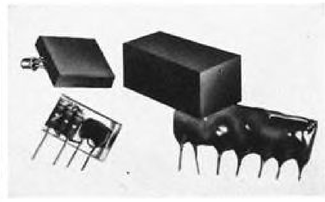

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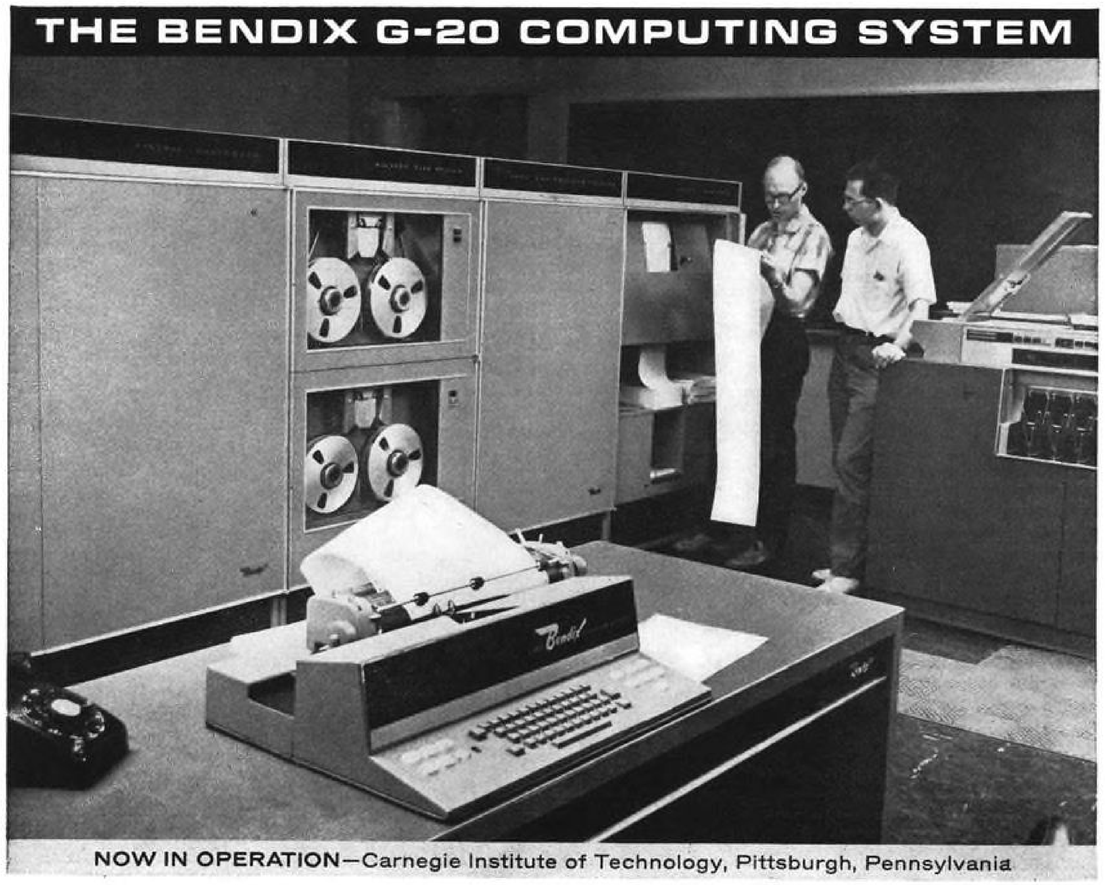

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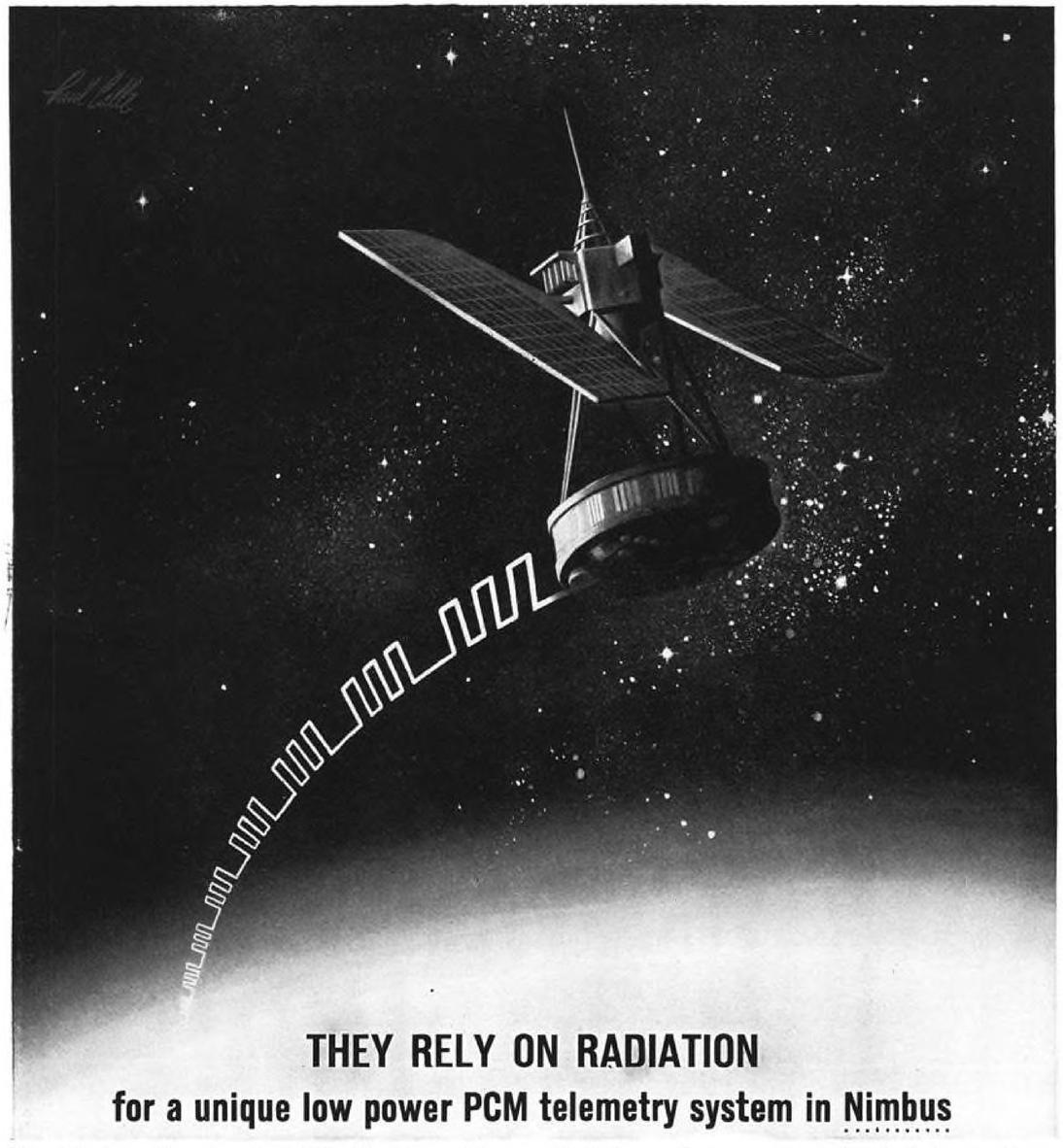

# THEY RELY ON RADIATION

## for a unique low power PCM telemetry system in Nimbus

When *Nimbus*—the meteorological Satellite System being developed by the Goddard Space Flight Center of the National Aeronautics and Space Administration—begins sending its global weather reports to earthbound meteorologists, a Radiation PCM telemetry system will prepare data on the status and condition of the satellite for transmission. Other Radiation-produced systems in the *Nimbus* ground stations will process these data.

Innovations in the spaceborne system will slice power requirements to a fraction of that needed for current PCM equipment. In fact, data from 650 transducers will be digitized with only *1.0 watt* . . . compared to many times that required in present systems.

The idea is as simple as turning off the lights in an unused room: just switch off the power during the microsecond intervals between pulses. Its execution wasn't that simple, but Radiation engineers, working under the first contract ever awarded for a satellite PCM system, achieved the result—and a notable advance in the state-of-the-art.

The *Nimbus* system embodies PCM experience dating back to 1951, when Radiation contracted for the first airborne PCM system. This fast-growing company offers attractive career opportunities in a broad spectrum of scientific and engineering specialties. For details on Radiation write Dept AW-22. Radiation Incorporated, Melbourne, Florida.

*Radiation is an equal opportunity employer.*

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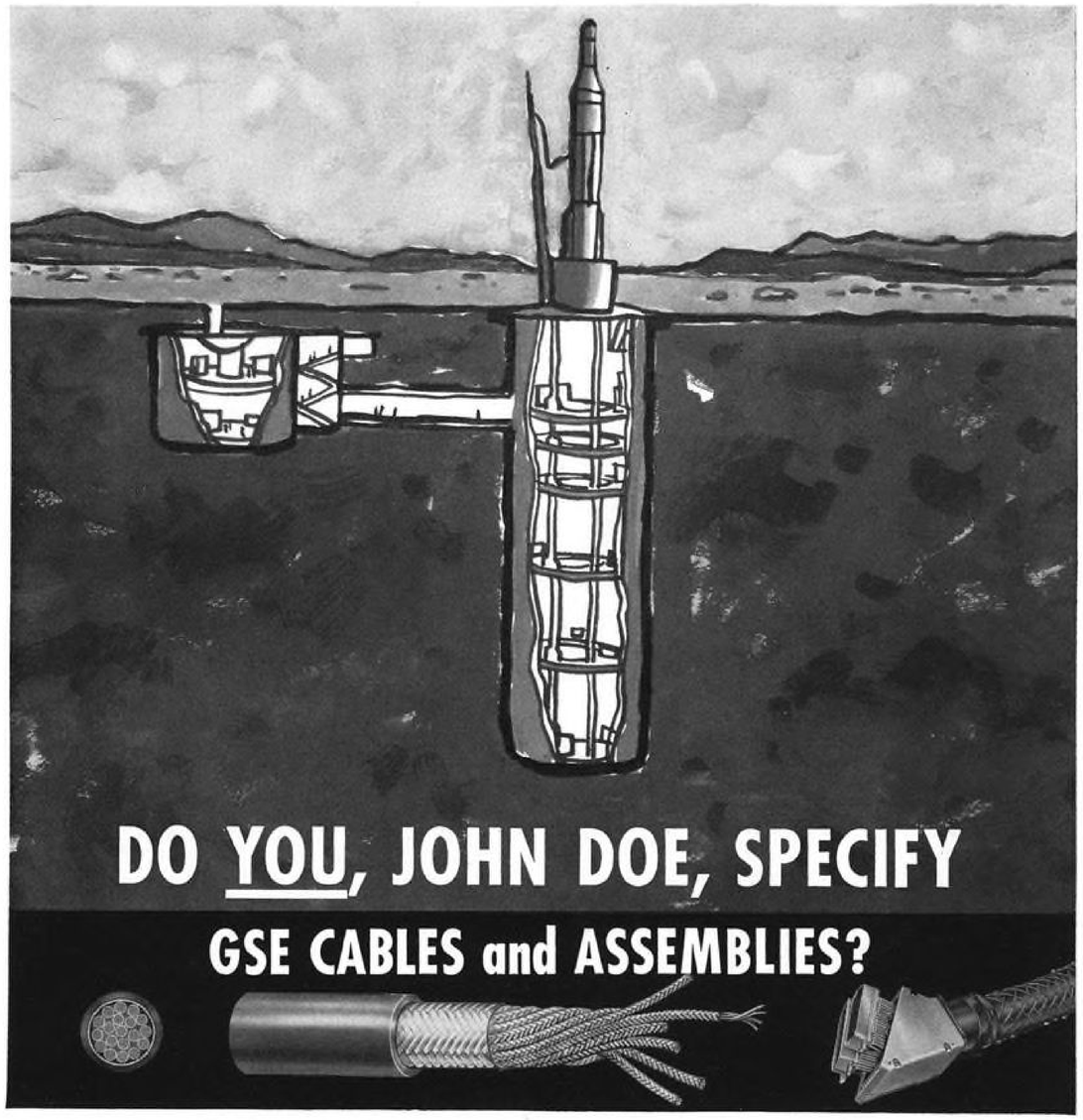


...and work on applications where oil, ozone, and weather resistance *really* count? You've plenty of company, John Doe. Other problems include the absolute necessity of good flexibility and stand-up to impact, bending, and twisting over an ambient temperature range from −65°F to +160°F—not to mention rough installations, reeling and unreeling over dry, rocky ground.

John, that reliability bit has more punch than we might think. Hitemp ground support cable and cable assemblies—CONFORMING TO MIL C-13777C—are precision-engineered for tough customers, like yours and mine. Applications? Power and transmission lines; ground support equipment cables for guided or ballistic missile launching pad; and test equipment cables for unmanned aircraft.

And how about this one, John? Hitemp has the whole setup required to make complete, ready-to-use assemblies—all complying with "13777C". Modular units that save real money in original and installation costs, as well as long-term economy. This also includes the entire custom design routine—whatever you need.

Hitemp is a rare one, John. We can write to them about our problem, send for their "Condensed Catalog", and possibly even their engineering assistance. What can we lose?

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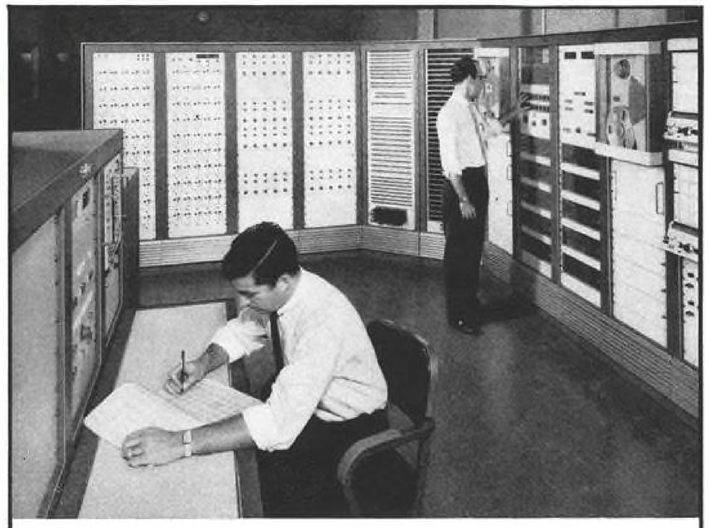
**ASTRODATA**

# NEWSLETTER

## 200-Channel Data System speeds space probes at Lockheed

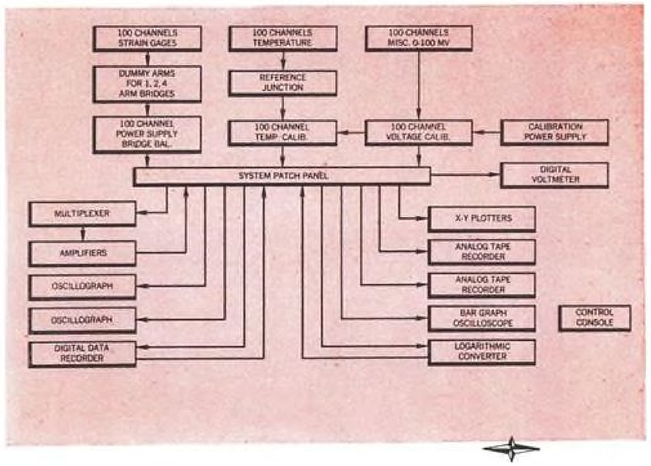


Astrodata high speed digital data system now in operation at Lockheed/Sunnyvale can handle 200 channels of information from any of three types of sources: strain gauge bridge signals, thermocouples, and miscellaneous millivolt signals.

Space research today demands fast, flexible and accurate data-gathering facilities. What this means in terms of functioning hardware, available *now*, is well-illustrated at Lockheed Missiles and Space Division's laboratory. Here are some of the environmental situations Lockheed engineers must instrument:

*Loads of 500,000 force-pounds down to 5, with instrumented load gradations as small as 0.02 force-pound—all recorded to 0.5% accuracy. Meanwhile the satellite may be experiencing a heat rise of 200° F per second and a 1000 g shock in 10 microseconds.*

To record structural, dynamic and electrical-electronic performance under these stringent conditions, Astrodata designed and produced this high speed, flexible and accurate digital data acquisition system.




### TECHNICAL FEATURES

* **Low level multiplexing** allows 40 wide-band differential amplifiers to operate 200 channels. Techniques saved approximately one-fourth over the cost of comparable systems.

* **Automatic accuracy-check** and fault-finder ensures overall system accuracy and simplifies system maintenance. Accuracy of the system is better than ±0.1% of full scale, excluding the end instrumentation and amplifiers.

* **Completely flexible,** the system can record from 1 channel at a 10,000 sample-per-channel-per-second rate to 200 channels at a 50-sample-per-channel-per-second rate.

### MORE INFORMATION AVAILABLE

Astrodata engineer William F. Kamsler has prepared a technical paper, given at the 1960 ISA conference, which completely describes this system. For a free copy, please write us.

**ASTRODATA INC.**
*Successors to Epsco-West*
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How Science Serves Defense at Westinghouse... Airborne Radar

Phantom II . . . the fastest, highest-flying fighting aircraft.

# Firepower CONTROL

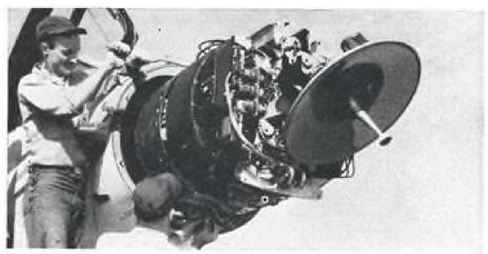
In defense or attack . . . in any weather . . . the Navy's new McDonnell F4H is a mighty potent fighting aircraft. It carries a variety of weapons . . . and relies on one of the most advanced and accurate airborne missile control radars ever built, the APQ-72 by Westinghouse.

Now operational, the APQ-72 is a proved radar. Long range. All-weather. Designed and packaged for high reliability and ease of maintenance, with "built-in" test features.

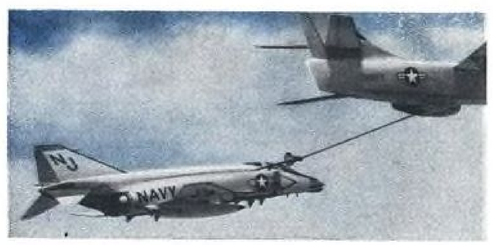
This modern, airborne radar is the latest in a succession of outstanding applications, which include the Bomarc target seeker and the Aero-13 system for the F4D "Skyray". It is another example of Westinghouse leadership in aerospace electronics.—Defense Products Group, 1000 Connecticut Avenue, N.W., Washington 6, D. C.

*You can be sure . . . if it's Westinghouse.*

**Westinghouse**



Years of airborne electronics experience at Westinghouse with such radars as the Aero-13 system in the Douglas F4D, and the Boeing Bomarc have produced many state-of-the-art advances. These are incorporated in the all-new APQ-72 system.




Accuracy and long range of the APQ-72 system were demonstrated during the 1961 record-setting Bendix Trophy race. It located tanker aircraft long before they were in sight, helping cut aerial refueling times in half.

## A NEW ERA IN ADHESIVE BONDING

**The world's largest autoclave** is being built at Rohr. With a 15-ft. working diameter, 30-ft. working length, 200-psi working pressure, and heat range to 500 degrees F, it will be ready to serve space-age production by mid-summer. This giant oven will accept any configuration and cure any size structure that can be handled by the nation's rail transportation. It will join our present battery of bonding autoclaves, and together with Rohr's tremendous metals processing, tooling and fabrication capabilities will provide the strongest bonding complex anywhere. Another instance of Rohr's aim to remain the world's largest producer of adhesive bonded structures for the aerospace industry. For details concerning adhesive bonding at Rohr, write Mr. A. R. Campbell, Sales Manager, Dept. 94, Rohr Corp., Chula Vista, Calif.

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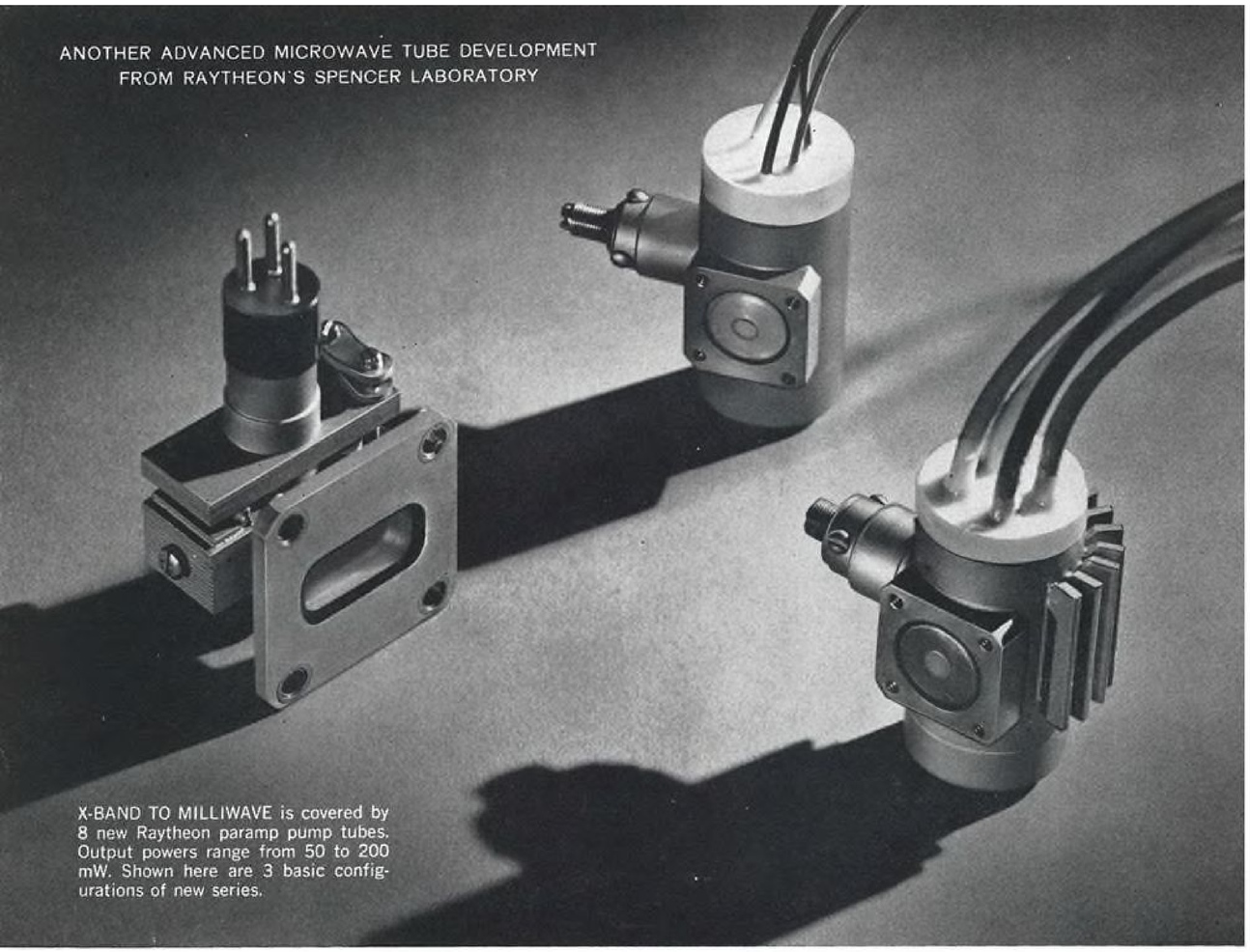


# 9.5-67.5 kMc paramp pump tubes join extensive Raytheon line

New rugged tubes extend Raytheon paramp pump tube coverage through millimeter region

Raytheon has added another eight paramp pump tubes to a line of 25 tubes extending the upper coverage into the millimeter wave region. The latest additions cover X, K and millimeter frequencies for application in laboratory, ground or airborne systems.

The new tubes which are extremely rugged and compact, offer a variety of power levels. The four trim tunable models permit ±50 Mc trim tuning and can be furnished with a dielectric tuner for broader mechanical tuning. All tubes are competitively priced.

Write today for technical details on the complete Raytheon line of paramp pump tubes. Address Raytheon Company, Microwave and Power Tube Div., Waltham 54, Mass.

**FREQUENCY AND POWER DATA**

| Tube Type | Frequency | Power Output |
|---|---|---|
| QKK 1022 | 9.5-11.0 kMc | 75 mW min. |
| QKK 1048 | 10.5-12.4 kMc | 150 mW ave. |
| QKK 1043 | 17.5 kMc* | 300 mW min. |
| QKK 1017 | 24 kMc* | 50 mw min. |
| QKK 991 | 24 kMc* | 200 mW min. |
| QKK 996 | 35 kMc* | 200 mW min. |
| QKK 1055 | 60-65 kMc | 200 mW min. |
| QKK 1056 | 63.5-67.5 kMc | 200 mW min. |

*Factory preset at desired frequency; trim tunable ± 50 Mc.

RAYTHEON

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MICROWAVE AND POWER TUBE DIVISION



February 12, 1962

# Aviation Week and Space Technology

Vol. 76, No. 7
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**COVER:** Huge 340-ton rotating precision antenna, which will serve as transmitting-receiving terminal for American Telephone & Telegraph Company's Telstar communication satellite, is nearing completion at Andover, Me. The $10-million facility was constructed by McKiernan-Terry despite winter weather under temporary air-inflated structure shown, provided by Birdair Structures, Inc. Permanent air-inflated radome will be 13 stories high. Antenna and equipment inside will be kept at controlled temperature using equipment provided by Carrier Air Conditioning Co.

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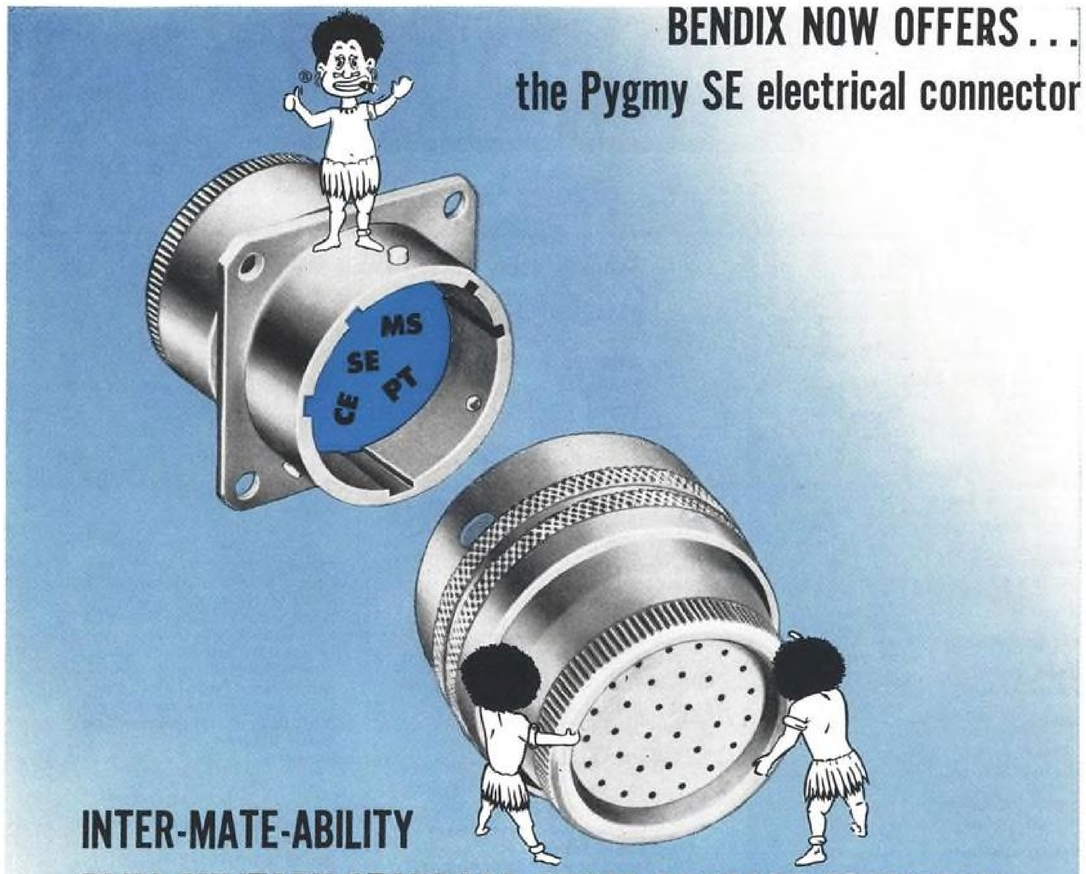




# EDITORIAL

## Comsat Corporation Proposal

President Kennedy's proposal to create a publicly owned, profit-making communications satellite corporation to develop and operate this country's portion of a global space communications network (see p. 26) is a bold and imaginative approach to what is certainly one of the most complex problems spawned by the space age.

Final judgment on whether the Kennedy proposal is the best possible method of solving this extremely complex problem should be reserved until a more detailed study of its provisions can be made and until all of its implications are fully developed in the congressional hearings as it passes through the legislative process.

But there are some broad aspects of this proposal that merit comment now. First is the fact that it has been developed and presented to Congress as a concrete proposal for specific action. This is in itself a heartening indication of the vigor and thoroughness with which this Administration intends to support its bold bid for U.S. space supremacy.

The complexities of the communications satellite problem are such that this issue could easily have been allowed to moulder in a legislative backwater or to be kicked from one agency to another as a political football. The preparation and coordination of this proposal at this early date assures prompt and, we hope, effective consideration of this organizational issue to keep pace with technical progress in the field. Again Dr. Edward Welsh, executive secretary of the national space council, deserves credit for keeping this ball rolling in addition to much of the specific philosophy incorporated in the proposal.

### Differences in Proposals

Second is the basic affirmation of private ownership and profit-making for this enterprise as opposed to another government monopoly. There may be some arguments over the detailed provisions of how this privately owned corporation should be constituted or regulated. But we doubt if there will be any major quarrel with the basic intent of this proposal. There are fundamental differences in this regard between the Kennedy proposal and that of Sen. Robert Kerr, chairman of the Senate space committee. We think that the broader ownership base stipulated in the Kennedy proposal will generate more legislative support than narrowing the field to common communications carriers in the Kerr proposal.

There is no longer much doubt as to the technical feasibility of a global satellite communications network offering the promise of expanded capacity with faster and more reliable service than present techniques. However, it is a long step from proving technical feasibility to building and operating a system that will provide the reliability required for reliance as a mass communications method. This long and difficult step from experimental proof to operational reliability is the major problem now confronting space technologists all along the technical spectrum.

They have already exceeded even the rosiest predictions in the exploratory area but the translation of these experimental successes into reliable working space systems will prove to be a much tougher problem.

The Comsat program will be one of the bellwethers along with the Nimbus weather program in gaging space technology's progress in making this transition. We suspect it is a problem not yet fully appreciated by all of the people working in this area, particularly at the managerial level, and we predict that some rude disappointments are in prospect before satisfactory operational goals are finally achieved.

### Barometer of Public Faith

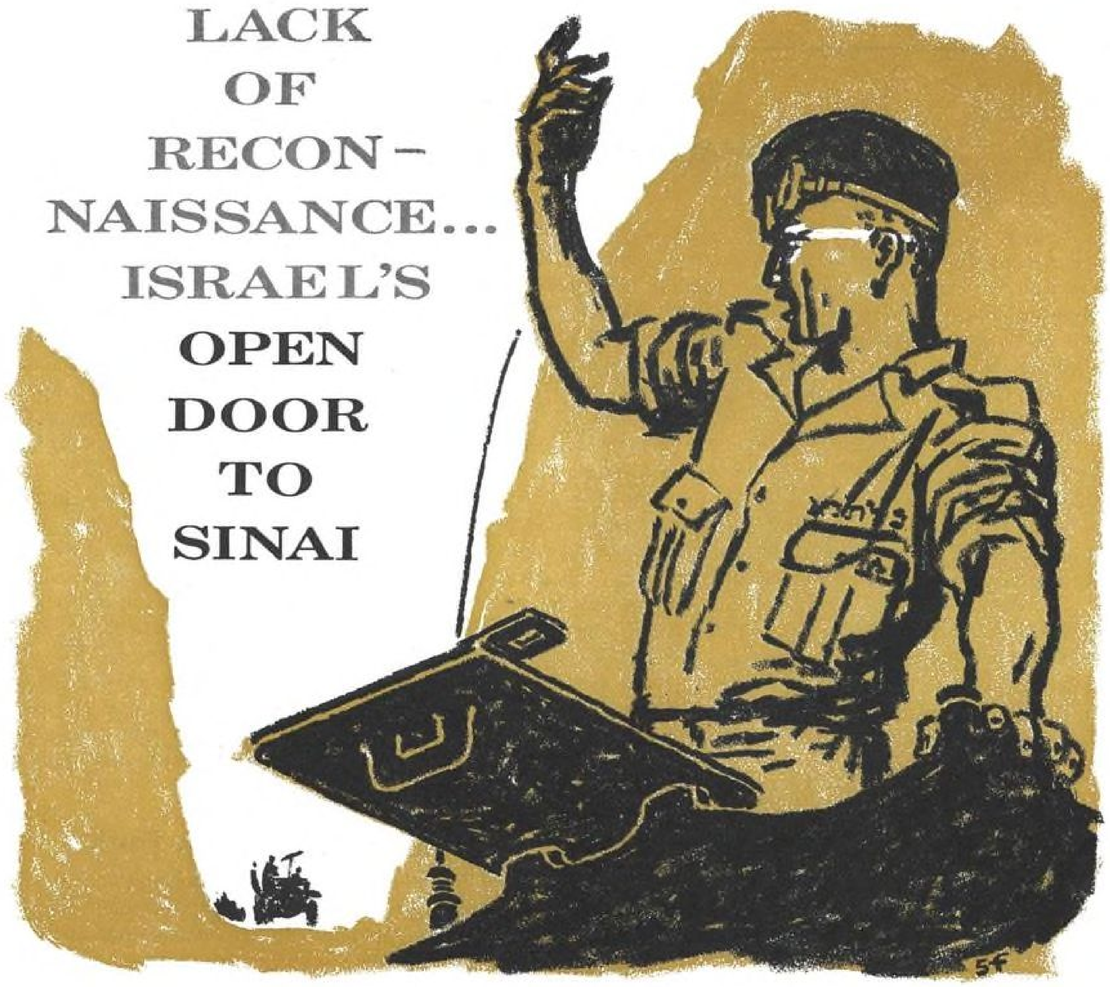
Public offering of the Comsat corporation stock should also provide an interesting barometer of public faith in the long-term prospects of the national space program. It is also a significant sign of our fast-changing times. If anyone had seriously proposed five years ago that public stock would be offered in a government-sponsored commercial space corporation, they would have been rushed off to a laughing academy without further ado. Yet it is almost certain that Comsat stock will be traded in the markets of a few years hence.

One point that is likely to be raised during congressional debate is the proposed $1,000 per share price for the publicly offered Comsat stock. This relatively high price would appear to mitigate against widespread public ownership and limit its sale more to corporations and institutional investors.

The Comsat corporation proposal is certainly one of the most interesting government-industry concepts to appear on the horizon for a long time. The Kennedy Administration has taken a bold step toward its eventual solution. Congress should apply equal vigor and intelligence to analysis of this proposal and its alternatives. Swift action is required to gear the organizational and financial machinery to the technical pace.

—Robert Hotz

# LACK OF RECON-NAISSANCE... ISRAEL'S OPEN DOOR TO SINAI



On October 25, 1956, Major-General Ali Abu Nuwar, Jordanian Army Chief of Staff, declared, "The time has come for the Arabs to choose the appropriate time to launch the assault for Israel's destruction."

Unfortunately for the Arab alliance, they had massed troops and gathered arms, but had not planned for reconnaissance . . . a military basic. On October 29, Israeli task forces slammed into Egypt, capturing initial objectives against confused resistance. Since shell fire and combat had become commonplace along the Israeli borders in 1956, the Egyptian High Command guessed after the first day's onslaught that these attacks were merely reprisals. Lacking reconnaissance "eyes", they could not detect the Israeli deep penetration tactics.

Battling against time as well as the Egyptians, the Israeli strike force often relied on reconnaissance to develop command decisions. For instance, General Dayan, Israeli Chief of Staff, was about to launch his 4th Infantry and 7th Armored Brigades to beef up the attack on the key town of Abu Ageila which was holding the advance. But a reconnaissance unit discovered undefended Daika Pass, 10 miles west, and Dayan poured through his 7th Armored. Abu Ageila, snared in a pincer, quickly fell.

This combat flexibility based on well planned aerial and ground reconnaissance key-noted the Israeli assault . . . helped make the famous Sinai "week-end" War a classic example of textbook military success.

Today, CAI's specialty in reconnaissance is helping shape history to the advantage of the Free World. Typical of CAI contributions is the Integrated Reconnaissance Intelligence System. Known as **IRIS**, the system features rapid processing and the ability to produce super-clear photos at any speed, any altitude, day or night. The **IRIS** system is in production and available now.

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## WHO'S WHERE

### In the Front Office

**Dr. William M. Duke**, president, ITT Federal Laboratories, Nutley, N. J., following his resignation as senior vice president of Space Technology Laboratories.

American Machine & Foundry Co.'s Government Products Group, Stamford, Conn., has appointed the following divisional vice presidents: **Frank B. Carder**-engineering unit; **Russel J. Keller**-manufacturing unit; **Neal H. Hundt**-legal counsel and contracts administrator.

**Malbon H. Jennings**, vice president for marketing for the Sperry Rand Systems Group and Sperry Gyroscope Co., with headquarters at Sperry Rand's Lake Success (N. Y.) facility.

**Robert L. Hoskinson**, vice president-corporate planning and control, Douglas Aircraft Co., Inc., Santa Monica, Calif., and **Louis Lieber, Jr.**, general counsel.

**G. Paul McCormick**, a vice president, North American Aviation's Columbus (Ohio) Division.

**Myron R. Prevatte**, a vice president, Librascope Division of General Precision, Inc. Prevatte continues as head of Librascope's Washington, D. C., office.

**E. Hugh Jones**, vice president-manufacturing group, Ex-Cell-O Corp., Detroit, Mich., and **Jack L. Mustard**, vice president-precision parts and assemblies group.

**John R. Clifton**, vice president-engineering, American Astro-Systems, Inc., El Monte, Calif., a division of Astro-Science Corp., and **D. B. Scheideman**, vice president-marketing.

**Lyle S. Garlock**, vice president-government relations, Eastern Air Lines, Inc. (AW Oct. 16, p. 23).

**Dr. John H. Roscoe**, vice president in charge of the Military Division of FMA, Inc., El Segundo, Calif.

**Daniel J. Fink**, a director, Allied Research Associates, Inc., Boston, Mass. Fink is the company's vice president of research and development.

Sprague Engineering Corp. has appointed **William D. Korli**, vice president and general manager of the company's newly acquired Inet Division, Compton, Calif.

**Dr. Harold Wooster**, head of the newly established Directorate of Information Sciences of the Air Force Office of Scientific Research, Washington, D. C.

### Changes

**Jackson E. Beighle** has been named European representative for Sikorsky Aircraft Division of United Aircraft Corp., a newly created post, with headquarters in the Sikorsky office in Cologne, Germany.

**W. R. Elliott**, corporate financial adviser, Southwest Airmotive, Dallas, Tex., and **Jack Mosier**, controller.

General Electric Co.'s Space Systems Operation, Santa Barbara, Calif., has appointed the following managers: **Dr. R. W. Bogle**-systems design; **L. M. Hughes**-space exploration; **R. E. Heath**-program administration; **N. Hall**-astrodynamics; **R. O. Williams**-systems test engineering; **F. B. Lowe**-marketing.

*(Continued on page 116)*

## INDUSTRY OBSERVER

►Two USAF-Lockheed Samos E-6 advanced reconnaissance satellites have been delivered to the Pt. Arguello, Calif., launching site. One will be used for checkout with its USAF-General Dynamics Atlas booster and ground equipment. The other is scheduled for launching about the end of this month. Samos television cameras will stay in orbit with the satellite, but recoverable film packs will be ejected in capsules similar to those used in the Discoverer research and development satellites.

►**A 200-fold increase in the coherence of optical maser radiation over that reported to date, which brings laser performance close to the theoretical diffraction limit, has been achieved by Westinghouse Electric's Defense Center, Baltimore. The advance, which permits a corresponding decrease in laser beam width and an increase in power density, was achieved using a cooled ruby crystal.**

►NASA hopes to hold the weight of the 18-orbit Mercury capsule to that of the three-orbit capsule by design considerations which include eliminating the need to carry an adapter section into orbit (AW, Dec. 18, p. 27). Adapter was originally thought necessary to provide oxygen and other capsule systems.

►**Proposals for three separate studies of radiation weapons, built around the potentially high-energy density of optical masers, are due at Air Force's Aeronautical Systems Division during the week of Feb. 19. Studies are small, but reflect growing military interest in possible use of optical masers for radiation weapons.**

►Air Force has had to budget for radically increased maintenance costs for the B-52 heavy bomber, KC-135 jet tanker, F-105 and F-106 fighters and T-38 jet trainer. Complete depot overhaul for the KC-135 now costs $126,000, more than twice the overhaul cost of the KC-97 tanker it replaced.

►**Associate contractor for USAF Minuteman backup radio-transmission launch system will be selected in competition to be held by Air Force's Ballistic Systems Division. New radio launch system will be available, along with present cable-transmission launch system, for Wing 6 and later units, giving the Air Force a dual launch system.**

►Recovery weight of the two-man Gemini space capsule will be about 2,850 lb., requiring either one 105-ft. dia. parachute or two 63-ft. chutes for descent. Glide-sail chute and a 96-ft. dia. chute have been considered but rejected (AW Dec. 11, p. 23). Some Gemini capsules are being designed to take Rogallo parawing recovery devices, but scaling problems now make larger parawings look less attractive than at first.

►**Air Force's Space Systems Division and Aerospace Corp., program directors for development of 120-in. dia. solid-propellant rocket motor, told prospective bidders that contract award would depend heavily on management and PERT 2 cost/scheduling capabilities. Proposals are due by March 13, probably will be submitted by Aerojet-General, Hercules, Lockheed Propulsion, Rocketdyne, Thiokol, and United Technology.**

►Gas chromatograph capable of performing real-time analysis of the Martian atmosphere during a 20-min. descent of a Mariner B spacecraft through the planet's atmosphere will be developed under a contract to be awarded soon by Jet Propulsion Laboratory. Contract will cover study and breadboarding of the unit, scheduled for a Mars impact shot in 1964.

►**Proposals for design, development and test of a flexible-wing glider for aerial delivery of 1,000 lb. of cargo are due today at Ft. Eustis, Va. for U. S. Army. Plan is to tow the flexible-wing delivery system to altitude using Sikorsky H-34 helicopters or de Havilland AC-1 Caribou aircraft, then cut the glider loose to home on the base being supplied.**

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# Washington Roundup

**Budget Dispute**

**First public dispute between the reorganized House space committee and the Kennedy Administration is likely to arise** over the manner in which the President's budgeteers handled funds for meteorological satellites this year.

**The space committee in a staff report last year said the National Aeronautics and Space Administration—not the Weather Bureau**—should receive the meteorological satellite money since its budget was big enough to absorb unexpected costs. Another important but unstated reason is that the House commerce committee—not the space committee—has jurisdiction over the Weather Bureau's budget.

**Budget Bureau rejected the space committee's recommendation and requested that the Weather Bureau** be given $45 million in Fiscal 1963 for its Nimbus program. Barring some last-minute compromise, the dispute will be aired within the next few weeks when the space committee begins hearings on the President's space budget.

**Atmospheric Testing**

**Debate continues to rage within the Kennedy Administration over whether the U.S. should resume testing nuclear weapons in the atmosphere.** The controversy has pitted the Air Force, which favors an extensive test series, against such top presidential advisers as Dr. Jerome B. Wiesner and Adlai E. Stevenson, U. S. ambassador to the United Nations.

**So intense is the debate that the once friendly relations between several Air Force leaders and Dr. Wiesner have chilled** to the freezing point. The controversy is also being punctuated by repeated demands for resumption from several members of Congress.

**President Kennedy will announce his decision within a month. In deference to world opinion, it is likely** that any test series will be less extensive than the military wants.

**Related issue is whether the President's civil defense program, now under the Defense Department, is adequate. Chairman Chet Holifield (D.-Calif.)** of both the Joint Congressional Atomic Energy Committee and the House Military Operations subcommittee, contends it is not. His subcommittee will begin hearings on the President's civil defense program Feb. 19, with Steuart L. Pittman, assistant secretary of defense for civil defense, the first witness.

**Non-Profit Study**

**Budget Bureau's long-awaited study of the government's use of non-profit organizations for such projects as development and evaluation** of weapons system (AW Dec. 4, p. 31) is slated to be ready for Attorney General Robert Kennedy when he returns from his world tour at the end of this month. The report, ordered by President Kennedy, was due Dec. 1. Meanwhile, Chairman F. Edward Hebert (D.-La.) of the House Armed Services Investigating subcommittee has been preparing for hearings in the spring on the military's use of these non-profit firms. He wants to find out if these firms are usurping the decision-making powers of the Defense Department.

**Dr. Edward C. Welsh, executive secretary of the National Aeronautics and Space Council, is at home recovering** from what his office described as a "mild heart flare-up diagnosed as a temporary coronary insufficiency brought on by extreme fatigue." Dr. Welsh had been hospitalized and is not expected to return to work full time for several weeks. The hard-working official, who was chief architect of President Kennedy's communications satellite bill (see p. 26), suffered a similar attack last spring.

**Aircraft Loans**

**Continued authority for the Civil Aeronautics Board to guarantee some private loans for aircraft purchases is being pressed** by Chairman Warren G. Magnuson (D.-Wash.) of the Senate commerce committee. He is sponsoring a bill to extend this authority for five years beyond its Sept. 7 expiration date. The CAB guarantees are for private loans to certificated carriers engaged in local or feeder service.

**Dr. Nicholas E. Golovin, who headed the joint NASA-Defense Department study group which recommended the orbital rendezvous technique** for the moon program, has left NASA to become an assistant to Dr. Wiesner, President Kennedy's chief science adviser. Golovin replaces Douglas R. Lord, who becomes assistant director for evaluation studies in NASA's Manned Space Flight Office.

**Renegotiation Act definitely will be extended this year. Only question is for how long. President Kennedy seeks** four years while the Joint Committee on Internal Revenue Taxation has recommended a two-year extension.

**The army of newsmen at Cape Canaveral has become so jumpy waiting for the oft-postponed launching of Lt. Col. John H. Glenn** that they almost believed an official who said the flight would be Feb. 29 for sure. Then a reporter remembered this February only has 28 days.

—Washington Staff

# Kennedy Urges Public Comsat Ownership

**Firm U. S. control of communications satellite corporation proposed; Rep. Celler praises plan.**

By Katherine Johnsen

**Washington**—President Kennedy last week recommended establishment of a publicly-owned, profit-making communications satellite corporation to develop and operate the U. S. segment of a worldwide space communications system—under extremely tight government supervision (AW Jan. 1, p. 20).

Rep. Emanuel Celler (D.-N. Y.), chairman of the House Judiciary Committee and leader of a congressional group that has vigorously protested against possible domination of a space communications system by American Telephone & Telegraph Co., said he was "greatly heartened" by the President's proposal. If it is adopted, he declared, "the hand of monopoly now shall not be laid upon this system."

Eugene J. McNeely, AT&T president, in a cautious first reaction, said he was "pleased to see the President's re-endorsement of private ownership. . . ."

Hearings on the President's legislation and another measure establishing a satellite communications corporation, introduced by Sen. Robert S. Kerr (D.-Okla.), are scheduled to start Feb. 26 before the Senate Aeronautical and Space Sciences Committee. Kerr is the committee chairman.

In the House, Chairman George P. Miller (D.-Calif) of the Science and Astronautics Committee has agreed to let the Interstate and Foreign Commerce Committee handle the President's bill. Rep. Miller said, however, there may be joint hearings by these committees on some aspects of the measure.

Chairman Warren G. Magnuson (D.-Wash.) of the Senate commerce committee said that his committee would assert its jurisdiction over communications satellite legislation after the initial hearings by the space committee.

The President's proposal and the Kerr measure differ basically as to ownership and supervision of the corporation.

### Kerr's Proposal

Under the Kerr proposal, the corporation would be "organized and operated as a communications common carriers' carrier." Ownership would be limited to common communications carriers authorized by the Federal Communications Commission. This would probably mean, at the outset at least, the ten international carriers—a group in which AT&T is dominant. The corporation would be capitalized at $500 million, consisting of 5,000 shares at $100,000 each.

Under the President's plan, the corporation would be financed with two classes of stock. The two classes of stock would be:

• **Class A stock** would sell at not less than $1,000 a share, and could be purchased by anyone, including communications common carriers. The corporation would be authorized a million shares outstanding, or a capitalization of $1 billion. No single entity—person or corporation—could own more than 15%, or $150 million, of the authorized capitalization, or no more than 25% of the actual outstanding capitalization.

• **Class B stock** could be purchased only by communications common carriers approved by FCC. The corporation is authorized 10,000 shares outstanding, at an unspecified price. Administration spokesmen indicated a price of $100,000 a share, to make a total Class B capitalization of $1 billion. There would be no limitation on the amount of Class B stock a single investor could purchase.

Only Class A stock would be eligible for dividends. Carriers buying Class B stock could write off their investment in rate increases.

Under the President's recommendation, a board of directors of nine to 13 members would be elected by Class A stockholders. In Kerr's proposed corporation, each carrier with an ownership interest would appoint two directors. Two additional directors would be designated jointly by users of the satellite communications system who do not invest in ownership.

### Industry Role

The question mark in the President's ownership plan is the extent to which aerospace companies, other private investors and the general public would invest in a system which will probably not become operational, commercially, for another five years—and then be limited to the "fair and reasonable" common carrier profit return. An Administration spokesman commented that "as long as the government is chartering a monopoly, it would be unconscionable not to give everyone the opportunity, at least, to be in on it."

Under the Kerr measure, the corporation would be regulated by FCC in the manner it regulates other companies.

In addition, the President's proposal provides for close White House supervision of the corporation from planning for its establishment throughout its operational period. In his message to Congress, President Kennedy said he would rely heavily on a Director of Telecommunications Management, a new post to be established in the Office of Emergency Planning, a branch of the White House.

Government officials designated by the President "shall have access to all books, records, papers, correspondence, and files of the Corporation, shall have the right to attend any and all meetings of the Board of Directors or of stockholders . . . and shall make certain that what is being done and what needs to be done, both by the corporation and by departments and agencies of government, are known at all times to the President. . . ."

### Competition Stressed

The President's measure emphasizes competition in the procurement of equipment and services by the corporation. It calls for "maximum competition," and directs the FCC to establish regulations to ensure this. The Kerr proposal directs FCC to require the corporation to use competitive bidding in equipment acquisition "to the maximum extent feasible."

Both measures direct National Aeronautics and Space Administration to coordinate its program in the space communications field with that of the corporation. They also provide for reimbursement by the corporation to NASA for vehicles and other expenses involved in launchings.

### Transponder Satellites

**Los Angeles—Two small, lightweight experimental UHF transponder satellites will be designed and developed by Aeronutronic Division of Ford Motor Co. under a contract awarded recently by the Naval Electronics Laboratory, San Diego, Calif.**

**Purpose of the satellites, to be called Mailbuoy satellites, will be to relay data from existing Navy UHF sea- and land-based communications gear between naval ships or ships and shore installations.**

**Chance Vought F8U-1T Begins Flight Tests**

Mach 1.4 was attained during hour-long first flight of Chance Vought two-place F8U-1T trainer at Dallas, Tex., Feb. 6. On landing, Pilot John Konrad deployed the airplane's 16-ft. braking parachute and rolled to a stop in 2,400 ft. Prototype F8U-1T was converted from an F8U-2NE which earlier had been converted from an F8U-1. Room for second seat was obtained by removing two of the F8U's standard four-cannon armament and some ammunition boxes, normally located behind pilot. Powerplant is a Pratt & Whitney J57-P-20 derated from 18,000 lb. thrust to about 16,000 lb. for this initial flight. Production version of the F8U-1T would have the engine further derated to match the 10,000-lb.-thrust-plus performance of the standard F8U-1 fighter. Navy as yet has indicated no additional funding beyond the prototype trainer.

# Air Force-NASA Liaison Office Stirs Protests From Army, Navy

**Washington**—Defense Department and the National Aeronautics and Space Administration last week began discussions of a proposed directive to create a formal coordination organization for the two agencies. The document has already become the subject of a Pentagon controversy reminiscent of the battle over the directive last March assigning military space responsibilities to the Air Force (AW Mar. 6, p. 26).

In effect, the directive would make the Air Force the executive agent for the Defense Department in dealings with NASA. The Army and Navy maintain that this would give the Air Force operational control of deployed forces and also a wide variety of logistic activities.

### Current Cooperation

The proposal, forwarded by Roswell Gilpatric, deputy secretary of defense, would make formal relationships which have been carried on by committees. Some 50 agreements between NASA and the military services are now in effect. These cover a wide range of services, from physical examinations for astronauts to bailment of aircraft and deployment of ships for Project Mercury recovery operations.

Gilpatric, in his covering memorandum, stated that recent changes in the organization of NASA, together with the increased tempo and scope of NASA-DOD planning in support of the manned lunar landing and other programs, make it necessary to clarify responsibilities and relationships within DOD and between the two agencies in the conduct of those programs.

The task of completing arrangements for DOD with NASA has been assigned to the office of Solis Horwitz, who is special assistant for defense management to Defense Department General Counsel Cyrus R. Vance.

However, the director of defense research and engineering would be responsible for establishing criteria on which agreements relative to DOD support of NASA would be based. He would also be responsible for policy guidance in regard to funding, scope of activity and level of effort and would make recommendations to the secretary of defense on the assignment of responsibilities for carrying out specific projects.

### USAF Responsibilities

The Air Force secretary would be assigned the following responsibilities:

• **Detailed project level planning** necessary to implement specific projects and programs arising from agreements between NASA and DOD.

• **Establishing and maintaining** such contacts and management arrangements with NASA as would be necessary to carry out programs and projects.

• **To ensure integrated planning** which takes into account the capabilities of all the components of the Defense Department, he would provide for the joint staffing of whatever office he may establish or utilize for the execution of the above responsibilities.

• **Coordinate with other military** departments as needed when their resources, facilities or personnel are required.

The Army and Navy brought the matter to a head last week before the Joint Chiefs of Staff. Both insisted on full representation in whatever office is established and also demanded safeguards on use of their forces and facilities.

### MA-6 Requirements

The Navy was particularly concerned because it had to redeploy 18 destroyers and two aircraft carriers, plus numerous other ships and aircraft in widely scattered parts of the world, for periods of up to three weeks because of the planned Mercury Atlas-6 launch.

Large portions of the communications facilities of the Army, Navy and the Air Force are also committed for Mercury shots.

Although NASA is now discussing specific examples of support coordination with the Air Force, it wants no part of the internal DOD dispute. It is concentrating on how the proposed directive would affect prior, current and future agreements. It wants cooperation at the working level, not at the level of NASA Administrator James E. Webb and Secretary of Defense Robert S. McNamara.

# Boeing Will Change Engine in TFX Bid

By Larry Booda

**Washington**—Boeing Co., whose proposal for the Air Force-Navy tactical fighter (TFX) was considered technically best by officials in the office of the Secretary of Defense, has been given a paid study contract to change its design from one utilizing the General Electric MF295 engine to one incorporating the Pratt & Whitney TF-30 engine. Both are turbofans.

At the same time, General Dynamics Corp. was awarded a similar contract to revise certain aspects in its TFX proposal, which already incorporated the TF-30 engine.

Both Boeing and General Dynamics were chosen as finalists in the competition which began last September when requests for proposals were sent out by the Air Force Aeronautical Systems Division to six contenders—three teams of two companies each and three individual firms (AW Feb. 5, p. 28). Both companies have 90 days from Jan. 31 to complete their studies.

Of the six submissions received by ASD Dec. 6., four favored the MF295 engine and two recommended the TF-30. All submissions included alternate engine recommendations. These were the first choices: Boeing, MF295; General Dynamics (teamed with Grumman Aircraft Engineering Corp.), TF-30; Republic (teamed with Chance Vought), TF-30; Lockheed Aircraft Corp., MF295; McDonnell Aircraft Corp. (teamed with Douglas Aircraft Co.), MF295; North American Aviation, Inc., MF295.

None of the submissions included as the first choice the Allison AR168—a version of the Rolls-Royce RB.163.

Two of the engines considered eligible for the performance envelope for the TFX are existing hardware—the TF-30 and the AR168. MF295 has progressed little beyond design stage.

The TF-30 design and development work was sponsored by the Navy originally as the powerplant for its Missileer subsonic fighter, which would be capable of firing long-range Eagle missiles to knock out enemy aircraft. The Navy is believed to have put more than $30 million into the development of this engine. It also could have powered a successor to the McDonnell F4H fighter which the Navy had planned before the Defense Department decided to combine the tactical fighter efforts of the services.

The Boeing proposal came from its Wichita Division where the last of the B-52 series of heavy bombers are now being produced. A major effort was mounted by its team of engineers there for the TFX project.

Now Boeing is faced with altering the design to accommodate a larger engine. This could change the dimensions enough to affect the performance of the original design. It has not been learned whether Boeing will be fully compensated for this major rework of its engineering proposals.

The General Dynamics effort was centered in its Ft. Worth Division, formerly the Convair Ft. Worth Divison. Production of the supersonic B-58 bomber there is expected to phase out in October. Air Force officials indicated that the proposal of General Dynamics ranked second technically to that of Boeing, but it incorporated the desired engine.

### Political Implications

Politically, the choice of a finalist has stirred intense activity in congressional delegations. Since both the Ft. Worth and Wichita plants are faced with a slowdown in the airframe business, the economic impact on each community is receiving priority attention in both Congress and the Executive branch.

Officials in the office of the Secretary of Defense and in the Air Force, which has developed responsibility for the TFX, have emphasized that their choice of finalists was based purely on technical evaluations. They say that both proposals contained certain aspects that needed alteration before a final choice was made.

The selection of an engine, they say, was based on past experience in airframe and engine development. Historically, they contend, engine design and development takes twice the time of an airframe.

The TFX decision encompasses considerations which go beyond this project. Some airframe and engine plants must be kept in operation so that they are available in time of national emergency. But airframe production is shrinking under the Defense Department's package programing concept which extends through the next eight years. This will also affect engine production potential.

### Some Plants Eliminated

Thus Defense is faced with making a decision which immediately affects two airframe plants. Four airframe and two engine plants had been eliminated in the first round of the TFX competition. This does not mean, however, that immediate disaster faces those eliminated. They have varying amounts of business which will extend from 10 months to several years. Many will be forced to diversify or change their lines to survive, however.

Another consideration of primary concern to Defense officials are the pools of engineering talent represented in the plants that are faced with shrinking business. They know, for instance, that when the final winner for the TFX is announced there will be advertisements for engineers placed by the winner in newspapers and technical journals.

Inevitably, many of those hired will come from the loser. The expense of these transfers will be borne by the government as part of contract costs.

### VAX Future

The fate of the VAX (heavier than air, attack, experimental) close support aircraft will depend on how the TFX development progresses. Air Force and Navy have recommended that this aircraft be supersonic (AW Feb. 5, p. 28) so that it can defend itself against enemy fighters in a battlefield area. By adding this requirement the aircraft is automatically taken out of the relatively low-cost, high-production class that the Army wants. Supersonic capabilities increase the cost by several times.

Although no decision has yet been made regarding the VAX, primarily because a recommendation has not yet gone to the office of the Secretary of Defense from the Navy which has cognizance in the project, the inclination is to let the project stall. Defense is willing for the VAX project to go ahead at higher cost if the original mission—close support of troops coupled with long loiter time and high payload—is not compromised.

As it stands now the TFX will be produced in two versions, one for Air Force requirements and the other for Navy aircraft carrier compatibility.

## No Ranger Design Changes Seen

Pasadena, Calif.—No changes will be made in the design of future NASA Ranger spacecraft to obtain reliability at the expense of performance, Dr. William H. Pickering, director of Jet Propulsion Laboratory, said last week.

Earlier reports (AW Feb. 5, p. 30) had indicated that such changes were being discussed after the failure of Ranger 3 lunar mission because of two component malfunctions and a simple error in system integration paperwork. Guidance failure of Atlas booster system caused upper stages to be accelerated to a velocity so high as to make the lunar intercept impossible.

A midcourse correction was devised to carry the spacecraft even farther from the moon so that the lunar encounter would occur at the optimum time for telemetry and operations to be commanded by the JPL facility at Goldstone, Calif. The correction included a 116-deg. pitch maneuver before ignition of the spacecraft rocket engine. Because a binary-coded command signal was accidentally written by a technician with the reverse of the correct value, the pitch maneuver was made in the opposite direction from that intended and the spacecraft passed about 2,000 mi. closer than planned to the moon.

Goldstone was still able to initiate the terminal operations at the point of closest approach but an extraneous yaw command apparently generated in the digital logic in the command control and sequencer unit aboard the spacecraft caused it to begin tumbling as it passed the moon, presumably preventing it from taking photos. Pickering said the false command could not have been sent from some other transmitter without being detected by telemetry receivers. After passing the moon the spacecraft stabilized itself with the solar panels facing the sun. No provision had been made for such a maneuver and JPL officials say it must have been caused by stabilizing gyros spinning up to speed as the random tumbling of the vehicle turned the panels toward the sun. Ranger Program Manager James D. Burke said the temperature control system aboard the spacecraft worked but temperature rose slowly toward the upper limit of the expected range. As a result the paint pattern on Ranger 4 may be changed.

## Contract Awards

Washington—General Dynamics Corp. has recently been awarded a $49.3-million Air Force contract for Atlas F and Atlas D missile systems, and $10.7 million add-on funds for the Army short-range solid propellant Mauler missile system.

Other recent contract awards included:

- Westinghouse Electric Corp.; $32.4 million from Navy for Polaris submarine reactor components, and $8.5 million from National Aeronautics and Space Administration for Nerva nuclear rocket components.
- De Havilland Aircraft of Canada, Ltd.; $30.9 million from Army for production of 53 Caribou aircraft.
- Aerojet-General Corp.; $15.8 million from Air Force for supplemental work on Minuteman, Titan 1 and Titan 2 propulsion systems.
- Douglas Aircraft Co.; $6 million from Air Force for continued development of the Skybolt missile.

# Effect of Atlas Insulation Removal Will Determine Final MA-6 Date

**Washington**—Full-scale fuel and pressurization tests were conducted Feb. 6-7 on the Mercury Atlas-6 (MA-6) launch vehicle to obtain data on the effects of removing insulation in the bulkhead separating fuel and liquid oxygen tanks.

Results of the analyses will be the determining factor in scheduling the three-orbit Project Mercury flight of Marine Corps Lt. Col. John H. Glenn, a mission which has been delayed since Dec. 19 because of weather and technical difficulties in booster and capsule (AW Feb. 5, p. 29). If no further technical troubles are found, weather will determine if National Aeronautics and Space Administration can meet its Feb. 14 launch date.

The insulation, a 60-lb. piece of 4-in. plastic foam, absorbed about 8-10 lb. of kerosene fuel, which could have been caused by overpressure in the spaceframe, a leak or over-fueling. When fuel soaks into the insulation, it is called "juicy."

The insulation is sealed from the fuel tank by a 0.0016-in. sheet of aluminum. The aluminum section cracked in the Ranger 3 Atlas (AW Feb. 5, p. 30), and the section was removed from the vehicle. No crack was detected in the MA-6 vehicle.

The decision was made to remove the insulating blanket from the MA-6 Atlas after removal from Ranger 3 did not affect the Atlas profile. Earlier, USAF had conducted tests which indicated heat transfer rates between the liquid oxygen and kerosene were not as high as had been thought.

The plastic foam blanket can absorb about 120 lb. of kerosene before it is saturated, and it was feared that the insulation might collapse into the fuel tank in MA-6 and be fed into injectors along with the fuel. The insulating bulkhead is vented, and when it is removed, any excess fuel is vented overboard.

The vehicle probably would have been launched if it had been a weapon system, since neither the Defense Department nor the Air Force see any requirement to remove insulating bulkheads, even when juicy, from operational Atlas missiles.

This is based on the fact that six of the last seven Atlas D launches have contained the insulation, and never has an Atlas failure been attributed to problems traced to the bulkhead. The bulkhead is not installed in Atlas F silo missiles, and most Atlas E missiles already have had the insulation blanket removed.

Gen. Thomas S. Power, Strategic Air Command commander, commented that "the problem referred to does not affect SAC's operational capability with the Atlas missile."

Meanwhile, VHF telemetry in the Mercury capsule has been re-wired, and the parachute canister replaced for the Feb. 14 attempt. VHF telemetry faded, cut off and then on during a checkout.

The 63-ft. Ringsail parachutes are pressure packed to 0.015 lb. per cubic inch, and a 30-day limit is set from time of packing so that a permanent crease does not set in the material.

## Russian Cites Haste In U.S. Space Effort

**Moscow**—Konstantin Mikhailov, identified as a Soviet master of science, has sharply criticized what he called "sensationalism and feverish haste" in the U. S. space program, but the criticism appears aimed in part at defending the secrecy which surrounds Russian space launchings.

Mikhailov, in a Tass report, hit at "the sensation outcry" of the American press over the Ranger 3 mission (AW Feb. 5, p. 30), noting that American scientists themselves believed its chances for success were not high. This was a reference to the pre-launch announcement which said the National Aeronautics and Space Administration will consider the Ranger program successful if one of three lunar landing payloads scheduled this year successfully completes its mission (AW Jan. 22, p. 37).

"Failure of the Americans, however, cannot be justified by the fact that it was foreseen, just as there is no justification for the feverish haste with which this work is conducted in the United States," he said.

"Success in space exploration is not attained by the statistical way at the price of many failures in the hope for a chance of success," Mikhailov said. He added that even failures can be used to secure more appropriations for rocket development, "but as a waste of scientific potential and material resources, they are most regretful."

Commenting on the postponement of the Mercury Atlas-6 flight of Lt. Col. John H. Glenn (see story above), Mikhailov said "the morale effect of the moon probe failure" may have played a role in the postponement, along with weather conditions or technical problems.

# Systems Command to Formulate Improved Development Process

**Washington**—Assistant Air Force secretary for research and development last week asked the Air Force Systems Command to recommend specific procedures for implementing the Defense Department's new program to improve cost-effectiveness of new development programs through the use of trade-offs (AW Feb. 5, p. 26).

Objective of the program is to devise techniques which will encourage defense contractors to propose trade-offs in performance specifications for weapon system and major equipment development programs to reduce cost and development time.

Defense Secretary Robert S. McNamara has authorized the director of defense research and engineering to devise innovations in current procedures and to establish one or more controlled experiments to evaluate their effectiveness. Defense research and engineering officials believe the program selected as a guinea pig should be in the $20-70 million range.

These officials recognize the need for a change in past procurement policies under which companies were reluctant to submit alternative proposals for fear of having their bids thrown out for noncompliance. However, they also recognize that if each contractor submits a proposal which deviates widely from the original specification, selection of the winning proposal may evoke criticism from unsuccessful bidders that they, too, could have submitted a similar proposal if they had known it was acceptable. This could result in the need for holding two or more competitions on each major procurement.

One remedy under consideration is to have the contracting service develop a numerical trade-off scale which would show quantitatively the relative importance of performance, price and delivery on the specific procurement. This would be used to evaluate the subsequent proposals.

For example, on a space surveillance radar, the Air Force might be willing to trade 10% less range for a 20% reduction in price, but it might not be willing to accept 25% less range at any price. Similarly, on certain programs a service might be willing to pay 10% more to shave six months off development time, while in other programs there might be no point to paying a premium for faster than scheduled delivery.

Officials admit that the problem is difficult, and say they are open to suggestions from defense contractors on ways to introduce effective trade-offs into defense procurements.

## HSS-2 Sets Record

**Navy-Sikorsky HSS-2 helicopter last week exceeded 200 mph. over a 19-km. (11.81 mi.) straight-line course between Milford and New Haven, Conn. Average speed was 210.65 mph. Record claimed is for 15-25 km. course. Two runs were made at 1,500 ft. in 4 kt. wind.**

**Previous helicopter speed record recorded during an official speed run was 199.4 mph. by a Russian Mil-6 over a 15-25 km. course.**

**The HSS-2 now claims five world helicopter speed records. It previously claimed records over 3, 100, 500 and 1,000 km. courses.**

**The speed run was conducted under the auspices of the National Aeronautic Assn. and is subject to confirmation by the Federation Aeronautique Internationale before being recognized as an official world record.**

## Military Is Blamed For Contract Waste

**Washington** — General Accounting Office, in a series of reports to Congress, said the Air Force and Navy wasted millions of dollars because of the way they contracted for cargo transportation, spare parts and B-58 construction facilities.

GAO estimated the Air Force wasted about $4.5 million in shipping military cargo overseas by commercial carriers rather than using ships. The agency estimated the Air Force paid more than $5.5 million in Fiscal 1960 to airlift about 2,000 tons of cargo overseas by commercial carrier under the Military Assistance Program (MAP). GAO said since there was no hurry for receipt of most of the cargo, it could have been sent by ships at a cost of $1 million.

The agency also said the Air Force shipped "a considerable amount" of cargo to Air Force units overseas even though the materiel was available in those foreign countries "at a fraction of its commercial airlift cost."

Air Force in July, 1958—partly because of pressure from the Air Transport Assn.—adopted a policy requiring airlifted MAP shipments to be carried by commercial airlines rather than the Military Air Transport Service. Army and Navy have not followed this policy. GAO said their reliance on MATS helped reduce their air freight bill in Fiscal 1960 to "less than 5%" of the amount paid by the Air Force for its MAP cargo.

Air Force, following GAO's disclosure, changed its airlift policies to use MATS more fully. The change was implemented in January, 1961, along with other actions to remedy conditions cited in the report.

Recent GAO reports cited these additional examples of money wasted by the services:

• **Navy wasted $3.2 million** by buying spare parts rather than getting them from excess Curtiss-Wright R3350-26WA aircraft engines already on hand, according to a GAO report based on Navy procurement from Jan. 1, 1959 to June 30, 1961.

GAO said the Navy could have reduced this $3.2-million waste to $1.7 million if it had acted when the agency first brought the matter to its attention. As of June 30, 1961, GAO said, about $2 million of the total spare parts order had not been delivered. If the Navy at that point had canceled outstanding orders and obtained its spare parts by dismantling the spare engines, some $1.5 million could have been saved. The same engines also could have provided another $4.4 million worth of spare parts for future needs, according to GAO.

On Nov. 7, 1961, Navy told GAO it had started to obtain spare parts from the excess engines but had decided not to try to cancel outstanding orders until it determined that all the parts needed could be obtained through reclamation.

• **B-58 controversy.** Air Force cost the government an unwarranted fee of $382,200 by writing the wrong type of contract with the former Convair Division of General Dynamics Corp. for the acquisition of equipment needed for the production of B-58 aircraft, GAO said.

GAO said the Air Force allowed Convair to acquire at government expense buildings and test equipment which could be used for almost any type of aircraft, not just the B-58 bomber. The cost of that equipment was covered under fee-type supply contracts rather than under the existing no-fee facilities contract. GAO said this was a mistake which cost the government "unwarranted fee allowances" amounting to $382,200.

The contracts were negotiated in 1958 and 1959. GAO said the Air Force should try to recover the fee paid to Convair, but Assistant Air Force Secretary Joseph S. Imirie wrote the agency that there appeared to be no legal basis for requesting a refund from the contractor. Convair contended the buildings and equipment were tailored specifically to the needs of the B-58 program and thus properly covered by the fee-type contracts.



# Vast Cape Expansion Will Start in March

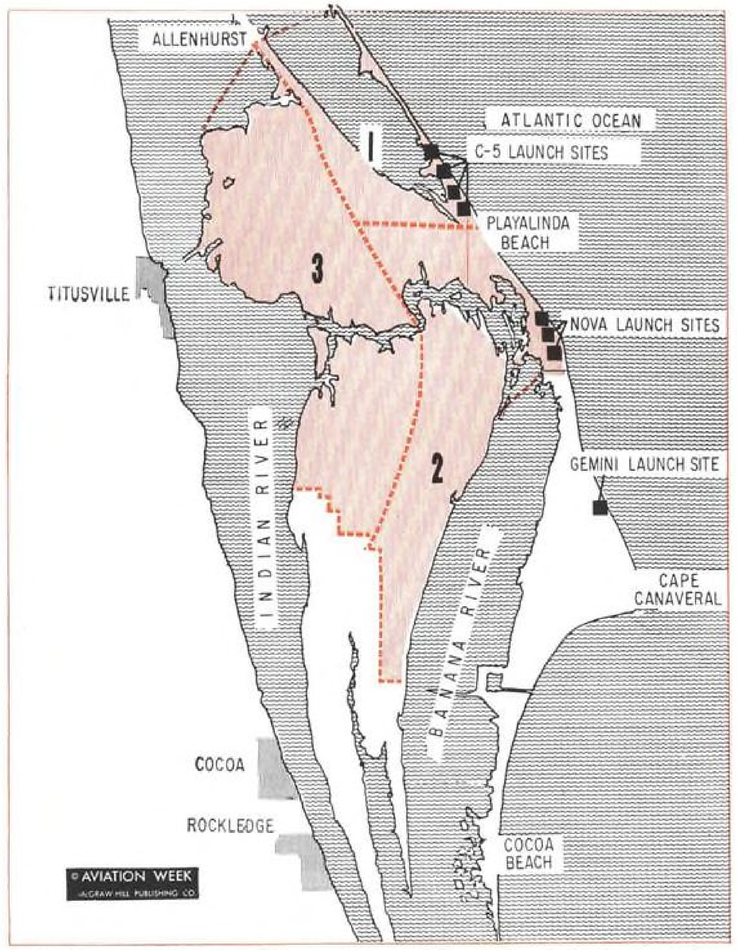
By Edward H. Kolcum

**Cape Canaveral, Fla.**—Site development is scheduled to start Mar. 15 for two Saturn C-5 pads here, the first significant construction in the $1-billion expansion of facilities from which manned lunar landings will be launched.

Construction activity will grow rapidly this year and reach a peak in 1964. With continued Administration and congressional backing, it will remain at a high level at least until 1966 so that facilities can be prepared and improved to meet the lunar landing mission target date of 1967.

Initial project will be two C-5 pads, followed by two more C-5 pads, and then by three pads to handle Nova-class vehicles. The Saturn C-5 is the vehicle for conducting the lunar landing mission by the rendezvous technique. In addition to site development, the building program this year will include construction or access roads, utility lines and communications facilities.

The basic character of the Atlantic Missile Range began to undergo a gradual change when the National Aeronautics and Space Administration selected 72,644 acres adjacent to the range as the site from which it will launch large manned space vehicles (AW Aug. 28, p. 30). Since AMR was established 11 years ago, it has been a research and development test facility. Design work now under way will alter this mission to one which is primarily operational, capable of routine, rapid fire of large payloads.




**LOCATION** of the four Saturn C-5, three Nova and Gemini launch sites is shown, along with the boundaries of land to be acquired in three increments. First section will be the site for C-5 pads. Nova pads will be located on the second section. Section 3 will be a noise and over-pressure buffer zone.

### Altered Skyline

The physical appearance of the launch area here will change along with the mission character. If present design plans are approved, the Cape skyline will be dominated by massive, 450-ft. high assembly sheds, where several C-5 and Nova vehicles can be prepared for launch simultaneously.

The sheds are the heart of a new launch technique called the Mobile Transfer Method, discussed briefly last fall by Dr. Kurt Debus, director of NASA's Launch Operations Directorate at AMR (AW Oct. 16, p. 23). Assembly and checkout will be combined in a single shed with four bays, and actual time on the pad can be reduced to a week.

Complex 34, the Saturn C-1 launch facility, can accommodate only four launches a year, since two months of assembly and checkout time on the pad are required before launch, and at least a month is needed to rehabilitate the facility after launch. Pad time has been a continuing problem even with much smaller vehicles. Vehicle for the Mercury-Atlas 6 mission has been on Pad 14 since Dec. 1, and the first Centaur test vehicle has been on Pad 36A since last summer.

First C-5 facility will be called Complex 39, and could accommodate as many as 10 launches a year. Estimated cost is $190 million, as opposed to $360 million to launch the same number of vehicles with standard assembly and checkout techniques.

Under the new method, vehicle stages are received at the assembly shed, assembled and then checked out, using the same umbilical system to be used for launch. This will eliminate changes in control equipment and power lines. The umbilical system will go with the vehicle throughout assembly, checkout and launch operations.

The vehicle will be erected on its transporter—either a railroad flat car or barge. When it is assembled and checked, it will be linked to the central control center and moved to an arming tower where control rockets and other pyrotechnics will be installed.

Service towers and gantries, such as the 310-ft. tower at the Saturn C-1 Complex 34, will not be used, since the umbilical tower will provide access for final vehicle preparation and loading the astronauts.

From the arming tower, the vehicle will be moved to the launch table, where the only critical operation remaining will be fueling.

Separation between the launch table and industrial area will be about 2 mi.,

## Optical Maser R&D

**Electronic Technology Laboratory of USAF's Aeronautical Systems Division will soon select a contractor, or several contractors, for what may be the largest active government-funded research and development program in optical masers.**

**The $1-million program will investigate materials, pump sources, crystal growth and device configurations, continuing a study begun a year ago by Hughes' Malibu Research Laboratories under a $370,000 ASD contract.**

**Program may be awarded to a single contractor or broken into several parts and given to more than one company. Proposals are due in Dayton Feb. 14.**

and analyses are now being made to determine which transfer mode presents the least problems. The C-5 vehicle will weigh 6-7 million lb., which would require a substantial rail bed if rail transport is chosen. Although it probably would be less expensive to dig a canal, unknown design factors exist in barge keel angle and effects of the wind on a vehicle 350 ft. high—height of the C-5.

NASA also is attempting to build flexibility into its shed and transport designs to afford capability to handle the 10-million-lb. liquid propellant Nova and the 20-million-lb. solid propellant Nova.

### Major Design Problem

The major design problem expected in the assembly shed is the foundation, since overhead cranes must lift multi-million pound loads, and the buildings must withstand winds of hurricane force.

The plan now is to drive piles to bedrock, about 150-200 ft. below the surface, cap the piles and use them for the foundation.

Planning for the vast expansion of launch facilities here began within weeks after President Kennedy announced the approval of the Apollo manned lunar landing mission as a national goal. Joint NASA-Defense Department agreement was effected in which NASA outlines mission requirements, and Air Force will provide range support as it pertains to the launch site.

In terms of cost and the time required to fulfill the mission, AMR was selected as the launch site over Brownsville, Tex., Christmas Island in the mid-Pacific, Cumberland Island, Ga., Hawaii, Bahama Island and White Sands Missile Range (AW Sept. 18, p. 28).

Executive management of the expansion will remain with NASA, since the agency must obtain approval for the construction projects and fund them. Air Force Missile Test Center here is acting as NASA's agent for design and construction of all support items—roads, bridges, communications and utilities—which it will accomplish through the Army Corps of Engineers.

NASA will control design criteria for brick and mortar construction, which is being done through the Corps of Engineers, and NASA will acquire launch systems through its own purchasing and contracting office at the Launch Operations Directorate.

Corps of Engineers also is NASA's agent for acquiring 4,000 individual tracts of land, including about 400 homes, which is being accomplished in three increments( see map p. 31).

Government spokesmen say by far, the great majority of landowners being dispossessed are content with what they are paid, but local newspapers frequently carry interviews with property owners who are dissatisfied with appraisals of their land.

Much of the land being acquired by NASA was bought on speculation several years ago when property values were at an all-time high. Because appraisals are being made on current values, they are frequently lower than the purchase price. Appraisals are done by non-government firms under contract.

Bulk of the acreage is a buffer zone on Merritt Island which contains some of Florida's best citrus groves. NASA will allow crops to be grown on some of the groves until June, 1964, but each grove will be controlled by a lease which can be canceled on 60 days notice.

The vast responsibility of the Army Corps of Engineers has become a source of concern for its Navy counterpart, the Bureau of Yards and Docks. The Navy bureau feels it has the capability to act as NASA's agent for at least a share of the work being done here, at the Mississippi Test Site and in Houston, where the Manned Spacecraft Center is being constructed.

So far, the Navy has acted as NASA's agent only for the new Scout launch pad at Point Arguello, Calif., and for an environmental chamber at Seal Beach, Calif., while the Army has won the remainder of the civilian agency's construction programs.

Navy feels it can handle NASA construction jobs at cost plus a 7% service fee. The Corps of Engineers declined to tell AVIATION WEEK its normal service fee.

Late last month, the Corps of Engineers established a space construction office in Washington to be headed by Brig. Gen. Thomas J. Hayes, who will coordinate all Army Engineers activities carried out for NASA.

Meanwhile, the local impact of the Cape expansion program is being continually analyzed by a Joint Community Impact Coordination Committee, consisting of Col. Asa Gibbs, who represents NASA, Lt. Col. C. A. McClelland, AFMTC legislative liaison officer and Max Brewer, member of the Florida Road Board from the Fifth District.

Col. McClelland said permanent employment during the next four years will grow from 20,000 to 30,000, and temporary workers will increase in number from 1,600 to a peak of 8,000 in 1964, with a plateau of about 4,000 after the peak. Temporary workers will be those who will construct the new facilities.

Expansion here also is reflected in AFMTC expenditures, which in Fiscal 1961 totaled $279.4 million, and in Fiscal 1962 will be $493.9 million.

### Impact Committee

The impact committee is concerned with the effects of the expansion on schools, roads and community services. Some feel the direct effect will be lessened because large contractors have indicated they will prefer locations near Miami and other metropolitan areas over Brevard, Seminole, Oceola, Orange and Indian River counties, which surround the AMR complex. Aerojet, for example, has an option to lease 90,000 acres in Dade County at the entrance to the Everglades.

In addition to the obvious requirements for increased housing, schools, hospitals and services, the expansion at AMR brings a need to improve commercial airport facilities. The problem becomes more pronounced in direct relation to launch activities of Canaveral.

Orlando, 52 mi. away, is the main connecting link for traffic north and west and as of Jan. 1 handled 45 flights daily. Jet traffic from New York City was inaugurated to Orlando Feb. 1, with aircraft using McCoy AFB runways. A plan to fly commercial traffic directly into Patrick AFB never went beyond the discussion stage.

The impact committee has estimated that commercial air traffic requirements will double as a result of the expansion.

## Inspector Probe

**Washington—Air Force Secretary Eugene Zuckert has ordered an investigation of reasons for the delay in Air Force's satellite Inspector (formerly known as Project Saint) being developed by Radio Corp. of America.**

**Zuckert is investigating a report that Air Force asked RCA to increase the capability of the vehicle beyond original objectives in expectation of getting additional program funding, which never materialized, and then was forced to tell the contractor to stretch the program to hold expenditures to authorized levels.**



# Rocket Ejection Aids in Crash Survival

**Washington**—Air Force Secretary Eugene M. Zuckert has taken his service to task for inadequate low-level escape equipment which has resulted in a continued high rate of pilot fatalities. Navy, however, has experienced such a dramatic decrease in such fatalities due to improved rocket type ejectors that it plans to install them on most of its fleet operational jet aircraft.

Zuckert, in his annual report covering Fiscal 1961, stated: "Proposed measures to overcome the deficiency included greater emphasis on training in ejection and water survival, installation of catapult ejection equipment and man-seat separators into most Century aircraft, and installation of man-seat separators into the T-33."

### Ejection Statistics

In revealing ejection statistics, Navy officials emphasized that even a perfect system could go wrong under certain conditions, such as an aircraft diving straight in, sinking too fast on a landing or a pilot making an ejection in an inverted position.

From July 1, 1960 to Nov. 1, 1961, the Navy recorded 156 ejections, of which 107 were made above 1,000 ft. altitude.

Of those attempted above 1,000 ft. all but two were successful for a nearly 99% success record.

It is in the category of attempted ejections under 1,000 ft., however, that the low-level action seats show their value. Examination of the statistics shows that there were 49 attempts made in this altitude range, and 29 were successful for a score of 59%.

On the face of it this statistic does not appear favorable. Looking further into the figures, it is shown all 20 unsuccessful attempts resulted in fatalities. But of these fatalities, 16 were attempts at ejection under the impossible conditions already mentioned or beyond the design limitations of the seats.

The true statistic, therefore, is that there were only four fatalities out of the 33 low-level attempts that were within the capabilities of the equipment.

Ejection seat development has progressed from the catapult type of installation to the rocket propelled type. The former utilizes a gunpowder charge in a cylinder, resulting in rapid acceleration up to 20 g. This rapid acceleration sometimes causes injury to the pilot's spine if he is not properly positioned. This is largely overcome by designing the pull-down curtain which places the pilot's arms in such a manner that his spine is aligned correctly.

The catapult type does not propel the seat sufficiently high to effect successful ejections at zero altitude. The rocket type can, however. Its thrust is prolonged and the acceleration slow enough to prevent injury to a pilot.

The first successful low-level ejection type of seat was the Martin-Baker, developed in England. The rocket type device was first installed in Navy aircraft in December, 1957. At present it has been retrofitted in the Chance Vought F8U-1, the McDonnell F3H-1, the Douglas F4D-1 and 2, the Grumman F9F-8B and 8T, and the North American FJ-4D. It is standard equipment in the F8U-2, McDonnell F4H-1 and the Grumman A2F-1.

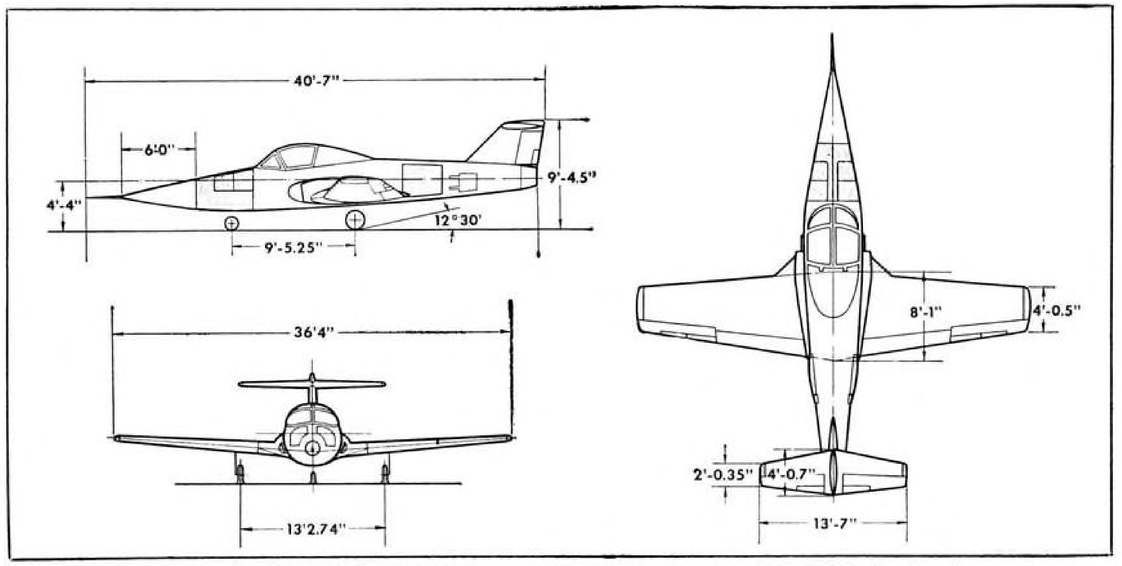
### Aircraft Attitude

Generally speaking, the Martin-Baker seat permits successful ejection at altitudes of 50 ft. or above and a minimum of 130 kt. indicated air speed. It varies with the aircraft, however, depending on the weight of the seat. Attitude of the aircraft must be level or nose high.

Another type of seat is the Douglas RAPEC (Rocket Assisted Personnel Ejection Catapult). It is installed in the Douglas series of A4D attack aircraft. It can be successfully fired at ground level at a minimum speed of 90 kt. in level or climbing attitude.

The North American rocket ejection seat is installed in the T2J and A3J aircraft made by the same company. Both can be fired at ground level, with a minimum speed of 100 kt. for the A3J and 75 kt. for the T2J.

The standard catapult seat can also




## Canadair CL-41R Will Provide Training in CF-104 Avionics

**Canadair CL-41R is a version of the Canadair CL-41 single-jet trainer which will be produced for the Royal Canadian Air Force as an advanced trainer in airborne intercept radar and communications systems which will be operational in the CF-104 intercept fighter also being produced by Canadair. The CL-41 is a side-by-side instructor and student aircraft with unswept wings which can be used for primary training of students and for transition from piston-powered aircraft to jet aircraft (AW Dec. 11, p. 54).**

## Ionized Cloud Study

**Propagation tests to evaluate feasibility of using man-made clouds of ionized particles produced by seeding plus earth-based radio beams to extend range of line-of-sight radio frequencies will be conducted this summer by USAF's Rome Air Development Center.**

**Sperry Gyroscope, which has proposed one technique for producing artificial ionized clouds, is expected to be one of several companies bidding for a contract to provide support for the RADC tests.**

be provided with a lower altitude capability by installation of the zero delay lanyard. Normally, the sequence that is followed automatically when the standard seat face curtain is pulled is: the firing of the seat, a delay of from 2¾ sec. to 4 sec. for deceleration, release of the lap belt, separation from the seat by an inflating bladder, release of the drogue parachute or the main canopy depending on the type of parachute, and deployment of the main parachute. Four to seven seconds elapse before full deployment.

### No Delays

With the zero delay lanyard there are no delays. This permits, generally speaking, a successful ejection at 200 ft. in level or climbing flight in the FJ-3, and the Lockheed TV-2 and T2V-1.

New rocket cartridges have been developed and are presently being installed in many aircraft. In some instances they will permit zero level firing at low speeds, with the seat traveling as high as 200 ft. before separating from the pilot.

Although some test work remains with specific aircraft, the Navy expects them to be installed in all fleet operational aircraft before summer. They will operate safely within the speed envelope of each aircraft, which means about 600 kt. and below.

Navy supersonic aircraft are equipped with g limiters. If an ejection is made at over 600 kt., the limiter works to prevent separation from the seat until a survivable speed is reached.

A rule of thumb that can be applied to low-level ejections is that 100 ft. of altitude is needed to overcome every 400 fpm. in sink rate.

### Accident Statistics

In Fiscal 1961 the Navy had a total of 602 aircraft accidents, resulting in damage to 338 aircraft which amounted to destruction, loss or damage rendering the aircraft of no value. Total dollar loss was over $297 million, an increase of $31 million over the preceding year. Although there were 53 fewer accidents, the average cost per accident increased from $407,000 to $494,000.

The Air Force major accident rate per 100,000 flying hr. for Fiscal 1961 was 6.3, compared with 6.5 in Fiscal 1960 and 9.7 in Fiscal 1959. The number of major accidents declined from 510 in Fiscal 1960 to 440 in Fiscal 1961. Accidents destroyed 306 aircraft in Fiscal 1961 compared with 358 in Fiscal 1958. Fatalities rose from 290 to 347, although fatal accidents declined from 144 to 122.

## Ultra-High-Speed Space Camera Planned

**Belmont, Calif.—Breadboard model of a potentially ultra-high-speed space camera system which utilizes a number of advanced electro-optical techniques will be fabricated here for National Aeronautics and Space Administration's Jet Propulsion Laboratory and delivered to JPL in October.**

**System is being developed by Optics Technology, Inc., under a $95,000 research and development contract from JPL's Space Sciences Division. It will use various components made of fiber optics (AW Nov. 21, 1960, p. 79) and photoconductive phosphors to give it combinations of features required for photographing and mapping planetary bodies from spacecraft. Typical of the assemblies being studied for the system is a combination fiber optics and phosphor high-gain image intensifier.**

**Among characteristics which this breadboard system might eventually yield are:**

- **Low relative apertures—less than //1.**
- **Wide field angles—20 deg. to 40 deg.**
- **Ability to approach in image quality the diffraction properties of light.**
- **Ability to perform under space environmental conditions.**
- **Ability to function not only in visible portion of the optical spectrum, but in infrared and ultraviolet as well.**

**The JPL contract calls for construction of a breadboard model of an optical system for study, testing and design. In addition, it specifies the use of fiber optics components which ultimately may reduce the number of components and minimize alignment difficulties encountered in optical systems.**

**At present, the system is not earmarked for any of JPL's space programs but many of these, especially the projected lunar orbiter (Surveyor orbiter) and the planetary-interplanetary programs, will require more advanced optical systems than are now available.**

## British Report Cost Of Blue Steel Program

**London**—Development cost of the Avro Blue Steel standoff bomb for the Royal Air Force V-bomber fleet, estimated at $35 million in 1955, rose to $168 million by September, 1960, the British comptroller general reported last week.

Development costs do not include the warhead. Blue Steel is due to enter V-bomber operational service this year as an interim missile for the Douglas Skybolt, programed for operational status with RAF in 1965.

A. V. Roe, the manufacturer, declined comment on the report by Sir Edmund Compton, but Ministry of Aviation, as the contractor, emphasized difficulties in estimating and controlling research and development costs of advanced projects.

The report contends that the ministry undertook Blue Steel in full knowledge that the missile might cost more than estimated.

Sir Edmund said that on a number of occasions between November, 1958, and February, 1961, ministry technical officers reported that progress on the Blue Steel contract had not been entirely satisfactory with various stages of work running much later than had been planned.

The company completed a comprehensive brochure on Blue Steel in July, 1960, for the first time, following a review of development costs.

When Sir Edmund asked the ministry whether a financial penalty or restriction on profits was to be allowed on the Blue Steel contract, the ministry replied that it had, from time to time, criticized the contractor's handling of the project and its organization and management.

Each time, the ministry told Sir Edmund, the contractor took appropriate remedial action.

Ministry claims A. V. Roe has progressively evolved an organization which the ministry considers should be able to complete Blue Steel in as short a time as practicable.

The ministry also pointed out difficulties in staffing and technical areas on development of a weapon new to Britain's armory.

Blue Steel originally was envisaged as an airborne weapon with a 40-50 mi. range, but specifications were enlarged for a greater range after development had started.

Funding for the weapon also was on a short-term basis.

Development cost of USAF-Douglas Skybolt is about $450 million (AW Jan. 15, p. 23). Britain reportedly pays about 15% of the cost of the Skybolt program.




# How Solar's experience with refractory components creates space-age structures

Current weapon systems require structural components that can withstand extreme temperatures. With solid fuel rocket engines operating at over 6000F and re-entry vehicle components experiencing equilibrium temperatures of 2000 to 5000F, materials systems are being taxed to their limits. Significant advances in high temperature structural technology are required to meet these demands.

*Experimental lithium-cooled rocket nozzle*

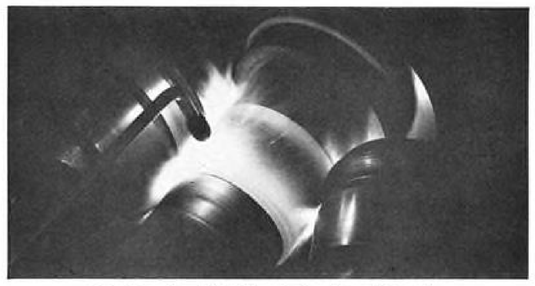
Solar has called on 35 years of experience in high temperature materials and structures to meet these problems. This experience has created an integrated, dynamic organization with materials research and development, structural analysis, prototype and production manufacturing capabilities.

Solar's work in rocket nozzle technology includes development of tungsten forming and joining techniques. Shear forming and hot die forming techniques are available for producing the complex shapes required for nozzle components. Joining tungsten by solid state bonding and reactive brazing has been accomplished, resulting in unrecrystallized joints with usable strength in excess of 4000F. A current program at Solar is aimed at design and fabrication of cooled nozzles for extreme temperature operation. Other research projects include compatibility of liquid metals and exhaust gas products with refractory metals, and a unique method of thrust vector control.

Re-entry vehicles require refractory components over a major portion of their outer surfaces. Solar is working on a contract to develop, fabricate, and test frontal sections for a super-orbital glide re-entry vehicle. Temperatures in excess of 5000F will be experienced during re-entry for this component, representative of the next generation of glide re-entry vehicles.

Solar's current capabilities in fabrication activities supply a broad base of supporting technology for refractory component assembly.

Plasma spraying techniques are available for the deposition of any of the refractory metals, as well as the ceramic materials which are difficult to fabricate by any other process. Recent projects at Solar have included the fabrication of parts from tungsten, 90Ta-10W, columbium, and molybdenum alloys.



*Spinning of centrifugally cast rings for rocket nozzle*

For further information about Solar's refractory component experience in materials research, design, fabrication, and testing, write Dept. J-203, Solar, San Diego 12, California.

SOLAR

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PHOTO BY PAUL WELLER


# THE EXTRA MEASURE

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## Coast Guard Selects S-62 as Replacement

Coast Guard selection of the Sikorsky S-62 turbine-powered amphibious helicopter as its new search and rescue aircraft, replacing the present HO4S (S-55), is the first government order for the aircraft and the first with quantity production potential.

A contract currently is being negotiated, with initial order expected to be for four helicopters and first delivery in December. Price will depend largely on the amount of electronic and auxiliary gear the Coast Guard will order for the helicopters, but is reported to be about $300,000 per aircraft.

The S-62 was selected, Coast Guard sources in Washington said, because of its price and amphibious capability, plus the fact that it has been certificated by the Federal Aviation Agency and in commercial service for some time (AW June 26, p. 42).

The helicopter underwent Coast Guard flight evaluation at Patuxent River, Md. A Coast Guard mockup board is due to meet at the Sikorsky factory at Stratford, Conn., Feb. 19 and a firm contract may be signed then.

In addition to search and rescue missions, the S-62 will be used for logistic support of outlying Coast Guard stations, particularly lighthouses. Some of these have come to rely heavily on helicopter support.

A rescue platform, which lowers from the interior deck through the hatchway to form a deck extension, will be included in Coast Guard versions, as will equipment for the service's concept of using helicopters to tow disabled boats.

Rescue platform originally was developed by Sikorsky in response to Swiss requirements and is being modified to meet Coast Guard needs. Experience has shown that persons in the water can be brought aboard the rescue helicopter more rapidly in this manner than by means of a sling lowered from hovering helicopter.

Sikorsky is hopeful that the selection of the S-62 by the Coast Guard will re-awaken Navy interest in the aircraft. The Coast Guard currently operates 38 helicopters, but would like to increase the number. Sikorsky believes total number of aircraft ordered by the Coast Guard may eventually be as high as 50. This is dependent on the Coast Guard's Fiscal 1963 budget appropriation, however.

Coast Guard version of S-62, called the HU2S-1, will be powered by a General Electric T-58-8 gas turbine engine. The aircraft has a useful load of 2,900 lb. and has operated from water in 8 to 10 ft. waves.

### Piasecki Model 16-H

**Piasecki Aircraft Corp. Model 16-H compound helicopter, now nearing first flight, was developed entirely with company funds as an entry in the Marine ASH competition and as a contender in the business aircraft market.**

**The five-place aircraft features an unloaded main lifting rotor and a "ring-tail," a shrouded pusher propeller similar to the "ring-wing" concept (AW Sept. 26, 1960, p. 54). Stub wings carry a major portion of the vehicle weight in forward flight.**

**A single Canadian Pratt & Whitney PT6 gas turbine, rated at 500 shp., powers the 16-H. A single transmission drives both the main rotor and the pusher propeller. The shroud carries slipstream deflectors for control of the aircraft, and protects ground personnel. Calculated cruise speed of the design is in excess of 150 mph.**

## Tiros 4 Will Provide MA-6 Weather Data

**Washington**—Fourth Tiros satellite, launched last week from the Atlantic Missile Range as a Delta payload, is expected to provide precise weather information on recovery areas in the Project Mercury manned orbital mission as an immediate operational objective, as well as continuing the development program which will lead to an operational meteorological satellite network.

The 285-lb. Tiros 4 payload was launched at 7:43 a.m. Feb. 8 into an orbit, which, on the first pass, had an apogee of 525 mi., perigee of 450 mi., and period of 100 min. Both video and infrared data was being received clearly. During its first few days of operation, it is expected to photograph cloud cover over the Atlantic recovery areas into which the MA-6 capsule will land after its first, second and third orbits (see p. 29).

The Tiros satellite series has become the most successful program being conducted by the National Aeronautics and Space Administration, with all four attempts providing a large amount of data (AW Oct. 2, p. 70). Tiros 4 is the last of the first generation, and a second generation of three Tiros satellites now will be scheduled at 90-day intervals. Although they will be similar to the first generation, they will contain components with longer lifetimes. Tiros 4 is expected to be operational 90 days.

The newest weather satellite is identical to Tiros 3, launched July 12 (AW July 17, p. 37), with the addition of a new lens on one of the two wide angle cameras designed to reduce distortion. New lens covers an area 450 mi. on a side, while the other camera covers 750 mi. on a side.

## News Digest

**Hawker Siddeley** is designing a turbofan-powered version of the Avro 748 transport aircraft, featuring aft-mounted engines. Designation is the Avro 778.

**Air Force Ballistic Systems** Division will issue requests for proposals to industry for the mobile mid-range ballistic missile. Associate contract areas for propulsion, re-entry systems, guidance, command and control, transporter-launcher, and systems integration, assembly and checkout have been created.

**Civil officials** in Bari, Italy have assumed responsibility for prosecution of formal espionage charges against Sublieutenant Miluse Solakov, pilot of a Bulgarian air force MiG-17 which crashed near a NATO missile base at Bari last month (AW Jan. 29, p. 31).

**British White Paper,** outlining defense policy for the next five years, is due Feb. 20 and probably will emphasize that the deterrent role remains with the V-bomber fleet, using Blue Steel standoff bomb late this year, and Skybolt by 1965.

**Bendix Corp.**'s Systems Division won the first contract awarded by U. S. Arms Control and Disarmament Agency last week. The $150,000-contract covers a study of techniques for monitoring production of strategic delivery vehicles, and is part of a long-range program of research in the areas of arms control and disarmament.

**Military Electronics Division** of Motorola, Inc., will be awarded a $3-million National Aeronautics and Space Administration contract for research and development of a mobile range and range rate system able to establish precisely positions and velocities of satellites. Three stations will be used to triangulate vehicles.

**President Kennedy** last week reappointed G. Joseph Minetti a member of the Civil Aeronautics Board for a six-year term expiring Dec. 31, 1967.

**British Aircraft Corp.** has dropped development studies on its P.T.428 missile, described as an advanced Mauler-type weapon, to concentrate development funds on its English Electric Blue Water replacement for Corporal now in service with the British army.

**Republic Aviation Corp.** net 1961 earnings rose to $10,692,844 on sales of $353,723,940. This compares with 1960 earnings of $4,703,000 on sales of $215,274,000.

# Atlantic Airlines Adopt Group Fare Plan

**IATA to hold meeting later this month to consider requests to extend area covered by cut-rate fares.**

By Glenn Garrison

New York—New group fare plan for North Atlantic air traffic was adopted last week by mail vote of International Air Transport Assn. carriers, despite misgivings on the part of some of them.

At the same tme, IATA advised the airlines that another meeting will be held this month to consider requests to extend the area covered by the new fares. This initially will include Europe, the Middle East and Africa, with the furthest eastern point being Beirut. Vice presidents of all North Atlantic and mid-Atlantic carriers, and of Japan Air Lines and Northwest Airlines, were advised that the meeting will be held to consider requests to extend the fares to India, Pakistan, Ceylon, Bermuda-Nassau and mid-Atlantic points.

Observers here felt that the proposed meeting resulted from objections of some carriers to the present scope of the plan. A carrier such as Air-India or Pakistan International Airlines would benefit less from the present plan than would a carrier with a terminal included in the area covered by the fare.

Some carriers, it is believed, might not have gone along with the vote unless they had had assurances of later adjustments.

IATA and the carriers officially are predicting substantial traffic gains from the plan and are touting it, but there was some grumbling behind the scenes on several points. There were no negative votes—otherwise the plan would not have been approved—but reportedly there were some abstentions. Those who had objections went along with the majority, or at least abstained, rather than be put in a dog-in-the-manger position.

### Critics' Comment

Critics feel the plan fails to meet head-on the need for general reduction of transatlantic fares. They believe it will lead to flagrant abuses of rules governing eligibility of groups and will be complicated to police and administer.

Under the new fares, which go into effect Mar. 10 assuming government approvals, groups of 25 or more persons may travel at jet fares as much as $186 below regular economy rates. The New York-London round-trip group fare will be $300 compared with $350 for the present 17-day excursion fare, which is in effect in the off-season only. The group fare will be year-round, with the exception of week-ends during May, June and July eastbound and August, September and October westbound.

Group fares on piston aircraft will be somewhat lower than the jet fares, according to IATA, although the exact level has not yet been set.

Groups may qualify for the lower fare in either of two ways: by showing definite association as members for at least six months with an existing organization not primarily formed for the purpose of travel, or by assembling spontaneously without solicitation.

### Advance Reservations

Reservations must be made 30 days in advance, and 30 days' notice is required for cancellation of groups. No refunds are forthcoming if cancellation is less than 30 days before departure, except that an individual passenger can get a refund if his place is filled by another legal group member.

An individual of a group canceling at any time can apply the price of his group ticket to a regular fare flight.

Under the rules, booking can be made through a travel agent, but the agent or airline can't create groups or solicit members. Members of the immediate family of a group passenger are eligible, and children under 12 are ticketed at half fare but count as only half persons in making up a group.

Group passengers must travel together on all flights. However, for the convenience of an airline, groups may be split on particular flights if seats on one aircraft are not available.

### Stimulate Travel

Sir William P. Hildred, IATA director general, predicted the group fare will attract hundreds of thousands of additional passengers, particularly Europeans visiting U.S. (see p. 47). It will also stimulate group travel as such, he said, because groups no longer must charter a whole aircraft and hence can be smaller. He also pointed out the advantages over charters of frequency and flexibility of scheduled flights.

Among airlines commenting on the development, Pan American described it as a major stride and predicted substantial traffic gains. Scandinavian Airlines System called the move a step in the right direction, and said it would be promoted strongly. Trans World Airlines predicted the fare will make transatlantic vacation travel possible for many more fraternal and community organizations whose membership is not large enough for charters.

Hildred noted that there have been four significant fare reductions on the route in the last 10 years, including the new plan, and said the others all had been followed by sizable increases in traffic. From the 1951 normal year-round New York-London fare of $711, the rate went to $486 in 1952 with introduction of the tourist fare, then back to $522 tourist; in 1958, the economy fare went in with a rate of $453.60 propeller and $486 jet. Considering a 10% lowering of the purchasing power of money, Hildred said, the new fare means a reduction of about 62% in 10 years in the lowest year-round transatlantic round-trip fare.

Critics of the group plan say it fails to meet head-on the need for general reduction of transatlantic fares to open new markets. They see the plan as a device to evade a general reduction.

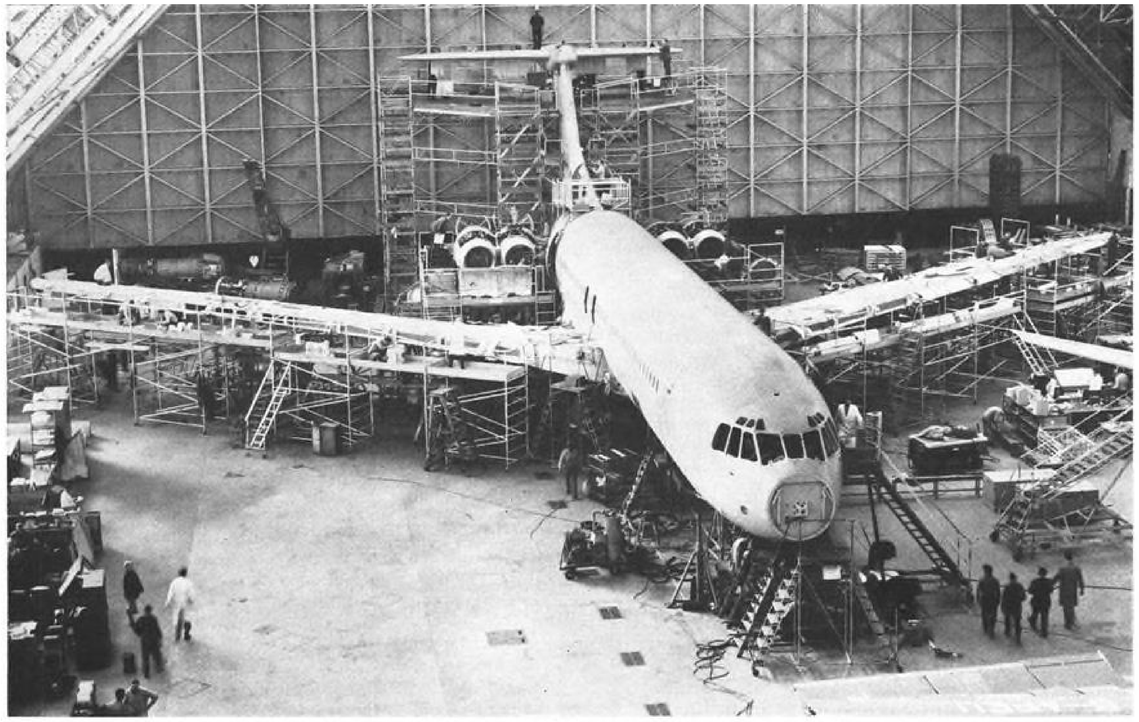
For the vacationer, the critics say, the weekend restriction during peak periods is a serious weakness. During the periods noted above, group fare passengers cannot travel between the hours of 7 a.m. Friday and 7 a.m. Monday. Most people, the critics say, count on weekends to give them a maximum of vacation days.

### Trident Delivery

**British European Airways last week estimated it will have its first de Havilland Trident three-jet medium-range transports about six months earlier than anticipated, on the basis of success of initial test flights.**

**The airline said delivery now is scheduled for mid-summer of 1963, rather than year-end. The airline will use the Tridents for Christmas peak traffic, after completing about four months of pilot training and route proving.**





**Wings Mated to Vickers VC.10 Transport's Fuselage**

First photo of Vickers VC.10 with both wings mated to fuselage shows aft-mounted nacelles being readied to take four Rolls-Royce Conway RCo.42/1 engines. Four Conways have been delivered to Vickers-Armstrongs' Weybridge plant for installation checks, with flight engines scheduled for April delivery. Airplane will make its first flight in May or June. Flight test equipment is currently being installed and main landing gear is being fitted. Cockpit instrumentation is well advanced and all major systems have been installed. First VC.10, registered G-ARTA, is owned by Vickers. Fuselages for first three for British Overseas Airways Corp. have been completed. Fourteen Conway RCo.42/1s have been built. Engine has run about 1,000 hr. on test stands. It will make its first flight on the VC.10.

Another point raised by critics of the plan is the fact that passengers can travel as part of a group, enjoying the low rate, to a European gateway and then strike out on their own for individual trips within Europe. Groups planning such an itinerary might be likely to choose London as a break-off point and thus deny revenue to carriers that have more distant destination cities.

As far as abuses are concerned, some officials consider it likely that a travel agent with 23 persons signed will not fail to find the other two somehow, perhaps by trading with another agent, or making an arrangement with an airline.

### Spontaneous Groups

As far as the spontaneous groups are concerned, it is felt that it will be extremely difficult if not impossible to determine whether any solicitation was involved in rounding up the required 25 people.

Under the plan, groups can make multiple-city trips as passengers can under existing tariffs. But flights between all points must be made as a group. If a passenger fails to show up on schedule, the group is permitted to go ahead but the missing passenger is on his own.

## Braniff Pays $14,000 Fine Levied by FAA

Dallas, Tex.—Braniff Airways has paid a $14,000 fine levied by Federal Aviation Agency for these alleged violations of FAA maintenance regulations:

- **That the carrier had** X-rayed a right front wing spar cap of a Douglas DC-6 on Jan. 14, 1961, that the films were developed, but not inspected. Although there was a crack in this component, the part was not repaired until Feb. 28, 1961, and meanwhile the airplane had made 126 scheduled flights, three training flights and completed one ferry flight.
- **That during October, 1960,** Braniff maintenance personnel released aircraft numbered 3407, 3410, 3411, 9703C, 9707, 9709 and 7075 on 13 different occasions without making the required entries in the aircraft logs certifying that the airplanes were in an airworthy condition.
- **That during October, 1960,** in Buenos Aires, Braniff maintenance personnel failed to conduct the required service checks on three Douglas DC-6 and DC-7 aircraft.
- **That on Jan. 15, 1961,** in St. Louis, Braniff maintenance personnel installed the wrong type hydraulic accumulator on a Convair 440, that in Dallas, 10 days later, this equipment was replaced with another wrong type, with the result that after a takeoff from Houston, the pilot was unable to retract the aircraft's nose landing gear. Following landing of the Convair 440 at Houston it was found that the accumulator had come loose.
- **That on Sept. 29, 1960,** at Dallas, Braniff maintenance personnel failed to install the ring clamps while installing a No. 2 power recovery turbine on the number one engine of DC-7C number 5906. Thereafter, the airplane was placed in operation in what FAA alleges was an unairworthy condition after improper maintenance.

FAA pointed out that Braniff was subject to a $1,000 fine for each violation. It agreed to accept the $14,000 as full settlement, however. "In suggesting this amount, we have borne in mind the fact that Braniff has recently made numerous modifications in its maintenance manual and procedures as required by FAA, although there remain several areas in which requests have been made but on which no action has been taken," FAA wrote the carrier.

# Airlines Differ on Overcapacity Solution

By L. L. Doty

**Washington**—Replies to a Civil Aeronautics Board request for suggestions as to how sagging load factors can be bolstered, again focus attention on marketing problems of the airline industry.

Response from those trunk carriers that had filed replies as of late last week revealed a wide variance of opinion on the faltering load factor issue. What little agreement there was lay in suggestions that the quickest way to boost load factors is by curtailing capacity.

Notably lacking, with a few exceptions, were plans to boost load factors through the only other apparent alternative: expansion of the airline market. Several airlines told the Board that steps had already been taken to reduce capacity.

The industry appears to be placing the blame for its present fiscal plight on excessive competition in major markets, which, coupled with a severe decline in historic growth patterns, has created the overcapacity problem. To correct this, some airlines feel that capacity should be reduced either on a voluntary basis or through inducement by the CAB.

While such a move could feasibly pump some life into load factors, it would not have the same value as an expansion of the current airline market. To a degree, this is borne out by this fact: a 1% increase in load factors brought about by increased traffic will increase operating profits by $30 million.

On the other hand, a 1% increase in load factors resulting from a reduction in capacity will increase operating profits by only $15 million.

Opinions as to where new airline markets lie also vary. There are even doubts that such markets actually exist. In a recent address (AW Jan. 15, p. 45), W. A. Patterson, president of United, questioned that automobile vacationers, the most obvious source of new air travelers, could be successfully lured to the airlines.

### Industry Disagreement

In addition, there is some disagreement about why this overcapacity exists. The obvious conclusion is that traffic in the past two years has remained at a standstill and the introduction of large, highspeed turbojet aircraft has generated an increase in available seat miles out of proportion to traffic demand.

That these factors have had a strong effect on the capacity problem is unquestioned, but another element often overlooked, which has influenced load factors, is the change in travel habits of air passengers during the past two years. Specifically, the steady switch from first class to coach travel has accounted for a substantial hike in available seat miles.

The industry has achieved remarkable success in holding seat capacity to a minimum despite the continuing introduction of new jet equipment. Available seat miles rose only 6.8% in 1961 and 7.3% in 1960 compared with increases ranging from 12.5% to 22.4% in pre-jet years.

However, a major expansion of coach capacity coupled with the decline of first-class seat miles has accelerated a growth in over-all available seat miles. If the coach to first-class ratio were the same today as it was in 1955, available seat miles in 1961 would have been only 47.3 billion compared with the actual total of 52.5 billion.

In other words, the switch from first-class to coach traffic can be assumed to be indirectly responsible for a 5.1 billion increase in available seat miles during those six years. On the same basis, it can be assumed that the load factor for the trunkline industry would have been 62.33% instead of the 56.23% actually recorded in 1961.

The trend is continuing. If the 1960 coach to first-class ratio prevailed in 1961, capacity would have increased only 1.4 billion seat miles rather than the actual 3.4-billion figure.

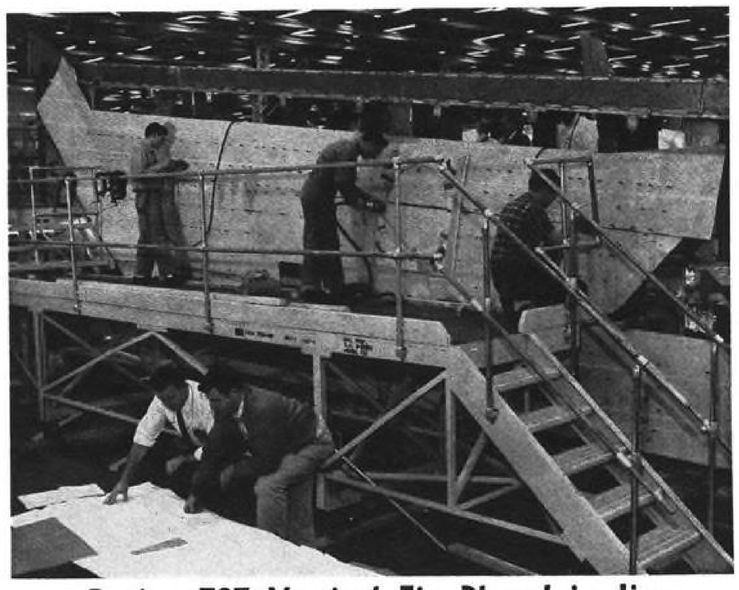
### Auto Market Untapped

This steady swing from first class to coach is apparently taking place largely within the industry's present market. While coach fares have undoubtedly diverted some traffic from the rails and buses, they have not penetrated the private automobile travel market to any marked degree.

In this connection, Maurice Lethbridge, executive vice president of Eastern, recently said that "at best, under present marketing concepts, air travel in the immediate future will little more than reflect the national economic health." He added:

"If we are to show dynamic growth in the 1960s, a departure from present thinking must be initiated." Lethbridge concluded that the industry must concentrate its principal effort toward attracting new business out of the present automobile market traveling over distances of 300 mi.

How this is to be achieved has not yet been delineated. An often-used saying in the industry is that the airlines know all about the person who flies but virtually nothing about the person who doesn't.



**Boeing 727 Vertical Fin Placed in Jig**

Side panels for the first Boeing 727 three-engine jet transport fin are placed in a jig at company's Renton, Wash., factory. The fin will be stressed to carry the aircraft's horizontal stabilizer at the top and will be contoured at the base to form an integral part of the center engine air intake duct. Rollout of the 727 is scheduled for fall.



Patterson doubts that the vast group of automobile vacationers represents a new market for the airlines, and noted in a recent address that "some haven't the desire to fly and no amount of advertising can awaken that desire."

He also deplores experimentation with fare reductions as a means of opening new markets, and has stamped such experiments as "perilous" in the absence of any proof that they can succeed. In his address, he admitted to the need for marketing surveys and proposed that the CAB conduct a marketing research program and subsidize any losses incurred by carriers.

### Continental's Position

Continental President Robert F. Six is convinced that low fares will produce new traffic and recently announced that he would ask CAB to set up long-haul experimental routes on which a low economy fare would be applied "to definitely test our belief that such fares will substantially expand the air travel market." No subsidy will be requested for the experiment, he added.

Between the extremists on the fare issue are those who would like to see a closing of the gap between coach and first-class fares by raising coach rates and those who feel that any further increases would depress the market the airlines now hold.

In his letter to the Board on the load factor problem, G. T. Baker, National's president, said that National had reduced capacity to fit available traffic but that competitors have not done so. He asked the CAB to induce Eastern to cut schedules on the New York-Miami market to a reasonable number.

Charles C. Tillinghast, TWA president, has similar grievances about his competitors who increase capacity when restrictions on capacity were more in line with conditions. He urged the Board to examine the problem in certain markets which "appear particularly suspect as examples of excess capacity."

### Action Suggested

Tillinghast suggested that the Board could take action under Section 411 of the Federal Aviation Act which gives the Board "power to order any airline to cease and desist unfair or deceptive practices or methods of competition." Lawyers here, however, emphasize that Section 401 of the Act specifically prohibits any restriction of a carrier's right "to add or change schedules."

Malcolm A. MacIntyre, president of Eastern, said that his carrier has been taking steps "to devise new services to tap new markets and stimulate traffic growth." He said that a survey has revealed that 17% of the air-bus passengers interviewed were taking their first trips by air and that 31% would have used surface transportation had air-bus not been available. MacIntyre added:

"In pricing these new services, we have never established a fare that is lower than that which we believe can be offset by cost reductions."

American said it had no specific suggestions for improving load factors. United echoed this opinion by stating that it "does not believe there is a feasible means of bringing about a substantial load factor increase in the immediate future."

In his statement, Patterson pointedly declared that "apart from the basic argument against dealing with the load factor problem through collective industry agreement, it is our conviction that it would not be possible for the carriers to reach an agreement."

**Dart Herald Outfitted for Royal Tour**

Handley Page Dart Herald twin turboprop transport in British European Airways markings is fitted with extra fuel tanks for a tour of South America this month. The aircraft will be flown by Prince Phillip, the Duke of Edinburgh, and BEA Capt. S. J. Nicolle. Tanks increase the Herald's normal capacity of 1,080 gal. to 1,740 gal. Military version of the Herald is competing with Avro 748 for an RAF order (AW Jan. 29, p. 23).

## Railroad Protests BEA Low-Fare Flight

**London**—British Railways is appealing an Air Transport Licensing Board decision allowing British European Airways to fly Vickers Vanguards between London and Glasgow at a new low fare structure of $9 one-way.

The flights, primarily scheduled during night hours, have been under way for about a month with marked success. The airline has heavy mail subsidy for the same flights to allow for the low fares.

British Railways complains that Vanguard flights, on a no-frill, high-density seating basis, have reflected a marked diversion of its normal surface traffic. A hearing has been set for Feb. 21 before Sir Arthur Hutchinson, appointed commissioner by Minister of Aviation Peter Thorneycroft.

## New York to Miami Shuttle Is Approved

**Washington**—Eastern Air Lines' New York-Newark to Miami low cost jet shuttle fares—$75 daytime and $57 at night including tax—went into effect last weekend after Civil Aeronautics Board rejected protests by competing carriers (AW Feb. 5, p. 40).

CAB said the complaints by National Airlines and Northeast Airlines—Eastern's two competitors on the route—did not give sufficient facts to warrant suspension and investigation. Both protesting carriers had told CAB the fares would not create new traffic, would aggravate the no show problem and reduce revenues.

The difference between Eastern's jet shuttle fare and its regular jet coach fare is that the shuttle passenger can not make a reservation. Both National and Northeast, which filed defensive tariffs reluctantly, have similar services which go into effect Feb. 15 and Feb. 18 respectively.

New fares will save passengers about $10 on a round trip.

In granting approval to Eastern, CAB required all three airlines affected by the tariff to submit information showing service available by type of jet aircraft, by direction—northbound and southbound and by class—first class, coach and no reservation.

CAB also wants an account of the number of passengers, the number of seats available and a breakdown showing the number of seats in each class. The reports have to be filed for February, March and April 20 days after the close of each month.

*The SEP2 is the Autopilot of the Comet, Britannia, Viscount, Vanguard and Friendship. It has been chosen for the Argosy and the Avro 748 because of its outstanding record of performance and unequalled reliability, proved over more than a million and a half hours in airline service. The SEP4 is the Autopilot of the BLEU Autoland System, and will form the heart of the first automatic landing system ever to go into regular operation. It is logical that the SEP5 has been chosen for the Trident, the first civil aircraft intended to perform regular automatic landings.*



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# FAA to Speed Flow of Part Failure Data

By David H. Hoffman

**Washington**—Fresh approach to airline maintenance taking shape within Federal Aviation Agency leans less on hard regulation but more on daily mechanical reports, which will be analyzed by agency computers, fed back to industry every 24 hr., and used to spot potential hazards.

Ultimate aim of FAA's Flight Standards Service is to lay groundwork for a system that could predict when a critical component was due to malfunction. With such knowledge, obtained from a massive store of timely statistics, FAA might permit airlines to run many parts to the brink of failure. By thus increasing equipment in-service time without sacrificing safety, the industry could slice the estimated $500 million it spends each year on maintenance and overhaul.

After giving his highest personal priority to the problem of maintenance supervision, FAA Administrator N. E. Halaby last week signed a rule that will require airlines to submit Mechanical Reliability Reports covering 17 specified types of malfunction to the agency. Two-way flow of the new reports—which replace the old, loosely-defined Daily Mechanical Reports—is scheduled to begin on Mar. 12.

## Immediate Hope

FAA's immediate hope is that daily analysis of the mechanical reports will enable the industry and the agency to identify, then promptly eliminate, mechanical flaws as they crop up in airframes, powerplants and vital components.

But important as it may be, the new rule implements only one of four major maintenance projects now under way within Flight Standards. Here are the others:

• **Drafting of common specifications** to govern when operators must overhaul used equipment acquired from other carriers. These specifications cover engines, airframes and certain components of all frequently traded piston-powered transports—Martin 202s and 404s, Curtiss C-46s, Convair 240s, 340s and 440s, Lockheed Constellations and Douglas DC-3s, DC-4s, DC-6s and DC-7s. They are scheduled for printing late in February or early in March. Airlines should receive full data near the middle of next month.

• **Development of maintenance** flight recorders. This recorder, similar to an elaborate strain gage, would measure the detrimental effect of forces acting on an aircraft and its component parts. A comprehensive study, completed by the Battelle Memorial Institute under FAA contract, was submitted to the agency in September. It recommended that FAA, after thorough preparation, sponsor a large-scale experiment in cooperation with the airlines to test whether such devices could predict forthcoming malfunctions.

• **Experimental program to control** the time between overhaul (TBO) authorized for engines in airline service. Now half way through a six-month trial, the pioneer control program has found favor with both the carriers and the FAA. In broad outline, the program (AW Oct. 30, p. 35) allows an airline to increase an engine's TBO either 100 or 200 hr. if not more than a specified number of in-flight shutdowns are experienced during any three consecutive months.

These three projects fall in the category of evolving ideas. None has reached the rule-making proposal stage as yet. But all are certain to assume greater importance as the airlines dispose of piston-engine transports, complete their transitions to turbine power and pay even more for maintenance and overhaul as a result.

## Self-Inspection Sought

As George C. Prill, director of Flight Standards Service and principal author of the agency's new regulatory philosophy explains, "FAA wants to get out of the airline overhaul business. It would favor a workable system under which carriers could establish their own overhaul and inspection periods in a controlled process."

Under current FAA directives, airlines must airmail Daily Mechanical Reports to FAA on any item that "may reasonably be expected, by the air carrier, to cause a serious hazard in the operation of an airplane." Vast discretion entrusted the companies under this policy led to inadequate and non-uniform reporting, according to FAA. During last summer's rash of hydraulic malfunctions on Douglas DC-8s and Boeing 707s, it was apparent from subsequent investigation that carriers were not reporting items FAA thought should be reported.

To remedy this situation without resort to rule-making, FAA issued a reporting guide and examined reports based on it for six months. Joint meetings with industry also were held, but the results were not considered satisfactory.

The FAA then proposed, on Feb. 8 of last year, a rule to make certain daily reports mandatory. An amended version of this proposal, signed by Halaby on Feb. 5, will force the industry to file Mechanical Reliability Reports on any malfunction that "has endangered or may endanger the safe operation of an airplane."

Although the phrase, "in the carrier's opinion," is retained in the new rule, these other broad categories of malfunctions are enumerated as must items:

• **False fire warnings** during flight plus all actual fires regardless of whether the aircraft's fire-warning system worked properly, malfunctioned, or was not designed to detect fire that had actually developed.

• **Components which, during flight** generate smoke, vapor or toxic fumes that enter the crew compartment. Powerplants, structures or equipment damaged by engine exhaust during flight also must be reported.

• **Engine shutdowns during flight** due to flameout, foreign object ingestion or icing, plus shutdowns involving external damage or the shutdown of more than one engine on the aircraft.

• **Propeller feathering system** malfunctions or inability of the system to control propeller overspeeding during flight. Fuel or fuel-dump irregularities affecting flow or causing "hazardous leakage."

• **Difficulty in extending** or retracting landing gear in flight or in operating the landing gear doors. Brake faults that result in decreased effectiveness while an aircraft is in motion on the ground.

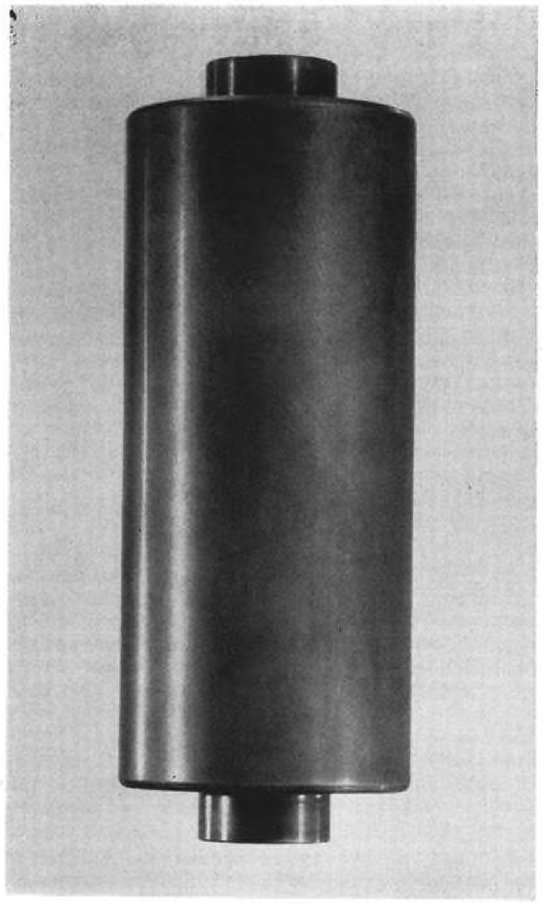
• **Cracks, permanent deformation** or corrosion of airplane structures that exceed the limits prescribed either by the manufacturer or the FAA. Any airplane structure requiring major repair.

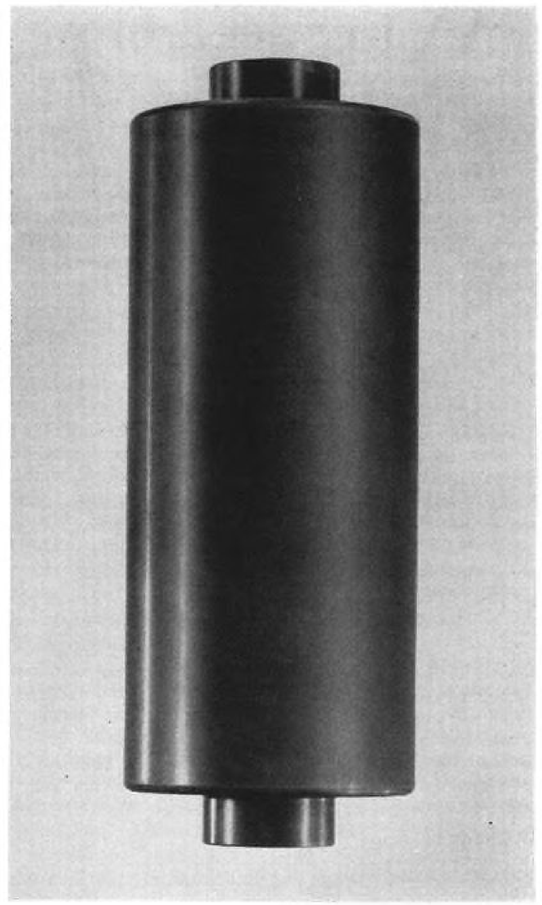
• **Any system or component** malfunctioning in a manner that forces the crew to take emergency action during flight. But the precautionary shutting down of an engine need not be reported under this provision.

Speed and precision in reporting, coupled with computer analysis of the assembled data, represent the key changes in the new system. Mechanically, it begins with the airline reports, which will be forwarded to 14 selected regional and district offices of FAA within 24 hr. after 9 a.m. on the previous day.

## Daily Report System

Teletypewriters in the FAA field offices will relay the daily mechanical reports to the agency's Washington headquarters' where a 24-hr. summary will be prepared. A second transmission will send this summary back to field offices minutes after the last report reaches Washington. Airlines can receive daily summaries instantaneously by leasing a teletypewriter drop from





# Which linkpin would you choose?

Each of these look-alike linkpins was sold as a replacement part for Pratt & Whitney Aircraft's famed R-2800 Engine.

The linkpin on the left is a "bargain price" engine part. The linkpin on the right is a Pratt & Whitney Aircraft *original equipment part*. Although the bargain linkpin resembles the genuine part, it is made of metal that is too soft for this application. Cracks which begin in minute defects beneath its plated surface could result in failure, causing major engine damage.

The genuine Pratt & Whitney Aircraft part is carefully engineered to endure flex loads as severe as 15 tons 20 times every second. Material used in the genuine linkpin meets specifications precisely. So do all of the more than 50 operations required in its production. These processes provide the long-term reliability which is the key to genuine economy in piston engine parts.

You ensure this reliability when you specify Pratt & Whitney Aircraft *original equipment parts*. They are quickly available direct from Pratt & Whitney Aircraft or from its authorized distributors in the United States and Canada.

Metallograph inspection—one of many extra tests genuine Pratt & Whitney Aircraft parts must pass.

**Pratt & Whitney Aircraft**
East Hartford, Connecticut

**Canadian Pratt & Whitney Aircraft Co., Ltd.**
Longueuil, P.Q., Canada




## FAA-Authorized Overhaul Times for Trunkline Turbojets

| | P & W JT3C-6 | P & W JT3C-7 | P & W JT3C-12 | P & W JT4 | GE CJ805-3 | Allison 501-D13 | P & W JT3D |
|---|---|---|---|---|---|---|---|
| **American** | 2,100 hr. Aug., 1961 | 1,300 hr. June, 1961 | None | None | None | 1,800 hr. Nov., 1961 | 1,200 hr. Sept., 1961 |
| **Braniff** | None | 1,400 hr. June, 1961 | None | 1,800 hr. Jan., 1962 | None | 2,000 hr. Dec., 1961 | None |
| **Continental** | 2,400 hr. Dec., 1961 | None | None | None | None | None | None |
| **Delta** | 1,600 hr. Dec., 1961 | None | None | None | 1,600 hr. Oct., 1961 | None | None |
| **Eastern** | None | None | 1,200 hr. Jan., 1962 | 2,000 hr. Dec., 1961 | None | 2,200 hr. Jan., 1962 | None |
| **National** | None | None | None | 1,800 hr. Jan., 1962 | None | 1,800 hr. Nov., 1961 | 800 hr. Starting |
| **Northeast** | None | None | None | None | 1,400 hr. Oct., 1961 | None | None |
| **Northwest** | None | None | None | 1,400 hr. Oct., 1961 | None | 1,500 hr. Dec., 1961 | 1,000 hr. Oct., 1961 |
| **TWA** | 2,600 hr. Jan., 1962 | None | None | 2,200 hr. Jan., 1962 | 1,600 hr. Dec., 1961 | None | 1,200 hr. Jan., 1962 |
| **United** | 2,100 hr. Dec., 1961 | 1,800 hr. Dec., 1961 | None | 2,000 hr. Dec., 1961 | None | None | 1,200 hr. Dec., 1961 |
| **Western** | 1,600 hr. Nov., 1961 | None | None | None | None | 2,000 hr. Nov., 1961 | 1,200 hr. Nov., 1961 |
| **Pan American** | 2,000 hr. Sept., 1961 | None | None | 2,000 hr. Oct., 1961 | None | None | None |

Note: Data furnished by Pratt & Whitney, Allison and General Electric. Time between overhaul (TBO) of a turbine engine generally hinges on two factors: when the engine was introduced in service, and the number of in-flight shutdowns or engine failures experienced by the airline in a three month period.

the appropriate telephone and telegraph company.

A list showing thousands of airplane parts, each catalogued by location, was developed by Air Transport Assn. and now is used by most of its 44 airline members. On the basis of this list, FAA will code, microfilm and file for future reference the reports received. It will also extract some statistical data for forwarding to Control Systems Division in Oklahoma City, where the information will be analyzed and cross-indexed for computer analysis.

Armed with such data, FAA may feel it can afford to be less conservative in awarding airframe, engine and component TBOs to the industry. Prill readily admits that airlines now are being forced to pull components for overhaul long before their individual failure rates could be expected to start climbing because of excessive service life.

Generally, according to Prill, part failure rates are relatively high early after overhaul. But these rates, when plotted, follow a very gradual curve that swings upward sharply only after an unknown number of service hours. Definition of this number for each one of the thousands of time-controlled components in airline use would be vastly important. For then, FAA could ensure that overhaul is required only at that point when there is a direct relationship between overhaul and airworthiness.

In FAA's opinion, rapid collection of data, its availability in statistically valid quantity and computer analysis soon may combine to make this approach possible.

To learn whether data can be gathered automatically at its ultimate source—the component or system in flight—FAA is taking a hard look at the concept of a maintenance flight recorder. At least one such device, known as MADREC (Malfunction Detection and Recording System) and manufactured by Lockheed, has been installed on some Air Force Boeing B-52s, B-47s and KC-135s.

Weighing 70 to 185 lb., MADREC can monitor up to 50 electronic components or systems simultaneously, or 250 if cycled switching is satisfactory to the operator. Systems that MADREC could monitor on a civil jet transport include autopilot, navigation (Doppler) radar, stall warning, instrument landing system, landing gear, pressurization, certain hydraulics and air conditioning.

Air Force operational tests, according to Lockheed, indicate that the reliability with which MADREC can pinpoint an incipient malfunction approaches 90%. In one experiment, 20 B-52s flew 63 sorties with MADRECs monitoring their bomb-navigation, autopilot and compass systems. Analysis of the recorders' readouts later showed that MADREC had verified and localized 12 crew-reported malfunctions in addition to 52 other discrepancies not yet detectable by the B-52 flight crews.

Rather than test MADREC or other state-of-the-art devices, FAA contracted with Battelle Institute to study which parameters might measure the airworthiness of turbine-powered civil transports. Confining 14 months of research to four major technical areas—structures, propulsion, electrical and electronic systems and mechanical systems—Battelle managed to identify many such parameters.

Some, it said, were predictive in that they enabled the plotting of performance versus service time for specific items of equipment. However, the institute cautioned that the numerical bond between these parameters and aircraft airworthiness could not be established with "the degree of accuracy

needed to fulfill the goals of this study."

Here, broken down by subject, are conclusions:

• **Structural.** The measurement of predictive structural parameters is "severely limited" by the current state-of-the-art. Strain gages, for example, lack the required reliability, and so many would be needed that their total output may not be compatible with electronic data processing techniques. General loads, moreover, are difficult to convert to local stresses. Assuming these handicaps can be overcome, a recorder should measure at least velocity, altitude and vertical acceleration to keep watch on structural integrity. And it would be desirable if the recorder also measured acceleration in all three directions plus rotational motion of the aircraft around its three axes.

• **Propulsion.** The report, optimistic in this area, said that data on exhaust gas temperature, rotational speeds, fuel flow, engine pressure ratio and inlet air temperature and pressure could be used to "compute trends describing the change with time of thermodynamic performance from a given norm." If trend analysis of this type is to work, however, cockpit gage accuracy must be greatly improved.

In addition—to predict bearing, accessory drive and lubrication system performance—data on vibration, engine run-down time, oil consumption and composition should be recorded. Each of these prospective parameters is being measured by various organizations, but no integrated program exists to assess their total effect on airworthiness.

• **Electrical and electronic systems.** Large number of tiny devices, coupled with numerous separate systems, make the measurement of significant parameters inherently difficult. Even though the reliability of single components is high, there are so many in each subsystem that over-all reliability is difficult to achieve. As a result, there is extensive electrical and electronic system redundancy and these systems are seldom critical from an airworthiness standpoint. "Considerable effort beyond that available for this study will be required to find measurable parameters that can be related to airworthiness," the report said.

• **Mechanical systems.** Battelle identified a total of 17 parameters that with the passing of service time affect the operation of seven major mechanical systems. Four of these—landing gear retraction time, maximum wheel brake temperature, flap extension time and hydraulic reservoir quantity—warrant "experimental verification." Monitoring of the 17 parameters probably would permit trend analysis if the precise numerical relationship between each parameter and airworthiness can be fixed by further study.

# House Group Criticizes CAB, FAA in Crash of Supplemental

By George C. Wilson

**Washington**—Stricter control of supplemental airlines and generally broadened powers for the Civil Aeronautics Board and Federal Aviation Agency were recommended last week by the House Armed Services subcommittee which investigated the Imperial Airlines crash.

The subcommittee, in its majority report, severely criticized the CAB and FAA, declaring the safety violations uncovered should have led them to revoke Imperial's operating certificate before the crash occurred last Nov. 8, killing 74 Army recruits.

In contrast, the CAB in its own report last week on the Imperial crash confined itself to technical findings and did not assume any blame or level any at FAA. The CAB did note that FAA had found "numerous improper operational procedures and maintenance practices" during its "extensive inspections" almost a year prior to the crash.

The Board blamed the flight crew for the Imperial crash itself, declaring "the probable cause of this accident was the lack of command coordination and decision, lack of judgment and lack of knowledge of the equipment, resulting in loss of power in three engines, creating an emergency situation which the crew could not handle."

The Board's report held that the two right-side engines on the Imperial Airlines Lockheed Constellation stopped in mid-flight because faulty fuel management exhausted the gasoline supply in the aircraft's No. 4 wing tank. It rules out fuel contamination as a contributing factor even though foreign matter was found in almost all the plane's engine inlet nozzles. Had the crew either opened the midship fuel cross-over valve or turned off the No. 4 boost pump after the dual engine failure was experienced, the two dead engines probably could have been restarted, the Board said.

The 25-page CAB report, which traced a history of questionable maintenance practices by Imperial, brought new demands in Congress for stricter control over supplemental airlines. Rep. Francis E. Walter (D.-Pa.), said the Imperial case showed "there is no reasonable basis for relying on any assurance given by the CAB at this time about any supplemental carrier or about the Board's ability to control these carriers in the future." He said the pending legislation should give the supplemental airline charter authority only.

This cross-fire of charges hit the supplemental airline industry while Chairman A. S. Mike Monroney (D.-Okla.) of the Senate Aviation subcommittee and Chairman Oren E. Harris (D.-Ark.) of the House Interstate and Foreign Commerce Committee were trying to work out a compromise on the widely differing bills passed last year by the Senate and House (AW Sept. 18, p. 45). The Senate bill would give supplementals authority to carry individually ticketed passengers and is in general more liberal than the House bill.

Supplemental airlines are operating under a temporary authority granted by Congress. The authority will expire Mar. 14. Consequently, the next few weeks in Congress will decide the future of the supplementals. Sen. Monroney has been arguing for his bill on grounds it will enable supplementals to achieve the economic stability needed to ensure safe practices. But the Imperial crash has charged the legislative arguments with emotionalism and greatly reduced the chances for a liberal bill.

The Imperial crash also has focused congressional attention on the general powers of the CAB and FAA, not just those over supplemental airlines. The House Armed Services subcommittee report recommended that the House Interstate and Foreign Commerce Committee offer legislation "to assure clearer statutory responsibility and authority to CAB and FAA for the adequate surveillance and regulation of the air carrier industry."

These were other findings and recommendations of the subcommittee headed by Rep. Porter Hardy, Jr. (D.-Va.):

• **U. S. needs a supplemental** airline industry, but it should be confined "to those carriers which are adequately financed, soundly managed and operated in a manner to achieve the greatest degree of safety." There should be a "substantial increase" in their inspections by FAA.

• **"There is uncertainty** and indecision on the part of both CAB and FAA as to their authority under existing law. In the granting of certificates of convenience and necessity, there has been inadequate attention given to the managerial capacity and financial responsibility of air carriers."

• **Secretary of Defense** Robert S. McNamara should rescind the part of his Nov. 17 directive requiring that individually ticketed military personnel travel in scheduled carriers exclusively (AW Nov. 27, p. 37).



# 'Visit U.S.A.' Is Spurring Group Tourism

By Arnold Sherman

**New York**—First solid results of the Visit U.S.A. program are beginning to roll in and the scoreboard seems to indicate that while the program in general is being well received, carrier interest is narrowing to specialized groups.

A survey of the transatlantic airlines shows, almost without exception, that the greatest impact has been made on European professionals, technicians and merchants traveling in common interest groups.

Europeans are evincing a strong interest in American technical progress and are gravitating to the United States in much the same way that artists sought out Paris during the 1920s.

Dutch auto engineers are less interested in the Rocky Mountains than in Detroit assembly plants; French electronic engineers would prefer to visit Boston than Las Vegas.

On the other hand, the impact on general tourism to the United States is less apparent. It is difficult to determine exactly how many Europeans have been motivated to visit the United States through Visit U.S.A. promotion.

According to statistics that are being sifted, however, it seems safe to say that U.S.A. travel impetus has not had a marked effect on the average European tourist who still finds it considerably easier to bask in the sun at the Riviera than at Miami.

This situation is still fluid though, and a resurgent West European economy coupled with a viable advertising program are bound to have a more forceful effect on foreigners visiting the United States.

The Visit U.S.A. theme is not new. Carriers have long been aware that a fertile, largely untapped tourist reservoir existed in Europe. As far back as 1946, Pan American was conducting a small Visit U.S.A. promotional program on its own. The arrival of jets, however, and the rapid buildup of the European economy along with its attendant broader sweep of individual wealth have encouraged a further development of the program.

A strong impetus was given last June when the U.S. government, anxious to offset the foreign trade imbalance and halt the steady drain of gold reserves, established the United States Travel Service. This agency, under Commerce Department aegis, was designed to create U.S. travel offices abroad and cooperate with the various local and national segments of the tourist industry (AW July 17, p. 40). Working in conjunction with the federal program, the carriers have opened the throttle wide on their respective efforts.

Frank Overcarsh, director of media relations for the federal agency, said that "all the carriers are cooperating closely with the Travel Service and they seem very enthusiastic about the results so far." Directed by Voit Gilmore, the agency, which was budgeted $2.5 million last year, is asking for $4.7 million to continue activities.

## Added Incentive

Overcarsh told AVIATION WEEK that as an added incentive to the Visit U.S.A. program the Waldorf Astoria Hotel, working with Varig and TWA, is implementing a "Weekend at the Waldorf" plan to offer reduced rates for foreign visitors to New York.

The major obstacle to any successful Visit U.S.A. program is money. As one KLM official said: "The average American can travel to Holland and vacation there for about one third of what a similar vacation would cost him in the United States. It isn't hard to understand therefore why American secretaries and bookkeepers are drawn to Europe on their vacations. Reverse the coin, however, and we have quite another story. It would cost the average Hollander three times as much to come to the States as he would spend in Europe—compound this with the cost of transportation and you see why the situation is gloomy."

Professional and technical groups, however, are by and large free from the monetary restraints imposed upon the general tourist. Frequently they are partially reimbursed for their expenses. They are generally of a higher income group and consequently have more money to spend. They can combine business and pleasure by visiting the United States, something they couldn't justify in an intra-European trip.

Airline reaction to the Visit U.S.A. program, on the basis of results already in, follows these lines:

• **Pan American World Airways** allocated nearly $3.5 million last year to Visit U.S.A. promotion. "We have several hundred offices spread around the world," a Pan American official told AVIATION WEEK, "and we intend to convert each of them into a center of Visit U.S.A. activity." Window displays, counter exhibits and advertisements in local newspapers are part of the PanAm project.

According to the airline, during 1961 alone Pan American's Visit U.S.A. program was instrumental in bringing an estimated 150,000 persons to the United States. These 150,000 persons through their purchase of transportation and goods and services inside the United States, represent an approximate expenditure $150 million.

Pan American is stressing study tours for business and professional people and claims that this type of business is growing at better than 100% a year. In 1962, under the aegis of this program, Pan Am carried 50 jet loads of passengers to the U.S. from Europe and the Orient. "Full potential of the program," according to a PanAm official, "hasn't even begun to be exploited. The funds we've allocated, however, I think are a good gage of how we feel about its prospects."

• **Trans World Airlines** has noted a marked increase in westbound traffic during the first two months of 1962 over last year and says Visit U.S.A. promotion undoubtedly is a factor in this rise. Airline is encouraging an exchange of TWA personnel at the sales representative level hoping that American personnel working overseas will have a salutary effect on foreign tourism and vice versa. The carrier is also preparing promotional booklets on American regional recipes, costs, etc.

• **Air France** contends that a good measure of its Visit U.S.A. success is due to the Common Market. "The Common Market has caused a quickening of the economic life of Europe," according to an Air France official. "America and American production know-how are still symbols to Europeans. The United States is looked up to in almost all phases of tech-

## TWA Piston Writeoff

Trans World Airlines in a year-end adjustment wrote down the bulk of its piston aircraft fleet to a residual value of 3% resulting in a special charge against income of $22,017,000 for the year 1961.

In preliminary figures filed with the Civil Aeronautics Board, TWA reported a net loss of $17,278,000 after taxes but before special item. Total loss would be $39,295,000.

The writedown to 3% residual value was from a previous four-engine piston airplane norm of 10% residual value at the end of a useful life of seven years.

The writedown largely comprises TWA's Lockheed 1649A Constellation, a relatively new and serviceable airplane but one made obsolete by jet aircraft. The 3% residual value is an attempt to fix a realistic market value for the piston airplanes but represents more than scrap value.

Operating revenues for 1961 totaled $362,966,000, operating expenses $375,175,000 and operating loss, $12,209,000.

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Tiny radios that tell space vehicles what to do . . . radar that pinpoints distant planes . . . devices that arm and fuze missiles . . .

These are only a few of the products from Avco Corporation's Electronics and Ordnance Division, prime contractor to each of the armed services and to NASA.

**Satellite communications.** Now in orbit aboard Explorer XI is an Avco receiver that converts NASA signals into impulses that switch satellite equipment on and off.

**Infrared.** Avco is a pioneer in infrared. One development is a tracking-scanning device that picks up heat emitted by missile nose cones or the exhaust of jet planes, while they are many miles away.

**Air traffic control.** Avco is a leader in air traffic systems. For example: Avco's AN/GSN-11, built for the Air Force, can direct 120 takeoffs and landings per hour in any weather, automatically.

**Height-finder radar.** Avco units, 3 stories high, can "see" planes while they're hundreds of miles away. These units are now on duty with the Air Defense Command.

**Front-line communications.** A new Avco radio, one-seventh the size of units it replaces, lets a combat commander direct troops, trucks, tanks and aircraft. Other features: 920 channels, push-button tuning.

**Missile arming and fuzing.** Working with the Naval Ordnance Laboratory, Avco designed and is making arming and fuzing kits for the Polaris Fleet Ballistic Missile. Avco is a major source of arming and fuzing devices for all the armed forces.

**Ordnance.** To cope with brush-fire wars, Avco is producing classified material for new weapons. Avco helps to keep our armed forces up to date—and *ahead* of date.

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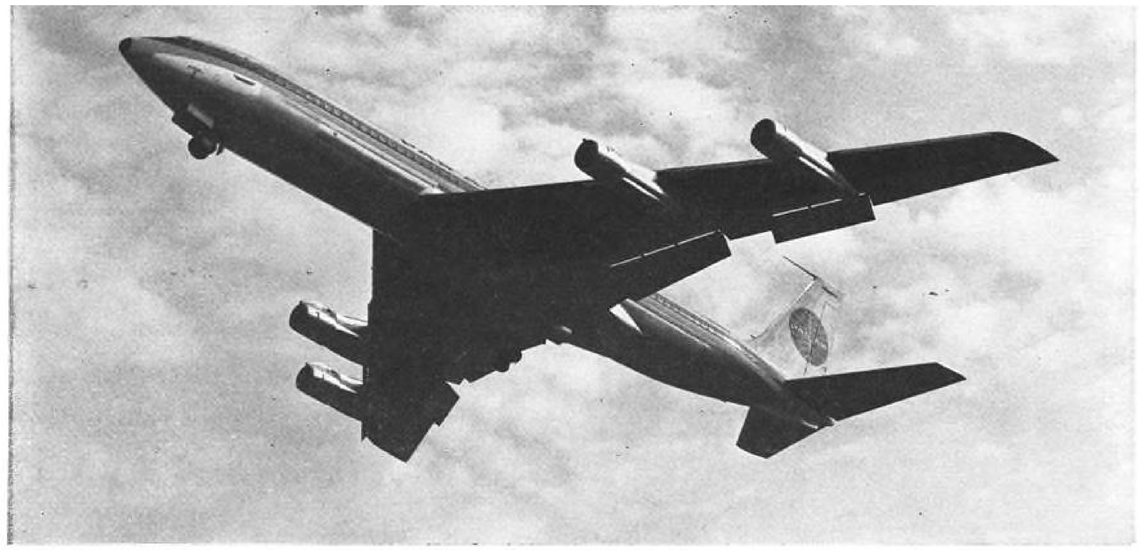

## First Turbofan-Powered 707-320B Flies

**Boeing Co.'s first turbofan-powered 707-320B long-range transport is shown in its initial flight from Renton, Wash. In addition to turbofan engines generating 18,000 lb. of thrust each, the 320B has an improved system of high-lift flaps on both leading and trailing edges of the wing, and extended low-drag wingtips. Aircraft is powered by Pratt & Whitney JT3D-3 turbofan engines. Delivery of the first certificated 320B is scheduled in late spring (AW Feb. 5, p. 36).**

nology and the Europeans want to know how the U. S. does it."

A comprehensive list of Air France 1962 bookings for professional and technical groups reads like an encyclopedia —from architects to zoologists. Three flights consisting of 402 pharmacists are scheduled for April alone. Innkeepers, grain merchants, dentists, editors, jewelry manufacturers have been signed up for common interest tours. The flights originate from Marseilles, Vichy, Paris, Lyon, Bordeaux, Frankfurt and Algeria.

• **British Overseas Airways Corp.** said that "North Atlantic traffic has increased considerably since the inauguration of the program, but it would be impossible to analyze how much of this traffic was due directly to the efforts of the promotion." While optimistic over common-interest tour results, BOAC is also concentrating on general tourism. Rapid growth of the British economy, proximity of the United States to Canada which is a focal point of many BOAC activities, and the lack of a language obstacle are the reasons BOAC's westbound competitive situation is good. Airline promotion is directed at breaking down the English suspicion that a trip to America is a rich man's hobby.

• **Scandinavian Airlines System** says that common interest groups "are its biggest source of 'Visit U. S. A.' traffic." SAS has drawn up lists of hundreds of U. S. corporations which have plant tour activities and correlates this information with European common interest groups.

• **KLM,** having sifted through recent Visit U. S. A. results, opines that the program must of necessity be directed at technical and professional groups. The airline gave the Visit U. S. A. program top priority in 1961 and plans are to continue at an accelerated rate. Previously, E. H. van der Beugel, KLM president, said that although Holland's population is only 12 million, it is fourth in the number of visitors it sends to the United States (AW July 17, p. 51).

• **Lufthansa German Airlines** has tied the Visit U. S. A. program in with its own People to People Program which is designed to encourage cultural and industrial tours. Lufthansa has established People to People Program offices in New York, Frankfurt, Cologne and Tokyo. The activity is headed by Richard Brookbank, industrial and professional tour manager. The airline is currently working on a plan proposed by the German American Chamber of Commerce and endorsed by the AFL-CIO whereby there would be an exchange of apprentices between the United States and Germany. This exchange would include trade apprentices, carpenters, brick layers, etc.

• **Alitalia,** according to the Italian airline's Visit U. S. A. Coordinator George Joannou, had about 1,500 westbound bookings last year. "We expect that figure to reach or exceed 10,000 this year," he said. Like the other carriers, Alitalia's pitch is directed primarily at professional and technical groups. However, unlike the others, Alitalia is custom-designing the U. S. A. tours itself. "If a group of auto engineers from Italy wants to visit Detroit," he said, "we make all the necessary arrangements at Detroit but in addition to that we try to arrange the itinerary so that the engineers are exposed to interesting American sidelights while they are here. This way they combine a business trip with a sightseeing tour." Joannou said that the success and flexibility of the Alitalia pitch is due to a large extent to the cooperation the airline has received from bus and hotel lines. "We must be flexible at all times," Joannou said. "We are trying to encourage Italian students to visit America but in order to accomplish this we have to consider that the average student is severely limited financially. So what we do is offer the student tours for about $15 per day, all inclusive. They give up a few of the first-class amenities but they do get to see America."

### Airline Parts Pool

**Seven U. S. carriers have agreed to a jet parts pooling program, scheduled to go into effect about Apr. 1, which will provide parts stockpiles at 33 airports throughout the U. S. and Mexico City.**

**American, Braniff, Eastern, Pan American, United, Western and Trans World reached agreement last week at a meeting in Kansas City. Value of the parts to be stockpiled will be $2,700,000, according to TWA.**

**Under the plan, parts will be owned by the seven carriers who will offer parts to each other when needed. In addition to increased economy, the plan is expected to improve on-time performance.**

**PanAm and TWA entered into a parts pooling arrangement in 1959 with a number of foreign flag carriers in order to reduce their expensive inventory of spare jet parts.**

# THE SHORT HAUL JET

## SOME ECONOMIC FACTS

**BREAKS-EVEN WITH VISCOUNT PASSENGER LOADS**

On 150-mile sector break-even point is achieved with only 30 passengers.

**JET SPEED WITH VISCOUNT FUEL LOADS**

540 m.p.h. cruise speed. As fast as the fastest jets over all sectors up to 750 miles—yet burning Viscount fuel loads!

**QUICKER TURN-ROUND**

Built-in air steps front and rear. Auxiliary power unit eliminates need for engine starter, electric and air conditioning trucks.

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# AIRLINE OBSERVER

► Flight tests of de Havilland Aircraft's new three-jet Trident are being accelerated. It is now flying twice daily and had accumulated 17 flights and 20 hr. as of late last week. Greatest takeoff weight has been 95,000 lb. and highest speed so far is 340 kt. indicated airspeed. Chief Test Pilot John Cunningham has also tested reverse thrust in flight and low speed regime testing will start this week.

► **Ansett-ANA, Australian privately-owned airline, has purchased a Vickers Viscount 810 turboprop transport from Cubana Airlines through a London aircraft broker.**

► Hawaii is borrowing California experience to determine whether two new carriers, Island Airlines and Alii Airlines, should operate state-regulated skybus service in competition with CAB-regulated Hawaiian and Aloha airlines. Hawaiian Public Utilities Commission has retained John F. Pearson, principal transportation engineer for the California PUC, as a consultant. Pearson gained intra-state air transport experience through regulation of Pacific Southwest Airlines and became familiar with the state-versus-federal jurisdiction issue in a United Air Lines suit over Catalina Island operations.

► **Flying Tiger Line's class cargo rate, a complicated tariff that bases cost of shipment on cubic volume and density weight of a long list of commodities, has generated so much confusion among smaller freight agents that the carrier is considering dropping it. Acquisition of the Canadair CL-44, which can carry up to 70,000 lb. of payload but has a relatively cramped cargo envelope, prompted Flying Tiger to file the controversial tariff with Civil Aeronautics Board last fall.**

► Newly-established Moscow-Djakarta service is Aeroflot's 24th link between the USSR and a foreign country. Scheduled time for the Il-18 turboprop transport flying the 6,200-mi. route between the Soviet and Indonesian capitals is 24 hr. 30 min. Intermediate stops are made at Tashkent, Delhi and Rangoon. Aeroflot says its international route network now totals about 49,860 mi. It claims that the number of passengers carried on foreign routes has more than doubled in the past two years.

► **Last of United's fleet of Vickers Viscount turboprop transports inherited in the Capital merger has been repainted and refurbished in United's colors and interior styling. Work time for each Viscount averaged five days and 1,500 man hr. Total cost was $500,000.**

► First production version of Nord Aviation's Super Broussard turboprop transport flew on Jan. 29. Nord expects to build ten this year, and could begin deliveries late in 1962. To date, no orders have been announced for the 26-passenger feeder-aircraft, which is powered by two Turbomeca Bastan turboprop engines delivering 1,085 ehp. The aircraft is slated to fly in September.

► **Air France will begin direct Houston-Paris flights with Boeing 707 Intercontinental transports beginning Apr. 25. Three flights weekly will be operated on the route via New York.**

► United Air Lines has changed turbine nozzle vanes on cabin compressors in its Boeing 720s to cut down bleed air leakage, thus reducing bleed air requirements and engine fuel consumption. The modification is expected to save the carrier $50,000 annually in fuel costs.

► **Czechoslovakia's state-owned airline, CSA, has been granted overflying and technical landing rights in Great Britain, using Prestwick and Manchester airports for landings only in case of weather or mechanical problems. The agreement, under negotiation with British Foreign Office for the past eight months, involves new CSA service from Prague to Havana, Cuba. Rights include refueling but do not allow embarking or debarking of passengers.**

# SHORTLINES

► **Boeing's Vertol 107** twin-turbine helicopter, which has received an FAA type certificate (AW Feb. 5, p. 35), has been approved for day and night VFR transport operations at a $V_{ne}$ (velocity never to exceed) of 168 mph. at 19,000 lb. gross weight. Transmission has been approved for 2,440 hp. twin-engine and 1,420 hp. single-engine operation.

► **British Overseas Airways Corp.** will begin a weekly jet flight between Sydney, Australia and Hong Kong via Darwin and Manila in April. Comet 4 jet aircraft will leave Sydney on Monday and arrive at Hong Kong on Tuesday. Return flights will leave Hong Kong on Sunday.

► **Continental Air Lines** will hire approximately 100 women during the next five months as hostesses for its Boeing 720 jets to be delivered this spring.

► **Eastern Air Lines** has begun nonstop jet service between New York and Charlotte, N. C., Louisville, Ky. and Orlando, Fla. Also, the airline recently has replaced its DC-8 jets on the Newark-Jacksonville-West Palm Beach-Miami route with Boeing 720s.

► **National Airlines** has asked Civil Aeronautics Board to make Northeast Airlines stop advertising it has the best jets and widest seats. National said the practice was unfair, deceptive and inaccurate.

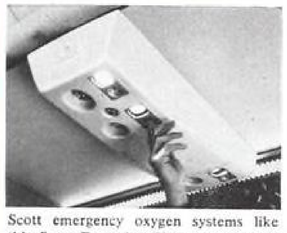
► **Pacific Northern Airlines** reports revenue passenger traffic increased 9.4% and cargo, including express, increased 28% during 1961 compared with 1960.

► **TAG Airlines**, an air taxi operator permitted to conduct scheduled service with aircraft under 12,500 lb., has added two evening flights to its Cleveland-Detroit daytime commuter schedules. The airline now conducts 20 flights daily between the two cities.

► **Trans World Airlines** reports increases of 34% in domestic and 37% in international airfreight volume during 1961 compared with 1960. Freight revenues increased 22% on domestic and 14% on international routes last year compared with 1960.

► **United Air Lines** reports its engineers have designed a vacuum oven to extract moisture from the aluminum cells of honeycomb structures in jet aircraft. The oven, now in use at San Francisco Maintenance Base, has drawn as much as six lb. of water from some cells.

# Scott put the LIFEGUARD on the 707



Scott emergency oxygen systems like this Scott Drop-Out Unit are standard equipment on the Boeing 707. Scott emergency oxygen systems are also used on Douglas DC-8, Convair 880, Lockheed Electra . . . and other leading commercial airliners.

The Scott Emergency Passenger Oxygen System is standard equipment on the Boeing 707 jet. This installation is typical of Scott's capability in the research and development of environmental protection to meet fast-changing requirements in rocket, missile, and aviation fields. In many of today's modern jets Scott has developed an integrated building-block concept of environmental protection. This method uses existing, proven Scott modular components in developing new applications. The result is reduced lead time, lower costs, and a much higher degree of configuration flexibility.

For more than a decade Scott has led the field in the production of high altitude survival equipment . . . an accomplishment built on a foundation of experience, research, and the manufacture of precision products.

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Great Britain Affiliate: The Walter Kidde Company, Ltd.

**ARMSTRONG WHITWORTH AW 650 ARGOSY** has entered service with British European Airways. Bulge under nose is wheel fairing.

***Aviation Week Pilot Report:***

# Argosy Combines Speed, Stability, Payload

By Herbert J. Coleman

**London**—Armstrong Whitworth AW 650 Argosy, workhorse of British European Airways' new turboprop all-cargo service, is a fail-safe concept airplane with a high degree of control in critical load conditions, designed for high-speed runs on medium stage lengths.

Airline and military pilots were unusually active in the actual design. The Argosy is easy to fly, and shows a remarkable capability in various engine-out flight regimes.

British European Airways, now shaking down its first cargo runs with the Argosy, also is concentrating on an intensive industrial education program to boost its freight tonnage.

In two months of scheduled operations, using two of its three Armstrong Whitworth Argosy freighters, BEA considers the new run a qualified success that has possibilities for expansion.

**COCKPIT WAS DESIGNED** after extensive talks with airline and military pilots. Configuration shown here does not include flight radar (at pilot's left in BEA Argosies) and instrumentation is rearranged in Royal Air Force cockpits.

The third Argosy is being used for airline crew training at Stansted Airport, near London. When the training phase is completed, BEA will have about 15 crews checked out and ready for line duty.

In the meantime, BEA has brought about these all-cargo developments:

- **Convinced** the Air Transport Licensing Board to relax its controls over air freight rates within the United Kingdom, opening the field to highly competitive prices.
- **Sponsored and conducted** an air freight symposium at Gibraltar, involving about 30 British industrial executives of chairman and director level, to explain the cost and time advantages of air freight in a specialized airplane.
- **Continued to push** for revamping of London (Heathrow) Airport's antiquated cargo storage and handling sheds, with the result that a new facility, now being built by Ministry of Aviation, should be ready in 1963. In addition, cargo facility improvement has been given Ministry priority at Manchester, Birmingham and Glasgow, key industrial centers in Great Britain.
- **Gave wide circulation** in both the United Kingdom and Europe to an air cargo potential report prepared by Hawker Siddeley Group, pointing up cost parameters, cargo breakdowns and market expansion (AW Aug. 28, p. 48).
- **Entered into a joint agreement** with Lufthansa in which the West German airline has contracted for a share of Argosy cargo holds between London-Dusseldorf and Frankfurt, on a six-night per week frequency.

As the route network now stands, BEA flies four times a week to Milan, a prime run; twice weekly to Paris and Jersey; five times a week to Manchester and thrice weekly to Glasgow, and to Copenhagen six times a week, in addition to the Lufthansa agreement.

All three Argosies are equipped with the Armstrong Whitworth Rollamat service, also used by Riddle Airlines in the U. S. Logair network, to speed loading and unloading. Since starting service in December, the major problems have involved ground personnel, rather than the airplane. For instance, the Christmas holiday rush piled up freight at London Airport, delaying a number of flights. Airline has also been plagued by union troubles, a built-in operational problem for all airlines operating out of London, particularly in the loader's sections.

But the airplane itself, according to BEA base training captains, has given little or no operational difficulty, even during the rugged training program which makes a high rate of utilization a prime requirement.

The Argosy designers, in what pilots consider a welcome change from British practice, have called on line pilots for their opinions and recommendations, primarily in cockpit layout. End result is a large cockpit, comfortable seating, instrumentation placed for easy reading and access, and an electrical color-controlled panel.

Pilots, however, have some complaints. For one thing, the ladder leading from the cargo hold to the pilot's compartment is too narrow, has no hand-hold and appears jury-rigged. Tiller for the nose gear has given some trouble and may be modified. Upward visibility in a turn is poor and could be improved by cutting a window in the cabin side roof section.

## Minor Difficulties

On the whole, Argosy snags have been minor. For instance, the airplane flown by this AVIATION WEEK pilot, No. 3 Argosy (G-AOZZ), was delayed for a short time by a small hydraulic leak, copilot's nose wheel tiller out of commission, and a red light showing a gear in unlocked condition after retraction.

The AVIATION WEEK flight was part of a routine pilot check program, lasting 4 hr., with one of three BEA base training chiefs, Capt. Roy Pigden, in command. Pilots undergoing training were First Officers George Noblett and Michael Smith, both Vickers Viscount copilots transferred to the cargo division.

Flight for this training period was aimed at control in asymmetric conditions, at critical attitudes. The airplane was ballasted to its 84,000 lb. maximum landing weight, with the ballast shifted

**CARGO PALLET** is loaded on to a truckbed at London's Heathrow Airport above. Argosy's door sill is four feet high for loading convenience. Loading through front and rear doors can be done simultaneously.

**GLIDER** is loaded into a BEA Argosy at Copenhagen Airport using Rollamat system above. View below shows rear door and main entry door. Argosy's hold can be pressurized to a cabin altitude of 8,000 ft.

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**ARGOSY'S MAIN GEAR** retracts rearward into tail boom. Nose gear retracts forward.

just ahead of the center of gravity to complicate matters.

On the initial takeoff in this regime, Capt. Pigden was in the left seat and First Officer Noblett in the right, flying the airplane. Full power was given to the four Rolls-Royce Dart 526 engines and the Argosy started its roll. Rotation, at full fuel, full maximum landing weight, was computed at 96 kt. At rotation, with the nose wheel off and main gear just leaving the runway, Pigden feathered No. 1 engine.

It was at this moment that the Argosy showed its high degree of stability and large design safety factor. The initial reaction was a tendency to yaw into the dead engine, but control was instantaneous through aileron correction and opposite rudder. With 12 deg. of flap down (preset for normal takeoff), the Argosy reached $V_2$ of 110 kt. and climbed to traffic altitude at about 750-800 fpm. Since the plan was to stay in traffic for an immediate landing, little trim was fed in. The only marked change from what would have been a normal approach was a higher approach speed and this was primarily due to the need for safety margin in the flareout, because of the forward center of gravity factor, rather than to nurse the dead engine.

Most of the 9 hr. flight time for checkout is spent in this manner, concentrating on emergency conditions at critical regimes, rather than "boring holes in the air," since basically the Argosy is quite easy to fly. Pilots also fly two route legs as observers and 13 route sectors in the right seat before being accepted for line duty.

The airplane flown is the AW 650 Series 200 type, with box-spar wing for full fail-safe concept (AW May 29, p. 36). Entry is by a door on the aft port side after the usual walkaround check of the Dowty landing gear and visual inspection of engines and airframe.

Argosy G-AOZZ had only four fuselage windows fitted, each of which can be emergency exits, along with two large emergency exit doors on either side. Another exit for pilots is in the cockpit roof. The freight hold, which has a gross capacity of 3,680 cu. ft., is built with a graded floor strength of up to 200 psf. loading intensity. Simultaneous loading can be effected through use of both fore and aft doors; the 4-ft. sills are at truck level. If necessary, the airplane can be fitted for mixed capacity, comprising 14,000 lb. of freight and 30-40 passengers, although BEA has no plans for this type of movement at present.

### Cockpit Drill

Cockpit drill prior to engine start has deliberately been kept to a minimum; initial check is for door locking and sealing. Start sequence is simple, with No. 4 started first (using the airplane's three batteries), steadied at 10,400 rpm., and followed by No. 3, 2 and 1. Throttles are on the center console and each lever controls fuel supply and propeller pitch for its associated engine. Propeller synchronizer alternator is driven by each engine and synchroscope is on the center instrument panel.

The starting system involves only a master switch, engine selector switch, starter pushbutton and start cycle indicator. Re-light switches and warning lights are on the aft center console, along with the fuel trimmer switches and indicators. These are used to control engine turbine temperatures by variation of the fuel flow for a given rpm.

Important control factor is the Ar-

*Engineered Environment*

Although vulnerable to heat, the spittle bug can blow himself a cooling bubble bath and thus "tailor" his environment to suit his needs.

Tailoring of environment is a vital requirement that must be built into today's weapons systems. Answering this need is specially designed AAF equipment for controlled environment. For example, AAF-engineered air conditioners were developed for the APCHE system. The units are installed in mobile vans used for prelaunch checkout of the Atlas missile. They provide conditioned air for personnel and for sensitive electronic equipment in the van.

Other AAF equipment supporting modern weapons systems include heating equipment utilizing various fuels or electric power, also packaged liquid chillers, heat exchangers, specialized blowers. You can increase your system reliability with AAF know-how and equipment.

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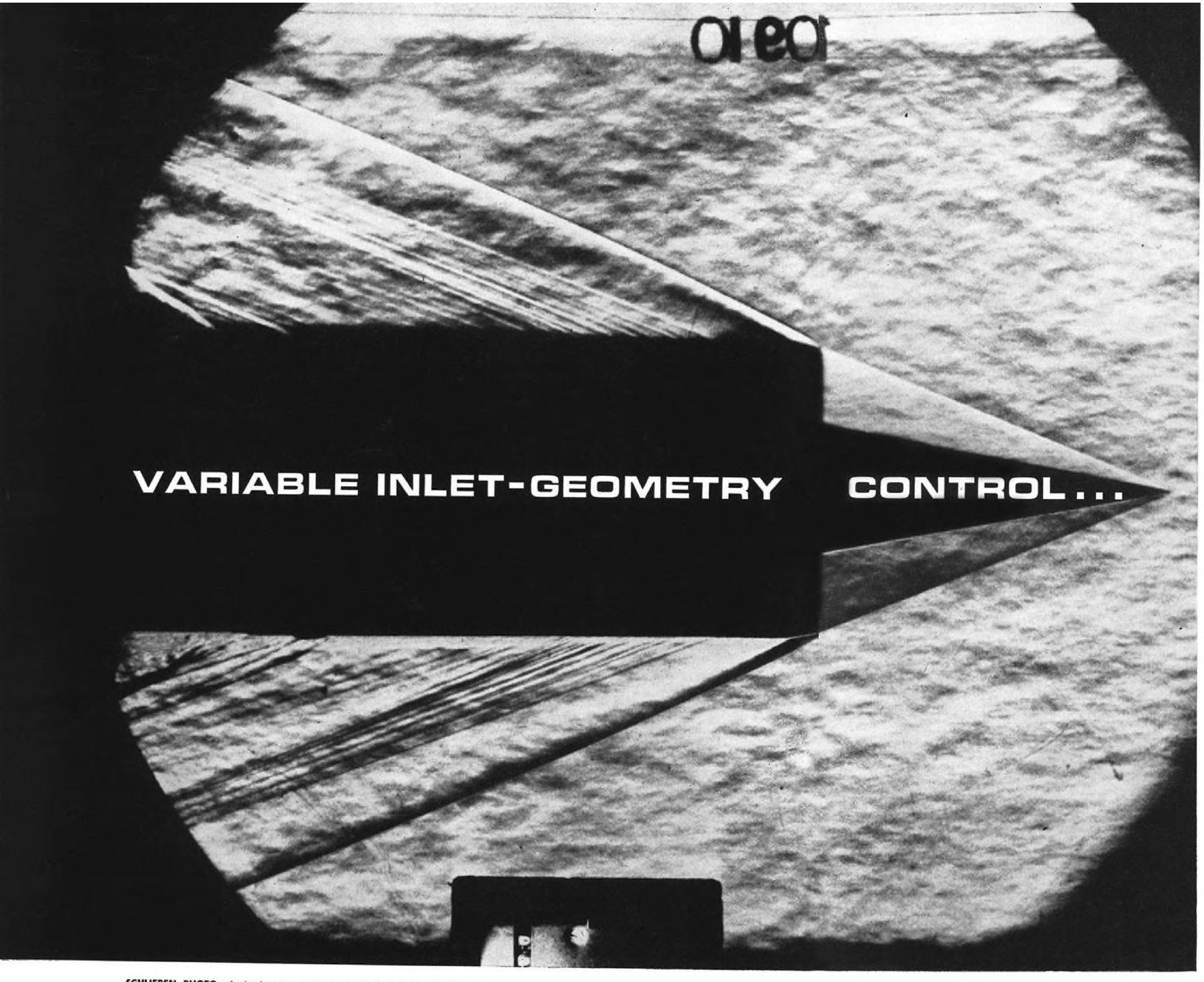


**SCHLIEREN PHOTO** of shock wave pattern at Mach 3, taken in United Aircraft Corporation supersonic wind tunnel—one of several advanced facilities used to develop Hamilton Standard variable inlet-geometry controls.

For flight above Mach 2, effective control of inlet pressure recoveries is indispensable to aircraft performance and safety. Primary control depends on an optimum variable-geometry duct design. But because of the wide range of air-speeds and densities encountered, precise, automatic control of the inlet geometry is vital. A comprehensive inlet control system is, consequently, an essential design consideration. Through its ability to reliably sense, compute, and correct for extreme environmental forces, an accurate variable-geometry control system can assure ideal inlet pressure recoveries through any flight regime.

Hamilton Standard has already designed and developed complete inlet control systems which fulfill these requirements. These systems, for active aircraft programs, incorporate such advanced control devices as . . .

# *key to the high Mach airplane*

- a Mach sensor with a response time of less than 30 milliseconds, accurate to ± 1% at temperatures up to 600°F.
- a compact closed-loop hydromechanical subsystem which controls pressure ratios in ambients above 1000°F and tackles multi-ton loads with a hydraulic actuator, requiring as little as 30 HP.
- a buzz sensor which effectively discriminates between normal transient pressures and abnormal pressure instability.

Hamilton Standard advances in variable geometry controls are a direct evolutionary result of the company's work in—hydromechanical, electromechanical, pneumatic, and hydraulic systems—for aircraft past and present. These technologies form a ready pool of design and developmental ability for meeting future ultra-high Mach requirements. Your inquiry is invited.

**Hamilton Standard** DIVISION OF UNITED AIRCRAFT CORPORATION

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# BRINGING OUTER SPACE "DOWN TO EARTH"

**(Or: Reliability revisited)**

Norm Froomkin (pronounce it as though there were only one "o") tells a story that sticks in the mind. A short while ago, Norm, who heads up Test Facilities Engineering at Budd Electronics, was discussing with an Air Force General the various and sundry inputs required for reliability testing of spacecraft. The General suddenly stopped, looked at Norm, and said, "You know what we really need to build? *An acre of the moon!*"

With due regard for the General's inspired cogitation, we're sure there are many others who long for a slice of lunar environment here on terra firma. What makes the idea so memorable is that it pretty well sums up the whole problem of getting our spacecraft . . . and our spacemen . . . to their destinations *with nothing less than 100% reliability.*

The problem basically is one of getting enough operational failure mode data.* (Is there ever enough?) Getting it from actual launchings is too costly and too slow . . . and, in the case of manned craft, unthinkable. Some of it we can get from single-force testing of materials and subsystems. But statistical extrapolation . . . from system elements under single forces to subsystems and complete vehicles in omniforce spatial environments . . . is not going to assure us 100% package reliability. We may have a good idea of the type and magnitude of the space force envelope, but what about the complex interacting and intermodulating stresses it produces on spacecraft? The solution . . . it becomes clearer every day . . . has got to come down to total simulation of space environments.

There's nothing new about the idea of simulative force testing as a means of assuring performance reliability . . . at least not here at Budd. It's been a way of life with us for nearly 50 years, put into practice on our own products in our own testing facilities. To this experience, Budd Test Facilities Engineering adds a thorough familiarity with force environments and their simulation . . . stress interactions and their analysis . . . and test facility design, construction and instrumentation. And that's giving you the story at Mach 5. It's actually conservative to say that every scientific and engineering discipline has to come into play in building what we call a Dynamic Omniforce Testing Facility.

We supply such facilities . . . as well as those for more conventional testing . . . on a turnkey basis, from force system analysis to final checkout. We also supply individual test modules for specific jobs, and consulting services on testing programs. If we've whetted your appetite, your letter or phone call will bring you more information or a provocative discussion of your needs. Test Facilities Engineering, Budd Electronics, 43-22 Queens St., Long Island City 1, New York.

*R & D terminology for "Why didn't it work *this* time?"

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gosy's flight fine pitch stop, integrated with the four throttles on the console. The stops, electro-hydraulically operated, prevent the angle of the Rotol propeller blades from falling below 19 deg. 30 min., thus cutting excessive windmill drag effects in flight. The fine pitch stop lever moves automatically to the "stop-armed" position when throttles are advanced to 100% power. When throttles are closed after touchdown, the fine pitch stop lever is moved rearward manually, thus permitting the blade angle to go to zero degrees, or ground-fine position, giving a slowing effect on the landing roll.

For taxiing, throttles were set at 11,000 rpm. and taxi speed controlled by braking. Weather for this flight was partly cloudy, with a 10 kt. wind from 240 deg. Visibility later dropped to about 1½ mi. due to ground haze.

Takeoff was achieved at 100% power (15,000 rpm.), rotating the Argosy at 86 kt. and climbing out at 130 kt. Flaps normally are set at 10 deg. for takeoff and retracted on climbout after the landing gear has been raised.

Despite its bulk, the Argosy has no tendencies toward control sluggishness, although aileron control is fairly stiff. Once trimmed, the Argosy could be flown hands off in spite of the forward center of gravity loading condition.

Gear usually is lowered for landing at 160 kt. and the pattern is flown at 150 kt. BEA practice is to time the legs, starting an elapsed time indicator when passing the runway threshold on the downwind leg, in this case, flying downwind 40 sec. before turning on base leg.

Final approach speed was 130 kt., crossing the fence at 127 kt. to keep adequate control on the nose-high flareout. Landing roll was short enough, with blades in ground fine position, to allow another takeoff from midway down the 9,000-ft. runway.

Normal cruise speeds are obtained by setting throttles at 14,200 rpm. and adjusting the fuel trimmer switches for a tailpipe temperature of 740 deg. Control forces, which are comparatively light, become heavy above 200 kt., which is the maximum speed at which full aileron can be used. Rudder control, quite effective down to 55 or 60 kt., remains moderately heavy. In turbulence, for instance, the manufacturer recommends a maximum speed of 155 kt. with flaps full up and the airplane flown manually.

The Argosy has excellent stall characteristics, and is docile in recovery. The airplane is equipped with a stick-shaker which is activated at a point above the stall speed. In landing configuration, gear down and 40-deg. flap setting, there is a mild aileron snatch at stall, and a nose drop, although wings remain level. In the clean configura-


*when you need* ***POWER IN THE AIR***

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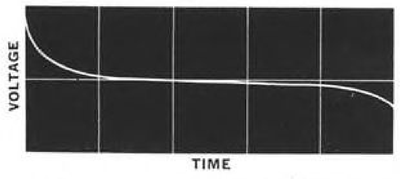


**One of the main advantages of nickel cadmium batteries, as compared with other systems, is the constant voltage during discharge—even under extremely heavy loads. Shown above is a typical discharge curve.**

■ On the ground or in the air, there can be no 'second guess' in specifying a basic power source to operate the control, guidance and telemetering systems for aircraft and space vehicles. Design engineers are specifying NICAD Nickel Cadmium Vented Cells, with assurance, for their extreme reliability and uninterrupted dependability in such critical applications.

NICAD, the foremost nickel cadmium alkaline storage batteries in service today, are widely used by power plants, utilities, hospitals, airports and industry. Under extreme conditions they have provided maximum performance instantly and efficiently. The all-steel construction—virtually indestructible—and non-corrosive electrolyte give NICAD batteries a greater life expectancy than that of any other type of battery.

All these features, coupled with exceptionally long shelf life when on open circuit stand, result in an economical, dependable power source.

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# Be fussy

Two things determine whether or not a particular printed circuit connector is "right" for your application:

1. How the printed circuit board mates with the connector, and

2. How the connector connects to the rest of the system.

Take mating, for example. Besides having the correct number of contacts, a printed circuit connector must hold the board securely whether the board happens to fall at the high or low end of thickness tolerances.

**IT TAKES THREE**

These considerations convinced Amphenol engineers that no single contact design could satisfy the requirements of a wide range of applications. So they designed three contacts that will.

One, used in Prin-Cir* connectors, looks a lot like a tuning fork with lips. The circle lip design makes contact overstressing or "setting" impossible —even after repeated insertions. The contact's long spring base also enables it to accommodate boards that range in thickness from .055″ to .073″, while doing an excellent "wiping" job.

**EASY DOES IT**

But not every application requires the Prin-Cir "bite." For this reason, Amphenol engineers designed connectors with ribbon contacts that mate with a gradual wedge-like force. In blind mating applications, gradual mating makes the feeling of *correct* mating unmistakable. (Just the thing when your equipment may eventually be maintained by less-skilled and less-concerned personnel.) Ribbon contact wedge action also makes it possible for connectors using these contacts to accept the same wide range (.055″ to .073″) of board thicknesses as do Prin-Cir connectors.

Finally, advances in micro-miniaturization (like Amphenol-Borg's Intercon® pre-fabricated circuitry) meant that tinier-than-ever-before connectors were needed. Amphenol's answer was the Micro-Min® receptacle and printed circuit board adapter. Micro-Min contacts are actually tiny springs of beryllium copper wire, formed in a precisely designed arc to assure firm circuit board retention. This unique design makes it possible to space contacts on .050″ centers and crowd 19 connections into a little more than an inch of space.

**TERMINATIONS COUNT, TOO**

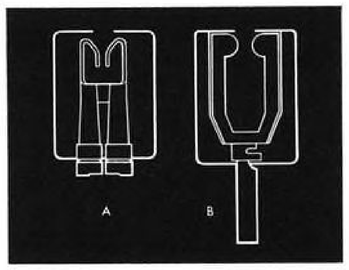
"How to connect connectors to the rest of the system" also merits a good deal of consideration. In some cases, hand soldered terminations will do just fine. In others, higher volume requirements call for high production rate methods like dip soldering and wire-wrapping. Some engineers prefer taper pin terminations.

Our printed circuit connectors are available with contact tails designed for each of these termination methods. In addition, adapters are available for use in connecting printed circuit boards at right angles to each other or in modular arrangements. We make printed circuit connectors with hermetically sealed contacts — still others with coaxial contacts.

Take your choice.

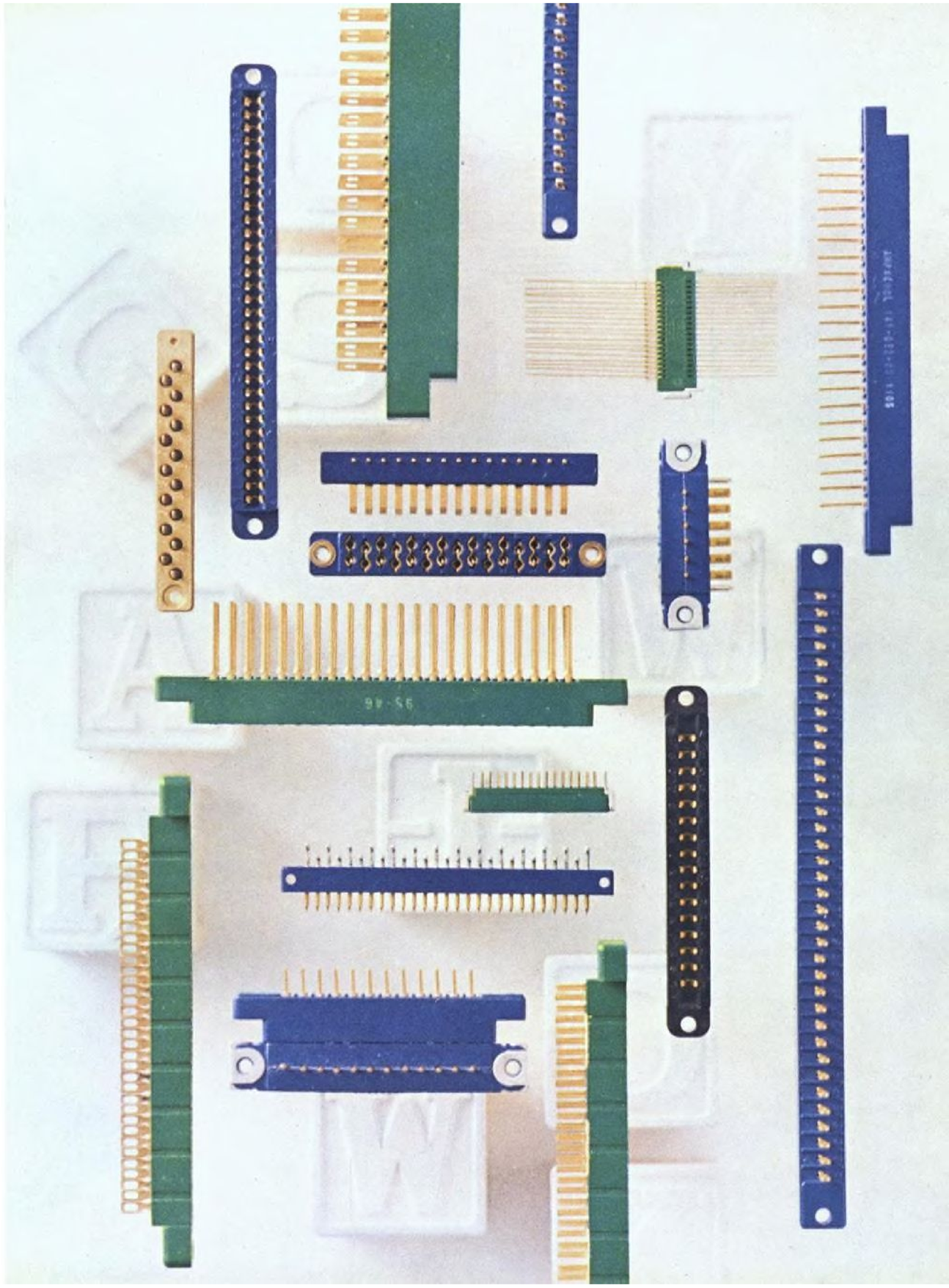
Any Amphenol Sales Engineer or authorized Amphenol Industrial Distributor will be happy to discuss printed circuit connectors (ours) with you. Or, if you prefer, write directly to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.

*T.M. Amphenol-Borg Electronics Corp.




Wedging action of Amphenol ribbon-type (A) and long spring base of Amphenol Prin-Cir connectors (B) assure firm printed circuit board retention, whether board happens to fall at low (.055″) or high (.073″) end of thickness tolerance.

AMPHENOL ***Connector Division*** / Amphenol-Borg Electronics Corporation



**KNOW YOUR ALLOY STEELS . . .**

*This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.*

# Cold-Finishing of Alloy Steel Bars: Turning and Polishing

Continuing our discussion of the cold-finishing of alloy steel bars, we take up the subject of turning and polishing. A later discussion will cover grinding and polishing. Both require removal of surface metal. In both the turning and grinding operations, adequate allowances provide for the removal of decarburization and surface defects which sometimes occur in alloy bars.

As previously stated, the outstanding advantage of cold-drawn bars over hot-rolled bars is the *bright, smooth finish.* However, the quality of the cold-drawn finish varies with the size and amount of draft (reduction of cross-sectional area) applied in cold-drawing. For example, by using a 1/16-in. draft, a 3/4-in. round would have a better cold-drawn finish than a 3-in. round.

When a superior mirror-like finish with additional accuracy is required on surfaces that are not machined (such as on shafting or machine parts), two processes other than cold-drawing are suggested: turning and polishing, and grinding and polishing. The first of these is discussed here.

*Turning and Polishing.* This method of cold-finishing is generally associated with centerless bar-turners, accommodating rounds from 1 1/4-in. to 6-in. diameter, inclusive. The process is the reverse of conventional lathe-turning, which is normally used for larger sizes. The centerless turning equipment uses two cutter heads which contain from one to four cutting tools. The system provides for both rough and finish cuts. The bar, which is stationary, is fed horizontally into the rotary cutter heads by means of a mechanical or hydraulic feeding mechanism. Most bar-turners are equipped with a series of polishing rolls that also rotate around the bar as it feeds from the rotary cutter heads. This, combined with subsequent burnishing action from the straightening rolls, imparts a high degree of polished finish to the product. A polished surface on a turned bar can also be produced by a number of passes through the straightening rolls.

This process is applicable to normalized, annealed, or heat-treated carbon and alloy bars. It does not materially affect the mechanical properties.

Bethlehem metallurgists will gladly work out any problem in the cold-finishing of alloy steel bars. Always feel free to ask for their services.

When you need steel remember, too, that Bethlehem manufactures the entire range of hot-rolled AISI standard alloy grades, as well as special analysis steels and all hot-rolled carbon grades.

*This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.*

Steel

*for Strength*
*. . . Economy*
*. . . Versatility*

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

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BETHLEHEM STEEL



tion, the stall is a gentle nose drop preceded by a mild airframe buffet and a tendency for either wing to drop slightly.

Argosy also performs well in the balked landing regimes, usually one of the most critical in view of high weight and loading condition of G-AOZZ. Go-around was ordered by Capt. Pigden at about 50 ft. altitude, with No. 1 engine windmilling. Three throttles were advanced to full power, gear retracted, and climbout effected at about 95-100 kt. and flaps milked up gradually. There was no particular necessity for use of rudder and aileron trim tabs, since the Argosy could be easily controlled without them.

### Engine System

The Rolls-Royce Dart engine system incorporates water methanol injection which is semi-automatic and admits the fluid into the compressor system to deliver rated "wet" power at the prevailing ambient temperature and pressure. The Dart 526 produces a total equivalent horsepower under static I.S.A. sea-level conditions of 2,105 ehp., made up of 1,910 shp. and 505 lb. thrust.

Automatic ice warning system is installed on the Argosy, picking data off two ice detector heads mounted on the lower sides of the forward freight door. When either detector ices up, an amber ice warning light flashes on the port cockpit roof panel, remaining on for 4 min.

It can then be reset. Two wing floodlights also are fitted for ice detection purposes.

Electrical ice protection is installed for windshield, propellers and domes, engine intakes, tailplane and fin leading edges, pitot heads and stall warning vane.

Wing leading edges are de-iced by heated air; ram air is taken through an intake in the side of each inboard nacelle and heated by passing through a heat exchanger in the jet pipe exhaust. After passing along the leading edge, the air is vented to the atmosphere through grilles in the upper surfaces of the port and starboard mainplanes.

At present, BEA plans to put its Argosy fleet on a 2,000 hr. per year program. First cost of the complete freighter version is $1,864,000. First cost of the Dart engine is $67,200. Spares costs are $163,520 for airframe and $120,876 for engine and maintenance. Depreciation is based on eight years and residual value set at 10%; insurance is 5% annually. Crew costs for a pilot and copilot amount to $16,310 per year, including salary and uniforms.

The manufacturer has computed hourly direct operating cost at $328 based on a 2 hr. 16 min. block time, hauling a 28,780 lb. payload, and using 7,370 lb. of fuel. Annual utilization, for this computation, would be 3,000 hr.

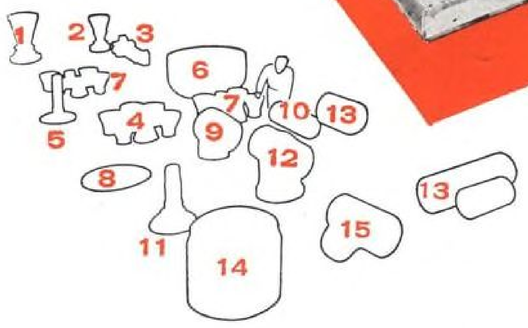
## Soviet V-2 Helicopter Shown In Flight

First flight photo of Russian six- to eight-place helicopter designated V-2 by Soviet sources emphasizes its derivation from the Mi-1 designed by Mikhail Mil's technical office. Two small turboshaft engines power the V-2. New photo of 26-place V-8 helicopter (AW Oct. 30, p. 29), shown below, also a turboshaft-powered product of the Mil team, shows inlet, cooling intakes and exhaust for the single engine powering the helicopter. V-8 apparently uses some dynamic components of the piston-engined Mi-4, but is substantially larger.

British European Airways presently is revising its United Kingdom freight rates, in view of the Air Transport Licensing Board's decision to dispense with tariff control. Before this, airlines flying United Kingdom freight had to obtain Board approval for rates charged, and once fixed required further Board approval.

End of Board control came at the Board's request (after some behind-the-scenes work by BEA) and British carriers now may charge as much—or as little—as they wish. Board move was made to streamline its workload and to stimulate use of domestic air freight. First reaction was by Silver City Airways which cut its rate two pence per kilo (2.2 lb.) for most types of cargo it flies between Bournemouth and the Channel Islands in lots of more than 45 kilos (about 99 lb.).

Besides the repricing of its commodity listings, BEA is working with British executives in a plan to reassess the nation's pattern of cargo distribution. For instance, some firms spend considerable sums in packaging their products for export, a cost which could be substantially cut by using the Argosy, and




1. Honest John Nozzle — Carbon Steel
2. Nike Nozzle — 4135 Steel
3. Jet Aircraft Landing Gear Assembly — 300M Steel
4. Polaris Nozzles — Molybdenum
5. Turbine Disc and Shaft — Inco 901
6. Polaris Aft Head — AM-256 Steel
7. Polaris Nozzles — Molybdenum
8. Jet Engine Seal and Support—V57 Vacuum Melt Steel
9. Nuclear Submarine Check Valve Body — 304 Stainless Steel
10. Nuclear Submarine Piping — Inconel
11. Jet Engine Turbine Shaft — Waspalloy
12. Nuclear Submarine Gate Valve Body — 304 Stainless Steel
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the subsequent cost savings applied to the air freight charges.

This factor was a main item on the agenda of the Gibraltar meeting, which was conducted by Sir Noel Hall, a director of Fisons and principal of Brasenose College, Oxford. The BEA team was headed by Anthony Milward, chief executive, and Clive Adams, general sales manager.

## Underwater Ramjet Tests Show Promise

Underwater ramjet powered by compressed air, which has been suggested as a powerplant for hydrofoil vehicles, has been tested with promising results by National Aeronautics and Space Administration's Langley Research Center.

The engine works like any other ramjet, except that compressed air is used as the fuel and there is no combustion in the conventional sense of the word.

In an air-breathing ramjet, the combustion process supplies extra energy which shows as increased exit momentum; the difference between that momentum and the inlet momentum is a measure of the useful thrust.

In the underwater ramjet, the compressed air mixes with the water and reduces its density, which results in increased exit velocity and useful thrust.

Primary use suggested for the underwater ramjet, or hydroduct as it is sometimes called, is for the propulsion of hydrofoil craft. These vehicles, which are borne clear of the water surface on submerged hydrofoils, could carry the hydroduct and its associated air supply system within the hydrofoils and their supporting structure.

Technical conjecture suggests that such systems would have less frontal area, higher speed capability and lower noise level than supercavitating propellers.

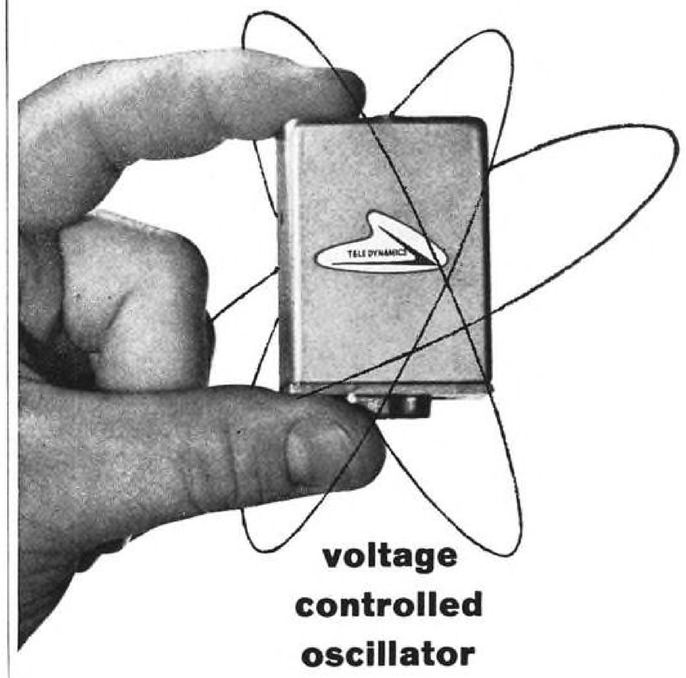
But the Langley tests showed that the thrust coefficient of the hydroduct, measured at a maximum of 0.10, was small compared with 1.07 for a supercavitating propeller.

Furthermore, the hydroduct produces no static thrust, and would require the carrying vehicle to have an auxiliary propulsion system to get the craft up to speed.

Maximum efficiency obtained during the Langley tests was about 53% at a thrust coefficient of 0.10 and a water speed of 60 fps.

Parallel studies of a theoretical method for thrust computation were made, based on the assumption that the water-air mix could be treated as a compressible gas. But there is a lack of information on the subject, and until this is rectified, neither the basic assumption nor an alternate can be justified.


# TELEMETRY BY TELE-DYNAMICS

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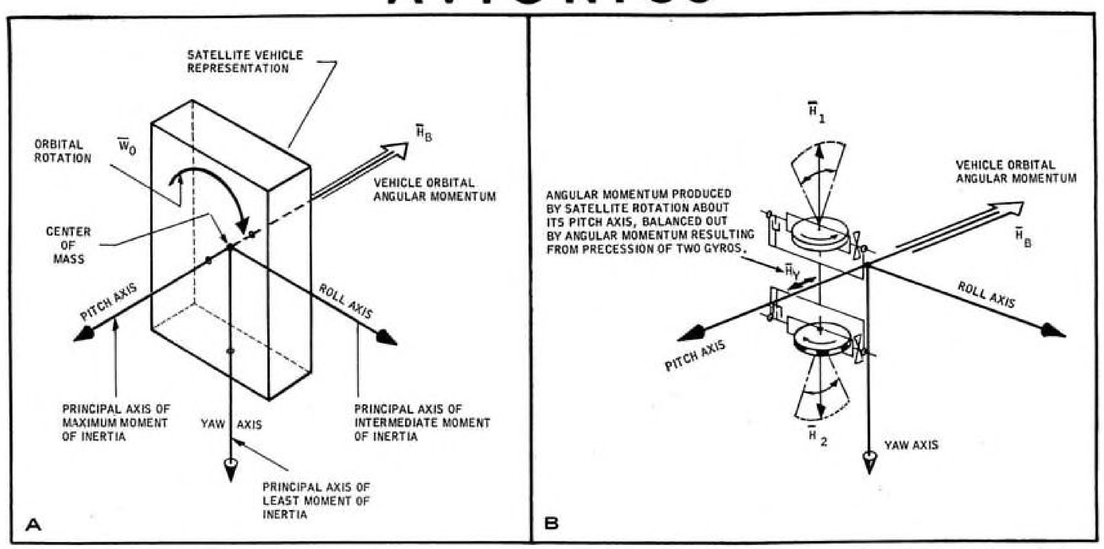



**FIG. A:** Semi-passive satellite stabilization technique makes use of gyroscopic properties of the satellite vehicle itself which result from its velocity around the earth. Satellite exhibits sizable angular momentum despite its relatively slow rotation rate because of the comparatively high mass of its payload. **FIG. B:** Pitch axis damping system uses two integrating gyros in a back-to-back arrangement in which their angular momentum vectors cancel out except when satellite undergoes transient motions about its pitch axis which causes both gyros to precess and provides a net gyro momentum which damps motion.

# New Gyro Technique Orients Satellite

By Philip J. Klass

**Washington**—New semi-passive stabilization technique for keeping a satellite oriented toward the earth (local vertical), which makes use of inherent gyroscopic properties of the satellite itself, has been developed by the Massachusetts Institute of Technology's Instrumentation Laboratory.

The technique requires the use of only one or two single-axis integrating gyros to achieve three-axis stabilization and earth orientation, eliminating the need for reaction wheels, gas jets or similar active means.

The concepts were described by MIT's Glenn Ogletree here at the recent national meeting of the American Astronautical Society. The report was jointly authored by Ogletree, Dr. J. E. DeLisle and Ben M. Hildebrant.

The configuration which requires only one integrating gyro was developed in a Bell Telephone Laboratories sponsored study aimed at possible use on a communication satellite to keep its directional antenna oriented toward the earth. Hildebrant is listed as the inventor of this concept in a patent application recently filed by MIT.

Based on MIT's analytical studies and simulation work, Ogletree estimates that the new technique can stabilize a satellite to within "a few degrees."

The gravity gradient (variation) between the top and bottom of a satellite produces a restoring force, known as the gravitational gradient torque, which can be used to keep a non-spinning satellite aligned to the local vertical. This "dumbbell effect," as it sometimes is called, has been proposed in a number of forms and is being tested in the recently launched Navy TRAAC satellite (AW Nov. 20, p. 34).

However, some additional stabilization means is required to prevent the satellite from oscillating in pendulum fashion about the local vertical. Also, there is no gravitational gradient torque about the satellite's yaw axis to provide azimuth orientation, if same is desired.

A satellite which remains approximately oriented to the local vertical as it moves around the earth is a form of gyroscope in which the vehicle itself functions as the mass, rotating once during each orbit. For this reason, it will exhibit certain gyroscopic properties and it is these which MIT seeks to harness.

Where a conventional gyro has a small mass which rotates at high speed, the satellite is a gyro with a very large mass which rotates at a slow (orbital) speed. Because the important characteristic of a gyro is its angular momentum, and this is the product of its mass and spin velocity, useful angular momentums can be realized at low angular velocity if the mass is sufficiently large, as it is in most satellites.

Viewed as a gyro, the satellite exhibits an angular momentum vector which is directed along its pitch axis. Following the basic reactions of a conventional gyro, any external torque applied to the satellite will cause it to turn (precess) its momentum vector toward the applied torque vector.

Thus any unbalanced torques occurring about the satellite's roll axis will cause it to precess about its yaw axis, while any unbalance about the yaw axis will cause the satellite to precess about its roll axis.

However, any unbalanced torque about the satellite's pitch axis will not cause gyroscopic precession. It will only change the magnitude of the satellite's angular moment in the same way that rotation of a conventional gyro about its spin axis causes no precession.

Because of this gyroscopic cross-coupling between the yaw and roll axes, it is only necessary to damp the vehicle about one of these axes to achieve stabilization of both.

In developing the semi-passive stabilization concepts for the AAS audience, Ogletree first described a pitch-axis damping system which employs two integrating gyros in a back-to-back configuration. The two gyros are mounted with their spin axes parallel to the satellite's yaw axis, and their sensitive (input) axes corresponding to the vehicle's pitch axis. Because the gyro rotors are



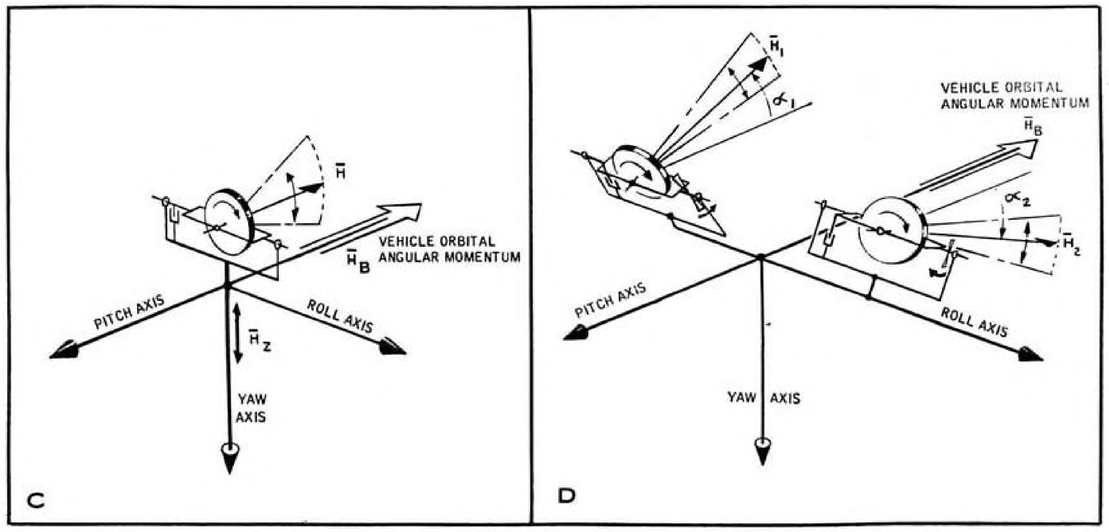



**FIG. C:** Roll-yaw axis damping system uses a single integrating gyro whose spin axis is aligned with angular momentum vector of satellite. Motion of satellite about its yaw axis precesses gyro, generating angular momentum which counters that of vehicle. Gyro could be aligned with input on satellite roll axis and also provide roll-yaw damping because of cross-coupling. **FIG. D:** Three-axis damping is provided by two integrating gyros in this "Roll-Vee" configuration in which one gyro case is tilted up, the other down. This provides combined momentum vectors for roll-yaw axis stabilization while vertical components cancel out except during transient motions about pitch axis when precession produces vehicle damping about pitch axis.

spinning in opposite directions, their angular momentum vectors cancel out when there is no oscillation of the satellite about its pitch axis, neglecting for the moment the vehicle's orbital velocity. Any tendency of the satellite to oscillate (librate) about its pitch axis, produces a new angular momentum vector along the pitch axis. But such instantaneous motion also will cause the two gyros to precess in opposite directions. This produces a momentum vector along the pitch axis which opposes that caused by satellite libration and thereby stabilizes the vehicle.

Because the satellite's movement in orbit appears to the gyros as a very slow angular velocity about its pitch axis, it is necessary to compensate for this steady state condition by applying a continuous compensating torque to the gyros, using torque motors or permanent magnets. This leaves the gyros sensitive only to the instantaneous libratory movements of the satellite about its pitch axis which must be damped out.

This back-to-back gyro damping system enables the gyros to serve as both sensors of vehicle rotation and as control devices, without need for separate computers. The same configuration also can be used for damping about the yaw or roll axis, but more simple and ingenious configurations can be developed from this basic concept.

Stabilization of both the roll and yaw axes can be obtained with a single integrating gyro by using it to stabilize either axis, and making use of the satellite's gyroscopic properties.

If an integrating gyro is installed in the satellite, for example, so that the spin axis of the gyro wheel is parallel to the effective spin axis of the satellite (when viewed as a gyro), then the integrating gyro's angular momentum vector will be aligned with that of the satellite when the vehicle is not oscillating. The sensitive axis of the integrating gyro is aligned with satellite's yaw axis.

Any libratory motion of the satellite about its yaw axis will produce an angular momentum whose vector is directed along the yaw axis. But this vehicle motion simultaneously causes the integrating gyro to precess in a vertical direction so that a portion of its momentum vector also appears along the yaw axis, opposing that of the satellite, and damping out the motion. Because of cross-coupling between the yaw and roll axes, this also will stabilize the vehicle in roll.

Experience has shown that there is an upper limit to the amount of yaw-roll axis damping that can be obtained in this way, Ogletree said. The optimum damping occurs when the angular momentum of the integrating gyro is approximately the same as that of the satellite vehicle.

Because the satellite angular momentum is determined by its inertial and orbital angular velocity, the principal parameter available to the system designer for optimizing system performance is the choice of integrating gyro damping factor.

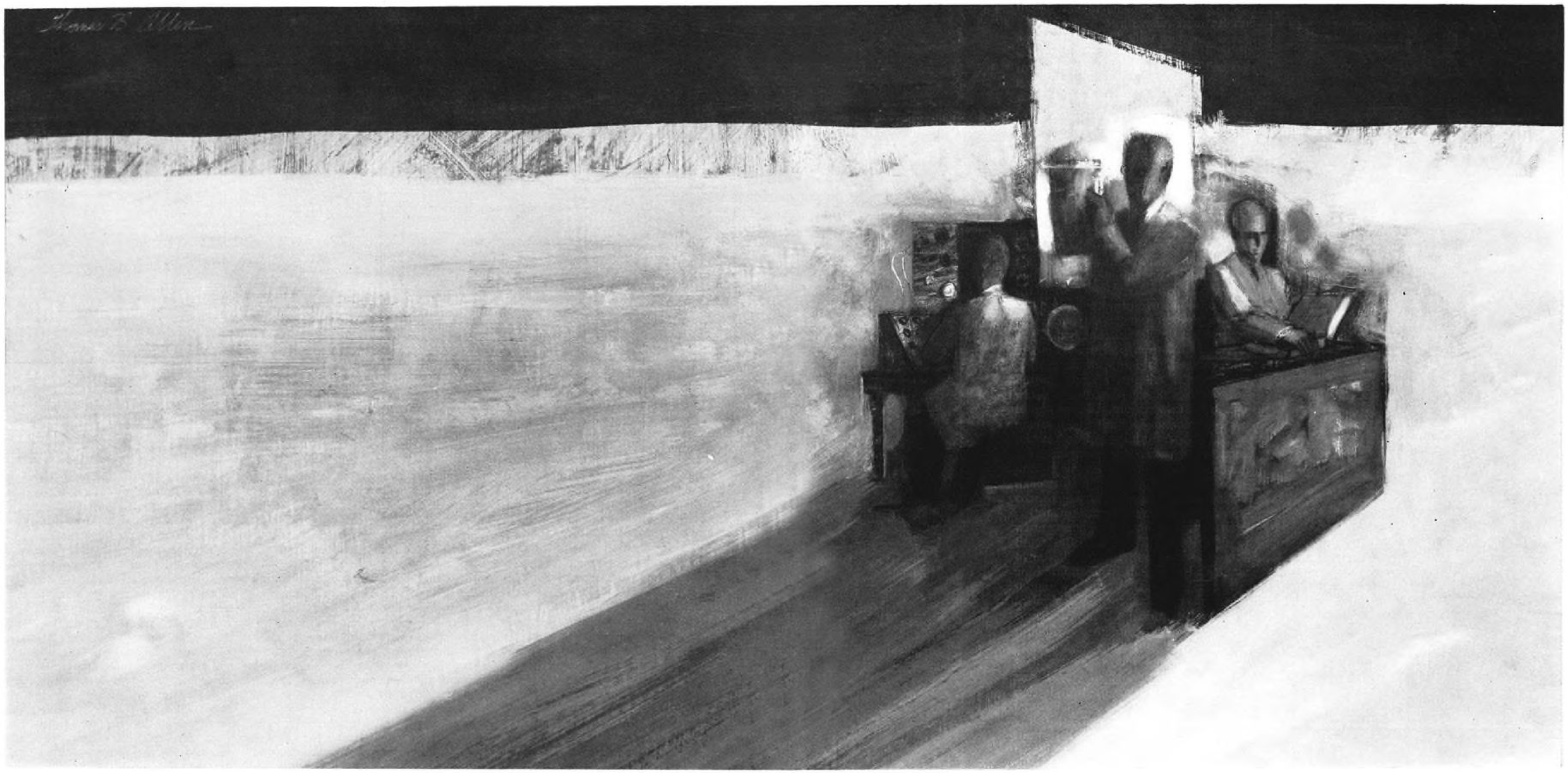
By combining the concepts of the back-to-back gyro concept described for pitch axis stabilization with the single gyro technique described for yaw-roll axis damping, it is possible to devise a two-gyro system which can provide stabilization about all three axes.

The technique in some ways resembles that used on certain types of missiles where a single two-degree-of-freedom gyro is used both for directional and pitch reference by tipping its spin axis at a 45-degree angle so that it senses motion in both the vertical and horizontal planes.

One possible implementation of the three-axis, two-gyro Vee configuration mounts the two integrating gyros so that their rotors spin in the same general direction as the satellite's orbital rotation, but with their spin axes tilted (skewed) in the vertical plane. This is accomplished by installing one gyro so that without external forces applied, its spin axis is tilted up by a suitable angle, while the other gyro spin axis is tilted down by the same angle.

The horizontal components of the two gyro angular momentum vectors lie along the pitch axis and therefore add to form an angular momentum vector similar to that of the single-gyro roll-yaw system described earlier. Any yaw motion of the satellite, whose angular momentum vector will lie along the yaw axis, will cause both gyros to precess in the same vertical direction, generating an angular momentum vector which also is along the yaw axis and which opposes the satellite motion.

Any motion of the satellite about its pitch axis will cause the two gyros to



## THE QUIET MEN

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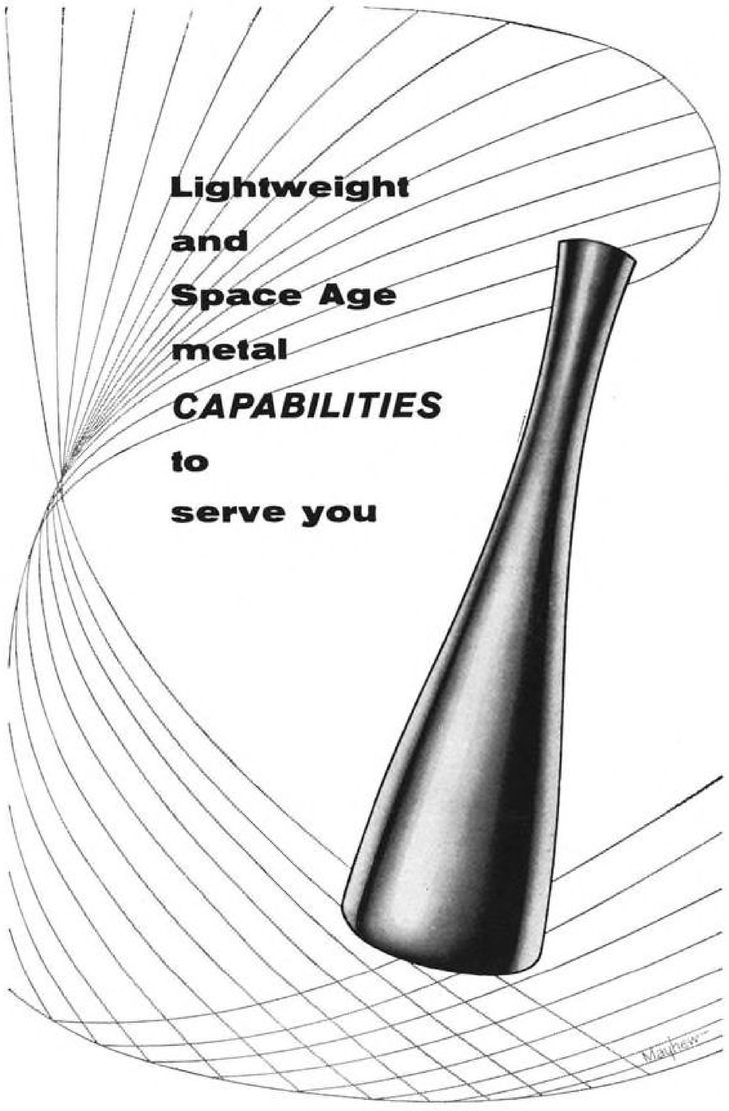


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## Gyro Damping Report

Use of integrating gyroscopes as both rate sensors and torque sources for stabilization of a satellite's motions is described in a recent report by National Aeronautics and Space Administration's Ames Research Center. The 37-page report describes analytical design and analog computer simulation of a three-gyro stabilization system for a vehicle such as the Orbiting Astronomical Observatory. Copy of the report, entitled "Study of a Satellite Attitude Control System Using Integrating Gyros as Torque Sources," AD-263282, can be obtained for $1.00 from Office of Technical Services, Commerce Department, Washington 25, D. C.

precess in opposite directions in a "scissors" type action which increases or decreases the component of their angular momentum vector along the pitch axis to compensate for and damp out the pitch axis motion of the satellite.

If the two gyros are installed so that their output axes lie along the yaw axis instead of the roll axis, the configuration is called a "Yaw-Vee," but the operation otherwise is similar.

### Matching Momentum

For the same reason that the angular momentum of satellite and integrating gyro are matched in the single gyro roll-yaw stabilization system described earlier, the tilt angle of the two gyros and their angular momentums are selected so that the sum of their vectors along the pitch axis is approximately equal to the vehicle's orbital angular momentum for optimum damping about the roll-yaw axes.

A trade-off between gyro tilt angle and gyro angular momentum is possible, but the increased tilt angle produces more pitch axis damping, which thus sets a practical upper limit on tilt angle.

Under most conditions the two gyros are tilted through equal (and opposite) angles and have approximately equal angular momentums, but under certain conditions slightly different angles and a mismatch of momentums of the two gyros may be desirable, Ogletree told AVIATION WEEK. For example, a satellite in a highly eccentric orbit using a twin-gyro Vee system would experience some oscillation about its pitch axis. By using an intentional mismatch of gyro tilt angle and momentum, it is possible to transfer this oscillation to the yaw axis where it would cause no operational problems for many types of satellites.

A similar concept of using tilted gyros for satellite stabilization was proposed several months ago by E. G. C. Burt of the Royal Aircraft Establishment at the Eighth Anglo-American Aeronautical Conference in London, Ogletree reports. For the tilted gyro system, Burt said that optimum pitch transient response occurs when the parameters are selected so as to provide three equal, real, negative roots in the pitch motion characteristic equation.

Ogletree says that the pitch error response to the forcing effects of orbital eccentricity may be greatly reduced by severely over-damping the pitch axis system, but with the resultant penalty in system transient response.

A more ingenious configuration which requires only a single integrating gyro to stabilize the satellite about all three axes is an outgrowth of posing the question of what would happen to a satellite stabilized with a two-gyro Vee system if one of the gyros were removed.

Under this condition, the angular momentum of the single tilted gyro, without the balancing momentum of the missing gyro, will react with the orbital angular momentum of the satellite causing the vehicle to roll through an angle sufficient to balance the component of angular momentum generated by the tilt of the integrating gyro.

Therefore, the entire satellite will be tilted about its roll axis so that its axis of minimum inertia no longer is oriented toward local vertical.

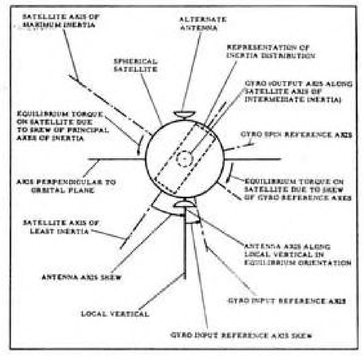
This is of no consequence for a communication or meteorological satellite, so long as the vehicle's antennas or sensors are located to take account of this steady state tilt of the satellite about its roll axis.

### Continuous Torque

The continuous torque applied to the integrating gyro gimbals in the earlier cited back-to-back damping system proportional to satellite orbital velocity must be altered in the single skewed gyro configuration. The continuously applied torque is made proportional to the satellite's combined gravitational and gyroscopic restoring torques in the equilibrium (skewed) orientation.

In the Bell Telephone Laboratories study, MIT assumed a 200 lb. satellite with unequal principal moments of inertia in a circular orbit at an altitude of 6,000 mi. Analysis indicated that such a satellite could be stabilized with a single, small integrating floated gyro with an angular momentum of approximately 100,000 gm. cm. per sec. per sec.

One disadvantage of the single skewed gyro technique is that there may be two stable positions of the vehicle about the roll axis, 180 degrees apart, depending upon the magnitude of the gyro's angular momentum. The same is true of the yaw axis, but this is of less importance for most applications. Like all satellites employing gravitational gradient torques for alignment to earth vertical, there also will be two stable positions about the pitch axis, 180 degrees apart.




**SINGLE GYRO** can provide three-axis satellite stabilization, providing vehicle's antennas or sensors are located to take account of skew in satellite's axis of least inertia.

There are several possible solutions to this bi-stability problem for a communications satellite. One is to equip the satellite with two antennas, 180 degrees apart, and automatically select the one which can receive a terrestrial radio signal. Another is to use a single antenna and a small flywheel which would automatically rotate the required number of times to flip the satellite over in the event no signal was received from the earth.

Of the several gyro configurations described, the MIT scientists believe the twin-gyro Vee and the single skewed gyro are the most attractive. The Vee configuration offers better damping capability if ordinary integrating gyros with positive elastic restraint coefficient are used at large tilt angles. If the gyro spring constants are modified to provide positive feedback, the single skewed gyro may be more attractive because of its simplicity. However, the latter may result in oscillations of the satellite if it is in an eccentric orbit, as previously discussed.

"For any proposed application, it is as necessary with these systems as with any other to weigh all factors in order to insure selection of the proper system," the authors conclude.

## FILTER CENTER

► **Integrated Circuit Military Computer**—What may prove to be the first operational military computer to employ integrated circuits is being developed by Martin Marietta Co. The system will use micrologic elements, manufactured by Fairchild Semiconductor Corp., in its logic and controls sections. A 10-oz. demonstration model general-purpose digital computer using integrated circuits was fabricated last year by Texas Instruments, Inc., under Air Force contract (AW Feb. 8, 1960, p. 79; Oct. 23, p. 30; Oct. 30, p. 81). AC Spark Plug also is building a guidance computer employing Fairchild micrologic as a backup computer for the stellar inertial system it hopes Air Force will select at the completion of a funded development project for MMRBM (Mobile Medium Range Ballistic Missile). The primary computer for the AC Spark Plug system is being developed by International Business Machines and there seems little likelihood the integrated circuit version would be completed in time to have it ready for MMRBM were AC Spark Plug selected as associate contractor for guidance (AW Dec. 25, p. 11).

► **Superpower Microwave Sought**—Contract to develop an X-band linear beam tube (klystron) capable of delivering average powers of one megawatt at about 8.5 kmc. will be awarded soon by Rome Air Development Center as the Air Force, Army and Department of Defense continue their search for the megawatt microwave tubes needed for ballistic missile and satellite space tracking systems and in anti-ICBM radar systems for Nike Zeus and Arpat. Bidders for the million dollar development contract include Eitel-McCullough, Radio Corp. of America and Varian Associates. Varian is working on megawatt average power S-band klystrons for the Army Signal Corps.

► **Navy to Buy Micro-Electronics**—Navy Bureau of Ships will shortly call for industry proposals for development of a family of micro-electronic, general use-age assemblies for use in time and frequency control system equipment. Representative equipment applications include time comparators, frequency deviation meters, frequency synthesizers, standards and counters.

► **USAF Seeks Microwave Semiconductors**—Research and development program aimed at utilization of microwave reactions in semiconductors to produce new and unusual devices is planned by USAF's Aeronautical Systems Division, Dayton, Ohio. Typical devices being sought include microwave switches, limiters, duplexers and phase shifters.

► **Zeus Discrimination Radars Installed**—New type radar designed to discriminate between ballistic missile warheads and decoys is being installed at White Sands Missile Range and at Kwajalein Island for Nike Zeus tests. Radar was designed by Sperry Gyroscope Co., under supervision of Bell Telephone Laboratories. It incorporates discrimination techniques evolved from studies by Bell Laboratories, Avco-Everett Research Laboratory, and Cornell Aeronautical Laboratories.

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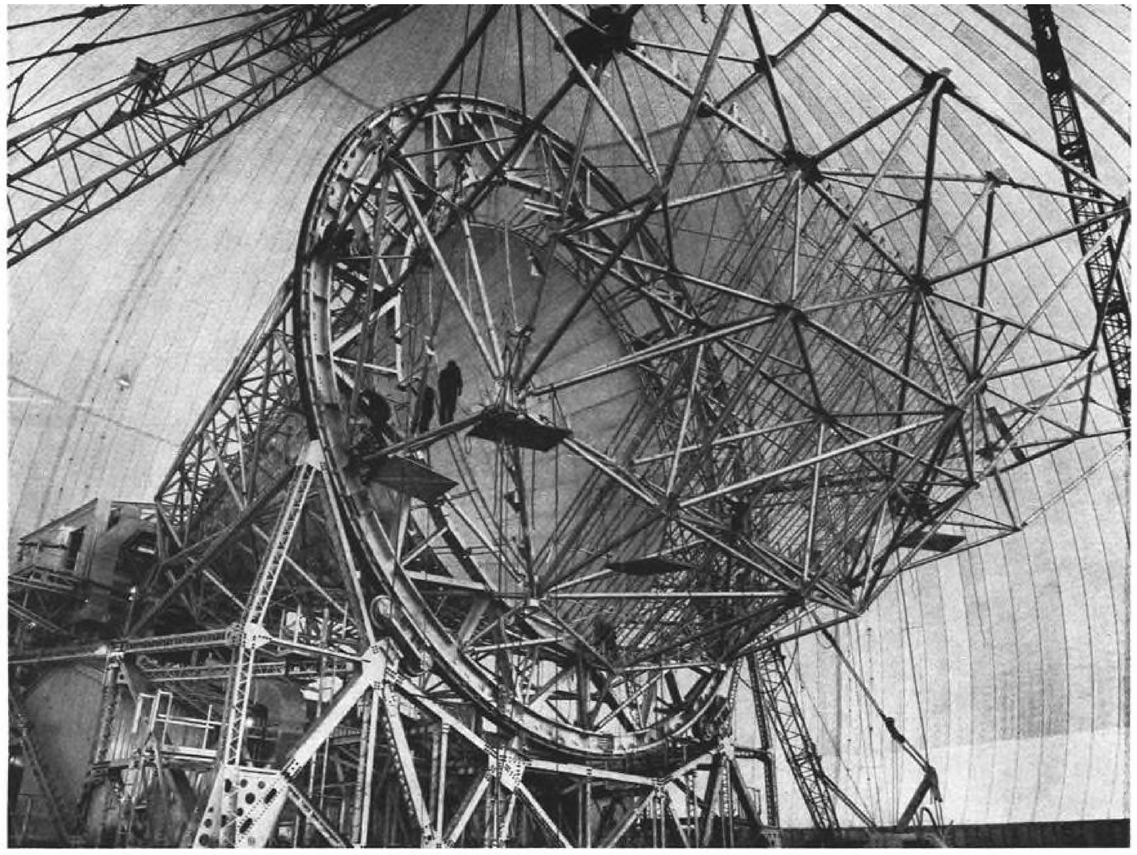
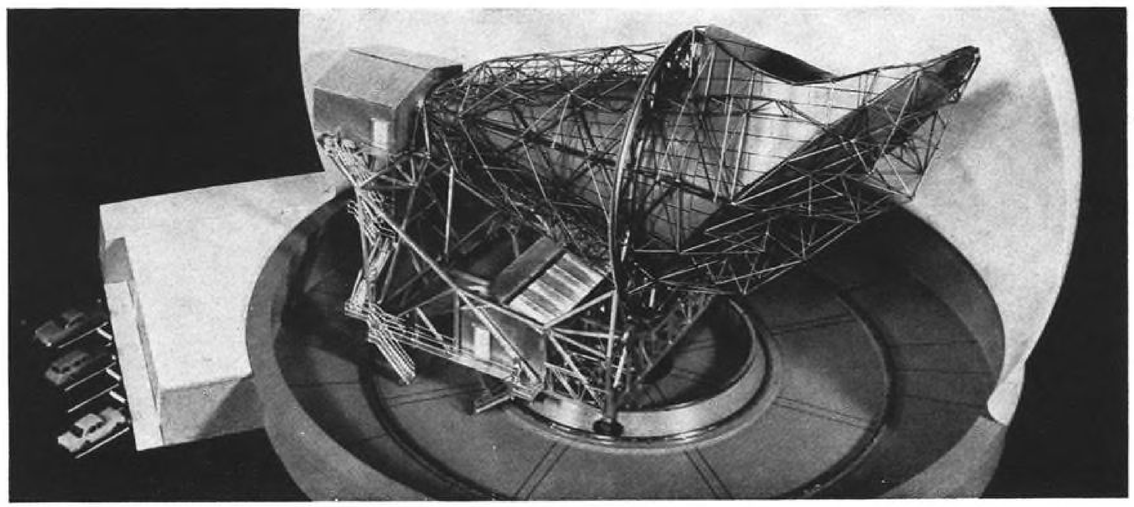
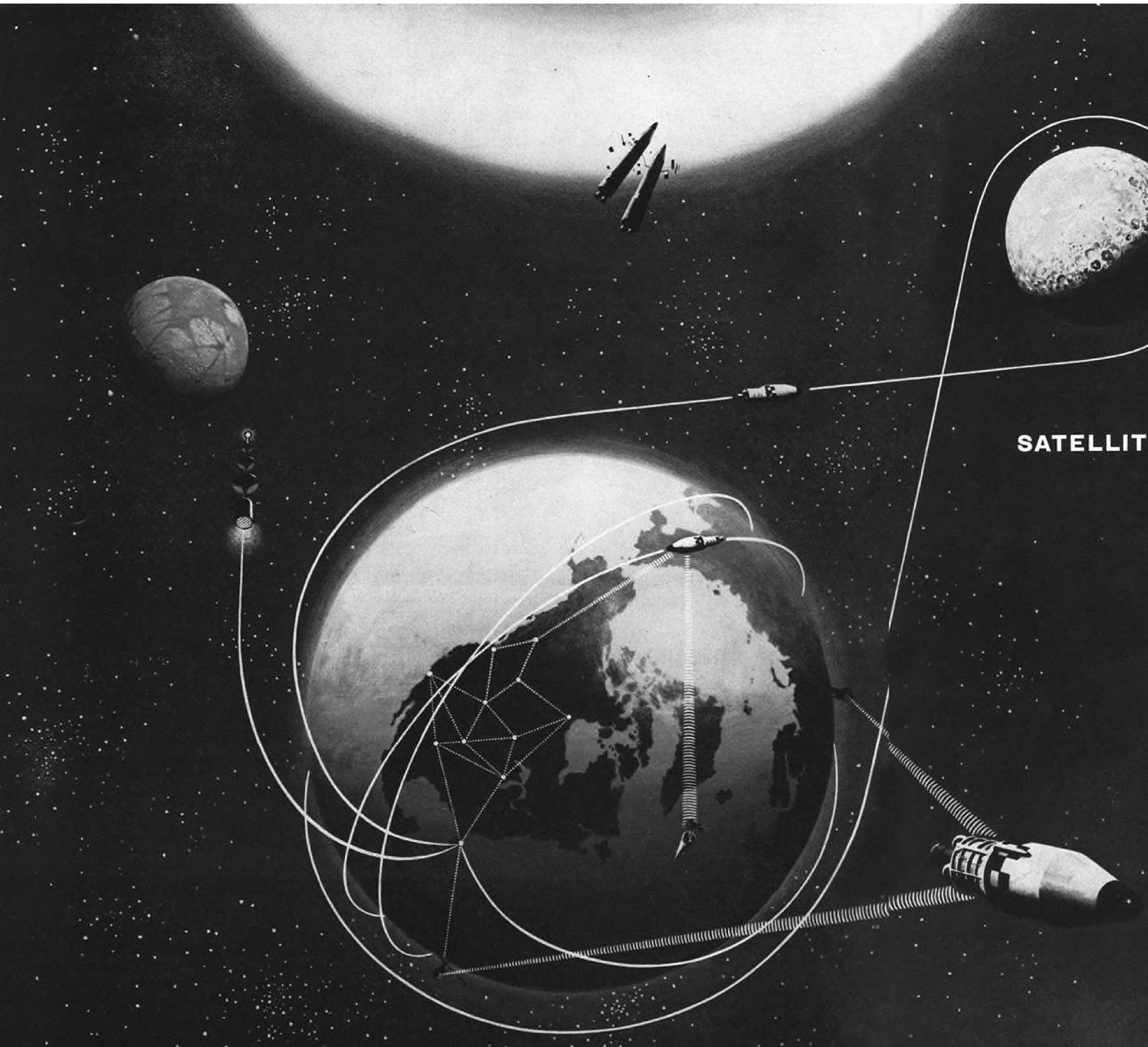


Bell System Telstar communication satellite antenna and ground terminal near Andover, Maine, expected to be in operation by April for first Telstar launch in mid-May, is being fabricated through winter months under an air-inflated structure. Antenna and terminal were designed by Bell and McKiernan-Terry engineers and fabricated by the latter company. The 300-ton structure and its 40 tons of electrical-electronic equipment will rotate in azimuth under precision control of two 25 hp. hydraulic drives on tracks set in concrete foundation, as shown in scale model below. Aperture of antenna horn, supported from 70 ft. diameter wheel shown, can rotate through 360 degrees in elevation. When antenna is completed, temporary shelter will be replaced by an air-inflated 210 ft. diameter radome, provided by Birdair Structures, Inc., to protect it from weather and sun's heat. Receiving and transmitting equipment will be located in upper house at apex of the horn, while lower house will contain electrical controls. The Bell System facility is expected to cost approximately $10 million, according to company spokesmen.

# Telstar Antenna Nearing Completion For May Operation





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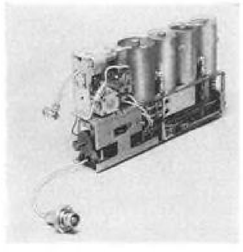

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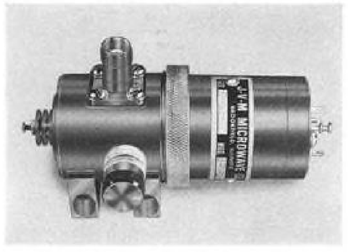

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JVM has also engineered and developed components for the major equipment in TACAN, DME and Transponder ground station beacons.

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# Grissom Gives Full Report on MR-4 Flight

*On July 21, 1961, USAF Capt. Virgil I. Grissom became the second U. S. astronaut to ride a Mercury capsule into space. The flight plan called for a ballistic trajectory with a maximum altitude of 103 mi., a range of 263 naut. mi. and a 5-min. period of weightlessness. Last Aug. 7 (p. 60), Aviation Week presented his informal pilot's report as he gave it to newsmen at Cocoa Beach, Fla., the day after the flight. The following is his informal chronological report on his activities before, during and after the flight.*

The preflight period is composed of two distinct areas. The first is the training that has been in progress for the past 2½ years and which is still in progress. The second area, and the one that assumes the most importance as launch date approaches, is the participation in the day-to-day engineering and testing that applies directly to the spacecraft that is to be flown.

Over the past two years, a great deal of information has been published about the astronaut training program and the program has been previously described in reference 1 (p. 88). In the present paper, I intend to comment on only three trainers which I feel have been of the greatest value in preparing me for this flight.

### Procedures Trainer

The first trainer that has proven most valuable is the Mercury procedures trainer which is a fixed-based computer-operated flight simulator. There are two of these trainers, one at the NASA-Langley Air Force Base, Va., and one at the Mercury Control Center, Cape Canaveral, Fla. These procedures trainers have been used continuously throughout the program to learn the system operations, to learn emergency operating techniques during system malfunctions, to learn control techniques, and to develop operational procedures between pilot and ground personnel.

During the period preceding the launch, the trainers were used to finalize the flight plan and to gain a high degree of proficiency in flying the mission profile. First, the systems to be checked specifically by the pilot were determined. These were to be the manual proportional control system; the rate command control system; attitude control with instruments as a reference; attitude control with the earth-sky horizon as a reference; the UHF, HF, and emergency voice communications systems; and the manual retrofire override. The procedures trainer was then used to establish an orderly sequence of accomplishing these tasks. The pilot functions were tried and modified a great number of times before a satisfactory sequence was determined. After the flight plan was established, it was practiced until each phase and time was memorized. During this phase of training, there was a tendency to add more tasks to the mission flight plan as proficiency was gained. Even though the MR-4 flight plan contained less pilot functions than the MR-3 flight plan, I found that the view out the window, which cannot be simulated, distracted me from the less important tasks and often caused me to fall behind the planned program. The only time this distraction concerned me was prior to retrofire; at other times, I felt that looking out the window was of greater importance than some of the planned menial tasks. In spite of this pleasant distraction, all tasks were accomplished with the exception of visual control of retrofire.

The second trainer that was of great value and one that I wish had been more readily available prior to launch was the air-lubricated free-attitude (ALFA) trainer at the NASA-Langley Air Force Base, Va. This trainer provided the only training in visual control of the spacecraft. I had intended to use the earth-sky horizon as my primary means of attitude control and had spent a number of hours on the ALFA trainer practicing retrofire using the horizon as a reference.

Because of the rush of events at Cape Canaveral during the two weeks prior to launch, I was unable to use this trainer. I felt this probably had some bearing on my instinctive switch to instruments for retrofire during the flight, instead of using the horizon as a reference.

The third training device that was of great value was the Johnsville human centrifuge. With this device, we learned to control the spacecraft during the accelerations imposed by launch and re-entry and learned muscle control to aid blood circulation and respiration in the acceleration environment. The acceleration buildup during the flight was considerably smoother than that experienced on the centrifuge and probably for this reason and for obvious psychological reasons, the g-forces were much easier to withstand during the flight than during the training missions.

One other phenomenon that was experienced on the centrifuge proved to be of great value during the flight. Quite often, as the centrifuge changed rapidly from a high g-level to a low or 1g level, a false tumbling sensation was encountered. This became a common and expected sensation and when the same thing occurred at launch vehicle cutoff, it was in no way disturbing. A quick glance at my instruments convinced me that I, indeed, was not tumbling.

CAPT. VIRGIL I. GRISSOM

The pilot's confidence comes from all of the foregoing training methods and from many other areas, but the real confidence comes from participation in the day-to-day engineering decisions and testing that occur during the preflight checkout at Cape Canaveral. It was during this time that I learned the particular idiosyncrasies of the spacecraft that I was to fly. A great deal of time had already been spent in learning both normal and emergency system operations. But during the testing at the preflight complex and at the launching pad, I learned all the differences between this spacecraft and the simulator that had been used for training.

I learned the various noises and vibrations that are connected with the operation of the systems. This was the time that I really began to feel at home in this cockpit. This training was very beneficial on launch day because I felt that I knew this spacecraft and what it would do, and having spent so much time in the cockpit I felt it was normal to be there.

### Spacecraft Activities

As a group, we astronauts feel that after the spacecraft arrives at the Cape, our time is best spent in participating in spacecraft activities. This causes some conflict in training, since predicting the time test runs of the preflight checkouts will start or end is a mystic art that is understood by few and is unreliable at its best. Quite frequently this causes training sessions to be canceled or delayed, but it should be of no great concern since most of the training has been accomplished prior to this time. The use of the trainers during this period is primarily to keep performance at a peak and the time required will vary from pilot to pilot.

At the time the spacecraft is moved from the preflight complex to the launching pad, practically all training stops. From this time on, I was at the pad full time participating in or observing every test that was made on the spacecraft-launch vehicle combination. Here, I became familiar with the launch procedure and grew to know and respect the launch crew. I gained confidence in their professional approach to, and execution of, the prelaunch tests.

On the day of the flight, I followed the following schedule:

| Event | a.m EST |
|---|---|
| Awakened | 1:10 |
| Breakfast | 1:25 |
| Physical examination | 1:55 |
| Sensors attached | 2:25 |
| Suited up | 2:35 |
| Suit pressure check | 3:05 |
| Entered transfer van | 3:30 |

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ARTHUR A. NICHOLS

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► 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.*

FIG. 1

**► 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 Figure 1).**

► The designer thus has the advantage of several variables to secure a given capacity within his space limitations: *Gerotor diameter*—which governs the area of the pumping chamber—*Gerotor thickness* which, taken with area, determines chamber volume — *Gerotor RPM*, since this is a positive displacement pump. Thus, it is possible to vary the diameter, the length and the speed of the pump within certain overall limits to secure the wanted capacity.

**► Unlike conventional gear pumps the Gerotor needs only a *single shaft* — both elements are substantially concentric to it. These are mated to provide continuous, fluid-tight engagement without the crescent structure necessary in other internal gear pumps. Further, Gerotor elements can be stacked along a single shaft and mounted on a single AN pad to perform multiple pump functions: lube, scavenge, boost, etc. (See Figure 2). Such compactness allows the pump to be "submerged" in a gear box or sump and frequently the sump may be part of the pump housing.**

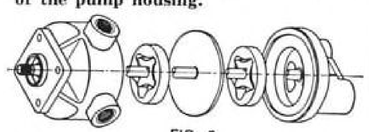
FIG. 2

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

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| | |
|---|---|
| Arrived at pad | 3:55 |
| Manned the spacecraft | 3:58 |
| Launched | 7:20 |

As can be seen, 6 hr. and 10 min. elapsed from the time I was awakened until launch. This time is approximately evenly divided between activities prior to my reaching the pad and time I spent at the pad. In this case, we were planning on a launch at 6:00 a.m. EST., but it will probably always be normal to expect some holds that cannot be predicted. While this time element appears to be excessive, we can find no way to reduce it below this minimum at the present. Efforts are still continuing to reduce the precountdown time so that the pilot will not have had an almost full working day prior to liftoff.

After insertion in the spacecraft, the launch countdown proceeded smoothly and on schedule until T — 45 min. when a hold was called to install a misaligned bolt in the egress hatch.

After a hold of 30 min., the countdown was resumed and proceeded to T — 30 min. when a brief hold was called to turn off the pad searchlights. By this time, it was daylight; and the lights, which cause interference with launch-vehicle telemetry, were no longer needed.

Once more hold was called at T — 15 min. to await better cloud conditions because the long focal length cameras would not have been able to obtain proper coverage through the existing overcast.

After holding for 41 min., the count was resumed and proceeded smoothly to liftoff at 7:20 a.m., EST.

The communications and flow of information prior to liftoff were very good. After participating in the prelaunch test and the cancellation two days previously, I was very familiar with the countdown and knew exactly what was going on at all times.

## Liftoff Sensations

As the Blockhouse Capsule Communicator (CapCom) called ignition, I felt the launch vehicle start to vibrate and could hear the engines start. Just seconds after this, the elapsed-time clock started and the Mercury Control Center CapCom confirmed liftoff. At that time, I punched the Time Zero override, started the stopwatch function on the spacecraft clock, and reported that the elapsed-time clock had started.

The powered flight portion of the mission was in general very smooth. A low-order vibration started at approximately T + 50 sec., but it did not develop above a low level and was undetectable after about T + 70 sec. This vibration was in no way disturbing and it did not cause interference in either communications or vision. The magnitude of the accelerations corresponds well to the launch simulations on the centrifuge, but the onset was much smoother.

Communications throughout the powered flight were satisfactory. The VOX (voice operated relay) was used for pilot transmissions instead of the push-to-talk button. The noise level was never high enough at any time to key the transmitter. Each standard report was made on time and there was never any requirement for myself or the CapCom to repeat any transmission.

## Flight Plan

| Time, min:sec | Event |
|---|---|
| 0:00 | Liftoff |
| 0:30 | Systems report |
| 1:00 | Systems report |
| 1:15 | Cabin pressure report |
| 1:30 | Systems report |
| 2:00 | Systems report |
| 2:23 | Launch-vehicle engine cutoff<br>Tower jettison<br>Retrojettison switch to off |
| 2:33 | Spacecraft separation from launch vehicle |
| 2:38 | Spacecraft turnaround to flight attitude on autopilot |
| 3:00 | Transfer of flight control from autopilot to manual proportional control system, and evaluation of system |
| 4:00 | Spacecraft yawed 45 deg. to left using horizon as attitude reference |
| 5:10 | Retrograde rockets fired manually |
| 5:35 | Retrojettison system armed<br>Transfer of flight control from manual proportional control system to rate command control system<br>Radio transmitter switched from UHF to HF |
| 6:10 | Retropackage jettison |
| 6:40 | Periscope retracts automatically<br>Spacecraft positioned into reentry attitude |
| 7:00 | Communications switched back to UHF transmitter |
| 7:46 | Re-entry starts |
| 9:41 | Drogue parachute deploys<br>Snorkels open<br>Emergency rate oxygen flow |
| 10:13 | Main parachute deployment |
| 15:37 | Landing |

Vision out of the window was good at all times during launch. As reviewed from the pad, the sky was its normal light blue; but as the altitude increased, the sky became a darker and darker blue until approximately 2 min. after liftoff, which corresponds to an altitude of approximately 100,000 ft., the sky rapidly changed to an absolute black. At this time, I saw what appeared to be one rather faint star in the center of the window. It was about equal in brightness to Polaris. Later, it was determined that this was the planet Venus whose brightness is equal to a star of magnitude of −3.

Launch-vehicle engine cutoff was sudden and I could not sense any tail-off of the launch vehicle. I did feel, as I described earlier, a very brief tumbling sensation. The firing of the escape-tower clamp ring and escape rocket is quite audible and I could see the escape rocket motor and tower throughout its tail-off burning phase and for what seemed like quite some time after that climbing off to my right. Actually, I think I was still watching the tower

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at the time the posigrade rockets fired, which occurred 10 sec. after cutoff. The tower was still definable as a long, slender object against the black sky at this time.

The posigrade firing is a very audible bang and a definite kick, producing a deceleration of approximately 1g. Prior to this time, the spacecraft was quite stable with no apparent motion. As the posigrade rockets separated the spacecraft from the launch vehicle, the spacecraft angular motions and angular accelerations were quite apparent. Spacecraft damping which was to begin immediately after separation was apparently satisfactory, although I cannot really report on the magnitude of any angular rates caused by posigrade firing.

## Spacecraft Turnaround

The spacecraft turnaround to retrofire attitude is quite a weird maneuver to ride through. At first, I thought the spacecraft might be tumbling out of control. A quick check of the instruments indicated that turnaround was proceeding much as those experienced on the procedures trainer, with the exception of roll attitude which appeared to be very slow and behind the schedule that I was expecting.

As the turnaround started, I could see a bright shaft of light, similar to the sun shining into a blackened room, start to move from my lower left up across my torso. Even though I knew the window reduces light transmissions equivalent to the earth's atmosphere, I was concerned that it might shine directly into my eyes and blind me. The light moved across my torso and disappeared completely.

A quick look through the periscope after it extended did not provide me with any useful information. I was unable to see land, only clouds and the ocean.

The view through the window became quite spectacular as the horizon came into view. The sight was truly breathtaking. The earth was very bright, the sky was black, and the curvature of the earth was quite prominent. Between the earth and sky, there was a border which started at the earth as a light blue and became increasingly darker with altitude. There was a transition region between the dark blue and the black sky that is best described as a fuzzy gray area. This is a very narrow band, but there is no sharp transition from blue to black. The whole border appeared to be uniform in height over the approximately 1,000 mi. of horizon that was visible to me.

## Cloud Coverage

The earth itself was very bright. The only landmark I was able to identify during the first portion of the weightlessness period was the Gulf of Mexico coastline between Apalachicola, Fla., and Mobile, Ala. The cloud coverage was quite extensive and the curvature of this portion of the coast was very difficult to distinguish. The water and land masses were both a hazy blue, with the land being somewhat darker.

There was a frontal system south of this area that was clearly defined.

One other section of the Florida coast came into view during the left yaw maneuver, but it was a small section of beach with no identifiable landmarks.

The spacecraft automatic stabilization and control system (ASCS) had made the turnaround maneuver from the position on the launch vehicle to retrofire attitude. The pitch and yaw axes stabilized with only a moderate amount of overshoot as predicted, but the roll attitude was still being programed and was off by approximately 15 deg. when I switched from the autopilot to the manual proportional control system. The switchover occurred 10 sec. later than planned to give the ASCS more time to stabilize the spacecraft. At this point, I realized I would have to hurry my programed pitch, yaw, and roll maneuvers. I tried to hurry the pitch-up maneuver; I controlled the roll attitude back within limits, but the view out of the window had distracted me, resulting in an overshoot in pitch. This put me behind in my schedule even more. I hit the planned yaw rate but overshot in yaw attitude again. I realized that my time for control maneuvers was up and I decided at this point to skip the planned roll maneuver, since the roll axis had been exercised during the two previous maneuvers, and go immediately to the next task.

This was the part of the flight to which I had been looking forward. There was a full minute that was programed for observing the earth. My observations during this period have already been reported in this paper, but the control task was quite easy when only the horizon was used as a reference. The task was somewhat complicated during this phase, as a result of lack of yaw reference. This lack was not a problem after retrofire when Cape Canaveral came into view. I do not believe yaw attitude will be a problem in orbital flight because there should be ample time to pick adequate checkpoints; even breaks in cloud formations would be sufficient.

The retrosequence started automatically and at the time it started, I was slightly behind schedule. At this point, I was working quite hard to get into a good retrofire attitude so that I could fire the retrorockets manually. I received the countdown to fire from Mercury Control Center CapCom and fired the retrorockets manually. The retrorockets, like the escape rocket and posigrades, could be heard quite clearly. The thrust buildup was rapid and smooth. As the first retrorocket fired, I was looking out the window and could see that a definite yaw to the right was starting. I had planned to control the spacecraft attitude during retrofire by using the horizon as a reference; but as soon as the right yaw started, I switched my reference to the flight instruments. I had been using instruments during my retrofire practice for the two weeks prior to the launch in the Cape Canaveral procedures trainer since the activity at the Cape prevented the use of the ALFA trainer located at the NASA-Langley Air Force Base, Va. This probably explains the instinctive switch to the flight instruments.

### Project Trump Tests

**Air Force will launch a total of 18 Nike-Cajun and Nike-Javelin vehicles this year from Air Proving Ground Center, Eglin AFB, Fla., carrying payloads in support of Project Trump (AW Jan. 22, p. 28).**

**Trump, which stands for Target Radiation Measurement Program, is designed to gather data on the infrared (IR) characteristics of ballistic missile launchings so that Midas missile-warning satellites will be able to distinguish the exhaust of a missile from a comparable source of IR radiation, such as a steel mill.**

**Air Proving Ground Center plans to launch approximately 190 space probes and sounding rockets during the next six months, ranging in altitudes from 20 to 200 mi. and down the Gulf of Mexico range from 3 to 330 mi. Vehicles to be used vary from the one-stage, 5-ft. Arcas to the three-stage, 42-ft. Exos. Payload weights run from 7.5-lb. to 800-lb. (AW Sept. 25, p. 96-97).**

## Retrofire Difficulty

The retrofire difficulty was about equal to the more severe cases that have been presented on the procedures trainer.

Immediately after retrofire, Cape Canaveral came into view. It was quite easy to identify. The Banana and India Rivers were easy to distinguish and the white beach all along the coast was quite prominent. The colors that were the most prominent were the blue of the ocean, the brownish-green of the interior, and the white in between, which was obviously the beach and surf. I could see the building area on Cape Canaveral. I do not recall being able to distinguish individual buildings, but it was obvious that it was an area where buildings and structures had been erected.

Immediately after retrofire, the retrojettison switch was placed in the armed position, and the control mode was switched to the rate command control system. I made a rapid check to ascertain that the system was working in all axes and then I switched from the UHF transmitter to the HF transmitter.

## HF Transmission Problem

This one attempt to communicate on HF was unsuccessful. At approximately peak altitude, the HF transmitter was turned on and the UHF transmitter was turned off. All three receivers—UHF, HF, and emergency voice—were on continuously. Immediately after I reported switching to HF, the Mercury Control Center started transmitting to me on HF only. I did not receive any transmission during this period. After allowing the HF transmitter approximately 10 sec. to warm up, I transmitted but received no acknowledgment that I was being received. Actually, the Atlantic Ship telemetry vessel located in the landing area and the Grand Bahama Island did receive my HF transmissions. Prior to the flight, both stations had been instructed to transmit on the assigned frequencies unless they were called by the pilot. After switching back to the UHF transmitter, I received a call on the emergency voice that was loud and clear. UHF communications were satisfactory throughout the flight. I was in continuous contact with some facility at all times, with the exception of a brief period on HF.

Even though all communications equipment operated properly, I felt that I was hurrying all transmissions too much. All of the sights, sounds, and events were of such importance that I felt compelled to talk of everything at once. It was a difficult choice to decide what was the most important to report at any one time. I wanted as much as possible recorded so that I would not have to rely on my memory so much for later reporting.

As previously mentioned, the control mode was switched from manual proportional to rate command immediately after retrofire. The procedures trainer simulation in this system seems to be slightly more difficult than the actual case. I found attitudes were easy to maintain and rates were no problem. The rate command system was much easier to fly than the manual proportional system. The reverse is normally true on the trainer. The sluggish roll system was probably complicating the control task during the manual proportional control phase of the flight, while roll accelerations appeared to be normal on the rate command system.

The rate command control system was used after retrofire and throughout the re-entry phase of the flight. At the zero rate command position, the stick was centered. This system had a deadband of ±3 deg. per sec. Our experience on the procedures trainer had indicated that this system was more difficult to fly than the manual proportional control system. This was not the case during this flight. Zero rates and flight attitudes were easy to maintain. The records do indicate that an excessive amount of fuel was expended during this period. Approximately 15% of the manual fuel supply was used during the 2 min. the system was operating. A major portion of the 2-min. period was during the re-entry when thrusters were operating almost continuously to dampen the re-entry oscillations.

The 0.05g telelight illuminated on schedule and shortly thereafter I reported g's starting to build. I checked the accelerometer and the g-level was something less than 1g at this time. The next time I reported, I was at 6g and I continued to report and function throughout the high-g portion of the flight.

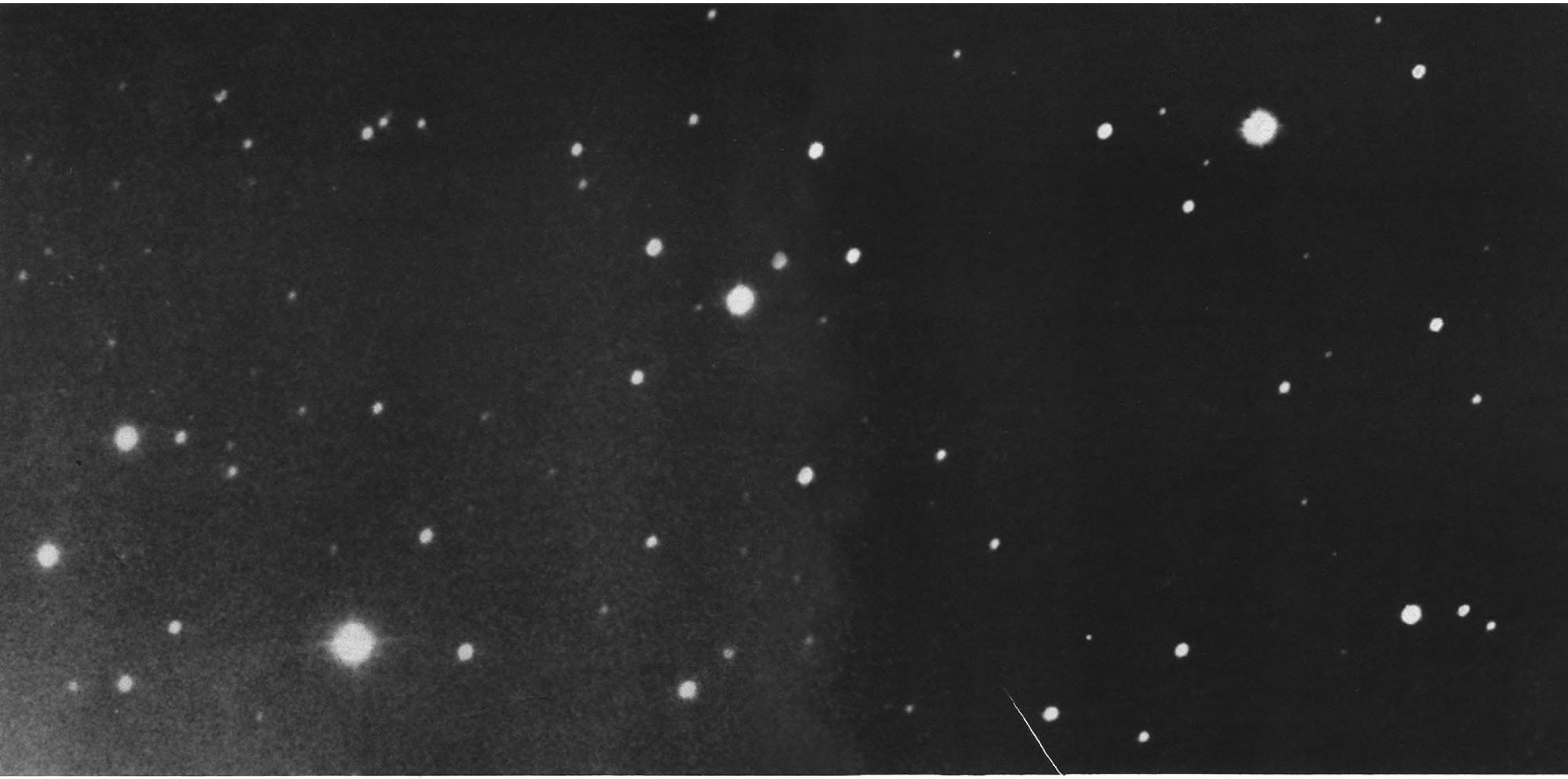
## Rates Increased

The spacecraft rates increased during the re-entry, indicating that the spacecraft was oscillating in both yaw and pitch. I made a few control inputs at this time, but I could not see any effects on the rates, so I decided just to ride out the oscillations. The pitch rate needle was oscillating full scale at a rapid rate of ±6 deg. per sec. during this time and the yaw rate began oscillating full scale slightly later than pitch. At no time were these oscillations noticeable inside the spacecraft.

During this phase of re-entry and until main parachute deployment, there is a noticeable roar and a mild buffeting of the spacecraft. This is probably the noise of a blunt object moving rapidly through the atmosphere and the buffeting is not distracting nor does it interfere with pilot function.

The drogue parachute deployment is quite visible from inside the spacecraft and the firing of drogue parachute mortar is clearly audible. The opening shock of the drogue parachute is mild; there is a mild pulsation or breathing of the drogue parachute which can be felt inside the spacecraft.

As the drogue parachute is released, the



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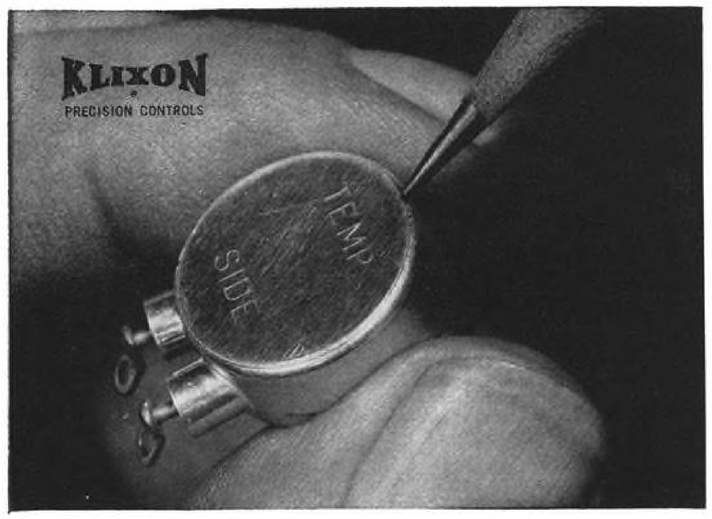


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1. the dependability of a snap-acting bimetallic disc;
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3. a welded hermetic seal;
4. a switch-action option of opening or closing on temperature rise or drop.

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**THE KLIXON M2 Optional Switch Action** allows you to use the same basic thermostat not only to control temperature in heating boots and blankets and anti-fogging systems but also to turn on warning lights when temperatures get too high.

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**PERFORMANCE CHARACTERISTICS of M-2 THERMOSTAT**

| | | |
|---|---|---|
| Calibration | 0-250°F Standard ±4°F on closing temp<br>Special ±3°F on closing temp | |
| Differential | 0-250°F 5 to 9°F or 2 to 5°F<br>251-350°F 5 to 9°F | |
| Temp settings | −65 to 350°F<br>350 to 450°F under development | |
| Switch action | SPST, closes on temp rise or temp drop | |
| Electrical rating<br>Voltage<br>30 V-dc/120 V-ac | Amperage (non-inductive)<br>2 amp | Cycles<br>250,000 cycles |
| Dielectric strength | 1250V rms, 60 cycles for 30 sec | |
| Vibration resistance | 5-500 cps at 10 G's accel. or .36 D.A. | |
| Leakage | Surpasses immersion test MIL-E-5272C | |
| Approximate weight | 5.6 grams | |

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spacecraft starts to drop at a greater rate. The change in g-field is quite noticeable. Main parachute deployment is visible out the window also. A mild shock is felt as the main parachute deploys in its reefed condition. The complete parachute is visible at this time. As the reefing cutters fire, the parachute deploys to its fully opened condition. Again, a mild shock is felt. About 80% of the parachute is visible at this time and it is quite a comforting sight. The spacecraft rotates and swings slowly under the parachute at first; the rates are mild and hardly noticeable.

The spacecraft landing in the water was a mild jolt; not hard enough to cause discomfort or disorientation. The spacecraft recovery section went under the water and I had the feeling that I was on my left side and slightly head down. The window was covered completely with water and there was a disconcerting gurgling noise. A quick check showed no water entering the spacecraft. The spacecraft started to slowly right itself; as soon as I was sure the recovery section was out of the water, I ejected the reserve parachute by actuating the recovery aids switch. The spacecraft then righted itself rapidly.

### Egress Preparation

I felt that I was in good condition at this point and started to prepare myself for egress. I had previously opened the face plate and had disconnected the visor seal hose while descending on the main parachute. The next moves in order were to disconnect the oxygen outlet hose at the helmet, unfasten the helmet from the suit, release the chest strap, release the lap belt and shoulder harness, release the knee straps, disconnect the biomedical sensors, and roll up the neck dam. The neck dam is a rubber diaphragm that is fastened on the exterior of the suit, below the helmet attaching ring. After the helmet is disconnected, the neck dam is rolled around the ring and up around the neck, similar to a turtle-neck sweater. This left me connected to the spacecraft at two points, the oxygen inlet hose which I needed for cooling and the helmet communications lead.

At this time, I turned my attention to the door. First, I released the restraining wires at both ends and tossed them toward my feet. Then I removed the knife from the door and placed it in the survival pack. The next task was to remove the cover and safety pin from the hatch detonator. I felt at this time that everything had gone nearly perfectly and that I would go ahead and mark the switch position chart as had been requested.

After about 3 or 4 min., I instructed the helicopter to come on in and hook onto the spacecraft and confirmed the egress procedures with him. I unhooked my oxygen inlet hose and was lying on the couch, waiting for the helicopter's call to blow the hatch. I was lying flat on my back at this time and I had turned my attention to the knife in the surviving pack, wondering if there might be some way I could carry it out with me as a souvenir. I heard the hatch blow—the noise was a dull thud—and looked up to see blue sky out the hatch and water start to spill over the door sill. Just a few minutes before, I had gone over

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**uses interchangeable FM and direct record/reproduce electronics entirely contained in 7″ x 19″ panel space**

**COMPARE PERFORMANCE, PRICE PER CHANNEL**

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The Model 2000 Magnetic Data Recorder has four speeds and uses standard ½-inch tape on 10½-inch reels. All controls are on the front, and several convenience features are included: an integral FM Alignment Meter that eliminates the need for electronic counters, an automatic squelch, a tape footage counter, and provision for using one channel for flutter compensation.

Complete details are available from Sanborn Sales-Engineering Representatives in principal cities throughout the U. S., Canada and foreign countries.

**Price FOB Waltham, Mass., in Continental U. S. A.; subject to change without notice. State and local taxes must be added where applicable.*

*(Specifications subject to change without notice)*

SPECIFICATIONS

*Input* ± 2.5 V into 10,000 ohms, single ended, adjustable.

*Output* ± 2.5 V into 1,000 ohms or more, single ended; level, position adjustable.

*Bandwidths (Max)*

| *Speed* | *FM* | *Direct* |
|---|---|---|
| 3¾″/sec | 0-625 cps | 50-6,250 cps |
| 7½″/sec | 0-1,250 cps | 50-12,500 cps |
| 15″/sec | 0-2,500 cps | 50-25,000 cps |
| 30″/sec | 0-5,000 cps | 100-50,000 cps |

(100% modulation on FM = ± 40% carrier deviation)

*Linearity* Max dc nonlinearity: 0.5%

*Drift* ± 0.5% of full scale for 10 V power line change, 10°C ambient temperature change, or for 24 hours at constant power line voltage and ambient temperature.

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*Direct:* 40 db at all speeds.

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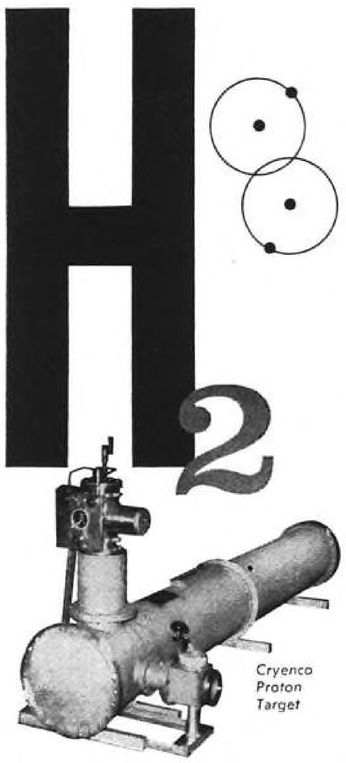


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egress procedures in my mind and reacted instinctively. I lifted the helmet from my head and dropped it, reached for the right side of the instrument panel, and pulled myself through the hatch.

After I was in the water and away from the spacecraft, I noticed a line from the dye-marker can over my shoulder. The spacecraft was obviously sinking and I was concerned that I might be pulled down with it. I freed myself from the line and noticed that I was floating with my shoulders above water.

The helicopter was on top of the spacecraft at this time with all three of its landing gear in the water. I thought the co-pilot was having difficulty hooking onto the spacecraft and I swam the 4 or 5 ft. to give him some help. Actually, he had cut the antennae and hooked the spacecraft in record time.

The helicopter pulled up and away from me with the spacecraft and I saw the personal sling start down; then the sling was pulled back onto the helicopter and it started to move away from me. At this time, I knew that a second helicopter had been assigned to pick me up, so I started to swim away from the primary helicopter. I apparently got caught in the rotorwash between the two helicopters because I could not get close to the second helicopter, even though I could see the copilot in the door with a horsecollar swinging in the water. I finally reached the horsecollar and by this time, I was getting quite exhausted. When I first got into the water, I was floating quite high up; I would say my armpits were just about at the water level. But the neck dam was not up tight and I had forgotten to lock the oxygen inlet port; so the air was gradually seeping out of my suit. Probably the most air was going out around the neck dam, but I could see that I was gradually sinking lower and lower in the water and was having a difficult time staying afloat. Before the copilot finally got the horsecollar to me, I was going under water quite often. The mild swells we were having were breaking over my head and I was swallowing some salt water. As I reached the horsecollar, I slipped into it and I knew that I had it on backward; but I gave the "up" signal and held on because I knew that I wasn't likely to slip out of the sling. As soon as I got into the helicopter, my first thought was to get on a life preserver so that if anything happened to the helicopter, I wouldn't have another ordeal in the water. Shortly after this time, the copilot informed me that the spacecraft had been dropped as a result of an engine malfunction in the primary helicopter.

## Postflight Examination

The postflight medical examination on board the carrier was brief and without incident. The loss of the spacecraft was a great blow to me, but I felt that I had completed the flight and recovery with no ill effects.

The postflight medical debriefing at the Grand Bahama Island installation was thorough and complete. The demands on me were not unreasonable.

From the pilot's point of view the conclusions reached from the second U. S. manned suborbital flight are as follows:

(1) The manual proportional control system functioned adequately on this flight. The system is capable of controlling the retrofire accurately and safely. The roll axis is underpowered and causes some difficulty. The rate command system functioned very well during this flight. All rates were damped satisfactorily, and it is easy to hold and maintain the attitudes with the rate command system. If the rate of fuel consumption that was experienced on this flight is true in all cases, it would not be advisable to use the rate command system during ordinary orbital flight to control attitudes. It should be used only for retrofire and re-entry. The autopilot functioned properly with the possible exception of the 5 sec. of damping immediately after separation. This period is so brief that it was impossible to determine the extent of any damping. The turnaround maneuver in the pitch and yaw axes was approximately as predicted, but the roll axis was slow to respond.

(2) The pilot's best friend on the orbital flight is going to be the window. Out this window, I feel he will be able to ascertain accurately his position at all times. I am sure he will be able to see stars on the dark side and possibly on the daylight side, with a little time to adapt the eyes. The brighter stars and planets will certainly be visible.

(3) Spacecraft rates and oscillations are very easy to ascertain by looking at the horizon and ground checkpoints. I feel that drift rates will be easy to distinguish on an orbital flight when there is time to concentrate on specific points outside the window.

(4) Sounds of pyrotechnics, control nozzles, and control solenoids are one of the pilot's best cues as to what is going on in the spacecraft and in the sequencing. The sounds of posigrades, retrorockets, and mortar firing are so prominent that these become the primary cues that the event has occurred. The spacecraft telelight panel becomes of secondary importance and merely confirms that a sequence has happened on time. The sequence panel's main value is telling the pilot when an event should have occurred and has not.

(5) Vibrations throughout the flight were of a low order and were not disturbing. The buffeting at maximum dynamic pressure and a Mach number of 1 on launch was mild and did not interfere with pilot functions. Communications and vision were satisfactory throughout this period. The mild buffeting on re-entry does not interfere with any pilot functions.

(6) Communications throughout the flight were satisfactory. Contact was maintained with some facility at all times. There was never any requirement to repeat a transmission.

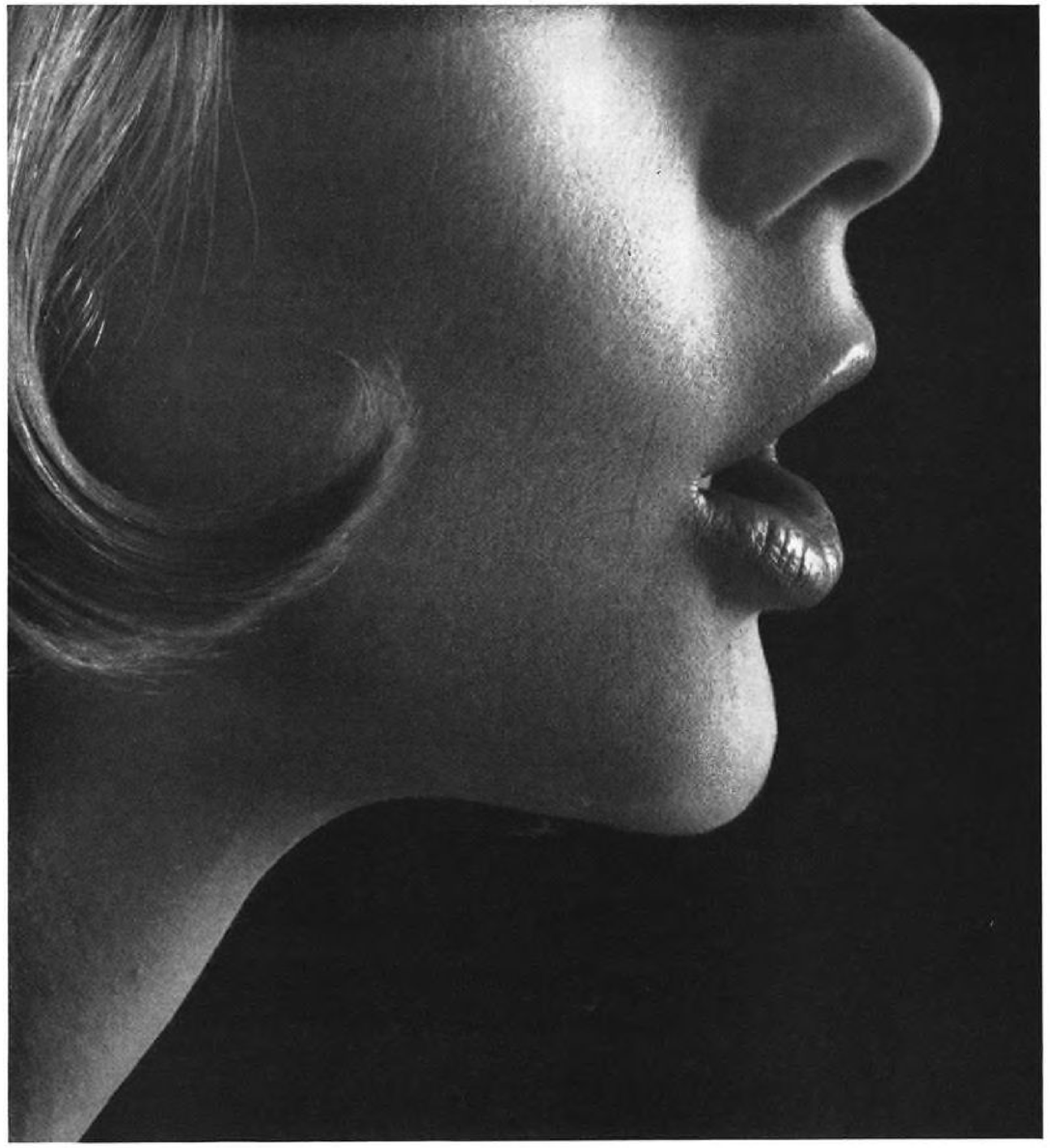
(7) During the flight, all spacecraft systems appeared to function properly. There was no requirement to override any system. Every event occurred on time and as planned.


Reference

1. Slayton, Donald K.: Pilot Training and Preflight Preparation. Proc. Conf. on Results of the First U. S. Manned Suborbital Space Flight, NASA, Nat. Inst. Health, and Nat. Acad. Sci., June 6, 1961, P. 53-60.







# This is a new warning system designed by Northrop

Northrop has developed an automatic voice warning system for aircraft crews which gets action 4 times as fast as the traditional red lights. Called VIPS for Voice Interruption Priority System, it uses a female voice, speaking directly over the pilot's headset, to describe the exact nature of the hazard.

In recent tests, proficient pilots reacted to warning lights in an average of 12 seconds and some lights went unnoticed up to half an hour. With VIPS, the average time was just 3 seconds, *and no warnings went unnoticed.*

With VIPS, the pilot doesn't have to watch for warnings, nor figure out what they mean. The voice can be programmed to suggest remedial action. If several things go wrong at once, a logic network will select the most important and interrupt any lower priority warning.

VIPS was conceived, designed and developed to its present high degree of versatility by the Nortronics Division of Northrop. VIPS will be installed in all Air Force/General Dynamics B-58 Hustlers.

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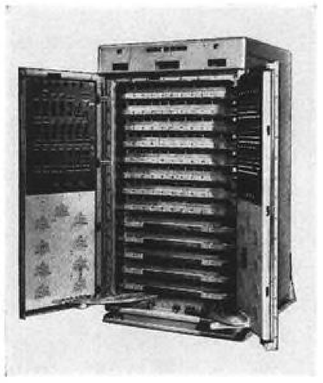
# Keeping a firm grip on the system

NTDS (Naval Tactical Data System) is the Navy's new tactical defense system in which UNIVAC® was a major contributor. Specifically, UNIVAC designed the System and also designed, developed, and produced the computers and related peripheral equipments. It finds approaching targets, calculates their course and speed, evaluates other tactical information, and recommends courses of action . . . all in practically "zero" time so that effective defensive measures can be taken. It ties an entire task force together in a vast network of instant data processing communications . . . lets the task force commander control his tremendous firepower as if it were all on one ship.

NTDS represents two major advances. Its computer is the first military real time computer . . . AN/USQ-20 (UNIVAC 1206 Military Real Time Computer). It completes complex calculations so rapidly that time lapse has to be measured in millionths of a second. In addition, the UNIVAC 1206 and all NTDS hardware is built to military environmental specifications (MIL-E-16400) so as to operate with a high degree of reliability under the most adverse shipboard conditions.

Much of the success of NTDS is the result of the comprehensive systems management program developed by UNIVAC. This program coordinates all phases of research, design and development, and manufacturing . . . and includes a parallel program of reliability engineering to assure operational reliability, beginning with the first delivery, that meets or exceeds all specifications.

The Univac 1206 (AN/USQ-20) Military Real Time Computer —a stored program computer that emphasizes random-access memory and ease of communication with a wide variety of peripheral equipment. It is *ruggedized* and thus makes possible many new shipboard, airborne, and mobile applications.



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# Grissom Flight Communications Reported

**The following is a verbatim transcript of the communications between Astronaut Virgil I. Grissom and the ground during his flight in the Mercury-Redstone 4. Stony is the astronaut communicator in the blockhouse. Bell 7 is the capsule (Liberty Bell 7). Cap Com is the astronaut communicator in the Mercury Control Center. Chase is an astronaut in an F-106 chase plane. ATS stands for Atlantic Ocean Ship, a Mercury range ship positioned close to the landing area. Hunt Club is the designation for the recovery helicopters, and Card File is a radio relay aircraft which relayed capsule communications to the Mercury Control Center.**

| Communicator | Time, min; sec. | Communication |
|---|---|---|
| Stony | 0:01 | Liftoff. |
| Bell 7 | 0:03 | Ah, Roger. This is Liberty Bell 7. The clock is operating. |
| Cap Com | 0:08 | Loud and clear, Jose, don't cry too much. |
| Bell 7 | 0:11 | Okedoke. |
| | 0:18 | OK, it's a nice ride up to now. |
| Cap Com | 0:20 | Loud and clear. |
| Bell 7 | 0:21.5 | Roger. |
| | 0:28 | OK. The fuel is go; about 1½gs; cabin pressure is just coming off the peg; the $O_2$ is go; we have 26 amps. |
| Cap Com | 0:36.5 | Roger. Pitch 88 (deg.), the trajectory is good. |
| Bell 7 | 0:39 | Roger, looks good here. |
| (1) | 0:54 | OK, there. We're starting to pick up a little bit of the noise and vibration; not bad, though, at all. 50 secs., more vibration. |
| Bell 7 | 1:01.5 | OK. The fuel is go; 1½gs; cabin is 8 [psi]; The $O_2$ is go; 27 amps. |
| | 1:08.5 | And [rest of communication not received] |
| Cap Com | 1:09 | Pitch is [rest of communication not received.] |
| Bell 7 | 1:10 | 4 [g], 5 [g] [Rest of communication not received.] |
| Cap Com | 1:11 | Pitch is 77 [deg.]; traiectory is go. |
| Bell 7 | 1:13 | Roger. Cabin pressure is still about 6 [psi] and dropping slightly. Looks like she's going to hold about 5.5 [psi]. |
| Bell 7 | 1:23 | Eh [Rest of communication not received.] |
| Cap Com | 1:23.5 | Cabin [Rest of communication not received.] |
| Bell 7 | 1:24 | Believe me, $O_2$ is go. |
| Cap Com | 1:26 | Cabin pressure holding 5.5 [psi.] |
| Bell 7 | 1:29 | Roger, Roger. |
| | 1:31 | This is Liberty Bell 7. Fuel is go; 2½gs; cabin pressure 5.5; $O_2$ is Go; main [bus] 25 [volts], isolated—ah, isolated [Bus] is 28 [volts]. We are go. |
| Cap Com | 1:46.5 | Roger. Pitch is 62 [deg].; Trajectory is go. |
| Bell 7 | 1:49.5 | Roger. It looks good in here. |
| | 1:56 | Everything is good; cabin pressure is holding; suit pressure is OK; 2 min. and we got 4gs; fuel is go; ah, feel the hand controller move just a hair there; cabin pressure is holding, $O_2$ is go; 25 amps. |
| Cap Com | 2:15 | Roger, we have go here. |
| Bell 7 | 2:16.5 | And I see a star! |
| Cap Com | 2:17 | Stand by for cutoff. |
| Bell 7 | 2:23 | There went the tower. |
| Chase 1 | 2:24.5 | Roger, there went the tower, affirmative Chase. |
| Bell 7 | 2:26 | Roger, squibs are off. |
| Cap Com | 2:31.5 | Roger. |
| Bell 7 | 2:33 | There went posigrades, capsule has separated. We are at zero g and turning around and the sun is really bright. |
| Cap Com | 2:42.5 | Roger, cap. sep. [capsule separation light] is green; turnaround has started, manual handle out. |
| Bell 7 | 2:47 | Oh boy! Manual handle is out; the sky is very black; the capsule is coming around into orbit attitude; the roll is a little bit slow. |
| Cap Com | 3:01 | Roger. |
| Bell 7 | 3:02 | I haven't seen a booster anyplace. OK, rate command is coming on. I'm in orbit attitude, I'm pitching up. OK, 40 (Rest of communication not received.) Wait, I've lost some roll here someplace. |
| Cap Com | 3:10.5 | Roger, rate command is coming on. You're trying manual pitch. |
| Bell 7 | 3:15.5 | OK, I got roll back. OK, I'm at 24 [deg.] in pitch. |
| Cap Com | 3:20.5 | Roger, your IP [impact point] is right on, Gus, right on. |
| Bell 7 | 3:24.5 | OK. I'm having a little trouble with rate, ah, with the manual control. |
| Cap Com | 3:28 | Roger. |
| Bell 7 | 3:31 | If I can get her stabilized here, all axes are working all right. |
| Cap Com | 3:36 | Roger. Understand manual control is good. |
| Bell 7 | 3:40.5 | Roger, it's—it's sort of sluggish, more than I expected. |
| Bell 7 | 3:45 | OK, I'm yawing. |
| Cap Com | 3:47.5 | Roger, yaw. |
| Bell 7 | 3:50 | Left, ah. |
| Bell 7 | 3:51.5 | OK, coming back in yaw. I'm a little bit late there. |
| Cap Com | 3:57.5 | Roger, Reading you loud and clear, Gus. |
| Bell 7 | 3:59.5 | Lot of stuff—there's a lot of stuff floating around up here. |
| Bell 7 | 4:02 | OK, I'm going to skip the yaw [maneuver], ah, or [rather the] roll [maneuver] because I'm a little bit late and I'm going to try this rough yaw maneuver. About all I can really see is clouds. haven't seen any land anyplace yet. |
| Cap Com | 4:15 | Roger, you're on the window. Are you trying a yaw maneuver? |
| Bell 7 | 4:18.5 | I'm trying the yaw maneuver and I'm on the window. I'ts such a fascinating view out the window you just can't help but look out that way. |
| Cap Com | 4:25 | I understand. |
| Bell 7 | 4:29.5 | You su, ah, really. There I see the coast, I see. |
| Cap Com | 4:30.5 | 4 plus 30 [elapsed time since launch] Gus. |
| (1) | 4:33 | 4 Plus 30 [elapsed time since launch] he's looking out the window. A-OK. |
| Bell 7 | 4:37.5 | I can see the coast but I can't identify anything. |
| Cap Com | 4:42 | Roger, 4 plus 30 [elapsed time since launch] Gus. |
| Bell 7 | 4:44 | OK, let me get back here to retro attitude, retro sequence has started. |
| Cap Com | 4:48 | Roger, retro sequence has started. Go to retro attitude. |
| Bell 7 | 4:52 | Right, we'll see if I'm in bad, not in very good shape here. |
| Cap Com | 4:57 | Got 15 seconds, plenty of time, I'll give you a mark at 5:10 [elapsed time since launch]. |
| Bell 7 | 5:01.5 | OK, retro attitude [light] is still green. |
| Cap Com | 5:05 | Retros on my mark, 3, 2, 1, mark. |
| (1) | | He's in limits. [Falls in the middle of the last Cap Com communication.] |
| Bell 7 | 5:11.5 | OK, there's 1 firing, there's 1 firing. |
| (1) | 5:12 | Retro 1. (Cuts out Bell 7.) |
| Cap Com | 5:13.5 | Roger, retro 1. |
| Bell 7 | 5:19 | There's 2 firing, nice little boost. There went 3. |
| Cap Com | 5:21 | Roger, 3, all retros are fired. |
| Bell 7 | 5:23.5 | Roger, Roger. |
| Bell 7 | 5:25.5 | OK, yeh, they're fired out right there. |
| Cap Com | 5:29 | Roger, retrojettison armed. |
| Bell 7 | 5:33.5 | Retrojettison is armed, retrojettison is armed, going to rate command. |
| Bell 7 | 5:36 | OK, I'm going to switch. |
| Cap Com | 5:38 | Roger. Understand manual fuel handle is in. |
| Bell 7 | 5:41 | Manual fuel handle is in, mark, going to HF. |
| Cap Com | 5:44.5 | Roger, HF. |
| | 5:52 | Liberty Bell 7, this is Cap Com on HF, 1, 2, 3, 4, 5. How do you read [Bell] 7? |
| (1) | | I got you. |
| Cap Com | 6:05 | This is Cap Com on HF, 1, 2, 3, 4, 5. How do you read [Bell] 7? |
| Bell 7 | 6:08 | . . . here, do you read me, do you read me on HF? . . . going back to U [UHF] . . . [received by ATS ship]. Boy is that . . . Retro, I'm back on UHF and, ah, and the jett—the retros have jettisoned. Now I can see the Cape and, oh boy, that's some sight. I can't see too much. |
| Bell 7 | 6:34 | Roger, I am on UHF high, do you read me? |
| Cap Com | 6:38 | Roger, reading you loud and clear UHF high, can you confirm retrojettison? |
| Bell 7 | 6:41 | OK, periscope is retracting, going to re-entry attitude. |
| Cap Com | 6:47 | Roger. Retros have jettisoned, scope has retracted, you're going to re-entry attitude. |
| Bell 7 | 6:51.5 | Affirmative. |
| Cap Com | 6:56.5 | Bell 7 from Cap Com your IP [impact point] is right on. |
| Bell 7 | 7:00.5 | Roger. I'm in re-entry attitude. |
| Bell 7 | 7:05.5 | Ah. |
| Cap Com | 7:07 | Roger, how does it look out the window now? |
| Bell 7 | 7:09.5 | Ah, the sun is coming in and so all I can see really is just, ah, just darkness, the sky is very black. |
| Cap Com | 7:14.5 | Roger, You have some more time to look if you like. |
| Cap Com | 7:27 | [Bell] 7 from Cap Com, how do you feel up there? |
| Bell 7 | 7:30 | I feel very good, auto fuel is 90 [%], manual is 50 [%]. |
| Cap Com | 7:33.5 | Roger, 0.05g in 10 [sec.]. |
| Bell 7 | 7:37 | OK. |
| Bell 7 | 7:50.5 | OK, everything is very good, ah. |
| Bell 7 | 7:54 | I got 0.05g [light] and roll rate has started. |
| Cap Com | 7:57 | Roger. |
| Bell 7 | 8:03.5 | Got a pitch rate in here, OK, g's are starting to build. |
| Cap Com | 8:09 | Roger, reading you loud and clear. |
| Bell 7 | 8:11 | Roger, g's are building, we're up to 6 [g]. |
| Bell 7 | 8:17 | There's 9 [g]. |
| Bell 7 | 8:19 | There's about 10 [g]; the handle is out from under it; here I got a little pitch rate coming back down through [g]. |
| Cap Com | 8:32 | Roger, still sound good. |
| Bell 7 | 8:34.5 | OK, the altimeter is active at 65 [thousand ft.]. There's 60 [thousand ft.] |
| Cap Com | 8:38.5 | Roger, 65,000. |
| Bell 7 | 8:42 | OK, I'm getting some contrails, evidently shock wave, 50,000 ft.; I'm feeling good. I'm very good, everything is fine. |
| Cap Com | 8:49.5 | Roger 50,000. |
| Bell 7 | 8:52 | 45,000, do you still read? |
| Cap Com | 8:54 | Affirmative, still reading you. You sound good. |
| Bell 7 | 9:00.5 | OK 40,000 ft., do you read? |
| Bell 7 | 9:07 | 35,000 ft., if you read me. |
| Bell 7 | 9:19 | 30,000 ft., everything is good, everything is good. |
| Cap Com | 9:24 | Bell 7, this is Cap Com. How . . . [Rest of communication not received.] |
| (1) | | Cap do you read? |
| Bell 7 | 9:28 | 25,000 ft. |
| Bell 7 | 9:36.5 | Approaching drogue chute attitude. |
| Bell 7 | 9:41.5 | There's the drogue chute. The periscope has extended. |
| Cap Com | 9:45 | This is . . . we have a green drogue [light] here, 7 how do you read? |
| Bell 7 | 9:49.5 | OK, we're coming down to 15,000 ft., if anyone reads. We're on emergency flow rate, can see out the periscope OK. The drogue chute is good. |
| Cap Com | | Roger, understand drogue is good, the periscope is out. |
| Bell 7 | 10:05.5 | There's 13,000 ft. |
| Cap Com | | Roger. |
| Bell 7 | 10:14 | There goes the main chute; it's reefed; main chute is good; main chute is good; rate of descent coming down, coming down to—there's 40 ft. per sec. 30 ft. per, 32 ft. per sec. on the main chute and the landing bag is out green. |
| (1) | | Ah, it's better than it was, Chuck. |
| Bell 7 | 10:40.5 | Hello, does anybody read Liberty Bell, main chute is good, landing bag [light] is on green. |
| Cap Com | | And the landing bag [light] is on green. |
| ATS | | Liberty Bell 7, Liberty Bell 7, this is Atlantic Ship Cap Com. Read you loud and clear. Our telemetry confirms your events. Over, Ah, Roger, is anyone reading Liberty Bell 7? Over. |
| Card File 23 | | Roger, Liberty Bell 7, reading you loud and clear. This is Card File 23. Over. |
| Bell 7 | 10:52 | Atlantic Ship Cap Com, this is Liberty Bell 7, how do you read me? Over. |
| ATS | | Read you loud and clear, loud and clear. Over. Liberty Bell 7. |
| | | Liberty Bell 7, this is Atlantic Ship Cap Com. How do you read me? Over. |
| Bell 7 | 11:12 | Atlantic Ship Cap Com, This is Liberty Bell 7, I read you loud and clear. How, me? Over. |
| ATS | | Roger, Bell 7, Read you loud and clear, your status looks good, your systems look good, we confirm your events. Over. |
| Bell 7 | 11:28 | Ah, Roger, and confirm the fuel has dumped. Over. |

(1) Communicator unidentified.

| | | |
|---|---|---|
| ATS | | Roger, confirm again, confirm again, has your auto fuel dumped? Over. |
| Bell 7 | 11:42.5 | Auto fuel and manual fuel has dumped. |
| ATS | | Roger, Roger. |
| Bell 7 | 11:47.5 | And I'm in the process of putting the pins back in the door at this time. |
| Bell 7 | 12:04 | OK, I'm passing down through 6,000 ft., everything is good, Ah. |
| Bell 7 | 12:15 | I'm going to open my face plate. |
| Bell 7 | 12:35 | Hello, I can't get one; I can't get one door pin back in. I've tried and tried and I can't get it back in. And I'm coming, ATS, I'm passing through 5,000 ft. and I don't think I have one of the door pins in. |
| ATS | | Roger, Bell 7, Roger. |
| Bell 7 | 13:04 | Do you have any word from the recovery troops? |
| Card File 23 | | Liberty Bell 7, this is Card File 23; we are heading directly toward you. |
| Bell 7 | 13:18 | ATS, this is Cap— this is Liberty Bell 7. Do you have any word from the recovery troops? |
| ATS | | Negative, Bell 7, negative. Do you have any transmission to MCC (Mercury Control Center)? Over. |
| Bell 7 | 13:33 | Ah, Roger, you might make a note that there is one small hole in my chute. It looks like it's about 6 inches by 6 inches — It's a sort of a—actually it's a triangular rip, I guess. |
| ATS | | Ah, Roger, Roger. |
| Bell 7 | 13:49 | I'm passing through 3,000 feet, and all the fuses are in flight conditions; ASCS is normal, auto; we're on rate command; gyros are normal; auto retrojettison is armed; squibs are armed also. Four fuel handles are in; decompress and recompress are in; retro delay is normal; retroheat is off, cabin lights are both. TM [telemeter] is on. Rescue aids is auto; landing bag is auto; retract scope is auto; retroattitude is auto. All the three, five pull rings are in. Going down through some clouds to 2,000 feet. ATS, I'm at 2,000 feet; everything is normal. |
| ATS | | Roger, Bell 7, what is your rate of descent again? Over. |
| Bell 7 | 14:39 | The rate of descent is varying between 28 and 30 feet per second. |
| ATS | | Ah, Roger, Roger, and once again verify your fuel has dumped. Over. |
| (1) | | Seven ahead at bearing 020. Over. |
| Bell 7 | 14:54 | OK. My max G was about 10.2; altimeter is 1,000 [feet]; cabin pressure is coming toward 15 [psi.]. |
| (1) | | We'll make up. |
| Bell 7 | | Temperature is 90 [deg. F]. |
| (1) | | We'll make up an eye rep. |
| Bell 7 | | Coolant quantity is 30 [%]; temperature is 68 [deg. F]; pressure is 14 [psi.]; main 0; is 60 [%]; normal is, main is 60 [%]; emergency is 100 [%]; suit fan is normal; cabin fan is normal. We have 21 amps, and I'm getting ready for impact here. |
| Bell 7 | | Can see the water coming right on up. |
| ATS | | Liberty Bell 7, Liberty Bell 7, this is Atlantic Cap Com, do you read me? Over. |
| Bell 7 | | OK, does anyone read Liberty Bell 7? Over. |
| Hunt Club 1 | | Liberty Bell 7, Hunt Club 1 is now 2 miles southwest you. |
| Card File 9 | | Liberty Bell 7 this 9 Card File. We have your entry into the water. Will be over you in just about 30 seconds. |
| Bell 7 | 16:35 | Roger, my condition is good; OK the capsule is floating, slowly coming vertical, have actuated the rescue aids. The reserve chute has jettisoned, in fact I can see it in the water, and the whip antenna should be up. |
| (1) | | Hunt Club, did you copy? |
| (1) | | OK, Hunt Club, this is . . . Don't forget the antenna. |
| Hunt Club 1 | | This is Hunt Club, say again. |
| Bell 7 | 18.07 | Hunt Club, this is Liberty Bell 7. My antenna should be up. |
| Hunt Club 1 | | This is Hunt Club 1 . . . Your antenna is erected. |
| Bell 7 | 18:16 | Ah, Roger. |
| Bell 7 | 18:23 | OK, give me how much longer it'll be before you get here. |
| Hunt Club 1 | | This is Hunt Club 1, we are in orbit now at this time, around the capsule. |
| Bell 7 | 18:32.5 | Roger, give me about another 5 minutes here, to mark these switch positions here, before I give you a call to come in and hook on. Are you ready to come in and hook on anytime? |
| Hunt Club 1 | | Hunt Club 1, Roger we are ready anytime you are. |
| Bell 7 | 18:44 | OK, give me about another 3 or 4 minutes here to take these switch positions, then I'll be ready for you. |
| Hunt Club 1 | | 1, wilco. |
| Card File 9 | | Hey Hunt Clubs, Card File, Card File 9, I'll stand by to escort you back as soon as you lift out. I keep other aircraft at at least 2,000 feet. |
| Hunt Club 1 | | Ah, Bell 7 this is Hunt Club 1. |
| Bell 7 | 20:15 | Go, go ahead Hunt Club 1. |
| Hunt Club 1 | | Roger, this is 1, observe something, possible the canister in the water along side capsule. Will we be interfering with any TM [telemetry] if we come down and take a look at it? |
| Bell 7 | 20:26 | Negative, not at all, I'm just going to put the rest of this stuff on tape and then I'll be ready for you, in just about 2 more minutes, I would say. |
| Hunt Club 1 | | 1 Roger. |
| Cap Com | | Liberty Bell 7, Cap Com at the Cape on a test count. Over. |
| Cap Com | | Liberty Bell 7, Cape Cap Com on a test count. Over. |
| Card File 9 | | Any Hunt Club, this is 9 Card File. |
| Hunt Club 1 | | Station calling Hunt Club, say again. |
| Card File 9 | 24:03 | This is Niner Cardfile, there's an object on a line in the water, Ah, just about about 160 degrees. The NASA people suspect it's the dye marker that didn't activate; Ah, say it's about, Ah, ¾ of a mile out from the capsule. Ah, after the lift out, will you take a check on it? Over. |
| Hunt Club 1 | | Ah, this is Hunt Club 1, Roger, will have Hunt Club 3 check at this time, you copy 3. |
| Hunt Club 3 | | Hunt Club1, believe he said ¾ of a mile? |
| Card File 9 | | This is 9 Card, That is affirmative. |
| Bell 7 | 25:19:5 | OK, Hunt Club. This is Liberty Bell 7, Are you ready for the pickup? |
| Hunt Club 1 | | This is Hunt Club 1; this is affirmative. |
| Bell 7 | 25:30 | OK, latch on, then give me a call and I'll power down and blow the hatch, OK? |
| Hunt Club 1 | | This is Hunt Club 1, Roger, will give you a call when we're ready for you to blow. |
| Bell 7 | 25:42 | Roger, I've unplugged my suit so I'm kinda warm now so. |
| Hunt Club 1 | | 1, Roger. |
| Bell 7 | 25:52.5 | Now if you tell me to, Ah, you're ready for me to blow, I'll have to take my helmet off, power down, and then blow the hatch. |
| Hunt Club 1 | | 1, Roger, and when you blow the hatch, the collar will already be down there waiting for you, and we're turning base at this time. |
| Bell 7 | 26:09 | Ah, Roger. |

No further communications were received as a result of the emergency egress required by the failure of the side hatch.

Reference —1. Slayton, Donald K.: Pilot Training and Preflight preparation. Proc. Conf. on Results of the First U.S. Manned Suborbital Space Flight, NASA, Nat. Inst. Health, and Nat. Acad. Sci., June 6, 1961, P. 53-60.





# Civil Helicopter Fleet Shows Expansion

By Erwin J. Bulban

Dallas, Tex.—Indications that the civil helicopter industry—both manufacturing and operations—is developing to sizable proportions and is heading toward a markedly accelerated growth during the next few years were strongly evident here at the Helicopter Assn. of America's annual convention.

It was just as evident that this fast growth of helicopters is accenting the need by industry and federal and municipal governments to revise some old concepts of air transportation to make possible continued development of vertical lift operations.

In the brief period of April, 1960, through January, 1962, the number of commercial helicopter operators on the North American continent has swelled from 193 to 325 and their fleet has developed from 705 aircraft to approximately 1,000.

## Executive Use

Similarly, the number of individuals and companies operating helicopters for executive use have increased from 94 in 1960 to approximately 150 currently and this fleet has grown from 94 machines to about 150. Another guideline that points up the increased acceptance of the helicopter is the increase in the number of helicopter flight schools in this short period—from 50 to approximately 85.

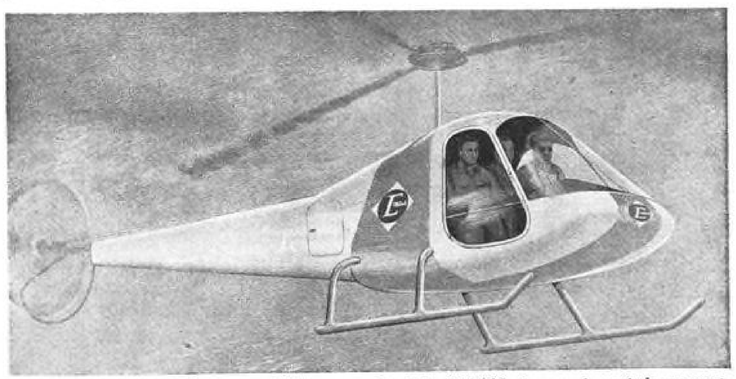
This growth is expected to be spurred at a faster rate than before because of the entry of new manufacturers in the field and the development of the lighter, lower-cost vertical-lift machines aimed at capturing a market that has been interested in this type of transportation but has previously hesitated because of relatively high initial costs.

Whether the ambitious production programs of these companies actually can be sustained by demand is something some conservative industry members question—but there is little doubt that helicopter production will show sharp increase in the next few years.

Hughes Tool Co. Aircraft Division representatives here discussed output of the $22,500 Model 269-A two-placer in terms of one-per-day in March with expectations that this would rise to two-daily by the end of this year. Brantly Helicopter Corp. pointed out that its facilities have been revised to handle a one-per-day output and Cessna indicated that its current production schedule of two Skyhooks monthly is

**PROTOTYPE BELL 204B** civil version of the HU-1B Iroquois gave flight demonstration from temporary heliport established near motel housing the Helicopter Assn. meeting in Dallas. FAA type certification is expected in just over a year from now, according to Bell officials. Company is studying use of a taxi-wheel gear for the 204B that probably would be located just ahead of the aircraft's center of gravity.

**QUICK ATTACH FLOATS** that are simply fitted to skid landing gear are a new equipment option on Hiller's E-4 and will be available for other models in Hiller's line. Landing skids protrude slightly beneath floats to enable safe running landings on terrain as well as water.



**ENTROM F-28** three placer, to sell for approximately $25,000, is seen in artist's concept. Flight tests of production prototypes are expected to begin this March. Testbed configuration has been flying since 1959.

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being doubled starting sometime in July.

The Hiller commercial helicopter representative noted that commercial sales for the first three weeks of 1962 have already topped the total sales for the first quarter of last year and the company expects to have "a very active commercial sales year" in 1962.

First details were also given on a new entity in the field by R. J. Enstrøm Corp., Menominee, Mich. Company is currently completing two production prototypes of the F-28 three-placer aimed to sell in the $25,000 price bracket. Initial flight tests are expected to start in March. Federal Aviation Agency type certification is targeted for the end of the year with initial deliveries made in mid-1963.

Initial specifications of the F-28 disclose that it will be powered by a 180-hp. Lycoming O-360, will have an empty weight of 1,200 lb., a gross weight of 1,950 lb., with allowances of 510 lb. for pilot and two passengers and 75 lb. of baggage. Cruise speed at 75% power is estimated at 90 mph., best climb rate at 1,125 fpm. and endurance at 3.85 hr.

Performance figures are based on 35 gal. of fuel. Main rotor will have three metal blades and be of 32 ft. diameter. The F-28's over-all length will be 29 ft. 5 in. and over-all height 9 ft. 1 in. Cabin interior width will be 64 in.

Design feature of this machine will be a rigid-in-plane main rotor configuration, eliminating lag hinges and dampers. Elastomeric bearings are planned for blade retention system. Main rotor transmission system will utilize a belt drive.

### New Hiller Model

Hiller also is planning a new model, the L-4, which it expects to have certificated this year and begin deliveries in 1963. Featuring a 305-hp. supercharged Lycoming VO-540, the L-4 will have a 3,100-lb. gross weight, wider-chord rotor blades than the current E-4 and will have available Hamilton Standard autostabilization equipment, which can possibly be tied to a light autopilot.

Discussions of the future of the large crane-type vertical-lift aircraft centered around the problem of their high costs. Sikorsky assistant sales manager, E. E. Gustafson, indicated that expenditure of $2 million to $4 million probably would be required to own even a minimum fleet, including a requisite standby aircraft and spares.

He also indicated that this type of commercial operation possibly would be contingent upon formation of a combine by operators to specifically handle this type of equipment as one way of financing the operation and deriving maximum utilization.

One of the biggest users of the helicopter on a contract basis, the U.S. Forestry Department, sees a constant upcurve in its demands for such service. Forestry utilization of helicopters totaled 14,000 hr. last year, compared with 9,000 the year before and approximately 6,000 hr. in 1959. On the basis of contract payments of $120 per flight hour for this equipment, it is evident that this is a major market for utility helicopter operators.

Monte K. Pierce, aviation director, U. S. Forest Service, noted that the agency is planning to evaluate the use of helicopters in logging operations in the Pacific Northwest as a means of taking out prime timber, obviating need for costly and time-consuming surface methods. Also, the service is considering purchase of light helicopters for use by forest rangers to replace ground vehicles.

### Evaluations Planned

Indications are that although the equipment would be planned for one-man use, the service does not see a need for a specialized design for this purpose but is contemplating operation of current two-and-three-man types and will put several of the small current models through evaluation this year. A potential of about 400 light helicopters was indicated for this mission.

Most heated debates centered around problems of insurance and federal and municipal regulation problems faced by the operators.

Insurance costs have replaced maintenance as the big burden of the helicopter operators, Helicopter Assn. President Hal Connors, who is also general manager of Butler Aviation's Helicopter Air Lift Division, Chicago, noted. He called for improved liaison between the association and the underwriters to develop better appreciation of the industry as a means of reducing high costs of hull coverage. Such liaison would attempt to develop higher standards of maintenance and flight operations, pilot proficiencies and claims settlements.

Several operators pointed out that they considered that hull insurance rates of up to 20% and 25% obliged them to drop this type of coverage as soon as they could. There were also complaints that the brokers and underwriters appeared to take little interest in the smaller operator's installations in that they rarely visited the operation and seemed to have little or no grasp of the management and technical aspects of rotary wing operations.

It was even pointed out that this lack of experience on the part of the insurance companies often resulted in overclaims on damage and in some instances, machines that were considered

## U.S. Business & Utility Plane Shipments

November, 1961

| Make & Model | No. of Units | Factory Billings |
|---|---|---|
| Aero Commander 500A, B | 4 | |
| 560F | 1 | $431,000 |
| 680F | 1 | |
| Beech G18S | 2 | |
| 33 Debonair | 23 | |
| 35 Bonanza | 38 | |
| 50 Twin-Bonanza | 1 | $3,376,000 |
| 55 Baron | 17 | |
| 65 Queen Air | 6 | |
| 95 Travel Air | 2 | |
| Cessna 150 | 28 | |
| 172, Skyhawk | 87 | |
| 175, Skylark | 19 | |
| 180 | 9 | $3,604 000 |
| 182, Skylane | 7 | |
| 185 Skywagon | 21 | |
| 310 | 1 | |
| 320 Skyknight | 16 | |
| Champion 7EC Traveler | 2 | |
| 7FC Tri-Traveler | 2 | $40,000 |
| 7GCB Challenger | 1 | |
| 7HC DX'er | 2 | |
| Mooney Mark 21 | 20 | $368,000 |
| Piper PA-18-150 Super Cub | 12 | |
| PA-22-108 Colt | 44 | |
| PA-22-150 Caribbean | 1 | |
| PA-23-160 Apache | 9 | |
| PA-23-250 Aztec | 3 | $2,199,000 |
| PA-24-180 Comanche | 10 | |
| PA-24-250 Comanche | 37 | |
| PA-25-150 Pawnee | 6 | |
| PA-28-150 Cherokee | 8 | |
| PA-28-160 Cherokee | 53 | |
| Totals | 493 | $10,018,000 |

Note: Deliveries January through November totaled 6,211 aircraft having a factory billing value of $115,295,000; the same period last year saw 6,792 aircraft delivered with a total factory billing value of $136,118,000. November, 1961 shipments are down 85 units and some $2,448,000 in total factory billings compared with November, 1960, with the decline generally most noticeable in the more profitable lines comprising the heavy single-engine and light-twin airplanes.

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as having suffered major or total loss have been rebuilt and put back into operation. The operators considered that such practices were a factor in keeping rates high, and several suggested that perhaps the underwriters utilize the services of helicopter maintenance chiefs or other skilled maintenance personnel from their organization to assess damage claims.

Indications are that the manufacturers are well aware that the high costs of rotary wing insurance are posing a major block to sales and several companies are working with insurance companies to develop specific plans that are aimed at bringing these costs down.

Brantly Helicopter Corp. has developed a plan with a Midwest underwriter, which includes some form of subsidy by the manufacturer in that the company furnishes replacement parts or helicopters to the insurance company on a reduced-price basis. In turn, the underwriter is providing hull coverage at rates averaging approximately 11.75%. But even with this program, the insurance company's representative indicated that is only covering about 4% of the hulls made.

### Sales Tool

Bell Helicopters also has developed a plan with a West Coast insurance firm, which it hopes will provide the manufacturer with a sales tool in selling new equipment, particularly to small fleet operators. Program involves no subsidy-type arrangement, instead is geared to the idea that close liaison between the insurance firm and manufacturer in monitoring the program will tend to upgrade standards of the users and thus tend to keep rates down. Indications are that the program provides hull coverage at a premium averaging 14%, and the plan permits the operator to insure full or partial values of the equipment.

Agricultural and student training operations are excluded from the normal rate structure of the policies and pilot requirements include a minimum of 1,000 flight hours, although if the pilot's record is considered satisfactory and he has 500 or more rotary wing hours, he may also be covered at the discretion of the underwriter.

Federal Aviation Agency is putting increased emphasis on monitoring helicopter operations and the problem of possible forthcoming regulations was debated in sessions between FAA representatives and users. FAA representatives felt that the experience of the members of the organization should be considered by the Agency by making it possible for them to sit in on developing draft releases of future helicopter regulations. George Prill, director of flight standards service, FAA, indicated that although he would welcome comments and technical assistance from the membership, he didn't believe that it would be possible to have them assist in writing the draft releases or reviewing them for corrections before they are sent out for comment.

Indications are that FAA will insist that helicopter operators working in congested areas develop emergency landing sites wholly under their control and for their specific use, although it probably will not require that they get into the real-estate business by acquiring these sites. As one FAA representative commented—"if the public knew that some of these operations involve use of public parking lots, schoolyards and similar spots as emergency landing sites, they'd be up in arms."

### Safety Records

FAA spokesmen pointed out that safety record of the smaller operators in these areas has been exceptionally good and there was no incident of damage to public property or loss of life due to this type of work. Nonetheless, John Degenkolb, fire chief, Los Angeles Fire Department indicated that he had an extremely difficult time trying to get information relating to safety standards and requirements for heliports and emergency landing sites to use in surveying such locations and indicated that municipalities may be forced to develop restrictive regulations individually unless national standards are developed.

FAA spokesmen pointed out that the operators should get busy selling municipalities on the benefits of helicopter transportation, just as they are aware of the benefits of providing airline terminal facilities.

### Prescribed Routes

FAA Administrator N. E. Halaby told the attending operators that although some of them had requested that the Agency establish prescribed routes and altitudes in congested area operations, FAA does not believe that this is practicable except for scheduled air carrier operations. Such prescribed routes would be burdensome to industry, he stated, pointing out that they would have to be established according to minimum performances and would seriously restrict the professional pilot and the average professional operator utilizing higher performance equipment.

Such a system of prescribed routes would also require routes and altitudes to every landing spot in a congested area that could be justified and FAA does not have the responsibility for providing blanket approval to schoolyards, parking lots and similar locations for emergency landing sites.

Halaby noted that the Agency has prepared a draft release regarding carrying of external loads by helicopters or for


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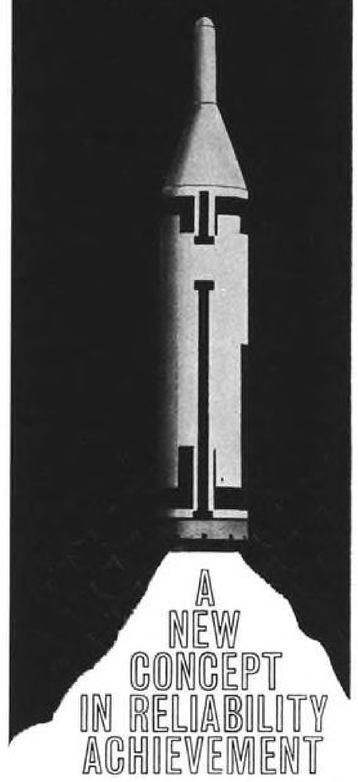

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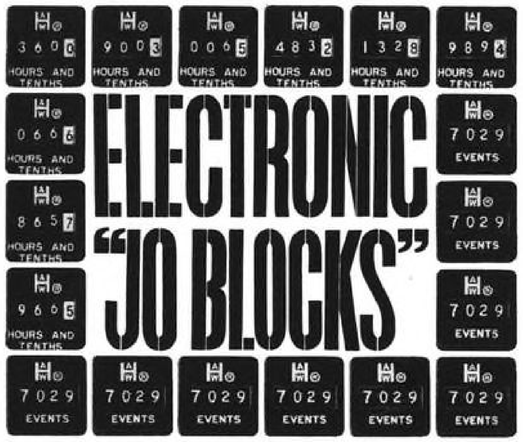


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towing objects on land or water for hire, outlining the specific requirements and operating limitations, the load configuration and weight.

Comments on the proposed regulation are requested from industry on or before Mar. 26.

Applicants for hauling external loads or towing loads would be required to submit data to FAA concerning weights and configurations and demonstrate compliance with specific strength and flight characteristics, also show that the aircraft is safely controllable while carrying these loads. For example, the rotorcraft shall be demonstrated to be capable of safe operation near the ground under normal operating conditions in a 20-mph. wind blowing from any direction.

For each load configuration selected, the applicant would have to demonstrate flight characteristics for a speed range from hovering to a speed 10% greater than the maximum allowable established for such a configuration. Emergency quick release devices readily accessible to the pilot would have to be available. Operation over congested areas with external loads that can be released in flight, or which would fall as a result of any single likely structural failure, would be prohibited without specific authority from the FAA administrator.

## PRIVATE LINES

**Cessna** probably will have flotation gear and cargo/rescue hoist equipment available for its Skyhook helicopter in the next three to five months. An ambulance version of the rotary wing aircraft is planned to handle two patients and an attendant.

**Hiller's Ten99** six-place turbine-powered helicopter (AW Nov. 13, p. 29) would be priced at more than $100,000 in production quantities, company representatives indicate.

**Flight tests** of Continental 217-5A (T72-T-2) 500-shp. turbine have been started in a Republic Lark (Alouette) helicopter at the engine manufacturer's facilities in Detroit. Free flight trials were made after 45 min. of tiedown trials. The powerplant recently completed its 50-hr. flight rating trials. Indications are that specific fuel consumption will be .67 at 500 shp. and .64 at 600-625 shp. Price of the powerplant in production, to airframe manufacturers, is estimated at $18,500.

**Piper Aircraft's 250th Cherokee** was delivered recently to Ed's Airmotive Service, Inc., Renton, Wash. Aircraft was ferried to Renton by Richard Woodin, United Air Lines pilot.



## PRODUCTION BRIEFING

**Pall-Ulster, Ltd.,** Irish subsidiary of Pall Corp., Glen Cove, N. Y., will build and operate a U.S.-owned plant near Belfast to manufacture micronic stainless steel and other types of wire cloth. Micronic cloth is used primarily to make high precision filters for aircraft, missiles, nuclear submarines and many industrial processes.

**Universal Match Corp.'s** Armament Division, St. Louis, Mo., will produce explosive parts for Minuteman stage separation systems under a $120,000 follow-on contract from The Boeing Co.

**Jeppeson & Co.,** Denver subsidiary of the Times-Mirror Co., will publish and update continental United States flight information charts for the Air Force under a two-year contract not to exceed $5 million. Work will begin in April.

**Bell HUL-1M** turbine-powered testbed is being fitted with a 50-hr. flight rated Allison YT-63-A-3 250-shp. engine and is expected to resume test program shortly.

**First Carvair ATL-98** Douglas DC-4 conversion (AW Sept. 4, p. 46) recently received its British Air Registration Board certificate of airworthiness. Airplane currently is being flown to meet U.S. Federal Aviation Agency certification requirements.

**Westinghouse Electric** has formed a new systems department to coordinate and manage large defense system programs which cut across product lines of two or more existing divisions or require management of several major subcontractors. The new department, located at the company's Parker Road plant near Baltimore, will be under J. B. Beggs, who retains his former responsibility for Navy Typhon weapon control system.

**Temco Electronics** will manufacture hydraulic valve assemblies for flight control surfaces on the Dyna-Soar manned space glider under a $600,000 contract from The Boeing Co.

**Ryan Aeronautical Co.,** San Diego, Calif., has received a Navy contract to design and develop a free-fall weapon, designated Rockeye, to be air-launched from carrier-based attack planes for close-in ground troop support. First prototype has been completed and delivered to Naval Ordnance Test Station, China Lake, Calif., which will serve as program technical director.


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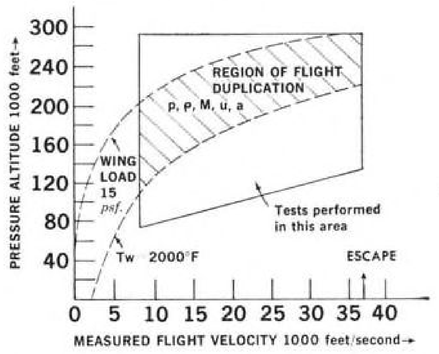


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# Martin Chairman Predicts Modest Growth

By Arnold Sherman

New York—Sales of the merged Martin Marietta Corp. amounted to $1.2 billion last year and George M. Bunker, president and chairman of the board, predicts modest growth in 1962.

"I chose the word modest with care," Bunker said. Although 1961 was Martin's best year and although continued good results for the company can be expected based on increased federal expenditures in the aerospace field, there are too many variables to permit a purely optimistic projection, Bunker said.

### Company Sales

Speaking before a meeting of the New York Society of Security Analysts, Bunker said that of combined company sales the Aerospace Division (formerly Martin Co.) had accounted for $830 million. Chemical Division sales were $140 million and the Construction Materials Division, $250 million. Last year's capital expenditures were $35 million. Earnings totaled $44.5 million or $2 per share of stock outstanding. In 1960, Martin's total sales amounted to $652.5 million and earnings before taxes were fixed at $34,654,540. American Marietta combined net 1960 sales were $368,107,115; earnings for the fiscal year ending November, 1960, were $24,429,000.

The Aerospace Division enters 1962 with a military backlog of approximately $900 million, 90% of which is held under cost-plus-fixed-fee contracts.

Bunker said that cyclic instability of both companies was a major reason for the Martin Co.-American Marietta merger last October.

Elaborating, Bunker said that Martin Co. business was almost completely dependent on government business which in turn is keyed to budgetary considerations. Feast years could easily follow periods of famine. "Martin had no doorway into the rest of industry. We were in a field responsive to limited outlets and with no access to industry."

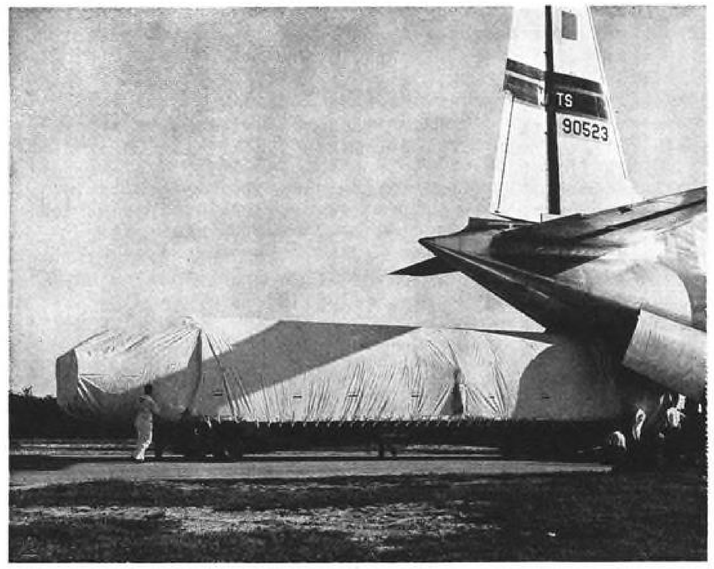
### Problems Cited

On the other hand, American Marietta had some real problems of its own, according to Bunker. The company is a major producer of construction materials, the second largest domestic producer of inks, a fabricator of resins and chemicals. However, since a large amount of its business was predicated on construction, the firm carried peak loads during heavy construction periods and slumped when building activities fell off—particularly during the winter months.

"No technically oriented company can ignore defense and space needs," Bunker said. American Marietta quite naturally wanted a share of the burgeoning defense and aerospace business. It benefited Marietta to join with a company already in the space business and at the same time it was an auspicious merger for Martin because it opened up wider and more stable vistas for that company.

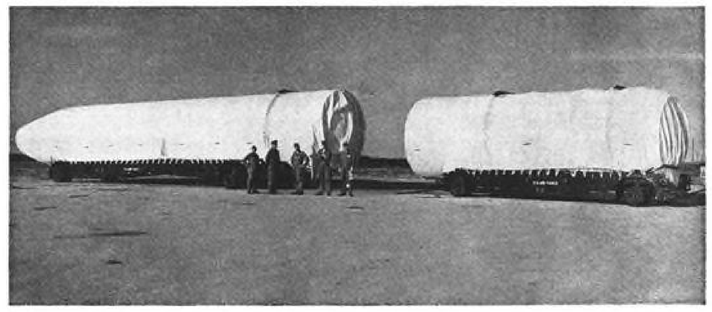
Bunker said that although other companies have tried "piecemeal acquisition" in decentralizing efforts, he didn't believe that method was the best for his company.

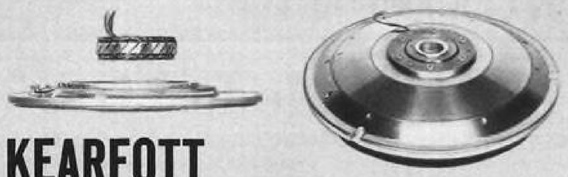
Together, "we hope to make two and two equal more than four—possibly five," Bunker said. However, a major problem both companies faced was the need to integrate two com-




**Titan 2 at Cape Canaveral**

First USAF-Martin Marietta Titan 2 intercontinental missile arrived at Cape Canaveral, Fla., Jan. 27 aboard a USAF-Douglas C-133B and is undergoing ground checkout on Pad 16. Above, the first stage, which uses two Aerojet-General storable liquid fuel engines to produce some 430,000 lb. of thrust, is unloaded from the aircraft at the skip strip on the Cape. Below, the 70-ft. first stage, left, and the 32-ft. second stage, which uses a single Aerojet engine producing some 100,000 lb. of thrust, sit in shrouds on their transporters before being moved to the launch site. Titan 2 is expected to be launched for the first time sometime during the middle of next month.





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**SPECIFICATIONS**

| Typical Part Numbers | Function | Excitation | Accuracy |
|---|---|---|---|
| 3Z6390-001 | Resolver Transmitter | 20v 900 cps | 3 min. |
| CZ06360-002 | Resolver Transmitter | 115v 800 cps | 20 sec. |
| 5Z6360-009 | Resolver | 115v 800 cps | 3 or 5 min. |
| 3Z6210-006 | Synchro | As req'd | 2 min. |
| 1/3Z6360-006 | Resolver | 115v 800 cps | 20 sec. |

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**CHARACTERISTICS**

| Part Number | Maximum Count | Counts Per Rev. | Maximum Speed RPM | Break-Away Torque IN. OZ. |
|---|---|---|---|---|
| C160432-( ) | 179° 59' | 20' | 1200 | .75 |
| C160431-( ) | 179° 59.9' | 2' | 1200 | 1.0 |
| C160435-( ) | 179.9° | 2° | 1200 | .75 |
| C160433-( ) | 99.9 | 2.0° | 1200 | .75 |
| C160434-( ) | 999.9 | 2.0° | 1200 | .75 |
| MK 3 MOD 1 | 359. | 2.0° | 1800 | .35 |
| C160407004 | 359.9 | 2.0° | 1800 | .35 |

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GENERAL PRECISION


panies with totally dissimilar product lines. The effectiveness of the merger, Bunker said, will be dependent upon the reorganization of the company.

As a first step, Martin Marietta was divided into three divisions. The old Marietta company was split into the Construction Materials Division, headed by Dr. H. N. Huntzicker, former executive vice president of American Marietta, the Chemicals Division under Matt J. Leckey, former president of Marietta's Sinclair-Valentine Division. The Aerospace Division is headed by William B. Bergen, former Martin Co. president. While a high degree of local autonomy was given each division, major emphasis was put on establishing a strong corporate identity. In other words, Bunker said, we want to accrue all the benefits of decentralization as well as the obvious advantages of consolidation.

Bunker said that a corporate management group was formed to "exercise close financial and policy control over all activities." In effect, Bunker is tightening management reins.

"A company doesn't grow by stability but by risk taking," he said. In line with this philosophy, Martin Marietta management is seeking other possible acquisitions to broaden the firm's prospects.

### Talent Utilization

Bunker said that he is aming for a high degree of cross fertilization of talent both on the technical and management levels. He said that Marietta has considerable research personnel and laboratory space and that these capabilities can be made to dovetail into the over-all corporate objectives.

Bunker said that the Aerospace Division is now performing broader base electronics business outside the realm of electronic support systems for missiles than ever before. He estimated that electronics business amounted to $20-25 million last year—or about 3% of total aerospace sales last year.

One immediate problem the company faces is a Federal Trade Commission anti-trust suit against Martin Marietta's Construction Materials Division. Commenting on this, Bunker said that any Construction Materials divesture would have no serious effect on the company.

Outlining areas of Aerospace Division interest in the future, Bergen, who was present, listed the following:

- **Project Rift.** Along with Lockheed and General Dynamics, Martin is a contender for National Aeronautics and Space Administration's nuclear-powered rocket stage.
- **Research into the requirements** for the medium-range ballistic missile.
- **Large booster development** in terms of Titan 3 development.

## New Offerings

**Electronic Controls, Inc.,** Stamford, Conn., principally engaged in the design, development and manufacture of automatic electronic and computer controlled drives and systems, helicopter checkout, flight control and landing control systems and multi-contact relays and switches. Offering is 100,000 common shares at $3 per share. Proceeds will be used to repay loans incurred for research and development, tooling and working capital purposes; for sales promotion and advertising; for additional tooling, machinery and test equipment, and for development.

**Vogue Instrument Corp.,** Brooklyn, N. Y., a contract manufacturer of precision metal products and electronic components for the computer, electronic, microwave, aircraft and missile industries; also, the company has developed proprietary products of its own design. Offering is 40,500 outstanding common shares by the present holders.

**Computer Components, Inc.,** Jamaica, N. Y., engaged chiefly in the manufacture, assembly and distribution of miniature and microminiature coils for relays which are components used in computer, aircraft, ground control equipment, missiles and guidance systems. Offering is 120,000 common shares at $3 per share; 90,000 shares for public sale by the company, and 30,000 outstanding shares by the holders. Proceeds will be used for test equipment and tooling for modules and reed relays; for additional machinery for coil department; for a model shop; for sales promotion for modules and reed relays.

**First Scientific Corp.,** New York, N. Y., organized in September, 1961, for the principal purposes of acquiring, investing in and financing patents and new scientific technology; to date the company has had no income and has not consummated arrangements for acquiring, financing or investing in any patents or new scientific technology. Offering is 200,000 Class A shares at $3 per share. National Patent Development Corp. is the parent company, and First Scientific intends to use the facilities and experience of the parent in its activities. James S. Lanigan is president of the company, and Martin M. Pollak, vice president. Pollak will receive an annual salary of $10,000, and the parent will receive an annual consultant's fee of $5,000; such amounts are payable whether or not the company has earnings and may be paid from the net proceeds. Balance of such proceeds will be used for office and administrative overhead; professional services; advertising and promotion.

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| | |
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| Gain Stability | ±3 db (—55°C to +125°C) |
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**Structures**

**Senior Dynamicist.** Must be capable of performing advanced analysis in structural mechanics. Will be required to calculate response of complex elastic systems to various dynamic inputs including random excitation. Must be capable of original work in developing advanced analytical techniques.

**Loads Analyst.** To establish structural design criteria for advanced missiles and spacecraft. Should be capable of determining external airload and inertial force distributions.

**Reliability Analyst.** To perform statistical analysis of structural loads and strength properties for the purpose of establishing structural reliability criteria on a probability basis.

**Stress Analyst.** To perform advanced stress analysis of complex and redundant missile and spacecraft structures. Will be required to solve special problems in elasticity, plasticity, short time creep and structural stability.

**Design.** Experience is required in preliminary and final structural engineering and design, including preliminary stress analysis. A knowledge of the effects of extreme temperature environment and hard vacuum, plus a background in materials is desired.

**Heat Transfer**

**Space Vehicle Heat Transfer.** Basic knowledge of radiation conduction and convection heat transfer with application to thermal control of space vehicles is required. Knowledge of spectrally-selective radiation coating, super-insulations and thermal vacuum testing is of particular value.

**Aerothermodynamicist.** Experience in hypersonic real gas dynamics, heat transfer, abalation; re-entry vehicle design, detection; shock layer, wake and rocket exhaust ionization; and anti-missile system requirements will be most useful.

**Equipment Installation**

**Packaging and Installation Engineer.** To perform optimum packaging and installation design for missile and or spacecraft units, considering amount and geometric shape of space available as well as weight and center of gravity distribution requirements. Must be capable of analyzing structural adequacy of unit under extreme environmental conditions.

**Controls**

**Optical Devices.** Design, development, procurement and test operations are involved. Considerable experience in the field of optical devices for space applications such as star, horizon, sun and moon trackers.

**System Test.** To plan and supervise the operations of a flight control system laboratory. Air bearing tables and a wide variety of optical mechanical and electrical equipment are involved.

**Control System Analysis.** Requires engineers at various levels of experience including senior men capable of taking over-all project responsibility in the synthesis and analysis of control systems.

**Circuit Design and Development.** Experience in design and development of transistorized control system circuits, including various types of electronic switching and modulation techniques is required.

If you are a graduate mechanical engineer, electronic engineer, physicist or aeronautical engineer, with experience applicable to the above openings, please airmail your resume to: **Dr. F. P. Adler,** Manager, Space Systems Division, Hughes Aircraft Company, 11940 W. Jefferson Blvd., Culver City 50, California.

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***CAB Accident Investigation Report—Part II:***

# Violations Cited in C-46 Crash Report

*(This is the second part of a Civil Aeronautics Board accident investigation report on the crash of a C-46F aircraft at Toledo, Ohio. The first part, which appeared in the Feb. 5 issue of* Aviation Week, *described the history of the flight, weather conditions at the time of the accident, damage sustained in the crash and the CAB investigation.)*

An analysis of the facts and evidence surrounding this accident reveals that the tragedy occurred as a result of a premature liftoff of an overloaded aircraft from an airport where zero visibility in fog existed.

Examination of C-46 performance data for the takeoff distance required with a 5 kt. headwind, at an elevation of 684 ft. m.s.l., and a takeoff weight of 48,859 lb., reveals that 2,750 ft. of runway would be required to take off and climb to 50 ft. This is based on a normal takeoff under standard conditions.

Calculation of the weight and balance of this aircraft and comparison of these calculations with the two filed weight and balance manifests for the Albuquerque and Youngstown departures indicate the disregard Captain Chesher had for regulations. In each case the actual weight of the aircraft exceeded the listed weight and allowable takeoff weight for these airports.

In computing the weight and balance for this flight, using the weights of the passengers, the total weight of the cargo recovered, including the company material spares and the known fuel load, the weight is broken down in the following manner:

| | |
|---|---|
| Passenger and crew | 9,038 lb. |
| Weighed baggage | 1,470 lb. |
| Unweighed baggage | 350 lb. |
| Company materiel | 154 lb. |
| Fuel (1,036 gals.) | 6,216 lb. |
| Oil (60 gals.) | 450 lb. |
| Basic weight of aircraft | 31,383 lb. |
| Total | 48,961 lb. |
| Less taxi and runup fuel used | —102 lb. |
| Total takeoff gross weight at Toledo | 48,859 lb. |

This weight distribution would have fallen within the c.g. limits of the aircraft even had the cargo been distributed in the most undesirable locations.

An analysis of the swerves described by the surviving passengers indicates that they were the pilot's efforts to maintain the aircraft on the runway while attempting to accelerate to $V_2$ speed and that he was experiencing difficulty with directional control. It is believed the pilot, upon recognizing his inability to maintain the aircraft on the runway, had to elect whether to abort the takeoff at this point or make a premature liftoff.

The decision was made to continue and a premature liftoff resulted. The ensuing climb to an estimated altitude of 50 to 100 ft. was probably made at an airspeed below $V_{mc}$. Several surviving passengers stated that once the aircraft was airborne it shuddered and while turning to the left descended rapidly and struck the ground. Based on witness statements that just prior to the crash there was a moment of silence, the Board believes that the pilot retarded his throttles before striking the ground. This is a normal reaction when a pilot realizes a crash is inevitable.

The testimony of weather personnel established that the weather conditions existing at the time of the accident were: zero visibility (less than ⅛ of a mile) in fog; sky partially obscured; temperature 39; dewpoint 39; wind from the east-northeast at 5 kt. This condition existed for a period of 29 min. prior to the takeoff of the aircraft. In fact, all regular air carriers operating at Toledo Express Airport had canceled all inbound and outbound flights as a result of poor visibility.

## Statements of Witnesses

On the basis of the statements of the witnesses and the flightpath of the aircraft prior to final impact, it is obvious the left engine experienced a power loss of some magnitude, either because of some disorder, or because the throttles were retarded by the crew in an attempt to get back on the airport or both.

Since the engine examination revealed no mechanical failures, the most likely sources of engine maloperation would be the ground-fouled spark plugs, the disconnected intake pipe gland nut, and the prevailing weather conditions (particularly the moisture content in the air).

The adverse condition noted on the spark plugs of both engines was a moderate-to-heavy overlay of black carbon deposits on the insulator core noses. This condition is characteristic of long periods of ground operation at low power. When power is increased rapidly to the takeoff setting, the coating of carbon deposits on such plugs causes scattered plug firing with some power loss.

These conditions would be evidenced by engine sputtering, roughness, and changes in exhaust rhythm as reported by various witnesses.

Investigation disclosed the engines were running approximately 24 min. from the time of starting to the time of takeoff. It is obvious that the engines were ground-operated at low power for a considerable period of time, and this could have caused the ground-fouled condition. It is also obvious from the results of the tests that the majority of the plugs in both engines would have functioned normally had an engine burnout procedure been conducted just prior to takeoff.

The prevailing weather conditions at the time of the accident—low temperature and high humidity—could also be conducive to spark plug fouling. Investigation conducted by engine manufacturers on the effects of humidity on power reveal that a portion of the dry air is replaced by water vapor in the atmosphere. This causes the normal fuel-air ratio to be enriched above the normal mixture strength, and, as a result, excessive richness and partial power loss occurs. Tests have indicated that a maximum of 12 to 14% power loss can occur at takeoff power with the mixture set at the auto-rich position during high humidity conditions. Based on the weather that existed at the time of the accident, a power loss of approximately 2% could have resulted from weather conditions alone.

The disconnected intake pipe gland nut could also have caused some power loss. It is obvious that the gland nut did not become disconnected at impact, particularly since it showed no damage, and the surrounding area was sooted. It is difficult to assess the amount of power loss which could result from such a discrepancy. The presence of a moderate coating of soot around the intake pipe and its adjacent areas is indicative of backfiring and partial power loss from cylinders Nos. 8 and 9 of the left engine.

The fact that the left engine was a model not currently certificated for use in the C-46 series aircraft had no direct bearing on the cause of the accident. However, the circumstances surrounding the installation of the R-2800-79 engine indicate the disregard the management of Arctic-Pacific had for established airworthiness compliance and adherence to the Civil Air Regulations. This is evidenced by the fact that Arctic-Pacific purchased the engine from a dealer in used metals; that Arctic-Pacific requested Newark Air Service to install the engine without furnishing the engine records; and that Arctic-Pacific knowingly permitted Newark Air Service to install and modify the engine knowing that Newark Air Service possessed only Class III Airframe and Limited Airframe repair station certificates.

## Engine Installation

Newark Air Service installed the engine as verbally requested by Arctic-Pacific's Director of Maintenance. Regardless of Newark Air Service's instructions from Arctic-Pacific, they failed to inspect the engine for airworthiness compliance as required by the Civil Air Regulations. The Chief Inspector of Newark Air Service testified that they were dubious of the airworthiness of the engine, particularly since there were no overhaul records with the engine. Nevertheless, Newark Air Service failed to bring this to the attention of the Federal Aviation Agency.

Although the Civil Air Regulations do

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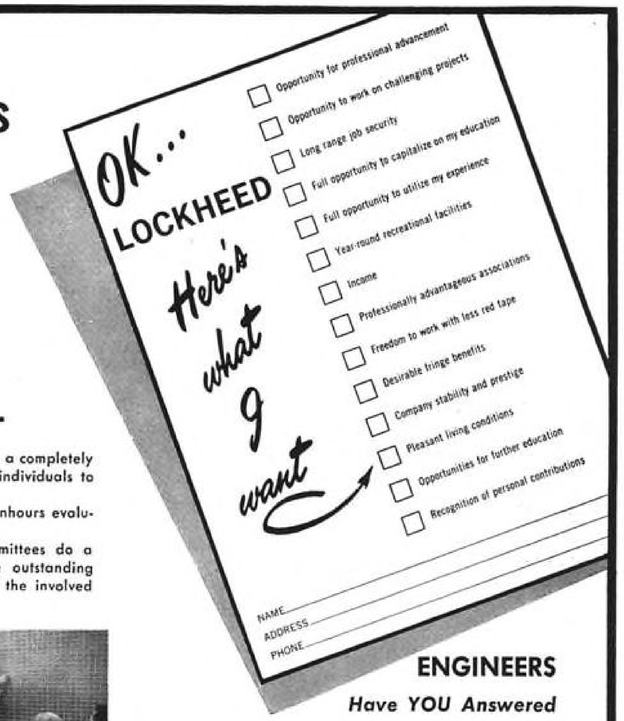


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not specifically require en route inspections, the Manual of Procedures for the FAA Air Carrier Offices do set forth the requirement. The Board notes that no en route inspections were made by FAA of Arctic-Pacific in the year 1960.

Since the Operations Inspector assigned to Arctic-Pacific was not able to inspect this carrier during the previous eleven months of operation, it is difficult to understand why the appropriate persons in the local FAA air carrier office did not apprise their superiors of this condition. This is especially true since the volume of correspondence over discrepancies noted on ramp checks at Oakland International Airport and airports other than the home base indicated deficiencies in Arctic-Pacific's maintenance program. This was also attested to in the FAA action against Arctic-Pacific.

Because of the weather conditions at Toledo Express Airport, certain economic factors confronted Captain Chesher. Captain Chesher had the responsibility for 43 passengers as well as the crew. If the flight did not depart, as planned, Captain Chesher, as agent for the Arctic-Pacific, would have been obligated to furnish lodging, meals, and transportation for these passengers. It is possible that the economic situation may well have influenced his decision to take off.

Since this accident the FAA has instructed its tower operators to withold takeoff clearance from an air carrier or other commercial aircraft operated for the purpose of carrying passengers or property for compensation or hire when the prevailing visibility for the airport of departure or runway visibility for the departure runway is less than one-fourth mile, or runway visual range is less than 2,000 ft.

The positions occupied by the flight crew at the time of the accident were established to be Copilot Perovich in the left seat and Captain Chesher in the right seat. Normally, under adverse weather conditions, it would be expected that the captain would be in the left seat and at the controls during the takeoff under the weather conditions which prevailed. The aircraft can, however, be flown from either seat, and there is no possible way of establishing who was actually controlling the aircraft at the time of the accident. Although Copilot Perovich had over 3,200 flying hours, 1,300 of which were in C-46, held an airline transport pilot certificate, and was qualified as a copilot in C-46 aircraft, he did not possess a type rating in C-46 aircraft.

Although the accident occurred during the takeoff from Toledo Express Airport, which was to be the first flight on the return to Santa Maria, California, the Board made an extensive analysis of the total flying time, en route time, on-duty time, and rest periods from the time the chartered flight departed Oakland Airport, California.

Four pilots were aboard the aircraft when it departed Oakland Airport but the second crew flew only the leg from Albuquerque, New Mexico, to Kansas City, Missouri, and left the flight at Kansas City. Captain Chesher was listed as pilot-in-command for the entire flight from Oakland.

Utilizing the arrival and departure times, it was determined that both Captain Chesher and Copilot Perovich were on continuous duty from departure at Oakland Airport to arrival at New Haven, a total of 26:40 hours. During this period, Chesher and Perovich were actually at the controls of the airplane for 11.15 hr. of the total 14.41 hr. of flight time to New Haven, Conn. The remaining flight time of 3.26 hr. was deadhead time between Albuquerque and Kansas City.

It is known that the crew had a layover of 29.10 hr. in New Haven, Conn., prior to beginning the return trip. However, during the morning and afternoon on the day of the accident, Copilot Perovich spent some time at the airport at New Haven attending to servicing and preflight duties.

Since the return portion of the trip from New Haven to Oakland would have been flown under the same conditions, e.g., two-man crew to Kansas City and four-man crew to Oakland, in addition to being a slower westbound flight due to prevailing headwinds, it may be concluded that the entire projected return trip would also have been flown in direct violation of Civil Air Regulation 42.48, had the accident not occurred.[5]

## Conclusions

Captain Chesher was briefed on the weather conditions which were below his allowable minimum prior to departure. Visibility at time of takeoff was zero in fog. During takeoff from Toledo Express Airport the aircraft, with the copilot in the left seat, swerved to the right followed by a violent swerve to the left just before the aircraft left the ground. The liftoff was described as abrupt or as a lurch into the air, and was accomplished before reaching $V_2$ speed. The aircraft shuddered or vibrated (characteristic of a stall) just prior to entering a left wing-down, nose-low attitude. The crew removed power from both engines just prior to impact, which occurred approximately 5,800 ft. from the threshold of runway 07.

The Board believes that the loss of power caused by the maloperation of engines not properly runup immediately prior to takeoff and the swerving takeoff run due to erratic engine performance and poor visibility resulted in a premature liftoff. The pilot was unable to remain airborne due either to a stall condition or a loss of power or both. The wreckage being 5,800 ft down the runway indicates that the above-mentioned conditions caused a longer than normal takeoff run.

The Board concludes that Captain Chesher and the management of Arctic-Pacific Airlines displayed utter disregard for the regulations set forth as to flight time limitations, minimum weather conditions, proper completion and filing of required paper work, good maintenance and inspection practices, and for compliance with regulations concerned with ensuring operation, including maximum gross takeoff weight, in a manner to guarantee safety to the public.

As a result of this accident, the FAA has published a notice in the Airman's Guide and has instructed its tower operators to withhold takeoff clearance from any air carrier or other commercial aircraft operated for the purpose of carrying passengers or property for compensation or hire when the prevailing visibility for the airport of departure or runway visibility for the departure runway is less than one-quarter of a mile, or runway visual range is less than 2,000 ft.

On Oct. 31, 1960, the FAA suspended, in accordance with Section 609 of the Federal Aviation Act of 1958, the air carrier operating certificate issued to Arctic-Pacific. Sub-

[5]CAR 42.48(d) reads as follows:

"Aircraft having a Crew of Four Pilots.

"(1) A pilot shall not be scheduled for duty on the flight deck in excess of 8 hr. during any 24-hr. period.

"(2) A pilot shall not be scheduled to be aloft for more than 16 hr. in any 24 hr. period.

"(3) A pilot shall not be on duty for more than 20 hr. during any 24 hr. period."

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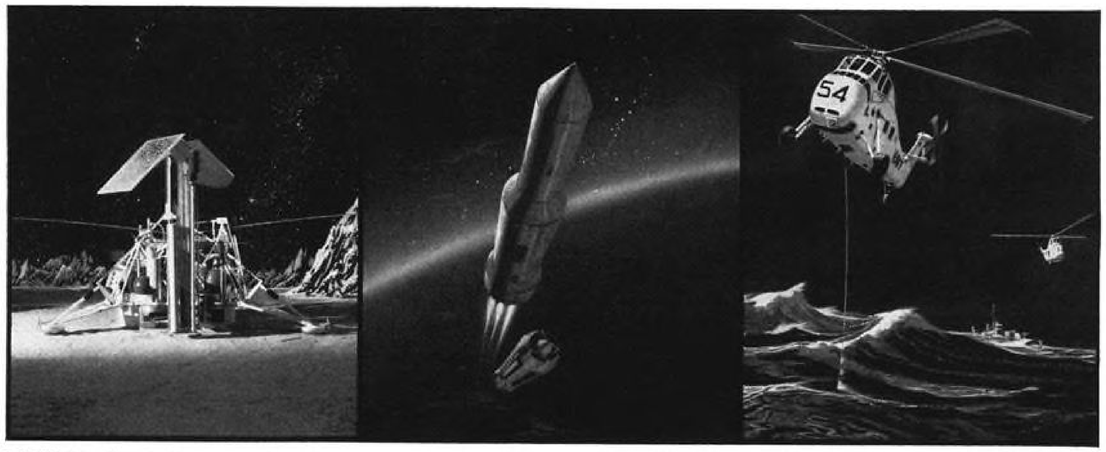

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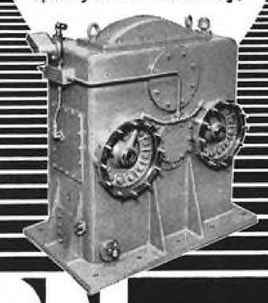

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sequently, the operating certificate, which expired on Nov. 14, 1960, was not renewed.

### Probable Cause

The Board determines that probable cause of this accident was loss of control during a premature liftoff. Contributing factors were the overweight aircraft, weather conditions, and partial loss of power in the left engine.

By the Civil Aeronautics Board:

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Chairman
ROBERT T. MURPHY
Vice Chairman
CHAN GURNEY
Member
G. JOSEPH MINETTI
Member
WHITNEY GILLILLAND.
Member

### SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident immediately after occurrence. An investigation was immediately initiated in accordance with the authority of Title VII of the Federal Aviation Act of 1958. A public hearing was ordered by the Board and was held at Oakland, Calif., on Feb. 1, 2, and 3, 1961. Depositions were also taken at Toledo, Ohio, on Jan. 11, 1961, and at Miami, Fla., on Feb. 24, 1961.

Arctic-Pacific, Inc., was a supplemental carrier, and incorporated in the State of Washington. It maintained its principal offices at the Oakland International Airport, Oakland, Calif. The corporation held a temporary CAB certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation of irregular passenger and cargo operations, and an FAA air carrier operating certificate which expired on Nov. 14, 1960.

Captain Donald L. J. Chesher, age 38, was employed by Arctic-Pacific, Inc., in July, 1957. He had been on a leave of absence from the company from the latter part of Aug., 1960, until Oct. 23, 1960, four days prior to the commencement of this series of flights. He possessed a valid FAA airman certificate with an airline transport pilot rating with airplane multi-engine land, with Douglas DC-3 and Curtiss Wright C-46 type ratings. His first-class medical certificate with no limitations was dated Aug. 3, 1960. He had accumulated a total of 6,364 flying hours.

Copilot Howard Perovich, age 30, was employed by Arctic-Pacific, Inc., in August, 1960. He possessed a valid FAA airman certificate with an airline transport pilot rating for airplane multi-engine land, and a Douglas DC-3 type rating. He also possessed an FAA mechanic certificate with airframe and powerplant ratings.

Hostess Susan Faith Miller had been employed by numerous air carriers and had a total of approximately 7,500 flying hours.

Curtiss Wright Super C-46F, N 1244N, bore manufacturer's serial number 22458. The aircraft was leased by Arctic-Pacific, Inc., from the Barter Island Company, Spenard, Alaska. The aircraft was powered by Pratt & Whitney R-2800-B series engines. The left engine was a 79 model engine and the right engine was a 75 model engine. The aircraft was equipped with Hamilton Standard, Model 23E50 propellers with model 6491A-6 blades.


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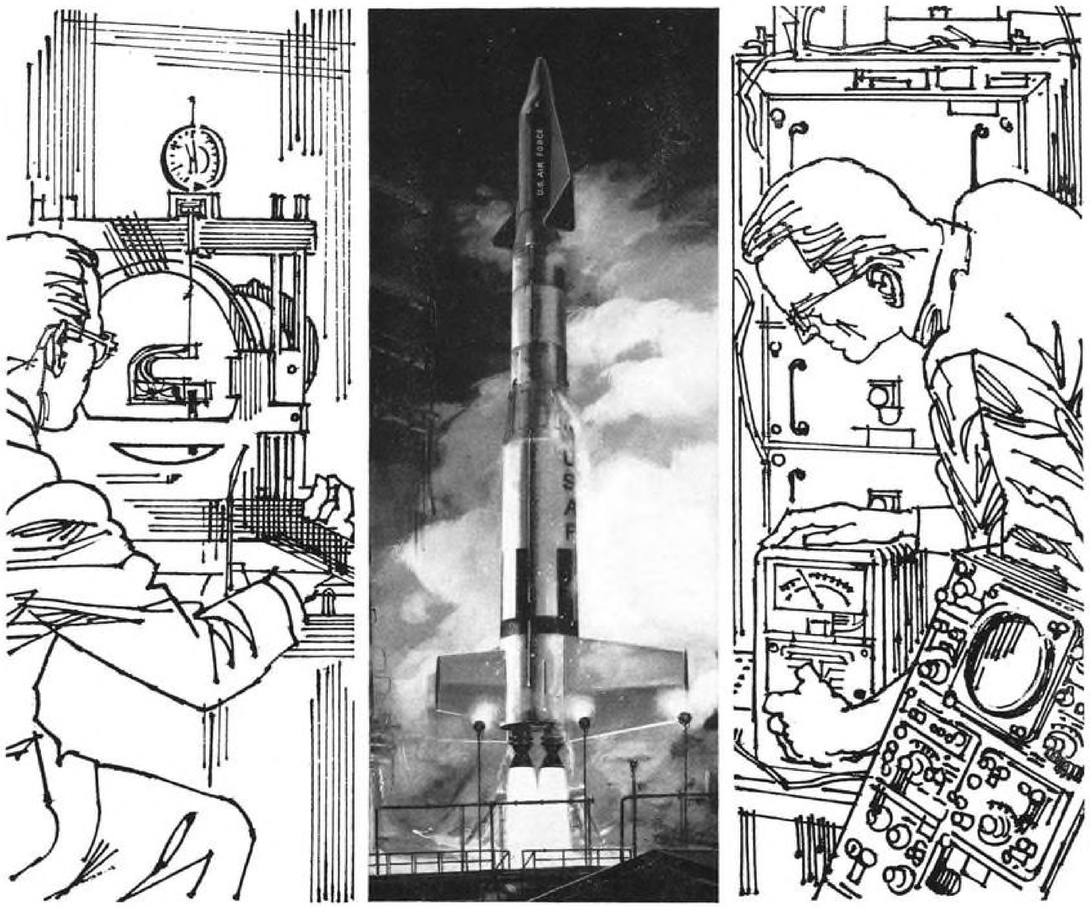

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## Cessna Reports Slight First Quarter Decrease

Slight decrease in sales for the first quarter of Fiscal 1962 compared with the same period of last year is reported by Cessna Aircraft Co., Wichita, Kan., but President Dwane L. Wallace says he sees signs of improvement in later quarters.

Sales of $23,581,000 and after-tax earnings of $1,441,000 or 44 cents per share are reported for the first three months of Fiscal 1962 compared with sales of $24,353,000 and earnings of $1,698,000 or 52 cents per share in the same period last year.

Industrial products sales were up substantially, setting an all-time first-quarter record, Wallace noted, adding that a substantial portion of this increase was due to the company's recently established plant in Scotland.

Military aircraft sales were up slightly over the same period last year and both Aircraft Radio Corp. and McCauley Industrial Corp., wholly owned subsidiaries, showed sales increases.

Business plane sales were the second highest in Cessna's history and export sales were also the second largest, nearly equaling last year's similar period. Commercial plane sales may exceed last year's in the remaining quarters.

Cessna directors have approved the regular 25 cents per share quarterly dividend, with payment to be made Feb. 15 to shareholders of record Feb. 5.

## Financial Briefs

**Raytheon Co.** reported net earnings of $6,877,000, or $1.69 per share of common stock, during 1961 on sales of $562,901,000, down from $8,105,000 net earnings, or $2.09 per share, during 1960 on $539,975,000 sales. Board Chairman Charles F. Adams said fourth quarter 1961 was the company's best period in terms of total operating profit since the first quarter of 1960. Funded backlog of government business was more than $360 million at the end of 1961, $80 million greater than a year earlier, Adams said.

**International Business Machines Corp.** showed net earnings of $207,227,597, or $7.52 per common share, an increase of $39,046,717, or $1.40 per share, over 1960 net earnings. The corporation's total assets at the end of 1961 were $1,768,649,296 The 1961 stockholders' report noted a substantial increase in direct sales of data processing equipment, in contrast to equipment rentals. This, the report said, returned heavy earnings which, on a rental basis, would have been spread over several months and years of the future.

**Garrett Corp.**, Los Angeles, had net profit of $2,526,228 on sales of $99,421,967 for the first six months of its fiscal year which began last July. This compared with $711,000 profit on $94,506,000 sales for the first six months of the previous fiscal year.

**North American Aviation, Inc.**, reported net earnings of $7,891,000 on $320,705,145 sales and income during the current fiscal year's first quarter, ending Dec. 31. Earnings were $4,601,000 on $245,961,451 during the corresponding period of the previous year. Backlog was $1,224,000,000 on Dec. 31, 1961, compared with $931,000,000 at the start of the quarter.


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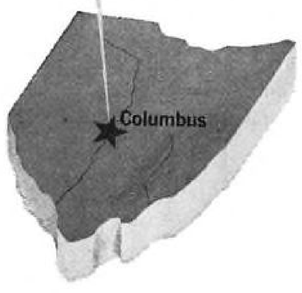


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# WHO'S WHERE

(Continued from page 23)

## Changes

**Joseph D. Schantz**, manager of the ZMAR (Zeus multi-function array radar) program, Sylvania Electronic Systems, Waltham, Mass., a division of Sylvania Electric Products, Inc. Also: **Robert J. Hannon**, assistant program manager and technical manager of ZMAR, and **William F. Rooney**, administrative manager.

Space Technology Laboratories, Inc., Los Angeles, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc., has announced the following appointments: **John F. Mandrow**, director of STL's BAMBI (ballistic antimissile boost intercept) Study Program; **Shelly B. Pfeiffer**, head of the newly created Transportation, Handling and Launch Equipment Section, Engineering Mechanics Laboratory; **Dr. Richard D. LeLauer**, associate director of the company's Ballistic Missile Program Management; **Fred H. Kaufman**, associate manager of the Systems Design Department, Systems Research and Analysis Division.

**Richard K. Waldo**, manager of aviation economics research, Stanford Research Institute, Southern California Laboratories, South Pasadena, Calif.

**Roy J. Sandstrom**, general manager, Mishawaka (Ind.) Division of The Bendix Corp., and **J. Pemble Field**, assistant general manager.

**Dr. Neal M. Burns**, director of the newly established Advanced Life Sciences Division, The Decker Corp., Bala-Cynwyd, Pa.

**C. B. Newman**, manager-ticketing and terminal services, and **L. Ronald Kister**, manager-reservations services, Traffic Department, Passenger Services Division, Air Transport Assn. of America.

**Jim Pearce**, director of Space and Missile Systems Test, North American Aviation's Space and Information Systems Division, Downey, Calif.

**Dr. Robert C. Hansen**, associate director for satellite control, Engineering Division, Aerospace Corp., El Segundo, Calif.

**Irving Cohen**, manager, and **Richard D. Quinn**, assistant manager, General Mills' Computer Development Laboratory, Minneapolis, Minn.

**Gerald P. Hoffman**, contracts manager, Aircraft-Missiles Division, Fairchild Stratos, Hagerstown, Md.

**William Semple**, director of operations, and **Frank Echolds**, director of engineering, American Electronics, Inc., Fullerton, Calif.

**J. Frank Tobias**, product manager-aeronautical instruments, and **Lee E. Cuckler**, product manager-industrial instruments, Robertshaw-Fulton's Aeronautical and Instrument Division, Anaheim, Calif.

**Kenneth W. Premo**, engineering supervisor of advanced design, B. H. Hadley, Inc., Pomona, Calif.

**Dr. George I. Cohn**, chief scientist, Fluid Physics Division, Electro-Optical Systems, Inc., Pasadena, Calif. Also: **E. Ronald Reese**, a senior engineer in the company's Advanced Electronics and Information Systems Division.

**D. J. Saunders**, assistant chief designer-special products, Bristol Aerojet, Ltd., Banwell, Somerset, England.




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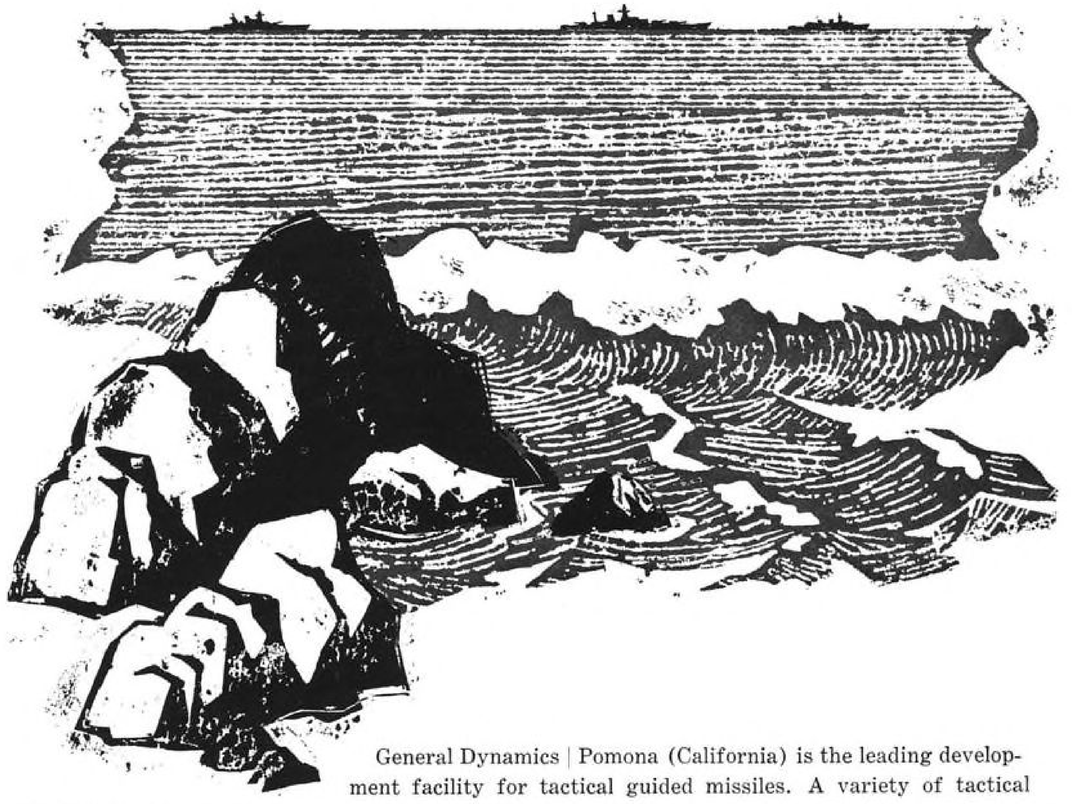

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Do you care? Would you care to know how your special talent might be used in JPL's world of other world exploration? Write us about yourself. We'd care to know.

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CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.


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## PROBLEMATICAL RECREATIONS 105

A castle and a bishop are placed at random on different squares of a chessboard. What is the probability that one piece threatens the other? *– Contributed*

Down-to-the-sea-in-nuclear-submarines-dept.: Our experience in inertial navigation systems, gyrocompasses, oceanic depth recorders, and a variety of marine electronics equipment will be broadened by the addition of our new division, Ingalls Shipbuilding Corporation, a major producer of nuclear-powered submarines for the US Navy. The USS Sculpin and the USS Snook, to name two. Expect Litton-Ingalls to move full speed on the development of advanced technologies in the marine field.

ANSWER TO LAST WEEK'S PROBLEM: General solution:

$$a = \left(1 + \frac{1}{n}\right)^n \text{ and } b = \left(1 + \frac{1}{n}\right)^{n+1}$$

One solution is therefore: $a = \frac{9}{4}$ and $b = \frac{27}{8}$.

**LITTON INDUSTRIES, INC.**
**Beverly Hills, California**

# LETTERS

***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.***

## Competitive Situation

I would like to add a few facts to Mr. M. Joseph Sheehan's criticism of your editorial praising Eastern Air Lines and Eastern's air shuttle (AW Jan. 1, p. 90).

I feel that in his enthusiastic effort to castigate you and Eastern Air Lines he very conveniently omitted some very important facts. He would like you to believe that first-class flights of Northeast Airlines provide better reliability and speed than the air shuttle of Eastern Air Lines. Yet the facts are that Eastern Air Lines has been the leader of all the domestic airlines in eight of the last nine months in on-time reliability.

Perhaps to the amazement of Mr. Sheehan, the air shuttle of Eastern Air Lines has the best record in the airline industry in on-time operation. Aside from the fact that no reservation or ticket is needed, Eastern Air Lines will guarantee you a seat. If it is reliability you are looking for, look to Eastern's air shuttle. Not a single passenger has ever been left. Even an extra flight for only one passenger. This is reliability-plus.

His statement that the air shuttle's low fare structure has yet to prove in any way that it can be profitable is merely an opinion. If he could substantiate this with facts, it would be of a tremendous interest to the other airlines. Mr. MacIntyre, president of Eastern, is keeping these facts to himself, and all of the other airlines are very much interested in them.

His claim that Eastern is attempting to inhibit Northeast from receiving permanent rights to serve this route would leave you to believe that this route is only the short haul Boston-New York, New York-Washington. But the area of biggest contest is the long haul to Florida and not the air shuttle routes. Northeast also filed a complaint with CAB against Eastern Air Lines inaugurating low cost air bus to Miami from Boston. Was this complaint in behalf of the public?

The CAB has added multiple competition on almost every route that Eastern Air Lines has pioneered and now admits that perhaps some routes have too much competition, but they are reluctant to correct their mistakes. All this competition was added while Eastern was awaiting delivery of its 30 big jets and 40 Lockheed Electras. What will be the cries of Mr. M. Joseph Sheehan when Eastern receives their 40 medium jets and their contemplated 40 small jets?

You claim that none of the major carriers, including Eastern, serving this route found it in the public interest to offer any effective competitive service to Northeast. Yet when Eastern does, you claim foul. I suppose you will say the same on Feb. 1 when Eastern starts nonstop shuttles to Washington from Boston and return.

I can only suggest that the 500,000 air shuttle passengers who saved over $2.5 million these past months would not agree with your motivation in condemning Eastern.

Northeast was given a temporary certificate to serve south of New England and New York to Florida five years ago when the CAB was boasting of a tremendous growth rate in airline traffic. What happened to this prediction? It is obvious that it fell flat on its face. It now appears that perhaps the CAB can only save face by forcing mergers, instead of the proper direction—denying Northeast the routes so recklessly given in mistaken judgment. Is this judgment going to go wrong again and just do patch on patch? Only time will tell if this CAB can face up to its responsibility.

It is implied in Mr. Sheehan's statement, ". . . there are those of us who appreciate the comfort, reliability, speed . . . to be had on first-class flights . . ." that he is one of these passengers who always flies first class as a passenger. Is it not a fact, Mr. Sheehan, that you are a captain for Northeast, having been hired on June 17, 1957?

I don't believe the management of Northeast would hide behind the anonymity of a supposed irate public traveler to take a swipe at their competitors, regardless how tough they are.

I hope the imaginative thinking in the management of Eastern, which has come up with the air shuttle, air bus and air commuter, continues to develop new markets. If Mr. Joseph Sheehan can't stand your editorials praising service improvements, I suggest that he cancel his subscription to your magazine because he hasn't heard the last on Eastern Air Lines.

J. J. O'Donnell
Eastern Air Shuttle Pilot

The recent letter of M. J. Sheehan (AW Jan. 1, p. 90), coupled with yesterday's announcement of Eastern Air Lines' air shuttle service to Miami from New York, prompts me to write in support of Mr. Sheehan's contention, that is, that Northeast's competition is responsible for Eastern's sudden interest in serving the public.

It should be obvious to even the least astute witness to Eastern's bitter fight against Northeast that Eastern's only goal and motivation is the bankruptcy of Northeast with its resultant loss to stockholders, employes, creditors, cities served, and taxpayers when they are forced to bear the losses, now borne by Northeast, of whatever service is continued in northern New England. Is this the noble purpose which you praise?

Before Northeast began competing with Eastern, Eastern shared the New York-Boston, New York-Washington, and Boston-Washington markets with American and dominated the New York-Miami market. Recently Northeast's penetration into these markets was about 40%, 30%, 80% and 25%, respectively. If Northeast collapses and American and Eastern merge, there will be no effective competition at all on the commuter markets, and American-Eastern will again dominate the Florida market. Keeping this in mind, doesn't it seem strange that Eastern, from all its city pairs, chose to use the air shuttle only on those routes which provide the lion's share of Northeast's revenue? Or maybe it doesn't seem strange.

For years Eastern has complained of excess competition and excess capacity on the Florida route. Perhaps this is so. Let's look at the record. Last winter three companies provided 15 daily jet flights between New York and Miami, about evenly divided between the three. This winter Eastern alone will operate 12 flights! Apparently competition and capacity are excessive only when provided by someone besides Eastern! I'm certain all your New York and Miami readers remember the days before the competition became excessive. In those years they used to call out the police every holiday weekend to quell the rioting passengers, confirmed tickets in their hands, stranded by the adequate competition.

Eastern's air shuttle provides excessive capacity at inadequate fare levels. How long do you really believe such an uneconomical setup will continue after Northeast has been destroyed?

Robert H. Booth
Pelham, N. Y.

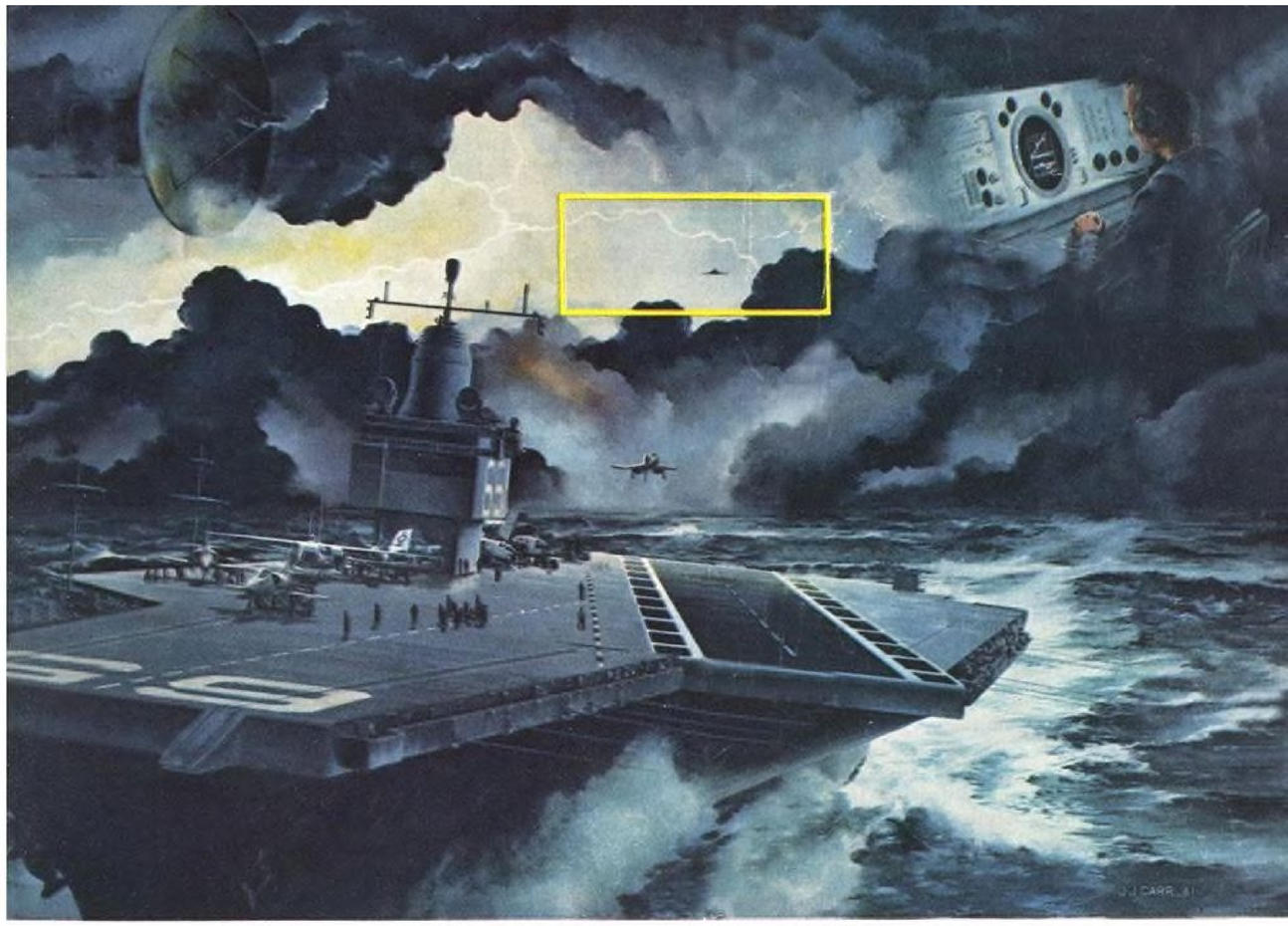
## Report Delays

Your article in the Jan. 22 issue (p. 38) describing a warning issued by President J. A. Stratton of Massachusetts Institute of Technology came at an unusually significant time for me. On the same day I received two secret technical reports, one issued by MIT's Lincoln Labs and the other by a competitor in this electronics industry of profit-making organizations. Our competitor's report, dated January, 1962, described results of a missile test held on Nov. 22, 1961. However, the Lincoln Laboratory report, which was a regularly scheduled Quarterly Progess Report, was concerned with a period of work from May 1, 1961, to July 31, 1961. The report was dated Aug. 15, 1961; issued Dec. 19, 1961. Thus the Lincoln report was received six months after the end of the report period.

In this rapidly changing electronics industry, six months is too long to wait for information developed by so powerful an adviser to DOD. Mr. Stratton stated that new information developed by MIT Laboratories "must be quickly and fully shared with all industry. This has . . . always been our practice . . ." If this report and others with similar delays are indicative of the usual practice at MIT, then now is the time that the practice be sharply accelerated. Perhaps the MIT Laboratories need report writing assistance to meet their responsibilities to DOD and the profit-making organizations.

(Name withheld by request.)
A Profit-Making Engineer
Stoneham, Mass.





**Bell's all-weather aircraft landing system increases operational capability of navy carriers**

Navy aircraft now will land more often and with greater safety on 10 modern aircraft carriers because each carrier will have Bell's new AN/SPN-10 All-Weather Carrier Landing System aboard.

SPN/10, developed and produced for the Navy by Bell Aerosystems Company, makes safe landings possible in foul weather or at night, even in heavy seas.

Proved out in more than 4000 completely controlled landings on both airfield and carrier deck, the SPN/10 provides vastly improved carrier-controlled approach capability using stabilized glide slope information, ship motion compensation and improved precision radar.

When a pilot enters the electronic "window in the sky" up to four miles out from the carrier, the new Bell system gives him a choice of three modes of operation: a fully-automatic "hands-off" landing, a semi-automatic cross-pointer approach or a talk-down GCA-type approach. Built into the system are features such as automatic or manual wave-off should conditions momentarily prevent a safe landing.

A major element in the Navy's All-Weather Return to Carrier System, the SPN/10 represents an important contribution by Bell Aerosystems to the Navy's positive efforts to improve aviation safety and operational scope.

For more information, write:

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BUFFALO 5, N. Y.
DIVISION OF BELL AEROSPACE CORPORATION
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# . . . at 1600 mph, the Sky is an Oven

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d region of aero-
t ermal thicket"
straightaway
speed record of 1606.3 mph.

An operational fighter, the Phantom II set the new record without rocket assistance. Powered by two GE-J79 engines, the Phantom II reached peak speeds in excess of 1650 mph on the 16-kilometer course.

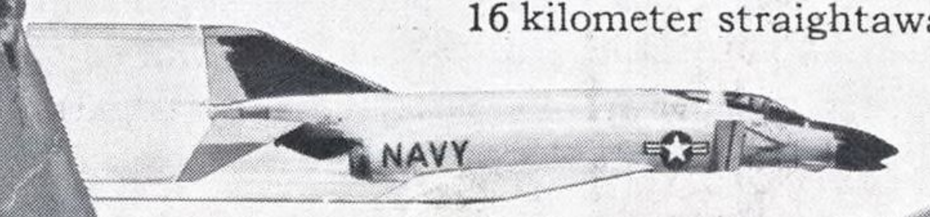
In combat, such speeds are required only for short periods of time. At 26 miles a minute, the Phantom II can cover vast distances before the oven-like heat can damage its surface. It has the speed to catch invaders . . . it has the speed to deliver an attack almost before radar can find it . . . and it has the speed to get away. At 26 miles a minute, it takes but 46 seconds to cross the English Channel. At 1600 miles an hour, it's less than eight minutes from New York to Boston, four minutes from Detroit to Cleveland.

The performance of the McDonnell Phantom II is matched by its armament versatility. The Phantom II can carry Sparrow III and Sidewinder missiles for air defense or air superiority missions. It can carry multi-ton loads of conventional bombs and napalm for troop support missions. It can carry nuclear stores for long range strategic attack.

FEB. 15 1962

## Record Flights of the Phantom II:

| | |
|---|---|
| Altitude | 98,557 feet |
| 100 kilometer closed course | 1390 mph |
| 500 kilometer closed course | 1216 mph |
| Los Angeles to New York | 170 minutes |
| 3 kilometer low altitude | 902 mph |
| 16 kilometer straightaway | 1606.3 mph |

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