Aviation Week & Space Technology

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November 25, 1963

Firms Propose Still Cameras For Lunar Use

Apollo Escape Tower Separates From Capsule in Abort Test

Canadair Completes CL-84 Transport Design

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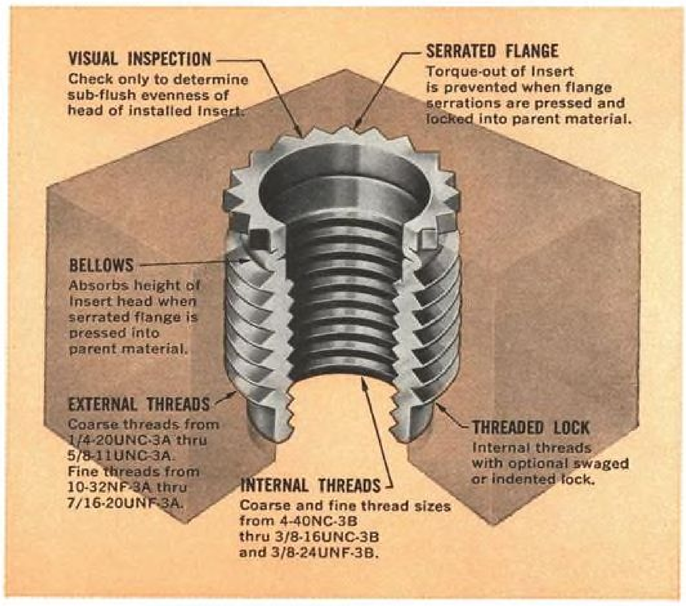
Now, for the first time, Secondary Reference Standards are available to the field in standard Army semi-trailers. The U.S. Army's new AN/MSQ-55 is a mobile, highly versatile, Secondary Reference Laboratory, directly traceable to the National Bureau of Standards. ▪ Calibration capabilities of the AN/MSQ-55 include: electrical, radio-frequency/time, microwave, and infrared measurements. It is readily adaptable to physical standards. Human-engineered for maximum operator convenience and measurement accuracy, the calibration van is environmentally controlled to maintain precise temperature and humidity tolerances. ▪ The AN/MSQ-55 was developed jointly by the U.S. Army and Aerojet-General's Astrionics Division for the FACTS Program—Field Army Calibration Team Support.

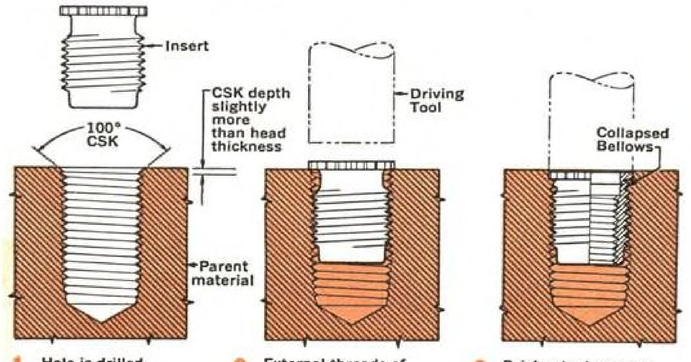
AEROJET GENERAL TIRE GENERAL T.M. ASTRIONICS DIVISION / Azusa, California

How the NEW HI-SERT™ THREADED INSERT

REDUCES YOUR INSTALLED COST



HOW THE HI-SERT™ INSERT IS INSTALLED



1. Hole is drilled, 100° countersunk and tapped with standard tooling.
2. External threads of Insert are screwed into threaded hole until serrated flange of Insert touches parent material.
3. Driving tool presses serrated flanges into the countersunk portion of hole . . . slightly sub-flush to surface of parent material.

REMOVAL No special tool is needed. Use drill to remove serrated head. Use "easy-out" extractor to unscrew remainder of Insert. Same threaded hole is reusable.

Here's a completely new insert, the one-piece HI-SERT. It provides high load-bearing threads for castings or plate material such as aluminum, magnesium, or zinc.

The HI-SERT is economical to use because its unit price is low, hole preparation is simple, and its installation is easy.

Unlike other inserts, special tools are NOT required. Use pressure-controlled equipment common to most shops such as an arbor press, hydraulic press, or squeezer. If volume production or mobility are considerations, efficient hydraulic tooling developed by Hi-Shear Corporation is available.

A variety of industrial applications, precision and commercial, can be met by HI-SERT configurations in Type 303 CRES or C1117 Carbon Steel. The insert will meet or exceed MIL-N-25027 requirements.

WRITE FOR the new 4-page descriptive brochure which gives complete details on HI-SERT features, physical characteristics and installation methods.

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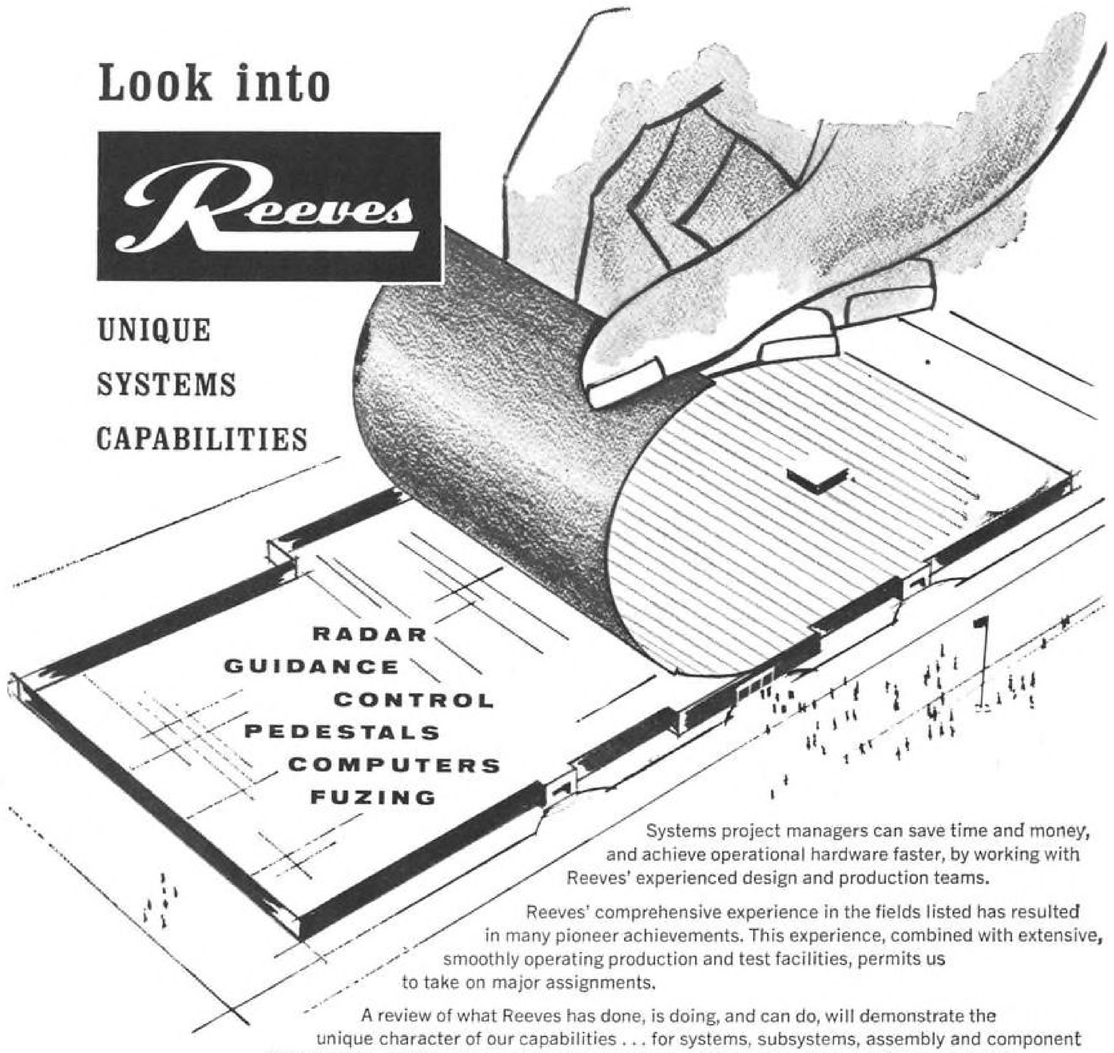

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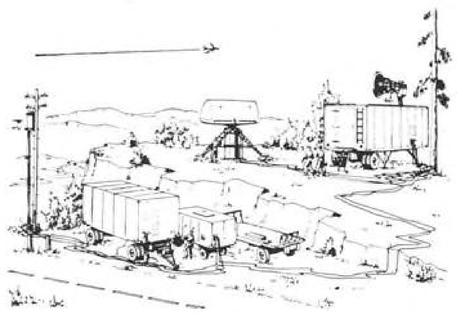
Reeves' comprehensive experience in the fields listed has resulted in many pioneer achievements. This experience, combined with extensive, smoothly operating production and test facilities, permits us to take on major assignments.

A review of what Reeves has done, is doing, and can do, will demonstrate the unique character of our capabilities . . . for systems, subsystems, assembly and component development, engineering, production, supply and field service. Data file 711 on request.



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These complete systems have been designed for compact housing in air-transportable vans for field service. They typify Reeves' comprehensive capabilities for systems' production, from concept to delivery of operational hardware.

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Reeves *Systems* *engineering...management...production...field services*

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AEROSPACE CALENDAR

Dec. 2-4—Annual World-Wide Information Officers' Conference, U. S. Army, Washington, D. C.

Dec. 3-5—Joint Annual Meeting and Convention, National Pilots Assn. and National Aviation Trades Assn. including the National Air Taxi Conference, Fontainebleau Hotel, Miami Beach, Fla.

Dec. 3-5—33rd Symposium on Shock, Vibration and Associated Environments, U. S. Naval Research Laboratory, Washington, D. C.

Dec. 3-5—Annual Meeting, Assembly of the Radio Technical Commission for Aeronautics, Washington, D. C.

Dec. 4-6—Testing of Manned Flight Systems Conference, American Institute of Aeronautics and Astronautics/AF Flight Test Center/NASA Flight Research Center, Edwards AFB, Calif.

Dec. 4-6—Ultrasonics Engineering Symposium, Institute of Electrical and Electronics Engineers, Marriott Motor Hotel, Washington, D. C.

Dec. 5-6—14th National Conference on Vehicular Communications, Institute of Electrical and Electronics Engineers, Adolphus Hotel, Dallas, Tex.

Dec. 6—Fourth Annual Seminar on the Reliability of Space Vehicles, Institute of Electrical and Electronics Engineers, Airport, Marina Hotel, Los Angeles.

Dec. 11-13—Conference on Heterogeneous Combustion, American Institute of Aeronautics and Astronautics, Palm Beach.

(Continued on page 7)

AVIATION WEEK & Space Technology

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Vol. 79, No. 22

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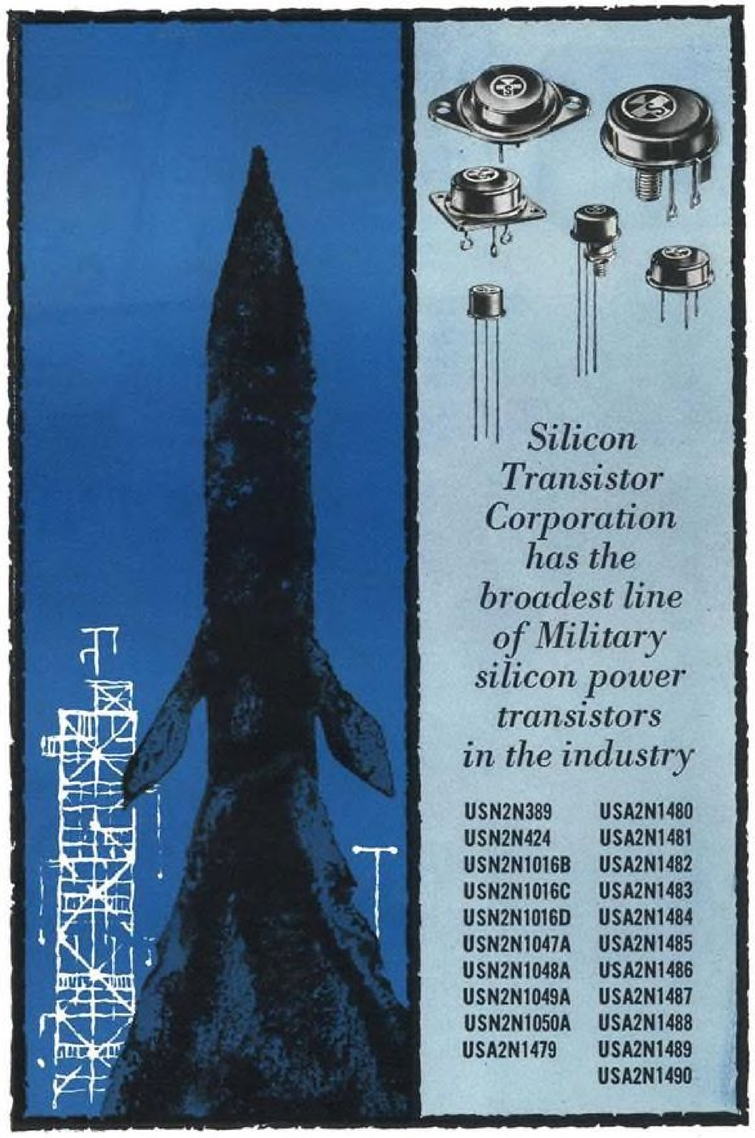

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D825

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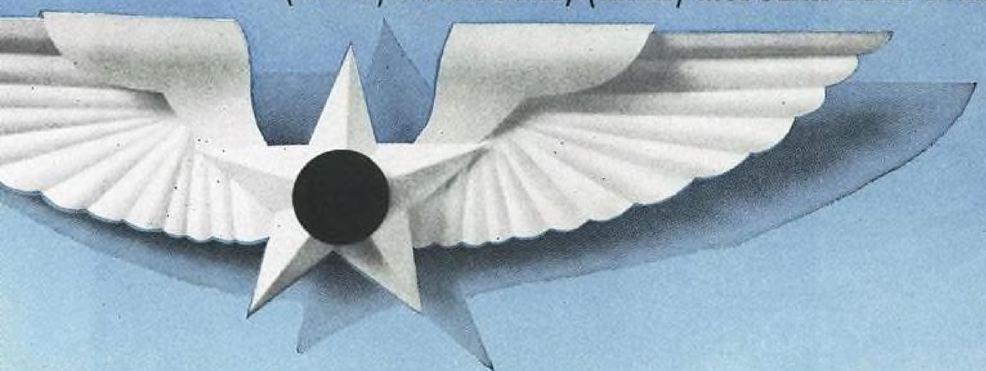

The heart of the Back Up Interceptor Control System (BUIC) is the Burroughs D825 Modular Data Processor. Thirty-four (34) D825's will serve in this capacity, gaining the following advantages for BUIC:

1. *Modularity*—All modules of the D825 are functionally independent, yet completely inter-connected, allowing simultaneous operation of multiple computers, memories, and I/O control elements within one system. This means that the system configuration can be tailored to the application from truly "off-the-shelf" data processing modules without having to pay for excess capacity. At the same time, of course, the system can be easily expanded by the addition of modules, should changing requirements so dictate.

2. *Real Time Response*—The comprehensive interrupt system of the D825 permits: rapid response to real time inputs; system flexibility, including a real time clock; easy programming of real time outputs. Through testing, the D825 has proved its ability to guarantee automatic recovery from power failure without loss of information.

3. *Programming*—Multi-address instructions of variable lengths, comprehensive indexing and indirect addressing facilities, and arbitrarily locatable programs provide high storage efficiency and simplified storage allocation.

Of course, even the D825's total modularity couldn't provide these advantages if it weren't for the capabilities of the modules themselves. The Computer Module in a D825, for instance, has a thin film "scratch pad" memory. The D825 will accommodate up to four such computer modules. Both computer and I/O modules have direct access to all (up to 16) ferrite core memory modules. In addition, machine features allow a D825 executive program to control multi-processing and parallel processing in managing system modules for unified system balance in various applications.

We would welcome an opportunity to prove this system's greater throughput on other applications. Or write for our folder, *Burroughs Militarized D825 Modular Data Processing System*, Defense and Space Group, Burroughs Corporation, Paoli, Pennsylvania.

Burroughs—TM

Burroughs Corporation

AEROSPACE CALENDAR

(*Continued from page 5*)

Dec. 13-14—National Vendors Meeting, Space and Flight Equipment Assn., San Diego Aerospace Museum, San Diego.

Dec. 16-17—Conference on Non-Linear Processes in the Ionosphere, National Bureau of Standards Boulder Laboratories, Boulder, Colo.

Dec. 16—Sixth Annual Army Aviation Contract Services Symposium, Mayflower Hotel, Washington, D.C. Sponsor: National AeroSpace Services Assn.

Dec. 30—Annual Meeting, American Assn. for the Advancement of Science, Cleveland, Ohio.

Jan. 7-9—Tenth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D.C.

Jan. 13-17—Society of Automotive Engineers Automotive Engineering Congress & Exposition, Cobo Hall, Detroit, Mich.

Jan. 19-23—16th Annual Convention, Helicopter Assn. of America, San Marcos Inn, Chandler, Ariz.

Jan. 20-22—Aerospace Sciences Meeting, American Institute of Aeronautics and Astronautics, Hotel Astor, New York, N. Y.

Jan. 25—Seventh Annual Inland Empire Quality Control Conference, American Society for Quality Control, California State Polytechnic College, Pomona, Calif.

Jan. 27-30—20th Annual Technical Conference, Society of Plastics Engineers, Chalfonte-Haddon Hall Hotels, Atlantic City.

Jan. 27-29—Conference on Control and System Optimization, Monterey, Calif. Sponsors: Society for Industry & Applied Mathematics; American Institute of Aeronautics and Astronautics; Institute for Mathematical Statistics; U. S. Naval Post Graduate School.

Jan. 27-30—Applications Forum on Antenna Research, University of Illinois' Midwest Electronics Research Center, Urbana, Ill.

Jan. 29-31—44th Annual Meeting, American Meteorological Society, University of California, Los Angeles, Calif.

Jan. 29-31—Solid Propellant Rocket Conference, American Institute of Aeronautics and Astronautics, Palo Alto, Calif.

Jan. 30-31—Annual Computer Applications Symposium, IIT Research Institute, La-Salle Hotel, Chicago, Ill.

Feb. 3-7—Fifth Annual Lectures in Aerospace Medicine, USAF School of Aerospace Medicine, Brooks AFB, Tex.

Feb. 5-7—Fifth Winter Convention on Military Electronics, Institute of Electrical and Electronics Engineers, Ambassador Hotel, Los Angeles, Calif.

Feb. 13-15—Golden Gate Metals Conference, American Society for Metals, Fairmont Hotel, San Francisco, Calif.

Feb. 19-21—International Solid-State Circuits Conference, Institute of Electrical and Electronics Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Mar. 2-6—Fifth Conference on Applied Meteorology (Atmospheric Problems of Aerospace Vehicles), Atlantic City, N. J. Sponsors: American Meteorological Society; Federal Aviation Agency.

Mar. 9-10—Aerodynamic Testing Conference, Marriott Twin Bridges Motor Hotel,

(*Continued on page 9*)

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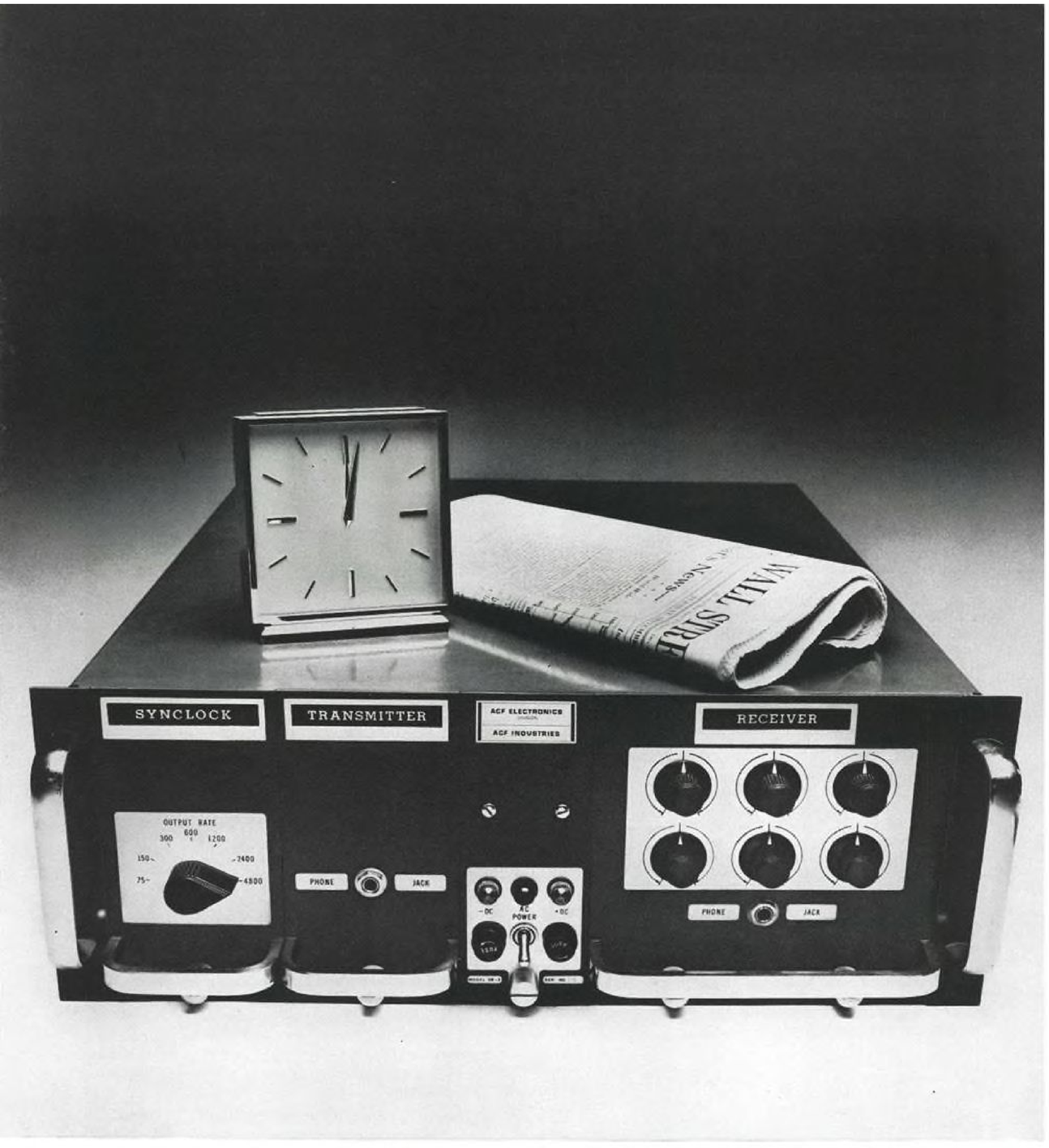

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AEROSPACE CALENDAR

(Continued from page 7)

Washington, D. C. Sponsors: American Institute of Aeronautics and Astronautics; U. S. Navy.

Mar. 23-26—International Convention, Institute of Electrical and Electronics Engineers, Coliseum and New York Hilton, New York, N. Y.

Mar. 25-27—Aerospace Bearing Conference (unclassified), El Tropicano Motor Hotel, San Antonio, Tex. Sponsors: USAF; Southwest Research Institute.

Apr. 1-2—Fifth Symposium on Engineering Aspects of Magnetohydrodynamics, Institute of Electrical and Electronics Engineers, Massachusetts Institute of Technology, Cambridge, Mass.

Apr. 1-3—Fifth Annual Structures and Materials Conference, American Institute of Aeronautics and Astronautics, Riviera Hotel, Palm Springs, Calif.

Apr. 6-8—International Conference on Nonlinear Magnetics (Intermag), Institute of Electrical and Electronics Engineers, Shoreham Hotel, Washington, D. C.

Apr. 13-16—Third International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 19-25—International Conference & Exhibit on Aerospace Electro-Technology, Institute of Electrical and Electronics Engineers, Westward-Ho Hotel, Phoenix.

Apr. 24-May 3—1964 German Air Show, Hanover Airport, Hanover, West Germany.

May 4-6—Aerospace Propulsion Meeting, American Institute of Aeronautics and Astronautics, Cleveland, Ohio.

May 4-7—American Astronautical Society's 10th Annual Meeting, "Technical Progress on Lunar Flight Programs," New York Hilton Hotel, New York, N. Y.

May 5-6—Fifth National Symposium on Human Factors in Electronics, Institute of Electrical and Electronics Engineers, San Diego, Calif.

May 11-13—16th Annual National Aerospace Electronics Conference (NAECON), Institute of Electrical and Electronics Engineers, Biltmore Hotel, Dayton, Ohio.

May 13-15—20th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 19-21—International Symposium on Microwave Theory and Techniques, Institute of Electrical and Electronics Engineers, Idlewild Airport, N. Y.

May 25-27—General Aviation Design & Operations Meeting, American Institute of Aeronautics and Astronautics, Wichita.

May 26-28—Second International Forum for Air Cargo, Sheraton-Mt. Royal Hotel, Montreal, Canada. Sponsors: Society of Automotive Engineers; American Institute of Aeronautics and Astronautics; Canadian Aeronautics & Space Institute.

June 2-4—National Telemetering Conference, American Institute of Aeronautics and Astronautics/Institute of Electrical and Electronics Engineers/Instrument Society of America, Biltmore Hotel, Los Angeles, Calif.

June 2-4—National Symposium on Global Communication (GLOBECOM VI), Institute of Electrical and Electronics Engineers, University of Pennsylvania and Sheraton Hotel, Philadelphia, Pa.

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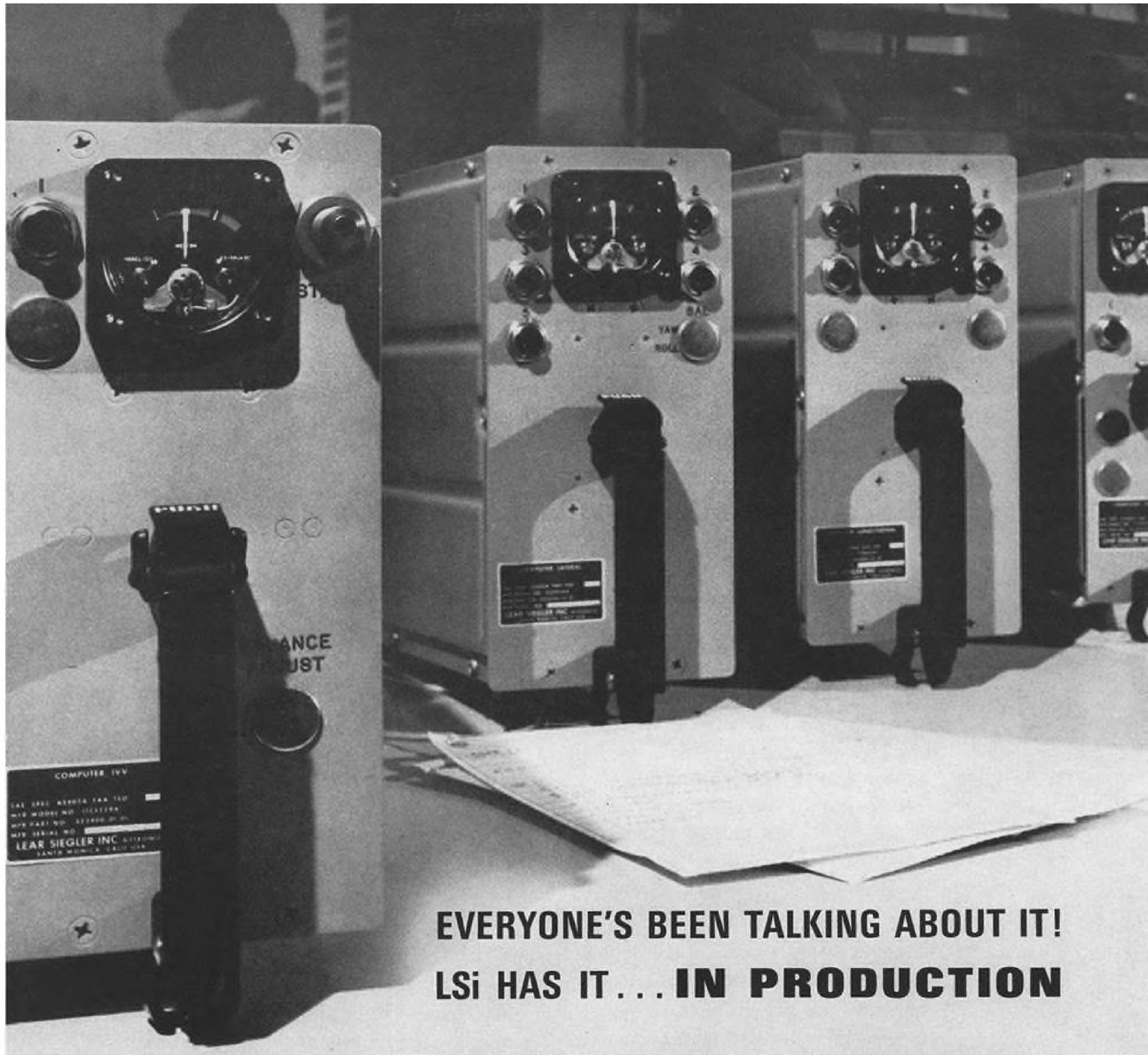

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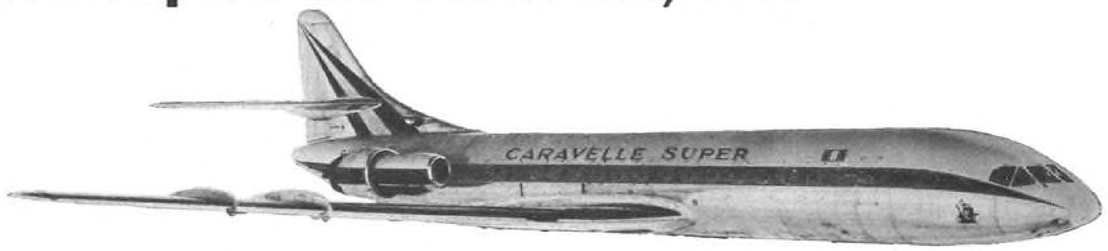

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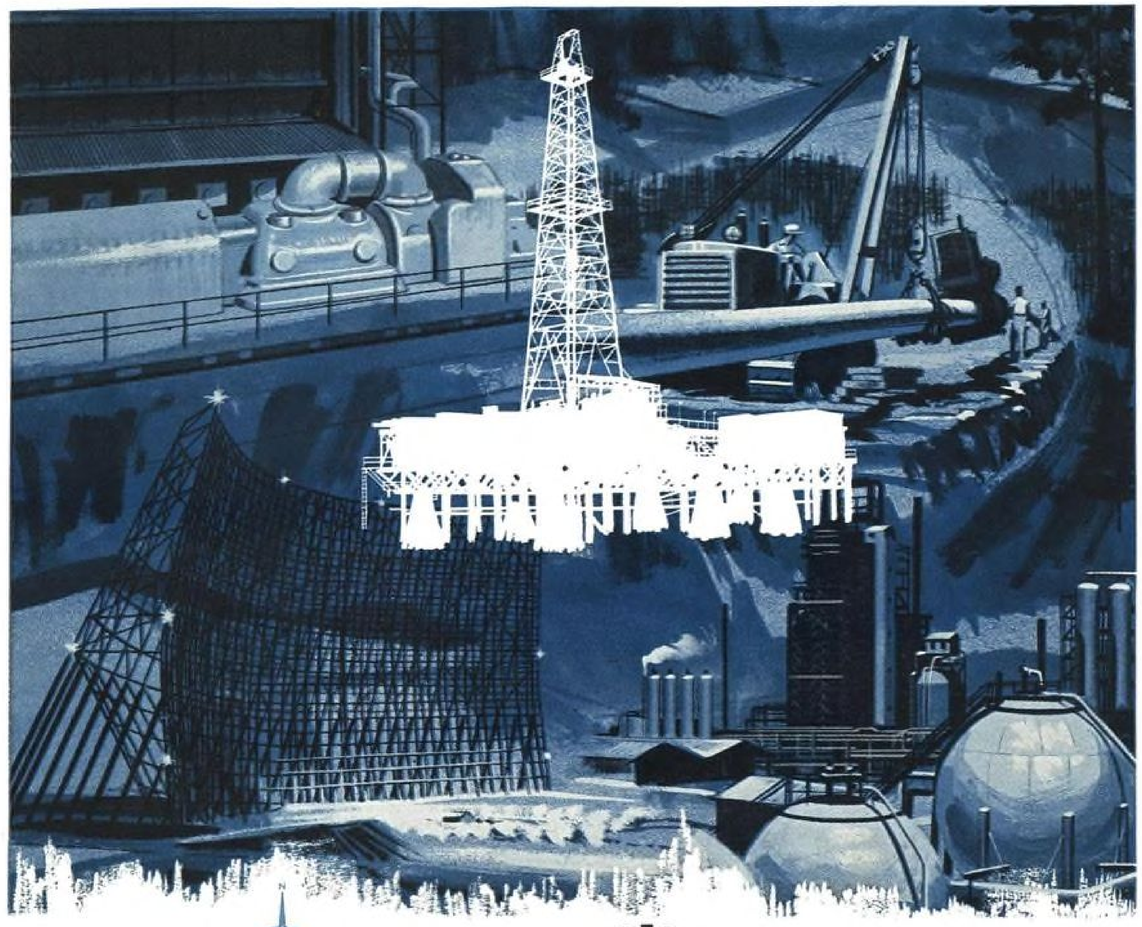

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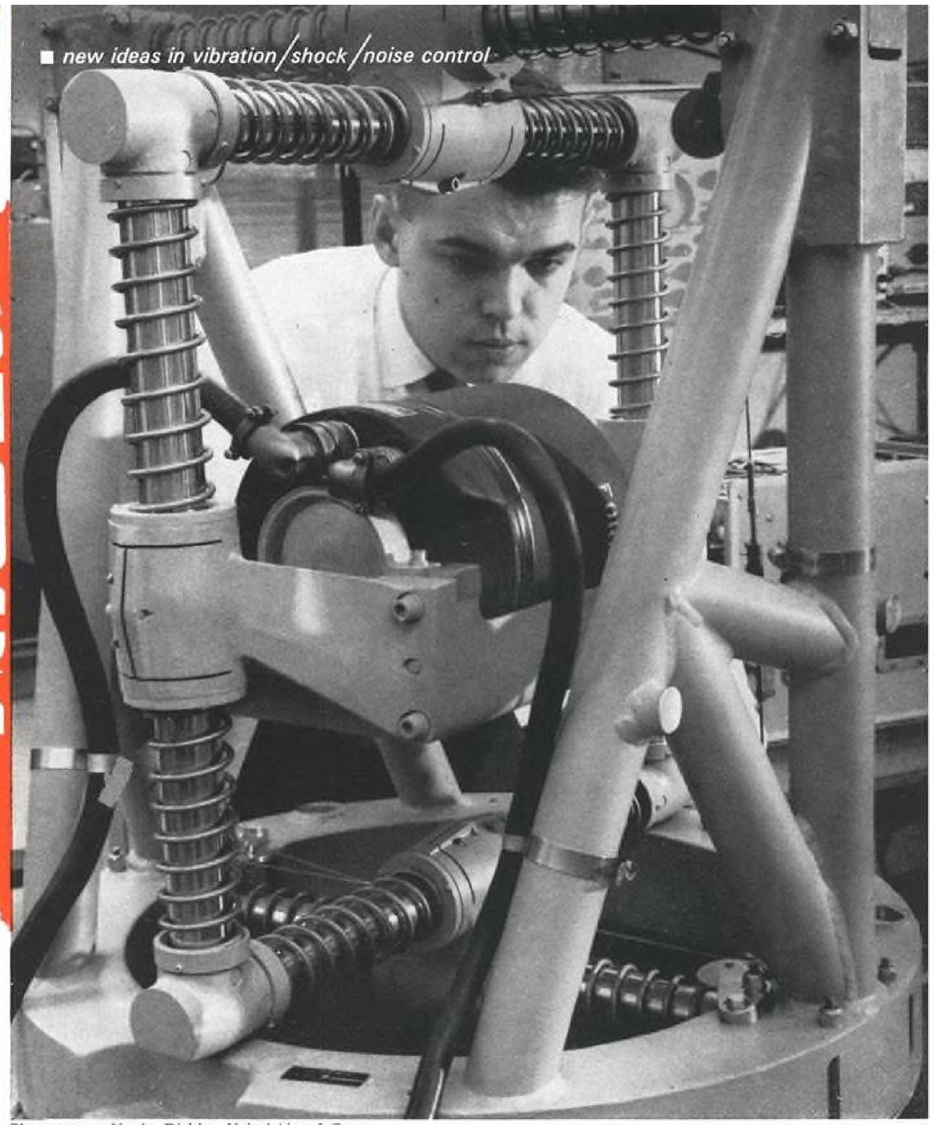

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Number 22

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November 25, 1963

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COVER: Escape tower is shown shortly after separation from an Apollo boilerplate capsule during the recent successful first test of the pad abort escape sequence at White Sands Missile Range, N. M., (AW Nov. 11, p. 42). This picture was taken by a Northrop Ventura photographer using a Hulcher camera with a 40-in. lens and shooting at 10 frames/sec. For additional details and rapid-sequence photographs of the pad abort test, see pp. 52-53.

PICTURE CREDITS
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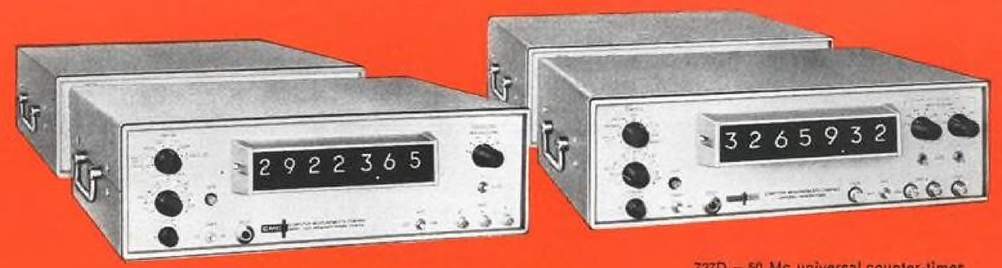

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EDITORIAL

Lessons From the Budget

The cuts imposed by Congress on the Fiscal 1964 budget for the National Aeronautics and Space Administration show clearly that the honeymoon of this executive agency and the legislative branch is over. Last January (AW Jan. 28, p. 21), we predicted that Congress would cut the defense and space budgets submitted by the President and this has come to pass.

The $620 million sliced from the NASA budget will not blunt the main thrust of its technical programs. NASA still has a $5.1-billion budget, the highest in its five-year history by more than a billion dollars (see p. 31).

Principal significance in the congressional budget cut lies in its reflection of the changing mood of Congress and its constituents toward the national space program. The country is not fed up with the space program, as some few pundits and scientists would have us believe. But neither is it so awed by the glamour of orbital flights that it is willing to provide a blank check for anything that is labeled "space." The fundamental feeling of the Congress this year was that it could no longer be dazzled by the oratorical pyrotechnics of NASA spokesmen about the wonders of the space age, and that it required a more realistic explanation of what NASA proposed to do with the $5.7 billion it requested. This is the mood that will certainly continue.

Unfortunately, the NASA leadership remained reluctant to heed sympathetic warnings from its friends that its blank-check tactics are obsolete, and it was left to Congress to make that point in simple arithmetic. Both the Congress and the public found their understanding of the national space policy badly confused.

One of the first steps in bolstering the space program for next year's fray is certainly a strong restatement of U.S. space policy by top officials, not only to clarify the confusion generated in recent months but also to provide the proper focal point for public and congressional support. In turn, NASA needs to broaden the base of its efforts to inform both Congress and the public on its activities and goals, using more of the technical working troops to brief Congress in place of NASA Headquarters operators. It might prove wise to devote some of the seasoned astronauts' time to explaining more fully and more convincingly the purpose and scope of their exploration on the space frontiers.

NASA needs to bolster its credibility factor for the long pull. The record of only six satellite firings thus far in 1963 in contrast to 40 scheduled launches leaves much to be desired, as does the constant overemphasis on the technical fall-out into the economy. There certainly is such fall-out, and there will be more, but the NASA super-salesmanship on this point has produced skeptical public reaction.

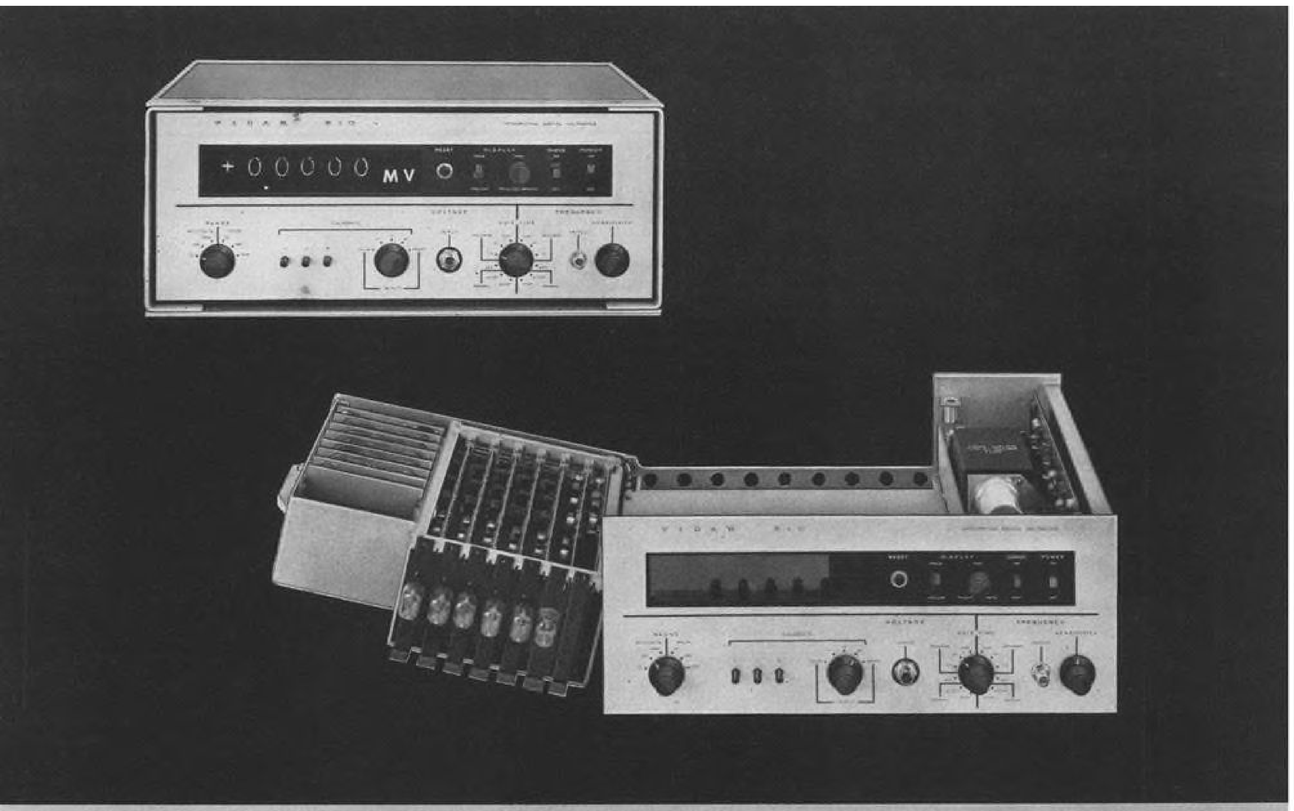
Any organization that has of necessity grown as fast as NASA is bound to accumulate some flabby administrative layers, and these merit attention when budgets tighten. Despite some hard raps from Congress and the press, NASA still has a predilection for scattering six-figure grants around the academic world for studies of nothing in particular. This imprudence cannot continue.

NASA has a record of solid achievement in exploring the frontiers of space technology and in laying the broad technical foundations for the programs it is now pursuing. It has lifted the U.S. into a position of international leadership in every facet of space technology except manned space flight. Its achievements in space sciences have drawn international scientists to its laboratories for assistance in developing their own national space science programs.

But 1963 is a year of transition both technically and politically. The successful completion of the Mercury manned space flight project marked the end of the era when NASA had to use essentially the technical hardware it found in the military and industrial inventory when it was created. Next year, as it begins the use of Saturn boosters and tests Gemini and Apollo capsules, it will enter the era when its own development programs will reach the flight operations stage, and the true potential of our currently building space capability can be exploited.

At the same time, the public support of the space program is passing from its first tremendous flush of enthusiasm—generated by the Mercury successes and the challenge of the lunar landing goal—to a long, hard look at where this effort should fit into our spectrum of national goals. A great measure of the technical success of the space program in the years ahead will depend on how perceptive the President and his advisers are in assaying this changing mood, and how well they develop sustained public and congressional support for this key technology over the long pull.

—Robert Hotz



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WHO'S WHERE

In the Front Office

Donald E. Craig and **Gerhard Neumann,** vice presidents, General Electric Co. Mr. Craig is general manager, Turbine Div., Schenectady, N.Y.; Mr. Neumann, general manager, Flight Propulsion Div., Lynn, Mass.

W. H. Patterson, vice president in charge of the newly established Systems Development Dept., General Dynamics/Astronautics, San Diego, Calif. The department is a consolidation of the Advanced Product Planning and Advanced Systems Depts. **F. J. Dore** continues as director of Advanced Systems.

Sidney Sternberg, vice president and general manager, Electro-Optical Systems, Inc., Pasadena, Calif.

Vernon M. Setterholm, president, Vitro Electronics, Silver Spring, Md., a division of Vitro Corporation of America.

J. R. Pascuzzo, group vice president, General Instrument Corp.'s Defense and Engineering Products Group, Hicksville, N.Y.

Douglass F. Johnson, a vice president, Atlas Corp., and president of the new International Services Div., Oakland, Calif.

Dr. James A. Perkins, board chairman of Cornell Aeronautical Laboratory, Buffalo, N.Y., and **Dr. Dale R. Corson,** vice chairman. Dr. Perkins is president of Cornell University, and Dr. Corson, provost. Also elected board members of the laboratory: **Dr. Franklin A. Long,** vice president-research, Cornell University; **Prof. Courtland D. Perkins,** chairman, Dept. Aerospace and Mechanical Sciences, Princeton University, and former chief scientist for the Air Force.

Robert E. Hollander, controller, United ElectroDynamics, Inc., Pasadena, Calif.

S. F. Follett, deputy controller of guided weapons, Ministry of Aviation, England.

Honors and Elections

Joseph J. Tymcyszyn, engineer-test pilot and chief of the Federal Aviation Agency's West Coast Supersonic Transport Office, has received the first Richard Hansford Burroughs, Jr. Award for his significant contributions to the safety and efficiency of flight testing. The award was established by United Aircraft Corp. in memory of late Richard H. Burroughs, Jr., and is administered by Flight Safety Foundation, Inc.

Changes

Dr. Howard S. Seifert, manager, United Technology Center's Physical Sciences Laboratory, Sunnyvale, Calif.

Robert G. Walker, head of Litton Industries' new electronic production facility, Lubbock, Tex.

Leonard R. Piasecki, deputy division chief, Propulsion Div., California Institute of Technology Jet Propulsion Laboratory, Pasadena, Calif., and **Winston Gin,** chief, Solid Propellant Engineering Section.

Dr. Robert S. Schairer, director of development planning, Lockheed Aircraft Corp., Burbank, Calif.

(*Continued on p. 118*)

INDUSTRY OBSERVER

► Aerojet-General may propose to National Aeronautics and Space Administration's Marshall Space Flight Center that the Douglas S-4B stage, now programed for Saturn 5, be used as an upper stage on a half-length, 260-in.-dia., solid-propellant booster to achieve a high payload capability. The 260-in. motor now is undergoing feasibility demonstrations by both Aerojet and Thiokol Chemical Corp.

► **Avco Corp. is modifying a number of its Mark 11A re-entry systems, developed for the Minuteman ICBM, for use in determining the vulnerability of missile re-entry systems to nuclear assault. The modified systems will be flight tested under a program designated Sleigh Ride and prepared for later testing in a nuclear environment in the event the Russians violate the current nuclear test ban agreement. Avco has a $32-million contract for Sleigh Ride from Air Force's Ballistic Systems Div.**

► Vulnerability of American satellites to interception, jamming and deception is being studied by Air Force's Space Systems Div. and Aerospace Corp. Industry participation in the studies is not expected for the time being.

► **North American Aviation, Inc., will begin testing a prototype Apollo environmental control system the first week in January. The system, developed by Garrett Corp.'s AiResearch Div., will be installed in a prototype command module and operated in a vacuum chamber at a pressure of 10^{-4}. Unmanned tests will be conducted with the system for about six months. Manned tests—which will include 3-, 7- and 14-day runs—are scheduled to begin June 1.**

► Following a study by Johns Hopkins Applied Physics Laboratory, Navy Bureau of Weapons' Astronautics group has recommended to BuWeps' special projects office that the Douglas Thor/Space General Ablestar be substituted for Scout boosters in future Transit satellite program launches. Ablestar, which has a restart capability for precise orbital injection control, has been used in some Transit launches. Navy has not been satisfied with Scout performance in the Transit program (AW Nov. 11, p. 34).

► **Some National Aeronautics and Space Administration officials believe that the organization's budget will hit a high of about $6 billion per year and level off at that figure within five years. Projected launch vehicles in the winged horizontal-takeoff and Nova vertical boost categories may absorb a substantial portion of this funding.**

► Langley Research Center's Lunar Orbiter payload, scheduled to take close-view photographs of the moon's surface in flights during 1966, probably will be limited to about 800 lb. The boost vehicle is programed to be an Atlas/Agena D combination.

► **Army Missile Command and prime contractor Martin Marietta Corp. may have to reduce the requirements for the high burning rate of Hercules Powder Co.'s propellant in the first stage of the Sprint anti-missile missile. This is a compromise to ease problems that may be associated with production of the rocket motor. The high burning rate is a prime factor in the missile's fast acceleration for intercept in the terminal phase of a re-entry vehicle trajectory.**

► British shipyards, Vickers and Cammell Laird have started prefabrication work on the first two Polaris submarines for Great Britain's underwater fleet. Keel laying is scheduled next year.

► **Syncom 3 communications satellite is scheduled to be the first payload launched with NASA's thrust-augmented Delta (TAD) boost vehicle. Launch is planned sometime next spring (AW Nov. 18, p. 30). Also being considered for boost by TAD is a Tiros meteorological satellite, which is to be placed into a synchronous orbital altitude to test the Aeros concept of a synchronous weather satellite. TAD is the thrust-augmented Thor with the standard Delta second stage and a new third stage—the ABL 258—which has a higher specific impulse than the ABL 248 motor is replaces.**

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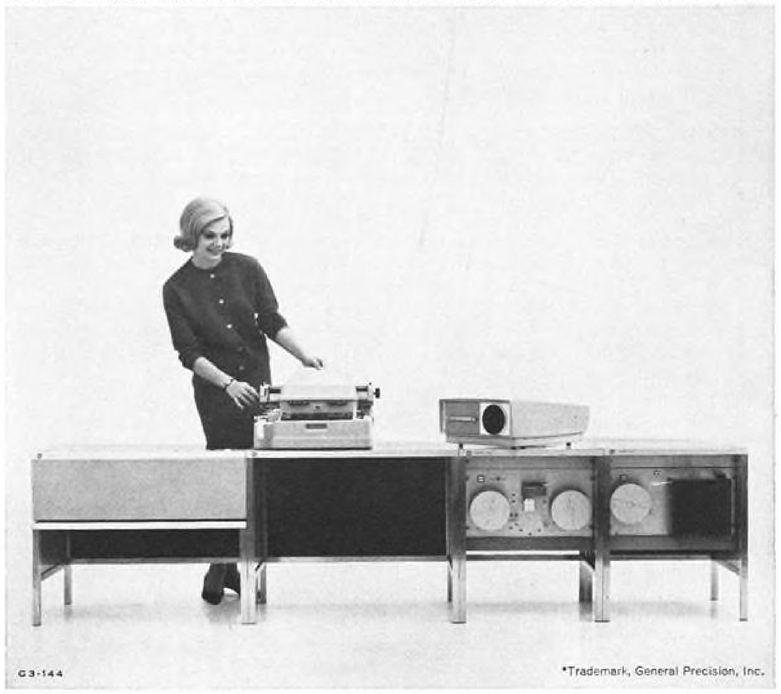

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Washington Roundup

Industry Straight Talk

Aerospace leaders are warning Congress that any significant reduction in their defense business will mean the shutdown of facilities and the lay-off of workers. A conversion of their highly specialized facilities to commercial production on short notice is an impossibility, they contend.

H. M. Horner, chairman of United Aircraft Corp., as lead-off witness for the industry in testimony before the Senate manpower subcommittee put the situation this way: "There is already open capacity within the civilian economy. . . We can't put some surprise item immediately into production" to replace defense business.

Over the long term, the industry generally was optimistic that aerospace technology can be reoriented to commercial production and urged that planning for the reorientation start now. Aerospace representatives told the subcommittee headed by Sen. Joseph S. Clark (D.-Pa.) that a good first step would be enactment of legislation establishing a "commission on the application of new technology to community and manpower needs." The commission's job would be to determine what the economic requirements and possibilities are that aerospace technology could fill.

Leonard Woodcock, vice president of United Auto Workers and spokesman for aerospace labor joined with industry to support the measure, sponsored by Sen. Clark, Hubert Humphrey (D.-Minn.), and Philip A. Hart (D.-Mich.).

Nuclear Stockpiling

Sen. Stuart Symington—who in the past has demanded more military spending in certain areas—is now demanding less for stockpiling nuclear weapons. He also is asking the Atomic Energy Commission to disclose more details to the public about its spending, especially for raw materials.

Noting the billions that have already gone into nuclear weapons and reactors, the Missouri lawmaker said "there should be some place at some time where we could reduce this gigantic and most expensive program without affecting the security of the U. S.

U. S. space agency estimates that eliminating six Saturn 1 flights as part of its own economy campaign will save $280 million over the next two years. The six flights were to test Apollo modules in earth orbit (AW Nov. 4, p. 27).

New NASA Approach

National Aeronautics and Space Administration has promised to give its contractors **greater freedom in designing components in exchange for better performance** after systems are built.

Dr. Joseph F. Shea, chief of Apollo spacecraft development, said last week that NASA will concentrate less on detailed specifications and more on defining system requirements. The agency hopes this will end confusion over responsibilities, increase reliability, and allow NASA to award more incentive contracts.

Dr. Jerome B. Wiesner last week accused Dr. Philip H. Abelson of having "a Bostonian's view of science"—comparing him to a Bostonian who felt the U. S. consisted of Boston and some other territory across the Charles River. This was in answer to Abelson's charge that Wiesner had been a "czar" while White House science adviser.

Civil Aeronautics Board refuses to be rushed as it deliberates whether it should reserve more of the cargo market for the all-cargo trunklines at the expense of lines that carry passengers and cargo.

Riddle, Slick and Flying Tiger all-cargo carriers are demanding fast action on their request for more economic protection. But CAB's answer to their "white paper" is not expected until next year.

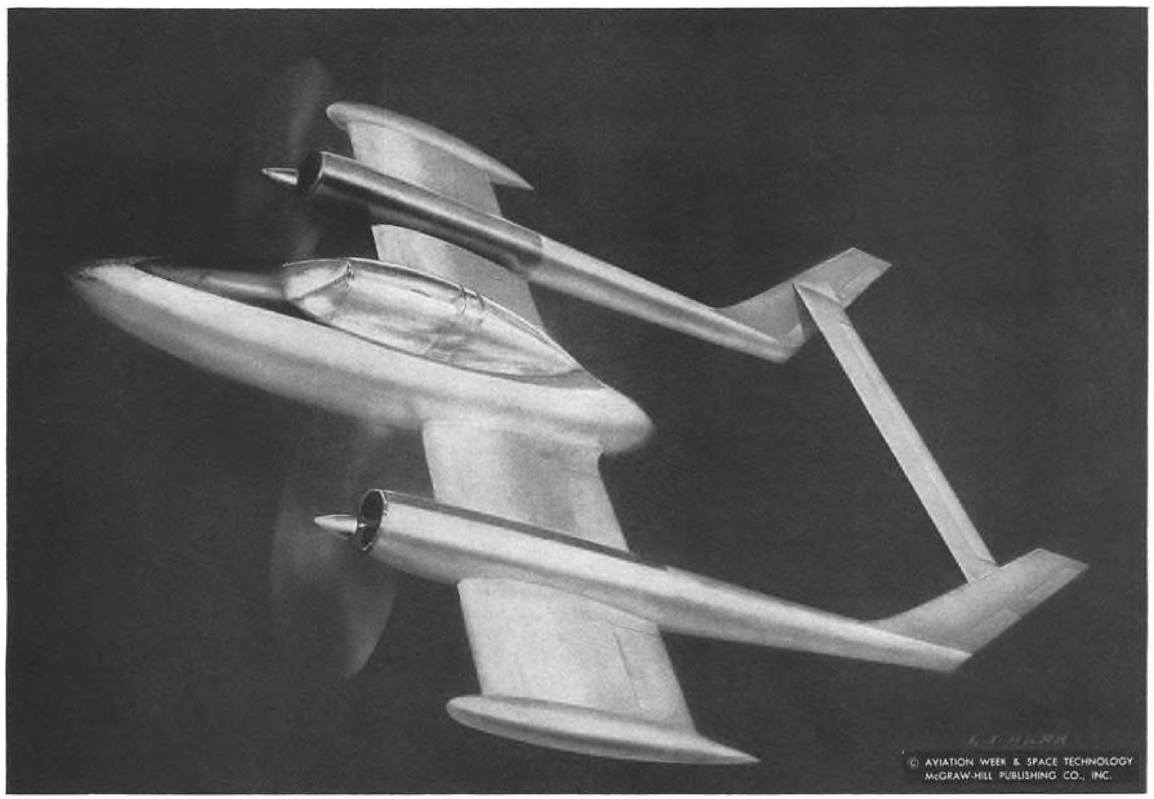
Eugene Black, former World Bank president, is far from finished with his report for President Kennedy on the economics of the U. S. supersonic transport program. But he said he is finding little enthusiasm in industry for the proposed 75-25% cost sharing.

TFX, Ad Infinitum

TFX hearings may extend into next year even though there are only two more main witnesses to be called—former Navy Secretary Fred Korth and Defense Secretary Robert S. McNamara. Problem is getting enough of the senators on the Permanent Investigations Subcommittee together.

Korth was slated to be called this week to explain those letters he wrote while Navy secretary, but the date of McNamara's appearance has not been set. Speaking dates and other commitments of the senators are working against any early finish to the inquiry (see p. 27). The hearing record will definitely be kept open well into next year and probably beyond.

—Washington Staff



Proposals for Navy COIN Aircraft Follow Generalized Design

Aviation Week & Space Technology artist's concept shows a general design approach followed by industry firms submitting proposals for Navy's light counter-insurgency (COIN) aircraft (AW Nov. 11. p. 43). The design features low-aspect-ratio, short-span wings with propellers effectively covering most of the span to provide positive airflow and high-lift characteristics during short-field takeoffs and landings. The aircraft is planned to carry multiple external stores, including fuel, reconnaissance gear and weapons pods. Navy has recommended four turboprop engines—Continental YT72, United Aircraft of Canada YT74-CP-4/6, Garrett-AiResearch YT76-G-2/4 and Turbomeca Astazou 2. Some firms, however, are considering other turboprop powerplants, such as the Allison T63 and Continental T65.

Remote-Area Conflict Research Sought

Washington—Advanced Research Projects Agency is soliciting aerospace industry interest in a broad range of technical problems peculiar to remote area conflicts that the agency has defined during two years of combat experience and tests in Vietnam and Thailand.

ARPA will spend about $30 million in Fiscal 1964 for remote area conflict and counter-insurgency studies and research under Project Agile (AW Sept. 17, 1962, p. 25). Although only 25% of this amount will go toward aircraft-oriented projects, the agency feels the best technical talent to solve its problems is in the aerospace industry.

Robert C. Phelps, who directs ARPA's remote area conflicts office, told Aviation Week & Space Technology that the agency uses as its operating arms combat development test centers in Vietnam and Thailand. Function of these centers, manned jointly by native and U.S. military and civilian technicians, is to identify the specific problems in these areas which require study, research or development.

When these problems are defined, they become contract projects for U. S. industry and universities. They vary in scope from air reconnaissance to nutritional requirements.

These are the major differences between the two combat development centers:

- **Vietnam** is considered the "quick fix" area. ARPA approaches research problems here from a viewpoint of what it can do on an immediate basis, and solely for this country.
- **Thailand** is used to define and proof-test longer-term projects, not only for this country, but for others which are largely jungle areas and which are located near the electromagnetic equator.

When Phelps' office was established, there was concern by Air Force and Army that its functions would duplicate those of the military services. This criticism was overcome by identifying the service most directly affected by the research project, and then designating it both contract monitor and agent.

The Vietnamese Air Force, for example, was using a 19-round salvo area fire rocket pod on B-26 aircraft, originally designed as a weapon against masses of troops and convoys. ARPA defined a requirement for a sequencer to allow single, multiple and salvo firings. The sequencer was developed under USAF management.

Approximately 85% of the remote area studies are conducted under the management of a military service. ARPA monitors projects that have no service connection. Among these is a recently-concluded Rand analysis of the research capacities of small U.S. colleges and universities that can be applied to counter-insurgency problems. Phelps' staff consists of eight civilians and eight military officers.

Although ARPA is not funding any portion of the counter insurgency (COIN) aircraft, it is involved to the extent that it has told Defense Dept. what it has learned through its combat development experience regarding characteristics and design philosophies most desirable for the aircraft. Competition for COIN production (see drawing, p. 26) is under way (AW Nov. 11, p. 43).

Phelps said ARPA is looking at the aircraft from the viewpoint of its use by local forces, supplied by the U.S. through purchase or military assistance program. "We are looking for a weapons system suited to the people, the type of war and the place it will be used [because] the air platform, with the human eyeball, is the best sensor for limited war," Phelps said.

He also feels the COIN aircraft should have interchangeable parts, easily replaceable.

Among other studies sponsored by ARPA is one dealing with the use of the Ryan version of the Rogallo wing for cargo delivery in Thailand. The agency found a requirement for extreme accuracy in jungle drops because a 1 to 2-mi. miss of the drop zone required a full day's time for the troops to recover the cargo.

Army tested the wing at Ft. Eustis, Va., and Yuma, Ariz., and in Thailand was able to obtain the accuracy demanded by using a wing with a 36-ft. span and payloads up to 300 lb.

Another Thailand study involves the problem of radio propagation characteristics peculiar to an area combining location on the geomagnetic equator and jungle humidity. Ambient noise level is so significantly different from an area such as Panama that the firm of Jansky and Bailey was contracted to make special studies in Thailand.

Stanford Research Institute is doing operations analysis studies in the general problem of remote area communications, down to the level of determining who needs equipment and what reaction times are required.

Senate TFX Probers Split on Gilpatric

By George C. Wilson

Washington—Deputy Defense Secretary Roswell L. Gilpatric fought his way to a split decision in a battle with the McClellan subcommittee last week on the question of whether he should have disqualified himself from participating in the F-111 (TFX) decision because of his previous relationships with General Dynamics, winner of the $7 billion fighter-bomber contract.

Sens. John L. McClellan (D.-Ark.), Henry M. Jackson (D.-Wash.), Karl E. Mundt (R.-S.D.) and Carl T. Curtis (R.-Neb.) said Gilpatric should have disqualified himself, while Sens. Sam J. Ervin, Jr. (D.-N.C.), Daniel B. Brewster (D.-Md.) and Jacob K. Javits (R.-N.Y.) said Gilpatric had no obligation to do so. Sen. Edmund S. Muskie (D.-Me.) indicated by his questioning of Gilpatric that he shared the latter view, although he told Aviation Week & Space Technology he would not express his opinion until after the hearings conclude. The ninth member of the subcommittee, Sen. Thomas J. McIntyre (D.-N.H.), did not express an opinion.

The basic question was whether Gilpatric was so intimately associated with General Dynamics before becoming deputy defense secretary on Jan. 24, 1961, that he could not be expected to act dispassionately on a proposal by the firm—especially one involving so much money at a time General Dynamics desperately was in need of the business.

Information Gathered

Chairman McClellan said the information gathered by the subcommittee staff showed Gilpatric was far more than an occasional lawyer for General Dynamics; that he was a close adviser on major policy matters.

"I think that you should have disqualified yourself, and I do not think that there is any question in the world about it. . . . ," Sen. McClellan said. "I do not see how you can say that you could have a client such as this, and have this relationship with it, in the biggest contract ever to come before you, and that you could forget it had been your client, and you could forget that you intended to return to the law firm, and you could forget that you were under some obligation to it by past associations, and be as objective and as fair and as impartial as if it was somebody you had no such relations with."

Gilpatric replied that he acted impartially at all times and that the attitude displayed by Sen. McClellan would make it difficult to attract good men into the government. He added that the Justice Dept. had found him free of any conflict-of-interest, and claimed Sen. McClellan was "going far beyond the law."

"I'm not so sure that I'm going so far beyond it," Sen. McClellan replied. He said the Justice Dept. "is not binding on my own conscience. It also cleared Korth." Sen. McClellan was referring to former Navy Secretary Fred Korth, whose resignation was believed due to a conflict-of-interest issue (AW Oct. 28, p. 22).

Gilpatric also stressed that he would have lost his usefulness as deputy defense secretary if he had refused to participate in matters involving any of the many defense firms that had used his law firm.

Sen Ervin said, "the sole question is whether or not your [Gilpatric's] prior relationship of attorney-client between you and General Dynamics had implanted in your mind in its favor which deprived you of your capacity to appraise objectively." Gilpatric said no such bias was implanted in his mind, as evidenced by decisions he made since coming to the Defense Dept. that were adverse to General Dynamics. Sen. Ervin said that during his own legal career, he had defended many murderers, but did not feel this meant he was in favor of homicide.

Subcommittee Documents

Stacks of documents gathered by the subcommittee staff showed that, before coming to the Pentagon, Gilpatric had: played a leading role in General Dynamics' attempts to merge with other firms; attended 18 of 31 board of directors meetings held at the various General Dynamics divisions from Nov. 25, 1958, through Dec. 21, 1960, when it was announced he would become deputy defense secretary; served as an intermediary in a dispute between General Dynamics and the Air Force over the target price for the F-102 fighter contract; wrote a letter to an Air Force general in 1959 urging procurement of more General Dynamics B-58s; helped recruit personnel for General Dynamics; and analyzed General Dynamics' prospects for obtaining additional defense contracts.

The subcommittee also disclosed that Gilpatric since becoming deputy defense secretary, talked on the telephone frequently with his former law partner about General Dynamics activities (AW Nov. 11, p. 27), including the selection of a successor to Frank Pace, Jr., as president of the defense firm. All of the 17 calls reported by the subcommittee were between Gilpatric and Maurice T. Moore, a senior partner in the New

Australian F-111A Price Undetermined

Washington—Actual price Australia will pay for the General Dynamics-USAF F-111A has not been established, according to Deputy Defense Secretary Roswell L. Gilpatric.

He told the Senate Permanent Investigations Subcommittee last week that $125 million for the 24 aircraft (AW Nov. 18, p. 34) is "the estimated cost because at this stage it is not possible for either party, either the Australian government or the U. S. government, to contract with reference to a fixed amount."

Gilpatric said the Air Force estimate of $5.2 million per aircraft includes spare parts, engines, associated ground equipment and some training. A firm estimate of development costs for the F-111, Gilpatric said, will not be ready before next April. Australia will pay $20 million a year until the ultimate cost of the F-111s is paid.

He said Australia decided to buy the F-111 after looking at the British Aircraft Corp. TSR.2, North American A-5C Vigilante and McDonnell F-4C. He said West Germany has not expressed any official interest in buying F-111s.

York law firm of Cravath, Swaine & Moore, where Gilpatric formerly worked. Moore was named a director of General Dynamics Dec. 20, 1962, a month after General Dynamics won the F-111 contract. Of these 17 telephone calls, 11 of them concerned General Dynamics, in the period Jan. 24, 1961, through Mar. 19, 1963, according to subcommittee records. Gilpatric said the talks with Moore right after he became deputy defense secretary concerned legal business he had done for General Dynamics, while the calls after that were about possible successors to Pace.

Besides the disqualification issue, this and other information raised these two related questions during the hearings Nov. 18, 19 and 20:

• **Did Gilpatric purposely try** to mislead the subcommittee in earlier testimony before it by telling less than the whole truth?

• **Did he break either** the conflict-of-interest laws or the Kennedy Administration's written code of conduct?

The first question centered on these statements Gilpatric made before the subcommittee Mar. 21, 1963: "Now after I left the Air Force in 1953—I had been under secretary for two years—I made it a matter of my personal policy never to represent any client in any dealings with the Defense Dept. I did do certain work for Boeing, and for General Dynamics, but I had no direct dealings with the Defense Dept." He said he did not bring General Dynamics business into the law firm, declaring: "I was acting on only a particular matter and the General Dynamics firm had its own general counsel. I was special counsel on a particular matter."

A third-person statement written by Gilpatric said that after he returned to his law firm, "Mr. Gilpatric followed the policy of never representing any member of the defense industry in dealing with the defense establishment. He did, however, serve as an adviser on other matters on a few occasions for concerns such as Boeing and Convair. Thus, during 1957 and 1958, Mr. Gilpatric was asked by the Boeing Co. to assist it in preparing its case against the Renegotiation Board in the U. S. Court of Claims, and, in 1958, he appeared as a witness for Boeing in that proceeding . . . Mr. Gilpatric also served as legal adviser to General Dynamics Corp. during 1959 and 1960 in connection with its acquisition of the business of Material Service Corp. . . . ."

Several subcommittee members claimed these activities constituted direct dealings with the Defense Dept.:

• **F-102 dispute.** Gilpatric intervened in a dispute between General Dynamics and the Air Force over the target price in the F-102 fighter contract. Sen. McClellan charged this work amounted to representing General Dynamics in a dealing with the Defense Dept. Gilpatric said, "I did not do more than to act as a bringer together of the two parties because I was concerned, frankly, that the position General Dynamics was taking with its principal customer, the Air Force, was wrong. . . ."

Gilpatric accompanied General Dynamics President Pace to a meeting at Wright-Patterson AFB with Gen. William F. McKee, USAF vice chief of staff, on Oct. 27, 1960. He also drafted a letter for Pace—which was never sent—to Air Force Secretary Dudley C. Sharp recommending that the F-102 dispute be elevated to the secretary level in an attempt to break the impasse. General Accounting Office had contended that the F-102 target cost of $318 million was $12.1 million too high.

• **B-58 letter.** Gilpatric on Oct. 13, 1959, wrote a "Dear Sam" letter to the home of Maj. Gen. H. C. Donnelly, deputy chief of staff for research and development, cautioning against sacrificing General Dynamics B-58s for the North American B-70. Although Pace asked him to write the letter, Gilpatric said he would have written on his own if he had thought of it, because it expressed his own convictions.

The letter continued, "What really frightens me about current Air Force thinking is the possibility that the Air Force may sacrifice the proven or promised capabilities of the B-58 in its present or improved configuration to a multi-billion dollar gamble on the B-70 . . . I do not believe that the B-70 program will ever be carried to completion . . . I do feel strongly that the Air Force is on the brink of decisions that could be fatefully wrong."

Gilpatric rejected Sen. McClellan's assertion that this B-58 letter amounted to representing General Dynamics in a direct dealing with the Defense Dept. "I wrote this letter simply because I believed in the B-58 program, and I was a friend of his [Pace], and I was glad to so state," Gilpatric said. He said he recommended against producing more B-58s after he became a defense secretary in 1961, and "saw the various other weapons systems that the Air Force has in its arsenal—the Atlas and Titan and Minuteman and the B-52 . . ."

Sens. McClellan, Jackson, Mundt and Curtis contended this information gathered by the subcommittee staff indicated Gilpatric did far more for General Dynamics than represent it in the Material Services merger:

• **Other mergers.** The subcommittee produced a letter showing that Gilpatric had worked on more than 20 acquisition or merger possibilities for General Dynamics. The list included American Motors, International Telephone and Telegraph, Avco, Atlas Powder, Western Union and such overseas firms as Hispano Suiza, Krupp and Societe Generale de Belgique.

• **Policy guidance.** On Aug. 3, 1960, Gilpatric submitted a memo for Pace entitled "Future for Convair" in which he predicted the Air Force would not push for B-58s as long as it "considers that there is any likelihood of its being allowed to proceed with the B-70."

He also said it was "not likely" USAF would continue to buy General Dynamics F-106As. Because of this and the fact General Dynamics had the most backlog in defense orders, Gilpatric said, "Convair cannot realistically expect to be assigned any major new aircraft program in the immediate future." He said these and other circumstances dictated that "Convair must face up to a choice between San Diego or Ft. Worth as the point of concentration for future weapons systems production. While political considerations may play a part (Nixon for California v. Johnson for Texas), objectively viewed, the plant complex to be selected for continuance would appear to be San Diego in view of past production experience and relative costs, labor availability, Convair's commercial aircraft program, the adjacency of General Atomic and the general pre-eminence of the Southern California area for growth in the aerospace and electronic industries. . . ."

Gilpatric said these activities were "inconsequential" alongside the work he did on the Material Services merger, and he therefore did not believe they contradicted his earlier testimony. He said all told he spent about one-fourth of his total legal time on the General Dynamics account in the 2¼-year period before he became deputy defense secretary.

Cravath, Swaine & Moore received $111,000 for that work, he said.

Legal Service

Another bone of contention was whether Gilpatric purposely tried to lead the subcommittee to the conclusion that he represented Boeing, the firm which lost the F-111 contract, in the same manner he represented General Dynamics. However, Gilpatric's only legal service to Boeing was appearing as a witness in a Renegotiation Board case. Gilpatric said he never meant to equate the work he did for General Dynamics with the work he did for Boeing.

Citing Gilpatric's earlier testimony, Sen. Jackson asked: "Would you not agree in all candor that the reason this hearing is on is because of possible unfortunate use of language in describing various activities at a previous hearing?" Gilpatric replied:

"I don't know what is in the minds of the committee."

No one on the subcommittee charged that Gilpatric has broken conflict-of-interest laws, although Sen. McClellan said he was not sure about this. Sen. McClellan quoted the Supreme Court decision in the Dixon-Yates case (U. S. v. Mississippi Valley Generating Co.) which warns public officials against getting into situations fraught with temptation (AW Sept. 9, p. 27).

Gilpatric told the committee his own situation differed from the one covered in the decision.

Justice Dept. Letter

The Justice Dept. made this distinction in a letter sent to Sen. John J. Williams (R.-Del.). Justice Dept., in its Oct. 21 letter, said Gilpatric participated in the F-111 decision when he was not a member of the law firm or sharing in its profits, "and there was no apparent prospect that the firm would perform any services for General Dynamics in connection with the contract. We therefore are of the opinion that Mr. Gilpatric's work on the TFX contract did not contravene" the conflict-of-interest law which prohibits officials from participating in matters where they are "directly or indirectly interested in the pecuniary profits or contracts."

McNamara Cites Arms Lead; Sees Defense Budget Leveling

By Katherine Johnsen

Defense Secretary Robert S. McNamara officially set the stage for a leveling off—or possible decline—in defense spending last week with a major address presenting an optimistic picture of U. S. superiority to the Soviet Union in conventional as well as nuclear forces.

"We and our allies need no longer choose to live with the sense or the reality of inferiority to the Soviet bloc in relevant, effective force," McNamara concluded in his speech to the Economic Club of New York.

"As our national productivity and our gross national product expand," he said, "the defense budget . . . need not keep pace. Indeed, it appears likely that measured in relative—and perhaps even absolute—terms, the defense budget will level off and perhaps decline a little."

A turn downward in military funding by the Kennedy Administration has been hinted at for several weeks (AW Oct. 14, p. 26). Over the past two years, the Administration has boosted the Defense Dept. budget by almost $10 billion and is now shifting concern to other national economic problems.

Two days after McNamara's speech, Defense Dept. Comptroller Charles J. Hitch told a congressional subcommittee that although the trend is downward, there are "no possibilities of a major reduction" in the defense budget. This year, in connection with the Fiscal 1964 budget, Defense Dept. acquiesced to a $1.5-billion reduction in its own $49-billion recommendation (AW Aug. 6, p. 26).

"What most needs changing is a picture of ourselves and of the Western alliance as essentially at bay, outmanned and outgunned except for nuclear arms no longer exclusively ours," McNamara observed. Following are the highlights of his analysis of U. S. forces compared with Soviet forces:

• **Strategic forces.** The consensus is that the U. S. could place twice as many bombers over the USSR as the USSR could place over North America on a first strike, and the USSR has "only a fraction as many intercontinental missiles as we do."

Soviet submarine-launched ballistic missiles are short range and are "not comparable" to the Polaris force, he said. The "very large threat" of hundreds of intermediate and medium-range ballistic missiles posed against Western Europe can be met by the clear superiority of U. S. strategic forces, he said. "I would not trade our strategic posture for that of the Soviet at any point during the coming decade," he said.

Larger budgets for strategic forces, McNamara emphasized, would not change the fact that a Soviet nuclear attack could inflict severe damage. "They could have only a decreasing incremental effect in limiting somewhat the damage . . . We can anticipate that the annual expenditure on strategic forces will drop substantially, and level off well below the present rate . . ."

• **Conventional forces.** Current figures on military manpower, McNamara said, "suggest the absurdity . . . of David and Goliath notions borrowed from 1949." He discredited the familiar estimate of a 175-division Russian army, and said the number of divisions is less than half that. The NATO alliance now has over five million active in their armed forces, compared with 4.5 million for the Warsaw Pact nations, including the USSR, McNamara said. In ground forces, he said, the comparison is 3.2 million for NATO, compared with about 3 million for the Warsaw bloc.

In Central Europe, McNamara declared, "NATO has more men, and more combat troops, on the ground than does the Bloc . . . It has more and better tactical aircraft, and these planes on the average can carry twice the payload twice as far as the Soviet counterparts."

Soviet response was prompt. Col. Gen. Vladimir Tolubko, first assistant commander of Soviet strategic rocket forces, declared that McNamara's "boasts" were meant for propaganda and to "soothe" the public, which is "learning ever more frequently about the failures of American missile and nuclear rocket tests."

Solar Device Orbited

Washington—Thirty-day orbital flight of a 4.5-ft. solar collector has indicated the device operated correctly, the Air Force said last week.

Air Force said the collector flew as a piggyback experiment, but would not disclose the date of the launch or identify the launch vehicle.

Air Force Systems Command said no attempt was made to convert solar energy into electrical power in the orbital test of the electroformed, nickel aluminized structure.

AFSC said a partial telemetry system failure limited the amount of information received on temperatures and tracking. The collector was developed at the Wright-Patterson AFB Aero-Propulsion Laboratory and was built by the Allison Div. of General Motors Corp.

Design Demands by British Navy Cloud Future of P.1154 Program

London—British Royal Navy objections to a proposed all-service vertical takeoff and landing strike fighter, based on the Hawker P.1154 concept, last week clouded the future of the entire project in the wake of an exhaustive review of all weapons projects.

The P.1154, supersonic development of the Hawker P.1127 VTOL, was to be provided for RAF and Royal Navy on a joint services basis as part of new government policy to coordinate weaponry throughout the three services as much as possible.

From the outset, the Navy had insisted on a two-place P.1154, while the RAF wanted a single-place fighter. The two-place version was designed by Hawker aviation through a slight stretch in basic specifications.

Since that decision, the Navy has reconsidered its VTOL program. The latest edict to Hawker was that the P.1154 have catapult capability, to allow expanded use of weapons stores and payload, but leading to a major redesign of the airplane. In addition, the Navy wants a defensive, rather than a strike aircraft, to protect its carriers.

Minister of Defense Peter Thorneycroft, architect of the tri-service hardware cooperation scheme (AW July 22, p. 327) last week acknowledged that plans to use the P.1154 to replace the RAF Hunter and Navy Sea Vixen had encountered difficulties.

"There is not a row going on, but there is a good deal of hard talk," he said. "If we cannot get a common aircraft, this leaves us with a problem about what to do about the Hunter replacement for the RAF and eventual replacements for the Navy.

". . . We have run into difficulties in using [the P.1154] for this common purpose, but it is not a difficulty created by the Sea Lords. It is created by the laws of gravity and other matters over which even their lordships of the admiralty have no control."

The latter comment apparently is a reference to the Navy desire for catapult launch capability.

In addition, the Navy is pushing for funds to build a new carrier (AW Aug. 5, p. 39).

As part of the Navy drive to break away from the VTOL concept, at least in the immediate future, considerable negotiations have gone on, and are still under way, for potential purchase of 50 McDonnell Phantom 2 strike fighters as interim aircraft. Under present thinking, the Phantom would be bought off-the-shelf with modifications made by McDonnell to take the Rolls-Royce Spey powerplant, probably the —25 version.

A naval source said use of two Speys would give the Phantom a 30% increase in range, cut acceleration time from Mach 1 to Mach 2 in half and increase the maximum speed "to the point of structural integrity."

A McDonnell technical team first proposed the Phantom 2 to the Royal Navy in the summer of 1962, when about 50 British pilots and technical personnel were flown in demonstration flights. The company has been quietly pushing possible license agreements on the European continent, particularly in Germany where the fear is that engineering teams may disintegrate when the Lockheed F-104G program is phased out.

The Chance Vought Crusader is under consideration by the Royal Navy, but is running second to the Phantom. The airplane would be built or assembled under license by Short Brothers and Harland in Northern Ireland, if selected. In any case, the Ministry of Defense hasn't made a decision and probably won't before late December.

Reason is that joint civil and military review board, headed by Sir Solly Zuckerman, the chief scientist, has not yet completed its findings on such projects as the P.1154, the Hawker Siddeley AW-681 VTOL transport, new carrier for the Navy and the replacement for the Shackleton maritime reconnaissance bomber; entries in this field are the DH-121 Trident military version the Breguet Atlantic and Lockheed P2V.

Another factor is that British Cabinet has told military planners to keep the budget to a grand total of $5.6 billion, despite the growth in the gross national product. The military now consumes 7% of the GNP.

Still another factor is the cost of the British Aircraft Corp.'s TSR.2, already the most controversial defense item in Great Britain's inventory and one which is under constant attack by the opposition Labor Party.

However, during a debate in the House of Lords last week, Lord Carrington, minister without portfolio, said the government has no intention of cancelling TSR.2.

S-1C Test Stand

Army Corps of Engineers has asked for bids Dec. 10 on the construction of the first part of a dual-position Saturn S-1C static test stand at NASA's Mississippi test operations.

In recent Saturn S-1B developments, NASA's Marshall Space Flight Center last week signed a $19.7-million contract (of which $6.5 has already been paid on a June 30, 1962, letter contract) with the Rocketdyne Div. of North American Aviation, Inc., for the manufacture of 114 H-1 engines. Engines will be used on Saturn S-1B boosters built by Chrysler at NASA's Michoud, La., plant (AW Sept. 16, p. 54) and will include spares.

Centaur, IMP Planned This Week

Cape Canaveral—National Aeronautics and Space Administration will attempt to launch both the second Atlas-Centaur vehicle and the Interplanetary Monitoring Probe (IMP) from here this week. Both now are scheduled for Nov. 26 and, if NASA is successful, it will be the first time in the 13-year history of the Atlantic Missile Range that two payloads were orbited in the same day by two different vehicles.

Centaur, which was erected on Pad 36A here on Sept. 14, at first was planned for launching on Nov. 12, but slipped successively to Nov. 15, Nov. 19, and Nov. 26 because of minor problems. The slippage from the 19th to this week was caused by the space agency's decision to add a supplemental gas system to the two-stage vehicle's interstage area. This supplemental system of ambient-temperature helium is expected to provide a totally-dry environment in and around the Pratt & Whitney RL10s during warmup.

Previously, gaseous nitrogen had been used both to purge this area of any contaminants and to provide the dry environment required by RL10 operating specifications. But when water traces were discovered in the engine area, NASA and P&WA decided to use helium as a separate drying agent and nitrogen as a contaminant purge only. The new helium system, which took about a week to install, exists partly in the ground support equipment, partly in the umbilical arm and partly in the interstage area. That segment of the system in the interstage area will remain with the Atlas-Centaur at liftoff, although the system no longer is used after that point.

The field projects branch of NASA's Goddard Space Flight Center, which assumed launch responsibility for Centaur last winter (AW Feb. 4, p. 32), hopes to get the Centaur vehicle off between late morning and mid-afternoon on Nov. 26. It then will launch IMP, which was delayed when ground tests of the new Delta third-stage, solid-propellant motor indicated possible spacecraft contamination, later that evening.

Senate Approves $5.1 Billion for NASA

Washington—Senate last week approved $5.1 billion for National Aeronautics and Space Administration for Fiscal 1964 after an amendment to cut the budget to $4.6 billion was defeated by only 10 votes.

The Senate action, which nearly completes congressional consideration of NASA's money bill, is a stinging rebuff to the Kennedy Administration. As finally passed, the budget is $620 million less than President Kennedy requested, $250 million less than the amount Congress authorized, and $90 million less than the Senate Appropriations Committee recommended (AW Nov. 18, p. 27).

NASA Administrator James E. Webb has consistently maintained that any substantial reduction in the $5.35 billion which Congress authorized for his agency will delay the Apollo manned lunar landing beyond its 1968-70 target.

Traditionally, the Senate votes a somewhat higher appropriation than the House and the two bodies then split the difference in a conference bill. But the NASA appropriations measure was pulled into a complex political cross-current.

Sen. J. W. Fulbright (D.-Ark.) led the fight for a flat 10% ($519 million) cut in the amount recommended by the Senate Appropriations Committee. Other Democrats including Sen. Joseph Clark (Pa.) and Sen. William Proxmire (Wis.) were chief supporters of the Fulbright amendment, which lost by a vote of 46-36.

After Sen. Fulbright's amendment was defeated, Sen. Proxmire offered an amendment to cut the NASA appropriation $90 million, to $5.1 billion. The amendment won by a single vote, 40-39. An effort to reverse the decision was beaten 41-38.

Sen. Fulbright denied an allegation by Sen. George A. Smathers (D.-Fla.), who suggested that Sen. Fulbright's amendment was an effort "to get even" for deep cuts voted earlier in the foreign aid bill.

"I don't want to eliminate this program [Apollo]," Sen. Fulbright said. "I want to see it done in a more practical and leisurely way."

Sen. Clark called the space program a "sacred cow" and said Project Apollo was like a "high school cross country race." He urged that the U.S. cut its space expenditures by seeking a cooperative international program involving the Russians and Western European nations.

Sen. Stuart Symington (D.-Mo.) was among those who attempted to hold off further cuts in the NASA budget. Sen. Symington cited the testimony of several military leaders who said the manned flight space program will contribute to U.S. defense capability.

Since the amounts appropriated by the House and Senate are the same, the only matter to be ironed out in conference is the ban in the House bill on using funds for a joint manned lunar landing program with the Soviet Union. The Senate bill softens this by prohibiting participation in a joint program "without consent of Congress." Senate's action last week increases the likelihood that NASA will ask for a supplemental Fiscal 1964 appropriation of about $300 million early next year.

UN Space Report

United Nations, N. Y.—Agreement on a declaration of legal principles for peaceful space exploration may be reached this week when the United Nations General Assembly's Political Committee meets to consider the report of the Committee on the Peaceful Uses of Outer Space.

Agreement on legal principles, long the space committee's knottiest problem area, seems possible since the U. S. and Soviet Union reported reaching agreement in informal meetings since last September (AW Sept. 30, p. 27). At that time wide agreement was reached over most legal principles except those involving a ban on reconnaissance satellites, harmful experiments in space and private space ventures.

The only problem area remaining, since the U. S. and Soviet Union have reached accord, is over wording of the draft resolution prepared for the General Assembly. The nations, reportedly India, Japan, and the United Arab Republic, want some formal reference to restricting outer space to peaceful use and inclusion of a ban on orbiting bombs.

USAF to Manage West Coast Ranges

Washington—Defense Dept. will unify management of its global satellite and missile activity during the next two years under terms of a directive that transfers the Pacific Missile Range from Navy to the Air Force and consolidates Pt. Arguello and Vandenberg AFB into a single facility.

The range unification measure, which was forecast by AVIATION WEEK & SPACE TECHNOLOGY (Oct. 28, p. 21), is designed to eliminate overlapping responsibilities, improve range coordination and standardize equipment, Defense Dept. said in announcing the move last week. It is expected that the ranges will come under a new Air Force Systems Command division to be commanded by Maj. Gen. Leighton I. Davis, now Atlantic Missile Range commander. New division probably will have its headquarters at AMR.

The directive vastly strengthens the Air Force position in the military space program, since it contains provisions specifying for the first time that USAF is responsible for control of all orbiting Defense Dept. satellites, except the Navy's Transit navigation satellite and the joint military communications satellite. In addition, the directive restates that USAF is responsible for all military space developments.

Army has been given the control responsibility for the communications satellite on the basis that it is responsible for ground stations for this system. Air Force is understood to have protested this provision.

Although the directive gives Navy management of all tracking ships, that service loses most in the unification. In addition to giving up the 14,000-acre Pt. Arguello complex to Air Force, Navy will transfer its anti-missile support base at Kwajalein to the Army, and will transfer its Pacific space tracking stations to Air Force. Navy gains Atlantic tracking ships from the Air Force.

These are the other major provisions of the directive as explained by Dr. Albert C. Hall, deputy director of defense research and engineering for space:

- **PMR headquarters** will eventually be transferred from Pt. Mugu to the consolidated Arguello-Vandenberg complex. Navy will retain Mugu as its range to test shipborne missiles. Justification for transferring Arguello, Hall said, is that 90% of the equipment and property are used by the Air Force.
- **Consolidation of tracking ship** management will "help" in the Apollo manned lunar landing program because of a centralization of ship activities. U.S. has about 17 tracking ships in Atlantic and Pacific oceans.

Navy technical bureaus will be responsible for instrumenting tracking ships, and Military Sea Transport Service (MSTS), which already operates Pacific Ocean ships, will operate those in the Atlantic. If the Atlantic ships continue to be operated under contract, MSTS will manage the contract.

- **Implementation of the directive** begins next July 1, when formal transfer of Arguello takes place. The other changes will occur in the succeeding 18 months.

Gaseous Core Reactor Deemed Promising

Gaseous core reactor appears to be the most promising nuclear propulsion concept now in view for providing significant improvement in performance capability beyond that attainable with the Rover type, solid-core reactor (see story, below).

However, the Air Force plans to continue its development work on the Orion approach to propulsion, based on a series of nuclear explosions, despite the fact that the nuclear test ban treaty presently rules out flight testing.

Speaking at an American Nuclear Society conference, Maxwell W. Hunter, a member of the professional staff of the National Aeronautics and Space Council, said that a gaseous core reactor combined with a high temperature (4,000-5,000F) space radiator would offer 15 to 18 times the performance of a Rover reactor and would be about three times better (a specific impulse of 2,000-3,000 sec.) without a radiator.

At present, work on the gaseous core reactor is being supported at approximately the same relatively low level as work on Orion. Among the groups reported to be working on the concept are United Aircraft Research Laboratories, NASA's Lewis Research Center, General Electric and Westinghouse. The work at United Aircraft, which started out basically as a fluid flow research problem, is believed to be funded at somewhat under $1 million per year.

Hunter said he favors the gaseous core concept over Orion because the test ban treaty will not interfere in any way with its development, and he sees how it can be incorporated into a better over-all operational package than Orion. In Orion, the impulse from the repeated explosions of possibly 100 small atomic bombs carried underneath the vehicle is transferred to the vehicle's tail through a piston or striker plate arrangement. Hunter believes the gaseous reactor will prove more economical.

At the same time, Hunter emphasized, he believes that development work on Orion should continue until there is an operational gaseous core reactor, because these are the only two possibilities presently in the research stage that offer significant potential improvements over Rover.

Kiwi Changes May Stop Vibration

By Michael L. Yaffee

New York—Significant, but not readily apparent, changes in the core design of the Kiwi nuclear rocket reactor are expected to remedy flow-induced vibrations that caused extensive damage during the last hot firing test on Nov. 30, 1962, according to Milton Klein, deputy manager of the AEC-NASA Space Nuclear Propulsion Office.

Extensive laboratory investigations and expanded cold flow tests carried out since the November firing pinpointed the cause of last year's failure and indicate that the design changes in the core successfully eliminated vibrations during cold flow runs, Klein said here last week at an American Nuclear Society meeting.

First operational test of the redesigned core will take place early next year with the hot firing of the Kiwi-B4D—the first hot firing since the Nov. 30, 1962 test.

Failure of last year's test led to an extensive rescheduling of the Rover nuclear rocket program and the first flight tests, last scheduled for 1968 (AW, Dec. 24, 1962, p. 25), are now expected to take place "in the early 1970s."

Exact nature of the core design changes was not spelled out by Klein, who said only that it involved a redesign of the supporting structure to enhance core stability. Information from other sources indicates that the flow-induced vibration problem during the last hot firing was caused principally by the hydrogen working fluid moving through leakage paths that developed in the reactor core.

The core supporting structure apparently was designed to provide for thermal expansion of the reactor elements and these expansion allowances provided alternate pathways for hydrogen flow. It is believed that the redesign of the supporting structure has eliminated these alternate flow routes.

Klein said that the Space Nuclear Propulsion Office is studying "at a low level" alternate refractory metal reactor designs under investigation by NASA's Lewis Research Center and AEC's Argonne National Laboratory. Theoretically, refractory metal reactors would have a longer operating life and better restart capability than the Kiwi-Nerva type reactor which has a uranium-filled graphite core. But at this point, it is not apparent that the refractory metal approach has any advantages over the graphite reactor, Klein said. All the emphasis is still on flying a graphite reactor in the Rover nuclear rocket program, he added.

A considerable amount of laboratory evidence indicates that the Rover graphite reactor should be able to restart, he pointed out, but it has not been proved that it can. Limited, or lack of, restart capability, which is not related to the vibration problem uncovered last year, would limit system flexibility somewhat but would not affect Rover missions, according to Klein. Mission analysis now under way (AW Mar. 18, p. 53) indicates that optimum use of nuclear rocket propulsion at its present state of development would require no restart capability or, at the most, a single restart capability, he said. Multiple restart capability would be a bonus in the Rover program, Klein said; but to exploit this capability, it would be necessary to have adequate insulation, micrometeorite shielding and other adjuncts not yet developed.

Except for some long lead time Nerva and Rift components, the whole Rover effort is now being paced by work on the reactor, Klein said. But substantial progress has been made in the program in areas such as the development of new materials and reactor control, he emphasized, and there has been no change in the operational goals originally set for the program. Among other things, the Rover reactor is still expected to produce a specific impulse "above 700 sec."

Another point brought out was that the nuclear test ban treaty will in no way affect the development and operation of Rover type nuclear vehicles. On the other hand, the treaty presently rules out flight testing of the Orion approach to nuclear propulsion in which the vehicle would be propelled by a series of nuclear explosions. The Air Force, however, plans to continue development work on the concept.

Radio Frequencies

Geneva—Proposals to reorganize and expand international radio frequencies alloted to general and commercial aviation activities will be considered by the International Telecommunications Union at a month-long meeting here beginning Feb. 10.

Officially designated the first preparatory session for preparation of revised allotment plans for the aeronautical mobile service, the conference also will deal with the question of assigning frequencies to new-generation vehicles such as the USAF X-20 (Dyna-Soar), which will operate both in and outside the atmosphere. Several proposals within this area were submitted at the ITU extraordinary space radiocommunications conference, which ended here earlier this month (AW Nov. 18, p. 35), but were shelved for consideration during the February meeting.

The preparatory meeting will be followed at a later date by an ITU plenary conference where final consideration and possible adoption of the new proposed frequencies will be made.

Command, Control Procurement Shifted

By Larry Booda

Washington—Commanders of U.S. unified and specified military commands will be given greatly expanded authority over design and procurement of the command and control systems they will use, and will bypass service headquarters staffs here in order to deal directly with service material commands in acquiring these systems.

The influence of individual services in generating command and control requirements will diminish. Aerospace companies who have been obtaining guidance on what was needed in communications, computer and display equipment from the headquarters organizations now will have to go to the individual unified and specified commands.

A memorandum signed Oct. 26 by Deputy Defense Secretary Roswell L. Gilpatric (AW Oct. 28, p. 19) ordered these major actions:

- **Joint Chiefs of Staff** will provide guidance and direction to the unified and specified commanders on development, acquisition and operation of the command and control systems.
- **Each commander will submit** his operational requirements directly to the joint chiefs and secretary of defense, bypassing service chiefs.
- **Each commander** will participate in the system design and specifications and the plans for engineering, management, procurement, facility construction and installations for command and control systems.
- **In addition, they will review** all these items after they are completed and before contracts are negotiated. Command recommendations will be sent to secretaries of the military departments that procure their systems before the secretaries take final action or forward their own recommendations to the defense secretary.
- **Service secretaries will order** the transfer of planning and management personnel to the joint chiefs and to the unified and specified commands as required.
- **For procurement,** the commands have been ordered to go directly to Air Force Systems Command and Logistics Command, the Chief of Naval Material and the Army Materiel Command.
- **Commanders must submit** their recom..iendations for implementing the changes in the systems to Gilpatric by Dec. 26.

Objections to Changes

The Gilpatric memorandum orders major organizational and procedural changes based on a directive issued in October, 1962, which described the concept of the world-wide military command and control system.

The world-wide system is designed to give the President all strategic and tactical information possible in a rapid and simplified manner, and then permit him to order actions with minimum delay. The new directive permits each unified and specified commander to design his own subsystems as he sees fit to meet his responsibilities for fast reaction.

Command and control systems consist of facilities, equipment, communications, procedures and personnel for planning, directing and controlling operations of forces assigned to unified and specified commanders.

Commanders of unified commands have area responsibilities, and heads of specified commands have control of certain kinds of forces. Most of them have been in existence since the mid 1950s.

Chiefs of staff of the Air Force and Army and the chief of naval operations with their staffs located here, will lose personnel to the joint chiefs, and unified and specified commands when the changes take effect. In addition, they will lose nearly all responsibility for generating command and control requirements.

All service military chiefs have objected in varying degrees to the ordered changes. They believe this is the first step toward eliminating them from setting requirements for weapon systems. Objections first were raised in 1962, after the world-wide military command and control system directive was issued. Adm. George W. Anderson, former chief of naval operations, made the strongest protests, maintaining that the changes would lead to the creation of a single chief of staff for the Defense Dept. by concentrating too much power in the chairman of the Joint Chiefs of Staff.

Air Force and Army are generally oriented toward the staff type of organization, so their exceptions are thought to have been made more for the record than to express their complete disagreement.

Until now, command and control networks have been mostly service oriented. The Strategic Air Command (SAC), for instance, is reputed to have the most sophisticated communications network for control of its global operations. Since SAC began as an Air Force command in 1946, its communications followed the patterns of that service even though it became a specified command in 1959. With the deployment of Polaris missile submarines, however, the Navy's communications network had to be integrated into the SAC system. On paper, the Navy still maintains operational control of its missile submarines, but for practical purposes the signal to unleash a missile attack would come from the President via SAC's coordinated joint target attack control.

Generally, the service military chiefs have operational control of some of their own combat forces only in the continental U.S. or close to it. When these forces are deployed, they are placed under the operational control of the unified or specified commander.

U&S Commanders

The unified and specified commanders operate under the over-all world-wide system. This is how needs under this system are described in the memorandum: "The specific composition of a command and control system of a U&S command depends on the missions of the command, its organization, the types of forces that, due to the nature of their combat employment, must remain directly and immediately responsive to command and control by the U&S commanders."

Staffs of the joint chiefs and the unified and specified commanders will have to be augmented from the staffs of the service military chiefs. These military men and civilians have been employed in the planning of communications systems and in monitoring the procurement programs.

Each commander will have to organize a command and control project office, staffed with over-all planners, comptrollers, systems engineers, technical directors and operations specialists. Some commands, especially SAC and the Commander-in-Chief, Europe, already have such organizations in operation and will only have to enlarge them. Others, such as Commander-in-Chief, Pacific and Commander-in-Chief, Strike Command, will have to build command and control project organizations from the beginning.

These internal organizations will have to cover a wide spectrum of personal abilities because, according to the memorandum, the commanders will have to, "review system design; system performance and design specifications; the principal engineering, management, procurement, facility, construction and installation plans and schedules pro-

KING AIR is powered by Pratt & Whitney PT-6A-6 turboprop engines with take off and maximum continuous power rating of 500 hp. plus 62 lb. residual jet thrust. Triple inlet under nacelle, combines turbine air inlets on each side with engine oil cooling inlet, center.

posed by the military department supporting his command. . . ."

The commanders also will have to provide guidance to subordinate commanders to assure compatibility of their command and control subsystems or elements with their own system. In addition, they will establish: procedures for operating command and control facilities, and receiving and displaying information; schedules and priorities for communication links, computers and display subsystems; information and documentation formats; content of computer programs and the basis of data used; and development of computer programs.

Inverted Transit

Los Angeles—Transit navigation satellite powered by a static nuclear generator and launched this fall from the Pacific Missile Range is in orbit upside down. The satellite was one of two vehicles jointly launched by the same booster into a low-altitude earth orbit.

The inverted satellite employed the gravity gradient stabilization technique (see p. 79). The vehicle has two stable orientations, but as a consequence of being in the unanticipated orientation, its antenna is pointing away from the earth.

A recurrence of this difficulty with future satellites of this type presumably could be prevented if an additional antenna pointing in the opposite direction were installed.

The boost vehicle is believed to have been a Thor Ablestar launched from Vandenberg AFB Sept. 28 (see p. 23).

$10.8-Million Backlog Reported By Beech for Turboprop King Air

Wichita, Kan.—Firm order backlog exceeding $10.8 million has developed for the new turboprop-powered Model 90 King Air business plane in the first 90 days since Beech Aircraft Corp.'s initial announcement of the program (AW Sept. 30, p. 34).

Indications are that additional orders currently being negotiated will raise this backlog substantially before the first production prototype starts its flight test program here late next month.

Acceptance of the airplane has been so rapid that the company declines to discuss its backlog in terms of units, apparently because of the adverse effect it feels such figures might have on potential sales because of the reluctance of customers to accept production line positions reflecting deliveries too far in the future. Beech states that the standard King Air, completely furnished with an executive interior will sell for approximately $300,000 and that the airplane will sell for less than $400,000 completely equipped with electronics systems, including weather radar.

First King Air deliveries to customers are now planned by next fall. Indications are that although the company earlier envisaged a market of some 200 King Airs in a four-year period beginning 1965, it has already revised its production planning to consider an output of approximately 100 additional units in this period.

U. S. Army has shown considerable interest in this turboprop-powered, pressurized-cabin development of the piston-engine Queen Air. An Army Queen Air, modified with installation of Pratt & Whitney PT-6A-6 turboprop powerplants, but minus the pressurized cabin feature, has been flying on testbed status since last May in an evaluation of the King Air concept for future Army light utility transport purchases. The testbed has accumulated approximately 120 flight hours.

Beech management emphasizes the firm nature of the King Air program, noting that its order backlog is based on customer deposits, which it states it would not permit its distributors to accept if it had not yet made the decision to go into production.

Rollout of the production prototype King Air here was marked with release of additional design details and preliminary performance data.

Although the King Air utilizes the basic Queen Air configuration, its structure has been considerably strengthened to provide for a pressurized cabin which will maintain an 8,000-ft. cabin altitude at 16,500 ft., the airplane's optimum operating altitude. A Roots-type blower driven by a hydraulic motor in the left engine nacelle provides cabin pressurization. A heat exchanger removes the excess heat resulting from compression. The blower maintains a flow rate of about 12 lb. of air per minute from sea level to 16,500 ft. Automatic pressure controls operate pneumatically. The rate of cabin pressure is adjustable. The pilot can override automatic controls for flexibility in climb or descent.

Air conditioning Freon-type refrigeration system, rated at 1.5 tons, will operate while the airplane is airborne or on the ground, with a 100,000-btu. heating system providing warmth. Systems will provide controlled cabin temperatures while outside temperatures range from −40F to 105F.

Electrical power is furnished by a nickel-cadmium battery and two starter-generators with generator output of 200 amp., 30 v. Power system makes the airplane independent of external starting sources. Electrical system will provide landing gear extension and retraction, and flaps operation.

Fuel system, with a total capacity of 384 gal., includes 58-gal. main tanks in each engine nacelle, plus auxiliary tanks consisting of three cells in each outboard wing panel interconnected to a cell in each wing center section.

Beech Model 90 King Air

Estimated Performance

Top speed	280 mph.
Cruise speed at 16,500 ft	270 mph.
Max. range with 384 gal	1,415 mi.
Rate of climb at sea level, two engines	1,950 fpm.
Rate of climb at sea level, one engine	460 fpm.
Service ceiling, two engines	30,000 ft.
Service ceiling, one engine	13,000 ft.
Stall speed	82 mph.
Accelerate-stop distance for safe abort	3,200 ft.
Takeoff distance over 50-ft. obstacle	2,000 ft.
Landing distance over 50-ft. obstacle	2,800 ft.
Gross weight	9,000 lb
Empty weight	5,200 lb.

Mission Profiles

Four occupants (crew and passengers), 146 lb. baggage, 384 gal. fuel:	
Range	1,265 mi.
Speed	270 mph.
Mission time	4.8 hr.
Max. range	1,415 mi.
Speed	210 mph.
Mission time	6.8 hr.
Five occupants (crew and passengers), 150 lb. baggage, 357 gal. fuel:	
Range	1,160 mi.
Speed	270 mph.
Mission time	4.4 hr.
Max. range	1,300 mi.
Speed	210 mph.
Mission time	6.3 hr.
Six occupants (crew and passengers), 180 lb. baggage, 326 gal. fuel:	
Range	1,045 mi.
Speed	270 mph.
Mission time	4 hr.
Max. range	1,170 mi.
Speed	210 mph.
Mission time	5.6 hr.

Note: Performance data is computed at gross takeoff weight of 9,000 lb., with the aircraft equipped for all-weather instrument flight operation. Ranges include taxi, climb to altitude and 45-min. reserve fuel allowances.

USAF Planning Try At Altitude Record

Los Angeles—USAF is planning an official assault on the world record for altitude achieved from a ground takeoff—a mark now held by the Soviet Union—following two recent flights which unofficially broke the Russian record.

The official attempt probably will be made early next month by Col. Charles E. (Chuck) Yeager, commander of the Aerospace Pilot Research School at Edwards AFB. He will fly a Lockheed NF-104, an F-104 Starfighter fitted with a throttleable rocket motor and reaction control jets (AW Aug. 5, p. 116).

The two flights within the last month which unofficially bettered the record of 113,890 ft. set in 1961 by a Russian pilot also were made in the NF-104, with USAF Maj. Robert W. Smith at the controls. Smith reached 118,600 ft. on the first flight and 114,500 ft. on the second, according to USAF.

News Digest

Curtiss-Wright X-19 VTOL made its first hover flights last week at the company's Caldwell, N. J., facility but was damaged when the left landing gear folded on the second landing. Damage was confined to the fuselage and engine nacelle skin.

Kaman Aircraft is planning to fly its K-20 jet augmented experimental helicopter for the first time this week. The aircraft, a modified UH-2 Sea Sprite with a General Electric YJ85 turbojet engine mounted on the right side of the fuselage, will explore helicopter high-speed regimes under a U. S. Army Transportation Research Command (Trecom) contract. Bell Helicopter Co. has been flying a UH-1B testbed for the Army with two auxiliary Continental J69-T-9 turbojets since Nov. 14.

Donald W. Douglas, Sr., founder of the Douglas Aircraft Co. and its present board chairman and chief executive officer, will receive the annual Wright Brothers Memorial Trophy Dec. 17 in Washington. The award is administered by National Aeronautic Assn.

Soviet Union said the 22nd in the Cosmos series of scientific satellites was launched Nov. 16, with these orbital elements: apogee, 245 mi., perigee, 128 mi., inclination, 64 deg. 56 min. and initial period, 90.3 min.

Debris found in the Gulf of Mexico, 40 mi. northwest of Key West, was positively identified by the Air Force Nov. 21 as the remains of a USAF Lockheed U-2 reconnaissance aircraft that disappeared the day before, apparently while on an intelligence-gathering mission over Cuba. No trace of the pilot, Capt. Joe G. Hyde, Jr., had been found late last week. There were no immediate indications that the U-2 had been fired on.

Martin Co. has received a $13-million Air Force contract to install electronic sensors in the reconnaissance version of the Boeing C-135. Installation of the sensors will give the aircraft the designation RC-135B. The RC-135A, with less advanced avionics, has been in service about two years.

First two McDonnell-USAF F-4C tactical fighters were delivered to the Tactical Air Command last week at MacDill AFB, Fla. More than 1,000 of the twin-seat, 1,600-mph. aircraft, a modified version of the Navy's F-4B, will be delivered to Air Force during the next five years under a contract valued at about $2 billion.

Payments Deficit Stirs International Rift

SAS, Alitalia Attack TWA's 'fly U. S.' drive to ease money drain; action by governments seen unlikely.

By L. L. Doty

Washington—Growing controversy between foreign flag carriers and U.S. airlines over the effects of international air transportation on the U.S. balance-of-payments deficit will be allowed to run its course without any government intercession.

The dispute, which has been kept under the surface for the past two years (AW Oct. 7, p. 47), broke into the open last week when Trans World Airlines President Charles C. Tillinghast, Jr. urged American travelers to use U.S. airlines in international travel to help stop the "dollar drain." The plea, outlined in a printed pamphlet, promptly evoked charges of "chauvinism," "restrictionism," and "protectionism" from the heads of Scandinavian Airline System, Inc. (SAS) and Alitalia in separate speeches on the U.S. West Coast.

Both SAS President Tore H. Nilert and Fabrizio Serena, general manager of Alitalia, devoted major portions of their addresses to attacking the Tillinghast campaign.

The TWA pamphlet bluntly declared U.S. carriers are superior to foreign flag airlines, noting that the "golden rules for choosing U.S. airlines" are based on experienced U.S.-trained crews, superior U.S. jet aircraft and precision maintenance. It added that "now we must add the newest golden rule: defense of the U.S. dollar."

Clear-Cut Issues

Government intervention in the North Atlantic fare fracas (AW Nov. 4, p. 45) was possible because the issues involved are clear-cut. However, the balance-of-payments problem is hazy, for these reasons: the issues are fraught with political implications; strong-arm adjustments of the payments deficit can have far-reaching effects on international trade; and the State Dept. is finding it virtually impossible to assess the full impact of air transportation on the unfavorable U.S. payments position.

The basic issue, on which TWA rests its case, is simple. There is a U.S. balance-of-payments deficit in international air travel. If this were wiped out, the deficit on U.S. balance of payments in the total transportation account would be sharply reduced, if not eliminated.

But there are other factors which, when viewed in their long-range aspects, cause the State Dept. to hesitate in enunciating a policy and are used by the foreign airlines in their arguments.

To begin with, the amount paid foreign flag carriers for transportation by U.S. citizens in 1962 was $362 million—a relatively small amount when compared to the $2.06 billion paid by U.S. citizens in 1962 to foreign surface and air carriers in every category of travel and shipping.

The $2.06 billion amounts to only 8% of U.S. expenditures abroad for goods and services.

In the same year, U.S. airlines earned $128 million from passenger air fares collected in foreign countries. This gives the U.S. a $234-million unfavorable balance of trade for air transportation in 1962, according to Commerce Dept. statistics.

In developing the transportation account, Commerce Dept. includes port expenditures, which cover such costs as fuel, loading fees, maintenance, advertising and salaries. In 1962, the U.S. received $190 million from foreign carriers for port expenditures, while the U.S. paid out $167 million abroad for these services, to reduce the payments deficit further.

Commerce Dept. holds that the port expenditures item is a balancing factor in the payments problem. The department said:

"A large imbalance in the transportation account is unlikely because of the countervailing effect of port expenditures resulting when either U.S. or foreign operators enlarge their carriage of U.S. commerce relative to the other... As U.S. payments to foreign carriers for the transport of U.S. imports and passengers increase, the port costs of these carriers in the U.S. must also rise since these charges are directly related to the increased activity of the carriers in the U.S."

Sales Favor U. S.

Air freight also is becoming a significant element in the balance of payments. U.S. airlines earned $56 million in 1962, against $24 million in 1952, on the transportation of U.S. exports. Air freight payments to foreign airlines for shipment of U.S. imports amounted to $26 million in 1962, resulting in a $32-million credit in air cargo.

Biggest item in favor of the U.S. comes from the purchase of flight equipment. According to Serena, Italy would need to export to the U.S. 5,000 Fiat sedans to balance the price of just one of Alitalia's Douglas DC-8 jet transports. Nilert said SAS had spent more money in the U.S. than its total sales intake since service began on the North Atlantic in 1946.

U.S. carriers argue that foreign purchase of U.S. equipment is not related to the air transport balance-of-payments problem. However, it is known that one of the reasons behind the U.S. decision to proceed quickly with development of a supersonic transport was to protect the nation against a large deficit in the payments balance that might be created by the purchase of the British-French Concorde by U.S. airlines.

It is interesting to note that TWA placed an order for four Concordes (AW Nov. 18, p. 39) at about the same time the "dollar drain" pamphlet was released.

President Kennedy is eager to chop payments deficits wherever possible, and will cut even the smallest dollar flow abroad in any case where repercussions from international interests can be avoided. As a result, the Administration is not likely to take a stand on the airline controversy, even though international relations may become strained, as they did in the fare battle.

Earlier this year, Congress launched a "See U. S. Now" program, aimed at diverting U. S. travelers from Europe to their own country. This plan was devised to help correct the balance-of-payments problem, but was quickly buried when the total effect of the plan on international trade was fully measured.

The "Visit U. S. A." plan is designed to draw European travelers to the U. S., but has been widely misinterpreted as part of the "See the U. S. Now" campaign. Last week, Stuart G. Tipton, president of the Air Transport Assn., attempted to dispel this misunderstanding by stressing the need of generating overseas traffic, and by pointing out that only 30% of U. S. travelers flying international carriers are on pleasure trips.

The chief problem created by the TWA campaign, according to a number of airline officials here, is that in view of the "Visit the U. S. A." program, travelers could be diverted, not necessarily from foreign flag carriers to U. S. international airlines, but from both these groups to domestic airlines.

In addition, the campaign is considered by some here as short-sighted, in that indications are strong that a travel potential is developing rapidly in the European Common Market countries, a source that will be difficult for U. S. airlines to tap if the theme of nationalism is pursued continually in promotions.

Military expenditures abroad account for a major portion of the U. S. expenditures abroad, but U. S. business interests also have an important effect on the current deficit. For example, direct foreign investment by U. S. companies abroad now total about $36 billion, and common business sense requires that the products and services, including air travel, offered by the countries in which the investments are held be used to the greatest degree possible by the investors.

According to the Commerce Dept., increased competition by foreign air carriers must be considered along with the expansion of international travel by U. S. residents as a factor in the growth of fare payments abroad.

But under the principle of reciprocity in international air transportation, there is no way that this competition can be arrested. In fact, the White House policy on international air transportation (AW Apr. 29, p. 34) discourages any attempts to restrict foreign competition.

In addition, the working group that developed the policy felt that the balance-of-payments problem should not be allowed to influence any U. S. policy on civil aviation.

FAA, CAB Funding

Washington—Senate last week preserved the $60-million appropriation requested by the Administration for research and development on the supersonic transport and increased federal subsidies for helicopter service in New York and Los Angeles to a total of $5 million.

An amendment by Sen. William Proxmire (D.-Wis.) to eliminate the $60 million from the Federal Aviation Agency's Fiscal 1964 budget was defeated, 72-7. The Senate voted $10.4 million for the Civil Aeronautics Board and a total of $770.5 million for FAA.

Slattery, Smallpeice Resign BOAC Posts

London—Sir Matthew Slattery, chairman of British Overseas Airways Corp., and Sir Basil Smallpeice, managing director, resigned last week on the eve of publication of a government White Paper on BOAC's finances and future.

At the same time, Anthony H. Milward, now chief executive British European Airways, was named to succeed Lord Douglas of Kirtleside, BEA chairman, upon his retirement next March. Both BOAC posts will be taken by *Sir Giles Guthrie*, a director of the merchant banking firm of Brown and Shipley, and a BEA director. Milward will take a seat on the BOAC board.

Refusal of the government to write off BOAC's $224-million accumulated deficit was regarded as the immediate cause of the two resignations.

Also a source of friction has been a secret report—from John Corbett, a private accountant, to Minister of Aviation Julian Amery—that partly became the basis of the White Paper. Neither BOAC nor BEA were told what the Corbett report contained, and both have complained that they have been forced into day-by-day planning as a result.

Slattery's term of office was to end next July. When Amery told him that his successor had been selected, Slattery said he asked that the change be made at once. Amery told the House of Commons that Guthrie planned to assume some functions of the managing director and that Smallpeice had agreed to step aside to facilitate the move.

Main points of the BOAC White Paper:

- **BOAC must operate as a commercial undertaking.**
- **Government proposes to strengthen the corporation's management.**
- **Government has decided against any merger with BEA.**
- **New chairman must prepare, within 12 months, a plan for making BOAC financially sound.**

TWA's Hall Selected to Succeed MacIntyre as Eastern's President

New York—Malcolm A. MacIntyre will leave his post as president and chief executive officer of Eastern Air Lines on Dec. 15, and will be replaced by Floyd D. Hall of Trans World Airlines.

MacIntyre listed "personal reasons" as the basis for his resignation, which was accepted by Capt. E. V. Rickenbacker, chairman of the board. Hall, who is senior vice president and system general manager of TWA, will also fill MacIntyre's vacancy on the Eastern board.

Eastern appointed George S. Gordon as vice president-marketing.

TWA said Hall would be replaced by Raymond M. Dunn, vice president of technical services who directs the airline's maintenance program at its Kansas City overhaul base. Dunn will also become a TWA director and a member of the airline's executive committee.

Alfred E. Jordan, staff vice president of maintenance and overhaul, will replace Dunn. Jordan's present position will be filled by William J. Neff, senior director of technical services.

In addition to Gordon's appointment at Eastern, more changes are expected when Hall takes office. The two men's approaches to airline operation are basically different, and the staff organized by MacIntyre may not be adaptable to Hall's policies.

MacIntyre's background, when he became Eastern's president on Oct. 1, 1959, was in the legal profession. He said at that time that "all I know about the airline business is that you buckle your seat belt and extinguish your cigarette when the light goes on." Hall, a 24-year employe of TWA, began his career as a pilot and rose to executive status through the operations ranks.

Operations—the day-by-day function of the airline—is one area in which many within Eastern feel the carrier has received lesser attention during MacIntyre's administration. It is generally conceded that Hall's experience in this area influenced the decision to offer him the presidency.

Eastern, admittedly, has encountered problems in recent years that would be difficult for anyone to resolve. Four strikes have contributed to the consistent losses, which totaled $12,500,000 in the first nine months of 1963 alone. Since MacIntyre took office, competition from National Airlines and Northeast Airlines has increased on Eastern's prime New York-Miami route. In an unsuccessful bid to influence the Civil Aeronautics Board to approve a merger with American Airlines, Eastern earned a reputation of being hard-pressed and cash-poor. That identity, hardly a favorable one to place before the traveling public, has not yet been fully reversed by the airline.

The shuttle service linking Boston, New York and Washington, has been

upheld as one of MacIntyre's major achievements. But even that innovation, despite wide public acceptance, has been the subject of re-evaluation at Eastern. Some within the airline, members of the board included, wonder if the shuttle is producing enough revenue to justify the great effort involved in running it. Some feel that Eastern's long-range service has suffered due to too much emphasis on the shuttle and its allied walk-on service such as that between New Orleans and Houston.

Principal drawback to the shuttle has been the guarantee of a seat. This has required extensive ferrying of aircraft during peak load periods and the maintaining of on-duty crews to fly extra sections. The walk-on service also has been unprofitable, and moves are already under way at Eastern to eliminate it. The opinion is frequently expressed within Eastern now that the shuttle service fare should have been higher at the beginning, possibly $20-25.

Although Eastern has had problems, the difficulties aren't viewed as being particularly different from those encountered by all airlines in recent years. But Eastern is still losing money while most other domestic carriers are reporting profits. Feeling is voiced within Eastern that this is partially due to excessive cost-cutting at the expense of competitive service.

Hall is credited at TWA with attaining a good return on money spent to run the airline. When he took office, advertising budgets were expanded and passenger service was dressed up to include better meals and even inflight movies. TWA has expanded its management force, particularly in finance and market research. And TWA is making a profit today, which it wasn't doing when Hall took office.

MacIntyre, who is 55 years old, was earning $80,000 a year at Eastern. He said his future plans are open, and denied reports that he would return to his former law firm, Debevoise, Plimpton and McLean in New York.

Although Hall's salary at Eastern was not disclosed, reports indicate he will receive more than MacIntyre, possibly in the area of $100,000 a year on a five-year contract.

U.S. Flag Carriers Receive SST Priority

By Robert H. Cook

Washington—U. S. Atlantic flag carriers were given top priority in the supersonic transport delivery schedule outlined by the Federal Aviation Agency in a policy statement last week covering the first 70 supersonic transports to be produced in this country.

The delivery policy, forecast by AVIATION WEEK & SPACE TECHNOLOGY (Nov. 4, p. 43), gives second priority to foreign Atlantic carriers, third priority to U.S. Pacific market carriers, and fourth priority to foreign Pacific route airlines. U.S. domestic carriers, with the exception of American Airlines, are allotted last priority.

The delivery policy follows a battle between Trans World Airlines and Pan American World Airways over which company will receive the first supersonic transport produced in this country (AW Oct. 21, p. 38). The policy is based on the assumption that airlines will make $100,000 down payments by next May to secure delivery options.

Delivery terms are a part of proposal requests to manufacturers by FAA. Manufacturers will assume responsibility for assigning delivery priorities beyond the first 70 aircraft produced.

Airlines that already have ordered the U.S. transport have expressed general agreement over the FAA priority schedule. While manufacturers have not stated a position, FAA is confident the policy will be accepted, according to Gordon M. Bain, deputy administrator for supersonic transport development.

In its schedule, which reserves 29 supersonic transports for U.S. international airlines, 26 for foreign carriers and 15 for U.S. domestic airlines, FAA noted it hopes to make aircraft available to at least 14 airlines in a production run expected to require more than three years for the 70 aircraft. Production rates should reach 14 aircraft per year by mid-1970, increasing to 22 the next year and 27 in 1972, Bain said.

Five U.S. and foreign airlines have paid FAA advance royalties totaling $3.9 million for 39 aircraft. Trans World Airlines will receive the first aircraft, since it made the first request for a delivery priority on Oct. 14, FAA said. TWA's initial order was for six U.S. supersonic transports, which it later increased to 10. TWA also has placed an order for four Anglo-French Concordes. PAA ordered six Concordes last June and, hours after the initial TWA order, made a $1.5-million down payment for 15 U.S. supersonic transports. This company will receive the second aircraft.

American will be the first domestic carrier to operate the U.S.-built supersonic transport, with delivery of the eighth aircraft from the production line. The airline has ordered six supersonic transports, and because it placed a down payment with FAA a week after TWA and Pan American, the agency feels it is justified in making an exception to the delivery schedule which otherwise withholds delivery for domestic use until production aircraft 38—about two years after the first aircraft are in scheduled service.

Alitalia, as the first foreign carrier to order the U.S. aircraft will get the fifth aircraft produced.

Japan Air Lines, the first foreign carrier to order for Pacific service, will receive the 19th aircraft.

FAA has spelled out these tentative delivery positions—reserving others—for the carriers which have placed orders:

- **Trans World Airlines**—1-3-6-11-15-26-33-47-52-55.
- **Pan American**—2-4-7-12-16-27-32-43-50-54-58-61-64-67-70.
- **Alitalia**—5-9-21.
- **American**—8-13-20-31-40-48.
- **Japan Air Lines**—19-23-30-46-57.

Early orders by TWA and Pan American for the U.S. transport plus their orders for the Concorde effectively protect their competitive position in the lucrative Atlantic market, but the FAA program serves to spotlight a gaping hole in both the Pacific and domestic areas.

While FAA has reserved position 21 for a "Pacific U.S. flag," Pan American will be in a strong position to take an early competitive lead in the area with its earlier deliveries. Japan Air Lines will not receive its first supersonic transport until a year after Pan American takes delivery on its first U.S. aircraft. By then, Pan American will have a fleet of five supersonic transports in operation.

Northwest Airlines is the only remaining U.S. flag in the Pacific, and even if the company orders supersonic transports in the near future it could face the combined competition of Pan American and Japan Air Lines.

United Air Lines is also in a quandary because of the delivery schedule since it has not yet ordered. If it did it would be relegated to position 38 or further back on the production line as a domestic carrier. Pan American, a heavy competitor of United in the West Coast-Hawaii market, could use the aircraft on this route. United, as a domestic carrier, could not get earlier than the number 22 delivery position under qualification as a U.S. flag in the Pacific, according to FAA.

Spokesmen for United contend that to order supersonic transports before FAA selects airframe and engine manufacturers is premature. They hold that FAA will not insist on an unyielding attitude in its priority schedule and predict there will be sufficient time to bargain for delivery positions later.

In explaining the delivery policy, Bain frequently noted that the schedule should remain "flexible," pointing out that factors such as making early down payments could change the schedule as it did with American. Detailed agreements covering the schedule will be worked out between FAA and the airlines in the future, and the delivery positions reserved for anticipated additional orders are tentative and subject to change, he said.

In cases where down payments are not made, vacated priorities will be allotted to airlines that have made deposits.

Prior to Nov. 1, 1965, airlines can withdraw from the program and have deposits refunded if the supersonic design fails to meet their requirements. On this date a second $100,000 deposit per aircraft will be required. Delivery priorities for these airlines will be cancelled and money refunded if they fail to make the additional payment. Beyond this date refunds will not be made unless the government terminates the supersonic transport program, FAA said.

By May 1, 1966, aircraft manufacturers and airlines on the priority list are expected to conclude contracts. Failure to complete contracts by this date will permit the manufacturer to cancel the airline's previously reserved delivery positions.

El Al SST Talks

Washington—El Al, the Israeli flag carrier, was expected to announce an order for the U.S. supersonic transport, following talks last week between the Federal Aviation Agency and General E. Ben-Arzi, general manager of the airline. El Al could obtain the No. 10 position on FAA's supersonic delivery priority schedule as the second European airline to order the U.S. aircraft. Alitalia, the Italian flag carrier, was the first (AW Nov. 18, p. 45).

Allied Pilots, American Sign BAC 111 Pact

New York—Allied Pilots Assn. signed an agreement with American Airlines last week to fly the carrier's 15 BAC 111 transports with two-pilot crews.

The American pact, effective when BAC 111 deliveries to American begin in 1965, calls for a captain on the British jet to receive $2,095 per month. Copilots will receive 67% of this scale. Captains on American's present Boeing 707s average $2,463 a month, with pay scales based on aircraft weight.

Allison Turboprops to Be Installed On Four Frontier Airlines Convairs

New York—Installation of Allison 501-D13 turboprop engines is scheduled on four of Frontier Airline's Convair 340 transports.

The $3,200,000 conversion will increase the 340's speed by 100 mph. and raise the allowable gross weight from 47,000 to 53,200 lb. Passenger capacity will be increased from 44 to 52 seats, keeping seat mile costs at about the same level as that of the existing piston-powered Convair.

Shaft horsepower of the Allison engine is 3,750, compared with 2,400 hp. for the Pratt & Whitney CB16 piston engines now on the aircraft. The increased power will triple the 340's rate of climb. This is an important factor for Frontier, which operates over mountain terrain where the minimum cruise altitude is often 16,000 ft. above sea level. The increased speed is also important, since Frontier's route stage lengths are the longest of any local service operator.

Frontier has taken an option with Allison for converting 14 more 340s to turboprop power. This would involve the purchase of four more aircraft. The airline presently operates 14 Convairs and 18 DC-3s.

The initial order placed by the airline is for eight engines on the aircraft and three spares.

The conversion is being financed through a loan from the Bank of New York. Pacific Airmotive, Burbank, Calif., will install the engines beginning Jan. 6. Approximately 90 days per aircraft is required for the work, and the first turboprop 340 should enter scheduled service next June. Allison Div. of the General Motors Corp. will provide overhaul service.

Frontier is asking the Federal Aviation Agency for a 2,000-hr. time-between-overhaul (TBO) on the 501-D13. The engine has been flown on Convair conversions for four years, accumulating 85,882 hr. through last September. Of the 25 converted aircraft now flying, the FAA has five, General Motors Air Transport Service has nine, and the rest are in executive service with various companies.

The airline earlier considered the Napier engine for a conversion such as that used by Allegheny Airlines. However, problems arose that prevented the TBO on the Napier engine from exceeding 600 hr., and Allegheny has discontinued its use. Frontier then turned to Allison, but delayed its decision to buy the engine until improvements were made in the gear box and turbine assemblies.

TWA African Bid

Washington—Trans World Airlines last week filed an application with the Civil Aeronautics Board for an extension of its Middle East routes through eastern Africa with a terminal point at the Union of South Africa.

TWA stressed the need for a U.S. air carrier representation in Africa to accommodate expanding business interests and tourism in the area, and petitioned for a route that would originate in Cairo and serve the Arabian Peninsula, Sudan, Kenya, Uganda, Tanganyika, Rhodesia and Nyasaland.

Canadian DC-9 Delay Raises Political Issue

Ottawa—Delay by the Canadian government in acting on a recommendation by Trans Canada Airlines board of directors to order the Douglas DC-9 short-haul jet transport has permitted the plan to blossom into a political issue.

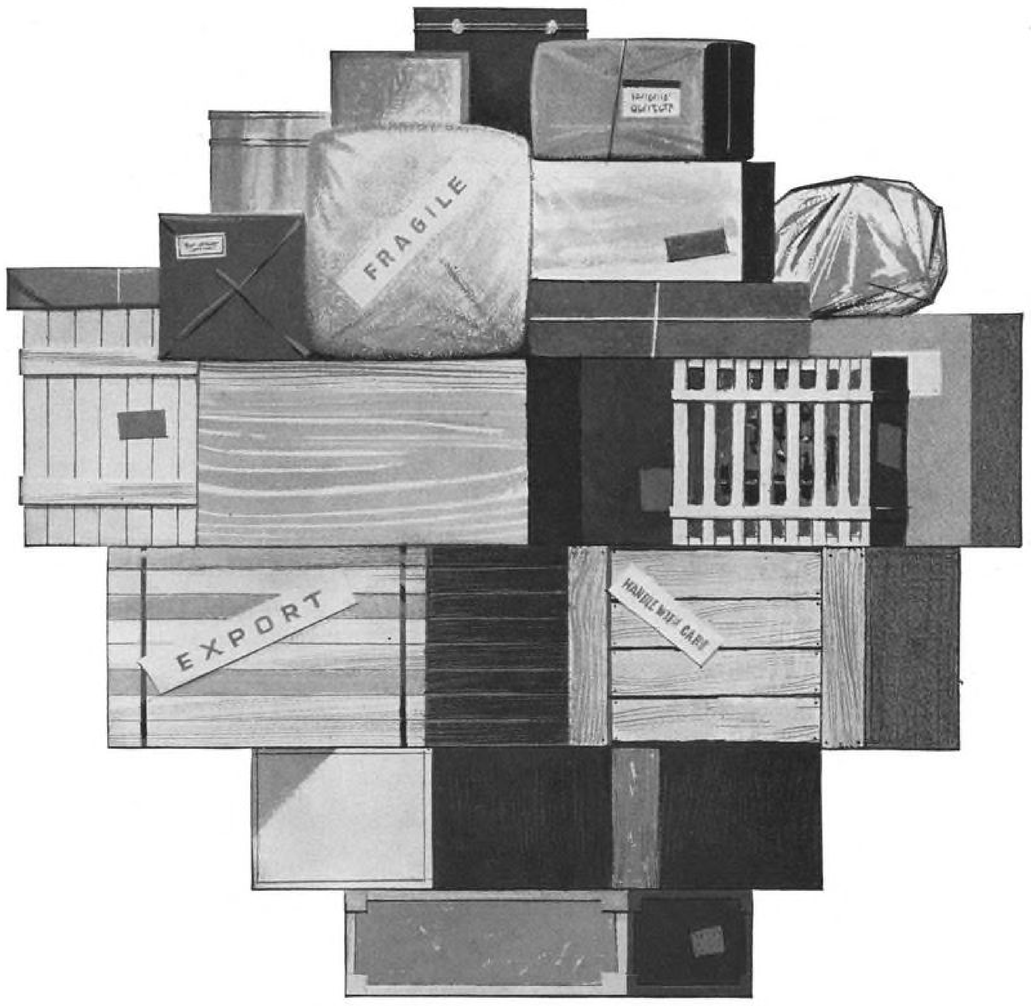
House of Commons members from the Montreal area have attacked the DC-9 order on the ground that the Province of Quebec, including Montreal, has the highest unemployment rate in Canada and that two competing manufacturers have offered to share production with Canadair, Ltd., whose plant is in Montreal.

Douglas has given a $65-million subcontract to de Havilland of Canada for wings and tail subassemblies of 125 DC-9s, calling for de Havilland to share development costs.

Sud Aviation has offered to license production of the Caravelle or Super Caravelle with Canadair if TCA would buy a version of this airplane. British Aircraft Corp. is proposing to subcontract $400,000 worth of BAC 111 components with Canadair for the first 120 airplanes, and to provide the same terms for all built over 120.

A major factor in the DC-9 decision was the fact that it could eventually give TCA, with its present DC-8s, a two-airplane, one-manufacturer fleet once the Viscount and Vanguards are phased out of service.

The DC-9 question was on the Canadian cabinet's agenda early last week, but no immediate action resulted. No overturning of the TCA board's decision, made Oct. 22, is likely, but a search for a formula to satisfy Quebec may be causing the delay.



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Financial Woes, Internal Strife Face KLM

By Cecil Brownlow

Geneva—KLM Royal Dutch Airlines is striving to overcome a management crisis plus a resultant split within its work force that already is threatening the carrier with additional financial problems and possible direct government intervention.

Most immediate source of friction is the airline's disputed decision that between 200 and 250 of its present force of 770 pilots must be laid off within the near future for financial and operational reasons.

This, combined with the appointment of an outside personnel director who will rule on the dismissals and the amount of compensation received, has led the KLM pilots union to announce that it has "no confidence" in the airline's new four-man management structure which came into being last January following the resignation of President E. H. van der Beugel (AW Jan. 21, p. 41).

The "no confidence" motion, which implied no threat of a strike attempt, also stemmed in part from the general knowledge that at least one of the four directors, E. H. Larive, was fighting against some of the proposals for a general reorganization of the carrier's operational structure recommended by McKinsey and Co., Inc., a New York management consulting firm, after a prolonged study last year of the carrier's over-all operations.

Larive also has hinted that he would trim the number of proposed pilot dismissals, a figure contained in the McKinsey report and one which has the backing of the other three managers.

A KLM spokesman said last week, however, that there now is "unity in the top management," although he conceded that "this doesn't mean that we still don't have our differences, but when a majority decision is made, it can be carried out."

The earlier plan to release between 200 and 250 pilots still remains in force.

Whatever unity has been attained by the management—and, admittedly, it is a tenuous one—has been spurred largely by mediation efforts plus indications that the government is prepared to step actively into the fray if the dispute continues unabated.

The chief mediator is A. H. C. Gieben, secretary general of the Ministry of Transport and the government's official representative on the KLM board of directors. Gieben is acting under the instructions of Dutch Minister of Transport Johannes van Aartsen, who has told parliament that he would be forced to take additional steps unless harmony is quickly restored both within management and in its subsequent relations with the pilot organization.

One possible emergency measure, a government spokesman told AVIATION WEEK & SPACE TECHNOLOGY last week, might be to call a stockholders' meeting to consider the McKinsey proposals and management opinion towards them.

As 68% shareholder in the airline, there is little doubt that the government would have its way at any such session. The government generally favors the approach taken by Larive's opponents in the internal struggle.

A new personnel director was named despite Larive's opposition and, according to one official, the KLM pilots fear that he will be "too severe" in ruling upon the amount of compensation each discharged employe is to receive.

KLM officials dispute that this is true and point out that a relatively generous compensation plan has been worked out for those pilots who indicate before Dec. 15 that they are willing to retire voluntarily. An individual pilot under this plan can receive up to $30,000.

"We know it will be difficult for them," one KLM spokesman said. "They have been trained as pilots, and there aren't many commercial pilots' jobs open to them in Europe, so most of them will have to learn a new profession. We want to be fair with them." Compensation for those who are dismissed after Dec. 15 is still under review.

Aside from the differences within the management, another difficulty that must be overcome is the split within the work force itself. The ground crew, flight engineer, steward and stewardess trade unions reportedly have lined up almost solidly against the pilots.

"What we have to avoid is a real split that could hurt us," one KLM spokesman said. "It's become a psychological thing. Distrust builds up, and it's hard to stop."

The psychological factor also is playing a major role in the additional financial strains being levied upon the airline by creating an uncertainty as to its future on the part of potential passengers who, KLM fears, may now be looking elsewhere for reservations. In the slack winter season, greatest losses could come from any decline in transatlantic charter business.

Ironically, the airline, which has suffered severe financial losses over the past two years, reported last week that the tide may be turning, at least temporarily. For the third quarter of the year, the KLM recorded a profit of approximately $4.4 million, and a KLM spokesman said October also was "very pleasant."

The airline's financial burdens over the past few years, which have necessitated large doses of government aid, stem from a variety of reasons, including the need to re-equip to an all-turbine fleet; the generally disastrous year of 1961; a dwindling of traffic, particularly on the Pacific routes as the Netherlands' colonial empire was whittled away; failure to gain a number of potentially profitable routes and a prolonged disinclination to eliminate others that had become guaranteed money losers.

Two prime reasons for trimming the pilot force are planned retraction of some of the carrier's service and the accomplished transition to an all-turbine fleet using Douglas DC-8 jet transports to most overseas points and Vickers Viscount and Lockheed Electra turboprop equipment within Europe.

KLM also hopes to place an order before the end of the year for a twin-engine, medium-range jet transport—probably the Douglas DC-9 or the British Aircraft Corp.'s BAC 111. When these arrive, another review of pilot needs probably will be made.

BEA Records Profit

London—British European Airways achieved a $22-million profit in first seven months from last April to October, Lord Douglas of Kirtleside said here last week. The figure was reached after paying interest on all capital.

The state-owned airline lost money in the last fiscal year, but has budgeted for a profit of $4.2 million at the end of this fiscal year (AW Sept. 2, p. 30). A profit was made in each of seven summer months for first time in three years.

During the seven-month period, BEA offered 6 million seats and flew 4 million passengers. In addition, the airline carried 32,000 tons of freight and 7,000 tons of mail.

The airline last week placed an order worth $7 million with Univac Computer Div. of Remington Rand for an automatic electronic seat reservation system. The system consists of two Univac 490 central processors, or computers incorporating magnetic memory stores. Delivery will be in mid-1964.

AIRLINE OBSERVER

► U. S. domestic trunkline passenger business continued to rise sharply in October when revenue passenger miles increased 19% over the volume handled in the same month last year. Chances are now strong that a 12% increase in revenue passenger miles will be reported for the year. Available seat miles in October were held to a 10% increase, to raise the industry load factor to 53.3%, a 4% increase over the load factor in October, 1962. At the present traffic growth rate, revenue passenger miles will pass the 40-billion mark in 1963 for the first time.

► **Local service carriers also showed similar gains in October, with a 19.6% increase in revenue passenger miles over the same period last year. Available seat miles rose only 8% to bolster the load factor of the 13 carriers to 46.1%, a 4.4% increase over October, 1962.**

► Plans to use the standard Vickers VC.10 jet transport between London and Montreal early next year have been dropped by British Overseas Airways Corp. (AW Apr. 1, p. 40). Instead, VC.10 service to North America will start in 1965 when the Super VC.10 enters service. A company official said the standard VC.10 has been diverted to Persian Gulf service, which is scheduled to begin next year. VC.10 was earmarked for Canada, he said, only because at the time of the decision, BOAC had no Boeing 707s available for this operation and the VC.10 would have provided extra capacity needed. Another factor is that the standard version was basically designed for hot country operations. In addition to the Persian Gulf, America and the Far East will be served by the VC.10.

► **Chances are strong that Pakistan may ask Britain again for landing rights at Hong Kong to permit operations from Karachi to Tokyo (AW Nov. 18, p. 45). Existing agreement between Japan and Pakistan provides for landing rights at Tokyo on flights operating through Hong Kong. But when Pakistan was denied rights at Hong Kong by Britain, it signed an agreement with Red China for landing rights at Canton and Peking. Japan refused to amend its agreement with Pakistan to provide for the routing through China. Britain reportedly barred Pakistan entry into Hong Kong for purely economic reasons.**

► Swissair has signed an agreement with Ghana Airways Corp. whereby Swissair will operate two flights weekly between Accra and London with Convair 990 transports carrying Ghana insignia and colors. Planes will retain Swiss registration and will be manned by Swiss flight crews and cabin attendants. Ghana pilots, pursers and hostesses will be aboard as observer trainees.

► **Eastern Air Lines has carried over four million passengers on its Washington-New York-Boston Air Shuttle operation since the service was inaugurated in June, 1960. In the first nine months of 1963, two million people were flown, and it is estimated that about three million passengers are using the service annually. Single-day all-time high was on Nov. 8 when 14,308 passengers boarded the Air Shuttle.**

► Pan American World Airways has been granted permission by the Federal Aviation Agency to operate Boeing 707-320 transports in scheduled thrift-class service with 187 passengers. Airline originally requested 189 seats but an evacuation test demonstrated that two seats adjacent to the overwing emergency exits should be removed. First test required 2 min., 20 sec. to evacuate 189 people, and seven crew members, ranging in age from 17 to 56 years. Second test, with 187 passengers and seven crew members, required 96 sec. for evacuation. Only exits on one side of the plane were used in order to simulate the realism of an accident.

► **Aeroflot has introduced the broadest winter passenger tariff discounts in its history, despite warning by the Russian carrier's economists that fare cuts are getting out of hand. New tariffs include 50% discounts for students riding Tu-104s, Tu-124s, Tu-114s, Il-18s, An-10s and An-24s between Nov. 10 and June 15. During the same period, tourists flying in groups of 15 or more will receive a 20% fare discount.**

SHORTLINES

► **American Society of Travel Agents** has proposed that governments purchase and stockpile supersonic transports and allow their flag carriers to purchase the aircraft as needed as a means of preventing the same overcapacity problem created by the introduction of subsonic jets.

► **Boeing 727** jet transport has returned from a world demonstration tour that took it to 36 cities in 26 countries, logging more than 76,000 mi. and 157 hr. flying time.

► **British Overseas Airways Corp.** has suspended direct London-Los Angeles polar route service and will concentrate its sales effort on the London-New York-San Francisco connection during the next two years while the New York World's Fair is in progress.

► **Civil Aeronautics Board** has approved first-, second- and third-class jet fares between New York and San Juan, Puerto Rico and between Miami and Puerto Rico. Third-class fares on propeller aircraft between New York and San Juan also were approved but the Board held that Eastern's third-class propeller fare between Miami and San Juan should be dropped from $41 to $38.95.

► **Civil Aeronautics Board** last week ordered a "use-it-or-lose-it" investigation of certain route segments of Lake Central Airlines. This is the 15th such proceeding the CAB has instituted.

► **Flying Tiger Line** has reported airfreight revenues of $1.1 million for October, an increase of 10% over the same month last year.

► **Kuwait Airways** has resumed flights between Kuwait and Baghdad. Original service between the two points was dropped three years ago.

► **Minnesota Mining** and Manufacturing Co. has purchased two Fairchild F-27 transports for executive use.

► **National Airlines** has increased its advertising budget for the current fiscal year to $4.5 million, a $1-million increase over last year's expenditure for advertising and promotion.

► **United Air Lines** has placed an order with Hardman Co. for the purchase of $1,256,000 worth of seats for expansion of its single-class service to the Boeing 727 jet transport. Initial order for the five abreast seats, when single-class service was introduced on the Boeing 720 fleet, totaled $2.5 million.

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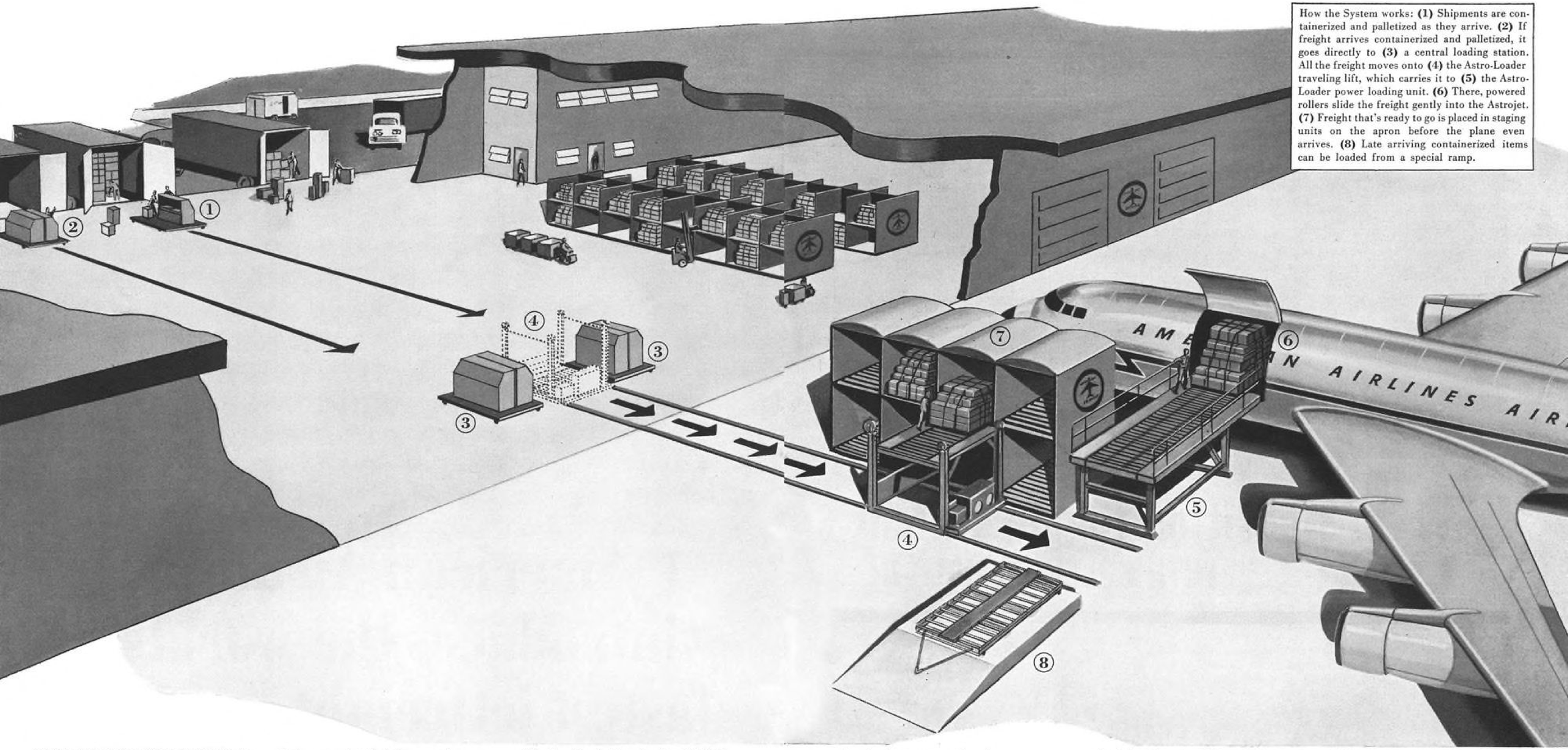

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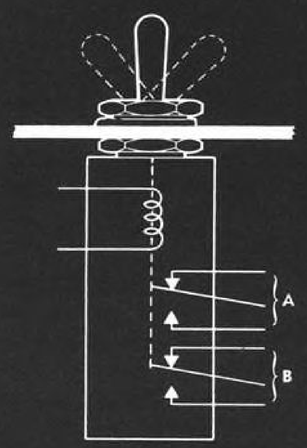

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Pilots Group Maps SST Operations Policy

By Herbert J. Coleman

London—Airline pilots from 30 countries warned last week that development of a supersonic transport should include their views on safe operations, and set next March for completion, at Manila, of a major policy statement covering their attitude.

In effect the pilots took the same "show-me" stand demonstrated last year at Amsterdam's blind landing system meetings (AW Nov. 5, 1962, p. 47) during the four day symposium here of the International Federation of Airline Pilots Assns. Key points:

• **Any attempt to introduce** SST aircraft on a commercial basis before their problems have been resolved to the satisfaction of IFALPA should be resisted by the federation and its pilots.

• **Airplane must be compatible** with other traffic, including those in the subsonic ranges.

• **Certification of SST aircraft** should be at the same level of safety as other aircraft being certificated by the same authorities at the same time. Pilots fear that attempts will be made to reduce standards for such items as pilot field of vision, fuel reserves or vertical landing gear loads at maximum weights.

• **Airplane must be designed** so that, in all foreseeable emergencies, chances for survival of passengers and cabin attendants must be either the same as, or the equivalent of, those intended for operating crew members. The federation will oppose any attempt to separate passengers from crews by pressure bulkheads. It is against providing crew members with special equipment which, in an accident resulting in passengers and cabin attendants being killed or seriously injured, would protect operating crew members. In addition, the federation said structural reliability of pressurized areas must be assured since the possibility of rapid decompression in flight cannot be tolerated.

• **In the area of SST noise,** the federation contended the airplane must not be such a nuisance to the public that the pilot in command is prevented from operating according to optimum procedure. This is a reference to further restrictions on in-flight maneuvers for noise abatement.

The federation, as always touchy in the field of licensing and pilot restrictions, claimed that an attempt may be made to prevent some airline pilots from flying civil SSTs because of age or physical and education characteristics. Federation members will strongly resist introduction by any authority of a special type of land-plane license for SST operations. They held that a pilot should, if qualified, be permitted to add any other type permit, including SST, to his current license.

Another problem is that of crew health, particularly in the field of radiation and other upper atmospheric phenomena. IFALPA said that until further evidence is available it will regard the maximum permissible whole-body doses and dose-rates recommended by the international commission on radiological protection as the highest allowable for federation pilots.

Other areas of concern:

• **Flight planning.** The federation said that prior to acceleration beyond subsonic speed, details of time, height and location at which the aircraft is due to return to subsonic speeds must be known in advance to the pilot in command. During the symposium, pilots expressed alarm that the necessary precision instrumentation for planning flight regimes does not yet exist, in view of 3 hr. of working time in the air.

• **Control and handling.** Every SST should be controllable as desired by the pilot or the copilot throughout the entire speed range and during any foreseeable emergency. Physical dimensions of flight decks must permit safe performance of pilotage, navigation, communications and systems management. Pilots indicated a fear that, in the search for greater aerodynamic efficiency, the trend in the industry is toward cockpits which are too small.

• **Navigational aids.** Each aircraft should be equipped with a proven, instantaneous, self-fixing navigational system so that both pilot and ground controller know the unmistakable location in transonic and supersonic flight. It was implied that nations involved provide ground personnel trained precisely for supersonic flight planning on the theory that the equipment is of no use unless properly manned.

Aside from what is now considered official IFALPA policy on supersonic transports, a considerable work program is being carved up between various committees for report to the Manila meeting.

For example, if a variable geometry wing is adopted for the U.S. supersonic transport, the federation will require that problems of possible asymmetry be designed out of the aircraft by fail-safe techniques. It wants the equipment to be satisfactorily demonstrated to members before operations commence. This includes all the work in the field of variable geometry intakes and exhausts such as those now under development for the Anglo-French Concorde and its Bristol Siddeley Olympus 593 powerplants (AW June 10, p. 61).

Another factor is flight controls. The federation will require that automatic subsystems, such as yaw and pitch dampers, be fully provided against failure, if any such failure would worsen the SST's handling characteristics. If new types of flight controls such as canard elevators are considered, the associated problems should be discussed with the pilot group involved—ALPA in the U.S., for example. Solutions

Subsonic Jets Near Technical Peak

London—Research and development is not likely to lead to more than minor improvements in subsonic jets—in engines, aerodynamics or structural efficiency—according to Dr. A. E. Russell, British designer of the Anglo-French Concorde supersonic transport.

Addressing a joint meeting of the Society of British Aircraft Constructors and Association International des Constructeurs de Materiel Aerospatial (AICMA), Dr. Russell explained:

"Certainly much has been claimed for boundary layer control to reduce aerodynamic drag. But this panacea has been known and discussed for many decades. Surely in so highly competitive a field as aviation, someone in some country would, by now, have invented a solution and offered it in some practicable form. The probability is that no solution exists."

Russell contended that the scope of inventiveness in subsonic aircraft is running dry "at least in so far as low operating costs are concerned . . . the facts are that the best types of current aircraft are safe, comfortable, reliable and reasonably fast. They are, however, at or very close to their pinnacle of technical achievement."

He acknowledged that supersonic transports will be more expensive. But he said that with the smaller fleet sizes made possible, improved frequency of operations and lower aircraft mile cost, "they offer the best chance in the long run of providing the most efficient means of transportation on long haul international routes."

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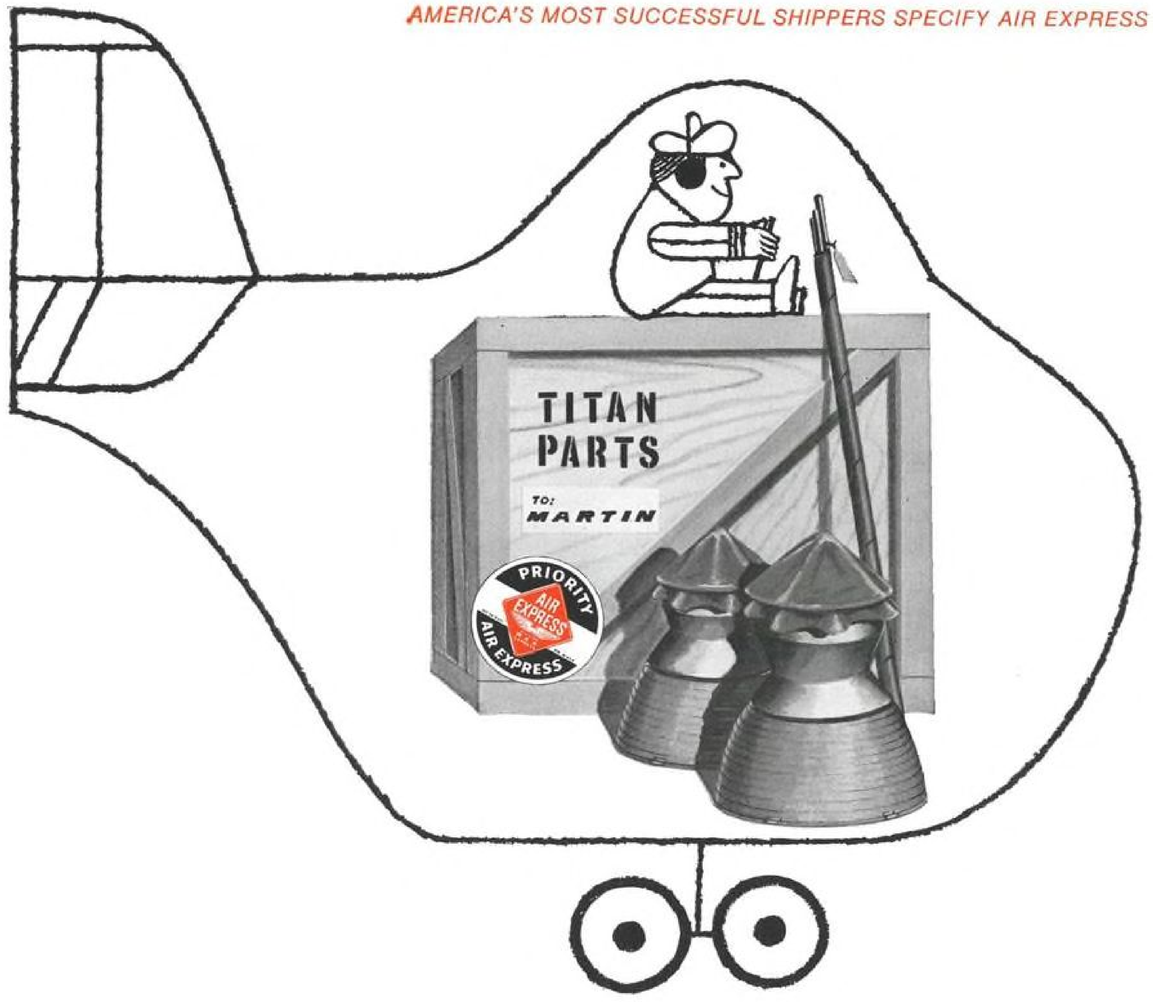

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adopted by manufacturers should be demonstrated to pilots before introduction into service.

Fuel control and systems were a major concern to pilots during the symposium. A special committee will study various parameters, such as fuel temperatures within the tanks, thermal degradation of fuel, and fuel balance. Another group will concentrate on ground handling and airport facilities, both existing and projected.

In the area of general working conditions, the federation is considering a requirement that, because of possible incidence of high g loadings caused by turbulence or transitional instability, a safety harness or some other protection should be provided for all occupants of the aircraft.

The symposium was planned for 250 delegates but attendance swelled to more than 450. It was opened by the Duke of Edinburgh—himself a licensed pilot—who warned that any ideas of introducing special flying techniques for supersonic transports to overcome noise, or to meet commercial requirements, should be abandoned.

"At best they hardly make any difference" he said, "and at the worst they can be very definite hazards to safe operation. Either the airplane is acceptable when operated in the normal way or it isn't. I see no point in compromising with safety."

The Duke agreed that pilots should be in on SST development from the start but added:

"Apparently this view is not universally held. For instance, there is no representative of active airline pilots on the government committee dealing with the Concorde project."

Another speaker was British Minister of Aviation Julian Amery, who acknowledged the present difficulties of design and construction of the Concorde but referred to "enormous quantities of brainpower and manpower to solve them."

Amery said he hoped that British Overseas Airways Corp. and Air France would be the first operators of the Concorde, although neither has indicated its needs as yet. Amery noted the airplane was off to a good commercial start with its foreign orders, (AW Nov. 18, p. 39) and added in an aside that if any of the airlines "unreasonably" cancel their orders, they will forfeit twice the money put down for places on the production line.

Discussing the design philosophy of the BAC-Sud Concorde, Pierre Satre, technical director of Sud Aviation, recalled that initial studies were aimed at a delta wing with a foreplane, because of the large lift obtained. Low-speed handling problems produced by this shape forced the team to abandon that direction. Satre said, for example, that at large angles of attack a canard surface forward of the main wing generated eddies which may seriously disturb flows around the other aircraft components.

"In particular," he continued, "the fin is greatly affected by the interaction of the canard surface. . . ."

Turning to a delta without a canard surface, Satre said it has proved necessary to alter the planform which was no longer a true delta shape, since the wing leading edge curved inward near the root, thus giving an increased sweepback, and the wing tips were truncated. This resulted in the so-called "Gothic" wing. Satre said it was also recognized by designers that the wing had to be given appropriate camber and twist, particularly in order to reduce balancing drag. That problem was resolved by the Concorde's principle of fuel transfer.

He said it was finally decided to provide a nose which also had variable geometry, meeting two requirements:

• **In cruise,** low drag and adequate visibility.

• **Visibility on takeoff,** during approach and in landing. Satre's comment could have been a reference to a new nose mockup now under construction at British Aircraft Corp.'s Bristol facility at Filton (AW Oct. 28, p. 35), which BAC refuses to discuss.

Satre said the variable geometry wing was dropped because of the cost of construction and maintenance. He said the absence of wing flaps was justified because of high thrust on takeoff, low wing loading on landing, and the "remarkable aerodynamic characteristics of the wing at low speed." He explained:

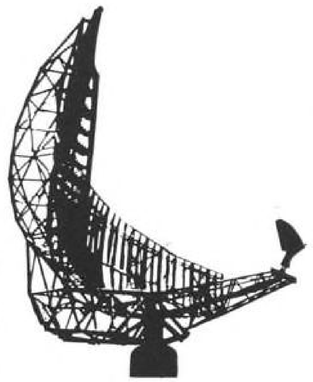
"This wing benefits in fact from natural additional lift resulting from a new type of flow—the leading edge vortices—which occur at landing angles of attack and persist beyond the normal operation limit without any sign of stall." Satre said that investigation showed the increase in lift obtained in this manner is on the order of 30% in relation to that forecast and measured for normal flow.

He added that an extremely favorable ground effect further increased the lift by 60% at the moment of landing gear touchdown. The airplane, he said, will have a high angle of attack in its approach configuration and the correspondingly heavy drag will ensure effective aerodynamic braking as soon as the pilot throttles back.

In supersonic cruise, the lift to drag ratio of the wing is on the order of 7.5 to 8. Normal flow is restored in subsonic cruise. Satre said that, due to the type of camber chosen, it is thus possible to obtain lift to drag ratios on the order of 13 to 14—about the same as on four-engine subsonic jet aircraft.

Satre also said that the high lift to

JET AGE TRAFFIC CONTROL



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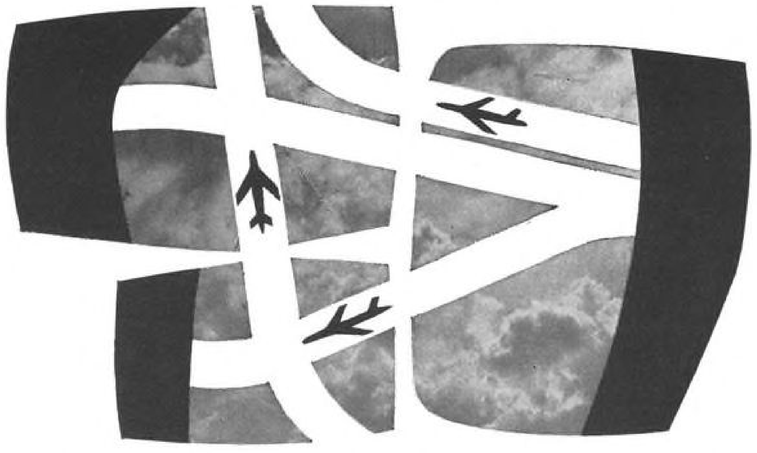

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drag ratio enables a high rate of climb-out, thus reducing noise on takeoff. Because this ratio is maintained on transonic flight, afterburning is not required for acceleration beyond Mach 1, Satre said.

"Defined in this way," Satre said, "the aircraft can be considered as remarkably simple. The wing is fitted with no moving parts, with the obvious exception of the elevons.

"The only systems which are at all new, such as the fuel transfer system and the variable air intakes, are relatively simple and will have been widely tried out on numerous aircraft already in service when the Concorde makes its first flight."

The Concorde will include an automatic throttling system tied in with blind landing system. Both devices now are being tested on the Sud Caravelle at Toulouse.

Shifts of center of gravity when the airplane goes from subsonic to supersonic speeds—in the case of the Concorde, the cg in subsonic flight is about 50% of the mean aerodynamic chord (MAC) and moves back to 60% MAC in supersonic flight—is accomplished by fuel transfer. This is done by transferring fuel from the forward tanks to a trim tank in the rear fuselage.

Safety of the fuel transfer system, Satre said, will be obtained through duplication of circuits and transfer pumps, and by making it possible to drain the after-tank. Last resort will be a jettison system.

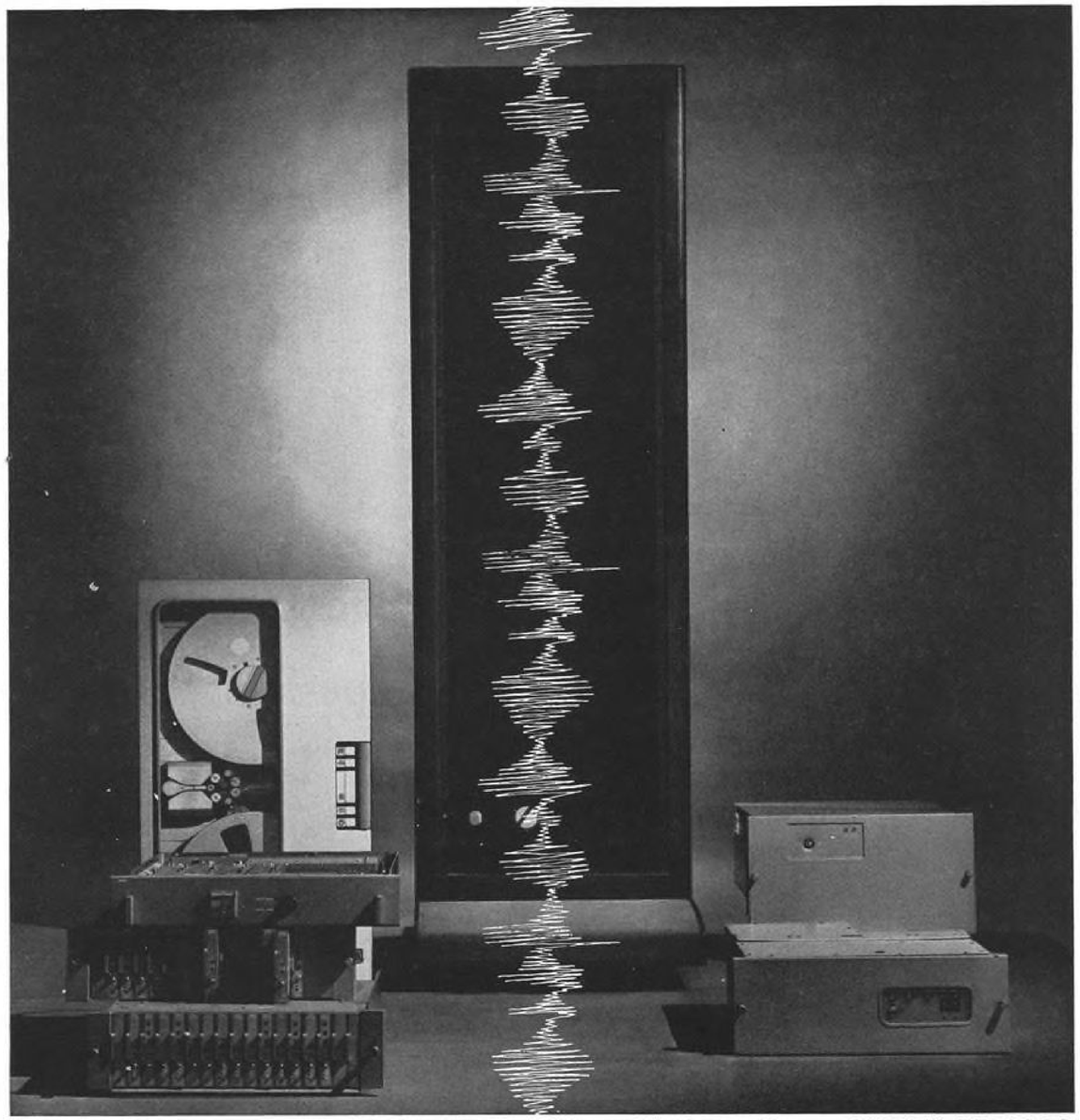
Discussing engines, Thomas P. Frost, chief pilot of Bristol Siddeley, and J. P. Little, Olympus 593 project engineer, told the pilots that the compressor and combustion system will be based on units now in service on Avro Vulcan Mark 2 bombers, but also will use materials under development for TSR.2 powerplants.

They said mass flow of the 593 has been increased. Hardware in this form has run for a considerable period on testbeds at Filton.

Frost and Little said jet pipe may contain a partial afterburning system. This is still a matter of discussions with the French but if the system is fitted, it will be a single gutter type with fuel injectors integral with the gutter. The increase in the jet pipe temperature obtained by this system will be on the order of 300C, with additional thrust of about 25% at Mach 1.2.

Use of the afterburner will be limited to short periods during transonic acceleration. The climb phase of flight and control will be of the on-off variety actuated by a single cockpit switch.

Speakers added that petals of the primary nozzle may be formed to carry silencing lobes, providing an additional degree of noise silencing of some 5 db. at the nozzle for a small thrust penalty.



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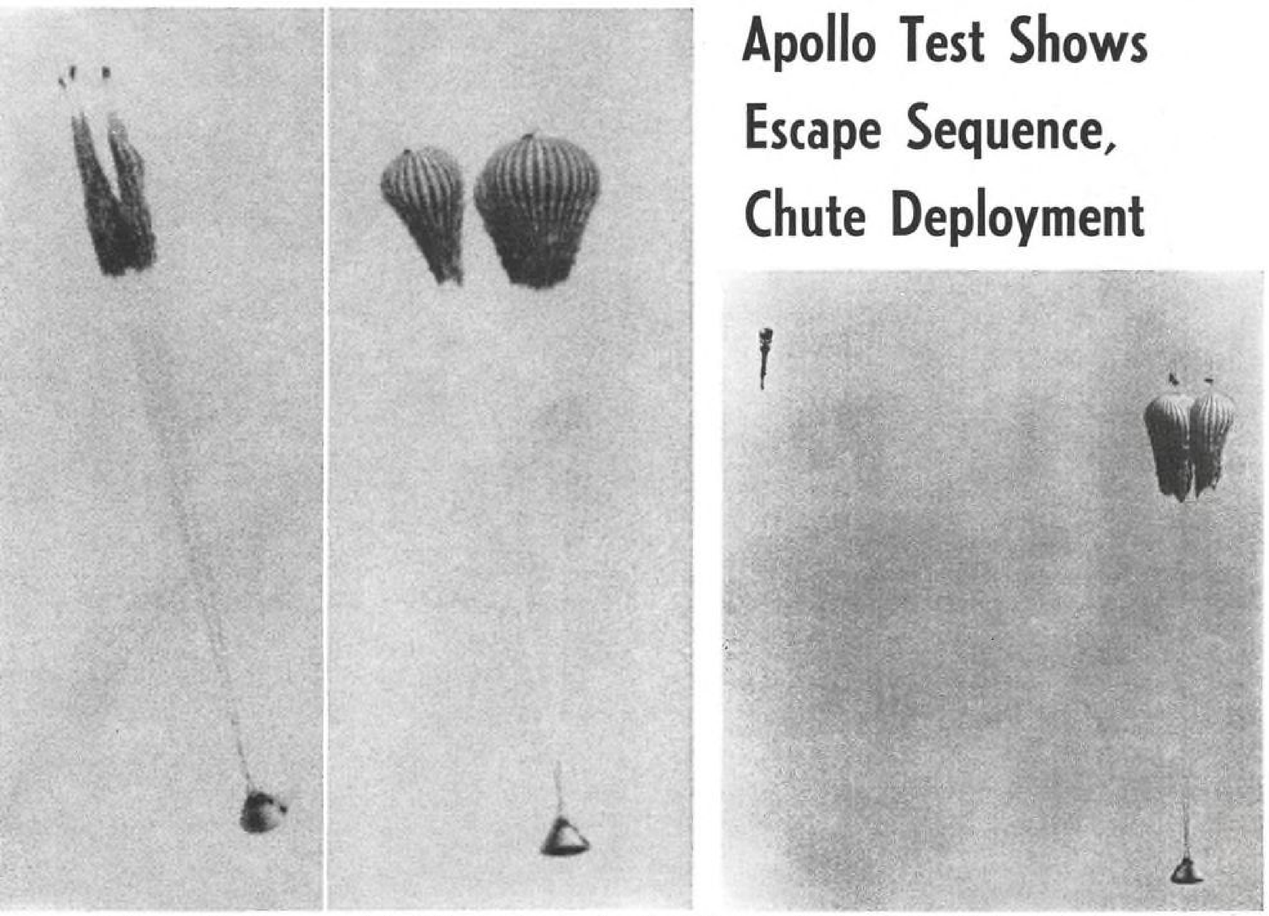
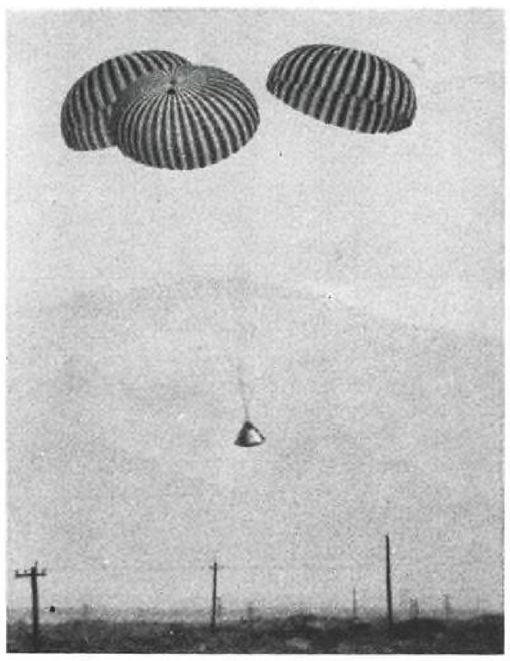
Main engine of Apollo escape system burned for 8 sec., with 155,000 lb. of thrust during test launch. Note exhaust of pitch control motor near nose (AW July 22, p. 44). Tower separation (above, center) shows ignition of Thiokol motor. Note command module at left between plumes.

Apollo Test Shows Escape Sequence, Chute Deployment

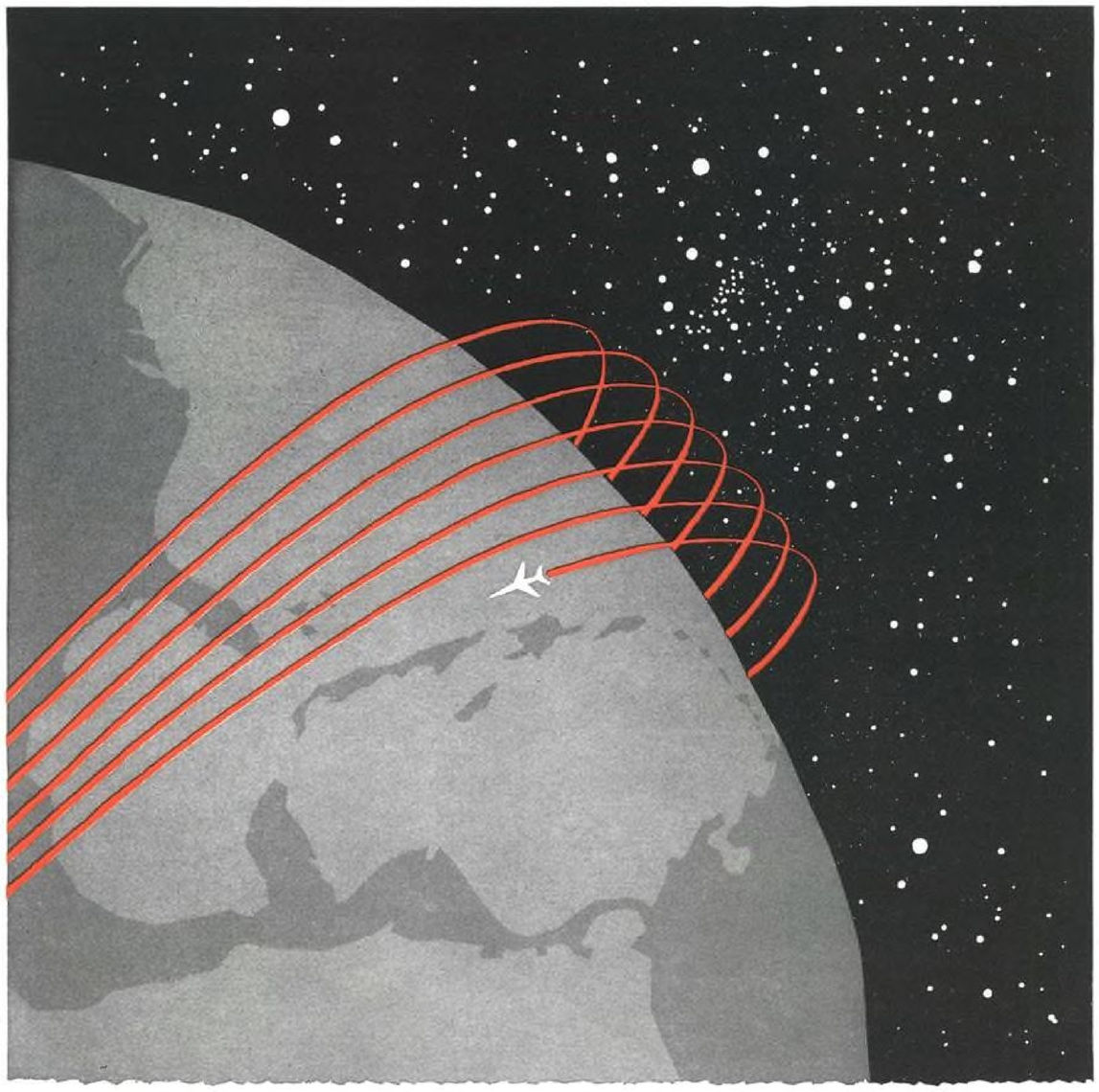
Tests of Apollo escape system at critical altitudes will follow successful first pad abort test at White Sands Missile Range, N. M., Nov. 7 (AW Nov. 11, p. 42). Purpose of the launching was to test operational characteristics and stability of Apollo escape configuration. Apollo boilerplate capsule was lifted beneath its 23-ft. escape tower to a height of 5,100 ft., propelled by solid-propellant launch escape motor designed and developed by Lockheed Propulsion Co. A second motor, for pitch control, controls direction of flight. Escape system above the command module is jettisoned by a Thiokol TE-380 rocket motor. Three Northrop Ventura main parachutes (below), each 88 ft. in diameter, deposited the empty Apollo capsule 7,600 ft. from the pad. Rate of command module descent was 24 ft./sec., compared with 30 ft./sec. descent for the Mercury capsule. Total flight time was 3 min. 45 sec. Only apparent damage to the spacecraft, developed and built by North American Aviation's Space & Information Systems Div., was slight singeing from rocket exhausts. Weighing about 9,000 lb., the boilerplate command module for the pad abort test measured 11 ft. 9 in. tall and 12 ft. 10 in. wide. It had a laminated glass heat shield and aluminum honeycomb core, but no ablative material.



Continuance of rapid sequence photos (left and center, above), made at 10-per-sec. rate, show Northrop Ventura main chutes in reefed condition immediately after extraction, and opening to allow descent of module at 24 ft./sec. rate. A different camera made photo (right, above) of jettisoned escape tower and module descending.



Near capsule touchdown, 88-ft. Ringsail cluster is shown fully inflated. Apollo boilerplate module (right) is inspected after touchdown.



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Still Cameras Designed for Lunar Mission

By Ward Wright

New York—U. S. camera manufacturers are proposing designs of still cameras for lunar exploration although the National Aeronautics and Space Administration has not specified a requirement for photographic coverage of the mission.

Unsolicited proposals or technical memos have been prepared by Graflex, Fairchild and Defense Systems, J. A. Maurer, Inc., Chicago Aerial Industries and others who anticipate a NASA need for hand-held or mounted cameras.

Although the initial Apollo missions are directly involved, manufacturers also are interested in later space exploration.

No photographic mission has been defined for Apollo. No money has been allocated or released to industry for studies. A few persons at NASA's Manned Spacecraft Center in Houston are studying what has been submitted so far, but no requests for proposals have been made.

There is concern that in the rush for more glamorous Apollo hardware the camera program may be left to the last minute, so manufacturers have gone ahead on their own in the hopes of proving their designs early.

Camera Categories

Suggestions for a lunar camera fall into two categories.

One approach is to enclose an existing camera, probably with necessary modifications, in a sealed container to protect it from the moon's environment. The camera could be controlled remotely.

The second approach is to design an entirely new camera specifically for lunar photography.

Maurer, whose lunar camera studies have been geared more to later lunar landing missions than to Apollo, believes a fresh design will be needed. Graflex says its studies indicate there is no existing camera—with or without professional modifications—which offers the needed reliability for the Apollo missions. Fairchild has considered both possibilities but says, in its memo on the subject, that a camera designed to operate without protection in the lunar environment would provide valuable experience for later manned space missions.

Regardless of what approach these companies feel is best for a lunar still camera, they are in agreement that any camera design will have to consider these environmental factors:

• **Temperature.** Lunar temperature ranges from about 270F in the center of the moon's bright side to —184F on the dark side. A larger lunar camera operating on the moon's bright side might suffer structural deformation and loss of focus until the heat differential between the sunlit and shaded portion of the camera were equalized through conduction. Maurer suggests a venetian blind used like a beach umbrella as a possible sunshield for its concept of a combination tripod-mounted, hand-held camera.

Fairchild and Graflex feel temperature does not pose a great problem for small, hand-held cameras in the "twilight" Apollo landing area. Temperature inside the Apollo vehicles, moreover, is planned for a 80-110F range—well within present camera limitations.

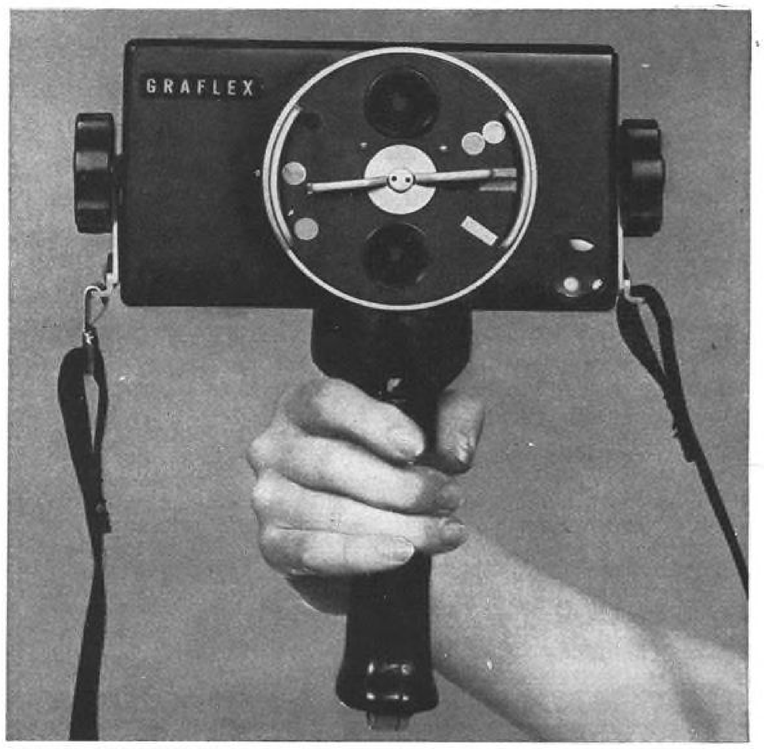
• **Pressure.** Camera design for a lunar surface pressure in the vicinity of 10^{-12} torr will require careful selection of materials to avoid welding of metals and "freezing" of mechanisms from vacuum distillation of lubricants. One solution suggested by Graflex and Maurer is to gasket the camera so that its interior will be pressurized on the order of 10^{-2} torr, to make the types of materials and lubricants less critical. Graflex, however, believes the most satisfactory approach is to design a camera to operate in the lunar vacuum.

A Mylar type film has been suggested as having good high vacuum properties and low temperature flexibility compared with normal plastic base films.

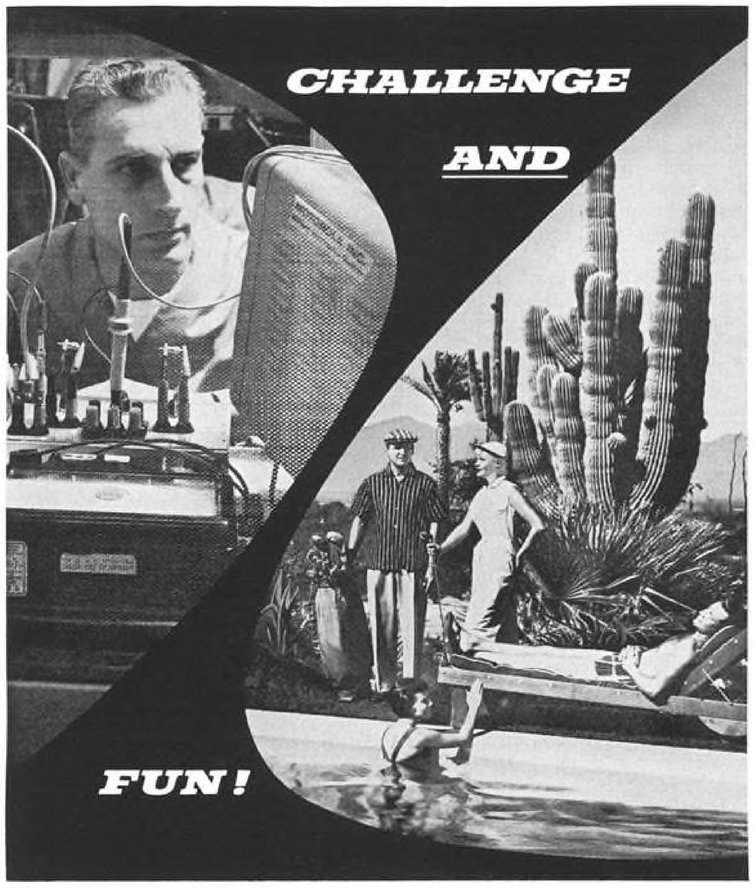
Effect of vacuum and lack of moisture on emulsions will require further study, the companies say.

• **Radiation and cosmic rays.** Radiation produces a number of harmful effects on photographic emulsions, including reduced contrast, higher fog level and increased grain size. For the Apollo mission, Graflex feels it is impractical to shield a hand camera from radiation or cosmic rays with any known materials. Because of the harmful effects of radiation on organic compounds—mainly outgassing and structural change—a lunar camera should avoid plastics as means of saving weight, Graflex says. In addition, Graflex recommends organic materials be kept away from film due to their tendency to alter the characteristics of the emulsion when in close contact.

Fairchild believes simple shielding and the bulk of the camera body itself



GRAFLEX HAS DESIGNED a mockup of a hand-held camera for lunar exploration by astronauts. Gunsight viewfinder, which is to be mounted on top of the camera, is not shown.



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will give adequate protection from most types of radiation. Gamma rays may be most troublesome of the lunar radiations because they can penetrate a film magazine and imprint a radiograph of the surrounding material on the emulsion.

• **Subject field brightness.** Sunlight entering a space vehicle or striking the lunar surface will be strongly collimated, compared with the diffused light of earth. Graflex feels that standard types of exposure meters won't be reliable unless heavily tempered with a professional photographer's judgment. Some modification of existing exposure meter applications will be called for, the company says.

Exposure Data

One of the problems all lunar camera designers face is the lack of exposure information on the moon. Graflex suggests that the first Apollo landing team take a variety of pictures at different camera settings to enable the best to be pin-pointed for the future.

Graflex believes 90% of all instrumentation, personnel and records within the Apollo vehicles can be photographed with visible spectrum black and white film and an electronic flash.

For shooting through the Apollo vehicle's ports, color film exposed through normal and telephoto lenses with proper filters will cover 80% of all photographic situations involving the earth, moon and objects outside the vehicle, according to Graflex.

Stereo might prove desirable for shots on the moon within 20 ft. of the camera, Graflex says. Lunar landscape shots can be taken in black and white or color through wide-angle lenses. Landscape details can be taken with normal and telephoto lenses.

Graflex Studies

Lacking specifications from NASA, Graflex has gone ahead with lunar camera studies and has suggested components and designs for 16-, 35- and 70-mm. lunar hand cameras. The company has also built lunar camera mockups which have been tested, with NASA's cooperation, for easy handling by astronauts wearing space suits.

Graflex, as have other companies, has indicated a preference for 35-mm. film for a lunar camera. This size used in Graflex's favored camera configuration effectively doubles the picture area yet increases the camera size only 4½% over a similar 16-mm. design. Even though 35-mm. film weighs about double that of 16-mm., Graflex believes the additional information gathered by the 35-mm. offsets any weight penalty.

Graflex's preferred camera design would measure about 7 in. long by 4½ in. high with a case thickness of about

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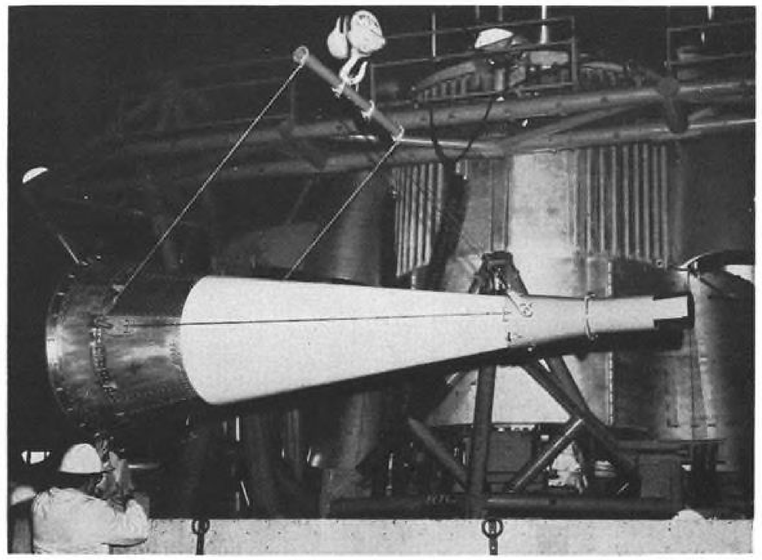
Chartered to give the U.S. Government the benefit of the best in space and missile knowledge and experience, Aerospace serves as architect-engineer in the advancement of space science and technology. It is an organization dedicated to planning, evaluation, and technical direction of missile and space projects for the Air Force.

Aerospace Corporation's product is thoughtful guidance. If *your* creative imagination and high technical competence combine to produce *guiding thoughts*, you will find opportunity for satisfaction at Aerospace.

For complete information, write to Charles Lodwick, Room 101, P.O. Box 95081, Los Angeles 45, California. An equal-opportunity employer.

AEROSPACE CORPORATION

Organized in the public interest and dedicated to providing objective leadership in the advancement and application of space science and technology for the United States Government



ABRES Experimental Re-entry Body Shown

Re-entry body Rex 3 (reduced exoatmospheric cross-section), developed by Chrysler Corp., was tested in a recent launch aboard an Atlas D ICBM from Vandenberg AFB, Calif., the fourth in a series of launches designed to advance the state-of-the-art of re-entry systems. The program is being conducted by Advanced Ballistic Re-entry Systems Office (ABRES) of USAF Ballistic Systems Div. The sharp nose of the body, blocked by the handling sleeve, is part of long, slender shape intended to reduce radar cross-section. Re-entry body is coated with special radar absorbing material, developed by Conductron Corp.

2½ in. The case would be topped by a gunsight viewfinder. It would be supported by a center-mounted, 4½ in. handle fitted with a trigger to the shutter action.

Its film would be dual, 35-mm. Mylar type double-perforated film strips packed in standard cassettes arranged one above the other horizontally across the camera. Unlike most 35-mm. packing, in which the film is wound onto a spool and rewound into the cassette, Graflex suggests using two cassettes with each film strip with the film prethreaded.

This method would ease an astronaut's task of reloading the film while wearing space gloves, and would eliminate the need for rewinding. Each cassette would contain 70 frames, 24 x 36 mm. each.

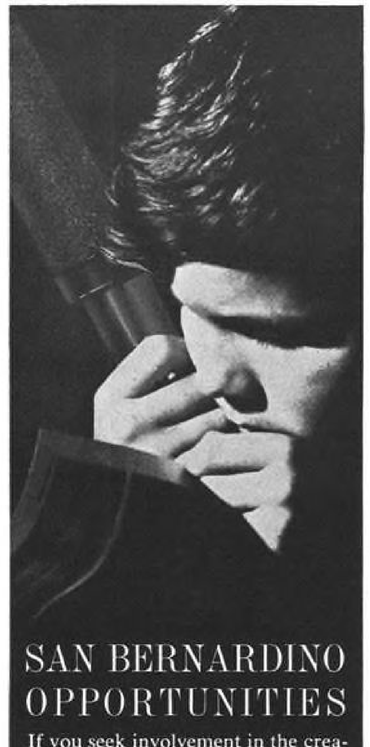
By using one color and one black and white film, a single camera can accommodate three modes of operation: At the option of the astronaut, either color or black and white exposures could be taken. Held sideways, and set for exposure of both color and black and white simultaneously, the camera would produce stereo.

Graflex says it favors a rotating disc, focal-plane shutter for maximum reliability and lubrication-free operation. With this type of shutter, a single rotating disc with its shutter opening could sweep past the upper and lower film strips and permit switching from one mode of operation to the other with minimum complexity.

Film transport might best be accomplished electrically, with a mechanical stand-by system, Graflex says. The company suggests that a small electric motor be buried in the handle with power supplied by a separate battery pack or from an outlet in the astronaut's life support pack. Frames could be changed mechanically in case of power failure by twisting the handle, according to the company.

Conventional, multiple-thread helical lens mounts for focusing may not prove feasible in space because of their dependence on lubrication for smooth operation. Graflex suggests a removable disc arrangement, mounting several lens and filter combinations. For a given shot, the astronaut could turn the disc to line up the desired lenses and filters. Or, if the lens and filter desired were not on the disc, it could be quickly replaced with another containing the proper one. An independent diaphragm aperture disc, mounted within the camera behind the lens disc, would regulate the light admitted to the camera.

Because of the strongly collimated light on the moon, Graflex would incorporate a 3 deg., narrow field of view, cadmium sulphide exposure meter which has been bore-sighted to the camera's viewfinder. The exposure meter then gets a reading on the actual object to be photographed. In the in-



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If you seek involvement in the creation of a new missile center, you should investigate unusual ground-floor opportunities in the following and other areas at Aerospace Corporation's new San Bernardino, California, facilities.

- Command & Control Systems
- Inertial-Guidance & Navigation Systems
- Vehicle-Control Systems
- Instrumentation Sensors
- Telemetry Systems - Transducers
- Guidance Computers
- Digital Data-Processing Techniques
- Re-entry Countermeasures
- Test Range Instrumentation
- Nuclear Effects
- Electrical Power Systems
- Electromagnetic-Propagation Theory
- Secure Communications

In order to qualify for these and other positions, you should have at least five years' experience and, preferably, an advanced degree. Qualified applicants are invited to contact Aerospace Corporation, an equal-opportunity employer. Please write to Mr. R. E. Durant, Room 101, P. O. Box 249, San Bernardino, California.

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terest of reliability, the company believes there should be no automatic coupling between the exposure meter and the camera's lens and shutter system.

Rather, it feels that the needle of the exposure meter should be manually matched with a pointer coupled to the camera's shutter speed and diaphragm disc system. The matching would be accomplished through a bulky, easily grasped knob on the left side of the camera case. A similar knob, on the right, would control the camera's mode of operation. Bayonets on the lens disc would permit easy attachment of a telescope.

Because the fixed window of the astronaut's helmet is about 3 in. from the eye, Graflex believes conventional viewfinders will be inadequate. They suggest imprinting a rectangle on the visor at eye level to define the area covered by the camera's lens, then lining up the camera's gunsight viewfinder with the object to be photographed.

PRODUCTION BRIEFING

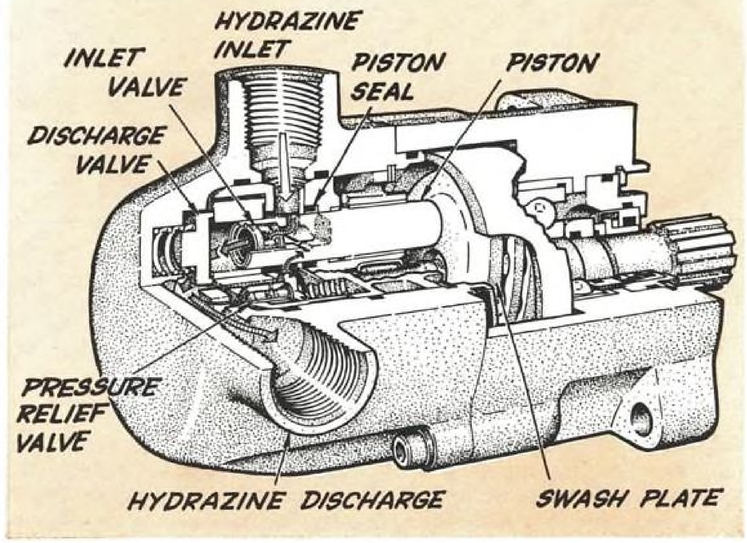
Lockheed-California has received a $74,000 study contract from Air Force's Aeronautical Systems Div. to determine means of evaluating mechanisms for orbital connection, docking, and object retrieval in space vehicles. The study is designed to lead to a method of simulating these procedures in a ground facility.

General Dynamics Corp.'s Ft. Worth, Tex., Div. has received a $200,000 contract from Air Force Systems Command's Aeronautical Systems Div. to investigate ways of improving the properties of metals by increasing both density and strength. By increasing the density to nearly 100%, it may be possible to fabricate thin-walled parts for space hardware from tungsten and molybdenum, according to the company.

Curtiss-Wright Corp. has received a $200,000 contract from Rocket Propulsion Laboratory of USAF Systems Command to conduct an applied research program for high-temperature rocket nozzles. The uncooled, restartable nozzles will be fabricated from pyrolytic graphite, a material which can be designed to absorb or dissipate extreme nozzle exhaust temperatures (AW Apr. 8, p. 94).

Greer Hydraulics, Inc., Los Angeles, Calif., will conduct additional research and development of missile launch site hydraulic power under a follow-on contract from National Aeronautics and Space Administration.

(Continued on p. 62)



PROBLEM: To Develop a Pump to Handle a Low Lubricity, Corrosive, Monopropellant for Space Application

SOLUTION: SUNDSTRAND'S POSITIVE DISPLACEMENT HYDRAZINE PUMP

In order to utilize lighter, low pressure fuel tankage for a storable space power system, Sundstrand engineers faced the problem of developing a fuel boost pump which would handle hydrazine.

Performance requirements were:

FLOW RATE	1 GALLON PER MINUTE
DISCHARGE PRESSURE	1450 PSI
OPERATING SPEED	6000 RPM
LIFE	75 HOURS

MAXIMUM RELIABILITY, MINIMUM SIZE AND WEIGHT

Here's where Sundstrand's long experience in the design of positive displacement pumps and motors paid off. More than 75 hours of operation at 6000 rpm as part of a space power system has proven that the Sundstrand-developed pump performs easily within these specifications. Volumetric efficiency of more than 90% has been demonstrated.

The poor lubricating qualities of hydrazine were side-stepped by eliminating sliding valves, minimizing side loading between piston and cylinder, and exercising extreme care in selection of materials. Lubrication of other moving parts was accomplished by isolating them from the hydrazine.

This basic pump design for low lubricity fluids has many applications in other hard-to-handle fluids. Perhaps you have an application for such a pump, or perhaps you have a fluid supply system problem that Sundstrand engineers can help you solve. For more information on this pump or a description of our varied experience and facilities, write to: Manager, Applications Engineering.

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AN EQUAL OPPORTUNITY EMPLOYER

HOW KEYS TO OUTER SPACE SECRETS WERE FOUND ON EARTH

When Eimac built its first vacuum power tube many years ago, we had no idea we were starting on a path that would lead us one day to outer space secrets. But we were. ■ A surprising number of materials that are now coming into prominence in aerospace hardware are well known at Eimac. For more than ten years we have kept a metallurgy laboratory busy dealing with the behavior of metals like titanium, tungsten, rhenium, columbium, and zirconium, in a vacuum and at extreme temperatures. Eimac was the first to exploit the desirable electrical and physical properties of ceramics for electron power tubes, and remains today their largest manufacturer.[1] At Eimac, the once black art of uniting metals and ceramics has become a science. This experience makes it possible for Eimac to design aerospace structures that will retain their strength in such highly corrosive environments as liquid potassium, caesium, and even lithium. ■ Among Eimac's notable accomplishments in the aerospace field are the development of hermetically sealed ceramic-metal plugs which give ready plug-in access to thermocouples to read temperature inside klystrons (or rockets)...nuclear batteries...bore seals to isolate reactive elements in nuclear generators...sapphire-to-metal bonding of rf and optical windows. These are but a few of Eimac's new contributions to aerospace technology which have resulted from years of capability in vacuum tube manufacturing. ■ We recently successfully designed rugged new electro-explosive devices[2] for rocket use. And we did it in less than four months. Reaction this quickly was possible only because we had the basic technology already at hand. Pin-to-ceramic and ceramic-to-body bonds are brazes of vacuum tube quality proved reliable in more than ten years' manufacturing history. These Eimac exploding bridge wire devices are now being flown on the new Polaris A-3 developed by Lockheed Missile and Space Company, Sunnyvale, California, for the U.S. Navy. ■ In short, through long experience designing and building electron power tubes, Eimac has created keys to new aerospace technologies, because we had to find out many answers that weren't generally available. We're taking these technologies out of our pockets to help unlock more of the mysteries of outer space, helping to open the way to new aerospace developments.

1. *We have a booklet crammed with strong facts about our ceramic-metal capabilities. It's yours for the asking.*
2. *They're detonators and squibs. Want details? We'll be happy to send you more information.*

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Eitel-McCullough, S.A., Geneva, Switzerland

(*Continued from p. 61*)

Convair Div. of General Dynamics Corp., San Diego, Calif., has been awarded a $31-million follow-on subcontract from Lockheed-Georgia for 127 empennages for the Air Force/Lockheed C-141 StarLifter jet transport.

Raytheon has received an add-on Air Force contract for $3.7 million for Project Red Mill, an over-the-horizon ICBM detection system, bringing total program award to date to $7.4 million.

Martin Co., Baltimore, Md., has been selected by the U. S. Atomic Energy Commission as one of two contractors to begin development of nuclear electric generators for communications satellites. The other contractor is General Electric Co., Valley Forge, Pa. Martin is exploring the use of Strontium-90 as fuel for the reactors under separate contract. Strontium-90 is being considered because of its low cost and abundance. Previous space reactors have used Plutonium-238 as fuel.

Pratt & Whitney Div. of United Aircraft Corp. will conduct further development of its RL-10 liquid hydrogen-oxygen rocket engine under a $3.3-million contract extension from National Aeronautics and Space Administration's Marshall Space Flight Center. Work will include engine modifications and testing.

Sundstrand Corp.'s Aviation Div., Rockford, Ill., will develop and produce a geared constant-speed drive to run the 400-c., 40-kva., a.c. electrical generators for the Douglas DC-9 twin-jet, short-haul transport. Contract was reported to be in excess of $2.5 million.

Kellett Aircraft Corp., Willow Grove, Pa., will supply hand-held, gas-cartridge-operated devices to cut parachute harnesses, shroud lines, straps and other materials under a $93,000 Navy Air Engineering Center contract. The devices are used in air-sea rescue operations.

Beech Aircraft Corp., Wichita, Kan., will continue to supply bomb dispensers and containers under a $3.3-million follow-on contract from the Army. Total dollar volume of work under the program to date is $8.1 million.

Emerson Electric Mfg. Co.'s Electronics and Space Div., St. Louis, Mo., will develop a combined weapons system for Bell UH-1B helicopters, integrating the M6 quad-mounted machine gun subsystem with two Aero 6D, 2.75-in. folding-fin aircraft rocket pods. Contract was awarded by Army for an undisclosed amount.

(*Continued on p. 67*)

Artwork by Glenn Dodenhoff—courtesy Northrop Corporation

Once again... CECO Fuel Pumps were selected

Northrop's highly versatile F-5 MAP supersonic fighter is powered by two General Electric J85 afterburning jet engines equipped with fuel pumps engineered and precision-produced by Chandler Evans.

This CECO product on the Northrop F-5 joins a distinguished line of pumps, main fuel controls, afterburner controls and other jet engine components in an array of important military aircraft as well as with many of the latest and finest missiles and commercial aircraft.

CECO is pleased to be "known by the company its products keep" and by the records those products establish.

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CECO® SYSTEMS CONTROLS

GAC participated in the development of—and is now producing—the plastic filament-wound first stage rocket motor case for the Polaris missile. GAC has been working on filament-winding since 1949, built the first plastic rocket motor case qualified for U. S. production.

Goodyear Aerospace has proved experience in plastics

Aerospace plastic experience at GAC—Goodyear Aerospace Corporation—covers everything from visors for jet pilots' helmets to radomes for space vehicles—from high-temperature-resistant cockpit canopies to 140-foot-diameter ground-based radomes—from glass filament-wound motor cases for Polaris A-3 to radomes for Gemini reentry vehicles.

Creating products like these calls for a knowledge of plastics in virtually every physical form and chemical composition . . . complete environmental and physical test laboratories... plus full development and production facilities.

Most important, it calls for a large staff of expert plastics engineers and scientists who, in turn, can call on GAC's capabilities in systems management, astronautics, avionics, advanced electronics, expandable structures, ground support, antenna systems and other aerospace areas. These aerospace capabilities are ready to help on your project, too. Write Goodyear Aerospace Corporation, Box 910AK, Akron 15, Ohio.

Some aerospace systems with Goodyear Aerospace Corporation plastics: McDonnell: F4-C • Ling Temco Vought: F8D and Norair F5A canopies • Grumman: A6A honeycomb radomes • Boeing: 707 and 727 windows • RCA: BMEWS 140-foot plastic radomes. Plants in Akron, Ohio, and Litchfield Park, Arizona.

GOODYEAR AEROSPACE

This is an incandescent ball of gases, plasmas, magnetic fields, thermonuclear reactions and mysteries.

But NASA has started to throw some light on it.

After all, the sun does sustain life on earth. It disrupts our communications, pours deadly radiation into space and makes our weather do tricks.

So we need to learn the how and why and when of the sun's phenomena. And in the process pick up some basic facts about the whole universe.

So far the trouble has been that our atmosphere acts as a barrier. It makes optical and photographic and spectrographic images shimmer and scatter. In fact it completely *stops* most of the sun's radiation spectrum.

Now . . . if we could only put our instruments *outside* the earth's atmosphere . . . in a new and extremely sophisticated satellite . . . pointed precisely at the sun . . . .

Today, development work for that satellite—the Advanced Orbiting Solar Observatory—is being performed at Republic, under a prime contract to NASA/Goddard.

The AOSO will orbit 300 miles above the earth. In sunlight uninterrupted for months on end. Carrying about 250 pounds of instruments to collect, store and transmit data on the sun's gamma-ray, x-ray and ultraviolet activity.

It will be aimed at the sun with an accuracy of five seconds of arc. That's like shooting at a dime one-half mile away. And hitting it.

NASA's Advanced Orbiting Solar Observatory will look something like the model below. Nobody expects it to find *all* the answers that solar physicists and astronomers have sought for 350 years. But after it has studied that incandescent ball for a while, we'll be a lot less in the dark.

REPUBLIC
AVIATION CORPORATION
FARMINGDALE, LONG ISLAND, NEW YORK

(*Continued from p. 62*)

American Machine & Foundry Co. has bought the Naval Ordnance Plant in York, Pa. for $9.6 million. Work will begin at the new plant on $25 million in Navy contracts, including anti-submarine rocket launching equipment and gun directors.

Hercules Powder Co., Magna, Utah, will continue research and development work on improved Stage 3 Minuteman ICBM motors under a $5.1-million Air Force supplemental contract.

Douglas Aircraft Co., Long Beach, Calif., will build A4E Skyhawk aircraft under a $46.7-million firm fixed-price contract from the Navy.

Beckman and Whitley, Inc., San Carlos, Calif., will provide destruct devices for Air Force's unmanned X-20 (Dyna-Soar) test vehicles. The $165,000 contract was awarded by Boeing.

Boeing Co., Seattle, Wash., and NASA have signed a supplemental agreement to the contract for development, fabrication, and test of the first stage of the Saturn 5 space vehicle at an additional cost of approximately $27.4 million.

Yale University, New Haven, Conn., has been awarded an $83,785 NASA contract to design and develop a worldwide radio monitoring network for studying Jupiter. Primary function of the network will be to monitor the low-frequency radio noises sporadically emitted from the planet. The monitoring system will consist of stations located at approximately every 90 deg. in longitude around the world.

General Dynamics/Pomona, has been awarded $2.9 million for continued R&D work on the Redeye surface-to-air guided missile.

General Precision, Inc., Little Falls, N. J., has been awarded a $3.6-million Army contract for Pershing missile equipment.

Belock Instrument Co., College Point, N. Y., will build 12 Hawk missile trainers under a $2.2-million Army contract.

Blount Bros. Corp., Montgomery, Ala., has been awarded a $5-million firm fixed-price Air Force contract to build a 50-megawatt electro gas dynamics research facility at Wright Patterson AFB, Dayton, Ohio.

Radio Corp. of America, Camden, N. J., will continue design, manufacture

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Model PA-1000
Maser Assembly

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• space probe tracking

• radio astronomy

If you are engaged in advanced space-age studies involving high sensitivity radar, space communications, low-noise radiometry or radio-astronomy, you are aware of the importance and increasing use of masers in microwave amplification.

Masers are used of necessity wherever low noise is a prime requirement.

Laser Systems Center, specializing in laser/maser R&D and manufacturing, now offers several varieties of masers for use in the X, XB, and KU bands. These include tunable cavity masers or complete maser radiometer packages (solid-state cavity, helium dewar, magnet, I-F amplifier, and detection and display equipment).

Typical signal characteristics (7 kmcs to 18 kmcs) using circulator input and open cycle refrigerant system: 70°K overall receiver noise temperature; 25°K to 35°K maser preamplifier noise temperature; 20 db to 23 db of preamplifier gain; 5 to 30 mcs bandwidth.

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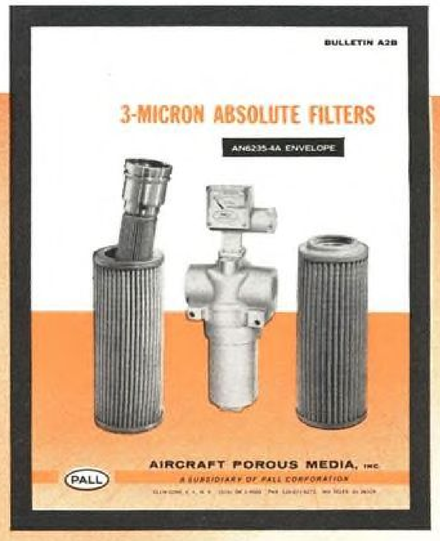
New studies by PALL and scientists at leading aerospace and industrial facilities have proven that the cause for continued wear is extremely fine contaminants circulating in the fluid. Too small to be seen by the naked eye, these less than 5-micron (0.0002") diameter particles act as a lapping compound and grind away at the surfaces by getting between the moving parts.

Naturally, these ultra-fine particles pass right thru the 10-micron nominal (absolute 25-micron) filters used in most systems. Most of them even go thru the nominal 1.5-micron (absolute 15-micron) filters found in a few of the latest systems. While these filters prevent passage of the large particles that might cause a catastrophic failure, they do little to control the wear caused by less than 5-micron contaminants.

Now there is an exclusive 3-micron absolute filter developed to continuously remove "lapping" size range particles, reducing wear and erosion to a negligible amount. Based on an epoxy impregnated and coated paper filter medium called ULTIPOR.9, these disposable and relatively inexpensive filters are available for a wide range of system requirements.



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■ Sized to AN6235-4A (1¾" dia. x 4½" long). ■ Both 2-stage & 1-stage filters fit into a standard MS28720-12 housing. ■ Absolute 3-micron particle removal per MIL-F27656A(USAF). ■ Absolute 1-micron rating using standard APM-F-9 glass beads. ■ Available off-the-shelf, with or without housing. ■ Zero media migration. ■ Disposable. ■ Low cost.

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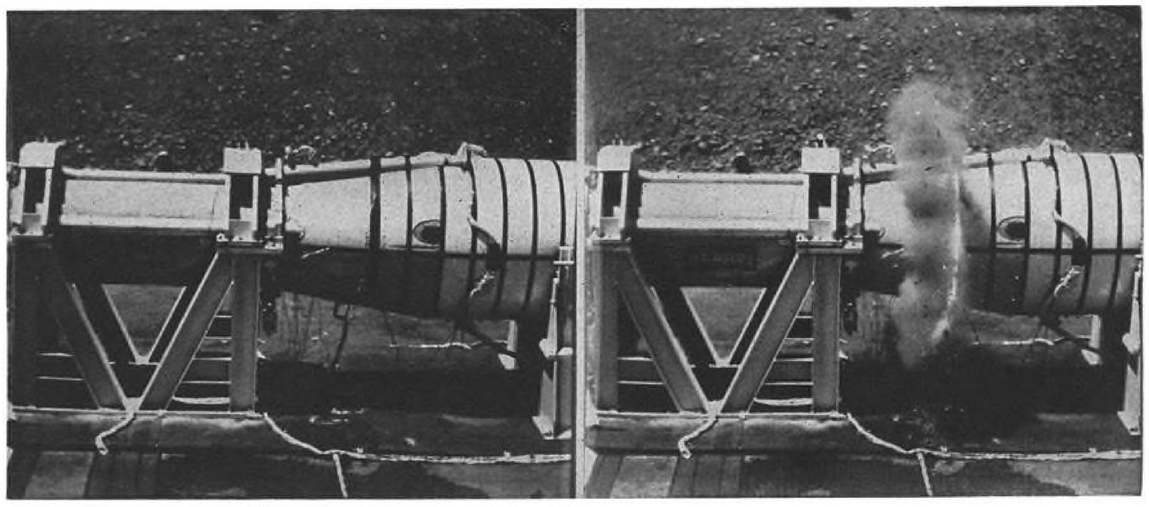
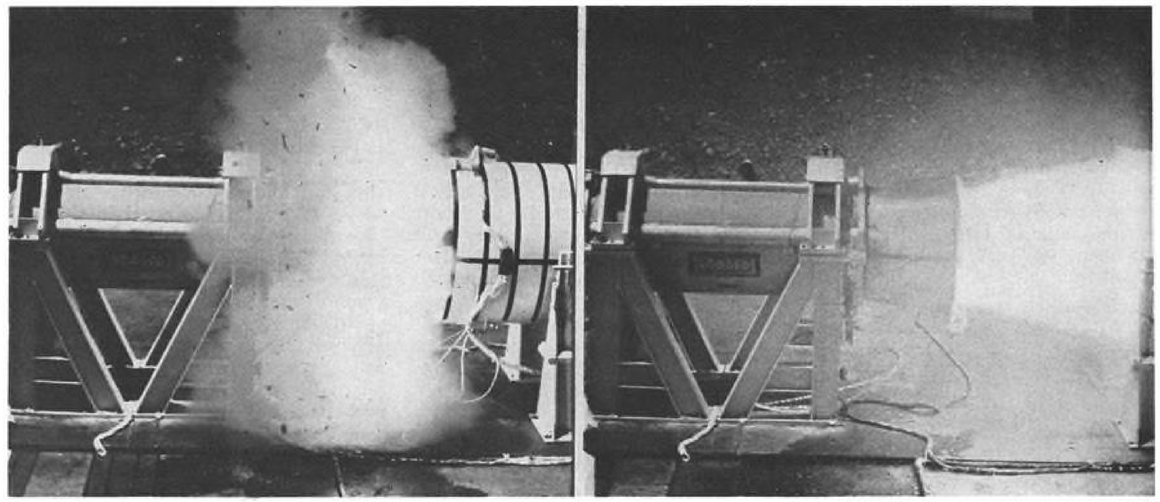


Minuteman Staging Sequence Demonstrated

Separation of the second stage from the first stage of a USAF/Boeing Minuteman ICBM took 0.25 sec. in a recent test series at the solid rocket plant of Aerojet-General Corp., which makes the second stage motor for the missile. The live second stage motor (upper left) was connected by flight hardware interstaging to a dummy first stage filled with water equal in weight to an operational first stage. Primer cord (upper right) severs interstage structure as the second stage ignites. Dummy first stage is thrust away about 100 yd. as second-stage motor develops full thrust (lower left). Exhaust temperature after separation (lower right) is more than 5,000F.



and test of Multi-System Test Equipment for various missile systems under a $4-million Army contract.

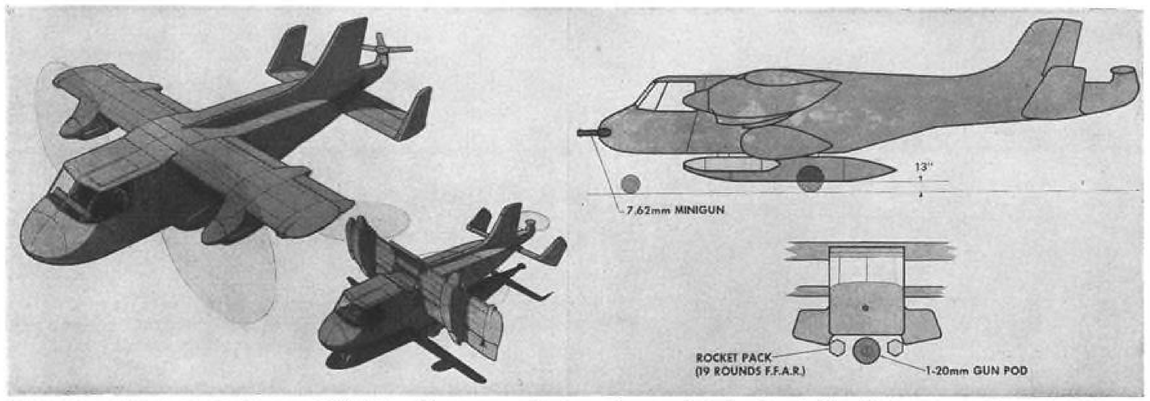
Kollsman Instrument Corp., Syosset, N. Y., will produce the Sheridan Shillelagh Weapon System Trainer Visual Subsystem, a training device which presents turret crews with a presentation of realistic simulated battlefield conditions. The visual subsystem presents a 360-deg. panorama from the periscope and tracking telescope. Moving targets are presented in color into the two viewing elements in real time motion seemingly at infinity focus. The simulator will allow the trainee to see the initial smoke and flash obscuring the telescope, as well as the receding missiles, and their strike or miss on the target.

Powertron Corp., Plainview, N. Y., subsidiary of Giannini Controls Corp., will provide ultrasonic propellant gaging sensors for the Titan 3 core vehicle under a $177,615 contract from Martin Denver. Signals from the sensors will monitor the supply of liquid propellant and initiate the staging sequence.

Grumman Aircraft Engineering Corp., Bethpage, N. Y., will build and install a three-degree-of-freedom g-seat dynamic flight simulator under $111,541 contract from North American Aviation's Columbus Div. Cockpit of the simulator will consist of a side-by-side seating arrangement with capability of producing a cockpit velocity of 20 fps. and accelerations as high as 4g.

Jackson & Moreland, Inc., Boston, has been awarded a $92,750 contract by the National Aeronautics and Space Administration to study the type and cost of equipment required for NASA's proposed Electronics Research Center (AW Sept. 2, p. 18).

Lockheed Aircraft Corp. will conduct research on the simulation of effects of high-altitude nuclear explosions under a contract to be awarded by Office of Naval Research.



CANADAIR, LTD.'S CL-84 tilt-wing, V/STOL utility transport is shown in an artist's drawing (left) with the wing and tail tilted for vertical flight and lowered for horizontal flight. As an armed helicopter escort, considered a primary role by Canadair, the CL-84 (right) will carry a 20 mm. gun pod, two rocket pods and a 7.62 mm. minigun in the nose.

Canadair Completes CL-84 VTOL Design

By Donald E. Fink

Montreal, Ont.—Final design of the twin-turboprop CL-84, a tilt-wing V/STOL utility transport, has been completed by Canadair, Ltd., and work on a flying prototype is scheduled to begin next month.

The aircraft is being developed under a $10-million program funded jointly by Canadair and the Canadian government (AW June 3, p. 28). It will produce one flying prototype, a backup airframe and an extra set of power equipment—engines, transmissions and propellers.

Roll-out of the flying prototype is scheduled for December, 1964. Six months of ground evaluation—including shake tests, structural checks and a 200-hr. engine test program—will precede its first flight, which is scheduled for July, 1965. The schedule then calls for the accumulation of 150 flight test hours on the prototype by September, 1966.

The CL-84 is a high-wing monoplane with a semi-monocoque fuselage of conventional aluminum skin and stringer construction. It is designed for a variety of military missions, ranging from assault transport to armed helicopter escort. The aircraft also is being proposed for some short-haul commercial roles.

The aircraft will have a maximum gross weight of 12,200 lb. for VTOL operations and 14,700 lb. for STOL operations. Its payloads under the two modes of operation will be 3,100 lb. and 5,600 lb. respectively.

The CL-84 will be 45.5 ft. long and 14.0 ft. high at the tail. It will have a slab-sided fuselage with a two-place cockpit and a cabin 10.0 ft. long, 4.7 ft. wide and 4.5 ft. high. The fuselage will be 5.4 ft. wide and will have a ground clearance of 3.1 ft. Access to the cockpit, which will seat the pilots side-by-side, will be through a rear, upward-swinging cargo door.

No other access to the cockpit is planned, but blow-out escape panels will be located in the roof over each pilot. Ground level ejection seats, capable of boosting the pilots past the wing in its upright position, will be installed.

The cabin will have a cargo volume of approximately 200 cu. ft. and also will be rigged with bench seats for 12 combat-equipped troops. A tricycle landing gear will be used, with dual wheel units at all three points. They will have 40 psi. tires for rough field operations. The nose wheel unit will retract rearward into a well between the pilots' seats. The main wheels will retract into fairings mounted on the lower sides of the fuselage.

Two 1,400 shp. versions of the Lycoming T53 turboshaft engine will power the CL-84. They will be interconnected by cross-shafting to a pair of four-bladed, 14-ft. variable pitch propellers and a 7-ft. tail rotor.

Four of the engines, designated T-53-LTC-1K-4A by Lycoming, have been ordered by Canadair. They will be delivered next October with their 50-hr. preliminary flight rating test qualification, which will include operation in the vertical position. These advanced versions of the T53 have redesigned compressor sections, which have increased pressure ratios and intake airflows, and two-stage turbine sections. Two of the engines will be used in the flying prototype. The other two will be used in engine and propeller static thrust tests and will be available for installation in the backup airframe if a second flying prototype is required.

Canadair, a subsidiary of General Dynamics Corp., currently is negotiating with United Aircraft Corp.'s Hamilton Standard Div. and with Curtiss-Wright Corp. for the propeller subcontract. Static thrust tests are being conducted by Canadair with models of designs from both companies. The final design will have glass fiber blades with hydraulically controlled pitch.

Canadair hopes to include the whole thrust train in a single contract covering the propellers, gearboxes, shaft couplings and tail rotor, according to Fred C. Phillips, CL-84 program manager. Phillips said the contract would include a bonus-penalty clause covering the static thrust guarantees, since static thrust in the VTOL mode determines the gross weight of the aircraft.

For vertical takeoff, the propellers will have to generate thrust equal to 1.05% of the maximum gross weight of the aircraft. The takeoff initially will be augmented by the slipstream ground effect, but this will be treated as a bonus.

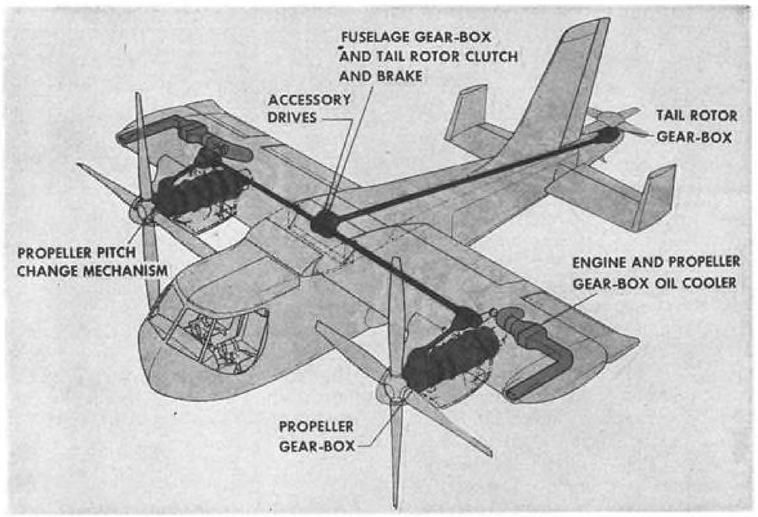
The engines will be mounted in nacelles under the wing, which will rotate through 90 deg. for vertical flight. The engine gearbox will be attached to the wing. The propeller assembly will be cantilevered off the front of it and the engine off its back. The nacelle, which will not be a load bearing unit, will function much like a jet engine pod, with its bottom portion forming a chin air intake for the engine and the oil cooler. The nacelle will be designed for quick removal to expose the power package for inspection.

The engine propeller gear boxes will be interconnected through a cross-shaft linkage. An output shaft will take power from the rear of each engine gear box and connect it to the cross-shaft, which is in line with the wing's pivot axis. The cross linkage passes through a fuselage gear box located in the wing root and connects with the output shaft from the other engine. This couples the propeller gear boxes and makes it possible to drive both propellers with one engine in case of an engine failure, which would be catastrophic in vertical flight if they were not interconnected.

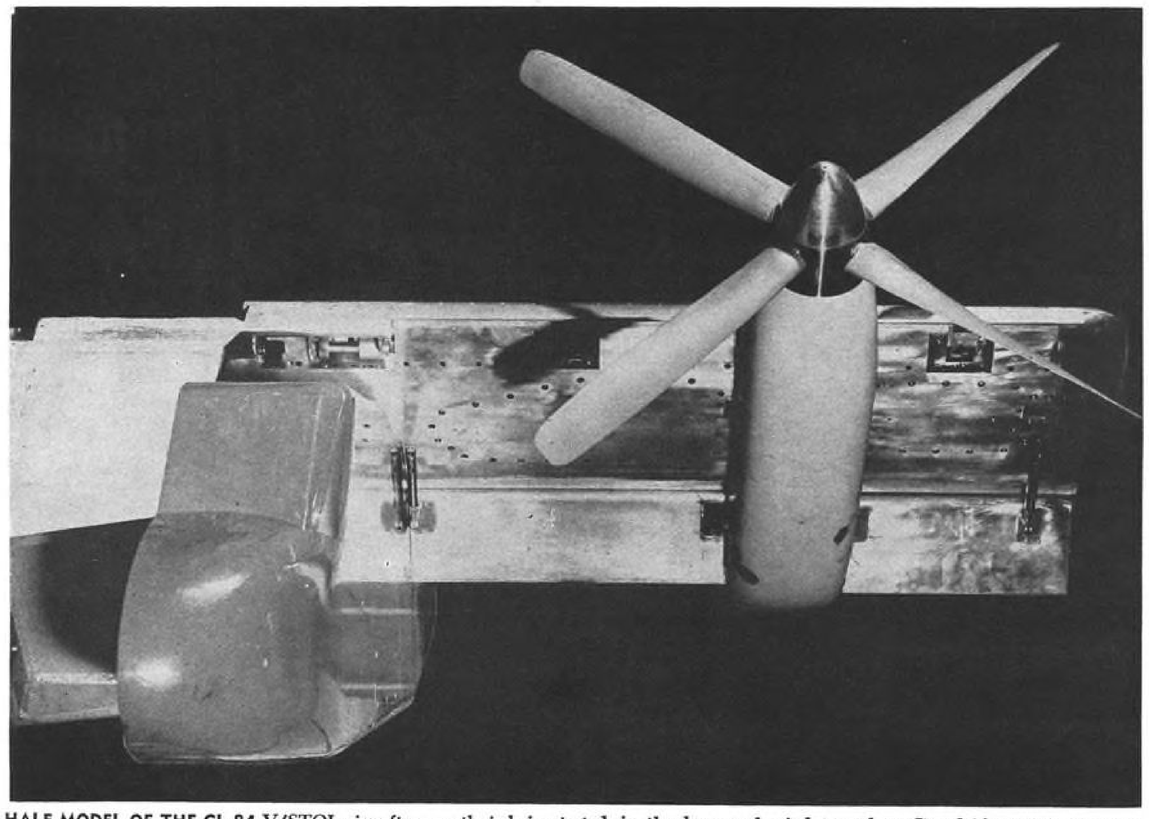
The tail rotor transmission also will be driven by the fuselage gear box through a shaft extending back along the top of the fuselage. Power outputs to drive the aircraft's accessory units also are taken from the fuselage gear box. Running the cross-shafting in line with the wing's pivot point makes it possible to design a simple U-shaped linkage, since the entire assembly pivots as the wing is tilted for vertical takeoffs.

The wing also will be designed to lock at intermediate angles for STOL operations, such as takeoffs in 500 ft. over 50-ft. obstacles. Phillips said that even under combat conditions there probably will be numerous small fields available from which the CL-84 can be operated as an STOL aircraft. This mode probably will be used whenever possible because of the increased performance it offers, he said.

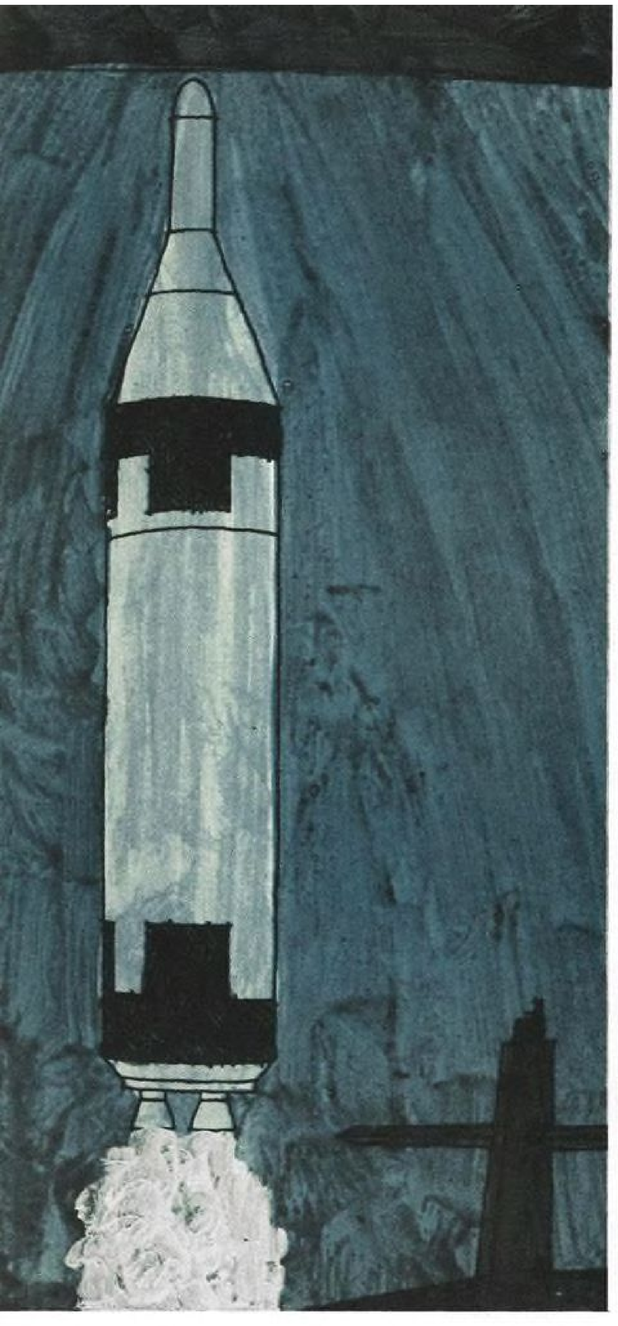
The CL-84 wing will be unswept and

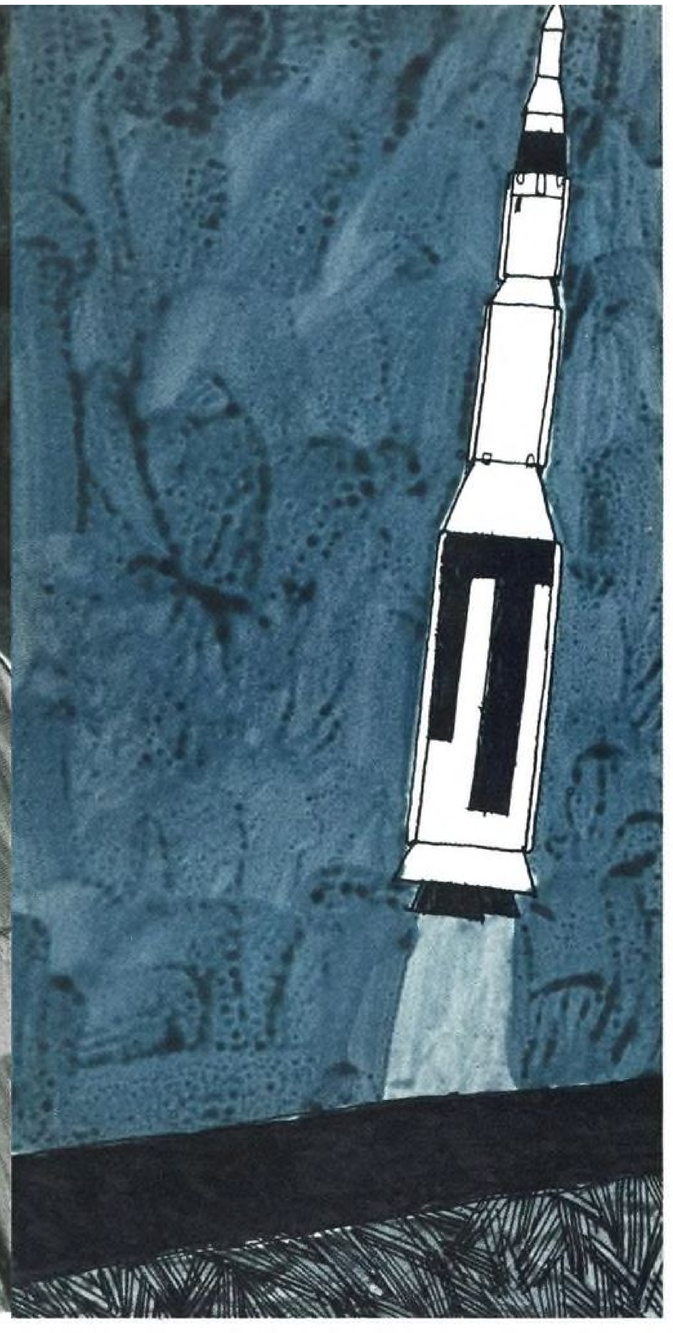


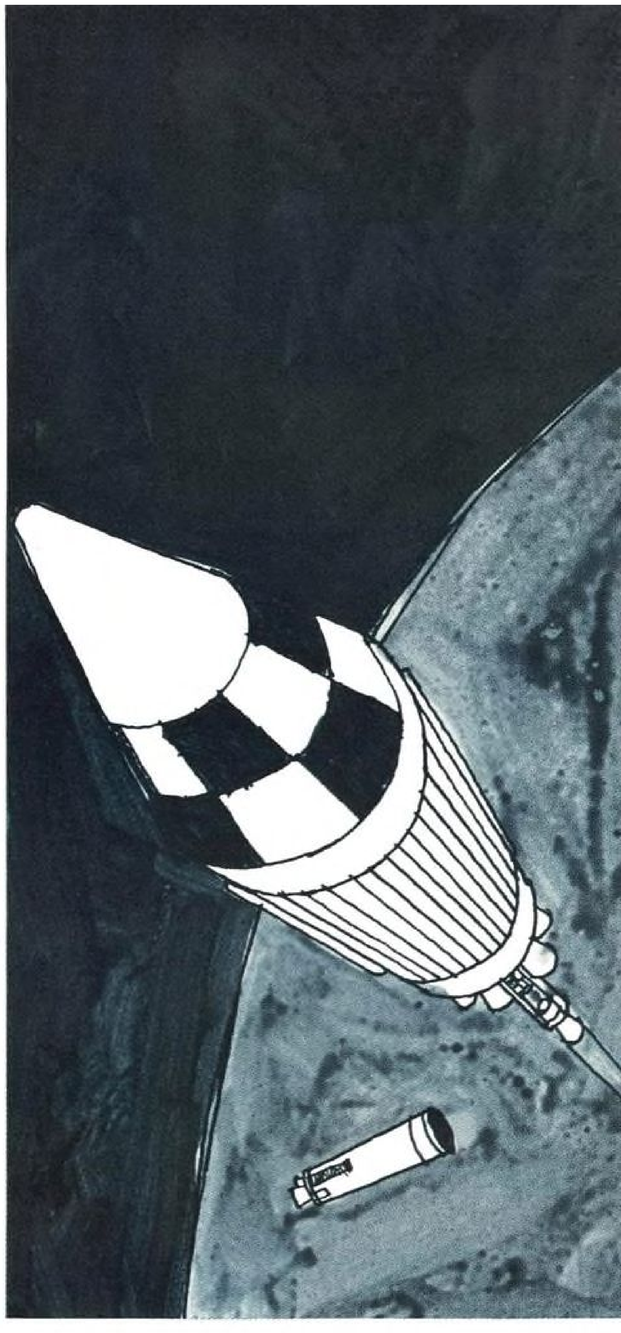
POWER TRAIN IN THE CL-84 will begin with the output shafts from the engine gear boxes, which connect to the cross-shaft. This runs along the wing's tilt axis and connects the two propellers. Tail rotor and accessories are driven from a fuselage gear box. Wingtip oil cooler inlets will be replaced with ones in the nacelle chin intakes.



HALF MODEL OF THE CL-84 V/STOL aircraft currently is being tested in the low-speed wind tunnel at Canadair's parent company, General Dynamics Corp. The model is about one-quarter scale. It is being used to measure aerodynamic forces acting on the airframe and to investigate airflow characteristics of the wing and nacelle in the horizontal, intermediate and vertical positions. Wing in the above photograph is in the intermediate position as it would be for STOL operations.







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CL-84 Prototype Performance Estimates

ITEM	VTOL MODE	STOL[1] MODE
GROSS WEIGHT AT SEA LEVEL, ISA - LB	12,200	14,700[3]
GROSS WEIGHT AT SEA LEVEL, 95°F - LB	10,600	12,700
GROSS WEIGHT AT 6,000 FT ISA - LB	10,600	12,700
FUEL LOAD INCL.(10%RESERVE) - LB	1600	1600
RANGE[2] AT S.L. AT 200K. - N.MI.	300	285
PAYLOAD FOR S.L. RANGE, ISA - LB	3100	5600[3]
PAYLOAD FOR S.L. RANGE, 95°F - LB	1500	3600
ENDURANCE AT S.L. AT 100-150K - HR	2.0	1.9
ENDURANCE AT S.L. AT 50K	1.4 HR	1.1
HOVERING ENDURANCE AT S.L.	0.9 HR	-
MAX. SPEED, MIL. POWER, S.L. ISA - K.	287	284
MAX. SPEED, NORMAL POWER, S.L. ISA - K.	274	270

NOTES
(1) CORRESPONDING TO TAKE-OFF OVER 50' OBSTACLE IN 500'.
(2) CONSIDERABLE IMPROVEMENTS POSSIBLE USING ONE ENGINE ONLY FOR CRUISING AND/OR HIGHER ALTITUDE.
(3) PERFORMANCE POTENTIAL ONLY - DEMONSTRATION LIMITED BY LOAD FACTOR AND CARGO SPACE.

will have a rectangular planform with a 33.3-ft. span. It will have full-span Krueger flaps on the leading edges and combination flap/ailerons on the trailing edges. These control surfaces will provide yaw control in vertical flight and roll control in horizontal flight besides supplementing the lift of the low aspect wing.

A fixed section of Krueger flap with an exaggerated chord also will be mounted on the front of the wing section that rests on the fuselage. This airfoil will improve flow curvature over the wing root and prevent the airflow from breaking away during slow flight.

Movement Controls

Two hydraulically driven ball-screw jacks attached forward of the main wing spar, will be used to raise the wing for vertical or STOL flight. The hinge brackets will be located behind the main spar. Vertical motion of the aircraft will be regulated by varying pitch on the main propellers, while the engines are maintained at a constant rpm. with governors.

Movement around the roll axis will be controlled by differential variation of the main propeller pitch. Yaw movement will be controlled by differential deflection of the flap/ailerons in the propeller slipstream. Pitch movement will be controlled by varying the tail rotor blade angle. The tail rotor will have an up-load that will be varied to provide the pitch control desired throughout vertical flight.

While transitioning to horizontal flight, a mechanical mixing unit will phase out the controls used in vertical flight and phase in conventional controls. The principal variant fed into the unit will be the wing tilt angle. As this changes, gear ratios in the mixing unit will change. Yaw control, for example, will be transferred from differential flap/aileron deflection to the rudder. As the transition proceeds into the horizontal mode, the tail rotor will be stopped and locked, and the differential variation of main propeller pitch will be phased out as a control means.

The basic cockpit controls in the CL-84 are conventional stick, throttle, rudder pedals and propeller pitch control units. The mixing system to which they are connected will be designed to produce normal aircraft responses to normal control movements in vertical, transitional and horizontal flight. This will eliminate special training for pilots of conventional aircraft who make a transition to the CL-84, according to Phillips.

The design and operating mode of the CL-84 created some aerodynamic problems not encountered with conventional aircraft. The changing angle of the CL-84's wing during transition, and the destabilizing effect of the larger than normal propellers dictated a special tail design, for example. It is considerably larger than that required for a conventional aircraft of the same size.

Angle of Incidence

The tail has a large, central vertical stabilizer mounted on top of the fuselage and two smaller ones mounted as end-plates on the horizontal stabilizer. The horizontal stabilizer also will have a 20 deg. variable angle of incidence, which will be regulated by the main wing tilt angle. In vertical or hover flight the slipstream over the wing will not affect the tail surface, but wind tunnel tests with CL-84 models showed that

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at low speeds and during portions of the transition, the slipstream hit the horizontal stabilizer at angles as great as 30 deg.

Coupling the tail angle of incidence with the wing tilt angle will keep the rear surface oriented at a positive lift angle in the slipstream. This will permit it to generate an up-load at all times and will prevent the slipstream from washing down on the tail and causing a pitch-up.

The tri-tail is the principal change made as a result of the wind tunnel tests with models of the first design, which was shown last spring (AW Feb. 18, p. 43). Other changes include a lengthened fuselage to balance the added tail weight, a dorsal fin to improve longitudinal stability and provide a fairing for the tail rotor shaft, and a change in the layout of the cockpit window.

Pilot Opinion Sought

The original design had deep side windows that were rounded at the bottom to give the pilots good downward visibility for vertical flight, but the windows in the present configuration will be rectangular. Pilot judgments were obtained on the cockpit and window layouts, Phillips said, and it was decided that the rectangular windows would provide a 20 deg. field of vision over the nose and to the sides. This is considered to be sufficient for the type of operations in which the CL-84 will be used, according to Phillips.

CL-84 V/STOL ROLES

MILITARY	COMMERCIAL
ASSAULT TRANSPORT	SHORT HAUL TRANSPORT
CASUALTY EVACUATION	EXECUTIVE TRANSPORT
LOGISTIC SUPPORT	AIR TAXI AND CHARTER
ARMED HELICOPTER ESCORT	SURVEY AND PROSPECTING
SURVEILLANCE	AIR AMBULANCE
SEARCH AND RESCUE	
ANTI SUBMARINE WARFARE	
V/STOL TRAINING	
GROUND SUPPORT	

Primary missions considered for the CL-84 are military. As an armed helicopter escort, Phillips said, the aircraft would be armed with a 20 mm. gun pod on an external pylon slung from the fuselage's centerline, folding fin rockets in fuselage pods on either side of the gun pod, and a 7.62 mm. minigun mounted in the nose. Ground clearance with the large gun pod attached would be about 13 in. Fuselage mounting of all forward firing weapons is required, according to Phillips, because it would be difficult to fire through the disc of the wide-blade propellers.

Range on an average mission at about 230 mph. will be about 345 mi. with a vertical takeoff and about 330 mi. after a STOL takeoff. The shorter range with a STOL takeoff is accounted for by the heavier payload. Maximum fuel load, including a 10% reserve, is 1,600 lb. carried in wing cells. Longer ranges will be possible under certain conditions—by using only one engine during cruise, or by cruising at high altitudes—Phillips said.

Varied Missions

Maximum speed expected from the CL-84 with military power and sea level conditions is 330 mph. Maximum speed with normal power will be about 325 mph.

Other missions projected for the CL-84 include anti-submarine warfare, surveillance, search and rescue and a variety of utility transport roles.

Phillips said the military roles are considered primary and the utility-support roles secondary.

Automatic stabilization equipment, similar to that used in helicopters, is being evaluated for the CL-84 to give it full IFR capabilities. Such equipment would be a requirement for anti-submarine work. Canadair intends to have auto-stabilization equipment available during the CL-84 flight program for operational evaluations.

Endurance on the variety of military missions the CL-84 is designed to perform varies from 2 hr., when the operating speed ranges between 120 and 170 mph., and slightly less than 1.5 hr., when the operating speed averages closer to 70 mph. Hovering endurance at sea level will be slightly under 1 hr., Canadair says.

Although Canadair plans the CL-84 as a conventionally constructed aluminum aircraft, it also is conducting a basic glass fiber structure research program. Engineers expect to complete it at about the same time the CL-84 flight test program ends. By that time they will have complete data on structural and fatigue problems involved with the aircraft. If the conditions appear favorable enough, they may use reinforced glass fiber materials and glass fiber honeycomb in production versions of the aircraft.

USAF Drops Bright Markings on Aircraft

Washington—Air Force has abandoned use of high visibility paint on its aircraft because it feels that its own statistics and studies by the Federal Aviation Agency have not been conclusive in proving that the paint minimizes mid-air collisions.

Called the "conspicuity program" by the Air Force, the bright red markings in the future will be used only on Training Command, tactical training and target aircraft.

All other major commands will remove the paint during regular maintenance or overhaul.

FAA studies showed that normally the aircraft silhouette can be seen as soon as high visibility markings.

Air Force said it has taken the following actions to reduce the chance of collisions:

- **Use of Air Defense** Command radars by FAA to control civil aircraft.
- **Establishing separate** refueling areas for military aircraft to provide separation of instrument flight rules (IFR) traffic.
- **Exercising positive control** of all Strategic Air Command and Tactical Air Command flights in coordination with FAA.
- **Separating student** jet training areas from civil routes.
- **Establishing military** climb corridors.
- **Developing terminal** radar service areas to control all aircraft within 15 mi. of an air base.
- **Publishing charts** showing military low-level high-speed routes.
- **Increasing the number** of IFR flight plans over the number of visual flight rule (VFR) flight plans.

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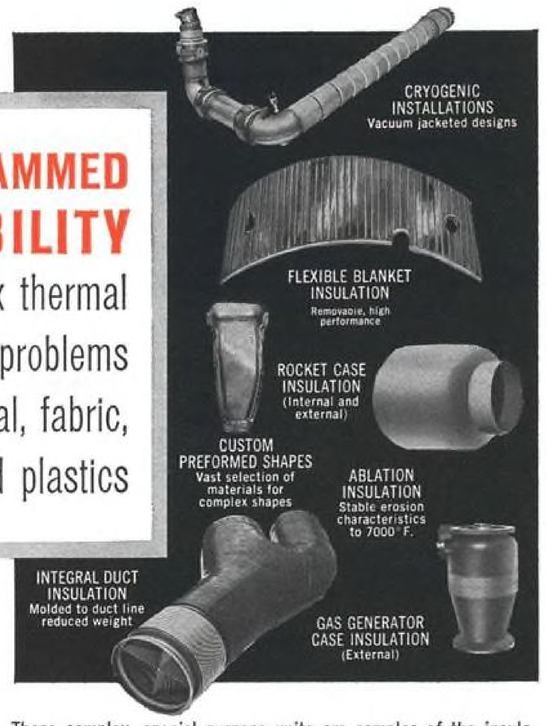

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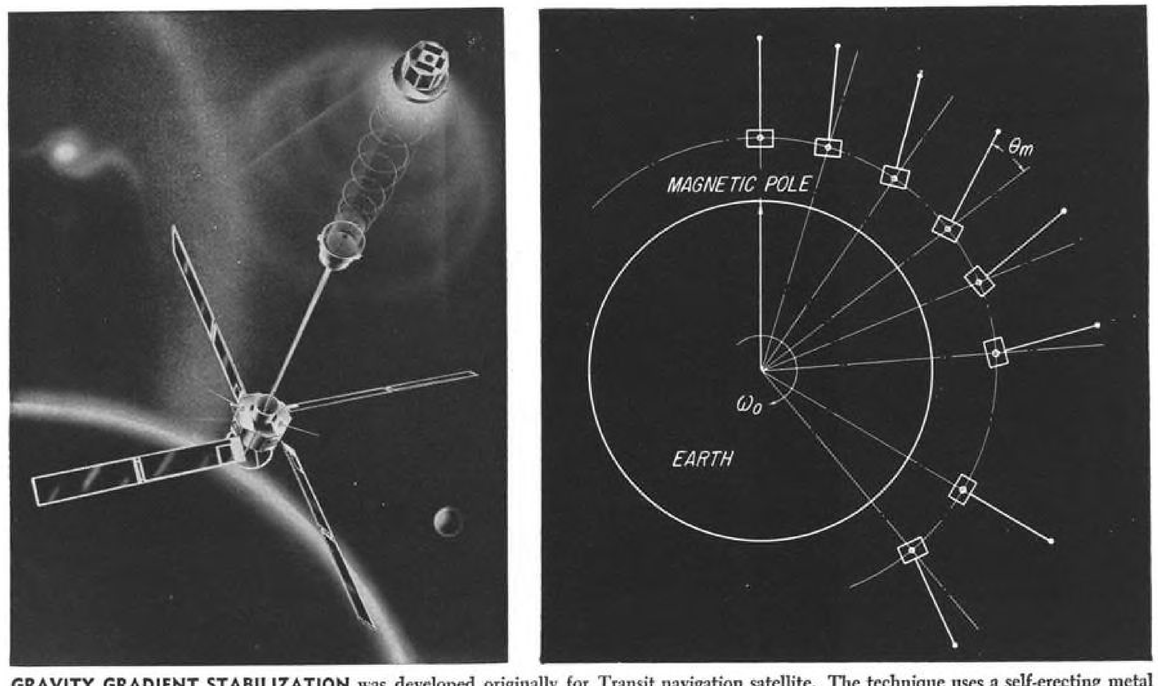

GRAVITY GRADIENT STABILIZATION was developed originally for Transit navigation satellite. The technique uses a self-erecting metal boom with a mass at the end which causes the satellite to seek vertical alignment. The satellite oscillates slowly about the vertical (sketch, right), but the amplitude of oscillation can be greatly reduced by using another mass attached to the boom through a weak damping spring.

Gravity Gradient Feasibility Test Planned

By Philip J. Klass

Washington—An extremely simple, lightweight and potentially long-lived device for keeping a satellite oriented toward the earth, using the principle of gravity gradient, is prompting increased interest for possible use in communication, meteorological and geodetic satellites.

Feasibility of the gravity gradient technique, a passive one requiring no electric power, was first successfully demonstrated by the Johns Hopkins University Applied Physics Laboratory (APL) in the Navy Transit 5B navigation satellite launched June 15 (AW July 29, p. 25). The concept had been suggested in the late 1950s by a number of scientists, and a configuration somewhat similar to the one used by APL, called "vertistat", was proposed by L. J. Kamm of General Dynamics/Astronautics in December, 1960, at a meeting of the American Rocket Society.

Defense Dept and the National Aeronautics and Space Administration have recently formed a committee, at Pentagon request, to formulate a program to test feasibility of gravity gradient stabilization at altitudes of several thousand miles for possible use in a second - generation medium - altitude military communication satellite. Gravity effect decreases as the second power of distance from earth center and has been demonstrated only to altitudes of 600 mi., but APL scientists are confident that it can be used with little increase in weight to altitudes of 5,000 mi., perhaps beyond.

NASA also is considering the use of gravity gradient stabilization in later versions of the Tiros meteorological satellite to achieve earth orientation with minimum cost and complexity for maximum orbital service life. However, the attitude stabilization requirement for a meteorological satellite is much more demanding than for a communication satellite.

The technique developed by APL for Transit was reported by Robert E. Fischell and Frederick F. Mobley at the recent East Coast Conference on Aeronautical and Navigational Electronics. The complete stabilization device used weighs about 9 lb. and contains a 100-ft. long beryllium-copper tape, 2 in. wide and 0.002 in. thick, which is wound flat onto a drum with one end of the tape secured to the drum. Prior to launch the tape is prevented from unwinding by an enclosure which later is released by an explosive squib detonated by radio command when the satellite is in orbit, Mobley reported.

The metal tape is pre-stressed so that when the squib is detonated, natural forces will cause it to unwind from the drum. As it unreels into space, the tape will curl into a circular rod. (First attempt to use gravity gradient stabilization on the Traac satellite launched in 1961 failed because the electric motor provided to unfurl the tape failed to function, which led to present motor-less design.)

The extendable boom mechanism was built by de Havilland Aircraft of Canada.

Attached to the free end of the 100-ft. long metal boom is a cup-shaped mass which houses a 70-turn helical spring with coil diameter of 7.6 in. One end of the spring is attached to the boom cup-mass while the other end attaches to another mass. The

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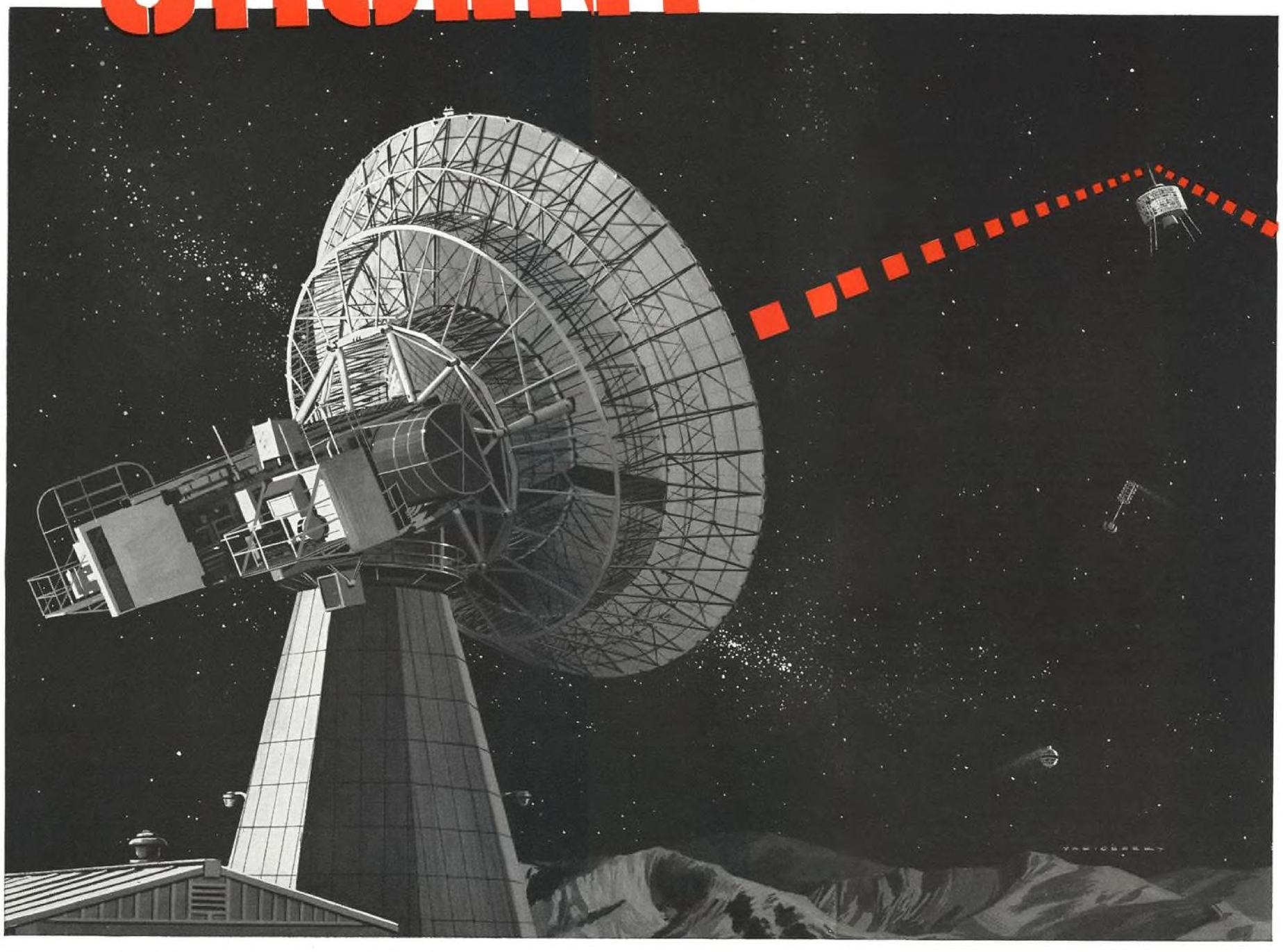

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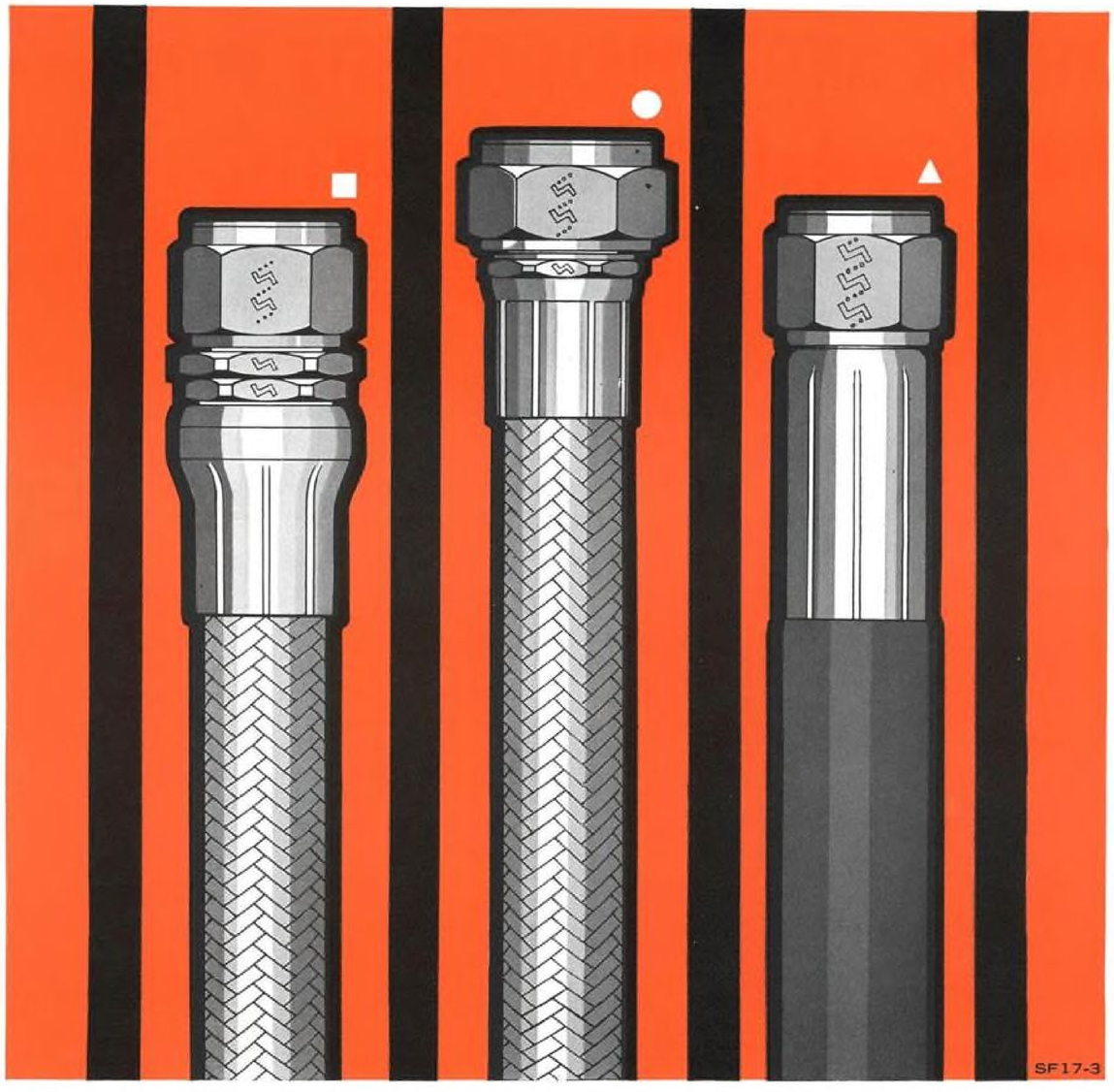

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spring and its mass are temporarily secured to the cup-shaped end of the 100 ft. boom by a material which sublimes slowly over a period of 12-24 hr., releasing first the spring's mass and then individual coils of the spring itself, until the spring and its mass extend out from the end of the boom (see sketch). The combination of the spring and mass serve to help damp out oscillations (librations) of the satellite about the local vertical; i.e., the line to the apparent center of the earth. When extended, the mass at the end of the boom weighs about 1.85 lb. while the mass at the end of the spring weighs 3.85 lb.

Gravitational Field

In this configuration, torques generated by the earth's gravitational field attempt to align the boom's long axis to the local vertical both in the plane of satellite motion (pitch axis) and at right angles to it (roll axis). The action can be compared grossly to that of a pendulum, except that due to the satellite's orbital velocity the boom can align itself either aimed toward the earth or away from the earth. For this reason, the satellite must be oriented so the boom will be aimed in the desired direction (up or down) before it is extended.

The magnitude of the gravity gradient torque generated is an inverse function of the square of the satellite's distance from the center of the earth, a direction function of the sine of twice the angle between the satellite's long axis and the vertical, and the difference between the moment-of-inertia about the roll/pitch axes and the moment of inertia about the yaw axis—assuming a symmetrical cylindrical satellite configuration.

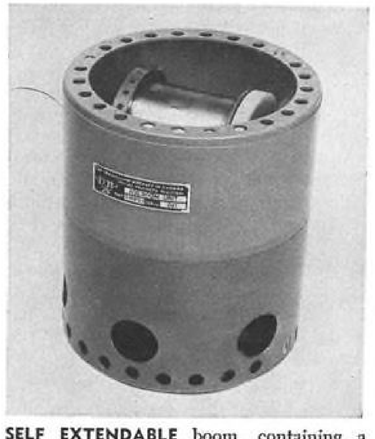
As seen by an observer fixed in space, an earth-oriented satellite must make one complete revolution during each orbit.

The torque that is needed to produce this one-revolution-per-orbit rotation is supplied, in this case, by gravity gradient effect. If the satellite is oriented so that the boom axis is nearly aligned with the vertical, as the satellite moves inertia will cause it to try to maintain its position in space until its boom axis is far enough off the vertical to generate sufficient torque to cause the satellite to begin to swing back toward the vertical.

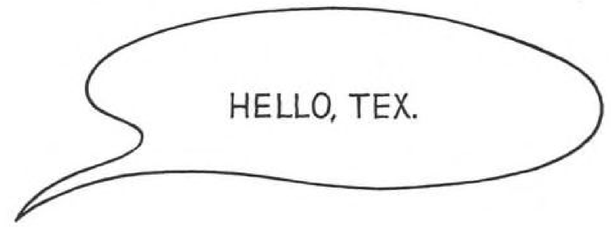
Because the satellite behaves somewhat like a pendulum it will overshoot the vertical until sufficient gravity gradient torque develops to cause it to swing back in the opposite direction, as shown in the sketch, p. 79. The natural period of this oscillation is an inverse function of the satellite's angular velocity and the ratio of its yaw axis moment-of-inertia to its pitch/roll axis moment-of-inertia.

Transit Configuration

For a gravity-stabilized satellite of the Transit configuration at an altitude of about 500 mi., the natural period of oscillation in the orbital plane is about 58 min. while the period at right angles to the orbital plane is about 50



SELF EXTENDABLE boom, containing a 100-ft. long ribbon boom, two masses and a helical spring, is made by de Havilland Aircraft of Canada. The total weight of the self extendable boom is 9 lb.



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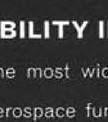
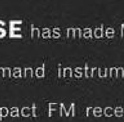
USED

COMMAND RECEIVERS

PROVEN RELIABILITY IN ACTUAL USE has made Motorola command receivers the most widely specified command instrumentation today for advanced aerospace functions. These compact FM receivers deliver a threshold sensitivity of 5 microvolts over a full temperature range of —54° C to +71° C, and have been fully qualified to other extreme environmental requirements of the most rigorous missile and space applications. They can also be supplied with a complete selection of tone channels from 0 to 20. For example... **USED ON SATURN,** Motorola Model MCR-101, shown in illustration above, provides 10 channels, weighs only 2 lbs., 15 oz. **USED ON AGENA**  MCR-307, the smallest, lightest 3-channel unit made, weighs but 2 lbs. **USED ON POLARIS**  MCR-312, features an isolated ground system, supplies 3 decoder channels, weighs 3 lbs. **USED ON MINUTEMAN** MCR-403, contains 4 decoder channels, weighs 3 lbs., 13 oz. **USED ON MERCURY** MCR-102/MAD-101, receiver-decoder combination, provides a 20 channel system, weighs but 5 lbs. Standard 3- and 10-channel receivers are available for fast, off-the-shelf delivery. For full performance specifications, or modification data to meet other parameters, write our Instrumentation Products Group today.

MOTOROLA *Military Electronics Division*
8201 East McDowell Road, Scottsdale, Arizona

SHOWN PARTIALLY UNREELED, self-extendable boom consists of thin pre-stressed ribbon of beryllium-copper tape wound flat onto a drum. When unlatched by explosive squib, once satellite is properly positioned in orbit, internal forces cause drum to unwind tape, which curls into circular shape to form 100-ft. long boom.

min., the difference being due to the gyroscopic effect of satellite motion in the orbital plane, according to Fischell.

The maximum angle through which a gravity gradient oriented satellite without damping provisions will librate is a function of the precision with which it is initially oriented to the vertical when the metal tape boom is erected and the ratio of the moments-of-inertia of the pitch/roll axis to the yaw axis.

Where the pitch/roll axis moment of inertia is very much higher than the yaw axis, which normally would be the case, the maximum angle of swing on either side of the vertical becomes essentially a function only of the initial angle of vertical misalignment at the time the boom is erected. A misalignment initially of 15 deg., for example, would result in a swing of 40 deg. either side of the vertical for a gravity gradient stabilized satellite without damping.

Oscillations of this magnitude are much too large for most applications, which explains why APL adds a damping spring and mass at the end of the 100 ft. boom. The technique of using an extremely weak spring and mass, suggested by APL's Dr. R. R. Newton, is only one of several possible ways of providing the necessary damping, but its feasibility has been demonstrated in the Transit launched in June.

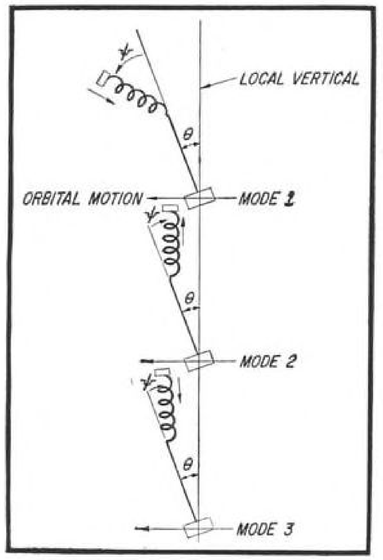
When the boom is erected by radio command, slots are opened which expose the biphenyl sublimation material holding the spring and its mass within the cup-shaped mass on the end of the boom to the vacuum of space. As sublimation takes place, the spring mass is first to be released a few hours later and the gravity gradient force acting on this mass pulls on the spring to release it a coil at a time. As the satellite and boom librate slowly, gravity gradient forces and libration motion will cause the spring mass to lag or lead the boom and to move toward or away from the end of the boom, compressing the spring length to about 10 ft. or extending it to about 100 ft.

By this means the libration energy is absorbed by the mechanical hysteresis of the spring and dissipated in the form of heat. To increase the damping effect, the beryllium-copper spring used in Transit was coated with an 0.0008-in. thick layer of mechanically soft cadmium which in turn was enclosed by an 0.0002 in. layer of deposited gold to prevent sublimation of the cadmium. The spring had a constant of 2.14 x 10^{-6} lb. ft.

Using the configuration described, telemetry data obtained from the Transit satellite indicates that it oriented itself to within about 6 deg. of the vertical, oscillating through a total angle of about 12 deg. (Because of Defense Dept. security policy, APL scientists do not use the name "Transit" but refer to the satellite by its official catalog number of 1963-22A, or just "22A".)

Launched from the Pacific Missile Range by a Blue Scout booster, the satellite was placed in a circular polar orbit at roughly 400 naut. mi. altitude with a period of 99.71 min. and an eccentricity of 0.0032. Satellite had a spin rate of about 200 rpm. immediately prior to separation from the final stage.

Shortly after separation, two "yo-yo" de-spin weights attached to cables were released, a technique used previously on Tiros and earlier APL satellites, to decrease the spin rate to 1.02 rpm., Mobley reported. Two magnetic



MOTION of the spring and its mass at the end of 100-ft. long boom, due to gravity gradient and libration forces, causes extension and compression of the weak spring, absorbing libration energy and dissipating it as heat to reduce amplitude of satellite oscillation. Several possible modes of spring-mass motion are shown in sketches above.

USED

TRANSPONDERS

PROVEN RELIABILITY IN ACTUAL USE makes Motorola radar transponders the logical choice for critical tracking, data and control missions. Case in point... AN/DPN-66 (Motorola SST-102A) illustrated above, **USED ON SATURN, PERSHING** and over 15 other current aerospace programs. A precision C-band unit, weighs 10.8 lbs., occupies 200 cu. in., it is just one of a complete line of transponders ready for fast, off-the-shelf delivery. Others include: **USED ON SCOUT, ATHENA** and at **WSMR** SST-131, this transponder is an extremely rugged microminiature superheterodyne unit, weighs only 3 lbs. and occupies just 40 cu. in., qualified for high-thrust, solid propellant boosters. Power: 400 watts. Sensitivity: —65 dbm. **USED AT AFMTC** AN/DPN-71, a high-power, superheterodyne unit for deep-space tracking assignments. Power: 20 kw. Sensitivity: —75 dbm. **USED ON SATURN,** and **PERSHING** AN/DRN-11, UDOP (UHF Doppler) transponder provides extreme range and position accuracy for ballistic vehicles. Power: 3 watts (15-watt power amplifier optional). Sensitivity: 5 microvolts. **USED ON NAVY AIRCRAFT** AN/APN-132, an X-band transponder with 5 channel decoder. Power: 100 watts. Sensitivity: —65 dbm. For full performance specifications, or modification data to meet other parameters, write our Instrumentation Products Group.

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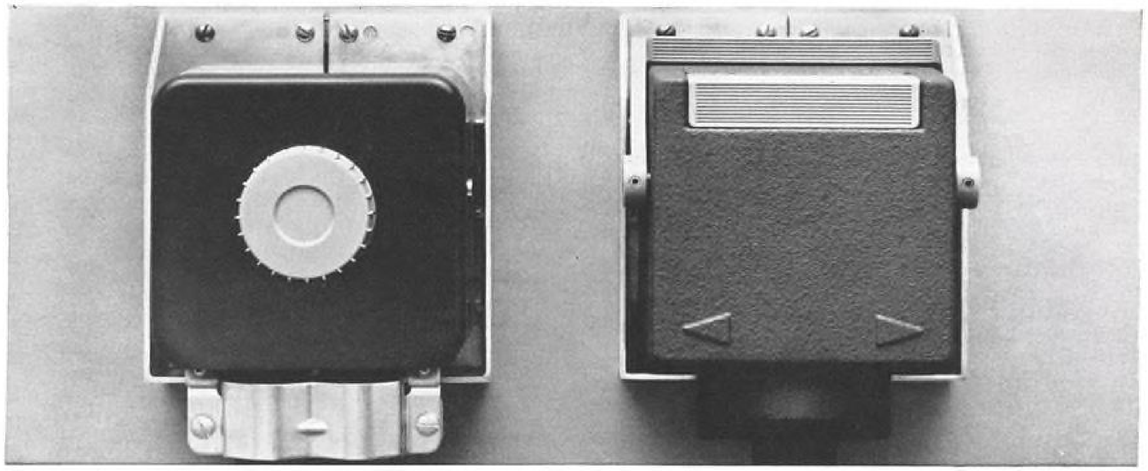

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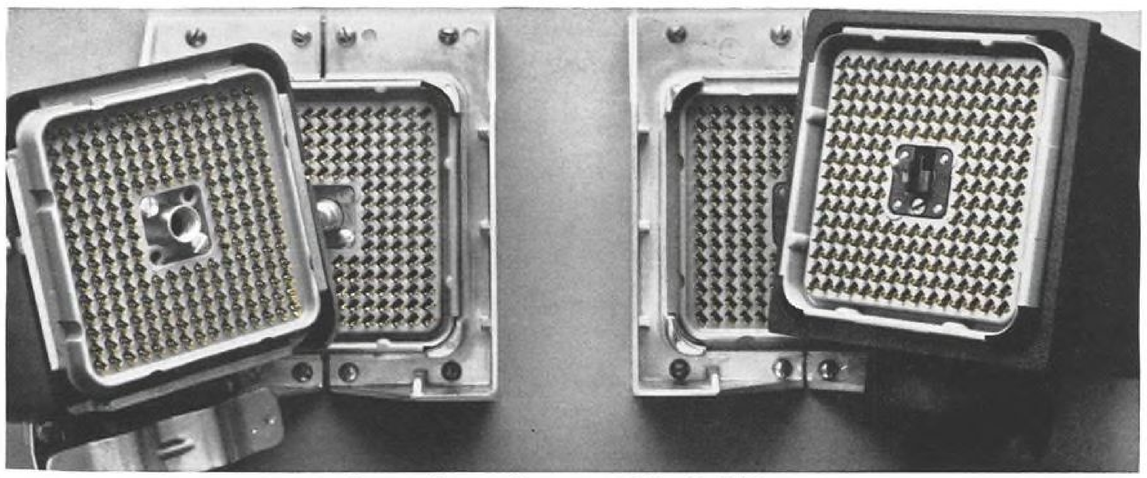

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hysteresis rods, at right angles to the spin axis and to one another, reacting with the earth's magnetic field then reduced the spin rate to less than 0.008 rpm. after 69 hr. in orbit.

At that point an electromagnet whose magnetic dipole moment axis coincided with the axis of the satellite which was to be earth oriented was energized by radio command. This generated a magnetic field that attempted to align the satellite's future-vertical axis to the direction of the earth's magnetic field which is horizontal near the equator but becomes vertical near the magnetic poles.

Boom Deployment

When the satellite has aligned itself to the earth's magnetic field and the satellite is over the polar region where the earth's field is nearly vertical, the tape boom can be deployed.

During the Transit (22A) experiment, the electromagnet was energized approximately 69 hr. after the orbit injection. Approximately 12 hr. later when the satellite was aligned to within a fraction of a degree of the earth's field and was over the pole where the earth's field is within about 11 deg. of the vertical, the boom was erected. The polarity of current used in the electromagnet had been chosen so that it would cause the boom to be aimed away from the earth. Satellite orientation with respect to the earth's magnetic field was determined by means of a three-axis vector magnetometer on board the satellite whose output was telemetered to the earth.

Telemetry Data

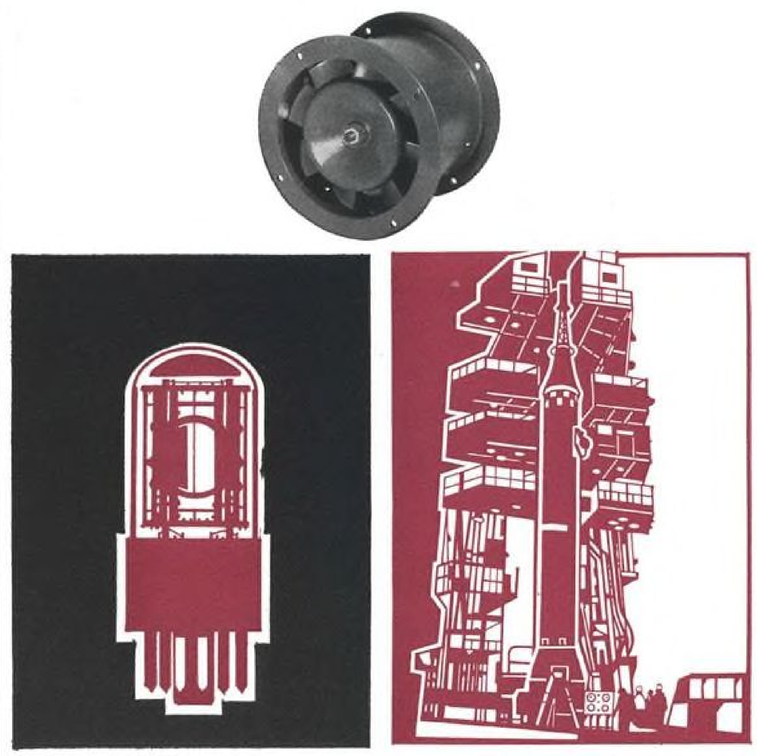
It required about 77 sec. after the squib was fired for the boom to fully unreel itself, as determined by telemetry data, according to Mobley. This figure was only slightly longer than that which was experienced in earlier ground tests.

To enable APL scientists to determine whether the damping mass and spring had deployed and were functioning as planned, the spring's mass was equipped with a small lamp, flasher circuit and its own solar cells to provide electric power. Inside the cup-mass at the end of the 100 ft. boom was a photo-cell which was exposed to the flashing light from the underside of the spring's mass. The intensity of photo-cell illumination, telemetered back to earth, was a function of both the distance the spring had extended and its angle relative to the boom.

Initially the photo-cell illumination was very low, suggesting either that the spring had extended more than 100 ft. or was tipped beyond the 45-deg. receiving angle of the photo-cell. But after several days the flashing light signals increased in magnitude showing that the spring was returning to its equilibrium extension of about 20 ft., Mobley reported.

Because there is no storage of data aboard the satellite and it is visible for only 10-14 min. during each 99.7-min. orbit, and because it is librating about the vertical, it is difficult to determine precisely the accuracy of the vertical stabilization achieved, Mobley points out. However, within these limitations the data indicated that the satellite had stabilized to within 8 deg. of the vertical along the orbital plane within one week after the boom was extended, and had achieved a similar figure in the cross-plane axis several days later. After 2½ weeks in orbit, the satellite appeared to be swinging no more than 6 deg. either side of the vertical in both the orbital and cross-axis planes.

Analysis of data from the 22A satellite showed that the side of the 100 ft. boom illuminated by the sun reaches a much higher temperature than the opposite side, causing the boom to be deflected by approximately 5 deg. from the vertical under such conditions. This also is believed responsible for a high frequency attitude oscillation, of about three cycles per minute, apparently caused by shock or vibration along the



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PROBLEMATICAL RECREATIONS 198

A man packing one-inch spheres into a rectangular tray exactly fills the tray in a single layer with no slack, using a rectangular packing. Trying a different arrangement, he fits in one more sphere. He then uses a third arrangement and fits in still another sphere. What is the size of the tray? —*Contributed*

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boom's length induced by the thermal bending.

By coating the boom with high-reflective material, such as silver, the heating should be greatly reduced, Mobley says, and he indicates that APL recently has obtained confirmation of this cure but declined to elaborate. Presumably this is a reference to the Transit 5B satellite launched on Sept. 28.

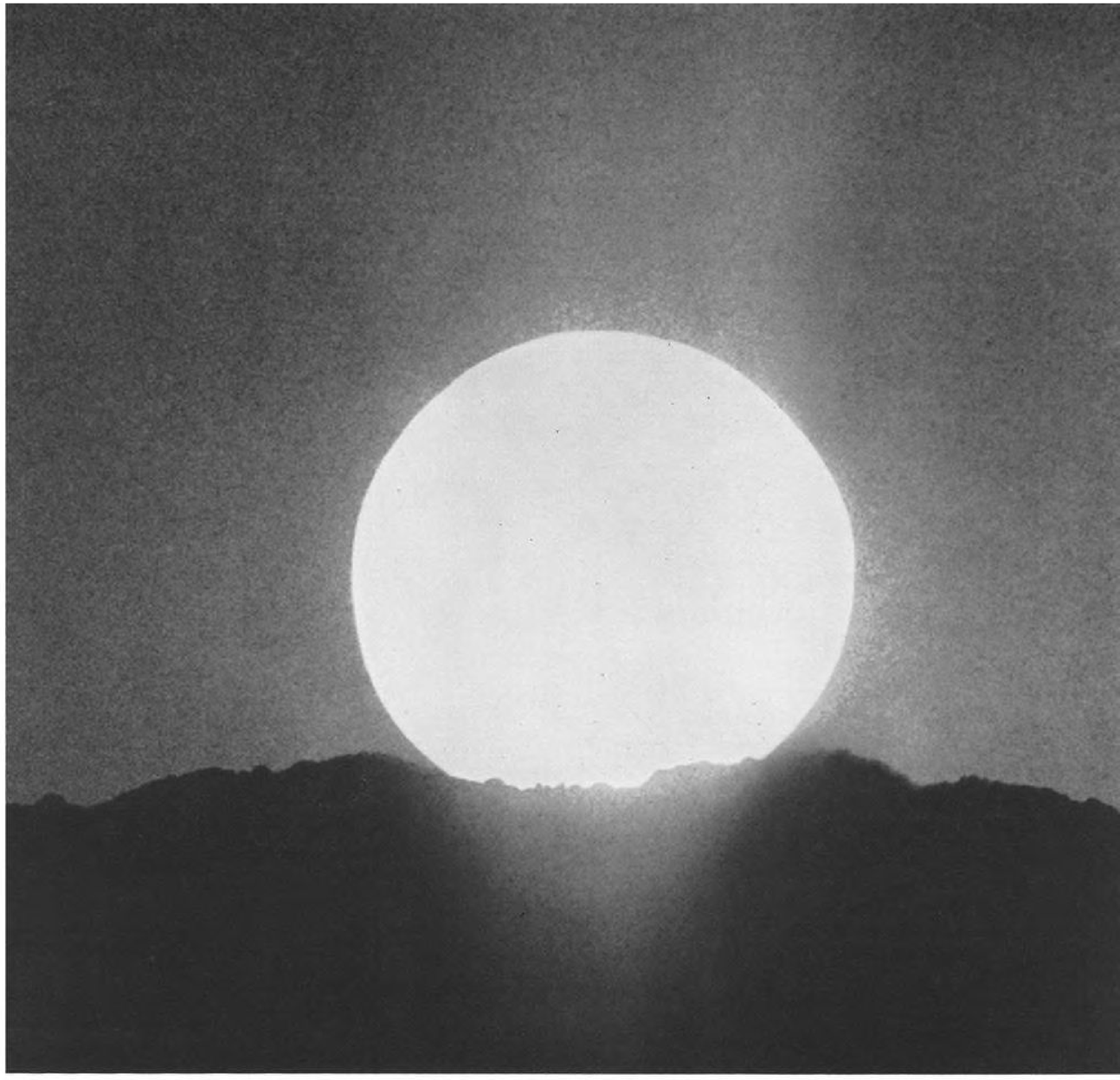
Full technical details on the APL technique, including a discussion of the effect of stray perturbing torques due to earth's field, solar pressure and aerodynamic effects, are contained in Applied Physics Laboratory report entitled : "A System For Passive Gravity Gradient Stabilization of Earth Satellites," by Fischell and Mobley, identified as TG-514. APL is located in Silver Spring, Md.

FILTER CENTER

► **Phoenix Microcircuit Sources Picked**—Four semiconductor companies were picked recently by Litton Industries as multiple sources for semiconductor microcircuits to be used in the computer and display systems for the Phoenix air-to-air missile. Litton is building these systems under subcontract to Hughes Aircraft Co., Navy prime contractor for the Phoenix, the primary anticipated armament for the F-111B (Navy version of TFX) fleet defense interceptor. The four companies, chosen as suppliers on what may be, along with Minuteman (AW Oct. 28, p. 70), one of the largest single microcircuit programs, are Fairchild Semiconductor and Motorola (sharing about ¾ of an initial order of about 80,000 units) and Sylvania and TRW Semiconductors, dividing the remainder of the order. The four were picked on the basis of a funded design program conducted by Litton among seven potential suppliers (AW Sept. 2, p. 87).

► **Motorola Wins Autonetics Competition**—Motorola has been selected by Autonetics Div. of North American Aviation as sole supplier of semiconductor microcircuits for its Monica general purpose digital computers (AW June 17, p. 90), now in design and early development under company funds. Autonetics has proposed a computer of this type in the Air Force's recent competition (AW Sept. 30, p. 30) for studies of a standardized space guidance system. Initial contract for 17 circuit types to Motorola is for $300,000.

► **Chelate Laser Promise Cited**—A chelate laser using an organic combina-



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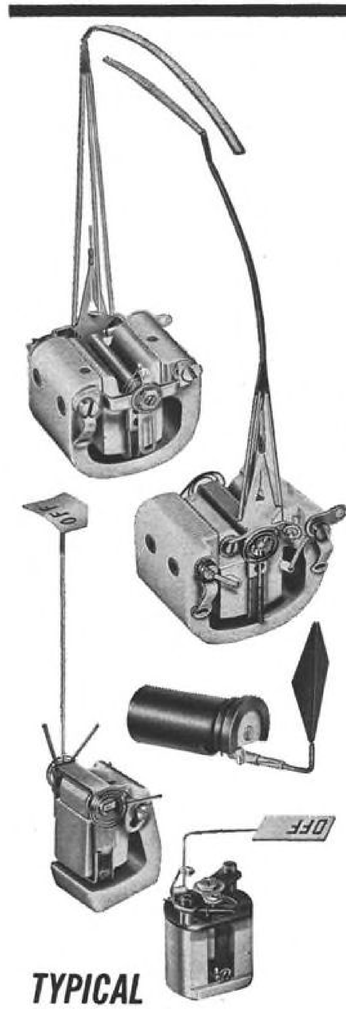

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tion of piperidine and europium benzoylacetonate in alcohol solution could open the door to a wide number of new liquid lasers, according to scientists at Electro-Optical Systems, where the new laser was operated. The compound consists of five ligands, a chelate composition not previously established, the company says. This may make possible many new chelate combinations. The laser operated by Electro-Optical is cryogenically cooled, and oscillates at 6,130 angstroms in the yellow portion of the spectrum. It may be capable of operating in continuous wave mode and eventually might provide higher CW power than available from lasers made of inorganic crystals.

► **Autonetics Forms Command and Control Unit**—A command and control department was organized recently within Autonetics' Data Systems Div. to exploit command and control business, particularly military systems requiring high reliability, small size and weight and ruggedness. A number of aerospace companies have been taking similar steps, several of them to capitalize on present and potential airlifted tactical command requirements.

► **USAF to Test Loran Receiver**—A simple, lightweight microminiaturized Loran C receiver (AW July 1, p. 89), developed by Sperry Gyroscope under contract to Navy BuWeps, will be flight tested next month by the Air Force's Aeronautical Systems Div. in a Lockheed C-130. The receiver, AN/ARN-76, uses 892 digital semiconductor microcircuits of five different types to satisfy 85% of its functional needs and to help make possible a fivefold increase in MTBF over a comparable Loran receiver. The ARN-76 is considerably simplified with operational controls reduced from 26 to 5 in number, weight cut to 20 lb. from a 60-70-lb. level. The company plans to build 100 models of a slightly revised version of this receiver, using microcircuits for 95% of its functions. Cost, Sperry says, could be reduced by as much as 80%, dropping receiver price to $5,000-$10,000. Four qualified microcircuit suppliers for the equipment are Texas Instruments, Fairchild, Westinghouse and General Micro-Electronics.

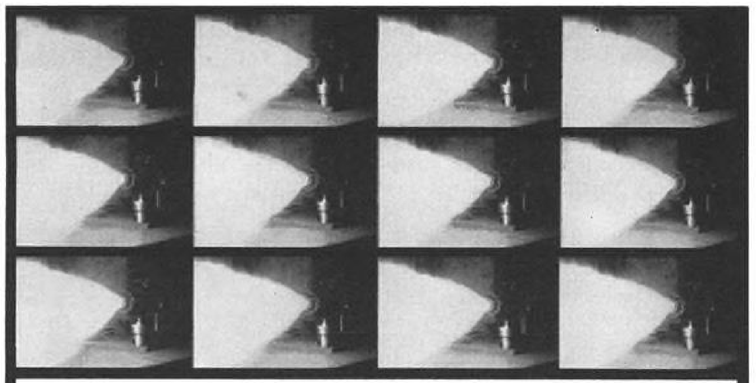
► **Hypersonic Velocity Sensing**—An unusual technique for determining velocity of a hypersonic vehicle is being explored by Giannini Controls Corp. under funding from USAF's Aeronautical Systems Div. A magnetic field will be set up that will interact with the plasma at the front of the vehicle, causing perturbations in the ion density. Several possible methods of then collecting measuring ions from which velocity can be determined are under investigation. The most promising of these appears to be the use of capacitive probes. The company will be testing a breadboard prototype of the sensor in the current phase of the effort.

► **Transitron Shows Three-Month Profit**—Transitron Electronic Corp. reports net earnings after taxes of $151,516 for the three-month period ended Sept. 28, compared with a deficit of $691,674 after tax carryback for the comparable period last year. Sales for the quarter were $5,022,395 compared with $5,450,623 for the like period.

► **First Microminiature Amplifier Stage**—using vacuum-deposited thin film components—has been fabricated and operated by the Army's Harry Diamond Laboratories. Two 30-mc. IF amplifiers with power gains of 15.1 db. and 14.7 db. and a bandwidth of about 10 mc. were constructed from vacuum-deposited thin-film conductors, resistors and capacitors and an inserted coil and transistor. Spark erosion machine was used to produce dimensionally accurate stainless steel masks. Designers of the amplifier stage believe that the thin metal film resistors, deposited from a vapor nickel and chromium, are more stable than conventional screen-printed carbon composition resistors. Thin film capacitors made from silicon monoxide and aluminum, exhibited capacitance values of 0.0011 microfarad, near the upper limit for capacitors of this type.

► **High-Power VHF Multiplier**—Harmonic generator using varactors which follow a $\frac{1}{3}$ power law rather than the $\frac{1}{2}$ power law of conventional abrupt-junction varactor, has yielded efficiencies of 70% in a frequency tripler which converts 50 mc. to 150 mc., and 60% efficiency for 150 mc. to 450 mc. conversion with input powers of 50 watts, according to a paper presented at Electron Devices Meeting by Dr. William Taylor, M. J. Bentivegna and Dr. Gerald Schaffner of Motorola Semiconductor Products Div. In addition to higher power handling capability, new $\frac{1}{3}$ power law devices have greater output linearity than the abrupt junction type varactors.

► **Long-Lived Magnetron Reported**—Inverted coaxial Ka band magnetron, developed for use with Federal Aviation Agency airport taxi radars, is expected to slash former tube replacement costs which annually exceeded original cost of entire radar by 30%, according to a paper at Electron Devices Meeting by Jerome Drexler, Paul Fenster and F. A. Feulner of SFD Laboratories, Inc. The new magnetron, which has operated for more than 7,000 hours without falling below rated 100-kw. peak output, is expected to have operating cost of 20-40 cents per hour compared to about $5.00



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Information Available: a. Classified ARPA-sponsored follow-on report of Hexcel's work . . . b. Unclassified structural report. Write to:

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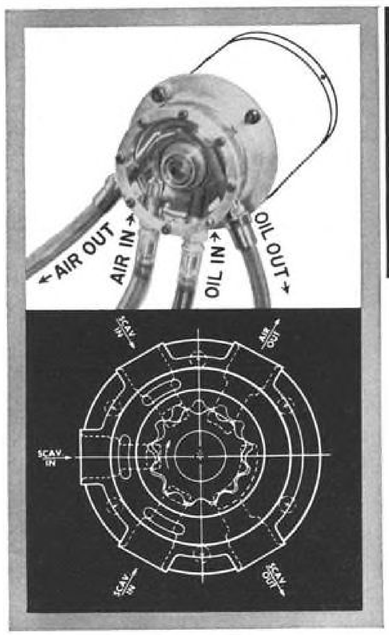

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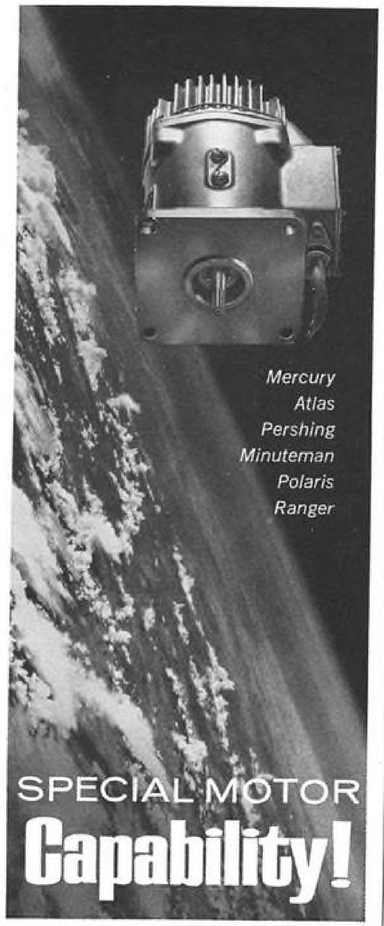
per hour for original tube used in FAA's ASDE-2 radar.

► **Improved Tunnel Diode Reported**—Tunnel diode which exhibits peak-to-valley current ratio of 40:1, with minimum parasitic inductance and capacitance, has been developed by International Business Machines Corp. using planar construction and epitaxial techniques. Device consists of epitaxial layer of gallium-arsenide grown on germanium substrate with tunneling junction formed by alloying tin to the gallium-arsenide. Fabrication technique permits peak current to be tailored to within 1% by altering impurity distribution near the junction instead of conventional etching process. Experimental units operate with peak currents of 10 milliamps and have a capacity of 1 picofarad/ma. Diode chip is covered with thin coating of high-temperature glass to protect it from contamination. Experimental diodes have been tested at 85C temperature, with 85% relative humidity for more than 1,000 hours with no significant change in electrical characteristics, according to a paper presented at the Electron Devices Meeting by Samuel S. Im. Paper was co-authored by J. H. Butler and Frank Masterson, all of IBM's Components Div. in Poughkeepsie, N. Y.

► **Single-Reversal C-Band TWT Reported**—A C-band traveling wave tube, using single reversal principle which provides light weight and low-noise performance, has been developed by General Electric, following recent announcement of a similar tube for X-band operation. The C-band tube operating in the 4-8 gc. (kmc.) range, has maximum terminal noise figure of 7.5 db. and minimum small signal gain of 29 db., GE's Dr. Karl Niclas reported at the Electron Devices Meeting. Output power from experimental models varies from 5-20 milliwatts across the band. The C-band unit, like earlier X-band model, weighs 8.2 lb., measures 11 in. long and 4 in. in diameter.

► **Data Interspersed With Voice**—Technique which permits transmission of up to 12 Teletype messages over a single voice channel while it is being used for voice communications has been developed by AF Cambridge Research Laboratories. Technique is similar in some respects to TACI used by Bell Telephone Laboratories to increase capacity of submarine cable by making use of frequent periods of silence in voice conversation between sentences, words and even between syllables. The AFCRL approach employs a "polymodal vocoder" which converts speech into digital form to permit its transmission at varying data rates and provides an indication of speech activity to control insertion of Teletype data during silent periods. AFCRL tests indicate that during normal two-way voice conversation more than 50% of the channel capacity is available for simultaneous transmission of Teletype and data, according to Caldwell Smith of AFCRL's Data Sciences Laboratory.



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► **Super-power Tube Development Slows**—Microwave tube companies are complaining about the sharp drop-off in Defense Dept. funding for research and development in the field of super-power tubes which is down about 85% from its Fiscal 1961-62 peak of about $12 million annually. Power levels now available appear to meet anticipated requirements for early warning and missile defense.

► **Why Navy Pushes For Reliability**—Navy's maintenance technician capability has dropped 75% in the past eight years in terms of numbers and experience level, and a similar drop is predicted for the next eight years, according to Navy spokesmen. During recent East Coast Conference on Aeronautical and Navigational Electronics, J. M. Brearley, head of advanced systems development for Bureau of Weapons Avionics Branch, said these figures explain Navy's push for increased reliability and growing use of computers for automatic check-out. He said that only one out of three aircraft in the Navy inventory is ready for combat at any time, the other two are undergoing maintenance. Three years ago the figure was only one operational out of four. Brearley said the Navy currently expends 40 manhours of maintenance effort for every hour of flight.

► **Hot Electron Amplifier Planned**—Theoretical and experimental investigation into materials and techniques suitable for a semiconductor-metal-semiconductor "hot electron amplifier," is planned by USAF's Aeronautical Systems Div. Qualified companies who wish to bid should contact Code: ASKS and reference KE-A4460-64-14.

► **Rare Earths Rotate Light**—Faraday rotation of plane-polarized light has been achieved using rare-earth phosphate glasses, according to Bell Telephone Laboratories. Of 13 glasses investigated, cerium, praseodymium, terbium and dysprosium produced the greatest rotation, roughly twice that of other glasses at room temperature and 140 times as much when operated at liquid helium temperatures, BTL reports. The phenomenon suggests use of rare earth glasses as effective isolators in laser and optical systems.

Package to ARINC 404

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Intended for prototype development the units are nevertheless priced competitively enough to allow them to be used economically as production run equipment. Write for detailed literature, price list, and discount structure.

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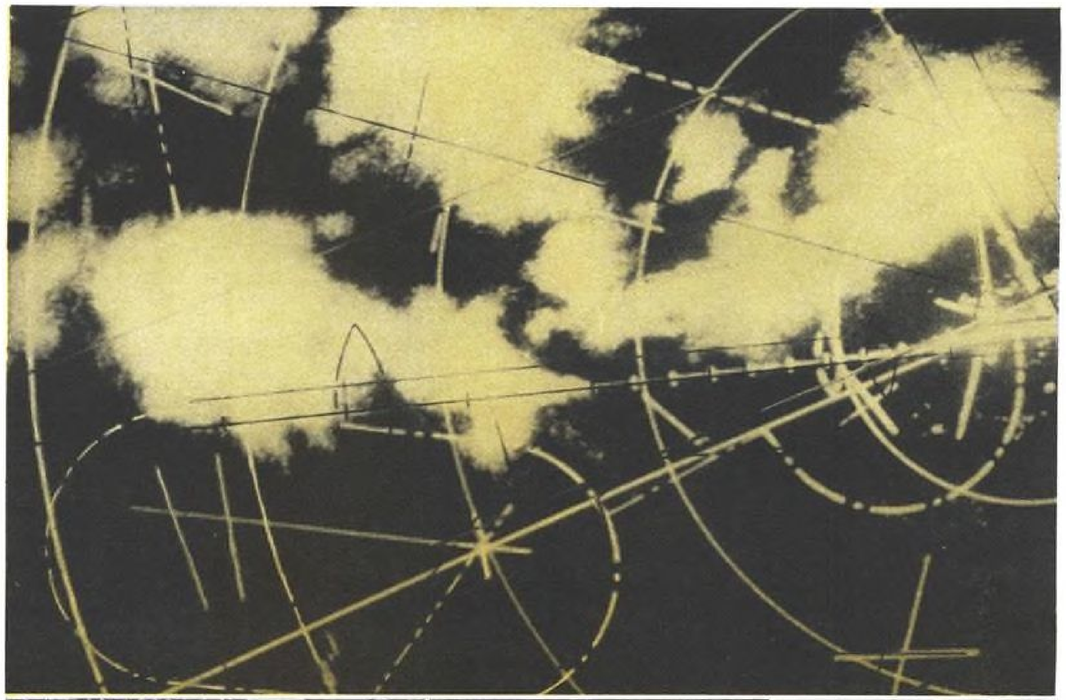

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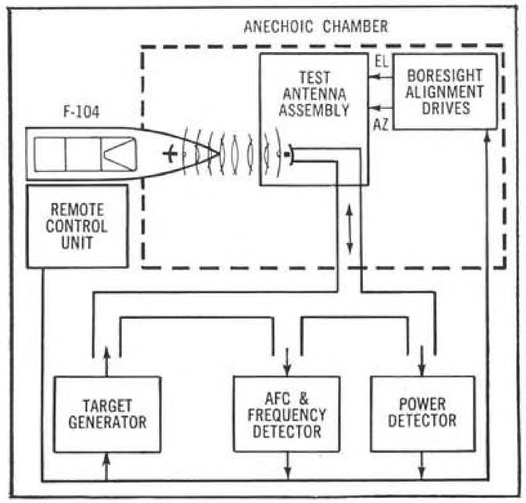

RADAR TARGET SIMULATOR which will permit rapid flightline checkout of airborne North American Search & Ranging Radar (NASARR) on F-104G interceptor is shown in block diagram (left). The boom and radome of a CF-104 are inserted in trailer containing anechoic chamber (right) in checkout operation. Operator in cockpit runs mode tests with aid of remote control unit. Simulators for the military assistance program F-104G are being made by Emerson Electric and Remanco; for the CF-104, by Remanco.

Target Simulator Checks F-104G Radars

By Barry Miller

Santa Monica, Calif.—Lightweight, transportable radar target simulators capable of performing dynamic checkout of multimode airborne radars in 20 min., are scheduled to be delivered to Lockheed Aircraft next spring for use in flightline checkout of the F-104G interceptors earmarked for the military assistance program.

The radar target simulators are being developed by Emerson Electric Mfg. Co., with Remanco, Inc., which is located here, serving as a subcontractor.

The simulators will be able to properly exercise all operating modes of the aircraft's NASARR radar without requiring the removal of the aircraft's radome or the need to make electrical connection between the radar and the test simulator. For boresight harmonization, troubleshooting and calibration, the radome must be removed to make necessary electrical connections. Calibrating the radar requires approximately 3 hr.

Each simulator consists of a small (4 x 5 x 13 ft.) trailer-mounted microwave anechoic chamber containing a pair of adjustable test antennas and optical boresight targets, with avionic and control equipment located in drawers at the sides of the trailer. The latter can be rolled into position on the flightline or in a hangar, and the aircraft's pitot-boom and radome inserted into the chamber through its template doors.

Effectively, the chamber encloses the radar. Absorbent material covering the inside of the chamber absorbs the RF energy during tests so as to simulate in-flight free-space conditions.

Boresight alignment mechanisms on the trailer drive the chamber and target antenna array into alignment with the aircraft radar line in response to signals from a remote control unit, which the operator takes into the cockpit with him.

When the aircraft radar transmits during checkout, an automatic frequency control (AFC) and detector (see simplified block diagram, above) lock onto the radar signal. The AFC can reproduce radar frequencies within 25 kc., according to Remanco. The target simulator returns the RF signal, simulating in frequency, pulse shape and width, range delay and power level the type of target return the radar would see in each of its modes.

Hence, the test antennas and associated avionic equipment function effectively as a transponder. Returns are transmitted by one or both of the test antennas positioned so that they realistically simulate the types of returns expected for operation in a given NASARR radar mode.

Changes in range, velocity and position of the target are remotely controlled by the operator in the aircraft cockpit. He monitors radar data detected and displayed on the remote control unit. He can check the transmitter, receiver and computer functions in all modes of operation. Two simulators are expected to be used with each F-104 squadron in the military assistance program nations, according to Emerson.

Among the operational radar modes that the equipment will check are the following:

• **Air-to-Air**—A target pulse of the necessary width, range and power level to simulate the desired airborne target is generated by the radar test generator. One of the two target test horns is moved in a circular path to test the angle tracking capability of the system. Various factors evaluated include lock-on, range and angle tracking, indicator presentation, gain tracking, clutter elimination and breakaway.

• **Contour Mapping Terrain Avoidance**—This test determines the ability of the radar to indicate terrain clearance during flight by generating a pulse to simulate typical ground targets. Range, power and test antenna depression angle are set to predetermined values. Varied conditions are used to check radar operation for different clearance planes with the target appearing in the upper and the lower antenna elevation beams at different ranges, according to the companies.

• **Air-to-Ground**—Two sequenced signals simulating a ground return provide for checkout of range tracking and computer performance for the air-to-ground mode. Pulse width and RF amplitudes programmed as a function of range simulate a ground return for given dive angles.

• **Ground Map Evaluation**—System sen-

MIT/RAYTHEON STATUS REPORT:

APOLLO Guidance Computer

Ralph Ragan (left), Manager of Raytheon's Sudbury Operation, and Eldon Hall, Director of Apollo Computer Division, MIT Instrumentation Lab, inspect onboard guidance computer for Apollo mission.

Predicted Reliability Increased More Than 2:1 ... Contract On Schedule

By incorporating the latest rope memory module and integrated micrologic techniques into Apollo's on-board guidance computer, the MIT/RAYTHEON team has *doubled* predicted reliability of the system with no loss in scheduling time.

Drawing upon a background of successful joint effort in developing the reliable Mark 2 Polaris missile guidance computer, the MIT/RAYTHEON team is striving for similar fault-free operation of its Apollo guidance system. The operating computer, less than 1 cubic foot in size, will provide mid-course navigation and guidance data for NASA's Apollo spacecraft mission.

The MIT/RAYTHEON-developed computer contains an extremely dense, low-powered, fixed memory of 5,000 bits/cubic inch. In flight, the astronaut will operate the computer through a 16-button coded keyboard. In case of input error or an "unacceptable" order, a light will warn the astronaut to erase the error. When the command is correct, he pushes an "enter" button and the computer will take over, using inputs fed to it automatically from the other subsystems in the craft.

Keyboard for Apollo's on-board guidance computer.

The working relationship of the MIT/RAYTHEON team in developing and producing the computer, its displays and keyboard, and its pre-flight ground support equipment, represents a truly unique capability in space age guidance and control. *Space and Information Systems Division, Sudbury, Mass.*

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. . . is the world's most sophisticated airborne navigation display. It presents the pilot or navigator with a continuous visual picture of the terrain over which he is flying and the area to which he is heading.

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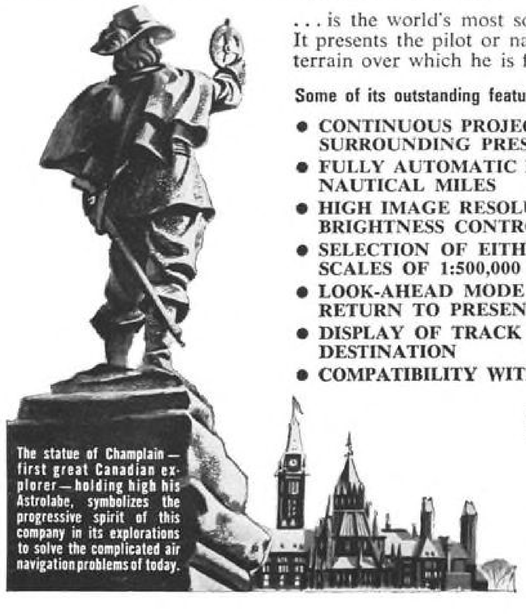

The statue of Champlain — first great Canadian explorer — holding high his Astrolabe, symbolizes the progressive spirit of this company in its explorations to solve the complicated air navigation problems of today.

Please write for complete information.

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sitivity, indicator alignment, maximum range and receiver gain controls, antenna tilt, intermode shift and noise are evaluated in a ground map test. With the target at different simulated ranges and changes in radar scale, proper circuitry is exercised to check intermode operation. Beam operation is tested by checking radar power for both pencil and spoiled (follow) beam operation.

The Emerson-Remanco simulator system makes use of what is called transition zone testing. The transition zone is that portion of the radiation field of a directive antenna, like the one employed for the NASARR system, lying between near and far field zones.

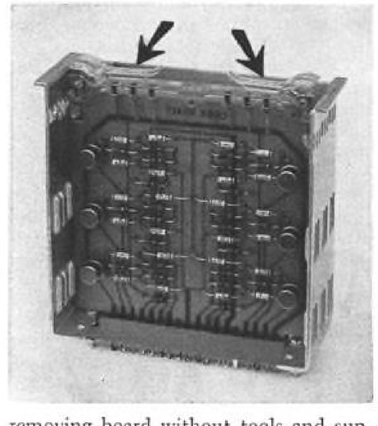
The anechoic chamber is positioned so that it encompasses the transition region of the directive radar antenna under test. It simulates free space, enhances radiation security and reduces interference.

Measurements are made in the chamber and correlated with what would be obtained in free space. A large chamber might more nearly reproduce conditions of free space, but this would, according to Remanco, pose difficulties in handling, storing and moving about.

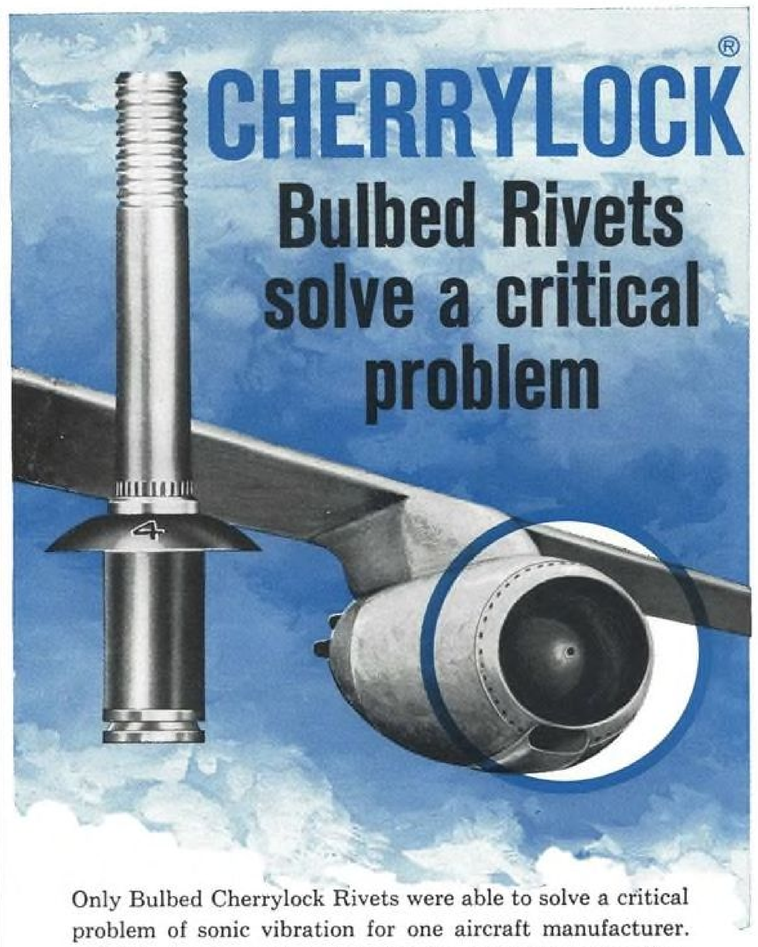
NEW AVIONIC PRODUCTS

• **Military wavelength signal generator,** covering frequency range from 17.5-100 gc. (kmc.), has short-term frequency stability of 5 parts in 10^8. Source can be tuned to desired frequency to within 0.01%. Manufacturer: Frequency Engineering Laboratories., Farmingdale, N. J. 07727.

• **Printed circuit lock-extractor,** fitted to end of printed circuit board, locks the board securely into place in modular card file by means of two levers (arrows), provides convenient means for



removing board without tools and supplies six test points. Device is attached



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Solid aluminum rivets failed in the original construction. Several blind rivets were field tested in flight, but only the Bulbed Cherrylock was satisfactory on this important rework job.

Try Cherrylock rivets on those difficult applications where other fasteners are not satisfactory. We can probably solve your problem.

For technical information on the Bulbed Cherrylock Rivets, write Cherry Rivet Division, Townsend Company, Box 2157N, Santa Ana, California.

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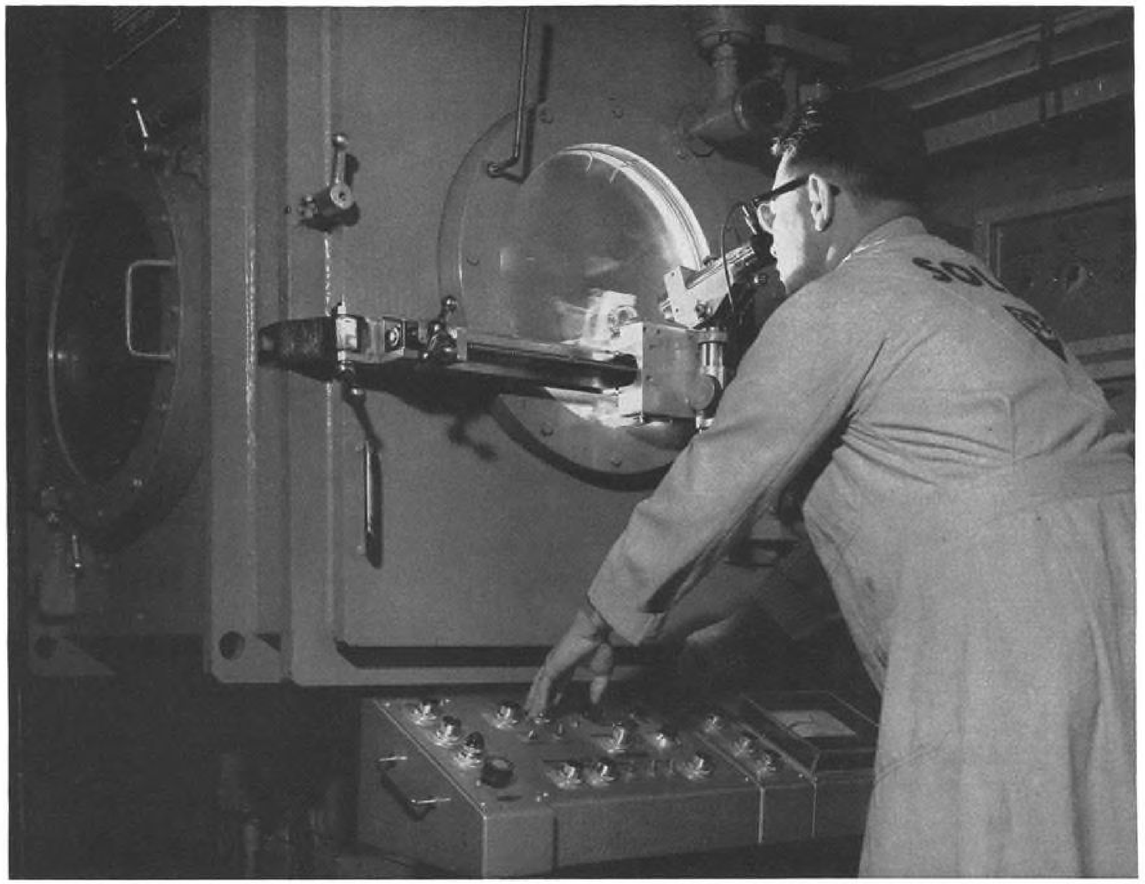


How Solar uses electron beam welding to join high alloy and refractory metals

The heat resistance of high alloy and refractory metals makes them ideal for many of the most advanced aerospace structures. This same quality, however, makes it difficult to join these "exotic" metals either to themselves or to other metals. Solar solves this problem by employing electron beam welding.

Basically, the electron beam welding process used by Solar is a type of fusion welding. Heat is generated by converting kinetic energy in a dense beam of high velocity electrons to thermal energy. The electrons cause instantaneous localized melting as they hit parts to be welded. The parts coalesce, forming a strong, precise bond.

Welding operations are carried out in a vacuum. This minimizes contamination from air and allows the beam of electrons to be concentrated on the weld without being deflected by molecules present in normal atmosphere. The welding chamber is evacuated to 1×10^{-4} mm of mercury. Interstitials or absorbed gas problems are eliminated, producing extremely clean welds.

Solar's two electron beam welders can also be used for heating, making holes and sealing holes, as well as welding. The larger of the units has a chamber that measures 50 inches long, 30 inches wide and 42 inches high. Extensions up to 12 ft on each side can be added to weld parts such as missile ducting. In a year and a half of operation, the electron beam welders have been used on over 1000 jobs—some representing as many as 30 welds.

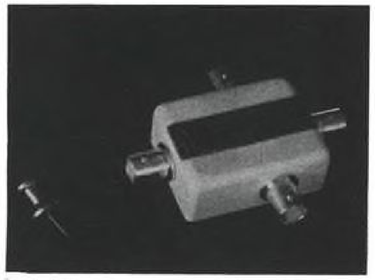
A partial list of metals joined by Solar with electron beam welding includes columbium, tungsten, copper, aluminum, tantalum, stainless steel, Hasteloys, Inconel, molybdenum, titanium, silver, nickel, rhenium and zirconium. Dissimilar metals that have been joined by electron beam welding include copper/stainless steel, vanadium/tantalum, vanadium/stainless steel, tantalum/copper, copper/steel and carbon steel/stainless steel.

Electron beam welding is typical of many advanced techniques that Solar uses to fabricate the most complex aerospace components. The company has been in the forefront of metallurgical technology for over 30 years, handling with ease the most challenging space age assignments. For more information about aerospace capability, write for brochure available from Solar, Department L-196, San Diego, California 92112.

SOLAR
A Division of International Harvester Company

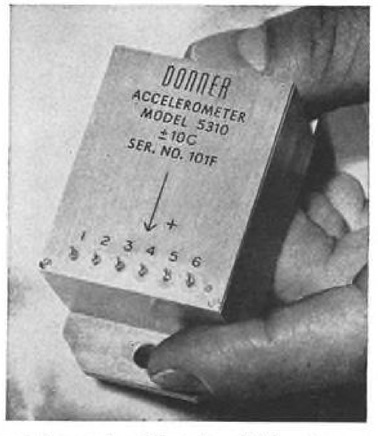
to circuit board by means of three roller pins. Extractor-lock is made of tough, resilient Lexan plastic, is available for circuit boards 4-6 inches wide in ½-in. increments or larger sizes on special order. Manufacturer: Admiral/Palo Alto, Stanford Industrial Park, Palo Alto, Calif.

• **Matched hybrid,** Model HV, covers decade of frequencies from 20-200 mc., providing outputs balanced to within 0.2 db. and phase balanced to within 1 deg. Isolation is greater than 30 db., insertion loss is less than 0.5 db. and VSWR is quoted at less than 1.2:1



Hybrid measures approximately $1\frac{13}{16}$ x $1\frac{7}{16}$ x ¾ in. Manufacturer: Adams-Russell Co., Inc., 280 Bear Hill Road, Waltham 54, Mass.

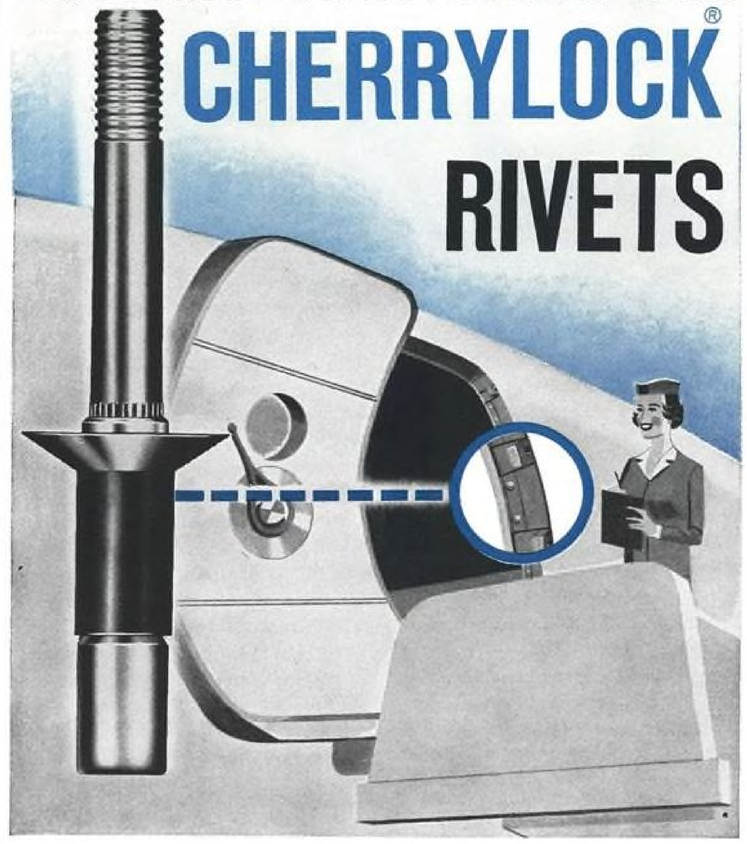
• **Ultra-rugged servo accelerometer,** Model 5310, a transistorized linear-force balance servo type which has accuracy quoted at 0.1% has only one



moving part, a hinge to which a torque coil is attached. Device is available in measurement ranges of ±10g to 100g, has hysteresis of less than 0.005% full scale and provides infinite resolution. It is available in a choice of operating parameters. Manufacturer: Systron Donner Corp., 888 Galindo St., Concord, Calif.

• **Microcircuit d.c. amplifier,** Model 1030, with preset gain up to 100, bandwidth of 100 kc. and drift quoted

customer satisfaction with CHERRYLOCK® RIVETS



Commercial jet transports must have perfect installation of fastening components for airline satisfaction.

Limited tool accessibility for bucking solid rivets often causes tipped heads and scuffing of the surface on interior door panels and similar components.

Aircraft manufacturers have discovered that Cherrylock Rivets, installed from one side of the work by one man result in perfect rivet setting, savings in installed cost, rework time and customer good will.

Try Cherrylock Rivets for your most difficult applications. We can probably solve your problem.

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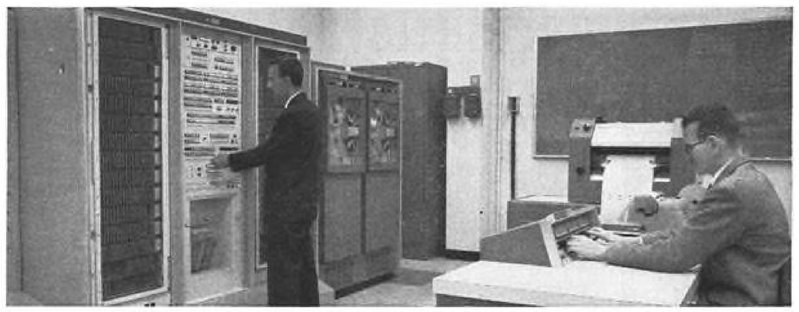

Checkout procedures on a newly manufactured space vehicle—its every component, subsystem and finally, complete system—have until recently been a monumental task. The complete performance of each item was recorded, then either processed and analyzed using entirely manual techniques, or run through computers, translated into digital language, and then manually interpreted and compared with predetermined optimum standards. Two to three weeks often elapsed before final approval could be given.

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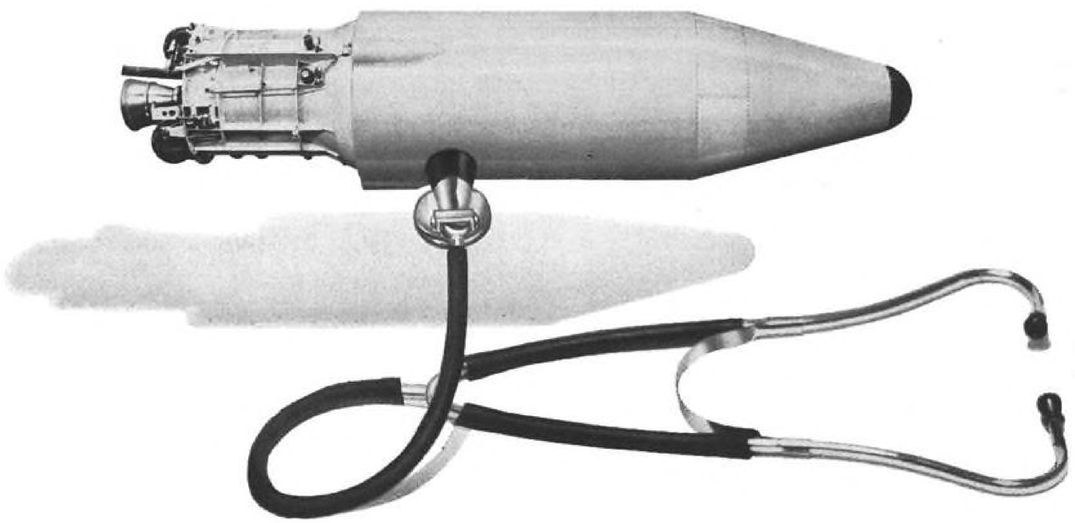

at less than 100 microvolts per deg. C, uses thin film passive components and discrete microsize active elements—silicon diodes and transistors. Device measures 0.75 x 0.55 x 0.10 in. not including leads. It is designed for operation over temperature range of −40C to 100C, requires supply voltage of +12 v. and −12 v. and has input impedance greater than 10,000 ohms. Manufacturer: Halex Inc., P. O. Box 546, El Segundo, Calif.

• **High-performance superconducting** wire, Type HI-120, provides 30-50% more field-generating capacity than niobium-zirconium wire, has 33% more current carrying capacity and offers

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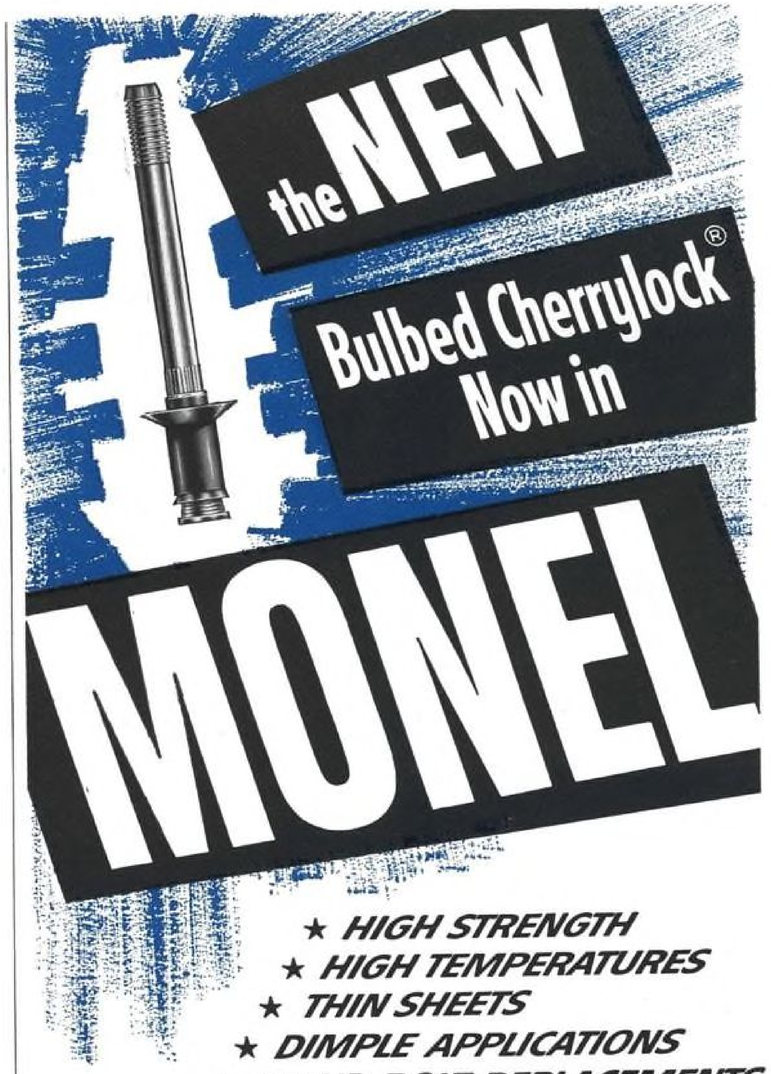
• **Phase shifter for 400 cps. voltages,** Model PG-9, designed for panel mounting, permits shifting up to 360 deg.

without introducing amplitude variations. Phase shift accuracy is quoted at 20 min. of arc. Device measures 3⅛ in. square x 3½ in. deep. Manufacturer: Theta Instrument Corp., Saddlebrook, N. J.

• **Laser energy monitor,** Model MI-2, permits measurement of energy during laser operation by beam sampling technique which permits laser to perform its intended function. Monitor provides



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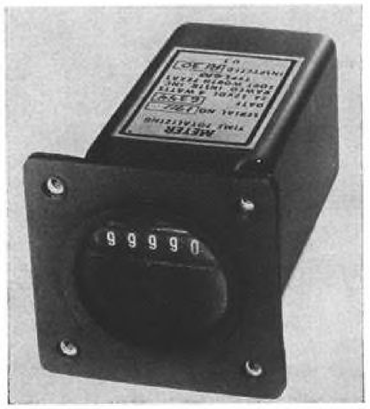
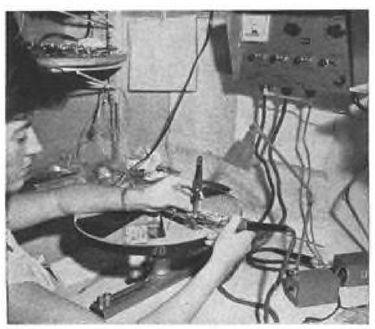
direct meter read-out in joules with accuracy quoted at 5% of full scale value. Holding circuit permits readings to be observed for up to 30 sec. after laser is fired. Attenuators enable device to be used for full-scale readings from 0.03 to several thousand joules. Monitor can accept beam outputs up to 1.25 in. in diameter and operates over range from 0.35 to 1.3 microns. Manufacturer: Lear Siegler Laser Systems Center, Ann Arbor, Mich.

• **AC/DC elapsed time indicator,** Type 610, operates from 28 v., either d.c. or 50 to 400 cps. a.c., is accurate to within



10% for voltage variations of up to 4 v., over temperature range of 40F-90F. Device, which can log up to 10,000 hr., measures 1.75 in. sq. x 4.2 in. deep. Manufacturer: Rawco Instruments Inc., 1400 Riverside Drive, Ft. Worth 11, Tex.

• **Controlled resistance soldering machine,** for producing thermally regulated solder joints in miniature and subminiature connectors, uses all solid-state controls to provide step-less heat control



with better than 1% repeatibility. According to manufacturer, equipment was used to make 140,000 soldered connections without a single reject. Manufacturer: Electro-Miniature Corp., 600 Huyler Ave., South Hackensack, N.J.

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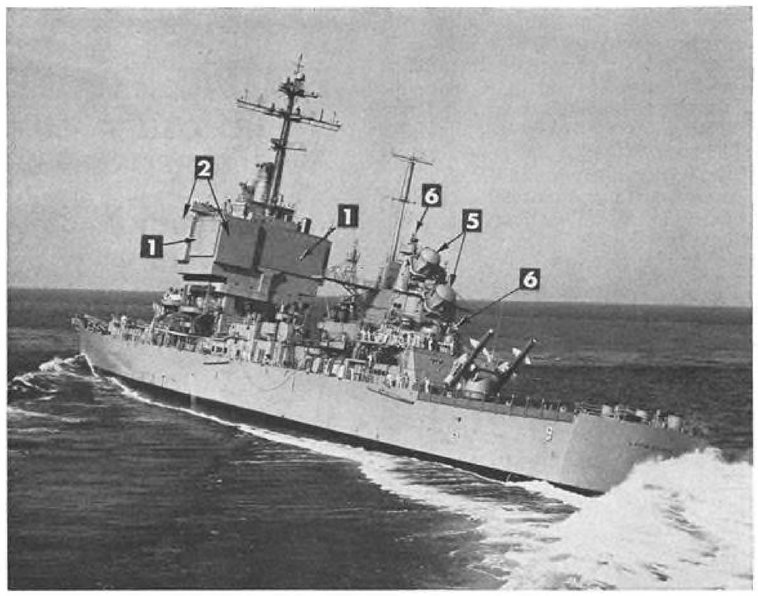

Long Beach Defense System Radars Shown

Advanced search and tracking radars, using flat billboard antennas mounted on four sides of the superstructure, provide the nuclear-powered guided missile cruiser USS Long Beach with a rapid, long-range, phased-array radar defense system. Each of four sides of the forward superstructure has a horizontal antenna (1) for a separate Hughes Aircraft Co. search and detection radar, AN/SPS-32, which electronically generates fan-shaped beams that provide range and bearing data on targets through 360 deg. of azimuth. Hughes AN/SPS-33 radar (2) generates pencil-shaped beams for automatically tracking many targets, furnishing range, height and bearing simultaneously. Also shown are four Sperry Gyroscope AN/SPG-55A circular antennas (3) associated with guidance and tracking radars for the two dual mounts of Terrier surface-to-air guided missiles at the ship's bow. Small parabolic dishes (4) situated beside each larger SPG-55A antennas are for Terrier target capture. Surface navigation and Tacan antennas are visible atop the main mast. Sperry AN/SPG-49 radar dishes (5) track targets for single dual-mount Talos surface-to-air missile. Small Sperry AN/SPW-2 antennas (6) point radar beams for Talos' semi-active beam-riding guidance. Long Beach has two reactors and can attain a speed of more than 25 kt. Crew complement is 900 men and 60 officers. Displacement is 16,200 tons. The ship also carries Asroc missiles.

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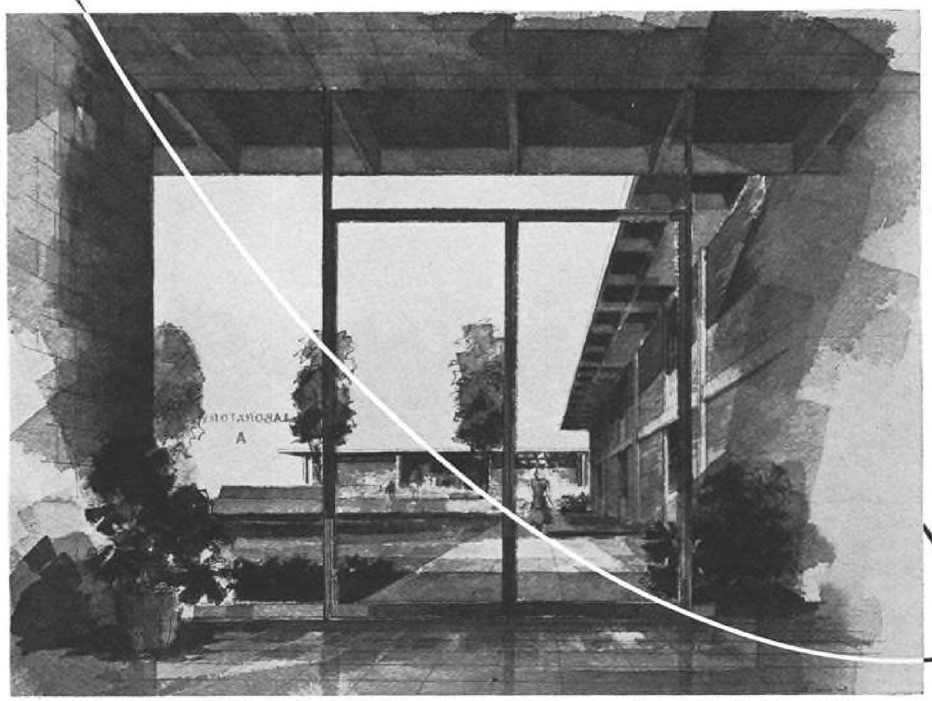

Artist's sketch looking through double doors of Material Sciences office and Laboratory Building

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HELICOPTER AGRICULTURAL OPERATIONS are expanding into areas previously dominated by fixed-wing aircraft, because of conditions where rotary wings are more productive. Hiller 12E, above, is defoliating cotton in Texas. Its downwash helps spray saturation.

Agricultural Aircraft—Part 2:

Helicopters Invading Agricultural Market

By David A. Brown

Increasing interest in the agricultural market as a possible major source of revenue for helicopter manufacturers has so far resulted in a number of study and development programs, an increase in sales activity directed at aerial applicator operators and at least one new helicopter.

The rotary-wing industry as a whole is working to displace the fixed-wing agricultural aircraft in many of the areas it has so far dominated (AW Nov. 18, p. 116).

Optimistic View

Bell Helicopter Co., which expects to have 5% of its total civil production go into agricultural work this year, is possibly the most optimistic of the major helicopter manufacturers in this regard.

Bell's agricultural sales were only 1 to 2% of the company's civil production as recently as two years ago, and sales personnel who specialize in the agricultural market believe the helicopter is on the verge of an even greater breakthrough.

Brantly Helicopter Corp. evidently shares this belief, for it is developing a new helicopter designed specifically for agricultural work. This helicopter, to be based on the four-place Brantly 305 (AW Oct. 14, p. 115), will have a different rotor system, designed to provide extra lift at the expense of speed.

Early Development

The company says the first hardware will not be available until October, 1964, and the first flight probably will be some time after that.

Irving Danielson, Brantly president, believes that the agricultural helicopter industry is still in the Model T stage, with much room for development.

The company hopes to be first on the market with a strictly agricultural machine, but Danielson notes that he has no plans to spread the small Brantly team too thin. The new Model 305 has first call and when it is certificated and ready for the market, the agricultural machine will be moved up in priority.

In addition to a high-lift rotor system, the agricultural helicopter will have a fuselage adapted to carry heavy loads and which can be rapidly cleaned.

A purely agricultural helicopter could be a further step in a trend noted also by Bell of an upgrading of helicopters used in agricultural work.

Bell market specialists have noted that the equipment now being used for this work is newer than in previous years, has better operating efficiency, has considerably lower operating costs and better pilot handling characteristics than older models formerly used.

Even though agricultural helicopters may still be castoffs from other work, they are tending today to be better machines, Bell notes.

Increased Efficiency

Bell says that 1963 was the first year in which rotary-wing aircraft were able to take business directly away from fixed-wing airplanes and attributes this to increased efficiency of operations and operating cost.

A portion of Bell's sales now is going to operators who formerly used only fixed-wing aircraft. One example is an operator in Chandler, Ariz., who purchased his first helicopter three years ago as an addition to his fixed-wing fleet. Now he operates eight helicopters.

There are a number of other instances in the past few years, Bell has noted, where operators have been purchasing their first helicopter to go with a fixed-wing fleet.

Research sponsored by Bell shows that the domestic agricultural helicopter fleet has increased about 33% in three years, from approximately 120 machines in 1960 to about 180 now.

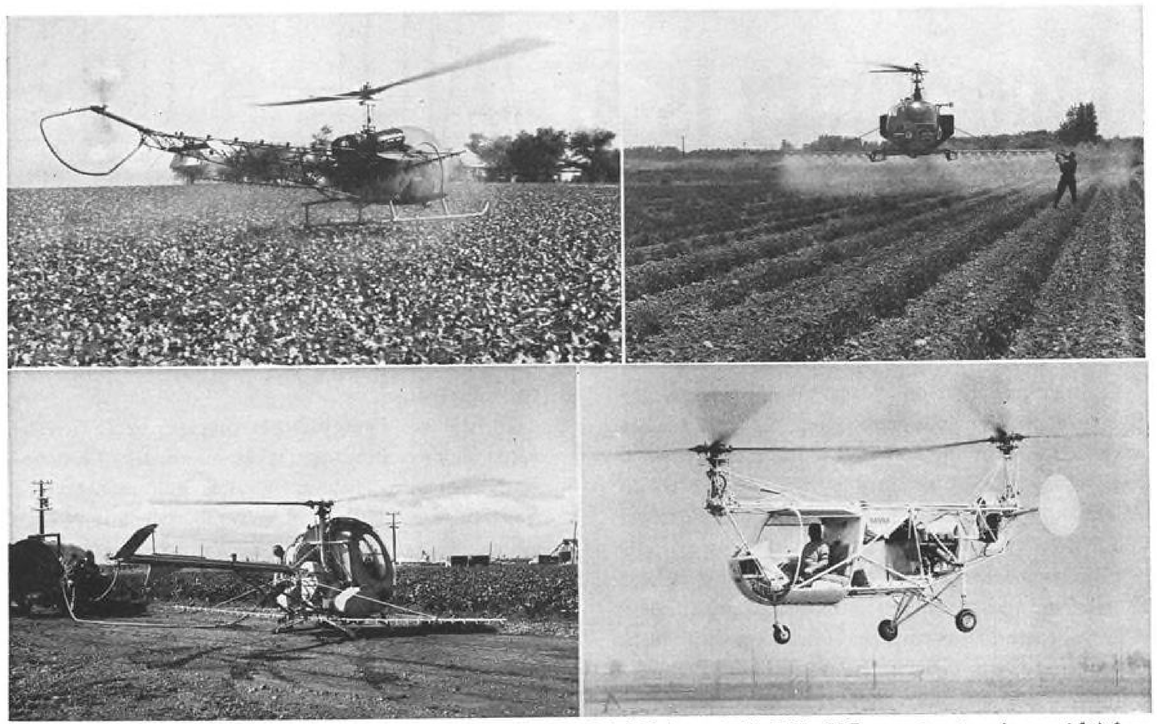
Foreign Growth

In foreign countries, the rate of growth may be even faster than in the United States, although specific figures are difficult to get. In Japan, for example, there are about 40 agricultural helicopters and the Japanese say they are increasing this number by about 20 a year as they expand their work through most of Asia.

In hours flown, domestic agricultural operations by helicopters increased about 500% during the period from 1955 to 1960, whereas the total hours flown by fixed-wing aircraft actually decreased slightly during the same time period.

In 1955, helicopters flew only about 10,000 hr. in agricultural work and fixed-wing aircraft flew approximately 841,960 hr. In 1960, helicopter hours flown in agricultural work increased to approximately 50,000, while fixed-wing hours declined to about 839,100.

Bell has been pointing out to operators that while helicopters are more costly to maintain and to purchase, their increased workload capability is



NOZZLE ARRANGEMENT ON SPRAY BOOM is evident on Bell Model 47G (upper left). Hiller 12E sprays tomatoes (upper right) from 140-gal. tank. Note flagman marking swath width. Pesticide is loaded on Hughes 269A (lower left). Jovair 4A (lower right) is new.

HILLER 12E SPRAYING FOREST shows versatility of helicopters when used over rough terrain. Helicopter manufacturers are optimistic on their chances in the market.

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■ Current development work in nuclear energy conversion at Allison holds great promise for solutions to the ponderous military problems of long, vulnerable fuel supply lines.

In Allison's Energy Depot concept, being investigated under contracts to the Atomic Energy Commission, mechanized field army units could manufacture fuel "on the spot" with a portable nuclear reactor system to synthesize the fuel from universally available elements, such as air and water. Another approach under study envisions using reactor-produced electricity to recharge a fuel cell supplying electric power to motors of each driving wheel of a vehicle.

Fundamental to the energy depot concept is a mobile nuclear power source. Meeting this requirement is the compact nuclear reactor, capable of generating 2000-3000 kw of electricity, also under development by Allison for the AEC.

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Case Study Compares Differences

Case study comparison, done by Bell Helicopter Co. in Finland, shows differences between helicopter and fixed-wing aircraft in forestry work. Both types of aircraft were used there on the same project, an attempt to control the pine looper. The aircraft were dispensing DDT dust.

	Airplane	Helicopter
Application, lb./acre	17.8	13.3
Payload, lb.	495	330
Swath speed, mph.	87	45
Average length of swath, ft.	2,000	2,000
Productivity, acres/hr.	136	161
Maximum wind for operation, mph.	5.5	10
Average working day	5.5	7.5
Cost/acre, dollars	.945	.92
Acreage dusted	5,180	10,440
Working days	7	10
Dust saved, lb.	....	67,500

making them economically competitive.

For instance, Bell says that helicopters must do about twice as much as a fixed-wing aircraft to achieve the same profit level, but points out that helicopters have proved themselves capable of doing as much as three or four times the work of fixed-wing aircraft (see box, above).

Downwash Helpful

They also contend that the helicopter can do a more precise job of application and, because of the peculiarity of its rotor downwash, needs to deposit less chemical per unit of area to gain the same coverage. Bell estimates this difference to be about 25% less.

Finally, helicopters are able to operate in higher surface winds, because the downwash of the rotor tends to offset wind dispersion of chemicals.

Another reason for the increased use of helicopters in agricultural work, Bell believes, is that the operators of helicopters are finding competition for all types of work more severe and are having to upgrade their equipment in order to meet this competition.

In upgrading their passenger or charter helicopters, they free earlier helicopters for agricultural work, which tends to have an upgrading effect on agricultural helicopters in general. Operators are finding a great deal more equipment on the second-hand market and some are finding it profitable to use new rotary-wing machines in place of castoffs.

Some, of course, use helicopters for agricultural work only part of the time and for charter or other use the rest of the year. These operators upgrade their equipment to meet non-agricultural competition and incidentally increase the quality of agricultural helicopters.

There is a strong possibility that helicopters may be able to increase whatever productive superiority they may now have over fixed-wing aircraft. Average swath width now is about 40 ft., but there are indications that it may be possible to triple this by taking advantage of the rotors' tip vortices.

Research now is being conducted on a new application boom which would spread chemicals out to a swath width of 120 ft., using the tip vortices to kick the material out on each side of the boom tips.

This study centers at present on nozzle size variation and placement. The completed boom assembly may be on the market as soon as next spring.

Hiller Aircraft Co. estimates that of the approximately 200 Hiller charter helicopters in the United States, 75% do agricultural work of some type or another at least part of the time. But the company has noticed no major change in the ratio of helicopters to fixed-wing craft except in forestry and seeding work.

Forestry Work

Most of the Hillers which do agricultural work are engaged in forestry work in the Western and Northwestern United States, Canada and Alaska.

Rough terrain allows the helicopter to put to use its unique aerodynamic capabilities and for this reason, helicopters have virtually taken over pesticide control and seeding work in forest areas where low-level runs must often be made in extremely rugged terrain.

To Hiller, this appears to be a major trend in the helicopter industry.

Other large-scale use of helicopters is being made in other areas where rough terrain prevails, including brush control in grazing land and utility rights of way.

A recent survey by Hiller showed that application of brush control herbicides by helicopters has increased markedly and is continuing to increase. Half of the major utility companies contacted in the survey listed herbicide spraying as one of the three top uses of helicopters, second only to powerline

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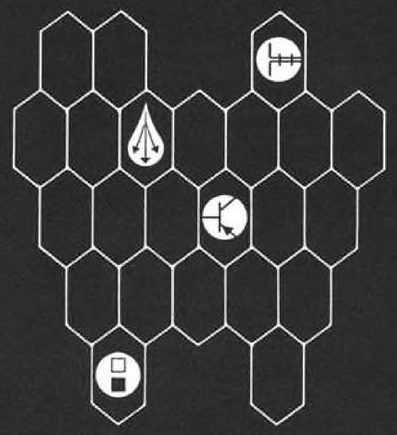

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patrol. Of total helicopter hours contracted by these companies, 18% was devoted to right-of-way control.

This ability to operate over more rugged terrain than fixed-wing aircraft can is making the helicopter complementary more than competitive, Hiller believes, noting that a number of California agricultural operators have added one or more helicopters to their fixed-wing fleet in recent years.

Another factor which Hiller believes is holding back agricultural use of helicopters is that the agricultural market, excepting government or large industrial companies, is not organized and is rather difficult for helicopter operators to contact.

These operators usually have limited sales promotion facilities and Hiller has not put a great deal of effort into promotion of agricultural work for rotary-wing aircraft.

This tends to increase the cost of sales and discourage the smaller helicopter operators, who are making their living on what is considered a more secure market based on industrial, government and charter work.

In addition, the cost of ground support equipment, loading gear, spray rigs for the helicopters and, in some cases, special licenses, also runs up the expense of operations.

Competitive Advantage

Spray rig equipment for helicopters has been improved and payloads have doubled in the past 10 years for smaller helicopters. Hiller believes that helicopter technology is moving faster now than competitive fixed-wing technology and that this will continue to work to the advantage of rotary-wing aerial application.

Hiller looks for the agricultural market to increase, especially if charter operators find methods and facilities for better promotion of their capabilities. The company suggested, for example, that charter operators may establish contacts with chemical companies and distributors in order to merchandise their services through them to the agricultural market.

First deep helicopter penetration of the agricultural market (as distinguished from forestry work) will be in areas where rough terrain predominates, where deep penetration of the chemical is desired–such as cotton defoliation and alfalfa discasement–in which the rotor downwash will aid, and where fixed-wing aircraft would have to operate from fields a considerable distance away.

The ability of helicopters to operate off unprepared fields of minimum length is counted by Hiller as a major competitive advantage over fixed-wing aircraft. With less ferry time to and from the operating site, the total cycle costs less in time and money–an important sales factor.

Another advantage, as Hiller sees it, is the helicopter's ability to provide better coverage of crops despite such obstacles as powerlines, fences, hills or trees.

For example, Hiller cites the comparative cost of California broadleaf (barley and oats) spraying, based on a 10-gal./acre application of 2,4-D growth hormone. Cost for application by a fixed-wing aircraft would be $1.20 per acre, while a helicopter would cost $1.50/acre.

Recover Lost Crops

However, if the fields were obstructed in some manner, fixed-wing aircraft could miss enough of the crop so that the lost crop yield would outweigh the cost/acre differential.

A relative newcomer to the agricultural market, the Hughes 269A helicopter, is receiving a strong boost from the manufacturer in this field.

A spray system for the machine was designed by Agricultural Aviation Engineering Co. (Agavenco) of Santa Clara, Calif., which has a 25-ft. boom and delivers a 30- to 40-ft. swath. The spray system employs a pair of 30-gal. chemical tanks.

Hughes has conducted tests with the 269A over a flat field in competition with a modified Stearman biplane. Results indicated that the two were approximately equal in the work performed.

The 269A dispensed 1,068 gal./hr. and the Stearman 1,094 gal./hr. The helicopter covered 107.5 acres/hr. and the fixed-wing aircraft covered 109.4 acres/hr.

Tests were based on a 3-mi. ferry distance for the Stearman. The runs were both quarter mile and half mile in length and the two aircraft each laid down a 40-ft. swath with 10 gal./acre coverage.

Covers 20 Acres

Fixed-wing speed over the run was 90 mph. and the helicopter speed was 60 mph. Tank loadings of 48 and 60 gal. were used on the 269A and 180 and 192 gal. were used on the Stearman aircraft.

Hughes calculates that the 269A will cover up to 20 acres with a 60-gal. load, based on a speed of 65 mph. and an application rate of 5 acres/min. Turnaround time between swaths is computed at 5 to 7 sec., compared with 24 sec. for the Stearman.

At present, about 20% of the 269As in service are used in agricultural work, at least part-time. Company officials hope that this will increase to about 40%.

Certificated, but not yet in production, is the Jovair 4A tandem-rotor hel-

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LIFE IN GEORGIA

Chicago Wife Is Georgia Church Greeter

By Doris Lockerman
Atlanta Constitution Columnist

"GLERC," smiled Mrs. Philip Syputa, "may be a funny word to you, but it's a very good one in our lives. Practically everything we do centers around it."

G.L.E.R.C. are the initials of the Georgia Lockheed Employees Recreation Club, open to all the plant's employees, with a wide-ranging program geared to their various interests and pleasures.

Philip Syputa, 35, Liaison engineer, is helping three buddies build fiber glass boats using GLERC facilities, to use on nearby Lake Allatoona. It will be his turn next.

The two Syputa sons, Larry, 14, and Bobby, 12, are family members of the GLERC gun club, use the club's firing range for regular practice, while Leola Syputa, 33, who has a natural flair for clay modeling, and their daughter, Laurel, 8, have joined the head of their household in a ceramics class, also courtesy GLERC. Many of the decorative objects they have made are in daily use in their home at 807 Wildwood Road, on the outskirts of Marietta.

Doris Lockerman

"But the thing in most constant use is our basement recreation room," Mrs. Syputa says. "It is full of boys and girls all the time."

A new, larger home was in the budget for the Syputas until their three children protested against moving from the pleasant, friendly neighborhood in which they bought when they came to Lockheed more than a year ago from Colorado. The below-zero weather of Colorado, and before that, the crowded condition of California, where they had worked with an aircraft plant, had conditioned the Chicago-born Syputas for Georgia's appealing climate.

Mrs. Syputa, a young, graceful woman does regular visitation work for her church, calling on new people in the community to welcome them and to offer them whatever aid they may need.

Her cosmopolitan cooking—Tacos from Mexico; Polish and other European dishes from Chicago; steaks on a spit, and chicken in orange sauce from the far West—wins the admiration of her friends.

"We show up at our square dancing club," Mrs. Syputa says, "And somebody yells 'Howdy! y'all,"—and then we proceed to execute nothing but Western dances."

If yours is an engineering or scientific family, join the swing in Atlanta. Write Lockheed-Georgia Company, 834 West Peachtree, Atlanta 8, Georgia, an equal opportunity employer.

icopter designed by the Jovair Corp. of Culver City, Calif.

The helicopter carries 80 gal. of chemicals in a center-mounted tank which can use Agavenco spray equipment. Cargo compartment holds 18 cu. ft. of equipment and foldable side racks can double this amount.

The Jovair 4A is certificated under CAR Part 3 for a gross weight of 2,300 lb. and when certification under Part 8 is complete, this will be increased to 2,500 lb. Empty weight is 1,340 lb. and cruise speed is 75 mph.

Powerplant is a Franklin 6A335 engine of 210-hp. An optional 235-hp. engine is being certificated for altitude work, and an autopilot also is being tested. Price is under $30,000.

D. K. Jovanovich, Jovair president, said hard tooling is completed at the company's factory but that the helicopter would be built only to order.

(This is the conclusion of a two-part series on agricultural aircraft. Part 1 appeared in Aviation Week & Space Technology, *Nov. 18, p. 108.)*

WHO'S WHERE

(Continued from page 23)

Changes

Lewis S. Billig, associate head, Communication Systems and Techniques Dept., The Mitre Corp., Bedford, Mass.

Jack G. Webb, special assistant to the associate administrator for programs of the Federal Aviation Agency, Washington.

Dr. Jacob Benveniste, staff scientist, Office of Research, San Bernardino (Calif.) Operations of Aerospace Corp. Other San Bernardino Operations appointments: **Dr. Martin Goldsmith,** group director, Weapon Systems Plans, Group B., Advanced Planning Div.; **Joseph J. Jerger,** senior staff engineer, Sensing and Information Sub-division; **Peter P. Radkowski,** senior staff engineer, Aerospace Mechanics Sub-division.

Beech Aircraft Corp., Wichita, Kan., has announced the following appointments in the Aerospace Div.; **Lloyd R. Mein,** executive project administrator; **Byron E. Thompson** and **A. W. Powell,** project administrators; **C. F. Singer,** assistant project administrator.

Gary G. Gould, manager-European operations, Data Systems Div., Litton Industries, with offices in Zurich, Switzerland.

Robert O. Blackert, program manager, and **H. Dean Gulnac,** telecommunications laboratory section head, Motorola Military Electronics Div., Scottsdale, Ariz., to direct the company's Apollo Up-Data Link Electronics Program.

James B. Taylor, manager of the newly organized Business Jets Div., of Pan American World Airways.

James S. Melton, manager of the Washington, D. C., office of the General Motors Defense Research Laboratories, succeeding **Kenneth Wydler,** deceased.

Merle J. Long, marketing manager, Electro-Optical Systems, Inc., Pasadena, Calif.

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CHAPTER III
PAN AMERICAN WORLD AIRWAYS
Equity Research Associates regards *Pan Am* as the "blue chip" of the airlines group. Earnings for 1963 should reach $4.00 per share and cash flow is running about $15 per share. Is a further sharp increase in 1964 likely? Does this stock still offer capital gains potential of substantial magnitude?

CHAPTER IV
NATIONAL AIRLINES
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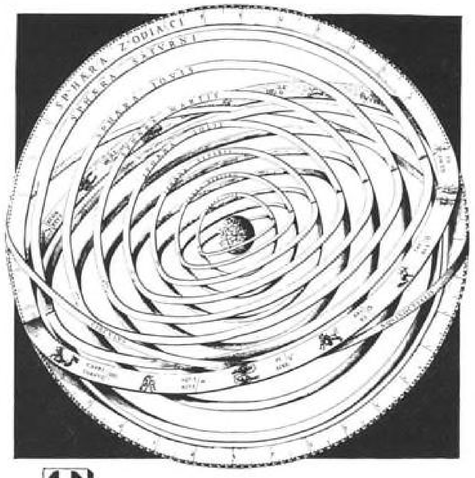

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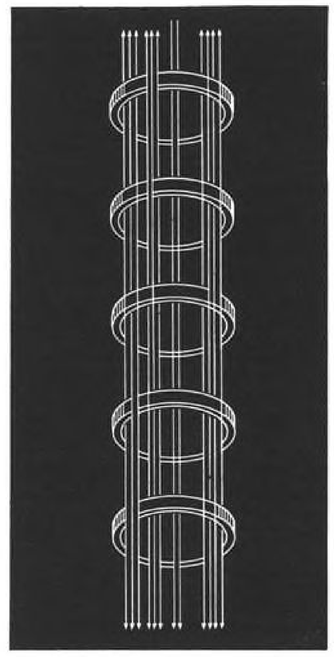

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LETTERS

Booklet Requests

Since our Oct. 14 ad in AVIATION WEEK & SPACE TECHNOLOGY, we have been swamped with requests for our "Good Old Flyin' Days" booklet. It seems that there are an awful lot of people interested in the older aircraft. Requests for the booklet have been averaging about 50 per day since the issue appeared last month.

Unfortunately, some people who have requested the booklet are going to be disappointed. Some neglected to give us their address, others we were not able to decipher, and a few letters have been returned to us as unknown or insufficient address. We would be pleased to send these people a copy of this booklet upon receipt of their correct address.

Would it be possible to print a portion of this letter in one of the future issues of AVIATION WEEK? That way, people who have not received the book within a reasonable length of time could write to us again for a copy.

R. S. BLOIS
Marketing Services
Aircraft and Missile Products
Barber-Colman Co.
Rockford, Ill.

Flight 1

A careful examination of the information currently available to me indicates that the launching on Nov. 1 of the Soviet satellite Flight 1 was rather less successful than Chairman Khrushchev would have us believe.

If we are to believe the newspaper releases appearing in the New York Times of Nov. 1 and 2 and in the (USSR) Krasnaya Zvezda on Nov. 2, the spacecraft was first placed in an orbit with perigee equal to 210 stat. mi. and apogee equal to 368 stat. mi. Following this the spacecraft is supposed to have changed orbits by increasing the apogee height to some 892 stat. mi., the perigee going to 213 stat. mi. In the latter orbit the inclination is given as 58 deg. 55 min., and the period as 102.5 min. No inclination or period are indicated for the presumed initial orbit in any of the publications that I have seen.

Soviet launchings of major consequence have always been made from Tyuratam, just east of the Aral Sea, at about 63 deg. E. Long. and 46 deg. N. Lat., and into an orbit whose inclination is within a few minutes of arc of 65 deg.

The first thoughts of everyone with whom I discussed this launching were that the orbit plane change for Flight 1 had been altered from an initial 65 deg. orbit to the orbit inclined at 58 deg. 55 min. This presumed 6 deg. 5 min. plane change would have required a velocity increment of some 2,600 fps. and the altitude increase required a few hundred fps. This demonstration of on-orbit propulsion capability with a supposed Vostok sized (10,000 lb.) spacecraft would be truly impressive had it actually occurred.

However, though many of us were rather convinced that this did happen, it wasn't necessarily so. The orbit plane change that may have occurred is more like 1 deg. 6 min., not 6 deg. 5 min. and, in fact, may have been no plane change at all.

Two Spadats bulletins on Flight 1 clearly offer evidence to support my contention. Bulletin 1 states an initial inclination of 59.99 deg. on the very first orbit; while Bulletin 2 shows the inclination to be 58.89 deg. At this time I do not know whether or not this slight change of inclination is merely a correction in the tracking program or a real plane change. I suspect, quite strongly, the former since bulletins in the past have often shown similar changes in the early tracking of a satellite.

Of course, if fine maneuvers were conducted such as those to be used in terminal rendezvous and/or docking, they may well have escaped notice in a coarse tracking program. It should be understood that the tracking is not so coarse as to have missed a 6 deg. plane change.

Perhaps others were misled about what was really accomplished on this Soviet launching. Much remains to be clarified but I expect that this note helps to place the mission of Flight 1—as performed—in proper perspective.

SAUNDERS B. KRAMER
Sunnyvale, Calif.

(Based on information supplied in Soviet reports, as well as information that was not supplied, AVIATION WEEK & SPACE TECHNOLOGY arrived at the same conclusions as Mr. Kramer regarding Polyot 1, in the issue of Nov. 11, p. 28—Ed.)

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Big Lift Rap

Congratulations to Reader R. Stargardter for his "Big Lift Useless" letter (AW Oct. 21, p. 106). Far too few voices of reason were heard through the military's roar of press agentry designed to dignify one of the most blatant examples in recent years of how to waste the taxpayers' money.

I won't discuss at length the obvious gaping holes in present massive airlift capabilities—Mr. Stargardter took care of those. Let me add just one point: Even under optimum wartime conditions for such an exercise (i.e., perfect weather, undamaged air fields, fully operative landing aids and support equipment), the Russians and their satellite armies hold such numerical superiority over the Allies that within 72 hr. they would undoubtedly overrun the Continent by the time we arrived. Our troops just might be met at planeside by a Soviet welcoming committee.

A military supersonic transport would cut the time required to reach Europe, and perhaps offset some of the Soviets' present advantage, but the SST is a long time coming, so let's keep those troops in Europe for the next few years. Who knows? You might have been able to pay their keep on the Continent for a quite a while just with the money that was wasted on Big Lift.

NAME WITHHELD BY REQUEST

How Much?

The current squabble about financing the supersonic transport is only another example of the futility of trying to separate the so-called private and public sectors of our economy where large projects are involved. The fact of the matter is that the supersonic transport development must be paid for by the labor of the people of the United States. The only question is: how much of the fruits of this labor is applied to the job to be done, and how much is siphoned off into non-productive paper profit?

There is really no doubt that we need a national transportation system which would include the airlines and the railroads. The spectacle of some dozen airlines whose rates and routes are regulated by the government, which are guaranteed against failure by government subsidies, and a large part of whose operating expenses are paid for by the government, pretending to be in competition, is simply ridiculous. The traveling public supports this farce by paying for multiple highly-paid managements, duplicated facilities, inefficient operation, and huge advertising expenses.

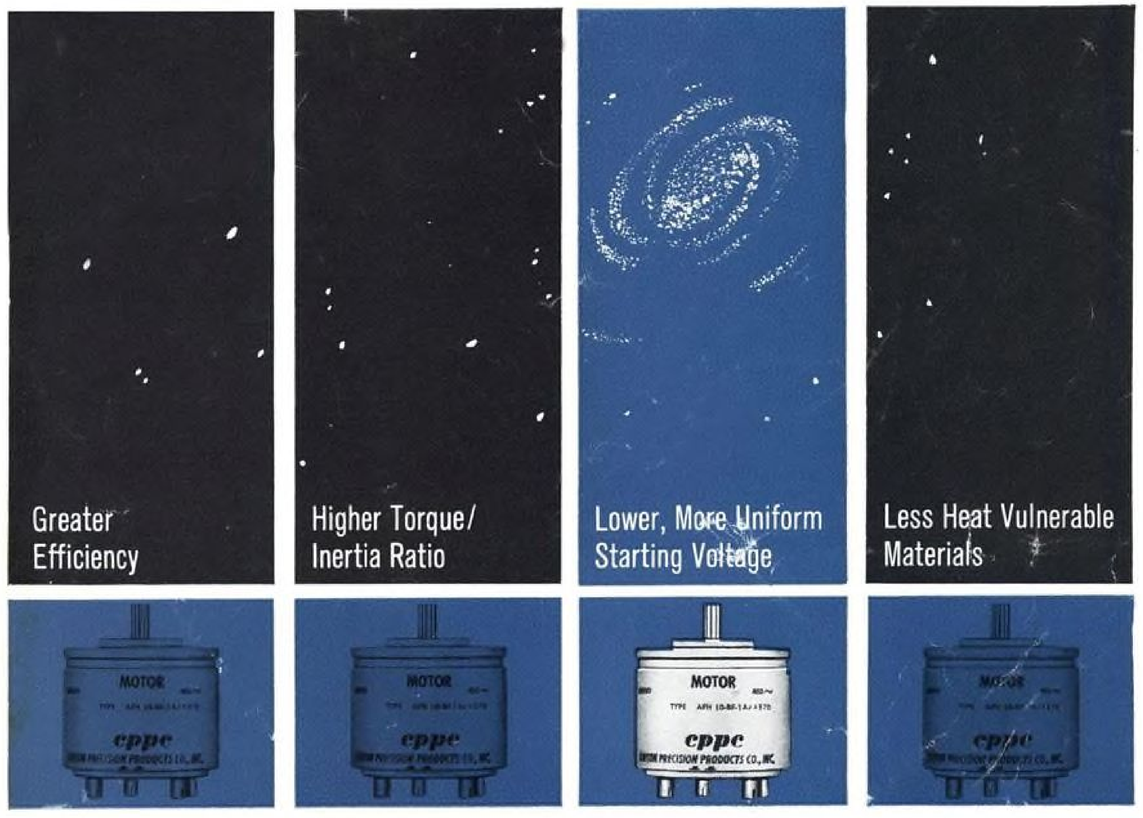
However, in view of the current state of our superstitions with respect to economics, it is unlikely that the Gordian knot of how to finance the supersonic transport will be cut by nationalizing the airlines, no matter how desirable this might be. Although the stresses and strains which this effort will place on the present system may hasten its demise. A reasonable compromise with orthodoxy might be for the government to develop and build the supersonic transport itself, letting contracts on a cost-plus-fixed-fee basis, and leasing the aircraft to the airlines. The rental charges could be set at a level that would pay back the development and production costs over the estimated life of the aircraft, and even (if it were permitted) show a paper profit for the government. (It should be realized, but not necessarily admitted, that actually the rental charge is a matter of indifference. The rate set merely helps to determine what air travel fares will be and/or the subsidy level.

The big advantage of the scheme I suggest is that it eliminates the paper merchants. The whole program could be financed out of taxes by simply diverting less than 1% of the current military/NASA spending to this project. (Taxes don't pay interest and are not inflationary). Furthermore there would be no need to cut the insurance companies in on the deal. All insurance does is to spread the risks over more people, and since the government includes all the people, there is no need to insure government property.

I realize, of course, that any sensible solutions to this problem that do not include paper profits for somebody have no chance of being accepted. But one can dream, can't one?

JOHN H. PRATT
Woodland Hills, Calif.

Precision announces 4 major improvements in Servo Motor performance



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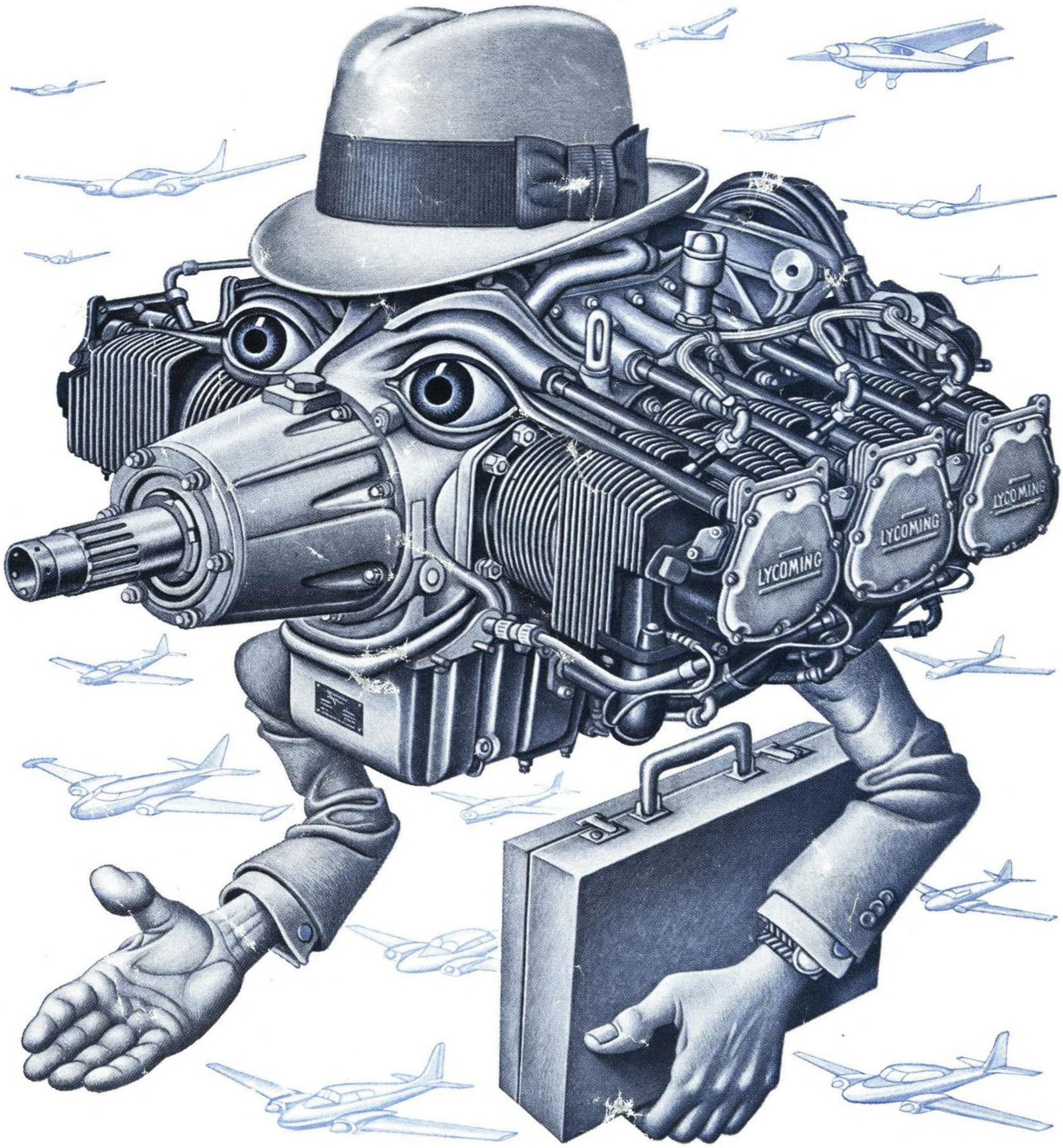

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