

Aviation Week & Space Technology

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October 29, 1962

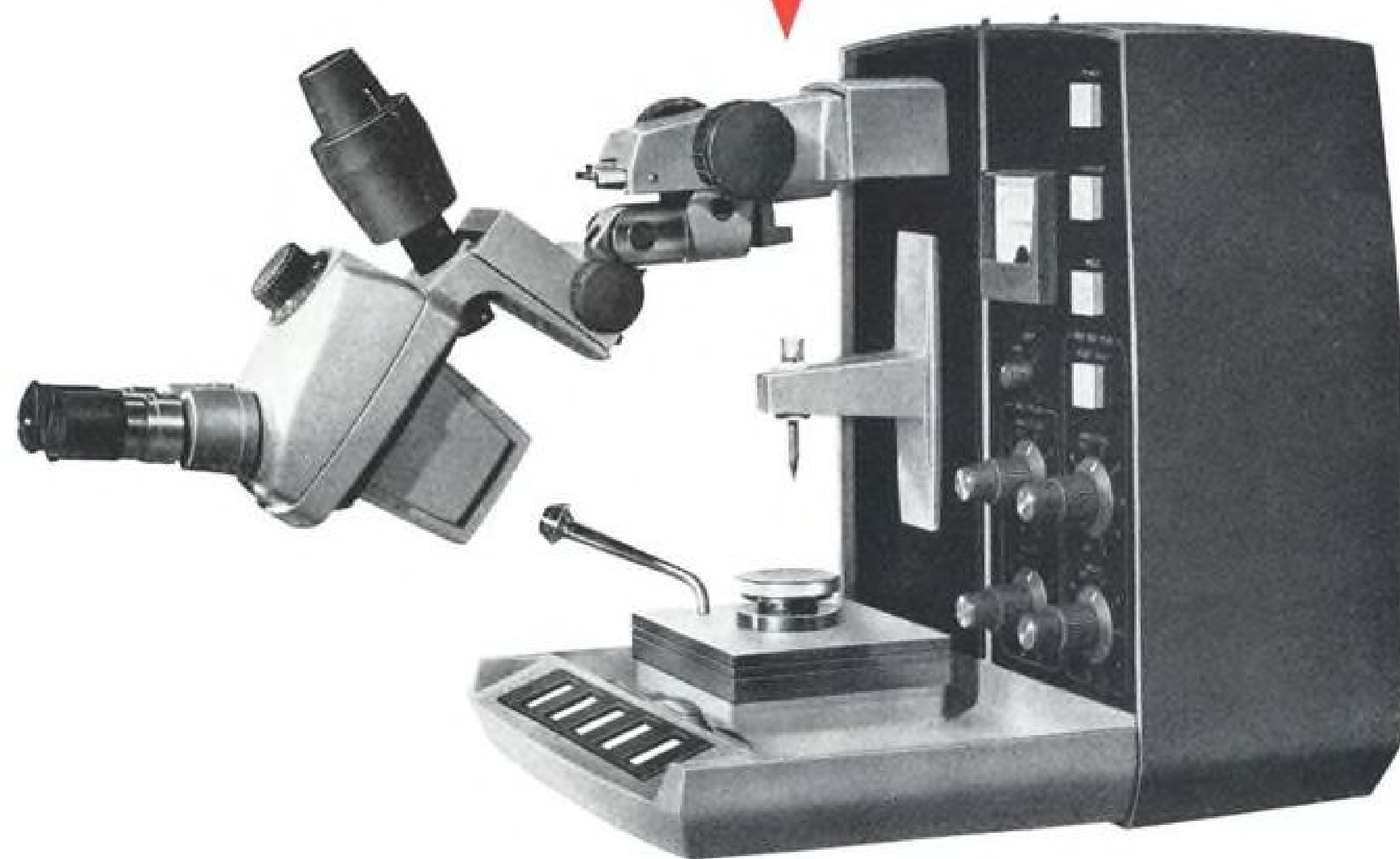
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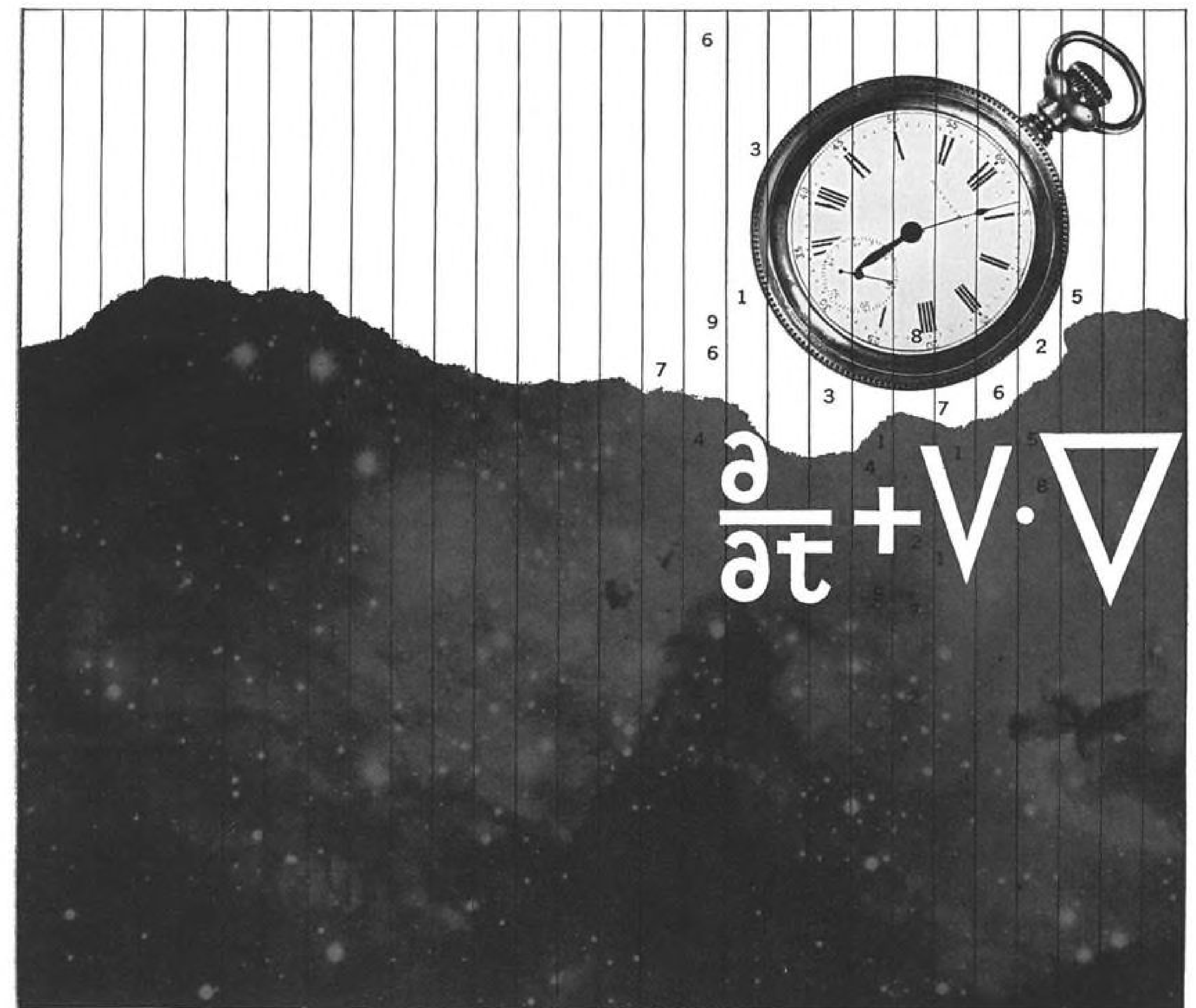
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AEROSPACE CALENDAR

- Nov. 5-7—Symposium on Protection Against Radiation Hazards in Space, Gatlinburg, Tenn. Co-sponsors: Oak Ridge National Laboratory; NASA Manned Spacecraft Center; American Nuclear Society.
- Nov. 5-7—Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Commonwealth Armory & Somerset Hotel, Boston, Mass.
- Nov. 5-16—16th Air Transport Management Institute, School of Business Administration, The American University, Washington, D. C.
- Nov. 7-8—Symposium on Lasers and Applications, Antenna Laboratory, Department of Electrical Engineering, Ohio State University, Columbus, Ohio.
- Nov. 7-9—International Air Cargo Forum, Dinkler-Plaza Hotel, Atlanta, Ga. Sponsors: Institute of the Aerospace Sciences; Society of Automotive Engineers.
- Nov. 12—Wings Club Annual Dinner, Americana Hotel, New York, N. Y.
- Nov. 12-15—International Air Transport Assn.'s Sixth Public Relations Conference, Shoreham Hotel, Washington, D. C.
- Nov. 12-15—Eighth Annual Conference on Magnetism and Magnetic Materials, Institute of Radio Engineers, Penn-Sheraton Hotel, Pittsburgh, Pa.
- Nov. 13-14—Retardation and Recovery Symposium, Imperial Motel, Dayton, Ohio. Sponsor: Aeronautical Systems Division's Flight Accessories Laboratory.
- Nov. 13-15—National Symposium: Materials Compatibility and Contamination Con-

(Continued on page 7)

AVIATION WEEK and Space Technology



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Vol. 77, No. 18



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A Look Over the Transom
at General Electric

**fuel
cells** NOVEMBER
1962

ABOUT THIS SERIES. Things are happening with G-E fuel cells. Looking back on our years of developing these power sources that generate electricity directly from a chemical reaction, the progress is enormous. We could write books—(in fact there are two of a progress report flavor already available; yours for the asking*)—but fuel cells are such a new and promising technology that this is hardly the stage at which to tell all. That's why, for now, we'd rather limit the world to occasional glances through our laboratory transom.

DAWNS THE HARDWARE ERA

There's a big difference between *making* a fuel cell, and *producing* fuel cells. We are now producing them.

Our new plant facility that went on-the-line at Lynn last month is (to our knowledge) the world's first fuel cell manufacturing operation. Working floor-space there now totals about 20,000 square feet.

The new facility's flow procedures are based on our lengthy experience with pilot plant operation. It handles electrode and solid electrolyte processing, single cell fabrication, battery assembly, and

testing, for cells rated at 35-40 watts/sq-ft. It will soon take on the more powerful 100 watts/sq-ft cells that are now being made in our laboratory and advanced engineering areas.

Quite obviously, all the output of our new operation will be limited for some time to our many development and advanced hardware programs. Though for now we're postponing any pats on the back, the new facility symbolizes turning the long-awaited corner from an exclusively R&D activity to hardware technology.

WHY WE'RE CONFIDENT ABOUT FUEL CELL SAFETY

The subject of safety compels us to dredge up a horseless carriage analogy. Way back when, we recall, there were antagonists who lambasted gasoline as a devastating hazard compared with oats.

So we duly tolerate the apprehensions we occasionally encounter concerning the presence of hydrogen and oxygen in our fuel cells. Our own have been long since dispelled, (to the point where, if you'll permit us the pun, we are anxious to make hay of our optimism).

Proximity of hydrogen and oxygen in an enclosure could, of course, be rightfully viewed as a potential hazard. Our own lack of concern is based on more than 100,000 hours of tests on some 1000 solid electrolyte cells, many of which we've purposely badgered with punctures, fissures, and jolts in futile effort to create trouble.

There are several reasons for our cells' safety. First, their mechanical design makes any delinquent mingling of fuel and oxidant highly improbable. The elastic limit of the membrane electrolyte separating the two gases averages 2000 psi, and hydrogen fed into the cells is constantly regulated.

POTABILITY: ON TRIAL BY MEN AND MICE

Byproduct water from our fuel cells is of course drinkable, as the many healthy G-E engineers who have quaffed it for demonstration purposes will attest. And to further establish its potability, we have had small animals living on it for many months. But putting an astronaut on an extended diet of such water may be something else again.

Working with the biosciences and human factors people at G-E's Space Technology Center, Valley Forge, Pa., we have enlisted a three-group colony of laboratory mice to refine our data. One 25-mouse group gets fuel cell water, another distilled water, and the third tap water. An interim lab report reads: "All

mice averaging 3.35 cc of water a day. All gaining weight, and all apparently pleased with the liquid portion of their diet."

Final data on this phase of the program are almost all in, and no deleterious effects have been noted. But, before the first Gemini astronaut becomes the first human to live on fuel cell water, further clinical testing will thoroughly prove its safety for prolonged human consumption.

*Bulletins GED-4111B (Some Plain Talk About Fuel Cells), and GEA-7538 (G-E Fuel Cell Development Progress). Also "recommended reading": Our '62 ARS paper, entitled "Gemini Fuel Cell Power Source—First Spacecraft Application." For copies drop us a line at General Electric Company, Section B183-10, Direct Energy Conversion Operation, 950 Western Ave., Lynn, Mass.

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Seven pounds light and seven inches narrow, this Leach Satellite Recorder/Reproducer has taken the rockiest launch

in stride, works in temperatures from —30°F to 130°F with an average power consumption of only 4 watts.

If you're in the satellite making business, you should make it your business to know more about this recorder/reproducer and how it can be adapted to your needs. You can know, too. Just send a line to Leach. You will get complete specs on this specially engineered recorder as well as other high environmental tape recorders—in the return mail.



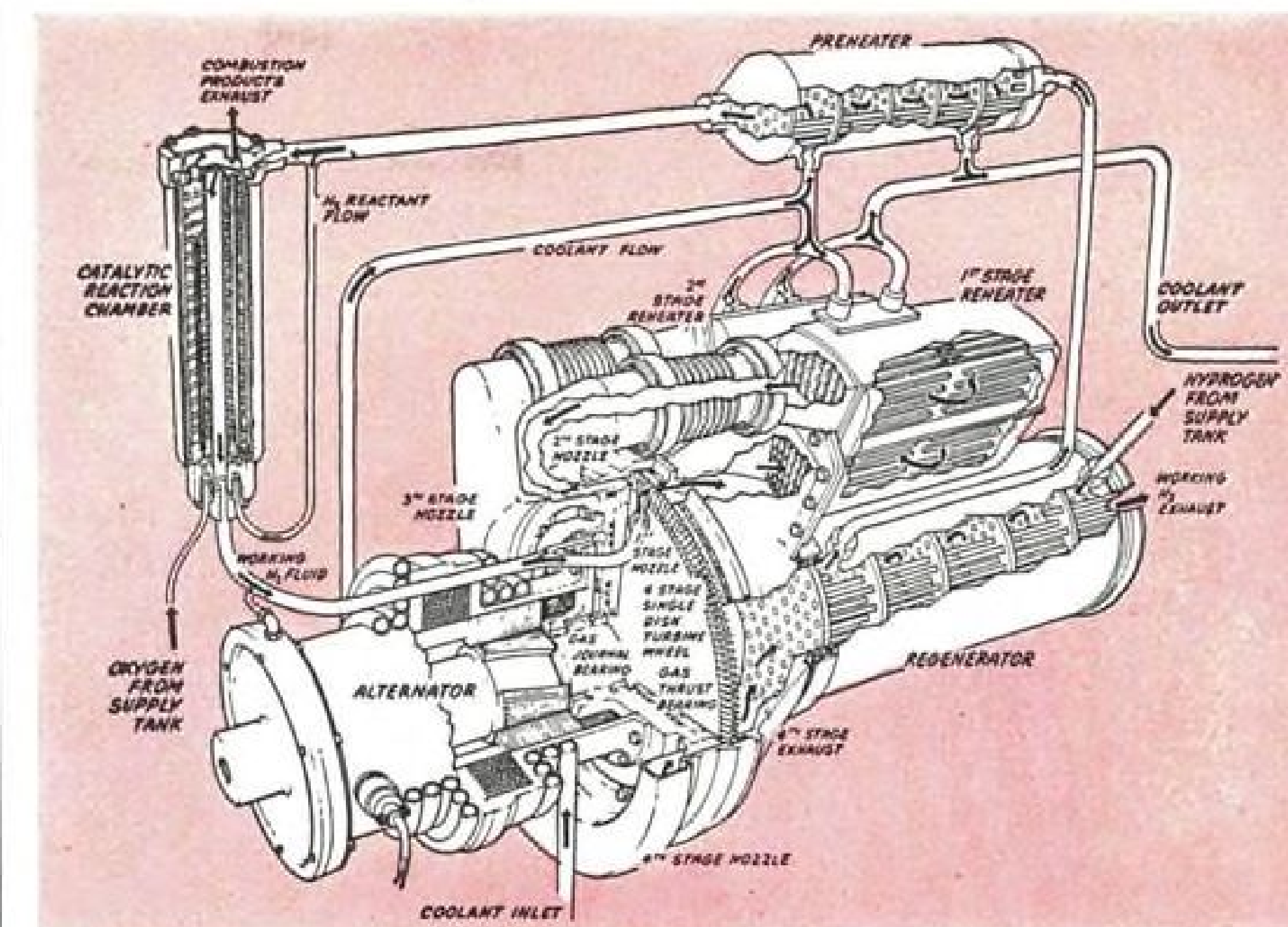
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AEROSPACE CALENDAR

(Continued from page 5)

- trol Processes, Society of Aerospace Material and Process Engineers, Hollywood-Roosevelt Hotel, Hollywood, Calif.
- Nov. 13-18—17th Annual Meeting and Space Flight Exposition, American Rocket Society, Pan Pacific Auditorium, Los Angeles, Calif.
- Nov. 14-16—17th Annual Meeting Armed Forces Chemical Assn., Statler-Hilton Hotel, Washington, D. C. Host: USN.
- Nov. 15-16—Seventh Symposium, Welded Electronic Packaging Assn., Thunderbird Motel, Los Angeles, Calif.
- Nov. 16-17—Second Canadian Institute of Radio Engineers Symposium on Communications, Queen Elizabeth Hotel, Montreal, Canada.
- Nov. 19-20—Mid-America Electronics Conference, Institute of Radio Engineers, Hotel Continental, Kansas City, Mo.
- Nov. 26-27—Western States Section Meeting, The Combustion Institute, Aerojet-General Corp., Sacramento, Calif.
- Nov. 26-29—Annual Coordinated Meetings: American Nuclear Society, Atomic Industrial Forum, and joint AtomFair, Sheraton-Park and Shoreham Hotels, Washington, D. C.
- Nov. 27-29—40th Meeting, Aviation Distributors and Manufacturers Assn., The Kenilworth, Miami Beach, Fla.
- Nov. 27-29—Fall Meeting, Radio Technical Commission for Aeronautics, Marriott Motor Hotel, Washington, D. C.
- Nov. 28-30—1962 Ultrasonics Symposium, Institute of Radio Engineers, Columbia University, New York, N. Y.
- Dec. 4-6—Fall Joint Computer Conference, Sheraton Hotel, Philadelphia, Pa. Sponsors: American Federation of Information Processing Societies; IRE.
- Dec. 4-6—1962 Convention, National Aviation Trades Assn., Fabulous Flamingo, Las Vegas, Nev.
- Dec. 6-7—Vehicular Communications Conference, IRE, Disneyland Motel, Los Angeles.
- Dec. 10-11—First Annual Symposium on Unconventional Inertial Sensors (classified), Republic's Paul Moore Research & Development Center, Farmingdale, N. Y. Co-sponsors: Bureau of Naval Weapons; Republic Aviation Corp.
- Dec. 10-12—Conference on VTOL Aircraft, New York Academy of Sciences, Henry Hudson Hotel, New York, N. Y.
- Dec. 26-31—Space Physics Meeting, American Rocket Society and American Assn. for Advancement of Science, Philadelphia, Pa.
- Dec. 27—American Astronautical Society Symposium on Scientific Satellites-Mission and Design, Franklin Hall, Philadelphia, Pa.
- Jan. 7-10—Millimeter and Submillimeter Conference, Institute of Radio Engineers, Cherry Plaza Hotel, Orlando, Fla.
- Jan. 13-16—15th Annual Convention, Helicopter Assn. of America, Cabana Motor Hotel, Palo Alto, Calif.
- Jan. 21-23—31st Annual Meeting (including Wright Brothers Lecture), Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y.
- (Continued on page 9)



A SENSIBLE WAY TO PROVIDE ACCESSORY POWER IN SPACE VEHICLES

This is the Sundstrand CRYHOCYCLE . . . a cryogenically fueled, fully integrated power generation and thermal control system. Sundstrand developed the turbine driven CRYHOCYCLE under a U.S. Air Force Systems Command contract. Powered by hydrogen and oxygen, the CRYHOCYCLE is unique in that normally wasted heat from energy conversion inefficiencies and even metabolic heat from the crew is recovered by the coolant loop and returned to the power cycle by interstage reheaters between each of the four stages of a single-disc turbine. Sundstrand has also developed a multi-stage reciprocating version of the CRYHOCYCLE for low power levels. This concept results in specific fuel consumption economy which has not been achieved by any other dynamic space power system. As a result fuel weight and volume are reduced. In addition, the CRYHOCYCLE operates at room temperature eliminating need for high temperature materials, solving wheel containment problems, and greatly improving inherent reliability and safety. Since the CRYHOCYCLE is independent of the environment, it is ideal for Lunar missions.

■ The CRYHOCYCLE is a sensible size, too. About the size of a gasoline lawn mower motor, it can be used in pairs for maximum reliability. ■ Several versions of this space power system are being developed which will be suitable for missions of several weeks' duration . . . at power levels from one kilowatt to 50 kilowatts. Both the turbine prime mover (shown) and the reciprocating machine have been publicly demonstrated to representatives of the aerospace industry and government service. ■ (A simple request on your business stationery and we will send you details concerning this and the other accessory space power systems which Sundstrand has under development.) ■ If you would like to work on the Sundstrand Engineering team in the development of practical solutions to challenging space power problems, write to: Personnel Director,



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RAYTHEON'S NEW SPARROW III GOES AIR FORCE

Already the U. S. Navy's prime air-to-air missile system, Raytheon's Sparrow III has now been selected by the U. S. Air Force for use on its F-4C tactical fighter.

The advanced Sparrow III which will be used by the Air Force is the result of a growth program that has seen major improvements phased in since the missile was first conceived in 1951. These improvements include substantial increases in range, speed and altitude capabilities.

The new Sparrow III employs a unique target seeker which provides maximum attack flexibility under operational conditions. Once locked on the target, the seeker guides the missile to the intercept, constantly refining its aim as it closes on the enemy aircraft.

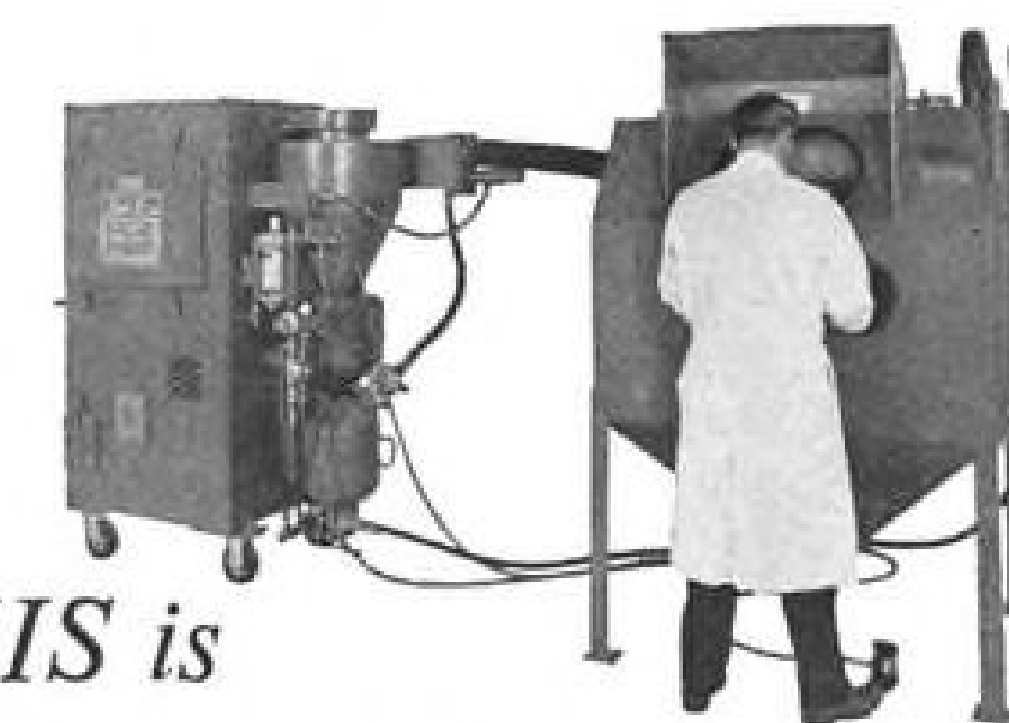
Sparrow III is further proof of Raytheon's ability to manage complex military systems — from early study through design, production and field support.

RAYTHEON

AEROSPACE CALENDAR

(Continued from page 7)

- Jan. 22-24—Ninth National Symposium on Reliability and Quality Control, Sheraton-Palace Hotel, San Francisco, Calif.
- Jan. 30-Feb. 1—Fourth Annual Solid Propellant Rocket Conference, American Rocket Society, Bellevue Stratford Hotel and The Franklin Institute, Philadelphia.
- Jan. 30-Feb. 1—National Winter Convention on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.
- Feb. 11-15—Third International Symposium on Quantum Electronics, UNESCO Building, Paris, France. Sponsors: International Scientific Radio Union; Office of Naval Research; La Federation Nationale Des Industries Electroniques.
- Feb. 20-22—1963 International Solid-State Circuits Conference, Philadelphia, Pa. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; University of Pennsylvania.
- Mar. 7-8—Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio.
- Mar. 11-13—Electric Propulsion Conference, American Rocket Society, Colorado Springs, Colo.
- Mar. 18-20—Space Flight Testing Conference, American Rocket Society and Institute of the Aerospace Sciences, Cocoa Beach, Fla.
- Mar. 19-21—Second Air Force-sponsored Symposium on Bionics, Biltmore Hotel, Dayton, Ohio.
- Mar. 25-28—International Convention, Institute of Radio Engineers, Waldorf-Astoria and Coliseum, New York, N. Y.
- Apr. 1-3—Fourth Annual Structures and Materials Conference, American Rocket Society and Institute of the Aerospace Sciences, El Mirador Hotel, Palm Springs, Calif.
- Apr. 2-5—Spring Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.
- Apr. 10-11—Fourth Symposium on Engineering Aspects of Magnetohydrodynamics, University of California, Berkeley, Calif.
- Apr. 17-19—International Nonlinear Magnetics Conference, Shoreham Hotel, Washington, D. C. Sponsors: American Institute of Electrical Engineers; Institute of Radio Engineers.
- Apr. 17-19—Southwestern Conference and Electronic Show, Institute of Radio Engineers, Dallas Memorial Auditorium, Dallas, Tex.
- Apr. 17-19—Technical Meeting: Nuclear Materials for Space Applications, American Nuclear Society, Netherland Hilton Hotel, Cincinnati, Ohio.
- May 2-3—Fourth National Symposium on Human Factors in Electronics, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington, D. C.
- May 7-9—Electronic Components Conference, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington, D. C.
- May 13-15—National Aerospace Electronics Conference, Institute of Radio Engineers, Dayton, Ohio.
- May 20-22—National Telemetering Conference, Hilton Hotel, Albuquerque, N. M.



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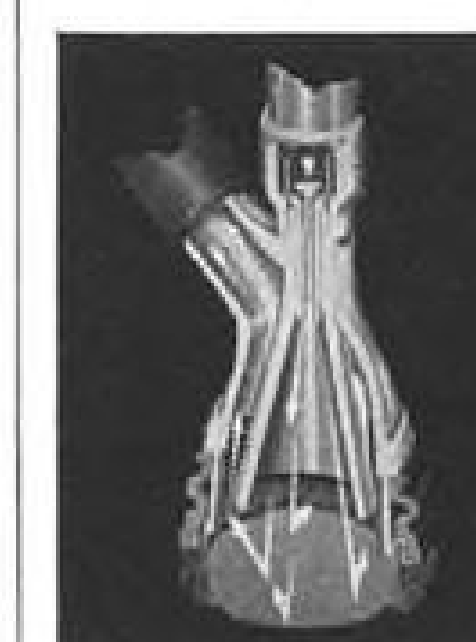


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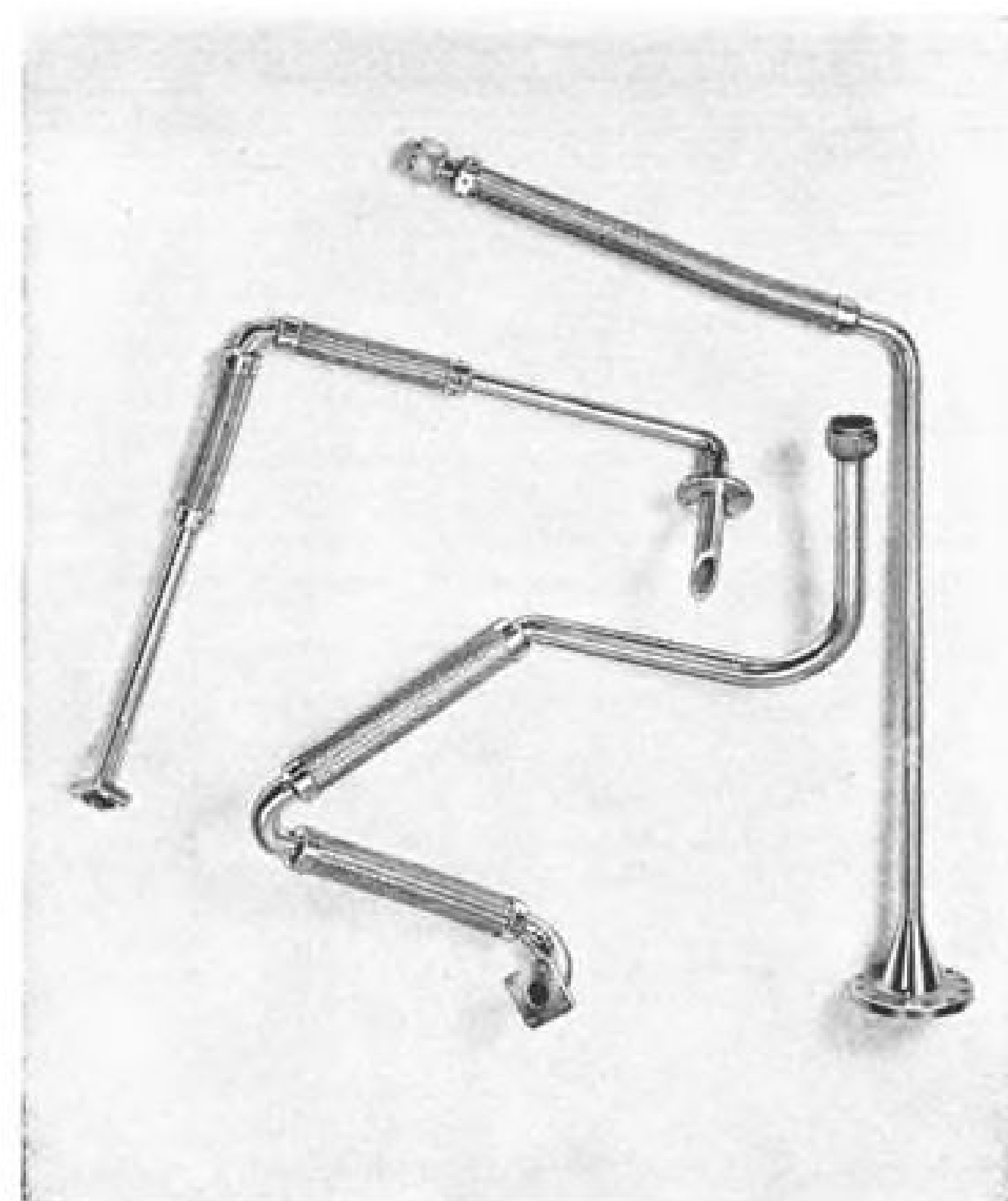
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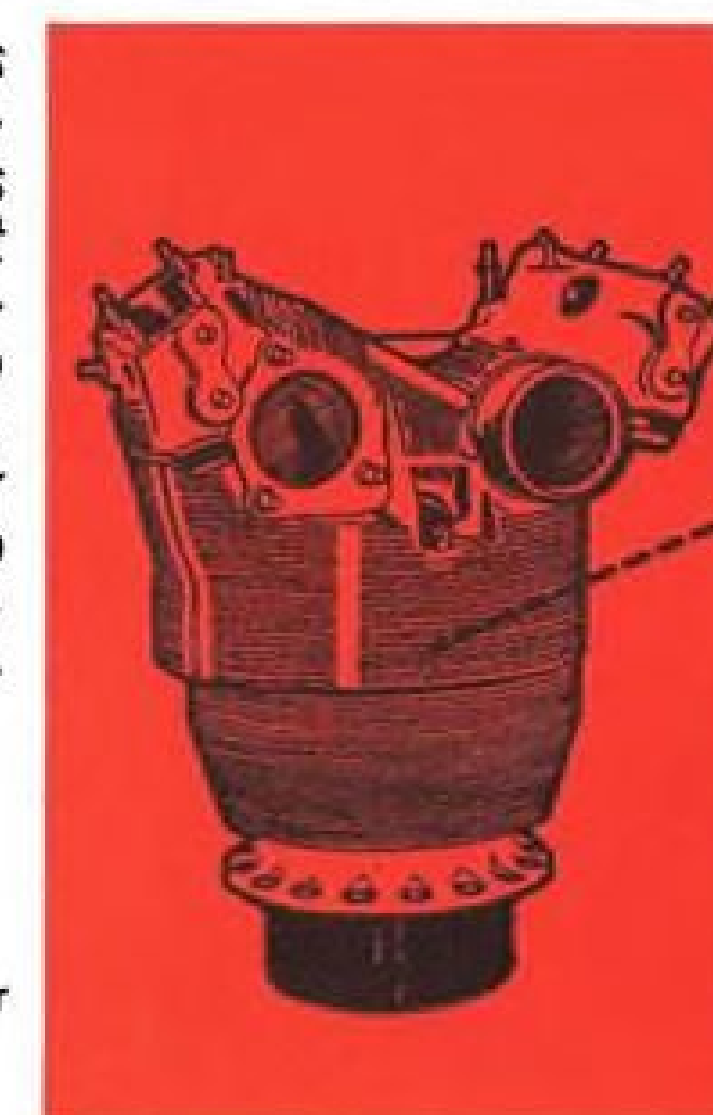
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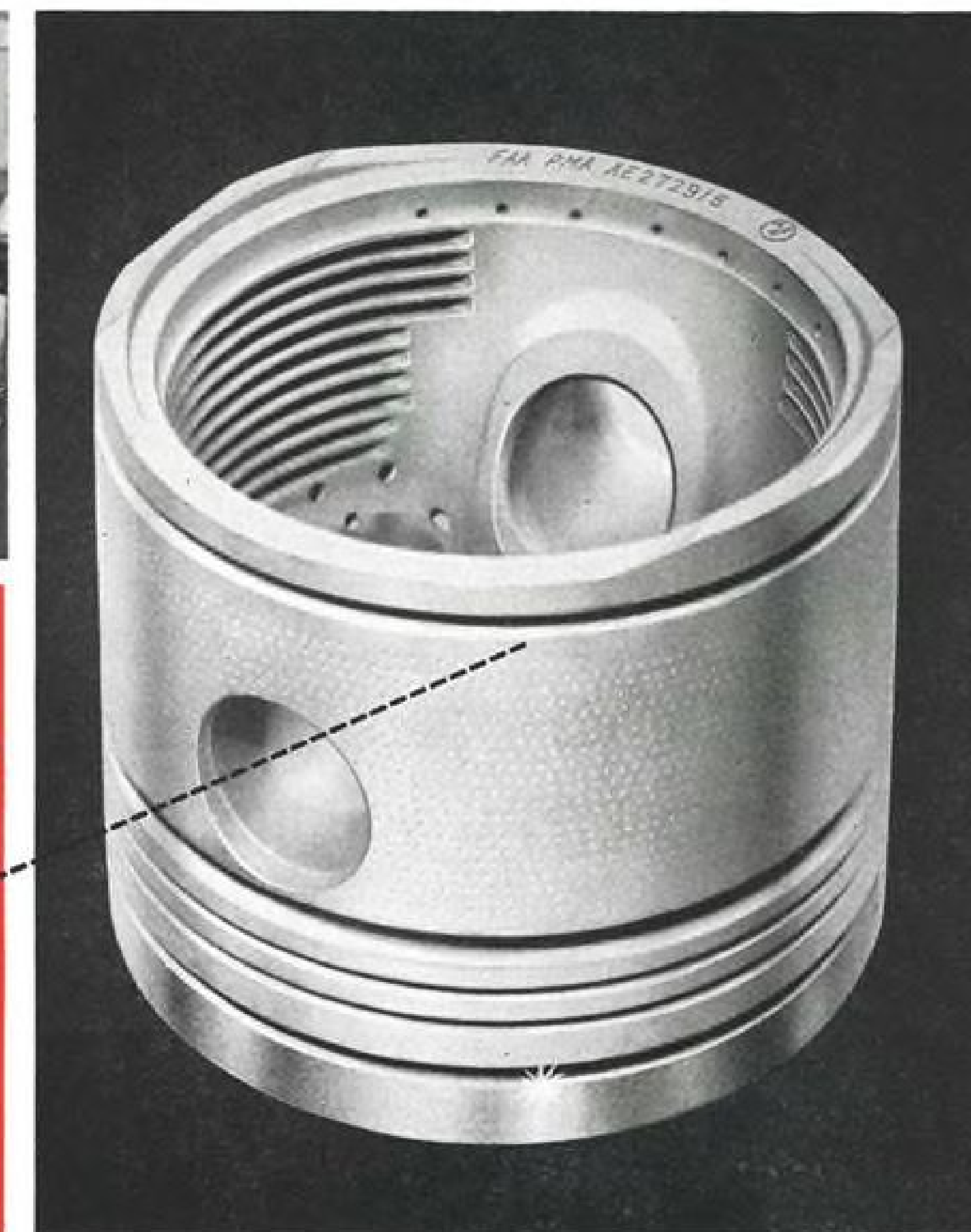
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Laboratory precision is maintained through procedures such as this electronic equipment capable of testing surface finish within micro inches. In background, quality control inspector uses metallograph to check metallurgical content of aluminum forging.



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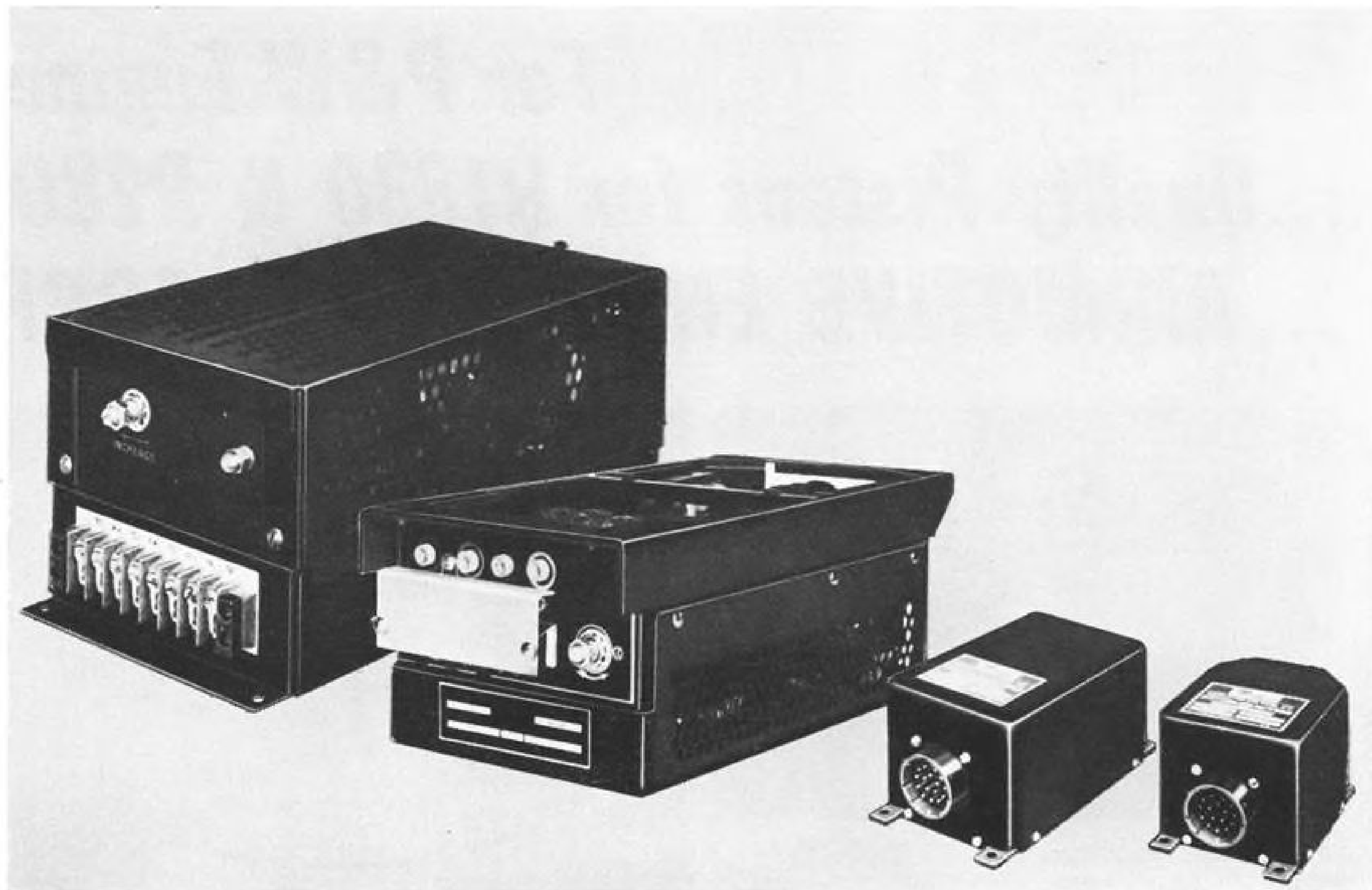
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to a handful.

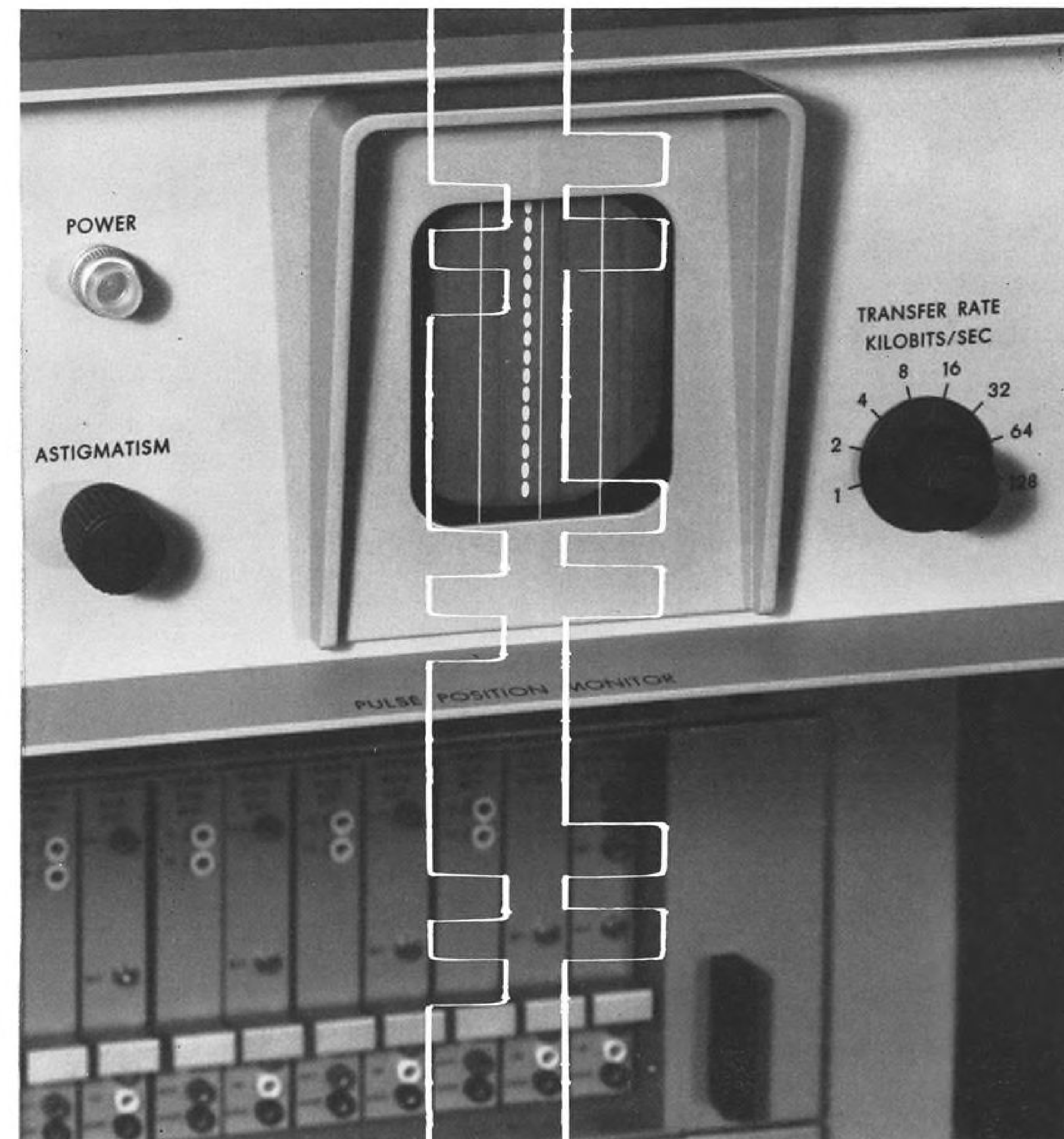
To be honest about it, we should say "less than a handful." But you get the idea. What was once a cumbersome piece of equipment now comes in a compact package that weighs exactly one pound. One pound!

These voltage regulators—for both aerospace and ground applications—are static, transistorized units containing no electron tubes. They are fully capable of

supplying all the necessary excitation of AC brushless generators (which we also happen to make) during both normal and fault conditions. We offer a complete line for any application.

We wrote a brochure to fill you in on all the details of our voltage regulators and brushless generators. Send for your free copy. Write us in Eatontown, New Jersey.

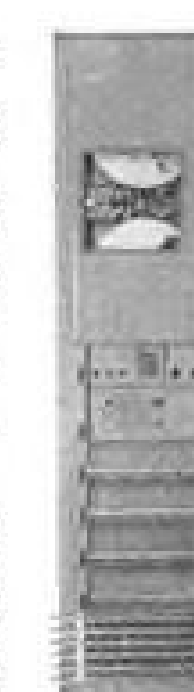
Red Bank Division



Who makes true PCM recording come true?

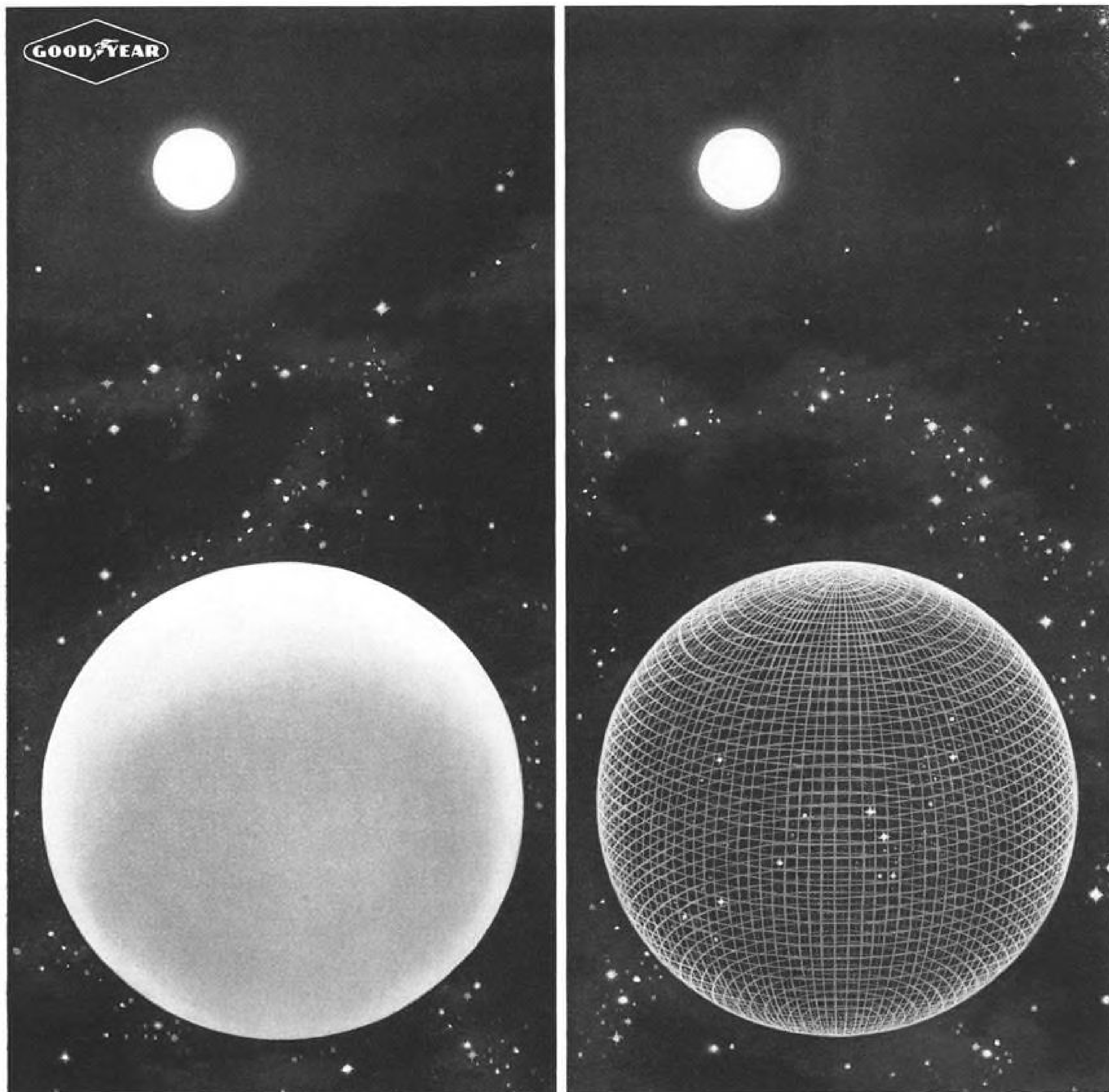
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You are looking at the newest PCM recorder designed to meet IRIG standards: the CP-200. This is not an adaptation of an FM or analog system. It's a pure PCM machine, especially designed to operate at 1000 bpi. (Maximum transfer rate: 120 Kc characters per second.) The CP-200 offers you this—and many other outstanding features. It has seven speeds, each electrically switchable from the front panel. It has a pulse position monitor and time



correction circuits to let you correct static errors caused by skew and gap scatter. It has modular construction, plug-in amplifiers and heads. And it bears the Ampex name—your assurance of reliable, superior performance. For more details on the CP-200 write the only company providing recorders, tape and memory devices for every application: Ampex Corporation, 934 Charter St., Redwood City, Calif. Worldwide sales and service.

AMPEX



IDEA: Build a communications satellite that's solar-pressureproof, but a mirror to microwaves

It's made of an inflatable rigid wire-mesh framework covered by a photolyzable film. The idea behind it: the film molecules unhook in space and disappear. This leaves a microwave antenna virtually unperturbed by solar pressure, impervious to meteorites.

This is only one of the GAC—Goodyear Aircraft Corporation—designed large antennas and structures for erection in space from small packages. We are building antennas with dielectric lenses; structures with coated plastic

films that are optically reflective but radar transparent; self-erecting flexible sponge-type structures; and pack-ageable horn antennas. Each is typical of GAC's capabilities in land, sea, air or space defense systems.

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Pictured above are only a few examples from an impressive variety of special quick disconnect couplings designed and produced by Aeroquip for manufacturers of aircraft, missiles, electronic equipment and ground support equipment.

Complex quick disconnect problems involving hydraulics, pneumatics, fuels, oils, corrosive fluids, gases and electronic cooling systems have been solved quickly and effectively. Basic coupling designs include threaded, PUSH-PULL, break-

away, remote control, self-sealing, miniaturized, SAF-LOC and many other types.

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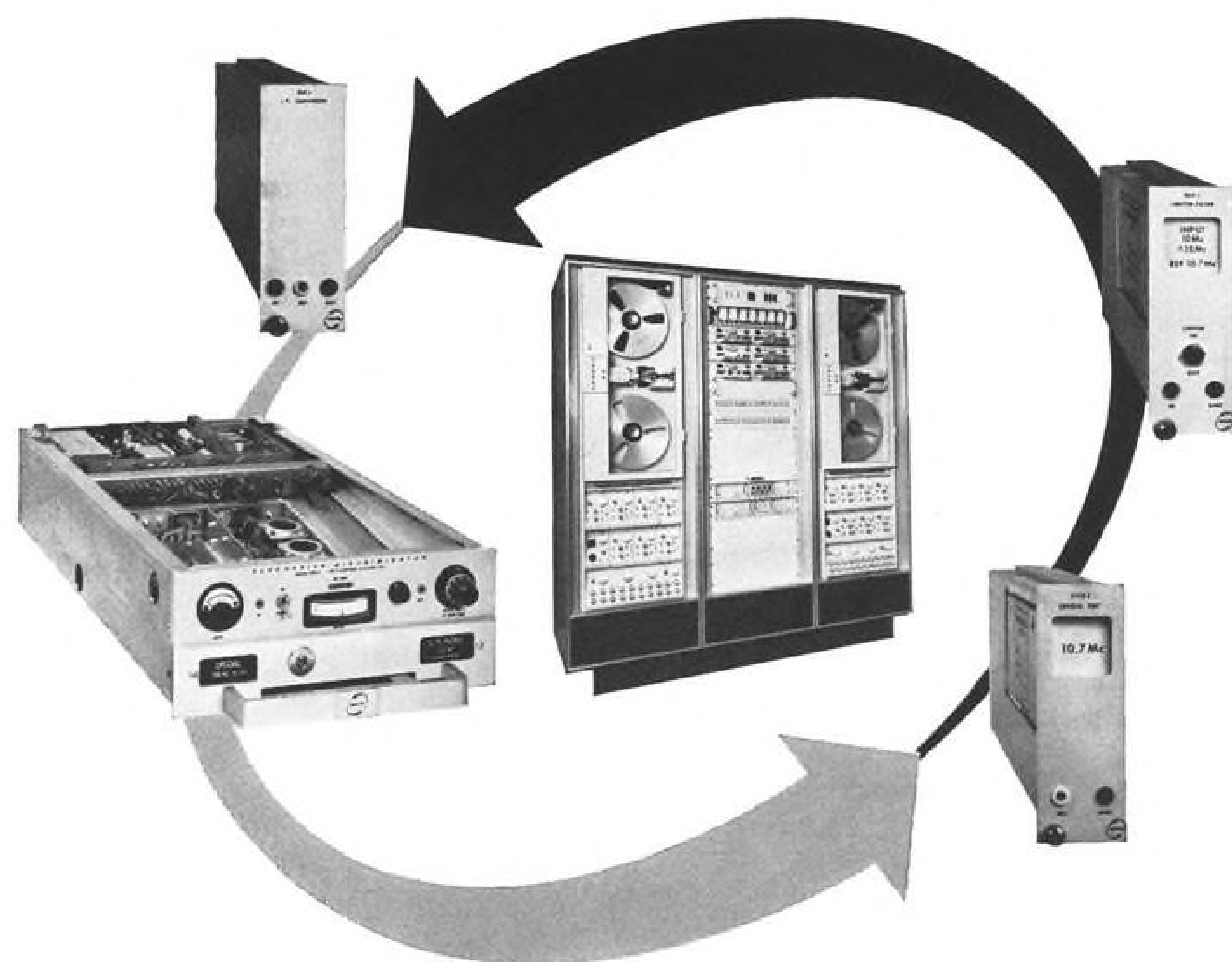
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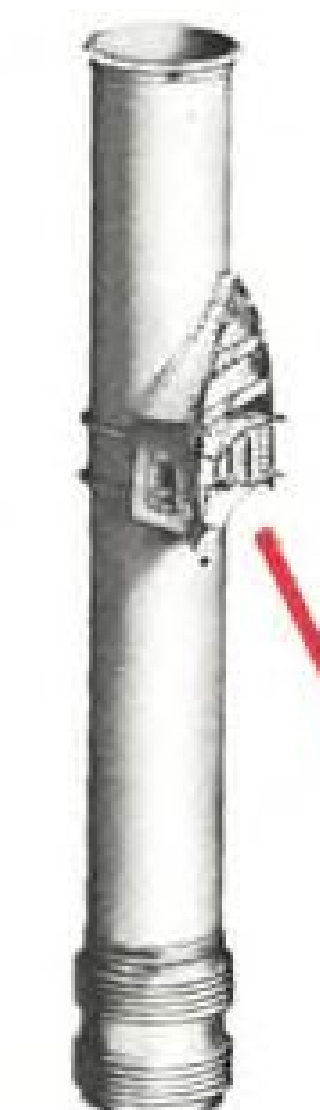
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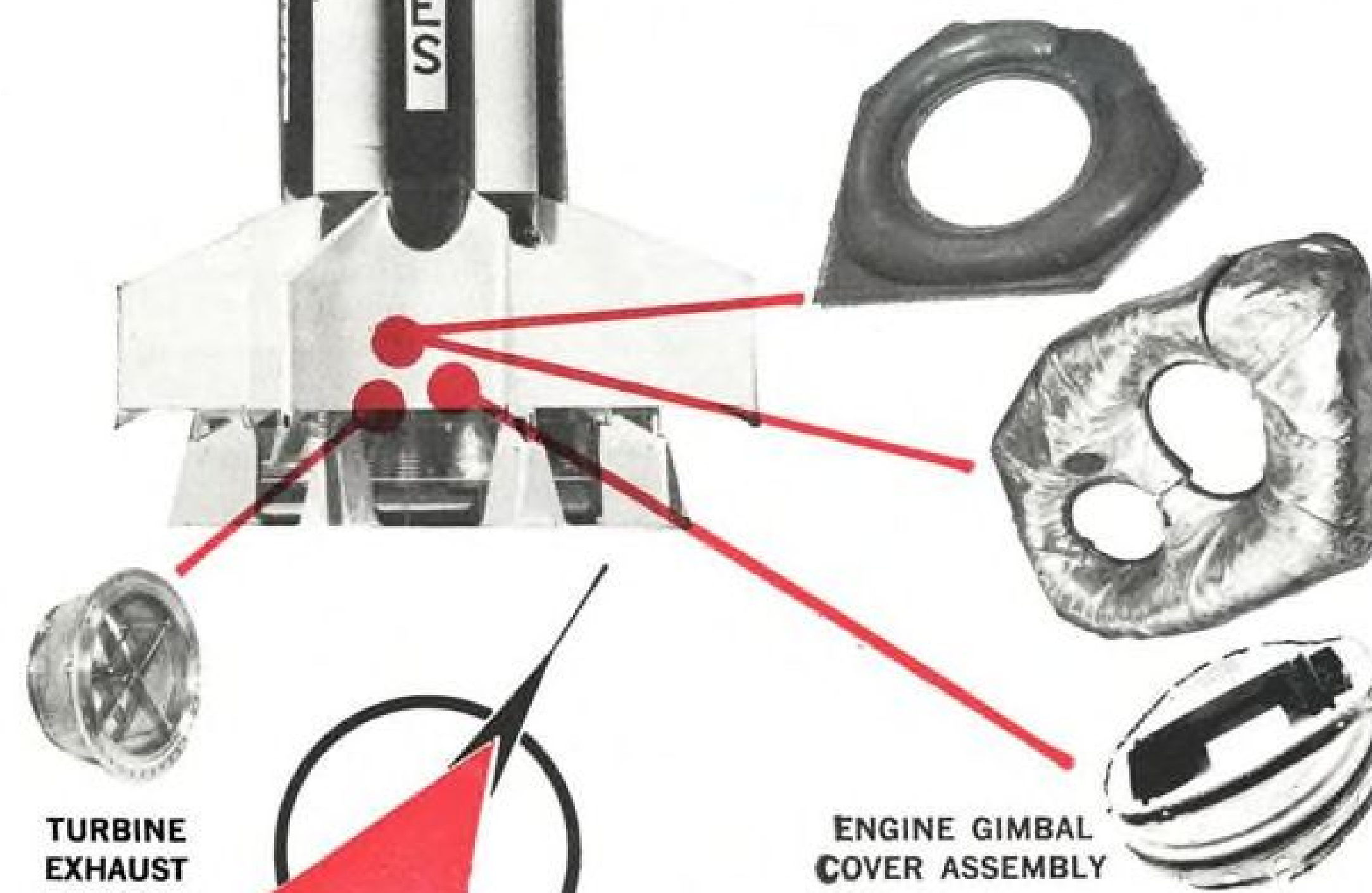
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Electro-hydraulic Servo Drives give "reflex action" to **MAULER** Launching Pod

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

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

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

Here, then, is the unique advantage offered by Vickers Incorporated to any potential user of electro-hydraulic servo systems: extensive design capabilities coupled with a broad line of existing

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

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MO-241

Volume 77
Number 18

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COVER: Rollout is of the first DC-8F Jet Trader—combination cargo-passenger transport. Aircraft is scheduled for delivery to Trans-Canada Air Lines for service beginning Jan. 2. This is the first of four DC-8Fs for Trans-Canada. A fifth has been ordered by Trans International Airline, a supplemental air carrier in which Studebaker Corp. recently acquired a controlling interest (AW Oct. 22, p. 38). Aircraft has a fully convertible interior which can be utilized either to carry 189 economy class passengers or as an all-cargo plane carrying 95,282 lb. of cargo, or 13 different combinations of passengers and cargo. Powerplant is a Pratt & Whitney JT3D turbofan with performance the same as the Series 50 DC-8.

PICTURE CREDITS

Cover: Robert Ferguson, Douglas Aircraft Corp.; 26, 27, 28, 30, 33—Dept. of Defense; 29, 34—Aviation Week; 39, 40—UPI; 43—American Airlines; 44, 45—Lockheed Aircraft Corp.; 47—Pratt & Whitney; 54, 55—General Dynamics; 57—NAA Autonetics; 59—(top), 78—Westinghouse, (bot.) EMI Electronics, Ltd.; 63—ACF Industries; 72—USAF; 73—Union Carbide Corp.; 77—Douglas Aircraft; 92, 93, 97—Omnipol; 99—Mooney Aircraft Corp.; 106, 107—Kaman Aircraft; 112—Lockheed Aircraft.

AVIATION WEEK and SPACE TECHNOLOGY, October 29, 1962

19

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EDITORIAL

The Cuban Crisis

The speed and firmness with which U.S. military power was applied to counter the threat of offensive nuclear weapons in Cuba was as heartening to the American people and their Allies as it was surprising to their foes. Establishment of the naval and aerial blockade to shut off the flow of Russian missiles and jet bombers to Cuba was certainly the most decisive reply to Soviet aggression since the Communist attempt to conquer Korea was repelled by armed forces of the U.S. and United Nations.

There are still several chapters to unfold in this Cuban crisis and it is premature to reach any firm conclusions yet. However, the initial Russian reaction in turning back a dozen of its Cuba-bound ships carrying offensive weapons, including the Poltava with a load of IRBMs, indicates the Soviets are wary of pressing their Cuban venture further in the face of U.S. military power. Certainly the next critical phase of the action initiated last week by President Kennedy will come from the choice of methods by which the missiles and bombers already in Cuba are withdrawn or rendered useless.

Diplomatic Deceit

The manner in which the Soviets attempted to set up their nuclear missile base in Cuba should convince anybody that still needs to be convinced of the utter folly of accepting anything the Soviet leaders say at face value. For at the very time Soviet Foreign Minister Andrei Gromyko was sitting in the White House assuring President Kennedy that the Soviets had no intention of supplying Cuba with offensive arms, thousands of Soviet technicians were building MRBM and IRBM missile pads in the Cuban hills, and assembling twin-jet Il-28 bombers on Cuban airfields, and a stream of Soviet ships was sailing for Cuba with deckloads of IRBMs and other missiles and bombers. Not since the Japanese ambassador chatted with Cordell Hull while the bombs rained down on Pearl Harbor has there been such a callous exhibition of diplomatic deceit perpetrated on this nation. The speed and magnitude of the Soviet ballistic missile build-up in Cuba showed clearly that once again they hoped to present the U.S. with an aggressive fait accompli, and then use it as a lever to extend Soviet imperialism by the negotiating technique of an armed robber.

The Air Force and Navy pilots who flew the photo reconnaissance missions that exposed this Soviet fraud deserve great credit for the skill and courage with which they successfully executed these missions, ranging from the extreme-altitude U-2 flights to the low-level oblique photo runs of Navy F8Us. The legion of skilled photo

interpreters that spotted and identified the vital missile installations are more unsung heroes of this and other episodes of the cold war's warmer phases.

With the incontrovertible evidence of Soviet deceit garnered by these pilots and photo interpreters, it was horrifying to see an intramural squabble within the U.S. government almost lose the total value of these pictures in establishing the validity of President Kennedy's case to even the most skeptical international observers. Some tiny minds in the intelligence bureaucracy stoutly maintained that public release of these pictures would compromise "their" intelligence techniques, as though aerial photography was a mystic rite known only to the druids of Langley Castle (Va.). President Kennedy's case would have gained even more impact if he had shown these damning pictures on television during his nationwide speech on October 22. But this powerful evidence was emasculated by the petty bureaucrats in the intelligence caverns. The spectacle of Defense Secretary McNamara waving these pictures before a Pentagon press conference—which included Russian reporters—and then saying they were too secret for the American people to see is a vignette of official stupidity that will be hard to top. The American Embassy official in London who "inadvertently" released them to the British press and television deserves his country's thanks and a medal, too, for breaking this bottleneck of bureaucratic absurdity and paving the way for this proof of Soviet perfidy to be plastered around the world.

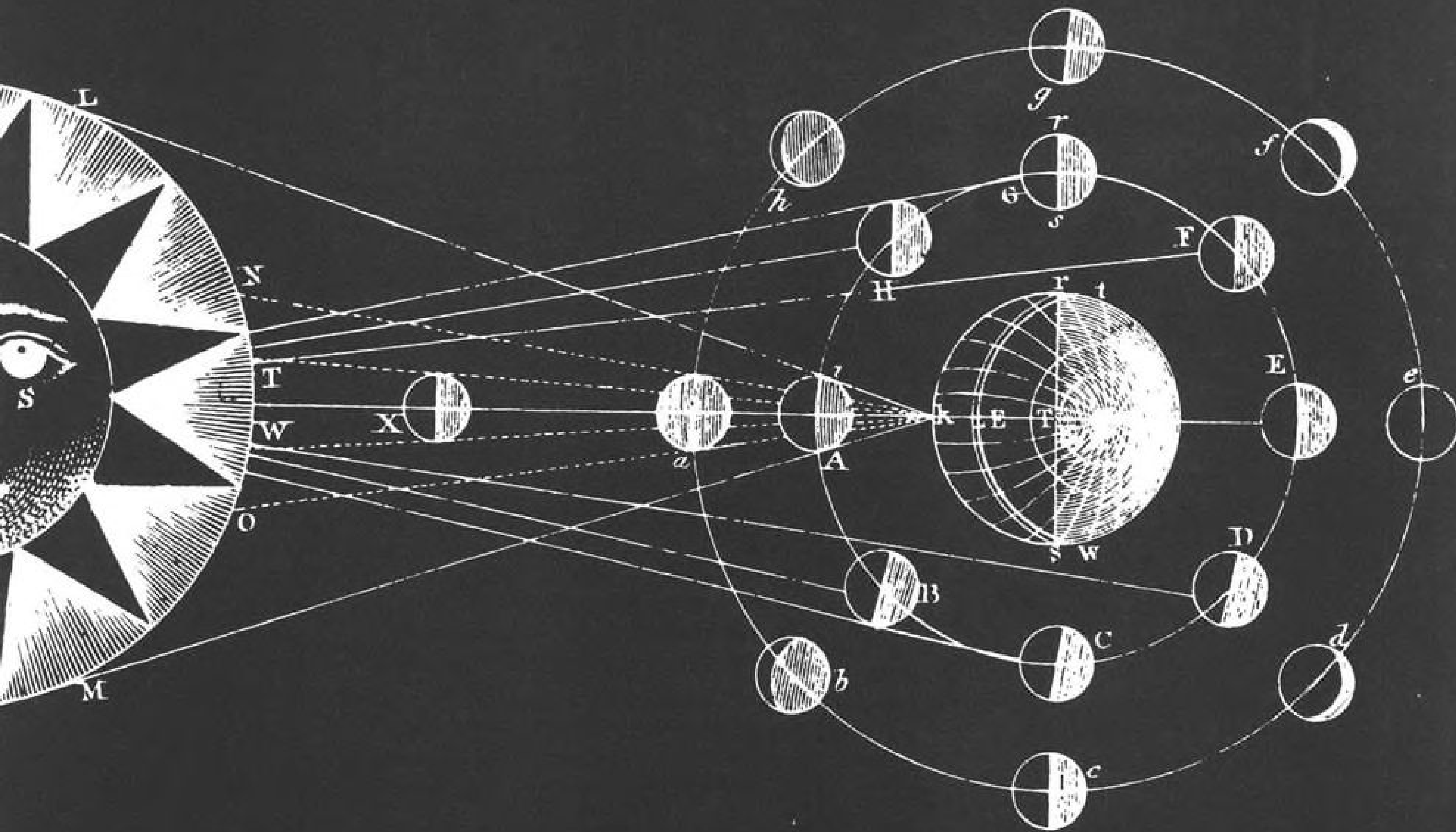
Long Overdue Move

The Cuban blockade is just the first step in a process—which should have begun many, many years ago—of opposing the extension of Soviet imperialism wherever it attempts to overflow its boundaries. It will require not only superior technical skill, such as the aerial reconnaissance techniques that unmasked the Soviet aims in Cuba, but also superior intelligence in their application and the determined stamina of national will that cannot be bullied or frightened into dissolving the basic elements of a free society.

Because we have retreated so long in the face of this Soviet imperialism and because we have taken so long to recognize the stark, ugly outline of this threat, the road back will be longer and the tolls along the way higher. But it is a road we must travel if the world is not to be inundated by a flood of ancient barbarity cloaked in the modern political dogma of communism.

—Robert Hotz

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



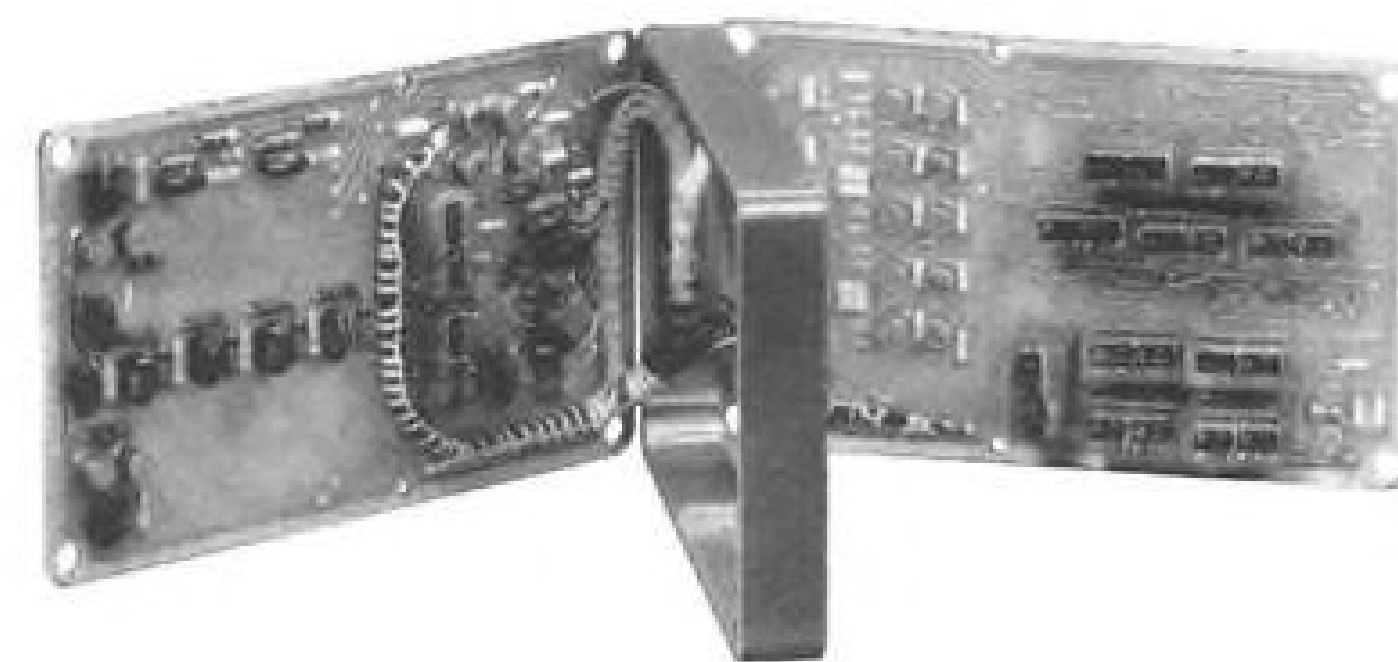
NEW DIMENSIONS IN SPACE

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

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

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

For more information write Marketing department—47.



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

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WHO'S WHERE

In the Front Office

Richard T. Orth, vice president and general manager, Eitel-McCullough, Inc., San Carlos, Calif. Also: **John W. Gilpin**, secretary.

John Mihalic, group vice president, Avco Corp., Cincinnati, Ohio, in charge of the Cincinnati, Richmond (Ind.) and Nashville (Tenn.) Divisions.

Rear Adm. Norman F. Garton (USN, ret.), vice president, Greer Hydraulics, Inc., Los Angeles, Calif., in charge of the company's Equipment Division. Adm. Garton has resigned as president and chief executive officer of Vought Camera Co. but continues as board chairman.

Thomas F. D'Andrade, vice president-sales, Advance Instrument Corp., Belmar, N. J.

Robert D. Calvert, president and general manager, Calumet & Hecla's Flexonics Division, Bartlett, Ill.

Paul S. Collins, vice president-corporate planning and product development, The Electrada Corp., Los Angeles, Calif.

Cornelius P. McNamara, vice president, Emerson Research Laboratories Division of Emertron, Inc., Silver Spring, Md.

Charles L. Elkins, vice president and treasurer, Hopkins Engineering Co., San Fernando, Calif.

Boeing Co. has named the following as vice presidents of the Aero-Space Division, Wichita, Kan.: **Robert W. Tharrington**-assistant general manager; **George H. Stoner**-manager, Saturn Booster Branch; **T. A. Wilson**-manager, Minuteman Branch; **George Snyder**-manager, X-20 (Dyna-Soar) Branch.

Thaddeus L. Dmochowski, executive vice president, ITT Information Systems Division of International Telephone and Telegraph Corp., New York, N. Y.

Machlett Laboratories, Inc., Springdale, Conn., a subsidiary of Raytheon Co., has elected the following as vice presidents: **Edward J. Gannon**-operations manager; **Rodney E. Nelson**-marketing manager; **Thomas H. Rogers**-X-ray product line manager. Also: **John F. McGovern**, treasurer, and **Dr. Howard D. Doolittle**, technical director.

A. W. E. Houghton, appointed to the board of British Aircraft Corp., London, England, as production director. Mr. Houghton continues as managing director of Vickers-Armstrongs (Aircraft), Ltd., a subsidiary of BAC.

Honors and Elections

Dr. Charles Stark Draper, head of the Department of Aeronautics and Astronautics of Massachusetts Institute of Technology, has received the Instrument Society of America's highest award, Honorary Lifetime Member, in "recognition and appreciation of his outstanding and dedicated service to the advancement of the science and technology of instrumentation . . ."

Harry B. Smith, engineering manager of the Westinghouse Defense Center's Air Arm Division, has received the David Sarnoff Award from the American Institute of Electrical Engineers for his "contribution to the field of Doppler radar and other areas of applied electronics."

INDUSTRY OBSERVER

► Four of the first five McDonnell Gemini two-man capsules to fly will be manned and will attempt full missions, under present planning by National Aeronautics and Space Administration. First flight will be an unmanned ballistic mission intended to man-rate the Martin Titan 2 booster (AW Sept. 3, p. 38) and to subject the capsule to severe heat loads. Second will be a manned, 18-orbit mission; third and fourth will be manned 14-day flights, and the fifth will be the first attempt at manned rendezvous with an Agena B stage. Standard capsule will weigh about 6,600 lb., and the rendezvous version about 7,700 lb.

► Kaman, Sikorsky and Vertol are expected to submit proposals for an Army fighter-helicopter similar to Bell's Warrior concept (AW Oct. 22, p. 32). Kaman previously has shown interest in jet thrust as a means of relieving rotor loading to increase helicopter speed. Sikorsky's proposal probably will center around a slimmed-down S-62. Rapid availability for use in a Vietnam-type environment is a major requirement. Longer-range studies also are under way for a large transport vehicle whose speed and payload requirements indicate that a compound helicopter would be required (AW Sept. 3, p. 13).

► All industry proposals submitted in Jet Propulsion Laboratory's competition for a 210-ft. antenna to improve deep space tracking from its Goldstone site (AW Sept. 3, p. 16) have been rejected because their prices exceeded funds allocated for the project. JPL is now considering relaxation of its requirements and is asking industry to compromise on price, preparatory to a new competition. Possibility of seeking a foreign source for the procurement was rejected by JPL and National Aeronautics and Space Administration. Companies believed to have submitted proposals include North American Aviation's Columbus Division, Radio Corp. of America teamed with Blaw-Knox, and Rohr Aircraft teamed with Minneapolis-Honeywell.

► British Aircraft Corp. is attempting to interest Ministry of Aviation and Air Ministry in the Hunting T.145 version of the Jet Provost trainer. Major change contemplated is a pressurized cockpit for high-altitude fighter training (AW Sept. 10, p. 26). The prototype will not be built unless government support is furnished.

► Operational experience with the French Sud Alouette turbine helicopter in Algeria—where sand proved to be a major source of foreign-object damage—provided initial impetus for Vertol's development of a particle separator for the Marine Corps' CH-46A Sea Knight assault helicopter (AW Oct. 22, p. 30). Vertol has found that even sand-impregnated, non-skid walkways on the upper fuselage are a source of sand particles, and these walkways are being eliminated.

► Time between overhauls on Rolls-Royce Tyne turboprop engines in Trans-Canada Air Lines' Vickers Vikings has been increased to 2,050 hr. TBO for Tynes in Canadair CL-44s has been increased to 1,600 hr. for Flying Tiger Line and 1,400 hr. for Seaboard World.

► Hunting Aircraft of England has completed engine runup tests of the H.126 jet-flap research aircraft (AW Sept. 3, p. 21) and will start taxi trials next week. On completion, the aircraft will be dismantled and trucked to the Royal Aircraft Establishment's flight test research field at Bedford for its first flight, scheduled for early December.

► Twenty Blackburn Buccaneer Mark 2 naval strike fighters sold to South Africa (AW Oct. 15, p. 37) will be fitted with slipper fuel tanks for long-range missions in patrolling Cape of Good Hope shipping lanes. The tanks will hold 250 gal. each and are hung outboard of the engine pods (AW Apr. 23, p. 19). The planes will be land-based, since South Africa has no aircraft carriers.

► Lockheed Propulsion Co. will deliver seven additional MG-18 high mass fraction (approximately 0.92) solid-propellant rocket motors to Air Force Space Systems Division, as a fourth stage for Blue Scout firings from Pt. Arguello for Deep Space Probe Program.



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Washington Roundup

Crisis Information Plan

Kennedy Administration is trying to develop a military information policy to fit the security needs of cold war crises like the Cuban one without resorting to the degree of censorship imposed during a shooting war.

President Kennedy himself gave the rationale for such an effort by declaring in his Cuba speech that "we no longer live in a world where only the actual firing of weapons represents a sufficient challenge to a nation's security to constitute a maximum peril."

White House Press Secretary Pierre Salinger last week took the first step toward implementing a "crisis" information policy by issuing guidelines to news media on the type of military information the Administration considers "contrary to the public interest." He contended the guidelines are not as far reaching as the voluntary censorship followed in wartime, but there is little apparent difference.

Salinger was particularly vexed about television interviews which tried to obtain from servicemen's wives such specific military information as ship and troop movements. The White House appeal to U.S. news media to "exercise caution and discretion" was to be followed up by discussions with foreign newsmen about safeguarding sensitive information.

The Administration is coupling its appeal to the press with strict rules about what military information Defense Dept. personnel can release. White House officials themselves consider the rules stringent. Immediate result of the new rules will be a clamp-down on all types of military information until Defense Dept. personnel feel more sure about what they can and cannot say.

Production Stepup

Defense Dept. last week started calling in aerospace contractors to learn how fast they could increase production if the need arose. The crisis atmosphere reduced the chance that Defense officials would go ahead with many plans to phase out aircraft production in several areas.

Political considerations are increasing the likelihood that Defense will choose a second source for producing the McDonnell F-4B Phantom for the Navy and Air Force (F-4C) (AW Sept. 24, p. 25). McDonnell contends it would be cheaper to increase production by letting the firm extend its subcontracting, asserting that 57% of the work on the aircraft already is subcontracted.

Explorers Club has succeeded in getting more than 50 leaders of aerospace firms to sponsor a dinner in New York Nov. 2 for National Aeronautics and Space Administration Administrator James E. Webb and the astronauts. The \$100-a-plate dinner is listed in the invitation as tax-deductible. Part of the proceeds will go into the club's building fund.

NASA's Talent Hunt

For the first time, NASA is employing management recruiting firms in hopes of finding 10 research and development executives to supervise integration and systems engineering for manned space flight programs. NASA will pay the Los Angeles firm of Ernest L. Lowen a \$9,000 fee and \$5,500 expenses, and the New York firm of George Fry a fixed fee of \$11,550. Both firms will submit lists of candidates and the space agency will choose 10 for positions paying \$16,000 to \$19,000.

U. S. and Japan are nearing agreement on the location and operation of a ground station in Japan to track Telstar and other communication satellites.

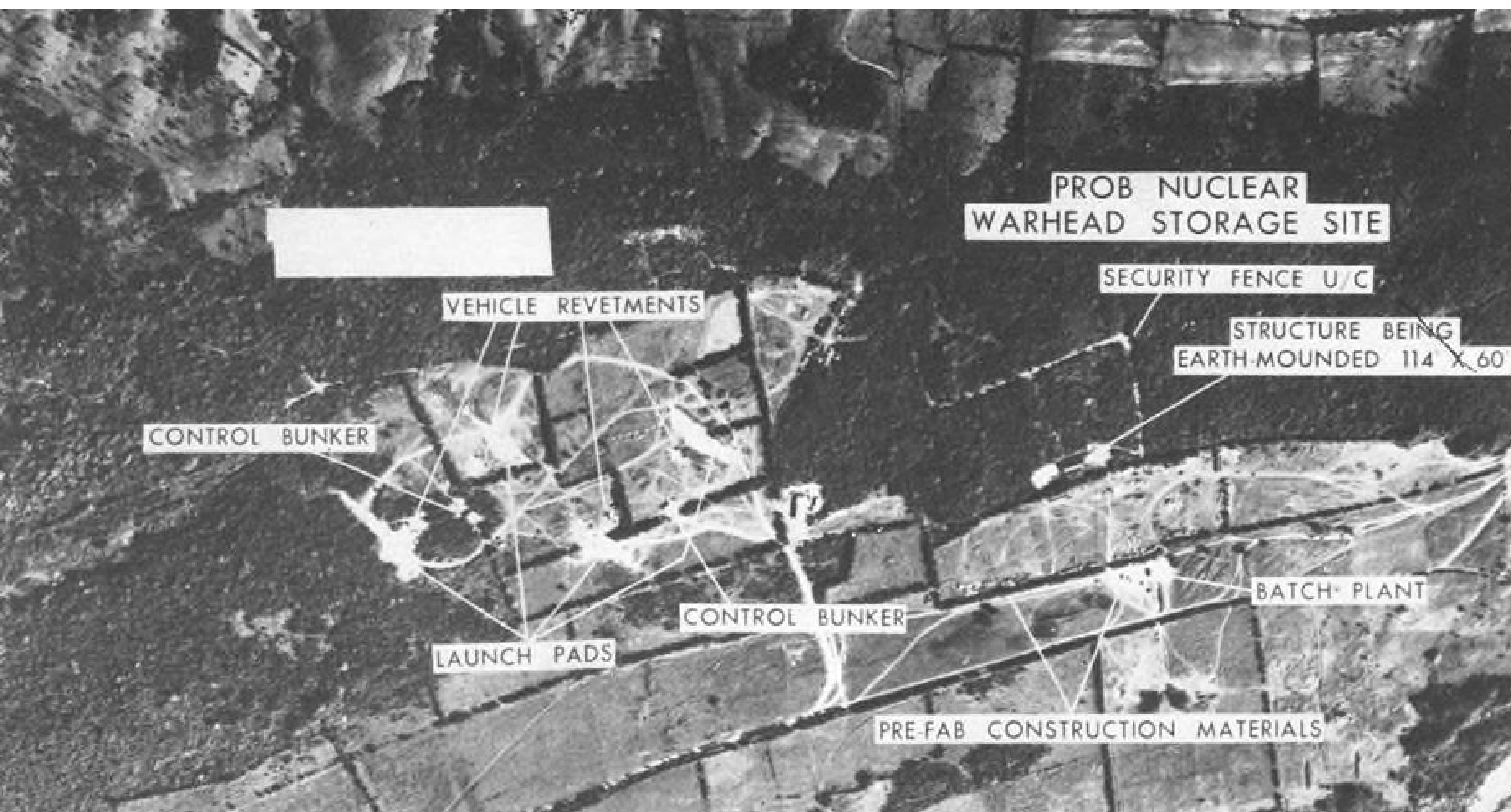
Maj. Gen. Alfred Starbird of the Army Engineers, former director of the Atomic Energy Commission's military applications division and now commander of Joint Task Force 8 conducting the current series of U.S. nuclear tests, has been named director of the Defense Communications Agency. He will replace Rear Adm. W. D. Irvin, who has headed the agency since its creation two years ago.

Cuban Refugee Airlift

Airlift of Cuban refugees who supplied vital information about the Soviet missile buildup on the island, ended last week when Pan American World Airways stopped service there (see p. 40). Pan Am, the last U. S. carrier to suspend Cuban service, flew more than 106,000 refugees from Havana to Miami since January, 1961. Another 50,000 Cubans were waiting to fly to Miami when Cuba ordered the service to halt.

Discordant note: New York Port Authority refused to let two Il-18 airliners carrying 100 Soviet musicians slated to appear in New York land at Idlewild unless the Russians provided information about engine noise. The Russians did not supply the information and landed in Philadelphia International Airport.

—Washington Staff



ONE OF THREE PHOTOS of Soviet ICBM sites in Cuba which were shown to newsmen by U.S. agencies last week shows preparation of fixed launch sites, plant for mixing of batches of concrete, probable storage facility for nuclear warheads. ICBM sites have four launch pads each, with one concrete bunker serving each pair of pads. They are soft installations. Missiles have 2,200-naut.-mi. range. No ICBMs had been spotted by early last week. U.S. discovered 8 to 10 sites for ICBM and medium-range ballistic missiles.

Russia Avoids Early Chance to Test U.S.

Washington—Soviet Russia avoided its first opportunity for a showdown late last week over a U.S. sea and air blockade designed to halt the sudden and rapid flow of offensive Soviet strategic weapons into Cuba. At least a dozen of the two dozen Russian vessels which were headed for Cuba when the blockade began turned back, Defense Dept. said.

The U.S. demonstrated that its blockade—announced Oct. 22 by President Kennedy and effective at 10 a.m. EDT on Oct. 24—was aimed only at specified Soviet weapons when it permitted the first Russian ship that encountered U.S. Navy forces to proceed because her cargo was petroleum.

Diplomatic moves aimed at promoting talks between President Kennedy and Soviet Chairman Nikita Khrushchev continued in the United Nations and among U.S. allies, Soviet bloc countries and non-aligned nations. But the U.S. appeared to have no intention of negotiating until it had some guarantee that President Kennedy's demand for "withdrawal or elimination" of the offensive weapons would be met.

Late last week the White House said that a number of Russian ships still were headed for Cuba and that "work is still continuing on Soviet missile bases in Cuba as of now."

Basis for the blockade—the strongest political-military move taken by the U.S. since the Korean War—was the discovery of Soviet medium- and intermediate-range missile sites and Ilyushin tactical bombers in Cuba (see p. 31). This is the first time that Russia has ever based strategic missiles outside its own territory. These missiles, designed to use nuclear warheads, were brought in with what the State Dept. called

"stealth and deceit" and upset "a very precarious balance which has existed now for some years" in the Western Hemisphere.

The blockade became effective only nine days after the discovery—apparently through aerial photo reconnaissance—that Russia at last had begun the long-expected delivery of offensive weapons to its Caribbean ally. It was preceded by a great strengthening of U.S. forces in the southern U.S. and in the Atlantic and a sharply increased state of readiness in this nation's military forces around the world (see box, p. 31).

The U.S. actions were the strongest counterthrust so far to a policy of "rocket diplomacy" and "missile blackmail" begun by Russia in the summer of 1957 when it announced shortly before the launching of Sputnik 1 that it had successfully fired an intercontinental missile.

A special U.S. blockade task force was prepared to halt, search and if necessary sink any ship of any nation that

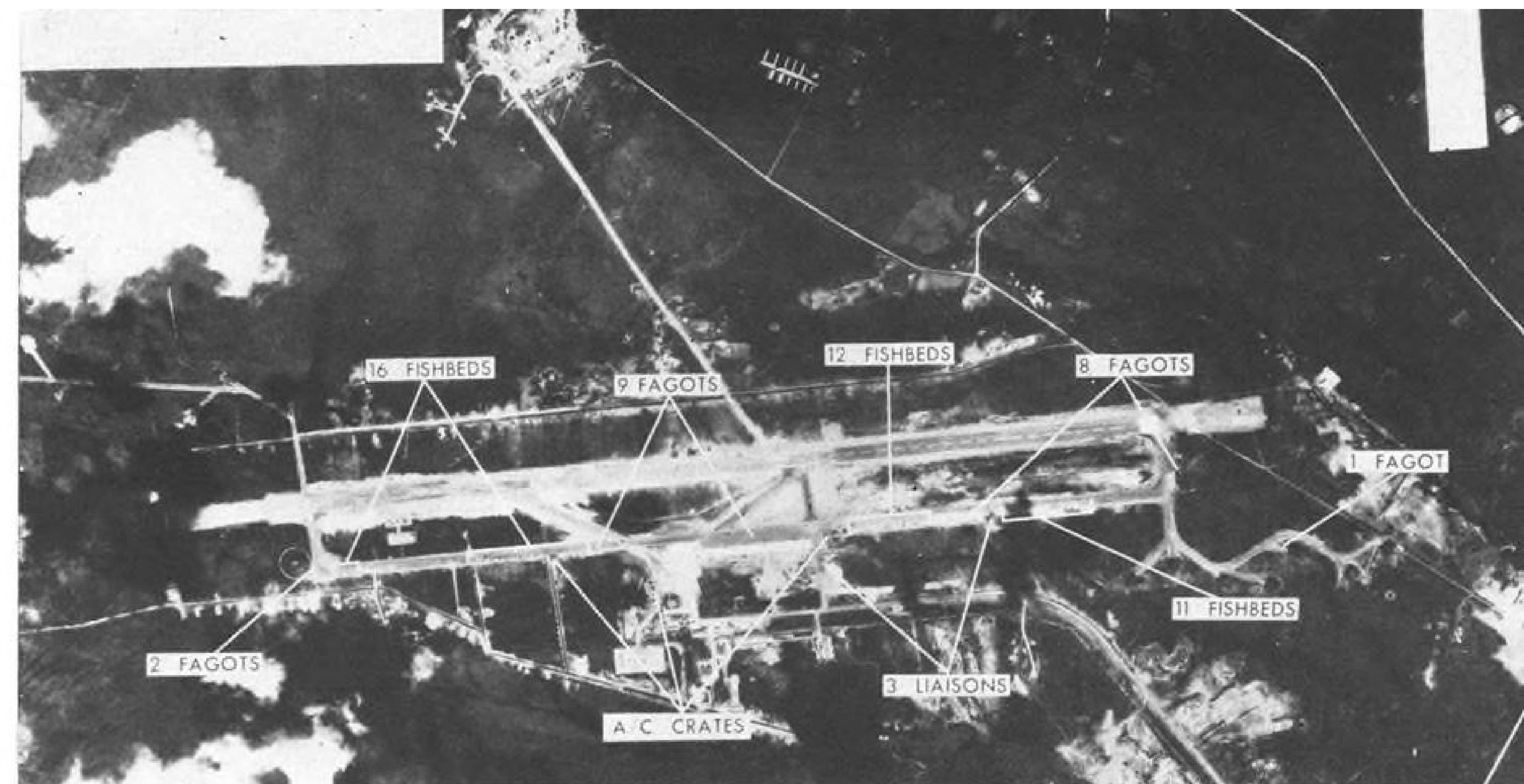
was attempting to take surface-to-surface and air-to-surface missiles, bombers, bombs, warheads and supporting equipment into Cuba, plus any other items that might be added to the list later. Defensive weapons such as anti-aircraft missiles were not included in the prohibited list. It was not clear whether fighter-interceptors, which could also be used as attack aircraft, were prohibited. Cuba now has at least 39 Soviet MiG-21 fighters and about 60 older MiGs.

A key element in the discovery of the quick buildup of offensive forces was the great increase in the number of Russian and Soviet bloc ships en route to Cuba. The island and the shipping lanes leading to it have been under intensive surveillance by sea and air for some time, and the arrival of offensive missiles has been expected by military strategists (AW Oct. 1, p. 20).

About 25 Soviet ships were en route to Cuba when the blockade took effect, another 10 or 12 were in Cuban ports and another 25 were en route from Cuba, according to Defense Secretary Robert S. McNamara.

A little more than 24 hr. after the blockade began to be enforced, Defense Dept. said it appeared that "at least a dozen Soviet vessels have turned back, presumably because, according to the best of our information, they might have been carrying offensive materials."

Defense Dept. would not define the blockade area, but said the first Russian ship, a tanker, was encountered shortly



SHIPMENT OF DELTA-WINGED supersonic Fishbed fighters is confirmed by the high-altitude photo taken from a Lockheed U-2 high-altitude reconnaissance aircraft showing a Cuban airfield with 39 Fishbeds and 20 MiG-15 jet fighters plus numerous crated aircraft not yet assembled. Three liaison aircraft are detailed in the center of the photo. Note the extensive dispersal area pattern. Fishbeds are armed with air-to-air missiles and they have top speed of approximately Mach 1.5.

Determination in Cuban Arms Blockade

after 8 a.m. EDT on Oct. 25. "It was ascertained by the U.S. Navy vessel that intercepted her that the tanker had only petroleum aboard," Defense Dept. said. "Since petroleum is not presently included as prohibited material under President Kennedy's proclamation setting up the quarantine, the tanker was allowed to proceed. The Navy satisfied itself that no prohibited material was aboard the particular ship."

The U.S. did not indicate that the ship was searched, although the blockade procedure called for Navy and Marine parties to board and inspect vessels if necessary.

In a speech to the nation on Oct. 22 that followed two days of rapid troop shifts and an atmosphere of crisis, President Kennedy said the purpose of Soviet-built and manned missile bases in Cuba could be "none other than to provide a nuclear strike capability against the Western Hemisphere."

The President said this obviously was planned months ago, and it contradicted repeated assurances from Russia—and assurances given to him personally on Oct. 18 by Soviet Foreign Minister Andrei Gromyko at the White House—that Russia was simply training Cubans and providing them with defensive weapons. The President had warned last Sept. 4 and 13 that any appearance of offensive weapons would represent a threat to the peace and security of this hemisphere.

U.S. strategic missiles "have never

been transferred to the territory of any other nation under a cloak of secrecy and deception," the President said. Turkey and Italy were given U.S.-built Jupiter intermediate-range ballistic missiles, openly and at their request, following the North Atlantic Treaty Organization's decision late in 1957 that such actions were necessary to counter Russian rocket threats against Europe, State Dept. said.

The spokesman recalled this state-

ment by Khrushchev in September, 1957: "I think I will not be revealing any secrets if I tell you that we now have all the missiles we need, long-range missiles, intermediate-range missiles and short-range missiles."

The President called for "prompt dismantling and withdrawal of all offensive weapons in Cuba, under the supervision of U.N. observers, before the quarantine can be lifted." He described this as one of the "initial

Germany Weighs Cutting P.1127 Support

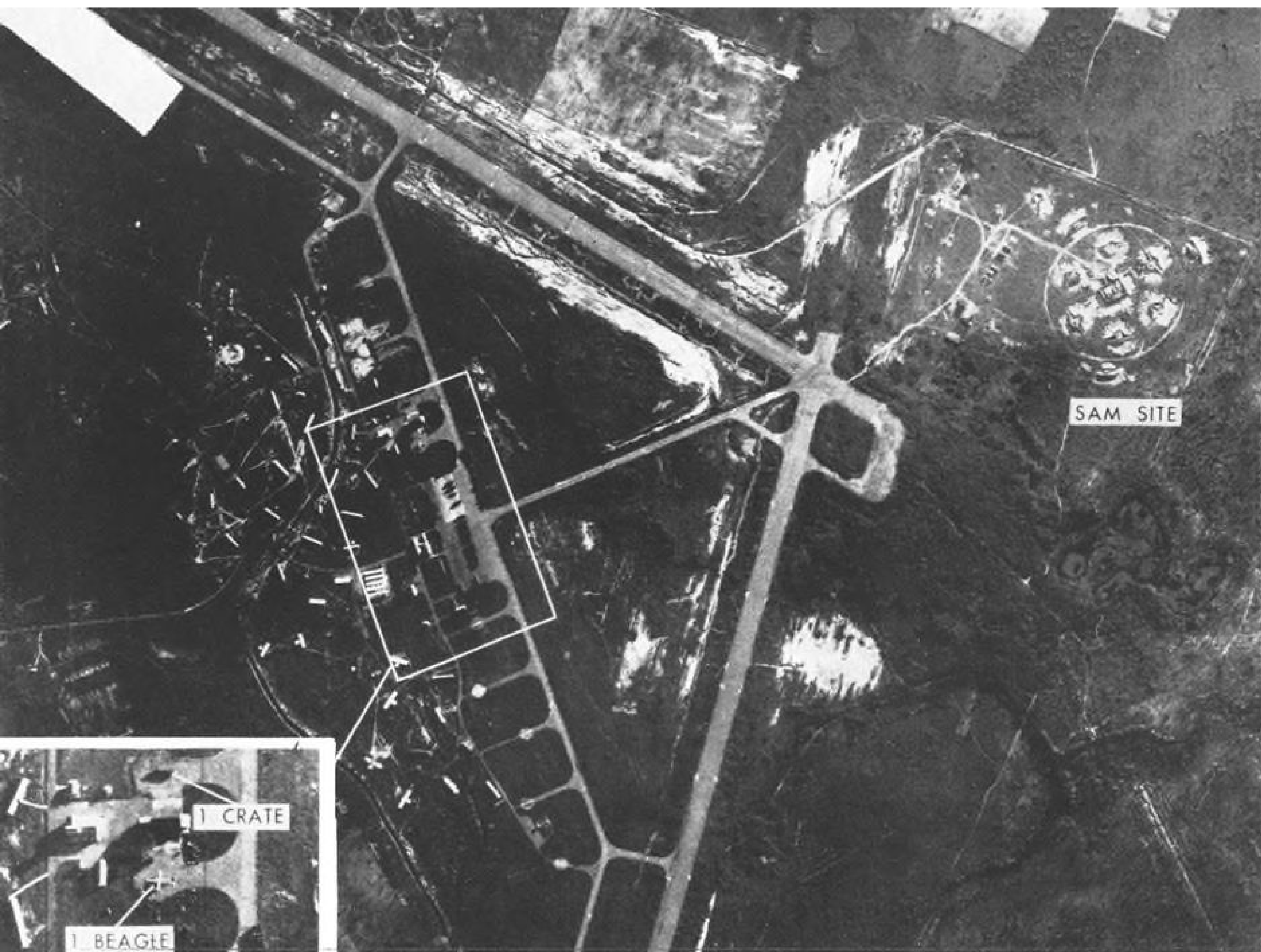
Bonn—West German air force, with a new commander and tightening budget limitations, may abandon plans to participate in development of Britain's Hawker P.1127 close-support fighter as part of its over-all review of future defense needs.

Discontinuance of its role in the P.1127 project plus cancellation of the West German program for development of the VJ-101D VTOL interceptor were major subjects of discussion at a recent meeting to review and pare existing programs. The meeting was attended by Defense Minister Franz Josef Strauss and other top officials, including new Air Force Inspector General Lt. Gen. Werner Panitzki.

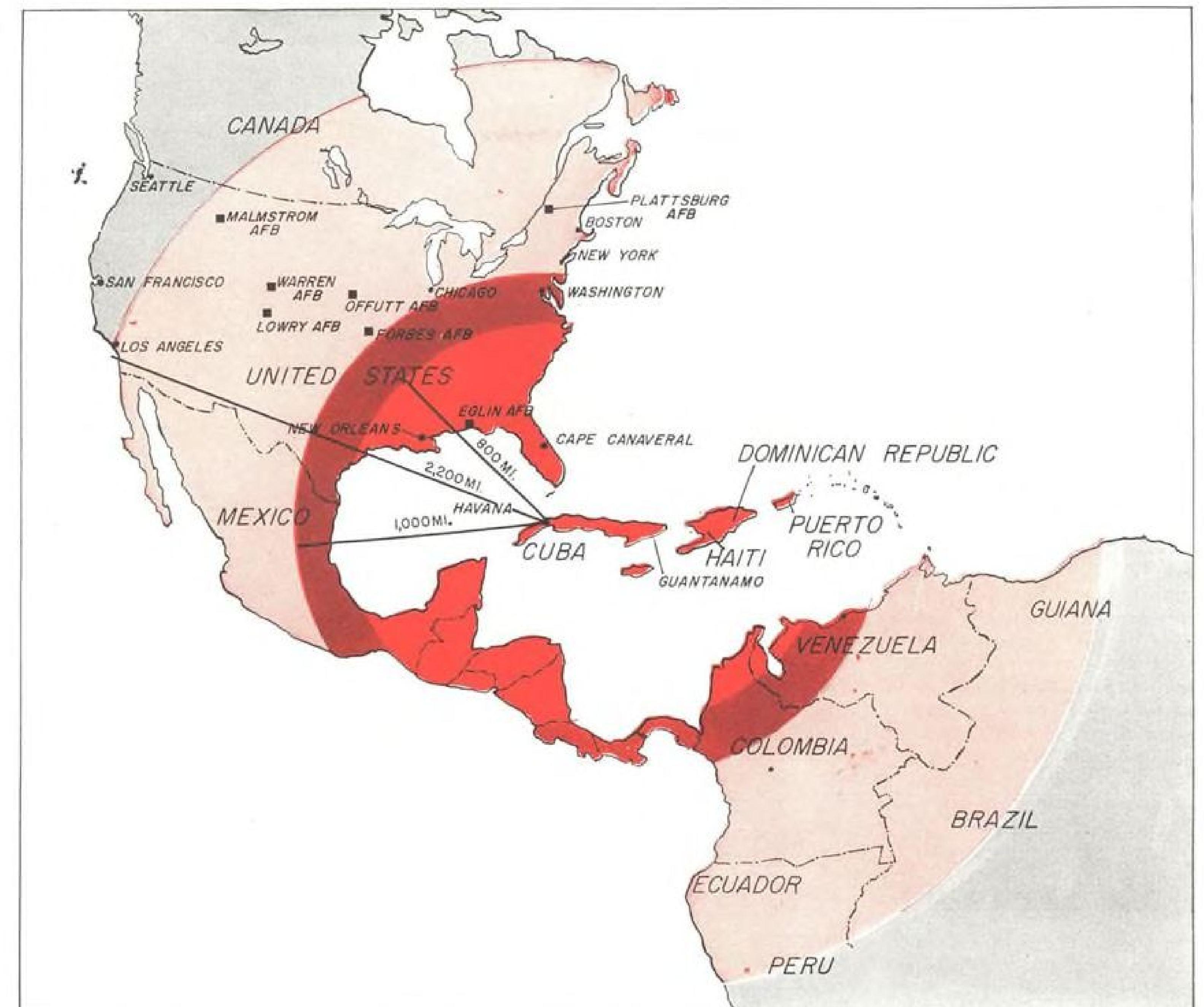
Aside from budget restrictions, Gen. Panitzki apparently feels that the problems of logistics support that would be required to meet the demands of large numbers of dispersed VJ-101Ds in the field would be almost insurmountable (AW Oct. 8, p. 30).

Under original programing, the 101D would have replaced the Lockheed F-104G as the West German front-line interceptor in the late 1960s, and Gen. Panitzki reportedly feels that, by this time, the mission can be accomplished more effectively and economically by surface-to-air missile units. Testbed model of the VJ-101 is now undergoing tethered trials, however, and a free flight test is scheduled soon.

Gen. Panitzki is still interested in a close-support VTOL fighter as an eventual replacement for the Fiat G.91 but, according to a defense ministry announcement, feels that a resurvey of all technical developments is needed before a firm decision on the type of aircraft to choose can be made.



ILYUSHIN IL-28 BEAGLE twin-jet bombers are shown being uncrated, assembled and tested on this airfield in Cuba. Enlarged inset shows 18 crates containing Beagle subassemblies, three fuselages uncrated and one completely assembled aircraft. Total of 30 Beagles have reached Cuba during past few weeks. Note anti-aircraft missile site at upper right of top photo. Installation is of igloo type with six launch pads arranged around a central fire control blockhouse. This is the second generation Russian surface to air missile with the NATO code-name Guideline. Runways at this Cuban field have been extended and extensive dispersal areas built to protect the Beagles. Russian ships carrying crated deckloads of Beagle subassemblies are photographed by U.S. military aircraft. Ten Il-28 fuselage crates are visible on one ship (top) inbound to Cuba while heavy deckload of crated aircraft is shown on another ship headed for a Cuban port (below).



AREAS IN NORTH AND SOUTH AMERICA within range of Soviet bombers and missiles now operational or being delivered to Cuba are shown by the three circles on map. Il-28 Beagle range of 800 mi. (inner circle) includes Cape Canaveral and Eglin AFB, Fla. Soviet medium-range ballistic missiles, now emplaced in Cuba, have 1,000-mi. range shown in middle circle, which includes Washington, D.C. Intermediate-range ballistic missiles, sites for which are under construction, cover (outer ring), Malmstrom AFB, Mont., where first Minuteman complex is located; Offutt AFB, Neb., where Strategic Air Command headquarters and an Atlas missile complex are located; Lowry AFB, Colo., first operational Titan site; Forbes AFB, Kan., an operational Atlas and jet bomber base; Warren AFB, Wyo., operational Atlas site, and Plattsburgh, N. Y., a jet bomber base and an Atlas site nearing completion. Range of the missiles extends southward as far as Peru, and covers all of Venezuela, Colombia and Ecuador.

steps," and left a clear impression here that invasion of Cuba could follow if it became necessary.

In an extremely strong statement, President Kennedy said the U.S. would regard "any nuclear missile launched from Cuba against any nation in the Western Hemisphere as an attack by the Soviet Union on the U.S., requiring a full retaliatory response upon the Soviet Union."

Russia's initial reply issued "a serious warning" to the U.S. and said if "the aggressors touch off a war, the Soviet Union would strike a most powerful retaliatory blow." The statement said that, "Whereas earlier the U.S. could regard itself as the strongest military power, it now has no foundations whatever for this." The statement referred

to the blockade as "piratic actions."

In the hectic period before the President revealed the nature and seriousness of the Cuban crisis, he canceled a political speaking tour related to the November elections and recalled Vice President Lyndon Johnson, cabinet members and congressional leaders to Washington. He later canceled all campaign tours and speeches for himself, vice president and cabinet. He asked key congressmen to be ready to return to Washington on 8 hr. notice.

As Soviet bloc countries and U.S. allies alerted their military forces, British Prime Minister Harold Macmillan told the House of Commons that Russia's missile buildup in Cuba was "a deliberate adventure designed to test the ability and determination of the

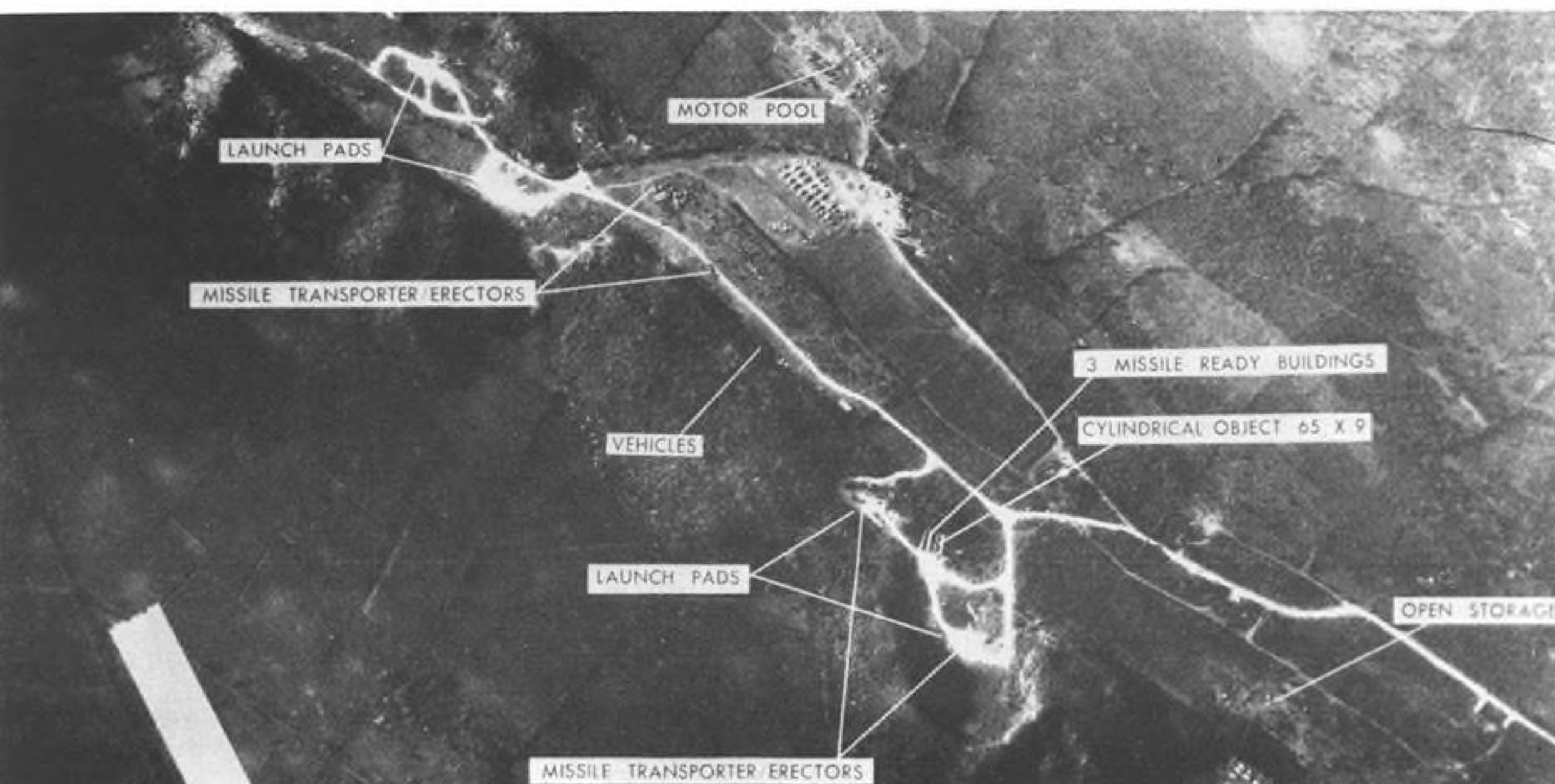
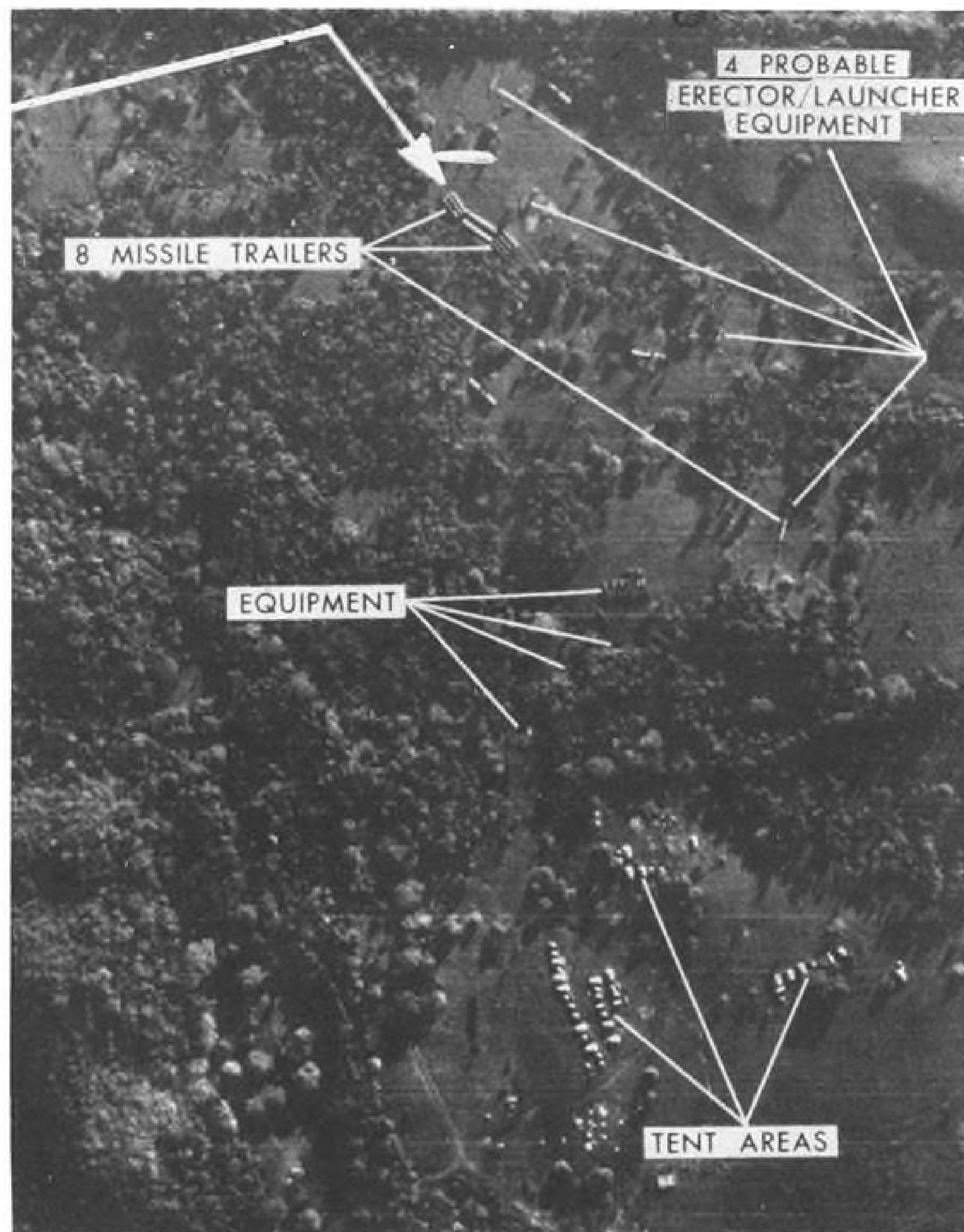
U.S." He said there "must be no break or wavering amongst the allies. That, perhaps, is the main purpose of the Russian initiative."

First military reaction to the blockade in Great Britain was the sailing of the Polaris submarine tender Proteus from its Scottish base. The Proteus normally does not leave its anchorage. One Polaris missile-carrying sub sailed shortly before the Proteus and five more serviced by it already were at sea.

France, the last of the major allies to put its armed forces on alert, did not do so until Oct. 25. France was among a number of countries that let it be known unofficially that it did not appreciate being notified of U.S. intentions only after a number of steps had already been taken in secret.



MOBILE SOVIET medium-range missiles with ranges of 1,020 naut. mi. are based at sites like these in Cuba. U.S. reconnaissance photo of one such site (right) shows eight missile trailers and four systems identified as erector-launcher equipment. Enlarged section (above) indicated by arrow shows close-up of seven of the missile trailers (lower left) and one of the erector-launcher systems (lower center). Another site (below) includes two sets of transporter-erectors, two launch pad complexes and three missile ready buildings. Sites are manned by Soviet personnel. Appearance of the sites is very recent. U.S. said on Oct. 22 that several sites had appeared in the previous five or six days and that the sites can be shifted literally in hours. The liquid-fueled missiles, which are transported on trailers, were hidden before the accelerated buildup in Cuba began.



Photos Documented Cuban Arms Buildup

Washington—First hard evidence of the extremely rapid buildup of modern Soviet offensive weapons in Cuba was obtained exactly one week before President Kennedy notified the world that the U.S. would halt the buildup by means of a naval and air blockade.

This buildup—so rapid that Soviet technicians did not take time to camouflage the construction of missile sites—set off an intensive U.S. aerial reconnaissance effort that occupied Defense Dept. and other intelligence interpreters and analysts 24 hr. a day and provided new evidence “almost literally every hour throughout the week,” according to Defense Secretary Robert S. McNamara.

By late last week, Defense and State Dept. had revealed these details on the buildup of offensive weapons—most of which had taken place since early October:

- **Intermediate-range ballistic missiles**—At least three sites for missiles with ranges of 2,200 naut. mi. are in various stages of construction. Defense Dept. refused to give specific numbers of sites for either medium-range (1,020 naut. mi.) or intermediate-range missiles, but said there are a total of 8-10 of the two types combined, located near the Cuban cities of Guanajay, Remedios, San Cristobal and Sagua la Grande (see map on p. 34). Defense said at first that it had discovered no intermediate-range missiles—only sites—but later refused to say whether any missiles had been discovered. Sites are soft—above-ground—but are fixed installations. Concrete block-houses serve two launch pads each, and so far all intermediate and medium-range sites have appeared with either four launch pads or less. McNamara said the U.S. had no missile that would intercept these Soviet weapons, and that any warning of a launch would be very short if at all.

- **Mobile medium-range ballistic missiles**—These also were discovered “rather recently,” and several sites appeared in the five or six days before the President’s announcement on Oct. 22. Some are now operational. Two aerial photographs, taken less than 24 hr. apart, showed “an increase of perhaps . . . 50% in the amount of equipment,” McNamara said. These liquid-fueled missiles have a range of 1,020 naut. mi. and are hauled on trailers, which are backed up to a combination erector-launcher. “They are planned to have a capability to be deactivated, moved, reactivated on a new site and ready for operations within a period of about six days,” McNamara said.

“We have detected the latest type of Soviet weapons among those pro-

vided to Cuba,” McNamara said. “For example, the MRBMs and IRBMs have not been provided to any satellite country heretofore. The surface-to-air missile systems are the latest systems that the Soviets are using in their own country. There are other weapons that are among the most modern that the Soviet Union possesses. We were quite surprised in observing that.”

- **Ilyushin Il-28 Beagle tactical bombers**—This subsonic, twin-engine bomber, with a radius of action of 800 mi., is relatively far less modern than the Soviet missiles in Cuba, McNamara pointed out. Appearance of these in Cuba also was detected for the first time in the week or 10 days preceding Oct. 22. Early in October, the U.S. observed ships moving toward Cuba with crates on their decks that appeared to be the right size for Il-28 fuselages. Progress

of the crates was followed to an airfield, chiefly by aerial reconnaissance. Until a few days before Oct. 22, the airfield had appeared to be abandoned. Continuous reconnaissance showed wings and fuselages emerging from crates and appearing as whole aircraft. One photo showed 22 crates of fuselages and four more uncrated.

- **Nuclear warheads**—McNamara said the U.S. had not detected the location of nuclear warheads and “I think it is fair to say we may never, by the means of intelligence open to us, but it is absolutely inconceivable to those of us who have worked on the problem and have been exposed to it that this equipment, in this state of readiness, a high state of operational capability, would have been placed in Cuba without warheads close to the missiles themselves.”

Photos shown to newsmen and later

U.S. Alert Includes Blockade Task Force

Washington—U.S. armed forces increased their state of readiness to the greatest degree since the Korean War in anticipation of a showdown with Russia over the blockade ordered by President Kennedy last week in response to the buildup of offensive weapons in Cuba.

Movement of ships, airplanes and troops indicated the Defense Dept. was prepared to go far beyond a blockade of weapons bound by air or sea for Cuba and invade the island if this seemed the only way to remove the Soviet offensive weapons there (see p. 26).

The blockade—steadfastly called a “quarantine” by Kennedy Administration officials—officially went into effect at 10 a.m. EDT Oct. 24. Defense Secretary Robert S. McNamara announced that Adm. George W. Anderson, chief of naval operations, was in charge of the blockade operation for the Joint Chiefs of Staff. Actual operations were under Adm. Robert L. Dennison, commander-in-chief, Atlantic, and Supreme Allied Commander, Atlantic, who headed a unified command equipped to enforce the blockade on the sea and in the air. His authority cut across service lines.

Adm. Anderson operated from the Pentagon and Adm. Dennison from Norfolk, Va. In direct charge of the blockade operation at sea was Vice Adm. Alfred G. Ward, commander of the Second Fleet, in a blockade task force designated Task Force 136. The Atlantic Fleet includes more than 200,000 men, 100 aircraft squadrons and 450 ships in the Second and Sixth Fleets. Defense said Task Force 136 would include seven aircraft carriers; six anti-submarine support carriers, more than 50 amphibious ships, 8 cruisers, 170 destroyers, 9 destroyer tenders, 40 mine sweepers, 90 submarines—some nuclear-powered—and 35,000 Marines.

Defense said the forces at sea would be supported by aircraft based on the East and Gulf coasts. U.S. aircraft assigned to support the blockade and bolster defense of the U.S. included additional North American F-100s and Lockheed F-104s to Homestead AFB, southwest of Miami, and F-100s and Republic F-105s at the Strategic Air Command base at Orlando, Fla. Defense Dept. also ordered some Convair F-106s into Patrick AFB, Fla., south of Cape Canaveral, and indicated the Naval Air Station at Opa Locka in Miami might be reactivated as a military base.

Such operations will be carried on from a number of bases both in Florida and Puerto Rico, with Lockheed P-2Hs at Boca Chica and Jacksonville doing a major portion of the job. Seaplanes may be based at Port-of-Spain, Trinidad, to cover southern approaches to Cuba. Destroyers were expected to be used for actually boarding ships stopped by blockade forces.

SAC increased its readiness by canceling leaves and assigning Boeing B-47s to civilian airports, a standard practice but one evidently intensified as a result of the Cuban crisis. Pacific Fleet Headquarters announced units of the First Marine Division were being sent from Camp Pendleton, Calif., to spend an indefinite time at sea “to provide the mobility and flexibility to deploy rapidly to any area where they may be needed. . . .”

Chronology of Cuban Military Buildup

Washington—Following is a chronology of the military buildup in Cuba since Fidel Castro assumed power in January, 1959:

- February, 1960: Trade agreement signed with Soviet Russia during visit by Soviet Deputy Premier Anastas Mikoyan; USSR extended \$100-million credit to Cuba.
- March, 1960: French munitions ship blew up in Havana Harbor. Castro blamed U.S.
- July, 1960: Soviet Premier Nikita Khrushchev threatened to strike U.S. with missiles if U.S. intervened in Cuba, but said later this was a "figurative" warning.
- September, 1960: Cuba announced that USSR would provide MiG fighters and heavy tanks to Cuba.
- October, 1960: U.S. placed embargo on all shipments to Cuba except food and medicine.
- January, 1961: U.S. broke diplomatic relations with Cuba, and in his inaugural address, President Kennedy warned Russia not to interfere in the Western Hemisphere.
- April, 1961: B-26 bombers manned by Cuban exiles hit two Cuban airfields, and a force of 1,500 exiles invaded the Bay of Pigs. Invasion failed (AW May 8, 1961, p. 25) and captured troops said the invasion was sponsored by the U.S. Central Intelligence Agency.
- April, 1962: State Dept. estimated that Russia had sent 50 to 75 MiG jet fighters to Cuba (AW Apr. 2, p. 15). First class of Cuban fighter pilots graduated. Cuban announcement did not specify training site, but it was believed to be Czechoslovakia. Aircraft were identified as MiG-17s and MiG-19s (AW Apr. 16, p. 25).
- August, 1962: U.S. confirmed heavy Soviet buildup in Cuba and arrival of several thousand Russian technicians. President Kennedy said U.S. had no information "as yet" on anti-aircraft missiles in place in Cuba (AW Sept. 3, p. 15) and Defense Dept. said it was keeping abreast of the military situation in that area.
- September, 1962: Cuba granted use of Havana Harbor to Russian fishing fleet. U.S. concluded Havana would become

base for Soviet nuclear submarines. President Kennedy warned Castro against any action in the Western Hemisphere. President said U.S. had evidence that Soviet anti-aircraft missiles, with a 25-mi. slant range, were in place in Cuba, along with several Soviet-made motor torpedo boats with 15-mi. range missiles (AW Sept. 10, p. 25). Tensions reached a new peak in mid-September (AW Sept. 17, p. 25) with statement by Russia that any assault on Cuba would mean the beginning of war. Secretary of State Dean Rusk briefed the first joint meeting in 16 years of the House Armed Services and Foreign Affairs Committees on the Cuban situation. Soviet technician strength said to total more than 4,000. President was given standby authority to call up to 150,000 reserves to "meet the challenges to the free world."

• Oct. 1, 1962: Aviation Week reported (p. 20) that the Cuban arms buildup was seen by Pentagon strategists as "the first step toward eventual construction of intermediate-range ballistic missile emplacements." Estimates of armaments listed in the same article were 70 MiG fighters available for operation, including 40 MiG-17s and the remainder MiG-19s. One MiG-21 was reported flying, with 8 to 10 more being assembled. Other aircraft included 12 Il-14 transports, 24 Mil-4 helicopters and 20 An-2 utility aircraft.

Under Secretary of State George W. Ball gave the first official public detailed report on the Cuban military buildup in testimony before the House Select Committee on Export Control on Oct. 3 (AW Oct. 15, p. 26). It closely paralleled the Aviation Week report of Oct. 1, but did not mention IRBM bases.

Sen. Kenneth B. Keating (R.-N.Y.) said Oct. 11 that construction has started on at least six IRBM sites in Cuba, and he called on President Kennedy to give the public the facts on the military buildup there.

In an address to the nation Oct. 22, President Kennedy confirmed the existence of IRBM installations and other offensive weapons in Cuba, and ordered a naval blockade against Cuba to take effect on Oct. 24 (see story).

released showed what State Dept. said was believed to be "a nuclear warhead storage facility"—a curved-roof building, at the bottom of an excavation, which probably would be covered over afterward.

There also is a specially secure port facility in Cuba, surrounded by a double security fence, that may be intended for off-loading of nuclear weapons, State Dept. said.

Surface-to-air missile sites, which the U.S. classifies as defensive rather than offensive, have grown from about a dozen at the beginning of October to at least 24 as of Oct. 22, and 22 of these were believed to be operational. The other two could be operational in about a week, according to State Dept.

Each surface-to-air site had six launchers. With a missile range of about 25 mi., the installations provide anti-aircraft coverage for most of the island.

U.S. reconnaissance also discovered at least three coastal defense missile sites, located on the main island and the Isle of Pines. Two of them were operational. They use winged, cruise missiles with a range of 35 to 40 mi.

and would be used primarily to hold off ships.

Earlier U.S. estimates that Cuba has a dozen Soviet Komar missile patrol boats, each carrying two launchers for missiles with 12 to 15 mi. range, had not changed early last week. The U.S. said it had no information on Soviet submarine bases in Cuba.

Pentagon strategists have been concerned for some months that the buildup of defensive arms in Cuba was merely a prelude to construction of intermediate-range ballistic missile bases. This, plus the fact that U.S. aircraft, including Lockheed U-2s, were regularly flying reconnaissance around and over Cuba, was first reported by AVIATION WEEK (Oct. 1, p. 20).

First concrete evidence that offensive missiles finally were moving into Cuba came to Secretary McNamara's attention at 10 p.m. EDT on Oct. 15. It was relayed to President Kennedy at 9 a.m. EDT on Oct. 16. Even this evidence was "partial," McNamara said. "It simply raised a strong suspicion that there was more than we saw in that particular instance. So we had to go back and systematically cover our areas."

The President immediately ordered "a greatly increased surveillance program," McNamara said. "... Photo interpreters working on literally thousands of feet of film and trying to pick this kind of a situation out—here are some more scars over here, and you try to examine the landscape of Cuba and separate this type of scar from this type of scar, it is a tremendous task.

"And they have been working 24 hr. a day since that time on this tremendous mass of material to try to sort out the probable from the improbable. And it is based on that very, very thorough analysis by literally hundreds of photo interpreters during this week that we have arrived at these conclusions."

President Kennedy was given a final, definitive report at 2:30 p.m. EDT on Sunday afternoon, Oct. 21. He announced his intention to blockade Cuba against delivery of offensive weapons at 7 p.m. EDT on Oct. 22 and demanded "withdrawal or elimination" of current offensive weapons. On Oct. 23, the President issued a proclamation which made the blockade effective at 10 a.m. EDT on Oct. 24.

Material prohibited under the block-

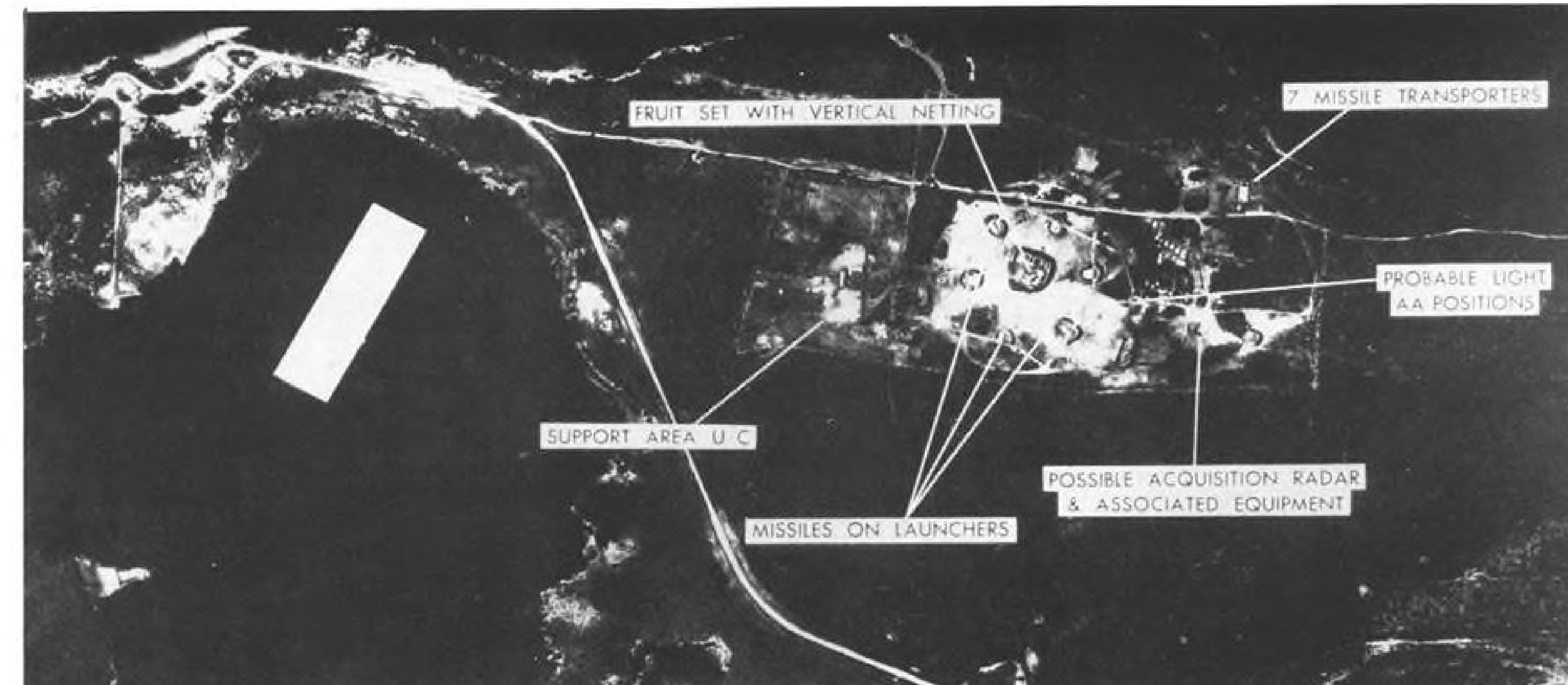
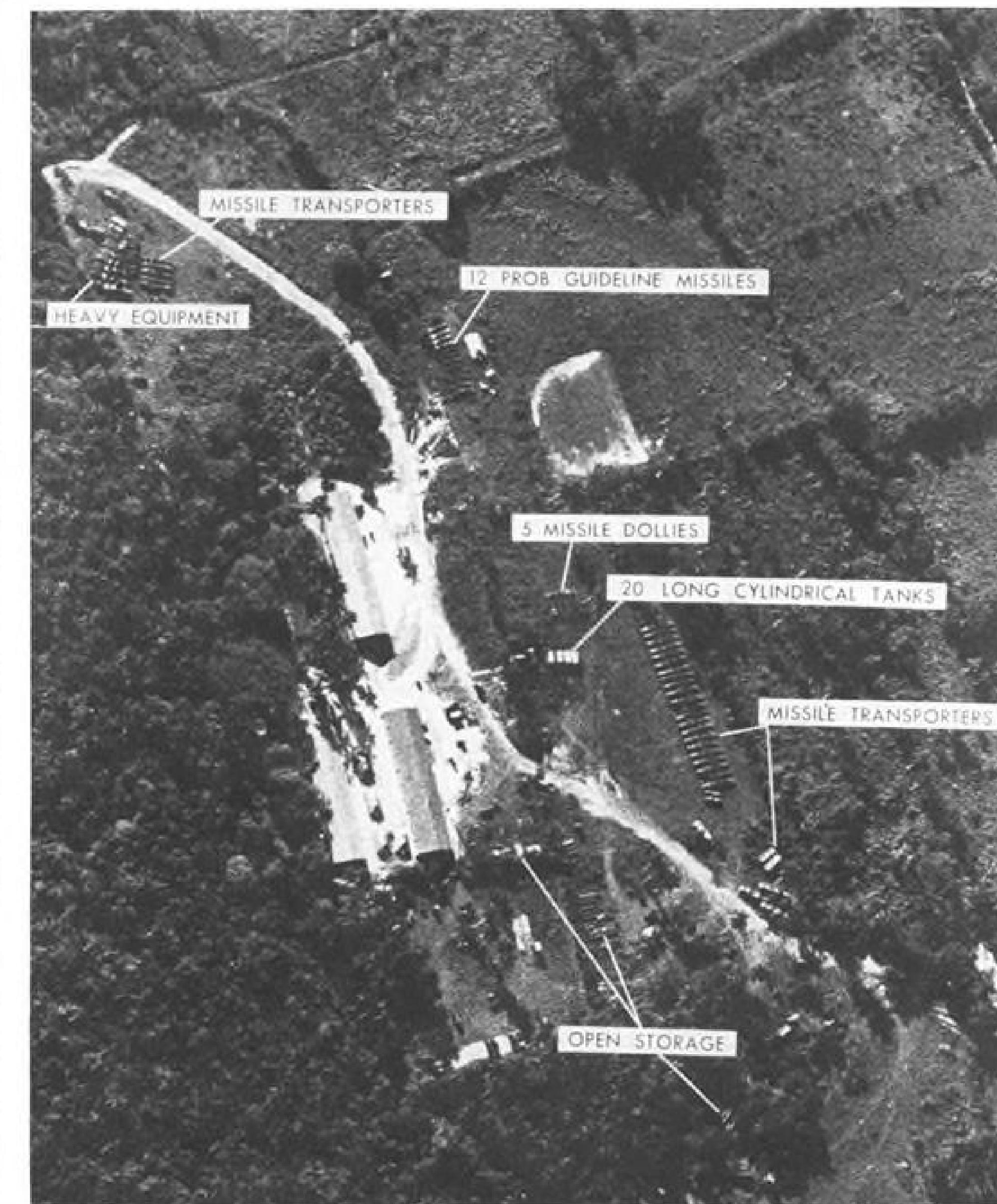
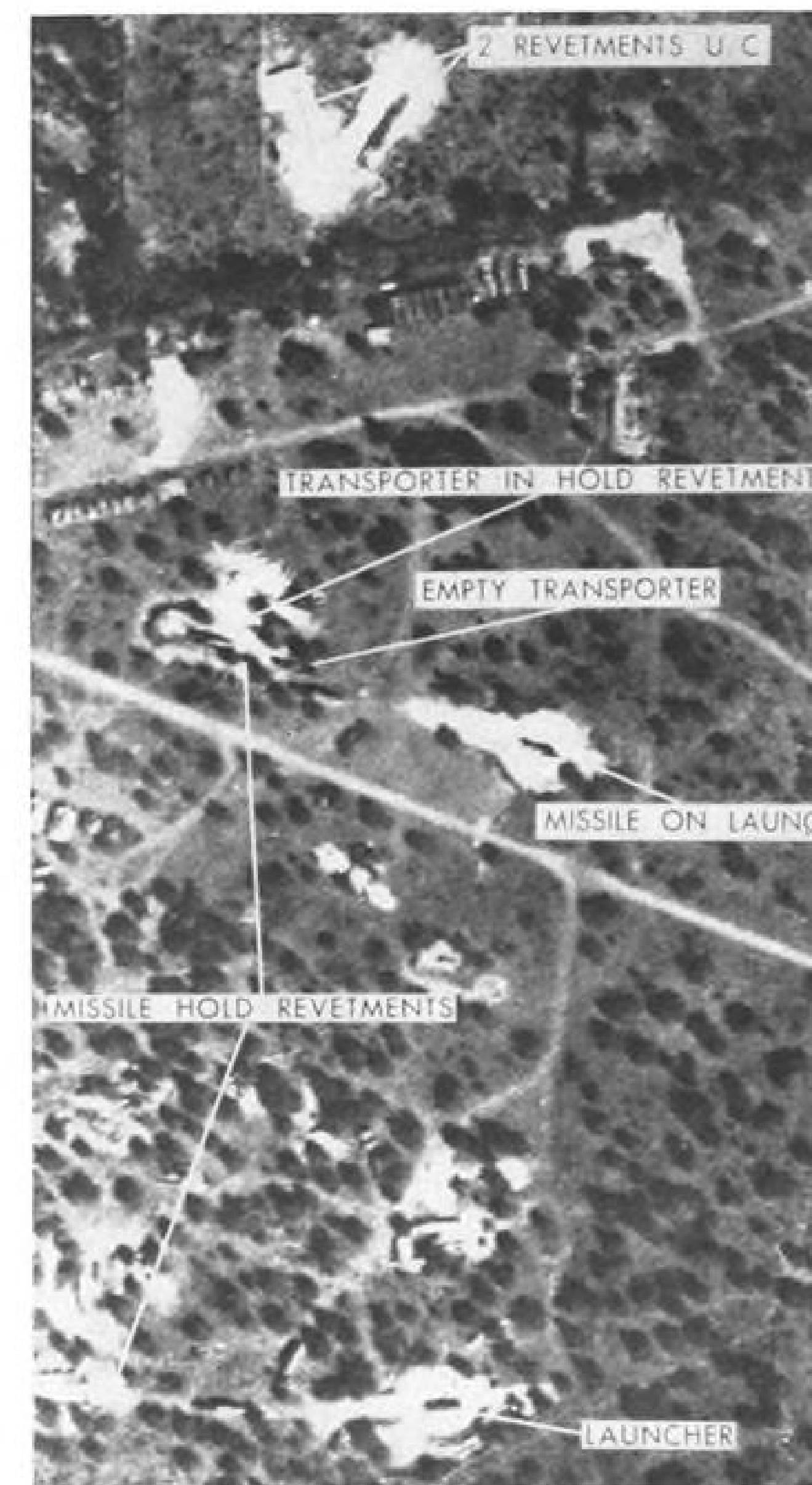


PHOTO SHOWS DETAILS of Soviet surface-to-air missile site in Cuba. Each site has so-called "fruit set" radar in center, surrounded by six launchers. Photo also shows seven missile transporters, probable light anti-aircraft positions as well as auxiliary equipment.



CUBA HAD AT LEAST three sites, like that shown at left, for Soviet surface-to-surface coastal defense missiles by early last week—on the main island and on the Isle of Pines. At least two were operational. They use a 35-40 mi. winged cruise missile. Soviet surface-to-air missiles in Cuba are believed to be latest types of Guideline missiles similar to those protecting Russian bases and cities. Cuba had at least 24 sites, 22 of which were operational by early last week. Missiles have a 25-mi. radius, provide coverage for most of the island. Some of these sites preceded recent accelerated buildup. Photo at right shows missile transporters, five missile dollies, 12 missiles.



EIGHT TO TEN medium-range or intermediate-range ballistic missile sites are in the four areas designated on the main island of Cuba. Sites for surface-to-surface coastal defense missiles on Cuba and the Isle of Pines also are indicated. Besides these, 24 surface-to-air missile sites are scattered over Cuba. Soviet-supplied arms buildup also includes jet fighters and bombers based at Cuban airports undergoing enlargement. MacDill AFB, Tampa, Fla., Patrick AFB and McCoy AFB both near Cape Canaveral, and Key West, Fla., are scene of heavy U.S. air activity during crisis. Also shown are import Naval bases at Guantanamo Bay in Cuba and Roosevelt Roads, Puerto Rico.

ade includes "surface-to-surface missiles, bombers, bombs, air-to-surface rockets and missiles, warheads for any of the above weapons; mechanical or electronic equipment to support or operate the above items, and any other classes of materiel hereafter designated by the Secretary of Defense for the purposes of effectuating this proclamation."

McNamara said the U.S. "has every reason to believe that these [missile] sites are being constructed by Russians and that the surface-to-air missile systems are being manned and operated by Russians, because they are highly technical and because they have just been installed and there has not been time to train the Cubans in their operations."

"It seems very clear that there are several thousand Russians on the island now performing military functions," McNamara said.

Launchers for the MRBMs are "aligned to a specific section of the U.S.," McNamara said. In the case of one launch site, where photos made less than 24 hr. apart showed a 50% increase in equipment, McNamara said "that particular site has moved into an operational condition since that photograph first came to my attention, which was no more than three or four days ago."

"So there has been a very rapid movement of mobile MRBMs on the sites and into the process of activation. How long these have been in Cuba, I can't answer . . . They have been crated or otherwise hidden prior to the time they began to move along the roads and move out into the open."

U.S. spokesmen have stressed the secrecy and the swiftness of the nuclear buildup. Never before, they said, has either Russia or the U.S. collected a

force of nuclear weapons either secretly or rapidly enough to upset the balance of forces in an area—chiefly because of a mutual fear that to do so might trigger a nuclear war.

Soviet MiG-21s—totaling 39 by early last week—have been involved in the recent buildup also, but they are a continuation of an influx of MiG fighters of earlier types which began arriving in Cuba more than a year ago, and apparently are considered a part of Cuba's defensive forces. Total number of MiGs of all types had reached 100 by early last week, State Dept. said.

State Dept., apparently using the MRBM example referred to by McNamara, showed one picture with 45 to 50 vehicles and a few tents but no missiles or erectors. Another photo of the same site, taken 24 hr. later, showed seven missiles, four erectors, 27 tents capable of housing 500 men, and 100 vehicles.

"This pattern of very rapid deployment has been going on throughout Cuba," State Dept. spokesmen said. "It has been extraordinarily swift."

All the MRBM and IRBM sites are designed for repeated launchings "and it's almost certain that there are missiles for at least a second salvo," State Dept. said.

The MRBM is the same one frequently paraded on truck-drawn trailers through Red Square in Moscow. It may have been this missile which set off the intense U.S. reconnaissance activity. A State Dept. spokesman showed one greatly enlarged picture of a missile container with a canvas cover over the missile itself, and said: "With calipers, you can identify it from its tail fins as the Soviet 1,000-mi. ballistic missile. The

same thing with the erecting and handling equipment. . . ."

No IRBM sites were operational as of early last week, but activation was considered to be "a matter of weeks," McNamara said. Photos of some sites showed only scars in the earth for placement of bunkers, runways for cables between the bunkers and the sites, etc. Others showed the sites "in a somewhat later stage of development."

McNamara insisted that "it was not until mid-Sunday [Oct. 21] that we had complete information." He said that areas of Cuba were examined early in the week and the conclusion drawn that there were no offensive weapons there. The same areas were re-examined later in the week, "based on the information that became available Saturday, and [we] concluded throughout the hours of Sunday morning that there were installations. These were detected when the pattern—the distances between certain specified objects appeared over and over again."

"You must recognize that this is a difficult job. Weather, clouds, the angle of the sun, the most amazing atmospheric effects complicate the photo-interpretation job. . . ." McNamara said.

McNamara said no U.S. reconnaissance aircraft had been knocked down, but he would not say whether they had been shot at. He said he thinks it is possible to camouflage the missile sites "and I believe they could have done so during the construction period had they so chosen."

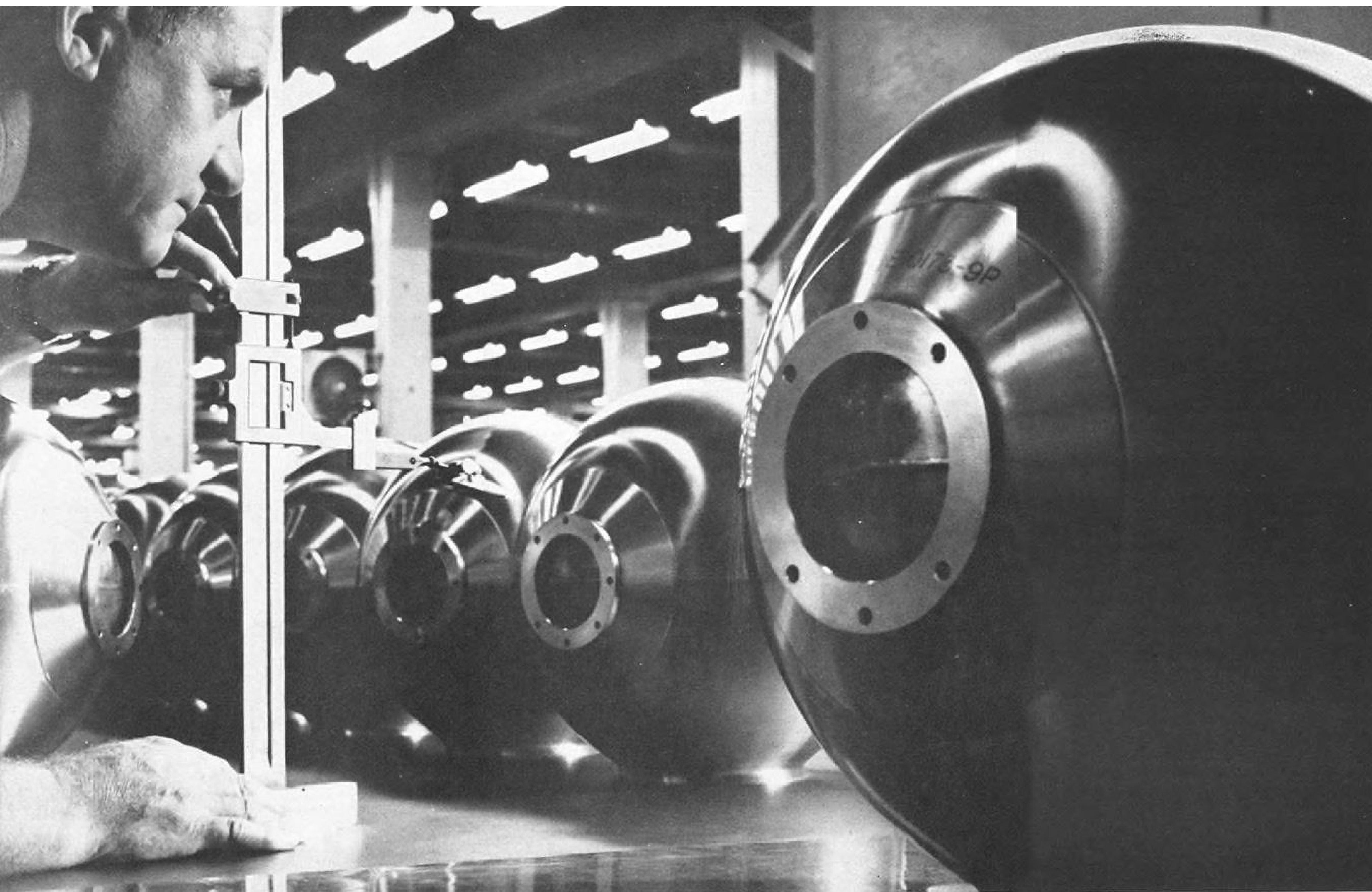
"I think that there is evidence that they were operating with such speed and such haste that they did not take the time necessary to camouflage."



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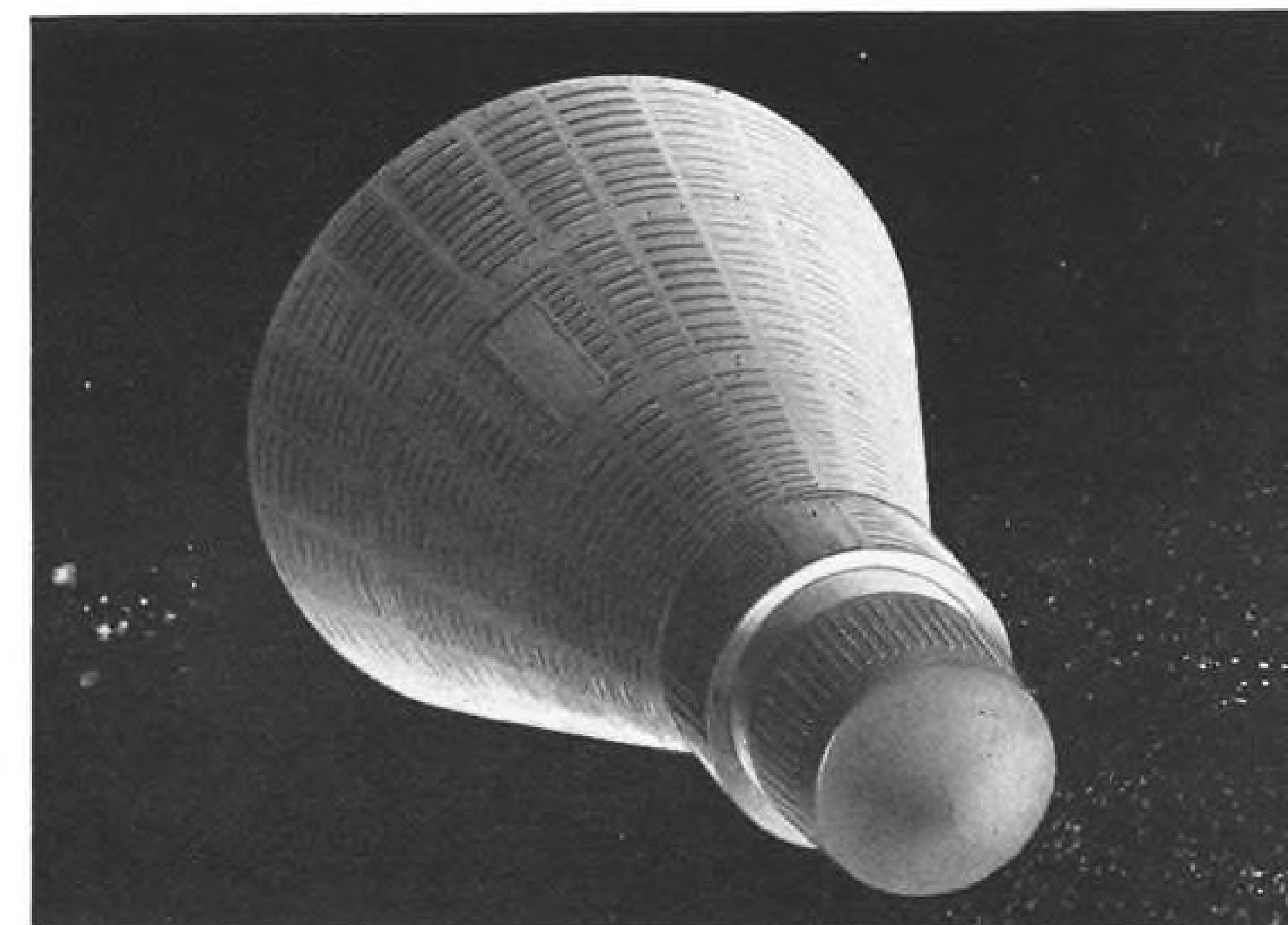
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NASA Board to Probe Ranger Program

By Edward H. Kolcum

Washington—Technical review board will meet this week to determine what changes are necessary to achieve success in the disappointing Ranger lunar exploration program, a vital forerunner to the Apollo manned lunar landing mission and planetary exploration. The board will make an extensive four-week study of Ranger hardware, procedures and management.

This is the most significant result of the failure of Ranger 5, which was the 13th U.S. attempt without notable success to develop instrumentation for lunar observations and to send payloads to the moon.

Ranger 5 was launched successfully Oct. 18 from the Atlantic Missile Range (AW Oct. 22, p. 35), but a malfunction not yet determined in the solar cell-battery power loop caused spacecraft power to become depleted about 8 hr. after launch.

Without power, the spacecraft could not transmit telemetry or obey program commands for the midcourse correction maneuver and activation of experiments. As a result, the spacecraft passed the moon at an altitude of 450 mi. Oct. 21 and went into a solar orbit.

Immediately after the failure, Oran W. Nicks, director of lunar and planetary programs for the National Aeronautics and Space Administration, was directed to form a review board within NASA with two fundamental objectives: conduct a failure analysis of the Ranger program, and study the coming series of Ranger payloads to assure that NASA is doing everything it can to make them work.

Nicks told AVIATION WEEK the board is not a court martial organized to find a program goat. Both he and Edgar M. Cortright, deputy director of NASA Space Sciences, emphasized what they called "utter confidence" in the system concept, management and the soundness of the Ranger program. This apparently means that the space agency plans no major management or design changes.

Cortright, who preceded Nicks as lunar and planetary program chief, said NASA is aware that it is being held accountable for the performance of the vehicles it launches, and while it must accept the series of Ranger failures it is "not doing so gracefully."

This feeling is reflected in the complete freedom with which the review board will operate. The board, under the chairmanship of Cdr. Albert J. Kelley, will consist of 10 or 11 members, not all of whom had been selected by late last week. Members will not be ap-

pointed from within the Space Sciences Office or from Jet Propulsion Laboratory. Space Sciences Office directs the program in NASA Headquarters, and JPL has the dual responsibility of program management and spacecraft fabrication and assembly. JPL has given full concurrence to the technical review.

Kelley, on detail from the Navy to NASA, has a doctor's degree in guidance and is director of electronics and control in NASA's Research and Technology Office.

Primary source of board members, Nicks said, will be the agency's Manned Spacecraft Center in Houston and Goddard Space Flight Center, both of whom have managed highly successful hardware programs.

Although the complete four-week itinerary of the group has not been completed, Nicks said members will go first to JPL for a thorough program briefing, which will include a review of design, test and procedures at all working levels.

Also on the agenda will be a briefing on spacecraft operations and spacecraft-launch vehicle interfaces at the Launch Operations Center, Cape Canaveral, and a review at the plants of several of the major Ranger subcontractors.

A detailed report of the board's findings, due Nov. 30, will cover all areas that might have even a remote influence on the problems the program has experienced, Nicks said. This will include such items as the effect of spacecraft sterilization on total component reliability, and the effect of window constraints on procedures.

Cortright pointed out that although Ranger appears to be one of the most complex payloads designed by the U.S., its engineering and science components for the first time provide a technology with a growth potential. It is keyed to a 1959 NASA decision to team up with the Air Force in heavy use of the Atlas Agena B launch vehicle, and at the same time, to cancel the Vega vehicle (AW Dec. 21, 1959, p. 18). The Ranger pro-

gram has since become fundamental to the future lunar and planetary exploration program.

U.S. began its lunar program Aug. 17, 1958, with the first of a series of lunar flyby missions designed to obtain data on the translunar environment. Although none of the 13 payloads launched in the program achieved their total objectives, they returned some significant scientific information. Pioneer 1 discovered the existence of an interplanetary magnetic field, and Pioneer 3 discovered a second region of high intensity in the geomagnetically-trapped radiation belt around the earth.

None of the four Atlas Able lunar orbiting payloads had an opportunity to perform, because the launch vehicles failed on all missions. NASA did not continue this program beyond the original four payloads because the agency wanted to get lunar surface data, rather than data from a lunar satellite.

This resulted in the decision to concentrate on Ranger, which first had five flight missions, then nine and now, 14. Latest increase (AW Oct. 22, p. 35) is designed to give more support to Apollo by providing detailed information concerning the surface characteristics of the moon.

Next series of Rangers, numbered 6 through 9, will contain only a high resolution television camera experiment, and not a camera and survival package as did Rangers 3, 4 and 5. Rangers 10 through 14 may contain one or both lunar experiments.

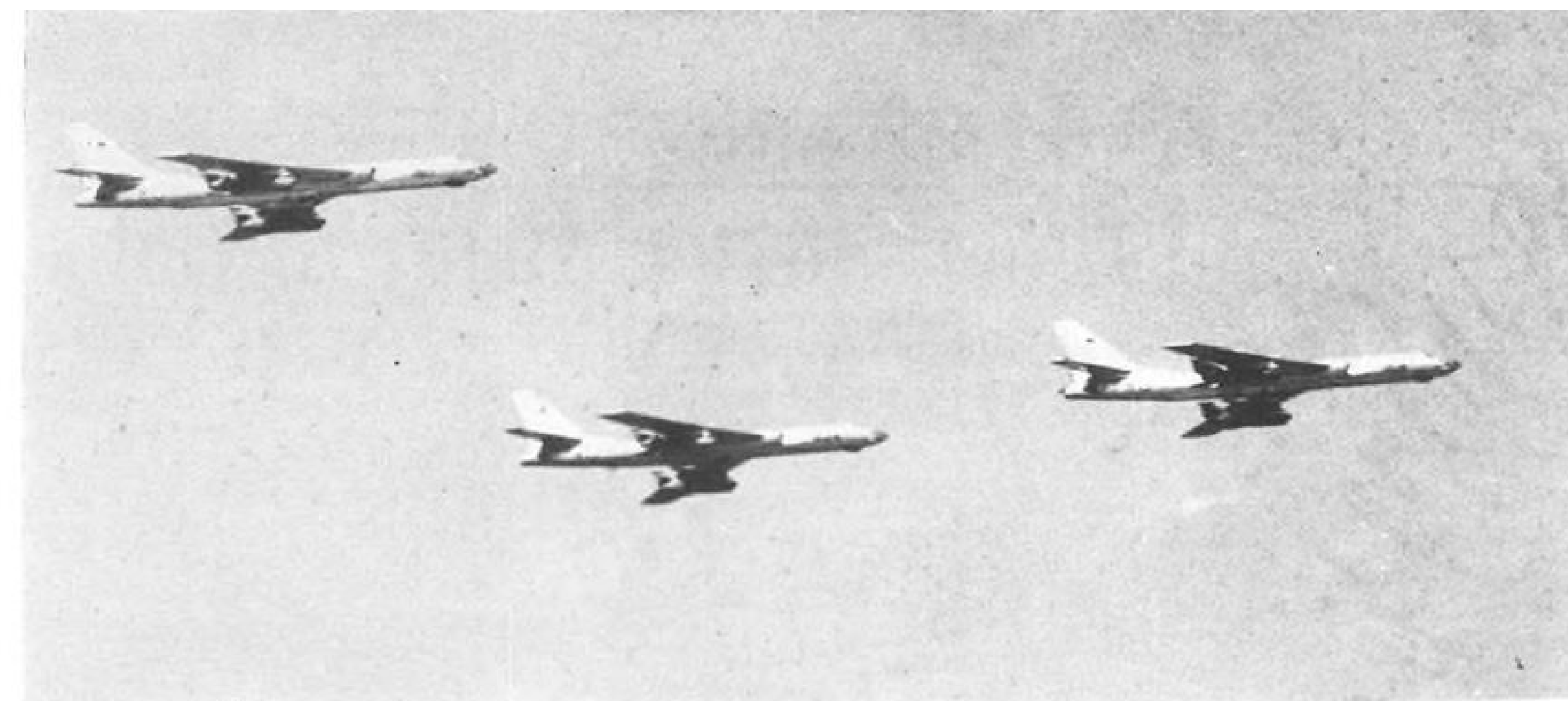
NASA faces a dilemma in any attempt it might make to trade complexity for simplicity and reliability. There are 19 mechanical functions Ranger must perform from launch to lunar impact, and Nicks pointed out that it is not the mechanical functions which have caused problems.

He said the crux is in the three-attitude control system, which operated well on both Mariner 2, now en-route to Venus, and Ranger 3, which missed the moon and is in a solar orbit.

Engineering systems and components in Ranger also will contribute to the Surveyor soft lunar landing spacecraft, to the two-man lunar excursion module for the Apollo mission and to future missions to Mars and Venus.

Nicks said he is disappointed, but not discouraged by Ranger performance to date because the problems in the last two flights have been confined to small areas.

Although the precise point of malfunction on Ranger 5 has not been determined, it is surmised to be in the power loop. The Woomera, Australia tracking station received telemetry sig-



Indonesian Badgers Carry Underwing Missiles

Indonesian Tu-16 twin-turbojet Badger bombers supplied by Russia each carry two underwing mounted air-to-surface missiles during flyby over Djakarta for Indonesia's Armed Forces Day celebration. Missiles are air-breathing and appear to be a relatively simple conversion of a MiG-15 or MiG-17 airframe, which the missile configuration resembles. They are not the Hound Dog type configuration seen at Tushino (AW July 24, 1961, p. 27). Large radome is mounted above the nose intake like the installation in the F-86D. Fairing at top of the missile's fin may also be an antenna. Lead bomber carries the serial number 1618 on the fuselage ahead of the intake and a two-letter identification on the aft fuselage ahead of the tail. The other two bombers carry similar markings.

nals indicating that solar panels were released from their stowed position, had deployed normally and were drawing power from the sun. Another signal indicated that the spacecraft's silver zinc battery had shut down, indicating proper automatic sequencing of sun acquisition, lock-on, solar power tap and battery shut-down was complete.

Thermal sensors on the sun seekers indicated that Ranger 5 was in a correct orientation; that is, sun seekers were hotter than the negative units.

Then one paddle appeared to go dead, and the Ranger spacecraft computer and sequencer reactivated the main battery.

After a period, the temperature data from the negative sensors became higher than those for the active sun seekers, indicating that the spacecraft had re-

oriented itself toward the earth rather than toward the sun.

The battery finally went dead and the spacecraft was without power at 9:45 p.m. EDT, Oct. 18, following the 12:59 p.m. launch that day. During the second hour of flight, the main beacon transponder on the spacecraft went dead for 20 min.

News Digest

USAF Atlas F missile was launched from Atlantic Missile Range on a 5,000-mi. flight Oct. 19. Avco data cassette was recovered in the target area, and two 16 mm. cameras, designed to monitor booster engines cutoff and jettison, were recovered 500 mi. down range. Army Pershing missile was fired 350 mi. from AMR Oct. 24. Transporter-erector-launcher was tilted to simulate battle-field launch conditions.

Royal Australian Air Force last week ordered 30 more Dassault Mirage 3 jet fighters, making a total of 60 to be phased into RAAF operational squadrons. They will be built in Australia under license. Funds also are provided for eight Bell HU-1 Iroquois helicopters.

North American X-15, with USAF Maj. Robert Rushworth at the controls, last week made the fourth in a series of flights from Edwards AFB, Calif., to determine vehicle performance during re-entry with the lower ventral fin removed. The No. 3 research plane

achieved a 15-deg. angle-of-attack with speed brakes open and then closed after engine shutdown. Maximum speed during the 10-min. flight was 3,818 mph., achieved at 113,000 ft. Maximum altitude was 134,000 ft., and engine burn time was 79 sec.

Robert W. Tharrington has been appointed vice president-general manager of the Vertol Division of the Boeing Co. (AW Oct. 22, p. 30). Appointment is in preparation for forthcoming retirement of Don R. Berlin who has been general manager of Vertol since 1960. Berlin will reach retirement age in mid-1963.

Charles T. McKinnie, 56, Pratt & Whitney Aircraft Division sales manager since 1958, died recently.

Cosmos 11 Launched

Moscow—Eleventh satellite in the Cosmos series was launched Oct. 20 into an orbit with an apogee of 572 mi., perigee of 152 mi., period of 96.1 mi., and inclination of 49 deg. Cosmos 11 is the seventh satellite in the series launched at a 49 deg. inclination.

The other four have been on a 65 deg. inclination.

Cosmos 11 is transmitting on frequencies of 20.0048 and 90.0216 mc. Soviet News Agency Tass called the launch routine, and said all equipment on board is operating normally.

Cosmos 11 is the 13th satellite to be launched by USSR since March (AW Oct. 22, p. 27), the most active period of space launches since its program began five years ago.

Ranger Studies

Washington—In addition to the technical review of the Ranger program which will begin tomorrow (see story), three other actions affecting the program are under way:

Jet Propulsion Laboratory in-house spacecraft design evaluation; reliability analysis being conducted by Fairchild Stratos under a \$35,000 contract; and control system analysis by Nortronics under a \$52,000 contract. JPL also is considering an evaluation of the Ranger Telecommunications system.

AIR TRANSPORT

U.S. Would Block Soviet Airlift to Cuba

Long-haul Moscow-Conakry-Havana route is the only access; Russian aircraft trying it will be 'forced down.'

By L. L. Doty

Washington—Any attempt by the Soviet Union to establish an airlift route between Russia and Cuba would be confined to the 4,500-mi. nonstop route between Conakry, Guinea, and Havana and would be subject to U.S. air interception.

A State Dept. spokesman last week told AVIATION WEEK that if the Soviets insist on sending aircraft into Cuba, such planes will be "forced down" well before reaching their destination on the island. This could be an amplification of Defense Secretary Robert S. McNamara's earlier statement that a procedure to cover inflight inspection had been worked out.

All Canadian airports were closed to the Soviets. Russia is not known to have bilateral agreements with any South American countries which are located so as to provide en route points between Africa and Cuba. The Scandinavian nations have also refused transit rights to the Russians, which prevents Aeroflot from flying the North Atlantic great circle route.

This leaves the Soviets with only the Conakry-Havana route as an aerial access to Cuba. A State Dept. spokesman indicated that it is doubtful that any attempt would be made to establish a supply line on this long-haul route.

Shortly after announcement of the Cuban blockade, the Castro government sealed off the island from all scheduled airline service by non-communist nations, warning pilots to stay clear of Cuban territorial waters.

Flow of passengers and airmail from

the island suddenly came to a halt. Evacuation of diplomatic personnel—a move still being studied by several governments as of late last week—was stymied temporarily by the ban.

Pan American World Airways, the last aerial link with Cuba, was advised Oct. 22 that all civilian flights from Cuba were grounded until further notice and that any plane taking off without military permission would be shot down.

Pan Am has been operating two round trips daily between Miami and Havana. Flights into Havana usually have been empty, and those outbound filled to capacity. The carrier was notified before its regular morning flight had departed, and that flight, along with all subsequent flights, were canceled.

Other U.S. carriers authorized to serve Havana—Braniff Airways, Delta Air Lines and National Airlines—discon-

tinued their Havana service many months ago. KLM-Royal Dutch Airlines suspended its regular service between Miami and Havana and between Havana, Kingston, Aruba and Curacao upon receipt of the Castro warning. Flights from Miami to Kingston and Aruba will be continued by skirting Cuban territorial waters.

Iberia Airlines of Spain, which operates fortnightly service between Madrid and Havana, canceled its eastbound flight Oct. 20 without explanation, but expects to resume the service in the future.

British Overseas Airways Corp. has rerouted its aircraft to bypass Cuban territory on its routes to Haiti, and Cunard Eagle took similar steps with its Viscount flights to Jamaica.

In other developments growing out of the Cuban crisis, the Federal Aviation Agency placed drastic restrictions on all civil aircraft flights in the southern two-thirds of the Florida peninsula. Under a special Civil Air Regulation issued suddenly by FAA Deputy Administrator Harold Grant, all aircraft operating in this area were ordered to file flight plans for military approval.

Aircraft lacking two-way radio communications and navigation equipment were grounded. Regulation applies at all altitudes and carries no expiration date.

Purpose of the curb on Florida flying is to "protect, identify and control" air traffic movements in a critical defense area, but not to restrict operations of commercial carriers, according to the FAA.

Airlines in the communist bloc will continue to serve Havana, although such service has never been heavy. Schedules of CSA Czechoslovak Airlines call for one flight weekly between Prague and Havana via Shannon and Gander, Newfoundland. CSA will probably operate nonstop between Havana and Shannon, bypassing Gander, although the Canadian ban specifically applies to Soviet Union aircraft en route to Cuba.

Cubana Airlines, which has been operating on a limited basis under the Castro regime, also uses Shannon and Gander on its once-a-week service between Havana and Prague. On Oct. 24, a Cubana Britannia, flying from Prague to Havana, stopped at Goose Bay, Labrador, for refueling because Gander was weathered in. At Goose Bay, all baggage aboard was checked by customs officials and a member of the Royal Canadian Mounted Police but there was no sign that future refueling stops at Canadian

FAA Distributes Airport Disaster Plan

Washington—New disaster control guide is being issued to U.S. airport operators by the Federal Aviation Agency. Distribution of the 36-page pamphlet, which describes what should be done in the event of nuclear attack, probably is not related to the Cuban crisis.

"The general location of airports away from cities and possible target centers and varying nature of damage (which might result from a nuclear strike) offer clues to the approaches management might take in survival planning," the guide states. It does not attempt to link any airport to a possible Soviet target area in the U.S.

Airport operators can anticipate that radioactive fallout will present the prime danger following a nuclear attack, according to the guide. Suggested survival measures include construction of shelters and acquisition of means to measure the intensity of radiation.

FAA also recommends that each airport operator appoint a disaster control officer, who should "establish contact" with local and state civil defense authorities and military units "to link the airport program with the efforts of these organizations."

Employing somewhat vague language throughout, the guide suggests that the disaster control officer develop procedures for all emergency actions, establish a disaster control center, train disaster control teams and work out mutual aid agreements with tenant organizations.

Decontamination operations following a nuclear strike would be under a radiological officer. If such efforts are successful, "your airport could serve as the hub for survival of your community," the guide tells local operators. It also warns that a radio or phone link for receiving alert warnings is an essential for every airport and spells out how these warnings would be sounded over various communications nets.

The guide was prepared in response to President Kennedy's February, 1962, executive order, which gave to FAA responsibility for ensuring the emergency management of the nation's civil airports. The guide was first applied to Wold Chamberlain Field, which serves the Minneapolis-St. Paul area. It is available through FAA's Airports Service.

ports would be barred during the crisis.

For some time, Russia's Aeroflot has been seeking a route to the Western Hemisphere with Cuba as an ultimate destination (AW June 25, p. 36). Failure to win traffic rights into the U.S. and South American countries, coupled with the Scandinavian ban on transit rights, has forced the Soviets to concentrate on the Conakry-Havana route.

Only one flight, a Tu-114 turboprop transport proving flight, has been conducted over the route, according to the State Dept. The Russians contributed substantial funds toward modernizing the Conakry airport so it would serve as a jumping-off point to the Western Hemisphere on the route from Moscow via Belgrade and Rabat to the west.

Plans to settle a bilateral agreement between the U.S. and Russia were abandoned last summer by the U.S., although Russia was known to have had a strong desire to launch the service (AW Aug. 6, p. 50). U.S. did not view the proposed pact as a normal economic exchange of traffic rights.

Issues at stake were considered political by the U.S. and the State Dept. did not care to enter into any agreement that suggested reciprocity as long as the cold war threatened to turn hot. The Russians expressed disappointment over this decision.

It was the ultimate goal of the Russians to get the Moscow-New York route and then seek beyond rights from New York to Cuba. This having failed, the Russians turned to South American

countries and made preliminary advances for bilateral agreements covering refueling and transit rights, but apparently made little progress (AW Sept. 24, p. 52).

The Russians hopefully had planned to use the long-range Tu-114 turboprop to cover the South Atlantic route, but this highly-touted aircraft has never appeared in Aeroflot service in any large numbers. Proving flights that opened Aeroflot routes in Africa were conducted with the smaller Il-18 turboprop transport (AW Sept. 10, p. 71).

The Tu-114 proving flight between Moscow and Havana—a 10,000-mi. trip—was completed in about 21 hr. flying time. The run from Moscow to Conakry was completed in 11 hr. Presumably, the flight was operated with a light payload, so operational and economic practicability of the flight cannot be determined (AW July 30, p. 34).

As of late last week, CSA had not accelerated its scheduled service between Prague and Havana. CSA headquarters in Prague said last week it has no plans to change its service and was prepared to operate the regular Friday Prague-Havana flight on schedule.

CSA operates British-built Bristol Britannia turboprop transports—former Cubana Airlines equipment repainted with CSA markings. The carrier has British Air Ministry approval to fly into Prestwick or Manchester for refueling, but normally operates through Shannon.

Bristol Britannia technicians once were stationed in Cuba in large num-

bers when Cubana was having maintenance difficulties, particularly in the training of mechanics. The team was recently recalled and only one Bristol-Siddeley Proteus engine technical representative remains in Cuba, as a manufacturer's aid to Cubana Airlines.

Because of the limited service operated by Cubana and CSA, lack of operating experience on the route to Havana by Aeroflot and transit restrictions, it does not appear possible that the Russians will be able to mount an airlift sufficient to serve as a supply line for weapons or troops. If this should be attempted, however, President Kennedy has stated that he was prepared, "if needed," to extend the shipping blockade to other "types of cargo and carriers."

Meanwhile, western carrier flights from Miami and other Gulf Coast terminals to South America were severely affected by the new Cuban policy. Under preferential routings worked out by U.S. air traffic control authorities, this traffic was being steered around the island, which sits astride heavily-used airways leading south from Florida.

Detour to the east generally adds about 30 min. to southbound flights across the Caribbean. To avoid flying over Cuban territory, aircraft are being cleared southeast to the radio beacon on South Caicos Island in the Bahamas, then southwest to Port-au-Prince in Haiti.

The leg from South Caicos to Port-au-Prince passes about 130 naut. mi. east of Cuba's eastern tip. But good navigation aids and distinctive island checkpoints mark the air route from the point it leaves the Florida coast, and there is little likelihood an airliner would stray off course if no one tampers with local radio facilities.

In its Oct. 23 Notice to Airmen (Notam), the Havana air route traffic control center banned all civil flights to Cuba, over Cuba or its territorial waters. No flag airline was excepted, not even those owned by South American governments which, in the past, have expressed some sympathy toward the Castro regime. CSA, however, apparently presumes this ban does not apply to it.

The Cuban government left itself a loophole to permit resumption of limited air service in the future. It said that flights "first authorized and approved by the military" could enter Cuba until further notice.

Latin American Division of Pan American, which operated a Douglas DC-7 on the route, asked what civil flights the Cuban military would approve. It was told by Havana center that Pan American's service was not among them.

Even before it issued the special CAR restricting flights in southern Florida, FAA had directed all U.S. civil aircraft



KEY WEST AIRPORT traffic controllers work in open while attempting to handle increased traffic in the South Florida area. Construction of new tower is going on simultaneously.

operators to comply with the Cuban Notam.

Under international agreements, Cuba has the responsibility for controlling air traffic within a broad area called the Havana Flight Information Region (FIR). It is this airspace, not just the airspace above Cuba, which U.S. airlines will try to avoid.

Although the eastern detour around Cuba contains no built-in hazards, the western route that skirts the Havana FIR may pose some problems. Its course lies almost entirely over water and there are few radio navigation aids en route.

Moreover, the western airway takes aircraft within 35 naut. mi. of Cuba's western tip. Cuba's westernmost province of Pinar del Rio contains the base of San Julian, where U.S. intelligence has reported large concentrations of MiG fighters. Airline pilots en route to Central American republics have reported instances in which MiGs flew their wingtips for many miles before turning back to Cuba.

However, there were no signs late last week that the Cuban situation was seriously curtailing the flow of commercial air traffic through the Caribbean. At Miami International Airport, officials said that no airlines had made changes in service despite the fact that the terminal was being used as a refueling stop for military airlifts. Miami, they added, had some surplus capacity and could accommodate additional flights if it proved necessary.

Air Transport Assn. said the Defense Dept. had made requests for information on the "availability of certain aircraft under certain conditions," but ATA would not elaborate on what this meant. It is almost certain, however, that the Civil Reserve Air Fleet (CRAF) will not be activated unless the crisis grows beyond the Caribbean.

Under the CRAF program, U.S. airlines make more than 200 long-range transports available to Defense Dept. during times of utmost national emergency. But activation of CRAF would have a disrupting effect on domestic airline schedules, and therefore is considered a last-ditch measure.

If extra airlift is needed by Defense Dept., Military Air Transport Service—the single purchaser for all the armed services—can and probably will acquire it through one of two other methods. First, MATS can exercise the so-called "expansion capability" clauses in the contracts it has awarded commercial carriers. These amount to pledges on the part of the airlines that specific aircraft, listed by tail number, can be pressed into service by the military.

Second way MATS can broaden its airlift base is to award short-term "call contracts" to carriers with surplus capacity. These can be accepted or rejected by the airlines.

Airline Executives To Probe Idlewild Noise

New York—Committee that will include top airline officials will be appointed soon by Louis J. Lefkowitz, state attorney general, to discuss aircraft noise around New York International Airport.

Following a public hearing last week, Lefkowitz said he wants further discussion by the committee on the noise problem before deciding whether he should seek legal means to correct the reported nuisance to communities.

"And I want the airlines' top brass on that committee, not their subordinates," Lefkowitz said. Civic groups, the Federal Aviation Agency and Port of New York Authority will also be represented, he added.

Austin J. Tobin, executive director of the Port Authority, told Lefkowitz at last week's hearing that sufficient legal procedures already exist for handling noise complaints in the courts.

Malcolm A. MacIntyre, president of Eastern Air Lines, encouraged search for a solution outside legal channels, saying he was backed in this approach by Charles C. Tillinghast, Jr., president of Trans World Airlines, and C. R. Smith, president of American Airlines. Harold E. Gray, executive vice president of Pan American World Airways, also appeared in support of MacIntyre's proposal.

Lefkowitz emphasized that there is no intention of curtailing air service at New York, but said he is not going to alter his search for an acceptable solution for all parties involved in the noise dispute.

No Agreement Seen On IATA Cargo Rates

Final accord on cargo rates still appeared highly unlikely last week at the International Air Transport Assn. traffic conferences in Chandler, Ariz., although agreement on passenger fares in the North Atlantic and Latin American areas seemed almost assured.

Passenger fare levels in the Pacific and Middle East areas were still in dispute as the conferences moved into their sixth week. Most delegates believed a recess on cargo rates is inevitable because of a stalemate on both specific commodity and weight break point rates.

Determination of Pan American and SAS to win authorization to charge piston-engine fares matching Loftleider Icelandic Airlines' non-IATA rates (AW Oct. 22, p. 36) still barred the way to a final decision on North Atlantic fares.

Compromise was reached on the con-

troversial "malpractice" resolution, which would permit three carriers to declare an open-rate situation if any carrier suspected of violating tariff regulations failed to put a stop to those violations within 15 days. Braniff Airways protested the resolution on grounds that on its South American route, the limited number of carriers would make it difficult to muster the support of two more airlines to condemn a third airline.

The conference voted to grant an exception to Braniff to permit it vote for passage of the resolution. A unanimous vote is required for approval of all rates, fares and resolutions.

Air France reportedly has been the major stumbling block to agreement on cargo rates because of its drive for a higher rate level. None of some 100 specific commodity rates presented to the conference was approved, with Air France being the lone dissenter in a number of the proposals.

Generally, however, widespread differences on the majority of these rates have kept the cargo conference in a tight deadlock.

Safety Experts Study Successful Ditching

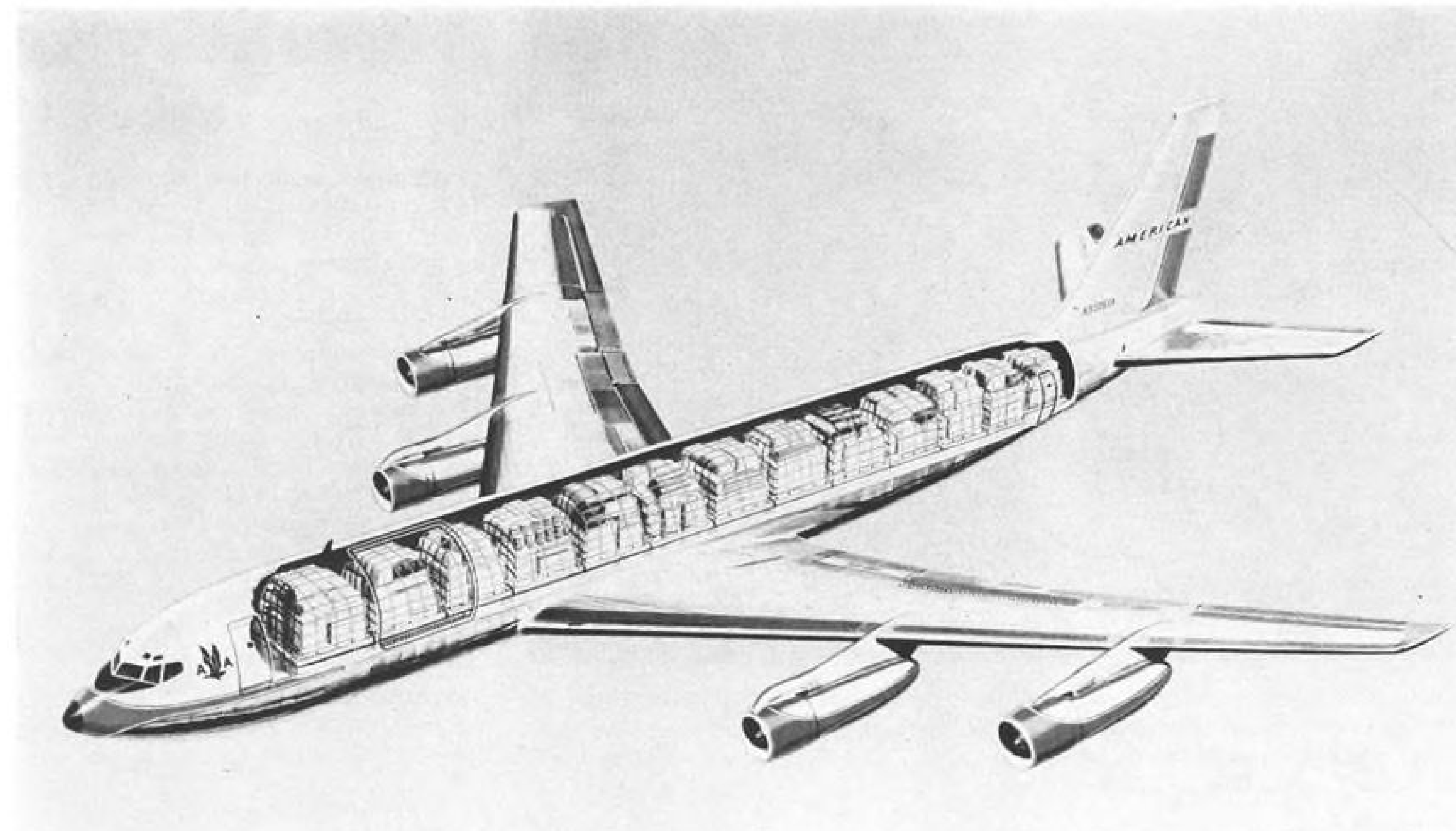
Washington—Civil Aeronautics Board investigators are taking a close look at how all 103 persons on board a chartered Northwest Airlines DC-7 were evacuated by crew-members after the transport had been ditched in the ocean near Sitka, Alaska.

Procedures employed during the water landing could set a pattern for changes in the Civil Air Regulations which CAB may recommend to speed evacuation of aircraft involved in other survivable accidents. More persons were saved during the Oct. 22 ditching than in any other similar incident in U.S. air history.

The DC-7, chartered by Military Air Transport Service, was carrying a number of women and children when a runaway propeller forced it down on the flight from McChord AFB, Wash., to Elmendorf AFB, Alaska. After descending from 20,000 ft. through scattered clouds, Capt. Vinton R. Hanson ditched in a calm sea near Sitka harbor. During the time the plane was afloat, almost 30 min., those on board were transferred to five, 25-man life rafts.

Before the DC-7 sank in about 300 ft. of water, all of the passengers and crew had been picked up by a Federal Aviation Agency supply boat.

CAB last week was studying whether to raise the aircraft from the bottom. CAB is considering a check to determine why the DC-7 could not remain airborne with three of four engines operating normally.



BOEING 320C JET FREIGHTER ordered by American Airlines has 88,000-lb. payload capacity, with space for 13 cargo pallets. Four of the aircraft were ordered for \$30 million. Aircraft, powered by Pratt & Whitney JT3D-3 turbofans of 18,000-lb. thrust, is pure freighter.

American Buys 4 Boeing 320C Freighters

New York—Move toward lower freight rates and increased sales emphasis on daytime shipments are expected as result of American Airlines purchasing four Boeing 320C turbofan freighters.

Carrier will receive the first of the 88,000-lb. payload aircraft late next year, and the other three in 1964. Purchase price of \$30 million is being drawn from available funds, without outside financing.

G. Marion Sadler, American general manager, said in announcing the purchase last week that it was too early to determine whether the airline would seek lower rates as result of the jets' greater capacity and lower operating costs.

"However, we would consider passing on any financial advantages of a jet operation to the shippers," Sadler said.

Any proposal to the Civil Aeronautics Board for a rate adjustment would come only after American obtains an accurate fix on the costs of a jet freighter operation following a period of experience, he added.

To obtain maximum utilization of the jets, Sadler said American will seek to shift traditional cargo emphasis on night shipments over to increased use of daytime schedules.

Significant in American's purchase is that the aircraft are pure freighters, not

convertible for passenger use as are the 320Cs ordered by Pan American World Airways. American's freighters have only two windows aft of the cockpit, these being for wing area observation.

Sadler said the encouraging growth of cargo volumes prompted American to buy the freighters.

"We're at the point where we had to make a decision," he said. "Frankly, we have been pressed to keep up with the demand with our DC-7Fs."

American's freight volume is up 26½% in the first nine months of this year. The airline anticipates it will fly 155 million freight ton miles in 1962 compared with 128 million in 1961. Approximately 7% of American's revenue comes from freight.

American operates 14 DC-7Fs, each with a 32,000-lb. payload capacity. Based on greater payload capability and utilization due to speed, the 320Cs will more than double the lift of American's present piston-freighter fleet.

Sadler said the 320Cs will operate at a direct operating cost of 5 cents per ton mile, and at something over 10 cents per ton mile when indirect operating costs are added. Direct operating cost alone on a DC-7F is 12 cents a ton mile, he said.

Daily utilization on the DC-7Fs averages 7 hr. per airplane day. American feels it will be somewhat higher on the

320Cs, although Sadler did not predict the increase.

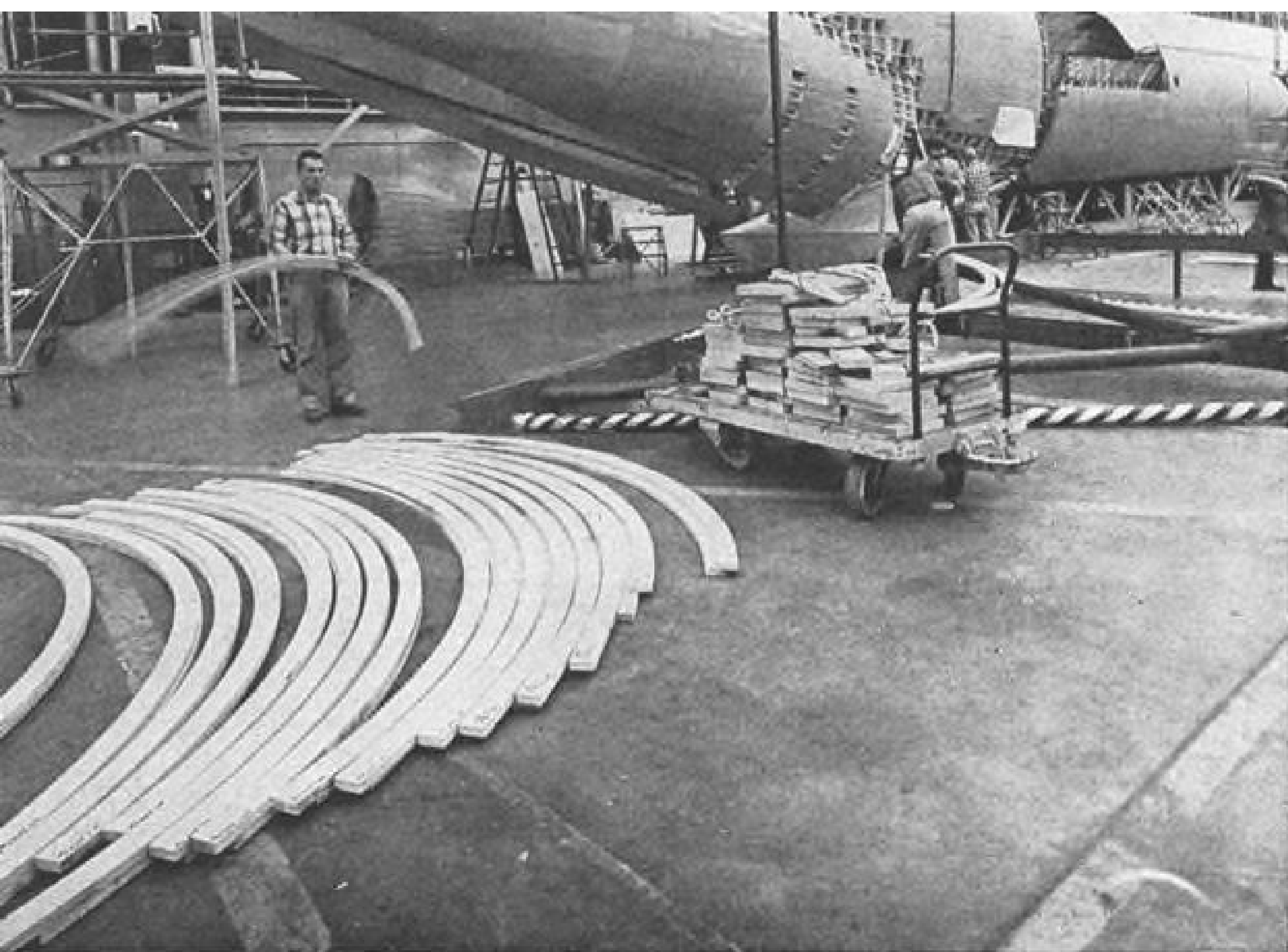
Jets will feature a roller and track loading system developed by American Machine & Foundry in cooperation with American, Sadler said. Thirteen pallets can be placed in the cargo bay, access being through a 7 ft. 7 in. x 11 ft. 2 in. door forward of the wing. Pallets are positioned manually on the roller tracks. Sadler said less than 10% of the fleet purchase cost went into the AMF loading system.

Even with current ground equipment, a full freight load can be unloaded and another placed abroad in 1 hr., Sadler said. American is continuing its research into more efficient and faster ground-handling equipment, Sadler said.

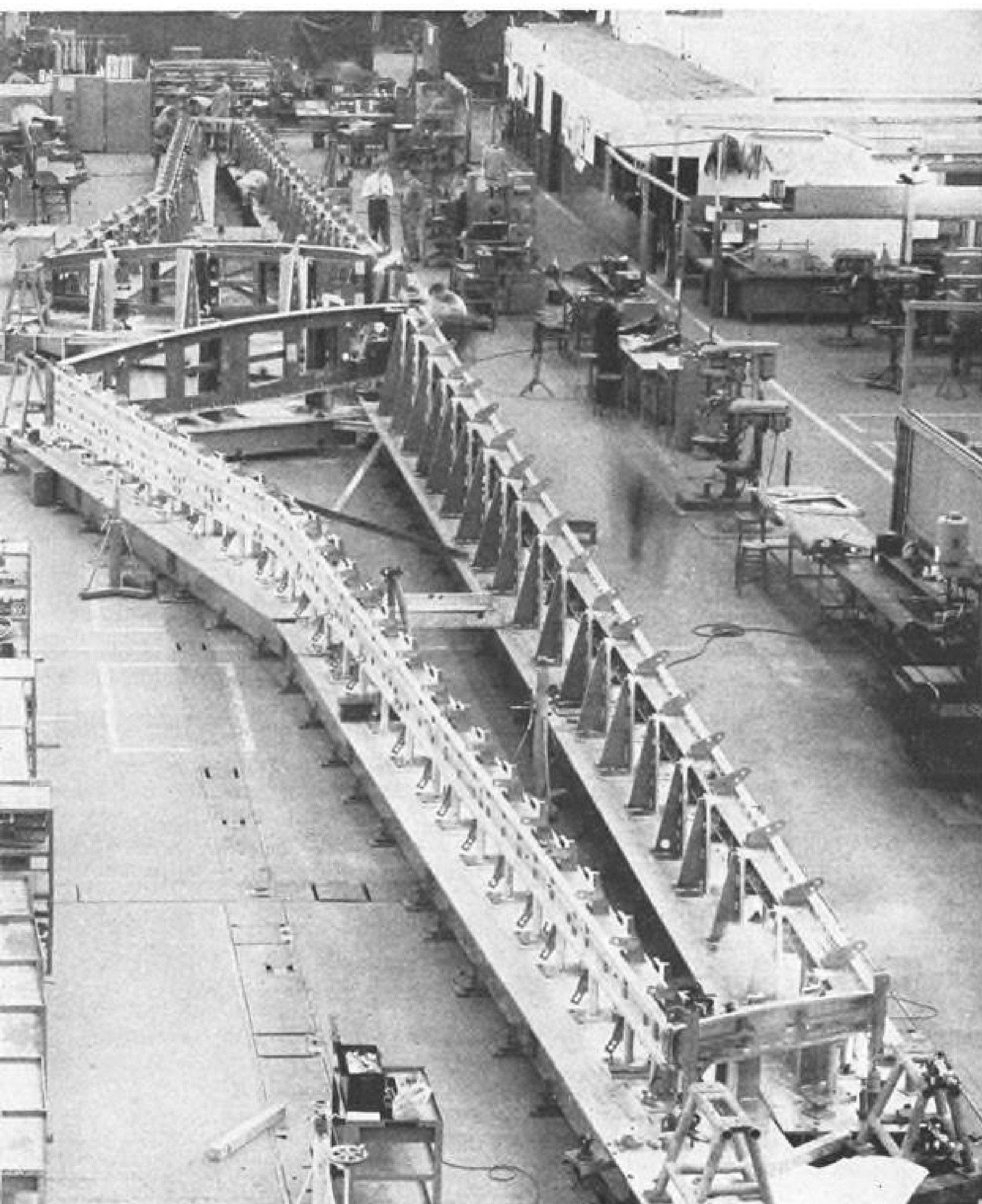
Aircraft will be used for transcontinental nonstop service, Sadler said, and perhaps on such short segments as Detroit-Chicago when demand justifies such flights. The planes will concentrate on the major, long-haul markets, with American retaining some of its DC-7Fs as support aircraft for lesser-volume points.

Sadler said that American will gradually sell its piston freighters, and may buy more jets as the market expands.

American anticipates the breakeven load factor on the 320C will be about 50% on transcontinental flights.



WIDE ACCESS DOOR of the Lockheed C-141 is evident on wood mockup (above). Loading platform, which extends with door opening, is adjustable to truckbed level, providing straight-in loading capability. Wing block of the C-141 (below) is assembled in Lockheed's West Coast facility. It will be shipped in sections to the Marietta, Ga., plant.



Versatility Key

By James R. Ashlock

Atlanta—Convincing the air cargo field that the C-141 jet freighter will be as efficient for commercial operations as for military service is a major project of the Lockheed-Georgia Co. sales group.

L-300, civil version of the C-141, is often regarded in commercial cargo circles as merely an adaptation of a military concept. Belief is also often expressed that the L-300 has range and payload limits below those of jet freighters which will be available well ahead of the L-300's projected 1966 availability date, and at costs comparable to the L-300's anticipated \$6,000,000 price tag.

"Criticism about military design is unrealistic," says H. S. Hopkins, sales representative for the L-300. "The military is just as interested in an efficient, low-cost aircraft as are commercial operators."

Lockheed is promoting the L-300 as a versatile freighter suitable for operation in the regional to international range.

"We believe that by the time this airplane is ready, there will be a need for it that jet freighters now being sold cannot meet," Hopkins said.

He maintains that Lockheed is sincere in its definition of the C-141 cargo transport and L-300 as a "design for double duty."

Even though current production is toward the military version—understandable since the C-141 is a government contract project—Lockheed has not hedged in its consideration of the commercial aspects, Hopkins told AVIATION WEEK.

L-300's ability to operate off 5,000-ft. runways is often minimized by cargo authorities who visualize long-haul as the key to air freight success. But Lockheed is confident that a changing air cargo market will make this a preferred asset.

"It is reasonable to forecast that the cargo market will expand into areas that have no air freight service today," Hopkins says, citing the continued decentralization of industry. "This will generate a shipping demand which the L-300 can serve from airports having only 5,000-6,000-ft. runways."

Lockheed's performance charts show that even on a 100F day, the L-300 can lift its 316,000-lb. maximum gross weight from a sea-level runway 7,300 ft. long.

Because the C-141's military requirements call for a 70,000-lb. design payload, the L-300 has generally been assumed to have the same. Actually, the L-300 offers a 96,125-lb. domestic payload maximum, although it can carry

Point in L-300 Commercial Sales Effort

this weight over only 500 naut. mi.

Payload/range capability chart shows that the L-300 is able to carry 84,750 lb. for 3,450 stat. mi. at the recommended 445-kt. cruise speed. The L-300's maximum payload is 89,250 lb. on 2,000-mi. flights, and 94,250 lb. on 1,000-mi. segments.

Direct operating costs for the L-300, based on the 1960 Air Transport Assn. formula, indicate that it will fly for 4 cents a ton mile on segments between 1,000 and 3,000 naut. mi. Absence of a single, defined low point in the direct operating costs, such as is characteristic with most piston freighters, is an asset Lockheed emphasizes in its promotion. Even carrying the 96,125-lb. maximum payload on a 500-naut.-mi. flight would not cost over 5 cents a ton mile, Lockheed officials say.

Indirect Costs

In adding indirect operating costs to determine total cost of operation, Lockheed assumed that each L-300 user would have at least three aircraft operating mainly over 1,000-3,000 naut. mi. distances. Indirect costs include loading crews, general administration, sales and advertising, non-aircraft maintenance, landing fees, depreciation of special equipment, training and pre-operating expenses.

"Even with a minimum three-plane fleet," Lockheed officials point out, "an airline could today, at an average rate of 20 cents per ton stat. mi., break even with a 50% load factor and a utilization of 5½ hr. per airplane day."

L-300 gains efficiency by not having to lift 7,600 lb. of equipment installed on the C-141. Main item is the floor, which is 3,590 lb. lighter on the L-300. The C-141 floor is heavier because of a military requirement that it sustain large, non-palletized loads such as vehicles and artillery. Strength for such items isn't considered necessary in the L-300.

Other weight cuts include flight station and avionics equipment, 1,390 lb.; troop provisions, 1,592 lb.; airdrop features, 440 lb., and miscellaneous, 590 lb.

Removal of the military provisions provides an additional 220 cu. ft. of cargo space beneath the flight deck, including a special lockup compartment for high-value items. Lockheed is also prepared to offer 130-cu.-ft. package areas in each of the landing gear pods, using space devoted to such items as an auxiliary power unit and life rafts on the C-141.

C-141 will be flown by a four-man crew, with berths and seating for a second four-man relief crew. But the

L-300, following the current trend for commercial operations, is designed for a three-man cockpit contingent.

L-300 is identical to the C-141 in main cargo compartment size. Seventy feet of its 81-ft. length is level. The last 11 ft. is on the adjustable loading platform, which slopes 11 deg. when retracted. Floor width is 123 in., with a walkway on either side. The usable height is 9 ft. 1 in., approximately 2 ft. higher than current freighters such as the CL-44. The 96,125-lb. maximum payload is based on a 16 lb. per cu. ft. density.

"This capability of high cube density is a real advantage," Hopkins says, "and is a good argument against those who feel the aircraft has too large a cargo area for practical commercial operation."

Hydraulically-operated aft loading doors, called "petal doors" because of their two-part, outward-swinging design, differ from those of the C-141 in that only one opening is provided. On the C-141, a smaller section of the door may be opened for air dropping small items or paratroops.

However, the single door of the L-300 is not only lighter, but affords better streamlining, so that rear area drag on the aircraft is no greater than on a Douglas DC-8 or Boeing 707, Lockheed officials say. The loading ramp, which is part of the pressure bulkhead when closed, is 50 in. above the ground when lowered, allowing straight-in loading from truckbed level. A self-contained stabilizing jack extends from the L-300's underbody for fuselage stability during

the loading and unloading operations.

Hopkins says that to minimize maintenance requirements, both the C-141 and L-300 are relatively conventional in design. The wings have only 25 deg. of sweep, providing good short-field and low-speed performance without a leading edge flap arrangement.

"The choice of wing geometry is probably one of the clearest examples of the Air Force's willingness to have the airplane optimized for minimum operating costs rather than for some arbitrary high-speed requirement," Lockheed officials note.

Combination of 25-deg. sweep with an average thickness ratio of 11.3% and an aspect ratio of 7.9 represents, in Lockheed's opinion, the best design for maximum operating economy.

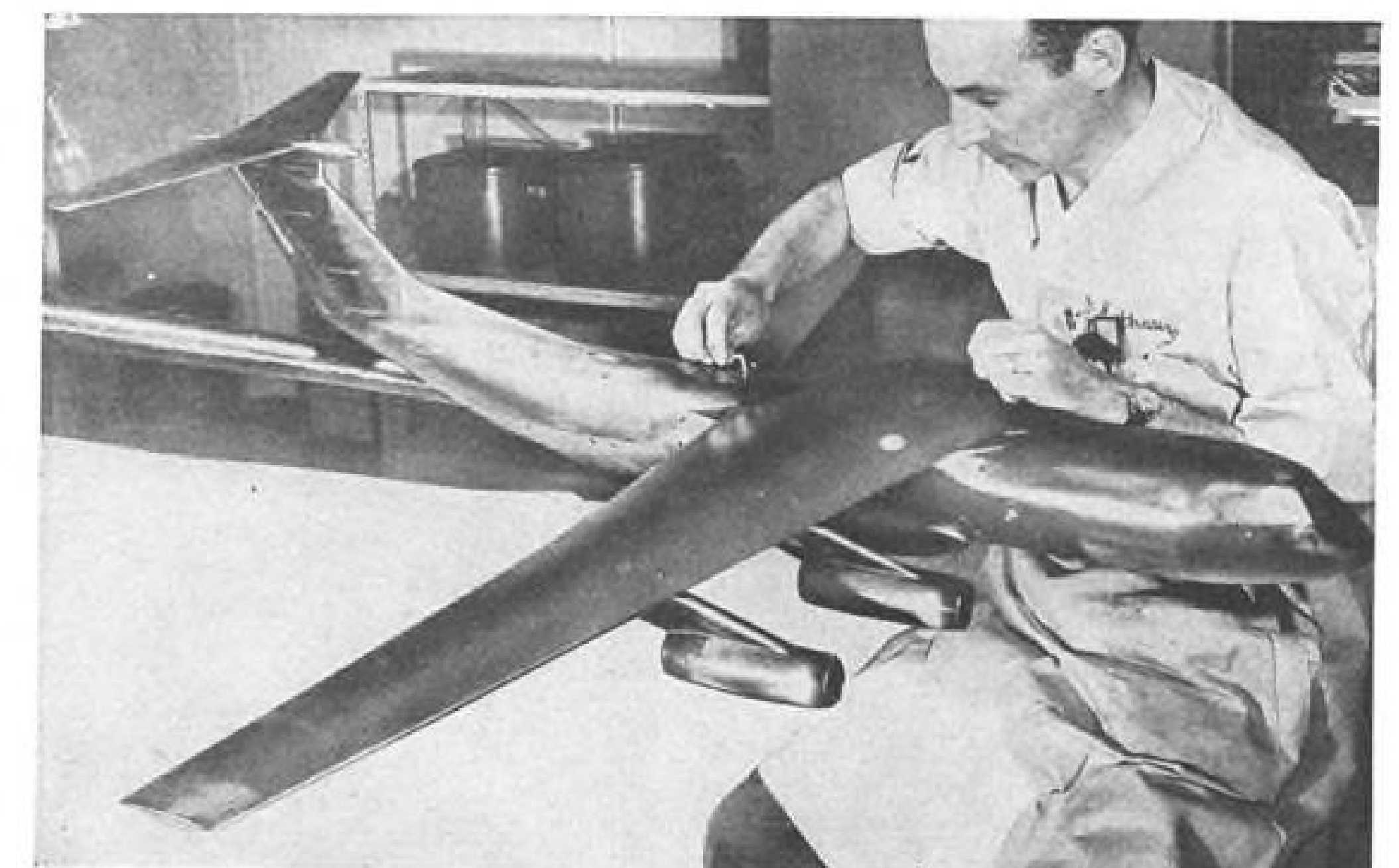
Vertical Stabilizer

Vertical stabilizer contains a ladder for maintenance accessibility, eliminating a need for exterior towers for line maintenance. A forward cargo door may be installed at the option of purchasers. Fueling is accomplished at ground level rather than through wing inlets, an advantage in view of the L-300's high wing.

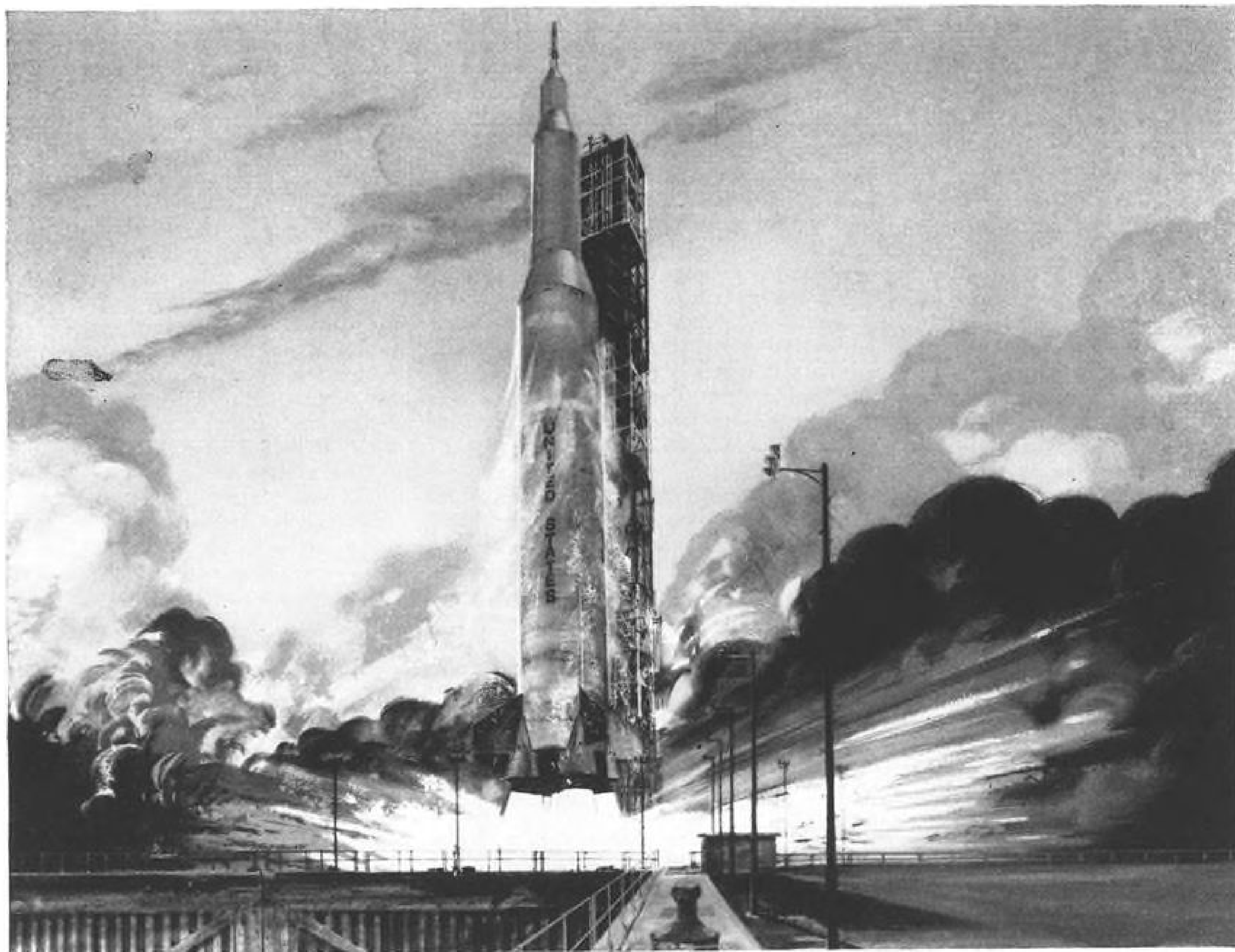
Although Lockheed has been working on boundary layer control, there is no plan to provide it on the jet freighter.

Lockheed feels the L-300's landing gear is the most practical possible from all standpoints, especially its location for maintenance, since it is contained in pods on either side of the fuselage.

"The gear is fundamentally short, rugged, simple and has heavy backup



WIND TUNNEL MODEL of the C-141 illustrates design of the Lockheed jet freighter. Because of its location atop the tail, the horizontal stabilizer is smaller than would be required if it were attached to the fuselage, resulting in a weight saving of over 2,000 lb. C-141 has a design payload of 70,000 lb.



ADVANCED SATURN, shown in artist's concept above, will be the free world's largest rocket, standing some 350 feet high and measuring 33 feet in diameter. Takeoff weight will be approximately 6,000,000 pounds. A National Aeronautics and Space Administration program, Saturn will be used to power orbital and space

flights, including the three-man Apollo vehicle's lunar flight. Saturn will be able to place 100 tons in earth orbit, or transport several tons of instruments to Mars. Boeing holds NASA contract to develop, build and test the S-IC first-stage booster, comprising five engines developing thrust equal to about 160 million horsepower.

Capability has many faces at Boeing



AIR CARGO enters jet age with new 707-320C cargo jets. Already ordered by two carriers (Pan American and World Airways) 320C can carry 45 tons at 575 mph, providing "next morning" deliveries across an ocean or continent.

HOT SHOT wind tunnel tests winged research model in re-entry attitude, part of extensive Boeing space vehicle research. Test was made at simulated speed of 12,000 mph and altitude of 215,000 feet, at temperature of 5300 degrees F.



MISSILE LAUNCH. U. S. Air Force photo shows Boeing B-52H launching a hypersonic Skybolt, the nation's first air-launched ballistic missile, now under development. Versatile B-52 missile bombers also carry and launch supersonic Hound Dog missiles, as well as bomb-lay weapons, enabling it to strike a number of military targets on a single mission.

BOEING



USAF B-66 is taking off from Bradley Field, Conn. Aircraft is acting as testbed for the Pratt & Whitney TF33-P7 21,000-lb. thrust turbofan engine which will act as the powerplant for the Lockheed C-141A Starlifter. Engine, which is a growth version of the 17,000-lb. thrust P&W TF33 which powers the Boeing B-52H, is mounted under the right wing. Left engine powering the aircraft is the TF33-P3 turbofan rated at 18,000-lb. thrust. The TF33-P7 is being manufactured at P&W's East Hartford, Conn. plant.

structure in an ideal place for gear-up landings," spokesmen say.

One handicap facing the L-300 is its weight in relation to the runway strength of airports from which it is designed to operate.

Lockheed is cooperating with Federal Aviation Agency on an airport survey in a study of this problem (AW Oct. 22, p. 37).

Pratt & Whitney JT3D-5A turbofan engines of the L-300 will each produce 21,000 lb. of thrust. Lockheed feels these engines, more powerful than those on any commercial jet now flying, give the aircraft a safety factor of special significance.

Hopkins says Lockheed is carrying the high power advantage proven with the turboprop C-130 Hercules through to the C-141. The C-130 is often operated on two engines during long-duration patrols by the Coast Guard, he said.

L-300's performance chart shows it capable of climbing 1,000 fpm. at 20,000 ft. with a 280,000 lb. gross weight, and 2,000 fpm. at 6,000 ft. Even on two engines, it can make en route climbs up to 20,000 ft. with a 280,000 lb. gross. All climb rates are based on maximum continuous thrust and standard temperatures.

Military version of the JT3D-5A, designated the TF33-P7 and marked for use on the C-141, is undergoing in-flight evaluation on a B-66 testbed aircraft.

F. A. Cleveland, assistant chief engi-

neer for C-141 development, says Lockheed received wide variances in the design criteria obtained from individual commercial carriers on their idea of an ideal freighter.

Maximum payload requests ranged from 20,000 to 200,000 lb. for ranges of 1,000 to 4,000 naut. mi.; cruise

speeds from 250 to 600 kt.; cargo compartment volume from 3,000 to 14,500 cu. ft., and maximum gross weight take-off field lengths from 3,500 to 10,000 ft.

"It is not surprising that any single carrier can truthfully state that this airplane does not fit its requirements in every detail," Cleveland says.

"It does appear from our continuing studies, however, that the fundamental payload/range, speed, cargo compartment size and airport performance of the aircraft are as optimum an answer to these many requirements as any single airplane can be," he adds.

British SST Tests

London—Royal Aircraft Establishment last week started tests on cooling and air-conditioning systems for supersonic aircraft, with emphasis on supersonic transport passenger cabins.

Cooling laboratory has been built at RAE Farnborough to test systems for a Mach 2.2 supersonic transport and the TSR.2 supersonic strike and reconnaissance fighter. Latter now is under construction, and the supersonic transport project is still being negotiated between British and French governments (AW Sept. 17, p. 34).

Farnborough technicians have built a passenger cabin section 12 ft. in diameter and 20 ft. long, mounted in an altitude chamber. Skin temperatures up to 300F will be simulated by 1,400 infrared heating elements mounted around the cabin. Cabin is fitted with 24 seats which will hold instrumented aluminum dummies in early test stages, and humans at a later date. At 240F, cabin temperature remains constant at about 65F. Laboratory can simulate flights up to Mach 5 at 100,000 ft.

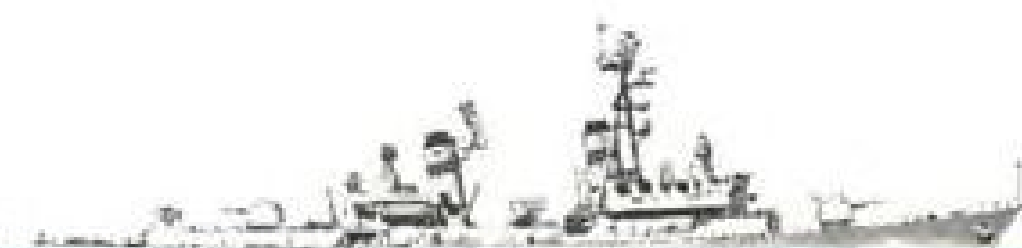
Public Vote Approves New Basle Proposal

Basle—Revised modernization and expansion proposal for Basle-Muelhausen airport's present facilities was approved last week by a 2-1 majority in a public Basle referendum.

Formal Swiss government approval of the plan is expected this fall. Under the revised proposal, funds have been reduced to approximately \$13.5 million, to be spent on construction of a four-floor terminal building, an additional hangar and badly-needed maintenance and overhaul workshops.

Original proposal (AW Jan. 8, p. 43), which called for about \$18.75 million for a five-floor terminal, longer runways and additional technical installations, was defeated by a bare majority in a public vote in June, 1961.

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Study Disputes Airlines on Deficit Issue

Washington—White House study of international air transport policy will take issue with the airline industry's stand that air transportation has been a factor in the U. S. international balance-of-payments deficit.

The White House steering committee, which will make final recommendations on an international air policy to the President on Dec. 1 (AW Oct. 15, p. 45), has not fully developed all details of its proposals. Late last week, the committee was still in heated discussion as to which factors of the study prepared by private consultants will be used in the final recommended policy.

However, it now appears that the balance-of-payment issue as proposed in the basic study will be adopted as one of the recommendations which will go to the President. In essence, the study states that balance-of-payments poses no real problem in the evaluation of the relationship between foreign and U. S. flag carriers.

Last week, Stuart G. Tipton, president of the Air Transport Assn., re-emphasized an earlier statement that the balance-of-payments deficit "gives urgency to the need for legislation to deal with foreign carrier destructive rate and capacity practices." He added:

"Air transportation is just as real a factor in our balance-of-payments position as any tangible commodity, and an international trip on a foreign flag airline rather than a U. S. airline has a similar impact on our balance-of-payments as the purchase of an imported typewriter. By the same token, when a U. S. airline serves a resident of a foreign country, this has a similar impact on our balance-of-payments as the export of a U. S. typewriter."

The White House study will argue that this reasoning, while correct, tells only a part of the story. It will state that balance-of-payments in air transportation favors the U. S. because:

- **Foreign flag carriers** purchase the vast majority of their aircraft, a large number of engines, spares and parts here, providing a dollar-flow to the U. S.

- **Foreign flag airlines** serving the U. S. spend substantial sums here in advertising, fuel, wages and rentals of sales offices, ticket counters and hangar space, adding to the dollar flow.

Tipton holds that the balance-of-payments deficit in air transportation is about \$150 million annually. He bases this on the fact that U. S. residents pay \$299 million to foreign flag carriers, while the U. S. international airlines receive only \$149 million from residents of other nations.

The White House study's solution to this ticket-sales deficit will be to pro-

duce more foreign visitors to the U. S. In fact, a key recommendation of the study is that the industry should concentrate on an expansion of the international market and place less emphasis on the dwindling share of U. S. traffic in the present market (AW Sept. 10, p. 53).

The study will suggest that the volume of foreign visitors cannot be increased if foreign flag carriers are restricted in their services to the U. S. Such a move, the study will suggest, would discourage foreign travelers from flying to the U. S., and thus reduce the market available to U. S. airlines.

An earlier White House study on aviation goals, Project Horizon (AW Sept. 11, 1961, p. 34), conformed closely to the airline industry's position on the balance-of-payment issue. Citing the need for continued U. S. pre-eminence on international air transportation, this study said:

"Our flag carriers should expand on a profitable basis, since our U. S. international air transportation system will play an important economic role in supporting our manufacturers of aircraft and related equipment, assisting underdeveloped nations, redressing the balance of dollar payments, and aiding many other segments of the national economy."

Plans were made last week to allow the airlines to see the first draft of the policy developed by the committee. This decision reportedly came about as a direct result of airline pressure on the committee.

Next month, Federal Aviation Agency Administrator N. E. Halaby, chairman of the steering committee, will meet with the airlines to review the policy. However, the original 600-page study, which was prepared by Systems Analysis and Research Corp. and Robert R. Nathan Associates, will probably not be released.

First draft was scheduled for circulation among the airlines last week. This week, the draft will be reviewed in a special session by FAA, CAB, State Dept., Commerce Dept., Defense Dept., Agency for International Development, White House staff and Bureau of the Budget.

Meanwhile, the airlines are not entirely unified as to what policy they want. The policy the industry has adopted in recent years is basic and fails to encompass important details because of sharp disagreements on a number of major issues.

The policy one carrier may want for Latin America, for example, could contradict the policy the same carrier might want for its Pacific operation which, in

turn, could be at odds with the policy of another U. S. carrier in that area.

In a more specific instance, Pan American World Airways is vigorously opposed to a CAB staff proposal that North Atlantic carriers serve Europe on a regional basis. TWA, on the other hand, strongly supports this principle, which is a basic recommendation in the White House study. These differences make it difficult for the industry to set an over-all policy satisfactory to all carriers.

Aeroflot Passenger, Cargo Data Revealed

Moscow—Russia's Central Statistical Administration has for the first time included specific Soviet air transport data in its annual economic handbook "The USSR In Figures."

The new information reveals a long U. S. lead over Russia in air cargo as well as air passenger traffic.

In past years, the Soviet publication gave specific data for rail, sea, river, pipeline and automobile transportation. But figures on Russian air transport were only provided in terms of percentage gain over an undisclosed 1940 base figure, which, for purposes of comparison, equaled 100%.

The Russian handbook confirms figures published by Russian newspapers earlier this year on the number of passengers carried by Aeroflot: 21.8 million in 1961, 16 million in 1960, 12.2 million in 1959, 8.2 million in 1958, and 400,000 in 1940.

The U. S. scheduled airline industry handled 58,441,000 passengers in 1961.

Other Aeroflot traffic information included:

- **Passenger-kilometers** (billions): 1961—16.4; 1960—12.1; 1959—9.1; 1958—6.4; 1940—0.2. U. S. scheduled airline industry flew over 64 billion passenger-kilometers in 1961.

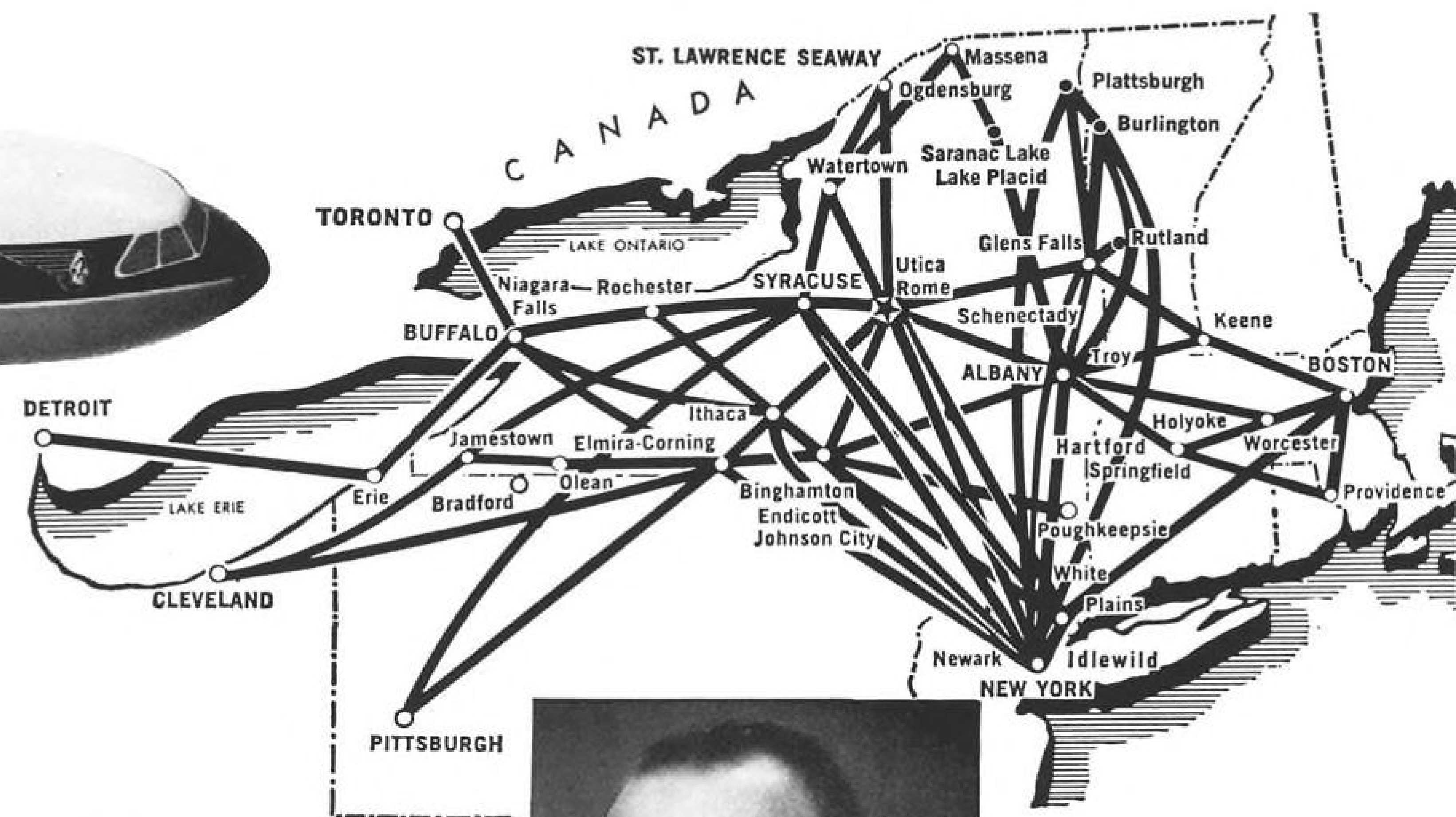
- **Mail** (thousands of tons): 1961—195.6; 1960—150.7; 1959—97.9; 1958—87.8; 1940—14.3.

- **Cargo** (thousands of tons): 1961—647.3, 1960—545.8, 1959—446.4, 1958—357.8, 1940—44.1.

- **Cargo** (millions of ton-kilometers, including mail): 1961—801.8; 1960—562.8; 1959—438.6; 1958—399.4; 1940—23.2. U. S. scheduled airline industry flew about 1,759 million cargo and mail ton-kilometers in 1961.

"The USSR In Figures" continued to present Aeroflot's unduplicated route mileage as percentages of the 1940 figure: 1961—254%; 1960—250%; 1959—247%; 1958—243%; 1940—100%.

MOHAWK CHOOSSES BAC ONE-ELEVEN



Mr. Robert E. Peach,
President of Mohawk Airlines Inc, says:

'Mohawk Airlines is pleased to be the first regional carrier in the United States to purchase the BAC One-Eleven. After intensive study we believe it to be ideally suited to our routes, the first pure-jet powered aircraft to be both adequate from a capacity point of view for Mohawk's heaviest segments, yet economic to operate over relatively short distances. We are proud to have shared in some of the developmental thinking of this aircraft which will provide Mohawk's customers with the finest jet equipment available.'



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AIRLINE OBSERVER

► Question of the extent to which U.S. airlines should be regulated under the Federal Aviation Act of 1958 again has been raised by a Civil Aeronautics Board chairman. Speaking at a recent Aviation Writers Assn. meeting (AW Oct. 22, p. 38), CAB Chairman Alan S. Boyd said that if the industry is to be wholly regulated, then the number of carriers operating is of little or no significance. If, on the other hand, competition is to be stressed, then mergers may be in order. Previous Board members have found that the legal requirement for fostering competition within a regulated industry creates a dilemma.

► Strong de Havilland sales team, including John Cunningham, chief test pilot and company director, was in Australia last week to push its Trident three-jet transport in competition with the Boeing 727. Potential customers are Ansett-ANA and Trans-Australia Airlines. Major sales points are ability to deliver on time and an extensive after-sales services organization.

► Japanese Ministry of Transport has issued a White Paper on civil aviation recommending that the government give more assistance to Japan Air Lines to improve its competitive strength in international operations. It also called for a loosening of regulations for domestic airline route licensing.

► Eastern Air Lines has graduated 450 certificated flight engineers since the program began last July (AW July 30, p. 29). Goal is 700 engineers, 100 more than the airline had when the flight engineers' strike began. At the present time, about 200 pilots are taking the 250-hr. flight engineer course.

► W. A. Patterson, president of United Air Lines, says he is convinced that fear—not fare—restricts the airline market. In a speech last week, he stated that "faremanship may look impressive in airline advertising, but it makes no impression on fear."

► U.S. Travel Service reports a 50% increase in the number of French travelers visiting the U.S. during the first eight months of the year. Number of U.S. visas issued French travelers increased from 12,140 in the 1961 eight-month period to 18,786 in the same period this year.

► Russia claims its single-engine An-2 biplanes are now serving 3,105 mi. of Air Mali routes in the African Republic of Mali. It says that the circular links connect a total of 20 cities and towns. The Russians have trained Mali citizens to be stewards aboard the An-2s, which are flown by Soviet pilots. Besides An-2s, Air Mali has Soviet-piloted, four-turboprop Il-18s twin-engine Il-14s and helicopters.

► Eastern Air Lines has blamed the industry's failure to adopt its new proposed tariff (AW Oct. 15, p. 42) as the reason for withdrawing major portions of the fare revision from the CAB. Provision for a 20% reduction on round-trip tickets during certain days of the week and proposal for a 4½% increase in jet day and night coach fares have been dropped. Request to reduce fares on the Air-Shuttle will stand unchanged, the airline said.

► New York Airways Vertol 107s are operating with transmission shafts strengthened by shot peening, and these in turn will be replaced by new shafts next year designed for unlimited life certification by the Federal Aviation Agency. Vertol also is working on a technique to reduce rotor flap noise in the aircraft, which Vertol believes is produced primarily by the rotor blade tips where the front and rear rotor disk areas impinge. Interior retrofits are planned to increase durability, but New York Airways cannot spare any of its three ships in service for this modification now.

► FAA has received a survey that measures the noise generated by 20 currently used turboprop transports, turboprop air freighters and turbine helicopters on takeoff and landing. It will use this data, which was compiled by an acoustical consulting firm called Polysonics, to update Planning Series No. 3. This document was issued to the Federal Housing Administration in 1960 to guide it in granting mortgage loans on property near airports. The new survey measures both the intensity of aircraft noise in decibels and its frequency distribution in cycles per second, and could serve as the base for an FAA regulation prescribing maximum noise levels around U.S. airports.

SHORTLINES

► American Airlines will begin service at Dulles International Airport Dec. 1 with three jet flights daily, two nonstop round trips between Washington and Los Angeles and one round trip from Washington to Dallas and San Francisco.

► International Air Transport Assn.'s sixth public relations conference will be held in Washington Nov. 12-15. Total of 70 delegates and observers are scheduled to attend.

► Lake Central Airlines has filed a tariff with the Civil Aeronautics Board which would permit foreign visitors to the U.S. to have unlimited air travel on the carrier's system during a 30-day period for \$75. For children of such travelers, the price would be \$37.50, under the tariff, provided they are under 21.

► National Airlines last week inaugurated non-stop jet flights from New York to Jacksonville and Tampa-St. Petersburg. One round-trip daily flight will be operated to each of the Florida areas.

► Northwest Airlines will operate 70 jet flights weekly between Chicago and Miami beginning Dec. 15. It will also increase its five flights a week between New York and Chicago and Hawaii to one daily.

► Sabena Belgian World Airlines flew a record 4,079 transatlantic passengers eastbound in September, a 37% increase over the volume handled in the same month last year. The carrier flew 5,670 passengers westbound in the same month, a 17% increase.

► Seaboard World Airlines has reported a net profit of \$382,000 for the month of August on revenues totaling \$2.6 million. For the first eight months of 1962, the airline showed a \$62,000 net loss.

► TABSO, Bulgaria's state-owned airline reported its route network totaled 3,533 mi. on the carrier's recent 15th anniversary. Included are 840 mi. of domestic and 2,693 mi. of international routes.

► Trans World Airlines has amended its application in the transatlantic route renewal case to include Lebanon as an additional area to be served by the airline if the CAB adopts a policy of regional competition for U.S. international carriers.



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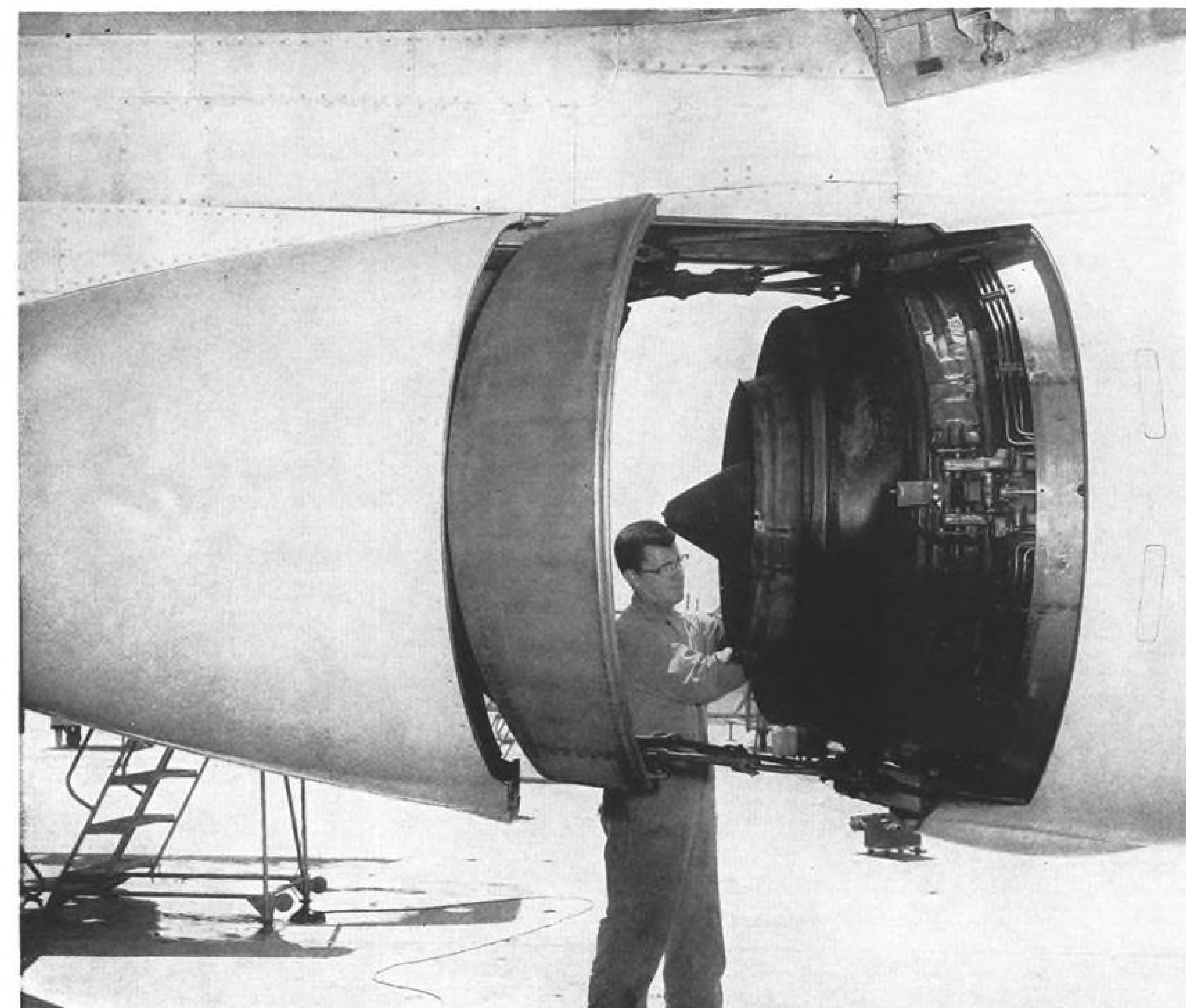
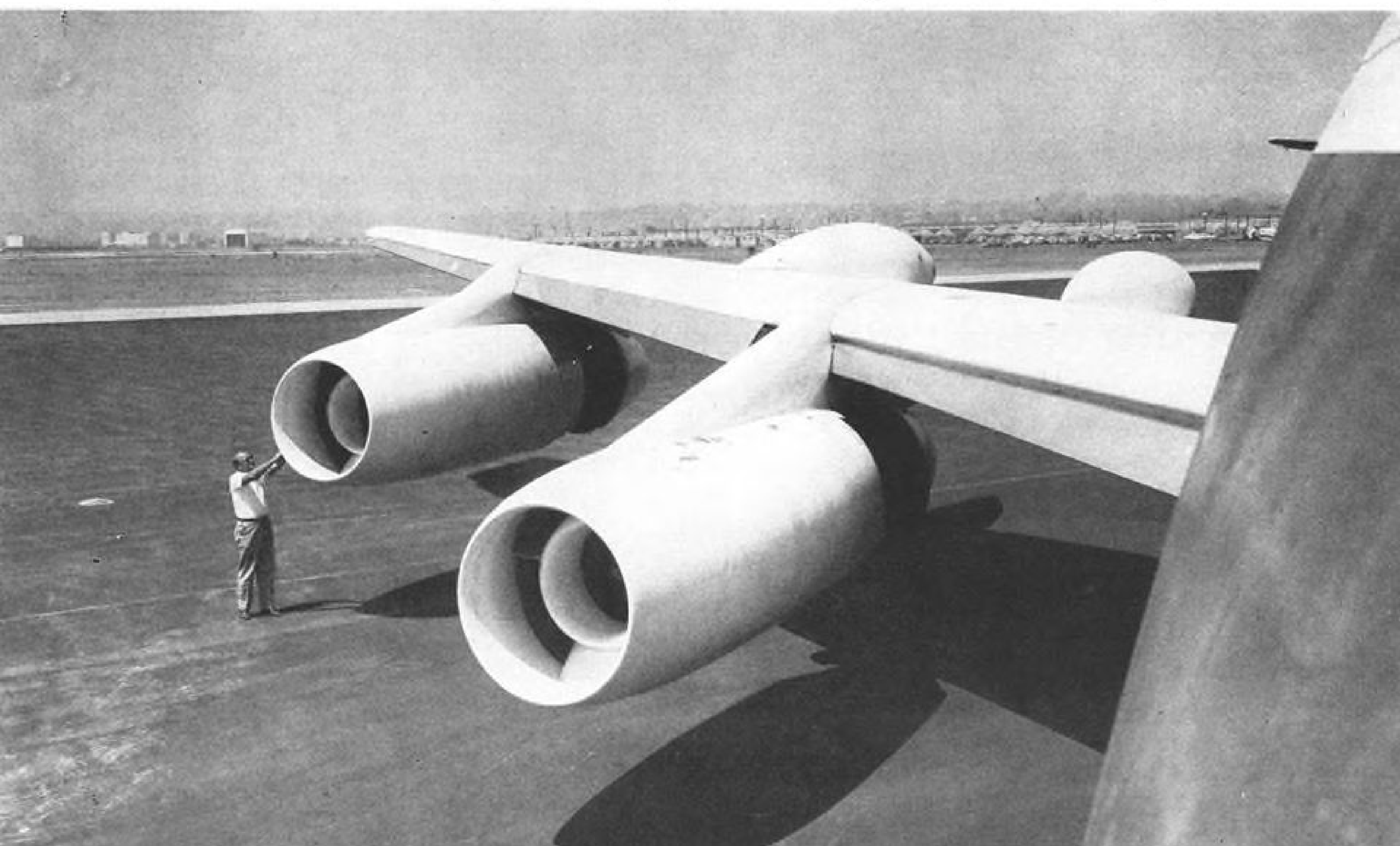




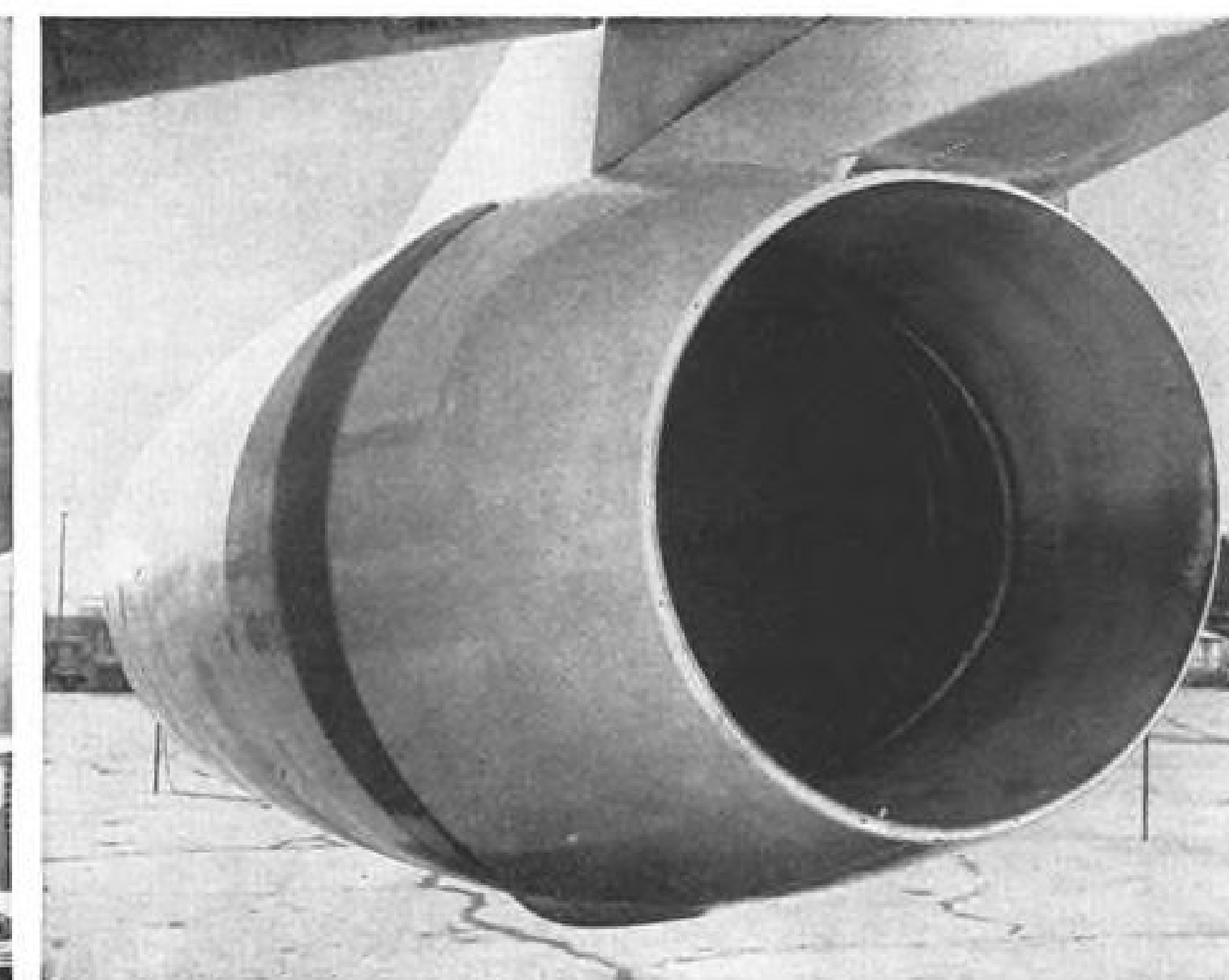
Convair 990A turbojet transport has new wing fillet (arrow), nacelle extensions, wing camber change and full-span Kreuger flaps to improve speed and short field characteristics. Changes were made under agreements reached with Swissair and American Airlines to bring the 990 up to original performance guarantees (AW Sept. 18, 1961, p. 40; Sept. 25, 1961, p. 354; Oct. 9, 1961, pp. 45-48).

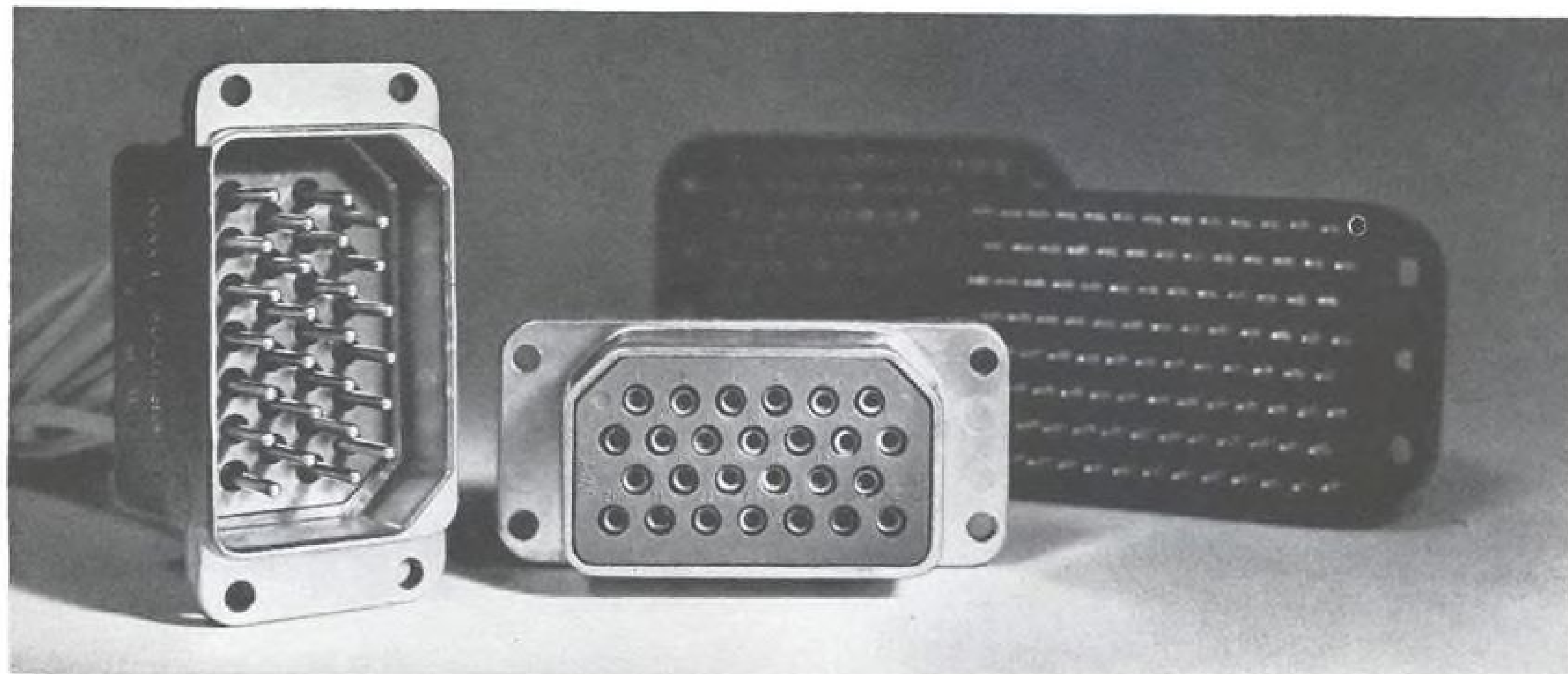
Convair 990A Has Wing, Flap, Nacelle Changes

Full length Kreuger flaps replace the former combination of Kreuger flaps and leading edge slats. Wing leading edge has been modified so that it has less camber. Convair-owned aircraft shown here incorporates changes designed for Swissair and has been certificated by FAA. Another version, for American but basically the same, will begin certification testing in November (AW Oct. 22, p. 50).

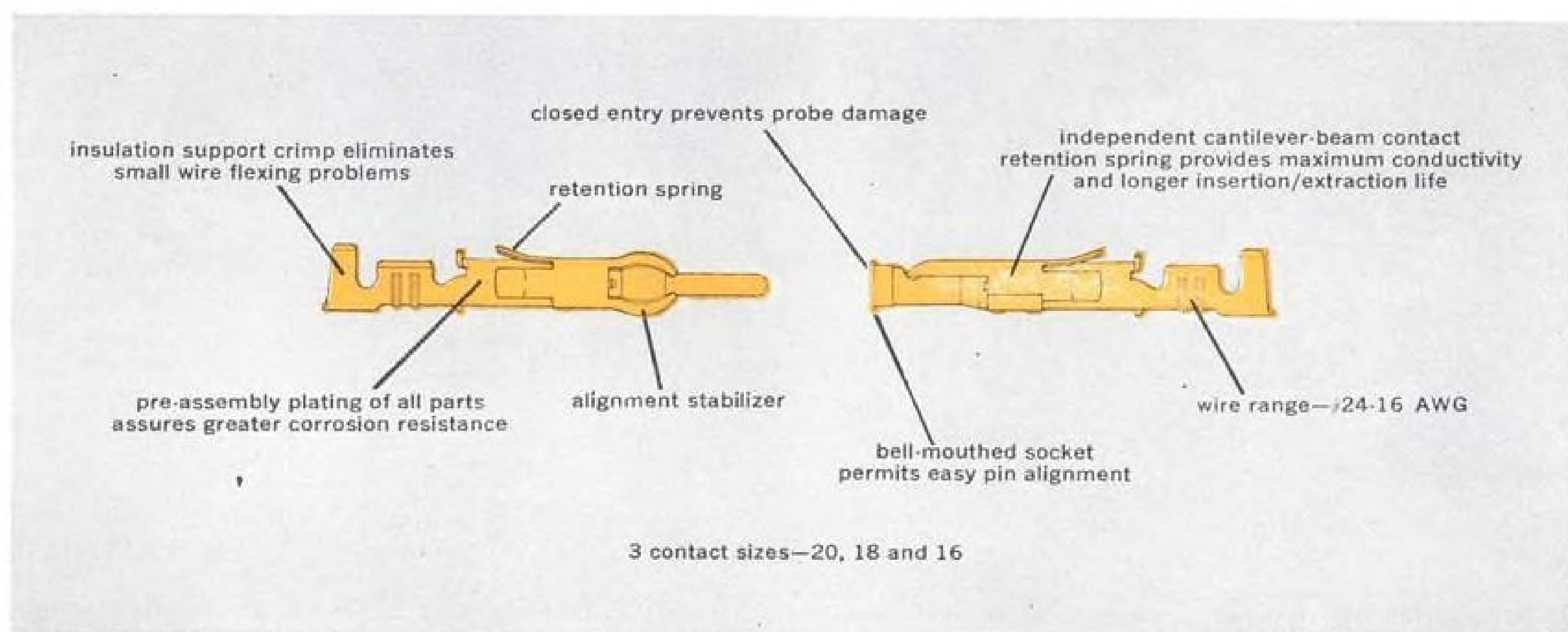


Engine pods have been extended rearward 25 in. to eliminate drag which prevented original 990 from meeting performance guarantees. Contour fairings have been added to the 990A engine pylons and terminal fairings on the inboard side of each engine exit nozzle, both of which are applications of area-rule design principles. Two photos (above, below left) show nacelle ejector open with thrust reverser clam shells visible. Nacelle below right is in normal flight position. Convair has flown 990A about 325 hr.





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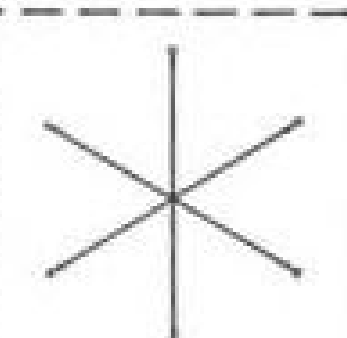
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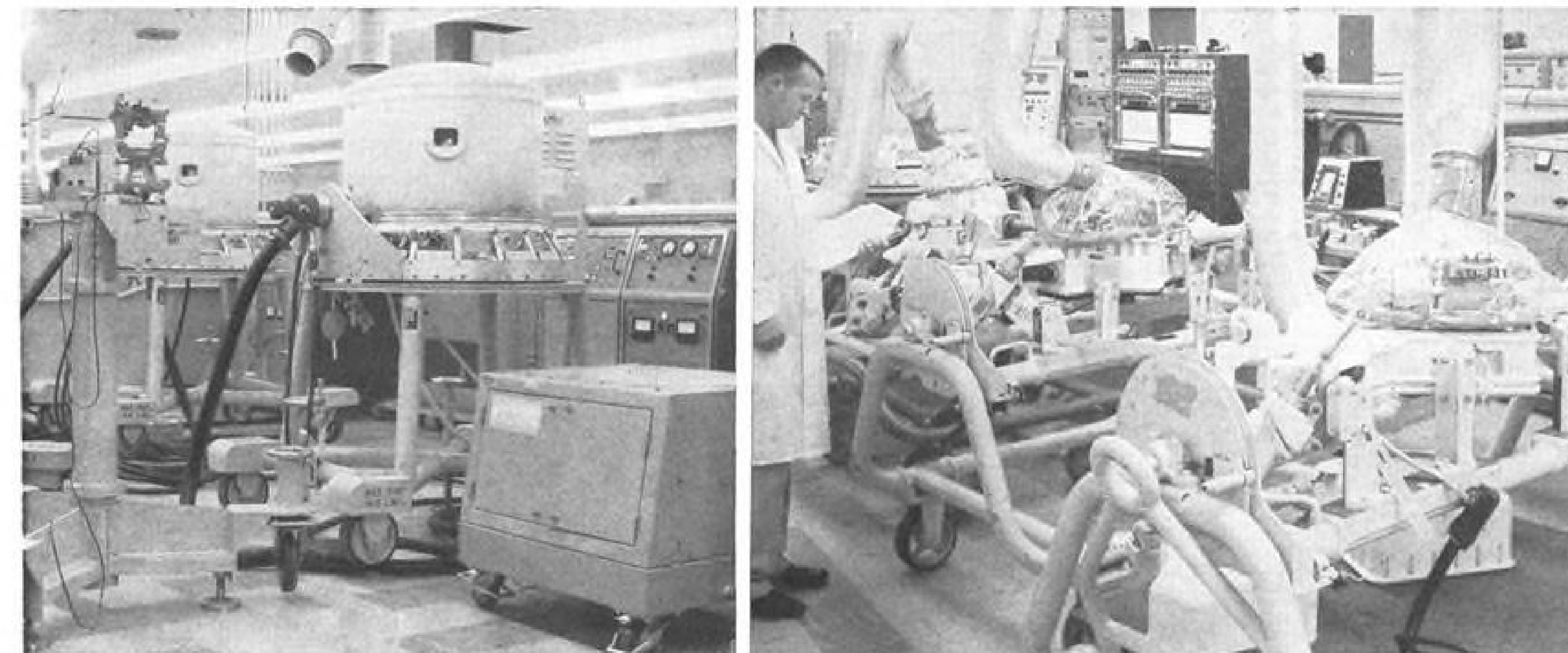
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AVIONICS



MINUTEMAN GUIDANCE AND CONTROL SYSTEM built by North American Aviation's Autonetics Division contains practically all of the avionics aboard the missile. Cylindrical container (left) contains guidance-checkout computer, gyro-stabilized platform and associated controls, plus batteries. Shown right are nozzle control units for each of the three missile stages, with first-stage unit in foreground and upper-stage unit in far background. Units contain electric and hydraulic power supplies and flight control amplifiers.

Minuteman Guidance and Control—Part 1:

Systems Keyed to Fast-Reaction Demands

By Philip J. Klass

Anaheim, Calif.—Many new engineering and management concepts are being pioneered by North American Aviation's Autonetics Division in its Minuteman guidance and control system program.

The innovations were made necessary by the rigorous operational requirements imposed by the Air Force for the new solid-propellant ICBM, requirements more demanding than any previously applied to a weapon of Minuteman's complexity.

Minuteman must be designed to remain on alert status continuously for several years, buried in unattended silos. If launch authorization comes, the missile must be able to take off in less than 60 sec. with a high probability of impacting on its intended target.

Minuteman represents a tradeoff. Air Force is accepting a missile with a smaller warhead than the Atlas and Titan in return for a more reliable ICBM which is far less expensive to build, to install, to maintain in hardened sites and with practically instantaneous reaction time.

To meet this challenge, Air Force, Space Technology Laboratories (which provides technical direction) and Autonetics have introduced many innovations in the management and design of the guidance and control system.

Nominally, Autonetics is listed as an

associate contractor for guidance and control. Actually, it is responsible for essentially all of the avionics equipment in the missile except for the warhead and a handful of resistors used in the fusing-arming circuits. This includes the flight control system, hydraulic actuators used to deflect rocket nozzles, hydraulic and electric power supplies for each of the three stages, and all interconnecting electrical cables.

Autonetics also is responsible for providing nearly all of the prelaunch checkout equipment at each silo, except that used to test the warhead.

By giving essentially complete avionics responsibility to Autonetics, the Air Force sought to avoid subsystem interface problems which have occurred in the past when many subsystem contractors were involved. To Autonetics competitors this Minuteman avionics package may seem like a juicy plum, but it also means that almost any failure which can be pinned on an avionics com-

ponent is laid on the Autonetics doorstep.

The act of contracting with a single company for a complex system does not in itself eliminate difficult interface problems, particularly when the company is as large as Autonetics, with about 34,000 employees. Unless steps are taken to provide internal direction and integration, the interface problems are only obscured from outside view until a crisis arises.

Originally, the Minuteman program involved three separate Autonetics product divisions. The Inertial Navigation Division was responsible for design and production of the gyro stabilized platform; the Computer and Data Systems Division for the missile guidance computer and automatic checkout equipment; the Armament Control Division for the missile flight control (autopilot) and nozzle controls. Recently, the latter group has been transferred to the Computer and Data Systems Division so that only two divisions presently are involved.

To serve as project manager and systems engineer, to integrate the efforts of the three (now two) divisions, Autonetics created a new Minuteman Systems Management Division under E. N. Ljunggren.

The division was given authority and technical manpower but no manufacturing facilities of its own.

Within Autonetics, the Minuteman Division functions as a customer for the

New Systems Division

Autonetics has formed a Systems Division to develop and manage major systems programs involving more than one of its product (manufacturing) divisions. The new group, headed by Robert L. Olson, vice president, will perform a function similar to that of the Minuteman Systems Management Division (see story) on other complex system programs.

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dc — 13 Mc	F-P	1,825	707B	1 μ sec to 10^7 sec	TIM	1,325	756B
1 cps — 35 Mc	F-P	2,300	709C	0.3 μ sec to 10^6 sec	TIM	1,580	757B
dc — 5 Mc	UCT	1,550	726B				

F = Frequency
FP = Frequency-Period

TIM = Time Interval Measurements
UCT = Universal Counter-Timer

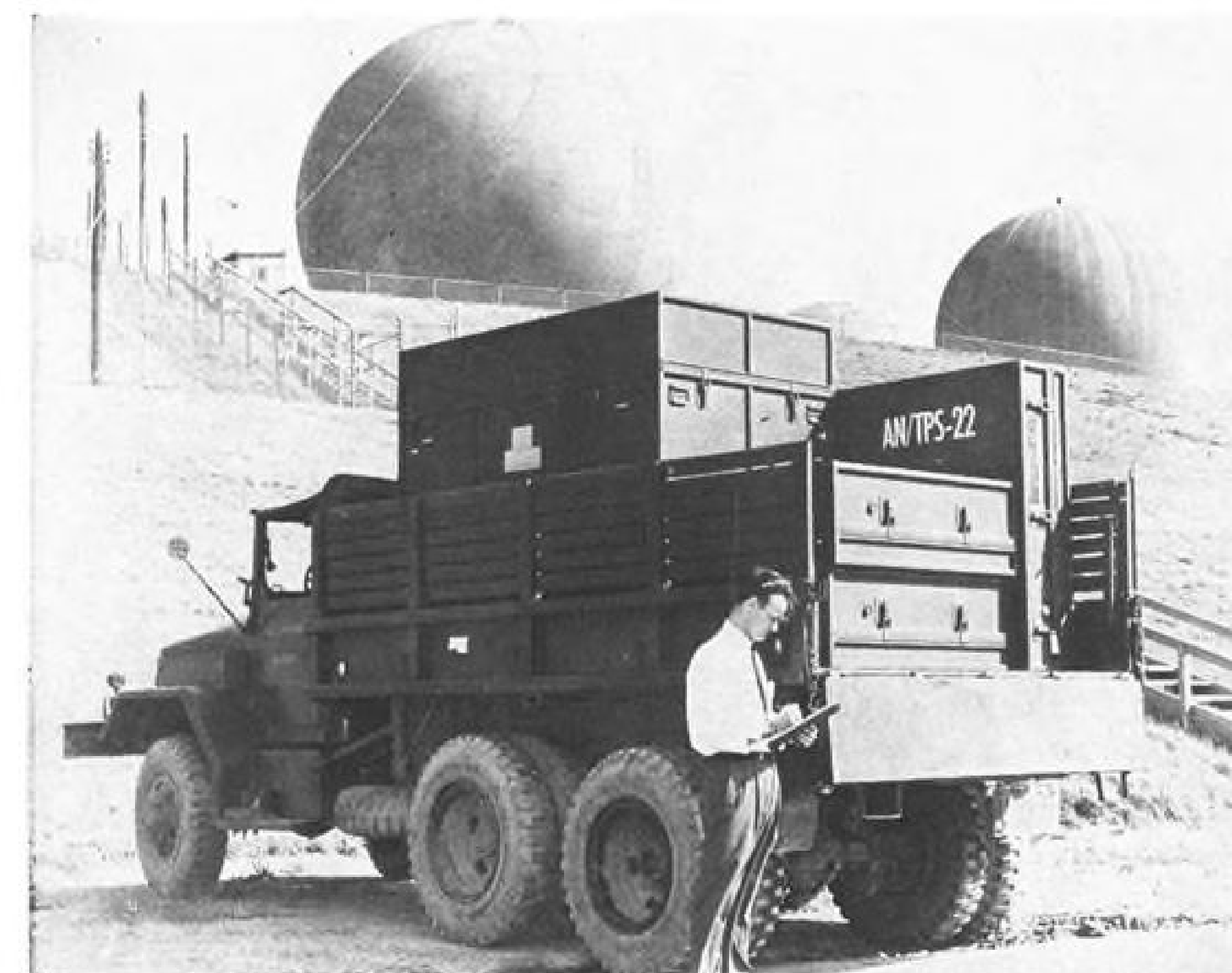
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412L Search Radar Delivered to USAF

First AN/TPS-22 tactical long-range search radar for use with 412L weapon control system has been delivered by Westinghouse Defense Center's Electronics Division to Seymour-Johnson AFB, N. C. Radar uses an air-inflated "paraballoon" antenna and inflated radome. This permits it to be disassembled and transported in five trucks of size shown. Radar can be set up and put into operation within six hours, Westinghouse says.

subsystems of the other participating product divisions. But to the Air Force, the Minuteman Division is the system supplier and speaks for Autonetics on the program, according to C. P. Ballard, chief engineer.

This division works with the Air Force to establish over-all system specifications, then in turn prepares specifications for all major subsystems on which the product divisions work. The Minuteman Division also prepares the over-all plan of action, prepares proposals, handles contract change notices, establishes and approves schedules and budgets.

Early in the program, the Minuteman Division purchased all high-reliability components, inspected and assembled them on printed circuit boards which in turn went to the product divisions for insertion in their equipment. This was done to assure a single controlled source for all components and circuits. Once the required standards had been established, this function was turned over to the Computer and Data Systems Division, which now performs the same function for both itself and the Inertial Navigation Division on the Minuteman program.

Additionally, the Minuteman Division conducts over-all engineering system tests to assure that specifications are being met in the Autonetics plant, at the Atlantic and Pacific Missile Ranges, and at the missile sites.

To carry out this mission, the Minuteman Division has about 1,600 employees of whom more than half are professionals. Of this total, about 25% perform off-site engineering and logistics functions at the missile ranges or bases. Although the bulk of the personnel doing systems engineering was drawn from the participating product divisions, other personnel came from



TV Camera Used in Towed Target Tests

Closed-circuit television camera has been mounted on a Gloster Meteor TT-20 jet to monitor performance of Del Mar towed target system during evaluation tests under way at Royal Aircraft Establishment, Boscombe Down, England. Camera unit, manufactured by EMI Electronics, Ltd., is mounted aft of the cockpit canopy and is powered by 12-v. battery. Receiver is mounted in front of the navigator, who also operates the target winch,

elsewhere in North American. For instance, Ballard came from NAA's Space and Information Systems Division, while Ljunggren came from corporate headquarters.

The division's responsibilities also include areas of finegrained detail which normally would not be assigned to a management division but which Autonetics President John R. Moore strongly feels must reside there if adequate control is to be exercised.

For example, the Minuteman Division is responsible for issuing lists of approved components which the product division engineers are allowed to use.

It standardizes the dimensions of printed circuit boards used in all subsystems, establishes parts application standards to assure that the same deratings are used by all designers working on the project.

In the near future, even more rigorous controls will be introduced, according to Ballard. For example, the product division purchasing departments will be prohibited from ordering non-approved parts without specific authorization from the Minuteman Division. Also, drawings can not be released for production without its approval.

Ballard concedes that this sort of authority does not breed popularity. But he says that these constraints are accepted by the operating divisions as necessary to achieve over-all program objectives.

This division also does a small amount of in-house design on special airborne instrumentation required for flight tests, or special checkout equipment needed for engineering tests. But the manufacture of such equipment is

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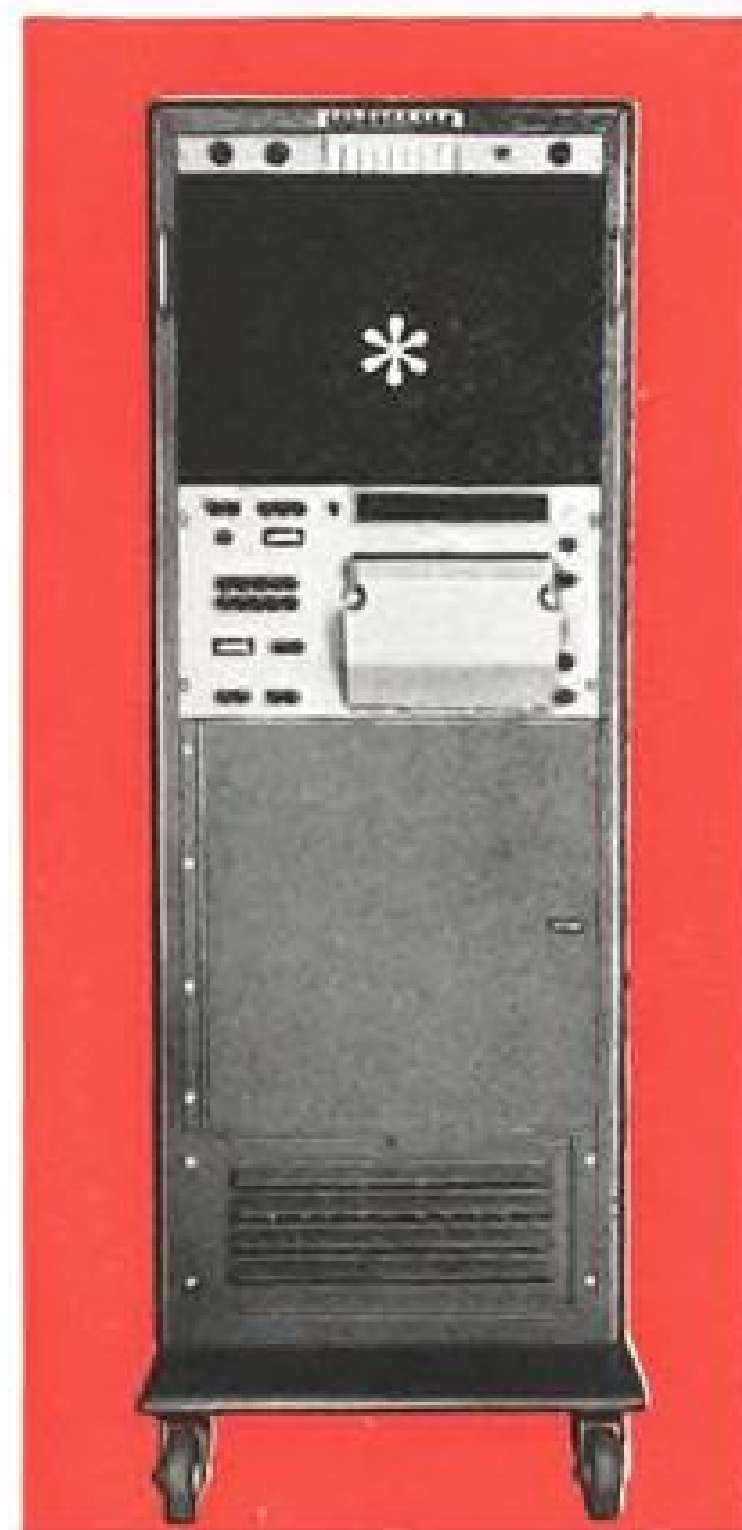
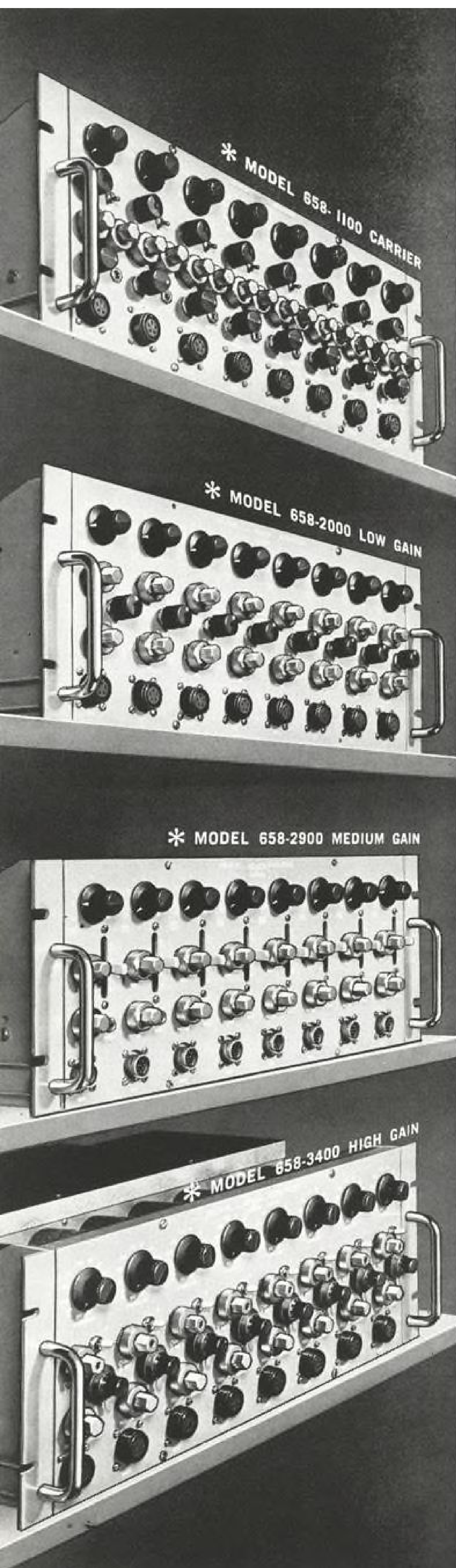
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porting ICBMs whole and carrying freight in bigger chunks than any other aircraft...the magnificent performance of C-47s flying "the hump" during World War II...the workhorse dependability of C-54s and C-118s during the Berlin airlift. And take note that the new DC-8F "Jet Trader" can be converted to any of 12 configurations in less than 2 hours.

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One of the important potential advantages of a digital computer over the analog type used for guidance in early ballistic missiles is flexibility—the ability to handle a variety of different problems. But little use has been made of this inherent versatility in ICBMs prior to Minuteman, except to permit rapid change of targets by changing stored computer program constants.

While the guidance computer plays a critically important mission role, in previous ballistic missiles this role has been a brief one lasting only during two or three minutes of powered flight, plus brief periods of operation on the ground when the computer was undergoing checkout.

Prelaunch Testing

To perform prelaunch testing of the missile's guidance and flight control systems, previous ICBMs have required separate ground-based equipment. This equipment, usually digital in operation, also had an important but brief role which ended when the missile was launched.

In the design of the Hound Dog air-to-surface missile, Autonetics first tried the idea of designing the missile's guidance computer so it could serve a dual function, being used also to test the over-all guidance system prior to launch.

This same concept has been applied to the Minuteman, with several important advantages. The cost and complexity of the silo installation is greatly reduced. The missile-borne computer is continuously exercised, without adverse effect on operational life time. If a poor quality component has slipped through the elaborate reliability screen, it is far better that it produce a random failure during peacetime than during critical moments prior to missile launch.

To provide this added capability increases the weight of the computer by less than 6 lb., or about 10%. But this greatly reduces the number of system wires which otherwise would have to be brought out through the umbilical, resulting in an over-all weight saving in the missile. Where the Atlas and Titan umbilicals have several hundred wires, the Minuteman contains a total of only 46, AVIATION WEEK was told.

At every stage of checkout, the digital computer serves as the Minuteman's communicator with the outside world. During the missile assembly, it is used to check out each stage, including tests of the nozzle control unit, flight control, staging devices, inertial components and other elements of the system, according to Dr. W. L. Morris, computer project engineer.

When the Minuteman is installed in the silo, the computer takes over the



Position Display for General Aviation Aircraft

Pictorial display for general aviation aircraft, called Flitefix 2, gives pilot continuous indication of aircraft position with respect to selected aeronautical chart. New display sells for \$2,250, measures 9 x 7 x 2½ in., and weighs 7½ lb., including remote transistorized avionics package measuring 8 x 6 x 4 in. Power consumption is 1½ amps at 28 vdc. or 3 amps at 14 vdc. Display obtains signals from aircraft's omnirange (VOR) and distance measuring (DME) receivers. Manufacturer: ACF Electronics Division, ACF Industries, Paramus, N.J.

routine testing and calibration. Finally, at launch time it performs the countdown tests and initiates the flight program. After launch, the computer switches modes and carries out navigation calculations.

Computer Functions

Where previous ICBMs have required a separate signal conditioner to convert guidance computer signals into a form suitable for operating the flight control system, this function also is built into the Minuteman computer, making it a triple-function device.

The computer determines when staging should occur, issues cutoff commands, and finally determines when the third stage should be cut free for the warhead to hit the intended target, according to Morris.

The missile computer performs two types of system checks. One, which it conducts continuously when the missile is on its normal alert status (ready

for launch within 60 sec.) is a qualitative check to assure that all subsystems are functioning.

Periodically, a more rigorous quantitative check is conducted by the computer which includes measurements to determine how well each element is operating and whether there has been any degradation in performance.

For example, where the routine checkout merely introduces a signal into the flight control amplifier to determine that each nozzle actuator moves in the proper direction, the periodic quantitative test measures the response time of the actuators as well.

During this checkout, the computer also automatically recalibrates elements such as gyros or accelerometers which might have drifted slightly since the last check. The results of all measurements are printed out for subsequent analysis.

Because the computer of the Minuteman performs the checkout, it is necessary to provide some external means to



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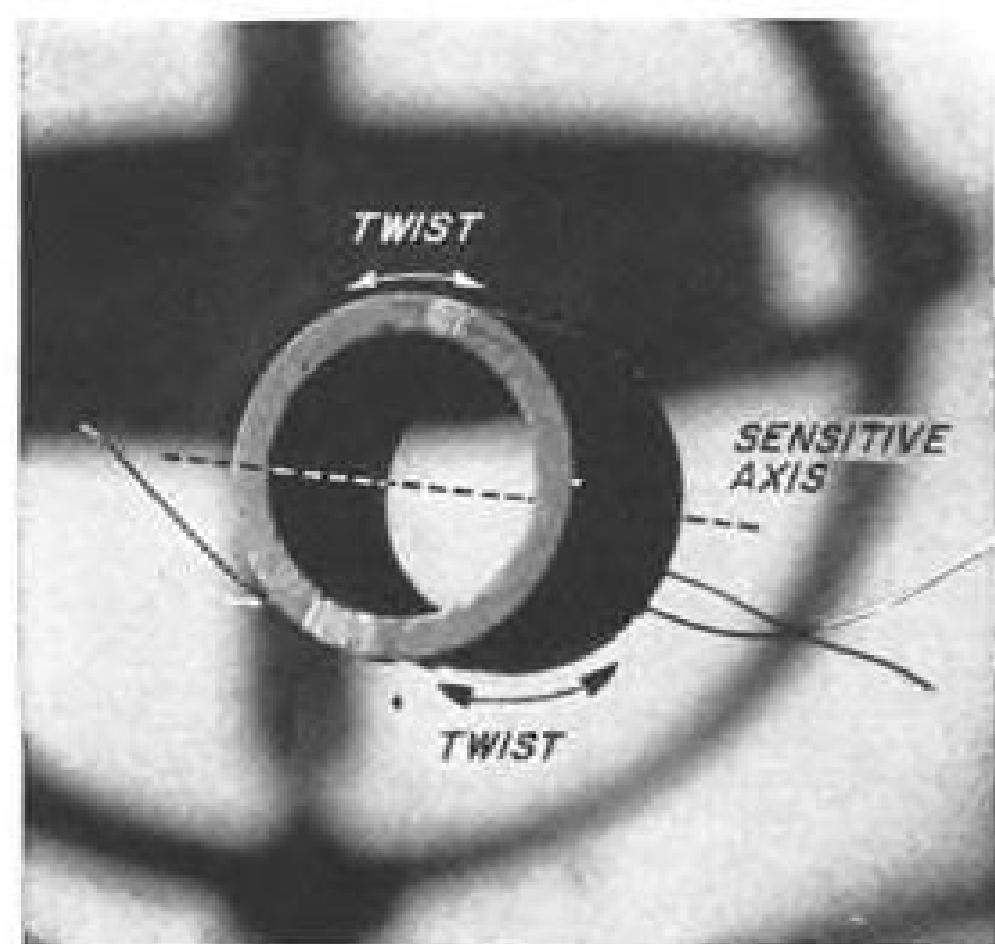
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assure that the computer itself is functioning properly. This requires only two small checkout panels at the silo.

However, Ballard says that Autonetics has devised an improved version of the guidance computer, which may be introduced in later wings, which could eliminate practically even this modest amount of checkout equipment now in the silo.

The Autonetics reliability program for the Minuteman is an innovation in terms of the scope and attention to small detail. Some critics charge that the Autonetics reliability program has been extremely expensive, but even they concede that the missile's operational requirements far exceed anything which industry has previously attempted to meet.

Where the AN/ARN-21C Tacan navigation set with 1,010 component parts has to exhibit a mean-time-between-failure (MTBF) of 150 hr., the specifications for the Minuteman guidance and control system, containing about 26,000 components, call for an MTBF of 1,700 hr. for Wing 1 missiles and about 6,700 hr. for later wings.

It is only fair to point out, however, that the Tacan set must exhibit its 150-hr. MTBF while being subjected to rigorous vibration and temperature cycling, while the Minuteman system is tested in the air-conditioned comfort in which it will live except for the last several minutes of its lifetime. The Au-

tonetics system also undergoes tests which simulate this rigorous environment.

To demonstrate an MTBF of 6,700 hr. would require that Autonetics test its systems 24 hr. a day for nearly nine months, a luxury that a high-priority program of this type can not afford.

Instead, Autonetics and the Air Force depend upon a more limited system test period, in which the equipment must operate for 250 hr. without failure, backed up by a calculated MTBF which is based on extensive life test data on every component used and controls which assure uniformity of components.

Company experience with the Hound Dog indicates that such calculated values of MTBF are pessimistic by a factor of at least 4:1 and perhaps by as much as 10:1 in a silo-type environment. Recently, Autonetics shipped three Minuteman systems to Cape Canaveral which had undergone more than 1,000 hr. of operation without a single failure.

To achieve the specified longevity and reliability required components having an MTBF roughly 100 times better than the best available components on the market at the time the Minuteman program was launched. Autonetics therefore launched its "cradle-to-the-silo" reliability program which started back at the source of supply. Component suppliers were carefully screened and culled on the basis of extensive life tests of their best components, and finally about 20 companies were selected to participate.

Each of the selected manufacturers agreed to set up separate white-room type manufacturing facilities and elaborate, tightly enforced quality controls.

Component manufacturers, working with Autonetics, launched investigations to determine the basic failure mechanisms in their components and to devise cures. Automatic test equipment was used to assure that each component would be subjected to identical tests at the component factory and at Autonetics. Each component was given an individual identification number so that its subsequent performance could be correlated with original characteristics (AW Dec. 12, 1960, p. 99).

This Autonetics reliable components effort has produced ripples far beyond the Minuteman program. Component manufacturers have been free to offer similar quality components to equipment designers on other demanding programs. This in turn has spurred non-participating component manufacturers to set up similar facilities and techniques to meet the competition. The net result has been a general improvement in the quality of components available for high-reliability defense and space projects.

Within Autonetics design groups, over-all system reliability figures were

broken down into figures for major subsystems, and then down to the individual module or circuit. From data obtained in life tests on components, design standards were established to tell individual designers what failure rates could be expected for each type component under different stress conditions. Designers were required to analyze each circuit in detail to take account of possible drift in component parameters over a period of several years.

While these procedures are familiar to other companies working on demanding defense and space projects and not original with Autonetics, the Minuteman performance requirements demanded a rigor found in relatively few programs.

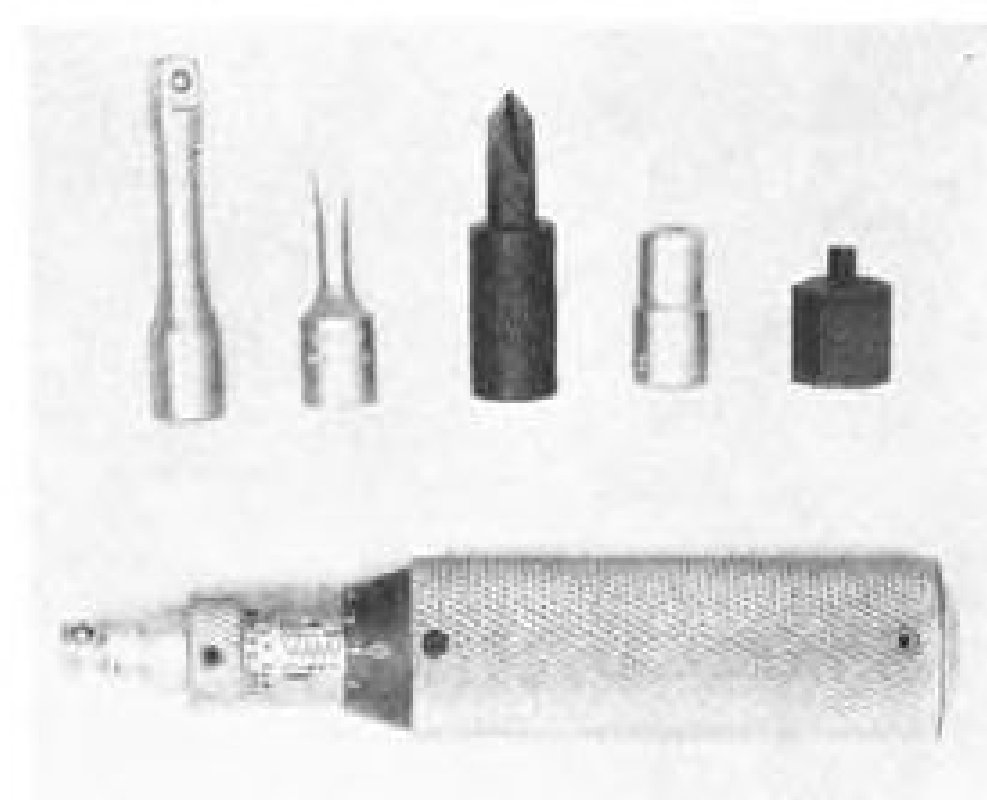
The evidence to date suggests that Autonetics' effort in reliability has paid off quite successfully. Minuteman has racked up an impressive record during the usually troublesome period of research and development flight tests.

Out of 21 attempted Minuteman launches to date, 15 are listed as completely successful, three as partial successes and three as failures. Autonetics has been tagged for roughly half of the malfunctions.

In at least one instance, the trouble was traced to circulating currents due to poor grounding which resulted from nearby thunderstorms. It has not been firmly established whether trouble occurred in Autonetics equipment or in special flight test instrumentation.

Naturally, Autonetics does not welcome being blamed for a failure. But Ballard points out that the "law of probability" is working against it because roughly 99% of the components in the entire Minuteman are in the Autonetics system.

(The second and concluding article in this two-part series, describing technical details of the Minuteman guidance and control system, will appear in a subsequent issue of AVIATION WEEK.)



Torque Screwdriver

Micrometer adjustable torque screwdriver, designed to release automatically when pre-selected torque is reached, is available either in ounce-inch or pound-inch models. Manufacturer: Proto Tool Co., 2209 Santa Fe Ave., Los Angeles 54, Calif.

Laser Radar Now Being Developed To Track S-66 Satellite Next Year

Moorestown, N. J.—An optical maser (laser) radar designed to track satellites is under development here by Radio Corp. of America's Missile and Surface Radar Division. The new radar is expected to be able to track the S-66 satellite scheduled for launch next year into a 600-mi. orbit by the National Aeronautics and Space Administration.

The experimental laser radar is part of a comprehensive optical maser program in several RCA divisions which ranges from basic research in laser materials through specific military and space applications. Examples are:

- **Cathode-luminescence pumping**, under investigation by the RCA Research Laboratories and the Electron Tube Division, which may offer two important advantages over presently used flash tubes. One is a much narrower spectral output which, if it can be matched to the required excitation wavelength of the laser material, will provide more efficient use of pump energy. The other advantage is the ability to control the waveform of the pump by means of a grid where modulation or waveform coding is desired.

- **Semiconductor pump source**, based on recent discovery by Lincoln Laboratories that voltage applied to a gallium arsenide crystal produces an intense emission of infrared energy at 8,600 angstroms wavelength. RCA Laboratories is investigating other materials, such as gallium phosphide, which emit at shorter wavelengths into the visible part of the spectrum.

- **Battlefield ranging systems** using lasers are under development by RCA's Airborne Communications and Controls Division, Burlington, Mass. These will use ruby crystals in a "Q-switch" configuration to generate a single 0.1 microsecond pulse with an instantaneous power of more than one megawatt.

The ground-based laser radar to be used for satellite tracking will use a crystal of neodymium-activated calcium tungstate. In the initial model, the laser is expected to develop a peak power of about one megawatt with a one microsecond pulse duration and a pulse repetition rate of 200 per second.

Using a lens to focus the emitted laser energy is expected to give a beam width of about two milliradians (roughly $\frac{1}{5}$ deg.). A separate receiving antenna will be used with a collecting aperture of 5 in. When used against a target equipped with a 2-in. corner reflector, the new radar is expected to have a range of 10 mi., an angular accuracy of 0.1 milliradian and a range accuracy of 150 ft., according to A. J. Talamini of

RCA's Missile and Surface Radar Division.

An improved version of the laser radar is expected to have a peak power of 10 megawatts with a pulse repetition rate of 1,000 per second and use a 20-in.-dia. receiving antenna. An improved lens is expected to reduce beam width to 0.5 milliradians, permitting a range of 70 mi. on a single pulse basis against a target equipped with a 2-in. optical corner reflector. Range accuracy of 6 ft. and angular accuracy of 0.02 milliradians are design objectives.

To enable the laser radar to track the S-66 satellite at 600-mi. altitude, the satellite will be outfitted with 35 sq. in. of optical corner reflectors.

The equipment will use many conventional radar-type circuits, such as range tracking circuits, while the angle error sensing circuit will be the optical equivalent of a simple monopulse radar receiver, according to Talamini.

There are many unknowns in the propagation of coherent light, which so far as is known is a recent man-made effect not produced in nature. The RCA experimental laser radar is expected to be a valuable tool for investigating these unknowns.

Talamini said that classical optics theory permits prediction of effects for relatively broadband, broadbeam radiation, but it is not known if this theory is equally applicable to narrow-band, narrow-beam coherent radiation.

Because of the low power and extremely high frequency of laser emission, the classical equations for effective transmission range may not apply. Under these conditions, the small number of quanta (photons) available is insufficient to represent a smooth sinusoidal variation and may occur as bursts with a certain amount of randomness which resemble quantum noise, making it difficult to discriminate between signal and noise, Talamini said.

RCA plans to use the experimental laser radar to study atmospheric bending, back scattering, scintillation and polarization as well as the effect of ambient sunlight. These effects could turn out to be real problems or useful aids in discriminating between target reflected energy and background noise.

Because of the extremely narrow beam width of the laser emission, it often will be smaller than the target it illuminates. Under such conditions, energy attenuation will be a function of the square of target distance rather than the fourth power of range as with conventional radar, giving laser radar an advantage for tracking.

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GENERAL ELECTRIC



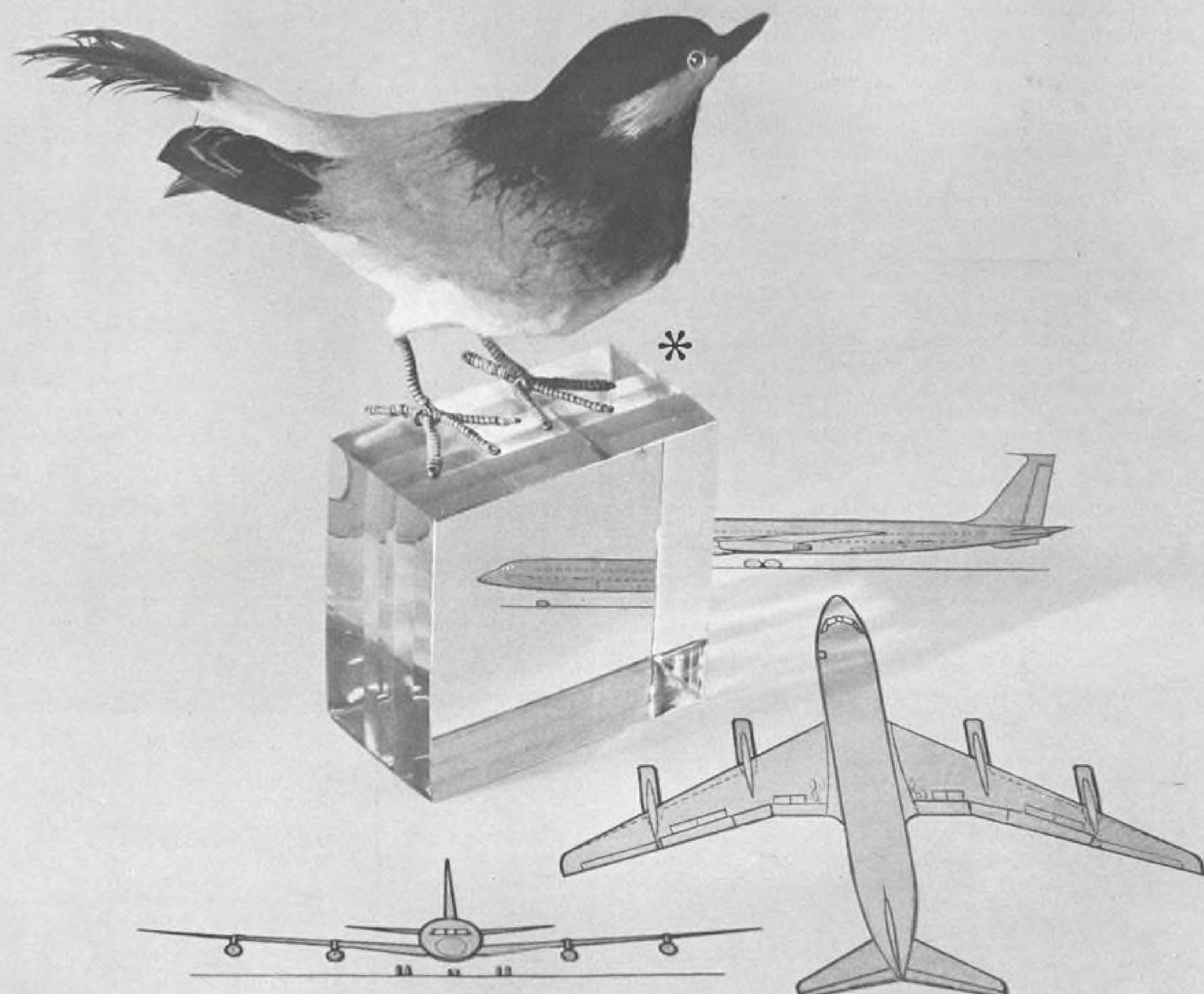
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► **Microcircuit Techniques Merging**—Rivalry between thin film and semiconductor microcircuitry techniques for industry acceptance may ease as companies merge the two techniques to take advantage of the inherent advantages of each (AW Mar. 19, p. 55). One straw in the wind is the fact that Fairchild Semiconductor Division, a pioneer in semiconductor microcircuitry, now is seeking thin film engineers with the objective of combining both techniques. Texas Instruments and Westinghouse Electric, two other semiconductor microcircuit pioneers, also have in-house thin film capability. Sylvania Electric, which has publicized its thin film accomplishments, soon will announce epitaxial semiconductor microcircuitry with operating speeds far above anything now on the market. Motorola is another firm with strong capabilities in both techniques.

► **Fewer IRE Conventions**—Number of technical conventions sponsored or co-sponsored by Institute of Radio Engineers during the next six months totals 26, a decrease of about 15% from the number it sponsored during the same six-month period two years ago.

► **RADC Tests Angular Diversity**—Experiments intended to determine the possible advantage of using angular diversity to obtain more reliable troposphere scatter communications are under way at the Rome Air Development Center. Transmission terminal consists of a 28-ft.-dia. parabolic reflector containing seven feed horns, each powered by its own transmitter, which produce seven beams, each emanating at a slightly different angle. Receiving terminal consists of two physically separated antennas, each with seven feed horns and using low-noise parametric amplifiers. Equipment was developed by ITT Federal Laboratories.

► **Molectronic Factory Planned**—Westinghouse Electric will build a 90,000-sq.-ft. facility near Baltimore to manufacture monolithic semiconductor microcircuitry, with operation scheduled to begin in the spring of 1963. Activities formerly carried on at the Air Arm Division and the Semiconductor Dept. in Youngwood, Pa., will be consolidated at the new facility. Employment initially is expected to total several hundred.

► **NRL Develops Ultraviolet Laser**—Naval Research Laboratory scientists report they have achieved laser emission at a wavelength of 3,125 angstroms from gadolinium-activated silicate glass,



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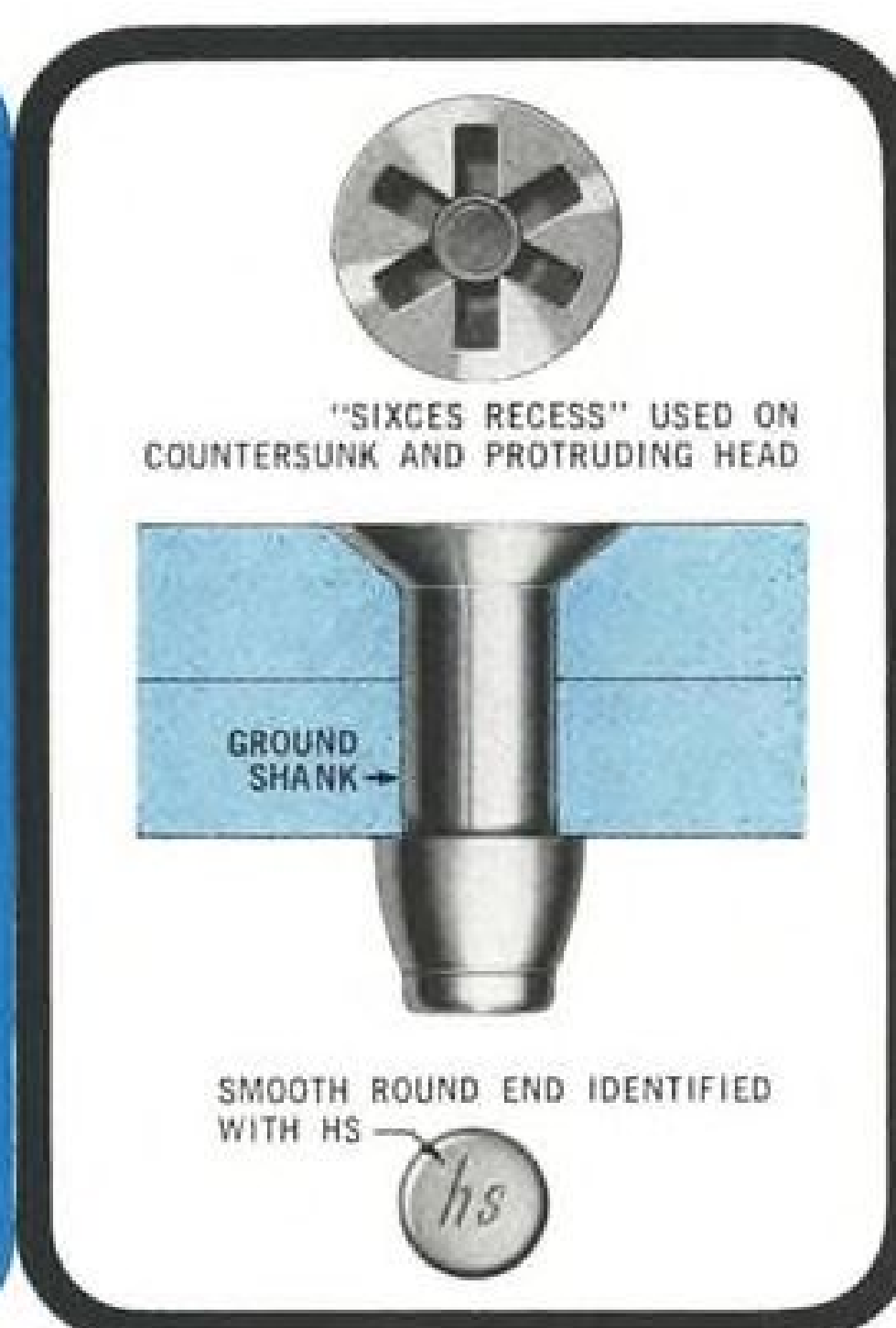
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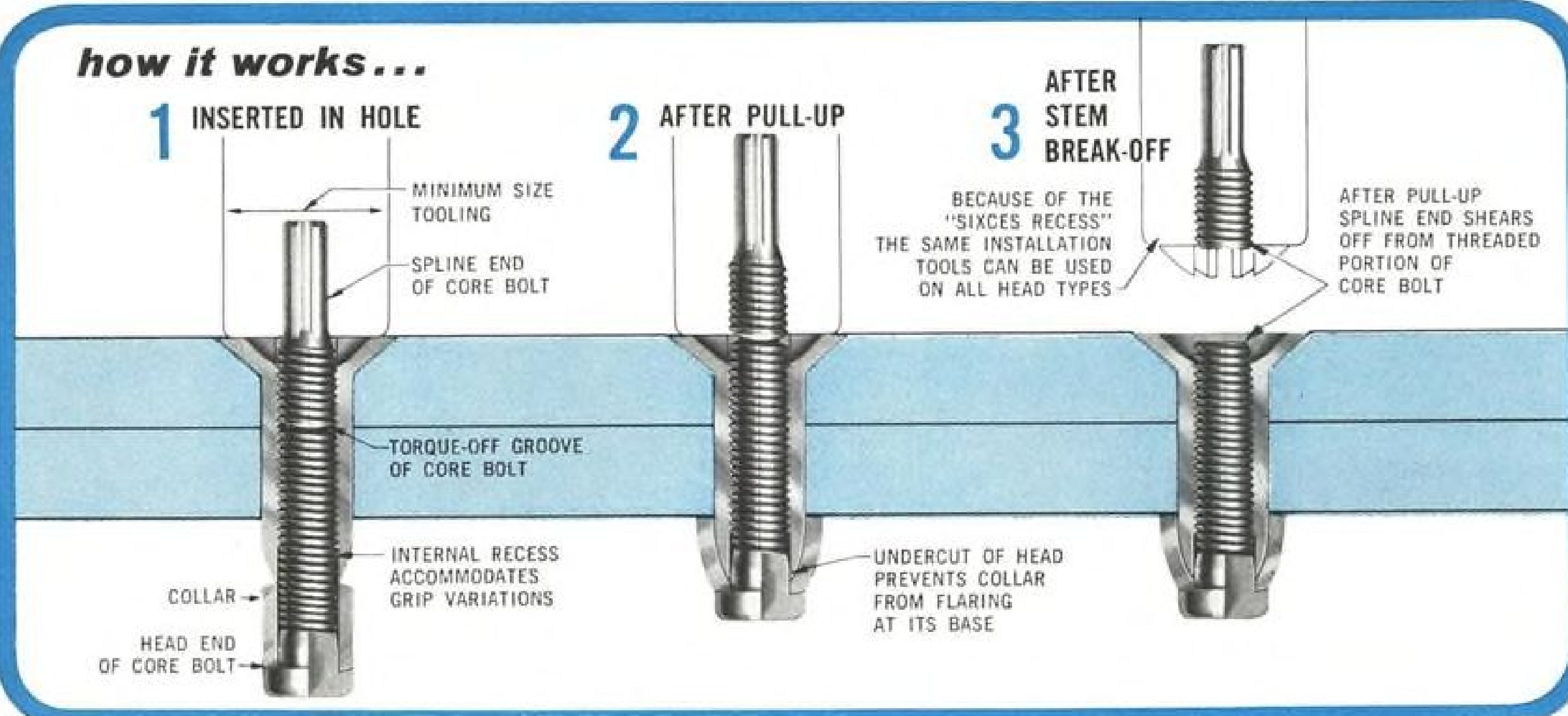
Three head styles are offered: an AN509 esk to permit direct substitution with similar headed blind fasteners, a compact esk for use in thin gauge material and a protruding style designed for minimum protrusion. Nominal shank diameters range from 5/32 thru 3/8 while a salvage oversize 1/64 series is also available. Grip lengths are in 1/16 increments with an additional built-in 1/32 grip for unexpected variations in work thickness. Beta Bolts are offered in alloy steel (180,000-200,000 psi

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how it works...



the same host material previously used with other rare earths to obtain emission in the infrared spectrum. New laser, operating at room temperature, gives 55-angstrom-wide luminescence emission which peaks at 3,125A.

► **AFCRL Captures Lightning Strokes**—Air Force Cambridge Research Laboratories has successfully "captured" two lightning strokes by bringing them down 1,500 ft. of wire carried aloft by ship-launched rockets during a squall in the Caribbean. Each of the two lightning strokes vaporized the wires, but not before AFCRL scientists made measurements indicating they had generated currents of 30,000 amperes. The experiments are part of a program to learn more about very low frequency (VLF) radio signals generated by lightning strokes and to investigate possible use of the ionized path produced by the vaporized wire to serve as an antenna for VLF signals.

► **USSR Uses "Knife-Edge" Effect**—Soviet Union reports that it has "developed and successfully put into practice the basis of a theory for the propagation of ultra short radio waves in mountains. It has been confirmed that radio waves, coming into contact with the tops of mountains, skirt around them. This makes it possible in certain enclosed spots, without expensive retransmitting stations, to receive long-range radio and television broadcasts." The technique has been "successfully and economically exploited in a wide network of mountainous radio relay stations," the USSR reports. The Soviets are not clear whether they lay claim to having discovered this principle which has been widely known for some years in the U.S. as the "knife-edge effect." It was extensively investigated several years ago by the National Bureau of Standards, which subsequently reported its findings.

► **Call for Naecon Reports**—Prospective authors who would like to present reports at the 1963 National Aerospace Electronics Conference (Naecon) in Dayton, May 13-15, should submit 500-word abstracts and biographical data by Dec. 1 to Dr. Walter L. Knecht, 1309 Shawnee Drive, Yellow Springs, Ohio.

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

- **Ford Motor Company's** Aeronutronic Division, Newport Beach, Calif.—Air Force contract to investigate optimum methods for displaying battle damage information, sponsored by Rome Air Development Center.
- **Maxson Electronics Corp.**, New York

City—\$134,445 contract to develop experimental Tacan station ground transmitter incorporating feedback techniques to improve performance, from the Federal Aviation Agency.

- **General Electric**, Technical Military Planning Operation (Tempo), Santa Barbara, Calif.—\$249,345 contract from AF Electronic Systems Division for studies on information processing in command and control.

- **Lear Siegler, Inc.**, Instrument Division, Grand Rapids, Mich.—\$525,810 for miniature attitude indicating systems for use on F-105s, from USAF's Aeronautical Systems Division.

- **National Cash Register Co.**, Dayton—\$98,000 contract from Aeronautical Systems Division for simulation and evaluation of various speech recognition techniques, in cooperation with Digital Voice Communication Laboratory of AF Cambridge Research Laboratories.

- **General Precision, Inc.**, Link Division, Binghamton, N. Y.—for a "Fringecount gonimet," an electro-optical instrument capable of measuring angles to within 0.1 second of arc, equivalent to being able to aim a radar beam to within two feet of a satellite at an altitude of 1,000 mi. Contract is from NASA's Marshall Space Flight Center.

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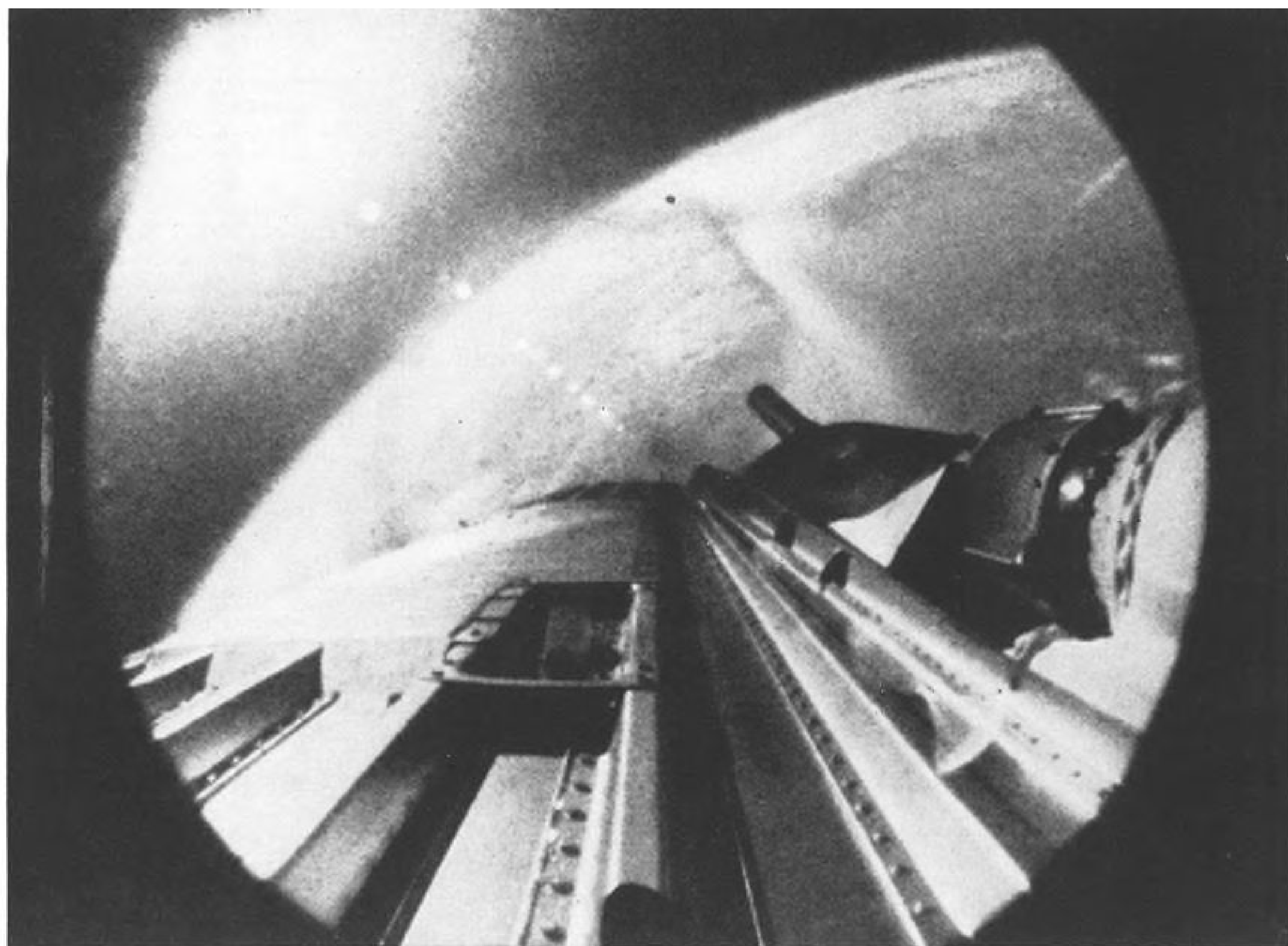
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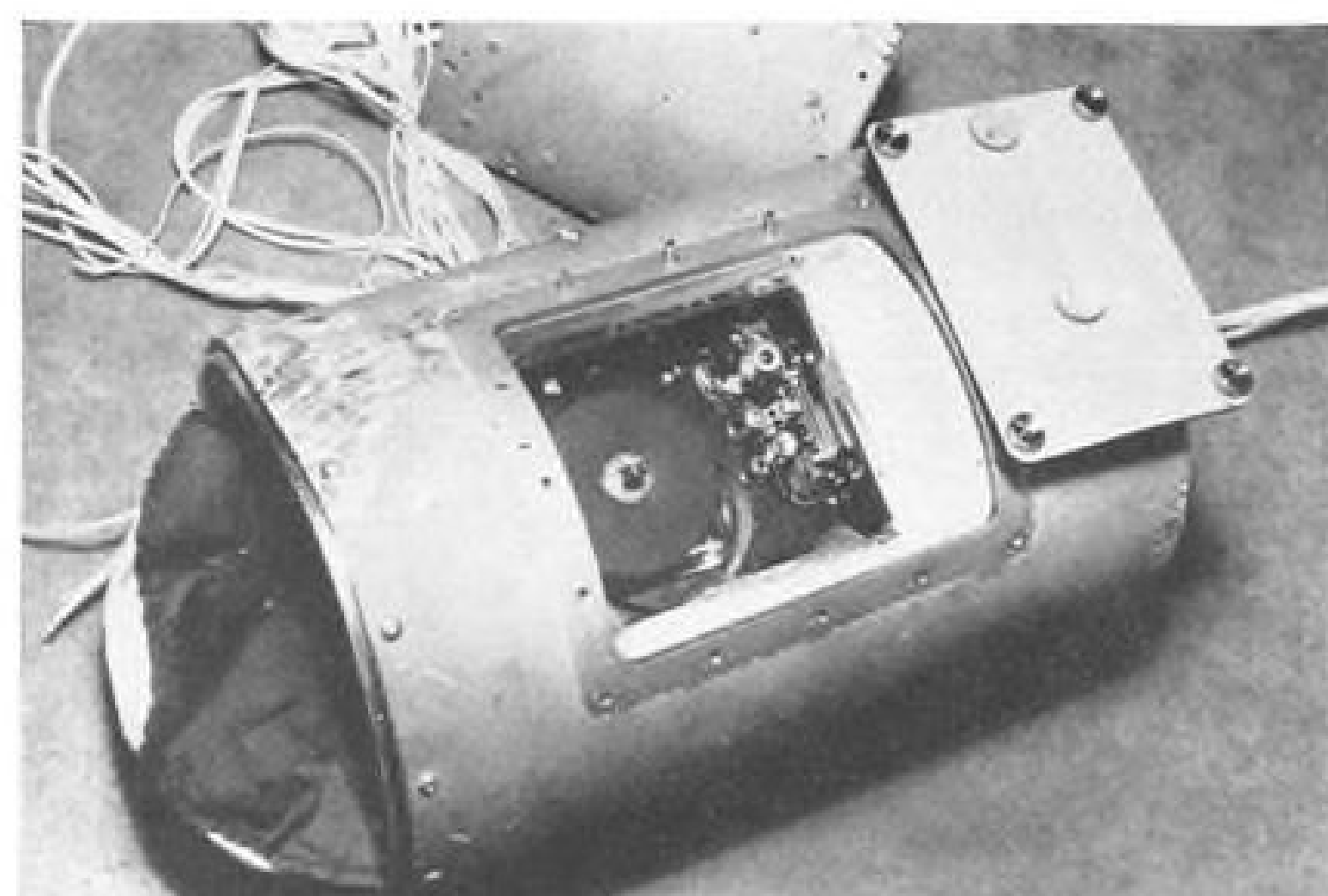
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Wide-Angle Camera Records Atlas Booster Separation

Wide-angle camera, mounted externally on an Atlas missile launched recently from the Atlantic Missile Range, photographed a 50-mi. view of the earth's curvature. Booster, foreground, is shown just prior to separation. Bottom left, smoke and flame partially obscure aft section of booster. Separation is completed, bottom right, sustainer engines continue to fire. White dots (upper left) are reflections on quartz glass through which photos were taken. Camera, right, is ejected from Atlas in flight using a paraballoon unit. The wide-angle camera in housing can be recovered on land or water.



SPACE TECHNOLOGY

Large Graphite Nozzle Cylinders Formed

By Donald E. Fink

New York—Four graphite cylinders, large enough to form nozzle liners for National Aeronautics and Space Administration's proposed 260-in. solid rocket motor, have been fabricated by Union Carbide Corp.'s National Carbon Division.

Cylinders will measure 103 in. outside diameter, 34 in. inside diameter and 70 in. long when they complete the cool-down phase of the 12-week bake process early in November.

New facilities, recently installed at National Carbon's Niagara Falls, N. Y., plant during a \$6-million expansion and modernization program, were used to fabricate the cylinders, which the company says are the largest graphite pieces ever formed.

Feasibility Study

Fabrication is the second phase of a three-phase feasibility study sponsored by a contract from Rocket Research Laboratories of USAF Systems Command's Space Systems Division. Contract calls for three cylinders, but a fourth is being fabricated as a spare.

First phase of the program called for modification of some production facilities to handle the large cylinders. The third phase will involve destruction testing of at least two of the cylinders to determine their properties. Also under phase three, the feasibility of using radiographic and ultrasonic techniques for non-destructive structural testing of such large shapes will be investigated.

While the primary aims of the program are first to determine the feasibility of molding graphite in large pieces and then to test its qualities, H. N. Townsend, manager of aerospace products for Union Carbide, said the 103-in. cylinders are large enough to form nozzle liners for the 260-in. motor NASA wants developed (AW Sept. 17, p. 37).

Nozzle dimensions for the big booster will vary from about 120 in. to about 150 in. outside diameter, depending on motor design, but Townsend said Thiokol and Aerojet-General, leading contenders in the 260-in. competition, both have said the 103-in. size could be adapted to a test motor.

Two of the cylinders will be tested to destruction, but the third and possibly the fourth will be available for the final nozzle forming process. This will involve machining the inside of the cylinder to form a throat contour. The

result would be a monolithic, uncooled nozzle liner of heat and erosion resistant graphite. The liner then would be encased in a plastic or metal container to form the complete nozzle assembly.

Test cylinders are made of grade CFW impregnated graphite, which has a density of about 112 lb./cu. ft. Several 48-in. nozzles were fabricated from grade CFW and tested with large solid motors. According to Townsend, the test liners showed a slow rate of erosion during exposure to temperatures in the 5,500F to 6,000F range for periods up to 120 sec.

Production of the 103-in. cylinders required a major expansion of standard graphite production processes. Steel molds, 105-in.-dia., with 32-in.-dia. mandrels, had to be built. The green carbon mold pieces measured 105 in. outside diameter, 32 in. inside diameter and 83 in. long. During the baking and graphitizing process, however, the cylinders shrink and expand several times. The completed cylinders,

therefore, are expected to meet contract specifications.

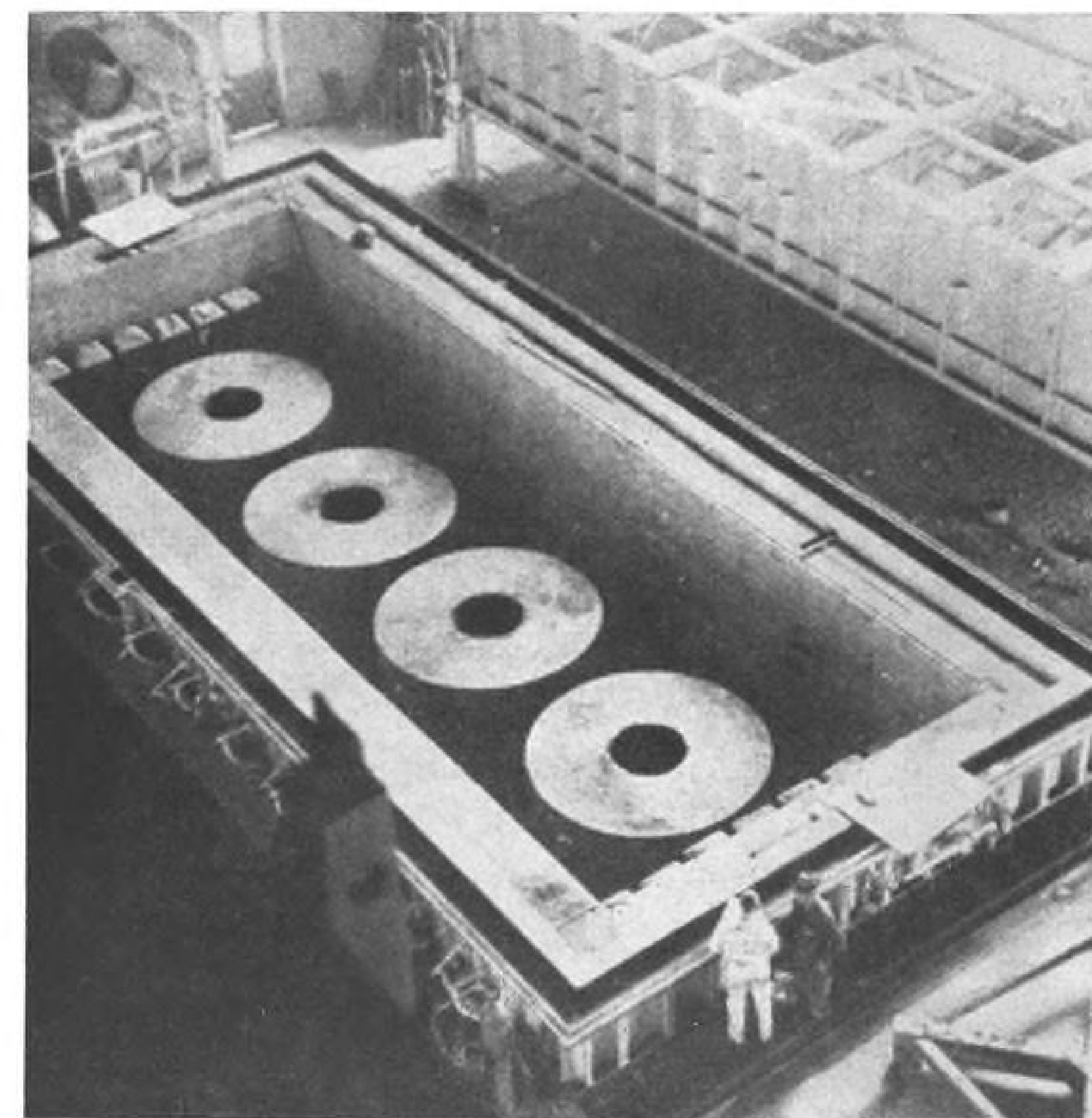
Inside diameter of the cylinders was chosen as an arbitrary figure, Townsend said. A solid core could have been molded, but the hole in the center makes it easier to handle the 40,000-lb. pieces. It also provides a starting point for the throat machining process.

Throat Forming

Townsend said graphite's machinability, comparable with that of hardwood or aluminum, will make the throat forming process relatively simple. Throat diameters may be as large as 90 to 120 in., depending on the outside diameter of the nozzles and the thrust values desired.

Cylinders could have been molded with inside diameters closer to the final desired throat contour, he said, but the thick-walled cylinders are easier to mold and handle. Material lost in the machining is not a significant factor in the over-all cost.

Most large boring mills could tool to



GREEN CARBON CYLINDERS, measuring 105-in. outside diameter, are shown in National Carbon Co.'s new bake oven. Finished graphite cylinders will measure about 103 in.

U.S.A.F. F-104 WINS AIR FORCE FIGHTER WEAPONS MEET

The Tactical Air Command has a new champion. In a world-wide competition among TAC fighters, the F-104 Starfighter carried off top honors in the William Tell A.F. Fighter Weapons Meet at Nellis Air Force Base, Nevada.

The F-104 pilot, Captain Charles E. Tofferi, of the 479th Tactical Fighter Wing, cinched his victory with 3 perfect scores in such vital events as straffing, air-to-ground rockets, and napalm drops. In the single air-to-air event, he set a new record, completely destroying his target in 63 seconds. His winning total for all events was 19,018 points — out of a possible 24,000.

Captain Tofferi's brilliant performance

proved what the F-104 can do. F-104 pilots all over the world know *the F-104 is a most effective all-around fighter*. It meets the TAC mission of close ground support and interdiction, with the same mastery it shows in air superiority missions.

The Lockheed F-104 is not so much a single weapon as an extremely stable platform which can adapt itself to almost any fighter weapons mission. Six of our allies chose the F-104 over every other jet in the world. It is now being produced in 7 nations for 11 air forces, including the U.S.

Captain Tofferi has demonstrated once again the reasons for this overwhelming vote of confidence.

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handle the throat machining, but National Carbon will soon have its own mill operating in the Niagara Falls plant addition. Other new facilities include a natural gas furnace, which can bake four of the 103-in. cylinders simultaneously, and a molding press capable of forming cylinders up to 200-in.-dia.

In addition to the four large cylinders, National Carbon also has fabricated 60-in. cylinders for United Technology Corp., recently chosen to develop the 120-in. segmented solid motor for the Titan 3 launch vehicle. Townsend said several cylinders have been delivered to UTC for testing. Others are now being fabricated to create a backlog for rapid filling of subsequent orders.

Canadian Missile to Be Fired From Naval Gun

Canadian Martlet-1 missile prototype, designed for upper atmosphere research, will be launched from a converted smooth-bore 16-in. U.S. naval gun late in November from the island of Barbados, British West Indies.

First firings of the 60-in., 550-lb. missile are designed to prove the feasibility of shooting a missile from a gun rather than using rocket propulsion. McGill University, Montreal, is manag-

ing the project and will use its high-altitude research facility at Barbados as launch site.

Martlet, which is designed to reach altitudes from 200,000 to 500,000 ft., is guided during the firing stage by two aluminum and glass fiber sabots enclosing the front and rear of the 8-in.-dia. missile. The sabots, which are the same diameter as the bore, prevent buffeting and injury to the spin-stabilization fins of the vehicle. Air pressure peels off the sabots after the missile leaves the gun barrel.

Muzzle velocity will vary from 5,000 to 7,000 fps, depending on altitude desired. A near vertical deflection of 88 deg. will be used. Primary funding for the project comes from two U.S. sources, the Advanced Research Projects Agency and the Army Ordnance Missile Command.

Telemetered data of pitch and yaw only will be recorded on the first test flight. Following successful test flights, McGill wants to develop the missile further as an upper atmosphere research vehicle.

Computing Devices of Canada, Ltd., Ottawa, Ontario, is building the telemetering equipment and is expected to receive the contract to build the vehicles also if the firings prove successful and the project is continued. McGill University is constructing the prototype vehicles.

NASA Contracts

National Aeronautics and Space Administration has recently awarded the following contracts and research grants. The figures shown represent the total estimated cost of contracts of \$50,000 or more let during the period.

GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.:

Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.—\$121,000 for liquid nitrogen storage tank.

Dynatronics, Inc., Orlando, Fla.—\$89,000 for pulse code modulating signal conditioners.

Air Force Systems Command, Arnold AFB, Tenn.—\$65,000 to perform simulated high altitude tests.

WALLOPS STATION, WALLOPS, ISLAND, VA.:

Milgo Electronic Corp., Miami, Fla.—\$63,000 for various electronic replacement parts compatible to those existing prior to storm damage.

Micromega Corp., Venice, Calif.—\$60,000 for low-noise preamplifier for Spandar.

Navy Military Sea Transportation Service, Washington, D.C.—\$130,000 for services and materials for range recovery ship as down-range tracking station.

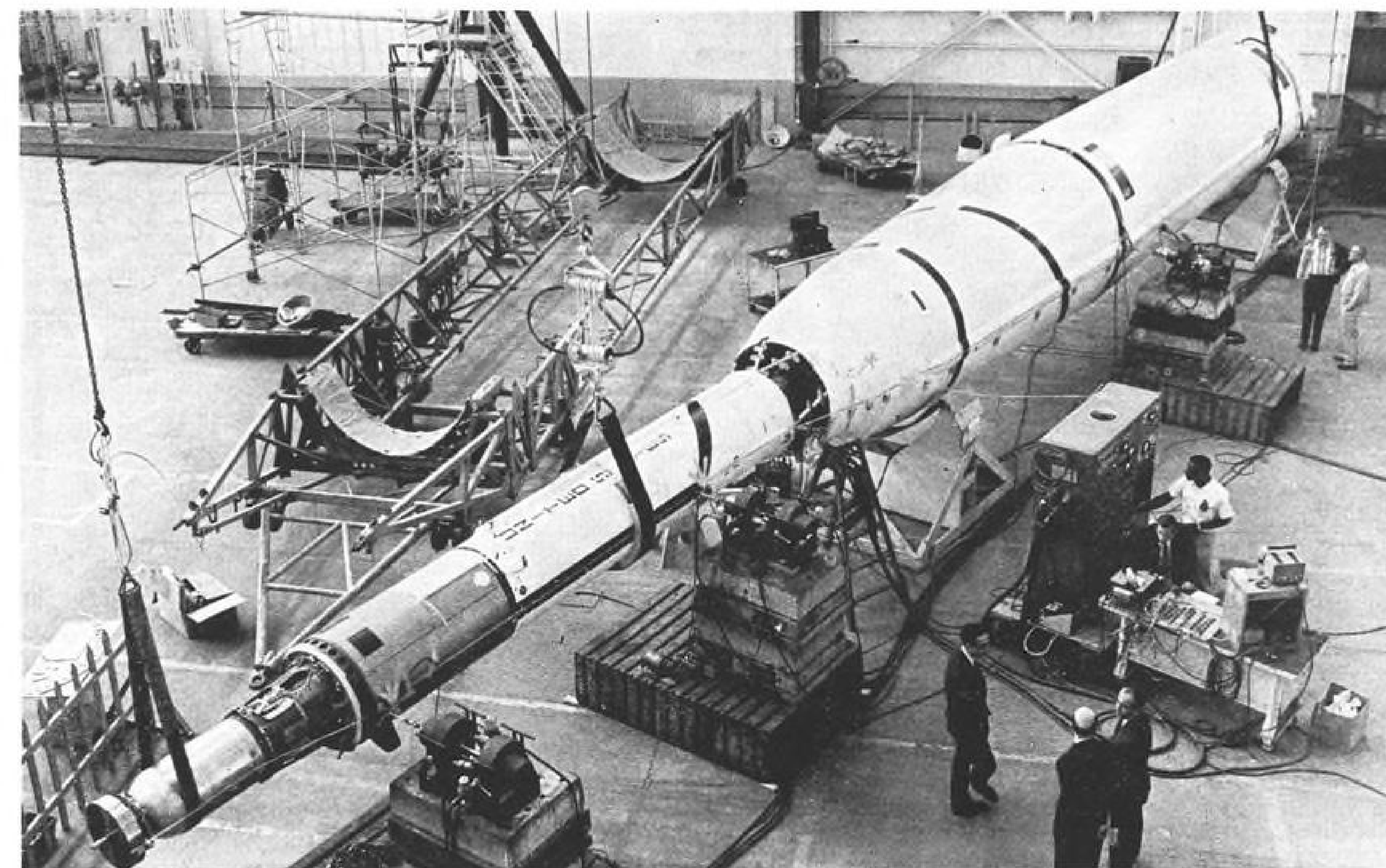
MANNED SPACECRAFT CENTER, HOUSTON, TEX.:

Phileo Corp., Palo Alto, Calif.—\$80,000 for Apollo information flow study contract.

Ralph M. Parson Co., Pasadena, Calif.—\$94,000 for flight type tape recorder/reproducer systems.

Bell & Howell Co., Chicago, Ill.—\$68,000 for continuous contact motion picture printers.

Atomic Energy Commission, Oak Ridge, Tenn.—\$465,000 for technical and scientific effort, materials and equipment for proton radiation shielding studies.



Vibration Test Performed on Delta Vehicle

Fully-assembled Douglas Delta space vehicle undergoes a vibration test at Douglas Missile and Space Systems Division, Santa Monica, Calif. Test determines control stability and body bending modes of the 80-ft.-long, 8,428-lb. vehicle.

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adding a new dimension to the capability of man

SUBMARINE FBM TRAINING FACILITY, designated 21A37/1, faithfully reproduces cruising depth, position, surface weather, wave conditions, distance and direction to the target. A variety of malfunctions for training can be introduced via pre-punched cards. The magnetic drums of the simulator store 2.5 million bits of data relating to the actual equipment installed in the submarine, the missile control center, and the missile tube area. Instructions can be flashed at the staggering rate of 18-million per minute.

PROJECT IN POINT:

This Polaris launch crew

thinks it is 40 fathoms deep!

Simulation reflects the ultimate in the application of science and technology. It is the electronic bridge from research to reality. At Curtiss-Wright, electronic simulation systems orient men and machines to missions for many military and industrial programs.

Project in Point: Today at the Navy's New London submarine school, Polaris launch crews are being trained by the largest, most complex, fully-digital simulator in use for any training application. Designed and manufactured by Curtiss-Wright, the simulator not only trains new crews but polishes the skill of Polaris vet-

erans as well. Short of operational experience at sea, no other training method is as practical.

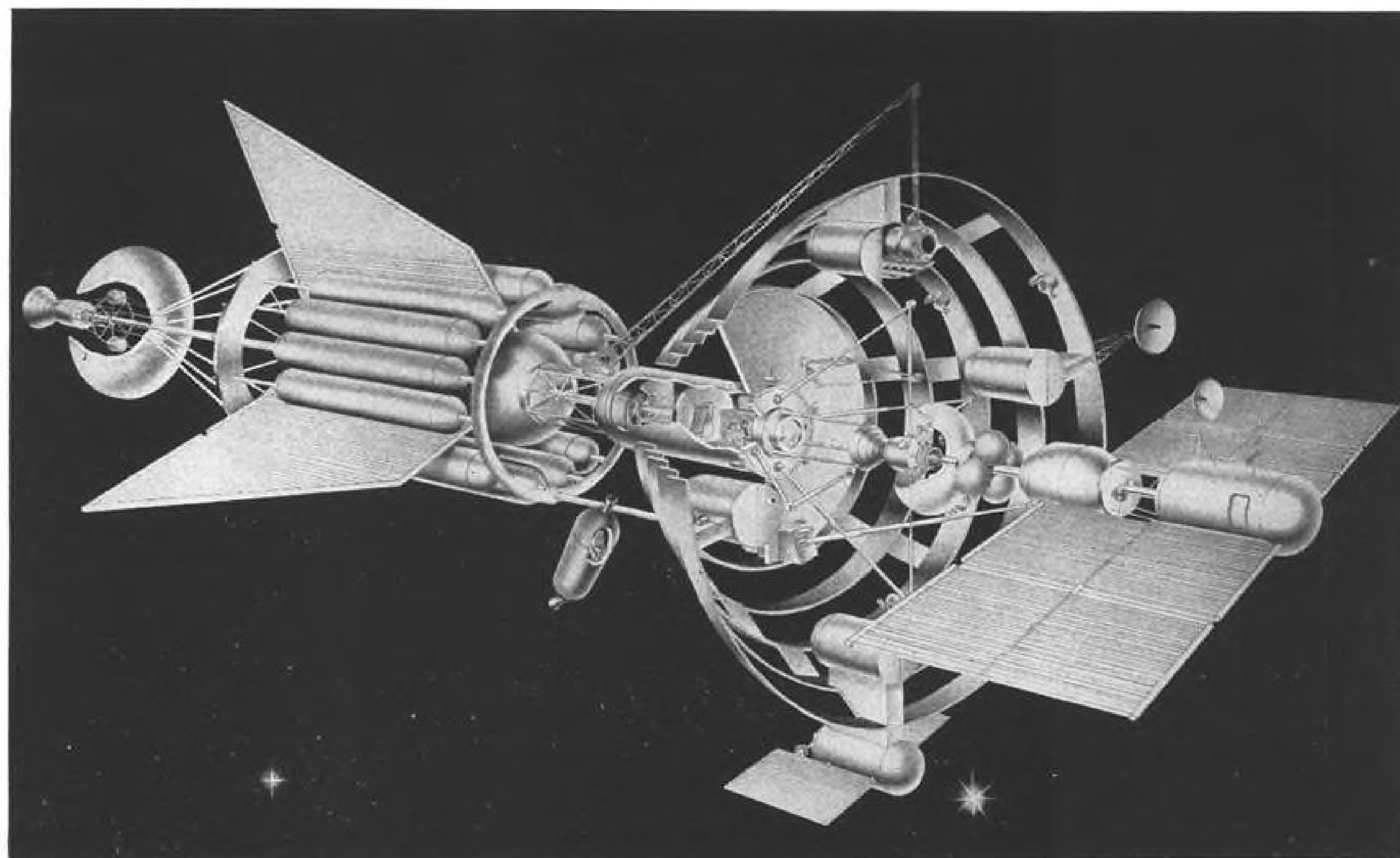
These and additional advanced activities in related fields have created immediate opportunities at Curtiss-Wright Electronics Division for solid state circuit designers, digital computer programmers and others experienced in the application of real-time digital computation to challenging simulation problems.

For information, write Mr. Gene I. Kelly, Manager of Professional Placement, Electronics Division. An equal opportunity employer.



ELECTRONICS DIVISION
CURTISS-WRIGHT CORPORATION

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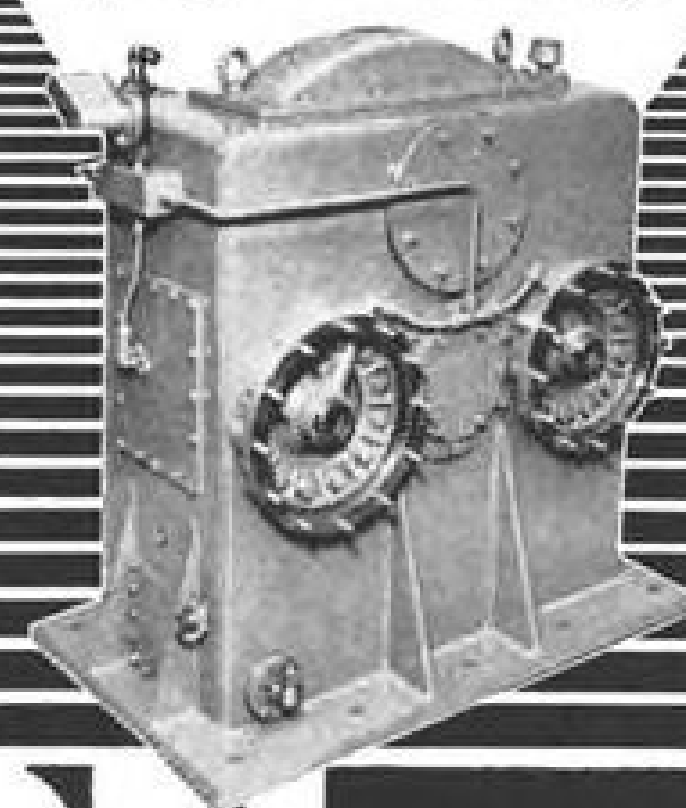
Maintenance Station Envisioned for Nuclear-Powered Spacecraft

Vehicle of the type shown in this artist's concept was suggested recently by Westinghouse Electric Corp.'s astronuclear laboratory as a permanent maintenance, repair and refueling center for nuclear-powered spacecraft. Concept shows self-propelled repair shop for radioactive equipment (right). Shielded personnel quarters are in the center, and the maintenance station propulsion system is at left.

SPECIFIED

FOR RELIABILITY

In the conquest of space high speed test stands have been equipped with S-N speed increaser units. For capacities to 2000 HP and for output speeds to 80,000 RPM specify S-N for reliability.



SN SPEED INCREASER UNITS
SNOW-NABSTEDT GEAR CORP.
101 WELTON ST., HAMDEN, CONN.

PRODUCTION BRIEFING

Astropower, Inc., Newport Beach, Calif., is designing zeolite wafers for possible use as solid electrolyte-electrodes in satellite or space vehicle fuel cells. Work is financed by a \$68,000 National Aeronautics and Space Administration contract. Wafers, containing an electrolyte made of a synthetic zeolite membrane compressed between two thin metallic layers, are expected to operate in many kinds of fuels and oxidizers, resist radiation and perform under zero-gravity conditions.

Lear Siegler, Inc., has received a \$750,000 subcontract from Curtiss-Wright Corp. to produce rocket case sections for the first stage of the Minuteman ICBM. Work will be done at the Astro Structures Division, El Segundo, Calif., on its spin-form equipment.

Douglas Aircraft Co.'s Missile and Space Technology Division has received a contract approximating \$50 million for continued research and development of Army's Nike Zeus anti-missile missile. The contract represents Douglas' portion of a \$145-million Army contract recently awarded to Western Electric Co., prime Zeus contractor (AW Oct. 8, p. 41).

American Brake Shoe Co.'s Aerospace Division, Oxnard, Calif., has received a \$1.5-million contract from McDonnell Aircraft Corp. to build hydraulics pumps for the F-110, Air Force's version of the F4H Phantom jet.

Diebold, Inc., Canton, Ohio, will build security mechanisms for personnel entry hatches and protection devices for hatch cover controls at Minuteman ICBM underground launching sites. Work is financed by a Boeing Co. contract for approximately \$1.7 million.

Kelvin Electric Co., Van Nuys, Calif., will produce precision wirewound resistors for use in the Gemini two-man spacecraft. Work is financed by a contract from International Business Machines Corp.

Hughes Aircraft Co., Culver City, Calif., has been awarded a supplemental Air Force contract for \$1.7 million to continue development of a fire control system for the GAR-9 Falcon missile.

Kaman Aircraft Corp., Bloomfield, Conn., has purchased Power Transmission Systems, North Caldwell, N. J., which specializes in production of gears

and power transmissions for aircraft. Purchase was made with cash and Kaman stock.

Brown University will conduct research in re-entry physics under a \$186,000 contract awarded by the Advanced Research Projects Agency and the Office of Naval Research. Purpose of the two-year study will be to gain basic knowledge for the design of ICBM detecting and tracking devices which will discriminate between decoys and actual warheads. Solution of the engineering problems of detection systems will not be attempted, but physical phenomena basic to such systems will be investigated both theoretically and experimentally.

Telecomputing Corp.'s Power Sources Division, Los Angeles, Calif., has been awarded an Air Force contract to develop and produce remotely-activated, silver-zinc primary batteries to supply airborne electrical power for range safety systems on space vehicle boosters. Batteries are designed to activate in 15 sec. and operate in temperatures from -35F to 160F.

Douglas Aircraft Co.'s Donald W. Douglas Engineering and Product Development Center has been officially dedicated at Long Beach, Calif. The research and development facility has 665,000 sq. feet of floor space and a heliport on the roof. The facility's administration building is nearing completion.

Nevada extension of the Atomic Energy Commission-National Aeronautics and Space Administration Space Nuclear Propulsion Office has been opened in Las Vegas with Robert P. Hegleson as chief.

Bureau of Naval Weapons has awarded development study contract to Sundstrand Aviation-Denver, for a solar-dynamic satellite power system capable of producing 1.5 kw. of power. Sundstrand, which is developing a 15-kw. solar-dynamic system for Air Force using liquid rubidium metal as working fluid, will use a low-temperature organic material as working fluid in the Navy system.

Army Corps of Engineers has awarded an \$83,960,000 contract to Morrison-Knudsen Co., Inc., of Boise, Idaho, and four associated contractors for construction of underground launch facilities for 200 Minuteman ICBMs near Warren AFB, Cheyenne, Wyo. Included are 200 launch silos and 20 underground controls centers. First 10 silos are to be ready next October and the entire 200 are to be finished in September 1964.

Callery fits your high energy needs

with these three high-performance headliners

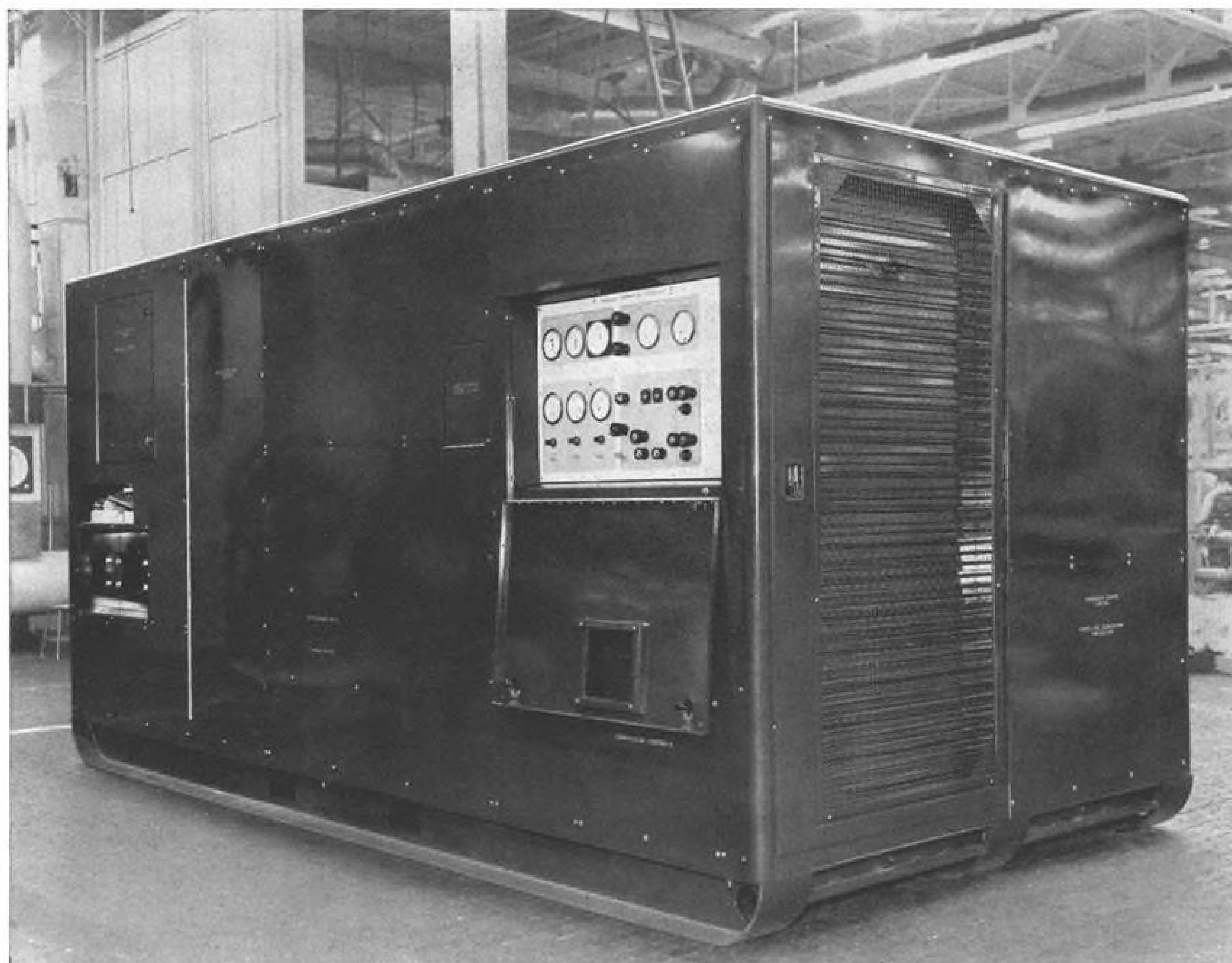
Diborane B_2H_6	Pentaborane B_5H_9	Nitronium Perchlorate NO_2ClO_4

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Automatic temperature control GSE for Titan II missile propellant

This new environment control package was designed and produced by Hamilton Standard for the Air Force's Titan II missile, made by Martin. It automatically stabilizes propellant temperature at $60 \pm 5^\circ\text{F}$ within a 20,000 gallon storage vessel. The unit electrically heats or mechanically cools a glycol and water heat transfer liquid, and then circulates it to the storage vessel heat exchanger. It is built to perform reliably in ambients of -35° to $+115^\circ\text{F}$, and from sea level to 6,000 feet.

The Titan II Propellant Temperature Controller is evidence of Hamilton Standard's ability to meet

environment control GSE assignments. It typifies the results attainable when engineering capabilities in pneumatics, hydraulics, electronics, and packaging, are combined with specialized manufacturing skills.

A NEW BROCHURE describing Hamilton Standard's environment control GSE capabilities for aircraft and missiles is available. To learn how this solid foundation of experience can be your key to dependable GSE, write: Sales Manager, Ground Support Equipment Department, Hamilton Standard, Windsor Locks, Connecticut.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

U
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FINANCIAL

New Offerings

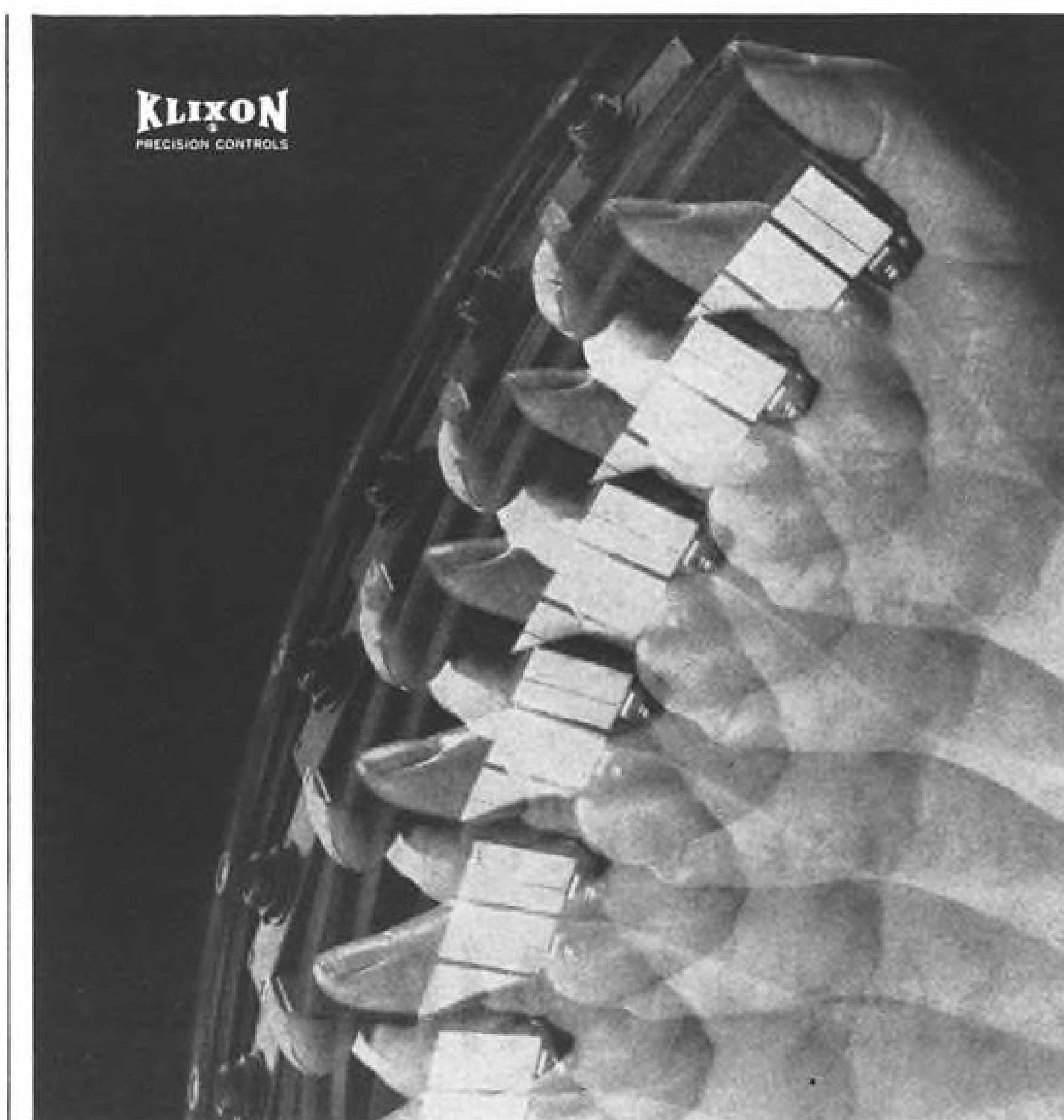
Control Data Corp., Minneapolis, Minn., engaged in the design, development and manufacture of systems, equipment and components used in electronic data processing and automatic control for military, scientific and industrial uses. Offering is \$15,000,000 of convertible subordinated debentures, due 1977. The proceeds of the debentures will be used in part to pay outstanding bank loans.

Textron, Inc., Providence, R. I., a multi-industry manufacturing company with six major product groups including defense. Offering is 40,000 outstanding common shares by Howard Kellogg and Doris K. Neale, as trustee of a certain trust.

American Brake Shoe Co., New York, N. Y., principally engaged in the manufacture of components, machinery and equipment for the manufacturing and transportation industries. Offering is \$12,000,000 of sinking fund debentures, due 1987. Proceeds will be used for general corporate purposes, including capital improvements estimated at \$13,600,000 for 1962.

General Aeromation, Inc., Cincinnati, Ohio, engaged in the development of, and has arranged for the manufacture of, equipment for ground movement of jet aircraft; it has developed two taxi-tender vehicles for such movement for commercial and military use. Since organization, the company has been solely engaged in development of inventions transferred to it by its principal stockholder and president, Henry J. Wiebe. Offering is 500,000 capital shares; 419,000 shares by the company, and 81,000 outstanding shares by the holders. Of the company's proceeds, \$118,500 will be used to pay certain notes and accounts payable; \$110,000 for corporate expenses for one year (including compensation to Wiebe and for promotion); \$110,000 to design, test and produce models of the equipment for jet aircraft ground movement; the balance of the proceeds for compensation to Wiebe and for general corporate purposes.

Solitron Devices, Inc., Norwood, N. J., engaged in the design, development and manufacture of semiconductor components consisting of silicon rectifiers used as integral components of most electronic and/or electrical items. Offering is 98,250 outstanding common shares by the holders.



LOW-AMP 3-PHASE CIRCUIT BREAKER RESISTS 500 CPS VIBRATION at 10 G!

This compact package integrates three miniature push-pull circuit breakers to bring unprecedented 3-phase protection to electronic components and cable in the $\frac{1}{2}$ to 10 amp range. An overload on any one phase trips all three breakers—and releases the single indicating button. When the button stays in, everything's "A-ok".

Tripping response is comparable with the speed of a slow-blow fuse . . . 2 to 20 sec at 200% rating. Since the KLIXON 7276 breaker is thermally responsive, it avoids nuisance trips on harmless current transients.

For complete performance and test data on the new KLIXON 7276 3-phase circuit breaker, write for Bulletin CIRB-27.

PERFORMANCE CHARACTERISTICS

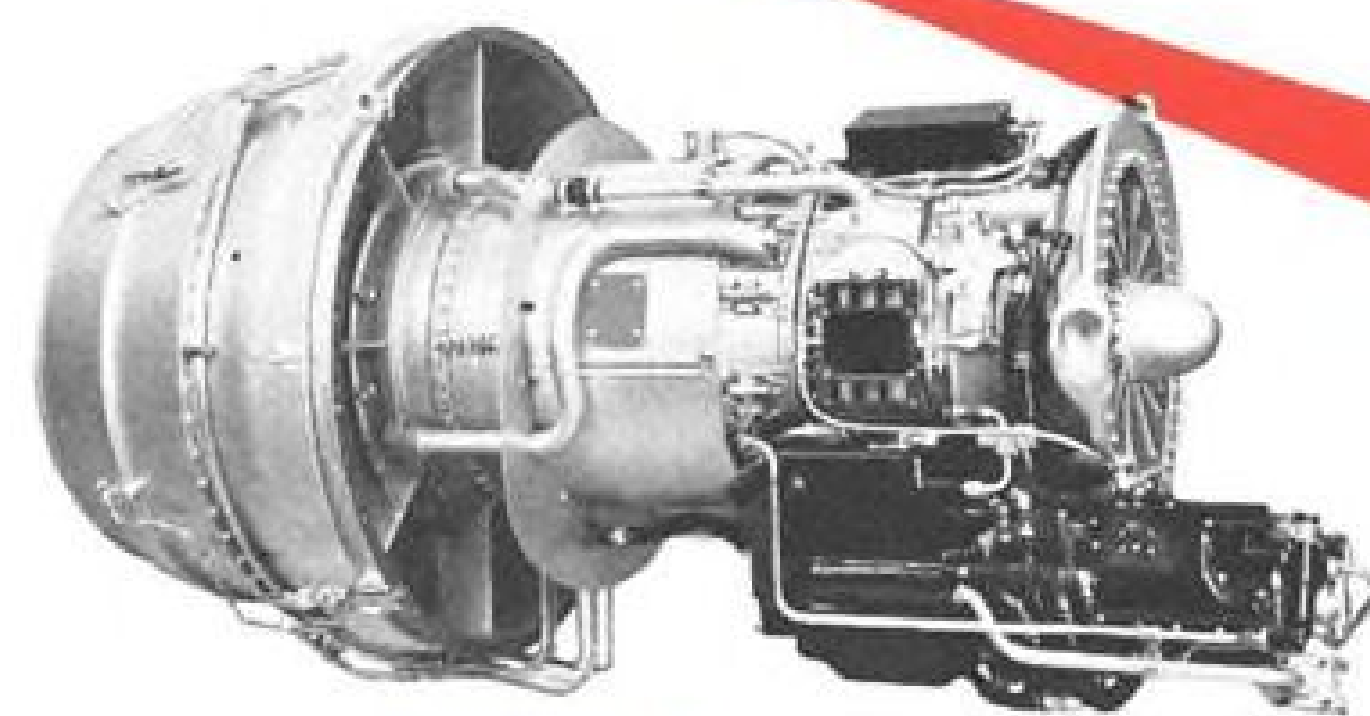
Dielectric strength	1500 volts, minimum
Insulation resistance	100 megohms, minimum
Strength of threaded parts	Terminals: 10 lb-in. Bushing: 40 lb-in.
Operating force	15 lb, maximum reset
Calibration	At 25°C , hold 115% and trip 145% rating.
Overload calibration	At 200% 2-20 sec.
Trip-free calibration	Same limits
Endurance	1000 cycles, 120 V-ac, 400 cps, resistive and inductive
Mechanical cycling	1000 cycles
Overload cycling	100 cycles at 200% rating
Vibration	10G minimum to 500 cps
Shock	25G



METALS & CONTROLS INC.

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A CORPORATE DIVISION OF

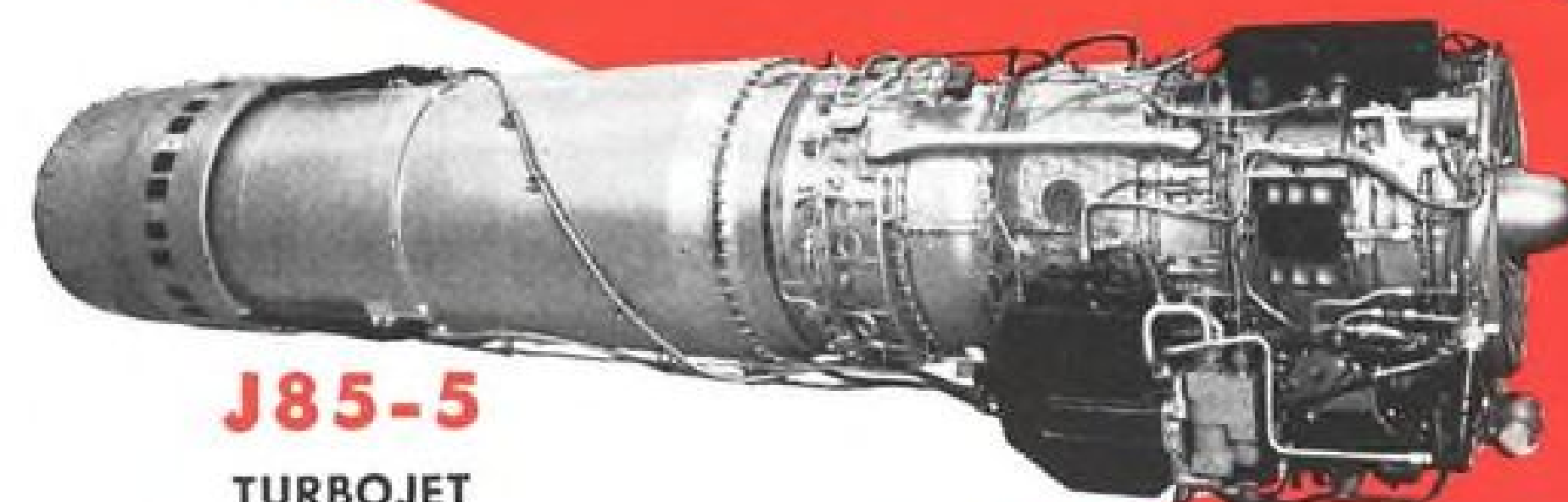
TEXAS INSTRUMENTS
INCORPORATED



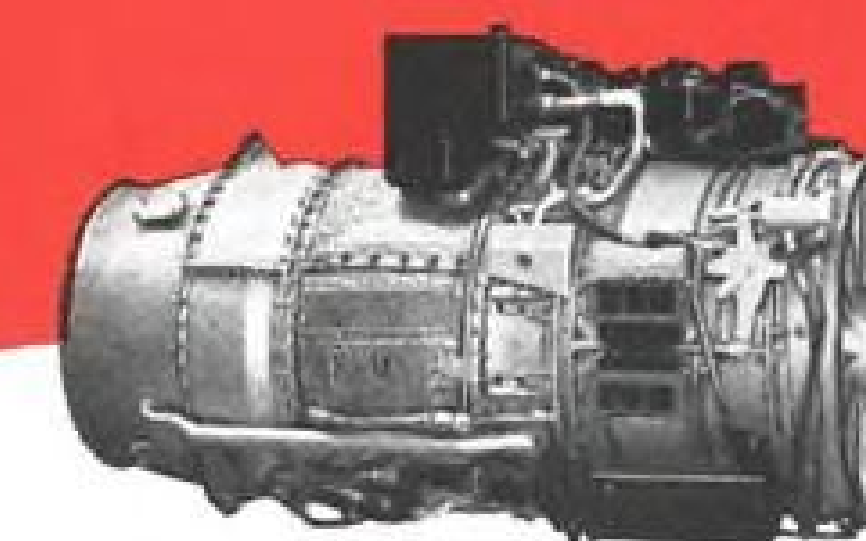
CF700
TURBOFAN
4200 LBS. THRUST
(Development)



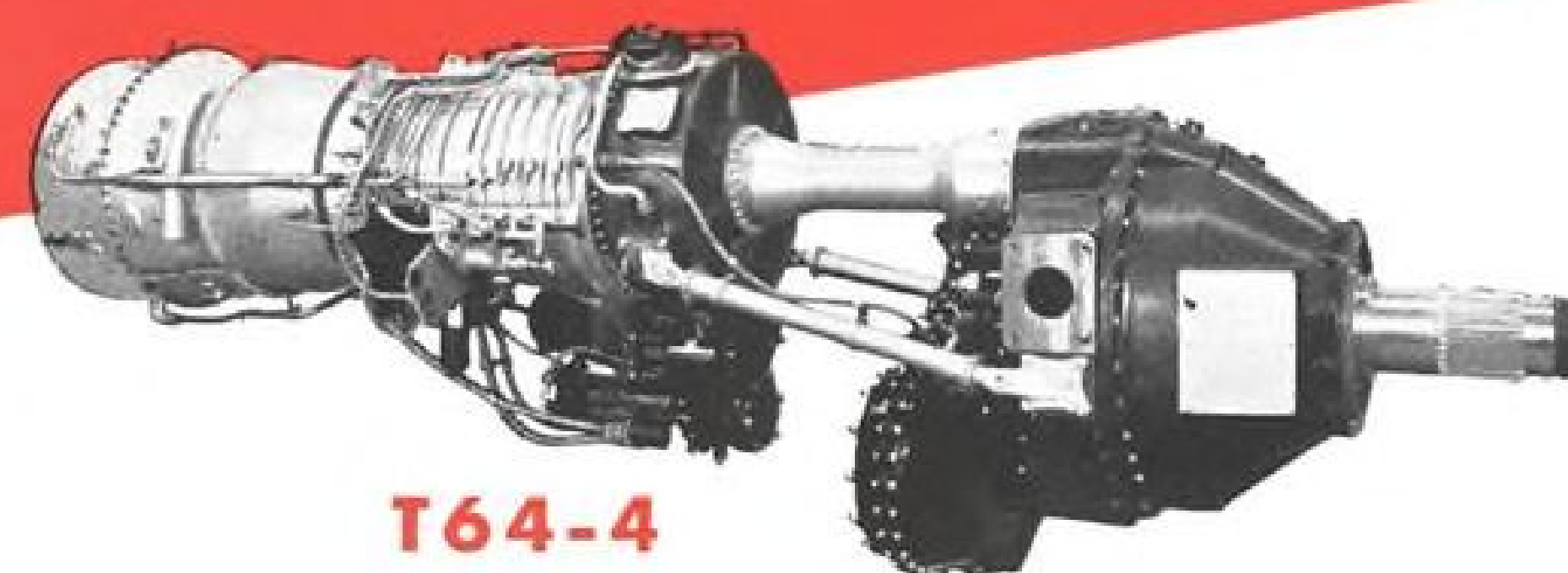
CJ610
TURBOJET
2850 LBS. THRUST
(FAA Certificated)



J85-5
TURBOJET
3850 LBS. THRUST



J85-7
TURBOJET
2450 LBS. THRUST



T64-4
TURBOPROP
2850 HORSEPOWER



T64-6
TURBOSHAFT
2850 HORSEPOWER



T58/CT58
TURBOSHAFT
1250 HORSEPOWER
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SMALL AIRCRAFT ENGINE DEPARTMENT
GENERAL ELECTRIC
FLIGHT PROPULSION DIVISION 186-64

Financial Briefs

Motorola, Inc., earned \$5.6 million for the first six months of 1962 on sales of \$159.6 million—compared with \$3 million and \$128.7 million, respectively, for the same period last year. Second quarter 1962 earnings totaled \$3.2 million on \$82.6 million sales. Same period last year showed \$2.2 million earned on \$68.3 million sales.

Thompson Ramo Wooldridge, Inc., had earnings of \$6.4 million on sales of \$231.6 million for the first six months of 1962. Same period last year showed

earnings of \$2 million on sales of \$200.9 million. Second quarter 1962 earnings were \$3.5 million on sales of \$119.9 million—compared with \$581,300 earned on sales of \$111.7 million at the same time last year.

B. F. Goodrich Co. reports net sales of \$406 million with earnings of \$14 million for the first six months of this year. Same period last year showed \$370.3 million in sales with a \$15 million profit.

Giannini Controls Corp., had earnings of \$429,000 on sales of \$11.7 mil-

lion for the first six months of 1962—highest six months in the company's history. This year's figures were 12% above last year's. Order backlog stood at more than \$9.6 million on June 30, compared with \$9 million at the same time last year.

Textron Electronics, Inc., of Providence, R.I., reports sales of \$14.4 million with earnings of \$899,000 for the first six months of 1962. Last year's figures for the same period showed sales of \$11 million with a net loss of \$598,000. Second quarter sales were \$7.4 million with earnings of \$489,000 compared with \$5.5 million sales and a \$322,000 loss for the same period, 1961.

Texstar Plastics, of Ft. Worth, Tex., has acquired a controlling interest in Fly-A-Way Components, Inc., of Blackwell, Okla., a manufacturer of "edge lighted" and printed circuit panels for aircraft and missile instrumentation. Fly-A-Way will move to Ft. Worth and be operated as a Texstar subsidiary.

Kellett Aircraft Corp. reports a net income of \$82,613 on sales of \$1.4 million for the first six months of 1962. The figures compare with a \$142,968 net loss on sales of \$675,784 for the same period last year.

Bell & Howell Co. reports a 19% increase in earnings for the first half of 1962 above the figure for the same period last year. Six month earnings this year were \$1.3 million on sales of \$65 million compared with \$1.1 million earned on sales of \$64.3 million this time last year. Second quarter earnings were \$912,000 on sales of \$35.9 million. Second quarter, 1961, earnings were \$911,000 on sales of \$35 million.

Radiation, Inc., reports earnings of \$229,300 on sales of \$17.6 million for a 40-week period ended June 30. Comparable figures for the same period last year showed earnings of \$447,100 on sales of \$20.5 million. Homer R. Denius, president, told stockholders that in spite of a drop in sales, the company has a record \$16 million order backlog.

Baldwin-Lima-Hamilton Corp. reports \$70.9 million sales with earnings of \$1.3 million for the first half 1962. Same period last year showed \$55.8 million sales with an income of \$518,898.

Bowmar Instrument Corp., Ft. Wayne, Ind., reported record sales of \$6,518,127 for the six months ended Mar. 31, 1962, more than double the previous year's six-month total of \$3,122,837. Net income rose to \$348,153 for the 1962 period, 86% above last year's \$187,285.

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NEW OSTER AVIONIC SYNCHRO CATALOG



This 16-page catalog, devoted exclusively to synchros, describes complete electrical parameters and mechanical characteristics of more than 175 basic synchros, including resolvers, transolvers and linear synchros in sizes 8, 10, 11 and 15. Outline dimensions and physical features of 29 basic synchro configurations also are included.

For easy reference, one page is devoted to definitions of synchro parameters and basic measuring techniques.

OSTER AVIONIC DIVISION

JOHN OSTER MANUFACTURING COMPANY
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Please send me your NEW Oster Avionic Synchro Catalog.
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MANAGEMENT MACHINE

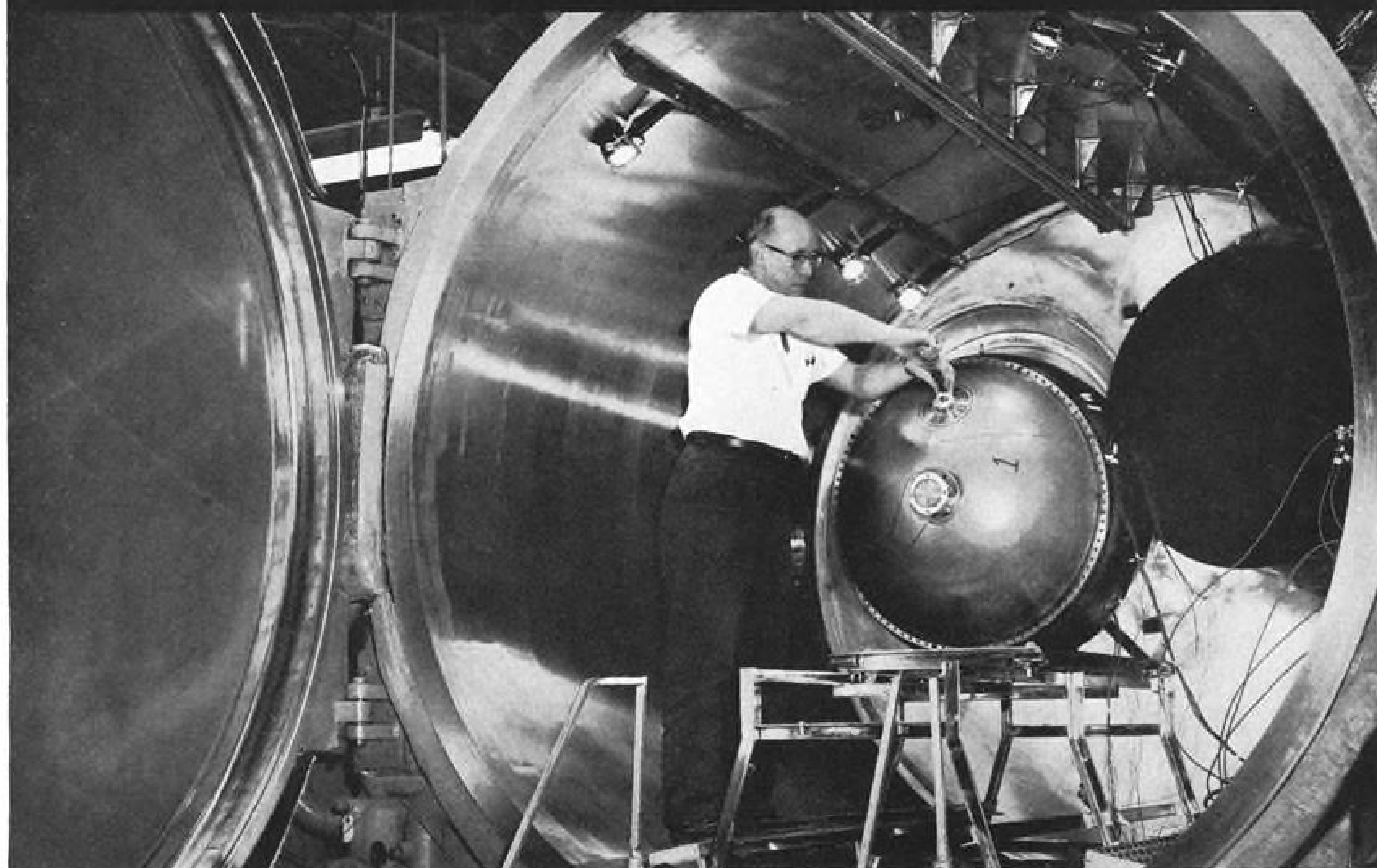
Regardless of the transportation equipment you now employ, this business machine can double or triple the productive time of your management men on the move. The all-weather Jet Commander carries up to 6 passengers and the crew in pressurized, air-conditioned comfort . . . flies at speeds above 500 mph . . . yet is capable of using virtually any airport, anywhere. The Jet Commander is for sale now under a purchase agreement which guarantees price, delivery date, performance and a 12 month warranty. Write for details of the Jet Commander, management machine of the air.



AERO COMMANDER, INC., BETHANY, OKLAHOMA, Subsidiary of ROCKWELL-STANDARD CORPORATION



"WORKHORSE" FOR GODDARD'S ENVIRONMENTAL TESTING



The 375-pound S-6 atmospheric measurement (135 to 540 miles) satellite being readied to undergo space environmental testing in the Stokes-designed and Stokes-built Goddard "8 by 8".

The Goddard "8 by 8" (8 ft. in diameter and 8 ft. long) horizontal test chamber is one of the key elements in the reliability testing program at NASA's Goddard Space Flight Center, Greenbelt, Maryland.

This Stokes-designed and Stokes-built thermo-vacuum unit was the first true space simulation facility installed at Goddard for testing unmanned vehicles under the fullest possible range of environmental conditions, and is the largest presently in use there. It has a vacuum capability of 1×10^{-7} Torr (200-mile altitude) under full load conditions, and is equipped with a heat transfer system capable of handling radiant wall temperatures from -65°C to 100°C .

Goddard's "8 by 8" will continue to serve as the touchstone for the Space Flight Center's highly successful reliability testing program until the enormous test and evaluation laboratories now under construction go into service early in 1963. Major space test chambers of this facility, which is expected to set the most advanced standards for spacecraft check-out, are two 35 ft. diameter, 60 ft. high thermo-vacuum environmental simulators. Stokes was selected as a prime contractor to NASA for complete vacuum and cryogenic systems for these huge chambers.

We welcome your inquiries regarding our capabilities and facilities for designing, fabricating, and erecting simulation facilities well in advance of the state-of-the-art, or any portion of a simulation project requiring high-vacuum and cryogenic systems. Space Systems Department, F. J. Stokes Corporation, 5500 Tabor Road, Philadelphia 20, Pa.

STOKES INTERNATIONAL: PHILADELPHIA • TORONTO • LONDON

STOKES

MANAGEMENT

New Yorkers Protest Defense Work Decline

Washington—New York congressional delegation has urged the Defense Dept. to cooperate with the White House's Office of Emergency Planning on a program of dispersal of military production and research and development facilities.

In a letter to Defense Secretary Robert S. McNamara, the delegation, headed by Rep. Emanuel Celler (D.-N. Y.), pointed out that Edward A. McDermott, OEP director, has expressed concern over "serious flaws" in mobilization planning and the concentration of defense industries. McNamara was asked for a report as to "whether some mechanism is being investigated at the highest levels to consider and take steps to counteract such concentration."

The New Yorkers protested a decline of over 10% in Fiscal 1962, from Fiscal 1961, in the proportion of Defense Dept. business that went to prime contractors in their state. Awards to California increased over 13%, giving the state 24% of the total Defense Dept. business for Fiscal 1962. New York's share of the total was 10.7%.

"We continue to feel the inordinate massing of procurement within one geographic area cannot be of ultimate benefit to the nation," the congressmen wrote McNamara. "Certainly, mixed with the challenges this country faces, there should be ever close consideration of deployment comportable with the national interest on the widest possible base."

Government-Industry Changes Are Requested

San Antonio, Tex.—New concepts of government-industry relationships are necessary to promote the application of U. S. technical resources on both sides of the fence, Northrop senior vice president-technical Richard E. Horner stated here during USAF's Annual Science and Engineering Forum.

Stating that "we have long outlived the utility of government subsidization in the defense industry," Horner noted that today the defense industry has grown into one of the largest segments of the total U. S. economy and the need for this kind of government support no longer exists. He said its continuation compromises efficiency on both sides.

Horner pointed out that defense companies today spend an average of 4% of total sales on technical overhead, including R&D and proposal activity.

HF SHF
UHF VHF
HF VHF
MF LF
VLF

'COMMUNICATIONS' IS OUR MIDDLE NAME

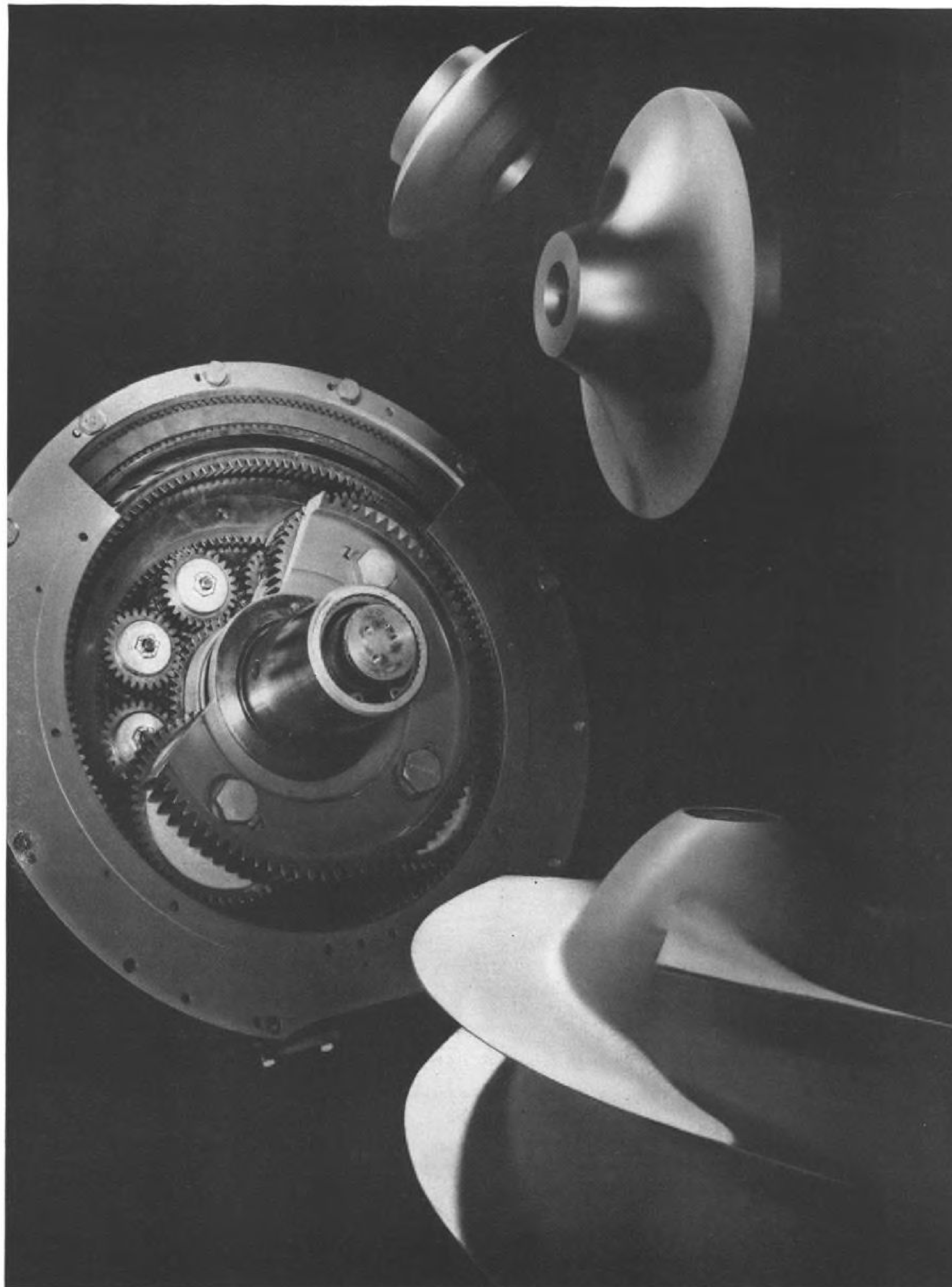
- A creative leader in command/control communication systems, Electronic Communications, Inc., maintains a continuing interest in the entire spectrum.
- Currently we are engaged in a number of advanced projects . . . serving as the prime communication system contractor for SAC's Airborne Command Post program . . . design, development and manufacture for NASA's Saturn Control Signal Processor and Flight Control Computer . . . to name but two.
- For these projects and other long-range research and development work, ECI has openings for qualified, creative senior and intermediate engineers with design experience in LF, HF, VHF, UHF and SHF equipment, digital communications, information theory, antennas, modulation techniques and ground communication systems.
- If you are interested in a challenging career and want to work for a growing Company (opportunities open in St. Petersburg and Timonium, Md.), contact: Professional Placement, Electronic Communications, Inc., P.O. Box 12248-A



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New Power Systems Take Shape at Curtiss-Wright

What you see to the left are three uncommon shapes with a common purpose: putting power to work. *More power—more efficiently*, by means of new transmission systems developed by the Wright Aeronautical Division for a variety of land-sea-air equipment.

Under contract with the Bureau of Ships, a new transmission system is now being developed which will handle inputs of 40,000 HP for near-future use aboard 500-ton hydrofoil craft. As a major producer of precision gears and gear systems, Wright Aeronautical has received aircraft sub-contracts for the design-and-production of a new angle drive mechanism that increases electrical capacity by as much as 50%.

Toroidal-traction drives offer power transmission

with a smooth infinitely-variable speed change—for military and industrial equipment—with a new order of fuel economy, overall efficiency, and grade-acceleration performance. Toroidal drives are lightweight, quiet, and practically free of vibration. Evaluation contracts have been placed by the US Army and the Link-Belt Company.

For industrial pumps and for both military and commercial water craft, an advanced water jet propulsion system—unique in design-simplicity and rugged in construction—offers a most efficient means of propulsion.

These systems are the result of generations of experience at Curtiss-Wright in power transmissions. They can mean more power to you and your power transmission program. Our literature is available on request. Write for it.



Wright Aeronautical Division
CURTISS-WRIGHT CORPORATION

Main and Passaic Streets



Wood-Ridge, New Jersey



PUMP PRIMERS

ARTHUR A. NICHOLS

High Altitude Pumping Efficiency

► Engineers concerned with the pumping of various aviation fluids know well the difficulties of getting good performance at high altitudes where low inlet pressures are encountered. Pumps which work well at low altitudes frequently run into trouble when they encounter the rapid pressure changes, shock and turbulence which promote foaming and lowered efficiency at high altitudes.

► Gerotor pumps are efficient at high altitudes and therefore are frequently specified for this service. A specialized form of internal gear pump, the Gerotor has an inner toothed element and



FIG. 1

meshing outer toothed element. The inner Gerotor has one less tooth than the outer and the missing tooth space forms a chamber for transporting the fluid from the inlet to the outlet port. ► Slow opening and closing of the chamber as it traverses the large inlet and discharge ports results in avoidance of the sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in foaming and lowered efficiency. Thus, Gerotor pumps offer exceptionally good performance at high altitude.

► Low relative speed and closely held clearances between the two Gerotor elements mean high volumetric efficiency is maintained.

► Low weight, high performance and unusual adaptability to space and geometry of housing structure make Gerotor pumps ideal for gearbox lube and scavenge service.

► Engineers concerned with drives, auxiliary power sources, gear boxes and various transmission design problems involving pressure lubrication have found Gerotor type pumps extremely useful in their attempts to hold weight down and achieve maximum compactness with high service reliability.

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

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

W. H. NICHOLS CO.

Makers of Zenith Metering Pumps and the Nichols Milling Machine "the miller that uses its head".

48 WOERD AVE., WALTHAM 54, MASS.

AERONAUTICAL ENGINEERING



BEDE AIRCRAFT BD-7 shorthaul airliner is built along same general lines as earlier XBD-2 experimental STOL aircraft. Airliner version has coupled CT58 engines driving a single propeller mounted inside an annular ring. Capacity is 24 persons.

Bede Aircraft Reveals First Design Details of Proposed BD-7 Airliner

First design details of the proposed Bede Aircraft BD-7 shorthaul airliner show it to be built around the major aerodynamic features of the company's experimental STOL aircraft, the XBD-2 (AW Feb. 19, p. 67).

Large flap area plus suction boundary-layer control on the upper surface of the wing give predicted maximum lift coefficients which should allow takeoff and landing speeds of 55 mph.

Pair of General Electric CT58 turbo-prop engines, rated at 1,250 shp, each, are coupled to drive a single propeller mounted in an annular surface at the tail.

Basic configuration has 15 seats in the cabin. At the aircraft normal gross weight of 11,500 lb., internal fuel provides a 1,340-mi. range with a 45-min. fuel reserve, according to the calculations. In a high-density version, where 24 passengers and baggage are carried for the same gross weight, the range is reduced to 305 mi., with the same reserve.

Company is now working on a detailed cost analysis of operations with the BD-7, using standard Air Transport Assn. methods. Calculations assume a 100-mi. stage length carrying 24 passengers. On this basis, the company reports, the cost per seat-mile calculates to be 28% lower than comparable figure for the Douglas DC-3. Cost per aircraft mile is calculated as 33% lower than the DC-3 cost.

Normal 15-passenger arrangement of

the interior uses seats in rows of three spaced at 48 in. pitch. This is reduced to a 36-in. pitch for the high-density version. Baggage compartment volume is 132 cu. ft.

Bede proposes an all-cargo version along with the passenger-carrying BD-7. It would have a special door 72 in. x 68 in. to give easy access to the usable cargo volume of 1,136 cu. ft.

Fuel load is 472 gal., carried entirely in the aluminum honeycomb wing structure. Maximum capacity of the wing tanks is 755 gal., and auxiliary tanks can be mounted in the fuselage to bring the total to 845 gal. At normal gross weight, with full wing tanks and auxiliary tanks, the ferry range of the BD-7 is estimated at 3,020 mi.

Performance data have been based on flight test data from the XBD-2, which have been continuing for about one year. They show a takeoff distance of 312 ft. over a 50-ft. obstacle on a 100F day. Time to climb to 25,000 ft. is 7.1 min.

At 25,000 ft., the cruise speed is 369 mph. Landing length over a 50-ft. obstacle is 480 ft.

On a hot day, the single-engine take-off distance is 568 ft., over a 50-ft. obstacle.

Maximum rate of climb on one engine is 2,150 fpm., and the single-engine ceiling is 29,000 ft.

Wingspan of the BD-7 design is 55.5 ft.; over-all length is 59.5 ft., and wing area is 400 sq. ft.

USAF Contracts

Following is a list of unclassified contracts as released by U. S. Air Force contracting offices:

Massachusetts Institute of Technology, Cambridge, Mass.—\$33,878 for study of theory and applications of analysis in function spaces; \$69,640 for cosmic ray research.

Wayne State University, Detroit, Mich.—\$10,793 for research on partial differential equations.

University of Canterbury, Christchurch, New Zealand—\$14,672 for investigation of radio noise associated with aurorae.

University of New South Wales, Kensington, Australia—\$24,100 for research on positronium; \$24,000 for research on nuclear three-body problem.

New York University, Institute of Mathematical Sciences, New York, N. Y.—\$30,138 for research in statistical fluid dynamics of gases and plasmas (hydromagnetic turbulence).

St. John's University, Jamaica, N. Y.—\$31,310 for research on calculation of collision cross sections.

Washington University, St. Louis, Mo.—\$125,795 for study of paramagnetic resonance absorption of free radicals and other substances.

Florida State University, Tallahassee, Fla.—\$309,060 for low energy (1-10 Mev protons) research using tandem Van de Graaff.

Commonwealth Scientific and Industrial Research Organization, Melbourne, Victoria, Australia—\$29,300 for study of thermal expansion of solids at low temperatures.

Callery Chemical Co., Callery, Pa.—\$29,541 for research on interaction of helium surfaces.

General Electric Co. (MSVD), Philadelphia, Pa.—\$42,879 for research on density of pulsed plasma.

Avco Corp. (Research and Advanced Development Div., Wilmington, Mass.—\$66,566, for measurement of total emissivity above 2,000C.

Melpar, Inc., Falls Church, Va.—\$36,056 for research on the role of lipid phase transitions in biological membranes.

Westinghouse Electric Corp., Washington, D. C.—\$79,051 for research on thermal conductivity and thermoelectric power of solids at low temperatures.



Manpack Radio

Manpack radio, weighing 7 lb. including battery, provides private, jam-resistance communications to selected receiver, using spread-spectrum technique known as RACEP (random access and correlation for extended performance), developed by Martin Orlando Division. Manpack shown has point-to-point range of 2 mi. with similar sets or more than 15 mi. with larger sets.

PROBLEMATICAL RECREATIONS 142

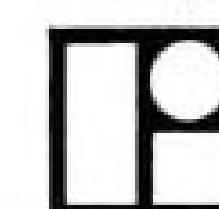


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ANSWER TO LAST WEEK'S PROBLEM: Exactly 600 yards. It can be shown that in any general triangle the shortest line dividing it in two equal areas is equal to $\sqrt{2} (s-a) (s-b)$, where s = semi-perimeter, and a and b are the two longer sides. The fence will terminate at the two longer sides.

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SIXTEEN CZECHOSLOVAKIAN MORAVA 200D executive twins move down the production line at the National Aircraft Works in Kunovice. Fuselage is all-metal semi-monocoque structure. Aircraft is certificated under CAR Part 3 (Category N).

Aviation Week Pilot Report:

Morava 200D Has Rough Field Capability

By Herbert J. Coleman

Brno—Czechoslovakia's successful light twin, the Morava 200 series, has been beefed up to extend its capabilities as an air taxi that can operate in rough fields in the Soviet Union and in emerging African republics.

But at the same time, during a period when the Czech aircraft industry is de-emphasizing work on business planes (AW Oct. 15, p. 125), the Morava 200D, the newest three-bladed propeller version, also is being pushed as a western export item to win foreign currency for the nation.

Because of its success with Aeroflot, the Soviet airline, and CSA, the Czechoslovakian airline, the Morava 200 designer, Lladislav Smrcek, put in considerable work on building a turboprop-powered version. However, in line with

the new policy, this project has been dropped as too expensive for an airplane which did not really fit the rugged operational mission.

The Morava 200D now is being phased into CSA air taxi schedules and about 27 will be assigned to the airline by the end of this year. They are operated on regular schedules, chartered for business and sporting parties, and used extensively as air ambulances to Czechoslovakia's many health spas in the Tatra Mountains, according to Petr Remek, chief sales officer.

Remek, who does considerable scheduling work, said at present operational times on the Morava 200D fleet average about three hours per day. CSA plan is to stretch this figure to six hours daily, since the air taxi division operates in the red as a vital service that currently is not economically feasible.

As an example of the renewed effort to make the taxi service profitable, Remek scheduled two Morava 200Ds as sight-seeing airplanes during the annual Brno International Trade Fair, flying them on 15 min. hops in the immediate Brno area. Charge for the flight was about \$2 per passenger. On the first day alone, the airplanes made about 70 trips, carrying three and four passengers at a time. Other airplanes, meanwhile, flew the Prague-Brno route in tandem with CSA's Avia-14, the Ilyushin Il-14 built under license, on both scheduled and charter runs.

The Morava 220D, flown by this AVIATION WEEK pilot from the Brno Sports Flying Club airfield about eight miles west of this industrial city, is a pilot's airplane, easy to fly and forgiving in almost every flight area.

With CSA air taxi pilot Vladimir Vlk

aboard, the Morava 200D, registered as OK-RHA and taken from CSA service for this flight, was taxied at speeds up to 40 mph. over rough, grassy land. Control response was immediate and turns could be made at relatively high speeds without danger of dragging a wing or digging in a propeller.

Vlk pointed out that the main reason for the propeller change, a V-506 steel, fully-feathering prop made by Avia, was to in effect lift the fuselage higher off the ground for Soviet operations into fields that often have 2-3 ft. of grass. Morava 200A models were fitted with two-bladed Avia 6 ft. 3 in. propellers that fouled in this type of landing condition.

Propellers are driven by two Walter M-337 air-cooled, in-line inverted engines which incorporate low pressure direct fuel injection before the inlet valves. Engines, which produce 260 hp. each, also include a disengageable centrifugal supercharger.

Morava 200D cockpit can be entered from either side through wide doors; rear compartment seats three persons comfortably and interior on OK-RHA was both colorful and well-constructed.

Side visibility is excellent but forward visibility for pilots leaves something to be desired. Windshield is split by structural bar running from nose to top fuselage and large magnetic compass is hung from this member; windshield fuselage bracing on either side also obstructs visibility. In addition, on this model, an archaic free-air temperature gage, a glass-mercury device about 10 in. long, was affixed on outer glass on the copilot's side.

A further cockpit complication for a pilot new to the airplane was the fact that instrument readings were in a mixture of Russian, French and German. Most Czechs speak the latter language, and French-data instrumentation had been recently added for demonstration trips to Africa. Radio package was a Russian pushbutton VHF unit.

Starting is simple, since Morava designers have adopted the pushbutton technique wherever possible. Master switch and both magnetos are pushbuttons, as are starter buttons for both engines. Start was accomplished by turning on booster pumps, by pushbutton, and hitting starter buttons after master and ignition switches had been activated. Internal battery power (24 v.) was used for this flight, although provisions have been made for external power units.

Supercharger was engaged for starting and then disengaged when engines reached 1,000 rpm. for warmup. Magnetos are checked at 2,200 rpm. by depressing the magneto buttons and watching for a 50 rpm. maximum drop. Pitch control also is by pushbutton.

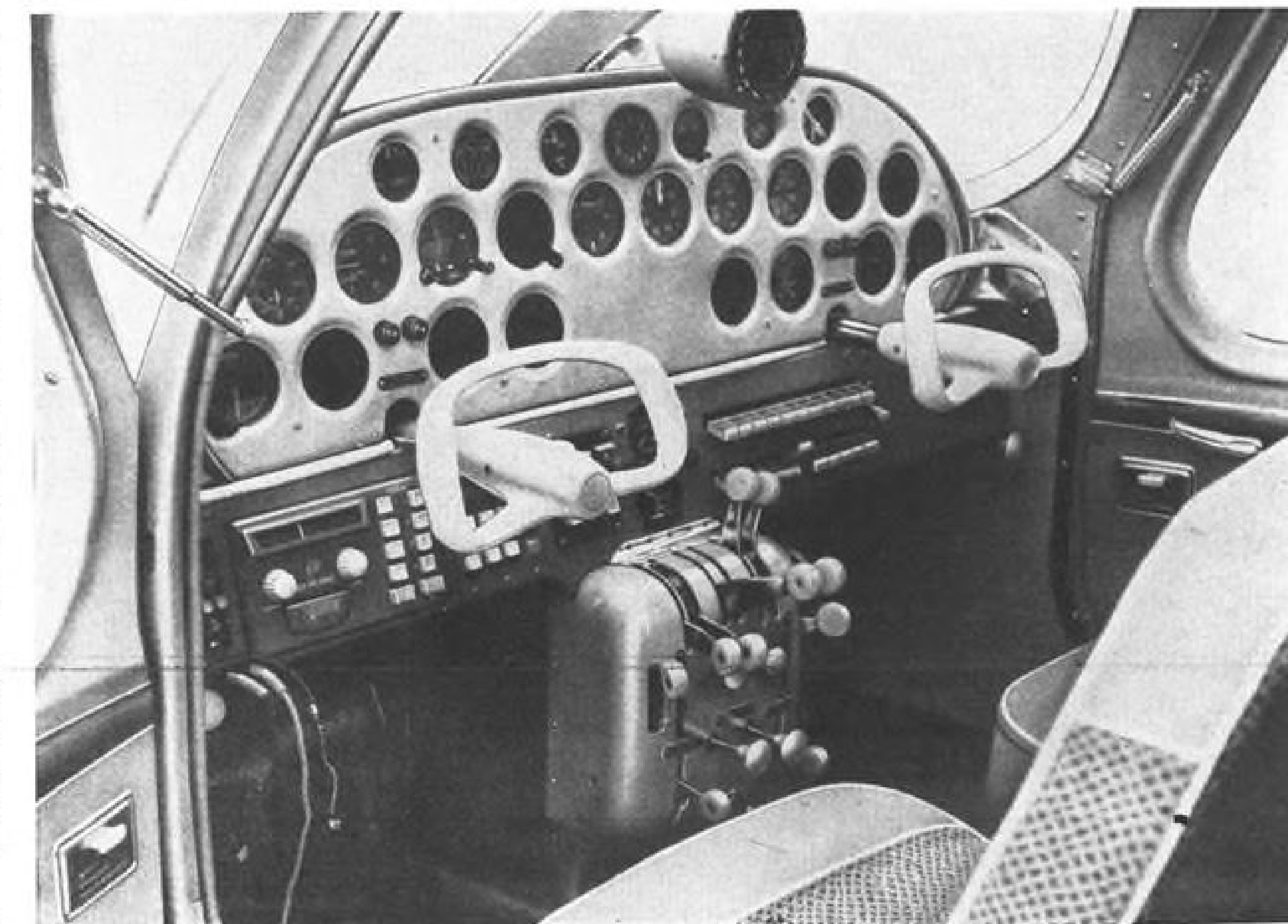
To facilitate the rough field mission,

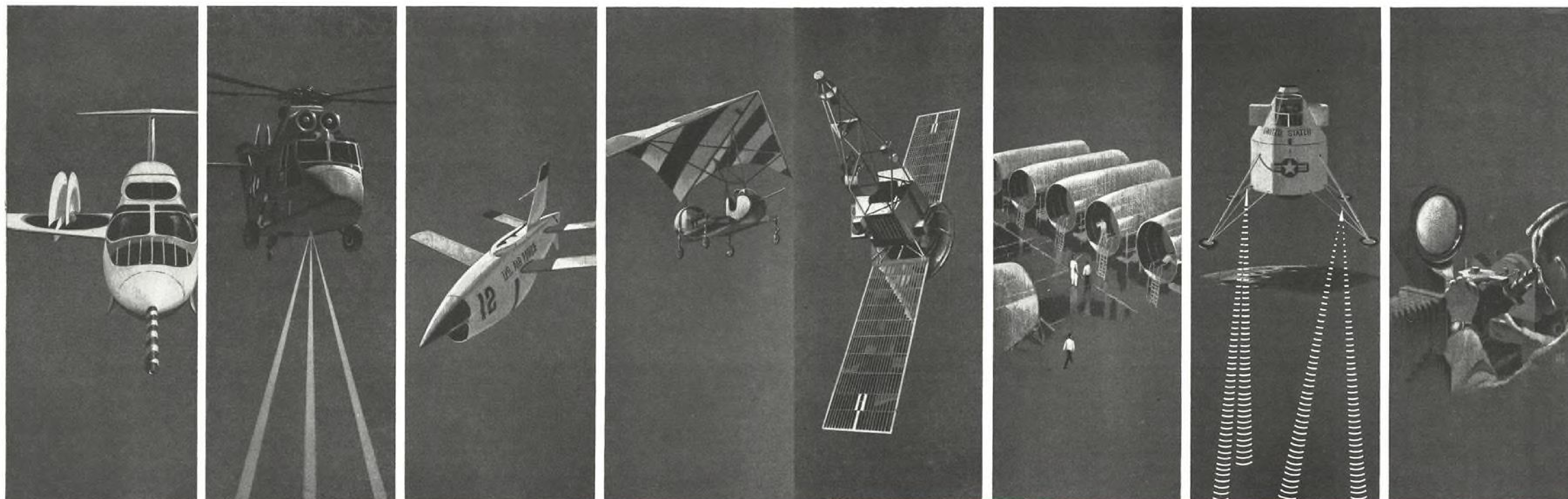


MORAVA 200D features a three-bladed propeller, is offered in four color combinations.



SOVIET UNION'S Aeroflot will take delivery on 10 200Ds for use as air taxis. Instrument panel, below, makes extensive use of pushbuttons. Note 10-channel Russian VHF radio.





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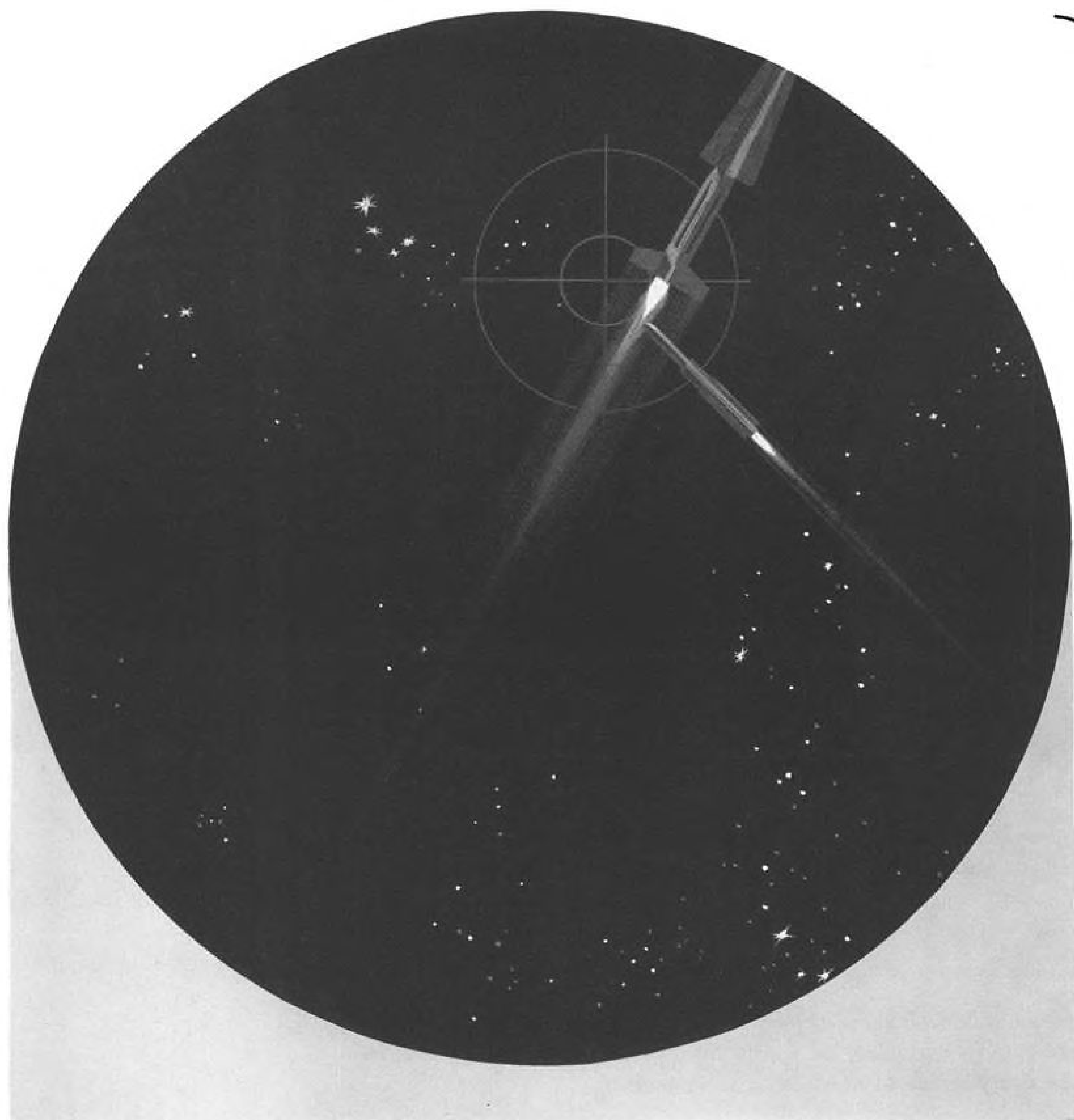
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The page opposite describes one of the many Dalmo Victor achievements. Scientists and engineers of unusual ability are needed to further this and other Dalmo Victor concepts. If you would like to work in this creative atmosphere, and enjoy the many advantages of living in the San Francisco Peninsula area, investigate a career with Dalmo Victor. It can be most rewarding.

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MORAVA 200D equipped for air ambulance service contains two stretchers and a seat for flight attendant. CSA, Czech airline, has a number of this type in operation. Baggage compartment is behind rear seat in passenger version.

Morava 200D's nosewheel is steerable from the rudder pedals. Landing gear is hydraulically operated and a warning horn sounds if throttles are retarded with the gear in an unlocked position. Nose gear is steerable through 360 deg. and hardware includes a shimmy damper and light.

Flight Characteristics

For takeoff, flaps are set at 15 deg. and supercharger is engaged. Actual takeoff run, even for rough ground conditions, was about 250 yards and Vlk performed it under "no-hands" conditions, merely using the rudders for directional control. Climbout was about 600 fpm. at 90 mph.

Flight sampling was conducted near the city of Brno after this pilot had been discreetly nudged away from the borders of the Brno military airfield, home base for about 36 MiG-19 jet fighters assigned to Czechoslovakian air force. Some appear to be on alert status, but most probably are used for final training phases of Cuban air force pilot trainees, now becoming a familiar sight in Czechoslovakia.

Morava 200D has very docile stall characteristics. In so-called "clean" configuration, gear and flaps up, the aircraft stalled at about 60 mph. Reaction is tail buffeting, warning horn sounds, and then an almost straight-ahead break. Reaction is similar with gear and 30 deg. of flap extended, with exception of a tendency for the Morava 200D to drop off slightly on the starboard wing. Stall speed was about 55 mph.

Design philosophy was to build as much structural strength as possible into

the airplane with a high degree of aerodynamic safety, in keeping with its short-field mission. This is best demonstrated in single-engine operation; with the starboard propeller feathered, airspeed dropped off only 10 mph. and only control reaction was slight rudder pressure. Morava 200D also could be flown in a 30 deg. bank to the right, into the dead engine, with only a little judicious use of trim to hold altitude, again with no appreciable loss of airspeed.

Stall with the right engine feathered was sharper and right wing fell off quickly, but recovery was accomplished by opposite rudder and slight aileron pressure, after dropping the nose to regain airspeed. Altitude loss was less than 100 ft. As in other stall configurations, changes of trim are small and can be controlled with one hand. In single engine flight, however, manufacturer recommends a 5-8 deg. bank into the operating engine.

Returning to the Brno sports field, Vlk demonstrated high maneuverability of the Morava 200D by executing a fighter-type "pitch-out" approach, div-

Morava 200D

Length.....	28.3 ft.
Height.....	7.4 ft.
Wingspan.....	39.4 ft.
Wing area.....	185 sq. ft.
Empty weight.....	2,805 lb.
Maximum gross weight.....	4,290 lb.
Payload.....	1,485 lb.
Wing loading.....	23.15 lb./sq. ft.
Maximum level speed.....	190 mph.
Cruise speed.....	183 mph.

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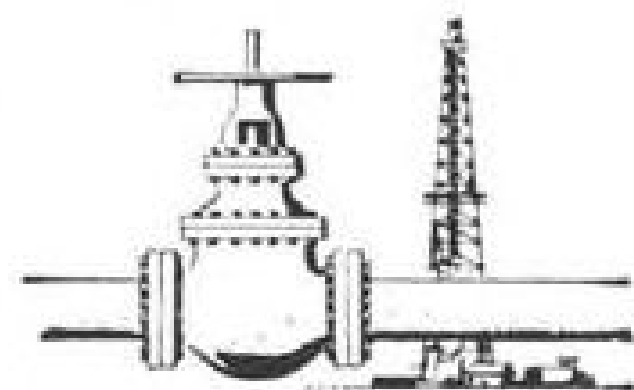
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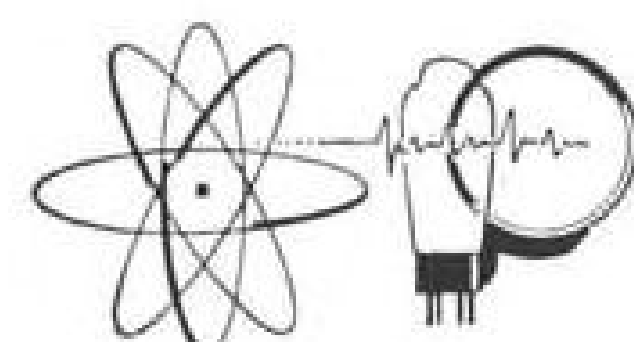
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ing the aircraft to a speed of about 200 mph. and then breaking sharply left at about 20 ft. altitude. Gear was dropped at about 400 ft. and the airplane continued in a diving turn, with flaps lowered to 30 deg. for the final approach. Airplane touched down at about 80 mph. on rough ground and Vlk jammed on the brakes. Landing roll was about 200 yards.

In a more routine landing, the procedure is normal, with speed lowered to 130 mph. on downwind leg, gear lowered, and flaps lowered to the recommended 30 deg. after establishing the final approach. Even with little use of brakes, the landing roll was short.

Morava 200D features twin rudders, although total rudder area has been kept small, partly to reduce the height of the aircraft for rough fields. Vertical tail surfaces are attached to horizontal stabilizer at points where they utilize most of the slipstream.

All-Metal Wing

Trapezoidal wing is all-metal and includes the slotted, rearward extending flaps. Wing also contains auxiliary fuel cells; main fuel tanks are the wingtip tanks, which hold 50 gal. each. An additional 42 gal. is contained in the auxiliaries. Pushbutton control box is used for fuel transfer, and each engine can be fed from either main tank.

Wing leading edge is double skinned and hot air is ducted from the engines for anti-icing.

United Kingdom distributor for the Morava 200D, Peter S. Clifford & Co., Ltd., has sold two airplanes to private owners in Britain. Export price of the aircraft, without complete radio package, is \$46,250.

Basic price, however, includes full cockpit instrumentation.

Southwest Facility

Ft. Worth—Investment of \$230,000 is planned by Southwest Airmotive Co. on a facility at Ft. Worth's Meacham Field.

Southwest Airmotive's contract with the City of Ft. Worth calls for it to spend at least \$63,500 on initial development, but the service company says it probably will spend closer to \$150,000 there in the first year of operation, including construction of a 10-unit T-hangar and an underground fuel tank farm, refurbishing of a sales facility and purchase of fuel trucks and aircraft ground servicing equipment.

Company plans around-the-clock transient service patterned after its Love Field operation and has leased 100,000 sq. ft. of ramp for aircraft parking and tie-down. Non-exclusive fuel sales agreement has been negotiated with the city, which had hitherto conducted this service.



DELIVERIES WILL BEGIN in January of the new Mooney Master, lower-cost version of the Mark 21, featuring fixed tricycle landing gear and simpler cabin furnishings, but otherwise identical to retractable-gear airplane. Mark 20D Master landing gear is convertible so that owner may later have it modified to be retractable at cost of \$1,600. Master will list at \$13,995 in basic configuration.

Mooney Displays Two New 1963 Models

By Erwin J. Bulban

Kerrville, Tex.—Mooney Aircraft, Inc., recently previewed its 1963 line of light aircraft and simultaneously outlined its future expansion plans.

New airplanes to be shown the company's distributor-dealer organization here in coming weeks are:

- **Mark 20D Master**, first addition to the company model line, which since 1955 has consisted of one airplane, which has evolved into today's Mark 21. Although basically a modification of the Mark 21, the new Master is a Mooney attempt to broaden its market by developing a lower-cost version for training, charter work and as a means of introducing low-experienced pilots to the line who feel that they are not yet ready for retractable landing gear. The Master is Mooney's answer to the Piper Cherokee and Beech Musketeer four-place fixed-gear lightplanes.

- **Mark 21** for 1963, refined in detail, with price unchanged from last year, will continue as the company's mainstay. Mark 20C is the technically correct designation for the four-place retractable tricycle-gear airplane which the company has termed the Mark 21 in its promotion since changeover to all-metal structure in 1961.

Mooney's plans for introducing its models to its field sales organization call for three separate three-day distributor-dealer meetings. After these meetings, the company will be able to plan production schedules for the Mark 20D

Master based on the backlog of orders. Deliveries to distributors are to begin by Jan. 1.

Mark 20D Master basically is a Mark 21 with fixed landing gear and less-plush interior and equipment. Basic price is \$13,995. Mooney says it developed the airplane as a result of distributor requests for a second airplane that they could use for training

student-pilots and prospects at lower cost.

Quickest solution, as the company saw it, was to take the Mark 21, revise the landing gear so that it was fixed and delete attendant retraction mechanism. This also provided the firm with an interesting possibility—that of providing a modification kit so that a Master owner could later have the airplane



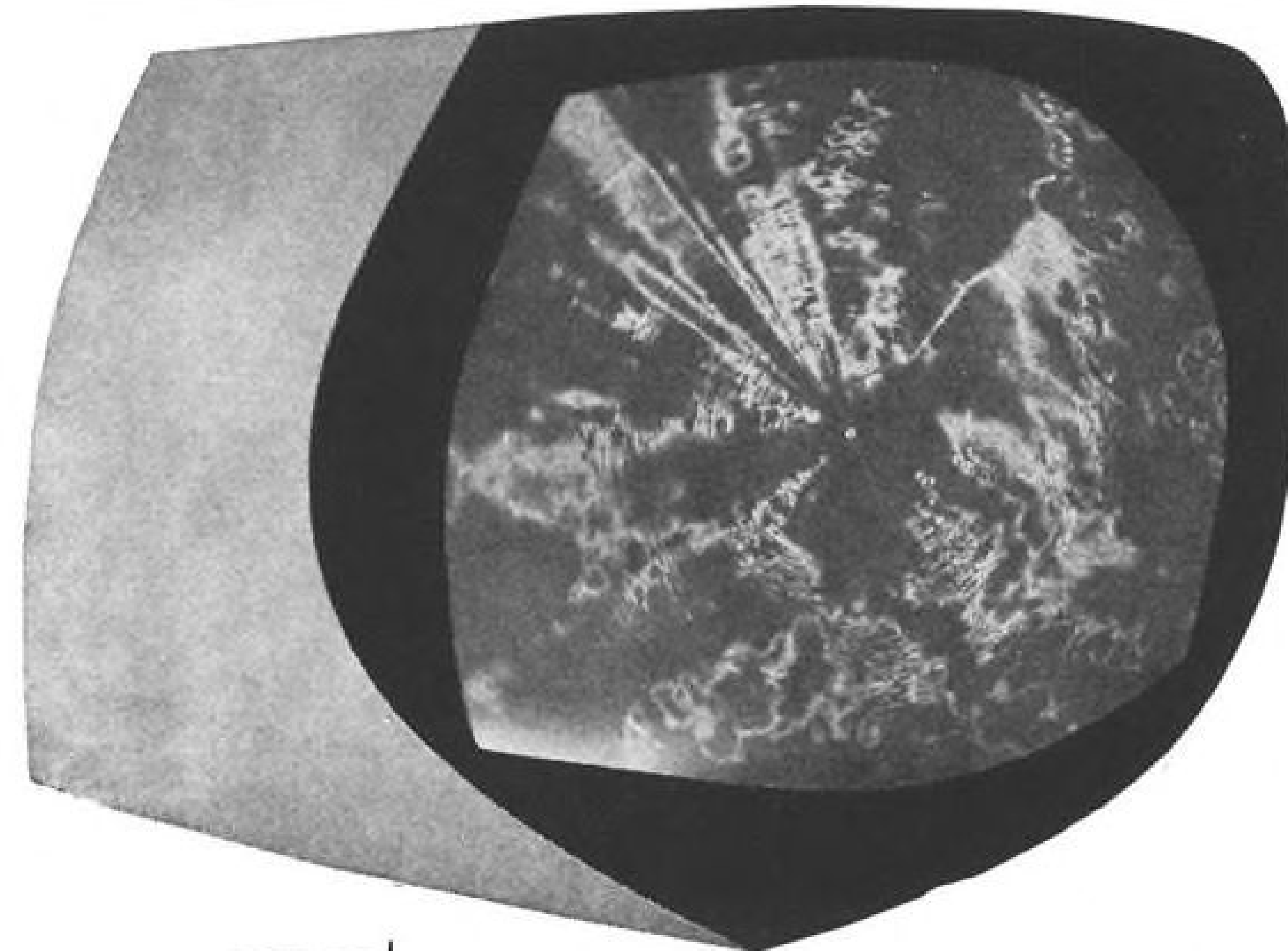
DUAL CONTROLS are standard on new Master, which also features simplified instrument panel. Interior furnishings also are more austere than Mark 21 to keep price down.

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converted to retractable landing gear at the factory for \$1,600. Landing gear used on the Mark 20D is a Mark 21 gear. All that is necessary is installation of retraction mechanisms, provision of cutouts in the underwing surface and addition of landing gear fairings to enclose the openings when the gear retracts.

Since the Mark 20D, when used in the training role, will impose harder temperature environment on the 180-hp. Lycoming than the Mark 21 encounters normally, its cowl flaps are adjusted to provide a slightly larger gap when in the closed position. Most performance data is similar to the Mark 21, although the fixed gear reduces top speed by 35 mph. Simpler interior and equipment increases useful load to 1,100 lb., compared with the Mark 21's 1,050 lb.

Mooney feels that the Master configuration provides it with considerable production flexibility. Both airplanes use the same tooling.

The 1963 Mark 21 basically is the same as last year's model. The aim is to hold the price line at \$16,450 for the standard airplane. Factory, however, will take orders only for airplanes equipped, pricing the Mark 21 at \$17,180 and moving up through \$20,995 depending on the equipment package selected—or even higher based on options chosen.

Most noticeable exterior change distinguishing the 1963 Mark 21 from previous models is a flush cabin air intake replacing the former protruding type. Airplane will be available in a choice of five exterior color schemes. Cabin features contoured sheet-metal seats replacing former built-up type of tubing.

Looking ahead, Mooney President Hal Rachal estimates that in 10 years, on the basis of completing its manufacturing expansion program, the company should be doing better than \$20 million annually—perhaps as much as \$30 million a year. By this time, in addition to current models, Mooney will have at least two additional airplanes in the line—a high-performance, single-engine, pressurized four-place development of the Mark 21, which should be in production within two years, and possibly a year after that, a high-performance, pressurized piston-engine light twin.

Mooney is trying to convince the Kerville community where its facilities are located, on the basis of plans to double its current \$1.7-million annual payroll and 400 employees over the next decade, to cooperate in providing the capital for the needed brick-and-mortar growth to approximately 500,000 sq. ft. of modern facilities.

The company currently utilizes 100,000 sq. ft. of area.

Mooney feels this could be handled by the city providing a "full-faith-and-credit" bond issue of \$700,000 to finance construction, repayable by the company on a lease-rental basis, payments covering principal and 4% interest and also a 40-year lease agreement.

If an agreement with the town cannot be reached the company will probably act to establish a satellite manufacturing facility. Rachal is negotiating with a number of other communities.

According to Rachal, plans are to turn out 425-500 airplanes in Calendar 1963 compared with 1962's 400 units. At the upper side of this production, it may be necessary to add extra shifts in some departments. In the coming 12 months, Mooney expects to add approximately \$100,000 worth of additional production tools. This added production capacity will make possible an output of 600-650 units with one shift of workers in 1964, he noted. Actually, he told AVIATION WEEK, management feels that the company's projected expansion plans will require an expenditure of \$50,000 annually for capital equipment following the \$100,000 expenditure in the coming year.

Mooney's factory dollar sales this year, in net billings to distributors and dealers, are expected to be \$5.5 million; they were \$4.27 million last year.



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Cruise speed at 75% power at 9,600 ft. at 2,700 rpm.....	141 mph.
Cruise speed at 75% power at 8,000 ft. at 2,400 rpm.....	137 mph.
Cruise speed at 65% power at 10,000 ft. at 2,400 rpm.....	130 mph.
Stall speed at gross weight.....	57 mph.
Rate of climb at sea level at gross weight at 92 mph. indicated.....	780 fpm.
Range at 75% power at 8,000 ft. at 2,400 rpm. (no reserve).....	610 mi.
Maximum range at 41% power at 10,000 ft. at 1,800 rpm.....	800 mi.
Service ceiling at gross weight.....	12,000 ft.
Takeoff run at sea level at gross weight, no wind, 15-deg. flaps.....	890 ft.
Landing rolls at sea level at 2,200 lb., no wind, 33-deg. flaps.....	550 ft.

SPECIFICATIONS

Gross weight.....	2,575 lb.
Empty weight.....	1,475 lb.
Baggage.....	120 lb.
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Power loading.....	14.3 lb./hp.
Span.....	35 ft.
Length.....	23 ft. 2 in.
Wing area.....	167 sq. ft.
Tread.....	9 ft. 3-in.
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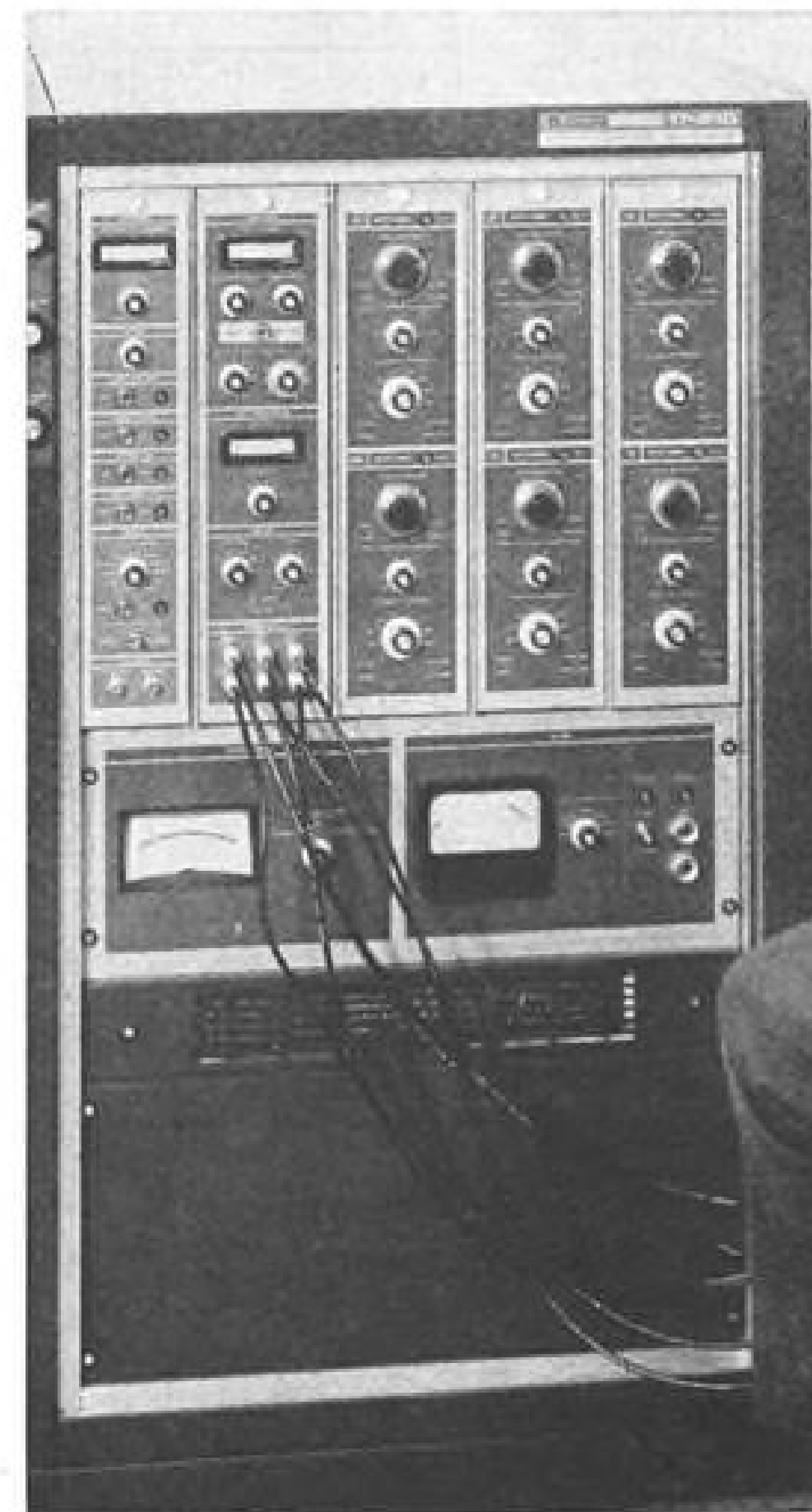
Armonk, New York ■ Tel.: ARmonk 3-3061
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■ INTEGRATED FLIGHT EQUIPMENT ■ ALTIMETERS ■ MACH AIRSPEED WARNING SWITCHES ■ MACHMETERS ■ AIR DATA COMPUTERS ■ FLIGHT INSTRUMENT SYSTEMS ■ SERVO INDICATORS ■ ALTITUDE RATE INDICATORS ■ PRESSURE SWITCHES ■ PRESSURE TRANSDUCERS ■ AIRSPEED INDICATORS ■ CABIN PRESSURE INDICATORS ■ AUTOMATIC FLIGHT CONTROL SYSTEMS ■ PRESSURE GAUGES ■ MACH AIRSPEED INDICATORS

NEW AEROSPACE PRODUCTS

Mass Spectrometer

Portable Time-of-Flight mass spectrometer (model 17-210) gives oscilloscope and strip chart display of qualitative and quantitative analysis of elements having a mass between 1 and 250.



The manufacturer says the spectrometer has research applications in cryogenics, high vacuum component testing and analysis of residual gases in ultra-high vacuum chambers in the 10^{-10} torr. region. Other uses include analysis of outgassing products in low vacuums, and provision of data on the kinetics of evacuating vacuum chambers.

Spectrometer is 52 in. high, 29 in. wide and 29 in. deep, and needs no water or refrigerant; electrical power required is 115 v., 30 amp., 60-cycle phase.

The Bendix Corp., Cincinnati Division, 3130 Wasson Rd., Cincinnati 8, Ohio.

Radiation Shielding

Material called Dyna-Therm Series NR 1000, combining thermal and nuclear radiation protection, offers the same radiation shielding capability as boron and lead but can be cast, molded, poured, sprayed or brushed on to form a thinner, more efficient coating than other materials, the manufacturer says.

Dyna-Therm incorporates boron and lead compounds dispersed in various epoxy, polyurethane and silicone binders. The manufacturer says shielding applications include nuclear medicine, aerospace vehicles and industrial and scientific nuclear reactors.

Dyna-Therm Chemical Corp., Beverly Hills, Calif.

Wind Force Indicator

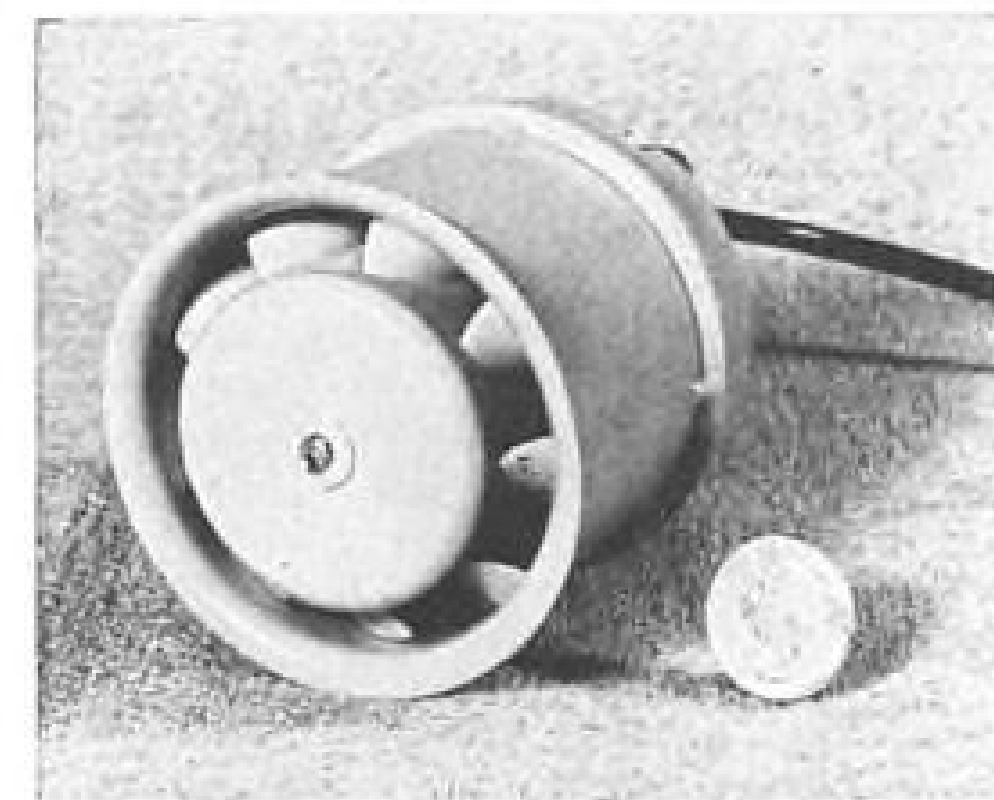
Instrument measures the magnitude and direction of wind force in both horizontal and vertical planes simultaneously, the manufacturer says.

The transistorized sensor, a 1-ft.-dia. sphere, is mounted internally on rigid supports. Wind drag displaces the sphere in relation to differential transformer slugs mounted on the internal supports producing signals linearly proportional to each component of the force.

The output signal, 0 to 0.5 v., 3,000 ohms impedance, will operate X-, Y-, and Z-axis chart recorders to provide true wind direction and force, and direction and force of each of the three components of the wind vector.

The unit requires 105 to 120 v. input and is designed to record and predict runway wind conditions for jet aircraft landing and takeoff, monitor wind conditions at missile launching sites and for general meteorological monitoring and recording.

Flow Corp., 205 Sixth St., Cambridge 42, Mass.



Cooling Fan

Compact, lightweight fan for high pressure airborne and electronic cooling applications delivers 100 scfm. at 8.8 in. w.g. while operating at 22,000 rpm.

Fan is 2 3/4 in. in diameter and 3 in. long and weighs 1 lb., 14 oz.

Blower Div., Electric Boat/General Dynamics, Groton, Conn.

Thermal Control Shroud

Shroud is designed for installation in a vacuum chamber to simulate, under regulation by a precise heat source, the space environment of rapidly fluctuating

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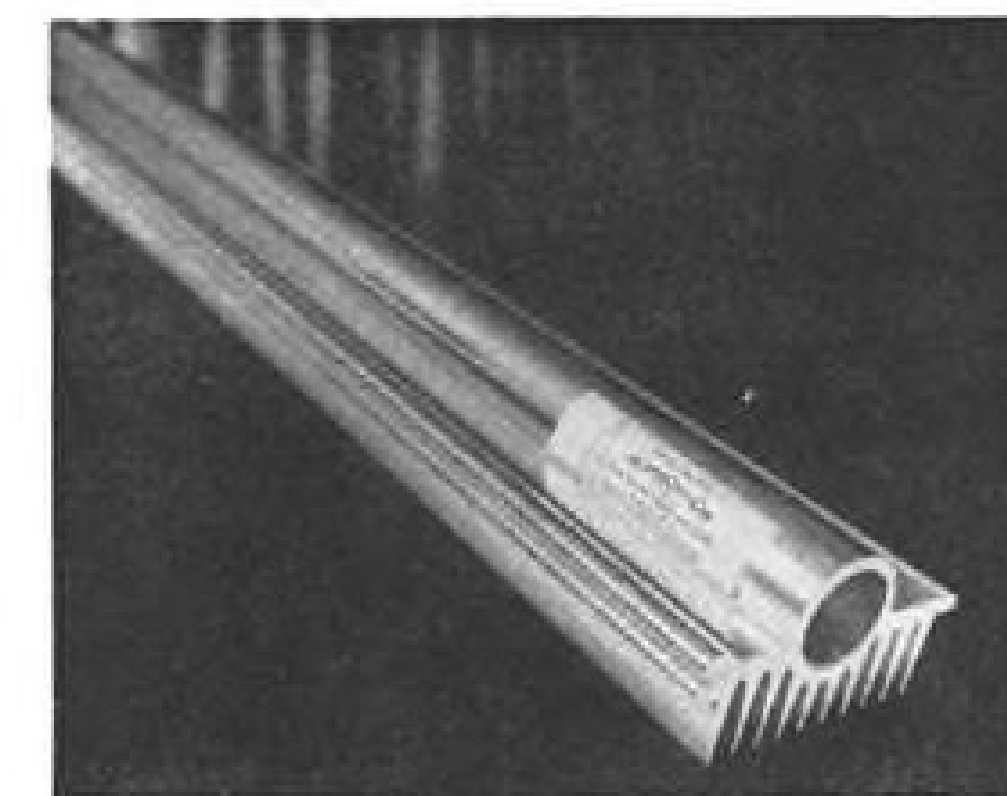
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temperature extremes and high vacuum. Electronic and mechanical components and systems, as well as complete satellites, can be tested under these conditions.

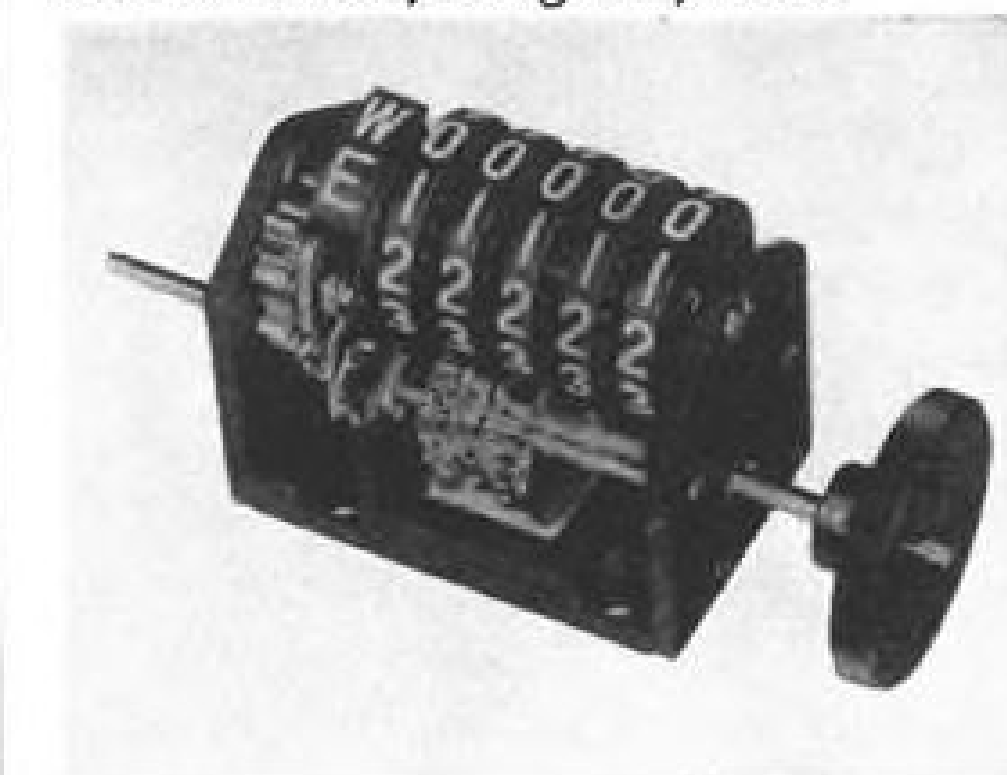


The shroud, called Cryo-Panel, has extruded finned aluminum panels through which freon, liquid nitrogen, or a heated brine fluid is circulated. Interior finned side of the shroud is painted black to provide a heat sink.

Two standard tube sizes are available for matching the shroud's heat transfer capabilities to the thermal load of the system.

Flexibility of manufacture permits fitting of the shroud panels to simulation chambers not originally equipped with Cryo-Panel, according to the manufacturer.

High Vacuum Equipment Corp., 2 Churchill Rd., Hingham, Mass.



Reversing Counter

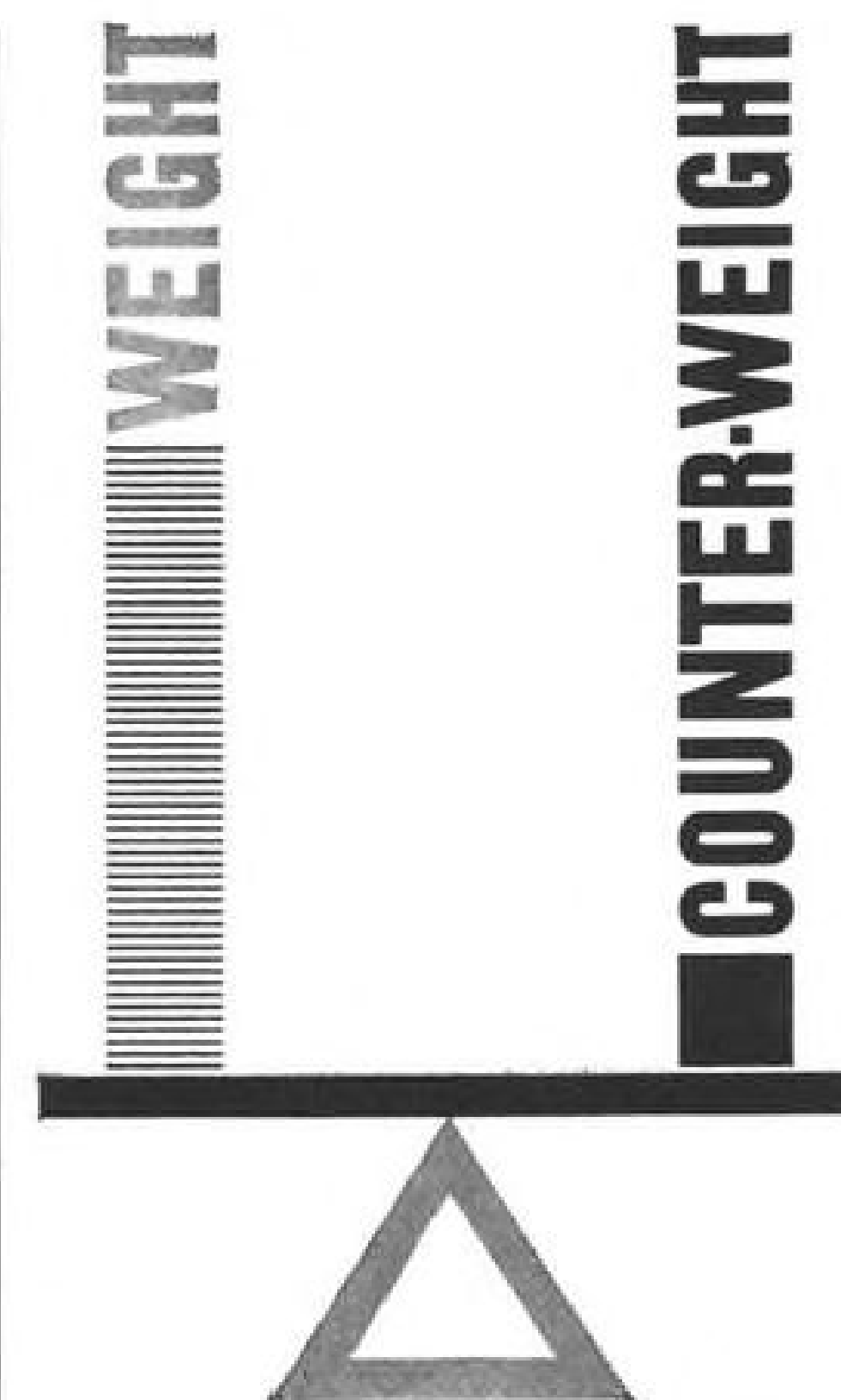
Navigational counter displaying latitude reverses automatically upon crossing the equator, eliminating the need for a dual-bank counter with a shutter mechanism. This saves weight and space.

Similar model reverses when passing from east to west longitude. A gearing arrangement within the counters reverses the direction of the wheel when a pre-determined "zero" point is reached, even though the shaft input is uni-directional.

The instrument is fabricated from corrosion-resistant materials and has white on black figures.

Torque is 1.5 oz. when all transfer components are engaged.

Veeder-Root Inc., 70 Sargeant St., Hartford 2, Conn.



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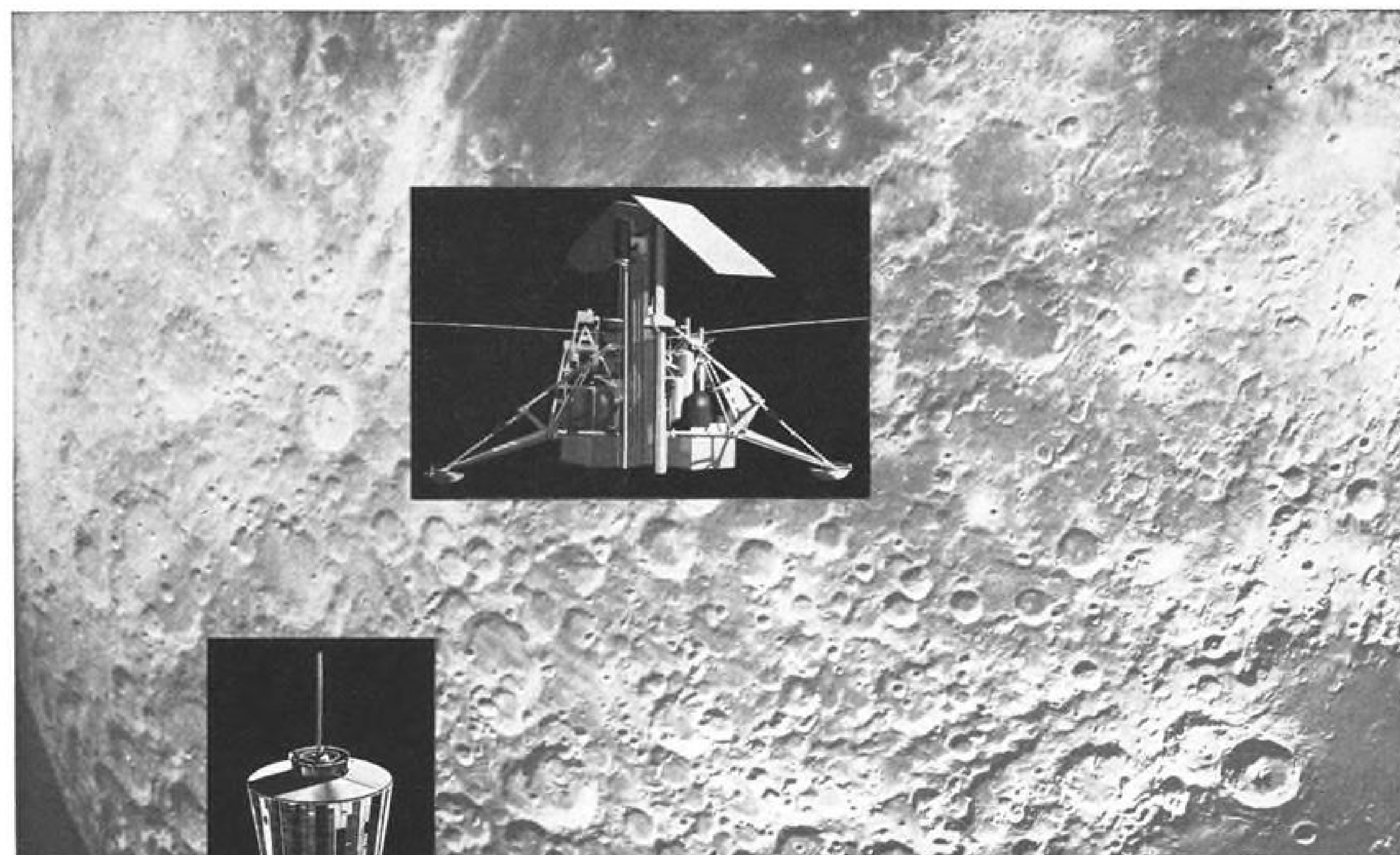
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SAFETY

Blast Caused Continental B-707 Crash

On the night of May 22, 1962, a Continental Air Lines Boeing 707-124, N 70775, operating as Flight 11 en route from O'Hare Airport, Chicago, Illinois, to Kansas City, Mo., was flying via Jet Route 26V at an altitude of 39,000 ft. A few minutes after Flight 11 had made a northerly deviation from course to circumnavigate a thunderstorm, in the vicinity of Centerville, Iowa, the radar image of the aircraft disappeared from the scope of the Waverly, Iowa, Flight Following Service. At approximately 2117¹ an explosion occurred in the right rear lavatory resulting in separation of the tail section from the fuselage. The aircraft broke up and the main part of the fuselage struck the ground about 6 mi. north-northwest of Unionville, Mo. All 37 passengers and crew of 8 sustained fatal injuries. The aircraft was totally destroyed.

The Board determines that the probable cause of this accident was the disintegrating force of a dynamite explosion which occurred in the right rear lavatory, resulting in destruction of the aircraft.

Investigation

Aircraft N 70775, a Boeing 707-124, arrived at O'Hare International Airport, Chicago, Illinois, from Los Angeles, Calif., as Continental Air Lines Flight 10 at approximately 1900 on May 22, 1962. At O'Hare, the aircraft received routine servicing and a turnaround inspection in preparation for scheduled departure to Los Angeles as Flight 11 with an intermediate stop at Kansas City.

The crew of Flight 11 had flown into O'Hare from Los Angeles as the crew of CAL Flight 4, a Boeing 720, landing there at 1913. The crew consisted of Captain Fred R. Gray, First Officer Edward J. Sullivan, Second Officer Roger D. Allen, Director of Passenger Services David E. Olssen, and Stewardesses Marilyn Bloomquist, Mary McGrath, Martha Rush, and Stella Berry. Flight dispatch was accomplished by the dispatcher at the carrier's headquarters in Denver through the customer service agent in Chicago in accordance with company policy and procedure. The dispatcher's proposed flight plan cruising altitude of 28,000 ft. from Chicago to Kansas City was changed to 39,000 ft. by the captain because he had knowledge of thunderstorm activity west of Chicago. An en route time of 1:01 hr. from Chicago to Kansas City was shown on the flight plan. Flight 11 was released from O'Hare with a takeoff gross weight and a center of gravity well within prescribed limits.

U. S. Weather Bureau forecasts indicated thunderstorm activity associated with an active cold front and prefrontal squall lines between Chicago and Kansas City. A severe weather warning was in effect for an area which lay across part of the proposed route of Flight 11, predicting heavy thunderstorms, maximum tops of 50,000 ft., with

¹All times herein are Central Standard Times based on the 24-hour clock.

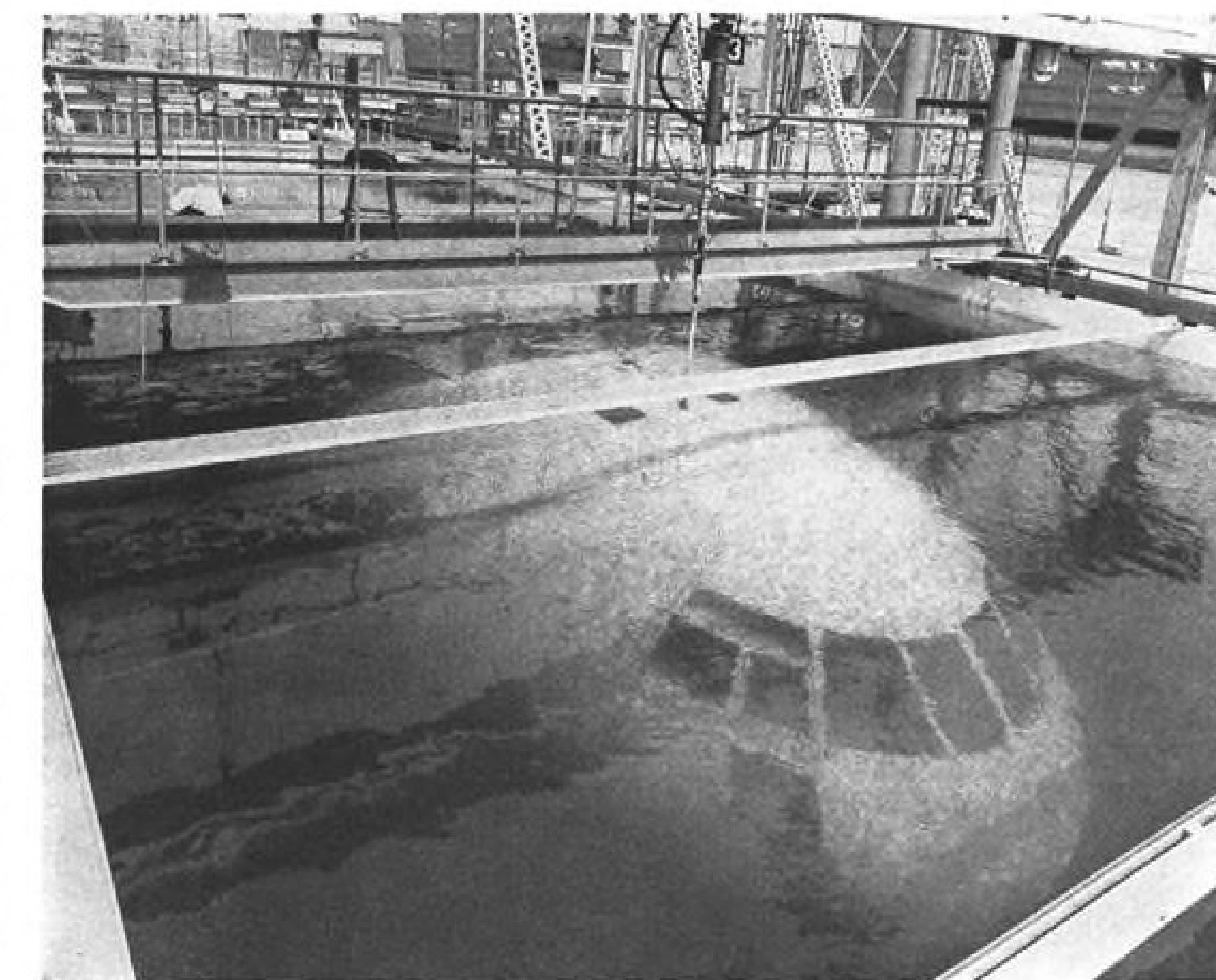
severe to extreme turbulence and possibility of tornadoes.

Flight 11 reported off O'Hare Airport at 2035 and was vectored by departure control to Bradford, Ill., reporting over Bradford at 39,000 ft. on Jet Route 26 Victor at 2052. Just east of the Mississippi River, at approximately 2101, Flight 11 asked Chicago Air Route Traffic Control Center if it had a radar picture of the squall line just ahead of the flight. The reply was negative and the center handed the flight over to the Flight Following Radar Site at Waverly, Iowa, one minute later. At about 2102, Flight 11 requested information regarding penetration of the storm area, and the Waverly controller suggested a southerly circumnavigation of a thunderstorm lying across the aircraft's flightpath.

Additional discussion between Flight 11 and the controller developed the fact that the thunderstorm could be circumnavigated either to the south or to the north. The nature of this discussion indicated that the aircraft's radar was operating satisfactorily, and Flight 11 elected to pass to the north around the storm cell. After the aircraft passed around the storm, the controller informed the flight that a direct course to

Kirkville from its present position should avoid all inclement weather. The crew then replied that they were starting a turn, and requested clearance direct to Kansas City. The Waverly controller approved this request and informed the flight that descent clearance was being processed.

For several minutes Waverly attempted to contact Kansas City Center without success and so informed the flight, whereupon Flight 11 replied "Okay, we can probably reach them on your radio, do you want to send us over?" This was the last transmission heard from Flight 11 and is believed, by the controller, to have occurred at approximately 2114. Within approximately one minute of this transmission, however, the Waverly controller established contact with Kansas City Center and attempted to effect a radar handoff of Flight 11. At the same time Waverly tried unsuccessfully to contact Flight 11 to request that they establish communications with Kansas City on 133.95 mc. Waverly also attempted to identify to the Kansas City Center the radar target location of Flight 11 as about 10 mi. south of the intersection of Airways J45V and J64V, and moving in a southerly direction. The Kansas City controller momen-



C-133 Undergoes Pressurization Test

Douglas C-133 is immersed in a hydrostatic test tank for pressurization cycling during recent 14-month USAF fatigue research program. Aircraft recently completed the equivalent of 30,000 hr. flying time, during which the aircraft underwent 12,000 simulated flights. Tests were conducted at Douglas Aircraft Co.'s Long Beach, Calif., facility. Only minor cracks in the skin, all reparable, developed during the test period which simulated pressurization, landing, takeoff and gust loadings on fuselage, wings, empennage and landing gear. Air Force may extend the test to 60,000 simulated hours.

tarily observed an indistinct target at this approximate position but this target disappeared after two or three sweeps of the antenna and was never useable for radar handoff purposes. The Waverly controller stated that at approximately 2115, one minute after Flight 11's last transmission, he observed the aircraft's transponder return and subsequently the primary target began to fade from the radar scope. It was later determined that the aircraft had crashed 6 mi. north-northwest of Unionville, Missouri.

Numerous people in the vicinity of the accident site were contacted during a search for eyewitnesses to the accident, but none could be found who could positively correlate what they saw with the Continental aircraft. Several persons in the vicinity of Cincinnati, Iowa, and Unionville, Missouri, heard loud and unusual noises. Two witnesses saw a big flash or ball of fire of short duration in the sky. The times at which these phenomena occurred were estimated by witnesses as between 2110 and 2130. All witnesses stated that the weather was clear at the time.

A B-47 from Forbes AFB, Topeka, Kansas, was flying in the vicinity of Kirksville, Missouri, at the approximate time of the accident and was headed in a northerly di-

rection at 26,500 ft. The aircraft commander later reported that he saw a bright flash in the sky forward of and above his position. After referring to his navigation logs he estimated the flash to have occurred at 2122, near the location where the last radar target of Flight 11 had been seen by Waverly. He further stated that weather in the area at the time was clear with little or no turbulence.

Flight Recorder

The foil magazine removed from N 70775's flight recorder showed little damage, but there was extensive denting of the recorder case, severe distortion of the mounting bracket, and considerable damage to the internal mechanism. All of the parameter values recorded on the foil were readable and showed a normal operation of the aircraft. These values closely coincided with the aircraft's reported flight profile from lift-off at O'Hare Airport until 42 min. later, when the vertical acceleration trace indicated extremely large excursions and all other traces became unreliable. The recorder indicated that the aircraft had encountered moderate turbulence at several intervals throughout the flight but that for about five minutes prior to the last normal

trace the air was smooth. Correlation of the flight recorder readings with the reported takeoff time indicates that at 2111, on encountering the last appreciable turbulence, the aircraft turned from a magnetic heading of 270 deg. to a heading of 247 deg.

It held this heading for about 30 sec., and then turned further left to 230 deg., holding within 10 deg. of the latter heading from approximately 2113 to the point where the traces became abnormal. The pressure altitude trace indicated a normal descent, from 39,000 feet, was begun at approximately 2115 and it continued at a fairly constant rate of 1,000 ft. per minute for 2 min. 7 sec. to an altitude of 36,800 ft. The indicated airspeed trace during this same interval of time shows an unsteady increase from 250 to 274 kt. The acceleration trace for this period of time varies little from 1.0g except for a five-second interval at about 2116, when it jumped slightly between 0.78 and 1.23g. Approximately one minute later, approximately 42 min. after liftoff, or at approximately 2117, the flight recorder traces became extremely active.

The fuselage of N 70775, minus the aft 38 ft., and with part of the left and most of the right wing intact, struck the ground, headed westerly down a 10-deg. slope of an

alfalfa field located about 6 mi. north-northwest of Unionville, Mo. and 1½ mi. west of State Highway No. 5.

The nose of the aircraft dug into the ground at a 20-deg. angle, with some telescoping of the fuselage just aft of the cockpit; however, the remaining fuselage, although badly broken, was not telescoped. The fuselage and wings struck the ground in a nose-down attitude and with the lateral axis almost level. There were indications of rotation about the vertical axis at impact, but the absence of drag marks down the hill reflected an almost complete lack of horizontal speed. The landing gear was down and locked; the wing flaps were up. An emergency checklist was found between the captain's yoke and his instrument panel. Two flight deck clocks had stopped at 2121:15 and 2121:45, respectively.

The engines were found at four separate locations within an area ½ mi. wide and ¾ mi. long, with the closest engine approximately 1½ mi. southwest of the main wreckage. Each engine was partially buried in the ground on impact from an almost vertical fall. Inspection of the engines indicated that there was little or no rotation of compressors or turbines at ground impact.

Four large pieces of the aircraft were scattered in a northeasterly direction along the aircraft's flightpath 4 to 6½ mi. from the main wreckage. One of these, a 29-ft. section of the left wing, was found about 4 mi. away. The outboard panel and tip of the left wing were located 6½ miles northeast of the main wreckage. The horizontal stabilizer and elevator assembly was lying in a hayfield about ½ mi. north of the 29-ft. wing section. About 6 mi. northeast of the main wreckage the vertical fin and rudder assembly, with about half of the station 1440 and 1507 frames and some top skin still attached, was found intact having dropped almost vertically into thick woods.

Abrasion Marks

A soot-covered "assist" handle from one of the airplane's lavatories, a pillow, and some tissue paper were found lodged inside an aperture between the station 1440 frame and the fin. A small amount of blood and other human remains were found on the aft surface of this frame. Numerous abrasion marks and several punctures were found on the surfaces of the fin. There were also abrasions on the right horizontal stabilizer with blue smears matching cabin interior components.

Fragments of the airplane were scattered along a narrow path 40 mi. long in a northeasterly direction from the main wreckage. Low density materials such as papers, napkins, pillows, and insulation were recovered at distances up to 120 mi. away.

Examination of the wreckage showed no evidence of metal fatigue, structural or systems failure or malfunction, fire in flight, or collision with another aircraft or foreign object. The condition and pattern in which the wreckage was found indicated a high altitude breakup and disintegration of the aircraft in flight.

During the initial stages of the investigation, about 20 ft. of the fuselage between stations 1220 and 1440 could not be found. An intensified search for the missing wreckage was conducted; all scattered wreckage, including pieces of the missing section, were consolidated at one location and two mockups of the aft fuselage area were constructed. One consisted of the fuselage exterior from about 10 feet forward of the main entrance door to the empennage; the other mockup, the interior in the same general area.

As interior and exterior pieces of the fuselage were refitted into their original positions on the two mockups it was found that



Helicopter open sea rescue equipment, developed by Kaman Aircraft under a \$109,000 Navy contract, successfully makes a simulated rescue at night in moderately heavy seas about five miles off Block Island, N. Y. Waves were about five feet high as helicopter moved in toward test subject. Kaman engineer in water supposedly was immobile and unable to help himself. Above, left, is pilot's view of engineer in landing lights. Right, pilot swings ladle-like rescue net out on movable arm.

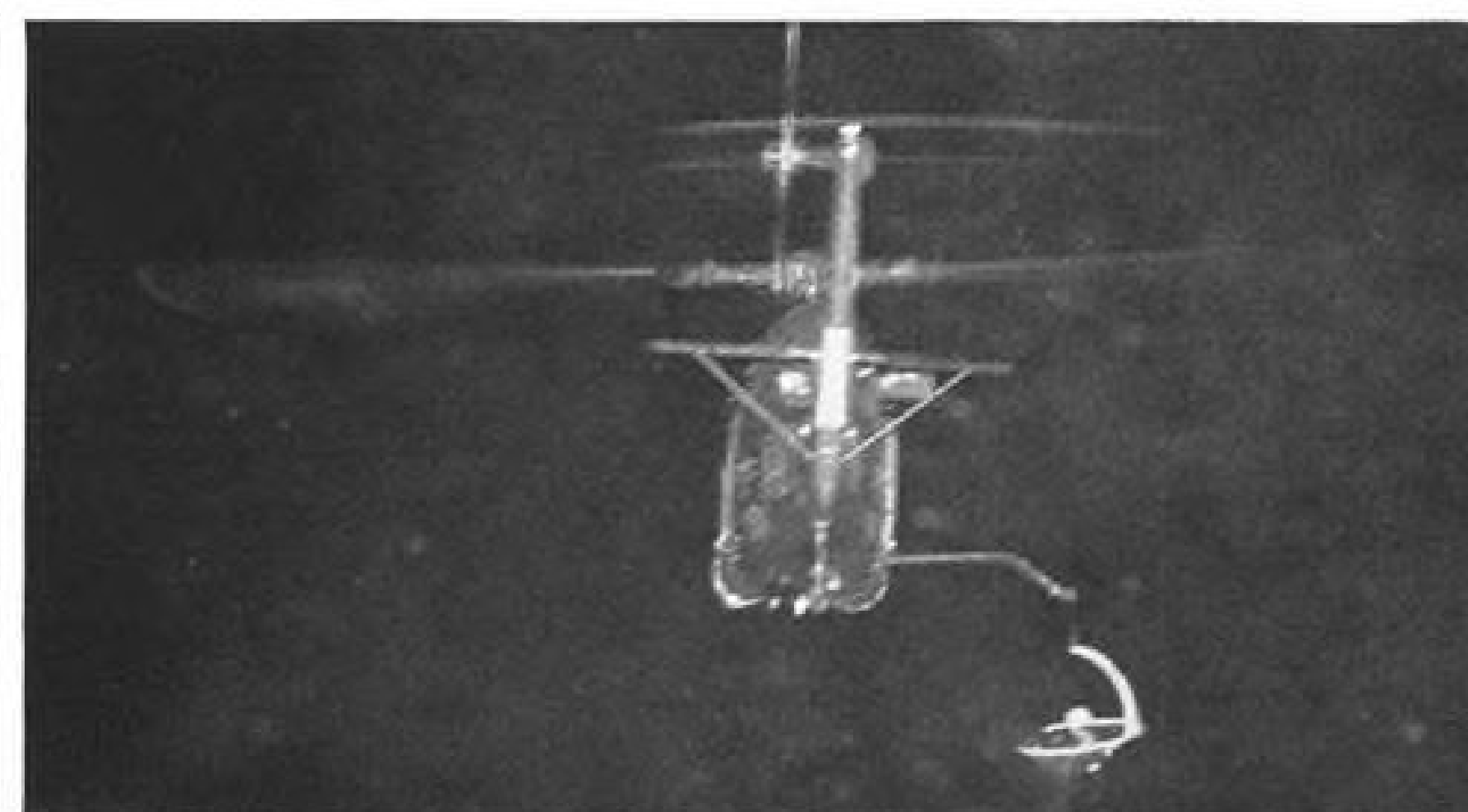


Cable, threaded through end of arm, lowers net to water level. Net is same size as standard Navy circular net, but effective area has been increased about 50% by use of ladle handle. Arm swings forward so pilot can see both person in water and net at all times. Hovering Navy HU2K-1 dips net below the surface and moves forward until the net is below the person to be rescued. Then the pilot increases the helicopter's altitude. Hydrodynamic forces swing the ladle arm away from the man.



Ladle Net Helicopter Rescue Gear Scoops Immobile

Engineer is scooped into net by forward motion of the helicopter, then lifted clear of water. Dummies have been used for a number of the approximately 35 open sea rescue tests made to date after it was found that live subjects tended to make an effort to assist the rescuers. Navy required rescue gear that could scoop unconscious or immobile persons from the water. Live subjects are pictured here. Sequence is composed of photos taken during two different rescues.



Test Subject From Running Sea During Darkness

Ladle net is lifted to cabin deck level by winch-powered cable in center photo below. Arm then rotates rearward to bring net flush against the open hatch. Person then can be pulled in by crewman or can simply roll in. Rescues have been made in daylight in 12 ft. seas with winds up to 25 kt. Numerous others have been made in calm lakes and rivers. Gear now will be turned over to Navy for service evaluation. Photos were taken from an open power launch.



When you follow these welding instructions— you can perform wonders with "T-1" Steels

USS "T-1" Steel, and "T-1" type A, are two of the most versatile steels ever developed. They combine very high yield strength (100,000 psi minimum), outstanding toughness, and ready weldability. Designers have taken advantage of this remarkable combination of properties to build stronger, lighter structures of many types, and to improve the performance of an impressive array of heavy-duty equipment.

Achieving great strength and toughness in a steel is not an earthshaking event. But combining these properties with weldability *is*, as in the case of USS "T-1" and "T-1" type A Steels. It is this weldability that permits the designer to take full advantage of the strength of "T-1" Steels.

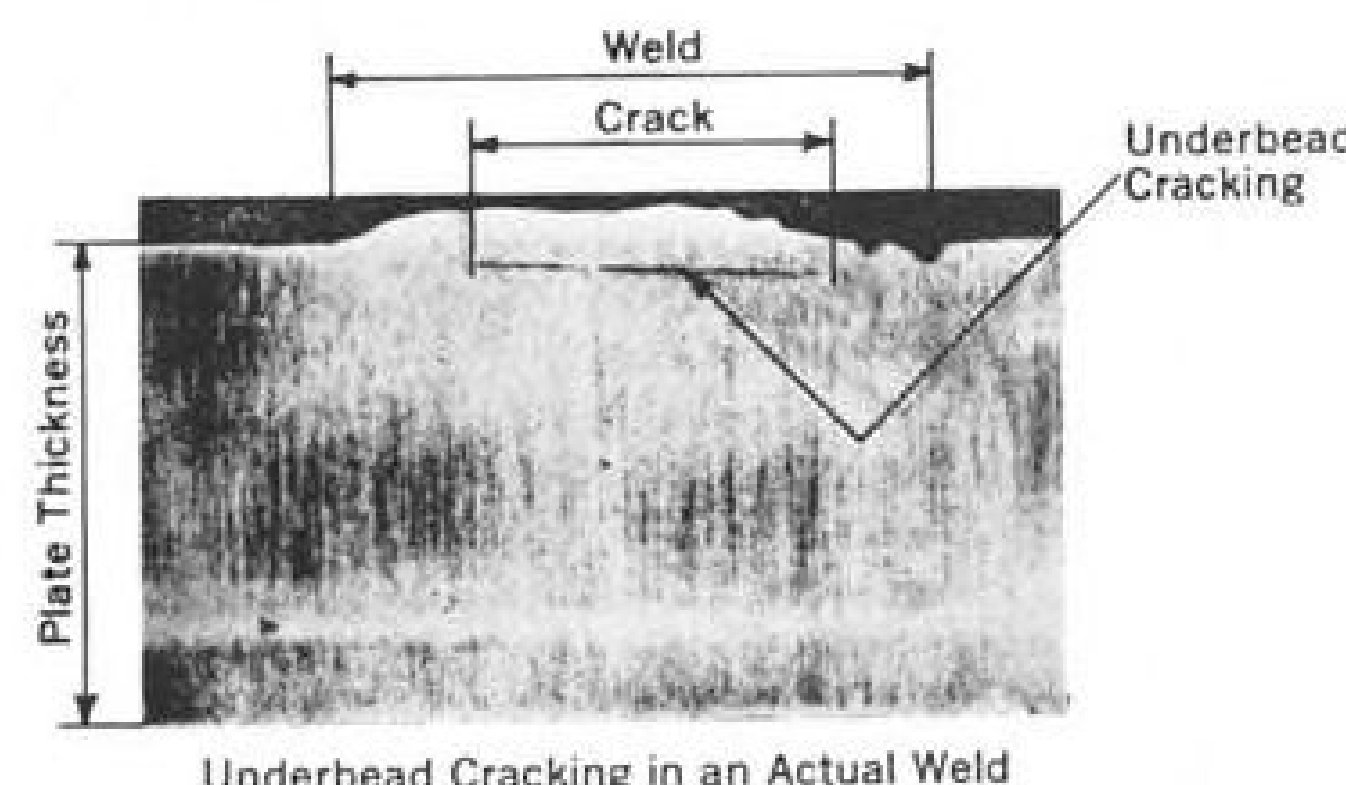
Being heat-treated constructional alloy steels, USS "T-1" Steels require different welding techniques than other high strength steels. They are not difficult to weld, just different. Strong, reliable joints are obtained when the following three precautions are followed. We invite you to read them as a guide to realizing the full benefits of USS "T-1" Steels. They are detailed in a booklet which includes a Welding Heat-Input Calculator, and in our new welder-training film, "How to Weld USS 'T-1' Steels" (see coupon).

RULE 1—Use the proper electrodes

When manual-arc welding "T-1" Steels, use only electrodes with low-hydrogen coatings. Or, use a welding method which is "low hydrogen" such as inert-gas shielded-arc or submerged-arc welding.

Hydrogen is the number one enemy of sound welds in "T-1" Steels, as in all alloy steels, because it causes underbead cracking, resulting in unreliable joints.

To be sure you have selected the correct electrodes, remember that low-hydrogen coatings are designated by the last two numbers of the electrode classification as 15, 16 or 18. None other. For example, E8015, E9016, and E11018 are satisfactory for welding USS "T-1" Steels.



When you want to be positive that the finished weld will be as strong as the parent "T-1" Steel, use E11015, -16, or -18 rods.

Never use electrodes or wire-flux combinations containing vanadium to weld "T-1" Steels if the weldment is to be stress relieved. Weld metal containing vanadium is likely to be made brittle by stress relief. (Stress relief is only necessary with "T-1" Steels when re-

quired by codes and one or two other special cases.)

When welding "T-1" Steels to a lower-strength steel, use low-hydrogen rods of the strength level recommended for the lower-strength steel.

Proper handling of electrodes is also important. When exposed to air, low-hydrogen coatings will pick up moisture which is a rich source of hydrogen. Keep your electrodes dry. Make it a practice never to open more than 30 minutes' supply of rods at a time. A sure way to keep rods dry is to keep them in a 250-300°F oven. If your rods have absorbed moisture, hot bake them in an oven according to the manufacturer's recommendation. One hour at 800°F is average.

To sum up Rule 1, for manual welding use low-hydrogen electrodes and keep them dry. For submerged-arc or inert-gas shielding arc welding, use thoroughly dry fluxes and water-free shielding gases.

RULE 2—Use correct welding heat

On most kinds of structural steels, high heat input results in superior welds. With "T-1" Steels, just the opposite is true. The best welds in "T-1" Steels depend on *never getting over a certain maximum amount of heat*. Less heat is used so the weld will cool quickly which, in "T-1" Steels, results in good, tough welds. Thus, *you must closely control the amount of heat put into the weld*.

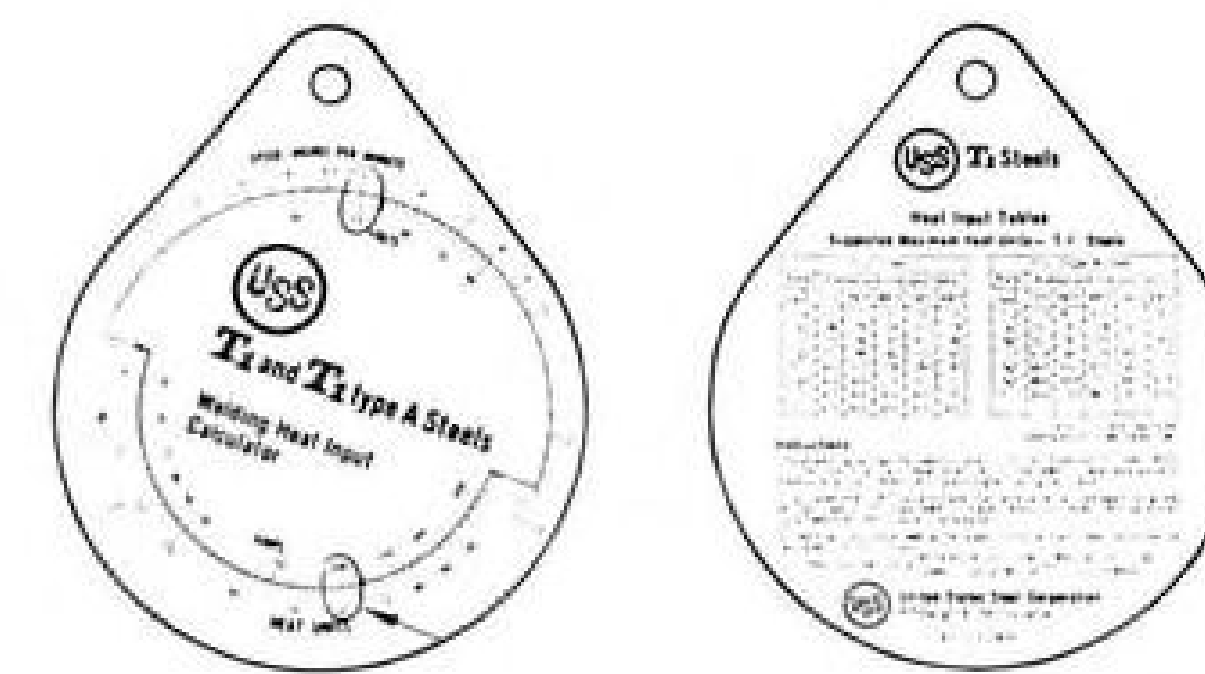
For this reason, never preheat "T-1" Steels except in special cases. Preheating means more heat to get rid of and a longer cooling off period, which can be harmful to welds on "T-1" Steels. The cases in which preheating is necessary are those in which the steel must be warmed to get rid of excessive moisture (a hydrogen source), where the piece is so restrained it doesn't have room to shrink after welding, or when thick pieces over 1" are being welded. Much of the time, however, preheating isn't necessary, and *never preheat* "T-1" Steels on hunch alone.

The heat you put into a weld depends principally on amperages and the speed at which the arc travels along the joint. The higher the amperage, the more heat input. The slower the speed, the higher the heat input. Controlling heat input requires keeping amperage below certain ceilings and keeping the speed of arc travel above certain speeds.

There are two other important items to keep track of: steel thickness and temperature. Thicker sections can safely soak up more heat than thinner ones, so you can use more amps and slower speed. As for temperature, the section may have been heated up by preheating or by previous passes of the electrode. So if the section is already hot, you must cut down on amps or increase speed to avoid excessive heat input.

Heat Input Calculator.

There's an easy way to determine the safe heat input for USS "T-1" Steels: the circular Heat Input Calculator which is provided with the book offered in the coupon. With it you can quickly find out what amount of heat will result from any given setup, and determine how much more you can safely put in. It is a



circular "slide rule" which tells, on the front side, how much heat will be put into the joint if you know the amperage, voltage, and arc speed. On the back side of the calculator are tables showing the safe heat inputs for "T-1" Steels in several different thicknesses at different temperatures. This handy device is designed to help you get good welds every time. Heat inputs may also be calculated from this formula:

$$\text{Heat Input per inch} = \frac{\text{Amperes} \times \text{Arc Volts} \times 60}{\text{Speed, inches per min.}} = \frac{\text{Watt Seconds (Joules)}}{\text{Per inch of weld}}$$

RULE 3—Use recommended welding procedure

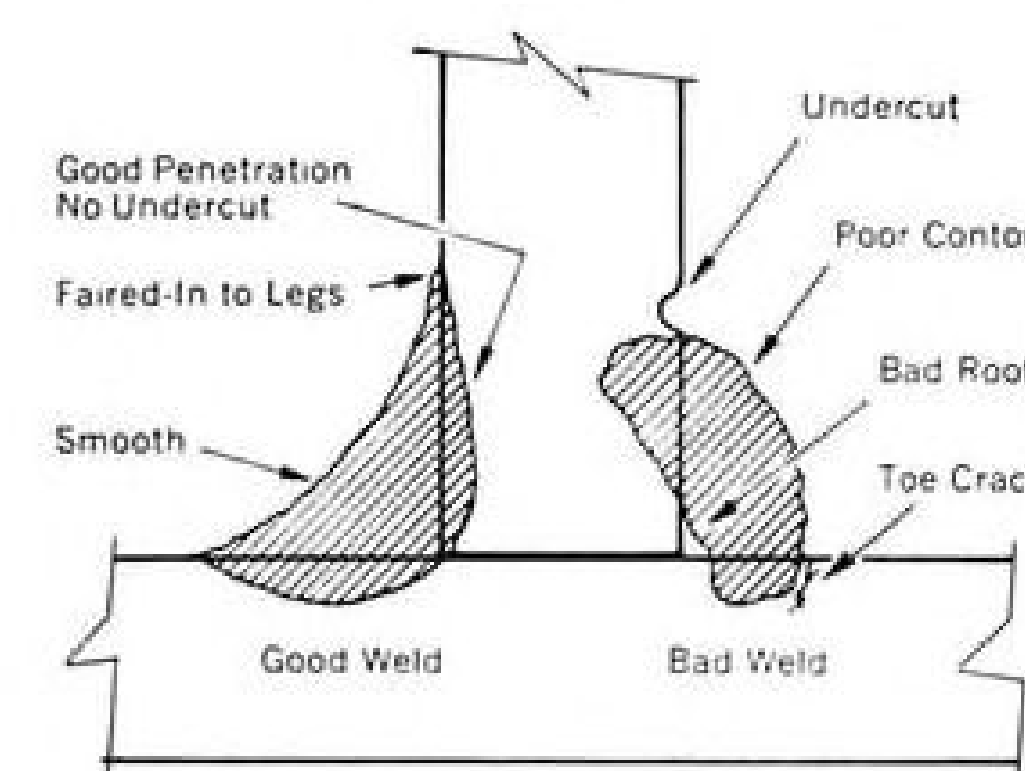
The straightforward stringer bead method is preferred for welding "T-1" Steels. *Do not use the "full weave" method*. Weaving heats the metal more because the arc travel speed is slower and may cause excessive heat input. The proper method is to fill the groove with a succession of stringer beads.

Before a bead can be laid over an earlier bead, the flux, scale, or oxidation must be removed.

Back gouging. The preferred method is arc-air gouging followed by clean-up grinding. *Do not use an oxyacetylene torch*. There is danger of overheating which may cause an unsatisfactory joint.

Speed. Whether you control speed by machine or hand, control it closely. The Heat Input Calculator described above is your guide to the proper speed to avoid excessive heat input.

Fillet welding. Good fillet welding technique is more important with "T-1" Steels because the joints are usually required to withstand greater forces. Fillet welds in "T-1" Steels should be smooth, correctly contoured and well faired-in to the legs of the pieces to be joined. The layers of each weld should be made so that there is good root penetration but no undercutting. The weld shown on the left is ideal, the one on the right is to be avoided.



When thick pieces are joined, and when the weldment is to be stress relieved, fillet welds can be troublesome because of toe cracking. There are several

ways to eliminate toe cracking near fillet welds on "T-1" Steels. In the case of Tee or Ell joints where lower strength welds are often the rule, use low-hydrogen rods of the E90, E80, and E70 classes. Being lower in strength and more ductile, they are less likely to "pull cracks" at the toe of the fillet weld.

Air hammer peening of the weld can also be very helpful in preventing cracks, especially if the weld is to be stress relieved. Joints made even with the higher strength rods (E100, E110 and up) should be free from toe cracks if peened. Sometimes it is necessary to peen each pass; at other times, peening only the toe passes will prevent cracking. After peening, the fillets should be smoothly ground to fair the fillet into the legs of the joint.

Other methods that can prevent cracking include use of a soft wire pedestal, machine grooving the base of the upright piece, and laying down "butter" welds in toe areas. The first two methods allow the upright leg to "shrink down." The "butter" weld strengthens the "T-1" Steel in the area where a toe crack may start. It is ground off prior to actual fillet welding and must be located so that the toe passes of the fillet will be laid right over the strengthened zone.

Free Welding Help. The above information is spelled out in greater detail in our free book "How to Weld USS 'T-1' and 'T-1' type A Steels." Included in the book is a Heat Input Calculator that helps the welder choose the proper welding machine settings. We'll gladly furnish enough free copies for your shop personnel. Also, you'll find our 18-minute, 16mm color motion picture of the same name a big help in demonstrating to your welders the proper techniques for welding USS "T-1" Steels. Send the coupon. USS and "T-1" are registered trademarks.

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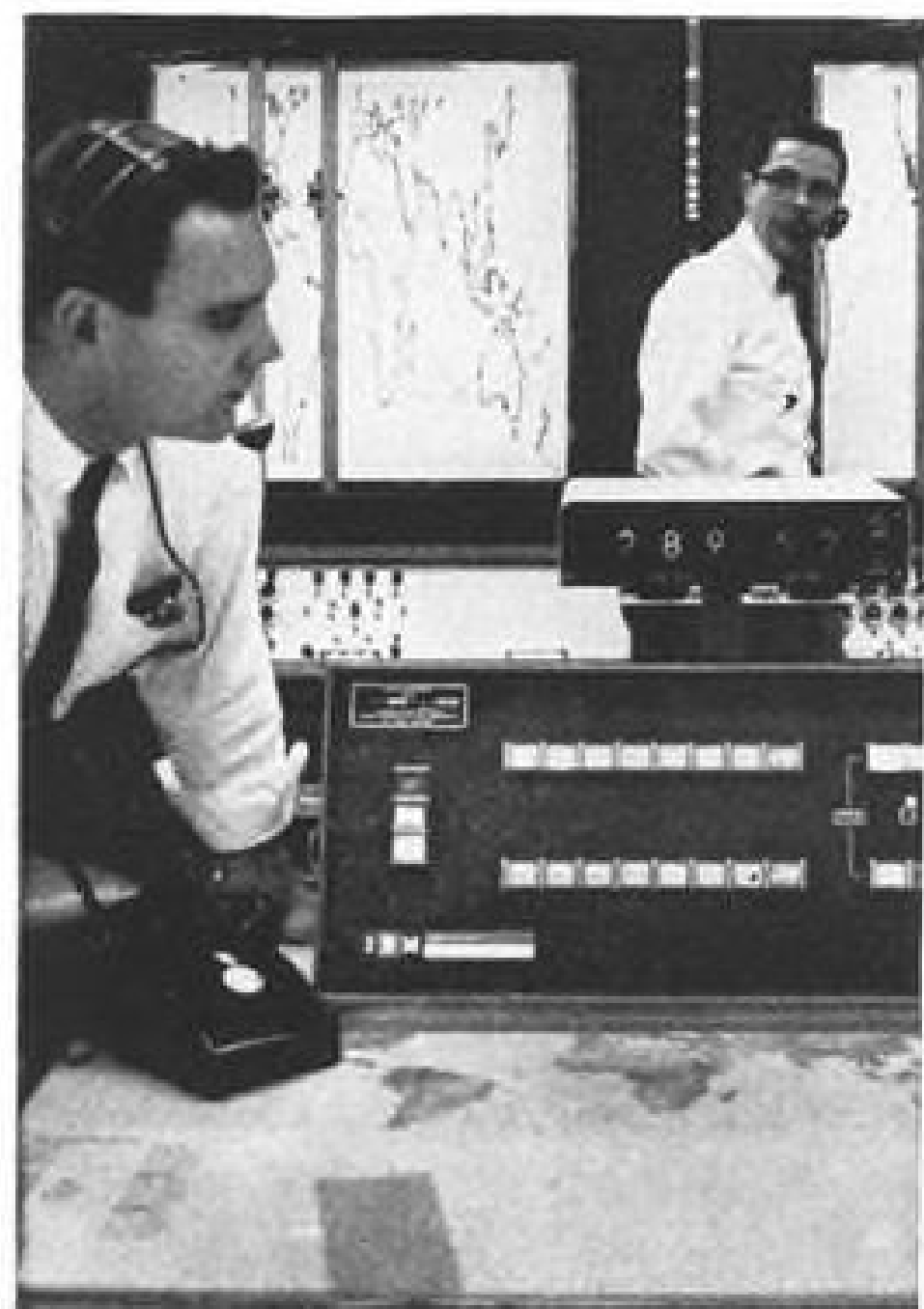
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the pieces became progressively smaller from all directions toward a focal point inside the right rear lavatory. Most of the pieces of this compartment were mere fragments or were entirely missing. Localized bulges and deformations of aircraft skin; jagged perforations of skin, structure and equipment from objects propelled at high velocity; concentrations of gray-black deposits applied under heavy force; aircraft skin pushed straight out over rivet heads; and other such evidence clearly revealed that a high-order detonating force had emanated from the lavatory. The physical evidence further showed that this force had originated in the waste towel bin underneath the washbasin counter of the right lavatory, and had acted in all directions from this point.

Thirty-six bodies were recovered from the main wreckage and eight were found at various points from three-tenths of a mile to almost two miles back along the flightpath. One passenger in the main wreckage survived the accident but succumbed to fatal injuries about 1½ hr. after his rescue, which occurred several hours after the accident. The captain, first officer, and second officer were in their normal crew locations. Three smoke masks in the cockpit were found with face plates demolished, oxygen hoses broken, and with blood and tissue adhered to the inside and outside of each mask. Toxicological and pathological examinations of the flight crew bodies disclosed no abnormalities. No indication of burns was found on any of the bodies.

A review of the maintenance records of N 70775 revealed no significant irregularities prior to the aircraft's departure from O'Hare Airport on the night of May 22, 1962.

Analysis and Conclusions

Regarding the operational and maintenance aspects of this accident, the records show that the flight crew was properly qualified, that the aircraft was dispatched in accordance with company policies and procedures, and that the aircraft was airworthy at the time the flight departed from O'Hare Airport.

Statements made by controller personnel who had the aircraft under radar surveillance during most of the flight, traces made by the aircraft's flight recorder, and witness statements regarding local weather conditions indicate that Flight 11, though having encountered thunderstorms across its flightpath, had safely circumnavigated them and was in clear weather conditions with no significant turbulence when the disaster occurred. It is therefore concluded that weather was not a factor in this accident.

All available evidence indicates that the aircraft started disintegrating at an appreciable altitude in the vicinity of Centerville, Iowa, and at a time determined to be approximately 2117. This conclusion is supported by the Waverly radar controller, who observed the aircraft's transponder and primary radar target begin to fade from his scope at approximately 2115. Ground-witnesses in the vicinity who heard unusual noises or saw a flash or ball of fire in the sky placed the time somewhere between 2110 and 2130.

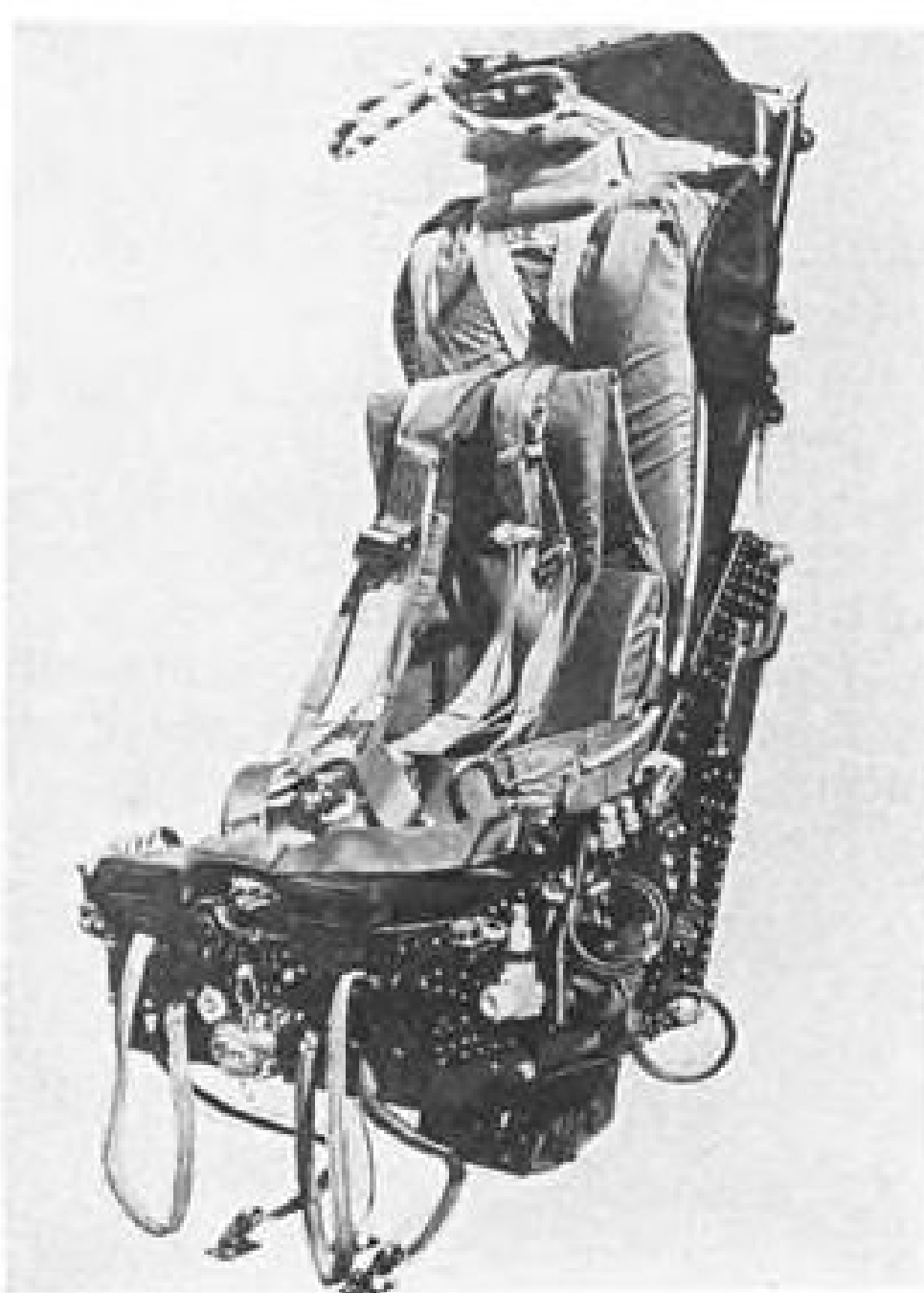
The B-47 pilot who saw a flash in the sky estimated the time of the flash as being

2122. However, the most reliable evidence regarding the time of the explosion is considered to be that indicated by the aircraft's flight recorder as being 2117.

The physical evidence showed that the landing gear was down and that the flight crew was wearing smoke masks at the time of impact. In addition, the emergency checklist was found between the captain's yoke and his instrument panel. This evidence leads to the belief that upon experiencing an explosion, which would of course be followed by explosive decompression, the crew initiated the required emergency descent procedures. It is also thought that the crew donned smoke masks due to the dense fog which forms in the cabin immediately after explosive decompression.

At separation of the tail, the remaining aircraft structure pitched nose down violently, causing the engines to tear off, after which it fell in uncontrolled gyrations. After separation from the aircraft, the engines assumed a trajectory which allowed sufficient time for their compressors and turbines to coast to a negligible rpm, before impact with the ground.

Reconstruction and examination of the aft fuselage proved conclusively that the forces which caused the initial disintegration radiated from a point within the used towel bin underneath the washbasin in the right rear lavatory. The violence of the explosion was clearly shown by the pattern of breakup and projection of fragments emanating from this focal point. Such evidence was in sharp contrast to the damage caused by an explosion resulting from any combustible material or source connected with the operation of the aircraft, its systems or components. The Federal Bureau of Investigation laboratory analyses of residues collected on material from the right rear lavatory and sur-



Rocket Ejection Seat

New rocket-powered ejection seat developed by Martin-Baker Aircraft Co., Ltd., will be installed in Hawker P.1127, Dassault Balzac and Messerschmitt-Heinkel-Bolkow VJ-101D. Rocket, which augments thrust of conventional gun, allows g forces to be reduced from 20g to about 15g.

IBM asks basic questions in space

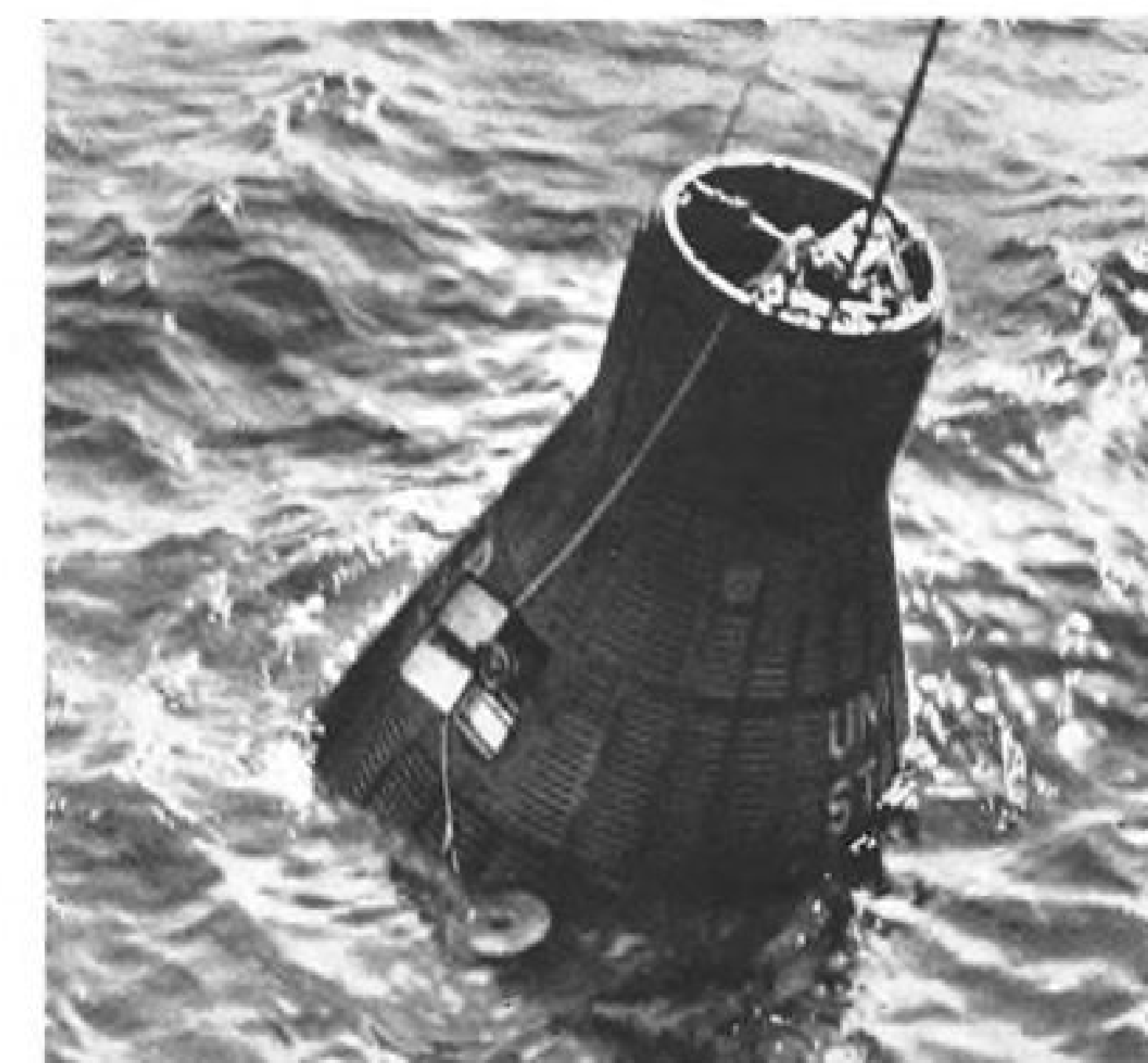
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than was possible by using mechanical methods—so that one radar can track many satellites and space vehicles simultaneously.

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rounding structure established that the explosive used was dynamite.

Evaluation of all the evidence leads logically to the conclusion that a dynamite device was placed in the used towel bin of the right rear lavatory with the express intent to destroy the aircraft.

During the early stages of the investigation, when the first clues of such a possibility were found, the Federal Bureau of Investigation was apprised of all such evidence so that the apparent criminal aspects of the accident could be properly pursued. The FBI immediately initiated a full-scale investigation.

Probable Cause

The Board determines that the probable cause of this accident was the disintegrating force of a dynamite explosion which occurred in the right rear lavatory resulting in destruction of the aircraft.

By the Civil Aeronautics Board:

ALAN S. BOYD
ROBERT T. MURPHY
CHAN GURNEY
C. JOSEPH MINETTI
WHITNEY GILLILLAND

Investigation

The Civil Aeronautics Board was notified of this accident at approximately 2130 on May 22, 1962. Investigators were immediately dispatched to the scene and an investigation was initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958.

Air Carrier

Originally incorporated as Varney Air Transport, Inc., in Nevada on Dec. 15, 1934, the name of the carrier was changed to Continental Air Lines, Inc., in 1937. With headquarters at Stapleton Field, Denver, Colorado, Continental Air Lines holds a certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation of persons, property, and mail. The carrier also possesses a valid air carrier operating certificate issued by the Federal Aviation Agency.

Capt. Fred R. Gray, age 50, held a valid airline transport pilot certificate No. 32369 with type ratings in Viscount, Convair 240, 340, 440, DC-6/7B, DC-3 and Boeing 707 aircraft. His physical qualifications were current and without waivers. Capt. Gray originally qualified in the Boeing 707 on May 18, 1959, and had his last proficiency check Apr. 26, 1962.

He had an estimated total flying time of 25,000 hr., of which 2,600 hr. were in Boeing 707 aircraft.

First Officer Edward J. Sullivan, age 41, possessed a valid airline transport pilot certificate No. 467903 with type ratings in DC-3 and Viscount aircraft. His physical qualifications were current, with a waiver concerning eyeglasses. First Officer Sullivan originally qualified in Boeing 707 aircraft September 16, 1961 and his last proficiency check was given on the same date. He had an estimated total flying time of 14,500 hr. of which 600 hr. were in Boeing 707 aircraft.

Second Officer (Flight Engineer) Roger D. Allen, age 32, held a valid flight engineer certificate No. 1319169 as well as a commercial pilot certificate with single, multi-engine land and instrument ratings. His physical qualifications were current and without waiver.

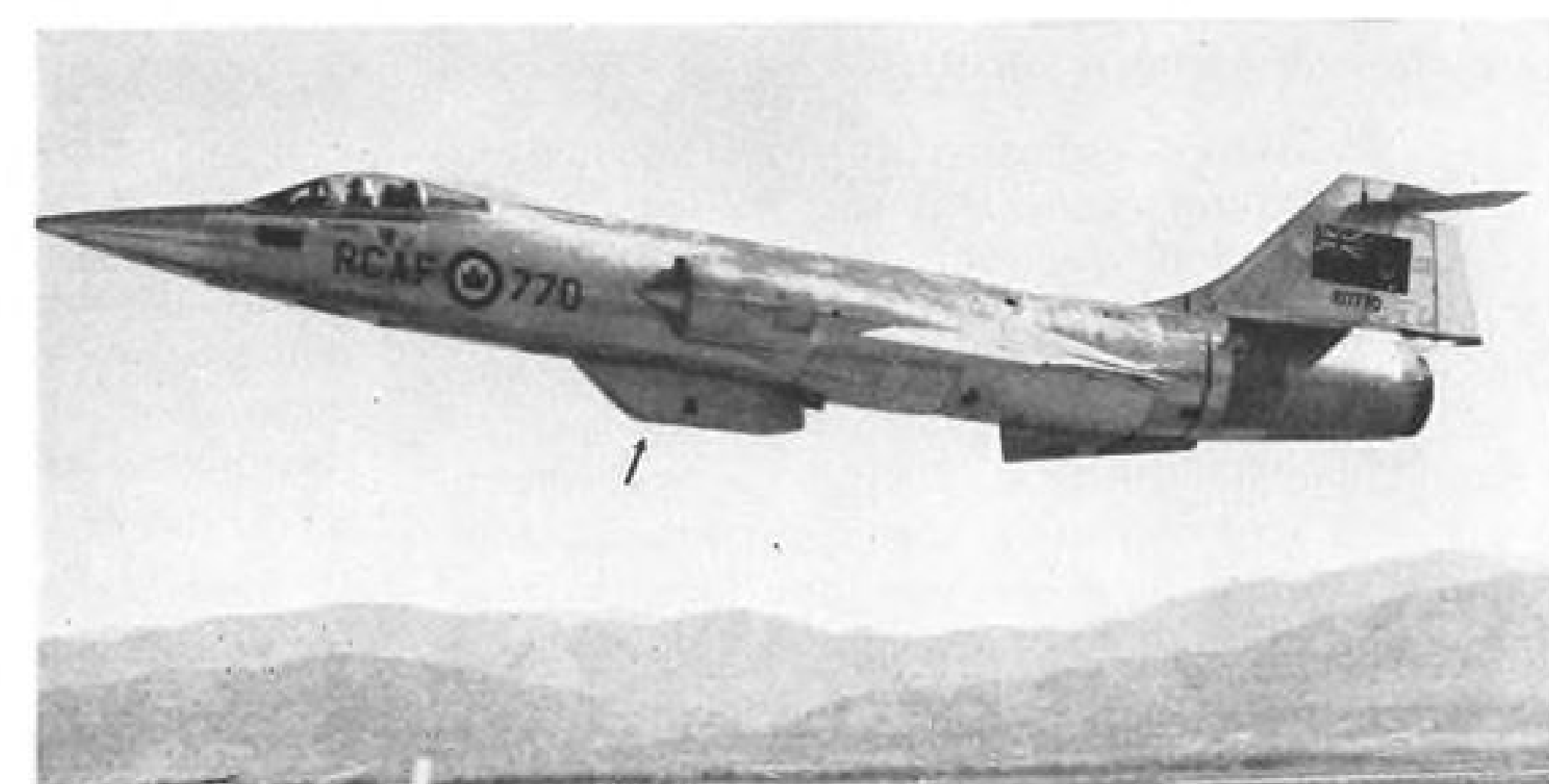
Second Officer Allen was originally qualified in Boeing 707 aircraft in June 1960, and his last line check was accomplished Mar. 27, 1962.

Director of passenger services was David E. Olssen, age 39.

Stewardesses were Marilyn Bloomquist, age 24, Mary McGrath, age 20, Martha Rush, age 23, and Stella Berry, age 21.

The aircraft was a Boeing 707-124, U. S. Registry N 70775, manufacturer's serial No. 17611, manufactured June 16, 1959, with a total flying time of 11,945:55. Time since last periodic inspection was 183:43. The aircraft was powered with four Pratt & Whitney JT3C-6 engines with time since overhaul and total times as follows:

Engine Position	TSO	TT
1	860:06	7561:42
2	2007:57	8409:33
3	1054:47	5893:16
4	1639:10	6535:34



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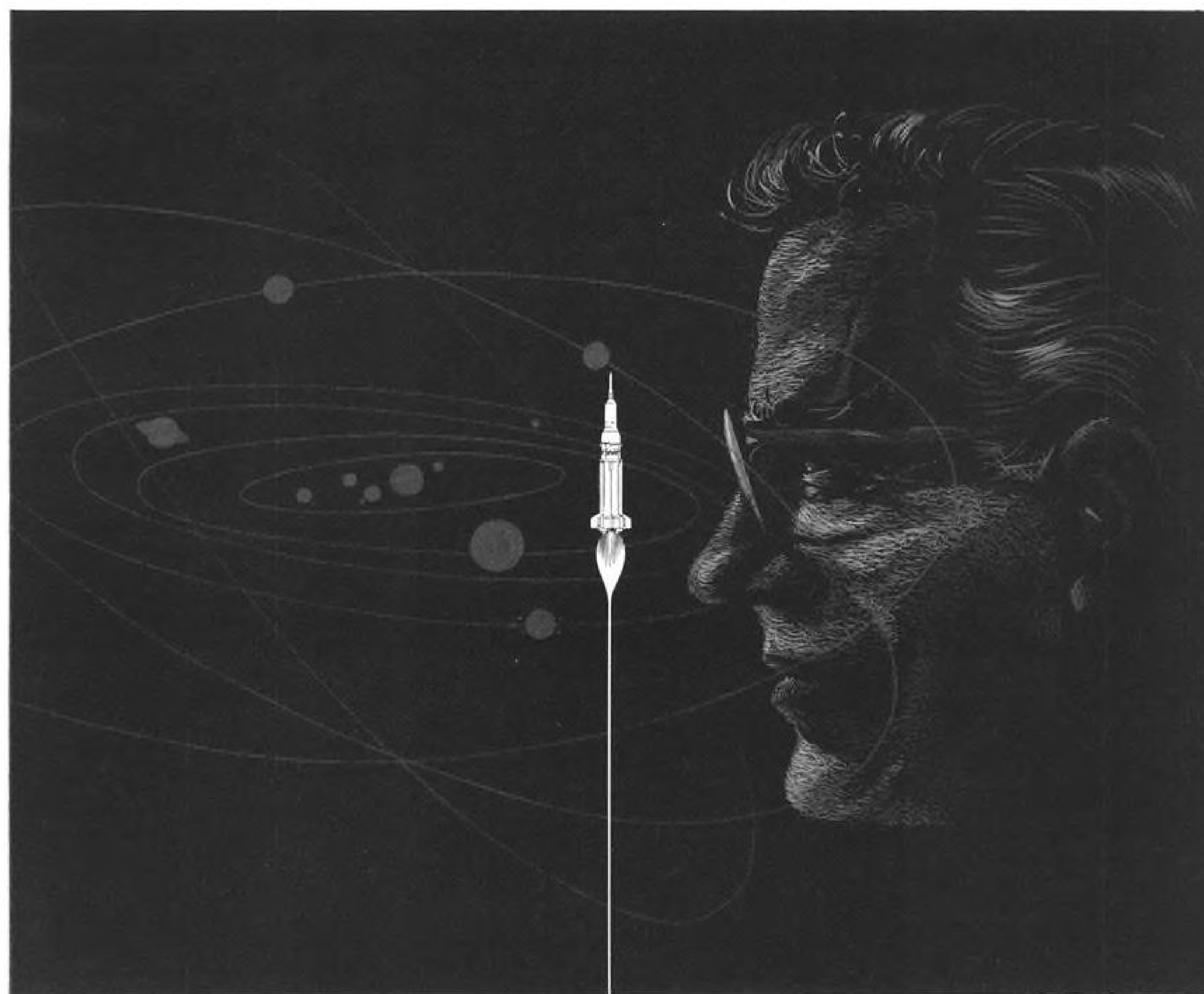
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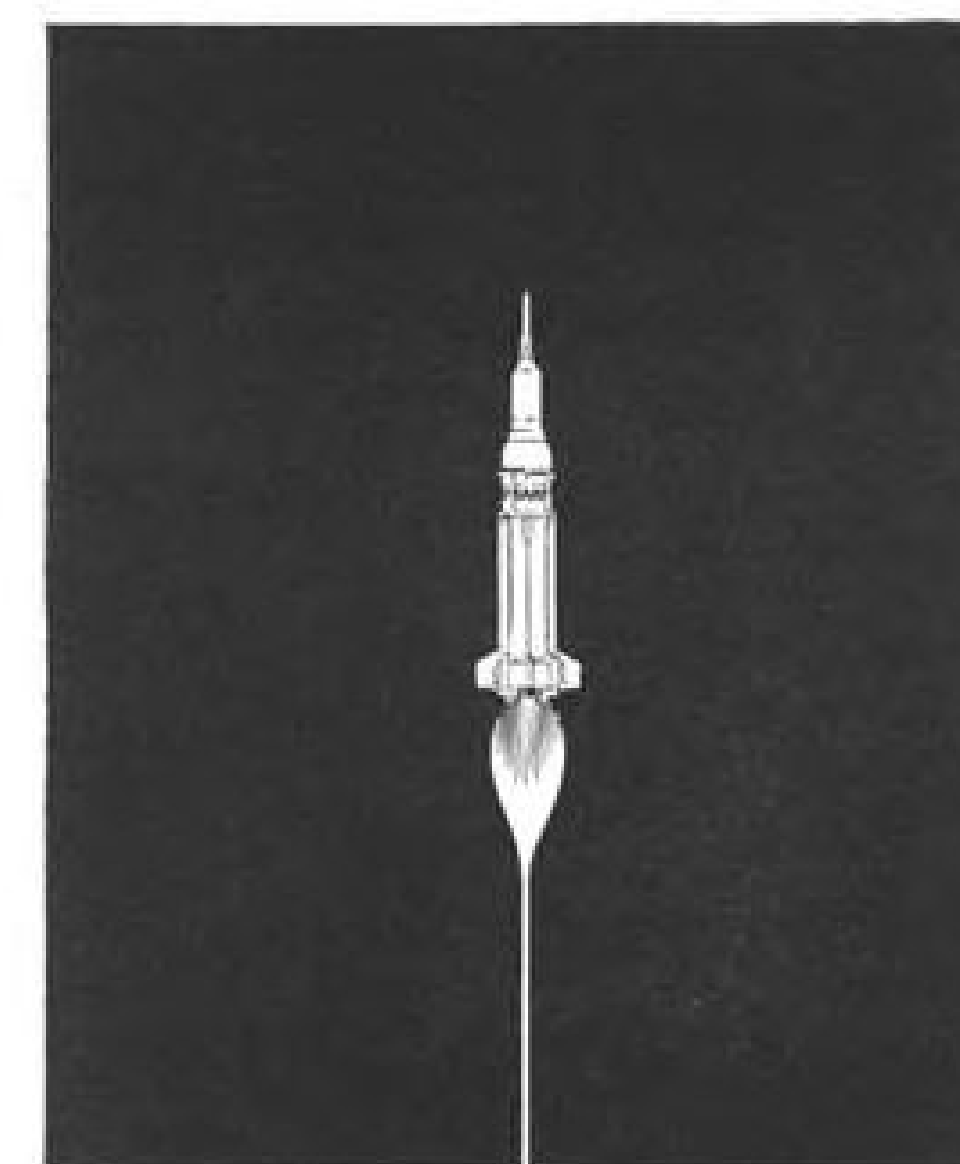
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LETTERS

Homer Nods . . .

Subject: Problematical Recreations #136 Revisited, and a personal message to S. M. Hamzeh, Bell Helicopter Co., Fort Worth, Tex. (Letters, AW Oct. 15, p. 138).

My congratulations to S. M. Hamzeh of Fort Worth and to all other readers of Problematical Recreations who found the alternate solution to Problematical #136. As you discovered, 494,209 does indeed satisfy the requirements of the problem. So does 998,001. We knew about both. We should have published both. We stand corrected.

In the words of Horace, "... even the good Homer sometimes nods." Dear readers, keep following the series. The puzzles may get better.

ANGELA DUNN
Copy Research Director
Litton Industries, Inc.
Beverly Hills, Calif.

. . . And Nods

Your issue of Oct. 8 (p. 92) lists as an answer to the Problematical Recreations No. 138 of Litton Industries, Inc., advertising in the Oct. 1 issue (p.83) the dimensions of two sails which answer the puzzle. It might interest you to know that there are an infinite number of right triangular sail dimensions which meet the requirement that their area and perimeter be numerically equal.

Given a right triangle with sides x and y and hypotenuse z where the area, A , is equal to $xy/2$ and the perimeter, P , is equal to $x + y + z$. If A is required to equal P numerically, then there are an infinite number of solutions for the sides x , y and z as follows:

first, define $x = [4n + 8]^{n=0}$

then, it can be shown that $y = 4 + 8/(x - 4)$, $z = x + 8/(x - 4)$ and $A = P = 2(x + 2 + 8/(x - 4)) = 2(2 + z)$. The following tabulation lists the first seven sets of sail dimensions in this series.

n	x	y	z	A & P
0	8	6	10	24
1	12	5	13	30
2	16	4 $\frac{1}{2}$	16 $\frac{1}{2}$	37 $\frac{1}{2}$
3	20	4 $\frac{1}{4}$	20 $\frac{1}{4}$	45
4	24	4 $\frac{1}{3}$	24 $\frac{1}{3}$	52 $\frac{1}{3}$
5	28	4 $\frac{1}{4}$	28 $\frac{1}{4}$	60 $\frac{1}{4}$
6	32	4 $\frac{1}{5}$	32 $\frac{1}{5}$	68 $\frac{1}{5}$, etc.

JOHN L. FREEMAN
Special Projects Department
Raytheon Co.
Missile and Space Division
Bedford, Mass.

Doppler Comment

It is not difficult to understand why screams of anguish have gone up from the Airline Navigators Assn. in their dispute with TWA over the use of Doppler radar as a primary navigation system. We have witnessed the same sort of thing in the case of the railroad firemen who are being dis-

placed by automatic equipment. Nevertheless, it requires only a little care when reading the assertions of the ANA to determine that their criticisms of the Doppler radars are misleading.

The big squawk is apparently concerned with the course deviations arising from erratic indications of magnetic north. A Doppler navigation system requires a heading input from an outside source because it does not itself generate such a signal. Ordinarily this input is supplied by a magnetic compass, and errors in the input signal will produce errors in the navigation system output. But blaming the Doppler radar, as the ANA does, is comparable to blaming a computer for wrong answers when the input data is erroneous.

It is interesting also to note that the other criticism voiced by the ANA is concerned with weak LORAN signals in the mid-Atlantic, and not with the Doppler system itself. If the ANA (and Rep. Gonzales) want to point the quivering finger, let them point at imperfect compass data and weak LORAN signals rather than Doppler radars. Or is it possible that calling attention to the real source of error would lead eventually to the very thing that ANA wants to avoid—the elimination of their function altogether?

JULIAN B. GRAFA
Advanced System-Electronics Division
Ryan Aeronautical Co.
San Diego, Calif.

Pilot Criticism

Due to deteriorating working conditions with the advent of the big commercial jets, I found that after five years as an American Airlines copilot my only course of action was to return to military aviation as a Marine Corps jet pilot.

The adverse criticism directed at the professional airline pilots during the current stewardess-pilot-flight engineer hearings has infuriated me and frightened the traveling public, as well as Mr. Halaby and his FAA, to the extent I feel compelled to make the following statements:

- In my five years I never witnessed a single act by any airline captain that I, with my limited 10,000 hr., could term a willful unsafe flight practice.
- I have never observed a stewardess or any other unqualified person at the control of a commercial airliner without complete control by the autopilot and further monitored by the remaining pilot.
- After many hours of solid instrument conditions, with all the associated stresses and strains, I have on occasion observed a pilot close his eyes momentarily or browse through approach plates, etc., to lessen the strain of continually monitoring instruments, harping of radios, and the other nerve-racking activity within over-crowded cockpits.

Any one of the above mentioned instances, if observed by a non-pilot engineer, stewardess, or any malicious person possessing a spy camera, could be given widespread false publicity to the uninformed public by completely misrepresenting the existing facts.

In conclusion, as long as non-pilot per-

sonnel of any type are permitted in the already over-crowded jet cockpit, there will be continued reports of the recent kind by those who cannot be expected to understand an airline pilot's action.

JAMES B. HETH
Captain, USMCR
MCAS, Cherry Point, N. C.

Dollar A Day

At the time of Glenn's three trips around the world I intended to write you, but the press of business deterred me. Now with Schirra's perfect flight I want to transmit the thought I had at the time Glenn, in passing over Australia, said, "Tell the Commandant of the Marine Corps that I have my flight time in for this month."

That thought was this: Every time we used to cross the 180th meridian going westbound we lost a day, and the Comptroller General, in his great wisdom and conscience, faithfully docked everyone for one day's subsistence. If one kept on going around the world westbound he never retrieved this subsistence allowance, but if he returned over the same route the Comptroller General, with his great generosity, restored the gained days' subsistence.

In view of the precedents established, as described above, would it not be appropriate to call the Comptroller General's attention to the fact that Glenn and Schirra, having witnessed a total of nine more sunrises than the rest of us and therefore gone through that many more days, should be entitled to three and six days additional subsistence respectively? Should there not be a ponderous decision on the part of the Comptroller General as to what constitutes a day—if this is questioned? What do you think?

M. B. GURNEY, Manager
Raytheon Co.
Western Region Offices
Hawthorne, Calif.

Engineer Overage

The little gem of a poem by an engineer's wife in the Oct. 1 issue of AVIATION WEEK (p. 102), regarding what happens to applications in personnel offices, was just the prod I needed to write a letter, too.

My husband, who has an M.S. in M.E., has worked at Cape Canaveral for six years in various aspects of launch operations. The missile companies are eager to have him back in California, but for personal reasons he must stay in Florida for two more years, and he is finding it very difficult to get a job here at the Cape. We, too, thought NASA, et al, were crying for engineers in order to get on with the race for the moon. Not so. And not only did NASA not want him, but it took three months for his application to wend its way through NASA's labyrinth of bureaucratic red tape!

Private companies are all saying that they can't hire until they get a go-ahead from NASA.

(Name withheld by request.)

ENGINEER'S WIFE
Titusville, Fla.



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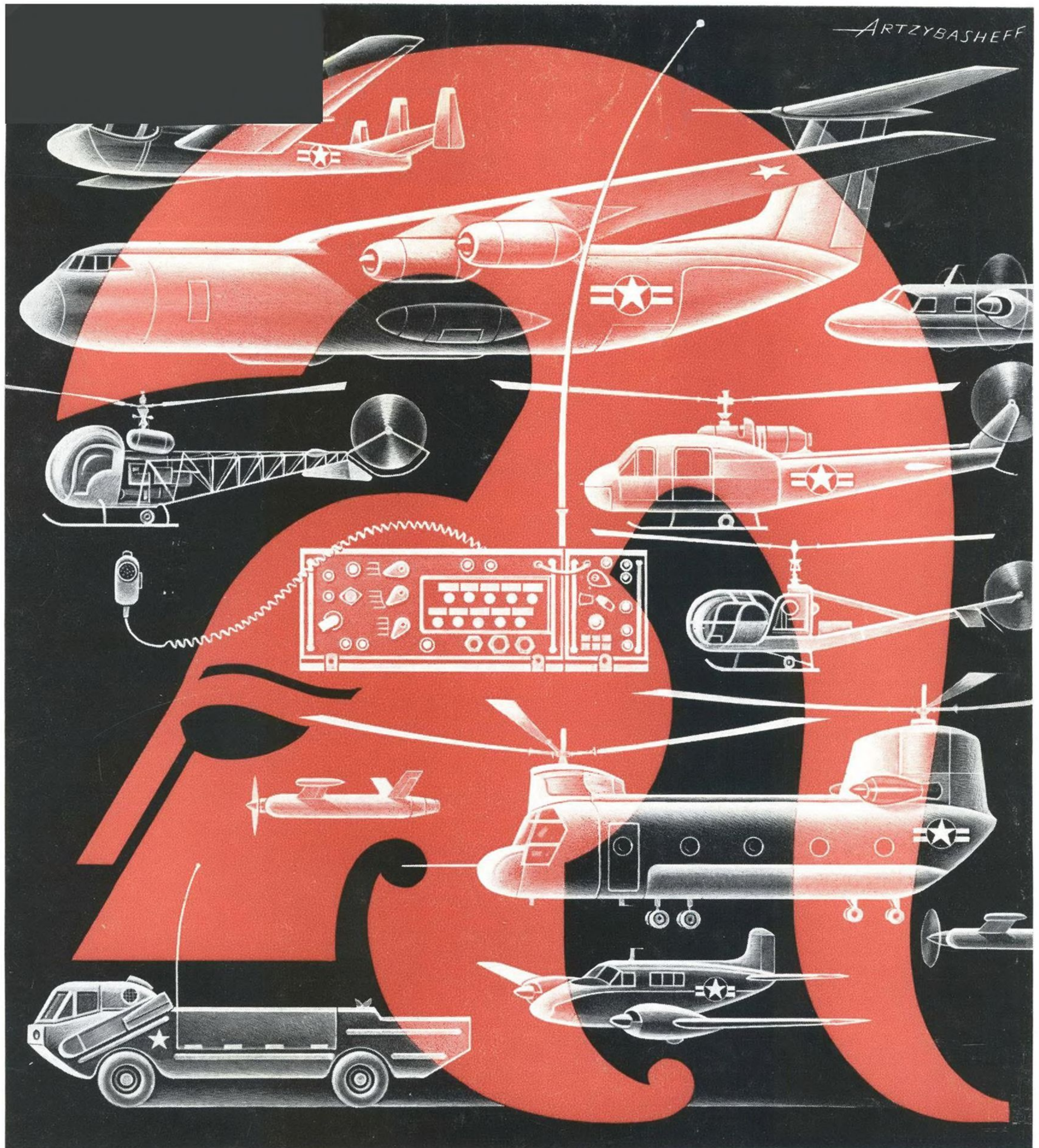
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