Aviation Week and Space Technology

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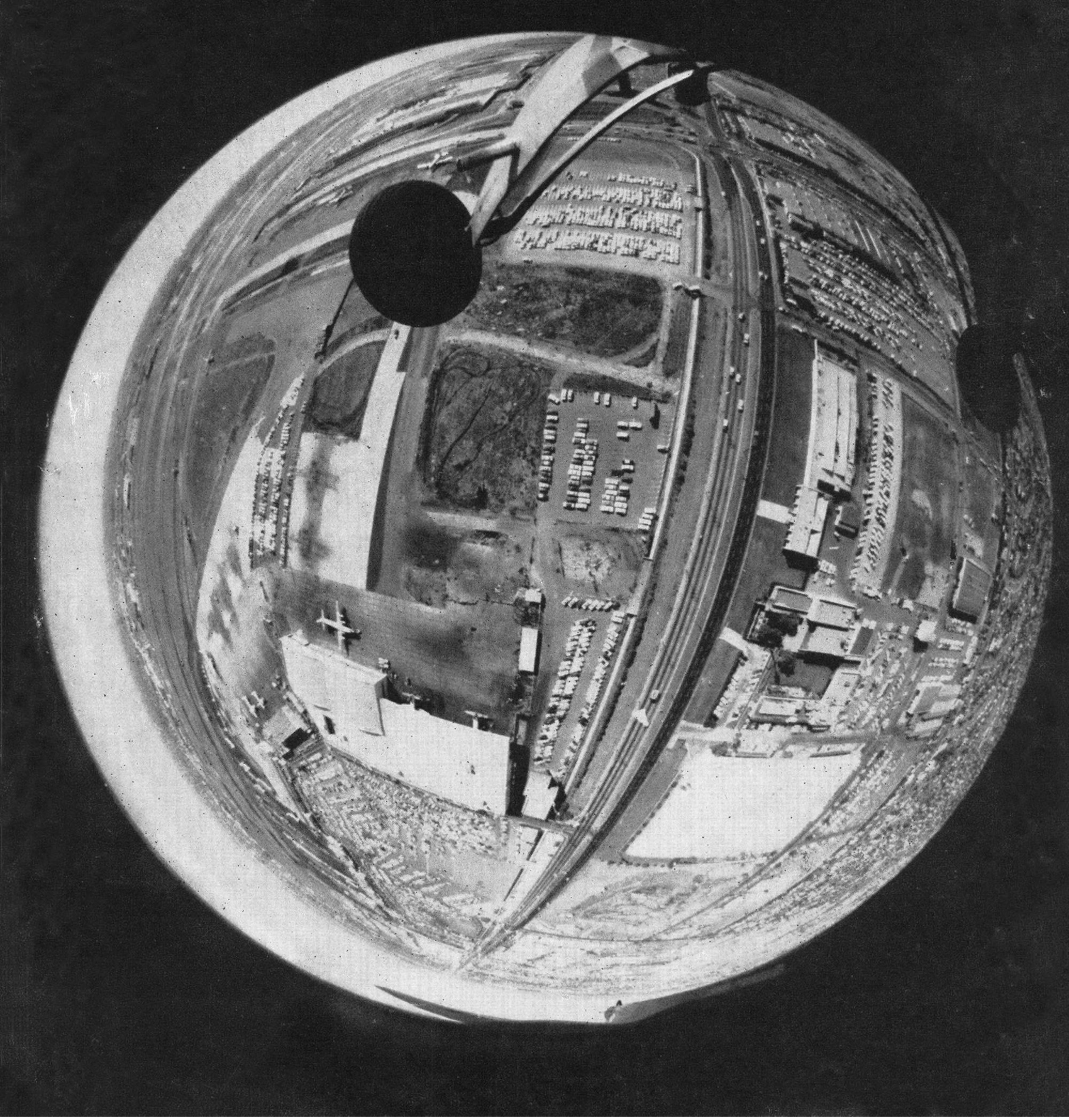
A McGraw-Hill Publication

January 29, 1962

Chrysler Space, Missile Work Shows Increase

LA Airport Photographed Through 180-deg. Lens



entwined in tradition?

Designers are too often bound by tradition. Traditional parts are only satisfactory until outmoded by parts of advanced design. Update your engineering — use KAYLOCK thin wall inserts.

REDUCE COSTS — *Standard taps and gages are used in hole preparation to accept the insert, together with simple KAYLOCK insertion tools. There are no tangs to break off or coils to distort.*

ADD STRENGTH — *KAYLOCK inserts, installed in any material, upgrade the strength in the fastening area.*

SAVE SPACE — *The thin wall design permits minimum boss diameters in the parent material, saving space and weight.*

HIGH RELIABILITY — *The KAYLOCK insert provides positive retention in the parent material. Mating bolt retention is assured by the proven KAYLOCK elliptical locking device, qualified to MIL-N-25027.*

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Equipped with Bendix brushless generating systems . . . the Navy's long-range, land-based P2V Neptunes are designed to handle many duties, including submarine detection, early warning, mine-laying. torpedo bombing, and over-water patrol. Well equipped with modern avionics installations, the Neptunes need the high quality AC electric power supplied by the Bendix® brushless generating systems.

Two brushless generators are the heart of the brushless systems. Rated at 30KVA each, they are built for long operating life, easy maintenance. Included in the systems is solid-state regulating and control equipment. It affords low transients with small line disturbances. It protects against over-under voltages, under-frequency, and feeder faults to insure a high-quality source of electric power.

Bendix has a complete family of modern brushless generating systems, rated from 10KVA to 80KVA. It is likely that one of them can fill your requirements. Write us for more details. General Products, Bendix Red Bank Division, Eatontown, N. J.

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ANOTHER IN A SERIES DEPTH MANAGEMENT IN ACTION

HOW LTV PUNCHED A HOLE IN THE IRON CURTAIN

For the past eight years, giant transmitters built by LTV's subsidiary, Continental Electronics Manufacturing Company, have been sending free world messages, despite Soviet jamming attempts, to an estimated three million listeners behind the iron curtain. A pair of these high-power units are combined to deliver one million watts continuous carrier power into a single antenna system — four million watts peak output power which is more than enough to reach every point on the globe!

Guiding projects of this magnitude calls for depth management—the kind of executive leadership found in Continental's President, James O. Weldon. Mr. Weldon began broadcast engineering work in 1927 and has directed the development and installation of much of the vast primary range transmitting equipment in use today by our military services and the U.S. Government.

Jim Weldon is another example of LTV depth management . . . the same caliber of management LTV is linking with technical competence in electronics, aerospace, communications and consumer products.

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

AEROSPACE CALENDAR

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 9—Symposium on Patent Rights under Government R&D Contracts, Hotel Statler, Boston, Mass. Sponsors: New England Council; Boston Patent Law Assn.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 15-17—Golden Gate Metals Conference, American Society for Metals, Fairmont Hotel, San Francisco, Calif.

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

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

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

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

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space

(Continued on page 7)

AVIATION WEEK and Space Technology

January 29, 1962

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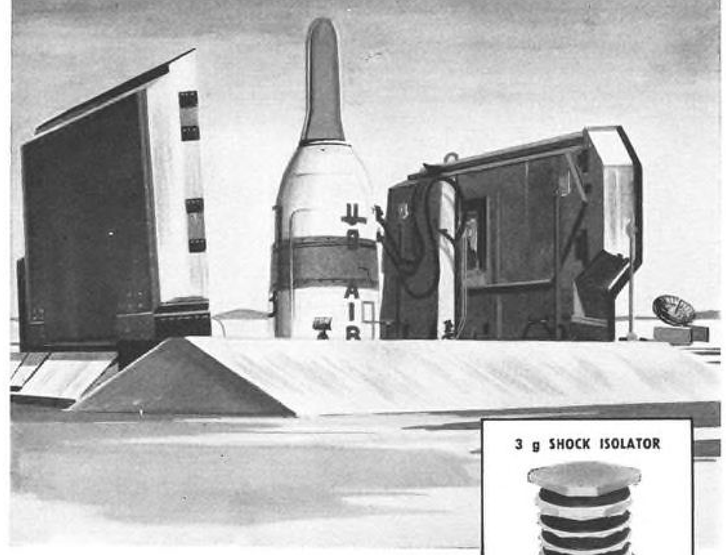
"... CARRY A BIG STICK!"



BARRY protects our ability to retaliate

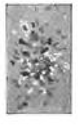
Hardsites — completely self-sufficient missile launching facilities, buried deep underground, are part of the "big stick" protecting our nation.

One of *many* shock, vibration and noise control problems solved by Barry Controls was that of protecting massive hardsite equipment from devastating effects of a thermo-nuclear blast.

Non-ruggedized commercial equipment, with unknown fragility levels, had to be efficiently isolated from shock and vibration in order to meet stringent hardsite specifications. Special Barry isolators, produced after careful analysis, design and testing, provided the protection.

For a technical analysis of this hardsite problem and solution, write for Barry Case History EA 8261. For the solution to *your* shock, vibration or noise problem contact the specialists:

New Product Digest available



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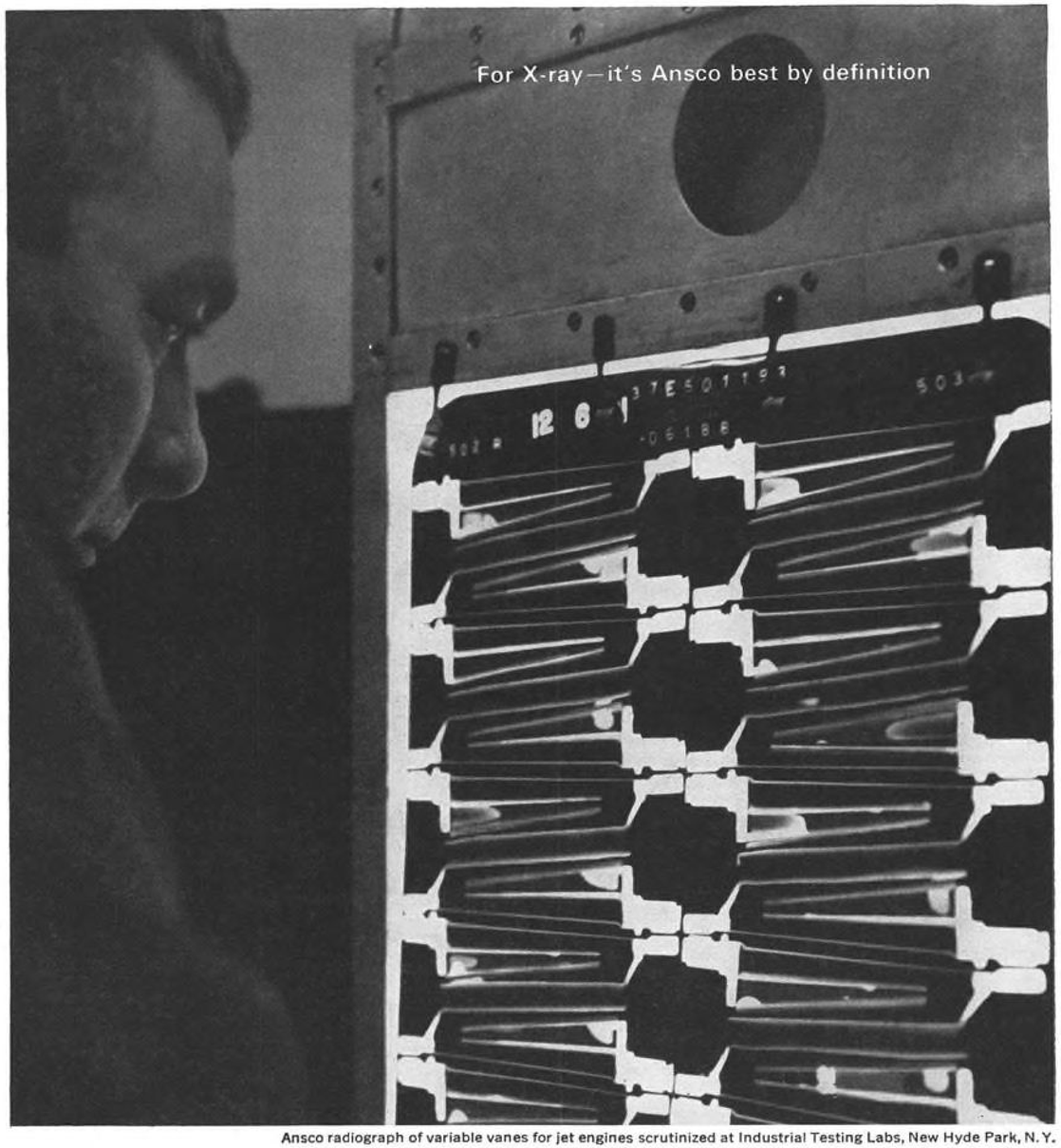

Ansco radiograph of variable vanes for jet engines scrutinized at Industrial Testing Labs, New Hyde Park, N.Y.

Checking a jet bird's "pin feathers"

Spotting the good and the bad in all kinds of aircraft assemblies (such as these "wasp alloy" vanes for jet engines) is a job Ansco Superay 'B' X-ray Film performs every day for the aircraft industry. Both for maintenance and for quality control in production, Ansco has the wide range of films, chemicals to keep quality control at its best, while keeping production lines moving. Your Ansco technical representative is ready to help you solve any X-ray problem. Behind him are the resources of America's first Industrial X-ray Film manufacturer—Ansco.

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AEROSPACE CALENDAR

(Continued from page 5)

Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

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

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

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

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

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

Mar. 19-20—University of Denver's Second National Symposium on Hypervelocity Techniques, Denver, Colo.

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

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

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

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

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

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

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

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

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

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

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

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

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

Apr. 25-29—Western Space Age Industries

(Continued on page 9)

(Or: The Stirring Saga of Sulfur Hexafluoride Subdued)

Over coffee one recent morning (our engineers always go right on thinking during coffee breaks), we observed one of the shining lights of our Environmental Control Systems Department wearing a grin that can be described only as Cheshirean. Ignoring previous experience under the stimulus of present curiosity, we inquired into the cause of his bliss.

Seems that the dielectric properties of air aren't good enough for it to be used as a pressurization gas for many of the high-power waveguide sections* being used today. The best job is done by SF_6—a gas that packs 2 to 3 times the dielectric strength of air at normal pressure, and even more at higher pressures.

Ah, but there's a rub (that is, there *was* a rub). If you want to depend on SF_6, you have to keep it pure. Arcing or corona discharge decomposes the gas, and the decomposition products would eat the head right off your favorite iron. The gas must be constantly recirculated to remove these corrosive products. And moisture, another troublemaker, must also be eliminated.

Enter our hero. Knowing full well his burden of honor to uphold (Budd Electronics has led in developing dependable equipment to meter and maintain the purity of SF_6 gas for waveguides), he led his group to glory. In mundane terms, they designed and perfected the Budd Model PHD-2002 system. Deceptively simple in appearance, this system stores the SF_6 . . . automatically regulates supply, compensating for normal leakage in the waveguides . . . and maintains both required purity and dryness. Its recirculation system (exclusively ours) delivers reliable, contaminant-free operation and long service.

At this point, our ad manager thinks we should remind you that our Environmental Control Systems Department didn't get into SF_6 handling by accident. We've been designing and manufacturing heat exchanger systems, refrigeration and air conditioning systems and pressurizer/dehydrators for electronic equipment for over 20 years. If you've got an equipment or tube cooling problem . . . space, ground or sea . . . or an operating gas problem with waveguides, cavities, rotary joints, coaxial lines or similar components, it's a sure bet you should know more about our current activities. Write Environmental Control Systems, Budd Electronics, 43-22 Queens St., Long Island City 1, N. Y.

*R&D terminology for glorified ducts.

Budd Model PHD-2002 SF_6 Handling System

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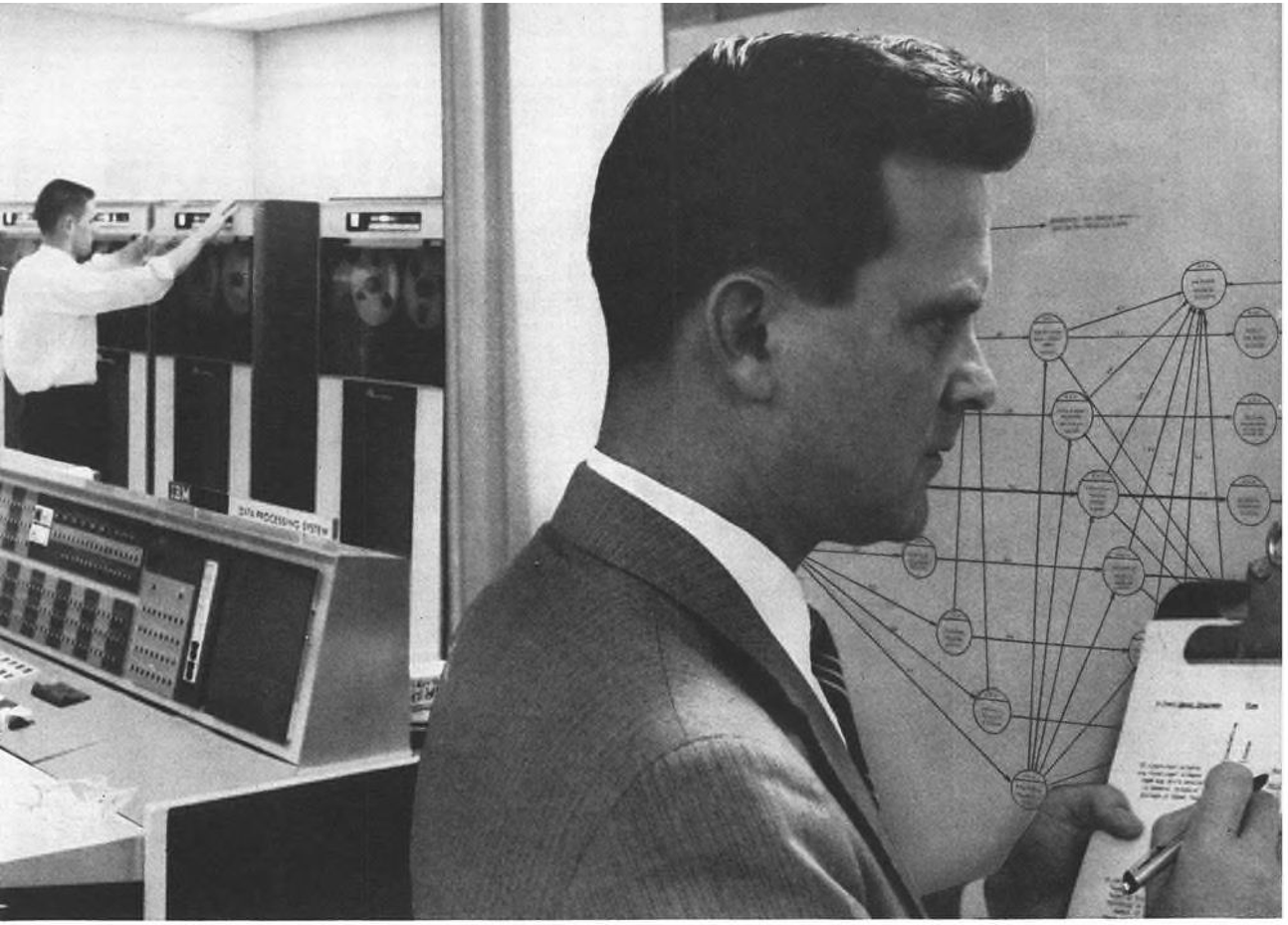


The Technique is Program Evaluation
The Capability is Systems Management
The Company is RAYTHEON

At Raytheon, electronic analysis techniques such as U. S. Navy-developed PERT take over program verification, performance report, variance prediction. The Raytheon Program Manager, thus freed from routine, can direct his efforts more profitably toward timely actions to ensure program success.

Raytheon's Surface Radar and Navigation Operation in Wayland, Massachusetts, utilizes such advanced methods as PERT and recently installed Development Program Cost Controls to aid Program Managers in more effectively accelerating projects through the engineering phase. The Raytheon Manager also applies automated production release, product cost control, and line-of-balance scheduling methods, in seeing the system through production — on time and within budget.

Some of these techniques are contributing to such Raytheon achievements as FPS-28 and SPS-38 radar systems, and MK 74 fire control systems. All are facilitating Raytheon's development of the Mauler fire control system and FAA's Bright Display radar programs.

Systems management capability of this magnitude, plus highly developed technical support (documentation, product assurance, installation, training and logistics) assures Raytheon customers on-time delivery of the most complex heavy electronic systems.

Executive Offices: Lexington 73, Massachusetts

RAYTHEON COMPANY

EQUIPMENT DIVISION

RAYTHEON

AEROSPACE CALENDAR

(*Continued from page 7*)

and Engineering Exposition, Cow Palace, San Francisco, Calif.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

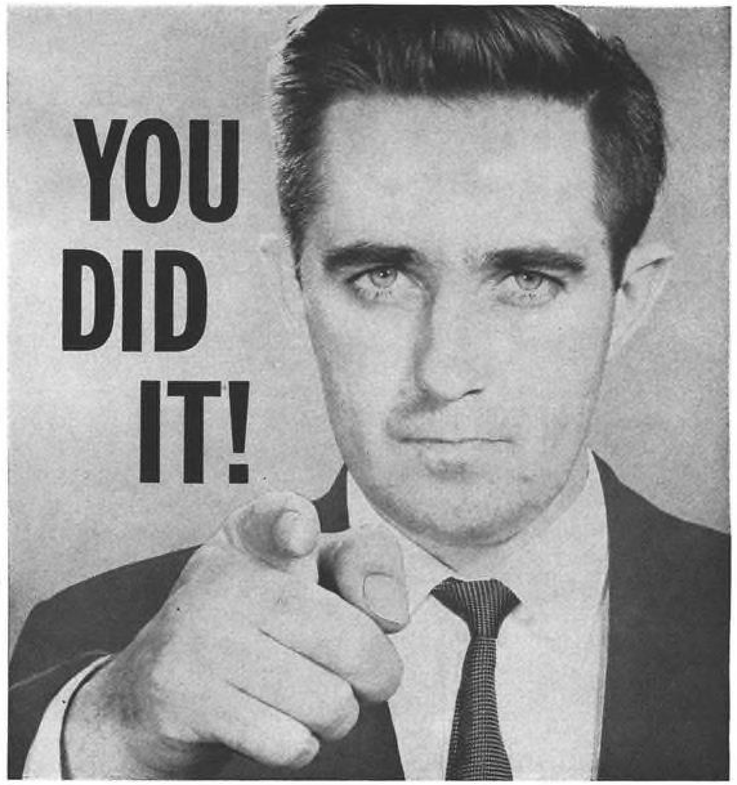
June 8-9—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

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

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

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

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



. . . by buying hundreds of thousands of EECo T-Series digital circuit modules. Yes, thanks to you, we have been able to effect drastic savings in production costs — **savings that we can now pass on to you.** ■ Here's how it works. Now that we are in our new plant, with its vastly improved facilities, we are able to use more efficient production methods . . . and still provide the same reliable, high-quality circuits you have been using for years. Your consistent purchases of EECo digital circuits has put us in this position of efficient, big-volume production. As an example, we are currently geared up to produce more than 4,000 T-Series circuit modules alone per week.

■ This greater volume naturally allows us to operate on a narrower margin of profit. But, in addition, it enables us to obtain significant price advantages from our vendors through large-volume purchasing. And these price advantages are even more significant in view of the recent general reduction in the price of transistors and other components used in EECo digital circuit modules. ■ So, you see, it all comes back to you — our thanks for your continuing orders . . . and the welcome savings you have enabled us to pass on to you.

Send for our new T-Series price list today. You will find it most attractive. For example, we now have flip-flops for less than $10.00 each in quantities as small as 200. Sound interesting?

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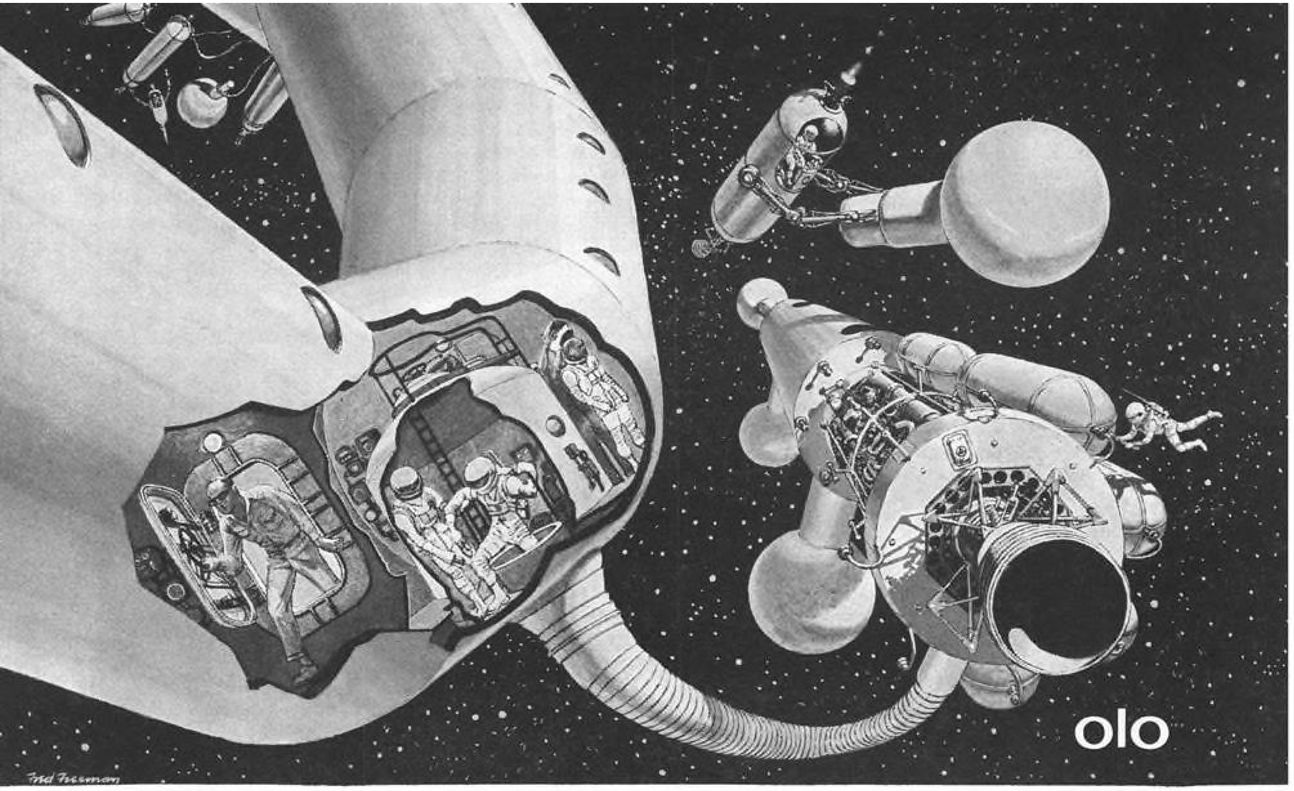
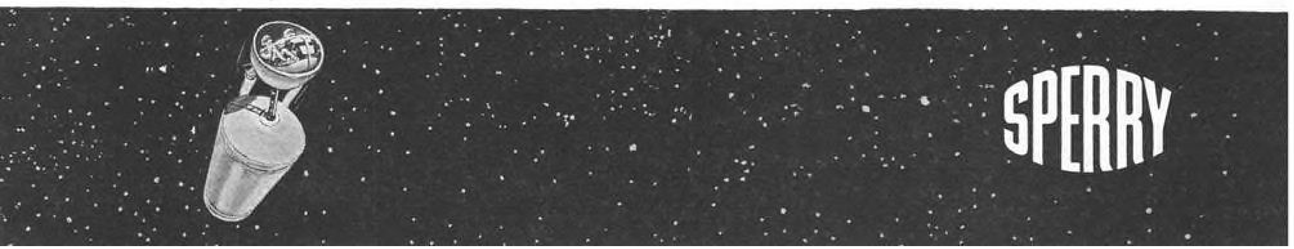
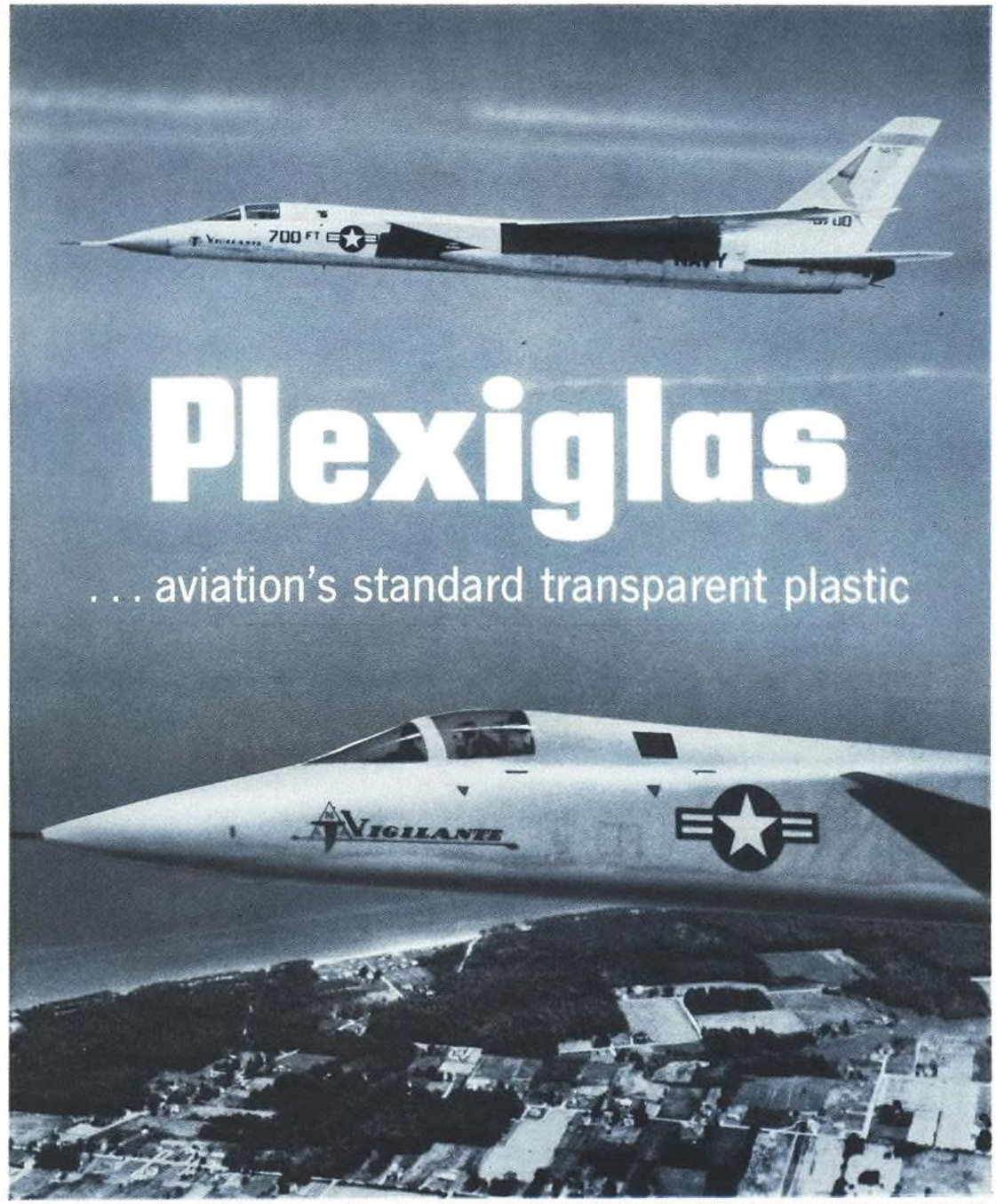


Orbital Launch Operations will call for the highest systems capabilities the nation can muster, in virtually every technology known. A space station must be orbited, piece by piece, with crews and their subsistence complex to assemble and man it—followed by a scientific laboratory that will become the launch facility in orbit, where the parts of the orbital launch vehicle then will be assembled. Such Sperry capabilities as rendezvous guidance, stabilization, deep space radar tracking, injection, command controls, data handling, optical communications, navigation and recovery systems—all are being applied to OLO programs.

The most important factor, however, will be a familiar one: *reliability*... both of systems and of management. Together these responsibilities spell program success. Sperry is a prime source for both. General offices: Great Neck, N. Y.





On the North American A3J Vigilante, new Navy all-weather attack aircraft with speed in the Mach 2 range, PLEXIGLAS 55 *acrylic plastic is used for the curved windshield and pilot's canopy.*

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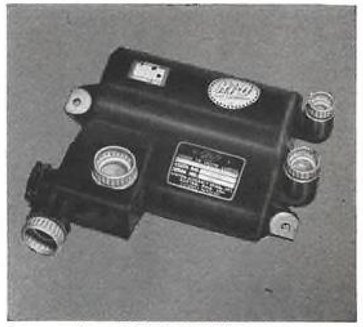
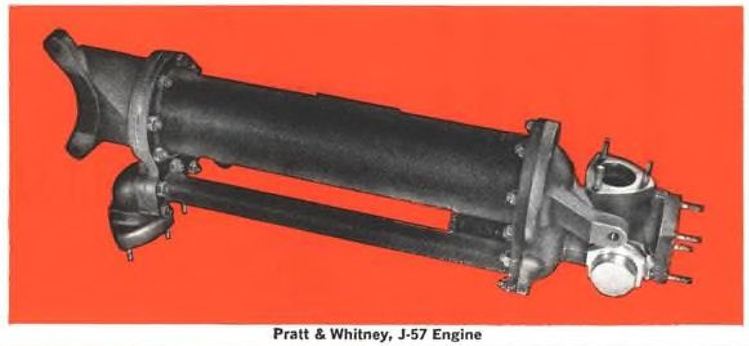
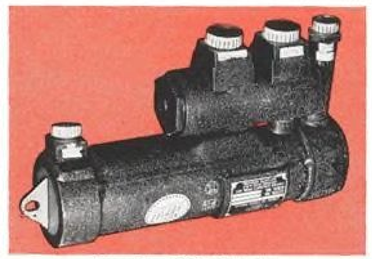


General Electric, T-58 Engine



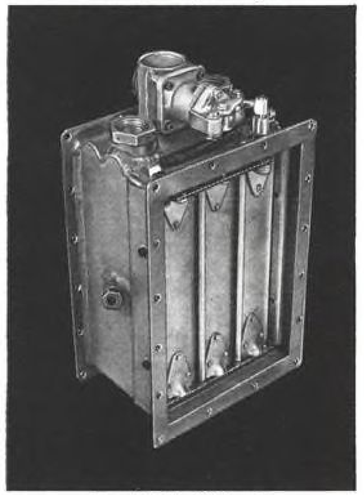
Pratt & Whitney, J-57 Engine

General Electric, J-79 Engine

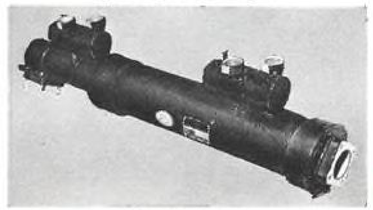


Lycoming, T55-L-5 Engine

Republic, F-105 Aircraft



Canadair, CL-28 Aircraft



Allison, J-71 Engine

IBM, B-52 Aircraft

Boeing, B-47 Aircraft

NOT FOR SALE

Not *these* models, anyway. They were custom-designed to customer specifications. And they're already performing cool miracles on reciprocating, gas turbine and jet engines, missiles and electronic equipment. However, UAP *will* design and build a heat exchanger to *your* exact requirements. Our qualifications? Been making aircraft heat exchangers since 1929. Rocked the industry when we introduced the Hi-D unit (one-third to one-fifth the size and weight of existing equipment). Have a customer list now that reads like "Who's Who in the Sky.'

Very strong on military engine and missile applications where reliability is a pre-eminent requirement. Write or phone 224-3841 today. UAP means United Aircraft Products. *A dynamic, independent company in Dayton, Ohio. A name to remember when it comes to heat exchangers.*

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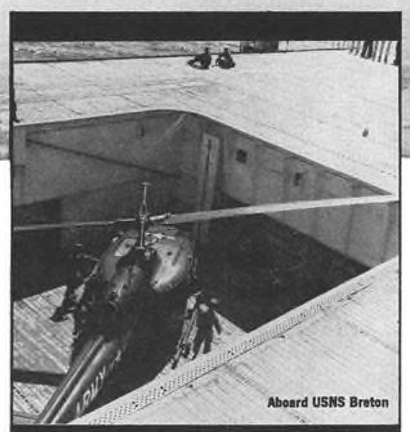

Aboard USNS Breton

Proven by crack Army units, Bell's turbine-powered, HU-1B helicopters fit the Marine mission perfectly. And with the HU-1B, the Corps gets *more* helicopter capability for its dollar, since major research and development has been completed. These Bells are the first production turbine helicopters in the U. S. with over 250 now on active military duty the world over. Picture this Bell supporting your assault mission.

■ Low battlefield silhouette ■ Compact size, easily transported by sea and air (GV-1) ■ Superior observation platform and target acquisition vehicle ■ 2 or 3 litters ■ 140 cubic feet of cabin cargo space ■ Single point external cargo sling ■ Can be armed with rockets and machine guns for combat reconnaissance ■ IFR proven ■ Fast field maintenance ■ 1,000 flight hours between major overhauls ■ Semi-rigid rotor system ■ Free of ground resonance ■ No starting or stopping wind limitations ■ Carrier qualified.

This *off-the-shelf* helicopter has proven itself with 70,000 plus flight hours over varying terrain . . under extreme climatic conditions.

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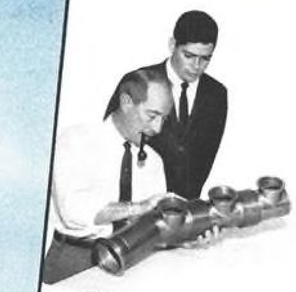

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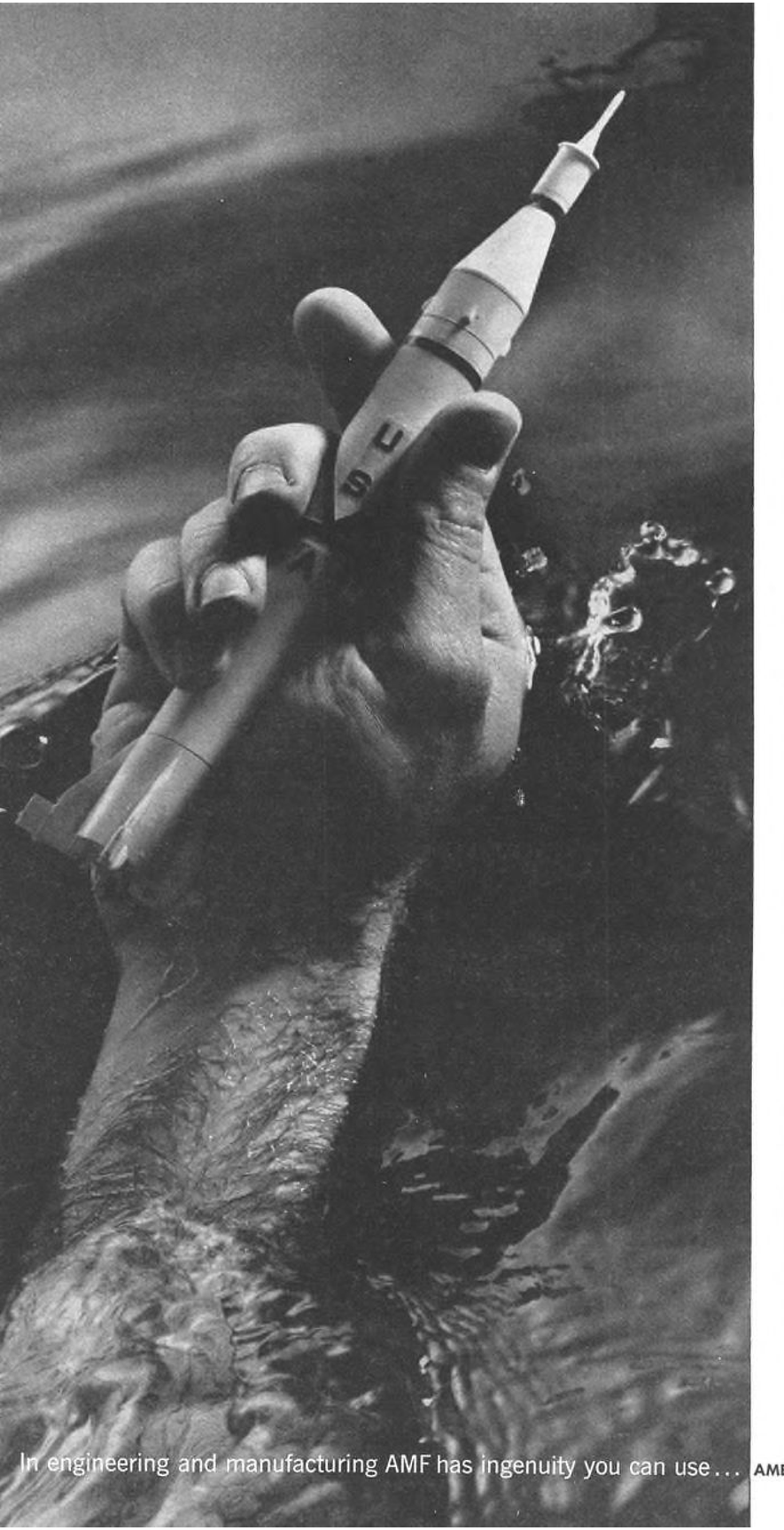

He's solving a real estate problem

This AMF engineer's job is determining how best to move big missiles off shore for launching. Should they be floated out horizontally, flooded to an upright position, and then launched? Or, would it be more feasible to barge them out? Might they be moved to or assembled on "Texas Towers," or would a causeway or simply land-fill be the answer?

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COVER: Los Angeles Airport was photographed recently through a new Paxar periphoto lens which has a full field angle of 187 deg. and a focal length of 6.5 mm. The picture was taken from a Piper Tri-Pacer flying at 500 ft. (Note aircraft's wheels at top of photo, tail at bottom.) The camera was a modified Leica M-3. The lens is produced by Pacific Optical Corp., a division of Chicago Aerial Industries, Inc.

PICTURE CREDITS

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Inside the little device shown above is a single chip of silicon about the size of this dot: ● Built right into the chip is a complex electrical circuit—combining several transistors and resistors. A family of six of these devices can form the complete logic section of a computer. As a result, the overall size of this section can be reduced as much as 90 per cent, and the total cost as much as 70 per cent. These devices were developed—and are now produced in volume—by Fairchild.

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A Lesson in Management

(There is almost universal agreement that proper management still is one of the major problems to be faced in the development of weapon systems. One of the most widely adopted management tools in recent years is PERT (Program Evaluation and Review Technique), created to help Navy produce its complex Polaris fleet ballistic missile system on time. Recently, Vice Adm. W. F. Raborn, director of the special projects office which handles Polaris, told a National Security Industrial Assn. meeting in Washington, D. C. of modifications and additions that Navy has developed to make PERT even more effective. Because of the widespread industry interest in PERT, AVIATION WEEK is presenting significant excerpts from Adm. Raborn's presentation.)

With full authority and total responsibility to accomplish this task, it was clear at the outset that "business as usual" could not be tolerated, that effective management must be sparked with no less attention than effort to advance the state of the art in science and technology. It was also clear that successful management and integration of the Polaris program would need extraordinary methods for effective planning, communications, coordination, and evaluation. "According-to-Hoyle" rules could not be applied. . . .

The program must not be hamstrung by conventional ways of doing things or by resistance to change for the better. I have always urged my staff and contractors never to rest on their laurels, to make continuous critical self-appraisals of performance, and to keep all minds open to new and better ways to develop superior hardware and improved management methods.

New Technique Sought

Early in the game, seeking management tools for adoption and adaptation to the program, we surveyed the systems employed by leading industrial and governmental organizations engaged in large R&D projects. We established our Management Center as the focal point for planning, communicating, coordinating, and critical self-appraisal of performance. We tested Gantt-charting and other more or less conventional methods for displaying plans and progress. Brief experience with these methods indicated that they fell short of the kinds of management tools Polaris would need. As a consequence, we designed novel tools on which to base management actions. These include the Program Management Planning (PMP) system for showing on a single-page standard format, for the total program and each of its segments, the job to be done, responsibility assignments, and significant milestones and schedules for completion; also, a simple contractor progress-reporting system of "need-to-know" information; and a thermometer-bar method for weekly status assessment by responsible staff members.

While these Polaris management tools were being widely copied by organizations in industry and government, we were never satisfied. In early 1958, we set up an operations research team to develop the first system in history for measuring and predicting R&D progress. Within a few months PERT was designed, pilot-tested, approved for application to the entire Polaris program, and placed in the public domain. The PERT system has won international acclaim as a "management breakthrough" for saving time in the space age.

The basic PERT system is a tool for managers to plan, schedule, and control the integrated influence of time, resources, and technical performance on the outlook for getting complex jobs done by deadline times. PERT uses time as a common denominator to represent resource applications and performance specifications. PERT gages the uncertainty in R&D tasks. It is being used by many organizations for complex projects requiring no R&D, with recognition that any task planned for the future involves some uncertainty, and that the delineation of sequence and interdependency of tasks is urgent for decision-making.

Outlining the Tasks

PERT blueprints the order of benchmarks in the current plan; continuously spotlights critical tasks and tasks having time to spare; and permits electronic computer simulation of the time-consequence of optional courses of action. Applications for Polaris have returned significant savings in time and resources and profitable trade-offs in technical approaches.

Use of the PERT system is spreading contagiously in defense and commercial organizations throughout the nation. Is this enough for Polaris? The answer is a firm "no!"

My organization has the only "Advanced Management Systems" office in government. This office has responsibility for creative action to design more management breakthroughs for Polaris and the public domain. Using PERT as a significant building block, action to evolve systems for measuring not only time, but also cost and technical performance, individually and in combination, is well under way. Pilot tests of systems for PERTing costs and for monitoring, estimating, and controlling over-all weapon system reliability (Program Reliability Information System for Management, or PRISM) are nearing completion. A system for planning, measuring and controlling dollar costs and physical resources through application of the PERT logic is being tested on one component of the A-3 Polaris program. This initial PERT-COST system is expected to yield great dividends for government and industrial managers, at all levels, as a tool for making time-cost tradeoffs; improving cost estimates and resource allocations; anticipating overruns and underruns; and justifying change in costs, times, and technical plans.

PERT paints only one picture for customer and contractor managers—insuring common understanding at all decision-making levels of management. Continuing operations research promises the early development of a package computer program to measure and interrelate the influence of time, cost, and technical performance on the successful achievement of advanced weapon and space system objectives. Such a package system for "multiple PERTing" would permit the simulation and testing of the significance of different mixes of these factors on achievement of objectives—and provide both government and industrial managers with sounder bases for making choices to "optimize" plans and improve the pay-off from always limited resources.

WHO'S WHERE

In the Front Office

George Douglas, corporate vice president and general manager, Radioplane Division, Northrop Corp., Van Nuys, Calif. Northrop also has announced the following appointments in the newly established Northrop Space Laboratories, Hawthorne, Calif.: **Dr. Ludwig Roth,** vice president and manager, Systems Engineering Department; **Dr. V. W. Howard,** vice president and manager, Research Department; **Alan Morgan,** vice president and manager, Business Administration Department; **George Mangurian,** manager, Applications Engineering and Planning Department.

George P. Hitchings, vice president-economic research and financial relations, American Airlines, Inc., and **Charles N. Oursler,** vice president-corporate planning.

Lucius E. Robertson, controller, United Aircraft Corporate Systems Center, Windsor Locks, Conn., of United Aircraft Corp.

Honors and Elections

The Institute of the Aerospace Sciences has announced the following as recipients of the IAS Honors and Awards for 1961: **American Fellowship** to **John Stack,** director of aeronautical research, NASA Office of Advanced Research and Technology; **Foreign Fellowship** to **Prof. Maurice Roy,** director general of the Office National d'Etudes et de Recherches Aeronautiques (ONERA); the **Louis W. Hill Space Transportation Award** to **Robert R. Gilruth,** director of the NASA Manned Spacecraft Center; the **John Jeffries Award** for the advancement of aerospace medicine to **Capt. Ashton Graybiel,** director of research, Navy School of Aviation Medicine; the **Robert M. Losey Award** for contributions to the science of meteorology as applied to aeronautics to **Arthur F. Merewether,** superintendent of meteorology, American Airlines; the **Sylvanus Albert Reed Award** for achievement in theoretical investigation in aeronautical sciences to **Dr. Alfred J. Eggers, Jr.,** chief of NASA's Ames Research Center Vehicle Environment Division; the **Lawrence B. Sperry Award** for a notable contribution to the advancement of aeronautics to **Dougles G. Harvey,** a project engineer for Martin Marietta Corp.; the **Minta Martin National Student Awards** to **Julius E. Harris,** undergraduate, Virginia Polytechnic Institute, **Bernard H. Carson,** masters' candidate, Pennsylvania State University and **Emmett A. Sutton,** doctorate candidate, Cornell University. Elected IAS Fellows: **Prof. Holt Ashley,** Massachusetts Institute of Technology; **Prof. J. A. J. Bennett,** The College of Aeronautics, Cranfield, U. K.; **H. G. Conway,** Short Brothers & Harland, Ltd.; **John C. Evvard,** NASA's Lewis Research Center; **Prof. Paul Germain,** University of Paris, France; **S. K. Hoffman,** president of North American's Rocketdyne Division; **W. H. Pickering,** California Institute of Technology's Jet Propulsion Laboratory; **Harrison A. Storms, Jr.,** president of North American's Space & Information Systems Division; **Charles R. Strang,** Douglas Aircraft Co.'s Transport Aircraft Engineering; **Prof. Itiro Tani,** University of Tokyo, Japan; **Alfred V. Verville,** Bureau of Naval Weapons, Department of the Navy.

INDUSTRY OBSERVER

► Rome Air Development Center is seeking qualified firms to conduct a research program aimed at developing techniques to enable a photo interpreter to more rapidly scan reconnaissance photos and identify objects of military interest.

► **Four-stage vehicle known as Tripod is being considered by Space Systems Division and Aerospace Corp. as a possible launch configuration for putting Navy's operational Transit satellites into precise orbits. Two-stage Thor Able-Star has been the launch vehicle for Transit research and development shots.**

► Air Force has issued requests for proposals for development of a 120-in. dia. solid-propellant rocket motor for Titan 3 (AW Jan. 22, p. 39). Contractors will be briefed Feb. 5 at Air Force Systems Command Space Systems Division. Proposal deadline is Mar. 13, but some leeway will be allowed. Bidders include Aerojet, Thiokol, United Technology Corp., Lockheed Propulsion Co., Hercules, and Rocketdyne.

► **Major advance by General Electric in electron optics technology for infrared videcon tubes is expected to lead to extremely sensitive airborne or satellite reconnaissance systems which weigh 15 lb. and consume only 15 watts power. Somewhat heavier prototype is scheduled for delivery to Air Force's Aeronautical Systems Division soon.**

► National Aeronautics and Space Administration is expected to call next month for industry proposals on production of Apollo guidance-navigation hardware being developed by Massachusetts Institute of Technology's Instrument Laboratory.

► **Hawker Siddeley has submitted to British Air Ministry a military version of the Avro 748 turboprop transport featuring aft-loading facility. It will be competing for a Royal Air Force order with a military version of the Handley Page Dart Herald. Final decision will probably be based on political, rather than technical, considerations since Handley Page is the only major aircraft firm which has resisted government attempts to merge it with either Hawker Siddeley or British Aircraft Corp., in line with the 1959 White Paper urging regrouping of the industry.**

► General Electric J93 turbojets for the USAF-North American B-70 Mach 3 bomber are being designed for 100-hr. time between overhaul (TBO). GE says designing the engine for any longer TBO would have lost them the competition because powerplants would have had to be much larger and heavier.

► **Navy will use the North American T3J-1, a twin jet, six-place aircraft, for training radar operators for the two-place McDonnell F4H-1 fighter. T3J-1's airframe and powerplant are identical to those of the Air Force T-39. Defense Department denied additional T-39 procurement for the Air Force, but $14.8 million in Fiscal 1962 and $19.3 million in Fiscal 1963 was allowed for the T3J-1.**

► Lockheed Propulsion Co., under a $340,000 priority program for Edwards AFB, is attempting to develop a high mass fraction solid-propellant rocket motor for possible use as the fourth stage of the Air Force Scout boost vehicle. Air Force is seeking higher performance than that available from the present ABL X248 motor. First firing of the Lockheed motor, an 18-in. unit, is expected soon.

► **Final plasma-jet tests on a wide range of ablative-sheath materials for insulation against heat during exit trajectory of new Minuteman Wing 5, growth version of the ICBM, have been completed by Chicago Midway Laboratories for Boeing Co., missile assembly and test contractor. Growth version Minuteman configuration was to be decided upon this month, with the probability that the booster and second stages will have plastic cases, as well as the third stage, which already is plastic. Temperature of interface between stages and ablative materials will have to be limited to about 350F.**

PERFORMANCE CHARACTERISTICS

VACUUM	SPECIFIED	ACHIEVED
1 x 10⁻⁵ mm Hg	4 hours	1 hour, 32 minutes
1 x 10⁻⁶ mm Hg	8 hours	3 hours, 32 minutes
5 x 10⁻⁷ mm Hg	20 hours	4 hours, 27 minutes
1 x 10⁻⁷ mm Hg	ultimate	7 hours, 32 minutes
5 x 10⁻⁸ mm Hg	beyond spec.	11 hours

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Washington Roundup

Centaur Shakeup

General Dynamics and the National Aeronautics and Space Administration have made major management changes in an effort to accelerate the lagging development of the Atlas-Centaur space vehicle.

Grant L. Hansen, formerly chief engineer for design at General Dynamics/Astronautics, becomes vice president and program director for Centaur. He replaces Krafft A. Ehricke, who will now direct advanced studies for the firm.

NASA has transferred its Centaur project office from Hawthorne, Calif., to the George C. Marshall Space Flight Center at Huntsville, Ala., and named Hans Hueter as director of the operation. Hueter, head of Marshall's Light and Medium Vehicles Office, will direct the Centaur project until a new manager is appointed. He replaces Lt. Col. John Seaberg, who has returned to duty with the Air Force.

Centaur is especially critical to the U. S. space program since it is the only booster available for major deep space missions until the 1.5-million-lb.-thrust Saturn is ready in 1963 (AW Oct. 2, p. 26, Oct. 23, p. 22).

NASA Budget Hearing

House Science and Astronautics Committee has broken the pattern of past years by organizing itself into four standing subcommittees, each of which will soon start hearings on different portions of NASA's Fiscal 1963 budget requests.

Chairman George P. Miller has promised to work through subcommittees and give their staffs more authority during hearings, rather than continue his predecessor's practice of holding full committee hearings on almost every subject. Rep. Miller succeeded Rep. Overton Brooks, who died late last year.

The subcommittees for the NASA budget and their chairmen: manned space flight, Rep. Olin E. Teague; advanced research and technology, Rep. Victor L. Anfuso; space sciences, Rep. Joseph E. Karth; tracking and data acquisition, Rep. Ken Hechler.

President Kennedy is expected to anticipate Congress by issuing conflict of interest regulations for the government's scientific advisers. The House Armed Services Special Investigations Subcommittee already is studying whether these advisers use inside government information to private advantage. Hearings are planned for March or April.

Enos' Misbehavior

A faulty micro-switch on one performance task circuit for the chimpanzee Enos caused him to receive shocks for performing correctly during his Mercury Atlas 5 flight in November. This single task represented 25% of Enos' duties during the flight. When he found the correct performance resulted in a shock, he quickly compensated by performing the wrong task to avoid it.

Civil Aeronautics Board this week is expected to send Congress suggested changes in pending legislation to give supplemental airlines permanent operating authority. House and Senate last year passed widely differing bills and have been delaying the conference on them until the CAB recommendations are received.

House Ways and Means Committee is so busy with reciprocal trade and other major legislation that it does not expect to get to President Kennedy's proposed aviation taxes until about May (see p. 40).

Minuteman Tour

Fourth successful silo shot of the USAF-Boeing Minuteman missile (see p. 35) **was watched last week by Maj. Gen. Thomas P. Gerrity,** commander of Air Force Systems Commands' Ballistic Systems Division, Brig. Gen. Samuel C. Phillips, Minuteman program director, and 21 other top officials from the Air Force and industry. Gen. Gerrity also took the group to the Minuteman assembly plant at Ogden, Utah, the first operational site at Malmstrom AFB, Mont., and the operational training facility at Vandenberg AFB, Calif. The trips are designed to reduce delays by acquainting management teams with every aspect of the complex Air Force missile programs, from research and development through base activation and operational training.

Problem of no-show airline passengers is defying solution despite 15 years of trying. Withholding part of the ticket refund has not worked in the past and now the CAB states airlines cannot fine no-show passengers unless the carriers pay fines for selling more tickets than there are seats. Airlines feel they would lose more than they would gain from this new approach, so they are not expected to try it.

—Washington Staff

Merger Debates Dominate IAS Meeting

Consolidation with ARS possible by mid-1962; committee established to draft recommendations.

By David A. Anderton

New York—Internal political arguments about the proposed merger with the American Rocket Society dominated the formal and informal business of the 30th annual meeting of the Institute of the Aerospace Sciences here last week.

While an IAS subcommittee met behind closed doors to consider the many factors involved, much of the open discussion in the corridors during technical sessions centered on the proposed merger.

Opinions vary widely across the membership of both societies, but strong and vocal factions within them are pushing hard to get IAS and ARS to join. "The merger is a certainty," said one society member, "but it's going to take place over a lot of dead bodies."

It now appears that the earliest possible date for consolidation of both societies into a single group is mid-1962. Latest action by IAS and ARS was taken at a joint meeting of the governing bodies of both societies last Thursday. They adopted a resolution to study the proposed merger in great detail with the aim of producing a final report for the memberships by early May. At that time, both societies will decide whether to submit the specific plan to their members for a vote.

The resolution also approved preliminary reports of a joint study group which has been considering the merger since late last year. The group had drafted recommendations for a future course of action, in effect, planning the merger in outline form.

Currently a ten-man consolidation steering committee, made up of the officers of IAS and ARS, is working on the proposal. They are being aided by five working groups: constitution and by-laws; organization; member services; finances; and ways and means.

Progress Reports

Progress reports from the groups will be delivered to the governing bodies of IAS and ARS before the beginning of May. After the committee's final report, the specific plan for consolidation will go out to members. The objective is to have the complete merger plan in the hands of members by mid-June.

There is little disagreement between IAS and ARS on the goals of each society and therefore on the possible goals of a merged professional group. But there is much difference of opinion on the means to reach those goals.

IAS, as the younger but more conservative group, recently issued a statement describing the "IAS in 1970." Outgoing President Dr. H. Guyford Stever said in the report that the Institute would not engage in membership drives, promote trade shows and exhibits, lobby or sponsor legislation. Future policy would ignore the task of communication with the public, and concentrate on the technical population. The IAS would plan its growth on the establishment of high professional standards for meetings and publications, and count on attracting desirable membership, rather than on actively recruiting members.

ARS, currently in the early stages of a major drive for members, obviously disagrees with most of these points. The Society's Space Flight Report to the Nation (AW Oct. 16, p. 27) was a mammoth scientific and technical exhibit that left no doubt about ARS future policy in that area. Furthermore, ARS activity in the political field has been responsible for major pushes behind the U.S. space program in the past, and the Society feels an obligation in this area.

Membership Figures

Membership is about equal in both societies, with IAS at a plateau of approximately 19,000 and ARS on a fast-growth curve now past the 20,000 mark. About 16% of IAS members also belong to ARS.

Other points at issue in the arguments include disposition of approximately $3.5 million liquid cash reserve of the IAS, largely represented by buildings and property in New York, Los Angeles and San Diego.

But while some groups were arguing the merger, other factions were loudly debating two controversial presentations during the three-day meeting:

- **Lockheed's rigid-rotor helicopter** concept, which stirred up more technical comment before, during, and after the session than any other single subject remembered from past meetings. The views ranged from the belief that Lockheed had made a major contribution, to considerably more conservative judgments of the concept's significance.
- **Defense analyst Herman Kahn's** speech at the Honors Night dinner (see box), which so enraged some of his audience that a few persons walked out. One Navy commander stood up during the speech to challenge Kahn, but was pulled down by his tablemates before he was able to fire his first salvo.

Kahn Favors "Planned Muddling"

New York—"Historically, muddling through beats long-range planning," Herman Kahn told the Institute of the Aerospace Sciences Honors Night dinner here last week. "But we've got to plan our muddling through from now on."

Kahn's general argument was that the pragmatic approach to world affairs worked better than long-range planning, primarily because of the short time between major technological revolutions. It takes too much time for broad policy to be translated to detailed planning and for the results of that planning to affect policy, he said.

There have been three technological revolutions in weapon systems since the end of World War 2, said Kahn, and there will be two more shortly. The task of the planners is to think two technological revolutions ahead in order to avoid the risk of falling hopelessly behind by the 1970s.

Kahn forecasts the next revolution for 1965. By then, he says, there will be 2,000 to 3,000 ICBMs emplaced by the U.S. and a like number by Russia; other countries will be acquiring nuclear strength; space will be playing important roles in communications, reconnaissance and surveillance; the possibility of accidental or inadvertent war will be greater than it is now.

The second revolution to come carries a 1969 date, says Kahn. This one will be characterized by cheap superbombs, cheap supermissiles, cheap satellites; there will be two or three more entries in the arms race; Red China may have a gross national product equal to that the USSR had in 1960; disguised or anonymous warfare becomes a troublesome possibility.

He cited three problem areas where he saw gaps in knowledge and understanding now: command and control, where the traditional system of authority vested in the man on the spot no longer can apply; the arms race, which he said has never really been studied as a general problem; and changes in the international order, which may well see the elimination of the 500-year old nation-state system.

First official details of the Lockheed work were released in a report prepared for the IAS meeting by Lockheed senior vice president Hall L. Hibbard and chief advanced systems research engineer R. R. Heppe, who presented the report.

Design Details

The design details confirmed information which appeared first and exclusively in Aviation Week (July 31, 1961, p. 26). Lockheed's CL-475 flying testbed is a conventional helicopter with a rigid three-bladed main rotor and a tail anti-torque rotor. Weight of the vehicle is about 2,000 lb.; main rotor diameter is 32 ft. Disk loading is about 2.5 psf. The helicopter carries two pilots side-by-side. Power comes from a single 140-hp. piston engine.

Lockheed's continual references to the Lockheed rotor tend to mask two facts:

- **Rigid rotor** is not a new development, and originated during the autogyro days. It has shown later in experimental vehicle work by E. Burke Wilford, by Kellett Aircraft Corp., and recently by Bell Helicopter Co. (AW Nov. 13, 1961, p. 76).
- **Lockheed's unique contribution** appears to be in the stabilizing and control system rather than in the rotor. Judging only by a short film of the flight tests, observers agreed that the system was stable, and that the large ring mounted free of the mast between blades and fuselage had much to do with that stability.

But all questions about the detailed functions or operations of the ring were answered in a vague manner, leading most questioners to the belief that Lockheed proprietary rights centered on the stability and control system.

Control Power

Lockheed has referred to high control power of the rigid rotor used in combination with a control gyroscope to provide stability. This is understandable enough; the only questions come in the details of just how this is done. Lockheed won't say. But there is some speculation. The rigid rotor has a large gyroscopic effect, obviously much larger than the ring. But a single gyro is not enough; two gyros are necessary for roll-yaw control coupling. One possible system could utilize the rotor as one gyro and the ring as the other gyro. With these two gyros as references, an automatic control system could be developed using displacement signals fed through a servo system to cyclic pitch controls on the blades.

Some of the basic claims made for the rigid rotor by Lockheed were documented in tests reported by W. L. Cresap, of Bell. In private conversations, engineers from other helicopter companies told Aviation Week that they were also studying the rigid rotor system, but had concluded at several times in the past that its disadvantages outweighed its advantages.

One engineer said that small test vehicles always seemed to work well; but when growth sets in, so do the troubles. He documented it with a list of problems his own company had.

Trouble Predicted

Another engineer predicted trouble for Lockheed when it tried to scale up the test vehicle into a large helicopter. "I think the hub and mast weight will convince them then," he said.

After the Lockheed presentation, one aerodynamicist specializing in stability problems commented that he didn't see how Lockheed could get stability in the vehicle. Lockheed's rejoinder was that it did; but it didn't say how. The engineer tried with another question, but didn't get an answer that satisfied him.

But one engineer from a major helicopter company said maybe Lockheed really had something, and he thought it was about time for him to take another look at the rigid rotor.

Lockheed has been flying the CL-475 with metal blades since early 1961, and before that, with wooden blades. Heppe said that on "several occasions people with no helicopter experience at all flew the CL-475 after a ground checkout period of less than one-half hour."

The company entered the design in the Army's light observation helicopter competition, and lost. Next steps in the development program will include full-scale tests in the NASA Ames Research Center 40 x 80 ft. wind tunnel, plus construction and flight test of two gas-turbine powered helicopters scheduled to fly this autumn.

Aerojet-General to Develop M-1 Engine

Washington—Aerojet-General Corp. was chosen last week by the National Aeronautics and Space Administration to design and develop the 1.2 million lb. thrust M-1 liquid hydrogen-liquid oxygen engine. A cluster of four M-1s would power the second stage of the Nova lunar launch vehicle in the event that a direct ascent mission to the moon is decided upon.

NASA has already requested $26 million in supplemental Fiscal 1962 funds for the project and has included $55 million in its Fiscal 1963 budget request. With overruns, the program is expected to cost $90 million (AW Jan. 22, p. 29).

Contract negotiations will begin as soon as possible in order to expedite work on the engine. The operational goal is 1965.

Although NASA has chosen the rendezvous method for its lunar landing program, it plans to have a direct ascent booster combination available in the event the rendezvous method does not prove feasible.

In the rendezvous method, the spacecraft would be launched into an earth orbit. Then boosters would be launched to rendezvous with the spacecraft for assembly into a combination which would escape from orbit for a trip to the moon. Direct ascent would mean a shot directly to the moon without a stop in orbit.

The M-1 engine will be 23 ft. high and will measure 15 ft. across at the nozzle exit. It will consume 85 tons of liquid hydrogen and liquid oxygen per minute. The four-engine cluster will sit as the second stage on top of the Nova first stage, which is made up of eight F-1 liquid oxygen-kerosene engines, each of which produces 1.5 million lb. of thrust. The third stage would be powered by a single liquid oxygen-liquid hydrogen J-2 engine producing 200,000 lb. of thrust. The F-1 and J-2 engines are being developed by the Rocketdyne Division of North American Aviation, Inc.

Negotiations for the M-1 contract will be conducted by the George C. Marshall Space Flight Center at Huntsville, Ala., which will also administer the contract.

Unsolicited proposals for the 1 to 1.5-million-lb. thrust engine were received from Rocketdyne, Aerojet and Pratt & Whitney. Development of such an engine, which was originally called the Y-1, was urged by the Large Launch Vehicle Group, or Golovin Committee.

Only upper stage uses are being considered for liquid hydrogen-liquid oxygen engines because at sea level they develop only about two-thirds as much thrust with lower specific impulse as they do outside the atmosphere.

Aerojet called its proposed engine the AJ-1000. Rocketdyne had no official designation, but called it the F-1H. It was a conversion of the F-1 using the different propellant combination.

The M-1 will be a conventional pump-fed, single chamber, hydrogen-oxygen system, six times larger than any other hydrogen-oxygen engine now under development. Rocketdyne is developing the J-2 and Pratt & Whitney is developing the RL-10 (formerly the LR-115) 15,000 lb. thrust engine to power the Centaur stage of the Atlas-Centaur launch vehicle.

Capsule Window Valuable Orientation Aid

By Edward H. Kolcum

Cape Canaveral, Fla.—Pilot's "best friend" on Project Mercury orbital flight missions will be the enlarged, rectangular window through which he will be able to ascertain his position at all times, according to Capt. Virgil I. Grissom, the astronaut who flew the second Mercury ballistic profile July 21.

Despite automatic indicators in the Mercury capsule, Grissom feels the best attitude and position reference will be the window, which is large enough to provide a view of earth and sky simultaneously. The complete control task for the flight was described as "easy" when only the horizon as seen through the window was used as reference.

Report on the Grissom Mercury Redstone-4 (MR-4) flight was made available here on Jan. 23 as preparations were being completed for the first manned Mercury orbital flight, designated Mercury Atlas-6 (MA-6). Only analyses of a general character are contained in the report, which consists primarily of pre- and post-flight physiological readings taken on the pilot, along with Grissom's pilot report.

Lt. Col. Stanley White, director of the Life Sciences Division of National Aeronautics and Space Administration's Manned Spacecraft Center, told AVIATION WEEK that the document makes no effort to interpret data from the Grissom flight, but only to report it. The MR-4 mission was conducted successfully through landing, after which the egress hatch was inadvertently blown and the capsule sank after shipping water (AW July 31, p. 30).

Grissom's ordeal in the water following his escape from the capsule was complicated by his being caught in the rotorwash between the helicopter assigned to retrieve him, and the one assigned to recover the capsule. He swallowed some salt water, and went under water "quite often." He put the pickup horsecollar on backward, but did not change because he was confident he would not slip out of the sling.

His major conclusions, from the pilot viewpoint are:

• **Manual proportional control system** was adequate, and is able to control retrofire accurately. Roll axis was underpowered and caused difficulty because of slow response rate. Command system functioned well, but the amount of fuel consumed with this system makes it advisable to use it only for retrofire and re-entry on orbital flights. Autopilot also functioned well.

• **Rates and oscillations** of the capsule were easily ascertained by looking out the window and in orbital flight drift rates can be determined by reference points seen through the window.

• **Main value of the sequence panel** is in telling the pilot when an event has not occurred. Primary indications of major events are provided by noises made by pyrotechnics, control nozzles, control solenoids, rockets and jettison motors.

• **Vibrations were mild,** and no difficulty was experienced during the maximum dynamic pressure phase. It was never necessary to repeat a transmission, nor was it necessary to over-ride a capsule system. Cdr. Alan B. Shepard, Jr., used the manual when his sequence panel light did not indicate this event occurred automatically during the MR-3 flight in May.

Training Complete

Capt. Grissom said he felt least prepared for the recovery portion of the mission, but like Cdr. Shepard, he feels the training program is thorough. He said also that he would have liked to have spent more time on the Alpha (Air-Lubricated Free-Altitude) trainer during the final two weeks preceding the flight. This trainer is at manned spacecraft center headquarters at Langley AFB, Va.

Because astronauts spend several weeks before each flight here at the Atlantic Missile Range they are unable to use it during this period.

The Alpha trainer provides accurate angular acceleration cues, and this device in combination with its large window, according to Grissom, is highly desirable training just before the flight.

The mission itself, Grissom reported, was considerably smoother in its acceleration changes than the centrifuge on which flight profiles were flown. The centrifuge, Grissom said, had prepared him for a momentary vertigo sensation he experienced just after launch vehicle cutoff.

Because "there are inevitably many small differences between the simulator and the capsule," Grissom said, participation in checkout activities at the launch site, and familiarization with the actual spacecraft to be flown are especially valuable to the astronaut.

Much of the report contains a comparison of data from the Grissom flight and the flight of Cdr. Shepard in MR-3. The MR-4 capsule was a later version than that flown by Cdr. Shepard, differing mainly in the large viewing window and in the explosively actuated side hatch.

Grissom had a viewing field of 30 deg. in the horizontal plane and 33 deg. in the vertical. Shepard had a smaller 10-in. octagonal viewing port, and depended mainly on his periscope for reference.

The egress hatch in the Shepard capsule, which was production capsule No. 7, was mechanically operated and weighed 69 lb. The explosively operated hatch in Grissom's capsule, which was McDonnell Aircraft Co. production capsule No. 11, weighed 23 lb.

Another major configuration change was streamlining the covers around the explosive bolts to reduce buffeting reported at maximum dynamic pressure by Cdr. Shepard. An earth path indicator was included in the Grissom capsule, but this device was inoperative.

Stabilization and control systems differed by the installation in MR-4 of a rate command control system which senses and commands capsule rates rather than attitudes.

Flight parameters for both pilots were very similar. Major parameters, with those for Grissom listed first included:

• **Range,** 262.5 mi., and 263.1 mi.
• **Apogee,** 102.8 mi., and 101.2 mi.
• **Maximum exit** dynamic pressure, 605.5 psf., and 586 psf.
• **Gravity loads,** exit—both 6.3; re-entry, 11.18 and 11.
• **Weightlessness,** 5 min., and 5 min., 4 sec.
• **Velocities,** earth-fixed, 6,618 fps., and 6,414 fps.; space-fixed, 7,580 fps., and 7,388 fps.

Physiologically, Grissom suffered no after-effects of his flight. Like Shepard, he had a rash around the tatoo marks on which the physiological sensors are attached, and this could result from repeated use of Bentonite paste, used to secure the floating sensing electrodes.

Vital medical signs showed a weight of 150 lb., 8 oz., at 7 hr. before launch, and 147 lb., 8 oz., 2 hr. after launch. Temperatures in this nine hour period were 97.8F and 98.4F. Pre-flight pulse rate was 68, and post-flight was 90. Grissom ranged to a high of 171 beats/min. at the time retrorockets were fired, and remained above 150 during the entire flight except for a brief period when he was weightless.

Grissom spent 3 hr. 22 min. in his capsule during countdown, and total flight time was about 15 min. Preparations for his ballistic flight, however, were the same under way for the past several weeks for Lt. Col. John H. Glenn, pilot of the orbital capsule. Grissom went on a low residue diet three days prior to the flight and went into semi-isolation about two weeks before the flight.

Report on his mission emphasized that he consumed no medication during pre-flight preparations, and that both Grissom and Shepard exhibited "the calm reserved air of confidence which typifies both of these pilots."

The report indicates a minor flight control problem was experienced in that design turning rates were not achieved with full stick deflection, a problem traced to control linkage.

Grissom's maneuvers during the astronaut mission phase were within the envelopes established in centrifuge runs.

He made 94 voice communications. One of the most significant was observation of re-entry shock wave, which looked to him like a contrail or smoke.

MMRBM Scope Grows

Washington – Word "mobile" has been added to the name of Air Force's solid propellant medium range ballistic missile, making it the MMRBM, and the scope of the project has been broadened by addition of a requirement for a sea launch capability.

Navy participation has been authorized to assure maximum adaptation to shipboard operations. It is also possible that provision will be made for surface launching from older conventional submarines, unlike the Polaris missile which is fired from a submerged position.

A System Program Office for the MMRBM has been established at the Ballistic Systems Division at Inglewood, Calif., which will be under the direction of Col. Edmund F. O'Connor, who has been fighter aircraft systems officer at USAF headquarters.

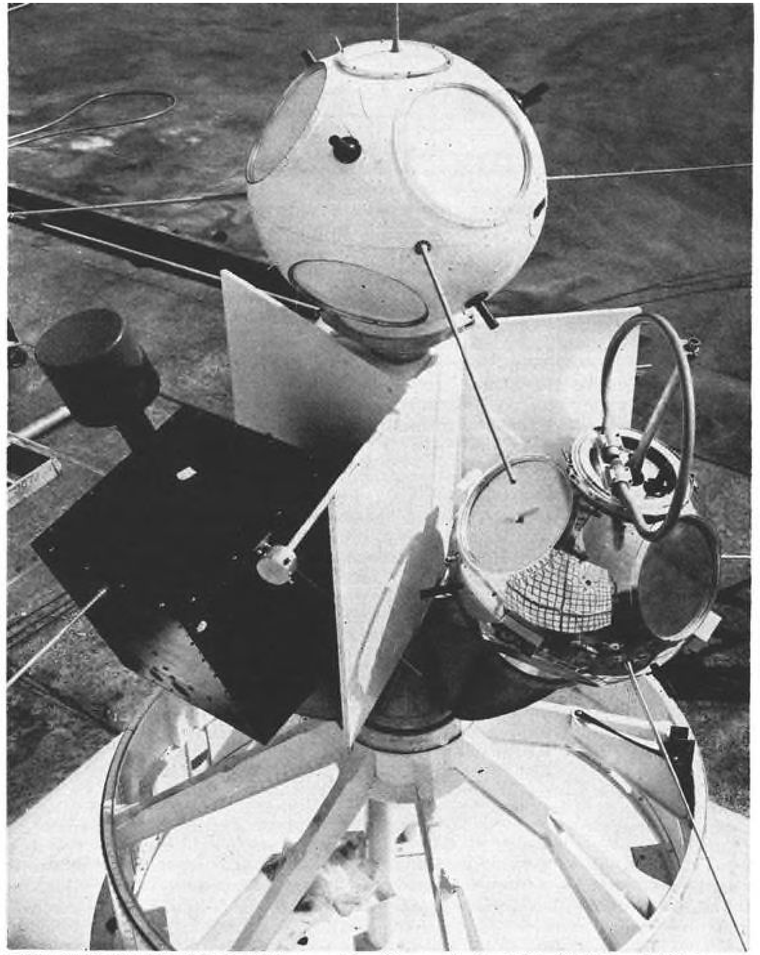
The system officer at USAF headquarters for MMRBM is Col. Donald L. Sanxter.

120-in. Solid Details

Proposals to be submitted by industry in March in the Air Force competition for development of the 120-in.-dia. solid-propellant rocket motor (see page 23) will be based on a requirement that development flights must be completed within three years of the program's start.

The program anticipates emphasis on a four-segment configuration, with provision for growth to five segments, which would make a total length of about 75 ft. including 10-ft.-long single nozzle, a weight of slightly more than 450,000 lb., a mass fraction exceeding 0.88 and a burning time of 100 sec. The four segment motor is projected to weigh about 375,000 lb., have mass fraction of slightly less than 0.88 and burn for 110 sec.

Specific impulse requirement will exceed 260, and burning will have to be controlled to keep acceleration within safe limits for manned spacecraft payloads. Fluid injection for thrust vector control also will be required.



FOUR OF THE FIVE SATELLITES comprising Composite 1, which failed to orbit last week, underwent integration tests at Space-General Corp. Shown are Injun 2 (left), SR-4 (center) and Lofti 2 (right). Secor 1 is out of view behind the protective baffle boards. Surcal was fixed to the structure of the Ablestar upper stage.

Composite Launch Attempt Fails

Cape Canaveral, Fla.—Composite 1, Navy's five-satellite pack aboard one launch vehicle, failed to orbit last week when the 8,000-lb. thrust Space-General Corp. Ablestar second stage developed less than the velocity required for orbital injection.

Navy spokesmen said there was no backup Thor-Ablestar launch vehicle available immediately, but that backup satellites could be launched either singly aboard Blue Scout or Scout solid propellant vehicles or piggyback aboard later Transit navigational satellites.

Composite 1 (AW Jan. 15, p. 26), also called Buckshot, carried three Naval Research Laboratory satellites—the 58-lb. Solar Radiation 4 (SR-4), which was to have measured the intensity of solar X-ray radiation; 58-lb. Lofti 2 (for low frequency trans-ionospheric), which was to have studied the effects of the ionosphere on very low frequency (VLF) transmissions; and 8-lb. Surcal (for surveillance calibration), which was to have remained aboard the Ablestar in orbit and calibrated the accuracy of the Navy's space surveillance system net.

Other satellites were the 59-lb. Injun 2, designed by the State University of Iowa, which would have provided data on the Van Allen radiation zone, auroral phenomena influence on radio propagation in polar regions and the relationships between the belts and other phenomena and the 36-lb. Army Corps of Engineers calibration sphere, previously called Secor. The latter was to have provided range calibration data.

USAF-Douglas Thor first stage orbited satisfactorily. Exact cause of the Ablestar malfunction was not immediately known, but there were indications that stage separation was not clean and that Ablestar tumbled end over end.

McNamara Says U.S. Is Capable Of Destroying All Soviet Targets

By Katherine Johnsen

Washington—U. S. program for strategic bomber and missile striking forces is based on a "reasonably precise calculation" of the number, types, and locations of the aiming points in the Russian target system and the explosive yields required to ensure their destruction, Defense Secretary Robert S. McNamara reported last week to the Senate Armed Services Committee.

A 106-page version of McNamara's presentation was made public, after security clearance. It was mainly directed to the Fiscal 1963 program—which allocates $9.4 billion for strategic retaliatory forces (AW Jan. 22, p. 26)—but also projected some weapons systems through Fiscal 1967. He qualified that "the further into the future we project the programs, the more provisional they should be considered . . . simply because we cannot see clearly the course of future developments."

He said: "There is no question but that, today, our strategic retaliatory forces are fully capable of destroying the Soviet target system, even after absorbing an initial nuclear surprise attack." The program for future forces, he said, is based on the assumption that "the Soviet Union will eventually build a large intercontinental ballistic missile force." On this assumption, he added, "we must concentrate our efforts on the kind of strategic offensive forces which will be able to ride out an all-out attack by nuclear-armed ICBM's in sufficient strength to strike back decisively."

McNamara noted that the Soviet Union did not build the large manned bomber force which was anticipated several years ago as the major threat to the U. S. by the early 1960's.

Strategic Retaliatory Forces

Following is his evaluation of individual weapon systems:

• **B-52 bomber.** The build-up of the B-52 force to 14 wings, which will be completed by the end of 1962, will be kept at this level "for a period of years," McNamara said. Defending his decision not to use $515 million voted by Congress last year for an additional wing, McNamara said that this would increase the operational inventory of B-52s by only 7%.

He estimated the total cost of the wing at "well over $1 billion," including tankers, Skybolt missiles, and operation for five years. "For the same cost," McNamara commented, "we can buy and operate for the same period of time 250 hardened and dispersed Minuteman missiles or six Polaris submarines."

• **Bomber alert.** The program implemented last July to place 50% of the manned bomber force on 15-minute ground alert is essential to the survival of the bomber force and will be continued indefinitely, he said.

• **Reconnaissance-strike aircraft.** McNamara reported that a reorientation of the B-70 Mach 3 high altitude bomber to a reconnaissance strike vehicle is under active consideration. "Such an aircraft might be useful in providing damage assessment and reconnaissance information for the retargeting of the missile force during the attack period," he observed. "It would also have a capability to attack previously unlocated, undetected or incompletely destroyed targets."

• **B-70 bomber.** McNamara re-affirmed his decision to hold this program to a $1.3-billion development effort, using $180 million of the $400 million appropriated by the Congress for the present fiscal year for Fiscal 1963 and later financing. "Considering the increasing capabilities of ground-to-air missiles, the speed and altitude of the B-70, in itself, would no longer be a very significant advantage," he commented. He said, as a bomber, it is unsuited to the era of missiles because it would be vulnerable on the ground and does not lend itself to airborne alert measures.

• **Fixed Minuteman.** Although the program, calling for a total procurement of 800 Minuteman missiles through Fiscal 1963, will not fully utilize the production capacity already built, McNamara said he would continue expansion of production facilities. Because of crucial uncertainties, an option should be provided now for a much faster build-up of the Minuteman force.

• **Polaris fleet ballistic missiles.** In view of the large Minuteman program, McNamara said, a force of more than 41 Polaris submarines cannot be justified. Funding for this force will be completed in Fiscal 1964. He said that $44.5 million has been included in the Fiscal 1963 budget to start construction of a West Coast complex, including a missile assembly facility, for deployment of Polaris submarines in the Pacific.

• **Mobile Minuteman.** McNamara gave these reasons for canceling this program, after an investment of approximately $100 million: the mobile missile would be several times as costly as the fixed versions and would be much more expensive to operate, it would be less reliable and less accurate, it would be much more susceptible to sabotage, and would involve many difficult operational problems such as safety and protection from fallout.

Unlike the strategic retaliatory forces, McNamara pointed out, "the defensive mission does not lend itself to even a reasonably close calculation of requirements. Further, we must bear in mind that no matter how much we spend, we simply cannot in this day and age provide an absolute defense for the continental U. S." He listed numerous measures under way to reorient the defense system from capability to meet a bomber threat to an ICBM defense.

• **Semi-automatic ground environment** system (Sage). Installation of manual-control backup facilities, including fallout shelters for crews, will be continued during Fiscal 1963, McNamara reported, to afford an alternative means of controlling our air defense weapons in the event that all or most of the Sage centers are put out of commission. A feasibility examination indicated that the hardening of Sage to withstand a missile attack would be impractical.

• **Manned interceptors.** Dispersal of fighter interceptors to additional bases to improve survivability is being pushed, McNamara reported. He said no new aircraft would be ordered in FY1963.

• **Nike Hercules.** A total of $105 million is earmarked in the Fiscal 1963 budget to purchase additional missiles and high-powered radar to increase the number of missiles per battalion.

McNamara raised the prospect that the U. S. may be confronted in the future with an endless series of guerrilla or sublimited wars.

"It may well be that as long as we maintain the kind of forces which would make global nuclear war, and even local wars, unprofitable for the Soviet Union, we could deter them from starting such wars," he commented.

McNamara was critical of the three services for their past practice of planning and constructing their conventional war forces in line with their individual views as to how a future war might be fought.

Although the problem of Air Force airlift for the strategic deployment of all the services had been repeatedly studied over the years, McNamara said, when he took office a year ago "this nation still did not have the capacity to airlift the forces, particularly the Army's, that had to be moved."

As another notable example of imbalance, McNamara pointed to Army planning for a large-scale conventional war of long duration and USAF planning for a short nuclear war. He said the result was that the Army's unrealistically large requirements were never actually used as a basis for annual procurement programs, while the Air Force lacked sufficient stocks of combat consumables for conventional warfare.

Italy Studying MiG-17 Equipment Before Preparing Spy Charges

By Cecil Brownlow

Rome—Italian government was completing its investigation of available evidence late last week before lodging formal espionage charges against a Bulgarian air force pilot who crash landed his Soviet-built MiG-17 jet fighter into a field near an operational base for the 1,500-mi.-range Jupiter IRBM.

Italian officials said the pilot of the low flying aircraft made two radar-tracked passes over the North Atlantic Treaty Organization base at Gioia del Colle before apparently clipping a tree with his wingtip and then slamming into the ground. The aircraft, which came to a halt 16 mi. southwest of the Adriatic port of Bari, was equipped with both still and movie cameras. According to Italian spokesmen, the film was recovered from the largely-intact fuselage. The officials declined, however, to disclose just what the film revealed after it had been developed.

They also refused to state whether the aircraft had been equipped with external fuel tanks, a factor that could affect official Bulgarian statements denying the espionage charge on grounds that the MiG-17 could not have been on a planned reconnaissance mission because of its limited range.

The plane, tracked by radar over much of its flight path, is believed to have taken off from its home base of Gabrovnitza about seven miles from the town of Berkovica near Bulgaria's western border, traveled over Yugoslavia, Albania and a 130-mi. stretch of the Adriatic with between four and eight other aircraft at an altitude of approximately 40,000 ft. As the group neared the Italian coast, the MiG broke formation, went into a dive and began a low altitude run, apparently in hopes of avoiding radar detection. It then made its pass over the Italian coast en route to Gioia del Colle.

Round-trip distance between Gabrovnitza and Gioia del Colle is about 720 air miles, a range beyond that of a standard MiG-17 without fuel tanks. With the tanks, the aircraft could have made the flight with fuel to spare.

Although declining to discuss the matter of external tanks, one spokesman did say a large quantity of fuel was aboard the plane leading to the suspicion that it had a long range.

Soviet high-altitude reconnaissance flights have been made in the past over the territory of Western Allies in the Balkans and Alaska and possibly over other areas as well.

The Bulgarians—who say the pilot lost his way on a regular training flight, flew across the Adriatic and landed as soon as possible after reaching Italy—contend that the range of the aircraft was insufficient for such a reconnaissance mission. Papers found on the pilot, 22-year-old Sublieutenant Milusc Solakov, identified him as a member of the 2nd Squadron of the 11th Fighter and Reconnaissance Group based at Gabrovnitza.

An official Defense Ministry statement issued shortly after the Jan. 20 incident said "the aircraft was identified as a MiG-17 of Russian production supplied to the Bulgarian air force. . . . It carries the number 22 in large characters on the fuselage and the number 8434 on the control surfaces of the vertical stabilizer. It is armed with a 37 mm. cannon and a 23 mm. cannon.

"During the accident, the airplane lost a portion of its wing and was otherwise damaged, but the fuselage was almost completely undamaged with the exception of its underside.

"In fragmentary statements made by the pilot immediately after the accident, he stated that he fled from Bulgaria for the purpose of escaping from the political regime of that country, and he said he did not wish to return. He also asked not to be placed in contact with the Bulgarian authorities in Italy. It is not yet possible to express final judgment on the nature of this event. However, a protest charging violation of the Italian air space has been registered.

"From the technical examination, during which photographic equipment was found with which aerial photographs can be taken, and from the formal questioning to which the pilot will be submitted as soon as his physical condition permits, it will be possible to draw precise conclusions as to whether the evidence points to a case of aerial espionage."

The incident, the statement concluded, had considerable international ramifications, both political and military, and by late last week the technical evidence appeared to be mounting that the pilot's statement was a planned cover story for use in event of capture. A Defense Ministry spokesman said espionage charges would be made within a few days, adding that the government was proceeding slowly in order to be sure of its case before taking formal action in the matter. Under Italian law, the maximum sentence upon conviction could be 30 years.

The Bulgarians say the pilot became disoriented due to bad weather and made his flight across the Balkans and the Adriatic while lost. Italian authorities point out, in turn, that he flew over the Italian coast shortly before 1:30 in the afternoon in near perfect weather.

In the crash itself, Solakov was thrown from the cockpit and was found lying unconscious on the ground by the first person to reach the scene. Apparently, he made no attempt, or had no time, to use his ejection seat. Injuries included a fractured collar bone and a possible skull fracture. He was taken first to a public hospital in the near-by city of Aquaviva delle Fonti, but officials planned to have him transferred to a military installation at Bari as soon as his condition permitted.

MiG Comment at IAS

New York—Complicated rules for engagement of hostile aircraft may have caused North Atlantic Treaty Organization forces to fail to shoot down the Bulgarian air force MiG-17, a speaker implied at the Institute of the Aerospace Sciences meeting here.

K. C. Black, president of Scientific Analysis Corp., discussing NATO air defense in Europe, noted that the engagement rules, which were not even formulated until the summer of 1960, "are several pages long and hard to understand."

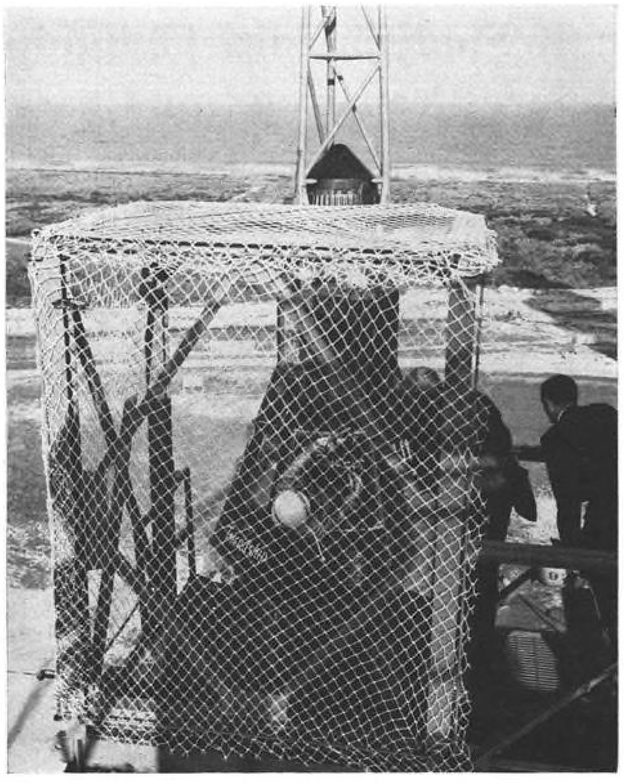
Black said that NATO forces "could have shot him (the MiG-17) down any one of four times" before the aircraft crashed near Gioia del Colle.

Aerojet to Produce Algol 2 Solid Motor

Cape Canaveral, Fla.—New first stage for National Aeronautics and Space Administration's solid-propellant Scout space vehicle, which will produce almost 25% more thrust than the motor now in use, will be developed by Aerojet-General Corp.

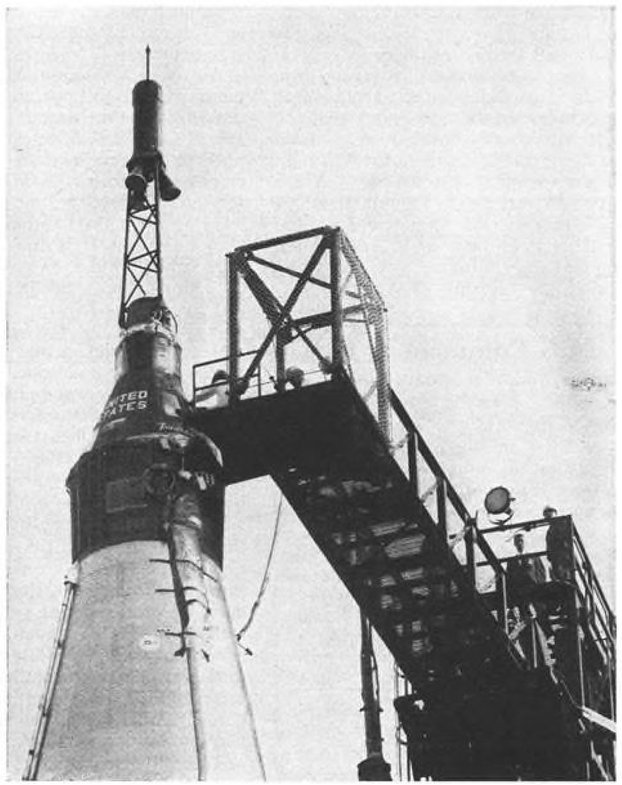
NASA has ordered 13 of the new Algol 2-A boosters which will use a new propellant cast in a new grain design to deliver a total impulse of almost five million pounds/second, compared with the four million produced by the present Algol 1. The new stage also will use a lightweight plastic nozzle instead of the present steel nozzle. It will have a mass fraction of 0.90 compared with 0.84 for the Algol 1.

Space Propulsion Division of Aerojet's solid rocket plant at Sacramento, Calif., will begin a limited proof-testing program early this year. New NASA contracts also call for one more Algol 1 unit, the first of which has been delivered. NASA's original order was for nine engines. Algol 1 has fired successfully in 12 flight tests and all ground test firings.



Support Teams Check MA-6 Capsule, Test Land Recovery

Astronaut John Glenn, who will make the manned Mercury orbital flight, is shown entering Friendship 7 capsule during prelaunch activities at Cape Canaveral, Fla. (top, left). Closeup of capsule atop booster is shown in photo at top right and lower right. Below, Canaveral pad safety supervisors, a fireman and army mechanics simulate spacecraft recovery. Three LARC vehicles and an M-113 armored personnel carrier are used in the exercises in support of the project Mercury program in the event of an abort in which case the capsule might land on the cape.



Manned Space Surveillance System Urged

Concept for a manned, global surveillance system in which orbiting space vehicles would gather military intelligence with a mixed array of electronic and photographic sensors was outlined to high Air Force officials at a recent briefing at Rome Air Development Center by two avionics companies.

The two, Litton Industries and Airborne Instruments Laboratory, are part of a team of aerospace/avionics companies currently presenting data to Department of Defense, federal legislators, other government officials and the Air Force on the need for manned-machine systems to gather intelligence from space to support operational requirements of aerospace weapon systems. Projected to use state-of-the-art hardware and techniques, this broad system probably would not emerge before the late 1960s.

Indications are that these ideas are receiving favorable response from Air Force officials and some congressmen who have attended briefings given in recent weeks by the team, which is spearheaded by North American Aviation.

The briefings are being held in Washington, Downey, Calif., and at key Air Force installations.

Groups which have been briefed include the space and astronautics committees of both houses of Congress, the five-man scientific staff of the National Space Council and Strategic Air Command.

The global surveillance system being proposed is an outgrowth or follow-on to a series of Air Force studies on this subject conducted under Study Requirement 178 (AW Feb. 27, p. 22).

The proposed system envisages a number of armed multi-man, earth orbiting, maneuverable aerospace vehicles in orbit, for perhaps weeks in duration, performing surveillance functions now provided or expected from aircraft and reconnaissance satellite systems.

It might offer long-lead-time photos and other data about hostile military buildups, missile and aircraft deployment and other key military information although it is not expected to usurp the function of Midas infrared satellites in giving early warning of a ballistic missile attack.

The global surveillance system would, of course, provide invaluable inputs on hostile military steps taken preparatory to ballistic missile assault.

At least certain Air Force officials are sympathetic to the proposals, industry sources indicate. Even if Defense Department does not give the go-ahead to the Air Force for such a system now, the Air Force likely will keep the system, or related ones, alive on a study basis, these sources believe.

In a related move, the Air Force's Space Systems Division recently sought approval from Systems Command headquarters of a planning study for an orbital weapon system, an outgrowth of several earlier study requirements including SR 178. Orbital weapon system is envisioned as a manned space system combining, in addition to surveillance, several capabilities including launch of missiles from orbit and bomb damage assessment.

Space Systems Division's orbital weapon system proposal is one of five studies it suggested to Systems Command as topics for Air Force Planning Studies (PS). The planning study concept is a successor to the Air Force's Study Requirement (SR) category and corrects what many felt were abuses in the latter. All planning studies will be funded, there will be no cost sharing and the number of parallel planning studies will be limited to two.

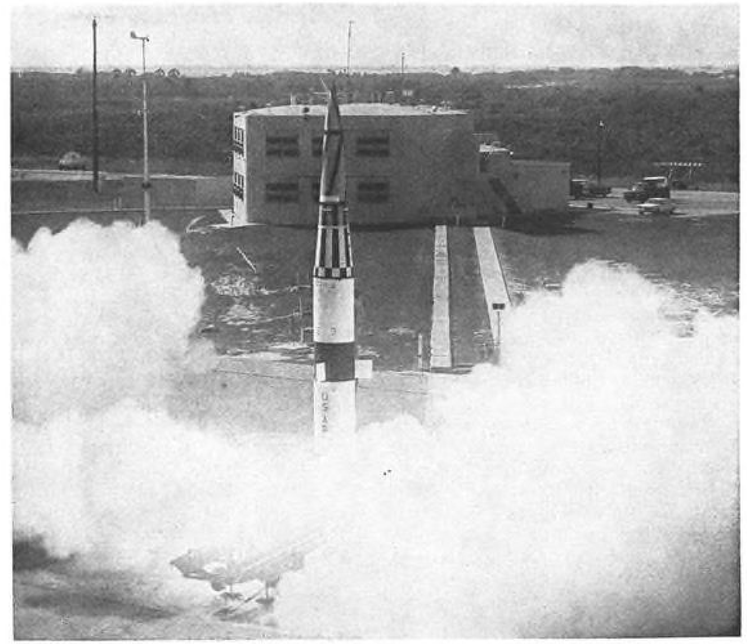
The first of five proposed topics, orbital defense system (AW Jan. 22, p. 23) was funded recently by Systems Command. It will be out for open industry bidding soon.

Participation in the orbital weapon system study, if it is approved by Systems Command headquarters, will be restricted to a competition among those companies that had one of the earlier family of study requirements from which the proposed planning study springs. This series includes, besides SR 178, SR 199A—Positive Control Bombardment System (AW Dec. 5, 1960, p. 27), the so-called "bombs in orbit" studies, which were SR 79821—Advanced Earth Orbital Weapon System, Low Orbit—and SR 79822,—Advanced Earth Orbital Weapon System, High Orbit (AW Apr. 10, p. 26)—and SR 181, a low-orbit weapon system.

The list of eligible companies would then include Boeing, General Electric, Martin, North American, Northrop and Raytheon.

While in some respects the global surveillance system may be regarded as duplicating the duties of the Samos photographic reconnaissance satellite system, it is actually far broader in scope. The intended duties of the Samos system would constitute only about a tenth of those of the global surveillance system as it is now being advanced by North American and its associates.

The latter system would carry a mix



Latest Pershing Configuration Tested

Latest configuration of the Army-Martin Pershing field missile is test-fired at Cape Canaveral, Fla. The missile attained a greater range than any previous Pershing test flight. This version is shorter than earlier models and is closer to that of operational Pershings. The firing, made from the missile's transporter-erector-launcher, was conducted by a Martin Marietta crew and personnel from Army Ordnance Missile Command.

of sensors, including infrared, radar, photographic and television cameras for selective use under varied climatic and atmospheric conditions, as well as electronic intelligence gear. It would gather and make available, its advocates are understood to believe, a wealth of indispensable data for the country's weapon systems.

One of the key points of controversy in the current global surveillance system concept, and in earlier Air Force studies, is the need for men in the system. North American considered the requirements of the system and is believed to have concluded that men are essential to the satisfactory performance of the system's missions. Man could add a discretionary and human judgment capability not available to an unmanned system. Others believe men would not justify the expense of including them in the system.

Companies cooperating in current efforts to enlist support for the system concept in the hope of stimulating an Air Force requirement for development of such a system and the probable role they would play in a combined effort are:

- **North American Aviation**—spacecraft and systems integration.
- **Litton Industries**—guidance and data-processing and data communication.
- **Texas Instruments**—infrared and radar.
- **Chicago Aerial Industries**—photographic equipment.
- **Sperry Gyroscope**—countermeasures.
- **Airborne Instruments Laboratory**—passive countermeasures.
- **Melpar**—electromagnetic sensors.
- **Tapco Group,** Thompson Ramo Wooldridge—power and environmental controls.

Award of the Apollo contract to North American apparently has not dampened its interest in global surveillance. The company is now building a full-sized mockup of a global surveillance vehicle's interior which will have mission simulation capability. It is reported ready to invest perhaps as much as $500,000 of its own funds in developing the operating simulator, and in promoting the surveillance system idea.

Meanwhile, there is growing feeling among avionics companies that any global surveillance system which may eventually evolve will require development and coordination of highly sophisticated optical and electronic sensors. Despite present sensor advances for satellite reconnaissance, Air Force has publicly stated (AW May 22, p. 26) that greater progress will be needed in meeting needs of satellite reconnaissance in the next decade.

A number of Air Force and company funded development programs intended to meet some of these needs are now under way throughout industry. The Data Systems Division of Litton, which is the principal avionics participant in the North American global surveillance system, recently won a $225,000 Rome Air Development Center contract for a surveillance program known as MUSIC (Multi-Sensor Intelligence Correlation). Space General Corp. has investigated the use of differential Doppler techniques for a high resolution satellite carrying radar (AW Apr. 17, p. 23) under contract to Aeronautical Systems Division.

Aerospace Corp., which evaluated studies of a global surveillance system conducted last year by industry felt that work should be begun on sensors for such a system now.

Most of the preliminary design efforts conducted by the North American team under the old SR 178 contemplated use of existing techniques and hardware in a system compatible with boosters expected to be available late in the decade. Even if the combined efforts of this team are successful in convincing the Department of Defense to go ahead with an industry competition for a development program in the near future, it is unlikely that an implemented system could be operational before the late 1960s.

Late last year, the Air Force was confronted with the question of how it should proceed with the global surveillance system concept. Four separate studies were conducted for it by aerospace/avionic companies under SR 178. Two of these studies, conducted by Martin and General Electric, were funded; the remaining two by North American and Boeing were not. Study reports were submitted late last summer (AW Sept. 18, p. 28) to Aeronautical Systems Division and an evaluation completed weeks ago.

The Air Force's failure to move forward on the project is explained by industry sources as an indication that the work was approaching the development phase for which the Air Force does not have funds.

A report to guide Secretary of Defense McNamara in deciding how much of a military requirement exists for a manned, maneuverable space vehicle was being prepared this month in the office of the Director of Defense Research and Engineering (AW Jan. 1, p. 15). It likely will play a large role in deciding how Defense Department will react to current global surveillance proposals.

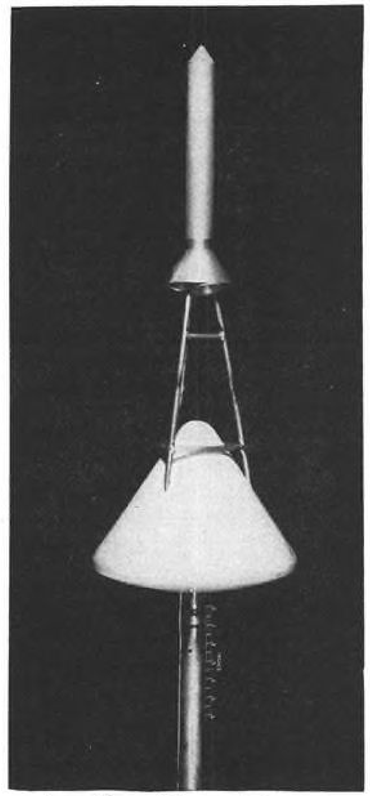
After McNamara's recent visit to Seattle to review the Dyna-Soar program, Boeing sharply cut back its advanced studies of the use of the Dyna-Soar vehicle for military missions like reconnaissance, bombing, etc. Boeing had a large share of both funded and unfunded Air Force studies on global surveillance, orbital weapon systems (SR 178, SR 79821, 79822) under its Boss-Wedge program (AW Apr. 10, p. 26).

It is expected that each satellite, or spacecraft, in the global surveillance system would be capable of deorbiting, re-entering the earth's atmosphere and with the aid of glide capability land in prescribed areas. Keeping satellites in orbit for extended periods would decrease the number of boosters required for the system, cut cost considerably. Cost estimates calculated by the team are reported to indicate that the proposed system could do the same job as equivalent airborne and satellite systems at less cost.

The present system concept was synthesized from a consideration of the needs of each subsystem, placing as few restraints on them as possible, rather than attempting to build a system around a specific spacecraft design.

In one of the earlier studies of a global surveillance system, an extensive in-orbit maneuvering capability was anticipated to permit the orbiting surveillance craft to swoop down from some polar orbit, perhaps about 300 mi. to as low as 100 mi. to make detailed close-view reconnaissance. Some such capability may be built into the currently proposed system, and would have the added advantage of making countermeasures and attack against the spacecraft more difficult.

Several of the leading names in aerial photography and photographic reconnaissance participated in the four industry SR 178 studies, indicating the high priority placed on these sensors. Besides Chicago Aerial working with North American, Hycon assisted Boeing, Fairchild Camera's Defense Products Division worked with General Electric, and RCA's Astro Electronic Products Division is believed to have provided Martin with photographic camera guidance.



Apollo Abort Tower

Aerodynamic stability of the Apollo abort tower is being tested in wind tunnel at Langley AFB. Tower model is attached to model of Apollo command module which houses crew, mission control, life support and re-entry systems.

Five-Stage Scout Set for First Firing

Cape Canaveral, Fla.—Scout solid propellant launch vehicle was scheduled to be used in a five-stage configuration for the first time in a re-entry heating experiment late last week from Wallops Island, Va., with two stages taking the payload to altitude, and three driving it to a re-entry velocity of 27,800 fps. This is equivalent to the speed of re-entry from orbit.

The flight was to be the eighth in the National Aeronautics and Space Administration-Chance Vought Scout development program, being conducted for the agency by its Langley Research Center.

Purpose of the flight was to measure heat transfer to the nose cap of a re-entry cone mounted to the fourth stage of the Scout vehicle. The cone, 3 ft. long, a base diameter of 20 in. and nose diameter of 17 in., will house fifth stage, a 17 in. spherical solid propellant rocket motor developed at Naval Ordnance Test Site at China Lake, Calif.

First two stages of the Scout were to boost the experiment package to an altitude of about 135 mi. Each stage of Scout is blast-separated from the vehicle by ignition of the next stage. The final three stages were to coast about 705,000 ft., nose over, and drive into the atmosphere.

The nose cap was expected to survive a few seconds, and then melt. The melted cap and its frangible supporting structure were to be blown away by the airstream, exposing an ablative Teflon cap expected to protect the payload during the final re-entry phase.

Telemetry data was to be stored on board so that when the influence of the ion sheath ended, data could be transmitted to Atlantic Missile Range and shipboard receivers.

Secondary experiment was inclusion of a camera pod attached to the second stage to photograph the exhaust pattern of the stage. The pod was to be jettisoned at second-stage burnout. Recovery was to be attempted by Navy air and surface units.

First stage Aerojet Algol motor was scheduled to burn 41.3 sec. and to cut off at 50,000 ft. All stages were to coast to 125,000 ft., and the second stage Thiokol Castor was to ignite at 63.53 sec. Burnout of the Castor was to be at 111.89 sec. at an altitude of 265,000 ft. After reaching a 705,000 ft. apogee and nosing over, the third-stage Hercules-Allegany Ballistic Laboratory Antares was to ignite at 292.75 sec., and to burn out at 332.8 sec. when the payload was at 675,000 ft. Fourth-stage ABL Altair ignition was to be at 352.8 sec. and at 640,000 ft. Burnout was to be at 393.83 sec. at 490,000 ft. The spherical motor was to ignite immediately, and burn 43 sec.

Primary research area was to be from 255,000 to 150,000 ft., and Langley was to attempt to photograph a meteor-like trail during this part of the flight.

Titan 2 Stage Tested

Cape Canaveral, Fla.—Complete second-stage Aerojet-General engine for the USAF-Martin Marietta Titan 2 missile, which will begin flight tests here in about six weeks, recently was fired 30 times in six working hours.

The 100,000-lb.-thrust engine was fired 22 times in 5 hours on one work shift and eight times in one hour on the next shift at Aerojet's liquid rocket plant in Sacramento, Calif. The engine uses storable, hypergolic propellants — aerozine-50, which is a 50-50 blend of hydrazine and unsymmetrical dimethyl hydrazine, and nitrogen tetroxide. Nozzle has an expansion ratio of 45 to 1 compared to 25 to 1 for the second-stage engine in the Titan 1.

Booster Malfunction Mars Titan 1 Firing

Vandenberg AFB, Calif.—Malfunction in flight caused the first stage of a USAF-Martin Titan 1 to shut down automatically about 80 sec. after it was raised from its protective silo and launched over the Pacific Ocean in a demonstration of launch, support and checkout systems.

The missile landed only 400 miles downrange but an Air Force Systems Command official said the primary objectives of the test were achieved. The checkout and launch were conducted by a Systems Command crew and observed by Strategic Air Command crews being trained to staff operational Titan squadrons. Range support was provided by the Pacific Missile Range.

News Digest

De Havilland Comet operators are checking pilots' artificial horizon indicators on the basis of a joint British European Airways/Ministry of Aviation recommendation following investigation of a BEA Comet takeoff crash Dec. 21 at Ankara, Turkey. The investigation team found a malfunction in the indicator which could have given the pilot false attitude information. The investigation is continuing.

Prototype Nike Zeus discrimination radar is under construction at Kwajalein Atoll in the Marshall Islands and another is nearing completion at White Sands Missile Range, Maj. Gen. August Schomburg, chief of Army Ordnance Missile Command, reported last week.

Eastern Air Lines last week asked the Civil Aeronautics Board to disapprove the charter of the newly-formed National Air Carriers Assn. (AW Jan. 15, p. 40) composed of supplemental airlines attempting to break away from the parent Independent Airlines Assn. Eastern claims IAA owes it $55,037 for an Air Travel Plan account, and it feels that if IAA—now in debt to general creditors for $95,000—is further weakened by loss of the breakaway airlines' dues, it would be unable to pay.

USAF-Boeing solid-propellant Minuteman was successfully launched from a silo for the fourth consecutive time at the Atlantic Missile Range Jan. 25. It flew about 3,200 mi.

Two Navy F4H-1 tactical fighters have been loaned to Air Force Tactical Air Command for 120 days for evaluation studies and orientation of pilots. These aircraft, designated the F-110A, are similar to the McDonnell F-110 which will be purchased in quantity by the Air Force (AW Jan. 22, p. 26).

Ruby optical maser (laser) for the first time has been operated continuously, instead of in brief pulses, by Bell Telephone Laboratories using new technique which reduces power required for optical pumping by a factor of 10:1.

Lewis to Succeed Pace

Frank Pace, Jr., will step down as chairman of General Dynamics Corp. sometime in April (AW Dec. 11, p. 25) and will be replaced as chief executive officer by Roger Lewis, executive vice president—administration, for Pan American World Airways. Earl D. Johnson, now General Dynamics president, will assume the chairmanship and Lewis will become president.

CAB Faced With Vital Merger Decision

American-Eastern combine would have wide effect on troubled industry; opposition, close scrutiny due.

By L. L. Doty

Washington—Impact of the proposed merger of American Airlines and Eastern Air Lines on the over-all structure of the U.S. trunk air carrier industry will be the pivotal factor in the Civil Aeronautics Board investigation of the case.

Since the proposed merger would profoundly alter the face of the industry, realign the relative competitive strength of each of the larger airlines and create a wider spread between transcontinental and regional carriers, the proposal is not likely to receive the calm reception given the United-Capital and the proposed Continental-National mergers.

Already, strong carrier opposition to the American-Eastern union is being shown. Congress, where concern over the proposed merger of the New York Central and Pennsylvania Railroads has been expressed, will take more than a passing interest in the case. Justice Department will undoubtedly scrutinize closely any possible anti-competitive or monopolistic aspects of the proposed merger.

Clearly, the challenge to the CAB is one of the most critical it has ever faced, because its decision will have far-reaching effects on the industry. The merger, which would produce the largest airline in the U.S. with potential revenues almost double those of United—currently the largest U.S. airline—highlights the plight of the industry.

It pinpoints the price of excessive competition, which in less than two years plummeted Eastern from one of the most profitable of all air carriers to one deeply in the red. It depressed net income of American from 11.7 million in 1960 to $6,833,000 last year. Equal to 80 cents per share, these earnings fall 20 cents a share short of covering American's $1 a share common stock dividend.

Although American will be the surviving carrier, financial experts see nothing in Eastern's financial stature to suggest it was forced into the merger. Eastern's balance sheet and income statement reflects the strains of buying and introducing jet equipment and experiments in new types of service, such as the air shuttle. Even so, its cash generation is still high and its deficits, in effect, represent investments which could pay out many fold in the future.

Prime reason for the merger, according to the official statement issued by C. R. Smith, American president, and Malcolm A. MacIntyre, Eastern president, is elimination of duplicating costs and better utilization of facilities and equipment.

New York financial sources are speculating that Eastern may have been motivated as well by one of two other possible considerations:

- **Long-haul versus short-haul.** Eastern may be facing a dilemma of being both type of carrier—but not enough of either—in an era of equipment change which intensifies the long-haul advantage. With no way out in prospect otherwise, Eastern turned to merger.
- **Psychological effect.** Some sources assume both carriers are aware of the tough fight likely to win CAB approval. Even taking the most pessimistic view—that disapproval is foreordained—this view holds that the proposal still might have significant effect in focusing the attention of the Board on the problems of the two carriers because of recent route awards, and especially on Eastern's competitive situation because of the certification of Northeast as a third New York-Miami carrier.

The two officials estimated that the merger will result in ultimate annual savings of some $50 million and will reduce future capital requirements by some $75 million.

Nevertheless, the Board must now ask itself whether other carriers may be headed for financial difficulties which could be compounded by mergers that would toughen competition. It must also make a penetrating analysis of the long-range effects the American-Eastern merger and other future mergers will have on air transportation.

In the final analysis, the merger drive was initially prompted by the Board (AW Jan. 22, p. 41). The industry is responding in the only manner possible: proposing mergers that are designed to reinforce financial structure and profit capability.

Size of the combined companies would be impressive by airline standards. But it still would fall far short of being an industrial giant in terms of general business. In gross sales, the combined airlines would rank 77th among all industrial firms in the U.S. It would rank fourth in the transportation field, led by the Pennsylvania, Southern Pacific and New York Central railroads.

In terms of capital investment, it would rank 140th in all categories of business, 22nd in the transportation industry. On the basis of the combined net income of American and the net loss of Eastern in 1960, it would rank 375th—headed by 244 industrial companies, 50 utilities, 24 railroads, 27 merchandising firms and 29 banks.

Within the airline industry, however, the merged company would take an easy first position

American now operates 16,217 nonduplicated route miles, Eastern 19,236 as of Dec. 31. Eastern's total will rise when it inaugurates service this spring to Buffalo and Toronto. Few of the carriers' routes parallel one another, so total route mileage would be near 35,000. United operates about 17,400 unduplicated route miles.

Of the 148 markets served by the two airlines, only 30 are served jointly and these are generally criss-cross points. Thus, competition within the industry is not as sharply reduced as a first glance might indicate. The combined carrier will have but two monopoly routes. The two routes are Washington-Charleston, W. Va. and Louisville-Nashville.

It will operate one route which is now served by nine airlines, three routes served by eight airlines, two routes served by seven carriers and six routes by six airlines. The merged company would serve 37 of the top 50 markets in the U.S. United serves 36. It would reach 19 of the leading 25 markets, the same number now served by United.

American employs 23,600 people, Eastern 17,000. United now employs an estimated 30,000 people.

The merged company may run into a jurisdictional dispute with mechanics who are now represented by Transport Workers Union on American and International Assn. of Machinists on Eastern.

Crew complements are the same on both carriers. Air Line Pilots Assn. indicated last week that it foresaw no unusual problems in the merger. Flight Engineer International Assn.'s contract with American remains in effect until 1963. Contract with Eastern is currently open on wage issues.

The combined revenues of the two companies in 1960 totaled $722.2 million. Combined revenues of United and Capital, which formally merged in June of last year, amounted to $480.8 million.

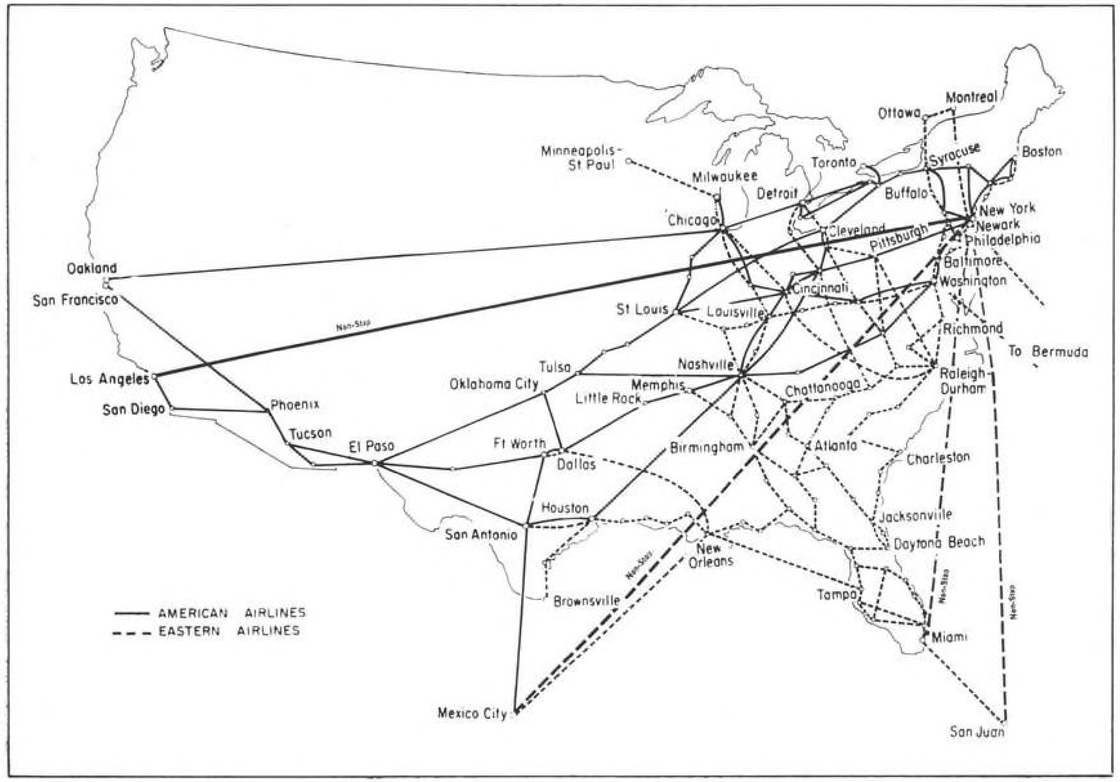
Combined assets of Eastern and American as of Dec. 31, 1960 amounted to $851.5 million, invested capital was $263.9 million and net income for both airlines totaled $8.1 million.

Ticket offices and other ground facilities would be combined at the 30 points served by both airlines as a means of curtailing costs. The merged company will contract with an engineering research firm for a full evaluation of its maintenance and overhaul bases to determine which can be combined or eliminated.

A reduction in fleet size is anticipated, although the merger would eliminate certain equipment shortage problems which, for example, forced Eastern to lease two Lockheed 1049 Constellations from Pan American to enable it to conduct the Boston-New York-Washington shuttle service.

American's fleet now consists of 49 Boeing 707 and 720 turbofan transports, 30 Lockheed Electras, 19 Douglas DC-7s, 50 Douglas DC-6s, 21 Convair 240s, 14 Douglas DC-7 freighters and two of the 15 Convair 990 turbofan transports it has on order. The airline has also ordered 25 Boeing 727 aft-mounted turbofan transports.

Eastern's fleet, one of the industry's most varied, consists of 15 Douglas DC-8 turbojet transports, 15 Boeing 720 turbojets, 39 Lockheed Electra turboprops, 48 Douglas DC-7Bs, 33



COMBINED ROUTE MAP shows relatively little American-Eastern route duplication. Some of their major nonstop services are omitted.

American, Eastern Main Nonstop Routes

American Airlines	Eastern Air Lines
New York—Washington	New York-Washington
New York-Boston	New York-Boston
New York-St. Louis	New York-St. Louis
New York-Dallas	New York-Houston
New York-Los Angeles	New York-Miami
New York-San Francisco	New York-New Orleans
New York-Chicago	New York-Atlanta
New York-Detroit	New York-Tampa
Baltimore/Washington-Los Angeles	New York-Jacksonville
Chicago-Los Angeles	Chicago-Miami
Chicago-San Francisco	Chicago-Tampa
Chicago-Boston	Chicago-Minneapolis
Chicago-Washington	Chicago-Atlanta
Chicago-Phoenix	Detroit-Miami
Chicago-Dallas	Dallas-New Orleans
Dallas-Los Angeles	Boston-Miami
Dallas-San Francisco	Miami-Pittsburgh
Boston-Los Angeles	Boston-Washington
Los Angeles-Philadelphia	Philadelphia-Miami
Los Angeles-Cleveland	Cleveland-Miami
Los Angeles-St. Louis	Washington-Miami

Industry Cautious on Merger Proposal

Initial reaction to the American-Eastern merger proposal was cool but cautious, and one of the first to comment was Charles C. Tillinghast, Jr., Trans World Airlines president, who himself had talked merger with Eastern (AW Jan. 15, p. 38).

Questioning whether the merger would aggravate competitive imbalances and industry economic problems rather than relieve them, Tillinghast said:

"Together, American and Eastern would represent a heretofore unseen concentration of economic power. They not only would constitute approximately 35% of the entire trunk airline industry, but in certain major markets they would represent well over half of the industry. These circumstances warrant the most careful consideration in terms of congressional and regulatory policy before the merger is approved."

This view was echoed by Rep. Emanuel Celler (D.-N. Y.), chairman of the House anti-trust subcommittee, who ordered the subcommittee staff to make a preliminary study of political, economic and legal consequences of the merger to help determine whether to hold a full-scale inquiry.

Neither he nor Sen. A. S. Mike Monroney, (D.-Okla.), chairman of the Senate aviation subcommittee, explicitly opposed the move, however.

"I don't know all the facts and figures so I would reserve my final position," Sen. Monroney said, "but I've heard nothing at this time to indicate that a greater degree of public service would be rendered by combining two of the largest airlines into a single airline."

Lockheed Super Constellations, 4 1049C Constellations in freighter configuration, 7 leased Douglas DC-6Bs, 39 twin-piston-engine Martin 404s and 20 Convair 440s. In addition, the company has ordered 40 Boeing 727s.

Future equipment plans are not firm in light of the question of CAB approval, but one likely course would be rapid retirement of virtually all piston equipment. All current jet orders probably would remain in effect, and since both Eastern and American have shown interest in a small jet transport (AW Nov. 6, p. 41), an order for the British BAC 111 or the Douglas Model 2086 might result eventually.

Under the merger plan, C. R. Smith would be chairman of the board and chief executive officer. MacIntyre would be president and, in the absence of Smith, would serve as chief executive officer.

Board of directors would consist of 24 members, 16 from American and eight from Eastern. For each share of Eastern stock held, Eastern stockholders would receive 1.3 shares of American, plus warrants to purchase an additional one-third share of American at $28 per share. Warrants would be effective for five years from time of merger.

The proposed merger was filed with the CAB immediately following approval of the two boards of directors, which met simultaneously last Tuesday. Plans for the merger have been under extensive discussion for many months.

C. R. Smith, William J. Hogan, American's executive vice president and Manley Fleischman, an attorney and director of American represented American in the talks. Eastern was represented by MacIntyre, Harper Woodward, an Eastern director who represents Laurance S. Rockefeller, and Rockefeller himself, who has a large invested interest in Eastern.

Captain E. V. Rickenbacker, former Eastern president and currently its board chairman, did not attend all the talks but was kept informed of the progress.

In a joint statement, the two airlines emphasized that the merger is "designed to provide a stronger transportation system which can survive today's financial crisis, meet its obligations to the public and cope with the technological demands of the future." They added:

"Today's trunkline systems are in large part obsolete as a result of new technology. Basically, they were designed around the abilities of small piston-engined airplanes, such as the DC-3. They are not best designed to secure most effective use of large jet aircraft. Further, the industry is suffering from over-production and over-duplication, both in the air and on the ground."

Arguments for the merger are strong in view of the industry's current fiscal problems. The case for this and other mergers can be summarized this way:

- **Opposition to subsidy** as a means of supporting trunklines through periods of even intense financial crisis is strong both in industry and government circles. A carrier in dire financial straits thus has but one recourse—merger. Capital's request for subsidy evoked the CAB "dismemberment" investigation.
- **Industry continues to report** inadequate earnings. This is attributed by many airline observers to duplication of routes, services and ground and operating facilities. Attempts by individual carriers to pool certain activities have not been too successful because of differences in sales and operating methods.
- **Drive for higher fares** as a means of bolstering revenues has all but subsided because of growing opposition. But need for higher fares will exist as long as wasteful duplication exists.
- **Excessive competition** could be eliminated by redistributing routes to air carriers now holding operating certificates, but this is fully impractical because of the outstanding stock and security investments in the systems.
- **CAB cannot dictate mergers** for the purpose of creating an ideal route system, since economic considerations of management, under a private enterprise system, is the final determination of what is best for the companies.

The American-Eastern merger by itself would not necessarily create an ideal route system for domestic air transport, but would be a major step forward.

To begin with, the merger would, if the National-Continental merger is approved, provide the U. S. with six transcontinental airlines—American, United, TWA, Continental-National, Northwest and Delta—each competitive but concentrated in specialized markets.

The three regional carriers remaining —Braniff, Western and Northeast— would be comparatively small, and would be in direct competition with the transcontinental carriers on many major routes. This would create a severe imbalance in big markets, but would fulfill necessary regional services.

If Hughes Tool Co. regains voting control of TWA, as it may attempt, Northeast would undoubtedly then be merged into TWA. In such an event, only Western and Braniff would remain as carriers without terminal outlets on both coasts, leaving the industry short of an ideal route system.

American, Eastern Operating Figures

(In thousands)

	For the 12 months ending Nov. 30, 1961		For the 12 months ending Nov. 30, 1960	
	American	Eastern	American	Eastern
Operating revenues	$412,676	$262,158	$421,723	$263,609
Operating expenses	393,746	281,441	402,015	267,185
Operating profit (loss)	18,930	(19,283)	19,708	(3,576)
Net profit (loss)	8,192	(9,059)	12,531	1,731

MATS Rate Minimums Lowered by CAB

Washington—New minimum rates for Military Air Transport Service international contract operations have been set by Civil Aeronautics Board and become effective Feb. 1.

The new rate minimums (AW Oct. 2, 1961, p. 42) are lower for all passenger and cargo operations except one-way passenger charter flights, which retain the present rate of 4.2 cents per passenger mile. CAB said it retained this rate over the objections of some carriers who felt it would not cover the cost per mile on the backhaul ferry leg—the return trip with no passengers.

CAB said these carriers generally overlooked the opportunity they would have to sell unused capacity on the backhaul trip to other charters. This possibility, CAB said, justified retaining the present rate even though it was moderately below the rate level indicated by costs.

Other Rates

Rates which CAB set in other categories include:

- **Round-trip passenger charters:** 2.75 cents per passenger mile. CAB said it determined that individual carrier's unit costs per passenger mile fell within 5% above and 4% below this rate. The Board said it recognized that jet operators might make more money than piston aircraft operators under the rate, but, in any case, the 2.75-cent rate would cover the fully allocated operating costs of any carrier.
- **Round-trip cargo charters:** 12.5 cents per ton-mile. The Board said it relied heavily on projected operating costs for Canadair CL-44 operations to reach the rate. CAB noted that the rate would have been much lower—12.12 cents per ton mile—if it had not considered L-1049H Constellation costs. Under the new rate the L-1049H operators should be able to make a slight profit, CAB said.
- **One-way cargo charters:** 21.5 cents per ton-mile. CAB said opposition to the rate was similar to that of the one-way passenger rate. CAB said the rate was fair if carriers took into consideration sales possibilities for the backhaul ferry leg.
- **Convertible cargo round trip:** 15.0 cents per ton-mile. The Board said it took into consideration reduced capacity during the cargo leg of the flight resulting from having to carry passenger equipment on both legs when it raised the rate from the proposed 13.8 cents per passenger mile.

CAB also ruled on proposed modification of the definition of "round trip" for rate making purposes. Three proposals were made to end the problem of the "open jaw" flight—a round-trip flight during which the aircraft has to travel empty for a distance without revenue. Proposals as adopted are:

- **Round-trip minimum rate** will apply to trips which originate and terminate at points within 250 mi. of each other.
- **A 50-mi. ferry leg** at no charge. This provision was designed to give MATS some flexibility in planning its operations at a minimum cost to carriers. CAB said it rejected arguments against the provision because carriers usually have to move aircraft to a military base to pick up charters. At the end of a round-trip charter, CAB said, it should make little difference to a carrier's costs if the charter terminates at a point that is within 50 mi. from where it started.
- **Flights having a ferry leg** under 1,500 mi. will be paid 75% of the regular minimum rate for either passengers or cargo. Original proposal had provided for a ferry leg of under 500 mi. at 50% of the regular rate. CAB said it changed the proposal after complaints by carriers that the discount was excessive and MATS argument that the original plan deprived MATS of needed flexibility.

CAB also changed minimum permissible cabin loads for two aircraft types. Cabin load is the minimum number of passengers or tons of cargo permitted for calculating the price of a given charter. Boeing 707 minimum passenger load was lowered from 160 to 159 seats and L-1049A Constellation aircraft minimum passenger load was reduced from 95 to 88 seats, so these aircraft would not have a competitive advantage over DC-7s.

Similarly, the L-1049A's minimum cargo load was trimmed from 15 tons for convertible aircraft and 18 tons for all-cargo aircraft to 12 and 15 tons respectively.

CAB did not set minimum cabin loads for DC-8 or Convair 880 aircraft because they are not presently used in MATS charter operations.

MATS Rate Comparison

	Existing rates	New rates as proposed	New rates as adopted, effective Feb. 1
Round-trip passenger charter	2.9 cents per passenger-mile	2.7 cents per passenger-mile	2.75 cents per passenger-mile
One-way passenger charter	4.2 cents per passenger-mile	4.2 cents per passenger-mile	4.2 cents per passenger-mile
Round-trip cargo charter	13.75 cents per ton-mile	12 cents per ton-mile	12.5 cents per cargo ton-mile
One-way cargo charter	22.5 cents per ton-mile	21.5 cents per ton-mile	21.5 cents per ton-mile
Convertible cargo round	16.5 cents per ton-mile	13.8 cents per ton-mile	15.0 cents per ton-mile

Two Major British Independents Merge

London—Two of Britain's largest independent airlines—British United Airways and British Aviation Services—last week merged in a $56-million deal to form a single holding company, Air Holdings, Ltd.

Combined fleets will total about 150 airplanes and helicopters. The new company will be about 40% the size of British European Airways, the state-owned airline and its prime competitor.

Unknown factor is the future of Britain's other major independent — Cunard Eagle Airways—which suffered a setback when its application for North Atlantic jet service was first approved by the Air Transport Licensing Board and then overruled by Minister of Aviation Peter Thorneycroft (AW Dec. 4, p. 41). Chairman of Air Holdings, M. H. D. Wyatt, head of British United, said no talks are being held with Cunard Eagle at present.

British United, largest stockholder in the merger, is primarily owned by ocean shipping interests (AW May 22, p. 35). Major holder of British Aviation Services stock is Peninsular & Oriental Lines, another ocean-shipping firm.

Deal brings into British United the cargo and charter lines of Silver City and Manx Airways. Silver City is the direct competitor of Channel Air Bridge, a British United Airways subsidiary that has developed the Carvair ATL-98 car ferry (AW Sept. 4, p. 46). It is likely that Silver City will adopt the plane for its car ferry routes to Europe and Ireland.

British United, which has 10 BAC

111s and four Vickers VC.10 jet transports on order, will turn a 1961 profit of about $2 million, Wyatt said.

Important factor in the merger is the independent's disenchantment with the government and its interpretation of the Air Transport (licensing) Act of 1960 which was designed to give them a larger share of United Kingdom-Europe traffic.

As Wyatt put it: "There can be no planning, no future for us until the government decides to give the private companies a fair crack of the whip," citing the Cunard Eagle transatlantic reversal as an example.

Subsidiary companies of Air Holdings will be British United Airways, Channel Air Bridge, Airwork International, Airwork Services, Aviation Traders (engineering), Dishley Engineering, Morton Air Services, Straits Air Freight Express and British Aviation Services (Silver City Airways and Manx Airlines).

Helicopter Group Is Cautioned on Subsidy

Civil Aeronautics Board Chairman Alan S. Boyd told a convention of the Helicopter Assn. of America that congressional limitation of helicopter airline subsidy funds should be taken as a challenge by those in the helicopter industry who really believe in its future.

Boyd, speaking last week in Dallas, Tex., told the convention that the $6-million subsidy limit set by Congress for 1962 (AW Oct. 23, p. 36) did not mean "the rug is being pulled from under the helicopter experiment."

Subsidy, Boyd said, should be reasonable in amount, and available on a basis sufficiently flexible to meet emergencies that might threaten the already considerable investment made in the future of the helicopter. Subsidy, he added, should not be allowed to become a cure-all or way of life.

While he is confident the industry could and would surmount the cost obstacles barring profitable helicopter operations, he said, it might be several years before it took place.

In the meantime, Boyd said, the introduction of the turbine powered helicopter with its improved economy over piston types should prove a major factor in sustaining the helicopter airline industry during its developmental period.

On the problem of heliport construction, Boyd said the great promise of the helicopter and STOL craft lies in their ability to take passengers from their actual origin to their actual destination. Heliport construction may be lagging, Boyd suggested, because the helicopter industry has failed to sell communities on this advantage of the helicopter.

Changes in Airspace Users' Tax Are Opposed by Industry Groups

Washington—Reaction to the Fiscal 1963 schedule of taxes President Kennedy would levy against users of U.S. airspace was largely negative last week, indicating the proposal will fail to win the aviation industry's endorsement.

In essence, the President's proposal recommends that the current 10% tax on airline passenger tickets be cut to 5% on Dec. 31 1962—six months after the comparable tax on rail and bus transportation would be abolished—and that a new 5% tax on all way-billed air freight be imposed next year (AW Jan. 22, p. 42).

The President's budget message also called for extending the present two cents per gallon tax on aviation gasoline to jet fuels and increasing the tax rate on general aviation fuels from two to three cents per gallon, in order to reflect more precisely how much benefit all branches of aviation gain from the air traffic control system.

Such measures "represent gross discrimination against the airlines and their passengers and their shippers," Air Transport Assn. President Stuart G. Tipton said last week. Particularly unfair, according to ATA, is the six months period during which airlines will continue to pay a 10% ticket tax while other transportation media escape the levy entirely.

The 5% tax on air freight, which ATA estimates will bring in $7.5 million in Calendar 1963, also is inequitable and contrary to the government's stated policy of encouraging the growth of air cargo, ATA contended. While agreeing to the principle of user charges, Tipton maintained that the Administration's proposal does not meet the standard of fairness and therefore must be opposed.

Aircraft Owners and Pilots Assn. also found cause for concern in what it described as Federal Aviation Agency's "ballooning budget requests." Last November, according to AOPA, the ratio of FAA employes to active, registered civil aircraft was 1.8 to 1. It said that each of these aircraft represented $9,266 in FAA's total budget. If FAA's $790.5 million Fiscal 1963 budget is approved, however, the employe-aircraft ratio will change to 1.7 to 1 and the budget allocation per aircraft will rise to $9,762, AOPA said.

On the specific issue of increasing the general aviation fuel tax, AOPA charged that general aviation should not be forced to pay for costly expenditures for which general aviation has no real requirement. Examples cited by AOPA include budget requests for funds covering the purchase of visual glide slope installations, development of a civil supersonic transport, construction of Dulles International Airport here and expansion of FAA's aviation medicine research program.

National Business Aircraft Assn. declined to comment on the President's tax package until the issue is placed before Congress. It noted that similar proposals have been made in earlier budget messages but never acted upon.

Reduced Flying Time Sought by Attendants

Members of the Air Line Stewards and Stewardesses Assn. International who broke away from the Air Line Pilots Assn. last April to become affiliated with Transport Workers Union have set reduced flying time as one of their chief bargaining objectives this year.

The new group, which has been granted autonomous bargaining powers under its charter with TWU, represents members employed by Eastern, TWA, Northeast, Northwest and Western. The American Airlines chapter is now conducting recertification elections.

An additional workload and higher flight frequency due to widening use of turbojet equipment is the prime reason for the union's drive to reduce working hours from 85 hr. monthly to 70 hr. Northwest recently agreed to the 70 hr. time ceiling, but the union settled for 80 hr. with Western after the carrier offered a wage increase.

The group also seeks to redefine flying time and will push for a program that will grant credit for actual or projected flying time, whichever is greater. For example, if projected time—scheduled flight time—is one hour but the flight takes 1 hr. 15 min., ALSSA wants credit for the longer period. If the same flight is completed in 50 min., the projected time of one hour would apply.

ALSSA, seeking to improve the professional status of its membership, will seek to require Federal Aviation Agency certification or licensing of all its members as a prerequisite to flying as crew members.

The union is also hoping FAA regulations will be amended to establish a minimum cabin crew complement for various types of aircraft. At the present time, only one cabin attendant is required by law on any aircraft.

President of the union is Roland K. Quinn, Jr., a former flight attendant with Eastern.

First Swissair Convair 990 Transport Delivered

First of Swissair's seven-plane 990 order from General Dynamics/Convair has been delivered to the airline. Three more will be delivered this month with single deliveries scheduled for February, March and August. Wing pods on the 990 are designed to control the flow of air over the upper surface of the wings during high-speed flight and to reduce the resulting drag. Pods also function as integral tanks.

Hughes-TWA Dispute Status of Trustee

By Glenn Garrison

New York—Successor to Ernest Breech as a voting trustee of the 78% of Hughes stock in Trans World Airlines has been sought for some time, it was indicated in recent testimony by TWA President Charles C. Tillinghast.

The testimony was given during pretrial depositions here in the suit by TWA against Hughes Tool Co., Howard Hughes and Raymond Holliday (AW Jan. 15, p. 38).

Breech, who is board chairman of TWA as well as one of three voting trustees, always had some concern about taking both jobs, Tillinghast recalled in his testimony. One factor was the public relations aspect of the dual positions.

It was felt that undue influence by one man might be construed because of the situation. Also, Breech felt the voting trusteeship was going to take up a lot more time and involve more problems than he had anticipated and he agreed to undertake it only for a limited time.

Candidates Approached

Among the candidates approached about succeeding Breech as trustee, Tillinghast said, was Donald David, who declined last December. Tillinghast said it was his opinion that it is a problem of obvious difficulty to find the type of person needed for the trusteeship who would be willing to subject himself to the controversy that exists in the TWA-Hughes situation.

Tillinghast said Breech told him he took the voting trust position out of a sense of national duty, believing it a shame that something as large and important as TWA had become "somebody's plaything."

According to the testimony, Tillinghast had grave reservations about taking on the job as Trans World president.

Finally Persuaded

He was first approached about Feb. 21 of last year when he received a phone call from Francis Reed, a former law partner of Tillinghast's in the firm of Hughes, Hubbard and Ewing. Reed said he had talked to Breech who thought it a fine idea to approach Tillinghast. Breech and Tillinghast had been associated in the past; Tillinghast's law firm did work for Bendix Aviation when Breech was president of that organization in 1942. Also, when Breech was executive vice president of Ford Motor Co., a Hughes and Hubbard partner went to Ford as general counsel.

Tillinghast met with Breech last Feb. 28 to discuss the TWA presidency and "Mr. Breech put on what one might call in the vernacular the hard sell," Tillinghast testified.

Tillinghast said finding a TWA president appeared to be a difficult undertaking and the airline had a "rather notorious history of being unable to get a president."

Tillinghast added that the problems included TWA's chronic inability to retain a chief executive, its loss of money and continuous financial dilemma, problems in getting Hughes Tool to make aircraft available, and difficulties getting Hughes' directors on TWA's board to appear and constitute a quorum.

One factor in Tillinghast's decision to become president was the fact that he was offered a contract similar to one Breech had with Ford—providing a life income if his job terminated for any reason or at any time. During the discussion with Breech, stock options were mentioned but Tillinghast "allowed as how I didn't think the airline business was comparable to the Ford Motor Co. and I wasn't going to make any decision on the illusion that if I had a stock option from TWA I would get as rich as people who had gone into the Ford Motor Co. in 1947."

Asked if he had assumed when he met with Breech that Breech dominated the airline's board of directors, Tillinghast said he had known Breech was one of the more influential persons on the board but had no reason to assume Breech dominated it. He assumed, he said, that Irving Olds—second trustee appointed by the lending institutions—was in sympathy with what Breech was trying to accomplish.

Hughes Control

Regarding the possibility of Hughes' regaining control of TWA—which would jeopardize Tillinghast's role as TWA president—Tillinghast said Breech didn't believe the Civil Aeronautics Board would let this happen. Furthermore, Breech indicated his view that if Hughes hadn't been able to avoid the

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*Monsanto trademark †DuPont trademark

Slick Airways Takes Delivery of Its First CL-44

Slick Airways' first Canadair CL-44 swing-tail turboprop air freighter will be used by the cargo airline to carry cargo and passengers under Military Air Transport Service. The airline will take delivery of its second CL-44 next month. The CL-44 is powered by four Rolls-Royce Tyne turboprop engines (5,730 ehp.) and can cruise at 402 mph. at 21,000 ft. at 165,000 lb.

trusteeship, it seemed unlikely he would be able to refinance in the near future.

Asked if Breech had suggested Tillinghast would have to be interviewed by the lending institutions before being approved as president, Tillinghast said Breech had not so indicated. As to the question of TWA being controlled by the institutions, Tillinghast said he has never been concerned about that question. He has high regard for two of the trustees—Breech and Olds—as men of outstanding integrity, he said, "and the exact nature of their relationship to the lending institutions is not one which I have considered it worthwhile to be particularly concerned about." Breech and Olds, he said, just would not bow to the control of anyone, even someone who had the power of removal as trustee.

As far as the contract was concerned, Tillinghast said, he was chiefly interested in being personally in a tenable position regardless of whether or not Hughes regained control of the airline. Having seen what happened to various prior occupants of the TWA presidency job, he said, he wanted to be sure he had an out if Hughes were back in control and "life was no better" than in previous cases.

At the Feb. 28 meeting, Tillinghast said, he learned that a committee had been appointed to select outside counsel to review the relationships between Hughes Tool and TWA and to advise what action, if any, should be taken.

It was also indicated to Tillinghast that TWA had a further equipment problem and that the financial institutions had indicated support if TWA had a president and a stable management. There was no discussion then of the Convair 990, Tillinghast said.

The subject of the authority of Raymond Holliday—the Hughes representative among the three trustees—came up during the Feb. 28 meeting, Tillinghast said. Breech commented that Holliday appeared to have no real authority and cited an incident that occurred before a directors' meeting. Holliday received a phone call before the meeting, Tillinghast said Breech reported, and, with some embarrassment, had to renege on a commitment. He had his orders, Breech reportedly said.

Asked if Breech specifically used the word "reneged," Tillinghast said he might have said "welched." Tillinghast could not recall the exact subject of the commitment, but thought it might have been related to the election of directors or to a stock option plan. It was Holliday's reneging, Tillinghast said, that led to the special stockholders' meeting at which new directors were elected and a board created which had a quorum consisting of people not under control of Hughes Tool.

Financial Support

Tillinghast didn't make up his mind to accept the presidency until Mar. 20, he said. In the meantime, he met Mar. 6 with officials of several of the lending institutions banks and insurance companies. This meeting was set up by Reed. Asked if the primary purpose of the Mar. 6 meeting was for the lenders to look him over, Tillinghast said he didn't know—but he suspected that was one reason for the meeting. Regarding chances of obtaining the needed financing, he came away from the meeting "satisfied that so far as one can obtain bankers' assurances under those circumstances, that I had them."

Among the problems he faced as new president of TWA, Tillinghast said, was a question of the loyalty of some officials to the chief executive. This question was raised by Carter Burgess, former TWA president, in conversation with Tillinghast, according to the testimony.

In the past, Tillinghast said, Howard Hughes would contact various TWA officials directly, a situation in which divided loyalties were more apt to appear. However, Tillinghast did nothing in the way of a "witch hunt," he said. He has become satisfied with the loyalty of all his top executives to TWA and to Tillinghast as president of TWA.

Asked if Burgess had not overemphasized the loyalty problem, Tillinghast said he did not believe so. Burgess was not without some reason to say what he did, Tillinghast said.

Doubts about the extent of TWA's obligation in connection with the 990s were expressed by former TWA director John McCone, according to the testimony. McCone and Tillinghast had several phone conversations on the subject and at one point McCone suggested that perhaps the airline should acquire 990s as well as Boeings.

As a means of accommodation with Hughes Tool, McCone thought possibly the 707 order might be reduced and 990s used additionally. McCone apparently was concerned about both the legal and moral obligations to Hughes Tool. He referred to the past practice of Hughes contracting for planes and eventually delivering them to TWA, and also to the fact that the tool company had contracted for the 990s and would be stuck with them.

Tillinghast pointed out the operational problems and lack of economy in using relatively small numbers of dis-

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similar aircraft. He also said it would be a mistake to once again get involved "in one of those endless and uncertain wrangles over what equipment would be available at what time." He told McCone he would welcome a solution to the problem but personally was skeptical of the possibility of finding one. Regarding moral obligation, Tillinghast referred to Hughes' practice in the past of turning over aircraft to Pan American and Northeast, and pointed out that the 990s were ordered without consultation with TWA and TWA's knowledge of the order had come only circuitously and not through Hughes Tool. McCone, Tillinghast said, changed his mind later on.

Difference of Opinion

At one point, Tillinghast testified, a difference of opinion developed between McCone and Breech. McCone was concerned as to whether TWA had made adequate investigation of the matter of obligation. Also, tenseness between the two men resulted from a telegram McCone sent to Breech. Tillinghast, who did not recall the contents of the telegram, said Breech believed McCone should have known his facts better before sending it.

Some time in late May, in a discussion between Breech and Tillinghast, Breech said he did not wish to become involved more than necessary in the matter of equipment selection. He also believed it unwise for Tillinghast to go to Seattle, as he was scheduled to do, to talk to Boeing. Breech's view was that Tillinghast should recognize he might be accused of having strong-armed the matter of equipment selection, and the record should be clear that selection was based on the technical recommendation of the operating staff of the airline.

However, although he generally agreed, Tillinghast did go to Seattle because he felt obligated to be as intelligent as he could about matters concerning items on which his people were making recommendations. He was not going to substitute his judgment for theirs, he said, but wanted to know as much about the problem as he could.

Public Relations

Testimony also covered the relationship between TWA and the outside public relations firm headed by Earl Newsom. Newsom was retained late last year. Tillinghast said the reason was that TWA needed to achieve a better public image, one aspect being the fact that Hughes Tool seemed to be engaging in a major public relations effort and TWA would have to be prepared to meet it to the extent it involved the airline.

Breech suggested Newsom be consulted, and made the first contact with Newsom, Tillinghast said. Newsom previously had performed services for Ford when Breech was with the motor company. Tillinghast said he was concerned about the expense of retaining outside public relations counsel; Breech felt that Newsom might serve TWA at a more modest fee than usual because of his past relationship with Ford. As it worked out, however, Newsom's position was that if he was going to be helpful to TWA he would have to work in his normal manner at the usual charges.

Breech offered Newsom a pass on TWA aircraft as an inducement, but the offer was declined. Newsom's fee actually is $36,000 a year plus charges for the time of Newsom personnel involved in TWA work, Tillinghast said.

In his first conference with Tillinghast, Newsom said his impression of TWA was one of controversy. They discussed Hughes Tool and the publicity attendant on Hughes' efforts to block the TWA purchase of Boeing aircraft. Another area in which Breech felt outside public relations counsel would be helpful was in labor problems.

Another matter covered in a later discussion with Newsom was the fact that Breech was contemplating retiring as a voting trustee and TWA would want to issue a press release on that.

Alitalia Plans Chicago DC-8 Service in April

New York—Alitalia plans to start serving Chicago about Apr. 5 with twice-weekly Douglas DC-8 flights to Rome via Montreal and Milan. Frequency will be increased to three times a week later in April.

The Italian carrier was given the right to serve Chicago under the U.S.-Italy agreement of 1960, and is expected also to be able to serve Los Angeles. The final Los Angeles authority, however, has never been forthcoming from the U.S. State Department (AW June 26, p. 45). Negotiations are still in process.

Final procedural steps are being taken with regard the Chicago service and no problems are foreseen.

Apr. 7 Hearing Set For NE-Hughes Case

Washington—Northeast Airlines-Hughes Tool Co. control case hearing has been set for Apr. 7. Civil Aeronautics Board Examiner Merritt Ruhlen notified parties at a prehearing conference last week that the issues will be discussed on a broad basis.

Of the issues listed in a comprehensive statement prepared by CAB's Bureau Counsel—Ruhlen ruled out only one—the question of safety if Hughes Tool is allowed to control Northeast. Issues allowed to stand include the effect of the acquisition on carriers not a party to the proceeding and the effect on Northeast employes.

Chester Davis, attorney for Hughes Tool Co., said Hughes Tool would willingly go along with any of CAB's requests for information and testimony in the case, but questioned the wisdom of trying to conduct an expedited case on issues having such a broad scope.

In a related development, proceedings in the New York-Florida Renewal Case (AW Jan. 15, p. 42), in which Northeast seeks permanent Florida operating authority, will resume Jan. 30. CAB Examiner Walter Bryan had postponed the case, presumably to allow parties to attend the prehearing conference in the control case.

BEA Cites Load Slump In Route Award Appeal

London—British European Airways, despite setting a new record by carrying 4.3 million passengers in 1961, flew with more than 2.5 million empty seats during the year, according to Lord Douglas of Kirtleside, BEA chairman.

He noted that BEA flew 7% fewer hours than in the previous year, but capacity had increased 21% primarily because of fleet buildup of the de Havilland Comets and Vickers Vanguards. BEA flew 196,200 revenue hours in 1961, against 183,000 hr. the year before.

Passenger load factor also dropped, from 67.5% in 1960, to 62.5% last year. Revenue load factor dropped from 66.2% in 1960 to 60.9%.

These slumps in load factors, along with what Lord Douglas calls the deteriorating financial state of the world's airlines, will be the keystone of BEA's appeals against a recent Air Transport Licensing Board decision to allow more routes to Britain's independent airlines, in competition to the state-owned BEA. (AW Dec. 4, p. 41).

"I am determined not to allow our 15 years of endeavor and achievement in buildup of a successful and profitable airline to be placed in jeopardy by the board's decision if we can possibly prevent it," Lord Douglas said.

The chairman's comments were underscored by Anthony H. Milward, BEA chief executive who contended, "It seems doubly strange that the British policy, far from consolidation, is toward more competition in a world where, as we have seen this year, too few passengers are already chasing too many seats."

Commissioner to hear the BEA appeal has not yet been appointed by Minister of Aviation Peter Thorneycroft. Hearings, however, probably will start within the next two months.

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AIRBORNE ELECTRONICS AT WORK: WEATHER RADAR

SHORTLINES

► **Air France** is offering a six-city tour of France by Caravelle jet for $59.40 plus its regular 17-day round-trip economy fare of $449 from New York. The tour encompasses cities in all corners of France and is designed to permit tourists to make side trips.

► **British Overseas Airways Corp.** has hired an industrial psychologist, Julian Knights, to deal with the stresses and strains of management. Post was deemed necessary because of the strain under which its managers work.

► **Delta Air Lines** reports it has installed Collins Radio Co. Distance Measuring Equipment (DME) on all of its jets at a cost of over $100,000.

► **Eastern Air Lines** will link Huntsville, Ala. with New Orleans, Birmingham and Chicago on Feb. 1 (AW Dec. 18, 1961 p. 47). Civil Aeronautics Board granted exemption authority after Eastern said the service was needed by National Aeronautics and Space Administration personnel at the George C. Marshall Space Center in Huntsville.

► **John Hoving,** vice president-executive action of the Air Transport Assn. is on loan to the White House to work with Howard Petersen, special assistant to the President on international trade programs.

► **Joint Panagra-Pepsi Cola** stunt to promote air travel to the U. S. and sell soft drinks backfired recently. The person who collected the most Pepsi-Cola bottlecaps would be sent on a jet trip to the U. S. Contest bogged down when the winner turned out to be the soda jerk in the Lima, Peru prison. He can't make it—he's serving four more years and contest rules say the trip must be made within one year.

► **Pan American World Airways** will begin nonstop jet service twice weekly between Seattle and Juneau, Alaska on Feb. 3. The jets will replace DC-6B piston flights on Mondays and Saturdays; DC-6B flights will continue on the remaining days of the week for the present time.

► **Sir David Ormsby Gore,** British ambassador to the U. S. expressed displeasure recently with plans to encourage American travelers to use American flag carriers when going abroad. Ambassador Gore, speaking at the opening of a BOAC office in Washington, D. C., said he did not think customers should be told what national airlines they should patronize.

AIRLINE OBSERVER

► Domestic airline traffic volume rose spectacularly during the first two weeks of January. If the trend continues, revenue passenger miles for the month may show as much as an 8% increase over the same period last year. It would be the third consecutive month that a substantial improvement in business has been registered by the industry.

► **Industry demand for the 1961 edition of the Civil Aeronautics Board's Handbook of Airline Statistics is increasing rapidly. The handbook, which details financial facts and operating data of the entire U. S. airline industry from 1927 through 1960, should become a classic reference work. It was prepared under the direction of Warner Hord, chief of CAB's office of carrier accounts and statistics.**

► Lockheed Aircraft Corp. has begun wind tunnel tests of bird ingestion by an Allison 501 turboprop engine, similar to those powering the manufacturer's Electra transport. Study is funded by the Federal Aviation Agency and is intended to define the results of different sizes and numbers of bird strikes at takeoff airspeeds.

► **FAA certification of the North American T-39 Sabreliner has taken more time than planned. Original estimate of 150 hr. flying time has already been exceeded. At present, 600 hr. have been flown and program is to continue until mid-February.**

► Recent Tu-124 proving flight between Moscow and Sochi on the Black Sea was billed as one of the last test runs prior to placing the new twin-turbojet transport in regular Aeroflot service. The 932-mi. trip was made in two hours. Aircraft used on the proving flight was the first-class version with a 12-seat forward compartment, 8-seat center section and 24-seat rear compartment.

► **People's Republic of China and the Kingdom of Laos have signed a bilateral air transport agreement. The agreement details air sovereignty principles for each country and provides for scheduled and non-scheduled commercial flights between the two countries.**

► New Zealand has given Russia permission to use Christchurch airport for regular stops for Il-18 and An-10 turboprop transports carrying technicians of the Soviet Polar Aviation Administration to its Antarctic bases. Russians claim the Il-18 can make the 14,880-mi. flight from Sheremetyevo airport, near Moscow, to the Antarctic bases in about 45 hr. flying time.

► **Hungary has ratified an agreement with Ghana providing for direct air service between Budapest and Accra.**

► Cargo tonnage of scheduled intra-European airlines increased 31% and passengers carried rose 9.1% during the third quarter of 1961 over the same period of the previous year. International Air Transport Assn. statistics show that a 19.5% increase in available seat miles produced an 11.9% gain in revenue passenger miles. Average load factor for the period was 60.7%, or 4.1% below that of the third quarter of the previous year.

► **Hawaii's transportation department began hearings last week to determine new landing fees at Honolulu's International Airport. New rates adopted Dec. 11 were repealed earlier this month after United Air Lines and Pan American World Airways filed suit against the state, claiming new landing fees were excessive and illegal.**

► Russia and the Republic of Guinea have signed an agreement providing for establishment of air service between the two countries. A pact between Aeroflot and Air Guinea, calling for reciprocal services, was signed at the same time.

THE CLEAN WING VC10 MEANS A QUIETER CABIN

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USA: BRITISH AIRCRAFT CORPORATION (USA) INC.,
399 JEFFERSON DAVIS HIGHWAY ARLINGTON VIRGINIA

Airline Income and Expenses—November, 1961

	Passenger Revenue	U.S. Mail	Express	Freight	Charter	Total Operating Revenues	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNKS								
American	30,406,626	804,191	428,895	2,287,377	---	34,297,607	35,088,942	− 791,335
Braniff	5,976,131	153,622	80,033	264,441	111,976	6,679,142	5,434,537	1,103,712
Continental	4,339,000	118,000	34,000	132,000	18,000	4,730,000	4,714,000	− 202,000
Delta	11,902,000	273,000	140,000	438,000	---	13,020,000	12,087,000	693,000
Eastern	20,478,669	480,104	---	1,101,199[1]	---	22,223,795	23,850,246	−2,132,031
National	6,100,150	151,287	39,995	331,299	54,683	6,853,425	6,646,772	407,632
Northeast	3,247,288	56,386	32,847	78,016	---	3,473,968	4,644,457	−1,398,633[2]
Northwest	5,464,019	196,466	---	487,767[1]	38,245	6,208,410	7,073,398	−1,131,312
Trans World	19,123,048	511,545	---	1,582,416[1]	196,625	21,744,848	25,495,647	−4,940,484
United	35,357,250	1,317,182	---	2,744,449[1]	181,286	39,996,977	43,609,241	−4,501,409
Western	4,849,790	109,785	---	190,091[1]	92,057	5,255,976	5,297,269	− 162,816
INTERNATIONAL								
American	473,245	4,693	133	43,641	---	548,904	520,700	− 28,204
Braniff	653,815	32,970	---	76,828	---	806,388	881,941	− 97,577
Caribbean Atlantic	300,148	2,680	---	22,053[1]	7,497	336,240	299,702	37,011
Delta	81,000	1,000	---	2,000	---	87,000	220,000	− 137,000
Eastern	2,031,388	51,918	---	137,773[1]	---	2,228,664	2,296,304	− 126,321
Mackey	93,617	---	565	4,294	---	114,182	159,580	− 44,327[2]
Northwest	1,773,853	790,232	---	359,386[1]	122,821	3,193,969	2,813,422	246,845
Pan American Combined	23,005,000	3,043,000	---	3,879,000	2,686,000	34,137,000	38,529,000	−5,477,000
Alaska	204,000	19,000	---	43,000	7,000	287,000	475,000	− 215,000
Atlantic	9,726,000	1,471,000	---	1,484,000	1,039,000	14,330,000	17,976,000	−3,559,000
Latin America	6,476,000	252,000	---	1,251,000	317,000	8,749,000	10,036,000	−1,356,000
Pacific	6,599,000	1,301,000	---	1,101,000	1,323,000	10,770,000	10,044,000	796,000
Panagra	1,386,000	65,000	---	308,000	---	2,003,000	1,864,000	153,000[2]
South Pacific	26,346	826	---	624[1]	---	27,944	75,770	− 53,687
Trans World	3,668,722	801,865	---	672,213[1]	78,338	5,424,069	6,697,775	−1,534,766
United	1,463,225	102,035	---	69,630[1]	---	1,699,804	1,613,650	42,458
Western	542,697	4,740	---	9,966[1]	---	558,725	395,432	153,295
LOCAL SERVICE								
Allegheny	1,154,656	12,948	29,705	47,359	---	1,259,576	1,697,560	37,839
Bonanza	489,696	3,596	2,371	7,551	880	781,130	693,159	64,286
Central	361,476	14,025	4,286	15,107	5,345	779,116	729,471	46,602
Frontier	583,209	11,623	5,160	29,335	3,302	1,218,502	1,205,182	21,227[2]
Lake Central	474,705	13,496	11,110	15,023	19,605	880,820	816,080	44,351[2]
Mohawk	1,343,660	20,507	19,583	41,418	31,380	1,971,861	1,895,812	16,228[2]
North Central	1,114,175	33,011	30,180	38,741	---	1,911,884	1,900,371	− 10,841
Ozark	697,135	17,436	18,115	25,384	4,779	1,101,804	1,035,835	54,570
Pacific	563,448	13,257	2,801	10,173	573[6]	920,214	824,212	68,751
Piedmont	712,413	11,824	10,649	16,828	---	1,187,293	1,069,377	98,300[2]
Southern	511,937	20,034	8,434	17,362	13,938	978,259	925,207	40,425
Trans-Texas	464,760	13,585	5,838	16,932	11,349	885,862	831,431	46,515
West Coast	527,838	9,337	2,337	11,222	5,805	1,008,293	933,040	58,463
HAWAIIAN LINES								
Aloha	316,566	1,952	---	3,927	---	334,331	430,964	−126,375
Hawaiian	444,754	3,441	---	77,529	1,104	531,924	626,286	−113,995
CARGO LINES								
Flying Tiger	---	5,166	---	854,908	2,522,253	3,384,756	3,182,976	4,877
Seaboard World	---	328,648	---	652,099	5,942,183[5]	1,771,382	2,170,282	−527,850
Slick	---	---	---	---	1,284,314[5]	1,298,686	1,200,372	57,603
HELICOPTER LINES								
Chicago Helicopter	97,500	120,278[3]	---	---	---	218,051	277,780	− 60,430
Los Angeles Airways	15,121	11,967	14,496[4]	---	175	131,598	123,271	9,956
New York Airways	92,270	6,247	2,434	3,158	---	298,235	334,095	−40,669
ALASKA LINES								
Alaska Airlines	292,338	50,793	546	56,357	102,352	756,619	880,019	−146,937
Alaska Coastal	60,398	9,332	---	10,781	2,264	165,425	162,877	− 1,001[2]
Cordova	15,772	11,834	---	11,720	13,958	100,973	110,553	−10,810
Kodiak	9,276	905	---	2,097	1,842	18,170	46,012	−13,470[2]
Northern Consolidated	64,291	67,555	---	40,304	---	330,927	269,164	21,402[2]
Pacific Northern	396,175	91,296	3,078	114,134	927	819,103	919,344	−114,673
Reeve Aleutian	115,967	59,947	---	41,671[4]	20,559	240,073	196,798	42,331
Wien Alaska	70,549	79,416	---	37,572	60,971	497,533	438,701	58,831

[1] Property: Figures include freight, express and excess baggage revenues.
[2] Net Profit or Loss
[3] Includes Federal Subsidy
[4] Includes Excess Baggage
[5] Passenger and Freight Charters
[6] Includes Contract Operations

Figures for Trans Caribbean, Aerovias Sud Americana, Riddle, Ellis, Western Alaska and Avalon were not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board

Signal Generator

Model 412 FM Signal Generator, for check out of command receivers operating in the 400-550 mc band, features direct six-place digital readout of frequency. Accuracy to within 1 kc prevails at any setting throughout the frequency range. Continuous coverage is provided by a single tuning control. The unit is ideally suited for both frequency search and for setting to a given frequency, as well as receiver alignment, bandwidth testing, discriminator measurements, sensitivity measurements, filter attenuation measurements.

Microdot Inc., 220 Pasadena Avenue, South Pasadena, California

Power Oscillator

These precision units are designed for laboratory use in the evaluation of antennas, calibration power measuring devices, driving of amplifiers, and other applications where higher power ratings are required. Model 410, shown above, offers a frequency range of 500 to 1050 mc direct reading. Power range is 50 mw to 50 w. The unit measures 8″ x 11½″ x 19″ and weighs 45 pounds. Other models cover ranges from 200-550 mc. All components are conservatively rated and carefully arranged for long life and convenient inspection.

Microdot Inc., 220 Pasadena Avenue, South Pasadena, California

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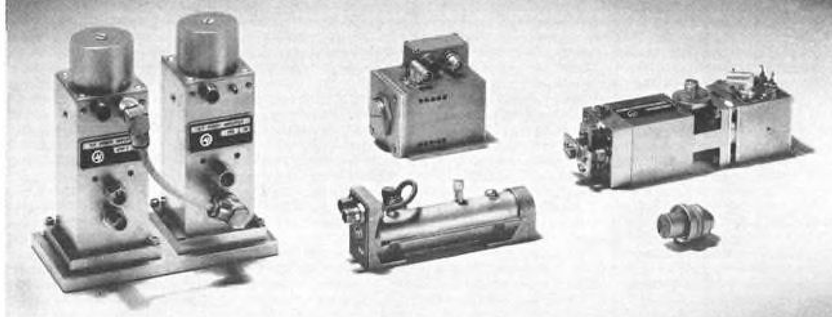

Signals from a two-pound Microdot 150-watt Power Amplifier have been recorded from a solar satellite more than twenty-two million miles beyond the earth... another indication of the proven performance of Microdot rf cavities aboard satellites, ICBM's, and rocket sleds under the most demanding environmental conditions. Dozens of types are available off-the-shelf as standard miniaturized modules, or Microdot can supply cavities to meet customer specifications.

Microdot Power Amplifier Modules are furnished as individual modules or designed into a complete Microdot transmitter, including power supply. Available with power output ranges from 10 to 150 watts and power gain of over 10 db, these units are used as power amplifiers and frequency multipliers.

Microdot Frequency Multiplier Cavities are standard modules assembled in a wide variety of combinations covering the entire frequency range from 100 mc to 3000 mc. Single cavities multiply as high as nine, have been cascaded for even higher multiplication, and will accommodate amplifiers to satisfy power requirements.

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For more information, write for these illustrated, detailed bulletins: Bulletin PTM-1, JSC-1, and ATC-1.

Microdot's Model 2406A UHF Telemetry Transmitter utilizes a unique, automatically stabilized circuit with the output frequency referenced directly to a quartz crystal, allowing greatly reduced size and increased reliability.

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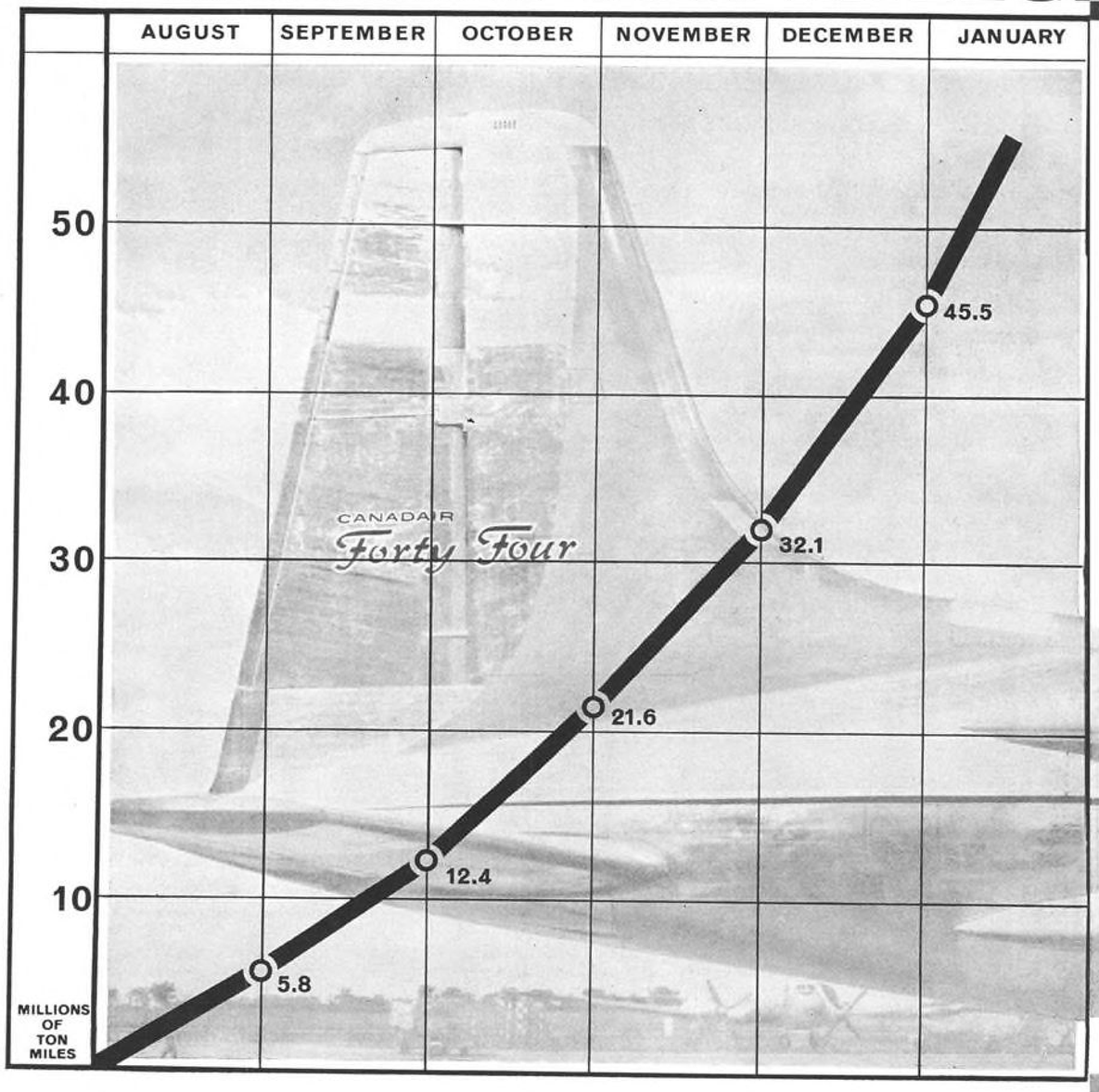

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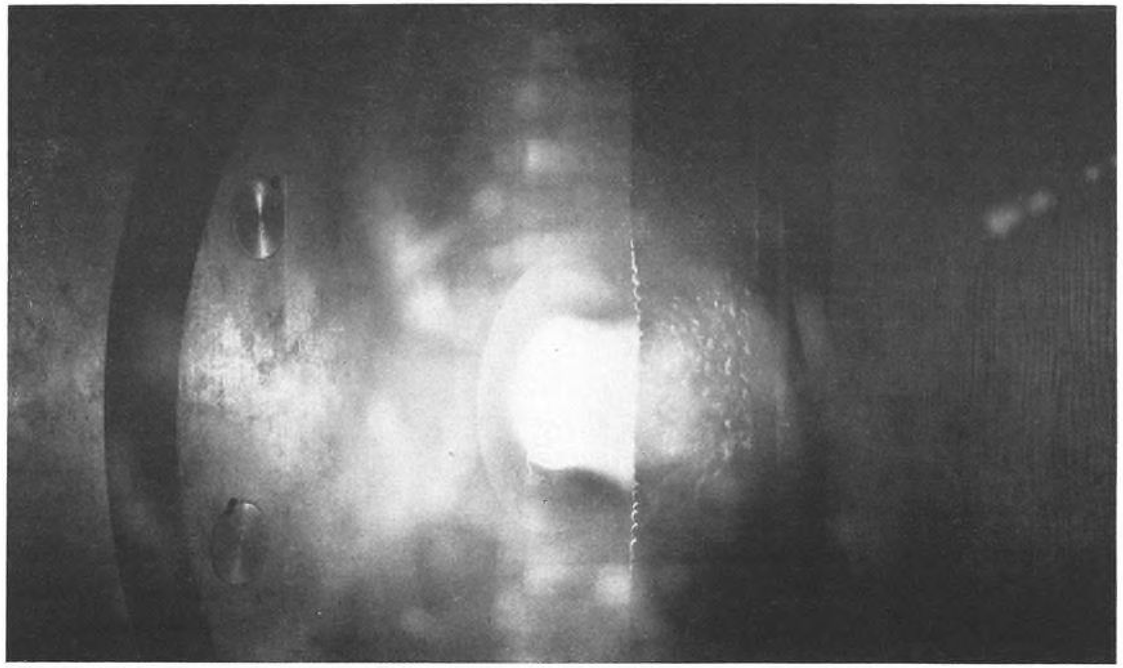

PLASMA JET tests of nose cone material show physical changes in ablating substance under evaluation at Chrysler's Missile Division.

Chrysler Increasing Missile, Space Work

By David A. Anderton

Detroit—Chrysler Corp's missile experience, once derived almost entirely from negotiated contracts with the U. S. Army, is now ranging across the field of space technology and weapons development for National Aeronautics and Space Administration and the three military services.

Company contracts are topped by the recent NASA Saturn S-1 booster award (AW Nov. 27, p. 22), which will cover the costs of construction, checkout, test and launching of the space vehicle. This contract, estimated at $200 million for the first increment of 20 S-1 stages, is expected to grow into a billion-dollar job that could eventually include systems integration and management for the complete Saturn C-1 vehicle, instead of only the S-1 booster.

Next biggest current customer is the U. S. Air Force, says Chrysler, represented by contracts from Ballistic Systems and Aeronautical Systems Divisions of the Air Force Systems Command, plus the final phases of production of the Jupiter intermediate-range ballistic missile developed for the Army but finally built for and operated by USAF.

Navy contracts included much development work on the fleet ballistic missile system. For Army, Chrysler built the Redstone tactical ballistic missile.

Chrysler's current position is one that it has been building for several years. The base is the experience available from past work; the superstructure is the scientific and engineering talent that covers a wide range of disciplines. As one result, the company is able to pick and choose its competitions carefully. Either alone, or teamed with another industrial partner, Chrysler Corp. bids only on selected contracts.

Sharing Contracts

Lack of propulsion and avionics capabilities limits the number of contracts available for bidding; it is in these areas that Chrysler seeks outside help. For example, its proposal in USAF's lunar roving vehicle competition (AW Dec. 18, p.56) is a joint effort with General Electric Co., with GE's share being in the guidance, navigation and communications fields.

As competitions and contracts have come and gone, Chrysler's internal organization has reflected the tempo of the times—but generally some months behind the rest of the aerospace industry. Recent trends inside the company seem to point to a new drive, attributable in large measure to the attitude of Chrysler's new president, Lynn A. Townsend. Near the end of 1961, Townsend spoke forcefully to an executive meeting, leaving them with the belief that cars may come and cars may go, but Chrysler's defense work is here to stay.

Latest step in the internal growth and transition of the company was the creation of the Space Division, formed specifically to handle the Saturn job at Michoud, La.

Space Division, with its new president, James C. Smith, Jr., joins the two established divisions of the corporation's Defense and Space Group:

- **Missile Division,** originally a production outfit, but now increasingly oriented toward research and development.
- **Defense Operations Division,** developers and producers of heavy military vehicles such as tanks.

Defense and Space Group, headed by group executive William S. Blakeslee, is two echelons removed from the corporate management level. Blakeslee reports to Thomas F. Morrow, group vice president in charge of the Defense and Space Group and Special Products Group, who in turn reports to Chrysler Corp. management.

The three divisions in Defense and Space Group are supported at a staff level by the Advanced Projects Organization, whose director is Lovell Lawrence, Jr., one of the four founders of Reaction Motors, Inc., pioneering U. S. rocket motor company. The Scientific Advisory Council, made up of five academic representatives and one formerly from Chrysler (see box), also supports Defense and Space Group at a staff level.

Group's Genesis

Chrysler's Advanced Projects Organization grew out of the corporation's loss of the Minuteman competition as a determined effort to do better the next time around. "Sure, it was a little late," said one engineer, "but before that, we were just opportunists in the field. We had to organize a serious effort to go after the big contracts in space we knew were down the road."

The organization functions as a technical staff to the group executive, and includes these three sections:

- **Systems Group,** whose members act as program managers. In this group, most of the work is pre-proposal or pre-requirement thinking, oriented largely to the special needs of the Air Force and Navy, and directed toward systems rather than toward invention or discovery.
- **Operations Research,** whose work follows that of the Systems Group. If USAF or Navy shows interest in some specific line of thinking, it is the job of Operations Research to do the deep analysis that helps rough out the form of the idea.
- **Technical Staff,** whose work goes one step beyond operations research. Conceptual design is the major task of this section; it takes the idea from Systems Group and the characteristics established by the Operations Research section, and develops them into a parametric design that can be presented in tangible form to guide the development of specifications or proposals.

Two staff organizations assist these three sections: Plans and Programs, concerned with the internal organization of the unit, and Manufacturing Planning, which keeps the ultimate goal of systems production in sight all through the development of a project in the three sections.

The Advanced Projects Organization is small, varying in size from 20 to 25 engineers. It serves as a training ground for engineering managers who will eventually be responsible for a complete program from thought to production. It also serves as the source for these program managers. When a system conceived in the organization becomes a program, its program manager leaves the Systems Group to run that program in one of the other divisions of the Chrysler Defense and Space Group.

Funds for operation of the Advanced Projects unit come from corporation overhead expenditures.

One typical investigation conducted by the Advanced Projects unit is a study of mobility feasibility: One of the many questions involved in mobility of a missile system is the actual geographic location of the battery when it stops to launch. "It just isn't possible to have a survey team out ahead of you on motorcycles," said Lawrence. "You've got to be able to tie your present position to some past reference."

So some of his co-workers borrowed a Chrysler XM-410 eight-wheeled vehicle and added a "fifth wheel"—a calibrated distance-measuring device built into a wheel mounted on a light framework attached to the rear of a car being tested—and a Kearfott attitude-reference platform used as an inertial platform. They took the XM-410 for a 20-mi. ride from its garage, where its position had been accurately located, ran it around the test track the company maintains for its automobile and military vehicle development, and brought it back to the garage again against its blocks.

Feasibility Test

"We did pretty well, even with the relatively crude rig we used," said Lawrence. "The error was about 187 ft. east-west and 176 ft. north-south." He pointed out that refinement of the test apparatus would have given much more accurate results, but that the whole object was to establish feasibility in the quickest and cheapest way possible. As a result of the tests, Lawrence and his engineers believe that it would not be a difficult trick to establish position accurately enough for field launching of mobile ballistic missiles.

Recognition problems are under attack by a team headed by David N. Buell, manager of the Operations Research section. Buell explained the need for a machine that would be able to recognize and identify shapes and ultimately to differentiate tones or colors of similar shapes.

Increased Effectiveness

"During four months of the Korean stalemate," Buell said, "the U. N. armies fired 240,000 tons of ammunition at the enemy. Remember, these were not prolonged engagements; just the occasional round or salvo directed at what somebody identified as an enemy target."

Buell said that estimates showed the effectiveness of that fire could have been increased by an order of magnitude if positive recognition of targets could have been obtained only 5% of the time. He said that even the simplest recognition task—finding straight lines, which don't occur in nature—would prove worthwhile.

This over-all recognition problem is far from solved. But Buell's team is working on a device which approaches the problem by simulating some of the functions of the human eye. A mechanical analog for the device has been built and can be used to demonstrate the first steps toward some future synthesized eye-plus-brain.

The development problems of the Missile Division are several steps removed from those of the Advanced Projects Organization. LaVerne R. Biascll, chief engineer for the division, explained that the original purpose of his division was production, but that it quickly was adjusted to try advanced development work and that led to future concepts of missile systems.

As one result, Missile Division is in transition to a research and development organization, with production capability as an important but not dominating factor.

Background experience of the division is with the Army Redstone tactical ballistic missile and the Air Force Jupiter IRBM. Organization includes a plant at Huntsville, Ala., to tie in with the former Army Ballistic Missile Agency there; range support operations at Cape Canaveral; and offices at White Sands Proving Ground and USAF's Ballistic Systems Division of the Systems Command.

Biggest customer of the division is USAF, with Navy, Army and NASA also purchasing work of one type or another.

Missile Division's work load includes a wide variety of projects, from the exciting fluid mechanics of re-entry vehi-

Scientific Council

Scientific Advisory Council, a staff organization in Chrysler Corp.'s Defense and Space Group, is made up of these men:

Prof. David M. Dennison, chairman, Dept. of Physics, Harrison M. Randall Laboratory of Physics, University of Michigan.

Dr. C. Stark Draper, professor and head of the Dept. of Aeronautics and Astronautics, and director of the department's Instrumentation Laboratory, Massachusetts Institute of Technology.

Dr. Jerome C. Hunsaker, professor of aeronautical engineering, emeritus, Massachusetts Institute of Technology.

Walter E. Jominy, formerly chief metallurgist, Research and Engineering Division, Chrysler Corp. Jominy has retired from Chrysler.

Dr. Franklin A. Long, chairman of the Dept. of Chemistry, Cornell University.

Dr. Ernst Weber, president, Polytechnic Institute of Brooklyn.

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For example, our development with the Signal Corps of the first large-scale, general purpose mobile digital computer (MOBIDIC) has created an important arm to military operations. No matter where the scene of action may be—in the desert, jungle, mountains or frozen North—a MOBIDIC can be on hand and working. It can process tactical and strategic data, logistical information—even command and control operations. Further, a number of these systems are now in operation and are so rugged they can be moved over extremely difficult terrain without damage to the systems.

Putting new and better data systems on wheels to help field commanders is just one of the many ways the scientists and engineers of General Telephone & Electronics corporate family serve the nation. The vast communications and electronic capabilities of GT&E, directed through Sylvania Electronic Systems, can research, design, produce, install and service complete electronic systems. These systems include detection and tracking, electronic warfare, intelligence and reconnaissance, communications, data processing and display.

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cles to the exacting statics of optical auto-collimating systems for Minuteman guidance.

The Minuteman system, being developed under a subcontract to North American Aviation's Autonetics Division, is one current project that traces its lineage back to a means for measuring the flexure of ships. During studies of the Fleet Ballistic Missile project, Chrysler engineers realized that there were no precise means for transferring the ship's position to the missile guidance system before launching. Furthermore, the physical distance between the ship's navigational system and that in the missile was great enough to show errors caused by the ship's flexing in response to the sea.

This thinking led to the development of an optical auto-collimator system for transferring coordinate information from one position to another. Tested on the USN Compass Rose, the system showed great promise.

The applications of such a system are many; one typical use would be to align all missiles in a particular complex with respect to a single known point. But suppose this area were in a desert; wouldn't heat shimmer play havoc with the accuracy of an optical system?

It would, and did. The solution to that problem was to use a beam of polarized light as the basic reference line. This produced an infinitely rigid measuring device, with this big advantage over the unpolarized beam: The polarized beam could be twisted to produce angular measurements. This system then worked as an "optical synchro," where the angular motion of a transmitter could be exactly duplicated by the receiver. Angular accuracies between one-tenth and one-hundredth of a second of arc are obtained.

The polarized light is unaffected by the bow shock wave as well as by heat shimmer; because of that, an important application was found at the sled tracks at Holloman Missile Development Center. Precise positions of the sled could be read with the Chrysler system, transmitting and receiving its polarized beam through both the shock and the shimmer.

Now Chrysler engineers are working on further improvements of the system, using lasers to increase the effective range and modulating the polarization angle to transmit intelligence along the beam. The applications to space communication or navigation devices, so necessary in orbital or space rendezvous techniques, represent a whole area of possible uses.

"In the final analysis," Biasell said, "the accuracy of the system depends on our ability to line up the individual molecules in the crystals that we're going to use."

Work on the re-entry body for Redstone led Chrysler's Missile Division into a host of new problems; solutions to them produced a large number of end products that can trace their development right back to the relatively simple one of getting the Redstone warhead to the ground.

The basic development line went from the re-entry body to the Redstone tactical warhead shape and then to the Jupiter ablative nose cone. This experience led Chrysler into competition with Aerojet-General, Avco, and General Electric for nose cones to be used as targets in the Nike Zeus firings. Chrysler lost the $10-million contract to GE, but gained valuable experience in the design of sophisticated re-entry systems. This is now beginning to pay off in the design of future hypersonic vehicles.

Chrysler's approach to the Redstone re-entry body was to use limit-load theory because of the short-time application of the re-entry loads on the vehicle. They built test rigs and cycled sample bodies through a re-entry. They also tested a variety of full-scale and scale-model bodies. This work, which produced the tactical re-entry vehicle, was supported by laboratory tests of subsystems and components that went into these two basic types of supersonic vehicles.

The Nike Zeus target cones presented a different set of problems. The idea was to be able to simulate eventually anything the enemy might throw at his targets: high-explosive, or nuclear warheads, with decoys, maneuvering flight and other penetration aids thrown in for good measure. But the first approach was to be fairly simple to establish feasibility; the trickery would come later in the program.

All of the work done on these target cones is well covered by the security blanket; but some of the problems are obvious to anyone who thinks about them. For example, what are the conditions under which the re-entry body can best be seen? What combination of infrared and radar techniques or other systems give the earliest sight of the on-coming target? And how would hits be scored?

To the latter problem, Chrysler had one answer, and came up with a Miss-Distance Indicator (MDI) for the Air Force.

To other problems, there was more than one answer. Some of the solutions to the problems led to two different areas of exploration: The search for "windows" in the plasma sheath that would be transparent to the transmission of intelligence; and the reduction of the strength of the plasma sheath itself so that it did not pose so formidable a barrier.

Another problem of missile operation is the damage assessment. How does the operator at the launching point know that the warhead got through and impacted in the target area? One way was developed at Chrysler: Eject a television camera in a suitable package, let it lag behind the warhead on the same trajectory and transmit all the way down until it is destroyed. This solution, which is currently in use in a number of applications, led to the development of a whole series of ejectable packages for remote visual observation of flight phenomena.

Trajectory studies which paralleled test work with Redstone and Jupiter led toward parametric analyses for space flight. Working in conjunction with NASA rendezvous analyses, Chrysler has developed some ideas of its own on the way to rendezvous in orbit, and believes its "optical synchro" is one of the best means available to link the meeting space vehicles.

The experience with Redstone and Jupiter, both large and complex missiles, kicked off a series of company-funded studies to see if there were ways to reduce the high cost of care and feeding of field missiles.

One major result from this program has sparked much military interest. It is a simplified control system, ". . . something that can be kicked, dropped, and shot at," in the words of an engineer. Cheap gyros with simplified air bearings are at the heart of this system. The gyro design has one bearing for two axes, plus a single spindle bearing. Tests have shown the gyro to be free of first-order g and g-squared errors. It has been tested up to 60g and has operated continuously and successfully at that high loading.

Component Testing

Missile components or systems up to five pounds in weight can be vibrated up to a 125g level with new equipment now in use at Associated Testing Laboratories, Inc.

Either sinusoidal or random vibration sequences can be produced over a frequency range from five to 5,000 cps. Components heavier than five pounds can be tested at lower g levels.

Associated has been testing components of Martin's Pershing this way as part of a three-year program. Automation has been used to get better simulation of actual flight vibration sequences.

During flight tests of a Pershing, the outputs of accelerometers are recorded on magnetic tape on the ground by telemetering. This creates a library of stored random vibrations from different locations in the missile and under different conditions of flight. Feeding any tape into an automatic control for the vibration equipment reproduces a typical sequence of the random vibrations actually encountered in flight.

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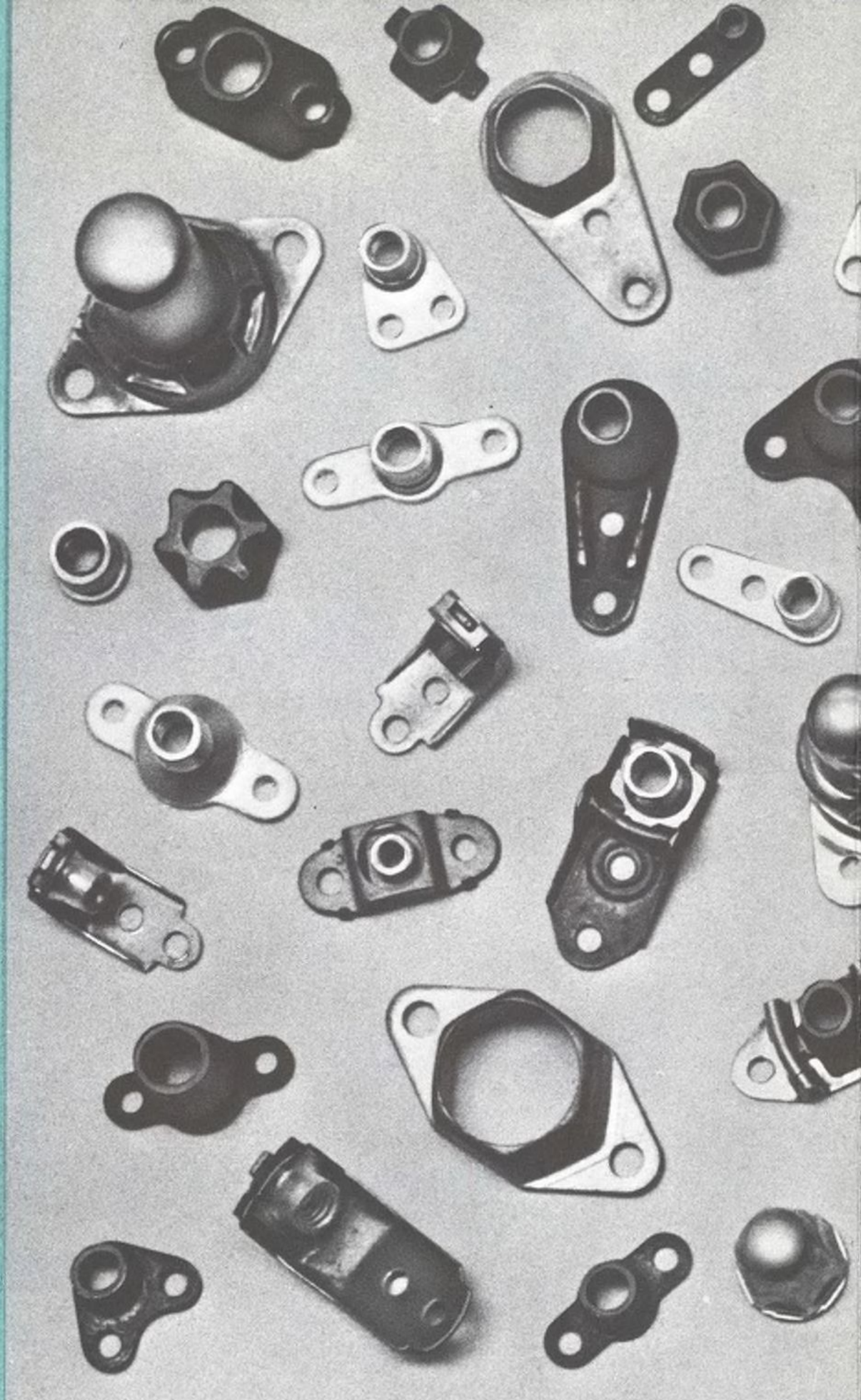
All Nutt-Shel fasteners meet or exceed AN-N-10 and/or MIL-N-25027 (ASG). Alloy steel nuts are serviceable to 550°F, corrosion-resistant steel nuts to 800°F. Available in self-locking styles in all sizes—#4 through $\frac{3}{8}$ in. For samples and engineering data on Nutt-Shel products shown, write to Sales Engineering, AIRCRAFT/MISSILE DIVISION, SPS, 2701 SOUTH HARBOR BLVD. • SANTA ANA 3, CALIF., or contact one of the sales offices listed on page 4.

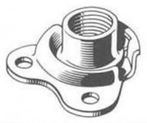
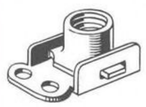
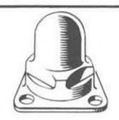


Nutt-Shel lightweight nuts are part of a complete line of SPS aircraft/missile fasteners which includes all AN, MS and NAS callouts —plus SPS special high-performance bolts, nuts and locknuts.

You can now specify threaded fastening systems for temperatures to 2000°F, tensiles to 300,000 psi, and shear strengths to 156,000 psi—each a pioneering achievement of the SPS laboratories for advanced research in fastener performance and reliability. Impressive in themselves, these fastening systems are equally significant in terms of the design opportunities they offer you. Among these opportunities are major reductions in fastener weight, numbers and bulk, along with equally important reductions in the size and weight of related components—flanges, tees and elbows.

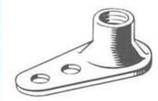
SPS / Nutt-Shel LIGHTWEIGHT FAST

CORNER ANCHOR NUTS

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Fixed* NAS 684, 1027	12620 12720	550 800
	Fixed Spacer	9620D	250
	Fixed Spacer Lightweight*	12621 12721	550 800
	Miniature Modified Fixed NAS 1067	M12640 M12740	550 800
	Fixed 100° Countersunk NAS 685, 1026	15620 15720	550 800
	Floating	13620 13720	550 800
	Floating Spacer	13621 13721	550 800
	Miniature Modified Floating	M13640 M13740	550 800
	Fixed Dome*	14620 14720	550 800
	Self-Sealing Floating Dome*	14650H 14650HA	225 375
	Self-Sealing Floating Dome Spacer	14652H 14652HA	225 375

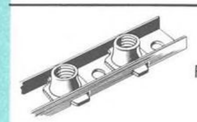
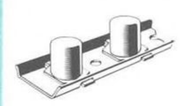
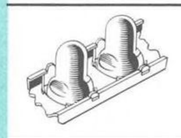
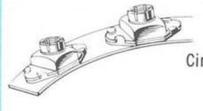
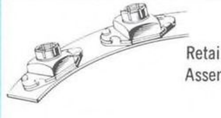
*Also available with reduced rivet spacing.

ONE-LUG ANCHOR NUTS

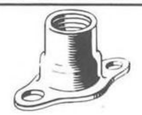
	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Fixed* NAS 682, 1025	12610 12710	550 800
	Fixed Spacer	9610D	250
	Fixed 100° Countersunk NAS 683, 1026	15610 15710	550 800
	Floating NAS 687, 1032	13610 13710	550 800
	Floating Spacer	13611 13711	550 800
	Hi-Float	NS230	550
	Fixed Dome*	14610 14710	550 800

*Also available with reduced rivet spacing.

CHANNEL

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Floating Nut	C136	550
	Self-Aligning Floating Nut	C1363	250
	Universal Spacing	C1360	550
	Floating Dome Nut	NS02291	550
	Floating Self-Sealing Dome Nut	CN1463H	375
	Circular Fixed Nut	NS112	800
	Retaining Ring Assembly Floating Nut	NS02289	1000

TWO-LUG ANCHOR NUTS

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Fixed* NAS 680, 1023	12600 12700	550 800
	Fixed Spacer	9600D	250
	Fixed Spacer Lightweight*	12601 12701	550 800

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Fixed 100° Countersunk NAS 681, 1024	15600 15700	550 800
	Floating* NAS 686, 1031	13603 13703	550 800
	Floating Spacer*	13604 13704	550 800

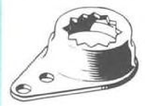
*Also available with reduced rivet spacing.

ENERS FOR AIRCRAFT AND MISSILES

SPECIAL-PURPOSE FASTENERS

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Threaded Insert	T-TL	300-1600
	Snap Nut	1332	250
	Floating Clinch Nut	13680	550
	Floating Swage Nut	13681	550
	Self-Wrenching Anchor Nut	NS228	550
	Dome Swage Nut	NS280	550
	Two-Lug Floating Shank Nut	NS102524	550

RETAINERS

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Two-Lug Cap Bolt	B1355	550
	Two-Lug Nut	6600	250-800
	Two-Lug Bolt	6800	250-1200
	Two-Lug Nut 220 ksi	NS02223	550-900
	One-Lug Nut	6610EWHT	550
	Corner Nut	6620SEW	1200
	Corner Bolt	6820SEW	250-1200

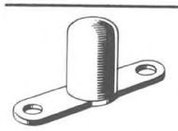
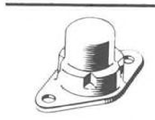
RIGHT ANGLE ANCHOR NUTS

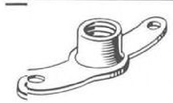
	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Miniature Floating NAS 1033	M136R M137R	550 800
	Floating	136R 137R	550 800

NUT ELEMENTS

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Cap Nut	26C 27C	550 800
	Lightweight Hex Nut NAS 679	96 97	550 800
	Replacement Nut	1323	550 800
	Replacement Spacer Nut	1331	550 800

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Floating Self-Aligning	13630	550
	Hi-Float	NS223	550
	Fixed Dome*	4600 4700	550 800

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Fixed Dome Lightweight*	14600 14700	550 800
	Floating Dome 160 ksi	NS267	550
	Self-Sealing* Floating Dome	14630H 14630HA	225 375

	Nutt-Shel Type	Representative Part No.	Temp. Range (°F)
	Miniature Floating Dome	14663 14763	550 800
	Floating 220 ksi	NS02331	550
	Fixed Curved Base	NS153	550

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AIRCRAFT/MISSILE Division SPS

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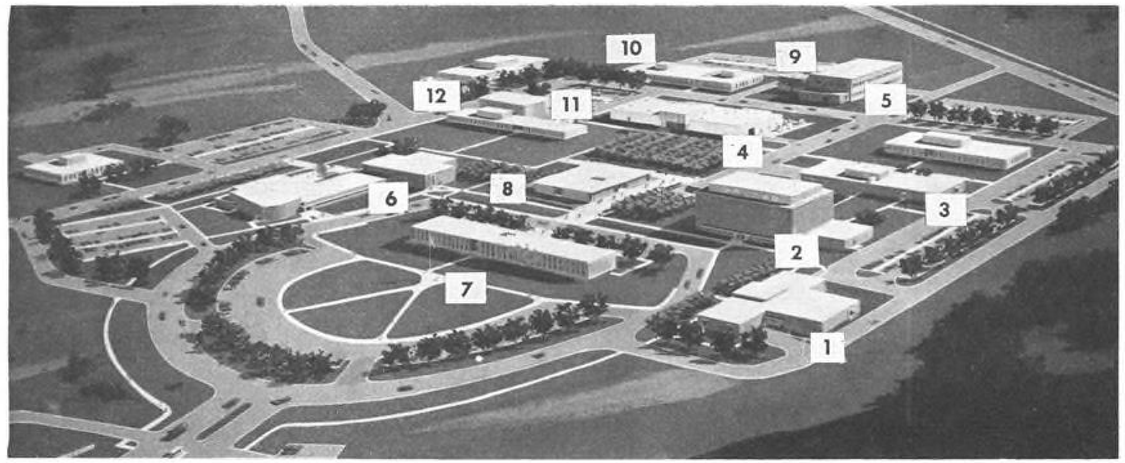

FIVE BUILDINGS, plus a powerplant addition, scheduled for completion by mid-1963, will markedly expand capabilities of USAF Systems Command's newly organized Aerospace Medical Division facilities at Brooks AFB, San Antonio, Tex. Existing structures: (1) flight medical building; (2) research institute; (3) research shops; (4) altitude laboratory; (5) powerplant; (6) academic facility will be expanded by addition of (7) professional building, (8) library, (9) powerplant addition; (10) bionucleonics building; (11) bioastronautics-biodynamics building; (12) vivarium. Facilities expansion would entail adding about 500 technicians to the present staff.

USAF Expands Bioastronautics Capability

By Erwin J. Bulban

Brooks AFB, Tex.—Major buildup of facilities and personnel, geared to expanding USAF's in-house bioastronautics capabilities, is under way here at the headquarters of System Command's newly formed Aerospace Medical Division.

Concurrent with the facilities expansion—which will cost $6.2 million in new buildings alone and entail adding approximately 500 technicians to the present staff—a significant reorganization of program management is under way here to coordinate future Air Force bioastronautics research and development more effectively than has been possible under the previous loosely knit aeromedical organization.

The new facilities and equipment to be installed here at Brooks AFB, near San Antonio, are expected to be completed in mid-1963. Presently, Air Force Systems Command headquarters is analyzing the organizational structure, submitted by Aerospace Medical Division headquarters, that will manage the complex of aeromedical laboratories that stretches from here to Alaska.

The first step of bringing Air Force's widely scattered medical facilities under one command, that of Brig. Gen. Theodore C. Bedwell, Jr., who heads the new Sixth Division of Systems Command here, was initiated Nov. 1 with creation of the Aerospace Medical Division with headquarters at Brooks.

Initially, these Air Force medical educational and research components were brought in: the Aerospace Medical Center, School of Aerospace Medicine, Lackland's USAF Hospital, 4th Casualty Staging Flight, headquarters of 6570th Air Base Group, 6570th USAF Dispensary, 6570th Epidemiological Laboratory, all formerly of the Air Training Command and the Arctic Aeromedical Laboratory, formerly of the Alaskan Air Command. Then on Jan. 1, 1962, these other organizations were transferred to AMD: Aerospace Medical Laboratory, Wright-Patterson AFB, Aeromedical Field Laboratory, Holloman AFB and the Personnel Laboratory, Lackland, AFB.

Next Step

Next step is to get AMD's proposed organizational structure that will manage and coordinate all of these entities approved by Systems Command. Pending approval, both Gen. Bedwell and his research deputy, Col. John E. Pickering, are reluctant to delve too deeply into details of the proposal, but Aviation Week received some insight as to general outlines of the future program.

With emphasis to be placed on applied research, studies will be handled under a technical area management concept, with five research divisions considered initially:

- **780-A—life support.**
- **780-B—aerospace clinical medicine.**
- **780-C—radiobiology.**
- **780-E—human performance.**
- **805—Biosciences (basic research).**

Gen. Bedwell's research deputy, Col. Pickering, would head up all research for AMD, with a technical area manager responsible for each of the five research areas.

These men will be competent scientists, specialists in their particular area, but their prime responsibility would be management on a full-time basis and they would be located at AMD's headquarters here, acting in effect as Col. Pickering's deputies.

Technical area managers, who will be either military or civil service personnel, would know not only their particular specialty thoroughly, but will be expected to know both in-house and contractor research capabilities in their field of work.

Gen. Bedwell and Col. Pickering would utilize a research council to screen all projects submitted by the various AMD aeromedical activities or by outside contractors to prevent duplication, to ensure that the work has practical merit and also to determine what facility or facilities would be best qualified to handle it. The program also would be assigned a project manager. This system, it was indicated, would far better utilize available funds and facilities than previously. Constant review would tend to eliminate

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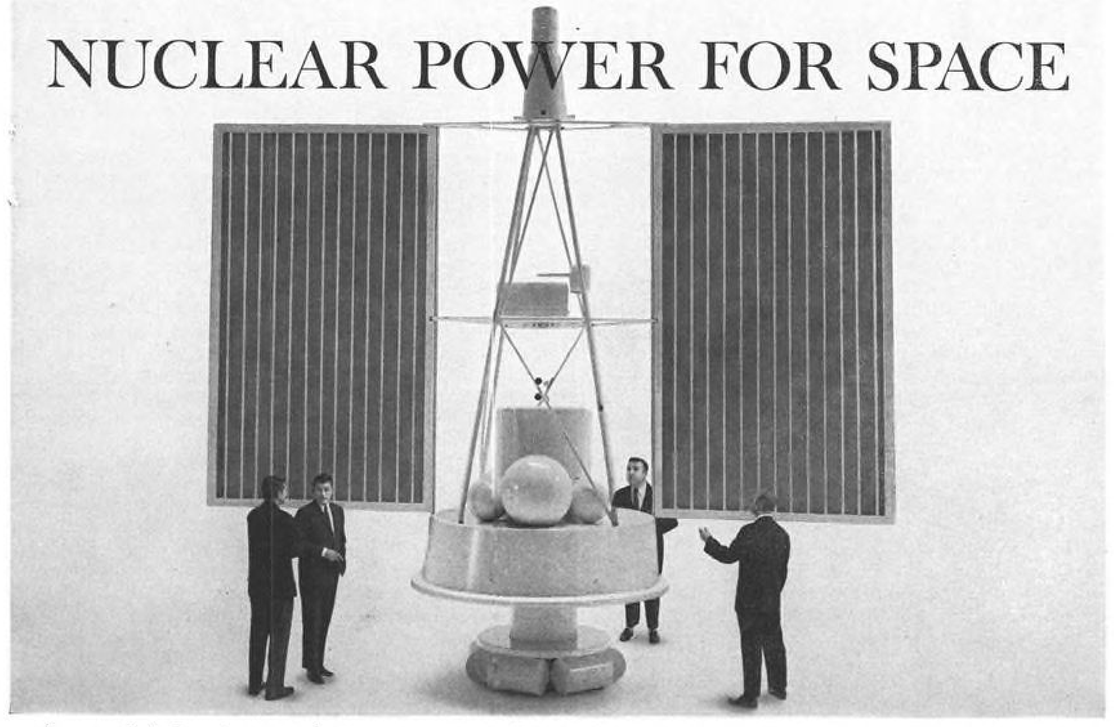

Space-minded engineers and scientists are invited to send resumes to Mr. Pierre Brown at Space-General Corporation (an equal-opportunity employer), 777 Flower Street, Glendale, California.

SPACE · GENERAL

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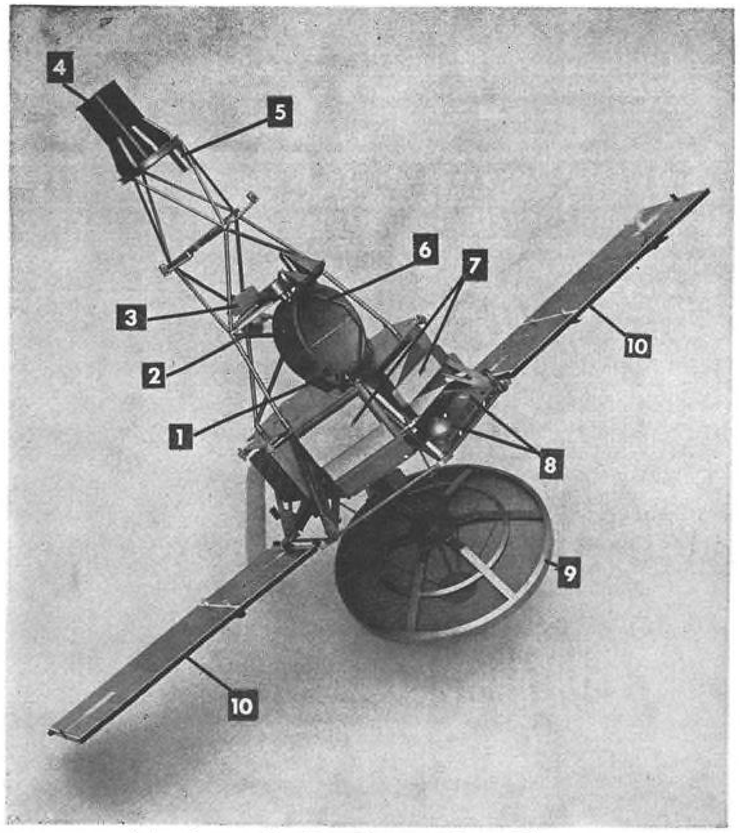


Mariner R Configuration Shown

Basic configuration of Mariner R, scheduled for Venus flyby attempt next summer, is shown in this scale model photograph. Items within view include infrared radiometer (1) and microwave radiometer (6) which will scan Venus temperatures on flyby, ion chamber (2), particle flux detector (3), omni-directional antenna (4), and a magnetometer (5), the latter for measuring magnetic fields in interplanetary space. Also, guidance and data electronic assemblies (7), bottles to supply gas for attitude control (8), directional antenna (9) and solar panels (10). Solar plasma detector and cosmic dust detector also to be carried on Mariner R are not visible. Total payload will weigh about 450 lb., about half the weight of the original Mariner A which it was forced to replace (AW Oct. 2, p. 26, June 12, p. 52) as a consequence of difficulties in Atlas-Centaur development. Mariner R will be launched by Atlas-Agena B.

those splinter groups, projects and also the "decimal point movers" which tend to dilute the over-all capability. Program evaluation review technique (PERT) can be applied to ensure that schedules are kept to also make fuller use of available time and talent.

Indications are that there will be no overnight or revolutionary revision of the various facilities and their missions. Gen. Bedwell told AVIATION WEEK he plans a tour of all of the facilities now under his command to become acquainted first-hand with their work and capabilities. And there is little evidence that the new division plans any major change in its present ratio of 60% of research activities being maintained in-house and the remainder handled by outside contractors.

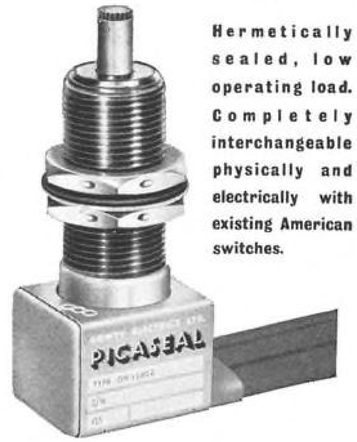
The evidence points toward AMD building up its in-house capabilities in facilities, equipment and personnel to a greater extent to attract and hold top-quality scientific personnel and technicians by offering them top-grade facilities and a scholarly climate in which to work.

Additional Structures

New structures being added to the present complex at Brooks include:

• **Bioastronautics-biodynamics building** which will feature among its equipment a modified RCT-21 centrifuge with a 20-ft. arm carrying a manned gondola with capability of being accelerated to provide force of 50g in 55 sec. with a rate of onset of 1g per second. Foundation of the building will be stressed to

PICASEAL



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TOGGLE SWITCH

Positive toggle action with ±24° 'throw'. Mechanical override capable of breaking a light weld between contacts. Designed to meet M.O.A. requirements.

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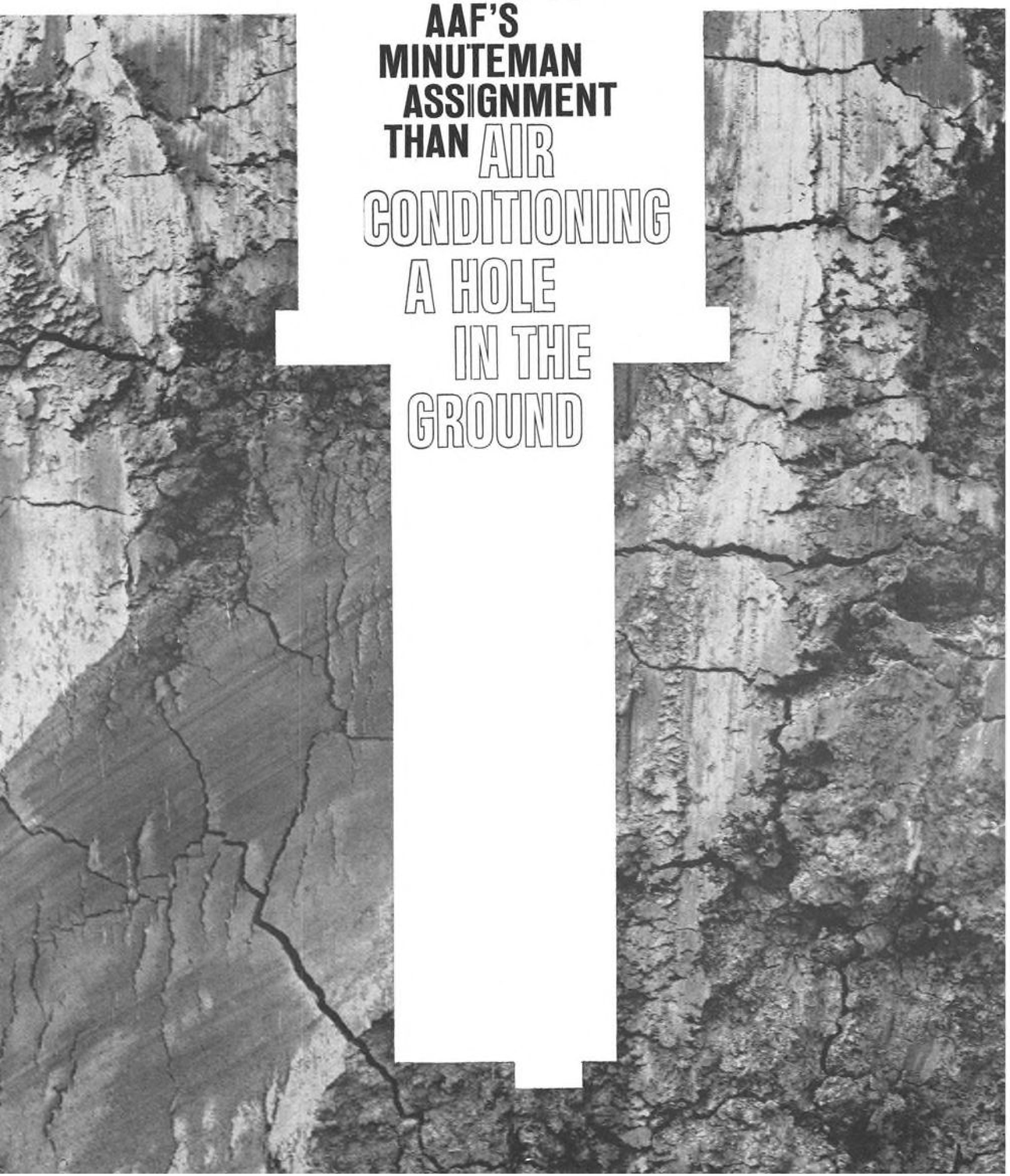
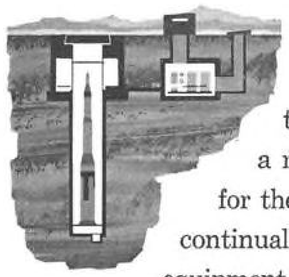


THERE'S MORE TO AAF'S MINUTEMAN ASSIGNMENT THAN AIR CONDITIONING A HOLE IN THE GROUND

Engineered Environment for Minuteman ...by AAF



Hidden away in underground silos and untended, each Minuteman must keep itself always ready, whether called to perform tomorrow, or years from now, or never. Here is a real challenge for the Air Force Reliability Program, and for the team that produces a weapons system that must remain continually operational. AAF has developed and is supplying the equipment which protects this weapons system from environmental conditions not compatible with intended Reliability and system requirements for operation readiness. As an integral part of the weapons system, the environmental equipment also lies buried, and untended, yet must function on and on, unfailing, through every change of season and condition.

The complete environmental systems capability of the American Air Filter Co., Inc. enabled us at AAF to accept the challenge to provide proven Reliability, to develop, design, produce and install the equipment that provides the proper ambient for the Minuteman System and the Air Force personnel operating the weapons system. Temperature, humidity, cooling, heating, refrigeration, and air filtration have been scientifically coordinated in one master system. Air for personnel will pass through chemical, bacteriological, and radiological filters to help protect them from possible enemy attack.

Reliability, shock, vibration, radio interference requirements, performance, and ability to meet the challenges of technical leadership in Environmental Systems are not cliches at AAF, they are the heart of our organization. Can we help with your program's requirement? Your inquiry is invited.

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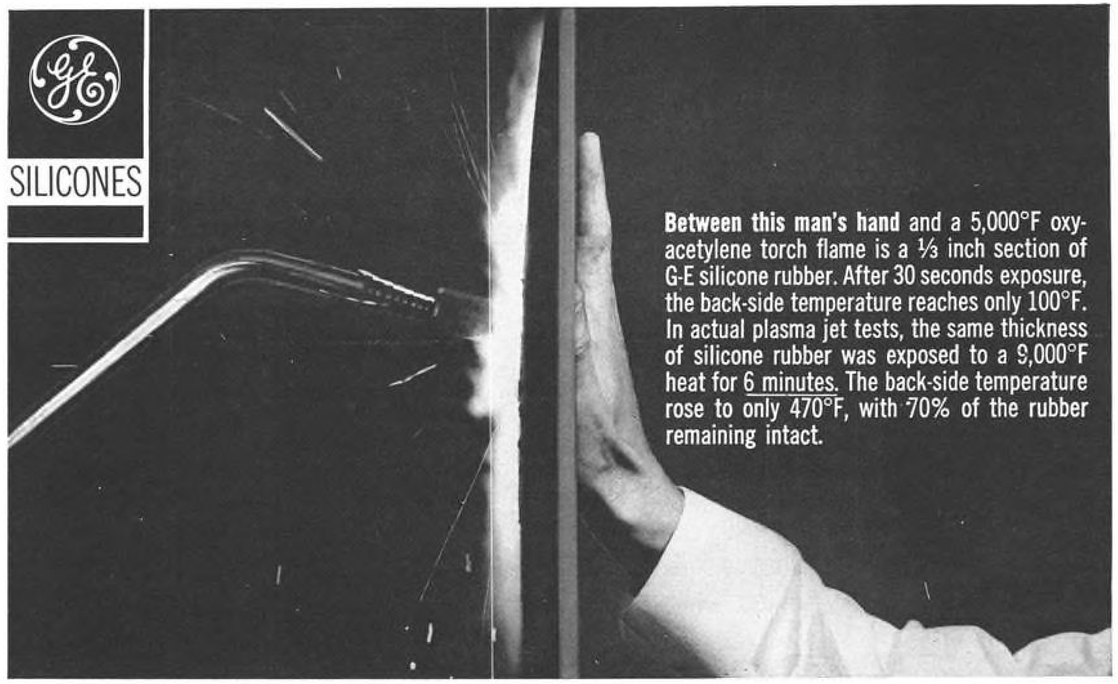
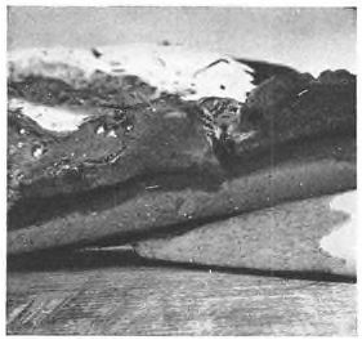


Thermal barrier against 5000°F flame

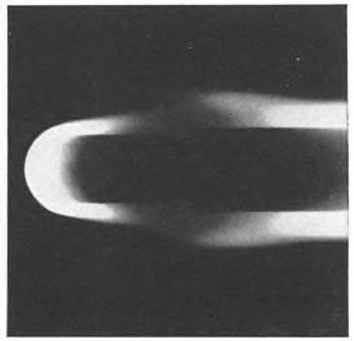
GENERAL ELECTRIC SILICONE RUBBER



RESULTS OF PLASMA JET TESTS AT 9,000°F

Flight Simulation
Vel. = 17,000 ft./sec.
Alt. = 250,000 ft.

Exposure time at 9,000°F	Back-side temperature of ⅓ inch section of G-E silicone rubber
30 seconds	100°F
2 minutes	210°F
3 minutes	300°F
4 minutes	375°F
5 minutes	430°F
6 minutes	470°F



The surface of the tested rubber section forms a hard, carbonaceous crust, while the underside remains flexible and undamaged. Preliminary tests showed the effective heat of ablation to be eight times better than presently used plastics, with one-seventh the rate of ablation and one-fourth the weight loss. Here is an excellent ablative covering with low thermal conductivity.

The above chart shows how the high thermal insulation of G-E silicone rubber is maintained during exposure to 9,000°F heat. It is also useful in mechanical and electrical applications at temperatures from —150°F to 600°F, where it remains resilient and flexible. It also maintains its excellent physical and electrical properties over this wide temperature range for extended periods.

Continued high temperature testing goes on at General Electric's Missile and Space Vehicle Department in Philadelphia. Shown above is a typical specimen undergoing plasma jet testing in an electric arc heated supersonic wind tunnel. Continuous testing like this will develop new data on the thermal and ablative uses of G-E silicone rubber.

To learn more about G-E silicone rubber, and its uses as a thermal and ablative material, write: General Electric Company, Silicone Products Dept., Section J1061, Waterford, New York.

GENERAL ELECTRIC

take equipment capable of 10g per second rate of onset. Equipment will cost about $180,000.

Also to be installed will be an 8-ft.-dia. opaque glass fiber plastic one-man sphere, to be supported on an airbearing and activated by inertial rings to provide complete freedom of movement in all conceivable axes. Equipment will be utilized for studies of physiological affects on humans of tumbling and their ability to maintain control when various maneuvers are introduced into the equipment. Information will be telemetered from the ball so as to enable complete freedom of movement and obviate errors in data produced using slipring attachments of leads. This $275,000 device is being fabricated by Norair Division of Northrop Corp.

The building will also house several space cabin simulators. One of these will be a six-man multi-occupant sealed environment simulator (MOSES) capable of not only checking crew performance, but also complete space vehicle systems. Concept for this equipment visualizes a two-story chamber, with one story housing the crew and the other providing space for equipment installation, with access being possible between the two to provide in-flight maintenance simulation while under a space environment.

This building will also house the division's current two-man and one-man cabin simulators, which will be useful in setting up space rendezvous type experiments, through linking of communications systems.

Specifications for MOSES have been determined and indications are that invitations for bids will be put out to qualified contractors in Fiscal 1964.

AVIATION WEEK was told that the bioastronautics-biodynamics building's 40-ft.-high ceiling is considered necessary to provide for even larger simulators in the future should they be deemed necessary.

• **Bionucleonics structure** is being built around a whole-body radiation counter similar to that used by Atomic Energy Commission's Los Alamos laboratory for measuring humans' natural radiation background. Since it is necessary to thoroughly isolate the room from outside radiation background influences in order to make accurate measurements on the subjects, the room is shielded by three feet of concrete and five inches of battleship-type steel, the latter obtained as surplus from U. S. Navy. The bionucleonics structure will also contain two sets of animal aerobiology exposure chambers which will be used in exposing specimens to varied stresses such as pressure, humidity and temperature. Virus, microbes and toxins, as well as animals will be studied under conditions simulating altitudes to 100,000 ft.

• **Professional building** will be a repository for the division's huge file of electrocardiogram and auditory records, which encompass every USAF aircrew member. Prime piece of equipment here will be an analog-digital computer that will also be used for providing real-time readouts of experiments being performed using the eight-foot plastic sphere reaction control simulator and also monitor flight work done with the F-100 fighters attached to the station. Heart rate, respiration and other data being telemetered to the ground from the instrumented pilot of the aircraft will be fed to the computer for instantaneous readout while the mission is being flown. Computer equipment is now in the evaluation stage and has been narrowed to three suppliers whose proposals are being studied.

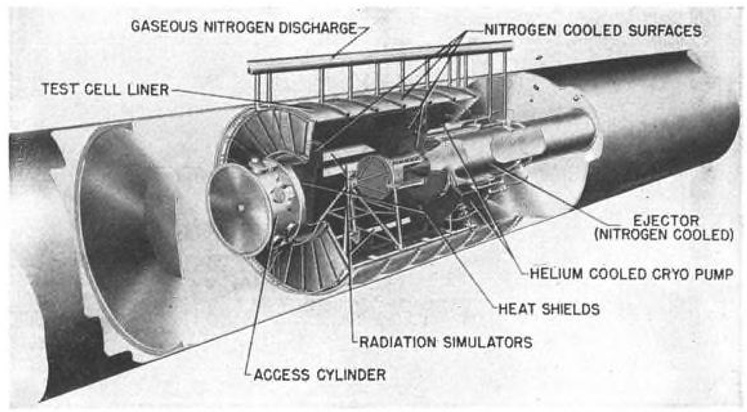
• **Library** is designed to handle approximately twice the division's current listing of about 50,000 aerospace medical volumes.

Bioastronautic Capability

San Antonio, Tex.—Air Force intention to maintain a strong bioastronautics capability was emphasized here by Air Force Systems Command Vice Commander Maj. Gen. C. H. Mitchell.

He stated USAF must support the National Aeronautics and Space Administration in carrying out the national manned lunar landing program to be achieved by the end of this decade, just as it now supports the NASA Mercury program and as it has supported other NASA programs in the past.

But the service must also develop operational capabilities for military space missions, Gen. Mitchell added.



CELL J-2 at USAF Systems Command's Arnold Engineering Development Center will simulate space environment for full-scale firings of large rocket engines.

Largest AEDC Horizontal Test Cell Completes Initial Test Successfully

First shakedown runs of Arnold Engineering Development Center's J-2 ultra-high-altitude test cell show it to be performing better than specifications.

Originally estimated to operate at a simulated altitude of 350,000 ft., J-2 has already shown simulation somewhat above 365,000 ft. During the remainder of the shakedown period, there will be a further decrease in the operating test pressure.

Cell J-2, which is the largest horizontal test cell at the Air Force Systems Command center (AW Sept. 25, p. 221), was modified to simulate a solar and orbital environment for large satellite or space vehicle rocket engines. Full-scale motors will be fired in the cell under very low pressure and temperature combined with the thermal radiation effects that would be encountered at extreme altitudes.

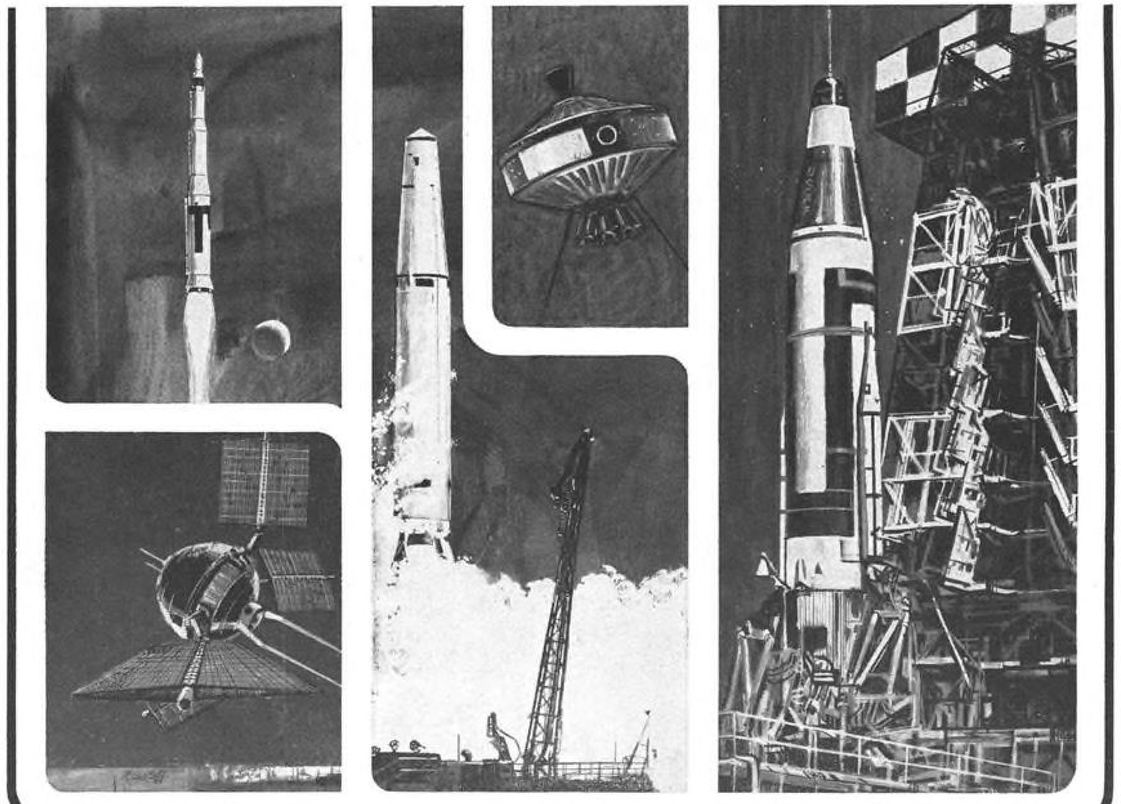
Simulated solar radiation will come from batteries of infrared heating lamps with a capacity of about 1,400 Btu. per square meter. The major increase in the altitude capacity of J-2 as it formerly existed is due to a cryogenically cooled liner, 18 ft. in diameter and 32 ft. long, placed in the exhaust ducting of the 20-ft.-dia. tunnel.

Diffusion Pumps

So far during the shakedown, only diffusion pumps have been used to attain the simulated test altitudes. Cryogenic pumping surfaces using gaseous helium will start operating during the next phase of shakedown. Final test ambient temperatures will be as low as —320F to simulate the heat sink of space.

J-2 and its modifications were designed and built and will be operated by ARO, Inc., the center's operating contractor.

CAREERS IN SPACE TECHNOLOGY LEADERSHIP



Of particular interest to engineers and scientists is the continuing growth and diversification of Space Technology Laboratories, Inc. What is now STL was founded as the Guided Missile Research Division of the Ramo-Wooldridge Corporation in 1954, when the Ballistic Missile Program was given highest national priority. ■ Assigned contractual responsibility for the program's systems engineering and technical direction, STL has grown in parallel with the need for its capabilities – from a small group of engineers, scientists and administrators to an industrial organization with a professional staff numbering more than 2,000 with 2,500 supporting personnel – from its initial headquarters in a suburban Los Angeles schoolhouse to the ultra-modern STL Space Technology Center nearing completion on a 110-acre site at One Space Park, Redondo Beach, California, close to Los Angeles International Airport. ■ During its years of Space Technology Leadership, STL has contributed importantly to the management of a program that, in a successful race against time, has given this nation the Thor, Atlas, Titan and Minuteman ballistic missile systems. At the same time, STL has been called upon to design, fabricate, instrument and successfully launch Pioneer I, Explorer VI and Pioneer V – all of which were tracked and commanded by STL's world-wide space communication network (SPAN) – and to contribute to the management of the Transit 1B, Transit 2A, Transit 3B, Courier 1B and Tiros programs. ■ Today, STL in addition to its continuing role in the USAF Atlas, Titan and Minuteman programs, is performing research, development, design and construction for three Orbiting Geophysical Observatories (OGO), as well as project coordination and systems planning for Project Relay, both for NASA; and participating in the Army Advent communication satellite project. STL's continuing program of original and applied research covers a broad spectrum of technical disciplines including particle physics, solid state theory, guidance space physics, communication theory, propulsion and power, and electromagnetic systems in the infrared, ultraviolet and microwave regions. ■ The expanding activities of STL create immediate career opportunities in Southern California and at Cape Canaveral for engineers and scientists of talent and vision. All qualified applicants are invited to communicate with Dr. R. C. Potter, Manager of Professional Placement and Development. STL is an equal opportunity employer.

Career opportunities exist at STL for qualified engineers and scientists in support of these programs:

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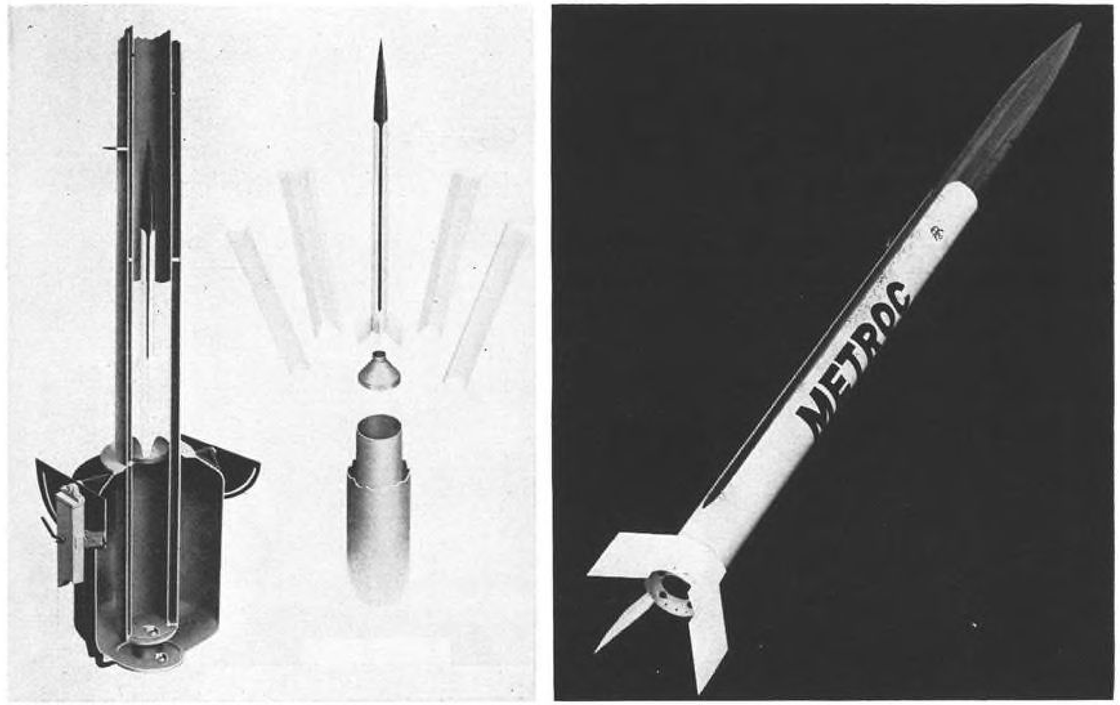
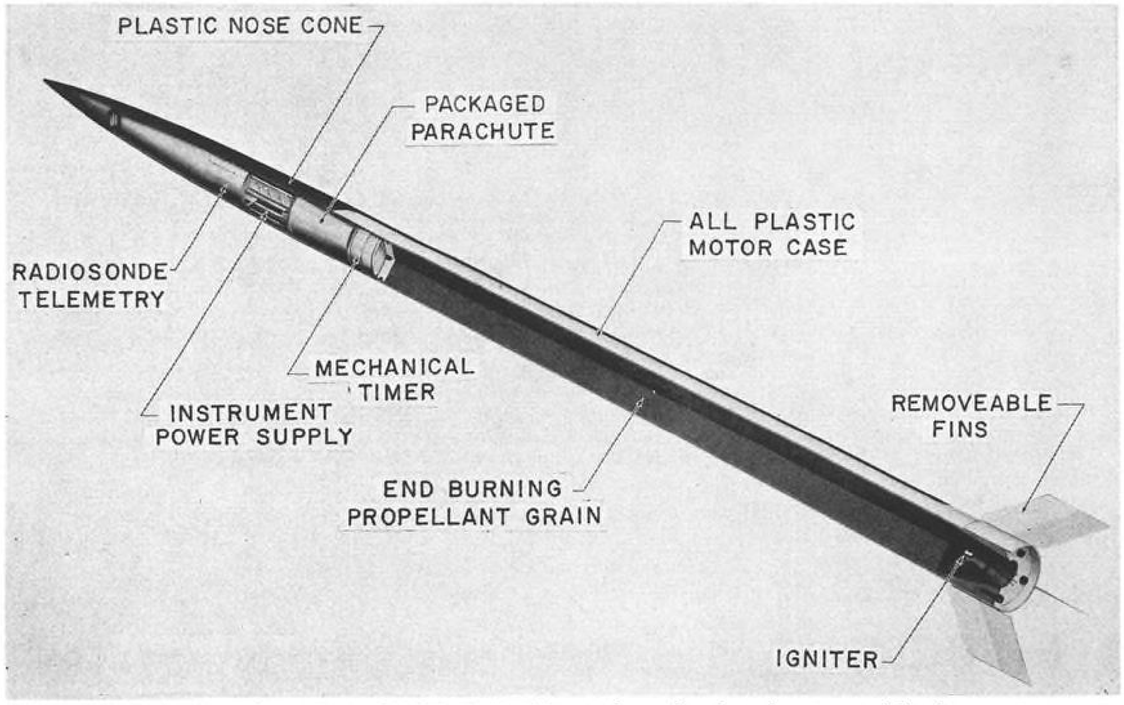


Atlantic Research Corp. 18-lb. Metroc rocket will undergo flight tests starting this month at Wallops Island, Va., after five successful static tests. The rocket is 4.5 ft. long and 3 in. in diameter. Drawing at left shows Metroc launcher operation. Rocket is positioned and supported during launch operation by four styrofoam spacers. These pieces and aluminum piston fall away as rocket leaves launching tube.

Metroc Sounding Rocket to Undergo Wallops' Tests



Metroc solid rocket motor produces a thrust of 130 lb. Designed for weather probes, the rocket can carry 3 lb. of temperature, pressure and humidity sensors to 100,000 ft. Rocket casing is plastic. Atlantic Research funded development of the sounding rocket.

for lower cost . . . lower thermal conductivity . . . greater molded strength

DESIGN with Hitco-C CARBON MATERIALS

The nozzle shown here is representative of missile components for which Hitco-C was developed. Parts fabricated from Hitco-C carbon materials are showing startling break-through characteristics for ultra-high temperature insulation and ablation uses. In comparative tests with other carbonaceous materials, Hitco-C demonstrates impressive advantages: • *Greater molded strength* • *Lower thermal conductivity* • *Lower cost* *Easier impregnation* • *Low ablation rate* • *Compatibility with most resin systems* • *Uniform quality.*

For missile component design, consider Hitco-C's additional features: It can be both compression-molded (fibers, combined with appropriate resin systems) and laminated (fabric, in rolls 33" wide and 50 yards or more long). The greater fabric length and stronger weave make Hitco-C superior for coating operations.

• *For full information write for Technical Bulletin 1-3B*

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USAF to Tighten AGREE Test Standards

By Philip J. Klass

Washington—Air Force plans to tighten up the AGREE reliability test procedures as a result of a year of controlled field tests of the AN/ARN-21C Tacan sets, the first avionic equipment built under the tough new Defense Department specifications intended to improve reliability. AGREE specifications were prepared by the Advisory Group on Reliability of Electronic Equipment from which the acronym is derived (AW Jan. 23, 1961, p. 91).

This was revealed here at the Eighth National Symposium on Reliability and Quality Control by Griffith W. Lindsay, Air Force Systems Command Avionics Division, Wright-Patterson AFB, Ohio.

When the ARN-21C sets were installed a year ago on McDonnell F-101 aircraft in three Air Defense Command squadrons, it was expected that they would equal and probably exceed the nearly 150 hr. mean-time-between-failure (MTBF) exhibited in factory tests at Hoffman Electronics Corp. (AW June 13, 1960, p. 87; Jan. 23, 1961, p. 91).

Instead, the Tacan sets in field operation tests at three ADC bases have exhibited an over-all MTBF of only 63 hr., Lindsay disclosed here. The highest MTBF of 77 hr. was obtained at Charleston AFB, while the lowest occurred at Glasgow AFB, with a MTBF of 56 hr.

Significant number of the failures were caused by two malfunctions:

• **Excessive tube filament voltage,** attributed to improper setting because of limited availability of proper field test equipment.

• **Silicon diode crystal mixer failures,** which subsequent analysis revealed also had occurred at the manufacturer's plant. However, at that time these failures had been classed as "secondary failures," resulting from other basic malfunctions, and under the terms of the AGREE test specifications the manufacturer was not required to substitute an improved diode, so long as the equipment met the specified MTBF, Lindsay said.

If failures from these two sources are excluded from the field test figures, the ARN-21C would have exhibited a MTBF of about 100 hr. This is within the statistical expectancy for a test designed for a 90% consumer confidence level at the 150 hr. MTBF test figure, Lindsay said.

Here are some of the changes in AGREE test specifications which Lindsay said the Air Force has adopted or will recommend:

• **Secondary failures:** Air Force recently has changed its standard contract form to require contractors working to AGREE specifications to take corrective action on all faults which exhibit a pronounced failure pattern, regardless of whether the equipment meets the specified MTBF without such action, Lindsay said. Analysis of ARN-21C factory tests showed that 46 out of 47 failures of the silicon diode mixer which occurred in the factory had been classed as secondary failures. Under the then-existing rules, no corrective action was taken by the contractor since the Tacan set met its specified MTBF.

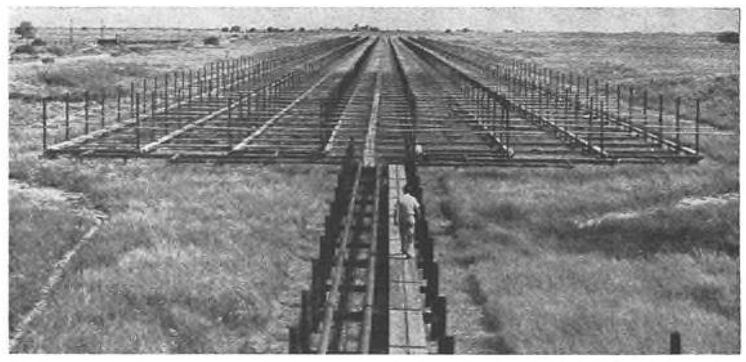
• **Equipment selection:** New provisions need to be established in selection of equipment which must achieve contract specified MTBF under the AGREE tests. Under present provisions, a contractor can place a large quantity of equipment on test, withdraw those that fail, until the prescribed number still operating accumulate required number of trouble-free hours. For example, Hoffman originally placed a quantity of 48 sets on test, only seven of which needed to operate for 450 hr. (three times the 150 hr. MTBF) to pass the AGREE specifications, Lindsay said. He called for plugging this loophole by requiring either that the seven units be selected completely at random, or seven consecutive sets off the line be used.

Year-long controlled tests, monitored by Vitro Corp. personnel stationed at each of the air bases, provided a number of other lessons from which both the military and industry can profit.

Where the AGREE tests provide for operating the Tacan sets at a maximum temperature of 55C, in the F-101 installations the equipment often operated at temperatures as high as 72C. Where the AGREE tests provide for subjecting the sets to 2g vibration over a narrow frequency spectrum, in the F-101, the equipment is subjected to as high as 10g over a wider frequency range.

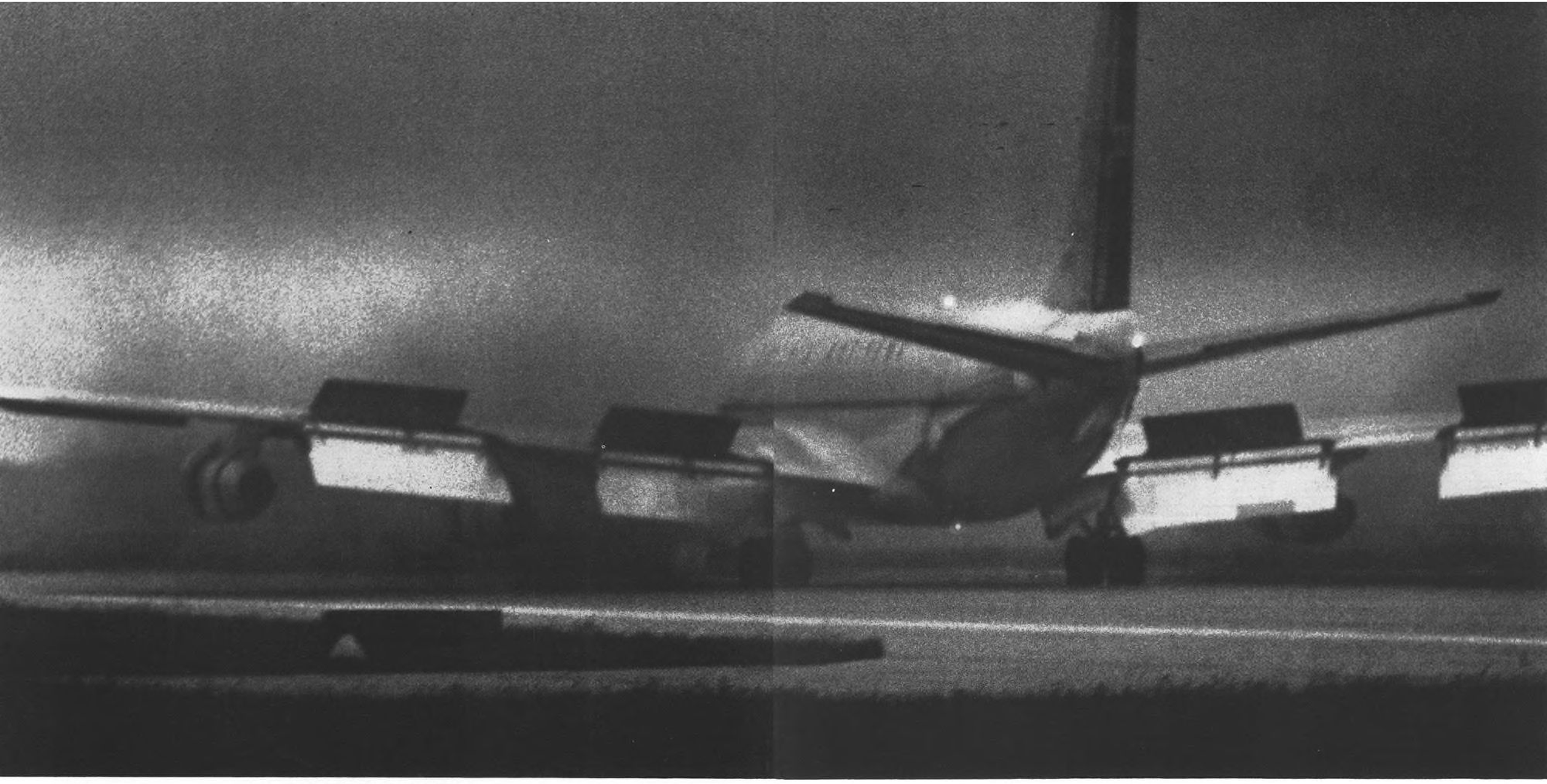
Environment in which the ARN-21C operates obviously is beyond the control of the equipment manufacturer. The recent field tests indicate either that the AGREE test conditions must be made more representative of actual field conditions, or the latter must be improved to provide a less hostile environment for the equipment.

A few of the ARN-21C failures were due to personnel handling of the equipment during installation, although the basic cause might be attributed to equipment design. In installing the equipment, military personnel occasionally applied pressure against an intake air screen, bending it sufficiently to contact a cooling fan and stall the driving motor. Without cooling air, the ARN-



Space Radar to Aid Sun Spot Study

Powerful new VHF space radar, located at El Campo, Tex., has been used by Lincoln Laboratory scientists for solar measurements which may increase knowledge of sun spots. Measurements to date indicate an effective radar cross-section which is substantially less than expected, suggesting that electron temperature in the solar corona may be only one-half million degrees, half the previously calculated value. Radar echoes were obtained at distances one-half a million miles out from the sun's photosphere. The radar, operating at 38.25 mc., with continuous output power of 500 kw., uses antenna consisting of array of 1,024 dipoles in eight rows extending for one-third mile, which provides fan-shaped beam ¾ deg. thick (north-south) by 15 deg. wide.



ON SCHEDULE

Bendix® all-weather flight control systems are helping to guarantee on-time departures and arrivals regardless of weather. Under present restrictions, jets can't land if weather minimums are less than 300 feet and ¾ of a mile. To help solve this problem, Bendix has developed equipment to extend the capability of its PB-20 automatic flight control system for operation under conditions of ever lowering minimums—right to the ultimate goal of touchdown.

Some of the equipment needed to implement this program is now being flight tested and planned for fall delivery.

VISIBILITY ZERO

New aircraft scheduled to fly with the all-weather PB-20 are the Caravelle Mark 10, BAC-111 and VC-10. Under a simplified modification plan, all 45 domestic and foreign operators who now have the basic PB-20* in service or on order will be able to adapt to the same all-weather capability.

All-weather landings are an inevitable development in the continuing drive for improved schedule reliability. Bendix all-weather flight control systems have shortened the time when this phase of aviation progress will be a routine bad-weather operation. *Eclipse-Pioneer Division, Teterboro, N. J.*

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- **wilcox** developed and produced the *first* commercial airline transponder—and has stayed far in advance of the field over the past five years —having delivered well over 500 transponders to most major airlines, both domestic and foreign.
- **wilcox** employs module construction in all of its transponders for ease of equipment expandability.
- The **wilcox** Model 714C-2 Transponder is designed to provide automatic altitude reporting information with the addition of a simple, plug-in module.

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21C quickly overheated and usually suffered a failure.

Field test program included a study to determine the length of time required to repair a faulty Tacan set, compared with a similar analysis conducted of failed sets at the factory. There was relatively close correlation between the two, indicating that the modular, plug-in construction with extensive test points provided in the ARN-21C make field repair almost as speedy as factory maintenance, Lindsay indicated.

The field test program results do not invalidate the usefulness or need for AGREE type reliability testing, Lindsay told AVIATION WEEK. But they do point up ways in which the test can be made more effective.

RCA Experience

The AN/ARR-60 data link, built by Radio Corp. of America, is the first avionic equipment designed from the start to meet AGREE reliability specifications, and preliminary field experience to date indicates that the equipment is giving good reliability, Lindsay said.

The ARR-60 data link contains approximately 6,000 components of which about one-third are transistors and semiconductor diodes. Under contracts totalling more than $100 million, RCA estimates that the cost of building and testing to AGREE specifications has added about $2.5 million to the total, or about 3%, according to Arthur Malcarney, RCA executive vice president. But the net savings to the Air Force in maintenance and logistics are estimated at approximately $50 million during the equipment's lifetime.

In a total of 10,120 hr. of AGREE testing on the ARR-60, RCA has achieved a mean-time-between-failure of 211 hr., slightly above the contract figure of 200 hr., Malcarney told the reliability symposium. Without the reliability effort that went into meeting the AGREE test requirements, Malcarney estimated the equipment's MTBF at about five hours.

To achieve this MTBF has required use of improved components and design techniques which give an average component failure rate of only 0.86% per 1,000 hr., Malcarney said.

AGREE Training Film

New basic training film on AGREE reliability test philosophy and procedures, which are being required in increasing numbers of military contracts, has been prepared by Radio Corp. of America under Air Force contract. The film, entitled "AGREE In Action," is available to defense contractors from the Air Force Film Training Center, 8900 South Broadway, St. Louis, Mo.

FILTER CENTER

► **Army Seeks 100 Gc. Maser**—Army Signal Corps has called for industry proposals to develop and fabricate a packaged millimeter wave maser amplifier suitable for use in low-noise radar, radiometer or communications system operating in the 70 to 100 gigacycle frequency range. Procurement is being directed by M. D. Handeli, Fort Monmouth, N. J. Other forthcoming R&D programs planned by Signal Corps include the following:

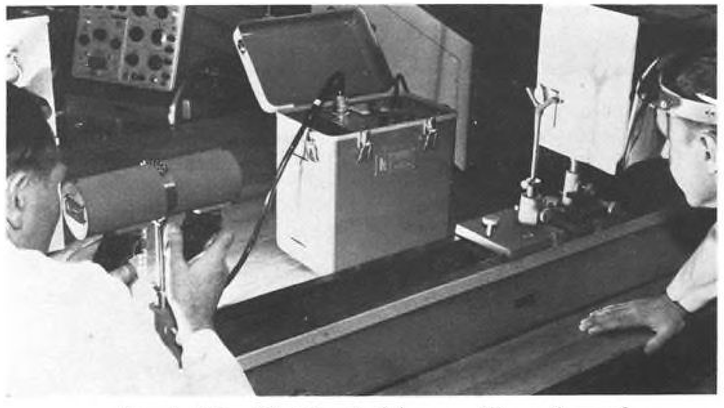
- **Microminiature layered printed wiring,** capable of integrating micro-assemblies made up of functional circuit wafers with thin film networks or semiconductor circuitry. The layered printed wiring is to be able to provide 400 terminations per square inch on 0.050 in. centers.
- **Research to determine cause** of transient changes in operating characteristics of vacuum tubes when subjected to pulsed nuclear environment.

► **Cost of Lunar Light**—Based on estimated cost of $1,500 per pound for transporting equipment and fuel to the moon by Saturn booster, it would cost $5 million to provide electric power to keep a 100-watt light bulb burning during a lunar night (14 earth-days long), but only $35,000 to power the 100-watt bulb for an entire year using a Snap nuclear generator, according to Bernard Raboy of Martin Marietta. By way of comparison, cost of electricity to operate a 100-watt light bulb continuously for one year on the earth amounts to less than $25.

► **Arma Miniature Guidance Under Test**—Miniature inertial guidance system developed by Arma, which weighs less than half as much as the one the company produces for use on the Atlas ICBM, is nearing completion of evaluation tests at Holloman AFB. System was developed under a $5 million contract with Air Force Ballistic Systems Division.

► **USSR Reports New Seismic Sensor**—Extremely sensitive sensors for detecting seismic disturbances, which are small, extremely simple and whose sensitivity is said to be independent of the period of the measured oscillation, have been reported by a Leningrad State University scientist, Y. M. Linkov. Sensor consists of a phototube, preferably a pentode, and a ring-shaped permanent magnet. The seismic detector is described in Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No. 9, 1961; p. 1373.

► **Soviets Describe Electromagnetic Pump**—An electromagnetic pump for transporting non-ferrous liquid metals by means of an external magnetic field, with efficiencies of 40 to 50%, possibly for use in nuclear power systems, has been reported by L. A. Verte in Tsvetnyye Metally, No. 9, Sept. 1961, p. 56. The article says new models with water-cooled windings made of copper tubing are being now tested for transporting liquid aluminum and iron. Thin-walled stainless steel pipes with protective internal coating may permit higher effi-



Portable Optical Maser Developed

Portable optical maser, one of four new models, two of which are battery powered, uses convenient pistol grip for laser head and produces up to four pulses per minute, each of 0.2 milliseconds duration at wavelength of 6,929 angstroms. Handgrip has two triggers, both of which must be squeezed to fire the device, as a safety measure. Rechargeable silver cells can provide 75 full-power pulses, or 150 minimum power pulses before recharging. Device weighs 21½ lb., including laser head. New PistoLaser, as device is called, is made by Kollsman Instrument Corp., Elmhurst 73, N. Y.

ciency in such induction pumps, the Soviet author says.

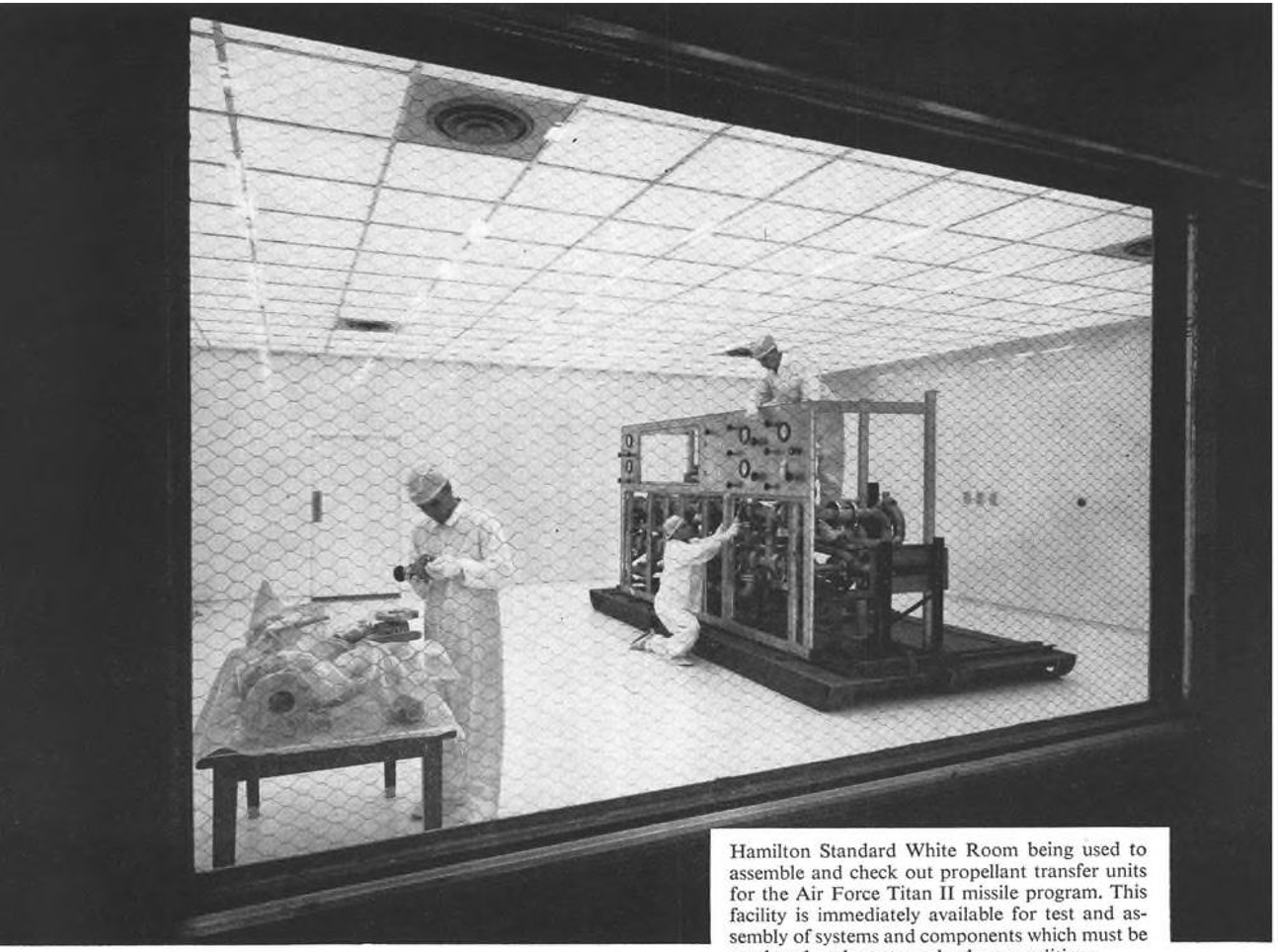
► **Very High Voltage Transistor Developed**—High-power silicon transistors capable of operating at 400 to 800 volts have been developed by Delco Radio Division of General Motors, Kokomo, Ind. Typical characteristics of the high-voltage units include saturation resistance of 0.2 to 0.3 ohm at 5 amps., current gains of 12 and 75 watts power dissipation at 100C. Sample quantities of the new transistor are expected to be available soon.

► **Horne Comments on Conventions**—Charles F. Horne, president of General Dynamics/Pomona, in a keynote address at recent National Symposium on Reliability & Quality Control, had this to say about technical conventions: "We've heard that there are too many meetings, symposia and conventions, and I want to join in saying that I agree. There are far too many conventions of various kinds and descriptions and too many people traveling around spending money we haven't got in order to listen to something that isn't worthwhile." But Horne quickly added that he was not making reference to the reliability symposium.

► **Lightweight Radar for Spotting Intruders**—Lightweight X-band Doppler shift radar capable of spotting intruders on installations such as ballistic missile sites has been developed by Varian Associates and is being evaluated by government agencies. The radar, which the company calls Intrudar, is contained in a 10-in. diameter cylinder with X-band horn protruding from the end.

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

- **Radiation at Stanford,** subsidiary of Radiation, Inc., $350,000 from National Aeronautics and Space Administration for three 20 kw. microwave transmitters to be used in Project Relay communication satellite program. Transmitters will accept either television or voice multiplex signals and provide a frequency modulated signal to the ground antenna.
- **Leach Corp.,** Azusa, Calif., $200,000 from Boeing for subminiature telemetry receivers to be used in the Minuteman ICBMs.
- **Guidance Technology, Inc.,** Santa Monica, Calif., $500,000 from Air Force for vertical gyros to be used in aircraft.
- **Kellett Aircraft Corp.,** Willow Grove, Pa., contract from Army Transport Research Command, for design, construc-



Hamilton Standard White Room being used to assemble and check out propellant transfer units for the Air Force Titan II missile program. This facility is immediately available for test and assembly of systems and components which must be produced under extremely clean conditions.

White room for the Titan II propellant transfer system

Development and production of equipment for handling extremely volatile missile fuels—like the propellant transfer unit for Martin Marietta Corporation's Titan II—demands a contamination-free environment, controlled to within 0.3 microns. Hamilton Standard's new White Room, especially designed for building missile fuel handling systems, even surpasses the exacting requirements of a hospital operating room. It provides 900 square feet of ultra-modern assembly and testing equipment. Detailed construction care and strict control procedures will maintain immaculate conditions always.

Building a propellant transfer unit for the Air Force Titan II missile program is just one of several recent GSE projects in which extreme cleanliness has been a major consideration. This package unit is skid-mounted, electrically powered, manually controlled (with automatic safeties), and capable of pumping either fuel or oxidizer. Performance is measured by its ability to absolutely contain toxic fluids and vapors. To meet these requirements, Hamilton Standard developed important new concepts in sealing and system reliability.

The White Room's capabilities work hand in hand with other key controls to provide manufacturing quality, functional reliability, low system cost, and on-time delivery of all Hamilton Standard Ground Support Equipment.

For the solution to your missile fuel handling problems . . . or any GSE assignment from miniature components to complete weapon support systems, phone: Manager, Ground Support Equipment Department, Hamilton Standard, Windsor Locks, Connecticut; or write for illustrated brochure.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

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Even at three times the speed of sound, there's no danger of structural failure in flight caused by dynamic stress variations. Why? Because every condition that might occur in the air has been accounted for **on the ground** . . . and simulated on a computer. This Air Force jet has been **completely** performance-proved—on a CompuDyne dynamic loading facility—before it ever takes off. CompuDyne Corporation is an automation company . . . everything from wind-tunnels to steel mills—is pretested and proven by computer analysis . . . then built on the basis of desired **process** performance, not **instrument** performance. Because the full range effect of **every** process variable is checked in advance, CompuDyne can **guarantee** predictable performance and improved operation. CompuDyne Corporation, Hatboro, Pa.

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CompuDyne Corporation: computer-operated automatic control systems and related electronic, hydraulic, and mechanical instrumentation for the aircraft, missile, space, and industrial process fields.

PIPELINE IN THE SKY

Riddle Airlines Inc. are flying Argosies up to 13 hours daily on the U.S.A.F. Logair routes. Logair is one of the world's largest scheduled cargo operations — an aerial pipeline for the quick supply of urgent military equipment. From coast to coast these new Armstrong Whitworth aircraft speed outsize military loads in their capacious 47 ft. long holds, over a network of routes covering the U.S.A. Daily schedules bridge more than 12,000 miles.

Soon, B.E.A. will be doing the same on their all-freight routes. Argosies will open up new high-speed supply lines for outsize cargoes between the U.K. and Europe.

An Argosy fleet means high speed delivery, reduced warehousing, less packaging, less handling time, less shipping cost and — above all — unusually large freight dimensions.

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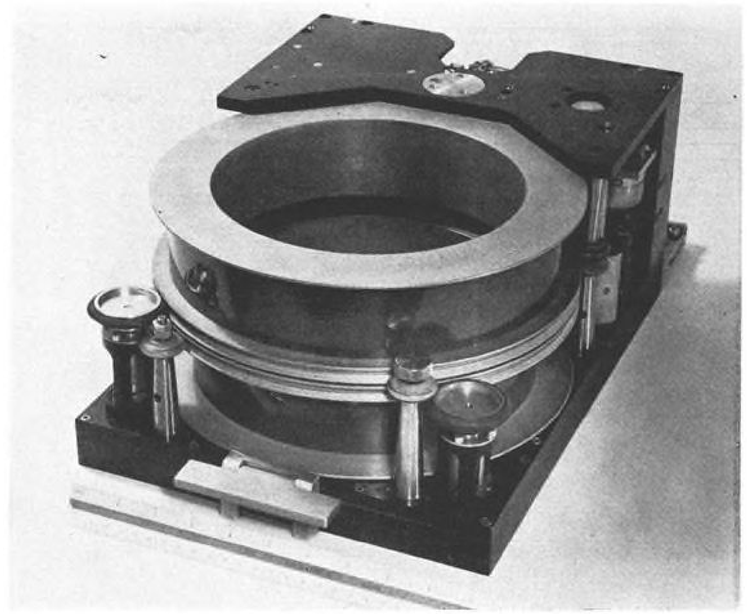
tion and testing of new static electricity discharger for helicopters.

• **General Telephone & Electronics Corp.,** Sylvania Division, $28 million from Army for continued development of Zeus Multi-function Array Radar (ZMAR), for possible use with Nike Zeus anti-ICBM missile system.

• **Granger Associates,** Palo Alto, Calif., $1.1 million from Rome Air Materiel Area for 70 broadband vertically polarized log-periodic antennas and for 60 high-power transmitting multi-couplers which permit up to four transmitters to use a single broadband antenna.

• **Raytheon's Italian affiliate,** Selenia, S.p.A., will build two long-range air traffic control radars, one for Sweden, the other for Norway. The two radars, one to be located at Stockholm and the other near Oslo, are expected to be delivered in mid-1963.

• **General Precision Inc.,** GPL Division, Pleasantville, N. Y., $150,000 award from Reeves Instrument Corp. for closed-circuit television systems to be used in mobile radar bomb scoring systems for Strategic Air Command. The GPL Division also reports $375,000 award from Air Force for computer systems to be used with Doppler radars in North American F-100 aircraft. Company's Link Division also reports $800,000 Navy contract to build three Land Mass Simulators for use in briefing aircraft carrier pilots.



Video Recorder Built for Advanced Satellites

This 30-lb. video recorder was developed by Ampex Corp. as part of the advanced development program for the National Aeronautics and Space Administration's Goddard Space Flight Center under a $96,000 contract. The recorder will fly in a number of second-generation satellites being managed by Goddard. Although it occupies less than a cubic foot of space, it can receive and store four million bits of data each second for 30 minutes, transmit, erase and repeat the cycle.

EXPLOSIVE ORDNANCE

to ignite to detonate to actuate to eject to open to close to pull to push to stabilize

M-100

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The stainless steel M-100 is designed for space travel (qualified for Titan II) — is at home in a variety of environments — and unlike most pressure cartridges, can do a myriad of "jobs." The M-100's versatility is in its ability to sustain pressure for relatively long periods (see below). Its extreme environmental capabilities are the result of resistance welding the closure to the shell providing an hermetic seal plus no fragmentation of the closure. A few of the M-100's characteristics:

safety — *1 amp no-fire and 2-amp sure-fire per bridgewire* **reliability** — *99.9% and 90% confidence* **functioning time** — *2000 psi in 5 milliseconds (in a 10 cc chamber)* — *sustains 1000 psi for 1 second* **environmental** — *200,000' altitudes, 100 g shock, random and Sine vibration in excess of MIL-E-5272, temperatures of — 100 to + 200°F.*

For complete specifications on the all-purpose M-100 and other McCormick-Selph advanced explosive ordnance devices — write stating requirements to address listed below.

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DESIGN ENGINEERS: Mail the coupon for a copy of Republic's new booklet, *Products for the Design Engineer.* Contains a useful Stainless Steel Selector Chart, and information on Republic High Strength Steels, Titanium, Electrical Steels, Vacuum Arc Melted Steels, and other high-performance metals.

VACUUM ARC MELTED METALS . . . Processed into billets, bars, plates and sheets, strip, or wire, Republic Vacuum Arc Melted Metals are produced in 4,000- to 20,000-pound ingots. The consumable electrode vacuum-melting process improves notched strength, ductility, fatigue life, and performance at high and low temperatures. Precise control reduces nonmetallic inclusions and harmful gases. Republic helps you choose the vacuum-melted metal best suited to requirements. You select from constructional alloy steel, high strength alloy steel, bearing steel, stainless steel, super alloy steel, titanium, or special carbon steel.

REPUBLIC PH STAINLESS STEELS . . . Republic PH 15-7 MO* for missiles and aircraft offers high tensile and yield strength with excellent mechanical properties to 1000°F. Republic 17-4 PH* for shafts, gears, pins, and other components requires only a one-hour heat treatment at 900°F to develop its full strength (tensile strength to 200,000 psi). Republic 17-7 PH* for pressure tanks, bellows, springs, and other applications provides high strength together with better corrosion resistance then the straight chromimum martensitic stainless types. Send for PH Stainless Steel booklet.

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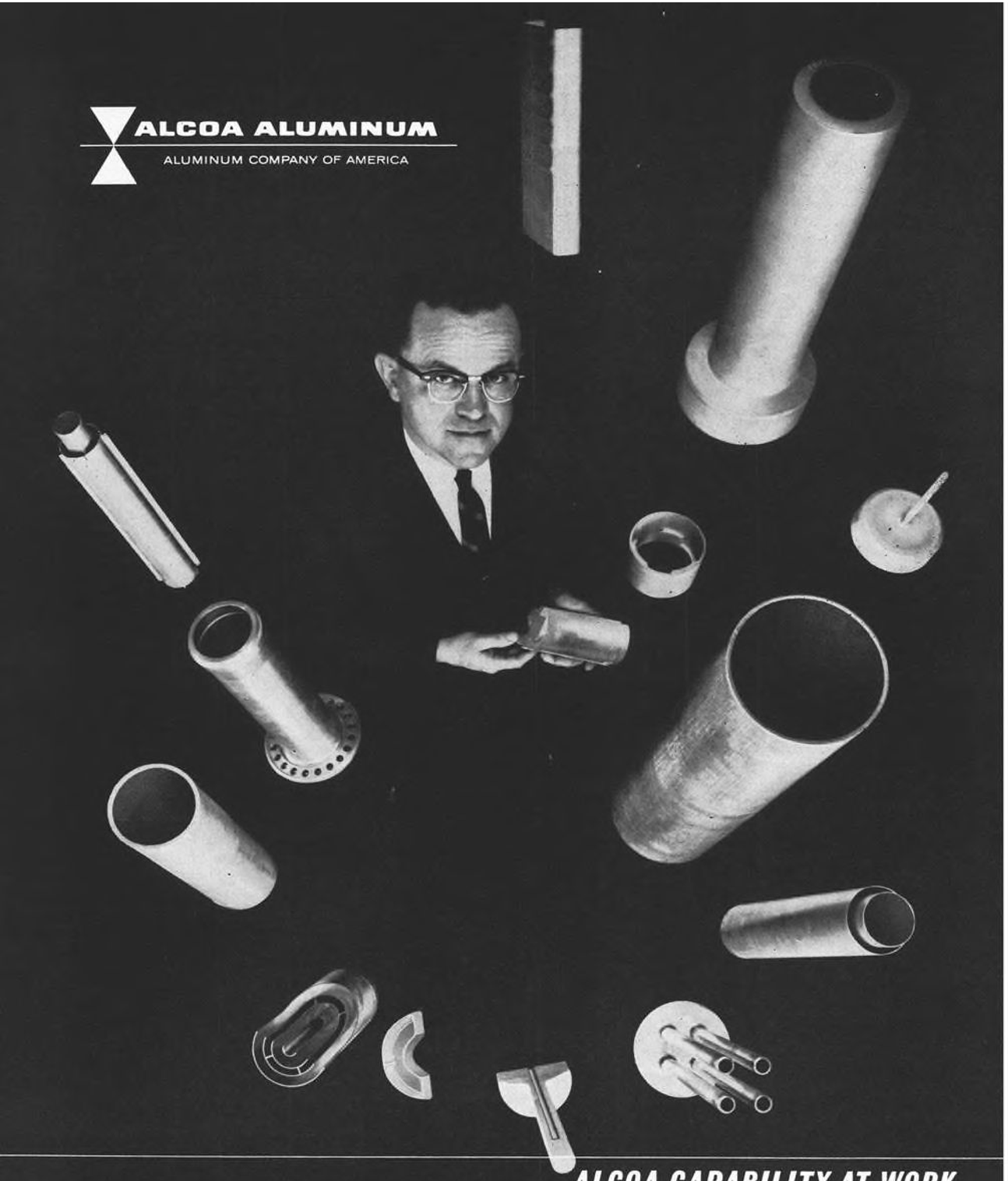

FINANCIAL BRIEFS

General Precision Equipment Corp., of Tarrytown, N. Y., reported net profits of $4,189,000 for the first nine months of 1961 compared with $3,622,000 for the same period last year, despite a dip in sales from $176,554,550 during the first nine months of 1960 to $171,196,090 for the corresponding 1961 period. Per share common stock earnings for the 1961 nine months were $2.47 compared with $2.17 last year.

Vanguard Air & Marine Corp., of Paoli, Pa., has received more than $170,000 in investment loans from a group including New Jersey Business Investment Corp., General Small Business Investment Corp. of Connecticut and Small Business Investment Corp., of Pennsylvania. The loan consists of five-year notes with detachable stock warrants.

Servomechanism, Inc., of El Segundo, Calif., showed net profits of $357,000 or 44 cents per common share for the first nine months of 1961 on sales of $9,358,000. This compares with a net loss of $771,000 on sales of $10,196,000 for the same period last year.

First quarter sales of $44,961,118 and a net income of $201,627 are reported by Collins Radio Co., reversing the downward trend experienced in the last half of the fiscal year ended July 31, although sales and earnings for the first quarter of FY 1962 were lower than the same period last year. Collins' backlog as of Oct. 31 totaled $162 million compared with $157 million on Aug. 1, the beginning of the current fiscal year.

Beech Aircraft Corp., Wichita, Kan. reported total sales of $15,137,396 and net earnings after taxes of $622,513, equal to 22 cents per share for the first quarter of Fiscal 1962. Earnings compare with 21 cents per share for the same period last year, adjusted for a stock dividend. Beech will pay its regular 15 cents per share quarterly dividend on Jan. 31 to holders of record Jan. 19. Company's 1962 business volume is estimated at between $72 million and $75 million as compared with $72,019,890 in Fiscal 1961.

Southwest Airmotive Co., Love Field, Dallas, Tex., reported an increase of 377% in net profit and 8% in gross sales for the first six months of Fiscal 1962 over the same period last year. Total gross income for the six months was $6,210,863, with net profit being $134,789 or approximately 13 cents per share.

Pacific Airmotive Corp.'s subsidiary, PacAero Engineering Corp., has bought California Airmotive Corp.'s aircraft overhaul and maintenance facility. California Airmotive will continue to sell and lease aircraft and to sell engines and parts. Terms of the sale called for PacAero to occupy California Airmotive's maintenance facilities at Lockheed Air Terminal in Burbank, Calif., and to employ all of their skilled aircraft maintenance personnel. Assets acquired by PacAero include equipment to overhaul Lockheed Constellations, PAC president Robert Earle said.

Airwork Corp., of Millville, N. J., reported net income of $110,362 on sales of $3,860,239 for the three months ending Oct. 31, 1961, compared with $54,784 earnings on $3,206,398 sales for the same 1960 period. President Francis L. Hine announced an increase in earnings per common share from seven to 14 cents from the 1960 quarter to the corresponding 1961 period.

Yardney Electric Corp. showed record half-year sales of $5,795,954 for the first six months of Fiscal 1962, ending Oct. 31, compared with $4,797,554 sales for the same period of Fiscal 1961. Net earnings for the six months of Fiscal 1962 were $325,518 compared with $281,131 for the same period in Fiscal 1961. Net earnings per share were 14.6 cents for the May-October, 1961, period, compared with 12.6 cents for May-October, 1960.

Dallas Airmotive, Inc., reported net income of $452,969, or 70 cents per common share, on sales of $7,547,522 for the nine months ending Nov. 30. This was a 69% increase over net income of $268,284, or 41 cents per share, on sales of $5,746,393 during the same 1960 period. President Henry I. McGee attributed the increase to three factors: a faster-than-expected growth rate in overhaul of Rolls-Royce Dart prop jet engines, substantial increases in commercial overhaul operations, and a significant boost in USAF contract work.

H. I. Thompson Fiber Glass Co. announced that 61% of its 1961 sales of $20,631,972 resulted from development and production within the aerospace industry, primarily involving structural plastics and precision metal parts for rockets and missiles. Net earnings for the year were $1,531,841, compared with $1,129,162 earnings on sales of $18,159,691 during 1960.

DEFENSE PARTS FROM 1 IN. TO 5 FT LONG IMPACTED IN ONE STROKE!

Quick as a wink an impact press can turn out a missile piston, a bomb part or a sonar equipment case. In fact, practically any can- or tube-shaped part with one end closed can be produced with a single, instantaneous stroke.

The part can be round, square, oval, rectangular or polygonal. Hollow or solid or a combination of both. With variable diameters up to 11 in. across. With internal or external ribs, bosses, splines or flutes. As small as a thimble or 5 ft long. Alcoa can impact *any* forging or extrusion alloy . . . even some alloys *not* suitable for conventional forging and extruding.

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Tooling costs, compared to other processes, are more economical. Impacting frequently eliminates expensive turning, deep drilling, milling and broaching operations—is sometimes the *only* way to make a part.

Alcoa, who introduced impacts to this country over 40 years ago, has more impacting experience and equipment than any other company and is prepared to handle both short and long runs. How can you use this capability? Write: Aluminum Company of America, 1865-A Alcoa Building, Pittsburgh 19, Pa.

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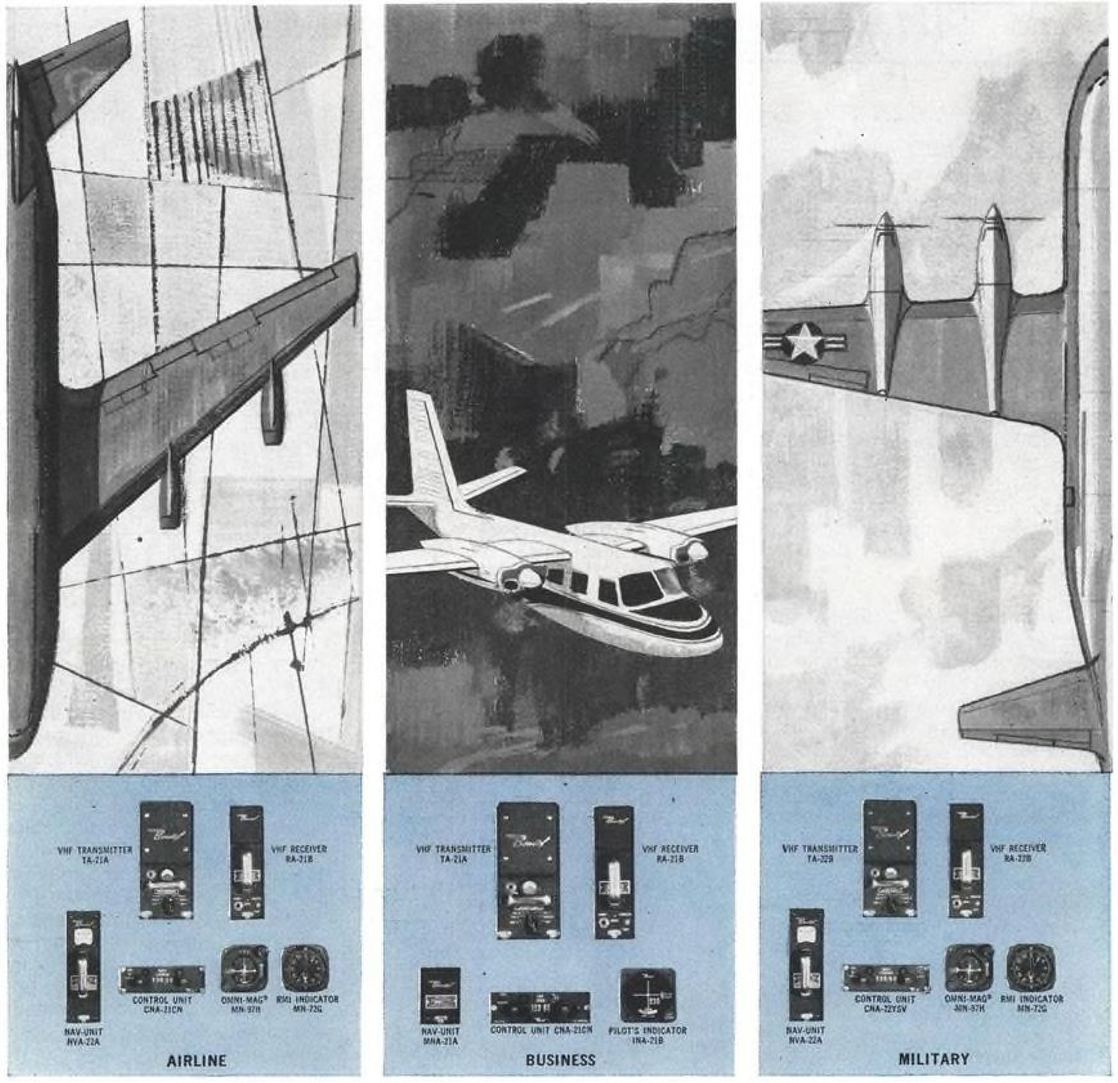

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Complete Bendix VHF line features 108.0 to 136 or 150 megacycles . . . new navigation unit with VOR-CHECK for in-flight system checking . . . sub-chassis construction for easier maintenance.

Regardless of your aircraft, you can put your VHF Comm/Nav needs into Bendix' hands with complete confidence. **Reason** #1: there's a system to match every need—from military and commercial transports right on down to light twin business aircraft. **Reason** #2: its long record of extra dependability on a wide range of aircraft under every conceivable operating condition. **Reason** #3: it incorporates latest operating advantages—such as VOR-CHECK circuitry, reduced size and weight, extended frequency range, greater reliability, easier maintenance. **Reason** #4: there's close-at-hand, authorized service when needed—wherever you may be.

For details on a Bendix VHF Comm/Nav system for your application write Bendix Radio Division, Avionic Products, Baltimore 4, Md. Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, New York. Canada: Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario.

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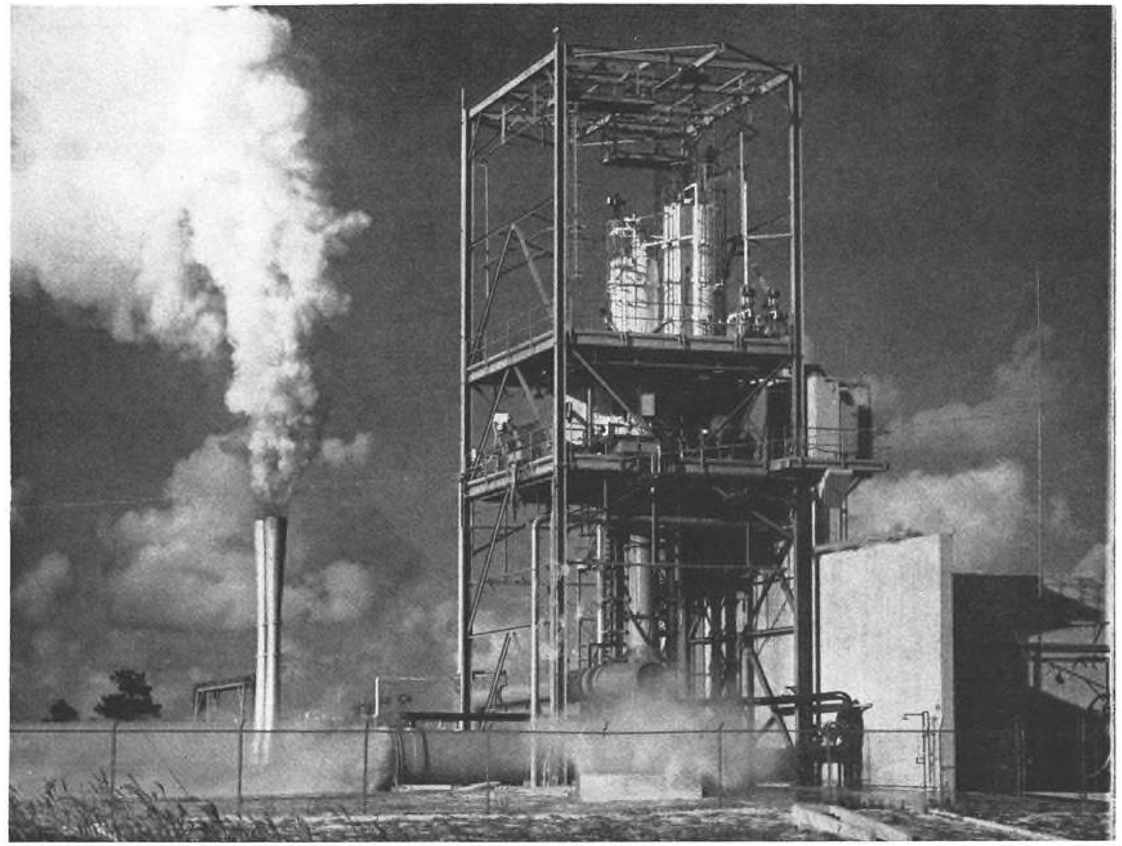


RL-10 Liquid Hydrogen Engine Test Fired

Pratt & Whitney RL-10 liquid hydrogen engine is test fired in vertical stand at the company's Florida Research and Development Center. The engine is located inside a diffuser which creates a vacuum to simulate space conditions. RL-10 is being developed for the National Aeronautics and Space Administration. Two engines will power the Centaur upper stage for NASA and military missions and six will power the Saturn S-4 upper stage. The engine has passed its preliminary flight rating test (AW Nov. 20, p. 27). First flight test in an Atlas-boosted Centaur stage was scheduled this week.

U.S. Space Program Hindrances Cited

Washington—One resource which the U.S. can least afford to waste in its space program is time, "and that is the resource wasted the most when we move slowly," Dr. Edward C. Welsh, executive secretary of the National Aeronautics and Space Council, told the American Astronautical Society recently.

Welsh, addressing the AAS' eighth annual national meeting here, said that 1961 was the nation's biggest year in space "primarily because it was in that year that a sense of urgency was combined with a willingness to make tough decisions."

Despite the Soviet Union's accomplishment of putting two men in orbit, Welsh said, the U.S. achieved a substantially greater rate of space progress in 1961 than did the USSR. "There is no reason why we can not do that every year," he added, which should give the U.S. an increasing lead in space. However, he cautioned "I am speaking of the possible, not the inevitable."

Pessimism Biggest Danger

Welsh said the smallest risk involved in the U.S. space program "is that we can not do the job." The most discouraging and unwarranted risk, he said, comes from the belief of some people that this country can not afford an all-out space effort. "There are those who seem to take for granted that a country like Russia, with less than half the per capita income of the U.S., can afford a major successful program, while we can not," he said.

However, he expressed the belief that the general public and Congress will make available the necessary funds and resources if they are kept fully informed on what is being done and why.

Dr. Welsh emphasized that "it is our national policy that all our space efforts are peaceful. We do not have a division between peaceful and non-peaceful objectives for space. Rather we have space missions to help keep the peace and space missions to improve our ability to live well in peace. There is no one agency in the government that has full responsibility for peaceful missions, just as there is no agency that has responsibility for non-peaceful missions."

Acknowledging that some fragmentation of space activities exists within the government, Welsh said that creation of a single agency, a Department of Space, at this time would produce more, not less fragmentation.

These are some of the developments

Objective: duplicate the cycle of life so man can sustain himself in space indefinitely

To leave the earth at all, man must take his environment with him. But no spaceship could hold all the air, food and water he'll need for any extended trip. His meager supplies will have to be constantly purified and renewed. There can be no waste. Every drop of moisture, every smidgeon of food must be reprocessed and reused.

This means that some substitute will have to be found for the fundamental cycle of life on earth. Northrop's Bioastronautics Laboratory is even now developing new strains of algae as a basic food source. They are investigating biological means of reclaiming waste and purifying air. Studying the effects of hard radiation on living matter unscreened by earth's atmosphere. Learning more about how life is affected by the absence of gravity. Coming to grips with all the interrelated problems of life support.

When men finally move out to occupy space, Northrop's foresight in research will have helped to make their long-term survival possible.

NORTHROP

reported in three days of technical sessions of the AAS meeting, attended by approximately 200 engineers and scientists:

• **Weight of manned space vehicle** is approximately three times that of an unmanned vehicle intended to perform a similar mission, according to study reported by Herbert C. Sanders of Boeing. The analysis was made for an astronomical observatory equipped with a 36-in. telescope placed in 500-mi. orbit for a six-month period. For comparison purposes, Sanders assumed that both the manned and unmanned vehicle would be designed to return to earth, although in practice the unmanned vehicle might return only a data capsule. The manned observatory was designed for a three-man crew.

The weight of the unmanned observatory was estimated to be 5,425 lb., compared with 15,195 lb. for the manned version, with proportionate ratios of booster weight. Sanders emphasized that the analysis made no attempt to justify or discourage the use of man in space, but merely to evaluate the comparative size and weight factors.

• **New passive satellite attitude** stabilizing technique, which requires use of only one or two floated integrating gyroscopes and makes use of the inherent gyroscopic properties of the satellite itself to keep the satellite oriented toward the earth's center (local vertical), was described by Glenn Ogletree of the Massachusetts Institute of Technology's Instrumentation Laboratory.

• **Military use of a cis-Martian** (between the earth and Mars) asteroid was proposed by Dandridge M. Cole of General Electric's Missile and Space Vehicle Dept. Cole suggested that a manned space vehicle landing on one of the Martian asteroids could plant a charge of hydrogen warheads which could propel it out of orbit to impact on the earth, providing an explosive force equal to a million megatons of TNT. Cole did not discuss how the asteroid would be guided to impact at the desired point on earth.

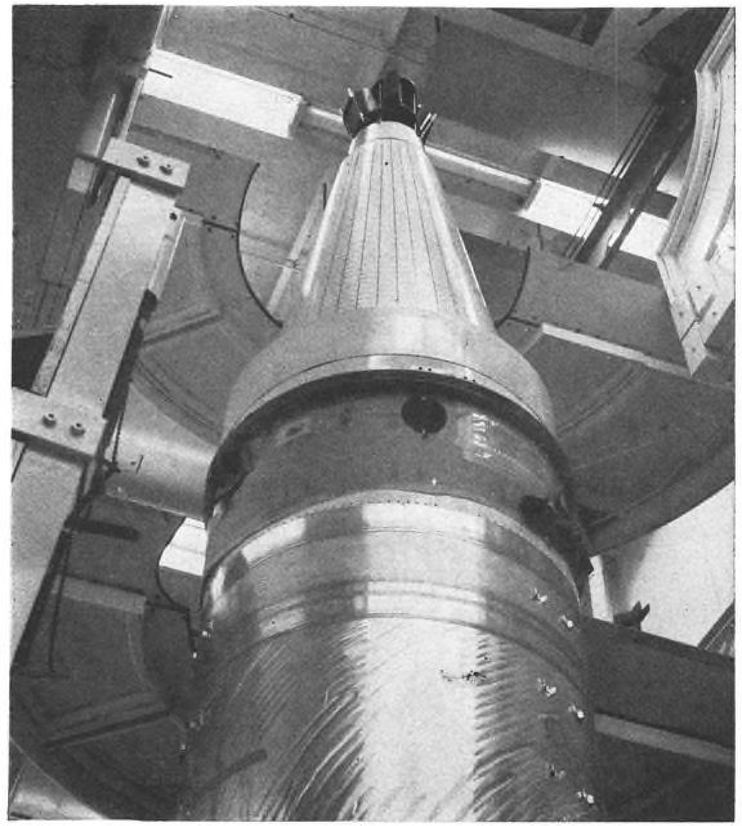
• **Analysis of radiation hazard** to lunar astronauts indicates that Van Allen belts do not represent a primary hazard for a direct ascent trajectory, but may pose a problem if a lunar mission must be terminated prematurely and the vehicle quickly returned to earth, Jacob Abel of GE's Missile and Space Vehicle Dept. reported. Solar flares present a more serious problem, but GE's analysis indicates that the probability of solar flare radiation crew exposure exceeding a safe limit of 100 rem. (roentgen equivalent man) can be decreased to less than one per cent with the addition of 800 to 1,600 lb. of special shielding.

• **Lunar return-to-earth injection** can be successfully made from any selenographic (lunar) longitude along the moon's equator, according to studies made by astronautics division of Ling-Temco-Vought and reported in a paper by John Swider and Robert Taylor. However, a restriction does apply to the lunar injection altitude of some longitudes because of the severe negative flight path angles required. Preliminary studies indicate that injection and successful earth return can take place also from any selenographic latitude, it was reported.

• **Surveillance satellite system** mathematical model which gives expected coverage and probability of observation for a group of satellites in random spaced orbits was described by Joseph A. Joseph of International Business Machines Corp. The model permits calculation of the effect of trade-offs between the number of satellites in orbit, their orbital parameters and the effective radius of their sensors.

• **Use of porous drag** or lifting re-entry bodies will cause severe heating problems, compared with the use of solid bodies, according to an analysis reported by Harold G. Lorsch of GE's Missile and Space Vehicle Dept. Lorsch warned that scientists who have proposed use of porous materials because of their flexibility, aerodynamic stability and ease of manufacture have failed to give adequate consideration to the severe heating that results from use of such materials.

• **Navy's Transit and TRAAC satellites** have demonstrated the feasibility of using the earth's magnetic field as a passive means of stabilizing a satellite, Robert E. Fischell of the Johns Hopkins University applied Physics Laboratory reported. Data obtained from Transit 4A indicate that within eight days after the satellite was placed in orbit, it had aligned itself to within four deg. of the earth's magnetic field. Similar data for TRAAC indicates stabilization to within two degrees within three days after the initial spin of the satellite had been reduced to about 0.025 rpm.

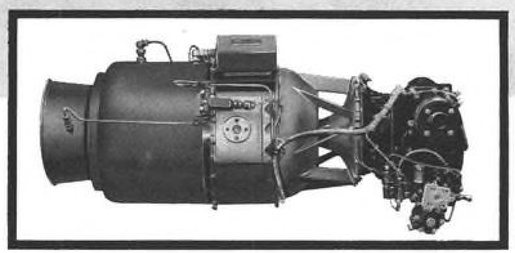


Snap 10A Mockup Shown

Mockup of Snap 10A payload is shown atop the Air Force/Lockheed Agena satellite which will be used as the orbiting vehicle in Snapshot project tests of nuclear-powered electrical power systems. The Atomic Energy Commission Snap tests will be made under an Air Force contract awarded to the Lockheed Missiles and Space Co.

Reliable Gas Turbines

for lightweight helicopters



J. J. O'Brien (foreground), vice president and manager, AiResearch Manufacturing Division of Arizona, and George Reno, test pilot, Republic Aviation Corporation, pictured during first flight of Republic's Lark helicopter powered by the AiResearch 331 gas turbine.

Garrett, one of the world's leaders in the development and manufacture of small gas turbines, now offers the new AiResearch 331 gas turbine as the most reliable, lightweight, low-cost engine for high-performance helicopters.

Producing 500 horsepower at an extremely low noise level, the 331 also sets a new standard for lower fuel consumption in this power class.

This single shaft model provides quick response and high maneuverability. AiResearch can also demonstrate the 331 as a split shaft unit. In achieving high compatibility to latest helicopter designs, extensive research has been devoted to controls and system dynamics.

The 331 has evolved from 9000 AiResearch gas turbines now operating in a wide variety of military, commercial airline and industrial applications.

Please direct your inquiries to Gas Turbine Sales, AiResearch Phoenix.

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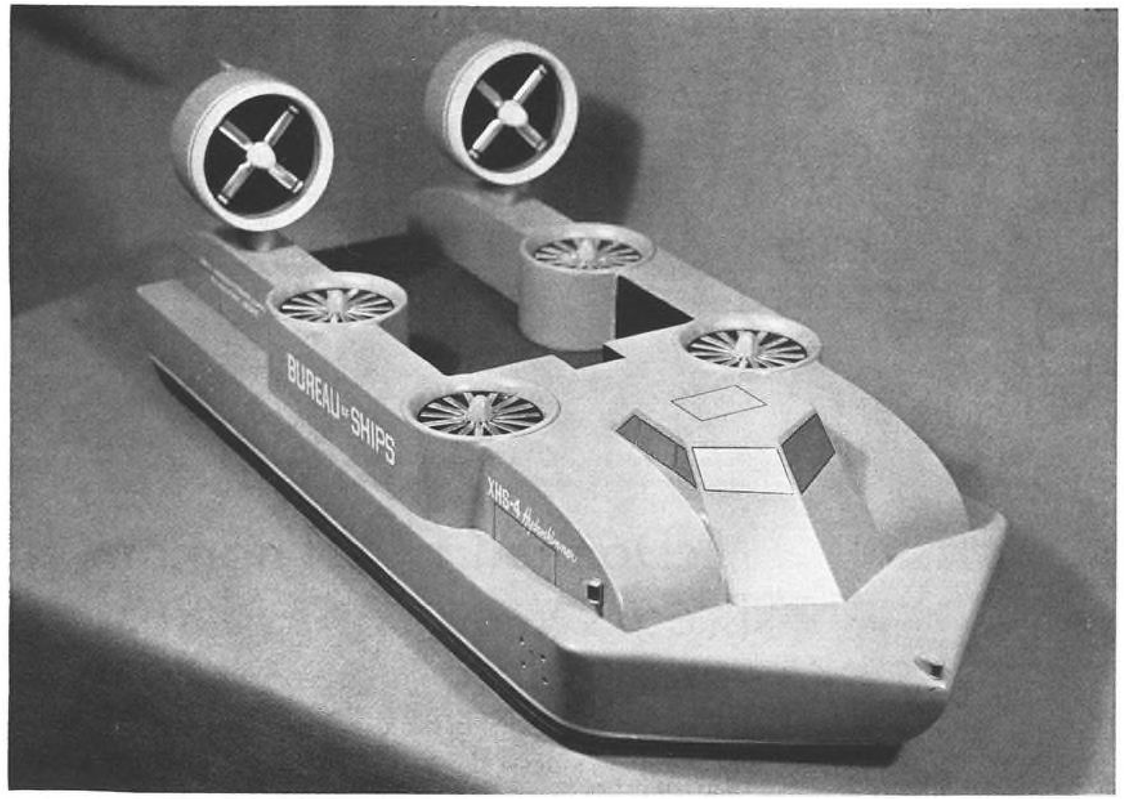


Bell to Build Air Cushion Vehicle for Navy

Navy Bureau of Ships has awarded Bell Aerosystems Co. a $2,040,000 contract to build an air cushion vehicle resembling this model. The research craft will be designed to skim over the water at speeds of 70 kt. Navy will test vehicle's suitability for anti-submarine warfare.

PRODUCTION BRIEFING

Del Mar Engineering Laboratories, Los Angeles, is completing delivery of air-to-air and ground-to-air intercept training system components to the Royal Danish Air Force and the U. S. Navy under four initial contracts representing sales exceeding one-quarter million dollars. Largest of these contracts is for aerial tow targets capable of supersonic speeds.

International Fermont, Inc., Ramapo, N. Y., subsidiary of Dynamics Corp. of America, will produce engine-starting equipment for the Lockheed F-104 under a $296,248 contract from Lockheed-Calif. Co.

Cryo-Therm, Inc., of Fogelsville, Pa., has received a $100,000 contract from Massachusetts Institute of Technology for design and manufacture of prototype temperature-controlled shipping containers for the Polaris Mark 2 guidance system.

United Electrodynamics, Inc., Pasadena, Calif., has received contracts totaling $800,000 from General Dynamics/Astronautics to build and operate six permanent and three mobile chemical laboratories at Atlas ICBM bases in Wyoming, Kansas, Oklahoma, Texas, New Mexico and New York.

Chicago Aerial Industries, Inc., Barrington, Ill., will produce automatic test equipment for airborne battlefield surveillance aircraft and drones under a $1.3-million Defense Department contract. The equipment is designed to enable one man to simulate an airborne mission while on the ground and check all photo system components in the surveillance vehicle within minutes.

Westinghouse Electric Corp. will build explosion-proof electrical equipment for Saturn Complex 37 at Cape Canaveral, Fla., under an order from Fischbach and Moore, New York, electrical subcontractors for the launch site. Some of the equipment will be encased in air-tight metal enclosures and pressurized with gaseous nitrogen to prevent arcing of contacts in the atmosphere when explosive vapors are present during fueling and launch.

Hayes Corp., Birmingham, Ala., has received a $1,818,572 Army contract for additional training equipment to be used in the Pershing ballistic missile program.

Garrett Corp.'s Air Cruisers Division, Belmar, N. J., has designed an inflatable pressure bag to hold slivers of inert material firmly against walls of rocket motors during motor preparation stage. The slivers, made by Thiokol, are bonded to the motor casing wall, eliminating necessity for bolts. Cylindrical bag is inserted inside motor casing with slivers and filled with air to a pressure of 1½ psi. until bond to rocket's inner walls is established.

North American Aviation's Columbus Division will build a 150-ft.-dia. aluminum and glass-fiber radome, one of

Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

T58-Powered HSS-2 Claims Four of Five World Speed Records

STRATFORD, CONN.—Three new speed records set last December by the U.S. Navy's Sikorsky HSS-2 turbocopter have boosted its claim to include four of the five recognized world speed records.

Powered by two General Electric T58 gas turbine engines, the big copter flashed over a closed circuit course along the Connecticut shore at 182.8 mph for 100 kilometers (62 miles); 179.5 mph for 500 kilometers (311 miles); and 175.3 mph for 1000 kilometers (623 miles).

The HSS-2's fourth world record was set last spring when it was clocked at 192.9 mph for three kilometers. The fifth world helicopter speed record is held by the Russian Mil-6 which recently flew 198.8 mph over a 15/25 kilometer course.

The new marks are subject to confirmation by the Federation Aeronautique Internationale.

The twin T58-powered HSS-2 is in quantity production at the Sikorsky Aircraft plant. It is the Navy's first helicopter that can detect, identify, track and destroy enemy submarines while achieving maximum designed range.

Each of the HSS-2's engines produces 1250 horsepower, and weighs only 295 pounds. Operating on only one of its twin T58's, the HSS-2 at normal ASW mission weight can continue to fly using the military 30-minute power rating.

'61 MILESTONES

1000th J85 DELIVERED

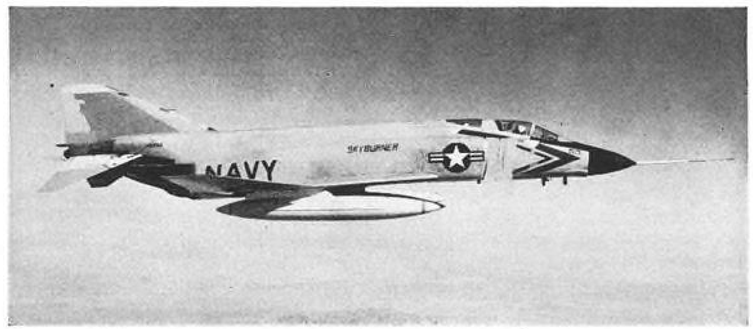
LYNN, MASS.—A significant production milestone was reached last December at General Electric's Small Aircraft Engine Department when its 1000th J85 turbojet rolled off the assembly line. Concurrently the department shipped its 1000th engine produced in 1961. The 1000 engines included G-E J85's, T58's and T64's.

Proven rugged and reliable in thousands of factory, field and flight operating hours, the J85 currently powers the USAF T-38 trainer; the N-156F "Freedom Fighter"; the GAM-72 SAC decoy missile; and the Q-4B target drone.

15,000th ENGINE REBUILT

CINCINNATI, OHIO—A General Electric J79 turbojet engine recently became the 15,000th engine to be completely rebuilt at the Large Jet Engine Department, Evendale, Ohio.

The General Electric Engine Rebuild Operation, as a result of its proximity to the Company's jet engine research and engineering operations, offers timely technological improvements to provide rebuilt engines with advantages and life expectancy of new engines.



McDonnell F4H Phantom II, powered by two General Electric J79 engines, adds another mark to its growing list of world-speed records.

McDonnell F4H Phantom II Breaks World Speed Record

CINCINNATI, OHIO—A new world record of 1606 mph over a 15/25 kilometer straight course was recently established by a U.S. Navy McDonnell F4H Phantom II. In setting the record, pilot Lt. Col. Robert B. Robinson, USMC, flew at an altitude of approximately 45,000 feet, and reached speeds in excess of Mach 2.5.

The flight, designated Project Skyburner by the Navy, was flown at Edwards Air Force Base, and was observed by officials of the National Aeronautics Association.

As a result of the J79-powered Phantom II's record-making flight, the General Electric J79 now holds the distinction of having powered U.S. aircraft to eight of the nine FAI-recognized world speed records over 1000 mph.

The Phantom II also holds the 500 kilometer closed course world speed record at 1216 mph.

The remaining 100-mph-plus speed marks are held by the United States Air Force Convair B-58 Hustler, which racked up six records a year ago over 1000- and 2000-kilometer closed courses.

J79-powered U.S. military aircraft now hold 18 internationally recognized records, including the new sustained-altitude record of 66,443.8 feet set by the F4H last December. The USAF Lockheed F-104 Starfighter holds all eight time-to-climb marks from 3000 to 30,000 meters, and the U.S. Navy's North American A3J holds the 1000-kg payload altitude record of 91,450.8 feet.

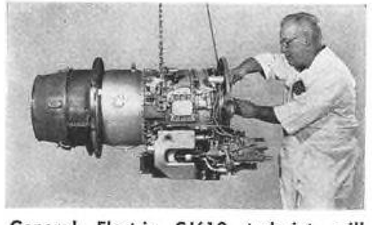
FAA Certificates CJ610 Turbojet

LYNN, MASS.—Certification for General Electric's CJ610-1 and CJ610-2B turbojet engines was received from the Federal Aviation Agency on December 6, 1961.

Built by General Electric's Small Aircraft Engine Department, the CJ-610 is designed specifically for executive aircraft, and has already been selected for three new business jets scheduled to fly in 1962.

The three new CJ610-powered aircraft are Aero Commander's Model 1121 Jet Commander, the Swiss-American Aircraft Corporation SAAC-23, and the Piaggio-Douglas PD-808. The Jet Commander will be powered by twin CJ610-1 turbojet engines, each of which produces 2850 pounds thrust. The Piaggio-Douglas PD-808 will also use the CJ610-1.

The CJ610-2B, developing 2400 pounds thrust, will power the SAAC-23.



General Electric CJ610 turbojet will power three new business jets in 1962.

The CJ610 weighs 355 pounds; is only 40 inches long, and 17.7 inches in diameter. CJ610's produce more power for their weight than any other engine in their class.

The FAA type certificate No. 1 E16 approves the engine without restriction for use in civil aircraft certified under Parts 3 and 4 of the Civil Air Regulations.

U.S. Army Awards G.E. Flight Test Contract For Lift Fan System

WASHINGTON, D. C.—A fan-in-wing VTOL propulsion system will be flight tested in mid-1963 under a $6.9 million contract recently awarded to General Electric by the Army's Transportation Research Command.

Ryan Aeronautical Company was selected as winner of a design competition to design and build the VTOL research aircraft as a major subcontractor to General Electric's Flight Propulsion Laboratory Department.

This Army VTOL research aircraft will be flight-tested starting in mid-1963.

Purpose of the program is to evaluate flight characteristics of the General Electric J85 lift-fan propulsion system in hover and transition, and to demonstrate in flight that the fan-in-wing configuration is compatible with high-subsonic-speed aircraft requirements.

The Army research aircraft will be designed to fly at 450 knots.

General Electric's lift-fan propulsion system consists basically of a J85 engine and a six-foot tip-turbine-driven lift fan that can be installed in either wing or fuselage. For vertical flight, a diverter valve channels the J85's jet exhaust to drive the lift fan. During transition to forward flight, the diverter valve closes off the fan and allows operation as a conventional jet aircraft.

The Army flight research aircraft will use two engines in wing-mounted configuration. Exhaust from each engine will be divided to drive both fans for engine-out safety. With one engine inoperative, both fans can still provide about 60 per cent of their design lift without imbalance in the aircraft.

G.E.'s current contract is Phase I of a complete program that will cost $10.5 million and will cover 24 months of lift-fan flight testing.

Convair 990 jet begins test flight. Having received FAA certification, the aircraft will start passenger service soon with American, Swissair, SAS, and REAL/Varig.

990 JET CERTIFICATED BY FAA; STARTS PASSENGER SERVICE SOON

WASHINGTON, D. C.—Convair's 990 jet airliner was awarded airworthiness certification by the Federal Aviation Agency December 18, 1961, clearing the way for start of scheduled 990 passenger service.

Powered by four General Electric CJ-805-23 aft turbofan engines, the Convair 990 will appear first on the routes of American Airlines, Swissair, SAS, and REAL/Varig. American will call its new jetliners 990 Astrojets, and will introduce them into U.S. service early this year. Swissair and SAS have named the plane the Coronado.

The 990 is the first jet transport designed specifically around the aft turbofan engine with its advantage in thrust and fuel economy. Each of the aircraft's General Electric CJ-805-23's is rated at 16,100 pounds thrust.

Final phase of the 990 flight test program was the functional and reliability FAA program during which the jetliner was flown on simulated airline schedules across the U.S. The 990 made more than 110 takeoffs and landings, and cruised some 76,000 miles during the 210 flight-hour program. Throughout the functional and reliability program, the General Electric CJ-805-23's functioned perfectly.

On December 2, the 990 set its first unofficial inter-city speed record. The plane flew a 1942-mile course between San Diego and Atlanta, Georgia, in three hours and 15 minutes, reaching a maximum ground speed of 662 mph. The official record set by a Convair 880 on May 11, 1960, was over a 1889.4-mile course between the same cities. The time was three hours, 23 minutes and 59 seconds.

Cathay Pacific Purchases Convair 880-M Jetliner

SAN DIEGO, CALIF.—Purchase of a Convair 880-M jetliner was recently announced by Cathay Pacific Airways, Ltd.

The 880-M—to be powered by four G-E CJ-805-3B turbojets—represents Cathay Pacific's first jet aircraft purchase. The airline plans to put the jetliner into scheduled service in April between Hong Kong, Formosa and Japan, with stopovers at Taipei, Osaka and Tokyo; Bangkok, Singapore and Djakarta.

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OCTOBER 10, 1924 COALINGA, CALIFORNIA

Yesterday—The roof wasn't new, but the message painted on it was... and spoken only to the sky. "COALINGA" it said. "That's where you are!" it meant.

It was the first in a system of airway marker signs, painted by Standard Oil Company on its Coalinga warehouse roof at the suggestion of Army Air Service pilots who often landed there for fuel during cross-country hops.

As the company proceeded to airmark its warehouses in hundreds of other Western towns, the idea spread across the nation.

Today—Rooftop airmarking still can be a lifesaver, though electronic aids and faster, all-weather aircraft often leave a pilot little time to wonder what might be seen on the ground. The "rooftop" today can be a "beep" ... or a swinging needle.

But after the wheels touch down? Pilots still want friendly, thorough service from a man who knows his job ... a man who's always careful. Everywhere in the West, pilots have come to look for *service* at one important landmark—the sign of the Chevron.

Chevron Airport Dealers take better care of your plane —at over 300 of the West's leading airports.

STANDARD OIL COMPANY OF CALIFORNIA

the largest in the world, to enclose an already existing Air Force radar antenna in eastern Oregon. The radome, roughly hemispheric in shape, will be erected atop a 97-ft. steel support tower, with panels arranged in random pattern for maximum efficiency in transmission and reception of radio frequencies. Cost is estimated at $500,000; completion is scheduled for September, 1962.

Air Reduction Sales Co., division of Air Reduction, Co., Inc., New York, will construct the first commercial liquid hydrogen plant on the East Coast at Pedricktown, N. J. Scheduled for completion in early 1963, the plant is expected to produce more than six tons of high purity hydrogen per day.

B. F. Goodrich Co.'s Aerospace and Defense Products Division, Akron, Ohio, has received an initial order to produce tires, wheels and brakes for the dual main gear and single nose gear aboard the SAAC-23, six-to-eight passenger executive jet transport under development by Swiss American Aviation Corp.

Northrop Corp. RP-76-4 rocket-powered Army target missile recently reached a speed in excess of Mach 2 at 65,000 ft. during a record 8¼-min. test flight at White Sands Missile Range, N. M. Designed as a high-altitude, high-speed training target for surface-to-air missiles, the RP-76-4 was air launched from an F-89 and controlled from the ground during its flight.

Cannon Electric Co.'s Salem Division, Salem, Mass., has received contracts totaling $191,079 from Boeing Co. to furnish electrical connectors for the USAF B-52H ballistic missile bomber.

Aircraft Armaments, Inc., Cockeysville, Md., has received a $13,134,800 contract from the Army to incorporate improvements into the Nike Ajax missile simulator system which will enable it to be used also for training crews at Nike Hercules sites.

American Orbitronics Corp., Hawthorne, Calif., will supply valves, valve seats, retainers, keepers, and injector valves for a hydrogen-oxygen internal combustion engine being developed for the Air Force Systems Command's Aeronautical Systems Division by Vickers, Inc., at Torrance, Calif. Vickers is a division of Sperry Rand Corp. Engine components will be made of exotic materials, including 10% rhodium, 702 inconel, rene 41, and sapphire, selected because of resistance to corrosion, electricity, and chemicals, and ability to withstand extreme heat.

North American Aviation, Inc.'s Autonetics Division, Downey, Calif., has received a second procurement contract from the Army for the portable gyrocompass known as ABLE. The contract, for 159 units, is valued at about $3.8 million.

Garrett Corp.'s AiResearch Mfg. Division, Phoenix, Ariz., has received a $1 million contract from Martin Marietta to produce ground support small gas turbine engines for the Army's Pershing missile.

Marquardt Corp. has successfully tested a rocket motor with cold outer walls, designed to be cabable of extended operation life in a steady state as well as pulse operation. The 25-lb. motor, aimed at satellite and space vehicle reaction control applications, was operated on a hydrazine blend and nitrogen tetroxide, producing an equivalent vacuum specific impulse of 310 sec. and a 25-lb. thrust with a 40 to 1 nozzle area. Initial tests included repeated pulsing and subjection to 20-sec., 60-sec. and 10-min. steady-state, full-thrust runs.

Link Division of General Precision, Inc., Binghamton, N. Y., will build two more C-130 cargo transport flight simulators for the Air Force under a $2-million contract, bringing the total order to five.

All American Engineering Co., Wilmington, Del., has received a $2.7-million Navy contract to develop a jet engine catapult system to launch various types of military aircraft from fields too short for normal takeoff. The system is designed as part of the Navy's SATS (short airfield tactical support) program.

Kearfott Division of General Precision, Inc., Little Falls, N. J., will provide additional self-contained hydraulic control units for the Pershing missile under a $2.4-million follow-on contract from the Army.

Vitro Corp. of America's Silver Spring Laboratory, Silver Spring, Md., will provide engineering service for the Navy's Terrier, Tartar, Talos and Typhon missiles under a $1,358,903 contract from Bureau of Weapons.

Moog Servocontrols, Inc., East Aurora, N. Y., will supply electro-hydraulic servovalves for Navy Terrier and Tartar missiles under a $1.7-million contract from General Dynamics/Pomona.

General Dynamics/San Diego has received a $5-million contract from USAF to develop a high-impulse upper stage vehicle for the Centaur space system.

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FRENCH-BUILT FOUGA MAGISTER jet, captured on the ground by United Nations forces, was used by Katangese in air strikes against the UN troops. Barrels under the wings of the wrecked aircraft were believed to have been used to block the runway, behind the jet, and prevent United Nations aircraft from landing. DC-3 behind UN soldier bears Air-Katanga markings.

UN Studying International Reserve Pool

By George Alexander

United Nations, N. Y.—Makeshift basis on which the United Nations was forced to gather aircraft, troops and equipment for the Congo operation has convinced UN military advisers that the traditional military measures of prior planning and preparation must be established in the world organization if similar crises are to be met successfully in the future.

Based on the UN's difficulties in assembling a Congo force, President John F. Kennedy and UN Acting Secretary General U Thant were understood to have discussed the possibility of an international pool of ready reserves during their Jan. 19 meeting in New York.

Analysis of the military operations in the Congo have led UN military advisers to these conclusions:

• **Building-block approach** should be followed in the creation of any future UN force. Each block would be built around a basic infantry unit, say 5,000 men, plus adequate equipment and supplies for a certain minimum time. The block also would include armor, artillery, communications, ground transportation, transport and tactical support aircraft, all in quantities proportionate to the basic foot-soldier unit. As the conflict grew, additional integral blocks could be added to meet UN requirements.

• **Index of forces available** from UN member states, maintained on a confidential basis and constantly up-dated, should be kept by the UN secretary general. Each UN nation would report to the secretary general the quantity and types of military forces it could provide on short notice to the UN.

• **Complete control of UN forces** should be vested in the UN commander. While there is no criticism of the help rendered to the UN Congo operation by various member states, the process of getting that help often left something to be desired.

Some countries laid down stipulations on the use of their troops or equipment prior to moving them to the Congo and others reserved the right to review the decisions of UN field commanders which involved their troops. In some instances, a UN commander requiring airlift, for example, had to relay his request to UN headquarters, which then called in the delegation of the country which had provided the aircraft. The delegation would receive the request, in turn relay it to its government, which staffed the query through its military organizations. The answer would then come back up through the same channels and would be finally delivered to the field UN commander.

As presently constituted, the United Nations can assemble a force only for a specific crisis and only upon approval of the Security Council and General Assembly. When the late Secretary General Dag Hammarskjold recommended creation of a standing UN force several years ago, the proposal was quietly ignored by the large majority of member states.

UN observers believe that this approach—i.e., an international pool of reserve units—is a reasonable compromise between a standing army and no army at all. There presently are no indications whether such a proposal will be placed before the UN either by the United States or the secretary general, or what sort of reception it would get from the UN general membership.

During the UN's 1¼-year operation in the Congo, air transport has been regarded as a more critical need than tactical air support.

In fact, it was the original intention of the UN field command to use the four Indian Canberra Mk. 58 bombers, five Swedish Saab J-29 fighters and four Ethiopian F-86F fighters that comprised the UN's tactical air force only to counter the Katangese French-built Fouga C.M.170 Magister jet fighter-trainers and to establish and maintain air superiority over the secessionist air force. These aircraft did not enter the Congo until the Magisters started inflicting heavy casualties on UN troops and hindering transport flights during November, 1961, and were not used for ground support missions until Katangese forces began using heavy mortars against UN positions with telling effect later in the year.

Katangese air force was varied and UN officers report that the secessionist forces used any thing that could fly in their struggle against the world organization. De Havilland Doves and Dornier Do.28 aircraft were used as bombers, with the bombs dropped over the side or through an open door.

The Katangese received seven Doves from the Belgian air force, when the latter quit the Congo in 1960. These aircraft had been stationed at Leopoldville, but were flown to Elizabethville, in Katanga, to be turned over to the Katangese. UN sources, however, say that there were never any more than three or four in operation at any given time.

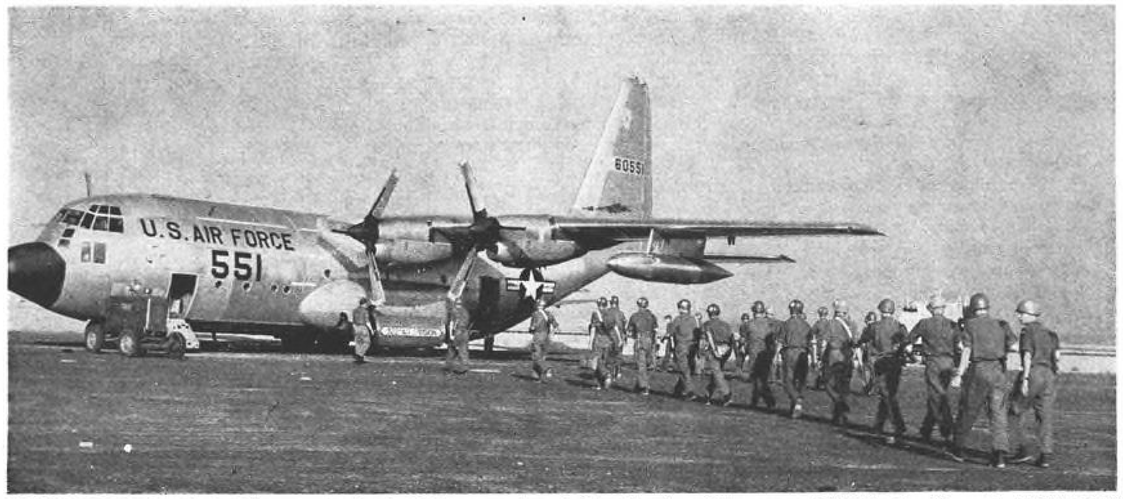
UN sources also say that Sabena Airlines provided a number of DC-3s and DC-4s to the secessionist province and helped to establish Air-Katanga, an internal carrier. Other DC-3s and helicopters flown by the Katangese air force, the UN believes, were bought from the evacuating Belgian air force as "surplus."

The secessionist government also purchased nine Fouga Magisters from France through the agency of a Katangese company. UN sources report that three of the jets were flown, disassembled in crates, into Katanga through the French-community African bloc, with the last stop before Elizabethville having been made at Brazzaville in the neighboring country of the Republic of the Congo. Of these three craft, one was destroyed in a training accident, the second was captured on the ground by UN troops and cannibalized, and the third was put out of action by UN ground forces in December, 1961.

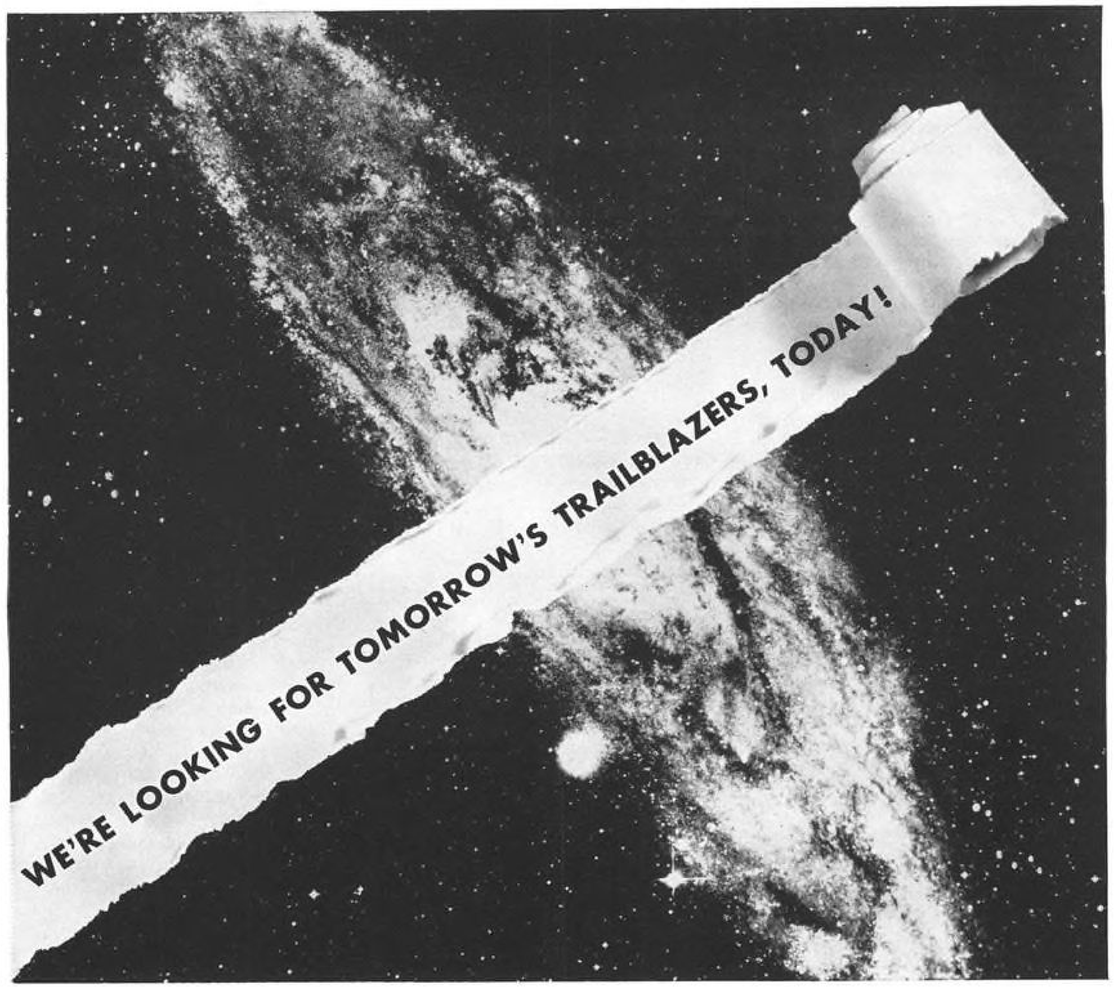
The remaining six Magisters are believed to be stored in countries neighboring the Congo, still in crates. UN forces also discovered that Katangese representatives tried to purchase old U. S. B-26 medium bombers and F-80 jet fighters in Europe. Negotiations were fairly advanced when the UN uncovered the plan and were dropped after the UN brought pressure to bear on the potential sellers.

UN recruitment of air transports followed the standard pattern of the world

BRIG. I. J. RIKHYE, left, of India, a member of the United Nations commander's staff in the Congo, prepares to make an aerial survey of the Kamina air base after it was taken over by the UN forces. At right is a Belgian officer. Sikorsky S-55 in background is one of the aircraft purchased by the United Nations.



SWEDISH TROOPS, who had been serving in the UN command patrolling the Gaza Strip, were airlifted to the Congo in USAF C-130 aircraft. Troops traveled from Gaza to Cairo by train, then boarded the transport aircraft. Photo above was taken at Cairo airport.



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organization's search for assistance of all sorts in the Congo operation: first, a list was drawn up of those countries that could be expected to support the UN's efforts in the Congo. Then, the list was narrowed to those nations possessing transport fleets of sufficient size, and requests for assistance were forwarded to corresponding governments; when replies were received, negotiations began.

At the start of the Congo conflict in July, 1960, the United Nations purchased five Fairchild C-119s from the U.S. and, piloted by Indian and Norwegian nationals in the employ of the UN, dispatched them for internal use within the Congo. Italy at first provided four C-119s, later 10 and then through most of 1961, kept six C-119s in the Congo for UN support. One Italian C-119 was lost in a crash.

United States Air Force responded to the UN's call for air support with Lockheed C-130 turboprop transports from the 322nd Air Division, Evreux, France, and Douglas C-124 Globemasters from the Military Air Transport Service (AW Aug. 15, 1960, p. 33; Aug. 22, 1960, p. 45; Aug. 29, 1960, p. 82; and Sept. 5, 1960, p. 39). So far, USAF has lifted into the Congo between 40-50,000 troops from various countries and 8-10 tons of supplies.

UN logistic requirements for the

UN AIR SUPPORT was provided in part by four F-86s of the Imperial Ethiopian Air Force. Ethiopian pilot climbs from cockpit of his aircraft after landing at Leopoldville's Ndjili Airport. Sweden and India also contributed tactical aircraft to the UN operation in the Congo.

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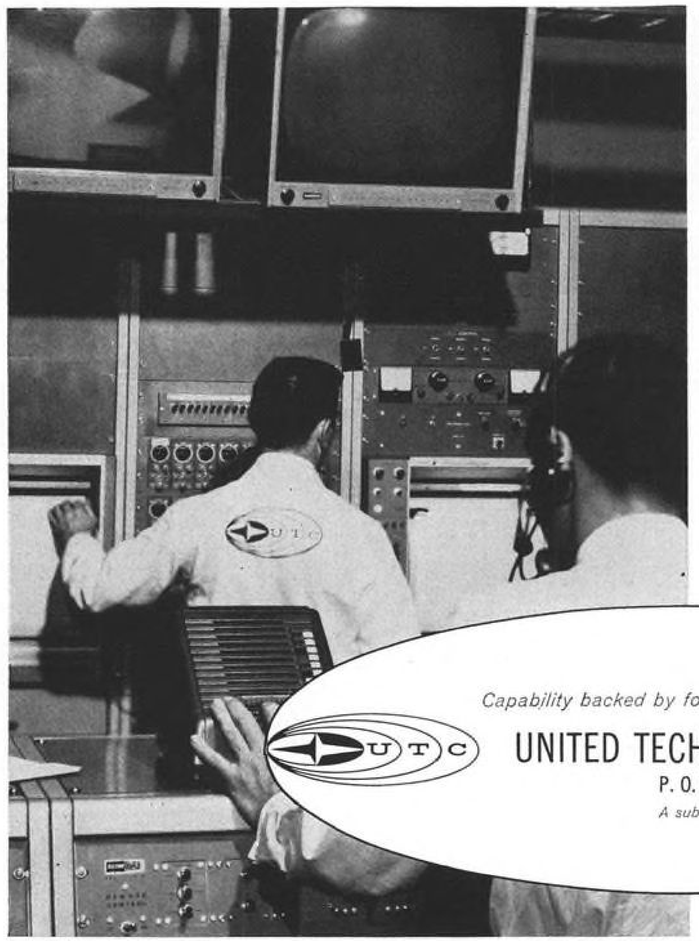

Left—The scene: UTC Development Center. The action: static firing test is monitored on closed-circuit TV in Remote Control and Data Acquisition Center.

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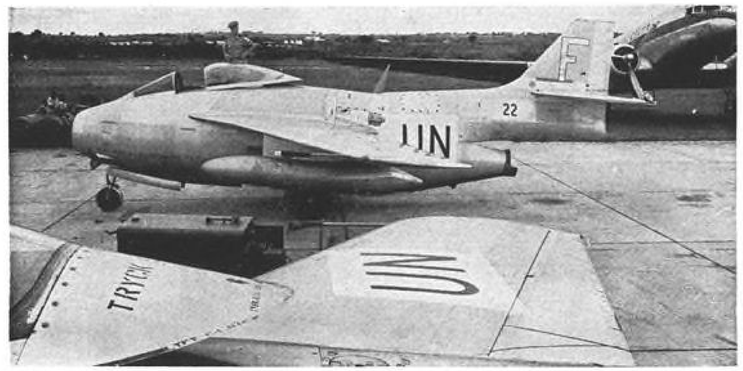
months of December, 1961, and January, 1962, as negotiated with USAF, called for 17 separate actions from the transport of spares for the Indian Canberras to the movement of 1,000 Nigerian troops and the shipment of nine Swedish armored cars. Total tonnage for these two recent months came to approximately 500 tons.

Aircraft at the disposal of the UN in the Congo have included 20 Douglas C-47s, four each de Havilland Otter and Beaver light utility and liaison craft, the C-119s already described plus four additional C-119s, two from Canada and two from Norway, for about a month in late 1961, and 16 Sikorsky H-19 and eight Bell H-13 helicopters. Three of the C-47 aircraft have been lost either in accidents or were destroyed on the ground by Katangese jets. The C-47 fleet was purchased by the UN in the main from the United States, with two aircraft bought from Sweden and four from a South American company. The Canadian-built Otters and Beavers were purchased from the U. S., as were the helicopters. The UN is understood to be negotiating with the U. S. now on the return of the helicopters, which have been withdrawn from the Congo operation.

The UN also chartered from 30 to 40 aircraft from a variety of airlines that included Swedish Transair, SAS Linjeflyg—a Swedish company, Inter-Ocean, Seven Seas and Panama Airways. These chartered lines were under contract to provide immediate service anywhere within the Congo, but the UN found that some refused to fly into trouble areas and that one firm was working both sides of the street—flying troops and equipment for the UN and delivering arms and supplies to the Katangese army.

The first UN aircraft into the Congo found, with few exceptions, that all beacons and navigational aids were shut down and the facilities unmanned. The meteorological service had ceased to function, according to one UN officer, and pilots frequently found themselves flying by dead reckoning toward destinations whose weather conditions were unknown. The officer also said there were dozens of fields throughout the Congo where the only navigational aid was a tattered windsock.

Problems were many and solutions scarce in the UN's first several months in the Congo. Ground crews to service the aircraft were few and far between and those available frequently did not speak English—the language selected as the standard tongue for air operations. It was primarily because of the scarcity of UN ground crews, however, that led the UN to contract maintenance of its aircraft to Sabena, which also was the prime petroleum gas supplier, and Air France at Brazzaville in the Congo.



SWEDISH SAAB J-29 strike fighters operated from Luluabourg airport. Swedish Air Force detachment, numbering approximately 40 pilots and maintenance officers, operated the aircraft. Note that Swedish national markings have been removed and replaced with UN lettering. Indian Canberras also flew in UN markings.

C-119 maintenance was done initially by the Italian air force at Leopoldville, the UN's air headquarters, and then later at Pisa, Italy, where two aircraft were always in the overhaul pipeline.

Maintenance of aircraft in the Congo never went below the first-line level, a designation subject to as many definitions as there were different ground crew nationalities, but which generally meant simple repairs made through an access panel.

Kamina air base, formerly a main Belgian training center, was eagerly sought by the UN because of its hangar and maintenance facilities. The UN took over the base in October, 1960, in two phases. In the first phase, some Belgian military maintenance personnel remained behind after the Belgian air force evacuated the base, to work for the UN as hired civilians. The second phase involved the gradual replacement of these military personnel with non-Belgian civilian employes, recruited by the UN mostly from Scandinavian countries. Although technically very competent, few of these new UN employes spoke French, the language of the native helpers on the field, or English, the language of most of the aircrews. As in other instances, the UN found that language barriers again worked against the effectiveness of its force.

As an economy measure taken late last year, when costs of the Congo effort began to soar, Kamina was reduced to a first-line maintenance center and the Scandinavian ground technicians returned to their countries. Kamina is now the support base for all UN tactical jet aircraft.

Although maintenance remains a problem even today, the UN managed to re-establish the traffic control system by bringing in International Civil Aviation Organization personnel to man the facilities and by inducing some native Congolese, who had been trained by the Belgians, to return to their positions.

Quantities and types of fuel stocks also presented serious problems to the UN air efforts. C-119 gas (115-145 octane) was unavailable in many places and the aircraft had to carry enough fuel for return flights, which cut heavily into their payload capacities.

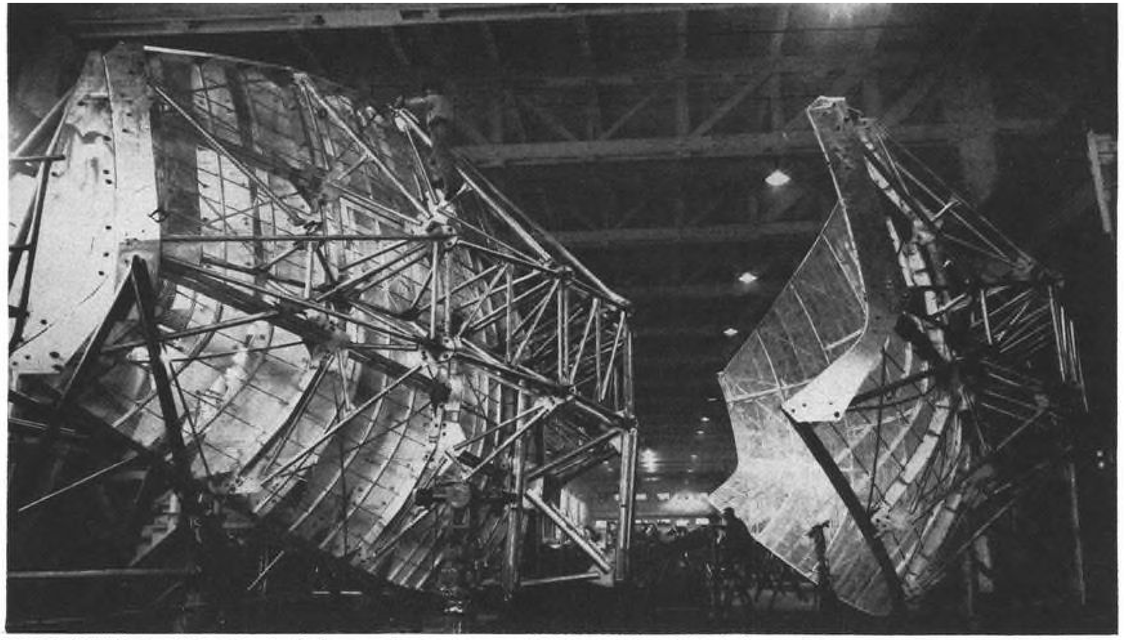
More Scientists Asked

Washington—President Kennedy has asked his Science Advisory Committee to recommend measures for developing an adequate number of scientists, engineers and technicians for the demands of government, industry and educational institutions.

Kennedy said the decline in college enrollment in scientific and engineering fields "is a matter of growing concern." The Federal Council for Science and Technology and the National Academy of Sciences will assist the advisory committee in its study and report. The President directed the committee to submit the recommendations to him "as quickly as possible."

The President, in his press conference last week, said that in 1951, U. S. colleges and universities graduated 19,600 students in the physical sciences. "In spite of the fact that the demand for people of skill in this field has tremendously increased with our efforts in defense, and space industrial research, and all the rest," President Kennedy said, "in 1960, the number had fallen from 19,600 to 17,100."

The President also said that the military-industrial alliance discussed by former President Eisenhower just before he left office "deserves continuing attention by the President and also by the Secretary of Defense. It gets to be a great vested interest in expenditures because of the employment that is involved. . . . That is one of the struggles which he had and which we have, and I think his warning or his words were well taken."



FPS-37 ANTENNA SCREEN is checked out against a master mold by optical and physical measurements at Portland Copper and Tank Works, Portland, Me. facility. Production is part of program to manufacture high-powered acquisition radar for Nike Hercules under General Electric subcontract. Portland Copper was recently wholly acquired by E. W. Bliss Co., Canton, Ohio.

Bliss Enlarges Its Aerospace Activities

By Arnold Sherman

New York—Bigger slice of the aerospace market is a major result of a top-level management shakeup in the E. W. Bliss Co., Canton, Ohio.

This move is representative of what appears to be some reversing of the trend of the last few years of diversification out of the aerospace field into commercial areas. Some recent examples of this reversed trend:

• **Ling-Temco-Vought** sold its Mobile Home Division and is in the process of disposing of its Information Systems subsidiary (AW Jan. 8, p. 22).

• **Curtiss-Wright** has dropped or sold various commercial lines it had entered including its Curon Division which manufactured foam plastic, and is now concentrating on rebuilding its defense business.

• **American Marietta** completed a merger with the Martin Co. that will bring it into the aerospace field. This case is not as clearcut as the others, however, since it also enables Martin to enter into commercial areas.

Bliss, a 104-year-old manufacturer of machine tools and heavy equipment, has had a relatively small stake in the aerospace business through its Aircraft Launching and Recovery Division which builds catapults and arresting systems for USAF and the Navy, and its Canton facility which produces Minuteman closures. The aerospace market, expanded with recent increases in the federal budget, appeared to offer the new Bliss management an area for suitable expansion.

Bliss has been experiencing difficulties for the past few years. A decline, which finally culminated in the management changes last year, can be traced back to 1958. Consolidated net sales for that year totaled $47,362,274 as against $73,562,123 for the preceding year. There was a loss of $153,827 for that year compared with 1957 income of $4,903,206. In 1959, return on net worth was about 1%. The beginning of last year saw Bliss' main Canton plant utilizing only 15–20% of its capacity, according to a Bliss executive.

Early last year, William Less, a partner and investment counselor of the D. H. Ellis Co. of New York, chairman of Bliss' board of directors and a major shareholder in the company, initiated revisions. The company board underwent changes and the management was shaken up.

Finally, in July, a new president was appointed—Carl E. Anderson, a director of Ebasco Services, Inc., a management consulting firm which had been called in to minister to Bliss' ailments. Anderson replaced Ralph Potter who was then acting president and who subsequently resigned from the board along with three other members.

Anderson's immediate objectives, all of which have at least partially been carried out since then, were to:

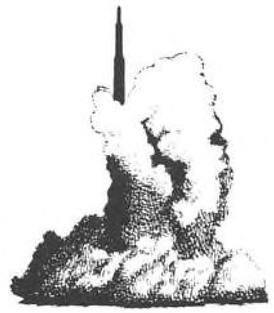
• **Build a stronger corporate identity** through tighter liaison between Bliss' varied U. S. and foreign interests.

• **Press for stronger research** and development activity in the direction of both industrial manufacturing techniques and aerospace component manufacturing and defense metalworking capability. "When I came to Bliss," Anderson said, "I was shocked at the lack of R&D expenditure. We were competent in certain areas—like our catapult and arresting gear department—but by and large the over-all R&D effort was pitifully lacking. We were not exploiting our capabilities to the utmost and we weren't sufficiently oriented to future national developments. We had been skirting the fields of missiles and space, for example, but we weren't sufficiently involved in either of these areas. With defense and space appropriations what they are, it doesn't take a pundit to understand why major companies have to take these fields under cognizance."

• **Develop a wider space** hardware-producing capacity through the acquisition of Portland Copper and Tank Works, Inc., Portland, Me. In his capacity at Ebasco, Anderson had investigated the Portland Copper operation before he came to Bliss. "I knew this was the kind of missile-oriented diversification we needed," he said. "It was the kind of outfit that fitted into the Bliss operation and also, and fortuitously I might add, took us deeper into a field I wanted to explore."

• **Create a systems capability.** Anderson

BOEING



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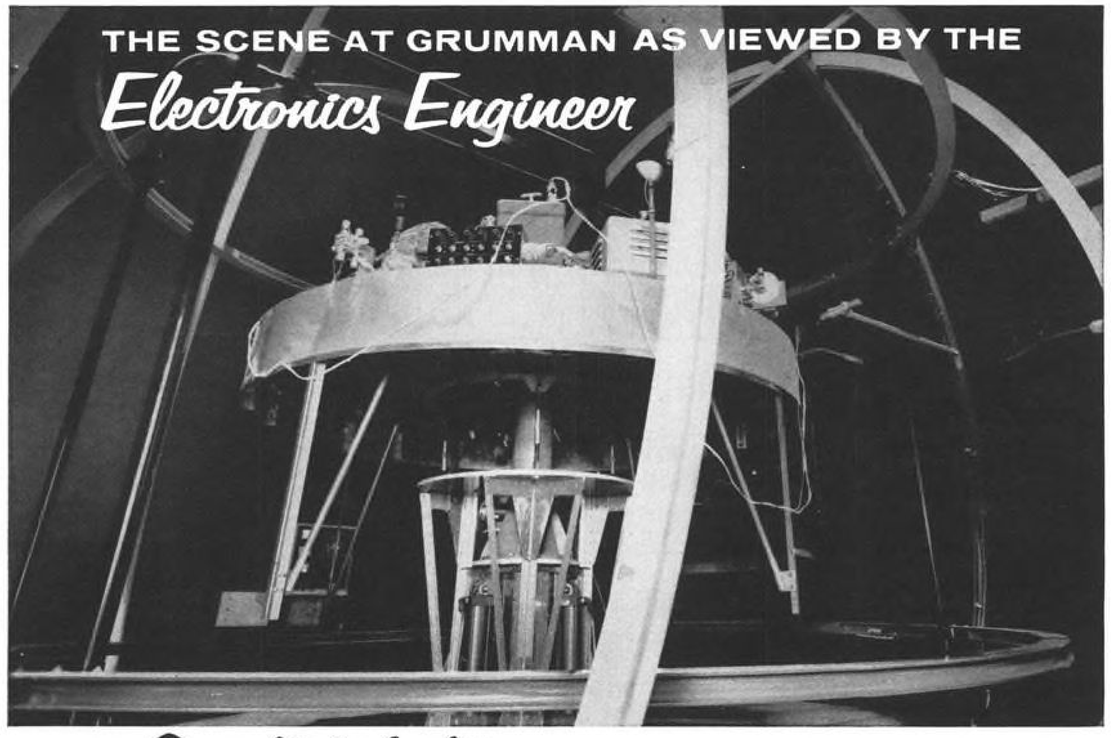

...Small World Space environment is being created at Bethpage, L. I. Using large Helmholtz coils, Grumman engineers can cancel the magnetic field at their earthbound test site and duplicate the magnetic environment of any satellite orbit around the earth. Either static or programmed time-varying magnetic fields can be generated in this facility. The Helmholtz coils and other devices reproduce many of the same environmental conditions encountered by an orbiting satellite. Literally putting a volume of orbital space in a room, this space simulator was constructed to test space hardware similar to that of the Orbiting Astronomical Observatory which Grumman is now building for the NASA.

Grumman electronics engineers are today involved in many interesting and intellectually stimulating projects involving our defenses, our retaliatory capabilities and our vital space activities. Electronics engineers with a similar work orientation are urged to investigate the following immediate positions:

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Radar Development Engineers—BSEE with a minimum of 4 years experience in the analysis, design and development of airborne radar systems. Should be capable of analyzing the radar system with the end view of integrating the equipment into a complex weapons system. Will fully participate in laboratory and flight development programs conducted in the finest facilities available in a professional atmosphere.

ECM Engineers — BSEE or BS in Physics with a minimum of 3 years experience in the fields of radar systems, passive and/or active counter-measures systems, and ECCM systems. Work involves the development of ECM systems and the integration of ECM equipment with navigation and digital computer systems. Background in digital computers and programming is desirable but not essential.

Digital Computer Systems Engineer—BSEE with a minimum of 4 years experience in the analysis design and development of digital computers. Will participate in the integration of digital computer into a complex weapons system. A significant part of the effort will be devoted to extensive laboratory and flight development programs.

To arrange an immediate interview, send your resume to Mr. W. Brown, Manager Engineering Employment, Dept. GR- 25 (U. S. citizenship required)

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contends that Bliss has the technical know-how and the manufacturing capacity to undertake larger projects in the defense and aerospace fields. "We are planning to add 50,000 sq. ft. to the Portland operation. Our engineers are already working on Dyna-Soar boost glide vehicle rocket nozzle subcontracts and I would like to see Bliss get into the field of missile transportation." On the Bliss drawing boards, according to Anderson, are plans for missile-carrying barges that are inflated with air and then towed to their final destination from Portland. "Guidance is another area," Anderson said, "in which we have an unexploited capability. Our Gamewell subsidiary, which manufactures timers, potentiometers and rotary switches, is being groomed for larger roles in that direction."

Major Step

Although Bliss has had a peripheral aerospace involvement for some time, the recent Portland Copper acquisition is the key to Bliss' aerospace ambitions.

Portland Copper's stainless steel and special alloy manufacturing has, to a large extent, been predicated on fabrication of components for jet and rocket engines. Through the acquisition, Bliss has inherited Portland's past and present capability in the following programs:

- **Talos, Tartar and Sparrow** hardware contracts for the Navy.
- **Large guidance control** radar reflectors for Army's Nike Hercules launching stations.
- **Jet engine components** for major powerplant suppliers.
- **First-stage Minuteman** thrust vector control nozzles.
- **Minuteman second stage** and Polaris nozzle subcontracts.
- **Ardeform method** of stretch-forming rocket cases by extending them at cryogenic temperatures, —320F.

Of paramount significance to the acquisition, however, was not only Portland's missile-fabricating capability but its 50% ownership of the Arde-Portland Co., Paramus, N. J., a research and development firm which Bliss now half owns.

Mission of Arde-Portland has been to acquire research, development and manufacturing contracts, turn the research activities over to Arde Associates, a New Jersey-based firm composed of research engineers formerly with the Kellogg Co., and the manufacturing tasks to Portland Copper. In the complicated acquisition, Bliss will operate Portland Copper as a wholly-owned subsidiary and Arde-Portland therefore will be, for all intents and purposes, the subsidiary of a subsidiary. Bliss retains the 50% interest previously vested in Portland Copper; Arde Associates holds the balance.

In line with its defense activities, Arde-Portland recently received a $5.5-million subcontract from Thiokol Co. for additional thrust vector control nozzles for the Minuteman first stage. This brings to $22 million the total amount received by the subsidiary for the first-stage nozzle. Arde Portland also is engaged in rocket nozzle work for the Dyna-Soar boost glide vehicle.

Although no official estimates of Arde-Portland's last year's aggregate contracts has been made available, reliable sources set the figure somewhere near $20 million.

Commenting on possible future Bliss moves to acquire Arde Associates itself, Anderson said, "We will not acquire Arde for two basic reasons. In the first place we feel that an outfit like Arde will function more creatively if it is not tied to any corporate entity. Second, Arde takes pride in its individual identity and we are content to preserve the status quo. There is a desire, however, on both our parts for closer cooperation between the two companies. We are working on an agreement now whereby Bliss will be given first option on all Arde [fabrication] contracts and in return Bliss expects to furnish Arde with the capital it needs for its research needs."

Bliss said that no immediate changes at Arde-Portland are anticipated. The company has, however, offered the subsidiary additional space at one of its Ohio facilities and of course Arde-Portland now will have a wider manufacturing capability to tap through the Bliss complex.

Stock Transaction

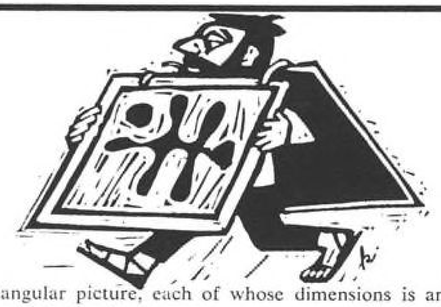
Bliss acquired Portland Copper for 55,000 shares of Bliss preferred stock, 49,000 shares of Bliss common stock at the market price at the time of acquisition, and 50,000 warrants exercisable at $35. Harmon Hugo, general manager and treasurer of Portland Copper, was retained as the president of the subsidiary.

Listed on the New York Stock Exchange, Bliss stock has been climbing fairly regularly since Anderson's arrival. The 1961 low for Bliss common was 16¼. Its high toward the end of 1961 was 36⅜. Shortly after news of the Portland acquisition was circulated, Bliss stock began moving up from about 24 into the 30s. Anderson said, however, "that although Portland had a salutary effect on our operation and consequently was reflected in the market, the stock was on its way up anyway."

Combined sales for Bliss and Portland in 1961 are estimated at about $100 million.

Bliss' third-quarter Fiscal 1961 report showed a net income of $855,002

PROBLEMATICAL RECREATIONS 103



A rectangular picture, each of whose dimensions is an integral number of inches, has an ordinary rectangular frame 1 inch wide. Find the dimensions of the picture if the area of the picture and the area of the frame are equal. —*Contributed*

Meanwhile, back in San Carlos..... Three new Elliott-Litton floating drift tube klystron oscillators are available from our Electron Tube Division. Operate in the 68 to 80 kmc range with a tuning range of ± 750 mc's. Data on these and other millimeter wave devices is readily obtained from: Marketing Department, Electron Tube Division, San Carlos, Calif.

ANSWER TO LAST WEEK'S PROBLEM: It does make a difference. A submerged body displaces its volume; a floating body displaces its weight. Since a penny is denser than water, dropping it into the canoe will raise the water level higher.

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ENGINEERS

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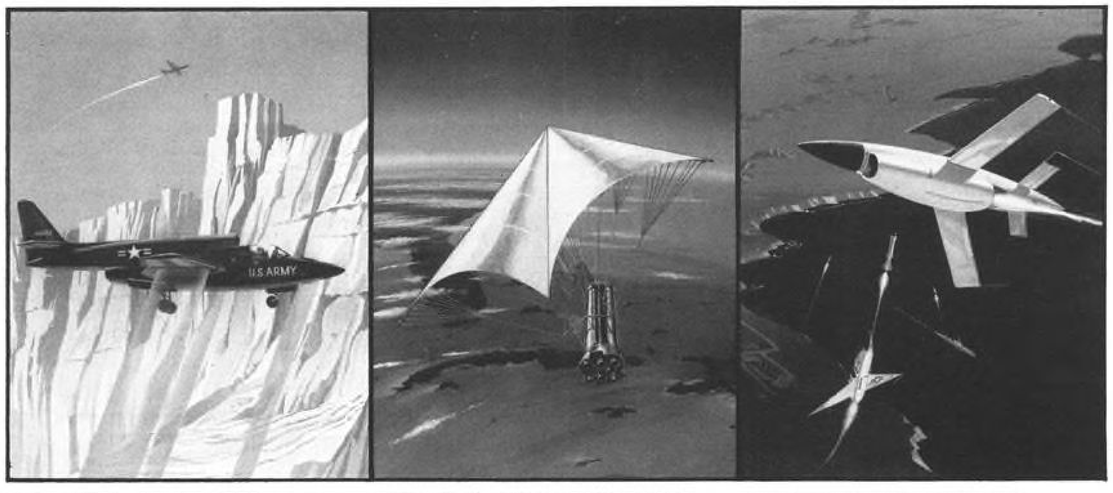

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or 65 cents a share, as compared with $377,083 for the same period the year before.

Sales for the quarter were $19,209,544, as compared with $20,644,315 for the comparable 1960 period.

During the first nine months of 1961, net income amounted to $1,840,216 or $1.38 per share, as compared with $1,315,947, or 95 cents per share for the same period in 1960. Sales for the first nine months of 1961 were $57,547,486 compared with $62,786,510 for the same 1960 period.

Commenting on how Bliss' aerospace ambitions would sit with some of the firm's customers—many of which also are involved in space and defense activities—Anderson said, "Although I would be less than honest if I didn't say that we gave this matter considerable thought, I don't think this is really a problem for us. While not discarding present programs, we are looking to new developments and the subsequent business they are bound to engender. Some overlapping might be unavoidable but this is not a major problem."

James A. Bray, manager of Bliss trade relations, told AVIATION WEEK how Bliss operations are beginning to dovetail. "For the past two years, the Bliss Canton plant has been manufacturing fore and aft closures for the Minuteman ICBM. The Portland-manufactured rocket nozzles for the missile fit on the bottom of these closures.

"Even in the field of machinery production," Bray said, "which after all is still the mainstay of our operation, we find that these goods are being increasingly used in aerospace applications. It seems that a certain pattern is being established for us."

Aerospace Interest

Bliss' aerospace concentration, prior to acquisition of Portland Copper, has been in two fields:

• **Aircraft Launching and Recovery** Division. Bliss was a prime supplier of catapults and aircraft arresting equipment during World War 2. With facilities in Philadelphia, Bliss has since then been contracted by both the Navy and Air Force for this equipment. Under a present $2-million Navy contract, Bliss is furnishing catapults for Marine Corps jet fighters in forward areas where adequate runways would not be available. Under separate $5-million contract, Bliss is supplying USAF with arresting units for its aircraft. The company is also negotiating with Japan for arresting gear units for the F-104J and has made a proposal to Boeing for an arresting unit adaptation for the Dyna-Soar.

Major Bliss effort in this field, however, has been to convince airlines and transport manufacturers that safety gear adaptations and even catapults have a useful place in civilian transport thinking. Bliss has achieved no notable success so far in this direction "but we are trying and will continue to try," a company executive said.

• **Gamewell Co.** In 1959 Bliss acquired Gamewell for one share of Bliss common stock and one-half share of Bliss $1.80 cumulative convertible preferred for each share of Gamewell stock. The Newton, Mass., company primarily is a manufacturer of fire-fighting equipment, potentiometers, rotary switches and timers. It is through Gamewell that Anderson hopes to develop a guidance system capability.

In keeping with Anderson's objectives, a number of high-level managerial changes were implemented.

• **W. Ben Flanigin** was moved into the newly created position of director of sales and marketing. At the corporate level this made Flanigin responsible for all domestic marketing, including sales, advertising, publicity and sales promotion for Bliss and its subsidiaries.

• **John J. Byrne,** former manager of Bliss' catapult operations, was appointed director of research and engineering. His appointment was a portent of more corporate research and development activities. His task is to coordinate company-funded research and development and to inject more research effort into all phases of Bliss' operation.

• **Olaf O. Vaught** was brought over from a Paramus, N. J., machinery manufacturer to become director of production operations. This effectively brought subsidiary production under the cognizance of the parent body.

These changes, along with a rash of other personnel shifts made since Anderson took office, indicate Anderson's preoccupation with consolidation within the Bliss corporate ranks. While it is Anderson's avowed intention to diversify Bliss, particularly in respect to aerospace capability, a counter-trend of centralization is taking place on the home front.

In addition to its domestic operation, Bliss maintains subsidiary holdings in Canada, England, France and West Germany. In 1960, the French subsidiary reported earnings of $213,034; profit level for the British-based company was $134,139.

West German operations consist of a licensing agreement with Henschel-Werk AG, a 151-year-old firm which manufactures diesel locomotives, trucks and heavy machinery. Under the agreement, consummated about two years ago, a new firm, E. W. Bliss-Henschel GmbH. was formed to produce heavy machinery for steel plants. The venture is owned by Bliss, with 60% interest, and Henschel with 40%. At last report the company had received $6 million in contracts from South American sources for steel-producing machinery.

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Israel Helicopters Fly Rescue Missions

By Cecil Brownlow

Tel Aviv—Israel's air force helicopter squadron equipped with Sikorsky S-58s and aging S-55s is filling a major auxiliary role as an emergency ambulance rescue service for residents of this sometimes sparsely settled, largely desert country.

Since its beginnings five years ago, the squadron has participated in well over 200 rescues, ranging from the ferrying of wounded from the border regions to city hospitals, the transfer of hospital cases from doctorless ships and the rescue of sunstroke victims from roadless desert tracts.

The reputation of the squadron as a messenger of mercy has, in fact, become perhaps too well known. The unit's rescue operations "have become so popular we've had to ask the people not to call us on small things," according to Maj. Uri Yarom, squadron commander and the air force's first helicopter pilot.

"Once," he adds, "we received a call to go to the desert. When the helicopter arrived, a man jumped in and said, 'It's me. I have a stomach pain.'"

Most, however, are of more consequence and often much more difficult.

The stage was set in 1957 shortly after Yarom returned from helicopter training in the U.S. A former fixed-wing pilot who had participated in both the 1948 Arab-Israeli war and Sinai campaign, Yarom received orders to intercept a doctorless Greek merchant ship 120 mi. at sea with Israeli immigrants aboard to pick up what was described as a "wounded man" and then fly him to a major hospital.

Flying out in an S-55 with a doctor and two mechanics aboard, Yarom radioed to squadron headquarters and asked that the ship be contacted and requested to come to a stop 90 deg. to the wind. The message, however, failed to get through and, when he found it, the vessel was traveling at near top speed.

Hand signals from the helicopter resulted in the ship's halting its engines, but Yarom had to make his approach downwind in order to place the door in the proper position for dropping the hoist. Once over the ship, he lowered a mechanic and a litter in respective placements of the hoist onto the vessel's fantail. Then, as the patient was being placed aboard the litter, the ship lurched under a swell, rolling toward the low-hovering helicopter, with three of the four main rotor blades slamming into a taut cable. "I could see pieces flying off the rotors as they hit the cable," Yarom says.

By applying full power, however, he found that he could still hover and hobbled back to board patient and litter. Then, he made a low, slow forward speed pass and retrieved the mechanic.

It was only after the patient had been placed successfully aboard that Yarom learned that, rather than a wounded man, it was a woman facing an imminent and apparently difficult childbirth. "The helicopter was shaking badly, and the mechanics kept yelling that the baby was about to be born," but Yarom managed to return to the Haifa airport where he made a running landing. The baby was born in a hospital several hours later.

On inspection, it was found that the entire tip of one rotor blade had been shorn away, half of a second tip was gone, and the third was badly dented.

Another long-distance sea rescue operation involved an emergency refueling landing aboard a U.S. Navy aircraft carrier, the Wasp, which providentially appeared at the right place at the right time for Yarom. Before sighting it visually, he had no idea it was in the area.

With a doctor, navigator and two mechanics aboard an S-58, Yarom's mission was to fetch an injured man from a cargo ship with a tanker configuration. Again, the vessel was about 120 mi. at sea, while the normal range of the S-58 is only about 225 mi.

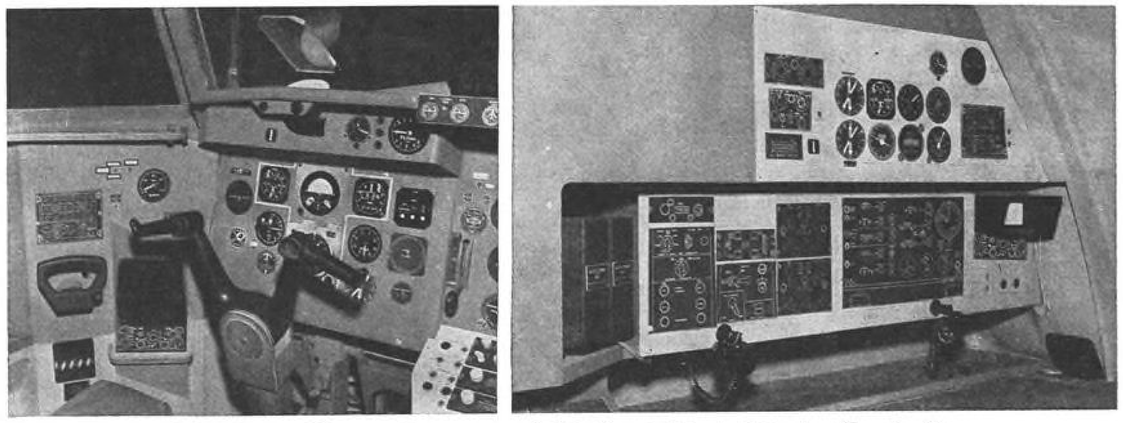
Yarom had another disadvantage, an impression that he was searching for a cruise ship. "That was one mistake," he says, and time was lost looking for a white-painted cruise ship rather than a drab cargo vessel.

"Finally, we saw a number of ships," the major recounts, "and we decided to lower a mechanic down on one. It turned out to be a U.S. Navy ship so we went on with the search."

By this time, an air force DC-3 also had been dispatched to help in the search, "but we never made contact. . . .

"We had a barrel of fuel on board with a long elastic pipe, and I thought, if we ran low on fuel, the mechanics would be able to reach out through the door and pour it into the tanks. When we were 10 min. from the point of no return, I told them to put in the fuel, but, with the cap off, the wind was sucking fuel out of the main tank, and we couldn't get anything in. . . .

"We were now near the point of no



Mockup Shows Layout of Belfast Freighter's Cockpit

Flight deck mockup of Short Brothers & Harland's SC.5 Belfast turboprop freighter shows pilot's transparent eye-level display mounted in front of windshield. Data such as altitude and indicated airspeed are projected on plate in green during day and orange at night. Flight engineer's station (right) is divided into panels diagramatically displaying aircraft systems information.

return when I suddenly saw this carrier. We didn't want to go back because the man was seriously injured, so I radioed headquarters and asked for permission to land on American territory. They told me it was my decision, and I decided that, if I had to be an American prisoner, it wouldn't be so bad. . . .

"I hovered three or four meters above the deck and yelled down to a member of the crew to ask if I could land. He just shrugged, so I began my approach. When I did, a man in a green shirt signaled me down, and I landed."

During a 30-min. stay aboard the carrier, Yarom's helicopter was refueled, and the carrier's control center pinpointed the location of the distress ship approximately 29 mi. away. The mission was then completed without further incident.

In another instance, Yarom was called upon to rescue an 18-year-old boy from the cliff face of Metsada, a Jewish shrine in the Dead Sea area.

The adventurous sometimes attack the 1,200-ft. summit from different angles, as did the 18-year-old boy who tried the northern face and fell badly injured onto the overhang of a precipice.

Squadron Alerted

After other methods of rescue had failed, the helicopter squadron was alerted, and Yarom, a doctor and two mechanics arrived on the scene in an S-55 as the sun was passing the horizon. A search of the cliff failed to produce any evidence, and Yarom landed at the base of the cliff where onlookers pointed out the site at an altitude of 300 ft. where they had seen earlier a faintly waving handkerchief.

Making another swing, Yarom spotted the youngster and saw that if he attempted a hover directly over the spot his rotor blades would strike the face of the cliff. He decided, instead, to hover to one side while one of the two mechanics lowered himself on the hoist and then swung pendulum-fashion until he reached the overhang.

By this time, it was almost dark, but the mechanic managed to place the loop of the hoist around the boy, and Yarom pulled him to safety. He then returned to his angled hover as the second mechanic rolled the hoist line into a ball and tossed it to his stranded colleague. He succeeded on the second attempt as darkness was falling, and Yarom flew off to deposit his patient on the grounds of a Beersheva hospital.

Capt. Amiti Hasson had a similar, more harrowing experience in the same area at a point 40 mi. from Metsada on the Dead Sea and 1.2 mi. from the Jordanian border. While flying with his copilot in an S-55, Hasson received radioed instructions to fly to Beersheva to pick up a guide and physician and then proceed to the border kibbutz (collective colony) of Angeddi to rescue a wounded man. The time was 4 p.m.

At the kibbutz, Hasson learned that a visitor had been wounded near the border by a roving band of Bedouin tribesmen and had attempted to escape by crawling down an almost sheer cliff. He now lay on a shelf midway down the precipice with five bullets in his body.

Hasson first landed on top of the cliff—again it was almost dark—and to properly survey the terrain worked his way tortuously down the cliff to the wounded man. The descent required two hours.

"When I saw the place," he says, "I asked him if I could take him out without the helicopter. He said he thought he was dying, so I looked around in the dark and found a place where we could come close with the helicopter. It was below where we were."

It required another two hours for Hasson to work his way back to the helicopter.

Once in the cabin, the copilot took over the controls while Hasson directed him through the darkness to the spot he had located. To have the door properly aligned to make it easier to get the wounded man aboard the helicopter from the narrow shelf, Hasson's copilot had to back the craft into position because of the lack of maneuvering space. There was room on the shelf for only one wheel, and the helicopter hovered in that position, while two litter bearers attempted to bring the wounded man down. They found, however, that there was insufficient clearance between the rotor blades and the cliff for them to pass, and the Hasson crew had to pull away again while the bearers edged the litter onto the shelf.

Then, Hasson, with half his body exposed, laid down in the cabin as the helicopter resumed its one-wheel stance, and the litter bearers handed the wounded man into his arms. After 20 min. of tugging, the man was half in, the captain still half out, and the helicopter flew off. They reached the hospital at Beersheva at 11 p. m.

When the helicopter squadron realized the scope its rescue role might encompass, it dispatched teams to every major hospital in Israel and helped train ground crews in the art of directing a helicopter onto its landing pad, setting out smoke lamps, removing the patients from the cabin, etc. And, sometimes, its capabilities can work to its own advantage.

"One of our squadron mechanics was crushed between a truck and a tractor," Yarom recalls. "We put him in an S-55, and he was in the hospital in a matter of seconds. The doctors said this saved his life. "Sometimes you have to help yourself."

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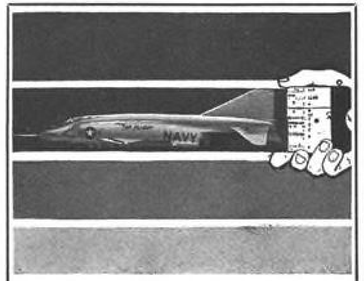

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PBY—5A—Two man crew—cargo doors and floor—seating 16 passengers—no corrosion, FS-8197, Aviation Week.

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LETTERS

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Ethnic Considerations

There is a serious error, either of language or intent, in the article on El Al Airlines in your Dec. 18 issue (p. 38). The author says, "The Jews and the Irish tend to ride their own national airline, if possible, no matter where they live now."

Whatever may be the conception of Jews held by El Al Airlines, it is an established fact that in the United States of America Jews are recognized as full and equal nationals of the United States. Their identification as Jews is by virtue of their voluntary association with a historic religion of universal values—not with a foreign nationalism.

There may be other ideas about what Americans of Jewish faith are, or ought to be, but they are contrary to the whole spirit and historic development of American democracy.

There is no American national airline. But if there were, it would be the national airline of American Jews—as of all other Americans. El Al is the national airline of the State of Israel—a nation as foreign to Americans of Jewish faith as to all other Americans.

To use "Irish" and "Jew" as if they were descriptive of the same category of human interests or characteristics is also erroneous. "Irish" is a national designation and it includes a considerable number of individuals of Jewish faith.

The proper legal name for the Zionist state in the Levant is "The State of Israel."

It is not a "Jewish" state, except in propaganda which is partisan to the idea that Jews are, as Jews, a nationality. Citizens of The State of Israel are of Jewish, Christian and Moslem faiths and the accurate description of their nationality is "Israeli."

Your readers are entitled to know that The American Council for Judaism is an organized group of Americans of Jewish faith dedicated to the following American concepts:

"Nationality and religion are separate and distinct. Our nationality is American, our religion is Judaism. Our homeland is the United States of America—not The State of Israel.

"We reject any concept that Jews outside of Israel are in 'exile.'

"The nationalism of Israel must be confined to the boundaries of that State. Its spokesmen, representatives, agencies and instrumentalities in no way represent us. No Jew or group of Jews can speak for, or represent, all the Jews of America."

ELMER BERGER
Executive Vice President
American Council for Judaism
New York, N. Y.

(The sentence referred to by Mr. Berger is a direct quotation given AVIATION WEEK *by an official of El Al Israel Airlines rather than a statement made by the author of the article.—Ed.)*

Irish Bilateral

AVIATION WEEK recently reported that our pre-holiday bilateral talks with the Republic of Ireland had netted another negative for America (AW Dec. 11, p. 47).

The U. S. taxpayer was again nicked and our negotiators out-negotiated.

American flag carriers, their employes, their suppliers, etc. pay vast sums in taxes to the local, state and national treasuries. In addition they employ thousands of American taxpayers, and provide a vital national strategic airlift reserve (unmatched by even the Soviet) at no cost to the overtaxed American.

Why should the Irish airline be permitted to serve markets such as the Boston metropolitan area (population 2,913,000) and New York City (population 7,781,984), and we be denied much smaller Dublin? The entire population of Eire is 2,846,000; less than a third of New York City and Boston. American citizens provide the bulk of the passengers. We serve Shannon Airport; nearest city Limerick, comparable to Riverhead.

Perhaps we should negotiate on the basis of equality; Riverhead for Shannon, and Dublin for Boston.

Perhaps flag airline seats should be limited to the traffic generated by the supporting mother country.

What has the American-give-away (Santa Claus) program in international air transport cost us? We Americans formerly carried about three-fourths of the transatlantic business, now only three-eighths. Foreign airlines, nearly all government owned and subsidized, have completely saturated Atlantic routes. Americans provide the bulk of their loads.

My employer has been forced to furlough nearly 20% of its highly skilled and world's best trained flight engineers and pilot-navigators.

Our strategic airlift capability is lessened by a like amount. The American taxpayer makes up the difference—the lost tax revenues; MATS requires additional $6 million jets, and the American balance of payments deficit continues to weaken the U. S.

Americans, let us resolve for 1962 to support our own privately owned American flag carriers and, in addition, match the shrewd diplomacy of the foreign government owned and subsidized airlines. Be American. Travel American.

A Fellow Taxpayer
R. C. (DICK) OTTO
Copilot-Navigator, DC-8, PanAm
Amityville, N. Y.

Case Against Safety

The Apollo project is already suffering from what I call the "hyper-safety fixation," and I'm afraid it will progress unchecked. It usually does.

Hyper-safety is supersafety carried to an extreme, and a fixation is a fixed attitude which is completely unaffected by reality—blind, unreasoning adherence to an idea (good or bad). The hyper-safety fixation is old stuff in rocketry. It results from engineers who take the easy position "there must be no failure, even if we engineer it forever" working on managers who take the easy position "decisions which consider all the factors are agonizingly hard; I shall find a simple generalization to follow." The generalization is, of course, that a man's life is infinitely precious and must be preserved at all cost. The resulting hyper-safety fixation is hard to oppose; a critic is automatically in the position of those who oppose motherhood and favor sin. But there is a case against safety, and I intend to present it.

First, the cost. In the long run, the cost of anything simply equals its labor content. Even unmined iron and oil are valued in proportion to the labor of finding more. So $100,000,000 spent on safety, whether for development or for materials, can be measured in man hours. One hundred megabucks represents the working lives of 300 men, spent because they might be needed to try to save one man's life. I contend that somewhere along the line it stops being worth the price.

Second, the mission. The entire Apollo program is oriented toward a safe failure. Successful abort is our primary goal, more important than a successful mission. If we planned to get greatest value from a successful mission we would use an entirely different flight plan. The cost of this to the mission is far from trivial. Eliminating even one layer of safeguards, such as abort after escaping from the earth's gravity, would save enough weight to "pay for" a fleet of electric cars and a water well drilling rig.

Third, the astronauts. It is said we should not ask these men to take any avoidable risk. This is pure nonsense; the men are not asked to take any risk at all. They volunteered, none of them with their fingers crossed. Observers of the real world note that many men take chances just for fun, e.g. Russian roulette players. Men who accomplish things expect to take chances. Of course, the astronauts expect a fair chance to return, but delaying the mission and sacrificing its usefulness for hyper-safety implies that somebody is "chicken." Whoever decides about safety should check with the astronauts whenever one feels faint. The United States has enough brave men to fill the Apollo capsule several times.

Without hyper-safety.

JAMES D. THACKREY
Santa Ana, Calif.

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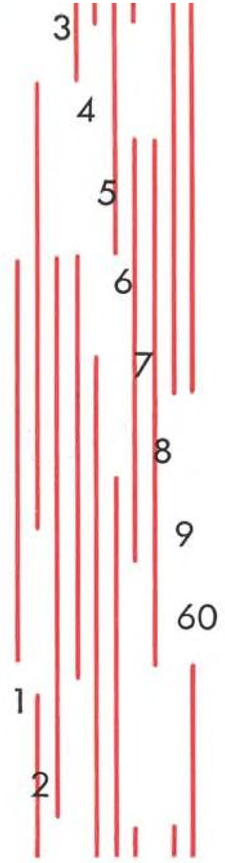

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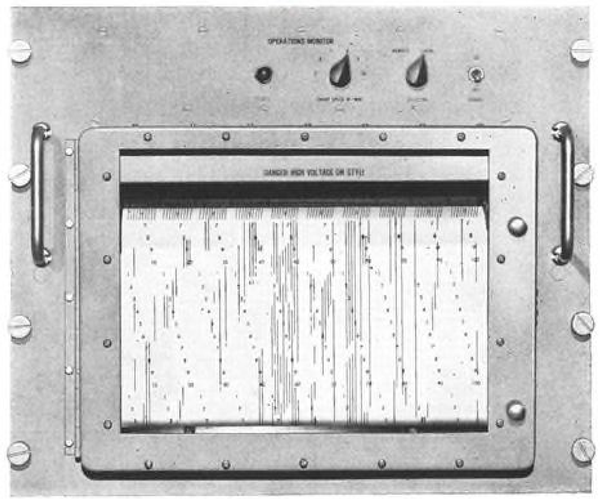

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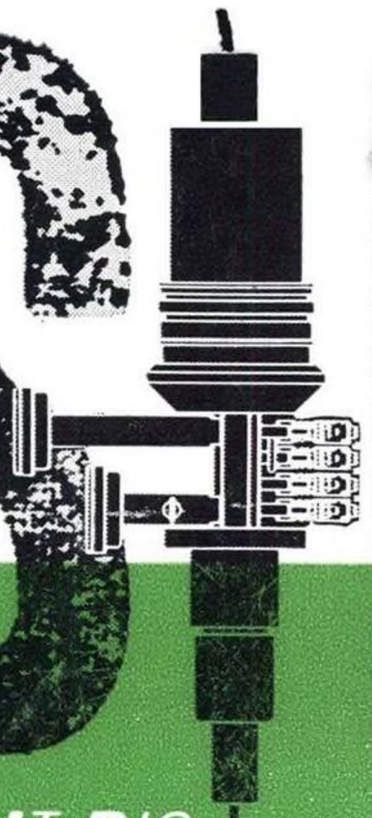

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