May 5, 1958

# AviationWeek

Including Space Technology

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Simulated Space
Missions Reveal
Crew Problems



JetStar Fast, Versatile in Evaluation Flight

# CONVAIR-Astronautics' ATLAS ... the free world's first ICBM

From Cape Canaveral came the news... CONVAIR AND THE AIR FORCE HAVE SUCCESSFULLY TEST-FLOWN THE ATLAS INTERCONTINENTAL BALLISTIC MISSILE. This momentous accomplishment has assured the U.S. Air Force a vital weapon for our national security and a key to ultimate peace. The free world's first ICBM is now in pilot production at CONVAIR-Astronautics' plant in San Diego, California

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OVERSEAS REPRESENTATIVE: The Sperry Gyroscope Co., Ltd.—Great West Road, Brentford, Middx., England

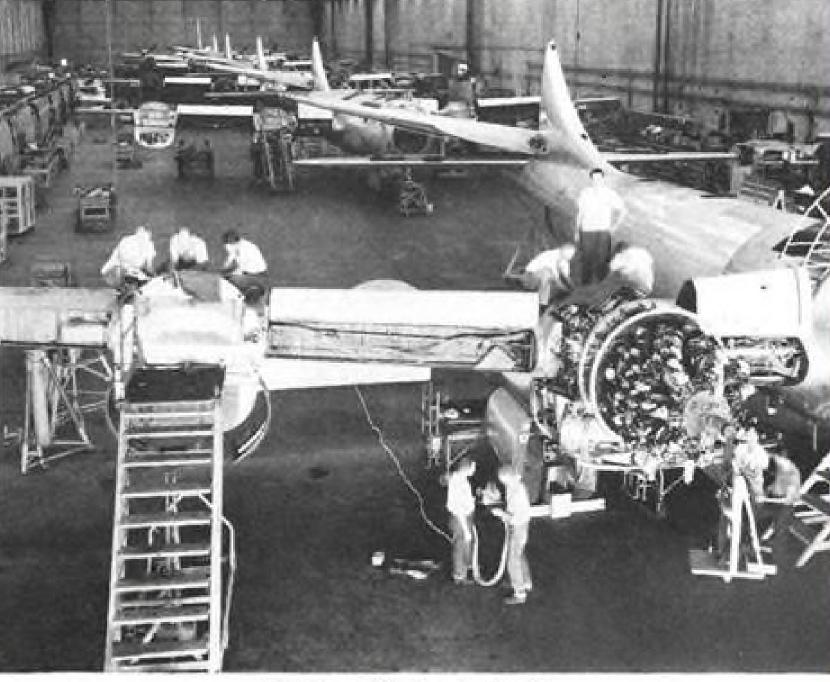
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Refueling reel pods for KB-50s.



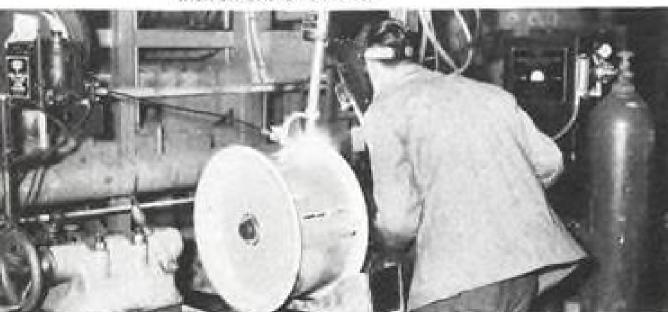
KB-50 modification in Bay 2.

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The Hayes aircraft modification facility is a highly diversified operation. From design, manufacture and testing of aircraft structures, Hayes activities branch out into a multitude of ramifications involved in aircraft modification. For examples, these include:

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**ENGINEERS • DESIGNERS** 

MANUFACTURERS

### AVIATION CALENDAR

May 12-14-National Conference on Acronautical Electronics, sponsored by Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 12-16-Airport Operators Council 11th Annual Meeting, El San Juan Intercontinental Hotel, San Juan, Puerto Rico.

May 12-16-Course on glass and ceramic materials for aircraft and missile engineers, Houghton Park, Administration & Research & Development Center, Corning Glass Works, Corning, N. Y.

May 14-16-Spring Meeting, Society for Experimental Stress Analysis, Hotel Manager, Cleveland, Ohio.

May 19-22-17th Annual National Conference, Society of Aeronautical Weight Engineers, Inc., Belmont Plaza Hotel, New York, N. Y.

May 21-22-Flight Safety Foundation, Inc., Regional Business Aircraft Safety Seminar, Palmer House, Chicago, Ill.

May 25-31-1958 Aviation Writers Assn. Convention, the Shamrock Hilton, Houston, Tex.

June 2-4-National Telemetering Conference, Lord Baltimore Hotel, Baltimore,

June 4-5-West Coast Magnesium Symposium, correlated program by the Society of Aircraft Materials and Process Engineers and the Magnesium Assn., Institute of Aeronautical Sciences Bldg., Los Angeles, Calif.

June 4-6-Second National Conference on Production Techniques, sponsored by the Institute of Radio Engineers Professional Group on Production Techniques, Hotel New Yorker, New York, N. Y.

June 5-6-13th Annual National Meeting. Armed Forces Chemical Assn., Hotel Traymore, Atlantic City, N. J.

June 9-12-American Rocket Society Semi-

(Continued on page 6)

AVIATION WEEK Including Space Technology



May 5, 1958 Vol. 68, No. 18



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# TRANS-SONICS

Precision Transducers

# AVIATION CALENDAR

(Continued from page 5)

annual Meeting and Astronautical Exposition, Hotel Statler, Los Angeles, Calif. June 9-13—Fourth International Automation Exposition and Congress, Coliseum, New York, N. Y.

June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D. C.

June 22-27-61st Annual Meeting, American Society for Testing Materials, Hotel Statler, Boston, Mass.

June 24-26—31st Meeting, Aviation Distributors and Manufacturers Assn., Mount Washington Hotel, Bretton Woods, N. H.

June 25-27—Air Transportation Conference, American Institute of Electrical Engineers, Hotel Statler, Buffalo, N. Y.

June 27—First Water-Based Helicopter Symposium, sponsored by the Bureau of Acronautics and Stevens Institute of Technology, Stevens Institute of Technology, Hoboken, N. J.

July 4-6-All American Aviation Exposition, County Airport, Pittsburgh, Pa.

July 8-11—The Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, Calif.

July 14-15—Triennial Inspection, National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

July 24-25—Fifth Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Colo.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Jointly sponsored by NBS, American Institute of Electrical Engineers, and Institute of Radio Engineers.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 25-30—Ninth Annual Congress, International Astronautical Federation, Amsterdam, Holland.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 6-14—International Aviation Show, Coliseum, New York, N. Y.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 8-13—Dynamics of Flight, University of Michigan intensive course for practicing engineers. For details: R. M. Howe, Dept. of Aeronautical Engineering, 1523 East Engineering Bldg., University of Michigan, Ann Arbor, Mich.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla. 750°F
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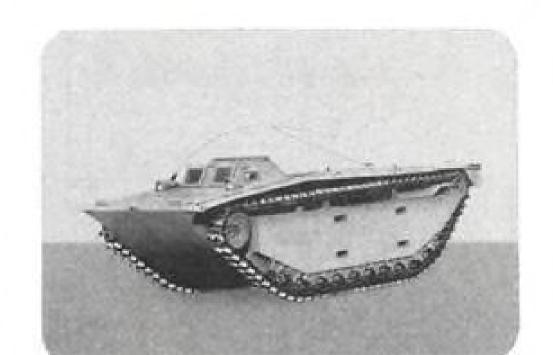
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1941...LVT 1 Amphibious Personnel-Cargo Carrier



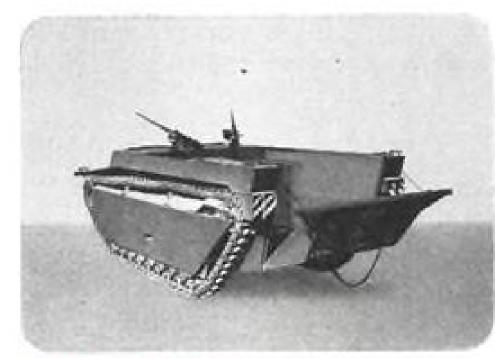
1942...LVT (A) 1 Amphibious Armored Assault Vehicle



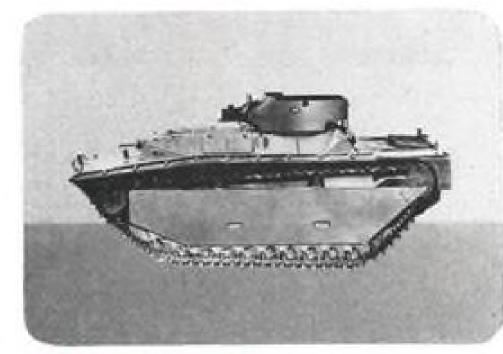
1942...LVT 2 Amphibious Personnel-Cargo Carrier



Amphibious Armored Personnel - Cargo Carrier



Amphibious Personnel-Cargo Carrier



1944...LVT (A) 5
Amphibious Armored Assault Vehicle



1945...LVT 4 Lightweight Amphibious Personnel-Cargo Carrier



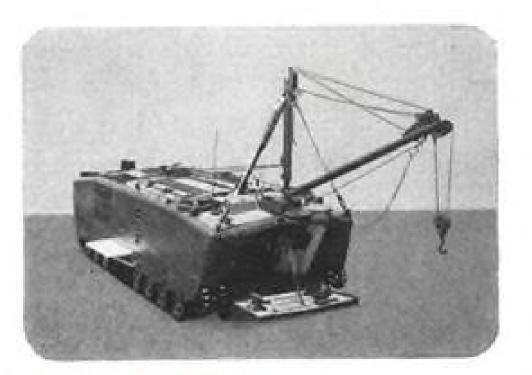
Amphibious Armored Assault Vehicle



Armored Personnel Carrier



1954...LVT P6
Amphibious Armored Personnel-Cargo Carrier

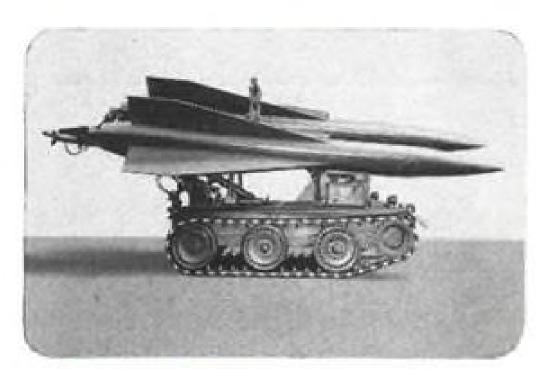


1955...LVTR-1 Modified Vehicle for recovery duty



1957...M-84 Mortar Carrier Vehicle

# HANDLE MISSILE LAUNCHER PROGRAMS



1957...HAWK Mobile loader Vehicle



1958...THOR
Transporter-erector Launching Mount &
Power Control Trailer

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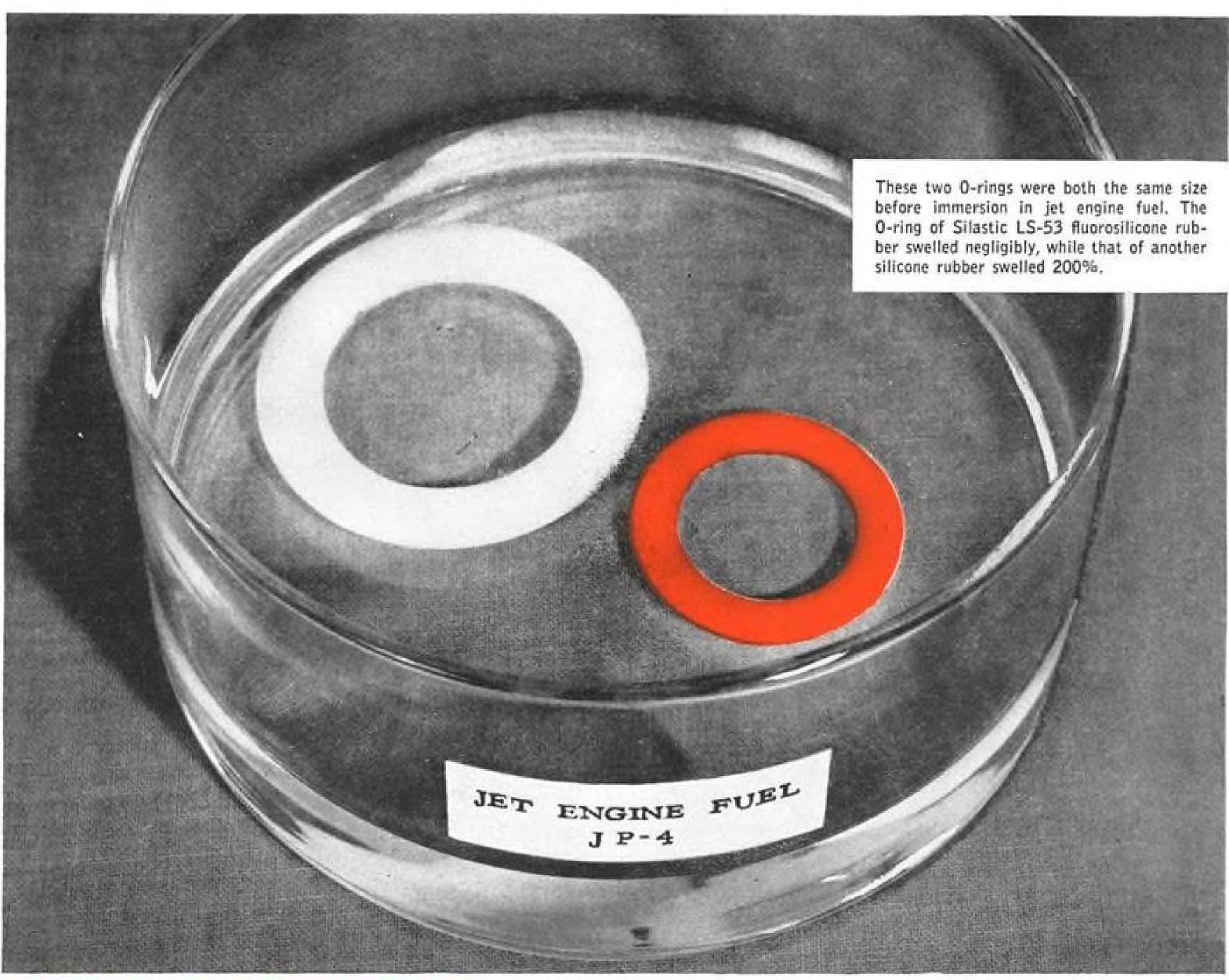


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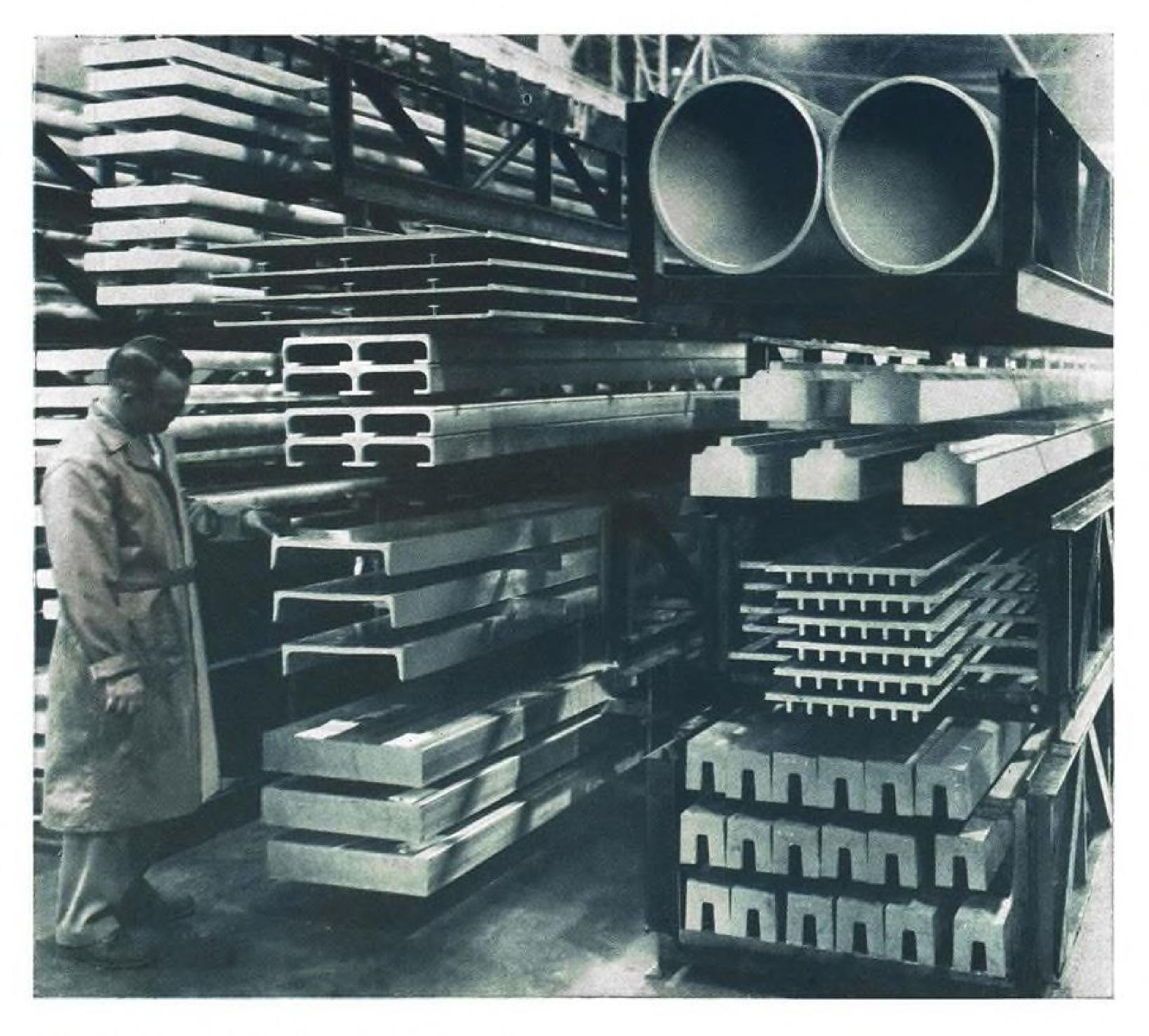
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• Compression set, %, 22 hrs @ 300 F	22
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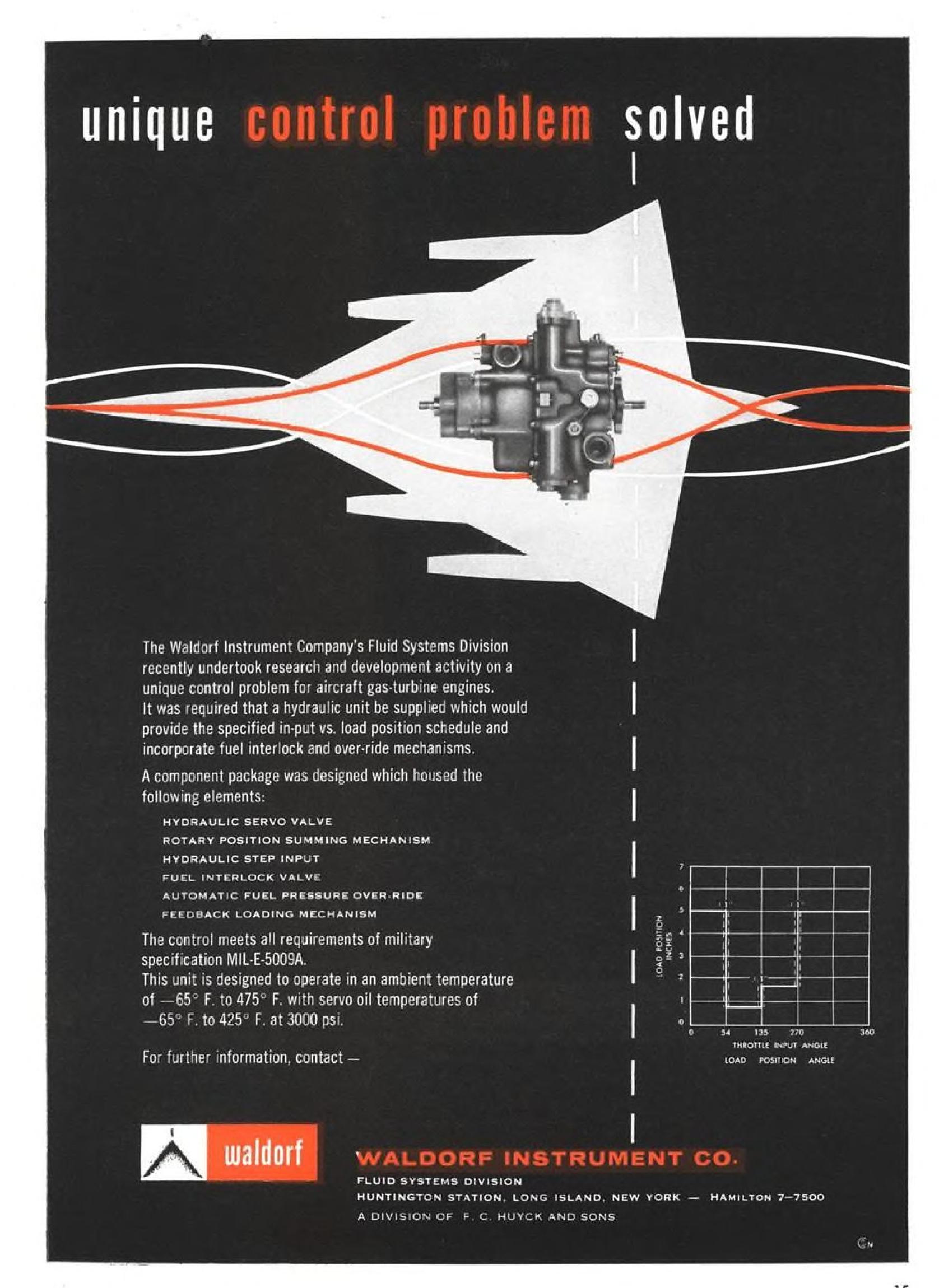
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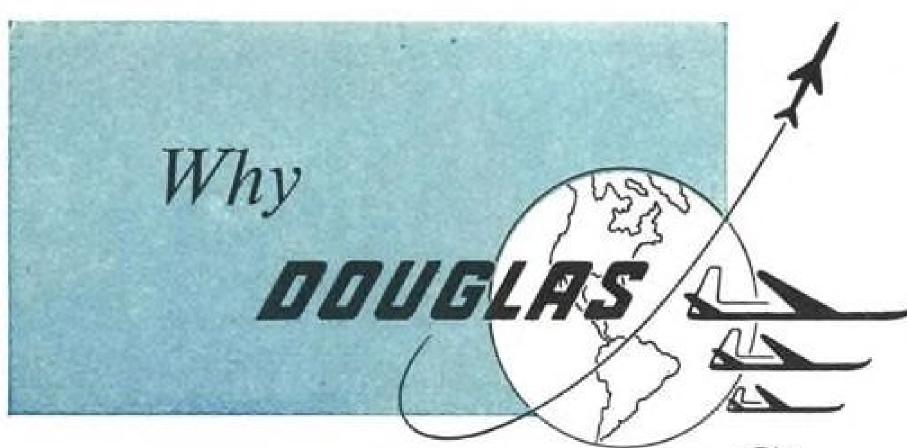
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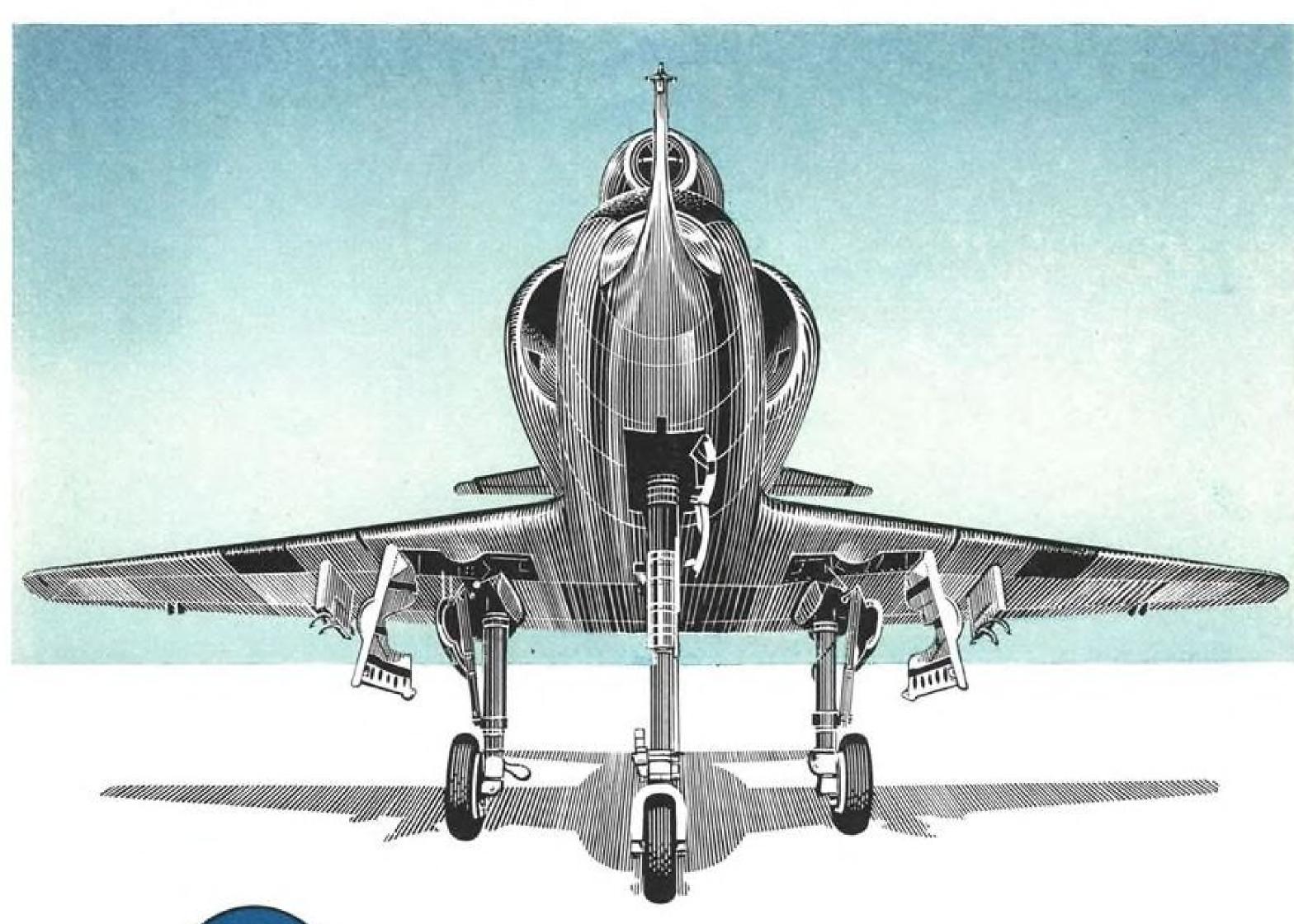
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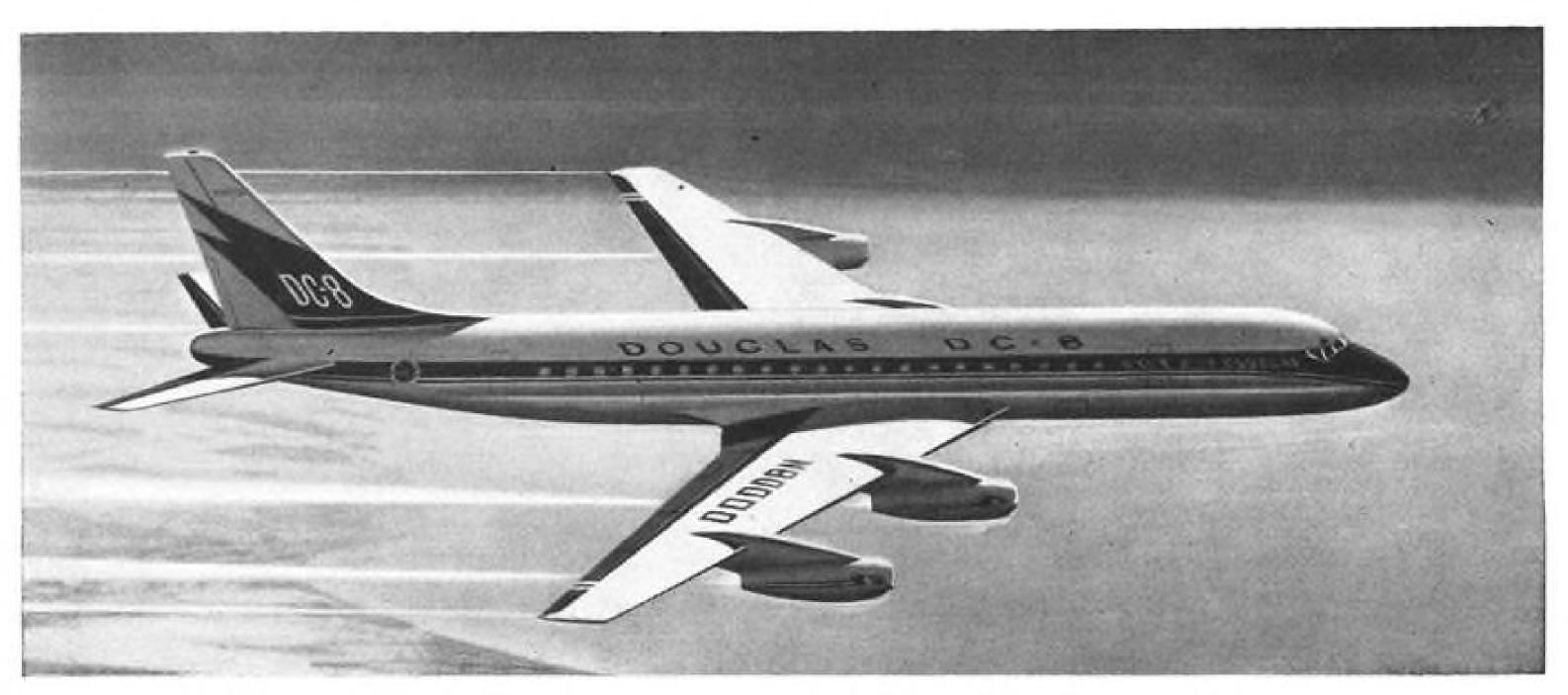


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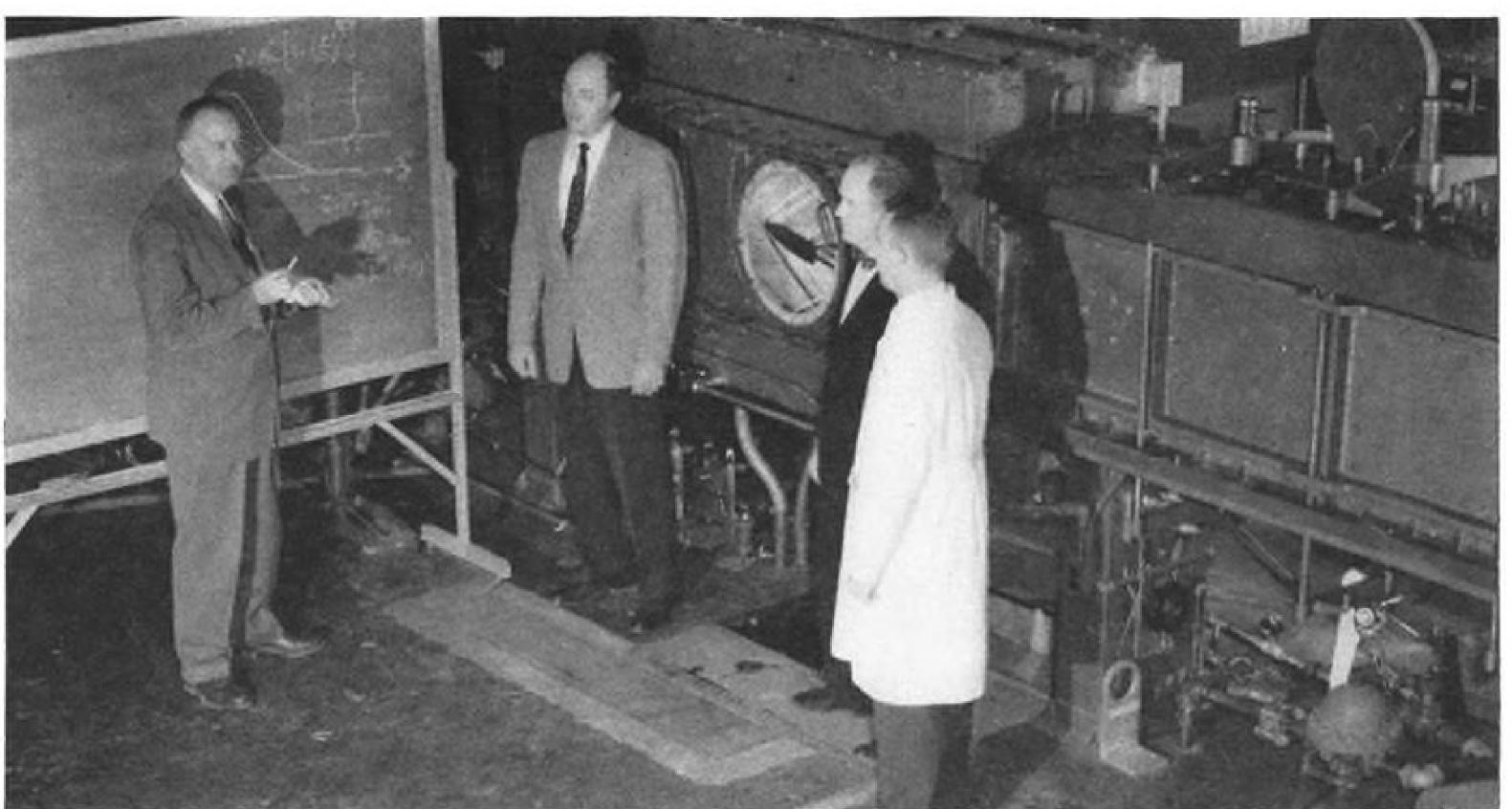
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Dr. H. H. Kurzweg, pioneer German rocket scientist who is now Associate Director for Aeroballistics at NOL, interprets nose-cone data obtained in supersonic wind tunnel test.

### U. S. Navy Photo

# FROM UNDERSEAS TO OUTER SPACE—WEAPONS OF THE NAVAL ORDNANCE LABORATORY GUARD OUR FREEDOM

Basic and applied research—and the development of advanced weapons for underwater, surface and air warfare—are the vital missions of the U. S. Naval Ordnance Laboratory near Silver Spring, Md.

Established in 1918 as a small experimental group to design sea mines and fuzes, NOL has become one of the nation's most respected institutions for military research and development. Three thousand persons, including 1,000 scientists and engineers, work at its modern \$50 million facility.

In its forty years, the Laboratory has made many notable contributions to science and technology, and to our national defense. In World War II, Nol-developed sea mines helped to strangle Japan's supply system. More recently, Nol's work on Tartar, terrier and talos greatly speeded the development of these needed missiles. The atomic depth charge weapon betty, conceived and perfected by Nol in less than five years, now provides the U. S. Fleet a massive defense against modern enemy submarines.

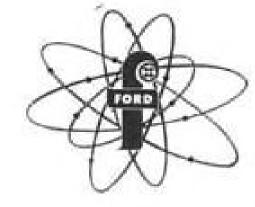
Today, NOL's work embraces virtually the entire field of advanced weapons design. One highlight is the

Laboratory's present key role in the development of POLARIS, the nuclear-capability missile that our submarines will soon be able to launch while submerged off enemy shores. This is one of many new weapons that NOL is developing or assisting with at present—weapons that are needed if the free world is to survive.

But in the long run, some of NoL's other work in basic and applied research may be of even more significance to mankind. For example, the advanced aeroballistics studies carried on at NoL, which already have solved some of the IRBM and ICBM problems, may help unlock the remaining doors to interplanetary space travel. Or NoL's work in advanced chemistry may provide entirely new and better types of metals, plastics and other substances. Or NoL's basic research in physics and mathematics may furnish a key to the internal structure of subatomic particles, and open up whole new worlds for science and mankind.

Thus the Naval Ordnance Laboratory aids our nation in two ways: by developing weapons that will insure the survival of freedom, and by finding new scientific knowledge that will enrich our lives.

This is one of a series of ads on the technical activities of the Department of Defense.



18

# FORD INSTRUMENT CO.

31-10 Thomson Avenue, Long Island City 1, New York
Field Sales Offices: Beverly Hills, Calif.; Dayton, Ohio



Engineer at Ford Instrument Co. checks out fire control computer developed and built by Ford for the U.S. Navy's Bureau of Ordnance.

AVIATION WEEK, May 5, 1958

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BUSINESS

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PRODUCTION MANAGER . . . . . W. V. Cockren

May 5, 1958

# Aviation Week Including Space Technology

Vol. 68, No. 18 Member ABP and ABC

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	Symposium questions whether man noise."
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### EDITORIAL

Toward a National Space Policy..... 21

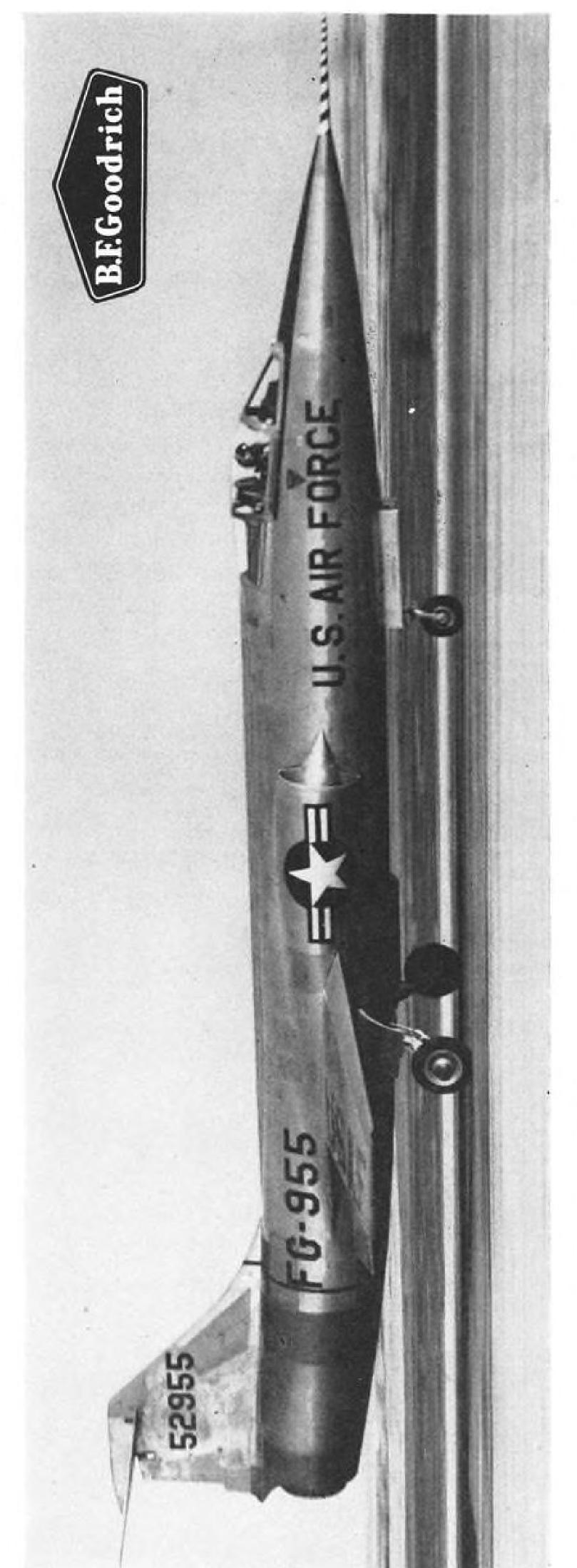
COVER: Second protoype Lockheed CL-329 JetStar is about to begin a series of nationwide flight tests, stopping at military command headquarters. JetStar was designed to fulfill USAF requirements for a fast, all-weather utility aircraft. Additional photos of the JetStar are included in an Aviation Week pilot report on the second protoype beginning on page 78.

### PICTURE CREDITS

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S S H S H S H S H

# EDITORIAL

# Toward a National Space Policy

Last week in Denver we indulged in two days of mental fermentation on technical problems of space exploration along with about 1,100 representatives of the military services, aviation industry and research organizations. Occasion was the second Astronautics Symposium sponsored by the Air Force Office of Scientific Research, the technical details of which are reported on page 26. This exercise was an extremely valuable step along the road toward eventual formulation of a sound national space policy. It was interesting to note that the first such AFOSR conference held in the pre-Sputnik cra last year in San Diego with joint sponsorship of Convair's Astronautics Division attracted 500 participants and severe skepticism from the top military and civilian leaders of our government.

This year in the post-Sputnik era, attendance more than doubled, and the only argument was over how soon and how much space exploration could be accomplished. Last year, Brig. Gen. H. F. Gregory, who commands AFOSR and was a pioneer in U.S. helicopter development more than a decade ago, took a beating from his superiors and the daily press for his statement to the San Diego symposium that "flight outside the atmosphere is a reality. Although it may be somewhat early to be building space ships, it is not too early to start thinking about it." This year, Gen. Gregory was justified in some oratorical nose thumbing at his critics, for events have proved his allegedly wild prophecy was really a most conservative estimate of the situation, and today the Air Force is scrambling into space with a wide variety of manned and unmanned vehicles.

# Future Knowledge

In his keynote speech to the Denver assembly, Gen. Gregory also had some other thoughts that are worth emphasis. "Future knowledge will stem from certain principles that have guided the airman in the past and which will continue to guide him in the future." He told the symposium that "the first of these is that there is a single continuum which surrounds the earth. Air and space are convenient ways of describing several parts of what really is a unified phenomenon. Any effort to define a dividing line between these two is so artificial that it should be apparent that we are talking of a single medium. Similarly, a distinction between aeronautics and astronautics is a convenient way of describing specialized segments of one applied science which deals with the infinite realm of the airman."

Gen. Gregory also warned that we Americans can no longer enjoy an exclusive "hunting license in the area of scientific exploration." He said, "it is open territory for any nation desiring to affect a scientific probe into the secrets of the universe. Such secrets, however, are not of the kind we normally associate with a military operation. They are available to all men irrespective of the motivation that impels their discovery. They cannot be held as a private domain by military security classification nor

can a scientific breakthrough by a would-be aggressor be rationalized as a security violation, a compromise of the taking of something that is rightfully ours . . . One of the most important jobs to be done in research and development today is that of insuring the adequate flow of research information.'

Dr. Clifford C. Furnas, chancellor of the University of Buffalo and former Assistant Secretary of Defense for Research and Development, also emphasized the need for an honest and adequate flow of public information on national space policy and its scientific problems. "If the public is kept honestly and fully informed of the military, political, scientific and technological aspects, I believe it will continue to support the exploration of space and many other important matters. If the information is spotty, misleading and less than straightforward, then confidence as well as motivation will wane and can only be revived by another major crisis. Then it may be too late."

# Solid Foundation

We heartily agree with Dr. Furnas on this vital point. We cannot afford the traditional start and stop, feast and famine policies in a national space program that have so vitiated our defense effort in the past and wasted billions of dollars without achieving the required results. A sound and effective national space policy, like any other national program, must be firmly based on a solid foundation of public understanding and support.

Everybody concerned with developing a sound national space policy must continually contribute to the effort required to achieve a higher degree of technical literacy and general understanding of space problems until the public and the Congress that represents it can distinguish for itself the difference between circus stunts in space and sound scientific programs and can spot the difference between the space pitch man and the scientists genuinely interested only in adding to the sum total of man's knowledge of himself and his universe. At this late date, the need for a permanent effective national space policy based on civil needs as well as possible military requirements should be self-evident to every citizen.

Unfortunately, this is not the case and a great deal more convincing is required before even the top leadership of our government fully understands the problem and the absolute necessity for tackling it on a long term basis. We have only the faint beginnings of a sound national space policy.

However, events such as the AFOSR symposium, which most certainly should be continued on an annual basis, and the public hearings now unfolding before the House Select Committee on Astronautics and Space Exploration are extremely necessary and vital contributions to the eventual formulation of a scientifically solid space program tailored to meet our national needs and genuinely enhance our international prestige.

-Robert Hotz

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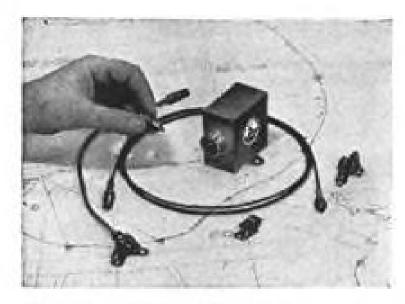


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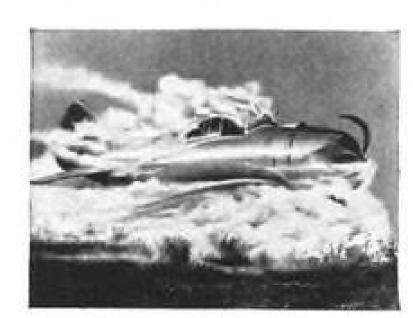
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# WHO'S WHERE

# In the Front Office

Frank L. Roberts, a director, Aeronca Manufacturing Corp., Middletown, Ohio. Nils Sundstrom and Brig. Gen. Tom C. Rives (USAF, ret.), directors, Aircraft Radio Corp., Boonton, N. J.

J. L. Plant, president and general manager, Avro Aircraft Ltd., Malton, Canada. Ray R. Eppert succeeds John S. Coleman as president, Burroughs Corp., Detroit, Mich.

Arie Vernes, president, Philips Electronics, Inc., New York, N. Y., succeeding Pieter van den Berg, now board chairman.

Wilson Bradley, Jr., vice president and general manager, Endevco Corp., Pasadena,

Space Technology Laboratories, division of Ramo-Wooldridge Corp., Los Angeles, Calif., has announced the following elections: Dr. Milton U. Clauser, vice president and director-Physical Research Laboratory; Allen F. Donovan, vice president and director-Aeronautics Laboratory; William F. Duke, vice president and associate director-Systems Engineering Division.

Bennett Hill Griffin, former director of Washington National Airport, has joined Howard, Needles, Tammen and Bergendoff, Consulting Engineers, New York,

## Honors and Elections

T. Claude Ryan, president of Ryan Aeronautical Co., has been named by the American Schools and Colleges Assn. as a recipient of the 12th annual Horatio Alger

Frazer B. Wilde, insurance executive and a panel member of the Rockefeller Brothers Fund, has been elected to the Board of Governors of Flight Safety Foundation, Inc., New York, N. Y.

C. F. Zimmerman, head of Continental Oil Company's Aviation Department, has been appointed to the Board of Directors of the National Business Aircraft Assn., Washington, D. C.

Lester Lees, professor of aeronautics at the California Institute of Technology, has been appointed to the Working Group on Re-entry of the National Advisory Committee for Aeronautics, Washington, D. C.

Dr. John R. Ragazzini has been named Dean of New York University's College of Engineering, New York, N. Y.

## Changes

Allan I. Benson, manager-scientific applications, Computer Department, General Electric Co., Phoenix, Ariz.

W. A. (Dick) Pulver, chief engineer, Georgia Division, Lockheed Aircraft Corp., Marietta, Ga. Mr. Pulver succeeds R. W. Middlewood who has been named director of the newly formed Georgia Nuclear Laboratories.

Claude H. Smith, director-contract management, Aeronautical Division, Minneapolis-Honeywell Regulator Co., Minneapolis,

(Continued on p. 129)

# INDUSTRY OBSERVER

- New Russian supersonic delta wing bomber with six turbojet engines is now undergoing flight test. Early reports on the aircraft indicate that it may have performance capabilities similar to those of USAF's B-70 chemical fueled bomber now in the design stage at North American Aviation.
- ▶ Major improvement in effectiveness of airborne electronic countermeasures is expected through use of fundamentally new family of spiral-shaped flushmounted antennas whose radiation patterns and polarization can be quickly changed by ECM operators to counter enemy anti-ECM efforts. Theory has not yet been developed which fully explains how new antennas function, but this will not delay their application. New antenna design was developed by Wright Air Development Center engineers and university of Illinois scientists.
- ► Flight control systems which automatically adjust their performance to give optimum stabilization on new aircraft/missiles without extensive flight testing, without prior knowledge of vehicle characteristics or use of air data actuated gain changers now required, have been successfully flight tested by Wright Air Development Center. New auto-adaptive techniques, slated for use on several new flight control systems now under development, should greatly speed up flight tests of new aircraft/missiles.
- ▶ Wright Air Development Center is negotiating a \$2.5 million contract with Corning Glass Works for development of windshields to operate above Mach 5. One configuration will be flat, others will include simple and complex curved surfaces. Windshield will consist of a sandwich of two pieces of glass with an electrically conducting glass on the outside for de-icing.
- Air Force recently asked both Lockheed and Convair to submit designs for a low-level, nuclear powered bomber.
- ► Army's Redstone out-of-atmosphere shots scheduled as part of Operation Hardtack in the Pacific (AW Jan. 20, p. 26) probably will be canceled. Air Force Thor shots seeking data useful to the design of anti-missile weapon systems will be carried out, however,
- Russians have used metal ablating parachutes in recent tests in which animals have been shot to more than 600,000 ft. and successfully returned to earth. Russians apparently are proceeding in the same step-by-step manner as the U.S. toward putting man into space rather than trying a one-shot attempt on a crash basis and risk losing the subject as has been rumored.
- ► New air defense system designated Project Sicklebar is being developed for Air Defense Command by Fairchild Engine and Airplane Co. and Hughes Tool Co.
- ► Kaman Aircraft Corp. is mapping a sales compaign for its K-600 commercial helicopter, a version of the company's HOK model. Major change is in the tail configuration. Two small ventral fins have been added for stability around all three axes. K-600 is equipped with Kaman's new in-flight tracking device which permits the pilot to adjust the rotor blade track under all flight conditions. If sufficient commercial interest develops, Kaman will proceed with CAA certification. Powerplant is a Pratt & Whitney R-1340 engine developing 600 hp. Prototype will be used as a demonstrator to potential commercial and foreign military customers.
- ▶ Japanese-built Sikorsky S-55 helicopters will cost \$166,666 each. Mitsubishi is expected to build a total of 23 S-55s in Fiscal 1958 and 1959, from nine to 15 in Fiscal 1960, for the Japanese Self Defense Agency. Japanese power companies, private railways, airlines and radio broadcasting firms are believed to have placed additional orders for approximately 50 of the helicopters.
- ► Present analyses indicate that excess floor space in aircraft and missile activities may total 57 million sq. ft. by 1961. Approximately one year ago, the figure stood at 22 million sq. ft.

# CREATIVITY and PRODUCIBILITY

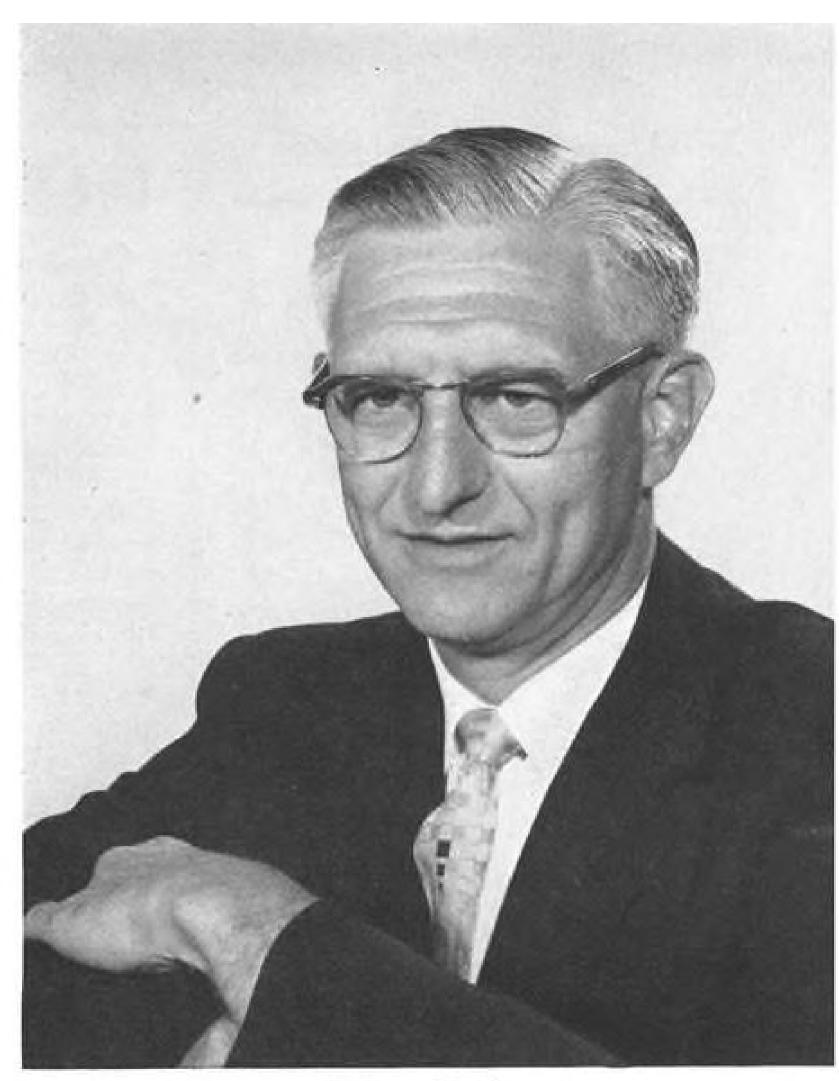
Basic research has been described as "a search for knowledge, unfettered by production demands." At Avco, we realize that fundamental new ideas cannot be programmed in advance to fit the needs of even the highest priority schedule. There will always be room here for this kind of basic creative work.

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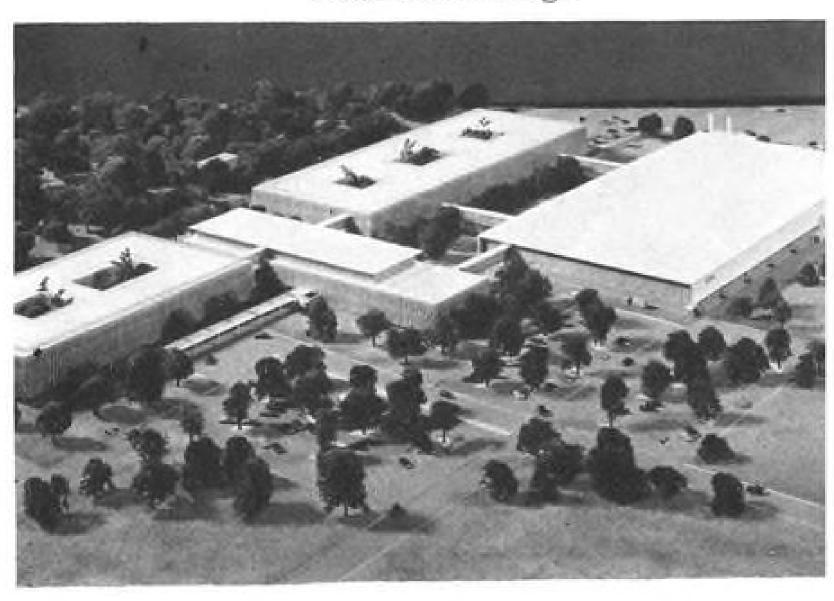
We see nothing inconsistent in the pursuit of new products simultaneously with the pursuit of new ideas—and doing both under the same roof. Rather, we feel that the continuous feedback resulting from close association of basic research people, applied scientists and engineers, test engineers and product engineers does as much for creativity as for producibility. And America's future depends upon a good supply of both.

Robert D. Grange

Robert D. Grange, Manager, Prototype Development Department



Robert D. Grange



Pictured above is our new Research and Development Center now under construction in Wilmington, Massachusetts. Scheduled for completion this year, the ultramodern laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.

Avco's new research division now offers unusual and exciting career opportunities for exceptionally qualified and forwardlooking scientists and engineers.

Write to Dr. R. W. Johnston, Scientific and Technical Relations, Arco Research and Advanced Development Division, 20 South Union Street, Lawrence, Massachusetts.



# Washington Roundup -

# Army and Industry

Army Ordnance, which includes the missile commands, has taken another step toward increased industry participation in its arsenal system of weapons development. Security regulations are being revised so that almost any contractor or qualified technical group in the U.S. can have, access to the Army's estimates of its future weapons and equipment requirements. Making more people familiar with the Army's advanced planning is expected to make the plans more realistic and eventually provide better weapons.

Maj. Gen. J. H. Hinrichs, Chief of Ordnance, explained the new security procedures last week to a meeting of the American Ordnance Assn. He stated simply that their purpose is to create weapon development "heroes." "Such heroes," he said, could only be made "when a man with vision as to how to solve an anticipated problem meets a man with the authority and money to carry it out and the solution is successful just at the time the problem becomes acute and very real."

# Senate Space Hearing

Senate Special Committee on Space and Astronautics is scheduled to begin hearings tomorrow on the Administration proposal to create a national space agency with the National Advisory Committee for Aeronauties as its nucleus. James H. Doolittle, NACA chairman, will be the leadoft witness, according to Sen. Lyndon Johnson (D.-Tex.) committee chairman.

The House Committee on Astronautics and Space Exploration is scheduled to conclude public hearings on the proposal on Wednesday and go in executive session to mark up the bill.

# Technology Act

Senate hearings on the proposed Science and Technology Act of 1958, which began last week, will be limited to consideration of a program for coordination of scientific and technical information. Sen. Hubert Humphrey (D.-Minn.) chairman of the Reorganization Subcommittee of the Senate Government Operations Committee, said other vital provisions of the proposed act are under consideration by the Committee on Astronautics and Space and will be deferred until a coordinated program can be satisfactorily worked out between the two committees.

Current phase of the hearings will be to develop information as to the need for further legislation to enable the government to establish a program to insure adequate dissemination of scientific and technical information.

## **Small Business**

Defense Department representatives have given Senate Small Business Committee an optimistic picture of the possibility of substantial participation by small firms in the military guided missiles, rockets and space programs as subcontractors. But they anticipated a trend away from smaller firms on prime contracts. Perkins McGuire, Assistant Secretary of Defense for Supply and Logistics, reported that about 20% of the money paid to prime missile contractors now flows to small business subcontractors in the first tier, Maj. Gen. Ben Funk, deputy Air Force director of Ballistic Missiles, put the USAF percentage slightly higher and estimated that an addi-

tional 7% of the overall dollars for missiles goes to second-tier small business subcontractors.

Aircraft Industries Assn reported last week that, of the S1 billion paid to subcontractors of the aircraft industry engaged in ballistic missile work during 1957, more than \$267 million—approximately 21%—was paid out to small business subcontractors. AIA said the small business share of the total "should be somewhat larger" as industry moves into production phase of the program.

# Pay Increase

Both the House and Senate have approved "incentive" military pay increases but differ on the amount necessary to attract and retain a career force. A conference committee has been appointed to work this out.

The House approved a measure that would provide \$683,000,000 annually in pay to the military; the Senate a bill that would cost a total of \$577,000,000. The legislation was patterned after recommendations of the Cordiner Committee and is designed to keep trained and qualified personnel in the armed services. The bill provides heavy increases for top officers and enlisted men and adds new grades to the present career incentives.

# CAB Red Tape

There is a move to reduce Civil Aeronautics Board red tape by eliminating non-essential hearings—for example, on the purchase or lease of a small number of aircraft. Legislation authorizing the Board to do this has been introduced by Sen. Warren Magnuson (D-Wash.), chairman of the Senate Commerce Committee, and Rep. Oren Harris (D.-Ark.), chairman of the House Commerce Committee. Magnuson estimates that the legislation could eliminate "as many as 10 hearings each year which are now required to be conducted at considerable expense in terms of time, effort and money expended by the Board's staff and by the applicants."

# National Air Museum

Proposals to create a National Air Museum in Washington are expected to be considered in executive session within the near future by the Senate Public Works Buildings and Grounds Subcommittee. According to Chairman Sen. Pat McNamara (D.-Mich.), public hearings have already been held.

# Airport Design

Civil Aeronautics Administration last week named the firm of Amman and Whitney, New York engineering consultants, to design the new Washington International Airport at Chantilly, Va.

Bennett Griffin, recently retired director of the Washington National Airport, has been appointed special aviation consultant in the current improvement program of the Miami international Airport. Griffin will be associated with Howard Needles, Tammen and Bergendoff, Florida engineering consultants retained by the Miami Port Authority.

The Washington terminal building, control tower and service buildings will be designed by Eero Saarinen, Michigan architect. Burns and McDonnell of Kansas City will design electrical installations at the new Washington airport and Ellery Husted of Washington will be the master planning consultant.

-Washington staff

# Man's Scientific Role in Space Debated

# Panel at AFOSR astronautics symposium questions whether man will be useful or merely "add noise."

Denver-Question of whether man would be a useful scientific observer in space or merely "add noise to the system and degrade the data" started a sharp controversy at the second annual Air Force Office of Scientific Research Astronautics Symposium here last week.

A six-man panel discussed the question and generally agreed that instruments can do the job better than man. But the bulk of the delegates at the well-attended session indicated a strong disagreement with the negative tone of the panel's conclusions.

Title of the discussion was: "Assume computing machine." a capability for manned space operations-for what purposes should this capability be utilized?"

This was somewhat unrealistic for two reasons:

 Panelists were specifically prohibited tary manned space flight.

 Military security obviously prevented panelists from drawing on their own knowledge of existing-but classifiedtechniques and devices that would promote the feasibility of manned space flight.

### Spilhaus Summarizes

Athelstan F. Spilhaus, dean of the University of Minnesota's Institute of Technology, summed up the panel's feelings this way:

"None of us here is arguing against manned space flight. What we are arguing against is doing it under the cloak that it will provide useful scientific information.

Approximately 1,100 delegates attended the two-day symposium, which was co-sponsored by the Institute of Aeronautical Sciences and co-chaired by Dr. Morton Alperin, Head of the Directorate of Advanced Studies of Air Research and Development Command's Air Force Office of Scientific Research. and Col. Paul H. Dane, chairman of the Rocky Mountain Section of IAS and professor of thermodynamics at the Air Force Academy.

Col. Paul Campbell, AFOSR flight surgeon who was chairman of the discussion of man's potential as a peaceful space observer, said USAF studies indicate a need for a life-sciences satellite observatory. "The presence of a trained man in the space laboratory is just as essential as it is in an earth laboratory."

"He can at the same time be the

observer and the observed," Col. Campbell said. "He can use scientific judgment to adjust unexpected developments in the course of an experiment. He can observe and take advantage of chance happenings which, in an unmanned laboratory, might prematurely conclude an experiment.

"He is a relatively lightweight, low energy consuming, versatile, mobile computer with judgment or we might say, horse sense. He will always be the father of, and never the child of, a computing machine-imagine a sexy

## Zero Gravity Effect

One of the most important unanswered questions in the life sciences is the effect of zero gravity on botanical life, Col. Campbell said. Even if man clared. from considering applications of mili- were not thinking of taking plant life along to sustain his own life in space, new knowledge in this might provide keys to the secrets of living matter.

While the effects of weightlessness on man have been discussed widely, Col. Campbell said, far less attention has been paid to such questions as: "Why do the stems and trunks of plants grow upwards while the roots grow downward?" or "What is the mechanism which controls plant orientation?" or "Is gravity one of the limiting factors in the growth of plants . . . in nutritional transport in plants?"

Spilhaus accepted the consensus that man is not necessary for scientific observation in space, and that he might require a prohibitive amount of extra weight to sustain him, but he said:

"The ability for man to go where he can and to try to go where he has not vet been is an end in itself needing no justification. This is what makes him

He foresaw man as an efficient contributor to "the observation of the behavior of living organisms and human beings in vehicles in space" and said that once the lunar and planetary entry

# Space Coverage

Second Annual Astronautics Conference sponsored by the Air Force Office of Scientific Research at Denver was covered by a special Aviation Week editorial team including Robert Hotz, editor, Irving Stone, Los Angeles bureau chief, and Evert Clark, space technology editor.

and landing problems are solved, "manned exploration becomes a sine qua non because there are so many things that the eye can see and accept more efficiently directly.

"There is a parallel to this in the investigation of the oceans," Spilhaus

"The oceans have generally been investigated by feeling somewhat blindly with instruments on long wires. The life in the oceans has been sampled by nets and trawls, sometimes going as deep as six miles from the surface.

"This has been compared to trying to understand the ecology on the surface of land by the hit-and-miss fishing up of rodents and other animals and plants by a long wire from a helicopter flying at the height of Mount Everest."

With these exceptions, however, "unmanned instrumented vehicles will continue to be more economical to use than manned vehicles," Spilhaus de-

Panelist Fred L. Whipple, director of the Smithsonian Astrophysical Observatory, said man's purpose in space will be to help eliminate the need for man

Man may be needed, for example, to adjust telescopes in a spatial astronomical observatory but only until "tele-puppets" with binocular television eves and mechanical fingers are perfected to do the same job. Dr. Whipple is an astronomer and dabbles in micro-

### Civil Satellite Applications

Whipple also listed 10 possible uses for non-military satellites:

• Environmental measurements, including magnetic fields, air density, cosmic radiation, etc., as in present satellites.

 Biological laboratories of the type Col. Campbell describes.

 Laboratories for performing physical experiments. Desirability is questionable except where weightlessness is im-

 Astronomical observatories "to see what colliding galaxies look like" and to study the entire energy spectrum.

 Meteorological observatories. These would be likely to bring the quickest great advances on earth, Whipple said. • Pure communications satellites, including television relays. "Three can supply the entire earth with soap operas," Whipple said.

 Navigation satellites. With electronic means available today and foreseeable in the near future, navigation probably can be handled better in some other way,

Whipple said.

· "Way stations," or space stations orbiting relatively near the earth from which long flights could be launched may be "very important," Whipple said. · Medical sanitoriums. There will undoubtedly be some infirmities which can be helped by weightlessness, although the moon, with one-sixth the earth's gravity, might be a better sanitorium. Urbanization of space. This possibility could lead even to "Space Subdivisions Inc.," Whipple said. He said he is sure there will be "some real surprises for us" in planetary exploration. George Gamow, of the University of Colorado, said that, although he does not expect that mosses or whatever plant life may be found on Mars will be different than mosses on earth, there are possibilities. All life on earth is built around 20 "left-handed" amino acids, yet chemists can produce hundreds of amino acids in the laboratory.

### Planet Life

Man might find that life elsewhere is built on acids other than the 20 that appear in earth life or the planetary acids might be the same ones found here, but be "right-handed," producing unexpected and unfamiliar forms of life, Gamow said.

Dr. William H. Pickering, director of California Institute of Technology's Jet Propulsion Laboratory, said that "the capability for manned space flight becomes useful only when we consider the exploration of other planets.

"Before that time comes, unmanned vehicles can accomplish almost all of the missions assigned to space flight in a cheaper and more reliable fashion." It was Dr. Pickering's paper that contributed the communications engineers' phrase that man might only "add noise to the system and degrade the data."

Only satellite application including human passengers, Pickering said, is "just that—passengers going along for the ride, to see the earth from a new viewpoint, to get across the globe in a few minutes, to have the thrill of a ride into outer space."

Paul Rosenberg, president of Paul Rosenberg Associates, said photo-mapping of the earth from satellites will not be feasible for some time-using unclassified, off-the-shelf equipment-because of the great size of the equipment needed to get the degree of resolution now obtained by aircraft. But he said current techniques and equipments are entirely adequate for the initial exploration of the moon and planets and for some time to come, until man is ready for lunar or planetary landings when greater accuracy becomes necessary.

Panelist H. J. Stewart, of Cal Tech's Jet Propulsion Laboratory, called for "a suitably balanced" national space program "unencumbered by the stresses of political conflict."

Earthbound Sentiments on Space

Denver-Some earthbound sentiments about space flight expressed at the second Annual Astronautics Symposium here last week.

- "The Egyptians utilized 20% of their national potential for 20 years to build the Great Pyramid. If we applied the same percentage of national effort for the same time, we could put the pyramids into orbit. I want to go on record that I am not advocating it."-Dr. Fred Whipple, director of the Smithsonian Astrophysical Observ-
- "I'm quite sure man will go into space before he is quite ready, because there is no such thing as being fully ready. We might get a man into space before we get a dog because we would not have trouble with the Humane Society."-Athelstan F. Spilhaus, Technology Department, University of Minnesota.
- The prime impulse back of present public support "for space programs" is feara motivating factor second only to sex in potency."-Dr. Clifford C. Furnas, chancellor of the University of Buffalo.
- On the likelihood that strategic minerals might be found on the moon and transported back to earth: "If one made an economic study of it, I think it would not pay even to bring large diamonds back from the moon. Only if there are minerals that are not available on earth would it be worthwhile, and I do not think that is likely." -H. J. Stewart, Jet Propulsion Laboratory, California Institute of Technology.
- One member of a panel discussing how the capability for manned space flight should be utilized if and when it is achieved, suggested that "if we put man into space, perhaps we should put woman there, too." Another panelist replied: "This has already been studied under the heading of occupational therapy."

"It would easily be possible to fall into an extreme position where an excess of effort applied to immediate scientific ends would make it difficult to proceed to the following step and conversely, an excess of effort applied to the engineering problems of the following step would make it necessary to lose those interesting scientific results which could be achieved by a more happy distribution of effort," Stewart said.

Other possibilities suggested by panelists and delegates included a germ-free satellite laboratory, and a "truly colossal" radio telescope in space, possibly 1,000 ft. to one-half mi. across.

As for man's future, Col. Campbell concluded that "man will some day go into space . . . and we will find uses for him that we do not understand now. You cannot keep him at home."

### IONIC PROPULSION

Techniques and equipment leading to space exploration were discussed in the following technical papers.

Thrust production and related data associated with ionic propulsion were analyzed by David B. Langmuir, director of the Electronic Research Lab-Ramo-Wooldridge Broad qualifications included observation that effective ion beam area will be less than total area, power wastage may occur through other causes than by radiation (tungsten ionizer), propellant may leak away as atoms instead of ions, charge neutralization problems might impair performance and that a field strength of 40,000 volts per centimeter required in high current cases may prove difficult to support. Langmuir declared that these broad conclusions seem to indicate:

- Effective ionization energies as low as 100 electron volts per centimeter may be realized by the thermal ionization method, leading to ideal efficiencies of conversion of electrical energy to beam energy of 90% with 1,000 volts accelerating potential.
- Thrusts of 0.1 gram per square centimeter might be realized. At one-ten thousandths G, one square meter of beam area would then be required to propel a 10,000-kilogram (22,000-lb.) space vehicle. This might be of practical interest, Langmuir pointed out.
- Electrode spacing must be small, one millimeter or less. This might prove to be one of the more serious difficulties, particularly because of associated charge neutralization problems that are involved, he said.

Calculated performance of alkali ion propulsion systems, using extrapolated data, was tabulated by Langmuir. Accelerating potential was specified as 1,000 volts. Using cesium ions, at velocity of 37.4 km. per sec., with critical tungsten temperature of 1,500 Kelvin, ion current is 0.12 amp. per sq. C.; tungsten power radiated is 5.1 watts per sq. C.; ionization energy is 42.5 electron volts per ion, mass flow rate is 0.165 milligrams per sq. cm. per sec.; thrust is 0.66 grams per sq. cm.

### PLASMA ROCKETS

Analysis of propulsion by acceleration of fully ionized plasma was made by Dr. Richard M. Patrick, senior scientist, Avco Research Laboratory of Avco Manufacturing Corp. In this scheme, plasma is confined to a tube and accelerating force results from magnetic pressure. Advantage of the process over the electrostatic method is that separation of ions is avoided, with emergent plasma being neutral, while an ion rocket accelerates a charged mass.

Device producing acceleration aimed to meet three requirements for electromagnetic acceleration of a gas:

- Production of uniformly ionized gas in the initial stages of acceleration process to provide uniform current in the
- Containment of gas sample behind shock wave to eliminate losses to walls. Acceleration over relatively long distances to provide enough time for a strong magnetic field to build up to furnish the accelerating forces.

Major portion of weight of magnetic thrust engine is made up of the mass of the capacitors furnishing the discharge current, Patrick pointed out. Calculations indicate that magnetic thrust motor would have similar performance characteristics to an ion rocket motor proposed by Dr. Ernst Stuhlinger (for trip to Mars), when operating at conditions where exhaust velocity is 120 km. per sec.

## Thrust Experiments

Preliminary thrust experiments supported by allied experimental and analytical research indicates that the plasma rocket may be one of the most practical propulsion systems for space vehicles, according to D. F. Howard, Giannini Research Laboratory. Although experiments have been made on crude models, it has been shown conclusively that sustained high specific impulse can be obtained with an electric are plasma generator, Howard pointed out, adding that it is reasonable to expect that further research will vield three to five times the specific impulses already measured. Specific impulse of 600 sec, has been obtained with argon, exhausting to atmosphere.

Commenting on thrust-to-weight ratios, Howard declared that it is highly doubtful that a plasma rocket will ever lift itself off the surface of the earth. He said it is reasonable to expect that values are possible which make this type of propulsion of interest in certain space missions originating and terminating at satellites.

Plasma generator itself probably will be the most reliable component in a plasma rocket. Problem items in the reliability category undoubtedly will be found in the electrical supply and control systems, Howard indicated.

With plasma generators using argon as the working fluid, four days of satisfactory operation can be expected normally. Experiments with helium and hydrogen are inconclusive, Howard said, but indications are that new design concepts will be necessary to achieve comparable life with these lighter gases.

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### ROCKET COMPARISONS

Nuclear rocket appears most suitable and versatile for space travel, according to Y. C. Lee and K. P. Conrad, of Aerojet-General Corp. Inherent throttleability of the nuclear rocket, coupled with attainable large specific thrust values, makes it a unique propulsion system capable of takeoff, landing and space travel, they said.

In general, chemical rockets using either solid or liquid propellants are not suitable for propulsion in space, but in certain specific cases a propulsion system using solid propellants appears feasible and may represent the most reliable system.

Practical space propulsion systems should utilize planetary atmosphere as one of their energy sources, it was indi-

Investigations show that a recombination engine with afterburning will increase values of thrust per unit frontal area and engine specific thrust.

Successful utilization of ions for propulsion would result in improvement in specific impulse of an order of magnitude greater than that attainable chemical propellants, nuclear rocket and recombination engines, Lee and Conrad indicated. To obtain a practical ion propulsion system, major problems in areas of high-yield ion sources and lightweight power supplies must be resolved, they pointed out. Preliminary calculations based on present technology show that net acceleration of an ion propulsion system is of the order of one-millionth G.

Combination of inertial and stellar types of guidance undoubtedly will prove to be the most important if not the only means of guiding the space vehicle in interplanetary travel, Lee and Conrad said, at least in the initial phases of this travel regime.

### MARS PHOTO-RECON

Technical feasibility of a three-year, unmanned photo-reconnaissance roundtrip to Mars was analyzed by J. Halcombe Laning Jr., Elmer J. Frey and Milton B. Trageser, Massachusetts Institute of Technology's Instrumentation Laboratory.

If a research and development program were initiated today, they said, a vehicle could be launched within five to seven years. Well-balanced, integrated system design based on known techniques should permit the mission to be accomplished with a reasonable probability of success.

Basic problem of navigation would be handled with a sun-tracking telescope and another telescope to track stars and planets.

Rotating flywheels would turn a gross sunfinder to put the sun-tracker on target and keep it there. Single axis gyroscope would keep the vehicle rotat- • Flexible launching site is afforded,

ing about the sun's axis until the startracker acquired its target. Feedbacks through a lightweight general purpose digital computer would allow the computer to control the vehicle's attitude through use of the flywheel. Orientation also would be controlled in part by solar vanes and a lower power propulsion system for supplying smallscale correction factors.

Viewing telescope with camera attached would have a 3-in. aperture, 20-in. focal length, and record on 70-mm. film. System would give 500ft. resolution at a distance of 4,000 mi.

Payload capability of ballistic vehicle and low-thrust vehicle, such as ionpropelled rocket ship, on roundtrip to Mars, was compared by J. H. Irving and E. K. Blum, Space Technology Laboratories, Ramo-Wooldridge Corp. Both vehicles start from 200-mi. circular orbit about earth, with low-thrust vehicle being boosted into initial orbit. Ballistic vehicle coasts to Mars on an elipse which depends on time alloted to trip. Low-thrust vehicle, powered all the way, first escapes from earth in a spiral orbit, then follows an optimum transfer orbit from earth to Mars, at same time matching velocity of Mars. Each vehicle enters an eccentric satellite orbit about Mars. On returning to earth, thrust reduces re-entry speed to earth's escape velocity. Re-entry is accomplished using aerodynamic decel-

For the same travel time, low-thrust vehicle having power supply weighing between 100 and 200 kilograms per kilowatt of useful power is about equivalent in payload capability to the best chemically propelled ballistic vehicles. If low-thrust power supply weighs between 30 and 70 kilograms per kilowatt, performance is about equal to that of ballistic vehicles using hydrogen heated by nuclear reactor.

If the weight of power supply can be reduced to one to 10 kilograms per kilowatt, payloads of over 50% of vehicle weight can be carried even on roundtrips to Mars, taking only four to six months total travel time, Irving and Blum contended.

### SPACE BOOSTERS

Launching of space vehicles by airbreathing lifting stage was outlined by Antonio Ferri, Polytechnic Institute of Brooklyn, and Lewis Feldman and Walter Daskin, Gruen Applied Science Laboratories Inc. By using lifting airplane as first stage of satellite launching system, thrust requirement can be reduced, and since lift means flight in atmosphere, propulsion by air-breathing engines is logical. Advantages for scheme include:

- Specific impulse is increased by an order of magnitude.

large fixed and expensive ground installations are eliminated.

- First stage is recoverable and versatile, important in repetitive operations such as launching a variety of satellite's without modification and in building space stations.
- First stage usually is largest and recovery promotes economy.

Reliability is high.

It will be possible to launch a 10,000-lb. package—7,500-lb. payload into high altitude orbit using supersenic aircraft, now technically feasible, and 15,000-lb,-thrust rockets.

Conventional all-rocket system would have somewhat higher initial weight than the air-breathing arrangement and would require rocket motor systems with thrust of about 1,000,000 lb.

Mass which can be put into orbit by a given rocket increases substantially with launch Mach number. As launch speed is increased beyond Mach 4, airframe disadvantages outweigh the disadvantages of large rocket engines.

Turbojet operation with JP4 was investigated for speeds up to Mach 4 and dual cycle engines were used at Mach 4 and Mach 6, with transition to ramjet and hydrogen fuel at Mach 2.75.

### RE-ENTRY

Distinctions between satellite and ballistic missile re-entry were pointed up by Frederick Riddell and J. D. Teare, of Avco Manufacturing Corp.'s Research Laboratory Division. Satellite, in general, experiences much lower decelerations, hence both deceleration and heating time occur over an order of magnitude longer than for a ballistic missile.

Also, the significant heating occurs at higher altitudes for re-entering satellite

and this gives lower heating rates but higher total heat inputs.

Satellite is not as accessible as ballistic missile to heat absorption methods for handling re-entry heating, but lower heating rates in satellite re-entry suggests use of radiating surfaces for heat

### LUNAR TRACKING

Ingenious method for optically following lunar vehicle trajectory is afforded by 10-ft. metallized balloons released at various points along the path, according to M. H. Johnson, director, nucleonics and physics, Aeronutronic Systems Inc. At lunar distances, this type of reflecting balloon illuminated by the sun appears as a 17th magnitude star, visible in 40-in, telescope. A dozen balloons with time and release mechanisms will weigh under 20 lb.

If number of balloons are released along the trajectory, pressure of sunlight produces acceleration of about .02 centimeters per sec. which separates the balloons launched a day apart by 1,000 km. To follow vehicle trajectory, moon should be at first or third quarter so that balloon dispersion is perpendicular to line of sight. With a angular position to desired accuracy.

This balloon barrage is one method of verifying impact since, if the vehicle strikes the moon, so also will a number of the balloons.

Method of measuring moon's radioactivity has the advantage that scanning is unnecessary because radiation received by spherically symmetric counter arrangement is proportional to solid angle subtended by moon at the counter, and whatever the orientation of the vehicle,

## Navy Chooses Electra

Lockheed Electra turboprop aircraft has been selected by U.S. Navy for use in its anti-submarine warfare program, after evaluation of "several" other air-

Navy said a research and development contract with Lockheed Aircraft Corp. will be completed shortly for a mockup model and further outfitting studies.

Aircraft will carry a crew of 10 men and considerable electronic instrumentation. Electra, which will replace Lockheed P2V Neptune, is powered by four Allison T56 turboprop engines each developing 4,050 hp. (AW Mar. 31, p. 46).

counter rate above background is inversely proportional to square of distance to moon.

### LUNAR PROBLEMS

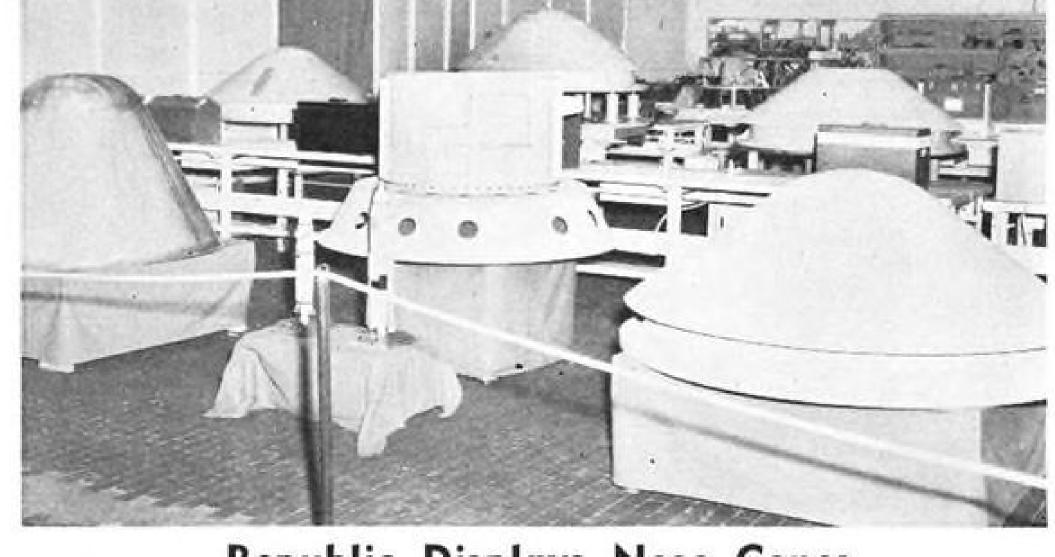
Scientific and engineering lunar explorations' factors were outlined by Dr. John L. Barnes, Systems Corp. of America. Precise lunar trajectories require a more precise and reliable value of lunar mass than present value with its one-third of one percent uncertainty. number of balloons, it would not be Flashes produced by magnesium-oxygen difficult in extrapolating the vehicle's charges from a lunar satellite could be recorded through 100-in. earth telescope to supply data. To pick up light of explosion on the moon's surface through the telescope, a matrix of photomultiplier cells with individual recorders might be used as a detector. Background light reflected from lunar surface is first balanced out; then only increases in light intensity are measured and mapped on field covered by the telescope at the particular time.

Additional test on body motion near the moon could be supplied by vehicleborne Doppler, and pulse radar could measure the moon's relative surface velocity and distance. Also, pair of lunar satellites could take telephoto or television pictures of each other with background of astral bodies to provide reference grid.

Other measurements Barnes suggested, included the moon's magnetic field, existence of atmosphere distinct from part of sun's "atmosphere" attracted by the moon's gravitational field together with determination of composition, density and temperature if this atmosphere exists, moon's material composition, its pressure and temperature.

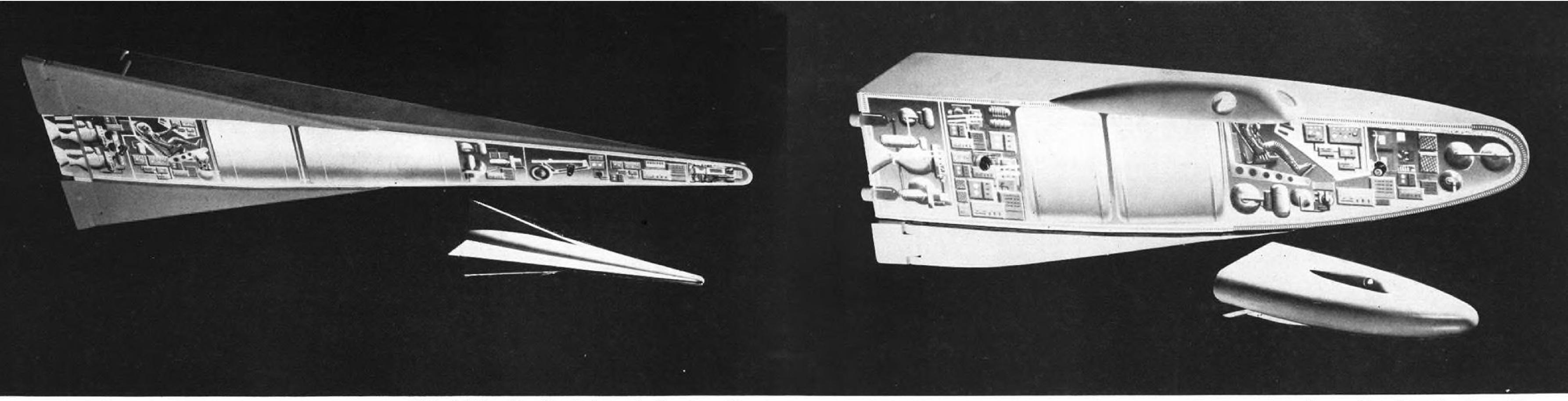
Among first engineering questions which will be partially answered by this exploration are best locations for landing instrument-carrying vehicles, landing and takeoff of manned observatories and manned and unmanned military bases, if not prohibited. Other answers would be best sources of water and oxygen bearing rocks, wanted minerals, and lunar road materials.

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# Republic Displays Nose Cones

Nose cones on display at Republic Aviation Corp., where they are produced under subcontract from General Electric Co., are destined for use on Thor IRBM's. Cone itself is unit at right and is the only part that actually shows on complete missile. Structure at the left is the afterbody. Unit in the center (just behind models of Thor and Atlas) is instrument carrier. The same re-entry vehicle will be used on the Atlas.



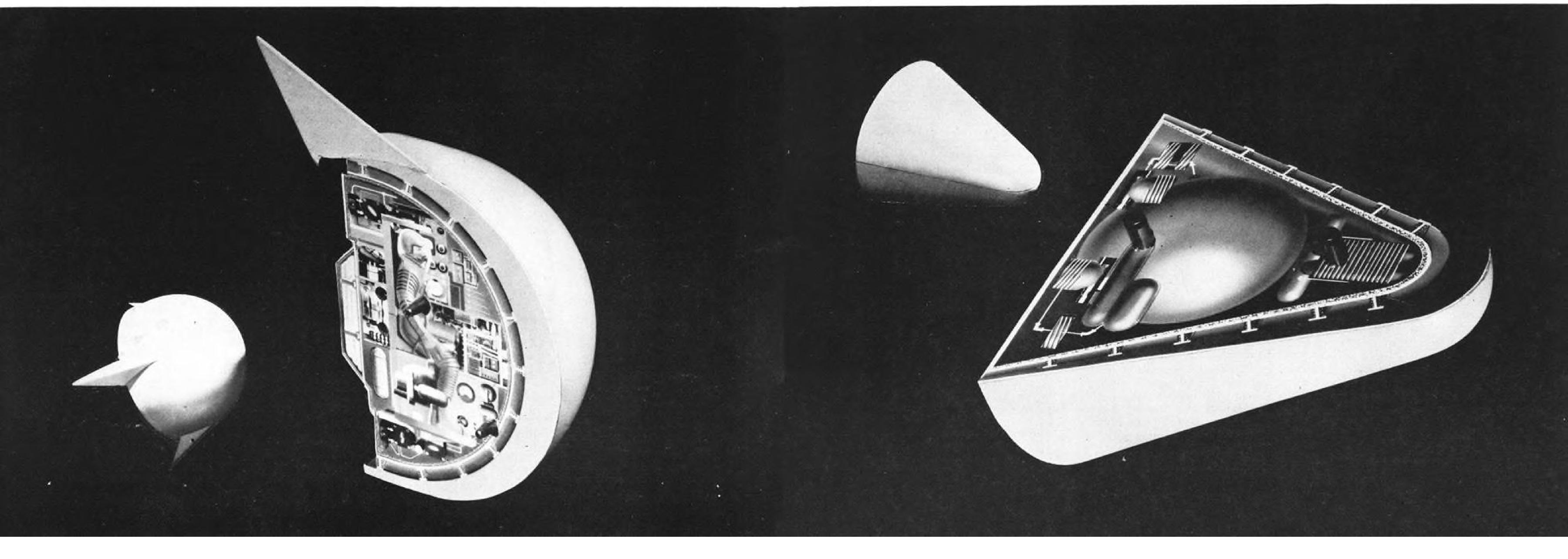
# SPACE TECHNOLOGY

# NACA Proposes Satellites Capable of Piloted Re-entry

National Advisory Committee for Aeronautics delta wing satellite proposal (above left) would have blunt nose and blunt, highly swept wing and fin leading edges to reduce aerodynamic heating. It would land fairly conventionally, compared with motor boat satellite (above right) and would have greater flexibility in choice of landing area. (Motor boat could land on water.) Delta wing would be subjected to more heating, especially at nose and wing leading edges. Both vehicles would have controls for maneuvering during re-entry and landing, would re-enter at high angles of attack,

and would be radiation-cooled. Relatively large rocket motor in motor boat, motors in delta wing, give final stage boost to satellite speed; small retro-rockets initiate re-entry. Reaction jets give space stabilization; internal components are located for aero-dynamic stability in atmosphere. Pilot sits in conventional position since re-entry deceleration should not exceed 2Gs. Hemisphere proposal (below left) has heat shield of combined radiation and heat sink design. Beryllium oxide outer shell is supported from inner capsule, which is heat-shielded by insulation. Seat rotates

180 deg. vertically so pilot can adjust self to resist maximum 8G deceleration forces. Internal equipment includes research and flight instrumentation and climatizing gear. Recovery chute at vehicle's base is for low speeds, low altitudes. Retro-rockets initiate re-entry. Fins roll-stabilize vehicle for nose-first re-entry. Ballistic missile (below right) has copper shell heat shield that is thickest in nose. Air gap and insulation separate shell from inner capsule. Payload is located sufficiently far forward in capsule to ensure stability of missile during atmospheric re-entry.



# Doolittle Urges Adoption of Plan For Civil Control of Space Agency

By Ford Eastman

Washington-Civilian control of the nation's space program is necessary if major objectives are to be accomplished, James H. Doolittle, chairman of the National Advisory Committee for Aeronautics, told Congress last week.

Doolittle appeared before the House Committee on Astronautics and Space Exploration to testify in support of the Administration proposal to create a National Aeronautics and Space Agency with NACA as its nucleus.

"It would be difficult or impossible for the nation to fully accomplish its major space objectives if the program were under strictly military control," Doolittle said. "Direction and leadership of the program must be the responsibility of a civilian agency as provided in the bill, with the necessary proviso that there must be effective cooperation and coordination between civil and military space work."

Doolittle told the committee that there were projects of clearly a military nature, others of a civilian nature and still others not so easily defined.

### Military vs. Civil

He explained that missiles and reconnaissance satellites are strictly military projects, while manned satellites and highly instrumented vehicles sent into space to gather scientific data would be civilian projects. Weather and communication satellites are examples of projects that have both civilian and military application.

Doolittle assured the committee that space projects of a military nature would remain with the Defense Department even though NASA would depend upon military hardware, for the time being at least, to get its civilian program into space. He also said he thought the military services should be permitted to continue some basic research in the space field on a coordinated basis.

"NASA, by cooperating with and coordinating the efforts of all concerned in a national space program," Doolittle said, "can do a better job more quickly and cheaper than separate agencies."

Earlier, witnesses testified that they felt control of the space program should be in a civilian agency but warned that the military services must play a greater role and that military needs be given priority over civilian scientific explora-

An NACA spokesman told Aviation

Week that the proposed legislation does not climinate the military services from an active role in space exploration in addition to missile development. He said NASA could conduct joint programs such as the X-15 program now under way with the Air Force, Navy

### Fulton Counterproposal

and NACA participating.

Meanwhile, Rep. James G. Fulton (R.-Pa.) a member of the House Space Committee, suggested that a commission of five members similar to the Atomic Energy Commission, might be he said. more effective than a director and advisory board as proposed under the NASA bill.

He said the 5-member commission should be composed of the "highest caliber" men and proposed the follow-

- Dr. Lee Dubbridge, president of the California Institute of Technology as president of the commission.
- Rear Adm. Hyman G. Rickover, assistant chief, Bureau of Ships, for nuclear propulsion.

# No Space 'Stunts'

Washington-Proposals to send rockets to the moon should be made a part of an overall national space program and not designed as a mere "stunt," James H. Doolittle warned the House Committee on Astronautics and Space Exploration last week

The chairman of the National Advisory Committee for Aeronautics said that hitting the moon with nuclear explosives or "dead dogs" would contaminate the air. The scientific community, he added, wants to keep the moon clean until it can be explored with scientific instruments.

Doolittle said projects of a National Space Program, now being prepared, should be designed to further two goals-(1) "Sending highly-instrumented vehicles into space that will send back, or bring back, the new knowledge that scientists need, and (2) the sending into space, craft that will carry men on voyages of exploration, but we must learn how to bring them back alive."

"In our programming, we should keep our eyes focused on these objectives," he said. "The fact that the Russians may accomplish some specific objectives in their space programs first should not in itself be permitted to divert us from our own designated objectives."

• Rear Adm. J. T. Havward, assistant chief of naval operations for research and development.

 Dr. Hugh L. Dryden, director of National Advisory Committee for Aeronautics.

• Dr. Herbert F. York, chief scientist, Advanced Research Projects Agency.

In his testimony, Doolittle strongly defended the proposal to name a director and 17-man board to head the agency as opposed to the commission

He advocates the smallest board possible that will still provide adequate representation of all the agencies involved. A board of less than 17 would not provide adequate representation and larger board would be cumbersome,

Doolittle added he favored representation of all three military services on the board in addition to one from the Defense Department, AEC, National Science Foundation and the National Academy of Sciences in addition to civilian representation.

The NACA chairman said it also is necessary that liaison be maintained at all levels, much in the same manner as the present liaison between NACA, the military services and civilian

### 'Decision Committee'

In addition, he suggested that it might be feasible at a later date to create a "Decision Committee" to iron out any problems that might arise. He said the committee should be composed of the President's science adviser, the NASA director, a Defense Department representative, the AEC chairman and the National Science Foundation director.

John W. McCormack (D.-Mass.) committee chairman, told Doolittle that when the hearings began, he was very enthusiastic about creating a civilian space agency but that as more witnesses appeared his enthusiasm waned.

"After hearing you, however, my enthusiasm is back to the original level," McCormack told Doolittle.

Dr. Walter R. Dornberger, technical assistant to the president of Bell Aircraft Corp., suggested to the committee that a space agency might be directed by a person with the equivalent rank of the U.S. vice president in order to place it on a higher level. He also supported the Administration proposal to create NASA but said that it should not try to develop its own space vehicles or to run projects.

NASA, he said, should serve as a basic and applied research facility only and serve scientists as well as the military.

# Furnas Urges Broader NASA Authority

Denver-National Aeronautics and Space Agency should have expanded authority and liberalized policies for the support of research by outside agencies over that now held by National Advisory Committee for Aeronautics, Dr. Clifford C. Furnas said last week

Furnas, chancellor of the University of Buffalo and former Assistant Secretary of Defense for Research and Development, expressed his views on NASA and Defense Department reorganization at the second annual Air Force Office of Scientific Research Astronautics Symposium. He said he believes using NACA as a nucleus for NASA is "an excellent idea" but that NASA should have broader contract powers.

"Certainly scores of excellent research laboratories in universities, research institutes and some industries should be supported by contracts in contributing research knowledge to the multi-headed problems of space," Furnas said.

### Inherent Dangers

"If this aspect is not adequately handled, the national program will be greatly weakened. There is always the tendency, even if not the intent, for large government organizations to become monopolistic," he said.

"This tends to freeze out great blocks of talent, new ideas and appropriate competition. Further it seriously shrinks the reservoir of man power from which future research talent can be drawn. I trust that adequate attention will be given to this important matter."

Furnas also raised the question of how far the military establishment should go in conducting or supporting research "of more or less fundamental character in the general field of space technology" if NASA is established. He said he could see "some very old arguments being dusted off and put out on display," including the one that the military should not "dabble in scientific

'More than any other, the military establishment should apply all possible foresight and should develop a philosophy and have support for developing the knowledge and the background gadgetry which is going to be needed in the future," Furnas said.

"If this is being adequately handled by civilian governmental laboratories or private organizations, fine. The military can then go on to deal with new problems of which there will never be a

easier to get financial support for a project under the military direction, particularly if the sums required are large, than it is for a civilian agency. As a nation we should push forward to get the necessary jobs done through whatever channel is most feasible."

Great cost of space exploration will make it "even more necessary than ever to achieve a truly adequate coordination between military and civilian pro-

Reorganization of the Defense Department "can be a key factor in achieving the desirable pattern of action," Furnas

". . . The anticipated changes in the research and development area is a good step in the right direction."

### Defense Reorganization

Two important aspects of this part of reorganization, he said, are:

 Director of Research and Engineering "will have a higher rank and more well defined authority than the present Assistant Secretary of Research and Engineering.

· This official will have at his com-

mand, and available, certain funds and transfer authority which will permit him to initiate and control important research projects, particularly those which are of potential benefit to all three services.

"This will give him a positive and constructive control which has been almost completely missing in the Assistant Secretary's office in the past. At the present, the Assistant Secretary effectively has only negative control."

Some fear that this would lead to "too much concentration of power" and lack of enough service competition, Furnas said. Some competition is desirable, he added, "but not the mayhem which is what we have been exposed to for quite some time. Even a football game needs a set of enforceable rules and an effective referee."

Furnas' talk was titled "How High the Moon?" He said that question cannot be answered yet in terms of human effort, "but whatever it may be, for our own immediate military welfare and for ultimate human advance, it is highly important that we get there and be-

# Blue Streak IRBM Tests Speeded

British Blue Streak intermediaterange ballistic missile is now nearing the systems test stage.

Major components of the de Havilland missile, which is designed for launching from underground sites, have already been tested at completed facilities. New test areas are rapidly being finished for the next development

Prime contractor for Blue Streak is de Havilland Propellers Ltd., which is also responsible for the Firestreak airto-air infrared homing missile.

Associated contractors include: • De Havilland Aircraft Co. Ltd., presumably responsible for airframe construction and final assembly.

 Rolls-Royce Ltd., responsible for powerplant development and production. Observers believe the liquid fuel rocket engine will be one of the highthrust Rocketdyne engines for which Rolls holds license rights.

 Sperry Gyroscope Co. Ltd., responsible for development of the missile guidance system and associated avionic

 Saunders-Roe, Ltd., responsible for development and construction of the Black Knight re-entry test vehicle.

Current facilities include the coldflow systems test towers at de Havilland Propellers Ltd., at Hatfield. Two stands "As a practical matter, it is often have been built and instrumented for cover nose-cone data."

captive tests of the Black Knight vehicle by Saunders-Roe at a remote location on the Isle of Wright. The Saro Towers resemble those of de Havilland Propellers.

Rolls-Royce is building a rocket motor test stand at Spadeadam Waste, Cumberland, for static firing of the engines and propulsion system develop-

Completed rounds will be fired on the extended test range at Woomera, Australia.

Development of the British IRBM is being coordinated with similar programs in the U.S. Cross-feed of information between the British program and USAF's Project Minuteman, also based on an underground launching complex, is expected by most observers.

Lack of facilities in Britain for basic development studies in the hypersonic speed range may necessitate use of a thermonuclear warhead and re-entry body either based on U.S. designs or supplied directly by one of the American firms doing this work. For example: General Electric's low-angle nose cone developed for the Douglas Thor could be adapted to Blue Streak. Technical interchange agreements in the gas turbine field already exist between General Electric and de Havilland, and presumably could easily be extended to

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# Executive Pay, Stock Holdings Reported by Aircraft Companies

Washington-Following is a list of executive salaries and stock holdings filed by aircraft companies with the Securities and Exchange Commission:

FAIRCHILD ENGINE AND AIRPLANE CORP .- R. Boutelle, president and chairman of board of directors, \$116,072 salary and 5,563 shares of common stock: A. F. Flood, executive vice president, comptroller and director, \$90,206 salary and 3,000 shares of common stock; W. L. Landers, vice president, \$75,450 salary and no stock; J. A. Allis, director, no salary, 2,600 shares of common stock; R. B. Carney, director, no salary, 105 shares of common stock; C. H. Colvin, director, no salary, 263 shares of common stock; E. A. Eyre, director, no salary, 500 shares of common stock.

E. Cook; director, no salary, 105 shares of common stock; S. M. Fairchild, director, no salary, 100,559 shares of common stock; W. P. Lane, Jr., director, no salary, 4,000 shares of common stock; G. Loening, director, no salary, 9,500 shares of common stock; F. R. Nichols, director, no salary, 2,730 shares of common stock.

CESSNA AIRCRAFT CORP.—D. L. Wallace, president and director, \$75,000 salary and 55,006 shares of stock; F. A. Boettger, vice president, treasurer and director, \$49,-920 salary and 3,150 shares of common stock; D. L. Roskam, vice president and director, \$46,800 salary and 4,725 shares of common stock; T. B. Salter, vice president-engineering and director, \$39,000 salary and 2,350 shares of common stock; S. Coleman, director, no salary, 945 shares of common; G. McDonald, director, no salary, 5,985 shares of common; R. Russell, director, no salary, 1,025 shares of common.

THE RYAN AERONAUTICAL CO .-T. C. Ryan, president and director, \$62,500 salary and 60,720 shares of common stock; G. C. Woodward, executive vice president and director, \$55,000 salary and 120 shares of common stock; C. A. Stillwagen, secretary-treasurer, \$35,450 salary and no stock; C. A. Smith, director, no salary, 1,200 shares of common stock; M. H. Lockett, director, no salary, 1,200 shares of common stock; R. C. Jackson, director, no salary, no stock,

NORTHROP AIRCRAFT INC .- W. C. Collins, president and director, \$91,250 salary and 8,406 shares of common; W. C. McDuffie, chairman, board of directors, \$50,208 salary and 1,000 shares of common; R. R. Miller, vice president, general manager-Northrop Division and director, \$62,-803 salary and 1,000 shares of common.

E. Schmued, vice president (resigned Oct. 15), \$56,625 salary and no stock; J. Allen, director, no salary, 200 shares of common stock; L. L. Austin, director, no salary or stock; E. W. Carter, director, no salary or stock; E. M. Jorgensen, director, no salary, 500 shares of common stock; R. W. Millar, director, no salary, 100 shares of common stock: R. R. Millar, no salary, 1,000 shares of common stock; J. O'Melveny, director, no salary, 342 shares of common stock; A. E. Ponting, director, no salary, 110 shares of common stock, A. C. Rubel, director, no salary, 100 shares of stock.

MCDONNELL AIRCRAFT CORP.-J. S. McDonnell Jr., president and chairman, board of directors, \$115,881 salary and 241,754 shares of common stock; R. H. Charles, executive vice president and director, \$62,843 salary and 6,113 shares of common stock; C. W. Drake, vice presidentmanufacturing and director, \$55,952 salary and 8,602 shares of common stock; K. Perkins, vice president-engineering and director, \$64,072 salary and 1.854 shares of common stocks L. Harrison, director, no salary, 30 shares of common stock; W. A. McDonnell, director, no salary, 4,346 shares of common stock; W. R. Orthwein Jr., loch, president, general manager and direcdirector, no salary, 11,276 shares of common stock; S. W. Souers, director, no salary, director, no salary, 700 shares of common. 700 salary and 21,189 shares of common. tor, 600 shares of common stock.

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GENERAL ELECTRIC CO .- R. J. Cordiner-president and director, \$264,973 salary and 41,639 shares of common stock; P. D. Reed, chairman, board of directors, \$168,740 salary and 35,651 shares of common stock; R. Paxton, executive vice president and director, \$170,603 salary and 28,294 shares of common stock.

The following persons did not receive a salary: S. S. Colt, director, 3,170 shares of common stock; D. K. David, director, 600 shares of common stock; C. D. Dickey, director, 9,000 shares of common stock; H. Ford II, director, 100 shares of common stock; G. P. Gardner, director, 58,000 shares of common stock; J. Holmes, director, 1,000 shares of common stock; F. L. Hovde, director, 10 shares of common stock; G. W. Humphrey, director, 100 shares of common stock; J. E. Lawrence, director, 100 shares of common stock; G. H. Love, director, 600 shares of common stock; T. B. McCabe, director, 2,500 shares of common stock; G. G. Montgomery, director, 1,000 shares of common stock: H. S. Morgan, director, 9,000 shares of common stock; R. T. Stevens, director, 500 shares of common stock; S. J. Weinberg, director, 1,500 shares of common stock; R. W. Woodruff, director, 1,590 shares of common stock.

AVCO MANUFACTURING CORP. -V. Emanuel, chairman, board of directors, \$130,000 salary and 26,000 shares of common stock: J. D. Shouse, vice presidentbroadcasting, chairman—Crosley Division and director, \$87,500 salary, 950 preferred shares and 4,050 shares of common stock: K. R. Wilson Jr., president and director (elected president on Oct. 28), \$77,517 salary and 2,500 shares of common stock; L. P. Smith, vice president, president-research and development and director, \$73,-333 salary and 1,500 shares of common stock; A. R. Kantrowitz, vice president and director, \$70,000 salary and 11,000 shares of common stock; M. A. McLaughlin, vice president, general counsel and director. \$63,124 salary and 1,075 shares of common stock; R. A. Rich (resigned as president in October), \$96,428 salary, no stock.

The following persons were not paid a salary: G. E. Allen, director, 2,500 shares of common stock; I. B. Babcock, director, 25 preferred shares and 2,097 shares of common stock; J. Bruce, director, 3,000 shares of common stock; M. W: Clement, director, 1,050 shares of common stock; C. C. Darling, director, 1,200 preferred shares and 3,000 shares of common stock; R. H. Detjen, director, 2,500 shares of common stock; R. L. Johnson, director, 900 shares of common stock; H. H. Kahn, director, 2,500 shares of common. E. H. Litchfield, director, 1,400 shares of common.

J. A. McDougald, director, 10,000 shares of common stock; M. A. Morgensen, director, 3,000 shares of common stock; W. I. Myers, director, 1,000 shares of common stock; B. N. Namm, director, 65 preferred shares and 1,912 shares of common stock; T. J. O'Hara, director, 235 preferred shares and 2.595 shares of common stock.

GRUMMAN AIRCRAFT ENGINEERING CORP .- L. R. Grumman, chairman, board of directors, \$50,200 salary and 145,380 shares of common stock; L. A. Swirbul, president and director, \$100,250 salary and 10.500 shares of common stock; W. T. Schwendler, senior vice president and director, \$50,250 salary and 50,300 shares of common stock; E. C. Towl, administrative vice president and director, \$47,750 salary and 9,000 shares of common stock; E. W. Poor, treasurer, salary not listed, 35,090 shares of common stock; A. P. Loening. director, no salary, 35,000 shares of common stock; C. A. Wight, no salary, 880 shares of common stock.

TEMCO AIRCRAFT CORP.-R. McCultor, \$84,700 salary and 45,559 shares of common stock; H. L. Howard, executive

stock; V. N. Ferguson, vice president-operations, \$37,863 salary and no stock; J. A. Maxwell, vice president-sales, contracts and sales programming, \$40,000 salary and no

I. N. Palley, vice president-engineering. \$40,000 salary and no stock; C. Williams. vice president and comptroller, \$40,000 salary and no stock; D. H. Byrd, director, no salary, \$31,000 worth of 51% convertible sub debentures and 145,058 shares of common stock; J. M. Cumby, director, no salary and 310 shares of common stock; H. N. Mullon, director, no salary and 3,015 shares of common stock; O. R. Moore, director, no salary and 60,300 shares of common stock; H. F. Volk, director, no salary and 45,000 shares of common stock.

BEECH AIRCRAFT CORP .- O. A. Beech, president and director, \$98,968.75 salary and 83,709 shares of common stock; J. P. Gaty, vice president, general manager and director, \$77,142.40 salary and 7,425 shares of common stock; F. E. Hedrick, vice president, coordinator and director, \$76,387.66 salary and 4,065 shares of common stock; C. C. Pearson, vice president-manufacturing and director, \$59,115,15 salary and 275 shares of common; D. S. Wallace, director, no salary and 5,430 shares of common.

CHANCE VOUGHT AIRCRAFT INC .-C. J. McCarthy, chairman, board of directors, \$67,450 salary and 1,000 shares of common stock; F. O. Detweiler, president and director, \$87,450 salary and 1,500 shares of common stock; H. B. Sallada, senior vice president and director, \$54,400 salary and 1,000 shares of common stock; C. E. Burt, vice president, controller and director, \$42,300 salary and 600 shares of common stock; D. A. Huley, director, no salary, 100 shares of common stock: L. F. McCollum, director, no salary, 800 shares of common stock; W. W. Overton Jr., director, no salary, 500 shares of common stock: R. L. Tayloe, director, no salary 100 shares of common stock: J. R. Wood. director, no salary, 200 shares of common

CURTISS-WRIGHT CORP.-R. T. Hurley, president and chairman, board of directors, \$311,690 salary and 15,500 shares of common stock; G. R. Hill, executive vice president, vice president-finance and director, \$153,100 salary and 17,600 shares of common stock; J. G. Byron, executive vice president and director, \$72,900 salary and 7,700 shares of common stock; J. V. Miccio, vice president, general manager-Wright Aeronautical Division, \$104,200 salary, no stock.

The following persons did not receive a salary: E. J. Beinecke, director, 100 shares of common stock; T. R. Berner, 1,200 shares of common stock; L. H. Campbell Jr., 100 shares of common stock; J. C. Cowdin, director, 100 shares of common stock; L. R. Crandall, director, 500 shares of common stock; C. A. Dana, director, 100 shares of common; S. R. Reed, director, 300 shares of common stock; L. H. Smith, director, 9,000 shares of common; H. S. Sturgis, director, 1,000 shares of common.

DOUGLAS AIRCRAFT CO. INC .- F. W. Conant, vice president, director-manufacturing and vice chairman, board of directors, \$108,750 salary and 2,060 shares of common stock; D. W. Douglas, chief executive officer and chairman, board of directors, \$163,025 salary and 15,000 shares of common stock : D. W. Douglas Jr., president and director (elected on Oct. 23), \$50,296 salary and 1,050 shares of common stock; F. E. Hines, vice president-finance and director, \$38,653 salary and 1,000 shares of common stock; N. Paschall, vice presidentsales and director, \$48,463 salary and 2,095 shares of common stock; A. E. Raymond, vice president-engineering and director, \$76,505 salary and 10,600 shares of common stock; J. A. Dundas, executive vice president and director, salary not listed, 800 shares of common stock.

The following persons were not paid a salary: M. W. Bekins, director, 600 shares of common stock; C. S. Jones, director, no stock: C. J. Lick, director, 600 shares of common stock; G. Mayo, director, no stock; E. H. McLaughlin, 1,200 shares of common stock: N. Petree, director, 150 shares of common stock; S. G. Welsh, director, 3,750 1,060 shares of common stock; J. E. Webb. vice president, treasurer and director, \$65,- shares of common stock; D. Whiting, direc-

AVIATION WEEK, May 5, 1958



It will operate Jetstar's stabilizer many times during an average flight, therefore hundreds of thousands of operations will be performed during the life of the unit. Reliability to the extremes of environmental conditions and ruggedness were prime specifications.

EEMCO's ability to produce these actuating units for Lockheed Aircraft Corporation in record time is a result of the fact that EEMCO has specialized in the design and production of aircraft motors and actuators for many years. It makes nothing else. And because of high ratio of output to weight and the reliability built into all of its products, there is an EEMCO special motor or actuator on the majority of the latest missiles and jet aircraft now in production or in prototype stage. Please note the specifications on this Jetstar component.

Stroke: 8.25 inches

Speed: .3 inch per sec. at maximum load Maximum Load: 10,500 lbs. on each jack, tension or compression

Maximum System Load: (both jacks) 15,000 lbs. Ultimate Load: 50,000 lbs. on each jack, tension or compression-100,000 lbs. total

Military Specs: Assembly designed to meet MIL-M-8609, MIL-A-8064 and MIL-E-5272A

### Features:

- Jacks are equipped with non-jamming stops.
- 2. Single power unit drives the jacks at synchronized speed
- 3. Jacks are equipped with auxiliary reduction for a control mechanism.
- 4. Motor has magnetic clutch and brake.

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first... plane to land at the South Pole

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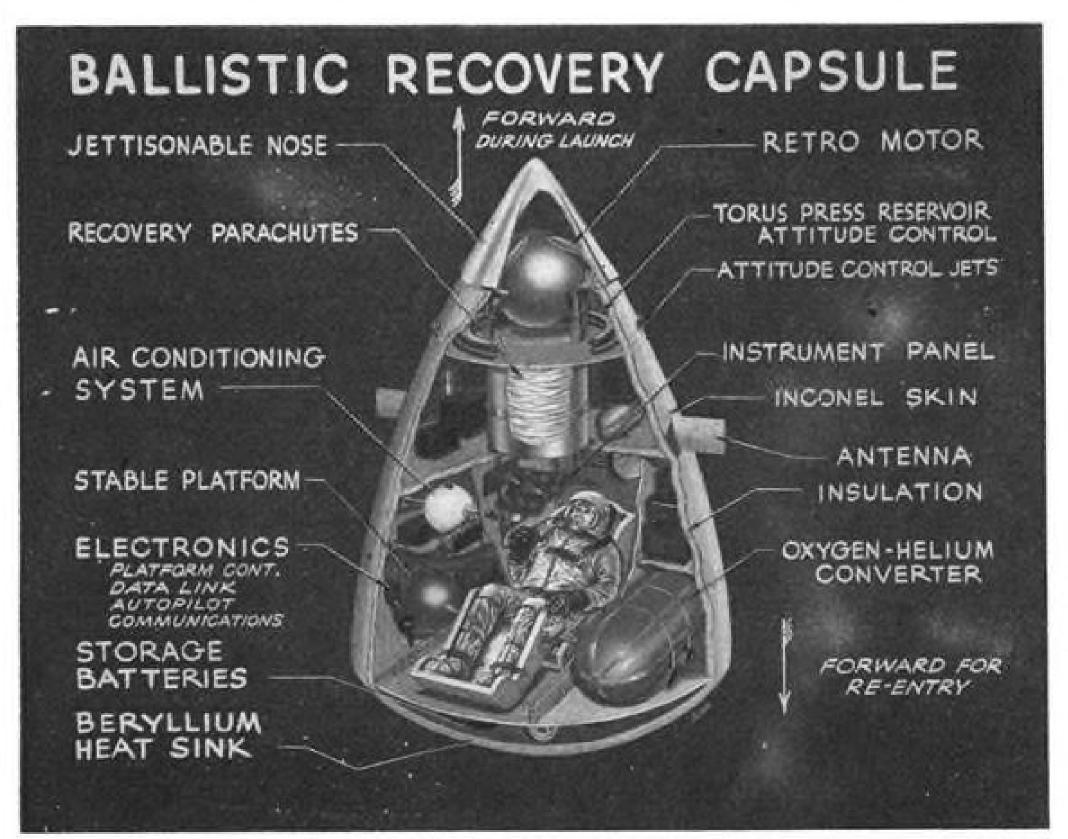
The first aircraft ever to land at the South Pole—and the first Americans to set foot at the South Pole . . . these were history-making feats achieved by Operation Deepfreeze II. The mission was carried out on October 31, 1956, by a party and crew of seven men in this Navy R4D. Naturally, Herman Nelson Portable Heaters were chosen as support equipment for this important mission, providing quick, unfailing heat. Herman Nelson's 16 years of experience in the portable heating and ventilating field can be put to work on your problem.



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NORTHROP Aircraft's proposal for a recoverable manned space laboratory would be based on a bullet-shaped capsule 7 ft. dia. and 10 ft. long, to be launched by existing ICBM.

# Manned Space Laboratory Plan Based on Bullet-Shaped Capsule

Los Angeles—Northrop Aircraft's plan for a recoverable manned space laboratory, which could be put into a 200 to 300 mi. altitude orbit within three years, was outlined here last week. George Douglas, vice president-engineering, Northrop Division, said company has developed basic design criteria for a perfectly feasible manned space laboratory.

Bullet-shaped capsule, approximately 7 ft. dia. and 10 ft. long, with man strapped inside, would possibly be launched by existing intercontinental ballistic missile coupled with a Polaris for additional stage. Capsule would weigh about one ton and would have a payload of approximately 1,000 lb. Man inside capsule would be in a nearreclining position to withstand forces of acceleration and deceleration. Equipment for air conditioning, communications, navigation, stabilization, instrument display, and all other functions necessary for the trip are included in capsule.

Nose of capsule contains reverse thrust rocket to be fired at a point about 180 deg. from desired landing spot, would change capsule attitude so it would land on blunt end. During launch, pointed end of capsule would be forward to reduce drag and would also position man so he could withstand acceleration forces from front to back. After obtaining orbit, capsule would make several revolutions until

exact position would be determined by tracking stations. Low thrust gas jets, acting on signals from navigation system, would turn vehicle to blunt end forward position. Navigation system would be a star-tracking system similar to one developed by Northrop for Snark missile.

Firing of reverse thrust rocket would reduce velocity so that capsule would go into elliptical orbit with lowest point being earth's surface. Capsule would re-enter the atmosphere at a shallow

# Computing Center Gets Equipment

Full complement of mathematical and simulation equipment has been assembled for Northrop's Computing and Datamation Center, Compadac, where announcement was made of the company's studies leading to the capsule proposal.

Analog equipment capable of simulation and model testing is provided, as well as analog calculation, digital calculation and data handling.

Another part of Compadac is devoted to studies of new methods and machinery which will further computation, data handling and calculations.

Compadae currently operates an IBM 704 digital computer, plans to install an IBM 709 in the future.

angle (about 2 deg.), keeping heating rate and deceleration at acceptable levels. High drag in blunt end forward attitude would slow capsule from 25,-000 fps. to 1,000 fps. (Mach 1) by the time it had descended to 60,000 ft. altitude, Capsule parachute would open at 20,000 to 30,000 ft. to ensure gentle landing.

Northrop feels that one of the more critical problems is controlling return of vehicle to earth. Reverse thrust maneuver must be controlled very accurately as well as velocity at end of reverse thrust, direction of thrust and timing to ensure return to desired area on earth.

Re-entry problems are much the same as those of a ballistic missile, mainly aerodynamic heating and deceleration. However, Northrop feels that by re-entering at low angle with high drag shape it can limit the maximum surface temperature to about 1,500F, and deceleration to about 8G. Temperature inside capsule would rise only slightly since maximum would occur for only about one minute and man's G tolerance would not be exceeded.

Three-year program would include unmanned flights prior to launching man-first with instrumentation only, then with animals.

Northrop's Advanced Design Department is active in several space projects, according to Douglas. Company has conducted numerous studies in field of astronautics and has surveyed existing knowledge and projected theories in this field over the past 2½ vr.

Douglas emphasized that manned satellite program is proposed as a necessary step before specific military vehicles can be developed for use in outer space. He believes that the currently fashionable promotion of space and lunar stations for strategic bombing and reconnaissance must not be allowed to divert men and money from the development of today's aircraft and missiles.

# British to Order Additional P.1Bs

Additional production orders for the supersonic English Electric P.1B fighter and a trainer version will be placed "as necessary to ensure continuity of production," British Minister of Supply Aubrev Jones told Parliament.

Estimates of the total number of additional airplanes to be built place the quantity at about 150 including both types.

Two-seat trainer has a side-by side layout, hinting at a possible operational role as an all-weather fighter in case system complexity rules out one-man operation. Aircraft is scheduled to fly early in 1959.

# Opposition Grows to Reorganization Plan

By Robert H. Cook

Washington-Congressional opposition to President Eisenhower's controversial proposal for reorganization of the Defense Department intensified last week following a vehement refusal by the President to alter the bill in line. with views expressed by the House Armed Services Committee.

Committee hopes that the Administration might "bend a little" resulted from testimony by Secretary of Defense Neil H. McElroy who said he was not "wedded" to the language of the proposal. Admitting that he would have preferred more time in office before becoming involved with the plan, Mc-Elroy said "there is an opportunity here for a good deal of mutual working out of language."

The President, however, has twice warned that there will be "no retreat from . . . or compromise in" the essentials of his bill.

Opposition to the Administration plan is following a line of attack that the proposal, if adopted, would place the future of the nation in the hands of a "military czar" and a "Prussian-type" general staff. Controversy centers around sections that expand the powers of the Secretary of Defense and increase the size of the existing Joint Chiefs of Staff.

Congressmen also fear that the present wording of the bill might eventually be interpreted to bring about a possible merger, or even elimination, of service branches under the guise of unified commands.

Secretary McElroy, Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff; Gen. Maxwell D. Taylor, Army chief of staff and Adm. Arleigh A. Burke, chief of naval operations have steadfastly denied these allegations in the face of a barrage of questions.

Supporting the plan, Adm. Burke cautioned against allowing the Joint Chiefs to become involved in too much detail which might result in "confusion of responsibilities." He added that he favors holding any increase in staff size to "a minimum."

Opposition to the proposal was introduced in a letter from H. Struve Hensel, former chief counsel for the Defense Department.

Terming the plan "180 degrees the opposite of" reorganization moves by the President in that year, the attorney wrote Committee Chairman Carl Vinson (D.-Ga.) that "I cannot believe" that the basic pattern of the Administration's present bill was "carefully thought through."

of the plan lies in the creation of two tracts and is advising them to use it.

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parallel chains of command . . . one for operations and one for support."

He said the President's 1953 plan was based on the idea of the Joint Chiefs acting as a planning body, with the Defense Secretary directing operations through the civilian secretaries of the Army, Navy and Air Force. The plan now being offered places responsibility for command functions, as well as planning, within the Joint Chiefs under the supervision of the Secretary of Defense.

Hensel questioned "this change in philosophy" since "both conflicting approaches" were offered in reliance "on the President's broad experience as a military leader.'

Two other additions to the bill, added by the White House, also added to the heat of cross examination. One clause repeals the right of an individual service to air complaints before Con-

gress after notifying the Secretary of Defense. The other allows the Secretary to make only one annual report, instead of the present semi-annual reports, to Congress from the individual services. Both would seal off points of contact between the services and Congress.

Secretary McElroy agreed to abandon both provisions after Pentagon counsel Charles A. Coolidge, who drafted the reorganization plan, stated the points were added while he was out of town.

Generals Twining and Taylor both challenged charges that a "Prussian" general staff would be created by expanding the present Joint Chiefs of Staff. Gen. Twining said that many staff functions which the services are authorized to perform were already being handled by the Joint Chiefs so that the President's proposal was merely a matter of clarifying the law so that two people won't be doing the same thing.

# West Coast Strike Threat Grows; Labor Aims at Busiest Companies

Los Angeles-Strike action of some sort is now considered likely in the West Coast aviation industry labor disputes but may appear as a selective attack against plants which are sensitive because of heavy business volume and tight schedules, rather than as a walkout in all companies now negotiating.

International Assn. of Machinists and United Auto Workers unions acting jointly have served contract termination notices effective 11:59 p.m. May 7 to Lockheed, Douglas, North American and Convair. This is not a definite strike indication but leaves the unions with only two other alternatives if agreement is not reached by that date: they can ask for a brief extension of existing contracts or can continue work without a contract. Formal decision rests with local bargaining units but observers feel alternatives would be adopted by certain units only to further aggressive tactics elsewhere.

Recession and possible damage to defense effort of a major strike are underlying factors which control stratcgy of both sides. Irving Bluestone of UAW and A. C. McGraw of IAM, heading joint board of strategy, charge the Department of Defense with being "the ghost at the bargaining table."

Bluestone said Department of Defense has issued a directive giving military plant representatives authority to veto reimbursement of a company for Hensel charged that the "major vice additional costs due to new labor con-

Effect would be to stiffen industry resistance to labor demands. An industry spokesman says plant representatives have always had broad authority but that intervention of this sort would be "unheard of."

McGraw told Aviation Week that the Department of Defense directive was behind resistance to labor demands in a Cape Canaveral missile range dispute. Bluestone said defense agencies and members of Aircraft Industries Assn. have banded together to present a solid front against labor. Selective union tactics would minimize the likelihood of Presidential intervention on grounds of a threat to national welfare. whereas such action would probably be swift in an across-the-board strike.

McGraw said Douglas, North American and Convair have made no "economic" proposals and have broken off talks to await the outcome of negotiations at Lockheed. He charged that Lockheed and other companies actually hope for a strike at Lockheed's Missile Systems Division, builder of Navy's Polaris fleet ballistic missile.

He said hope is grounded in the belief that President Eisenhower would refuse to permit a strike because of Polaris' high priority, thereby robbing the union of its ultimate weapon and making it possible to set a precedent favorable to management for later negotiations.

Lockheed sources denied emphatically that the company wants federal

AVIATION WEEK, May 5, 1958

intervention. McGraw refused to discuss union plans in detail but said that if strikes are called, "they happen where they hurt most." In Lockheed Aircraft Corp., it would "hurt most" in the Missile Systems Division, according to John Snider, president of IAM District 727, Lockheed bargaining unit.

A growing issue in the Lockheed negotiations is the company argument that a separate contract should be written for the Missile System Division rather than including it in a settlement for the Burbank Aircraft Division.

Snider reported that early in negotiations, Lockheed had professed willingness to accept a contract similar to that signed by Republic Aviation, N. Y. Snider said unions are now prepared to sign such a contract immediately. He described the Republic pact as offering a factor hourly rate of from \$2.02 to \$3.10, a 10-cent raise across the board next year, a cost of living clause, a union shop, eight paid holidays, a 29 cent per hour swing shift differential and a group insurance plan.

Lockheed hourly rate is now \$1.73 to \$2.75. Company denied ever making the statement attributed by Snider. Lockheed spokesman said a company official had suggested a pay raise proportionately as large as that given Republic employes.

Meaning of pay raise proposals by either side is clouded by different interpretations of the cost of living increase being offered by the company. Contracts signed by Douglas and North American two years ago included cost-ofliving escalators.

The unions have said Lockheed owes its employees the increase now offered and refuses to count it as a pay raise. Because of this they consider Lockheed offers far less than that obtained from Republic.

In its most recent proposal the company has offered a raise graduated from zero to four cents per hour plus another 35% increase next year for factory workers in addition to the cost of living pro-

IAM and UAW call the proposal "inadequate, unrealistic and unacceptable." Original union request for a general 6% increase has been cut to 31% which would average from six to 10 cents per hour. Snider says that unions will reject any proposal which ignores the labor position on severance pay, seniority and job descriptions regardless of the size of the pay raise offered. He charges that Lockheed intends to negotiate a pay raise by gerrymandering job descriptions so as to lower the labor grade classification of certain jobs. Union is also demanding that if an employe is transferred to another division, he cannot use his continuing seniority to return to the first division and bump his replacement.

# **Unexpected Cosmic Radiation** Could Raise Space Flight Problem

Washington - Unexpectedly intense cosmic radiation of unidentified nature which could raise serious problems for manned space flight over extended periods has been discovered at altitudes above 621 mi. in data obtained from Explorer I and III satellites.

This is one of preliminary findings revealed last week in the first official report on analysis of data obtained from two U.S. International Geophysical Year satellites.

The report was made to members of National Academy of Sciences and American Physical Society.

Telemetered data received from Geiger counters aboard Explorer I and III suggest that cosmic ray count of 30-40 per sec." experienced at 200-300 mi. altitudes reached 35,000 per sec. at altitudes above 1,000 mi. Scientists thus far have been unable to determine whether the radiation results from proton bombardment from space or from X-rays generated by the satellite shell under electron bombardment.

satellite is estimated at 0.06 roentgens per hour, one-half the maximum allowable human dosage per week. This in- turn a single propeller. dicates that humans in space vehicles at altitudes beyond 621 mi, will require special shielding, greatly increasing vehicle weight. Radiation also would pose a problem for transistors and other avionic equipment compo-

The 35,000 counts/sec. figure is based on deduction rather than actual measurement. Scientists found that Geiger counter output suddenly dropped off sharply at high altitudes without apparent reason. Analysis and subsequent laboratory tests on identical Geiger counter suggested that the device was being overwhelmed by the intensity of the cosmic radiation. Laboratory tests using X-rays indicated that a count of 35,000/sec, would produce an effect similar to that observed in satellite telemetered data.

Intensity of radiation may be sufficient to contribute "significantly if not dominantly to heating of the upper atmosphere," Dr. James A. Van Allen, University of Iowa professor and a member of the U.S. technical panel for the earth satellite program, re-

He suggested that the nature of new radiation might be determined by investigating the amount of atmospheric ionization, light and radio noise pro-

Highlights of reports by other quarter ending March 31.

scientists on satellite findings to date

• Explorer I lifetime is now estimated at three to five years.

 Atmosphere density at 230 mi. is about two oz. per cubic mile, or 14 times the figure that had been predicted.

 Micrometeorite intensity has not been unexpectedly severe. Data indicates that an area one square meter in size will encounter a particle four microns or larger in diameter once every 100 sec., a particle 10 microns or larger once every 1,000 sec.

# News Digest

Lycoming Division of Avco Corp. is developing a helicopter version of its T55 engine designated the T55-L-3. The 695 lb. turboprop version, the T55-L-1 rated at 1,676 eshp., has passed its 50 hr. qualification test. Heli-If the high count rate results from copter version will develop 1,850 eshp. X-rays, radiation intensity within the Army, which is financing both versions through their 50 hr. tests, is considering using paired turboprop engine to

> De Havilland Comet IV jet airliner last week made its first flight and certification tests will begin immediately. First flight included climb to 40,000 ft., lasted 1 hr. 20 min. British Overseas Airways said it is considering putting Comet IV into transatlantic service before Pan American World Airways begins that run with its Boeing 707.

Republic Aviation Corp. consolidated sales totaled \$35,831,275 for the quarter ending March 31, compared with \$76,645,222 for the same period in 1957. Net income after taxes was \$702,029, or 48 cents per share on 1.472,013 common shares outstanding March 31, compared with \$1,776,738 or \$1.21 per share on 1,472,013 common shares outstanding at the end of the comparable 1957 period. In a letter to stockholders, Republic reported a \$347 million backlog in orders for USAF F-105 and said an additional \$300 million of orders for F-105s and parts is contained in the 1959 fiscal procurement program.

Vertol Aircraft Corp. first quarter earnings dropped from \$733,721 a year ago to this year's \$162,635. Sales in the same period declined from \$21,-748,647 in 1957 to \$10,387,289 for the

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# AIR TRANSPORT

# Airlines May Face Military Traffic Loss

Defense officials foresee diversion of traffic if examiner's proposal to drop discount is approved.

By L. L. Doty

Washington-Strong possibility that airlines face a cutback in military traffic was revived last week by a Civil Aeronautics Board examiner's initial decision opposing continuance of the 10% fare discount on military transportation.

Seriousness of the threat is underscored by the fact that the Defense Department is now the largest single source of passenger revenues available to the scheduled airlines.

Last year, certificated airlines grossed approximately \$63 million from military traffic, or about 58% of the total domestic military passenger travel market.

### Defense Stand

However, Defense Department officials contacted by Aviation Week were virtually unanimous in their opinions that present austerity programs within the department would force the diversion of some traffic away from the airlines if the existing 10% discount on official military traffic were removed.

They echoed an earlier warning by Maj. Gen. George Hickman Jr., Army Judge Advocate General, who testified on March 14 before the CAB for the Secretary of the Army that "disapproval of the agreement (10% discount on military rates) will unquestionably result in the diversion of an indeterminate amount of first-class air travel by the military agencies to other modes of transportation."

In his initial decision, the Board's hearing examiner, Edward T. Stodola, concluded that the discounted and equalized fares granted to military passengers traveling on government transportation requests are "unjustly discriminatory" and "unlawful." Equalized fares, a second preference granted by the airlines to only official military travelers, provides that if a fare via a circuitous routing is within 10% of the fare via a direct routing, the military traveler will pay only the direct fare.

Both issues have been a source of controversy within the airline industry for the past six months. The dispute first came into the open last fall during an Air Traffic Conference meeting in New Orleans when American Airlines announced its opposition to both the discount and fare equalization. Eventually, seven carriers joined American's stand and excluded the two fare preferences from their fares charged for military traffic.

However, a threatened loss of traffic to those carriers still offering the discount forced the dissident airlines to reverse their decision within 21 days and to resume the discount and equalized fare practices.

Prior to the reversal, Maj. Gen. E. C. Lasher, then executive director of the Military Traffic Management Agency, wrote the Air Transport Assn. that military agencies considered it mandatory in the interests of economy to issue directives discouraging use of the dissenting carriers. He added that this would have the effect of "reducing official travel on lines of carriers not joining those accepting the traditional discount."

According to the Civil Aeronautics Board record in the case, the discount and equalization provisions of the agreement with the military are now opposed by American, United and Northeast Airlines. The 10% discount is supported by the Military Traffic Management Agency, Delta, Northwest, Continental and Southern, Only Trans-Texas supports both the discount and the equalized fare issues.

Privately, a number of carriers fear that strong support of the discount may prejudice their positions in the General Passenger Fare Investigation by implied contradiction. Braniff, Capital, Eastern, National and TWA offered evidence for the record in the case but have taken no position as to its merits.

Airlines made their first inroads on military traffic beginning in June, 1951,

## Military Market

Washington—Increase of airline participation in the military market in fiscal year 1957 over fiscal year 1954. Earlier statistics are not available because of differences in reporting systems employed by various military services prior to 1954.

### PERCENT OF PARTICIPATION

			Passen-	Passen-
Fiscal		Passen-	ger	ger
vear	Mode	gers	Miles	Revenues
1954	Air	14.31	34.38	43.64
	Rail	33.87	49.46	47.41
	Bus	51.81	16.16	8.95
1957	Air	25.82	49.00	58.03
	Rail	30.48	39.69	36.08
	Bus	43.70	11.31	5.89

when the so-called "preferential clause" in the military agreement with the railroads was removed. This clause, which was in effect for 35 years, made it mandatory that the military select rails for transportation of personnel with certain limited exceptions.

Airlines supporting the 10% discount maintain that a serious threat to airline business lies in Section 22 of the Interstate Commerce Act which authorizes free or reduced rates of transportation for persons traveling for the U. S. government. These airlines contend that elimination of the discount will force military agencies to return to rail if only for economic reasons.

### Delta's Brief

In its brief to the Board, Delta Air Lines said the "growth in military traffic (by air) can be attributed almost entirely to the granting of the 10% discount and the elimination of the preferential clause in the railroad agreement . . ."

In emphasizing how the airlines can afford to absorb the discount without seriously affecting revenues, Delta had this to say:

 Reservation costs for military traffic are cheaper. One call will complete reservations for 10 to 12 people traveling on military business, while other traffic must be handled individually.

 Ticketing costs are less for military traffic. Blocks of tickets can be prepared in advance before rush hours at ticket counters and military passengers can be checked in at airports in groups rather than individually.

 Cost of sales is less for military traffic. Delta said that in October, 1957, a city ticket office and a Joint Military Traffic Office (JAMTO) in one city each produced \$18,000 of on-line business. Ratio of ticket office costs to sales was 6.28% at the city ticket office and 1.99% at the JAMTO.

 Average length of haul of military passengers is about twice that of nonmilitary passengers. Domestic civilian passengers average about 543 miles as compared with the military passengers' average of 969 miles. Delta said a 69-passenger DC-7 at first-class fares will recover fully allocated costs with 30 passengers on a trip of 1,000 miles but that the same DC-7 will require 35 passengers to break even on a 500 mile trip.

 Advertising costs per military passenger are less.

In its stand against the discount, American Airlines said that it is no

cheaper to transport a military passenger than any other passenger. The carrier, represented by Vice President Walter Johnson, said the "vast majority of military TR (transportation receipt) passengers do not originate at JAMTO offices and are, therefore, ticketed at a city ticket office like any other passenger.

Johnson said military passengers incur the same amount of advertising expenses as other passengers. He explained that the American advertising program is "designed to reach any and all persons it can" and added: "Its purpose is to inform and to influence and that purpose applies to all potential trav-

Johnson said the discount was introduced as an "emergency measure" and has always been "approved on a year-to-year basis." He pointed out that the discount cost American more than \$1 million during the 12 months ending last Sept. 30.

### Air vs. Rail Trend

In dismissing any fears that the airlines would lose traffic to the railroads because of the elimination of the discount, American pointed out that schedule frequencies of the rails have declined sharply in the past nine years as opposed to a marked increase in airline schedules. Using 100 as a 1949 index, the American brief said domestic standard fare plane miles in 1956 were 153 while Class I first-class railroad car miles declined to 73 in the same year.

Available seat miles, the American brief emphasized, showed similar trends. Airline available seat miles jumped from 11.2 billion in 1949 to 23.1 billion in 1956 while railroad available seat miles declined from 21 period.

In his conclusions, examiner Stodola found the law requires that charges for transportation should be the same to all passengers when the service is the same. He added that military passengers traveling under discounted or equalized fares receive the same transportation and services offered standard fare passengers on the same flights and that the airlines impose no restrictions on military travel that do not apply to civilian travel.

He further found that, although the "lack of equality of competitive opportunities between air and surface transportation once justified partiality in charges to the military services, this end ing. has now been accomplished and the factor of competition should no longer continue as an excuse for fares which are obviously unfair."

fail to prove the airline industry will suffer a loss in military traffic as a re- Lines, has opened offices in New York,



IRISH AIR LINES Super Constellation St. Patrick is serviced on landing at Dublin airport. Kilted band, right, and large crowd meet the aircraft.

# Irish Air Lines' Transatlantic Run Ties U.S., Off-line European Cities

By William H. Gregory

Dublin-Irish Air Lines, after false starts in 1948 and 1952, began transatlantic service last week, tving in for the first time a long haul segment to the ultra-short-haul routes of its sister corporation, Aer Lingus.

Expansion to the west has long been a primary goal for the state-backed Irish air system. Now Ireland is at the center of its route complex instead of on the western fringe of it.

The Irish hope to gain three major billion to 14.8 billion in the same advantages with the transatlantic route: Increased tourist traffic from the U.S., benefiting Ireland's economy generally. Last year 55,000 travelers from America visited Ireland, roughly half arriving by air. This figure can be doubled in three or four years, the Irish Tourist Board believes.

> • Traffic from the U.S. to feed the Aer Lingus short haul system in Europe. • Traffic from Europe to feed the long sought long haul route. The result, the Irish hope, will be to make Dublin a gateway to and from Europe.

As a competitor to the established transatlantic carriers on one-plane New York-London or New York-Paris runs, Irish Air Lines would find it tough go-

But it has certain advantages in specialized areas the big carriers now cannot or do not serve.

Lovalty of Irish-descended U.S. cit-Stodola also concluded that records izens is one. The Irish Tourist Board, coordinating its efforts with Irish Air

of these citizens to see the old country again and to sell Ireland to tourist generally. As an indication of the progress of the campaign, Irish Air Lines had 3,000 bookings in the U.S. as of April 19, and new bookings were being made at a rate of 100 a day since then.

Another area is for tourists who want to visit Ireland first before going on to Great Britain or the Continent.

Still another is transporting Europeans from points off routes of other transatlantic carriers but served by Aer Lingus on to the U.S. or U.S. travelers to these points. Some examples:

 New York-Lourdes. Irish Air Lines. which advertises the most direct service on this journey, expects a sizable traffic this year because of the centenary observance at the Catholic

Last year Aer Lingus carried only 3,500 scheduled and 1,000 charter passengers there. This year it has 9,000 scheduled bookings from Dublin and expects to carry 12,000 scheduled passengers plus 40,000 charter passengers, from Dublin or Britain, with 25,000 bookings already in hand.

 Birmingham-New York. This is chosen as an example simply because Irish Air Lines happened to pick up an unexpected revenue passenger at Shannon who joined the non-revenue inaugural flight last week. He was a German who had business in Birmingham and then wanted to go on to New York.

This could be typical of many Aer Lingus points, such as Cardiff, Manchester, Dusseldorf, Barcelona-none sult of the elimination of the discount. Chicago and Boston to whet the desire major U.S. traffic points themselves

AVIATION WEEK, May 5, 1958 41 AVIATION WEEK, May 5, 1958



with the help of heat-treated TITANIUM ALLOY

On high speed military planes, such as the Douglas A3D-2 Skywarrior and other jet aircraft, the bomb ejector rack is a complicated and critical mechanism. Any failure might endanger both airplane and pilot.

Three basic parts make up the ejector . . . cylinder, piston and breech. The latter presented the greatest design problem, due to its multitude of functions and irregular shape. Similar breeches made from stainless steel frequently heat-checked and failed, during test firing or hydrostatic testing.

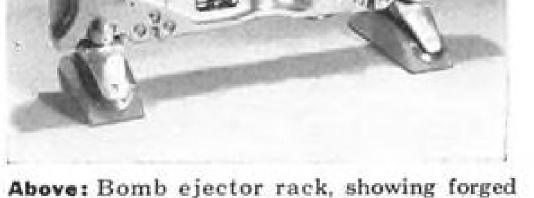
Experience and design calculations suggested that 6Al-4V titanium alloy, produced by Mallory-Sharon, was the metal most likely to meet the exacting requirements.

Actual firing tests confirmed the advantages of titanium for this application.

...... The titanium alloy breech with-

stood 300 firings before any evidence of heat checking appeared. No failures occurred in firing . . . and the breech withstood hydrostatic pressure of 27,000 psi without failure.

> Here's one more example of titanium's outstanding performance in meeting critical design problems. May we help you explore its advantages for your product or application? Write for "Titanium Fact File".



titanium alloy breech (circled).

Below: Titanium alloy ejector breech, before and after machining.



## WHY TITANIUM WAS CHOSEN

- 1. High strength-to-weight ratio at elevated temperatures for short times.
- 2. Superior corrosion and erosion resistance.
- 3. Excellent forgeability.
- 4. Good machineability in the heat-treated
- 5. Low susceptibility to hydrogen embrittle-

\*

Good thermal stability.

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but having possibilities when assembled.

Thus the Irish Air Lines (Aerlinte Eireann in Gaelic) has arranged its transatlantic schedules and Aer Lingus its European schedules to give the maximum amount of possible connections.

Irish Air Lines has leased three Lockheed 1049H Super Constellations from Seaboard and Western Airlines to provide a daily flight each direction-including a required stop at Shannon.

(Dubliners question the value of the Shannon stop, but the investment of the Irish government in the field plus its establishment as a free port to stimulate tourist buying in stopovers make it

a political necessity.)

Seaboard and Western provides the crews; Irish Air Lines the hostesses. Initial schedules will be three flights weekly each direction until June 2 when the daily service begins. Eastbound, the flight will leave New York at 2:30 p.m. and arrive in Dublin at 7:30 the next morning. The New York flight will leave Dublin at 7:25 a.m. and arrive at 10 p.m.

The traveler to Dublin can get an Aer Lingus Viscount flight the same

day to:

• Lourdes departing at 9:10 a.m. and arriving at 12:10 p.m.

• Rome departing at 2:35 p.m. and arriving at 8:50 p.m.

• Manchester, departing at 9:20 a.m. and arriving at 10:10 a.m.

Not all European points will be served daily, but similar schedules apply to most Aer Lingus cities on at least a thrice-weekly basis.

Civil Aeronautics Board authority for the Seaboard lease expires May 1, 1960. Irish Air Lines may attempt to renew the lease, perhaps with encouragement from Seaboard, which took a 25% share of the airline as part of the payment for the lease.

However, the carrier plans to set up study committees to consider purchase of turbine transports. Informally, the Irish Air Line management appears to lean toward turbojets, possibly the Vickers VC-10 because of its tail mounted engine configuration and projected use of Rolls-Royce engines, which would give the line an all Rolls fleet.

When it first planned transatlantic service, the carrier had purchased Lockheed 749s. An election and a new, economy-minded government in 1948 canceled the program and forced sale of the aircraft. Delay in CAB approval caused a halt in the service when it was revived in 1952 with the return to power of the Eamon de Valera government.

The airline realizes it is now coming on stage late in the play, but the importance of the expansion is considered such that the risk must be taken.

non-stop service in each direction. A future possibility is a Chicago stop.

Seaboard is providing 101 seat economy configuration aircraft, but seats sold will be held at 93 to 95 as a measure to obtain non-stop service. The three Seaboard airplanes are painted white on top with a green stripe and a shamrock marking on the tail. Irish Air Lines has agreed to accept unmarked aircraft to maintain daily service.

Seaboard will do the major overhaul at its New York International Airport base. It also has shops at Shannon. Aer Lingus will do turnaround checks at Dublin, billing Seaboard for the work. One-plane service beyond Dublin by the Constellations is under discussion.

Seaboard is considering re-engining of the Constellations with Allison 501 (T56) turboprop engines. This would cut an hour from the transatlantic flight time and add 1,000 lb. payload.

The inaugural flight got an unanticipated amount of publicity when a group of reporters, travel agents and guests, including Mayor Robert Wagner of New York, had to make an unscheduled landing at Gander on the way to Ireland.

No. 1 engine showed an abrupt drop in BMEP when the airplane was cruising at 13,000 ft. three hours out of New York. The engine analyzer confirmed complete loss of ignition in one cylinder and that the situation was spreading to other cylinders, indicating broken metal was being carried from the initial failure to other cylinders.

The engine was feathered and course changed to land at Gander. Just before landfall, 1,500 gal. of fuel-9,000 lb.was dumped to bring the airplane down to its 113,000 lb. maximum gross weight. GCA approach and landing were normal, but No. 3 engine torched as the propellers were reversed after touchdown, further unsettling some pas-

Ground inspection showed a nut on the Curtiss-Wright 3350-DA3 Turbo-Compound engine (AW April 27, p. 38) had backed off on the rocker arm on No. 15 cylinder. The loosened push rod then began to hammer rather than push the valve, the stem soon broke, and the valve was swallowed.

The aircraft was flown back to New York on three engines and Seaboard's overhaul base at New York International Airport changed the No. 1 engine. Then the aircraft was flown back to Gander to pick up the guests bringing a total delay to about 20 hr.

# Details of Probe Into Collision of United DC-7, F-100 Reported

Washington-First detailed findings in the investigation of the mid-air collision between a United Air Lines DC-7 and an Air Force F-100F on April 21 were disclosed last week in testimony before a House Appropriations Subcommittee.

Emphasizing that the Civil Aeronautics Board's investigation of the accident is still under way and uncompleted, Oscar Bakke, director of the board's Bureau of Safety, brought out these facts before the subcommittee which is looking into the joint use of airways by civil and military groups:

• Prior to impact, the F-100F was declining at a bank of about 80 deg. It has not been determined whether this was a right or left bank.

 Flight path of the F-100F was across the nose of the DC-7. Right wing of the F-100F passed through the right wing of the DC-7. Wing of the DC-7 was sheared off at a point beginning approximately 10 ft. from the right wing tip and extending rearward at a 45 deg. angle to a point 5 ft. from the wing tip at the trailing edge.

 Portion of wing approximately 8 ft. in length was cut off the F-100F. Wing pieces of both aircraft fell free. the moment of impact. Point of collision has been set at a point approximately five or six miles southwest of the Las Vegas Omnirange station.

# 'May Day' Call

According to Bakke, communications were received from the United DC-7 after impact. He said, ". . . the United aircraft stated, the sense of his comment was, 'midair collision over Las Vegas. May Day."

Bakke told the subcommittee that it has not been determined whether communications from the F-100F were received after the collision or prior to the

He said the message received from the Air Force plane began with "May Day" but added that there was some doubt as to whether the words that followed were "Flameout" or "bail out."

In his testimony, Bakke said that the United plane reported over Daggett at 8:11 a.m. at 21,000 ft. toward Las Vegas, estimating over the Las Vegas omnirange at 8:31 a.m.

At approximately 8:31, the F-100F with an instructor pilot and a student pilot in the rear seat concluded training maneuvers to begin a jet penetration Boston will be added as a stop later this year, giving added insurance to computed at about 3.6 min. from to return to Nellis AFB, Bakke said. He



# Flying Tiger Asks Passenger Route

Flying Tiger Line last week applied for a new passenger, property and mail route between Miami and the coterminals San Francisco and Oakland. The all-cargo carrier asked Civil Aeronautics Board to consolidate its application into its new transcontinental route

The airline said such a route across the southern part of the U.S. would help provide the same transcontinental service now enjoyed between the Eastern Seaboard and the West Coast. Flying Tiger wants to provide intermediate stops at Orlando, Jacksonville and Tampa, New Orleans, Houston, San Antonio and El Paso, and San Diego and Los Angeles.

The request is FTL's first for a domestic passenger service.

Flying Tiger last week also announced purchase of an additional Super H Constellation at a cost of \$2.3 million to replace two DC-6As previously sold to U. S. Overseas Airlines.

explained that procedures called for a "teardrop" penetration which uses as its basic navigation aid a commercial broadcasting station, KRAM, located in the city of Las Vegas.

Bakke said the F-100F pilot contacted a VFR control unit at Nellis for clearance of the jet penetration. He said the descent was presumed to have been started in accordance with procedures on a heading of 170 deg. which would have brought the aircraft "somewhere between 30 and 45 seconds off the airway."

According to Bakke, broadcasting station KRAM is located within the limits of the airway.

He added that the descent was to have continued to 14,000 ft. where a gradual turn was to begin to bring the aircraft on a course toward KRAM.

During the descent, Bakke said, the F-100F and the DC-7 collided.

### Flameout?

Bakke explained that if there had been a flameout of the F-100F, "it would be reasonable to assume that the pilot of the F-100F would make a rather substantial bank in turning back toward Nellis in order to execute an emergency landing."

He added that in such a case, the pilot might have left the jet penetration procedure by making a steep right turn and "being preoccupied with the normal procedures for an aerial descent, have collided with the DC-7.'

He re-emphasized that he did not wish "to suggest any causative factor."

He continued that "were we to as-

the jet penetration procedure . . . and with the DC-7. suddenly the DC-7 became visible to turned sharply to the left to avoid collision and upon reaching an angle somewhere beyond 90 deg., then collided

Bakke said the F-100F was following the instructor pilot," he may have normal procedure in accepting descent clearance from the Nellis AFB control unit without a clearance from the air traffic control agency of the CAA.

# Airlines List Salaries, Bonuses, Stock Holdings of Top Executives

Washington-Following is a list of airline officers' salaries, bonuses and indirect compensations, expenses and stock holdings compiled from airline reports to the Civil Aeronautics Board.

### **Domestic Trunk Carriers**

AMERICAN AIRLINES INC .-- C. R. Smith, president and director, \$81,278 salary and 35,000 shares of common stock; W. J. Hogan, senior vice president-finance, \$66,278 salary and 2,500 shares of common stock; C. W. Jacob, senior vice president and secretary, \$63,139 salary, 20 preferred shares and 5,000 shares of common stock; O. M. Mosier, senior vice president-operations and director, \$66,278 salary and 400 shares of common stock; C. R. Speers, senior vice president-sales, \$53,139 salary and 3,200 shares of common stock; T. L. Boyd, vice president-flight, \$30,000 salary and 1,600 shares of common stock; G. J. Brandewiede, vice president-purchasing and stores, \$32,500 salary and 2,200 shares of common stock; S. C. Dunlap, vice president-cargo, \$23,139 salary and no stock : L. E. Glasgow, vice president and controller, \$35,000 salary and 606 shares of common stock; W. H. Johnson Jr., vice president-passenger sales, \$35,569 salary and 1,660 shares of common stock; P. W. Kayser, vice president-personnel, \$38,139 salary and no stock; W. Littlewood, vice president-equipment research, \$34,069 salary and 6,000 shares of common

W. Player, vice president, (joined American in September) \$11,667 salary and no stock; G. M. Sadler, vice president-customer service, \$17,502 salary and no stock; N. L. Smith, vice president-economics, \$30,000 salary and 10 shares of common stock; R. W. D. Smith, vice president-public relations, \$35,000 salary and 300 shares of common stock; S. Spink, vice president-merchandising, \$26,250 salary and 100 shares of common stock; E. C. Taylor, vice president-maintenance and engineering, \$27,905 salary and 100 shares of common stock G. C. Van Nostrand, vice president-properties and community affairs, \$38,139 salary and 250 shares of common stock; M. Whitlock, vice president-operations planning, \$27,500 salary and 500 shares of common stock; P. G. Larie, treasurer, \$23,442 salary and 2,000 shares of common stock; M. G. Beard, assistant vice president-equipment research, \$23,875 salary and 3,000 shares of common stock; J. V. Dooley, assistant vice president-operations, \$18,883 salary and no stock; R. A. Goebel, vice president-purchasing and stores, \$22,500 salary and no stock; W. B. Hickman, assistant vice president-economic research, \$21,587 salary and no stock; T. F. Holden, assistant vice president-properties and facilities, \$17,442.

J. D. Hungerford, assistant vice president-schedules and tariffs, \$20,000 salary and 600 shares of stock; W. C. Lawrence, assistant vice president-engineering, \$25,-000 salary and 680 shares of common stock; P. F. O'Donoghue, assistant vice presidentoverhaul, \$25,000 salary and no stock; M. L. Rinehart, assistant vice president and assistant treasurer, \$27,942 salary and 100 shares of common stock; M. W. Shipley, assistant vice president, \$21,256 salary and 400 shares of common stock; A. E. Smick, assistant vice president-aircraft mainte-

vice president, \$15,429 salary and no stock; W. G. Whitney, assistant vice presidentplanning, \$23,442 salary and 10 shares of common stock; F. C. Wiser, assistant vice president-operations, \$13,487 salary and no stock; V. J. Long, assistant controller and assistant secretary, \$22,000 salary and 200 shares of common stock; W. J. Corbett, assistant treasurer and assistant secretary, \$17,492 salary and no stock; A. A. Paradis. assistant secretary, \$15,492 salary and 112 shares of common stock; A. R. Bone, regional vice president-Western, \$30,639 salary and 2,700 shares of common stock : W. N. Bump, regional vice president-Eastern, \$31,569 salary and 1,000 shares of common stock; R. C. Fitzpatrick, regional vice president-Southern, \$20,825 salary and no stock; S. G. King, regional vice president-Central, \$26,569 salary and 2,000 shares of common stock; H. J. Lyall, regional vice president-New England, \$20,-000 salary and 600 shares of common

The following persons did not receive a salary: H. T. Ames, director, 3,000 shares of common stock; J. W. Aston, director, 300 director, 2,000 shares of common stock: J. Burce, director, 1,100 shares of common stock; W. W. Candy Jr., director, 200 shares of common stock : A. G. Carter Jr., director. 9,400 shares of common stock; C. S. Cheston, director, 400 shares of common stock; T. J. Conroy, director, 200 shares of common stock; R. S. Euler, director, no stock; J. W. Farley, director, no stock; C. T. Fisher Jr., director, 1,000 shares of stock: M. Fleishmann, director, 100 shares of stock; E. H. Herzog, director, 600 shares of common stock; J. A. Jackson, director, 500 shares of stock; R. W. Miller, director, 1,000 shares of common stock; E. M. Queeny, director, 15,000 shares of common

Alvord & Alvord, legal services, \$20,881; Antell, Wright & Kiernan, management consultants, \$7,621; Brond & Nelson, architects, \$48,904; R. E. Buck, legal services, \$9,017; E. S. Chambers, architect, \$7,560; Covington & Burlington, legal services, \$311,657; C. Cramer, M.D., medical services, \$5,460 Dickie Raymond, sales planning, \$7,500; Debevoise, Plimpton & McLean, legal services, \$137,462; W. C. Gilman & Co., economic consultants, \$19,069. Gardner, Carton & Douglas, legal serv-

ices, \$9,391; Gibson, Savage & Benefield, legal services, \$6,483; Hedrick & Stanley architects, \$7,014; Jaros, Baum & Bolles, consulting engineers, \$8,898; Kahn & Jacobs, architects, \$47,378; Lovelace Foundation, medical research, \$11,683; McDonald, Kuhn & McDonald, legal services, \$12,080: McKinsey & Co., management consultants \$109,142; J. P. Morgan & Co., investment bankers, \$13,733; Morrison, Lloyd & Griggs. legal services, \$12,779; J. C. O'Donnell construction engineer, \$16,278; Opinion Research, marketing research, \$198,214; Overton, Lyman & Prince, legal services, \$7,492; Poetzinger, Dechert & Kielty, sales planning, \$28,840; Real Estate Research, marketing research, \$14,137; Wallace, Clark & Co., management consultants, \$16,491; White & Weld, investment brokers, \$12,000; Wilkie, Owen, Farr, Gallagher & Walton, legal services, \$10,108; Arthur Young & Co., public accountants, \$43,508; American Red Cross, contribution, \$20,150; Flight Safety Foundation, contribution, \$15,000: Greater New York Fund, contribution, \$12,sume that the F-100F were in fact in common stock; C. H. Startup, assistant \$6,000.



Los Angeles 45, Cattfornia - Thochta, misona

Systems, Packages and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

46

# SHORTLINES

► Alaska Airlines has placed its first-Douglas DC-6A—which the airline bought, converted and is calling a DC-6C—in service on the Portland-Scattle-Fairbanks route.

The aircraft will make round trips from Fairbanks to Anchorage before returning to Seattle.

- ▶ Canadian Pacific Airlines is scheduled to begin Bristol Britannia 314 service from Vancouver to Amsterdam on June 1. The recently delivered Britannia made the England-Vancouver flight in 16 hr., 35 min., with a fuel stop at Calgary, Alberta. Canadian Pacific has been authorized by the Canadian Air Transport Board to make a stop in the Azores for passengers and cargo on its scheduled flights from Montreal to Lisbon and Madrid.
- ▶ De Havilland Aircraft Co. Ltd. tested the first production model of the Comet IV last week on a flight around London. The company is scheduled to begin delivery of the Comet IV to British Overseas Airways Corp. in September.
- ► Hawaiian Airlines has completed the sale of \$1 million in debentures in the last phase of a financing program to cover the purchase of six new transport aircraft.
- ▶ Pan American World Airways has filed with the Civil Aeronautics Board for a one-way fare of \$45 between New York and Puerto Rico. If approved, the new fare would go into effect on May 22.
- ► Southern Airways reports a first quarter revenue passenger figure of 50,000, a 4% increase over the same period last year. Revenue passenger miles flown was up 8½% over last year at 9,050,000 mi.
- ➤ Trans-Canada Airlines is scheduled to begin its Toronto-Montreal-Zurich service on May 17. In turn, Swissair is scheduled to start Zurich-to-Montreal flights the next day.
- ▶ United Air Lines reports first quarter 1958 revenues of \$66,143,912, a 10% increase over the same period last year. Operating expenses were \$66,722,376, making a loss of \$599,964. However, \$215,371 gained from the sale of surplus aircraft held the overall loss to \$384,593. Total revenue passenger miles for the period were 1,754,950,000, a 6% increase over the first quarter of 1957.

# AIRLINE OBSERVER

- ▶ Watch for a new route for Japan Air Lines from Tokyo to Los Angeles in addition to its present Tokyo-San Francisco route to emerge as the chief outcome of present talks in Tokyo on amendments to the U.S.-Japan bilateral agreement. In exchange for the route, restrictions on the frequency of flight schedules of U.S. carriers into Tokyo probably will be eased. Present thinking leans toward an unrestricted number of flights without prior Japanese government approval, which is now required, with a provison that schedule frequency must be cut back after a period of time if traffic does not justify the schedules.
- ► Northeast Airlines is transferring two Douglas DC-6Bs from its New York-Miami run to New England routes to handle summer traffic in the northern sector of the airline's system.
- ▶ Russian delivery of additional twin-engine II-14s and single-engine An-2s will enable the Bulgarian airline TABSO to increase traffic "substantially" in 1958, according to K. Kirilov, Bulgaria's civil aviation chief. Kirilov said the carrier surpassed its passenger and cargo goals in 1957 and reduced ton-kilometer costs by over 12%. Rumanian airline TAROM reports an 18.5% increase in passengers carried last year and hopes to expand its international routes in 1958 through negotiations with Greece and Egypt.
- ► American Airlines' target date for the first scheduled jet transcontinental nonstop service is Nov. 1.
- New York Airways has made an agreement with Vertol covering the trade-in of the carrier's fleet of Sikorsky S-55s and S-58s for five Vertol tandem-rotor 44-Bs. New York Airways says trade-in of present fleet and related spares will bring between \$1.1 million and \$1.2 million, "representing recovery of the net book value" of the aircraft.
- ▶ Pan American World Airways is renewing its drive for a re-opening of the Transpacific Route Case. Latest efforts by the carrier for reconsideration brought the case back into the White House but there it has been stalled, at least temporarily, by lack of Presidential action.
- ▶ Civil Aeronautics Board has denied a request by California Air Charter, a supplemental air carrier, to conduct unlimited flights over strikebound Western Air Lines' route between Salt Lake City and Los Angeles for the duration of the strike. The Board found that alternative means of transportation are available to passengers who would otherwise use Western's services and that California Air Charter failed to back its petition by showing that a critical or emergency transportation situation exists.
- ▶ Air Transport Assn. has petitioned the Civil Aeronautics Board for authority to hold a meeting to discuss passenger fare discounts. Participating carriers would include only those involved in the particular discount under discussion such as family plan, student fares, children fares and open jaw rates. ATA is seeking uniform standards in discount plans to eliminate inconvenience to passengers, complicated ticketing procedures and unnecessary costs.
- ► Chicago Helicopter Airways has received authority to expand its scheduled passenger service to include Winnetka, Ill., and Gary, Ind. Present passenger service is confined to the triangle route between O'Hare Field, Midway Airport and the Chicago Loop.
- ▶ Civil Aeronautics Administration's accelerated drive toward positive control of air traffic as a key step in the reduction of the mid-air collision threat is still being retarded by lack of long-range radar facilities (AW April 28, p. 40). Last year, House Appropriations Committee sliced radar appropriations for fiscal year 1958 from a requested \$30 million for 20 radars to \$15 million for 10 radars with instructions to make better use of military radar facilities. Military services have been cooperative in establishing joint-civil use of radar but the procedure is not always satisfactory for civil purposes.



### Low operating costs

On short-sector, high-frequency flights the new Local Service Viscount will provide the lowest operating costs of any postwar aircraft in this category. Design refinements make possible exceptionally low break-even load factors on local service operations. Vickers engineers will gladly make a complete cost analysis of your routes.

## Proved popularity . . . big capacity

Since its introduction to American service in 1955, the Viscount has firmly established itself as the most *preferred* of all modern airliners. Because of its famed smoothness, silence and speed, the jet-prop Viscount has boosted load

factors an average of 35% for 27 airlines worldwide. The new Local Service Viscount will comfortably accommodate from 54 to 65 passengers. In either configuration there is ample space for passenger baggage and mail.

# Dependable, economical Rolls-Royce power

The Local Service Viscount is powered by four performanceproved Rolls-Royce Dart 506 jet-props. These engines have demonstrated their outstanding ruggedness and reliability under operating conditions similar to those of local service operations. The Dart 506 engines are unsurpassed for economy, ease of maintenance and hours between overhauls. (TCA reports approval for 1800 hours—with current test engines being run to 2000 hours.) They give the Viscount exceptional take-off and climb performance and a cruising speed of 300 mph at 10,000 feet.

FROM THE WORLD LEADER IN JET-

# Fast intermediate servicing and terminal turn-around

The Local Service Viscount can be operated on routes of up to five 100-mile sectors—without refueling and with a minimum of ground handling. Provisions are made for fast under-wing pressure refueling at terminal points (overwing fueling points are also provided).

Less ground equipment is needed and valuable time is saved by the Viscount's integral, hydraulically operated stairs. Further savings are assured as the engines rarely

require water-methanol at intermediate stops.

The #4 engine can be kept running during intermediate stop-overs—thus assuring ample power for restarting the engines. If longer stop-overs are required, internal restarting is still possible because of increased battery capacity. Brakes on number 1, 2 and 3 engines prevent windmilling of props, permit safe, quick on-and-off loading of passengers on the left side, freight on the right.

# Local Service Viscount means Jet Age growth for you and the communities you service!

By cutting flying time almost in half—and by introducing Jet Age service comparable to the best offered by the "trunk" lines—the Viscount will open doors to important new business traffic that means accelerated growth. This growth will benefit not only local carriers, but the areas they serve—areas that deserve the opportunities that come with the best and most modern airline service.

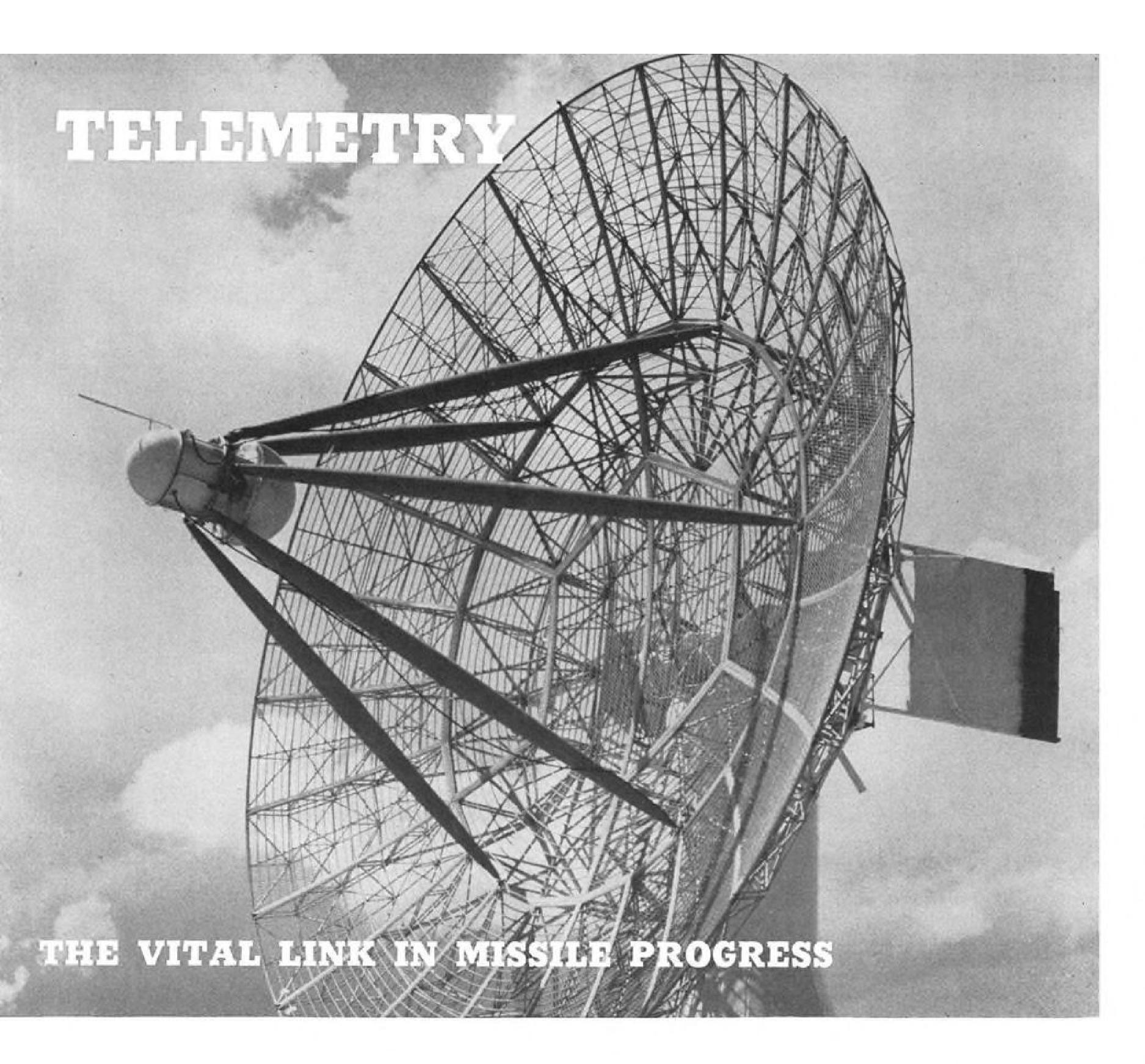
Because the Local Service Viscount is tailored for highly economical operations—and because its payload capacity is sufficient to absorb future growth—it is the ideal airliner for local service carriers today and tomorrow!

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Missiles are test fired for only one purpose: to obtain data that will help build better missiles. If the test does not yield this information it must be considered unsuccessful - regardless of how well the "bird" performed.

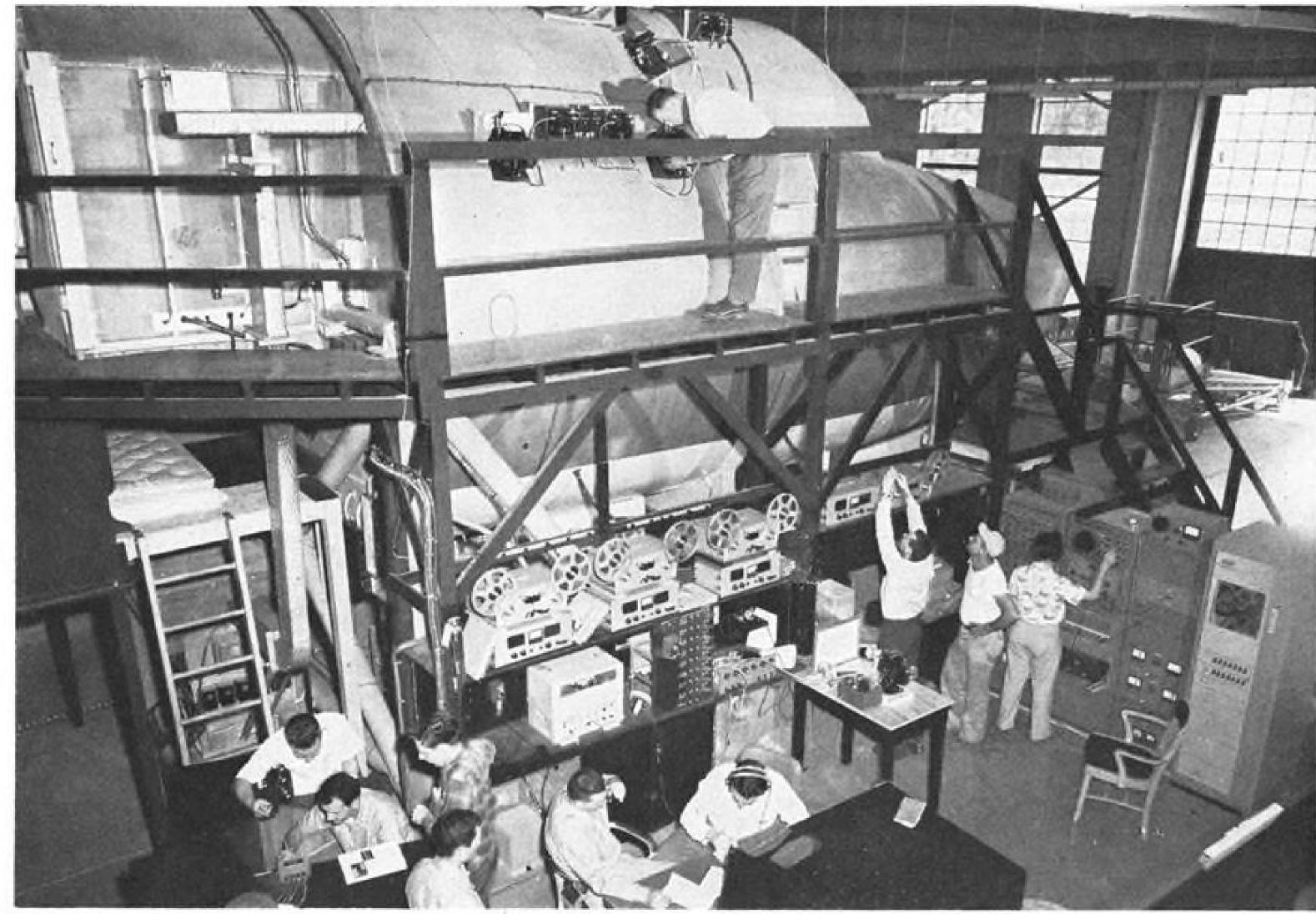
Telemetry, consequently, assumes a vital role in the development of the missiles so necessary to our defense program. There is no other way to collect and preserve the all-important data from unmanned and unrecoverable test vehicles.

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# SPACE TECHNOLOGY



FIVE subjects occupied space cabin simulator at Wright Air Development Center for 120 hr. during a space flight experiment.

# **USAF Simulates Space Crew Conditions**

By Evert Clark

Dayton-Project Longshot-a series of simulated space missions flown by five men sealed in a capsule—is convincing researchers that human factors will play an increasingly dominant role in the design of future USAF weapon

Weight, a prime consideration in designing systems for atmospheric flight, will be even more important in space vehicles. Man must not only take his environment with him into space, he must get it there against the con-siderable resistance of the atmosphere.

Reliability, less critical in atmospheric systems because escape is possible, will become far more critical in space flight.

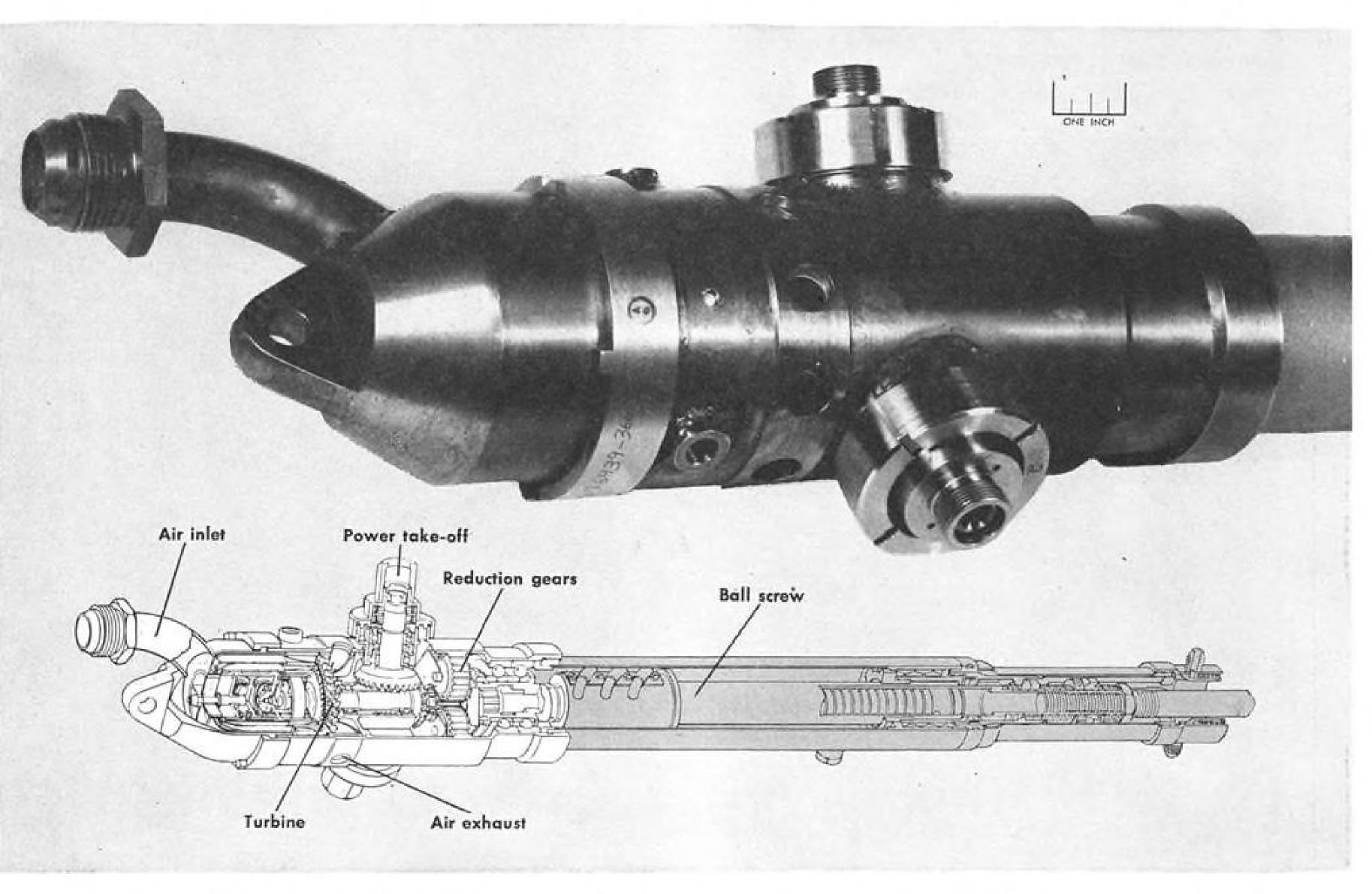
Range, still measured in distances for flight within the atmosphere and even for transitional vehicles such as intercontinental ballistic missiles, is being measured more and more in a new dimension by the planners of space flight -that of time.

Because time is becoming so vital a



PHOTOGRAPHIC equipment monitors volunteers in WADC space cabin simulator. part of the weapon system design equa- Equipment is used to record volunteers' physiological, psychological and psychiatric behavior.

# TURBO-ACTUATOR



# NO EXTERNAL COOLING REQUIRED in ambients up to 600 F. New 15-lb unit produces 75 hp for linear or rotary actuation.

The high Mach performance of modern aircraft demands a totally new concept in the methods and mechanics of hightemperature actuation. General Electric's new position servo-called a turboactuator-is designed to meet this demand. Here's why the turbo-actuator promises a new standard in engine and airframe "muscles":

REQUIRES NO COOLING. Unlike conventional actuation systems, the turboactuator makes no demands on already heavily taxed heat sinks. It can presently operate in 600 F ambients without external cooling, and since its working medium is air, the turbo-actuator is temperature-limited only by the bearing lubricants required. General Electric developments have already extended the potential of liquid lubricants to 800 F and solid lubricants to 1000 F.

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response of the turbo-actuator is flat to approximately 10 radians per second. With a 45° phase shift, it will provide response of 30 radians per second.

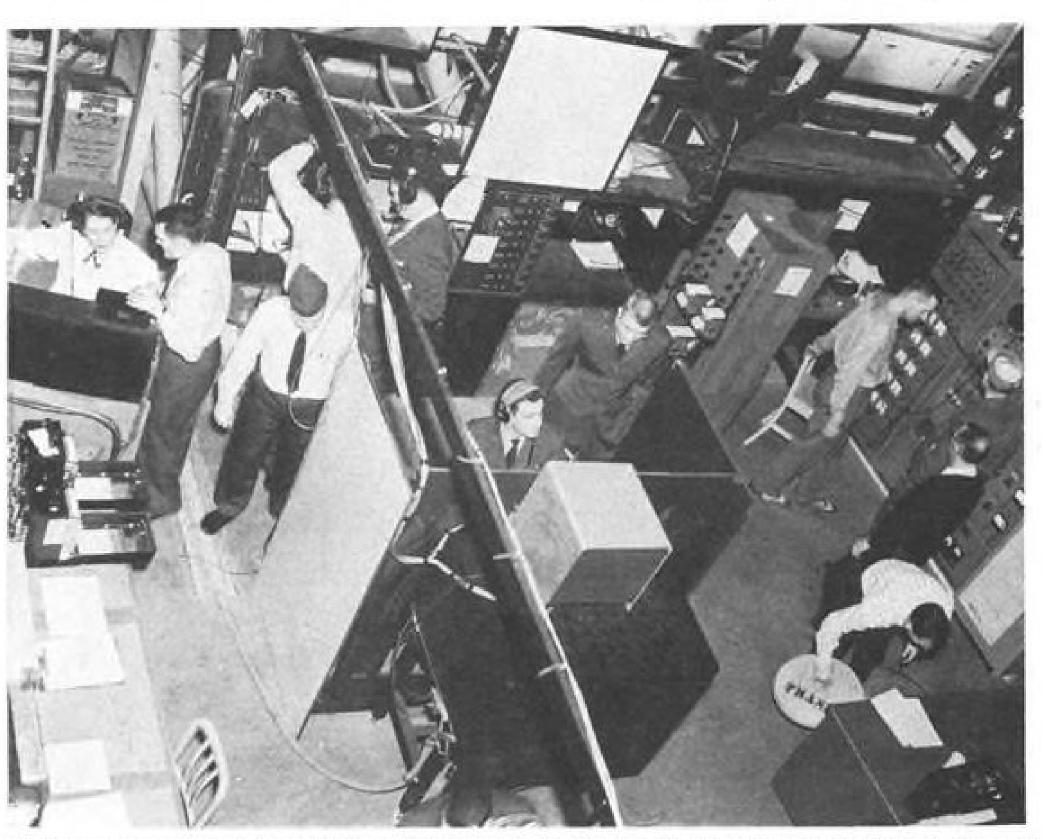
Whatever your actuation requirements -from engine inlet guide vanes to thrust reversal devices . . . from wing flaps to landing gear-it will pay you to investigate the possible application of General Electric's new turbo-actuator concept.

If you'd like more information on turbo-actuator development, just fill out and mail the attached coupon . . . or contact your local General Electric Apparatus Sales Office.

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SUBJECT standing in WADC five-man space cabin simulator is preparing a meal at food bar. Man behind him is in rest area. Others are on duty in specially designed capsules.



TEST personnel operate psycho-motor test machines, recorders, communications equipment and closed-circuit TV viewers during simulated space flight which took five days, five nights.

tion, man and his reaction to long periods of confinement, separation and uncertainty must be explored-and allowed for-to a degree never before attempted.

"The compromise with human factors will be greater and greater," a psychiatrist at Wright Air Development Center's Aero Medical Laboratory said recently. "There is no need to have a machine if everybody in it goes

Nothing that aeromedical researchers have learned so far indicates that

contrary, man has held up well in his laboratory-bound excursions beyond

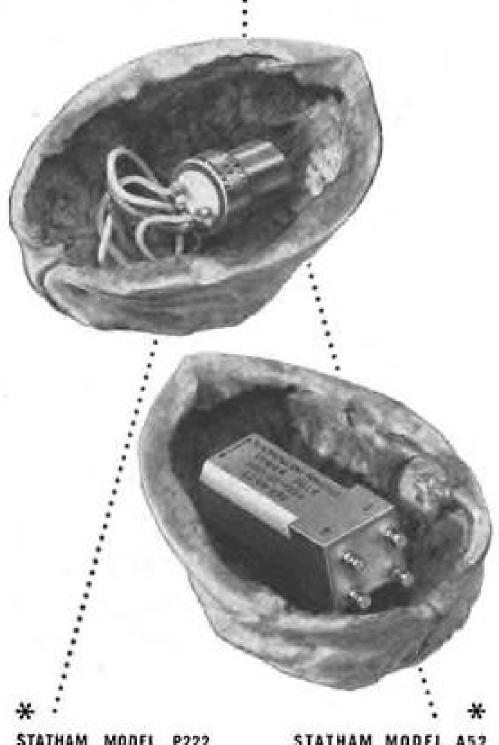
But nothing in human experience duplicates the combinations of stresses that man will undergo in lunar and interplanetary exploration.

Long prison terms, extended submarine runs, wartime air and sea patrols, exposure in open rafts or in junglesall prove that man is a durable animal, able to withstand great stresses and

In none of these situations, however, man cannot take space flight, even over has man been studied as microscopiextremely long periods of time. On the cally as he should before he is commit-



miniaturization in:a nutshell



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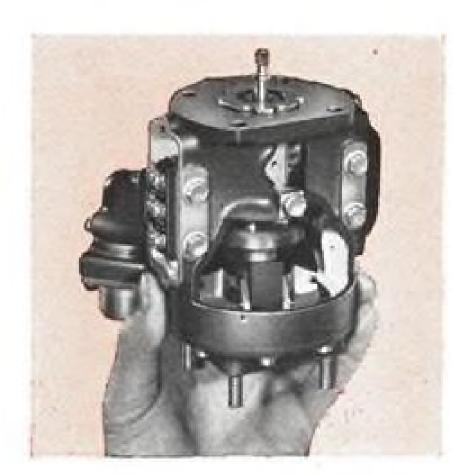
\*Model shown actual size. omplete data are available upon request

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ted to the risks that will be involved in space travel. None answers the basic question of space survival, much less the question of efficient operation of a complex machine.

To get the necessary answers, USAF researchers must attempt to simulate as many space flight conditions as possible. Weightlessness, acceleration, deceleration, exposure to cosmic rays, heat, cold and isolation, buffeting and vibration at re-entry, and other aspects of orbital and long-range space flight have been explored in some degree here and at other Air Research and Development Command Centers-but combining all these conditions still is impos-

Project Longshot aims at studying in great detail some of the most critical and least known factors-the physiological, psychological, psychiatric and sociological reactions and interactions of five men exposed to long-term confinement.

All missions are flown in a specially designed mockup of a crew compartment used earlier for confinement studies in the WS-125A nuclear bomber program.

## **Outgrowth of Studies**

The current series of experiments is an outgrowth of confinement studies dating back to 1952, when one man sat in the grounded cockpit of an F-84 for

First five-man, five-day mission was flown in May of 1957. Nicknamed "Long Gone," it was a dry run designed primarily to teach the researchers what the problems of conducting the experiment would be. Next run was made last August, with a different crew.

The most recent run, called Starlight 2, took place last March 12 to March 19 with still another crew.

Its 120-hr. duration was only a few hours short of the 157 hr. necessary to circumnavigate the moon on one proposed orbit.

Next mission will be somewhat longer-possibly 15 days, simulating the 360-hr. run along a more profitable moon-reconnaissance orbit.

All experiments are set up as actual missions with specific tasks and specific work cycles assigned to each man. Starlight 2 called for takeoff and landing at Wright-Patterson AFB and seven orbits around the earth, and required the crew to report as they passed over Minitrack stations.

Critical period in the mission was from 100 to 104 hr., when the profile called for the vehicle to change orbits for a photo-reconnaissance run over Tokyo in a maneuver called Artful Dodger.

Only mishap of the five-day flight occurred just at the beginning of this critical period when waste in the elec-

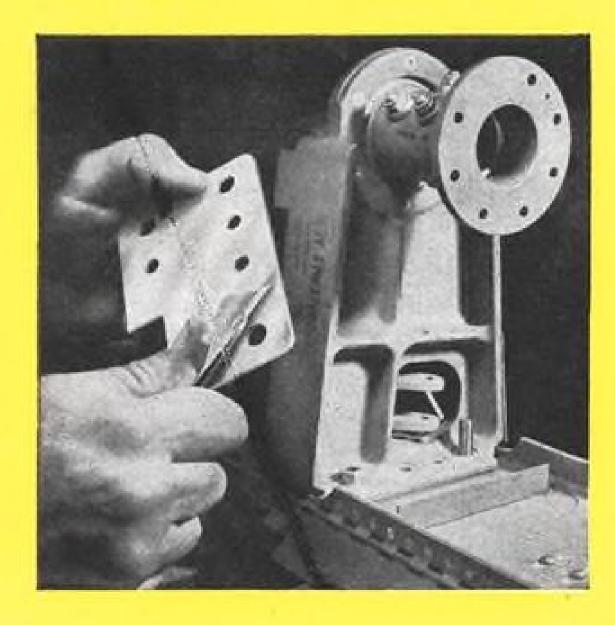
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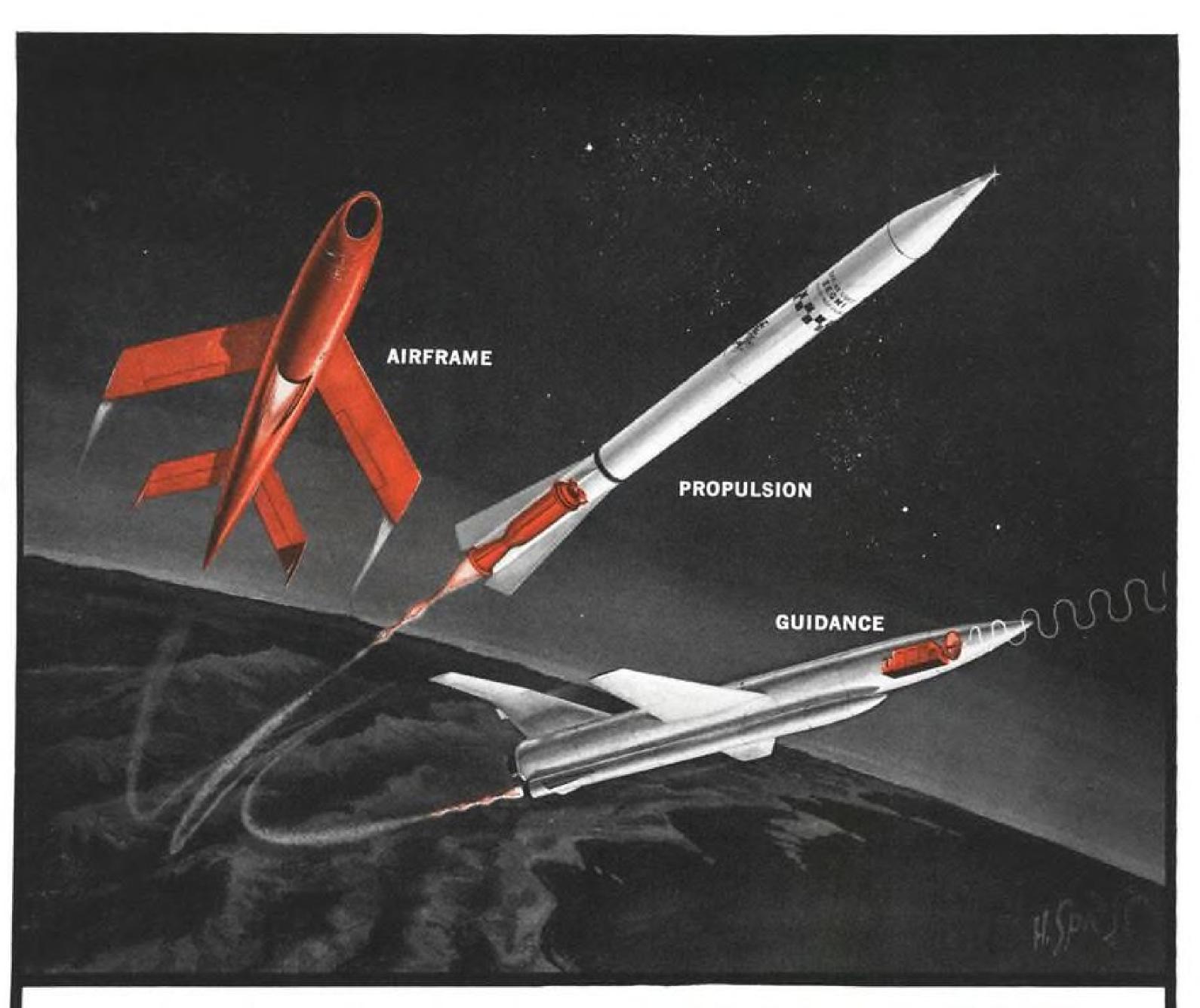
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tric toilet caught fire. Members of the 35-40 man support team outside the compartment quickly substituted a chemical toilet and performance of the mission went uninterrupted, although some crew members reported later that they had smelled smoke.

Even this incident proved valuable. Design of the electric toilet, a type used on the B-36, has been modified to pre-

vent a recurrence.

Compartment incorporates a number of unusual design features. It is 17 by 6½ by 6½ ft. Its 710 cu. ft. are divided into a work area, made up of five crew stations, a food bar and a leisure area containing a pull-out bunk.

Stations consist of integrated instrument panels and individual escape capsules for use if an emergency occurs in the atmosphere. Both compartment and capsules are designed so that no parachute, headgear or pressure suit is necessary, and capsules include 3,200 cu. in. of space for global survival gear.

Capsules are designed for minimum volume and maximum comfort. Polyurethane foam seats have proved so comfortable that some crewmen spend 90% of their 16 hr. on-duty time sitting down. Padded capsule headrests incorporate two fixed, low-output speakers. Crewman's head is at the focal point of the speakers and he selects one of three channels of tape-recorded music to relieve boredom, even while he is on duty. Radio and intercom override the music at all stations.

On the first and second five-day runs, crewmen preferred music from the "stimulus" channel-rock and roll, cha-cha, jazz, etc.-at their equivalent of morning and the "relaxation" channel-opera, show tunes, dinner music -at evening. "Combination" channel got less use. But on the third mission, no preference pattern emerged.

Design of the compartment employs such psychological devices as a shoulder-level concept of keeping all separating sections low to give an impression of roominess; a lower and much softer floor in the recreation area to give the feeling of a step down to leisure; different color schemes in the two main areas to separate "home" from "office"; and deep, 120-hr, ashtrays. Some subjects have suggested that more privacy is needed in the sleeping area.

In line with the philosophy that pleasant circumstances will relieve stress and keep efficiency higher, each man is allowed considerable freedom in his choice of high-energy, low-bulk frozen meals and snacks.

Eating becomes extremely important. Activity logs kept on every movement each man makes from point to point show that considerable time both on

and off duty is spent in the dining area. "They practically live at the food

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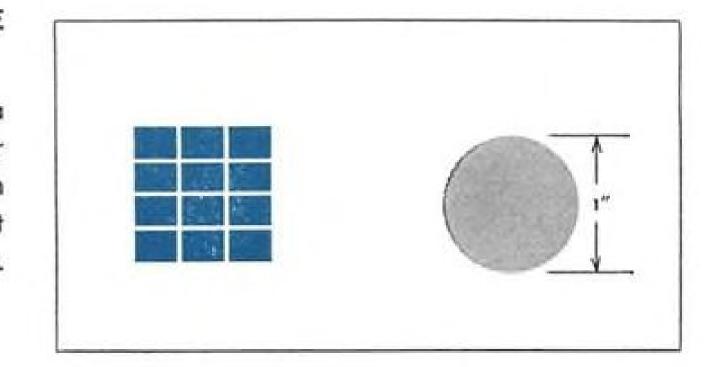
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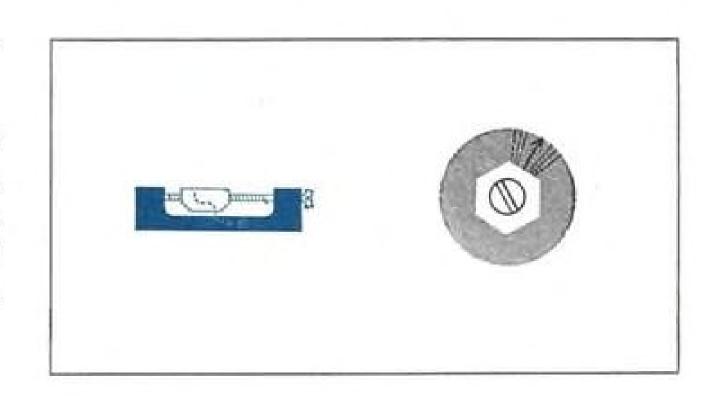
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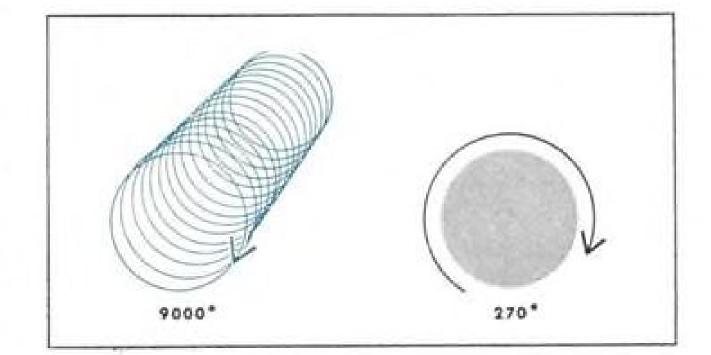
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### CIRCUIT BALANCING ACCURACY

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bar," one of the planners of the experiment said. "It's seat to food bar, recreation area to food bar-it's just food bar, food bar."

Reasons are boredom and the unusual amount of thought that crewmen give to food because they know they must prepare it themselves, observations so far indicate.

On the mission last August, weight gains for the five men ranged from 8 oz. to 8 lb., and researchers began to wonder what might happen on a mission of months or years.

On the most recent run, however, weight gains were insignificant, so some recapitulation was called for.

"We found that the other time we had a food-obsessed leader," one physician explained. "He was a big eater and he talked food and fixed food all the time. It was the power of suggestion. On the next flight, all personnel just snacked."

Researchers recognize that crews will have to be selected carefully because of the effects of each on the others. Preliminary training in mockups and development of techniques to minimize group conflicts may be necessary.

### Day-Night Cycles

Adjustment to new day-night cycles proved to be a problem for some crewmen at first. Although this solved itself on the short flight, there is still considerable question about much longer flights, since man's physiology now is oriented to and regulated by the physical phenomena of the sun-earth relationship.

No two men were on the same daynight cycles. The aircraft commander, copilot and flight engineer worked 16 hr. and rested eight, but their shifts were staggered. The navigator and defense director worked a 12-on, 12-off routine.

There was always a refreshed man coming on duty to serve as a sort of catalyst. Crewmen slept an average of more than 70% while off duty.

Although the subjects are pre-selected in the sense that they were USAF pilots with considerable multiengine time, there has been little special screening for the five-day missions.

There has been, however, extensive testing beforehand to gain a baseline for evaluating biochemical, physiological, psychological, psychiatric and sociological changes. Extensive testing also is done immediately following a mis-

Five days of briefing and three of practice, using an operating manual, precede each mission, partly to create the psychological orientation that the men are a crew. Each man also spent 21 hr. in individual isolation.

During the mission, crewmen were

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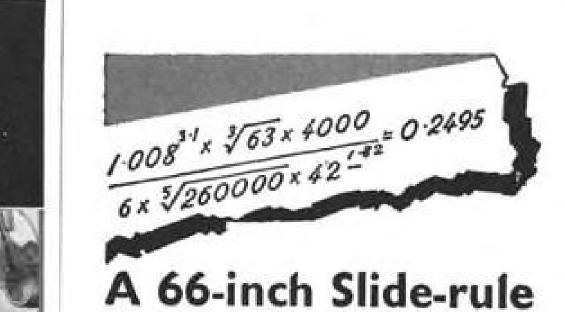


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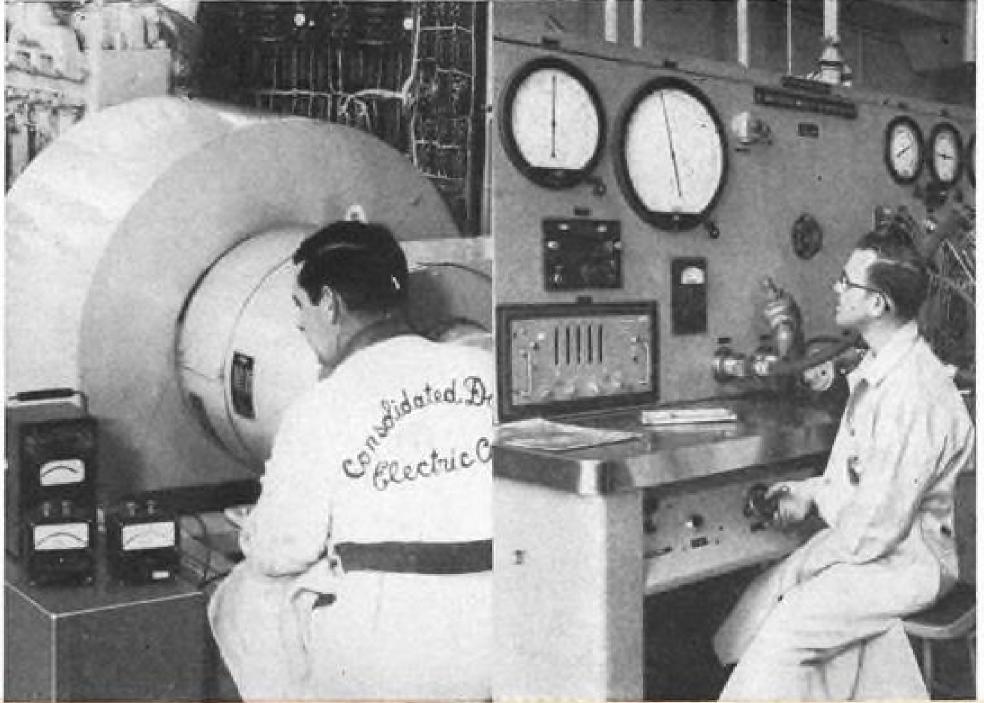
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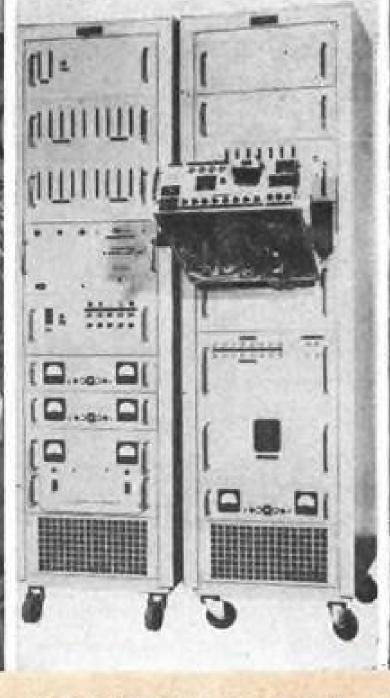
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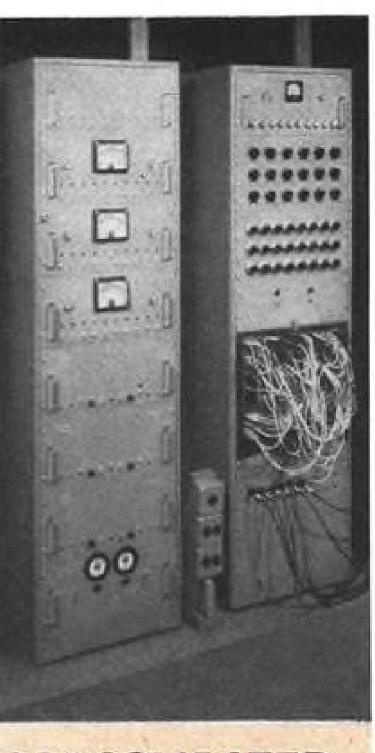












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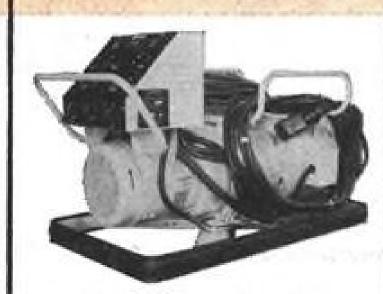
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ILS tracking scores and other measures of performance show excellent results. On the August mission, preflight Link trainer scores for all five men were above average. Post-flight scores indicated B or C performance for four men, but the fifth was scored below average. In last five minutes of flight, the copilot-one of three who had little sleep in the last day and a half-tracked 95% on the glide path

under simulated GCA monitored land-

ing conditions.

For one minute of each hour of flight, electroencephalogram and galvanie skin resistance readings were taken on each man by means of simple, lightweight harnesses which were plugged in at duty stations. Also, each man kept a diary, and to tell researchers more he took psychological tests each day into which he projected feelings he might not reveal otherwise.

Data reduction and correlation is a lengthy process. The Starlight 2 mission was not flown until a good percentage of the information from last August's flight had been studied.

No technical reports on the Longshot flights have been released so far, and researchers are cautious about official conclusions.

Although weightlessness, a true sense of danger and other factors cannot be simulated in these flights, researchers bere feel the Longshot flights are yielding extremely valuable information on the effect of confinement and time on personal responses and group dynamics.

# Curtiss-Wright Gets **AEC Reactor Permit**

Washington-Atomic Energy Commission has announced it proposes to issue a license to Curtiss-Wright Corp. for operation of a pool-type research reactor at Quehanna, Pa. A construction permit was issued in May, 1957.

Reactor is to be used for experimental program covering shielding studies, reactor component and instrument development, investigation of radiation damage, neutron physics and isotope production.

Facility, operating at a power level of 1,000 kw. (heat), is housed in company's Radioactive Materials Laboratory on a 51,000-acre tract near Quehanna. License will be for 20 yr.

In another action, the AEC said it also proposes to issue a permit to General Dynamics Corp., San Diego, Calif., for construction of a research reactor at Torrey Pines Mesa, San Diego.

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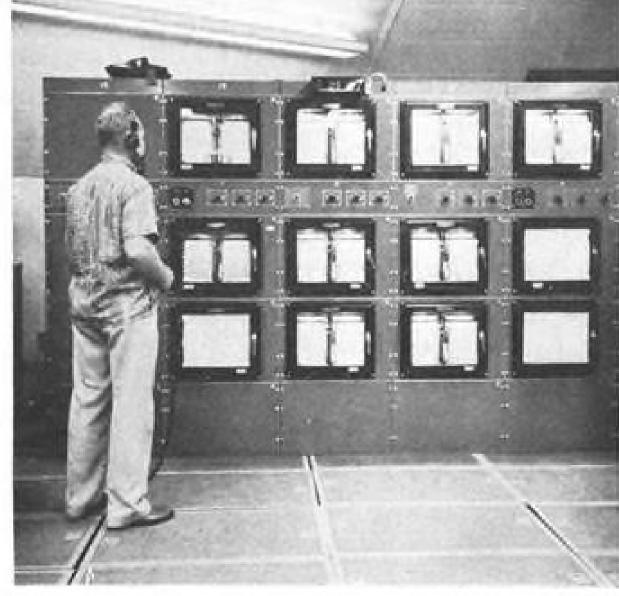




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# MISSILE ENGINEERING







CLOSED-CIRCUIT television screens (left) show various angles of launch pad. At center, technician monitors a bank of pen-trace recorders. Periscope monitor (right) checks sections of missile and associated systems.







LIGHTS on control panel (left) indicate status of a missile system. Tenseness shows (center) as missile engines start. Man in foreground, K. W. Jeremiah, Chief Test Conductor, shows relief (right) at liftoff.

# Missile Countdown is Complex Procedure

By Richard L. Sweeney

San Diego-Missile countdown, often the cause of pronounced emotional reactions during final minutes before launching, is a comprehensive sequential checkout encompassing as much of the missile as possible prior to flight. Procedure has its roots in the very design concepts of weapon systems such as the Atlas ICBM.

Primary goal of countdown is assurance, before expensive and complex missile is committed to flight, that all parts will work, that all desired data will be obtained and that as both a development test vehicle and weapon system the mission will be accomplished.

back almost to preliminary design, since design provisions must be made for accomplishing the countdown checkouts of the missile and its myriad used to prepare the missile and site for of certain facility components such as

64

explosives are installed, propellants are placed aboard-and before it is pared with countdown itself. launched.

In the case of many missiles, instrumentation to gain desired test and development data is an integral part of early configurations of the missile, since these data must be gathered before opcrational design is made final and before all systems are performing at optimum.

## **Ensure Compatibility**

Countdown also is considered in design of ground service equipment, to further the complete ground checkout philosophy and to ensure compatibility Consideration of countdown goes of all elements in the design.

Countdown has a defined length of time for accomplishment of detail functions, while other procedures are

parts before it is "loaded"—i.e., before the flight. These preceding activities are countdown preparation, as com-

> On the day before an actual firing, frequently designated X Minus One Day, checkout is begun of support equipment and facilities used to carry out operations. Items checked include such things as materials and supplies on hand, from film to liquid oxygen to hand towels.

> Simultaneously, requisitions are made for delivery to firing sites of necessary supplies which, by their nature, are last minute items such as propellants, liquid oxygen and helium. Details concerning final delivery times are settled, ensuring that all required deliveries will be made at a specific time and will not delay the event.

Hardware goes through as complete checkout as possible, with actuation

# Cape Canaveral Atlas Countdown—Step by Step

Cape Canaveral-Here are final stages of a typical Atlas developmental test flight countdown:

- At T-minus-35 min. the Atlas launch complex is cleared of all personnel except occupants of the massive domed blockhouse, 750 ft. from the pad. Pumping of liquid oxygen and other final preparations are conducted remotely by engineers and technicians working at consoles within the shelter.
- At T-minus-10 min. the blockhouse counter begins calling off the passage of each minute. At 5 min. before launch all intercom sets are switched to the test conductor's main circuit. If all continues to go well, the countdown enters the final three minutes.
- At T-minus-3 min. test conductor announces, "T-minus-3 minutes and counting." Transfer of missile's a.c. power circuits from ground sources to missile sources is completed, checked, verified. Weight of missile is recorded by instruments in blockhouse. Helium supply pressure is checked. Level of liquid oxygen in missile tank is checked and the flight pressurization sequence is started. Sequence involves 12 tasks, ending with checks of pressure in liquid oxygen and fuel tanks, and actuating "pressurization complete" switch.
- At T-minus-2 min. 30 sec., the liquid nitrogen dump switch is opened and the liquid nitrogen drained from the missile. Draining process is monitored by blockhouse observer through
- At T-minus-2 min., blower system bringing air from outside into blockhouse is turned off as safety measure, blockhouse is sealed. This action reported to launch pad safety officer. Safety command system (missile destruction) switched to internal power, arming device for system checked. Emergency dump valve opened to permit quick dumping of liquid oxygen from missile in event of an emergency.
- At T-minus-1 min. 30 sec., securing of liquid oxygen tanking started. Level is checked and brought to correct flight level. At T-minus-1 min. 25 sec., missile d.c. circuits are switched to internal power sources from external sources. Instrumentation gyro "uncaged" as first step in switching telemetering systems to launch condition. Telemetering systems ready when launch-test switch turned to launch.
- At T-minus-1 sec. 20 sec., test conductor makes these checks. Panel operators respond. "Command on internal (power)-

- Roger." "Telemetry in launch condition-Roger." "Missile on internal d.c.-Roger." "Pressurization complete-Roger."
- At T-minus-60 sec., test conductor announces "T minus 60 seconds and counting." Range safety command devices (engine cutoff and missile destruct explosives) armed.
- At T-minus-50 sec., pad safety officer reports the range is ready for firing.
- At T-minus-45 sec., test conductor makes these checks, panel operators respond. "Range safety armed light on-Roger." "Range ready-Roger." "Water system ready-Roger." "Preparation complete light-Green." "Liquid oxygen tanking secured-Roger."
- •At T-minus-35 sec., engine fire extinguishing system checked, found ready. As the countdown proceeds, the conductor glances periodically at a dozen indicator lights on the prestart panel. One of these glows green at completion of each key function. Until all of the lights are burning, an interlock circuit makes it impossible to start the rocket engines.
- At T-minus-27 sec., test conductor announces "T minus 27 seconds and counting." Test conductor pushes vernier engine start button. This is the last manual operation. From this point through release, all operations are automatic, but will be stopped by control system if failure occurs, also can be stopped manually by test conductor if he sees malfunction or is informed of one. Documentary cameras start.
- At T-minus-20 sec., ground fuel start tank is pressurized.
- At T-minus-15 sec., oscillographs that record information from missile in flight are turned on.
- At T-minus-5 sec., vernier engines start.
- At T-minus-3 sec., flame deflector water valve switch goes to full open. This increases water flow into flame bucket to 35,000 gpm.
- At T-minus-0, main engines start. Test personnel watch recorders closely, launch still can be stopped if malfunction is detected.
- At T-plus-10 sec., automatic launcher release occurs. A periscope observer reports the missile is beginning to lift off the pad. All eyes are on the television screens that show the pad. The missile rises slowly at first, the TV cameras pan upward to follow it. The test conductor breaks the silence first. "She's going," he exclaims, "going . . . going . . . going."

valves in the water system for exhaust deflector cooling, diesel electrical generators and air compressors. This procedure complements periodic maintenance and ascertains that periodic maintenance has been accomplished.

Simultaneously, such things as switches are positioned properly on the many checkout panels, and possibly a few parts of the missile itself are actuated. Perhaps the missile's batteries would be installed at this point.

Pre-countdown, with starts before the countdown itself, follows the "day before" checkout. It covers a specific list of things to do and a definite sequence. Although not a minute-byminute timed affair, it is scheduled to be completed within a certain block of

At pre-countdown, all scheduled deliveries are made and double checked at

be installed on the missile. A checkout is accomplished of such things as power lines and gas transmission lines.

Now the time approaches when the people involved begin to settle down. The fidgeting in seats, the trips to the coffee pot or cigarette machine and concern with extraneous affairs begin to come to a halt. Preliminary nervousness wears off and people settle down to the serious business at hand.

### Stations Manned

Final checkouts are made to see that all supplies and materials are delivered, that all people are at their stations and that communications are in working order. In this effort, problems frequently are found which block start of the main countdown itself.

As the timed countdown starts, an effort again is made to check and operation can begin with assurance that flight will follow.

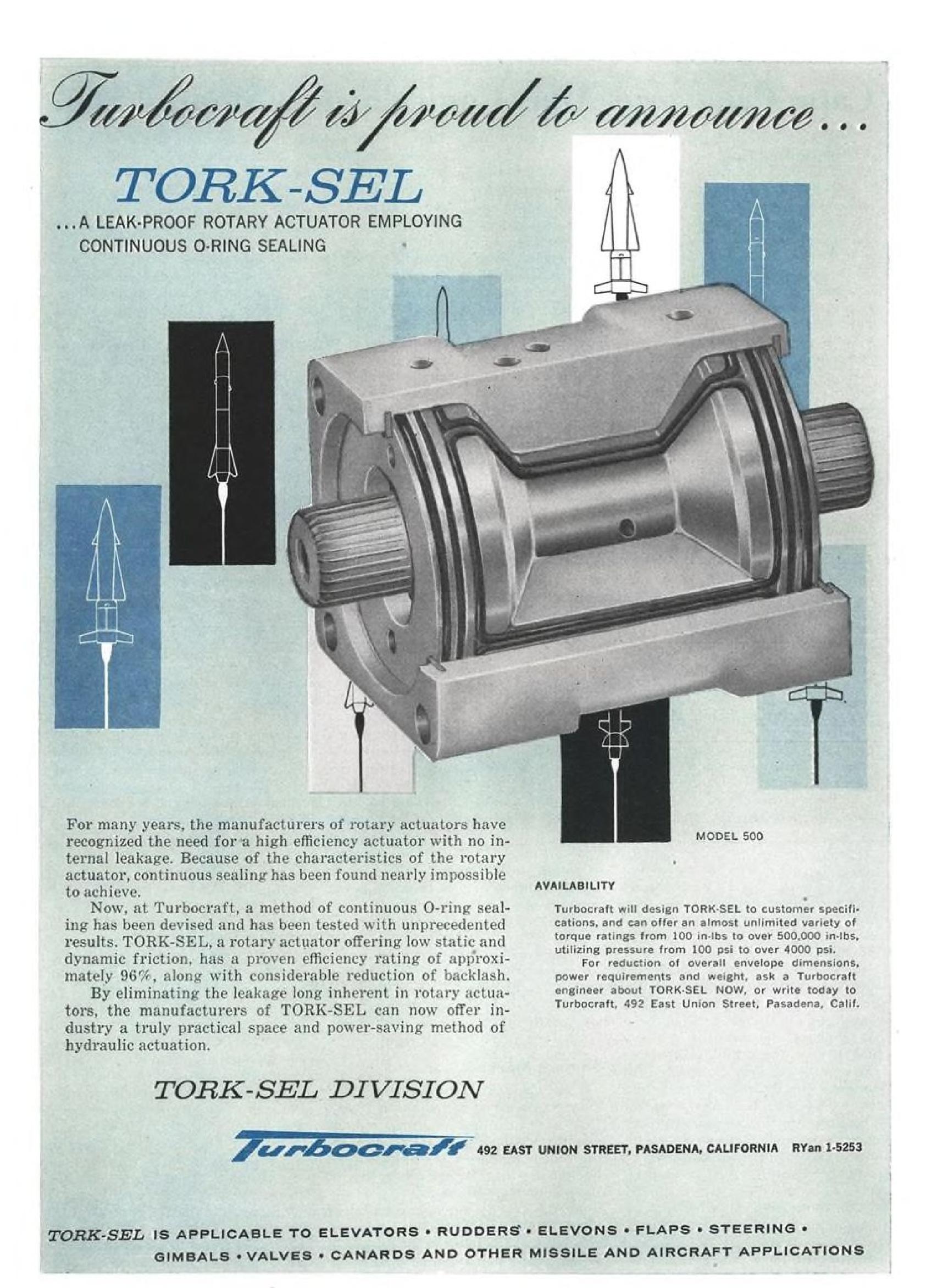
At this stage, the goal is to accomplish all checklist items to the best possible standards, rather than at high speed. Countdown here is tailored to development rather than operational conditions, although operational type countdown is used wherever possible. In any case where a choice is necessary, operational countdown is sacrificed to developmental countdown in order to obtain required data.

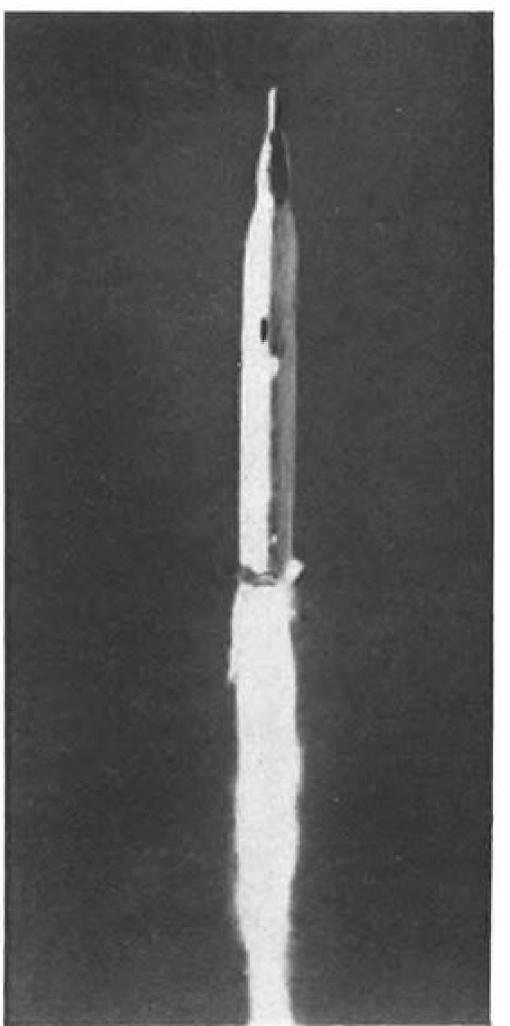
Developmental timed countdown will vary in time span, the shortest running about 4 hr., the longest according to mission requirements. Timing usually will start at Cape Canaveral anywhere from 3 a.m. to 7 a.m., depending on the type test to be run.

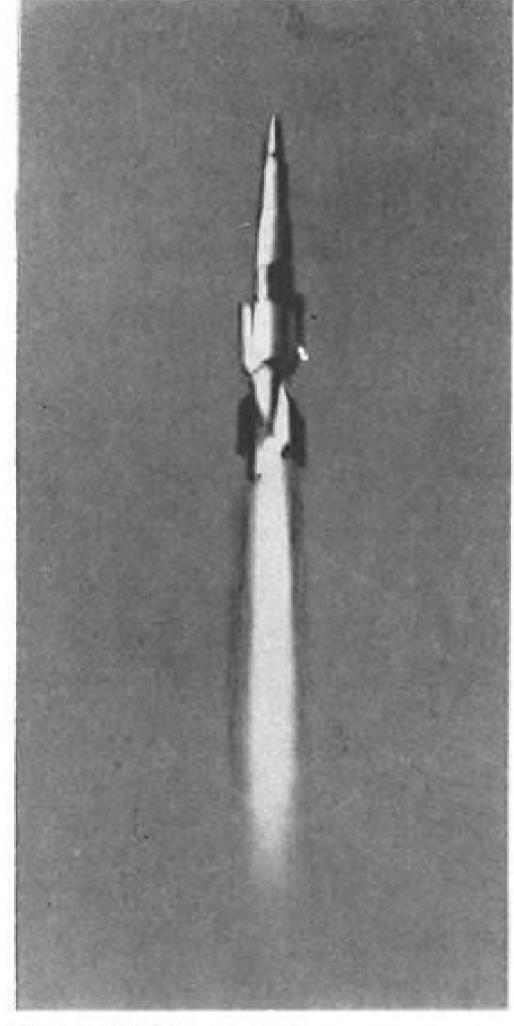
Among the factors which can influence start of a countdown are:

the site for accuracy of quantity and erate all possible parts of the missile to Requirement that particular sun quality, even though they may not yet ensure that the hazardous fueling op- angle exist at missile launch, or at par-

AVIATION WEEK, May 5, 1958







# Soviets Claim Record Launch

Russians claimed a record height of 294 mi. (473 km.) after launching of single-stage rocket shown at left last Feb. 21. Rocket was launched from European section of USSR and carried geophysical scientific instruments, radio-telemetrical devices and food. Engineers said 3,344 lb. rocket followed pre-planned flight. Research equipment was carried in nose. Rocket at right reached 132 mi. (212 km.) and carried equipments on left side.

ticular spot in missile's trajectory.

• Weather conditions over full range which affect photography, optical tracking.

· Weather effects on communications, electromagnetic tracking equipment and systems.

the missile is "loaded," when propellants and explosives (used to destroy missile in case of malfunction or to mark impact), are placed aboard, and the missile becomes "hot" or hazardous.

At this point, access to the missile is removed; that is, the gantries are rolled back, ladders and other access equipment is taken away and all operations become remote. Emergency provisions must be made for "ballpeen" adjustments, since missile stands in hazardous condition.

Although fuel is sometimes loaded with gantry still in place, liquid oxygen is never placed aboard the missile until the area is completely cleared. Safety is a top consideration at all points in missile operations, and Convair has never had a major accident in its operations, back to the days of the research vehicle MX-774.

While there is a set of time variables in loading the missile, when liquid oxygen is placed aboard, the missile is within 1 hr. of launch. After access to the missile is removed, all operations still can be performed remotely from the blockhouse, such as propellant Final phases of countdown start after · loading and tank topping, pressurization and depressurization, and defuel-

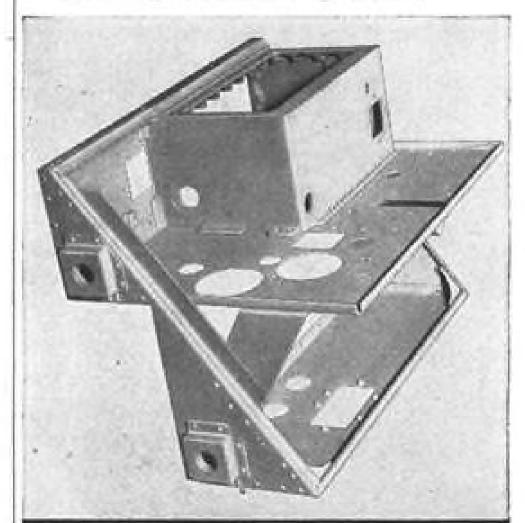
### Tension Mounts

It is here, after the missile is loaded. that the tension mounts.

Systems are turned on now, and left on. Confirmation is obtained from range monitors as to their observations of certain conditions aboard the missile, such as instrumentation working, which range monitors are able to check by radio link. Contractor's Test Conductor (TC), the boss for the contractor crew and blockhouse operations, cannot continue with his countdown until authorization has been obtained and range clearance acknowledged from the proper range personnel.

Monitors can stop a countdown if their indicators do not show a certain piece of essential instrumentation in proper working order; since this is de-

# MAGNESIUM? STAINLESS?





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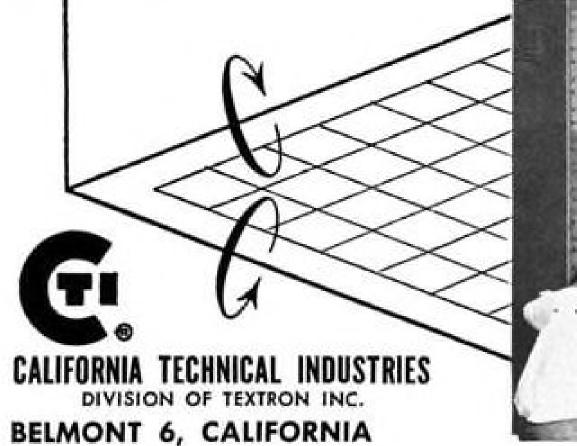
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into a position corresponding to the defined space vector.

By thus reproducing the conditions of an actual high-performance aircraft or missile in flight, the unit expands the capabilities of any laboratory.

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velopmental flight test, the goal is data.

Overall firing chief is the Superintendent of Range Operations (SRO). He monitors the range, while the TC monitors the missile itself. These two merge their activity and efforts to ensure successful data gathering during the flight.

### Firing Team

Two additional key personnel in a firing are the Pad Safety Officer in the blockhouse, who observes progress of the missile toward the launch, and the Range Safety Officer in the Control Center with the SRO, who presses the destruct button if missile wanders off course.

During this part of the timed countdown, either the SRO or TC can adjust (stop and restart) the countdown as problems arise, working with each other. Final clearance to fly the bird is given by the SRO, and must be given before automatic sequence starts.

Automatic sequence period varies from 60 to 30 sec. prior to zero time, performs the last-minute operations automatically, but with manual override from blockhouse control center in case of malfunction.

Zero time is a highly variable point. Its variations can include:

 Time ignition of rocket engines take place.

• Time propulsion system goes into main stage, or full propellant flow and thrust buildup to maximum.

Time of actual launch itself.

Primarily, zero time is a reference point rather than a signal for any particular element in a missile launch to occur. Elements which come into play at launch are the radio frequency links, command, telemetry equipment, the destruct circuits. Developed by Convair, the Azuza system now serves for range tracking, but it has capabilities for becoming a guidance system.

As automatic sequencing of missile events starts, range instrumentation is at its tie-in point and it also enters auto sequencing stage; that is, certain elements are automatically activated, ranging from launch cameras to adjacent radar sets to downrange radar sets. This can be recycled in case of a malfunction or adjustment of the countdown which causes the automatic sequence to cease on order of the manual override control equipment.

# Vanguard Designers Detail Second Stage

Azuza, Calif.—Second stage Vanguard rocket engine is fabricated from 52S0 weldable aluminum alloy tubing, utilizes a square cross section steel wire external wrapping to absorb loads, Aerojet-General Corp., fabricators and de-

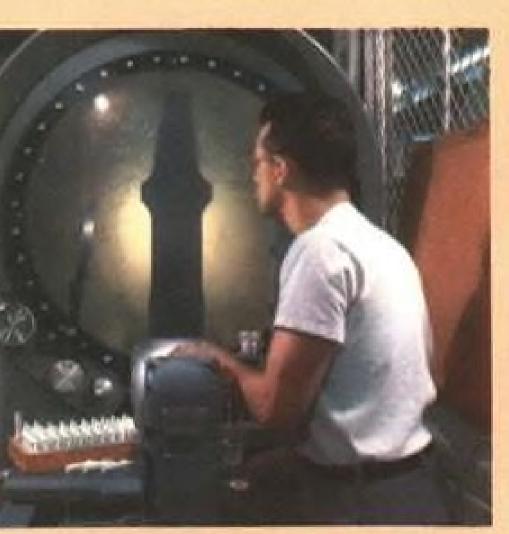


# FLYING STARTS WITH WHERE EVERY RESOURCE OF CHEMICAL, METALLURGICAL, ELECTRONIC AND APPLIED SCIENCE IS DEVOTED TO THE QUALITY-CONTROLLED

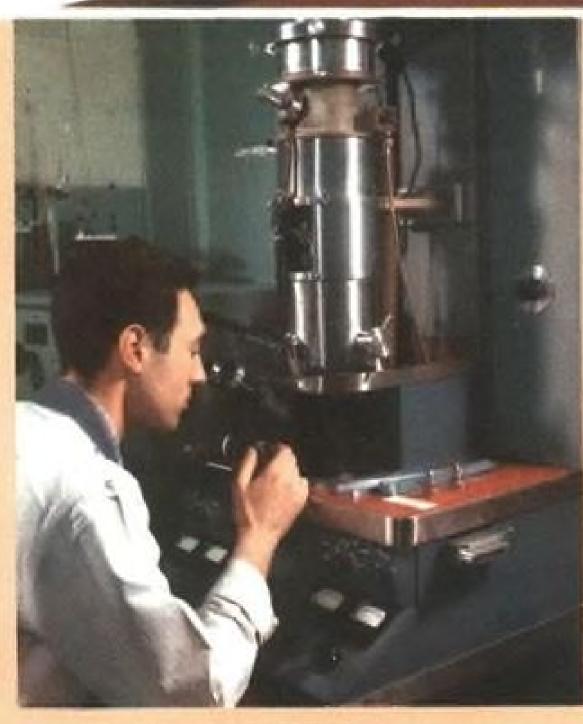
PRODUCTION AND EXHAUSTIVE TESTING WHICH INSURE AC AIRCRAFT SPARK PLUG RELIABILITY!



SPECTOGRAPH analyzes materials both quantitatively and qualitatively to an accuracy of one part in one-million! The spectrum of a blinding arc of the material is recorded photographically for analysis.



KODAK CONTOUR PROJECTOR magnifies the profile of the insulator blank ten times to be sure it coincides perfectly with the king-size master template in every detail.



ELECTRON MICROSCOPE photographs shapes and sizes of crystals in insulator materials and how these materials bond together. Pictures are studied by carefully trained technicians to insure that all insulators meet the most rigid specifications.



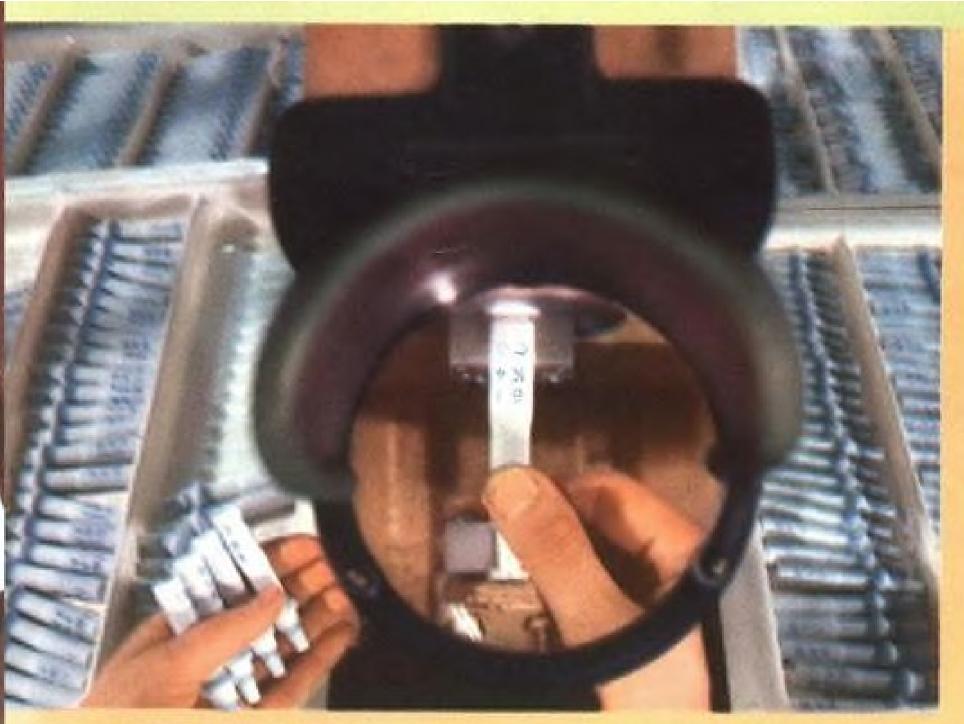
KILN CONTROL PANEL accurately measures both time and temperatures for the all-important insulator blank firing and glazing processes from four stations in the automated high-temperature kiln.



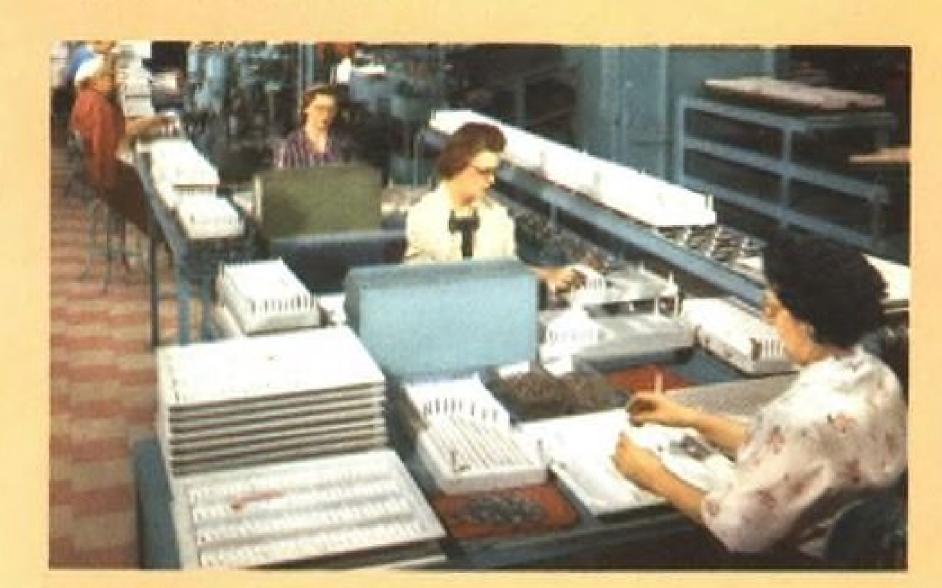
RUBBER MOLDS automatically form insulator blanks with precise accuracy through modern compression methods. After molding, the blanks are precision ground to insure uniformity in length and contour. This method is typical of AC's uncompromising accuracy.



FINISH GLAZE is applied to the insulator barrel and sealing surface prior to final firing. Glazing provides super-smooth surface which minimizes barrel contamination throughout its lifetime.

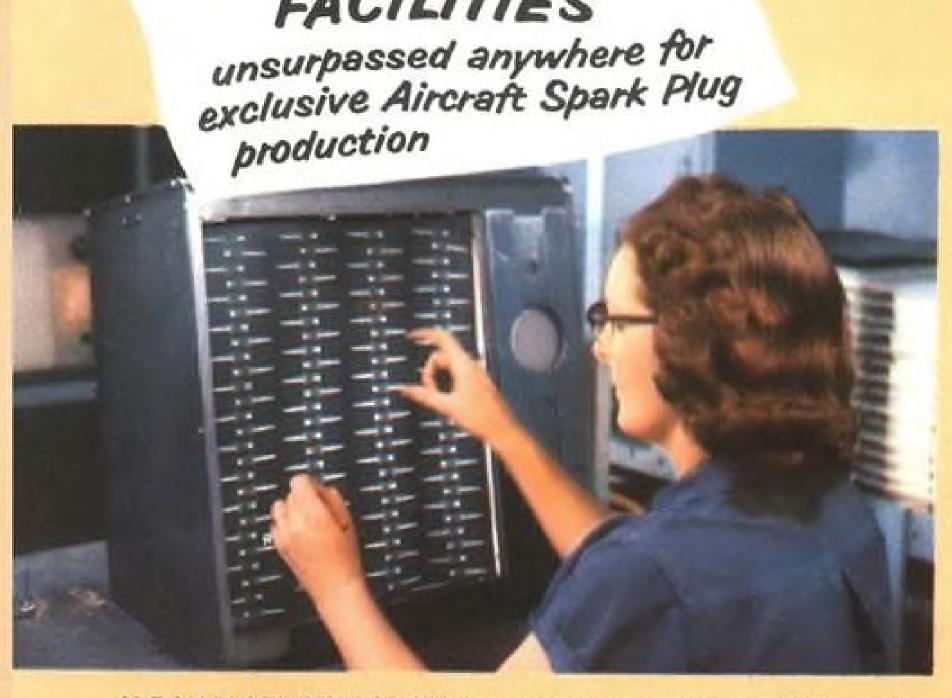


LIGHT BEAM TEST illuminates the entire fired insulator blanks from the interior to disclose even the slightest imperfection. After this check, insulators are assembled into plugs for engine dynamometer test.



INSULATOR ASSEMBLY—here the center electrode wire is matched to the body and the ceramic-metal sealing powder loaded for firing in the electric glass-seal furnace. The leakproof ceramic-metal seal is exclusive with AC.

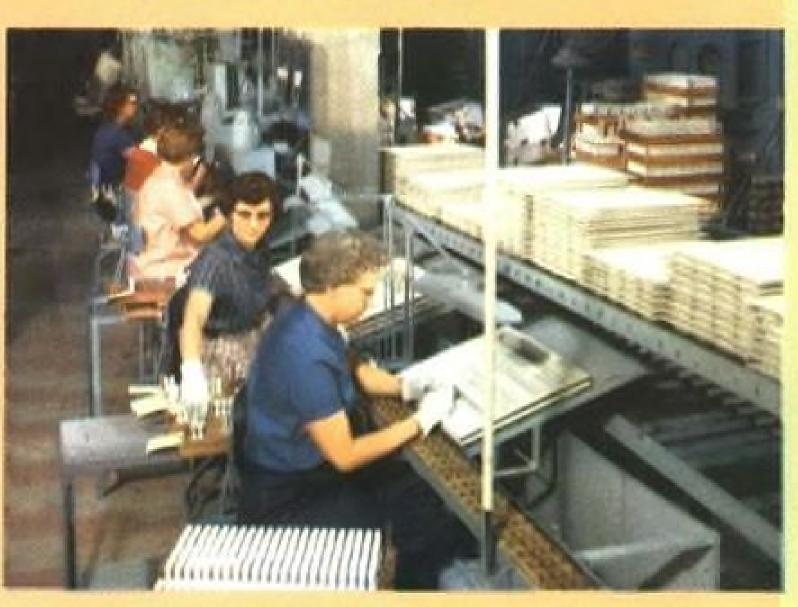
FACILITIES



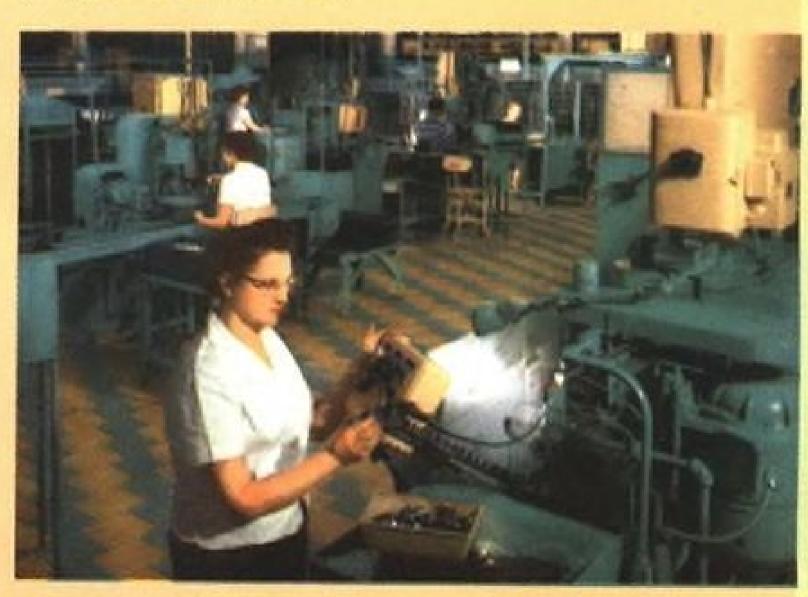
X-RAY PLATE INSPECTION of every insulator assembly insures 100% perfection. Before it can pass its physical, every AC aircraft spark plug insulator assembly is subjected to the final X-ray test. Plates are made of groupings and technicians scan them to detect any rejects. All plates are read in special, darkened booth.



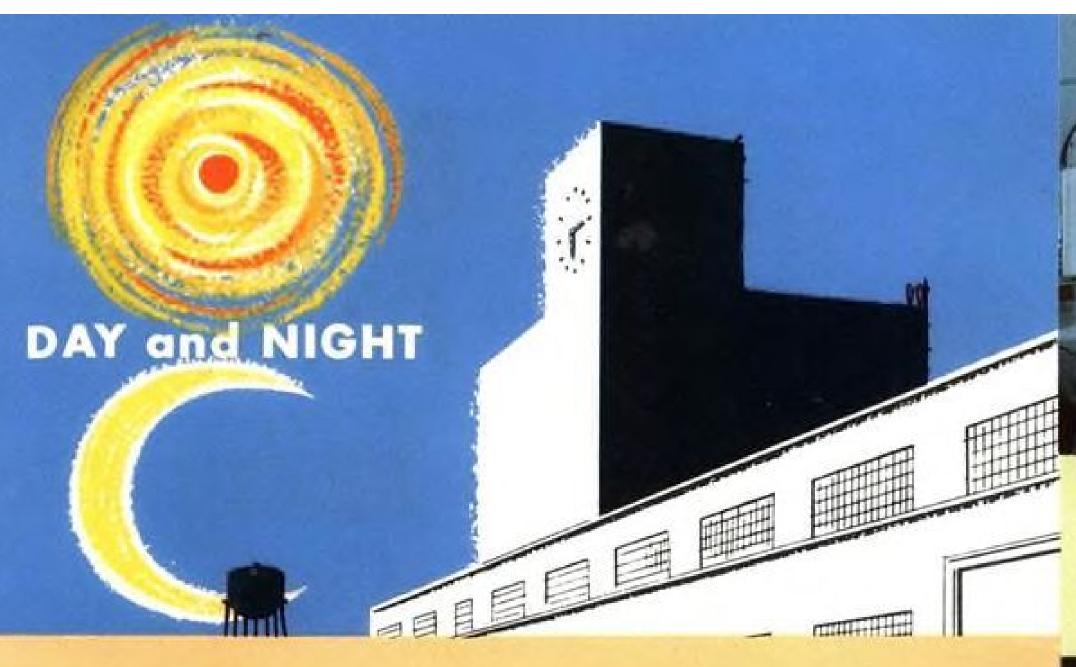
DIAMOND GRINDING of insulator shoulder is confined to extremely close tolerances. This final precision operation insures perfect matching of insulator and the spark plug shell.



INSULATOR ASSEMBLY INSPECTION includes high-voltage electric current, Zyglo dye, black light, visual plus X-ray for each spark plug of the entire production.



MACHINING AND PLATING are done by the most modern methods, many of them conceived and perfected by AC. This scene is only a portion of the vast facilities devoted exclusively to the production of AC Aircraft Spark Plugs.





FINAL ASSEMBLY where the insulator assembly is mated to the shell. Starting with a resistance check of the insulator, the finished aircraft spark plug begins to take shape. After the shell components are in place, they are crimped, welded and brazed to form a leakproof unit. This unit must then pass a 1,000 p.s.i. air test.

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MEN, MATERIALS, **MACHINES** combine to build aircraft spark plugs that spark modern flight!



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AC SPARK PLUG # THE ELECTRONICS DIVISION OF GENERAL MOTORS

signers of the propulsion system, disclosed last week.

Use of tube yields natural channelization for regeneratively cooled chamber while wire wrapping allows chamber pressures as high as 500 to 1,000 psi, although the Vanguard chamber pres-sure is less than 300 psi.

Hypergolic propellants, unsymmetrical dimethylhydrazine for fuel and inhibited white fuming nitric acid for oxidizer are pressure fed, with helium as pressurizing agent, and are injected at a mixture ratio of 2.8.

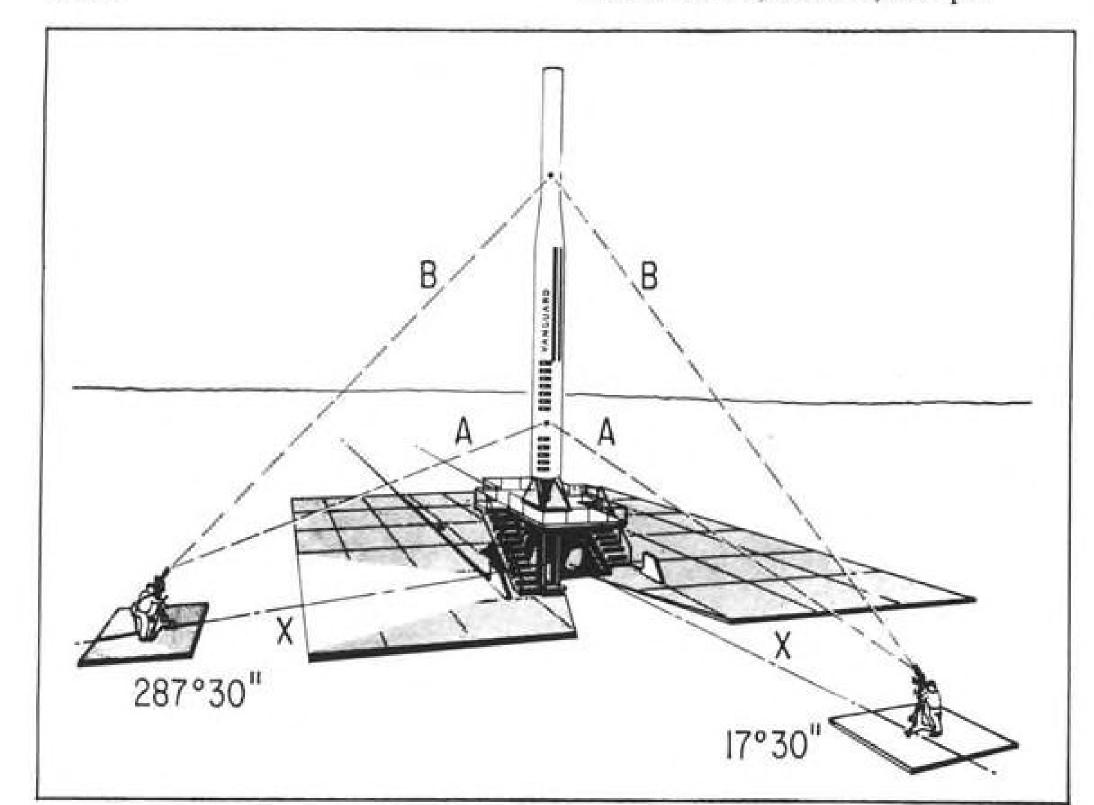
Although flame temperature is in the range of 5,000F, the high conductivity of aluminum alloy and flow rates of the inhibited white fuming nitric acid oxidizer, which is the cooling fluid, combine to limit thrust chamber wall temperature to 450F at maximum.

Thrust chamber is gimballed, vields 7,700 lb. thrust at altitude, has a burning time of 120 sec. Dry weight of the propulsion system is 380 lb. maximum. Minimum specific impulse in a vacuum is 271 lb./sec./lb. Minimum total impulse to total weight ratio is 238 sec. Propulsion system is designed to carry second and third stages from 36 mi. to 300 mi. distance from earth surface.

Tubing for the chamber is of varying size due to variations in shape for the nozzle, wall. Thickness is below

Tubes are shaped to the thrust chamber, nozzle throat and nozzle proper configuration in specially made forming dies, then welded together for the

Nozzle expansion ratio is 20-1, and exhaust velocity for the engine at altitude is from 8,500 to 9,000 fps.



VANGUARD must be vertical at time of launching. Diagram shows how engineers check vehicle's position against hypothetical reference line formed by intersection of two optically generated, right-angle planes.

## Optical Tooling Devices Check Missile for Correct Alignment

In launching of large missiles, misalignment can result in trajectory deviations and excessive fuel consumption which may cause an expensive piece of hardware to miss its target.

Problem of alignment is basically the same for all large missiles, whether they carry a warhead or a satellite, and it makes little difference whether they are aligned to true vertical or to some specific angle less than 90 deg.

What actually creates a problem is the high degree of precision required-

conventional mechanical or surveying tools alone. To achieve desired accuracy, missile crews use optical alignment devices, some of which have been developed specifically for this work while others were adapted from units already in use on the production line.

For the Vanguard, the error in alignment of the primary axis-the calculated center line running through the vehicle-must not exceed two minutes of are deviation from true vertical. To plumb the vehicle within these limits, preciseness beyond that attainable with optical tooling devices supplied by Keuf-

## Complete Aircraft Testing

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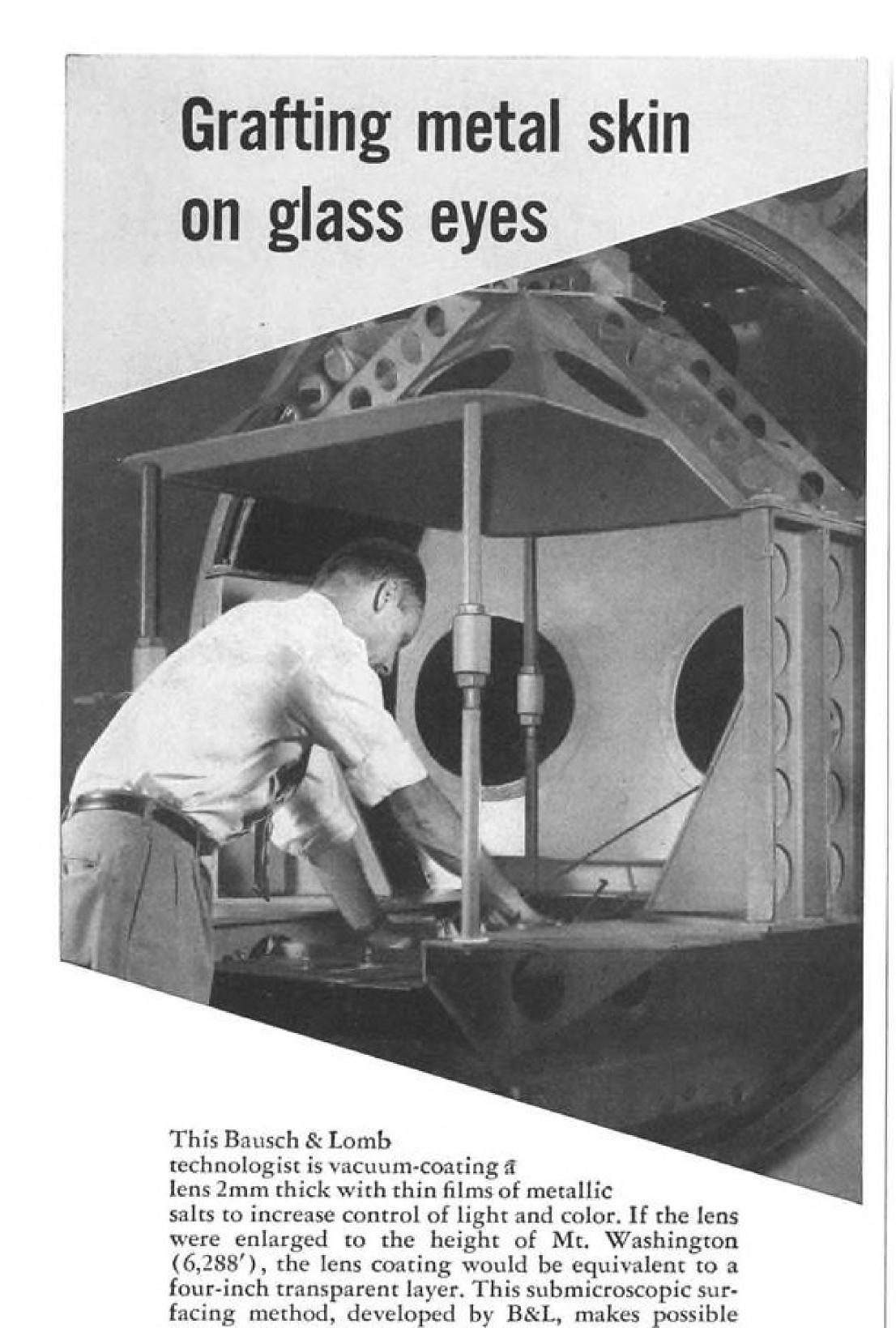
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fel & Esser Co. are used as follows:

Two transits equipped with optical micrometers capable of measuring 0.001 in. are set on two lines X and Y (established by conventional surveying procedures) which converge at a right angle. From each station, the line of sight of the transit is able to describe an optical plane which is vertical. (Each transit is carefully leveled on its own special platform to make sure that the optical planes are truly vertical.) The intersection of these two planes forms a hypothetical vertical line at the center of the rocket.

Two sights (lines A and B on diagram) are made from each station against cross-hair target placed on the outside of the vehicle, top and bottom. with reference to the calculated center line. The placement of the target takes place while the Vanguard is still in the Martin Co. plant in Baltimore, Md.

When the upper target reading, as measured by the micrometer, conforms to the lower target reading within specified tolerance; i.e., when the displacement of each target is the same from the optically created plane, the vehicle is vertical within one plane. When the target readings from the second transit similarly conform, the vehicle is vertical in a second plane. And since the two planes are at right angles, the rocket is then truly vertical. (Adjustments in either plane are made as needed with leveling jacks which are under the launching pad.)

### Vanguard Alignment

In the case of Vanguard, there are other problems presented by alignment of the third stage. When third stage is attached at the launch pad, its thrust axis must be aligned to the primary axis within six minutes of arc. But the third stage is too short to use the same techniques as before; i.e., external markers would be spaced too close to define the centerline accurately.

To solve this problem, Keuffel & Esser developed an optical instrument called an auto-collimating plumb aligner, which is essentially a fixed focus telescope held vertically in a special mount. Technique for using it is as follows:

Front-surface mirror is affixed to a flat pad mounted on top of the third stage engine so that the mirror surface is square to the thrust axis, the amount of tilt of the mirror corresponding to the deviation of the third-stage thrust axis from the primary axis.

To measure the amount and direction of the tilt, the collimator is raised on the gantry to a position above the third stage. The cross-hairs of the instrument are aligned parallel to the previously surveyed ground lines with the aid of one of the base transits and two offset



Official U.S. Navy photograph

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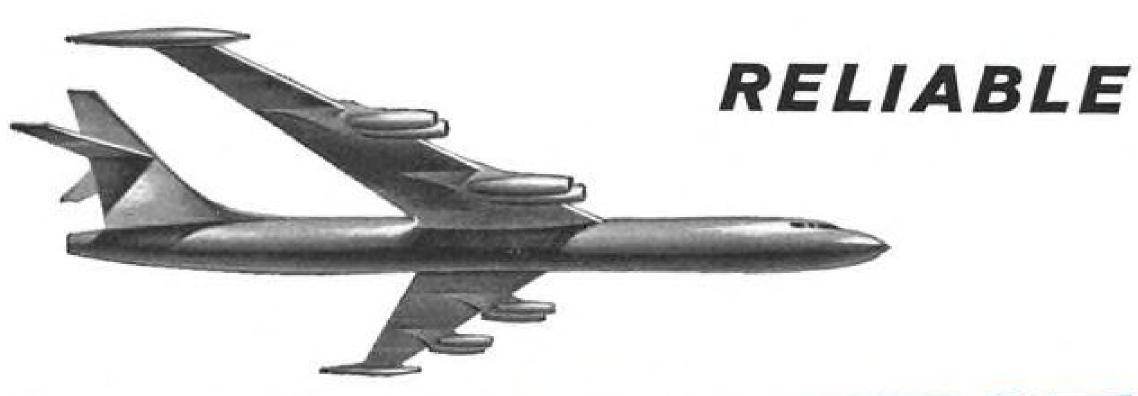
With over 20 years experience in airborne electronics, including the highly efficient Aero 13 and related systems, Westinghouse is developing advanced concepts and systems in:

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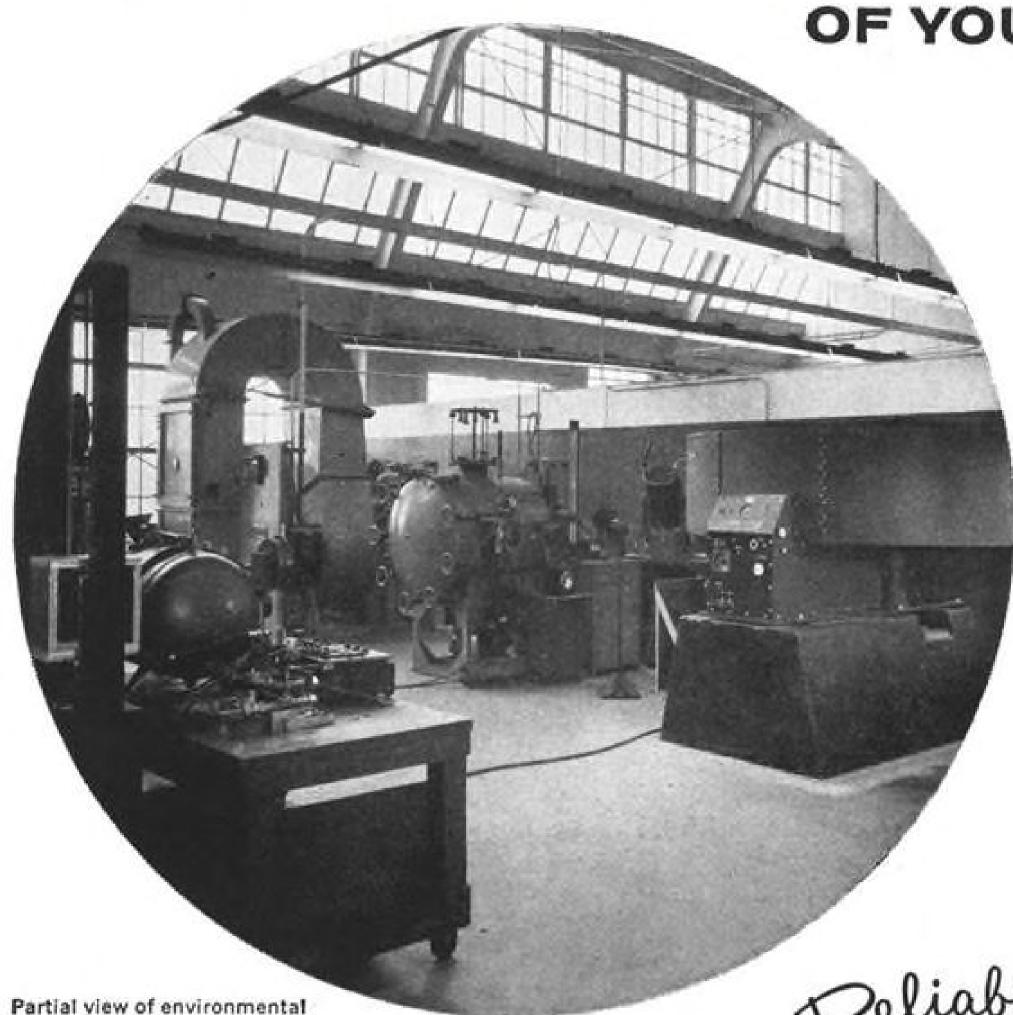
For information on these advanced developments, call or write the Westinghouse Air Arm Division, P.O. Box 746, Baltimore 3, Md. Westinghouse AIR ARM DIVISION

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DESIGNERS, DEVELOPERS, MANUFACTURERS AND TESTERS OF AIRCRAFT AND MISSILE HYDRAULIC, PNEUMATIC, FUEL, MECHANICAL AND ELECTRICAL EQUIPMENT • • • • • • targets attached to the collimator. This gives the collimator its geographical position. A level bubble vial attached directly to the barrel of the instrument gives it its vertical position.

Light bulb is placed in the eyepiece so that it shines down the barrel through the cross-hairs and onto the mirror attached to the third stage. The beam, of course, is reflected. Direction of the reflected beam depends on tilt of the mirror. Idea is to bring the reflected beam in line with the incident beam by tilting the third stage with its attached mirror.

The direction in which the thirdstage motor must be tilted can be determined by reference to the cross-hairs which already have been lined up geographically. When the reflected image of the cross-hairs is superimposed (autocollimated) on the actual cross-hairs, the third stage thrust axis is properly aligned with the primary axis and the Vanguard is correctly aimed for launch-

### **Navy Contracts**

Following is a list of unclassified contracts for \$25,000 and over as released by Navy Contracting Offices:

DEPARTMENT OF THE NAVY, Bureau of Aeronautics, Washington 25, D. C.

Wilding Picture Products, Inc., Chicago, production of two (2) 35 mm sound motion picture training films with master shooting script, in a joint a/w Army-Navy spec. JAN-P-55 and amendment no. one thereto, NOas58-569-f(PH-51-5092-58), \$33,-561.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., 120 man months of field engineering services in the maintenance, repair and operation of aircraft electrical and electronic equipment, NOas58-269-s(MA-42-3279-58), \$144,123.

Specialties, Inc., Syosset, N. Y., angle of attack systems, transmitters in a/w spec. MIL-T-7785A, and indicators in a/w spec. MIL-I-18856(Aer), NOas57-664-f (PD-42-1300-57), \$639,517.

Designers For Industry, Inc., Cleveland, Ohio, study of the application of mechanical data handling systems to the production data package, NOas58-459-d(IP-31-4387-58, \$78,503.

AiResearch Manufacturing Co. of Arizona Division, the Garrett Corp., Phoenix, conduct product engineering improvement program, NOas58-380-c(PD-42-1490-57), \$135,-710.

Northwestern University, Evanston, Ill., conduct an aerodynamic investigation of comparative separation in subcritical Mach region, NOas58-452-d(AV-34-2460-58), \$31,350.

Convair Division, General Dynamics Corp., San Diego, Calif., 96 man months field engineering services, NOas58-230s(MA-42-3259-58), \$126,368.

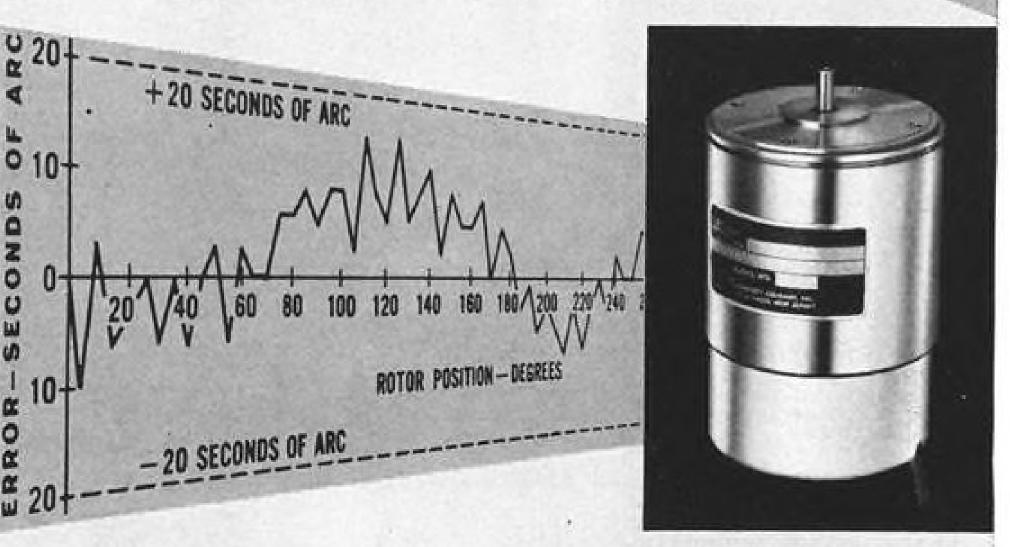
Fairchild Engine and Airplane Corp., Alexandria, Va., study and evaluation of in-flight guided missile environmental data, NOas58-539-c(AV-31-2437-58), \$48,440.

Audio Productions, Inc., New York, N. Y., preparation and production of two 16mm sound motion picture training films with master shooting script in a/w Army-Navy spec. JAN-P-55 and amendment no. one thereto, NOas58-527-f(PH-5-5076-58), \$41,-531.

AiResearch Manufacturing Co. of Arizona Division, the Garrett Corp., Phoenix, services and materials to pursue product improvement engineering program on GTC 85 series gas turbine compressors, NOas58-362-c(PD-43-5509-57), \$477,532.

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### NEW ULTRA-PRECISE SIZE 25 SYNCHROS

Extremely precise data transmission is possible through the use of Kearfott's Size 25 synchro resolvers. The inherent precision of these units provides a three sigma accuracy of approximately 35 seconds in a typical 3 unit string without the use of auxiliary equipment. Ruggedly constructed of corrosion resistant materials, they possess the required reliability for all missile applications. Available as transmitters, differentials and control transformers with a maximum error from E.Z. of 20 seconds arc.

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### SIZE 11 SYNCHROS

Size 11-2 phase 4 wire synchro resolvers for data transmission combine the advantages of small size with high accuracy. Corrosion resistant materials are used in the construction of these units. Available as 60X transmitters, differentials and control transformers with a maximum error from electrical zero of 3 minutes arc. Standard 3 wire synchros are available from production with 5, 7 and 10 minute maximum error from E.Z.

ENGINEERS

Challenging opportunities at Kearfott in advanced component and system developments.





KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

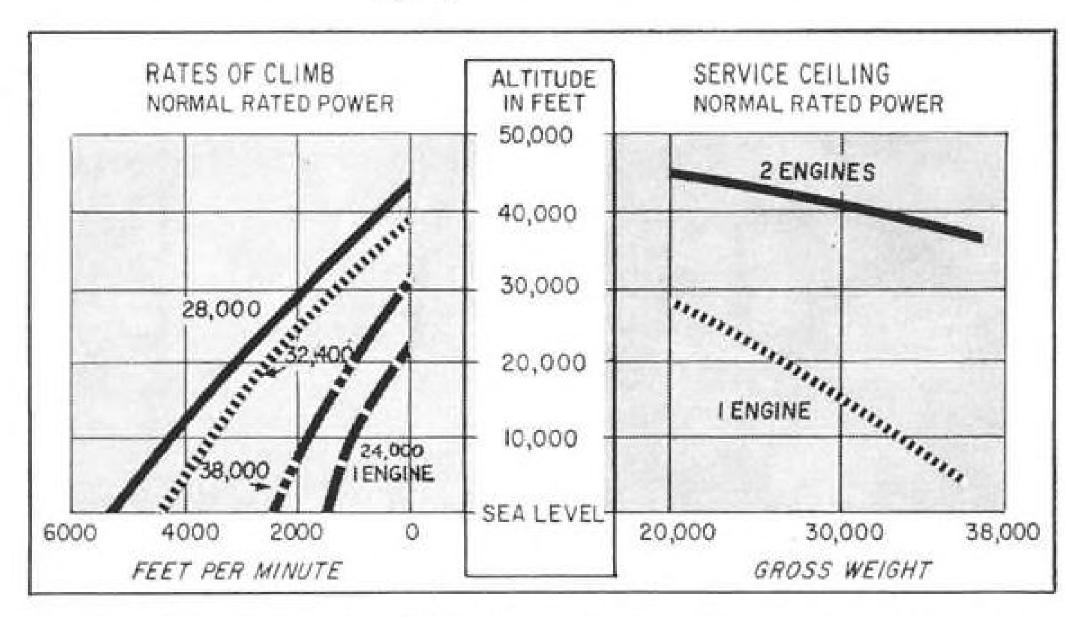
Sales and Engineering Offices: 1378 Main Avenue, Clifton, New Jersey Midwest Office: 23 W. Calendar Ave., La Grange, Illinois South Central Office: 6211 Denton Drive, Dallas, Texas West Coast Office: 253 N. Vinedo Avenue, Pasadena, California



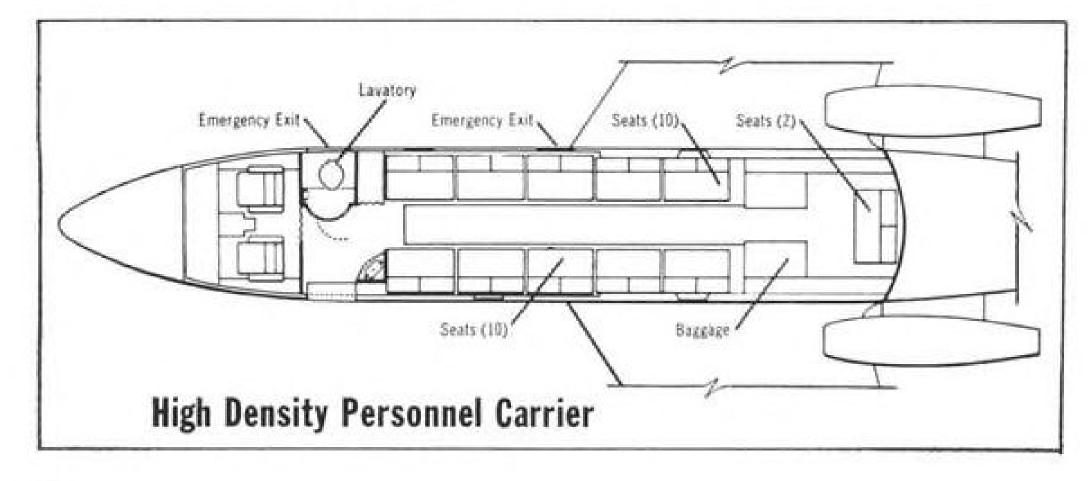
LOCKHEED CL-329 JetStar ground visibility runs 40 ft. ahead of nose. Tread is 10 ft. 9 in.; wheel base is 20 ft. 9 in.

Aviation Week Pilot Report

## JetStar Appears to Meet USAF Needs



PERFORMANCE above based on TJ37 turbojets. Configuration below carries 22 passengers.



By Robert I. Stanfield

Marietta, Ga.-Performance and characteristics at varied speed regimes and altitudes indicate that Lockheed's fast, all-weather JetStar CL-329 is tailored to USAF's urgent need of a flexible jet replacement for its current crop of obsolete World War II piston-vintage utility aircraft.

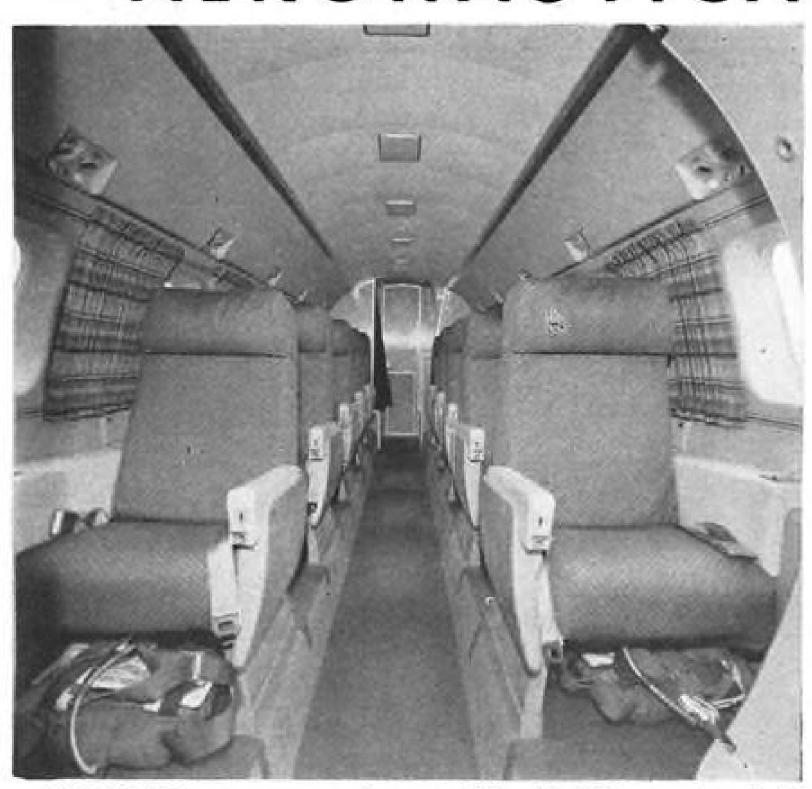
JetStar, currently powered by two Bristol Orpheus 1/5 turbojets (AW Sept. 30, 1957, p. 108), demonstrated its adaptability for training navigatorbombardiers, towing targets, doing high-speed reconnaissance, and operating as an electronic or advanced trainer. In addition to its qualities as a highflying 10-passenger VIP jet transport, it can haul some 4,000 lb. of cargo.

Flight evaluation by Aviation Week pointed up these key features of the 600-mph. CL-329:

 Acceleration and climb. Airplane accelerates from idle to maximum-throttles to 10,000 rpm.-in about five sec. Prototype we flew was off the ground in less than 3,000 ft. at about 120 kt. Acceleration to initial climb speed of 180 kt. was rapid. Passing over the end of the 10,000 ft. runway, our normal climb speed was 235 kt. We were held to initial rate of climb of 4,000 fpm. because of low cloud deck. Maximum, at sea level, is 6,400 fpm.

Slow flight and landing. CL-329 han-

## AERONAUTICAL ENGINEERING





STANDARD passenger carrier seats 10 with 40-in. spacing (left). Flight controls are dual (right); engine controls are centered.

dles smoothly at all speeds. Pattern reciprocating engine aircraft. We flew downwind at 150 kt., base at 130 kt., final at 115, touchdown at 90. Landing distance approximated 3,000 ft. Wind was quartering at 10 kt.

• Jet power. Engine pods are mounted high and aft on fuselage. Current turbojets are prototype Curtiss-Wright axial flow type TJ37s rated at 4,850 lb. sea-level thrust at takeoff; 4,130 lb. thrust for maximum continuous operation. Dry weight of engine is 990 lb. Thrust/weight ratio is 4.9 to 1. Compression ratio is 4.4 to 1. Air flow is 81.6 lb. per sec. Prototype JetStar has been flown single-engine from 115 kt. on takeoff; accelerated at 1,800 fpm. to 7,000 ft.; climbed single-engine from 15,000 to 25,000 ft. at 600 fpm.

 Speed and altitude. Over-weather capabilities of CL-329 are evident. We reached 35,000 ft. in about 10 min., including time spent searching for hole in low-level cloud laver. At normal power we trued out at about 553 mph. Airplane has flown at altitude of 45,000 ft, at speeds in excess of 630 mph. Air conditioned and pressurized, JetStar was comfortable and quiet. Cabin pressure altitude of 8,000 ft. is maintained at 45,000 ft. altitude. Cabin pressure differential is 8.7 psi.

### Fuel and Range

Fuel is carried in wing integral tanks, plus sump tank of about 130 gal. in inboard end of wing tank. Capacity of each wing, including sump, is 820 gal. for normal total of 1,640 gal. or 11,000 lb. Fuel is kerosene type-JP-1.

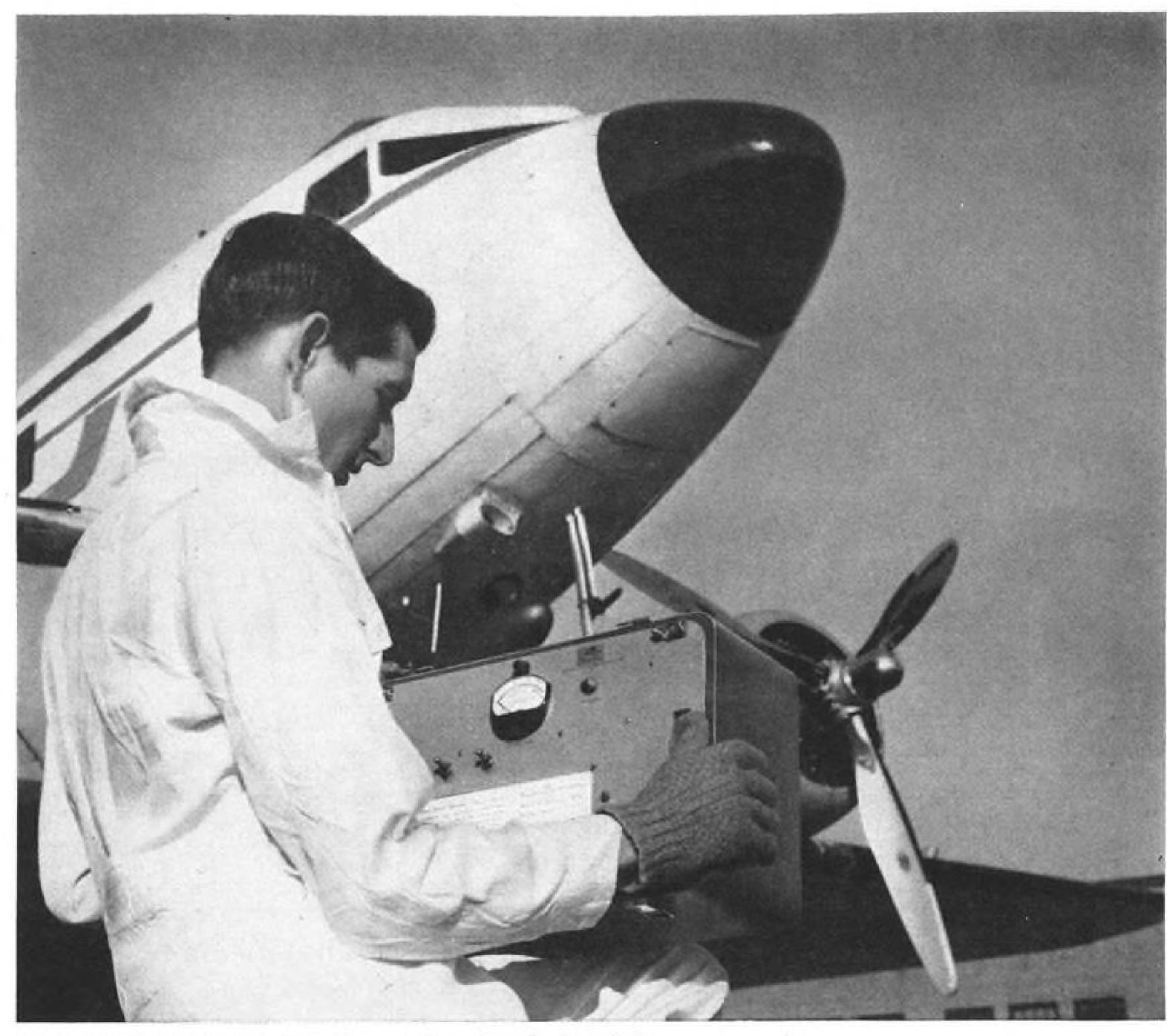
Range may be increased via 300 gal. speeds are on a par with many similar slipper tanks or 640 gal. glove tanks and four-engine configurations, embracon each wing. Normal range of the ing either the two Curtiss-Wright JetStar is 1,500 naut. mi. With two TJ37Als (Bristol Orpheus built under glove tanks this would be increased to license), or four of the estimated 2,500 2,200 naut. mi. Range is based on 70 lb.-thrust-each Fairchild J83s or Genkt. headwind plus 30 min. endurance at sea level in lieu of Mil. 501-A.

Airplane will be offered in both twin eral Electric J85s when they become available. Indications are that USAF

### JetStar CL-329 Dimensions

Wing area (so ft)	52
Wing area (sq. ft.)	
Aspect ratio	
Taper ratio	
Thickness	
Sweep C/4	30 deg
Span	53'8'
Length	58'10'
Height	20'6'
Horizontal tail area (sq. ft.)	
Horizontal tail span	24'9'
.t/MAC	
Vertical tail area (sq. ft.)	
Γotal wetted area (sq. ft.)	
Total wetted area ratio	
Fuselage diameter outside	
Head room, aisle to ceiling	
Cockpit length	68'
Cabin length	257
Seat spacing	
Crew/passengers	
HO	
Max. density seating	10
Max. litter capacity/attendants	
Max. cargo (lb.)	
Normal fuel, internal wing (gal.)	
* Intermediate fuel (gal.)	2,240
† Maximum fuel (gal.)	2,920
° 300 gal. slipper tank per wing.	
† 640 gal. glove tank per wing.	
TOUR AND THE CONTRACTOR OF THE SECTION & AND THE SECTION OF THE SE	

78



Panel light indicates when radar's ring time exceeds predetermined standard. Other checks can be obtained with frequency indicator and relative power meter.

## New portable radar tester makes fast "go, no-go" check

Tests all radars aboard aircraft, requires no training to operate

Here's the fastest means yet developed for testing aircraft radar on the flightline or in the field. It's the new Sperry Microline® Radar Performance Tester and anyone can use it-no special training is required.

Weighing only 24 pounds (30 for Cband), this tester is self-powered (standard batteries) and is easily carried about. It prevents costly delays by providing a quick, over-all check of all aircraft radars in only minutes.

This is the only performance tester that checks the alignment between transmitter and receiver positively and accurately by flipping a single switch. Interchangeable plug-in echo box cavities permit checking either C or X-band radars. Transistorized circuits with builtin testing feature contribute to light weight and reliable performance.

new Sperry Microline Radar Performance Tester, write our Microwave Electronics Division.

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BROOKLYN . CLEVELAND . NEW ORLEANS . LOS ANGELES SAN FRANCISCO . SEATTLE. IN CANADA: SPERRY GYROSCOPE If you'd like to know more about the COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC.



SECOND JetStar prototype is about to touch down. Flaps are full-span slotted type. Drag chute can be used if necessary.

prefers the four-jet configuration with 185 turbojets.

Lockheed also holds reserve delivery positions for about 58 commercial firms, pending USAF order.

Lockheed specs show top speed of the four-engine configuration to be 613 mph. for normal mission; 595 mph. for extended range. Optimum cruise speed with four engines would be 510 mph. for normal mission; 484 mph. for extended range. Stall speed, best condition, at max. landing weight of 26,000 lb., is 106 mph.

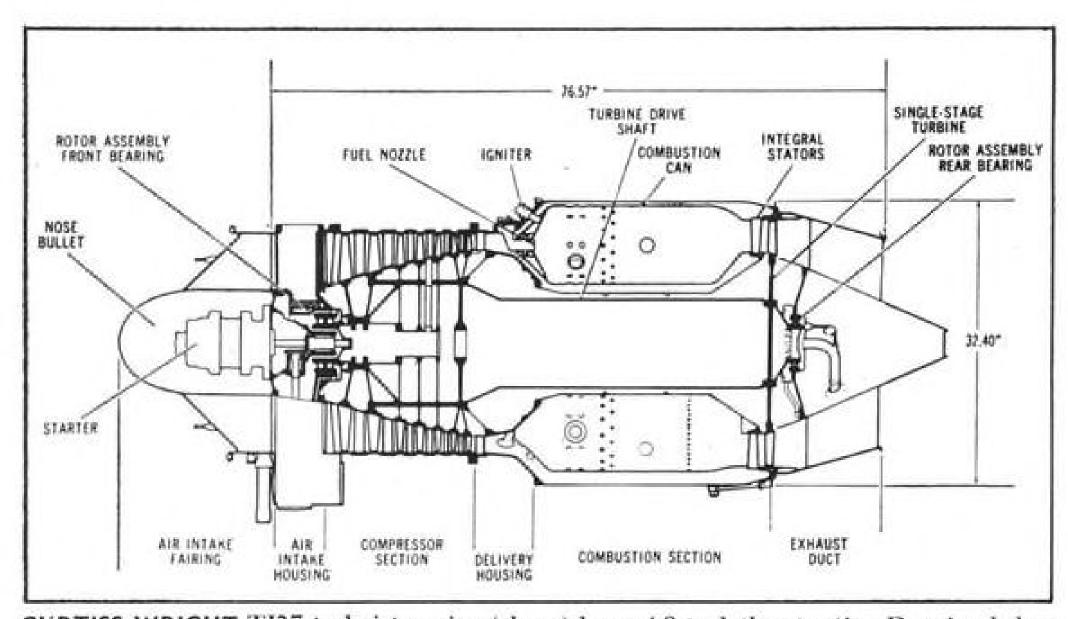
### **Engine Availability**

Production TJ37 engines, 150 hr.type certified, will be available in April, 1959. Predicted overhaul period is forecast to be 500 hr. by mid-1960. Two JetStar prototypes have been flown about 230 hr. with TJ37 prototypes. Aviation Week was told that prototype engines have delivered more, never less, than sea-level rated 4,850 lb. thrust; that no JetStar flight was ever delayed because of engine trouble.

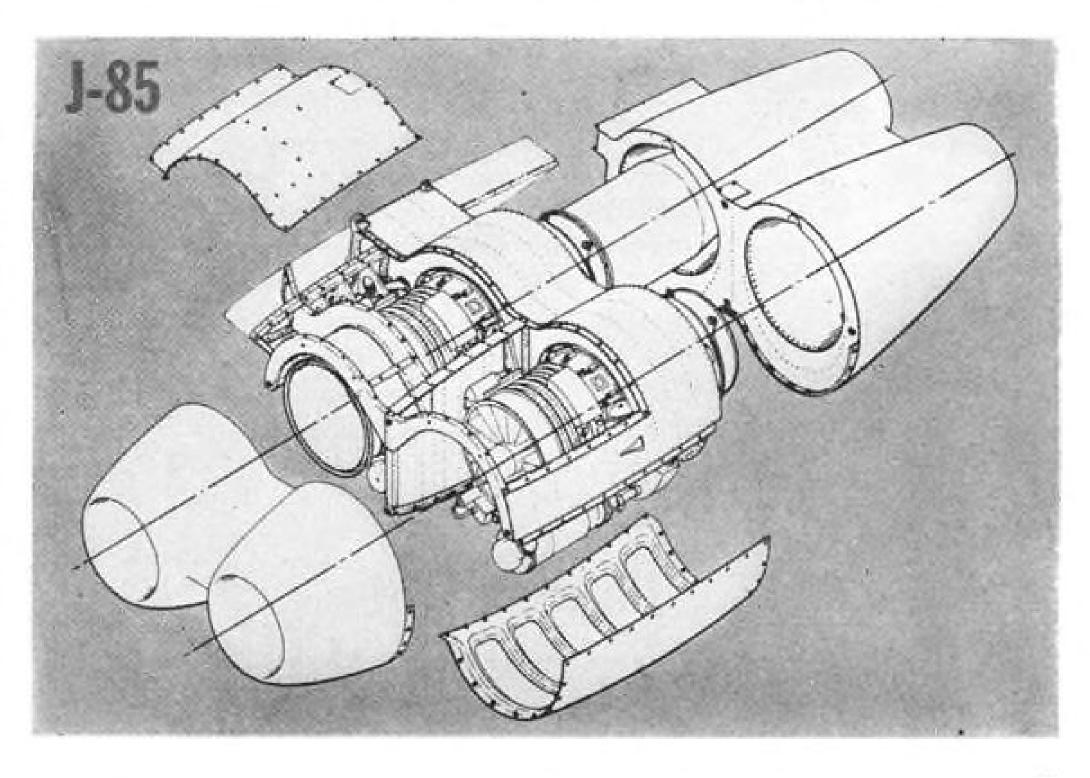
Airplane we flew was number two prototype, N329K, which previously had been flown about 25 hr. Number one prototype, N329J, with total time of about 200 hr., had been flown about 30 hr. by USAF during Phase II testing at Edwards AFB, Calif.

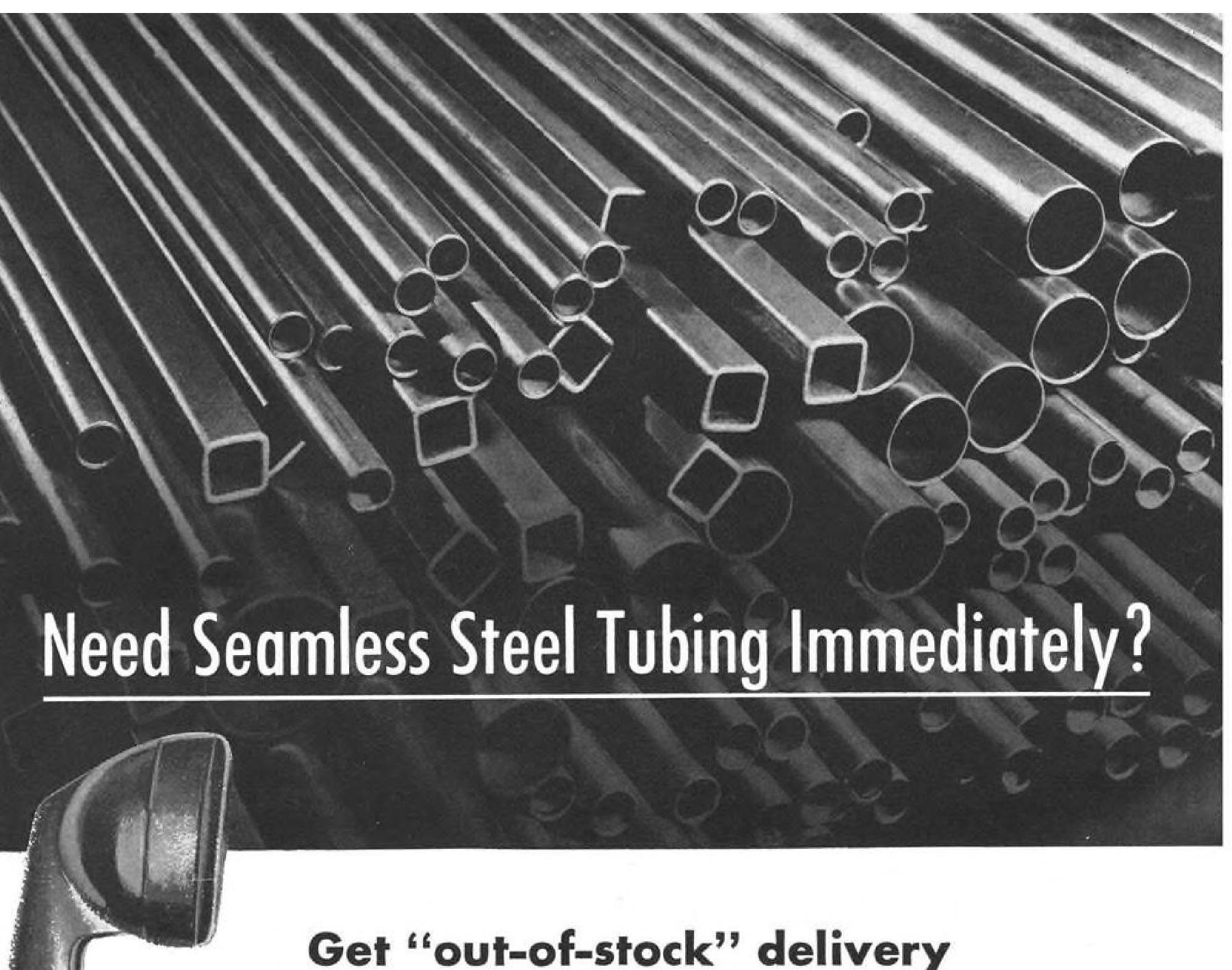
Long-nosed airplane-58 ft. 10 in. long, with wing span of 53 ft. 8 in.sits low and snug to ground. Height over tail is 20 ft. 6 in. Wheel tread is 10 ft. 9 in.; wheel base is 249 in. Nose houses antenna and electronic equipment. Because of nose size JetStar cannot mount AN/APN-59 radar. Lockheed will propose use of smaller commercial equipment.

Hydraulic and air conditioning sys-



CURTISS-WRIGHT TJ37 turbojet engine (above) has a 4.9 to 1 thrust ratio. Drawing below shows how two General Electric J85s would be installed on a four-engine JetStar.





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tems, plus baggage space, are located just forward of empennage; are accessible through speed brake door. Cabin length of 28 ft. affords flexibility of interior arrangement.

Walk-around inspection shows cleanness of design. Wings are swept back 34 deg, from fuselage. Engines, aft of wing, can be easily serviced and maintained. Access to single-spool seven-stage axial-flow compressors is provided by split housing. Either half is quickly removable for inspection of upper or lower portions of compressor.

We entered aircraft through cabin door located aft of pilot's compartment and forward of cabin, on left side. Door swings inward and aft to open. Control handles are inside and outside, and door is secured by four bayonet-type locks. Outside handle fits flush in door when locked. To lock and unlock, handles are rotated 90 deg.

Cabin is luxury type and roomy. With 6 ft. 2 in. head clearance we didn't have to duck, Airplane was standard 10-passenger carrier configuration. Cabin baggage compartment, 27 by 38 in., faces door. More baggage space is provided aft of cabin in space entered via belly speed-brake door. Emergency exit is located adjacent to right-hand number three passenger scat, which opens over leading edge of right wing.

To the rear is wardrobe of 28 by 39 in.; galley of 29 by 39 in., and lavatory, 42 by 79 in.

### Comfortable Cockpit

One man alone can fly airplane without any strain. Pilot's seats adjust to height, fore and aft movement and tilt of backrest. Flight controls are dual; conventional wheel and rudder pedals. Knob adjustments for latter are on control columns. Flight instruments are mounted on both pilot's and copilot's sides. Engine instruments are centered.

Engine controls, autopilot, speed brake switch, fuel dump-crossfeedtransfer controls, VHF, ADF, are lo-



SPEED brake is close to ground, cannot be used during taxiing, takeoff, or landing.

cated on control pedestal between pilots.

Overhead panel, directly above, includes cabin heat and pressure instruments and selectors, starting switches, cabin loudspeaker and light switches. Panel lights, oxygen regulator and radio controls for each pilot are mounted adjacent to seats.

Each engine contains air-driven starter within air intake duct bullet. Air furnished at pressure of 200 psi. operates single-stage turbine which in turn rotates engine through system of planetary gears, clutch and engaging mechanism.

Starting procedures for JetStar are

relatively simple. Number three hydraulic pump on. (System provides pressure for operation of fuel boost pump). Start selector to left engine. Ignition turned on. Start air selector; throttle to idle. Engine start switch on. Same procedure is followed for right engine.

Left engine fired up quickly and rpm, was advanced to 5,000 to supply sufficient bleed air for operation of left air turbine motor. With left ATM on, generator was cut in and battery switched on. (Two air turbine motors are contained in baggage compartment, entered via speed brake for operation of two hydraulic pumps and two d.c. gen-

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### OVERWING REFUELING

No. 9162 high capacity nozzle features easy opening, soft closing, minimum shock, during refueling operations. Also No. 8385 Non-Drip oil nozzle for delivering lube oil. Features sure shut-off, non-drip valve in end of tube.

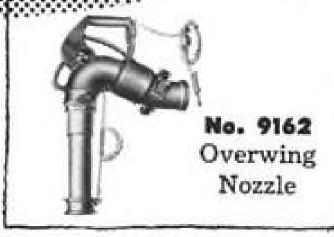
### UNDERWING REFUELING

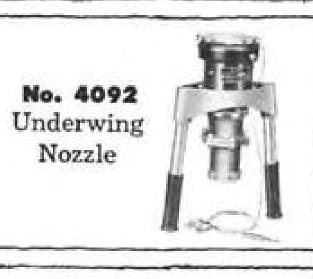
No. 4092 valve is easily connected to aircraft fueling adapters. Makes a positive, leakproof connection. Basic mechanism designed to deliver 600 g.p.m. at pressure drop of 8 PSI through valve and adapter. Several different models available.

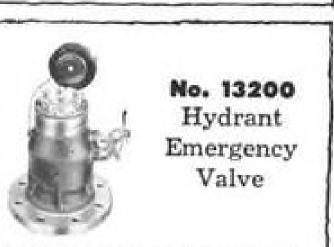
### HYDRANT SYSTEMS

No. 13200 Emergency Shut-off valve can be remotely controlled. Adapter poppet valve and emergency shut-off valve work independently of each other.

Also No. 4096 series standard hydrant adapters; No. 4093 series hydrant coupling valves.





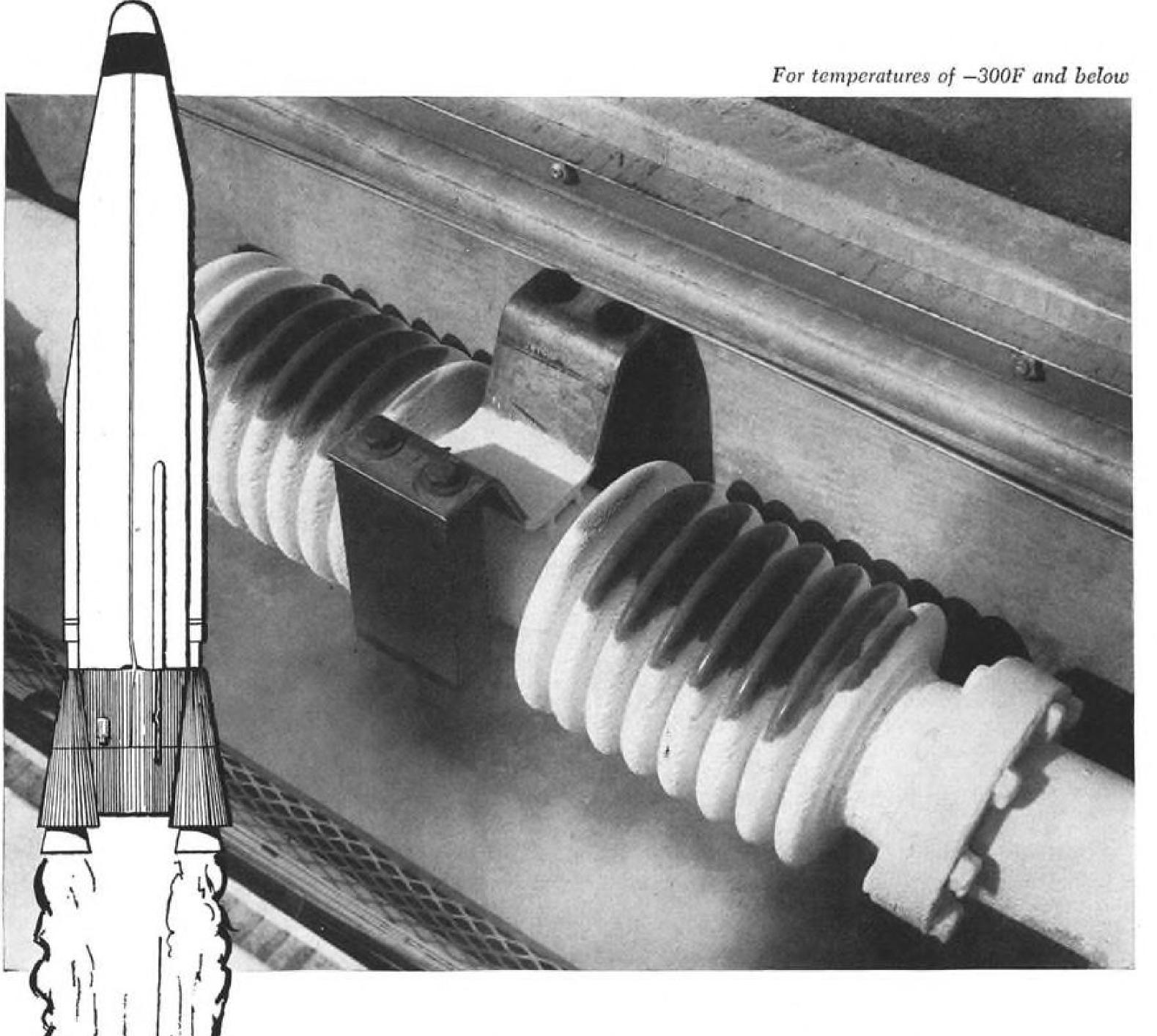


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AVIATION WEEK, May 5, 1958

83



## Sola-Flex<sup>®</sup>joints provide safe, easy handling of liquid missile fuels

ICBM, requires the very best handling know-how—and equipment. These rugged Sola-Flex expansion joints are in use on Convair's fuel test facility at San Diego, California. Made from 321 stainless, the 6 in. double-end anchor-base unit handles over 5 in. of axial movement in a LOX test line.

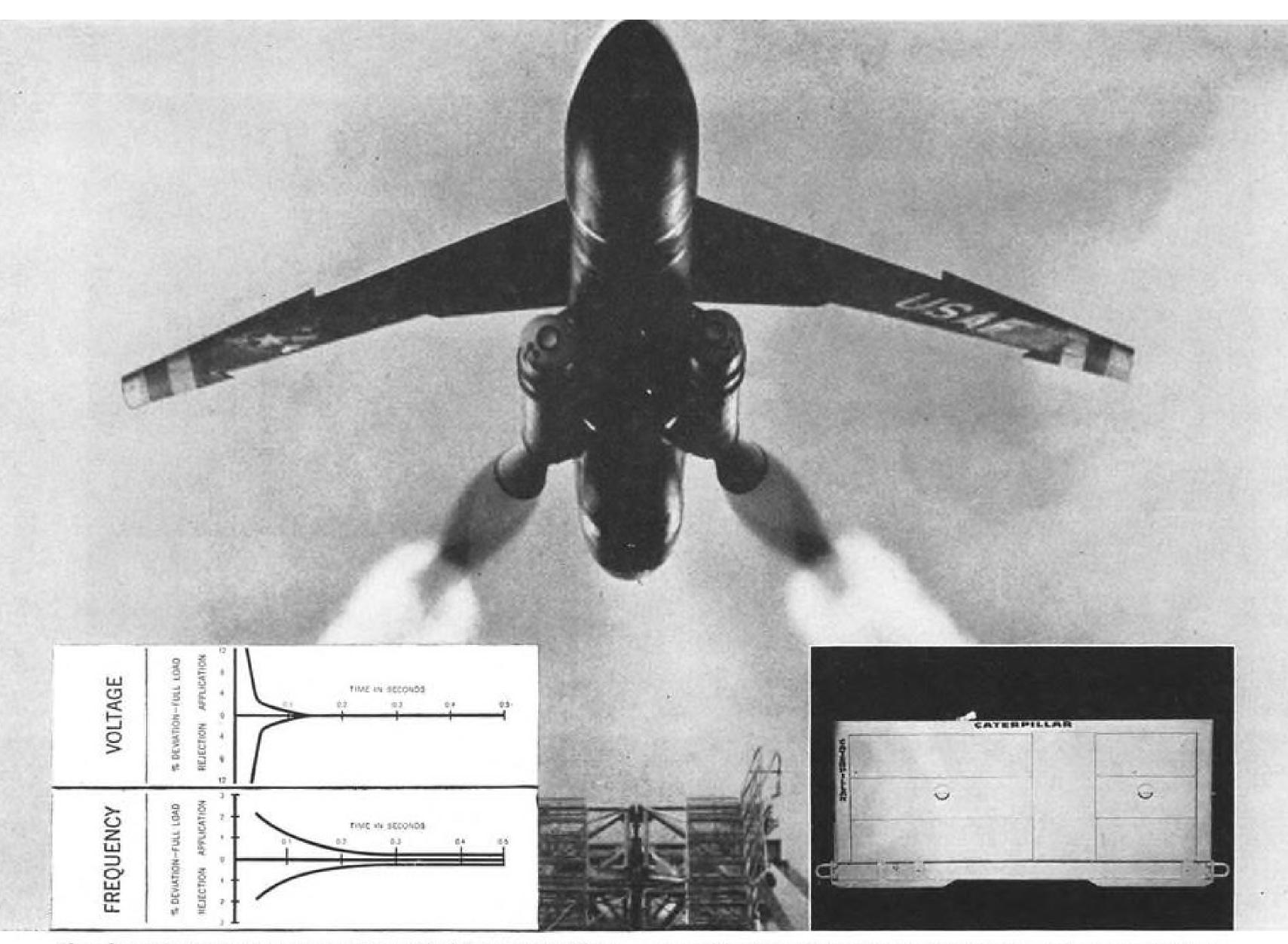
Solar manufactures the most comprehensive line of bellows and expansion joints in the world. They are made from a wide variety of stainless and high alloys for important nuclear, missile and industrial applications—in sizes ranging from ½ in.

to 35 ft in diameter. They are built for service from -320F to 1200F. And they tame "hard-to-handle" pressures up to 3500 psi for special applications.

A new pamphlet describes Solar's complete line of expansion joints. Write for it to Dept. F-16, Solar Aircraft Company, San Diego 12, California.







The almost instantaneous return to normal of the new low-silhouette Cat power unit under conditions of full-load application, and load rejection (117.4 volts), is shown in the above graph.

Low-silhouette Cat power unit with close voltage regulation is now being used in connection with ground support for jet starting and firing. The 400-cycle phase is specifically adapted to missilry.

## Caterpillar power fires SNARK...first U. S. intercontinental missile

The U. S. Air Force Snark SM-62, the first U. S. intercontinental guided missile, is fired with power from an electric set, developed by Caterpillar and now being supplied to the military.

The full designation of this specialized power unit is Caterpillar 60 KW 400-cycle 120-208 voltage low-silhouette portable ground support unit with precision voltage regulation.

The secret of this unit is the almost instantaneous recovery to both applied and rejected loads.

Other advantages found in all Caterpillar Engines include: trouble-free operation over a wide range of loads; dependability and long life; economy of operation; maintenance and operation by unskilled personnel; world-wide parts and service, and the ability to operate on any fuel from JP-4 through No. 2 furnace oil.

Creative engineering and quality of manufacture

have made Caterpillar the diesel leader for more than 25 years. For detailed information on the Cat 60 KW 400-cycle portable power unit with close voltage regulation, send in the coupon below.

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erators). Right engine was held to idle. Self-contained starting system elimi-nates need for APU, with saving of

weight.

Taxiing was smooth and all-around windshield space made for good visibility. We moved at a fair clip with that high rpm. on left engine. Air turbine motors for hydraulic and electrical systems will be removed on production models. System will be run off directdrive type pads on each engine.

### Nose Wheel Steering

Nose wheel deflection for steering, via wheel on pilot's side, is 50 deg. in each direction. Brakes can be used where necessary.

There were 12 of us aboard, including Leo Sullivan, chief engineering test pilot of Lockheed's Marietta Division, and Bob Schumacher, special projects test pilot who has been with the JetStar since its inception.

With full complement, plus some 6,000 lb. of fuel, airplane grossed out at 24,233 lb. Center of gravity was 25% MAC.

Wind at takeoff was from 50 deg. at 10 kt. Sea level pressure was 29.97 in. Outside air temperature was 67F.

We took off to the east, no flaps, with throttles to 10,000 rpm. Acceleration-from idle to full power-took about 5 sec. Airplane moved fast down runway and at about 50 kt. rudder became effective. Nose was raised at about 95 kt. and JetStar was airborne at 120 kt.-before we hit the third marker on the 10,000 ft. runway.

With 45% flaps, CL-329 can get off at 10 kt. slower speed; use less runway. Full flap travel-100%-extends flaps 50 deg.

### Climb Speed

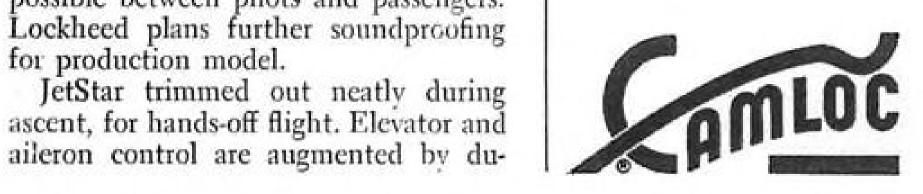
Airplane climbed swiftly, initially at 180 kt. and 10,000 rpm. Maximum specified speed until gear retracts is 200 kt. At 3,000 ft. we faired into best climb speed of 235 kt. IAS, reducing rpm. to 9,500. Speed and rpm. were held constant on up to 35,000 ft. (Max. continuous power is 9,500 rpm. or 630C exhaust gas temperature).

Visibility was excellent during climb. However, we had to restrict rate of ascent-holding to 4,000 fpm.-because of cloud deck at 5,500 ft. About 15 mi, east we found a hole and went

At 9,000 ft. rate of climb was 4,500 fpm. Exhaust gas temperature was 610C; fuel flow 2,820 lb. per hr. Relative quietness of airplane was evident during climb. Normal conversation was possible between pilots and passengers. Lockheed plans further soundproofing for production model.

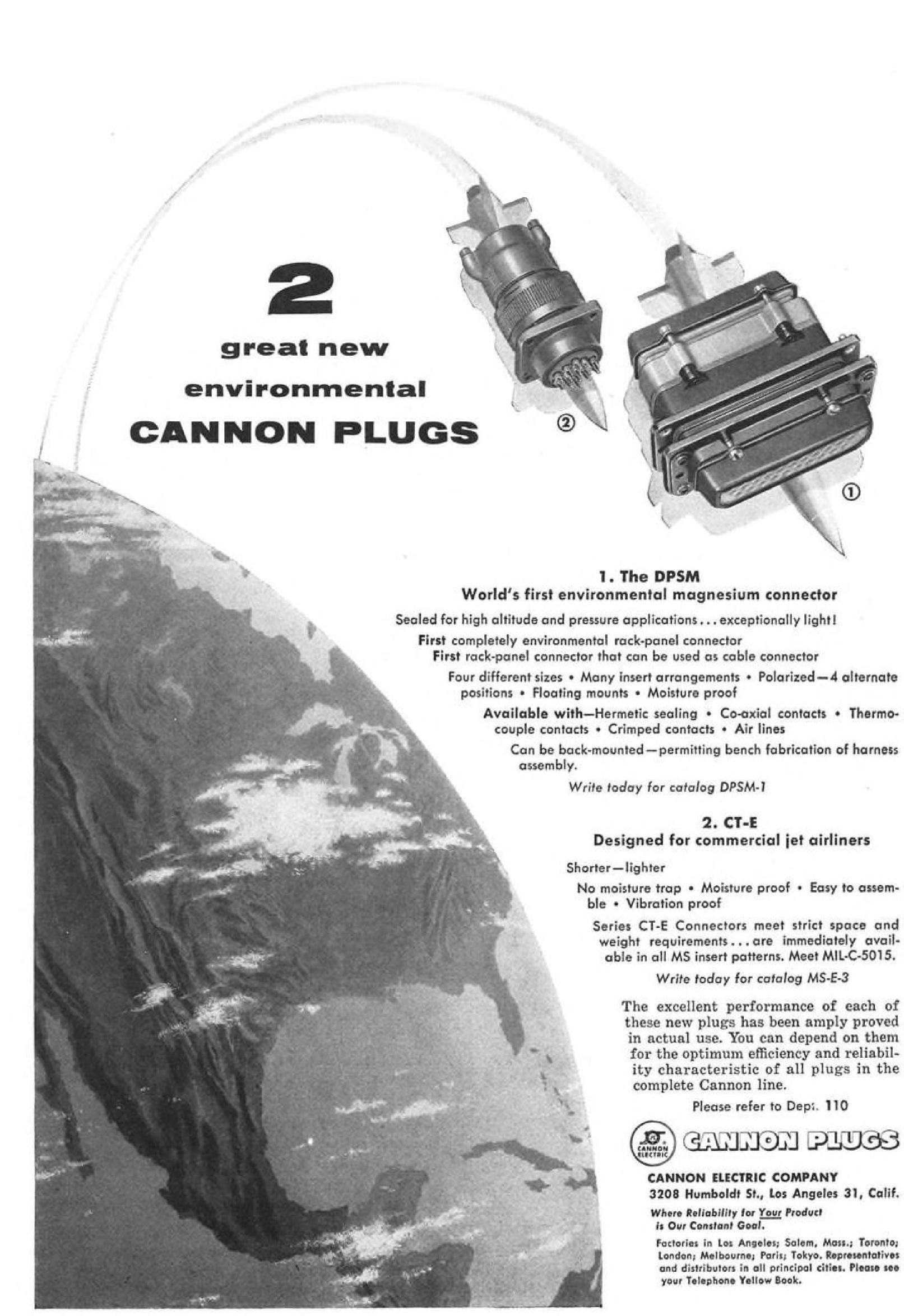
JetStar trimmed out neatly during ascent, for hands-off flight. Elevator and





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plex boosters. Pilot supplies only oneeighth of total force required for aileron centrol; one-third of force required for elevator control. Rudder pedal forces are reduced by means of the servo action of trim tab.

Airplane climbed through 20,000 ft. at 3,000 fpm.; from 30- to 35,000 at 1,200 fpm.

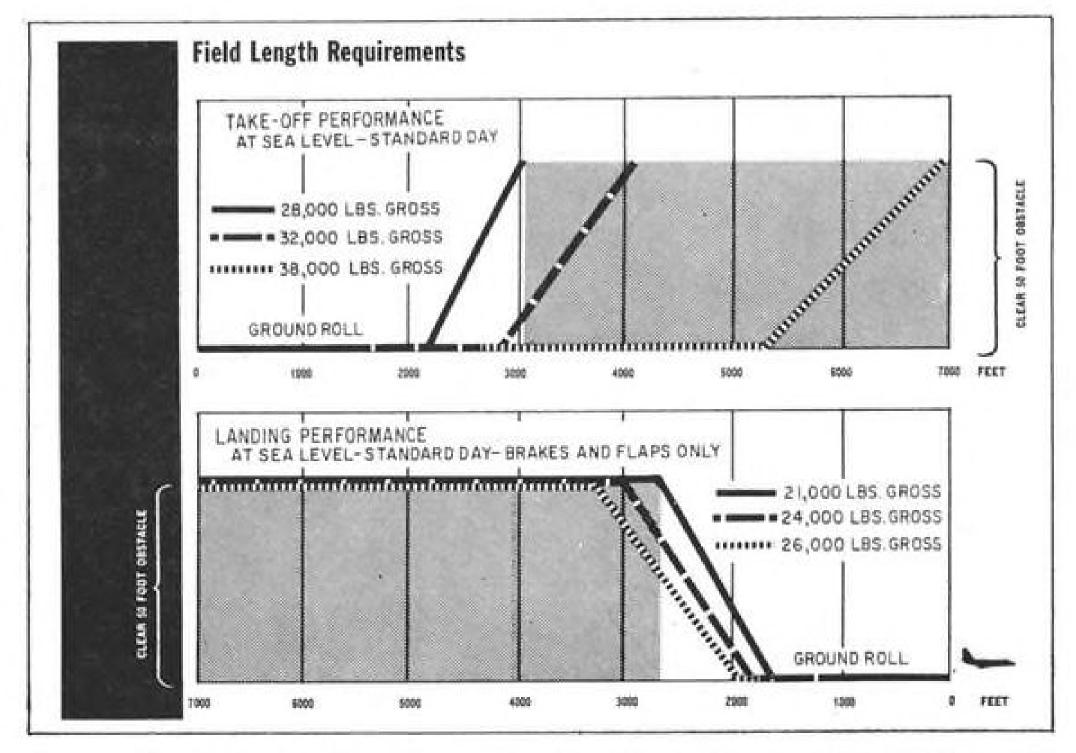
At altitude, pulling 88% power, Jet-Star indicated 270 kt. Airplane was not equipped with free air temperature gage. Estimating outside air temperature to be about -40C, we figured our TAS to be 480 kt. or 555 mph.

Control at 35,000 ft. was good. We had no trouble (outside of our own roughness) holding altitude during turns at varying degrees of bank and airspeed. JetStar is trimmed laterally by switch on center pedestal, which electrically actuates tab on left aileron.

Entire empennage rotates fore and aft for longitudinal trim. Vertical fin is hinged at lower aft corner and is rotated by d.c. motor-driven double screw jack. Total travel is 9 deg. of stabilizer angle. Two switches located on each side of pedestal, for pilot and copilot, control trim.

wheel so that either pilot may sever all power connections to trim actuators.

During flight airplane remained



quite comfortable. Cabin pressure altitude held to 8,000 ft. Passenger oxygen system will automatically pressurize should cabin altitude reach 14,500 ft. Should depressurization occur, small compartment door adjacent to each pastriggered by pilot.

If cabin altitude exceeds 10,000 ft. -which will happen at 45,000 ft. if

engines run below approximately 8,600 rpm.-warning light will alert pilot.

Airplane is presently limited to 425 kt. IAS for extension of speed brake, located under and aft on fuselage, just forward of empennage. Brake will serve In event of runaway trim, disconnect senger seat pops open, revealing as baggage compartment door on proswitch is positioned on each control plugged-in masks. System also can be duction models; on prototype, as access to air turbine motors, hydraulic and air conditioning systems.

Speed brake contains small hinged



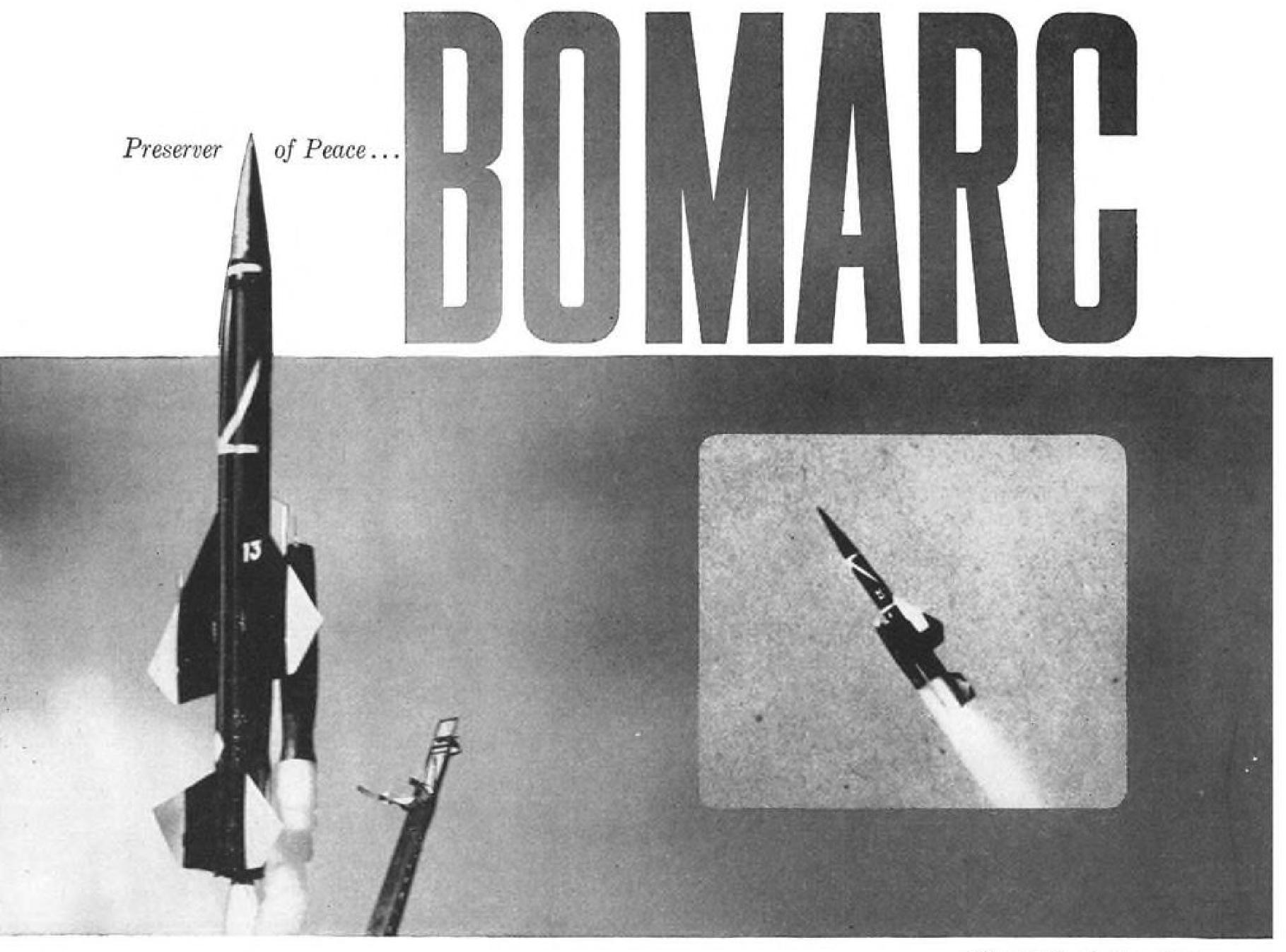
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## It tracks down an enemy at 300 miles

Described as the most potent of all ground-to-air defense missiles, the Bomarc pilotless interceptor, designed by Boeing, stands poised for the destruction of any "enemy" bomber within a 200-300 mile range. Its booster rocket has the power to hurl it more than 60,000 feet straight

up; then, powered by two ramjet engines, it hurtles by electronic instinct to its target at up to 3 times the speed of sound. For this guardian of our homes and way of life, RCA has been privileged to supply important advance components of the guidance system.



CAMDEN. NEW JERSEY

doors within its main structure to reduce buffet. Full travel is about 60 deg. We dropped brake at altitude and felt immediate deceleration of aircraft, with only slight pitching tendency.

With brake extended, and throttles to idle, descent can be made from 45,000 to 10,000 ft. in about four minutes—at rate of 8,500 fpm.

We dropped down to 21,000 ft. at rate of 4,000 fpm. At that altitude we cut back power and stalled JetStar in clean configuration. Entry was made with zero yaw, ball centered. Right wing was slightly heavy due to excess of fuel over left, necessitating aileron control during entry.

Stall warning—continuous annunciator signal through headsets and loud-speaker—sounded about 120 kt. IAS. Stall was preceded by steady buffet before break. Airplane broke at 100 kt. There was no sharp drop. With normal recovery procedures, altitude loss was about 200 ft. Airplane can be "walked" out of stall.

Automatic wing leading edge slats, over outer span to wing tips, aid in providing reduced stall speed and improved characteristics at slow speeds.

We stalled airplane a second time with boost off. While increased pilot force was used, excessive strength is not required to fly airplane. Stall results were about the same.

### Single Engine

With turbojets mounted on rear fuselage, single-engine performance presents no control problem. Rapid trim is not necessary. We cut the right engine and needed but two degrees of sudder trim to maintain directional control; slight elevator trim as airspeed dropped to 235 kt.

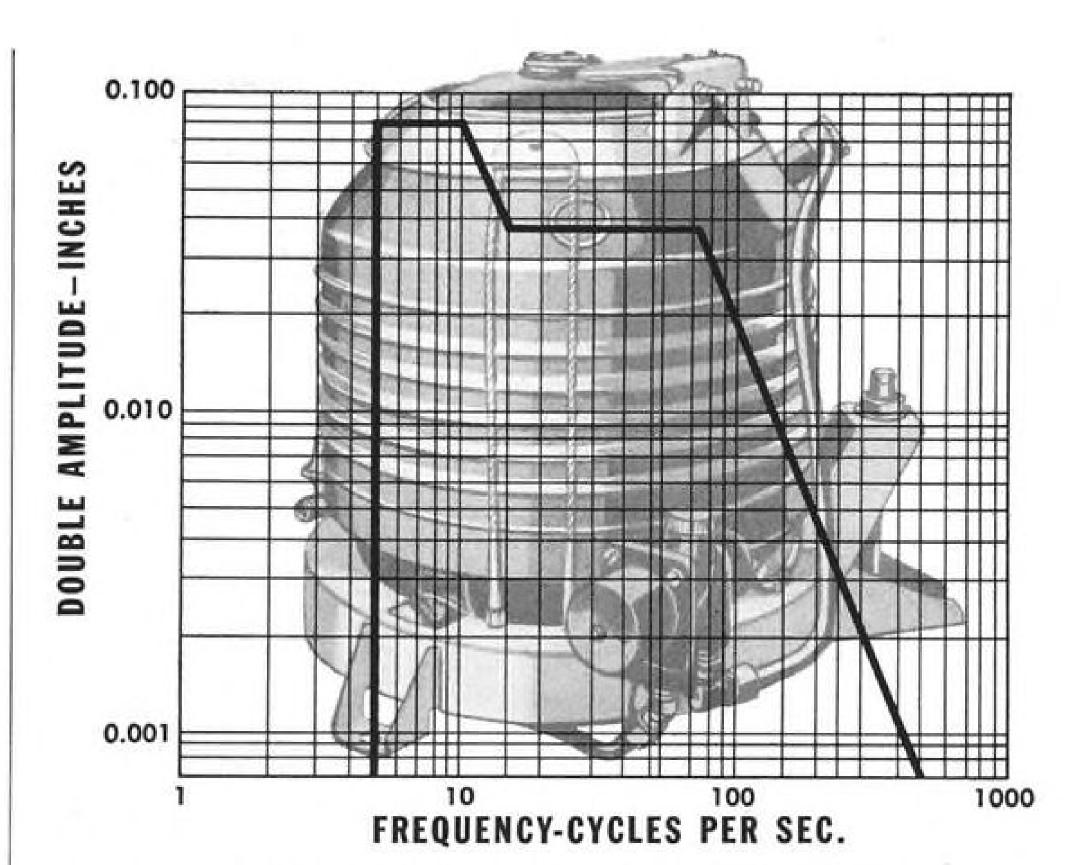
Turning away from and into dead engine, flight characteristics were normal. Specifications state that best single engine speed, gear up, is 165 kt.; gear down, 137 kt.

Air starts are simple, and made with throttle closed, emergency fuel shutoff valve open, crossfeed on. Rpm. of 1,300-1,600 should be maintained at airspeed of about 165 kt. Turning ignition to air start, throttle was advanced, light-off occurring before throttle reached idle. After rpm. stabilized, ignition was turned off.

No engine fire extinguisher system is installed in JetStar. Guarded switches on main instrument panel, which operate valves located in wing fillet, permit emergency fuel shutoff in event of engine fire.

Two-shot fire extinguishing system, consisting of two 6.5 lb. CF<sub>3</sub>BR bottles at 400 psi. are provided for speed brake compartment. Switch is on copilot's instrument panel.

Automatic anti-icing is provided by bleed air. JetStar plans boots on wing,



## NEW "RUGGEDIZED" BENDIX OXYGEN CONVERTERS

meet MIL-E-5272, Procedure I, vibration requirements

The superior design and shock-resistant features of Bendix'\* new liquid oxygen converters was proved recently in severe vibration tests conducted at Pioneer-Central Division, premier producer of airborne liquid oxygen systems. There advancedtype 10-liter units withstood Procedure I resonance and cycling vibration tests at room temperature as specified in MIL-E-5272, Section 4.7.1.

Moreover, these compact converters weigh less than 75 per cent of the weight allowed by Military Specifications and require less space than their 8-liter predecessors.

Other design features include: An economy circuit that permits low pressure operation with maximum use of available gas, with little or no

waste; a capacitance gaging probe that not only constantly senses the liquid level inside the converter regardless of pressure, but by being removable greatly facilitates replacement and converter decontamination.

Bendix Liquid Oxygen Converters are available in a variety of configurations—including an inverted mounting design. They are easily adaptable to virtually any type high-performance aircraft. No matter what your oxygen breathing requirements may be—either airborne or otherwise—Bendix is prepared to serve you. PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORPORATION, DAVENPORT, IOWA.

West Coast Office: 117 East Providencia, Burbank, Calif. Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N.Y., Canadian Affiliate, Aviation Electric Ltd., 200 Laurentien Blvd., Montreal, Que.







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AVIATION WEEK, May 5, 1958

91

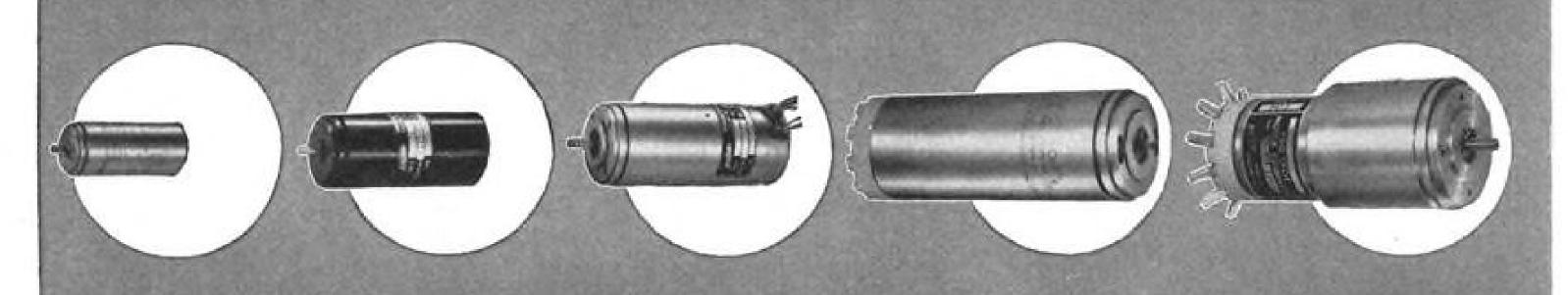
### COMPLETE LINE 125° C

## SERVO MOTOR TACH GENERATORS

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- Both Damping and Integrating types available with parameters to your requirement.
  - Complete size range: 8, 10, 11, 15, 18. Can be designed with gear train.
  - ► —54°C to +125°C ambient temperature range.
  - Designed to MIL-E-5272.
  - Assembled under closely controlled environmental conditions.



### 400 CPS SERVO MOTOR - TACHOMETER GENERATORS

						MOTOR	t				GENE	RATOR		
Oster Type	Size	Length Inches	Wt. Oz.	Rotor Inertia gm cm²	Rated Ø 1	Voltage Ø 2	No load speed RPM	Watts per phase @ Stall	Stall Torque OZ, IN,	Excit. Volt.	Output Volts per 1909 RPM	Lin.% to 3600 RPM	Null MV	Phase Shift @25°C
8MTG-6201-01	8	1.850	2.3	0.77	26	40/20	6,500	2.2	0.16	26	0.25	0.5	15	± 5°
*10MTG-6228-02	10	2.157	4.2	0.72	115	115/57.5	9,500	2.8	0.26	115	0.45	1.5	19	± 10°
10MTG-6229-12	10	2.100	2.9	1.09	33/16.5	52/26	9,500	3,0	0.28	26	0.45	1.5	13	±10°
*10MTG-6229-03	10	2.100	2.9	1.09	26	26	10,500	3.0	0.26	18	0,3	1.5	12	±10°
10MTG-6229-15	10	2.100	2.9	1.09	26	26	10,500	3.0	0.26	26	0.3	1.5	12	± 10°
*10MTG-6232-05	10	2.104	4.2	1.1	115	36/18	6,500	3,5	0.26	115	0.30	1.5	15	± 10°
11MTG-6251-13	11	2.531	7.0	1.3	115	115/57.5	6,500	3,5	0.63	115	0.55	0.5	19	± 10°
11MTG-6251-00	11	2.531	7.0	1.1	115	40/20	6,500	3.5	0.63	115	0.55	15	19	± 10°
11MTG-6254-01	11	2.200	6.0	1.1	115	115/57.5	6,500	3.5	0.63	115	0,55	1.5	19	± 10°
15MTG-6280-01	15	3,281	14.0	5.3	115	115/57.5	5,000	6.2	1.5	115	3.0	0.2	13	± 5°
+15MTG-6276-03	15	3,875	15.0	4.4	115	57,5	8,500	5.8	0.70	115	2.75	0.2	13	± 0.5
18MTG-6302-02	18	3,680	20.0	5.7	115	115/57.5	9,000	16,0	2,7	115	3,0	0.2	13	± 5°
18MTG-6302-04	18	3.680	20.0	5.7	115	115/57.5	4,800	9.2	2.4	115	3,0	0.2	13	± 5°

\*These units designed for 85°C ambient but same characteristics can be designed for 125°C. †Additional 21.4 watts for heater, the values given are independent of ambient temperature.

Other products include servos, synchros, resolvers, motor-gear-trains, AC drive motors, DC motors, servo mechanism assemblies, reference and tachometer generators, servo torque units, actuators and motor driven blower and fan assemblies.

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stabilizer and fin. Windshield is heated by hot air.

Prior to landing speed brake was dropped and initial approach made at 200 kt. Brake was raised and gear and half flaps dropped. Present drag brake cannot be used in landing, taxi or take-off because of ground clearance problems. Extended, it's only about five infrom ground, would hit on nose-high approach. USAF reportedly would prefer brake forward; combine it with escape hatch.

Airplane flew downwind at 150 kt. Turning base, rpm. at 6,000, we dropped full flaps; reduced speed to 130 kt. Flaps are full-span slotted type, two sections on each wing. Actuation is hydraulic. JetStar was turned on final at 120 kt., rpm. still at 6,000. We were over the fence at 115 kt., with gradual flareout. Touchdown was at 90 let

In event of go-around, throttles would be advanced to 10,000 rpm., slow-retracting flaps and gear raised, and climb-out initiated at 180 kt. Closed pattern, at 6,000 rpm., can be flown on less than 200 gal. of fuel.

### Drag Chute

CL-329 ground roll can be reduced a minimum of 400 ft., with resultant brake saving, by use of drag chute. Self-packable 16-ft, chute is installed in fuselage tail cone. Maximum speed for release is 130 kt. Control is located on right side of pilot's instrument panel. Chute may be left in deployed position for taxi with both engines operating.

Cost of the JetStar will approximate \$1 million. Production would begin on July 1 at Lockheed's Marietta Division if an Air Force order is received in time. First rollout of the utility jet would be 17 months later, in November, 1959. Production would accelerate to 10 a month about two years after the initial go-ahead date (AW Mar. 31, p. 15).

Using a modified Air Transport Assn. method of computation, based on 600-hr.-year utilization, Lockheed figures that the JetStar, using TJ37 engines, would run \$1.08 a statute mi.; 12.5¢ per seat mile. Total operating cost per aircraft hour, Aviation Week was told, would be \$496.

Other estimates: Maintenance, based on 750 hr. overhaul cycle, \$58.37 per hr. Fuel—JP-1 type at 14.5¢ gal.—\$51.30 per hr. Oil, \$3.73 per hr. Annual crew salaries computed are \$16,-000 for pilot; \$8,000 for copilot. Expenses for the two, at \$2.50 per hr., would total \$1,500. Insurance cost is put at \$83.71 per hr.

Commercial market over the next 10 years would embrace about 700 aircraft, Lockheed representative estimated.

As a standard plush 10-passenger

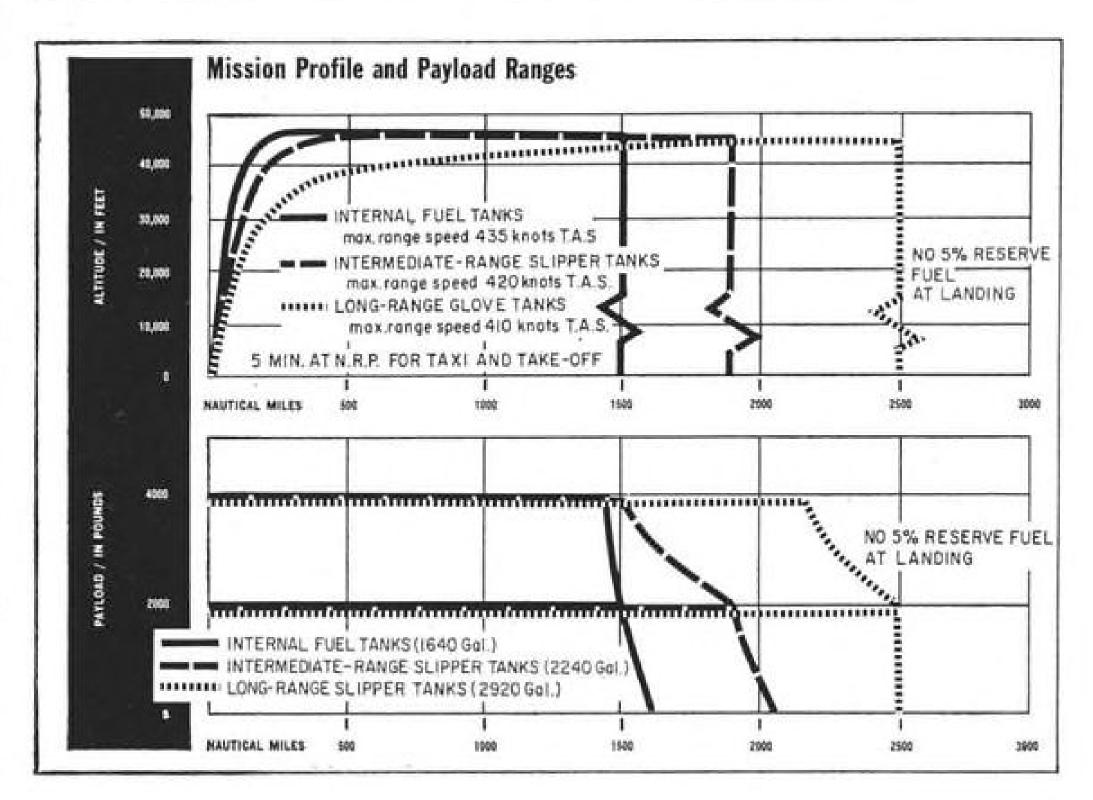
### JetStar Normal Mission

	GENERAL ELECTRIC J85	CURTISS- WRIGHT TJ37A1
Takeoff Gross Wt	28,872 Lb.	29,127 Lb.
Passengers	10	10
Fuel Wt	10,894 Lb.	10,894 Lb.
Range*	1,550 N.M.	1,500 N.M.
Max. Cruise Alt	45,000 Ft.	45,000 Ft.
Service Ceiling (TOGW)	47,150 Ft.	44,450 Ft.
Service Ceiling, 1 Eng	41,650 Ft.	25,000 Ft.
Cruise Mach	.77	.76
Mil. Critical Field Length	2,610 Ft.	3,300 Ft.
Landing Speed (Mil. Spec.)	88 Kt.	88 Kt.
CAA Takeoff Field Length	3,760 Ft.	5,500 Ft.
CAA Landing Field Length (21,000 Lb.)	5,550 Ft.	5,310 Ft.
Landing Ground Roll (1/2 Fuel)	1,755 Ft.	1,735 Ft.
With 20 Ft. Drag Chute	1,365 Ft.	1,350 Ft.
Landing Distance (1/2 Fuel)	3,040 Ft.	3,000 Ft.
With 20 Ft. Drag Chute	2,650 Ft.	2,615 Ft.

### Extended Range Mission

	GENERAL	CURTISS-
	ELECTRIC J85	WRIGHT TJ37A1
Takeoff Gross Wt	38,032 Lb.	38,287 Lb.
Fuel Wt	19,214 Lb.	19,214 Lb.
Range*	2,380 N.M.	2,200 N.M.
Max. Cruise Alt	45,000 Ft.	45,000 Ft.
Service Ceiling (TOGW)	40,500 Ft.	38,300 Ft.
Service Ceiling, 1 Eng	33,300 Ft.	16,300 Ft.
Mil. Critical Field Length	4,770 Ft.	6,000 Ft.
		(20% Thrust
		Augmentation)
Landing Speed	91 Kt.	91 Kt.
CAA Takeoff Field Length	7,950 Ft.	8,230 Ft.
CAA Landing Field Length (21,000 Lb.)	5,550 Ft.	5,310 Ft.
Landing Ground Roll (26,000 Lb.)	1,930 Ft.	1,855 Ft.
With 20 Ft. Drag Chute	1,495 Ft.	1,455 Ft.
Landing Distance (26,000 Lb.)	3,280 Ft.	3,230 Ft.
With 20 Ft. Drag Chute	2,845 Ft.	2,800 Ft.

\* With 70 Kt. Headwind, Plus 30 Min. Endurance at Sea Level in Lieu of Mil 5011A.



## Today's air power in action:\*



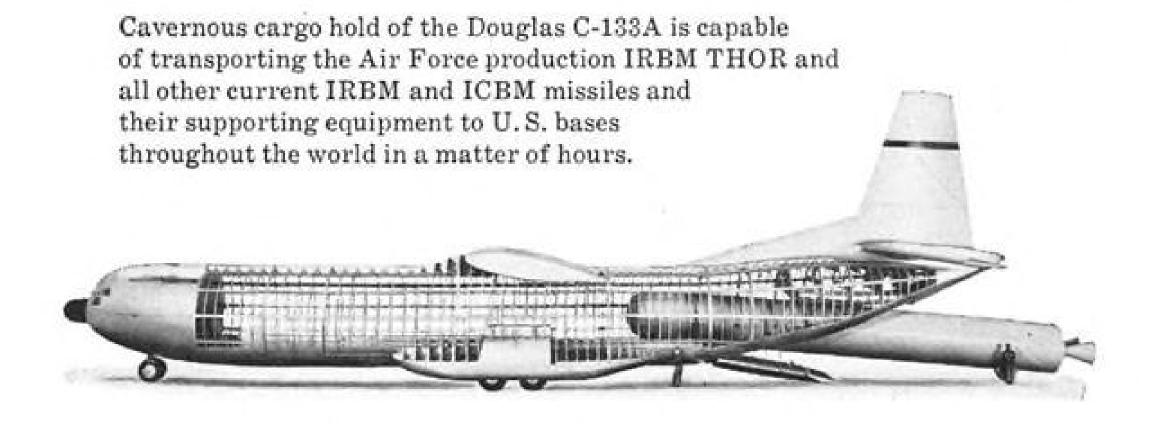
## This Air Force giant can swallow an ICBM

The new Douglas C-133A is the only jet age airplane capable of transporting both IRBM and ICBM missile systems. It dwarfs all other U.S. cargo aircraft in productivity, capacity and range, yet operates at the lowest cost in air logistics history.

This huge turboprop air freighter can airlift 100,000 in hours, the C-133A makes it possible. Its can be considered as low as 5¢ on both short and long haul in hours, the C-133A makes it possible in hours, the C-1

operations. It has the fastest loading and unloading time per ton of any modern airplane. Yet, despite its huge size and 350 mph+speed, it can operate from short runways.

Because of its ability to move the giant new missiles and their supporting equipment anywhere in the world in hours, the C-133A makes it possible to achieve a major increase in the effectiveness of our overseas bases while decreasing their size. It will buy more protection per dollar for the American taxpayer.

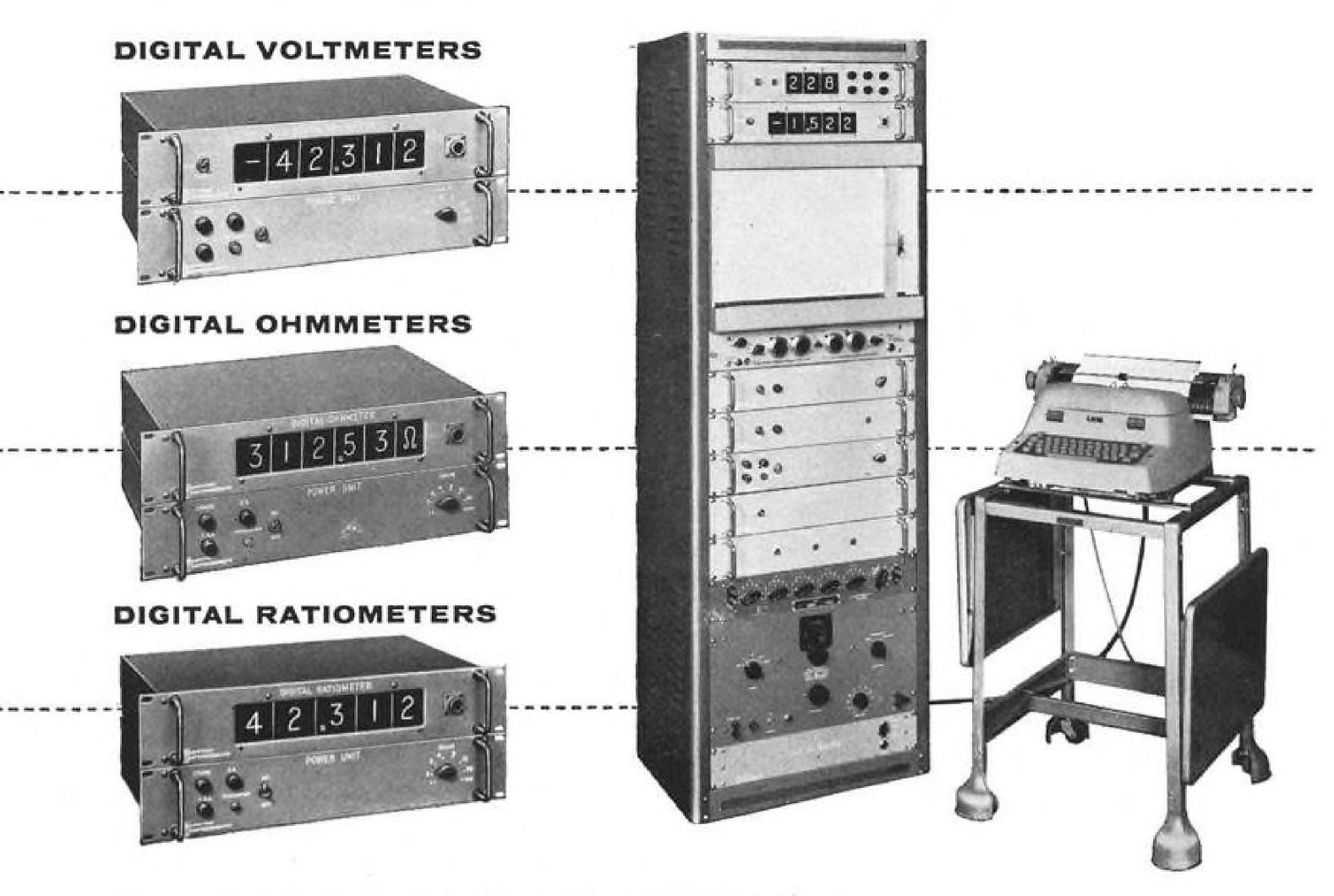


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Fully transistorized circuits result in increased reliability, reduced power consumption, low heat dissipation, miniaturized packages, and eliminate radio noise and line transients.

Important new specifications—Wider, dynamic ranges cover all voltages from 100 microvolts to 1,000 volts; resistance from 10 milliohms to 10 megohms. Input power frequencies from 50 to 400 cycles. New balance logic speeds down ranging. Automatic AC ranging from 30 to 10,000 cycles. Use of transistors increases switch life by a factor of three.

Wide selection of input and output modules for operating printers, IBM punches, etc., can be accommodated without modifications. All contacts are accessible at rear panels with connectors. With plug-in modules, digitized data is provided in printed form, punched cards or tape without modification to basic measuring instruments.



San Diego, California



ENTIRE JetStar empennage rotates fore and aft for longitudinal trim. Total travel is nine degrees of stabilizer angle. Speed brake serves as access door to rear compartment.

carrier, JetStar carries 10 forward facing airline seats on 40 in. spacing. As a high-density personnel carrier it can carry 22 people on two facing rows of 11 side-by-side seats. Utility cargo version provides space of 716 cu. ft. Payload capability of 4,000 lb. is achieved with on-load densities of 6 or 7 lb. per cu. ft.

In addition to factors previously cited, there are other advantages to mounting turbojets on the rear fuse-lage:

• Engine noise sources and rotating parts are located aft of cabin.

• Air inlets are protected by the wing from foreign object ingestion.

• Airframe structure is separated from exhaust wake, avoiding buffeting, vibration and fatigue.

• Engine fire hazards are isolated from airframe by free-stream air spaces. While uncontrolled fires can result in pod loss, pod should fall free of airplane.

 Rear engine layout makes for more satisfactory airflow speed pattern in front of compressor intakes.

Passengers and ground personnel are immune from intake or jet blast danger.
During belly landing engines would not be subject to direct impact.

JetStar's fuel system incorporates low pressure filter, two parallel enginedriven fuel pumps, and a combined fuel control unit. Fuel is delivered by boost pump via low pressure filter to enginedriven pumps which discharge it at high pressure to combustion chamber burners via combined control unit. Flow to burners is subject to automatic correction for engine rpm., barometric

carrier, JetStar carries 10 forward facing airline seats on 40 in. spacing. As a high-density personnel carrier it can carry 22 people on two facing rows of acceleration.

Fuel is transferred into sump tanks by d.c. motor-driven dual tank transfer pump. Float switch is set at 130 gal. level. Indicator light shows on warning panel when sump quantity falls below 65% (about 85 gal.).

### **Dump System**

Airplane's dump system consists of a two-inch fuel dump line extending from wing tank center through solenoid dump valve to dump chute located at wing tip trailing edge. Inlet end of dump line is located above tank bottom to prevent dumping below approximately 258 gal.

Dump rate is about 35 to 40 gpm. from each tank. System has proven satisfactory in investigation up to 250 kt., gear and flaps retracted.

Airplane start air system is located in aft baggage compartment and consists of two 15 in. spherical pressure receivers containing 19.75 lb. air at 2,600 psi. Two safety relief valves set to open at 3,000 psi. are located on high pressure manifold. Two air pressure regulators mounted in series reduce high pressure air to 200 psi. for delivery to engine starter.

Ground start cart has same components as airplane's start system except that pressure containers consist of four "Argon T" cylinders containing 24.6 lb. air each at 2,600 psi. One-inch fitting for cart connection is installed on JetStar at speed brake opening right side.

In event of compressor failure or low pressure in bottles and no cart available, a \(\frac{1}{2}\) in. fitting and \(\frac{1}{2}\) in. fitting on left side of speed brake opening are used for connecting external nitrogen cylinders.

Electrical system is 28v., d.c., singlewire circuit that is grounded through aircraft structure. Alternating current is supplied by two rotary inverters energized from d.c. system. Direct current is supplied by two ATM-driven 350 amp. generators paralleled with two 12v. batteries connected in series for 24v. operation.

Normal inverter supplies 3 phase, 400 cycle, 115v. power and is rated at 1,500v. amp. Emergency inverter (250v. amp. rating) supplies 3 phase, 400 cycle, 115v. power to essential bus only for



### B-58s Receive Between-Flight Maintenance

burners via combined control unit. Five Convair B-58 Hustler bombers receive between-flight maintenance in experimental hangar at Ft. Worth, Tex., which accommodates six B-58s but could hold only two Convair correction for engine rpm., barometric B-36 heavy bombers. Length of the B-58 is 97 ft.; length of the B-36 is about 162 ft.

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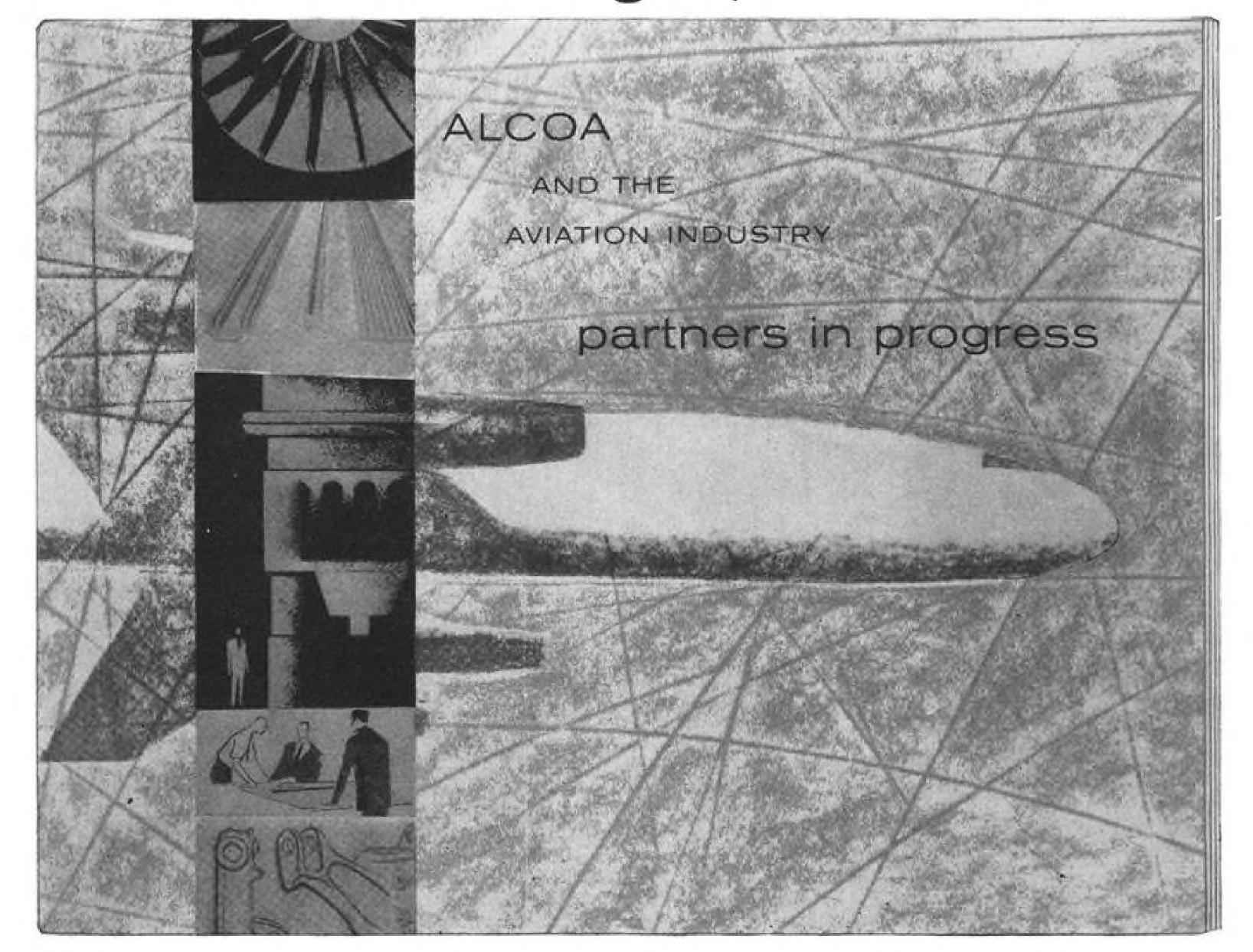
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### Rotodyne Flies With Complete Tail

British Fairey Rotodyne makes flight with complete tail; first flight of the transport was made without canted surfaces on upper portion of the tail (AW Nov. 18, 1957, p. 37). Rotodyne is powered by two Napier Eland propeller turbines, each rated at 3,500 eshp. Air from engines passes through rotor blades, burns with fuel in four Fairey tip pressure jets.

navigation and engine instruments, fuel quantity system, air conditioning control and hydraulic pressure indicators.

Engine oil system is automatic and requires no controls. System is drysump type which lubricates all bearings by continuous oil circulation, except turbine bearing which is lubricated by metered dead-loss supply. Tank is mounted on top of compressor casing. Capacity is 14.4 pints.

JetStar has three hydraulic systems: · System I. Operates wing flaps, speed brake, aileron and elevator boost systems, landing gear, nose gear steering, brakes. This is constant pressure system incorporating an accumulator, reservoir, and self-regulating pump driven by left air turbine motor.

· System II. Operates aileron and elevator boost, right fuel boost pump, and, upon selection, may be used for wing flap and brake operation. Pump for this system is driven by right air turbine motor. System contains reservoir but no accumulator.

• System III. Primary purpose is to provide hydraulic pressure for operation of fuel boost pump for initial engine starting. It is used as emergency source of system pressure whenever ATM-driven pump is inoperative. Pump is d.c. motor-driven, connected in parallel with System I ATM-driven pump. System I hydraulic pressure is 1,500 psi. when operating on System III pump.

System III pump does not provide enough pressure to retract gear or flaps. But gear extension is satisfactory. Airplane's boost system will operate on either System I or II pressure, should one or the other fail.

Should the left engine fail with gear down, retraction cannot be made. Only

gear will be partially extended. Emergency gear extension is made via "T" handle on pilot's side of instrument panel. Gear will free-fail; airflow will lock it down.

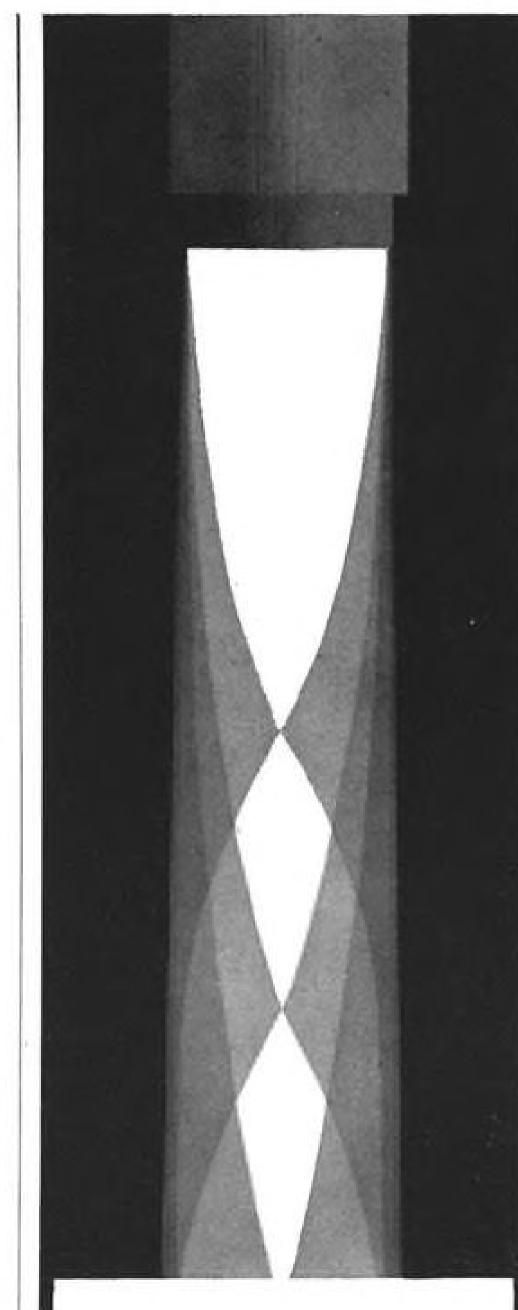
Lockheed set a production record by putting the JetStar into the air within 34 weeks. It did this by forming a separate outfit, under Corporate Vice President Kelly Johnson, and isolating it. Second prototype JetStar, N329K, at this writing is about to begin a series of nation-wide flight tests, stopping at military command headquarters.

### Liquid Fuel Engines **Use Standard Parts**

Mass production techniques in the normally critical manufacture of liquid propellant rocket engines are utilized in manufacturing drone powerplants by Reaction Motors, Inc., Denville, N. J. Company says that design simplicity and standardization of components permits the tailoring of engine systems to meet requirements of drone designs.

The regeneratively cooled propulsion units, based on a simple design approach, achieve versatility through the interchange of standard components. Specifications for supersonic or subsonic drones are met by varying combinations of thrust chambers, sustainer and booster units, chamber pressures, propellant combinations and other factors.

Engines are re-usable in surveillance and target drone applications, but Reaction Motors claims that its cost is low enough to permit them to be used in expendable vehicles. In regard to cost, availability and performance, the new liquid propellant systems are said to nose gear will retract, and flaps. Main compare favorably with other engines.



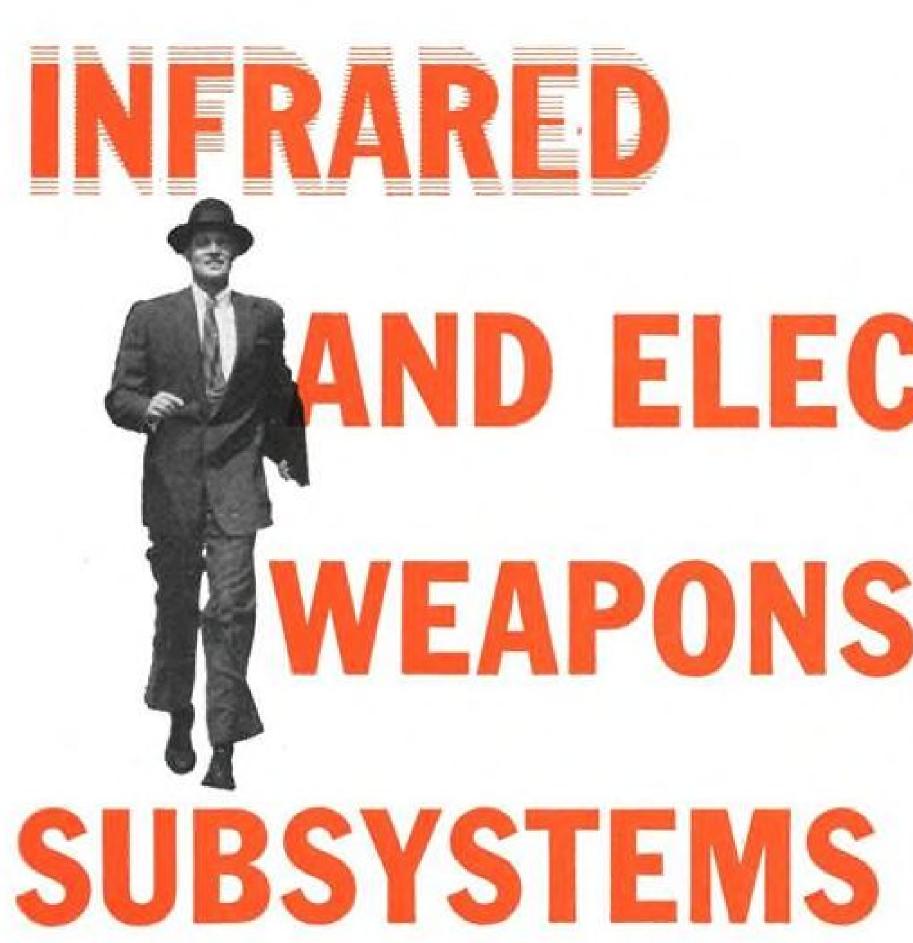
### SOLID PROPELLANT **ENGINEERS**

Advancements in ballistic missile and space vehicle design have opened broad new fields for solid propellant rockets. Space Technology Laboratories has challenging positions in this field for engineers with five to ten years of experience in the design and development of solid propellant rocket engines.

Inquiries regarding these positions are invited.

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\*Current contracts of classified nature are not listed.

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AN/TRD-3 Direction Finding

Equipment AN/TRD-10 Direction Finding

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Ship to Ship Digital Data Transmission System for ASW

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IR Arctic Region Crevasse Detector

for IR Systems

Field Service Project

IR Gun Flash Detector

Track-while Scan Radar

AN/ASQ-4 - IR Search Set

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Airborne Infrared Monochromator (WADC) Infrared Source Study

Finding Equipment

Finding Equipment

Equipment

Equipment

**BOMBING SYSTEMS** AF 33(038)-17396

DIRECTION FINDING SYSTEMS

DA-36-039 SC-5606

DA-30-069-ORD-2135

Sub-Contract Sub-Contract

Specialties Sub-Contract

NAVIGATION SYSTEMS

AF28(099)-27 NOa(s)-10893 DA-36-039 SC-42719 AF 33(616)-3102

AF 33(600)-35159

DATA TRANSMISSION SYSTEMS W36-039-sc-44559

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N383-45488A CONTROL SYSTEMS W33-038-ac-17019 AF 30(602)-1629

AF 33(616)-2963 Burroughs Sub-Contract

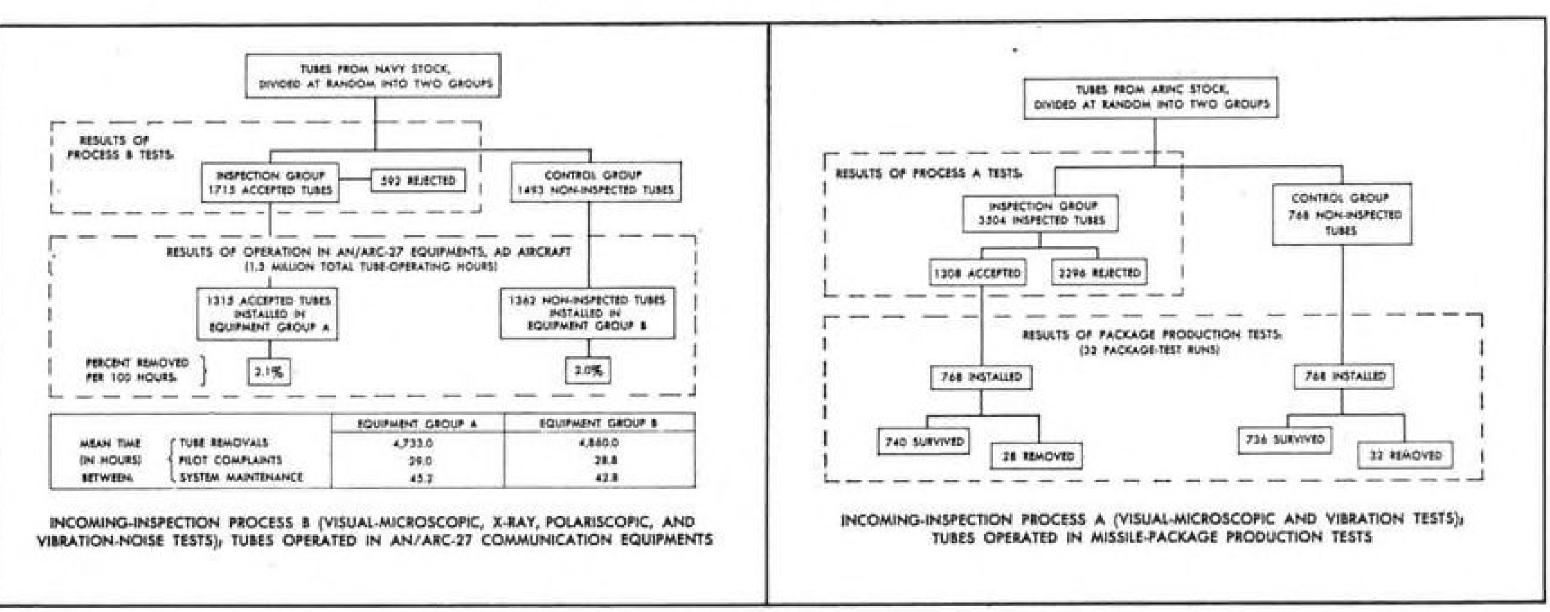
Servo Control System Servo Control Preamplifier Radar Height Indicator Aircraft Engine Flame Detector System Azimuth Mark Generator for use in SAGE System

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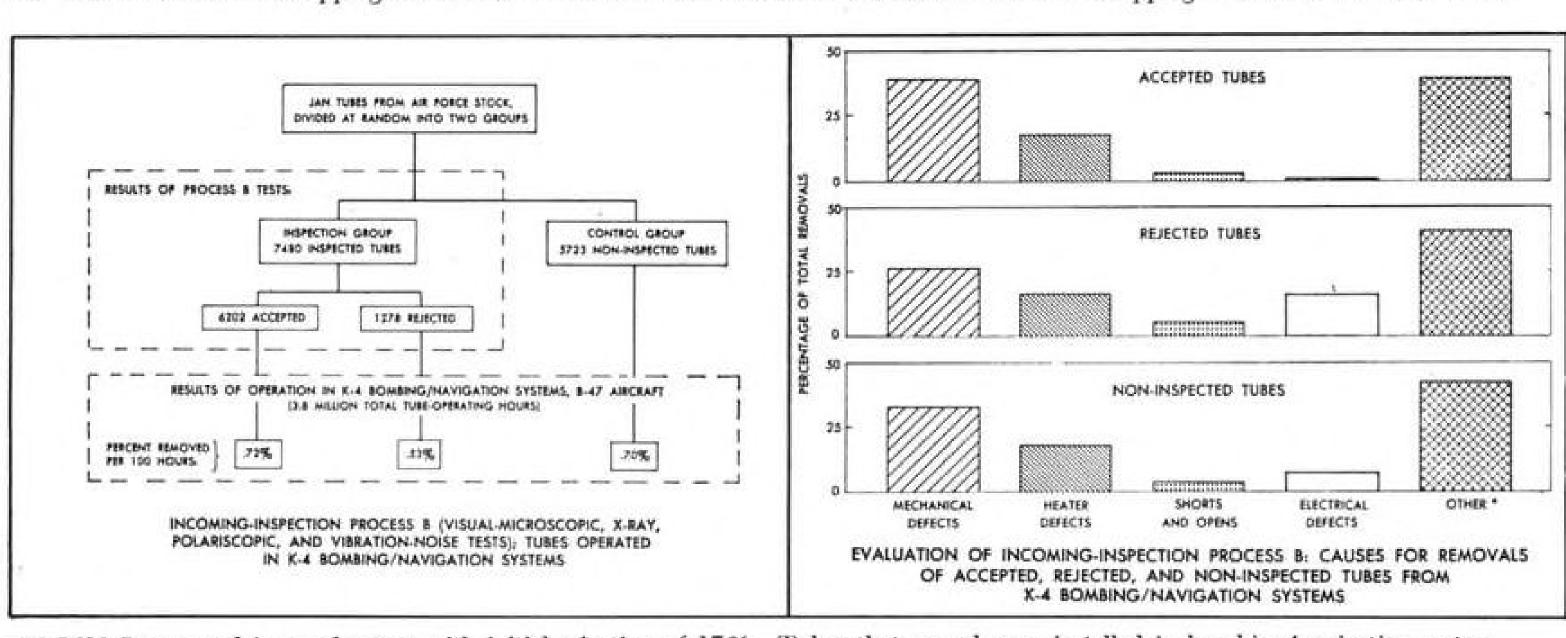
W28-099-ac-313

Transmitting Buoy

### AVIONICS



PROCESS B resulted in scrapping about 25% of tubes in one evaluation. Process A resulted in scrapping of 66% of the tubes tested.



PROCESS B was used in another test with initial rejection of 17%. Tubes that passed were installed in bombing/navigation system.

## Tube Tests May Not Improve Reliability

By Philip J. Klass

Washington-Missile and avionic manufacturers who subject vacuum tubes to special tests and processing in the belief that this weeds out potential failures and improves equipment reliability will be jolted by results of Defense Department investigation.

Its conclusions: costly, time-consuming special tube testing produces no measurable improvement in reliability, possibly has the reverse effect.

Eve-opening results are contained in new report by Aeronautical Radio Inc. Reliability Research Department which carried out investigation for the military services. Arine's report suggests that the conclusions also may be valid for special testing of transistors and other avionic components.

Theory that special tube tests devised

by many missile/avionic manufacturers do not improve reliability was first advanced more than two years ago by Arine, and reported by AVIATION WEEK (Nov. 28, 1955, p. 45). This hypothesis, resulting from Arine's extensive reliability studies for Defense Department and the airlines, conflicted sharply with views of companies using such procedures. At that time Arine lacked sufficient data to prove its point.

### Convincing Evidence

Evidence obtained during past two years in scientifically controlled tests is so convincing that the three manufacturers whose tube processing procedures were used as guinea pigs in the investigation have voluntarily abandoned their use, Arinc reports. Other firms are following suit.

that check performance of incoming tubes to military specification standards to which they are designed, or with the use of testing to full MIL-spec compliance using quality control sampling techniques. Arine also concedes that special testing may have been justified a few years ago before quality of tubes had been raised to present levels. Arine acknowledges that some of the

company-devised special tests may be valuable for quality control purposes, but believes these should be conducted by the tube manufacturer so that prompt corrective action can be taken in tube design and/or manufacturing.

Here are a few of the findings of the Arine investigation:

 Process A, consisting of two-stage visual-microscopic inspection and a vibration-noise test, resulted in scrapping Arinc has no quarrel with companies 66% of the tubes tested. Yet when the MARK I-A

of the

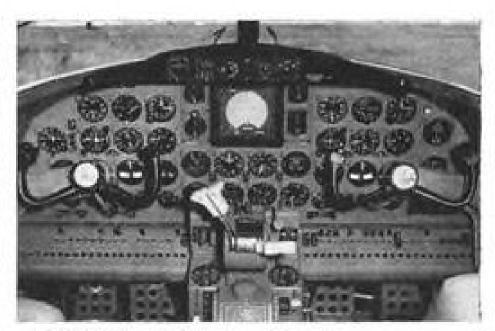
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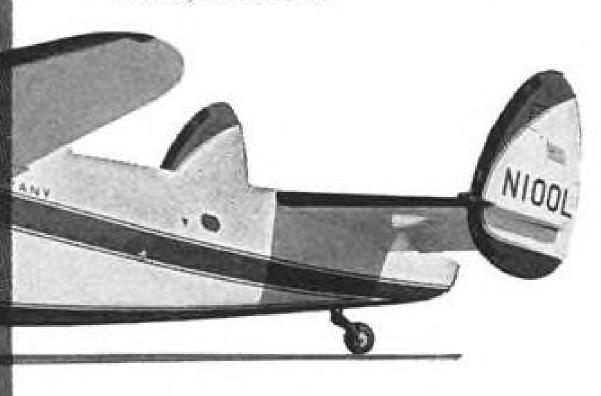
NEW "straight ahead" radar screen mounted in LEARSTAR Mark I-A instrument panel



NEW custom-built to Solo Cup Co. specifications is roomy, divan equipped lounge



NEW galley location in rear provides easy access, convenience



This proud new Learstar, built for Solo Cup Company, Chicago, represents another triumph in aircraft engineering. Combined are the high performance characteristics of both Learstar Mark I and Mark II. In every measure of safety, power, payload, cruising speed and range, the new Learstar Mark I-A matches the famous Mark I - yet it is offered at a greatly reduced initial cost. Fully loaded, with a crew of two, ten passengers, and 700 pounds of baggage, this new Learstar can travel coast to coast non-stop at a speed of 280 miles per hour. Learstars are the only business aircraft of intercontinental range - the only business aircraft that match airline speed and range.

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a realistic view of corporate economy. If you now own or contemplate operating business aircraft, it will pay you to investigate the advantages of Learstar-how this superior business transport compares favorably with other business aircraft, both in original cost and economy of operation.

### cations sets installed in Navy AD-type aircraft as were a similar number of unprocessed tubes drawn at random from Navv stock. After accumulated total of 1.3 million tube operating hours, Arine found the unprocessed tubes actually had a slightly lower removal rate than those that had passed the extensive inspections, i.e. 2.0% vs. 2.1% per 100 hr. operation. • Process B also was used in another

tubes which had passed tests were op-

drawn from stock, 3.7% of the proc-

essed tubes failed, compared with 4.2%

for unprocessed tubes. This insignifi-

cant difference in failure rates does not

justify cost of tests and scrappage,

• Process B, consisting of visual-

lariscopic examinations plus vibration-

25% of tubes in one evaluation. Proc-

essed tubes that passed were installed in

Arine says.

evaluation with initial rejection of 17% of the batch. Tubes that passed were installed in K-bombing/navigation systems flown in Air Force B-47s together with unprocessed tubes drawn from regular stock. After accumulated total of 3.8 million tube operating hours, Arine again found that unprocessed tubes had slightly lower removal rate (0.70% vs. 0.72% per 100 hr.).

Third batch of tubes, consisting of units which had failed to pass one or more of the special process B inspections but which were otherwise operative, also were installed in B-47 bombing systems. Surprisingly, this group suffered the lowest removal rate of the three-only 0.53%. However, Arine cautions that the number of tubes involved in the sample is too small to assure statistical validity. It therefore does not recommend use of test rejects for maximum reliability.

These two inspection-processing techniques, plus a third involving use of thermal shock procedures, were selected



Cold Plate

Heat generated by power transistors used in ground and airborne avionic circuits is dissipated by means of a cold plate which transfers the heat across a pressure thermal contact to cooling air. Unit has been designed for Collins Radio Co. by United Aircraft Products, Inc.



USED BY LEADING AIR LINES, THESE INDICATORS HAVE PROVEN THEIR RELIABILITY BY YEARS OF SATISFACTORY SERVICE.

### THERMOCOUPLE TYPE

All LEWIS thermocouple indicators are fully cold-end compensated, magnetically shielded and are available for use with iron-constantan, copperconstantan or chromel-alumel thermocouples in all standard ranges for the thermocouple material used. A few typical ranges are listed below.

MODEL 17B, 234" case to AND 10401 -50 to +300°C Cylinder Temp. (AN 5536-1A or T1A) -50 to +300°C Bearing Temp. ... 0 to +1000°C Exhaust Temp.

MODEL 49B, 17/8" case to AND 10403 -50 to +300°C Cylinder Temp. ... 0 to +1000°C Exhaust Temp.

MODEL 76B dual, 234" case to AND 10401 -50 to +300°C Cylinder Temp. (AN 5536-2A or T2A) -50 to 300°C Bearing Temp. 0 to +1000°C Exhaust Temp.



MODEL 17B



MODEL 49B



MODEL 76B

### RESISTANCE TYPE

Accurate ratiometers, these LEWIS indicators are remarkably free of voltage error, have nearly linear scales (not crowded at the ends) and are magnetically shielded. A few typical ranges are given below. Not shown is Model 46B, 23/4" single.

MODEL 47B, 1%" case to AND 10403 -70 to +150°C AN 5790-6 or AN 5790T6 0 to +125°C Oil Temp. ... -50 to +50°C Air Temp.

MODEL 77B dual, 2¾" case to AND 10403 -70 to +150°C AN 5795-6 or AN 5795T6 +30 to +230°F Oil Temp. ... +100 to +300°C Cylinder Temp.



MODEL 47B



MODEL 77B

FOR BEST RESULTS USE LEWIS THERMOCOUPLES AND LEWIS BULBS WITH THESE INDICATORS

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Manufacturers of Complete Temperature Measuring Systems for Aircraft

by Arine as representative of those used by industry. Arine carefully planned tests to minimize effects of external factors which might bias a fair comparison of reliabilty between processed and unprocessed tubes. Sample sizes were selected to provide statistically significant data.

Evaluation of Process A took place in the factory of the missile manufacturer that developed the technique, because of impossibility of obtaining data from actual missile firings. Arinc used equal numbers of processed and un-processed tubes of identical types which were installed side-by-side in the same equipments.

In evaluations conducted at Air Force and Navy air bases, processed tubes were installed in specified sockets of bombing, or communications equip-ment in half the aircraft, unprocessed tubes in corresponding sockets of the other half.

Tubes removed during the investigation were later analyzed to determine the reason for removal to see if there was any significant difference in types of failures between processed and unprocessed tubes.

In the case of the missile manufacturer using Process A, Arinc found that roughly 90% of the tube removals were for failure to meet required performance tolerances, which was due to inadequate circuit design rather than tube shortcoming. Special processing tests for tubes could not correct this equipment design deficiency and thus at best could only cut tube removals by 10%.

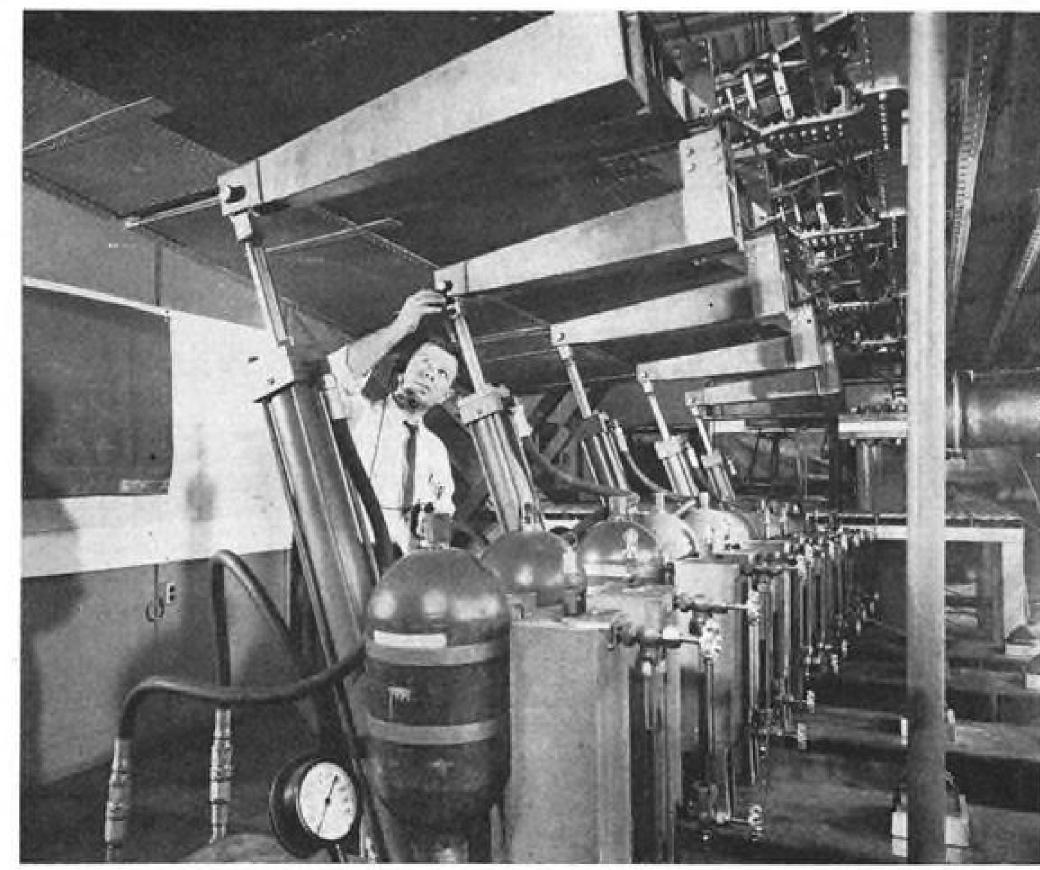
### Tube Scrapping

Tube removals due to basic tube shortcomings (mechanical, electrical, noise) totaled four for the unprocessed tubes, only two for the processed tubes. However, samples were too small to permit a valid statistical conclusion that tube processing pays off even here, Arinc believes. It questions the wisdom of scrapping some 1,500 in the special processing merely to reduce the number of tube defect removals from four to two.

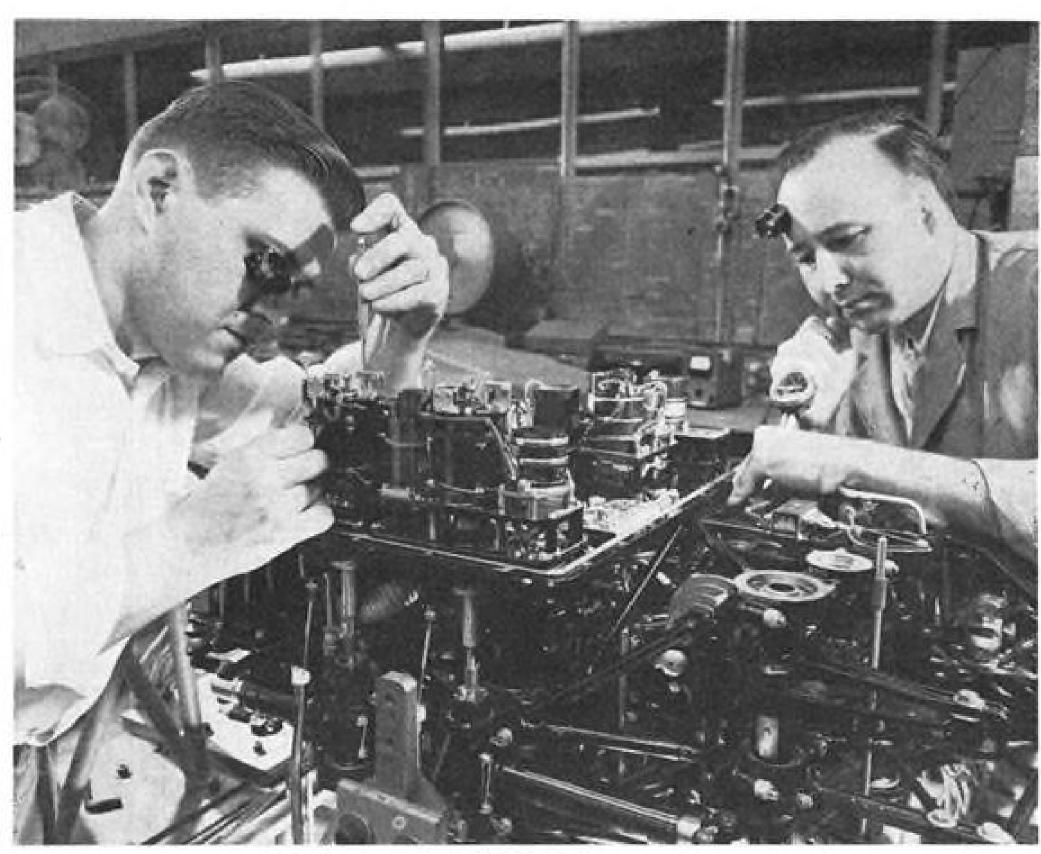
Analysis of tubes removed from ARC-27s and K-bombing systems during Process B investigation showed no significant differences in the types of tube faults between processed and unprocessed tubes, or between those which were rejected during processing

Processed tubes used in ARC-27s experienced seven times as many heater defects as did the unprocessed tubes drawn from stock, but the former represented less than 5% of the total tube removals. Heater defects also were slightly higher for processed tubes removed from K-systems in B-47s.

## Simulator Tests B-58 Flight Controls

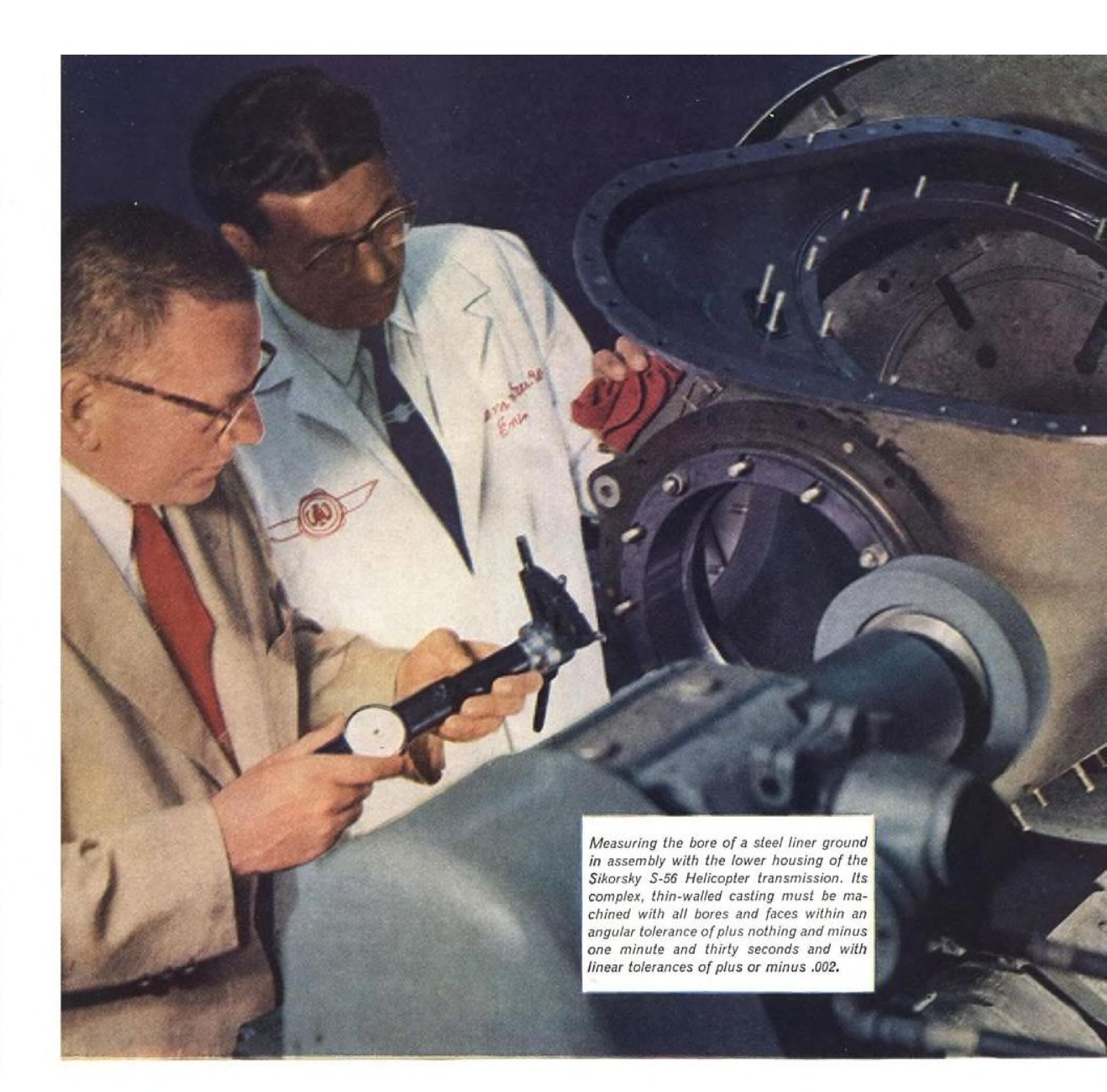


Convair B-58 Hustler flight control system is tested on full-scale mockup simulator at Eclipse-Pioneer Division of Bendix Aviation Corp. Ten hydraulic rams are used to actuate each B-58 elevon, develop total torque of 240,000 in./lb. Amount of control surface deflection for given movement of pilot's stick is automatically varied over a 25-1 range as function of airspeed, air density and G-loading without pilot being aware of any change in stick feel. System includes automatic G-limiting function which prevents pilot from overstressing Hustler airframe.



Complex power control linkage used in B-58 flight control permits pilot to superimpose manual maneuvers on autopilot stabilization, provides synthetic feel. Flight control amplifier is completely transistorized, employs 140 transistors, occupies a volume of 2.2 cu. ft. System provides familiar autopilot functions including altitude, Mach number control. On the other hand, processed tubes Aircraft has flown supersonic speeds for more than 90 min. (AW April 14, p. 19).

104 AVIATION WEEK, May 5, 1958



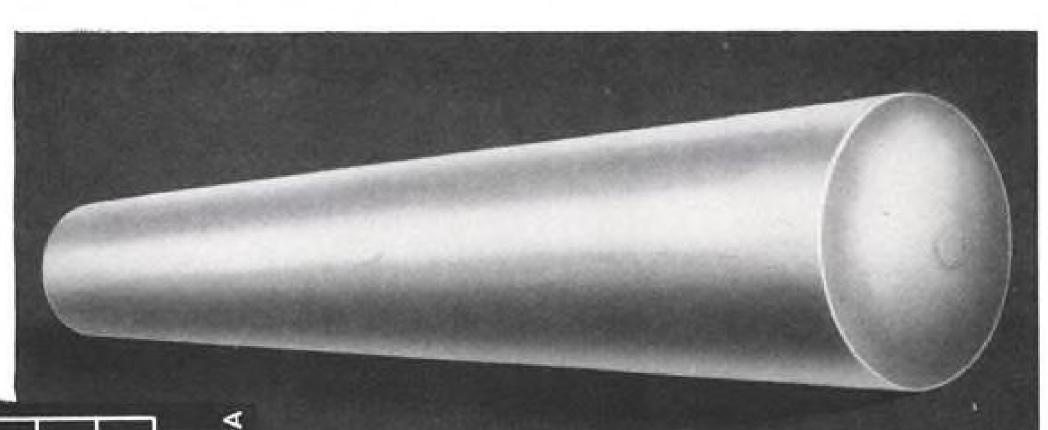
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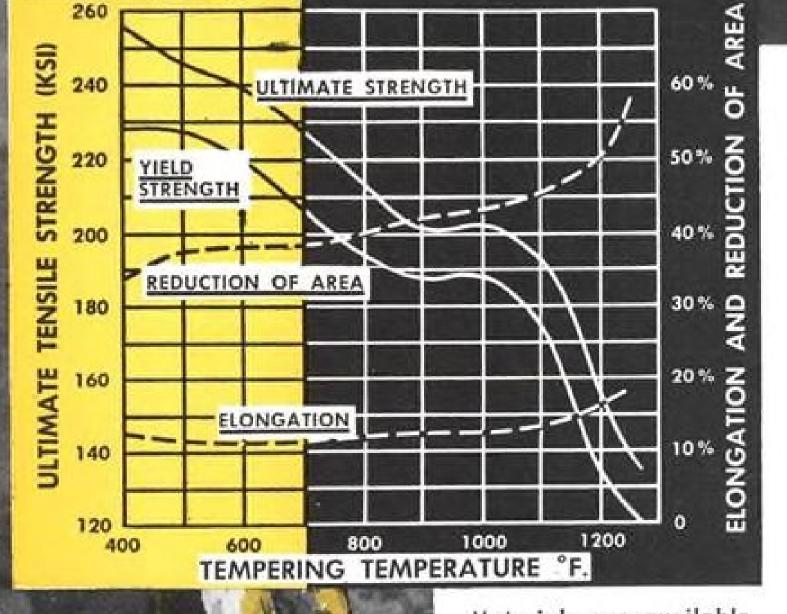
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Typical missile propellant tank as produced by A. O. Smith. Diameter is 40", length 28'. The highly stressed longitudinal welds in the "rall and weld" fabrication method can be flash-welded for higher strengths.

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A. O. Smith has produced tanks with guaranteed minimum yield strengths of 190,000 psi.... wall thicknesses from .050"-.220" . . . diameters over 50" . . lengths to 28'. Proposed designs and recent fusion weld developments indicate minimum yield strengths of 210,000-225,000 psi are attainable in weld areas.

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experienced slightly fewer shorts and open circuits than the unprocessed tubes from stock, but the difference does not appear statistically significant, according to Arinc.

Arine advances four possible explanations for the failure of special processing tests to successfully screen out potential tube failures and thus to improve reliability:

• Unrealistic screening criteria: Test criteria used to determine which tubes are acceptable or unacceptable during special processing fail to duplicate ac-curately the criteria by which tube reliability is judged when tubes are used

in ultimate equipment.

- Subjective testing lacks repeatability: Processing procedures which require human judgment, such as microscopic and X-ray inspection, lack uniformity and consistency. To illustrate this point, Arine cites investigation where a group of 672 tubes were run through microscopic inspection three successive times, without knowledge of the inspectors. During this triple inspection, 156 tubes consistently were passed as satisfactory, 144 tubes were consistently rejected, but 372 tubes received mixed appraisals. • Tests may reduce useful life: Dete-
- rioration which results from handling and operation during screening tests may actually offset any gain from possible weeding out of potential troublemakers. · Screening does not solve design problems: For every equipment failure
- caused by an inherently defective tube, Arine believes there are between three and 10 malfunctions which should be attributed to tube defects which are induced or defined by the way the tube is applied in the circuit. If special processing does improve tube reliability, this improvement is masked by the preponderance of tube failures resulting from misapplication which are unaffected by such tube screening.

### Transistor Use

Although Arine's investigation was limited to vacuum tubes, it believes that the findings may be equally valid for special inspection and selection procedures used with other basic components. The widespread trend toward using transistors "has created a critical need for a careful analysis of transistor problems and an objective evaluation of the special processing techniques aimed at solving this problem," Arine's report says. "Only in this way can industry avoid resorting to the myriad of special tests which spring from intuitive reasoning alone . . . (which) can be a costly disappointment."

Copies of the Arine report, Publication No. 117, may be obtained from Arinc's Reliability Research Dept., 1700 "K" St. N.W., Washington 6, D. C.



## SPIRATUBE helps keep jet's brains cool

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- ► Russian-English Glossary Approximately 30,000 aeronautical-technical terms are listed in new Russian-English language translation aid prepared by Air Force and now available from Office of Technical Services, Dept. of Commerce, Washington 25 D.C. The 704page document, identified PB-131634 "Russian-English Glossarv of Aeronautical and Miscellaneous Terms" is priced at \$7 per copy.
- ▶ Transistor Sales Continue Climb-Semiconductor manufacturers sold slightly more than six million transistors during January-February, nearly twice the number of units sold during first two months of 1957. Dollar value was \$13.5 million, compared to \$9.3 million for same period of 1957.
- ▶ Electron Devices Meet Scheduled-Institute of Radio Engineers annual conference on electron devices will be held Oct. 30-31 at Shoreham Hotel, Washington, D. C. Persons interested in delivering papers should submit abstracts by Aug. 1 to S. T. Smith, Code 5240, Naval Research Laboratory, Washington 25, D.C. Papers should emphasize developmental techniques and devices, such as tubes and transistors, rather than basic research on circuit applications, IRE says.

▶ Signed on Dotted Line-Major contract awards recently announced by avionic manufacturers include:

- Sperry Gyroscope Co.-has received three Navy BuOrd contracts totaling \$63 million. Largest contract, for \$59 million, goes to Sperry's Surface Armament Division for production of AN/ SPG-49 and AN/SPW-2 guidance and surveillance radars to be installed on Talos guided missile ships. Second contract, for \$3.1 million, covers design and production of Mark 2 weapon directors for tracking targets in Talos and Terrier missile ships. Third contract, for \$1 million, covers production of Mark 3 computers for Talos guid-
- Wilcox Electric Co. has sold 10 additional 200-watt VOR (omnirange) stations to French government, bring- JET ENGINE DEPARTMENT



### an expression of interest!

General Electric's Jet Engine Dept., Cincinnati, Ohio, is now interviewing Engineers with 3 or more years experience in the following fields:

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This is *not* an application for employment; it is merely your expression of interest. Upon receipt of this coupon, we will forward a brief form to return to us describing your interests and experience. You may then be asked to visit Cincinnati, at our expense, to discuss with us, in as great a detail as you wish, your future with the Jet Engine Dept. of GE.

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The uniqueness of the new NAVTAC en route navigation and instrument landing system by Stromberg-Carlson is in its combination of functional modules.

The NAVTAC equipment is an assembly designed to provide high-performance aircraft with the TACAN navigational aid, plus marker beacon receiver, glide slope and runway localizer for instrument landing situations.

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ment of the high-performance aircraft of today and tomorrow. Its operating ambient temperature range is -60 to +125 degrees C. at altitudes up to 70,000 feet. Widespread use of semiconductors in the ILS receivers and TACAN circuitry means high reliability, small size and low power consumption.

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Complete technical details on the NAVTAC system are available on request.

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 ing total to 22 purchased by France.
 General Controls' Electronic Controls Division has received Air Force contract for an advance air data computer system for use in century series fighters.

• General Electric Light Military Electronic Equipment Department and Philco Corp. have received Navy BuOrd contracts for continued production of Sidewinder infrared-guided air-to-air missile. GE contract is about \$9 million, Philco's for about \$16 million.

 Servo Corp. of America reports \$584,-000 development award from Wright Air Development Center for what company calls "most advanced version of a military infrared reconnaissance system" for use in high altitude reconnaissance missions. Company will build five systems under the contract.

 Telecomputing Corp. has received \$489,000 contract for roll-controlled gyros for use in Bullpup air-to-surface missile being produced by Martin's Orlando Division.

### Expansions, Changes In Avionics Industry

Cutler-Hammer, Inc., Milwaukee manufacturer of industrial control and aircraft relays, will acquire Airborne Instruments Laboratory, Inc., Mineola, N. Y., if stockholders of both corporations approve on May 26. Acquisition will be accomplished through a one-forone exchange of Cutler-Hammer stock.

Other recently announced changes and expansions in the avionics field include:

• United Electric Controls Co., Watertown, Mass., has acquired Aerotech Specialties, Inc., Glastonbury, Conn., producer of transducers. New subsidiary remains at present location.

 Servomechanisms Inc. will move its research laboratory, Goleta, Calif., into larger quarters an 11,000 sq. ft. building, starting April 1. Laboratory staff is being increased and will be divided into basic and applied research groups. Company's Subsystem Division's advanced engineering department also will move to new facility.

 Summers Gyroscope Co., Santa Monica, Calif., has started move to new 100,000 sq. ft. facility recently added. Librascope's Burbank Division has moved into larger building at 40 East Verdugo Ave., Burbank, Calif. Main plant remains at Glendale, Calif.

• Radio Corp. of America has formed new RCA Semiconductor and Materials Division which is responsible for engineering, manufacturing and marketing company's semiconductor devices and materials. Dr. Alan M. Glover is general manager of new division, whose headquarters will be Somerville, N. J., at plant of former RCA Semiconductor Division.

## Radio Noise Spectrum Concept Has Arctic Early Warning Value

Boston-New concepts of the radio noise spectrum, varying from emissions of interstellar gases to man-made static, have been described at a tutorial conference sponsored here by Harvard College Observatory under U. S. Army Signal Corps contract.

More than 250 scientists from industry, government and education attending the conference heard among the subjects discussed:

· Auroral reflections. Radio and radar signals can be reflected by the aurora. These effects are being studied for immediate application to Ballistic Missile Early Warning System radars to be installed in the Arctic.

• Radio noise from Jupiter. Except for earth, the only planetary body so far discovered that is a source of radio noise other than simple thermal noise is Jupiter which emits intense noise bursts varying both in time and frequency.

• Solar whistlers. Theory has been advanced that the sun emits radio signals that are propagated along the lines of its magnetic field to a conjugate point in the opposite hemisphere in about the same manner as earth's whistlers.

These signals are believed to intercept earth and cause periodic fluctuations of the earth's magnetic field.

• Radio noise from meteors. Attempts to obtain correlations between atmospheric penetration by meteors and radio noise spikes resulted in 30% correlation, confirming results of a Russian researcher who interpreted this as proof that meteors generated noise. Further tests resulted in 30% correlation for meteors that did not intersect the receiving antenna beam, and 30% correlation against a table of random numbers, casting doubt on meteors as a source of radio noise.

 Interstellar hydrogen. Structure of the galaxy and large scale structure of the universe can be studied by determining quantity and motion of the tenuous hydrogen gas that is a major constituent of the universe. These measurements can be made using the 21 cm. radiation of hydrogen in its hyperfine transition, but the signals are very weak and would be blocked if this band comes into use.

Study of the effects of radio and radar reflections from the aurora are being conducted by Stanford Research Institute under a contract from USAF's Rome Air Development Center. Most immediate purpose of the study is to determine problems that will be faced by radars of the Ballistic Missile Early Harvard College Observatory.

Warning System which will be installed in the Arctic area, but effects on HF and VHF communications will also be studied.

Radio and radar signals at frequencies up to several hundred megacycles are reflected by ionization irregularities associated with the aurora. Scattering appears to take place at irregularities aligned with the earth's magnetic field lines. Reflected signals are subject to rapid fading and large Doppler shifts, and are most intense when the ray from a radar meets the magnetic field line nearly perpendicularly.

Noise received from planetary bodies can be described as either thermal or non-thermal. Thermal radio noise is simply the noise generated by any body above zero degrees Kelvin and has been observed from Venus, Mars, Jupiter, Saturn and the moon at centimeter wave lengths. Noise from some nonequilibrium source is called non-thermal and, except for earth, the only established source is Jupiter.

Non-thermal radiation from Jupiter is apparently centered in the metric wave lengths, occurring in intense bursts lasting about one second over periods from a few minutes to one or two hours, varying both in time and frequency. The noise source is apparently centered in hot spots on the planet because the signals vary in relation to the period of rotation of the planet. Researchers at the Carnegie Institute of Washington who were performing the study attempted to find a relationship between the noise period and the well-known "red spot," but none seems to exist.

Harvard College Observatory astronomers have offered a theory suggesting that radio energy emitted from disturbances on the sun's surface are propagated in the "whistler" mode and interact with earth's magnetic field in such a manner that the effect noted is a rapid periodic fluctuation of the earth's magnetic field.

While earth whistlers are propagated in the approximate frequency range of from one to four kilocycles, frequency of solar whistlers would be much lower, perhaps a factor of 1,000, in the range from 0.1 to 100 cycles per second. Change in frequency would be very slow-on the order of two to three cycles every 15 min. Signals of this type are believed to exist and to have been measured with sensitive magnetometers.

Research both on the subjects of radio noise from meteors and interstellar hydrogen has been carried on at



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A decade ago, Esso Research anticipated the need for a new synthetic lubricant for aircraft turbine engines. Working with American and British designers and manufacturers, Esso Turbo Oils 15 and 35 were developed. Because these synthetic lubricants were used by manufacturers of jet engines in the development and testing of these new engines, they are thoroughly time tested and performance proved.

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## BUSINESS FLYING

## Air Fleet Furthers Jungle Bible Work

By Erwin J. Bulban

Varied fleet of more than a dozen aircraft is pacing the advance of a missionary service deep into the jungles of South America, compressing to approximately one fifth the time that would be normally required to bring the rudiments of civilization to primitive tribes.

Flying portion of this operation is the responsibility of Jungle Aviation and Radio Service (JAARS), which provides the night and compressions

vides the airlift and communications needs of a widespread network of missionary linguists of the Wycliffe Bible Translators.

Latter was founded in 1934 by W. Cameron Townsend and incorporated as a non-profit organization in California. Through an affiliate, Summer School of Linguistics, the organization is dedicated to providing an accurate replica of the Holy Bible in the indigenous language of the some 2,000 primitive tribes in out-of-the-way areas of the world.

In the past two years, JAARS' airplanes, ranging from a Piper Super Cub to a PBY-5A Catalina amphibian, have flown the equivalent of more than 1.5 million passenger-miles in the back jungle areas of Bolivia, Ecuador and Peru. Operation of Wycliffe is geared to the airplane in these primitive areas. According to the organization: "In jungle areas Wycliffe cannot advance faster than JAARS."

### Large Operation

This is one of the most novel largescale aviation operations in the world, consisting of some two-dozen U.S. and Canadian pilots, many of whom are exservice fliers who are also qualified aircraft and engine mechanics. They work entirely without pay, as do all other members of Wycliffe, living on financial aid sent them by their friends. Help is sometimes supplemented by a special fund of the organization in cases where outside aid is not sufficient to take care of minimum needs. It is estimated that a minimum of \$105 a month per man is required to take care of members' wants.

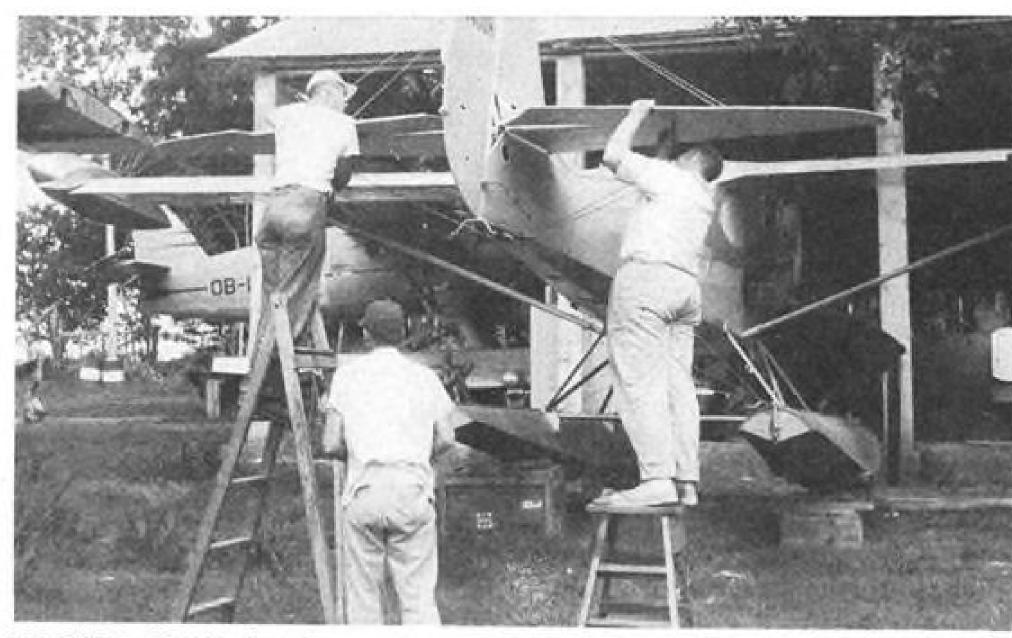
Most of the pilots get 40-60 flying hours a month. Despite the conditions and lack of anything but the most basic aids, the organization has experienced only two crashes since its inception and in neither case were there any serious injury.



JAARS' HELIO COURIER at typical jungle landing strip, its wheels deep in loamy soil.

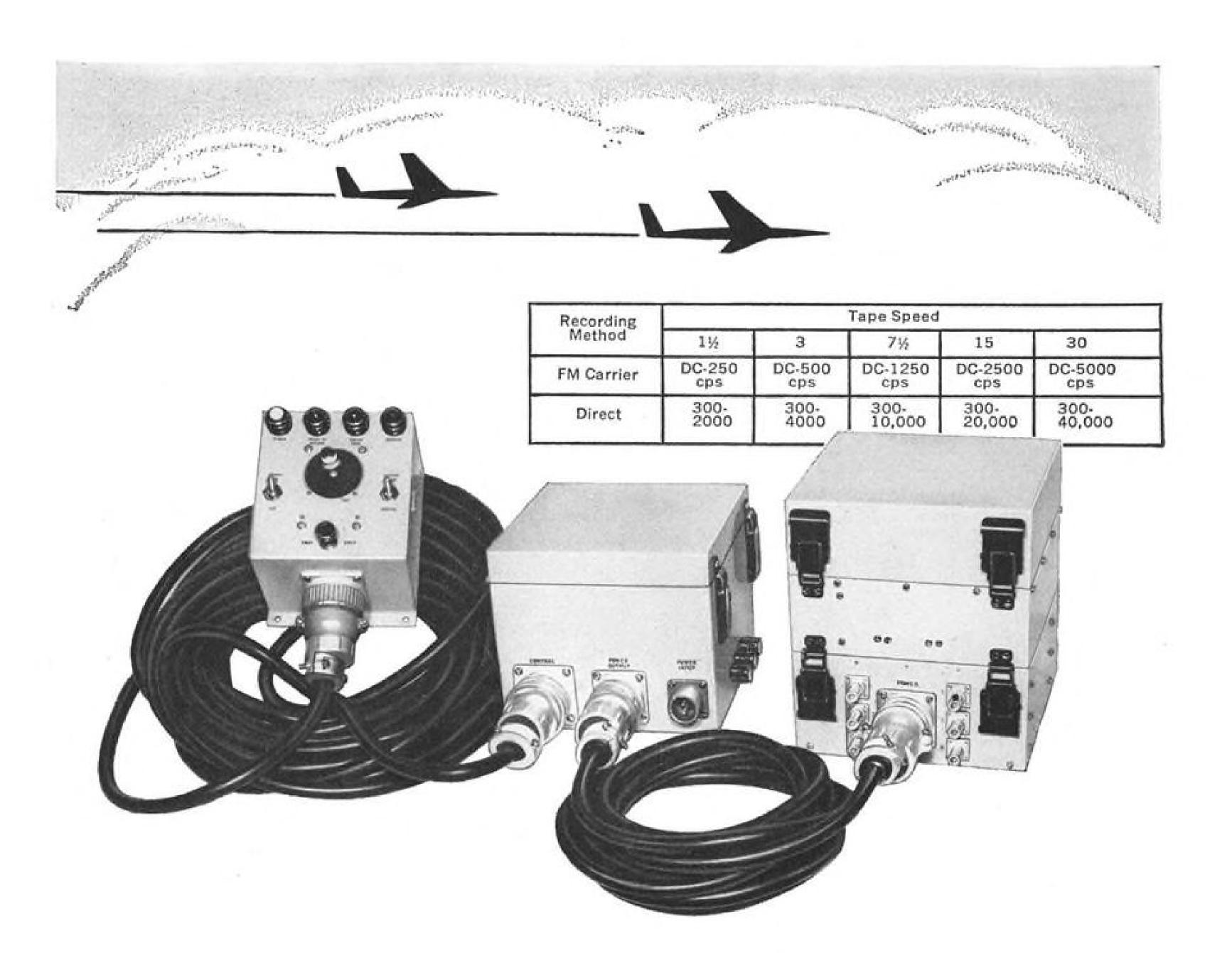


J2F DUCK, with which JAARS started in 1946, on ramp at Peruvian base.



Flying is primarily by time, dis- AERONCA SEDAN floatplane undergoes check at JAARS' Peruvian overhaul base.

113



## Airborne magnetic tape recording...

6-track . . . . 60 minutes . . . < 0.5 ft3

When you need compact, lightweight magnetic tape facilities for permanently recording instrument and flight performance data . . . turn to Davies' Miniature Airborne Magnetic Tape Recording System. Here's optimum performance in an absolute minimum space and weight-ideal for any type aircraft or missile installation . . . under any service conditions.

Separate recorder, power supply and optional remote control, interconnected by flexible cables, permits complete freedom in locating and mounting the equipment. All components, including the remote control box, total less than 28 pounds.

Yet, performance is king-sized . . . six frequencymodulated-carrier channels plus a reference signal, or six direct-recorded tracks can be simultaneously taped. By selecting the recording technique, tape

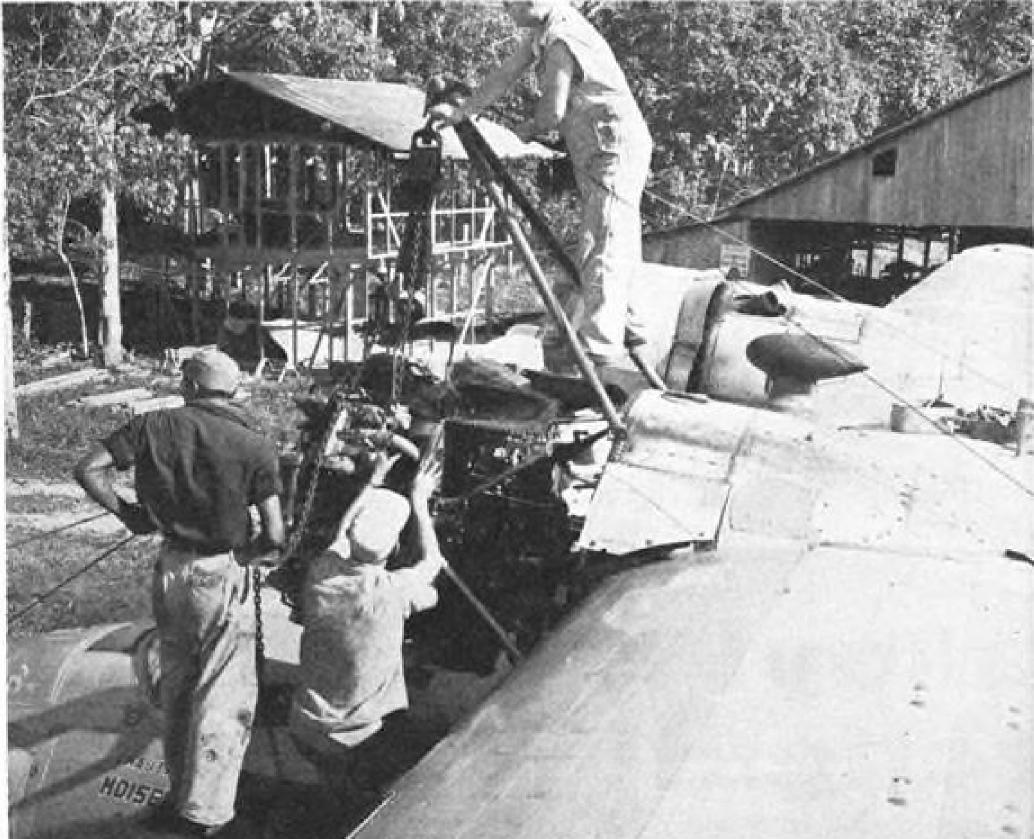
114

width and transport speed, virtually any class of data can be recorded. As much as a full hour of 6-channel intelligence can be recorded using the new thin tape at 1½ ips. Frequency response at the various tape speeds, with both recording techniques, are shown in the above table.

Complete characteristics, technical information and application data may be had on this and other airborne and ground magnetic tape recording systems and equipment. Write Minneapolis-Honeywell, 10721 Hanna Street, Beltsville, Maryland.

## Honeywell





ENGINE CHANGE in the open air on JAARS' PBY Catalina at Peruvian jungle base.

tance, airspeed and checkpoints. Pilots ards on all its work. It stocks some use rivers for navigation as much as possible, particularly when weather is marginal. Should it turn bad, procedure is to land on the water (in case of floatplanes), and wait the weather out.

Major base of JAARS is in the Peruvian jungle some 300 mi. northeast of Lima across the Andes near a natural lake. Facilities include two runways approximately 1,500-ft. and 1,200-ft. long and a cement scaplane ramp. All JAARS aircraft are brought here for overhaul and repair-personnel handle every phase of these operations, including recovering, except for overhaul of the PBY's Pratt & Whitney R1830 engines which are overhauled by Compania de Aviacion Faucett, S.A.

### Radio Gear

JAARS' radio technicians here also modify military surplus radios used for two-way communication in aircraft and by teams of linguists for maintaining contact with base. Ground units are basically ARC-5s which are revamped so that they weigh some 55 lb. compared to original weight of 75-80 lb. JAARS developed 110-v generator power supply weighs 48 lb. Experience shows that these units have a range of up to 600-800 mi. during the morning; get 300-400 mi. any time during the day due to their modified and improved circuitry. Technicians are currently working on a program to transistorize some units to save fuel of the gasolineoperated generators.

In spite of home-made facilities

\$40,000 inventory of parts. Since its inception, JAARS has maintained a remarkably low turnover of personnel. Only two pilots have left since 1946, when the present-day fleet was started with purchase of a surplus Grumman-designed J2F biplane amphibian from the U.S. Marine Corps mission in Peru. An Aeronca Sedan was acquired three years later and the

fleet now comprises a PBY-5A Catalina donated by a group of Mexican busi-nessmen, the J2F, four Aeronca Sedan floatplanes, a Cessna 180 floatplane, a Piper Super Cub, a Noorduyn Norseman floatplane, a metallized Stinson SR-10, a twin-engine Cessna T-50 used for instrument and pilot checkout and a half-dozen Helio Couriers.

Top-rated plane in the fleet is the Courier, JAARS aviation superintendent and USAFR Capt. Larry Montgomery told Aviation Week. This is due to its proven exceptional short takeoff and landing capabilities, practical useful load and safe flying characteristics. Organization intends to use the Helio Courier as its basic jungle airplane, since it can work easily in areas that cannot be handled well by other types.

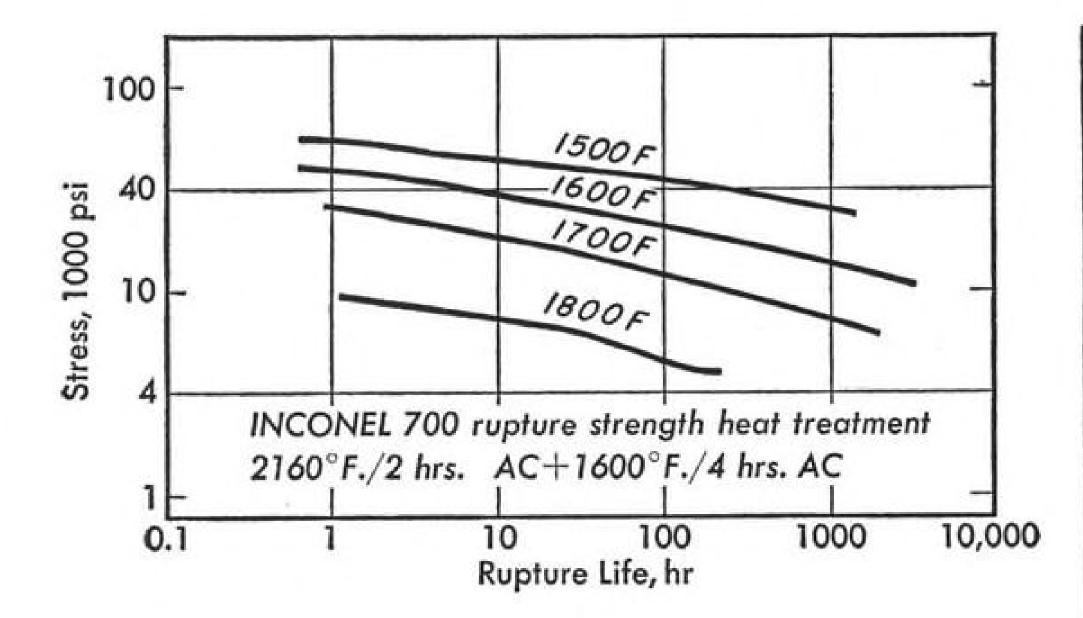
### Jungle Strips

JAARS flies into some 30 strips in South America, at least 15 in Peru, about 11 in Ecuador and four or five in Bolivia. For the most part these strips are hacked out of the jungle near tribes with hand tools and wheelbarrows. Smallest landing site, in Arapicos, Ecuador, is only 369 ft. long and is at 3,000-ft. elevation. Another, Chinimbi airstrip in the same country, is at the same elevation, has a 550-ft. runway of soft, loamy soil with tall trees at one end and a 150-ft. cliff at the threshold. Montgomery noted that he had flown the Courier out of this strip a number of times at takeoff gross weight of 2,855 lb. with main wheels sunken to the hubs and tailwheel com-



Helio Delivers Five-Place STOL

New five-place version of Helio Courier STOL business plane is shown climbing steeply after short takeoff run from taxiway at Westchester County Airport, N. Y. Recently JAARS maintain CAA or better stand- certificated by CAA, five-place version sells for approximately \$29,600.



## New alloy! New strength!

Graph shows excellent stress-rupture strength of Inconel "700" in 1500° to 1800° Frange

Inconel "700" age-hardenable nickel-cobalt-chromium alloy is a new heat-resistant material developed by Inco to meet stress and temperature conditions beyond the range of Inconel "X"\* age-hardenable nickel-chromium alloy. (Specifically, it goes beyond the operating temperature range of Inconel "X" by 100°F for the same rupture strength.)

Inconel "700" also has good corrosion and oxidation resistance. It can be forged, machined and welded.

### Availability

Inconel "700" is available in forging quality rounds from 1/2-inch to 2-inch diameters. Larger diameter bar is available on experimental basis.

### More information

For particulars on properties, send for the Inconel "700" basic data sheet. It gives graphs on yield strength, tensile strength, elongation; covers such data as composition, thermal conductivity and the like.

### Technical assistance

Inco has accumulated a great deal of knowledge and experience in heat-resistant materials which may be helpful in solving problems involving missile hardware. All the information and help we can give you are yours for the asking. Just write.

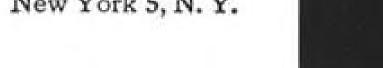
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### THE INTERNATIONAL NICKEL COMPANY, INC.

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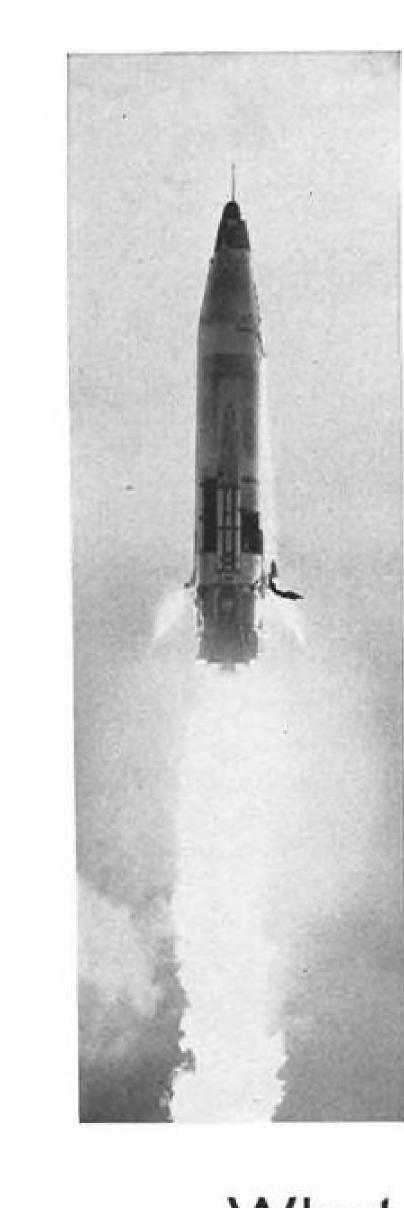


New York 5, N. Y.



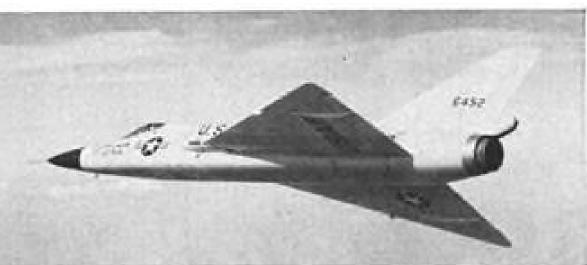
The Nike Missile

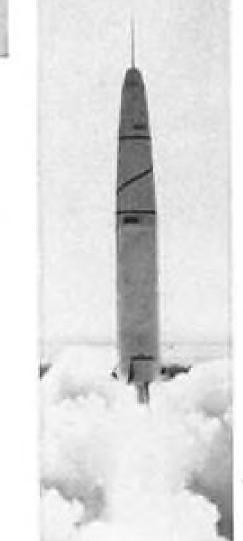
### INCO NICKEL ALLOYS NICKEL ALLOYS PERFORM BETTER LONGER



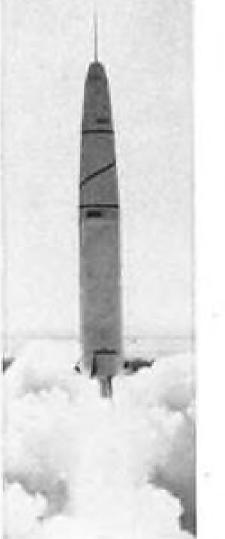


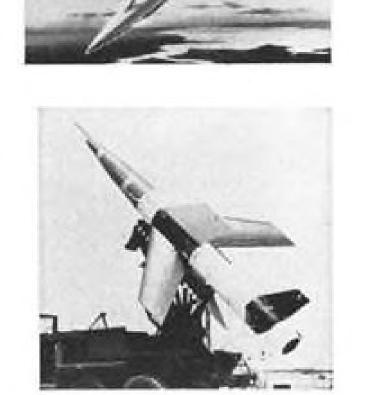












### What do these latest aircraft and missiles have in common?

All are equipped with Genisco flight control or instrumentation accelerometers. What better proof of reliability?

With component reliability getting increased attention from missile and aircraft designers, it is significant to note the number of supersonic weapon systems equipped with Genisco accelerometers.

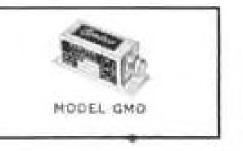
A complete list reads like a roll call of tactical and strategic missiles and aircraft now in the nation's arsenal. Included are such weapons as the Atlas, Thor, Nike Ajax, Nike Hercules, Bomarc, LaCrosse, Bull Pup, Talos, Dart, Matador, Corporal and Terrior missiles; and the F100D Super Sabre, F101 Voodoo, F106A, and Canada's CF105 aircraft. What better proof of the reliability of Genisco instruments than this acceptance by designers of these weapons?

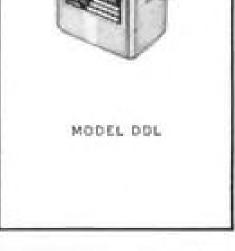
Combining product reliability with guaranteed delivery schedules and competitive pricing has made Genisco the free world's largest producer of potentiometer-type flight and fire control accelerometers. More than 40,000 have been delivered to date.

Send for technical data sheets on all Genisco Accelerometers.







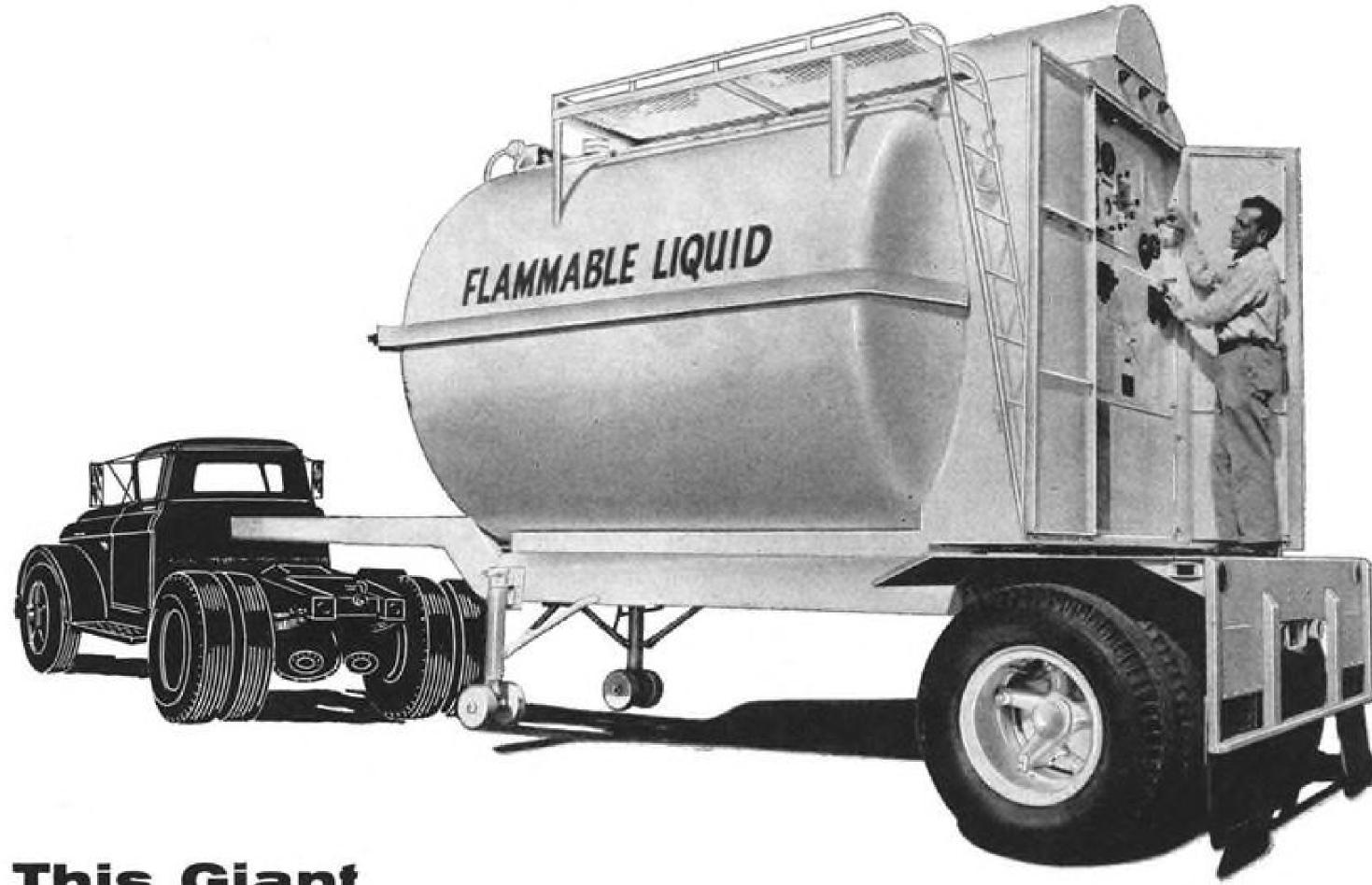






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## This Giant SPACE-AGE THERMOS Simplifies the Handling of Liquid Gases

How to transport hundreds of gallons of liquefied gases with maximum safety, maintain near-perfect vacuum and hold temperatures approaching 460 degrees below zero without the use of auxiliary refrigeration equipment? This was the problem successfully solved by Beechcraft engineers in only five month's time with the design, development, production, and delivery of the Beechcraft Dewar, first of its type ever produced.

Beechcraft scientists and engineers are at work on numerous projects involving transporting and storing of cryogenic liquids, plus projects in many aeronautical fields. A letter today to our Contract Administration Division will bring full information on how Beechcraft's five major plants, 13/4 million square feet of plant area, and 7,000 skilled craftsmen can help solve your research, development, or production problems.



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Beech Builds: U.S. Navy T-34 . U.S.AF T-34 . U.S. Army L-23 . Bonanza . Travel Air . Twin-Bonanza . Super 18 Executive Transport

pletely buried at the start of takeoff.

Crash safety features of the Courier, which is especially designed to maintain structural integrity of the cabin in event of an accident, is also a big factor in choosing the airplane. Montgomery noted one crash, in which the Helio hit some stumps on takeoff and the plane was overturned. Occupants were uninjured; also, he said, the cabin doors opened as easily as they would normally, indicating that the structure resisted twisting.

Only major problem encountered thus far with the Courier has been overhaul life of its Lycoming GO-435, according to JAARS' aviation superintendent. Cylinders wouldn't last even 500 hr., although they were supposed to go for 600 hr., he said, and even the Lycoming technicians couldn't lick the problem. So JAARS is chrome-plating its Courier engine cylinder and expects to get at least 1,200 hr. on them, although they should go 2,000 hr. with this treatment, he noted. Montgomery pointed out that they have no similar problem with other aircraft.

### Types of Operations

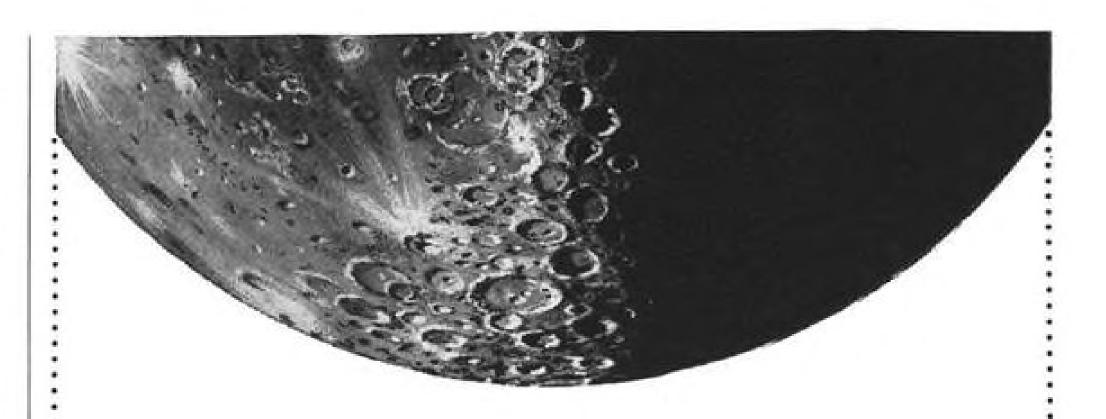
Major part of JAARS flying operations involve flying language specialists trained by the Summer School of Linguistics, comprising a family, sometimes with small children, sometimes a pair of young girls, into the jungles to live with the primitive tribes for six months at a time, in order to study their dialect first-hand and attempt to evolve an accurate grammar in order that the language can be translated into the Scriptures and that native teachers can be indoctrinated.

Airplanes also fly in all the material needed by the teams, including food, medical supplies and the two-way radio equipment. A JAARS' airlift brings in other necessary gear, mail and sometimes gasoline-powered refrigerators, and occasionally brings out the sick and injured where necessary. Procedure is for the first flight to usually take in two translators with two weeks' supplies in one flight, then immediately make sufficient flights to build supplies to a three-month level. Then it maintains air contact with each camp at least once a month.

At the end of the half year, the translators are brought back to the base camps to work on the material they have collected. They spend perhaps six months on this and then return to the tribes for additional periods as long as

the job requires.

JAARS' aircraft are also used by many other people traveling in these areas, including members of other missionary or religious groups, Point Four technicians, scientists and native and foreign civilians having business in the areas it operates. In Peru, for example,



Specialists wanted for study and research on

## **Nuclear Rocket Engines**

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You'll work with Dr. H. E. Dillaway, one of the nation's fore-

most nuclear propulsion scientists.

Please check the following list of positions now open in engine feasibility studies and preliminary design:

- 1. Senior Engineer Research or Engineering: Nuclear physicist, PhD. (or equivalent experience) for basic studies in the application of nuclear power to air vehicles.
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- 5. Senior Engineer Research or Engineering Specialist: PhD. desired with a background in nuclear energy, servo mechanism, controls or instrumentation. Should have preferably 4 years additional experience.
- 6. Senior Engineer Research: PhD. or M.S. degree with a background in heat transfer relating to gas or liquid cooled nuclear power plants, preferably of aircraft type.
- 7. Senior Structural Engineer or Stress Analyst: Several years experience in mechanical stress and structural analysis. M.S. or B.S. degree or equivalent.

Please direct your inquiry to Dr. H. E. Dillaway, Nuclear Propulsion Group, 6633 Canoga Avenue, Canoga Park, California

## ROCKETDYNE IR

BUILDERS OF POWER FOR OUTER SPACE



it is chartered by the air force military ample, it was possible to set up a base air transport service to provide air serv- with only two flights in the PBY, savice where there is no other way of ing an estimated three years in getting getting around. Surface travel is so difficult it can take three or four months to reach some areas, while an airplane gets to the same place in hours. When persons not belonging to the Wycliffe organization are carried, the charter uals. provides them with insurance in event of accident; normally JAARS carries no insurance on either its equipment or personnel.

Occasionally JAARS also supplies charter service to some companies working in the area. In one case it operated a petroleum company's Catalina for several months when that firm's pilots ing to him. Give Wycliffe your share couldn't handle the job, for a nominal fee of \$125 a month. Missions involved considerable flying over mountainous owner made the offer to Wycliffe, terrain.

### Fuel Consumption

sumed some 45,000 gal. of aviation a little more than a year ago it owned gasoline-91 octane is standard. Its own PBY is often used as a tanker to replenish gas caches along the rivers in is campaigning to get more of the \$25,the areas the organization operates. Procedure is to fill the Catalina with the Philippines and New Guinea. 1,110 or 1,200 gal. of fuel, drain off

loads long distances. In Bolivia, for ex- airplane after that donor. The Couriers

material to the spot.

Where does it get the equipment and funds to operate? All the money is donated by businessmen, companies. clubs, churches and interested individ-

### **Donated Equipment**

Some equipment is also donated, but most is purchased by JAARS' buyers from surplus stocks, if necessary. In the case of the Cessna 180, the story is that a part-owner couldn't sleep one night because he "heard the Lord talkof the Cessna 180 you hold in partnership" was the message. And the partwhich had enough funds to buy the remaining half ownership.

JAARS' answer is simply, "We put JAARS' operations last year con- God on the spot and he delivers." Only two Helio Couriers-it now has a halfdozen, expects to get another soon and 000 STOL airplanes for operations in

When it receives sufficient funds required amounts at the various caches. from a community's groups to purchase Catalina is useful in flying heavy an aircraft, procedure is to name the



Monte-Copter Flies New Configuration

Latest version of pressure-jet powered Monte-Copter, shown during test flight at Boeing Field, Seattle, Wash., has completely covered fuselage and new tail. Earlier prototype (AW Mar. 31, p. 83), was uncovered, featured twin-finned tail surfaces. Two Continental 140 -air hp. engines are mounted in pods on each side of fuselage.

### Controls Development at Marquardt



Roy E. Marquardt, President

Marquardt was established in early 1944. Concurrently with the early development of the ramjet engine, controls had to be designed which would operate within the ramjet engine under severe environmental conditions.

The extreme velocity and acceleration of the engines created controls requirements well beyond the limits of the turbojets then in development and operation.

Marquardt engineers and scientists solved these early controls problems . . . creating components which produced reliable performance in the high Mach ranges; and today under Chief Engineer Tony Kreiner have gone on to develop a family of even more advanced controls and accessories:

In rotating accessories, Marquardt's pioneering turbine and pump work has culminated in emergency power units for the Chance Vought F8U-1 Crusader, and the Lockheed F-104 Star Fighter.

In the area of supersonic engine inlets, Marquardt engineers and scientists have been engaged in broad research and development programs for the past ten years. This aero-thermo knowledge coupled with our controls background has led to applications for variable geometry inlet control systems on North American's Hound Dog electronic countermeasures missile and McDonnell's twin-engine all-weather fighter.

And in afterburner controls, exit nozzles, noise suppressors and nuclear controls, Marquardt engineers have and continue to achieve significant engineering breakthroughs.

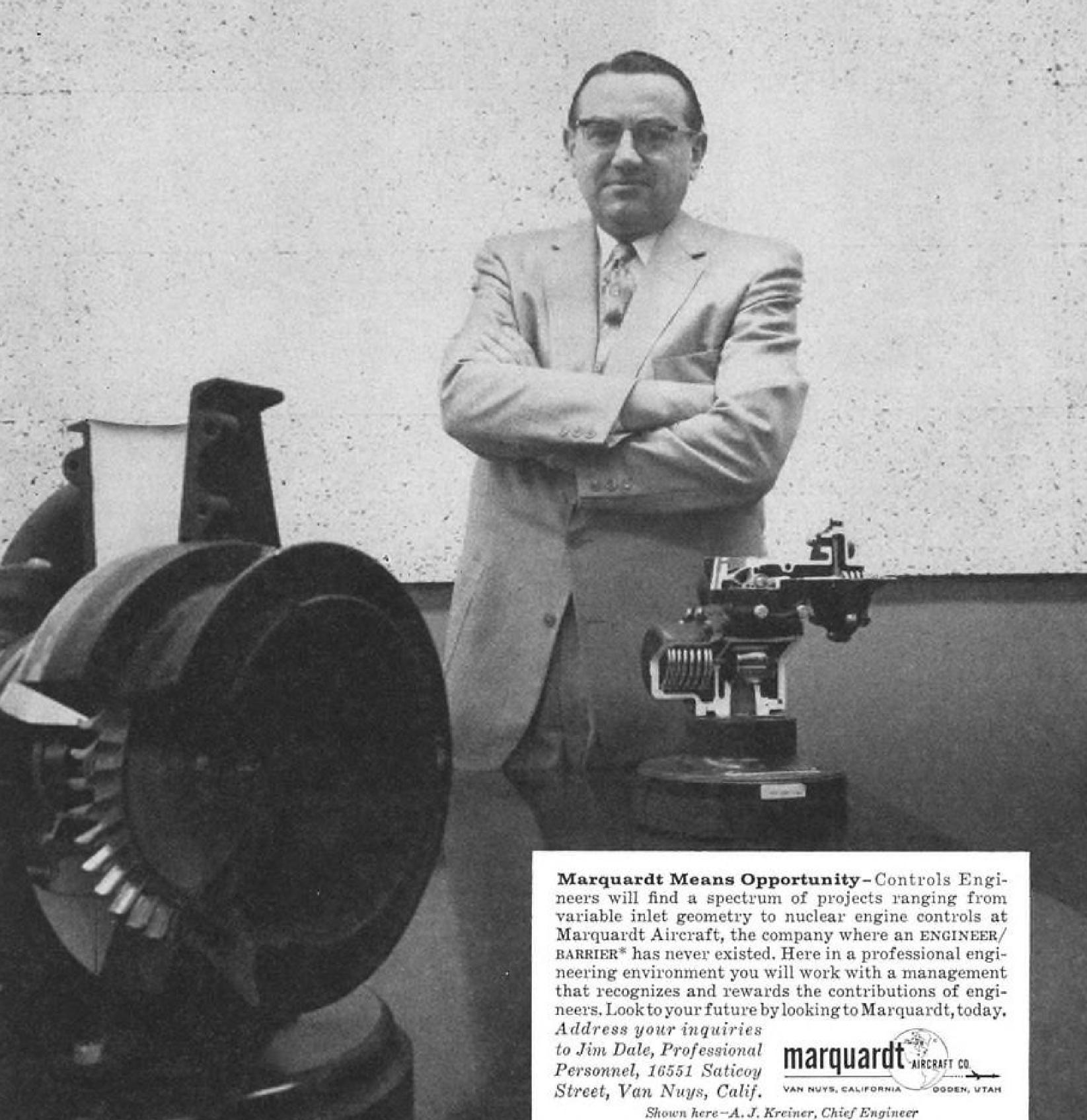
Professional engineers will find a broad range of challenging assignments and projects at Marquardt, plus opportunity to further their carrers through supplemental educational programs.

For information about the professional engineering environment at Marquardt, we invite you to contact Jim Dale, Professional Personnel today.

Koy & Warquards



# To Controls Engineers Facing an ENGINEER BARRIER\*



\*ENGINEER | BARRIER-an achievement level beyond which you cannot advance

Controls & Accessories Sub-Division



### -FLY WEATHER-WISE----



These weather items prepared in consultation with the United States Weather Bureau

## TEMPERATURE VARIATIONS

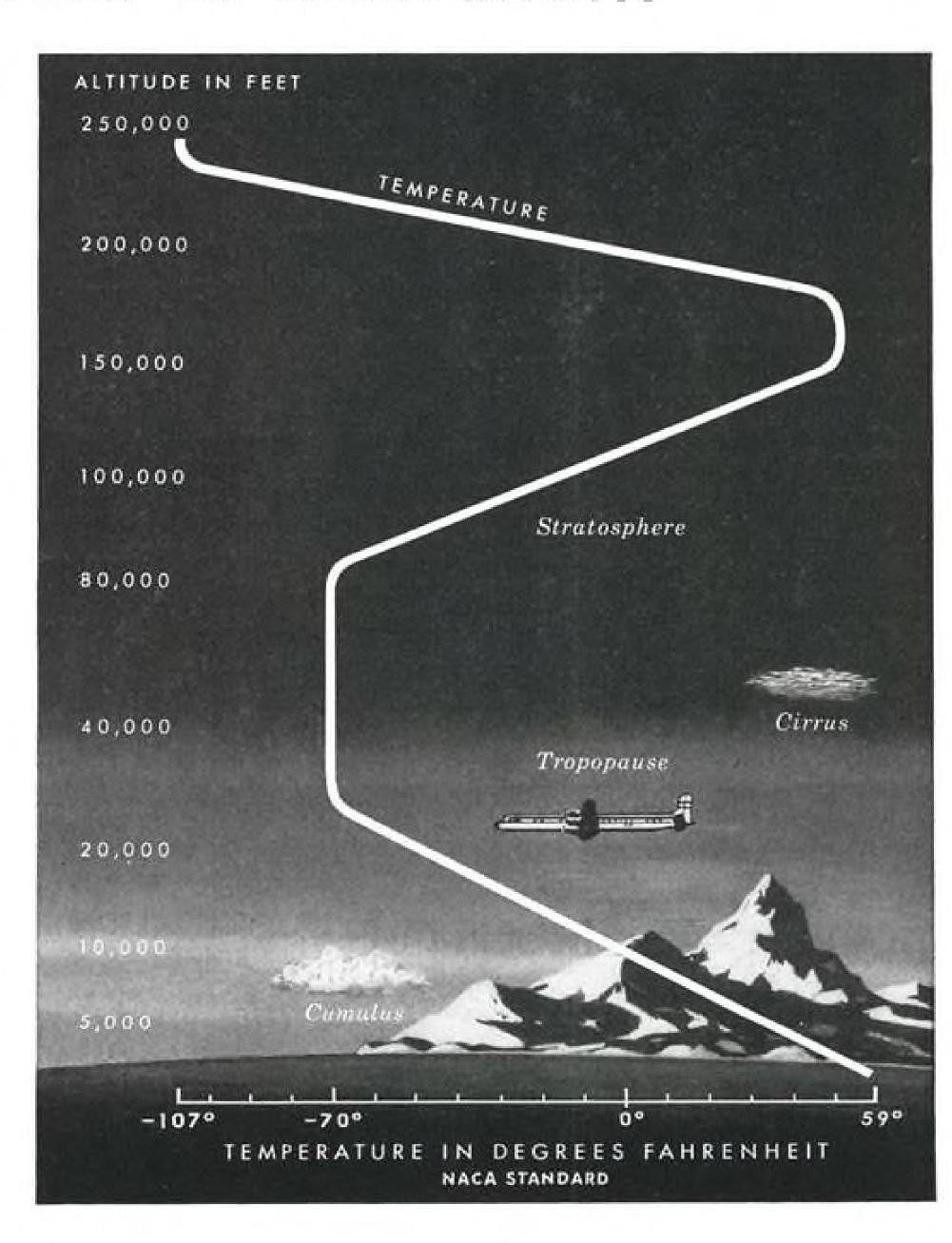
IN RELATION TO ALTITUDE ...

TEMPERATURES encountered in a single ▲ flight may vary as much as 130°F. or more. These variations are associated with altitude and weather patterns and can affect flight performance.

Temperature and altitude—Heat from the earth warms the atmosphere with steadily decreasing effect as altitude increases. Temperature normally decreases with altitude at the rate of 31/2°F. per 1000 ft. At the tropopause (top of troposphere) temperature remains almost constant up to 80,000 ft. Therefore, modern aircraft encounter coldest air in the tropopause layer which varies from about 28,000 ft. in the polar air masses to 54,000 ft. in the tropical.

As altitude increases from approximately 80,000 ft. to 150,000 ft., the temperature returns to almost sea level condition. This is the result of strong absorption of the sun's ultra-violet rays in the layer of ozone gas at very high altitudes.

At still higher altitudes, the temperature reverts to extreme cold.



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Instant control response can be yours despite extreme temperature variations, thanks to the wide range of temperature characteristics of these top-quality Mobil products.

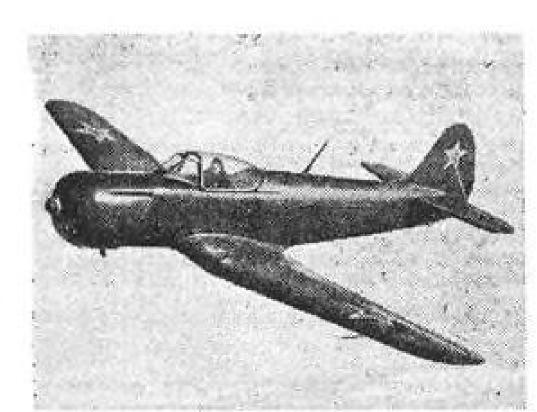
Mobil Aero Hydraulic Oil HF and HFA-These low pour point and high VI oils help assure trouble-free operation of hydraulic control systems, brakes and struts through all temperature ranges.

Mobilgrease Aero Lo-Temp and General Purpose—These Aero greases help assure smooth operation of all sliding and rolling surfaces of aircraft parts . . . control systems, bearings, and gears.

of its Latin American Inter-American Friendship Fleet, for example, are named "City of Chicago," "Spirit of Kansas City," "Friendship of Orange County, Calif.," etc.

Organization places title of the air-

planes in the name of the governments where it is operating to demonstrate its cooperation, which aids in cementing ties of friendship. Many of the governments cooperate to the extent of their limited resources; last year the Peruvian government donated 40,000 gal. of fuel to JAARS.



YAK-18P has top speed of 174 mph.

### Russians To Produce Yak-18s in Quantity

Two new versions of Russia's singleengine Yak-18 trainer have completed flight tests and are slated for quantity production.

Both planes-the Yak-18P and Yak-18A-embody substantial improvements in design and performance over their prototype. They will be delivered to the Red Air Force and to aero clubs operated by the U.S.S.R.'s huge, semimilitary DOSAAF (Voluntary Society for Cooperation with the Army, Air Force and Navy).

• Two-place Yak-18A has a maximum speed of 161 mph, at sea level, service ceiling of 16,897 ft. and normal range of 466 mi. With auxiliary fuel tanks, range can be increased to more than 2,484 mi.

Main point of the Yak-18A, according to Soviet reports, is its high rate of climb. It can reach 3,281 ft. in 3½ minutes. Horizontal speed and maneuverability are better than for the Yak-18.

• Single-seat Yak-18P has a top speed of 174 mph. and service ceiling is 21,982 ft. Takeoff run is 394 ft. and landing distance using brakes and flaps is about 656 ft.

Yak-18P's trieycle landing gear is fully retractable, while the Yak-18A's is only semi-retractable. Both craft are low-wing monoplanes powered by aircooled, radial engines. They have twoway radio and all-weather navigational equipment.

### AERODYNAMICISTS & STRUCTURES ENGINEERS

### VERTICAL TAKE-OFF ...

...a new Landmark of Aviation Progress



Bell Aircraft now presents the opportunity to be associated with the development of high-performance, jet aircraft which will take off and land vertically in a conventional attitude. Two test vehicles, one of them the X-14, have been flown successfully, and an operational aircraft is now being designed for the United States Navy.

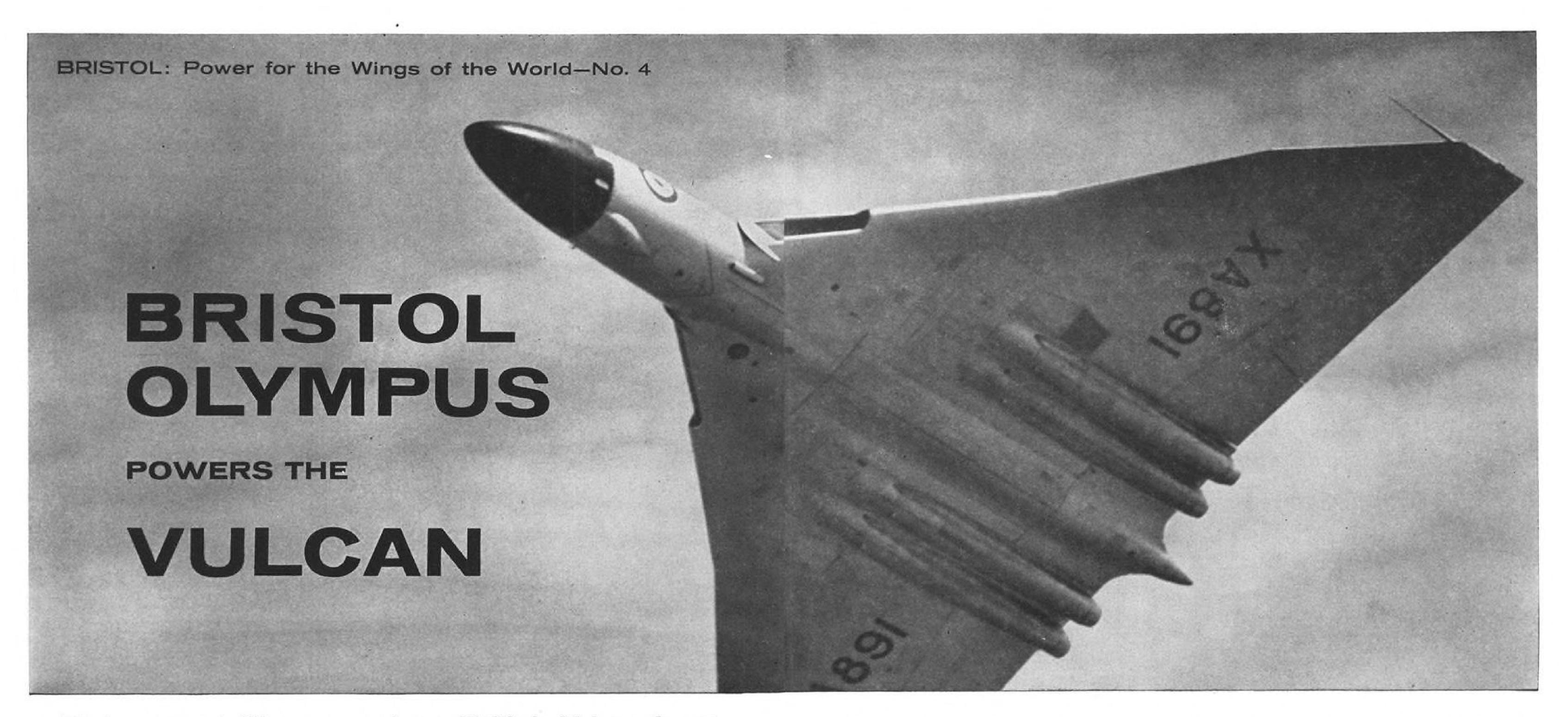
Expansion of this VTOL program has created openings for experienced aerodynamicists and structures engineers with experience in these fields:

- Structural Design and Analysis
- Flutter and Vibration
- Flight Control Systems
- Propulsion Systems Design and Analysis
- Armament and Installation Layout

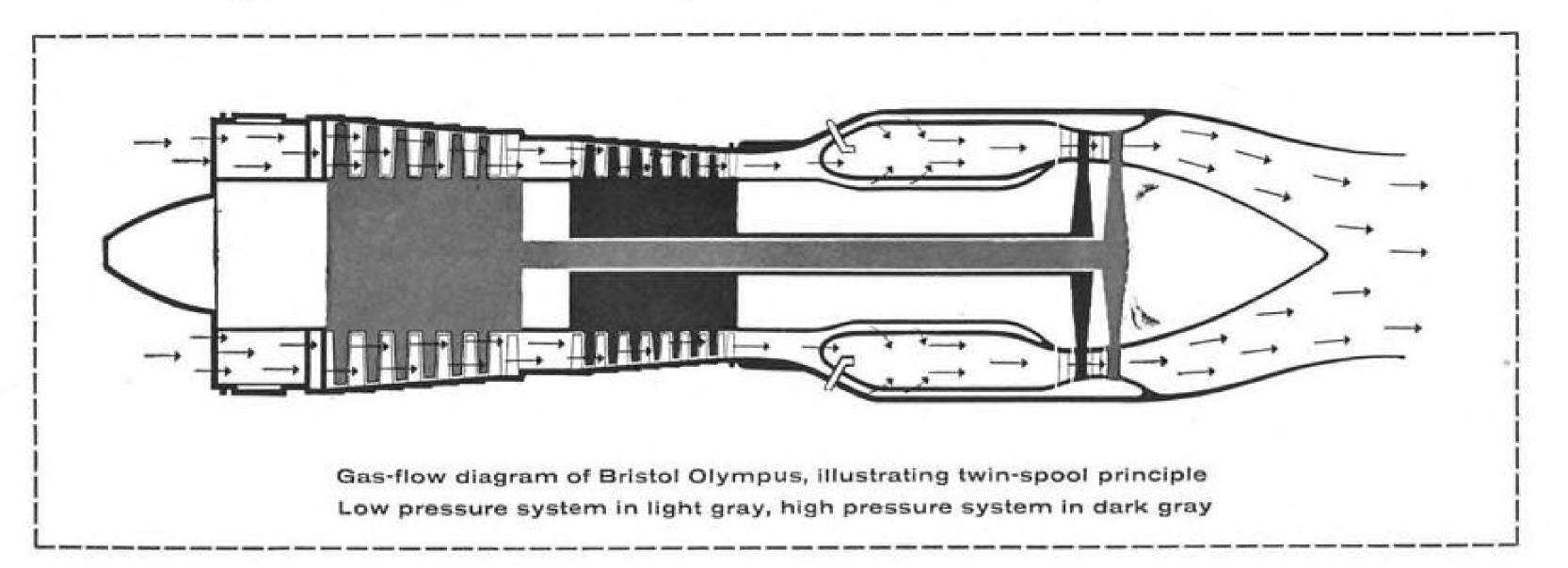
Here are challenging, long-range opportunities to participate in the production of the planes of tomorrow. Salaries commensurate with your background, good living and working conditions, and liberal benefits. Please write: Supervisor of Engineering Employment, Dept. E-25, BELL AIRCRAFT CORPORATION, P. O. Box 1, Buffalo 5, N.Y.



123



## Twin-spool Olympus gives British V bombers, great speed, high ceiling, long range



The great Avro Vulcans of the British Royal Air Force are powered by Bristol Olympus turbojets. These V bombers owe their great speed, high ceiling and long range largely to the Olympus—an engine which uniquely combines great power at high altitudes, very low specific fuel consumption, and exceptional, proven reliability.

The British Under-Secretary of State for Air, Mr Charles I. Orr-Ewing, has stated: "The Vulcan has probably had the minimum amount of teething trouble of any aircraft introduced in the RAF over the last 10 years."

Bristol twin-spool system. The Olympus employs the Bristol-pioneered twin-spool system. This system makes starting easy, eliminates surge, and gives a rapid response to control. Vulcan pilots regularly put the Olympus through "slam" accelerations and decelerations at altitudes well above 50,000 ft—one of the most severe tests to which a turbojet can be subjected. The Olympus responds magnificently every time.

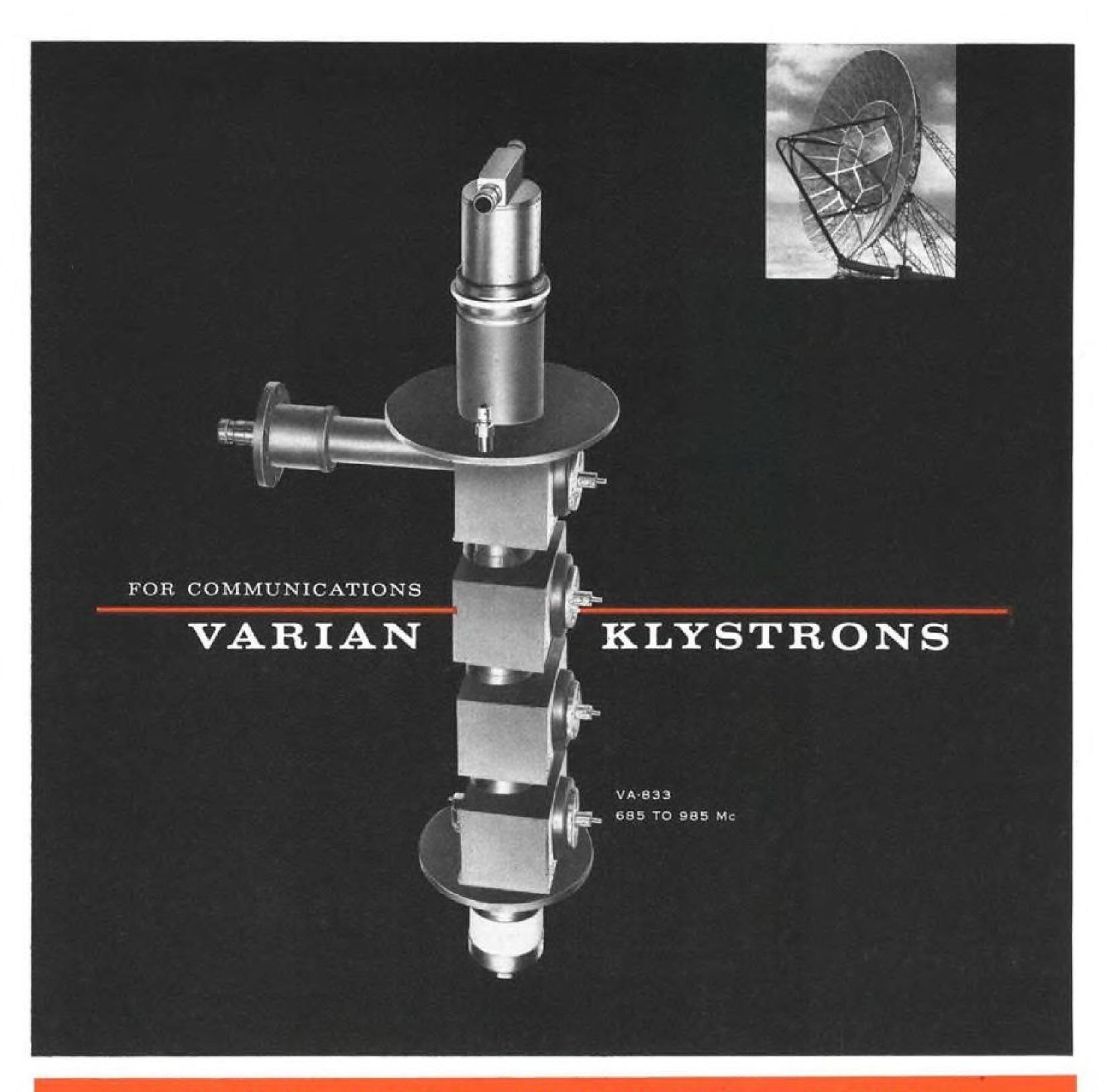
Latest version—the Bristol Olympus Mark 200 is type tested at 16,000-lb thrust—without reheat. It is now in production for the Vulcan B Mark 2 and gives the bomber even better performance. A civil version of this turbojet—the Wright TJ 38 Zephyr—has been jointly developed by Bristol and Curtiss-Wright.

Olympus development. The Olympus is capable of development into the 20,000-lb thrust class. It has already run at observed thrusts of over 17,300 lb without reheat.

## BRISTOL Aero-Engines

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### WIDE TUNING RANGE, WITH HIGH GAIN, HIGH POWER

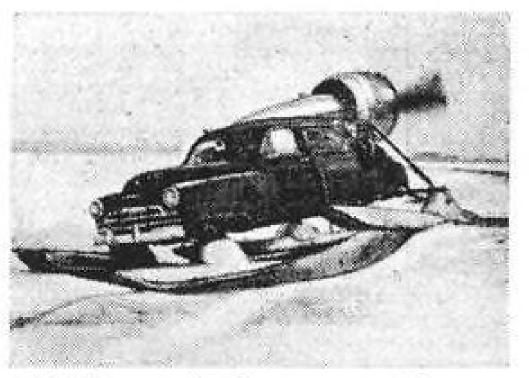
Now, one Varian Klystron tunes the range 685 to 985 Mc... another tunes from 1700 to 2400 Mc. Both feature integral cavities and non-critical magnetic focussing to assure simple installation, reliable operation, ease of maintenance and long life—all of which mean low operating costs.

Varian makes a variety of Klystrons for both Forward Scatter and Line of Sight Communications. And all offer the finest performance and dependability. Over 100 tubes are described and illustrated in our new catalog. Write for your copy.





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PUSHER propeller has reverse action.

### Russian Snow Sled Uses Aircraft Engine

A propeller-powered Russian "airsled" built by helicopter designer N. I. Kamov for surface transportation over snow and ice in the far north has successfully completed its tests.

Vehicle consists of a standard Soviet Pobeda automobile—minus wheels—mounted on runners. On top of the car body is a 260-hp. AI-14R piston engine—the same powerplant used in Russia's new Antonov An-14 Pchelka (Little Bee) short-haul airline transport plane.

A two-bladed, variable-pitch pusher propeller provides forward motion and braking. If necessary, the propeller can furnish reverse thrust for backward movement.

Russian reports state that the Kamov air-sled is more powerful than similar vehicles built earlier "which didn't provide even minimum comfort, were short lived, and had many operational troubles." The Kamov model is said to be as comfortable as a passenger car and can be operated by anyone familiar with an automobile's controls.

Space originally intended for the automobile engine is used for baggage. Tanks with a fuel capacity sufficient for five hours' operation are located under the car's front fenders.

Sled is equipped with a special heater used to warm the engine before starting.

It also heats the car's "cabin" when traveling and can warm the underside of the runners if they should become frozen while the vehicle is stopped.

### PRIVATE LINES

DOBIAN

Test program for Russia's twin-engine Antonov An-14 Pchelka (Little Bee) short haul transport calls for approximately 83 flight hours. An-14 made its first flight in mid-March (AW Apr. 21, p. 43). Standard version will carry six passengers and 330 lb. of baggage for 375 mi.; a proposed cargo model will carry 1,320-lb. payload up to 621 mi.

Executive versions of Fairchild F-27 turborpop transport are now scheduled to go to following: Continental Can Co., General Tire & Rubber Co., Butler Aviation, Bank of Mexico, Westinghouse Electric Corp., Champion Spark Plug Co., Kimberly-Clark Corp. and Ideal Cement Co. In all, 13 firms have ordered planes for private use. Fairchild has total of 93 orders on books for R-27s, including airline types.

Half-dozen separate aerial survey contracts covering some 60,000 sq. mi, of Bolivia have been awarded Canadian Hunting Group by several international oil firms. Amount of contracts exceeds \$500,000, calls for aerial photography, photogrammetric mapping, mosaics, astro control, airborne magnetometer surveys and their interpretation. Hunting is employing a Boeing B-17 photoship and two Lockheed Hudsons equipped with magnetometer and photogear.

Three Vertol 44 helicopters have been purchased by Canadian government at cost of approximately \$1 million, with spares. Vertols will be turned over to Spartan Air Services, Ltd., which is handling supply of Mid-Canada Early Warning Line installations under RCAF contract.

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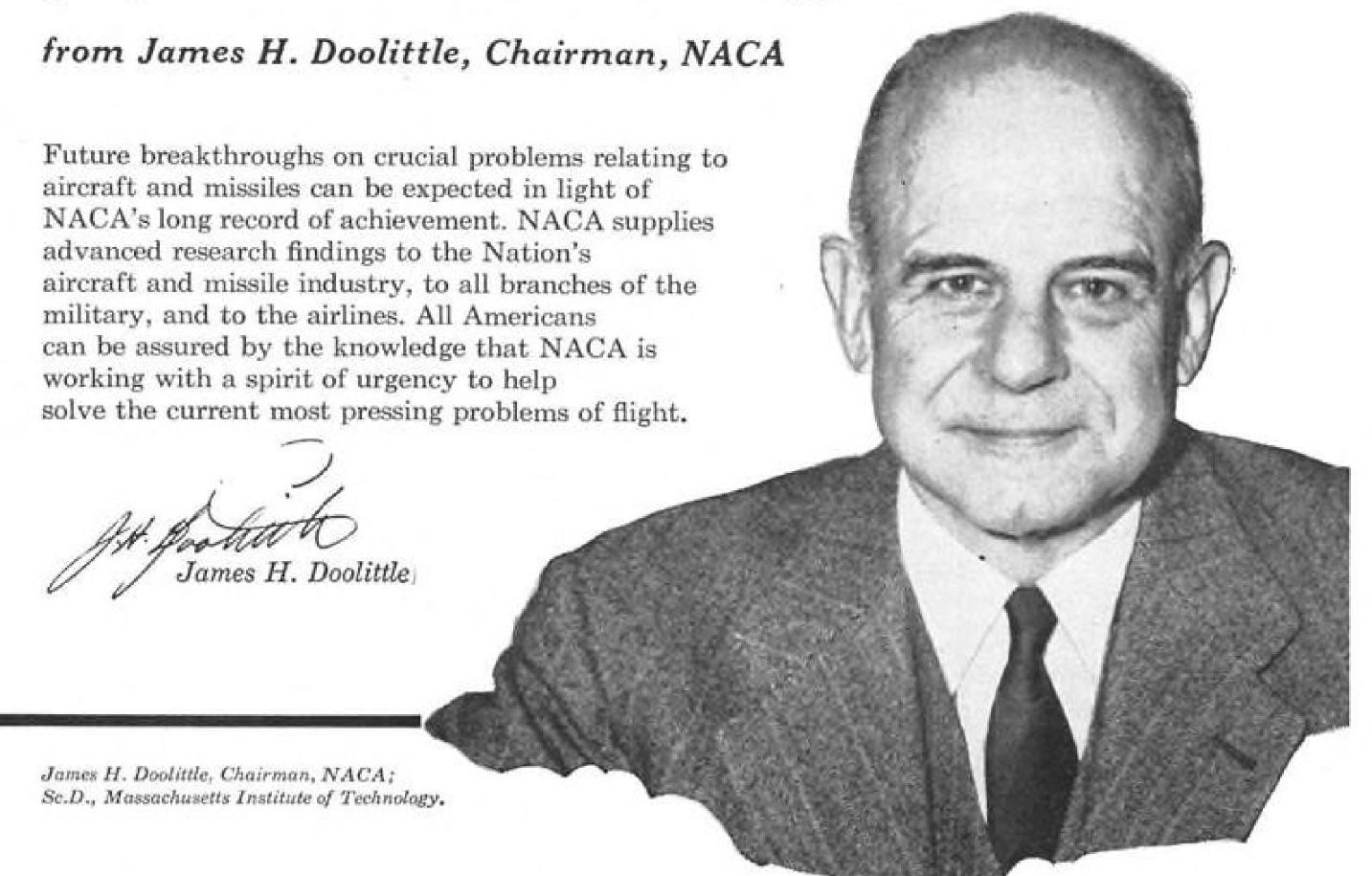
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## A message for young physical scientists & engineers



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NACA Fields of Research Include: Aerodynamics, Aircraft and Missile Structures, Materials for Aircraft and Missiles, Automatic Stabilization, Propulsion Systems, Propulsion Systems Structures, Rocket Systems, Solid State Physics, Fuels, Instrumentation.

A number of staff openings are becoming available. You are invited to address an inquiry to the Personnel Director at any one or all four of the NACA research centers:

> Langley Aeronautical Laboratory, Hampton, Virginia Ames Aeronautical Laboratory, Mountain View, California Lewis Flight Propulsion Laboratory, Cleveland, Ohio High-Speed Flight Station, Edwards, California

(Positions are filled in accordance with the Aeronautical Research Scientist Announcement 1B)



The Nation's Aeronautical Research Establishment

### WHO'S WHERE

(Continued from page 23)

### Changes

John Casey, manager, newly established Weapon System Support Department, North American Aviation, Inc., Los Angeles, Calif.

Edwin A. Raney, manager, Dynamics Division, Wyle Research Corp., El Segundo,

Clyde Bishop, manager, Pacific Airmotive Corp.'s aviation products branch, Burbank, Calif.

Gershon R. Makepeace, manager, propulsion staff-Polaris project, Missile Systems Division, Lockheed Aircraft Corp., Sunnyvale, Calif.

Sidney J. Nelson, manager-flight operations, and Walter R. Kyse, senior flight manager, Transocean Air Lines.

K. A. Groff, Washington, D. C., district representative, Sundstrand Aviation and Sundstrand Turbo Divisions, Sundstrand Machine Tool Co., Rockford, Ill.

Peter H. Wenzel, managing director, Pan American World Airways for Venez-

John K. Campbell, manager-government sales, Government and Industrial Division, Philco Corp., Philadelphia, Pa.

Rear Adm. Ford Newton Taylor, Jr., (USN, ret.), director-Washington, D. C., operations, Fairchild Camera and Instrument Corp., Syosset, N. Y.

Hugh A. Young, sales manager, Technical Products Division, Packard-Bell Electronics Corp., Los Angeles, Calif.

Col. J. G. Mayton (USAF, ret.), staff consultant, National Research and Development Corp., Atlanta, Ga.

Rahland C. Zinn, assistant base manager, Lockheed Aircraft Service-International, New York International Airport, N. Y.

Bob A. Wilson, assistant to missile products manager, Missile Applications Department, Exide Industrial Division, the Electric Storage Battery Co., Philadelphia, Pa.

Roy S. Dahmer, assistant general manager, and Martin W. Uitvlugt, experimental and development engineering manager, Aircraft Division, Eaton Manufacturing Co., Battle Creek, Mich.

Dallas A. Murphy, spare parts procure-ment engineer-commercial jet engine sales, Production Engine Department, Aircraft Gas Turbine Division, General Electric Co., Cincinnati, Ohio.

H. David Honan, manager-industrial sales, and Arthur G. Curtin, manager-contractor sales, I-T-E Circuit Breaker Co., Philadelphia, Pa.

James R. Garner, chief manufacturing engineer, Technical Products Division, Waste King Corp., Los Angeles, Calif.

Martin Rubin, senior mechanical engineer, Waugh Engineering Co., Van Nuvs,

Maj. Gen. Samuel S. Jack, Director of Aviation at Headquarters Marine Corps, will move to Marine Corps Air Station, El Toro, Calif., as Deputy Commander, Aircraft, Fleet Marine Force, Pacific; Maj. Gen. John C. Munn, Commanding General of the 2d Marine Aircraft Wing at Cherry Point, N. C., will replace Gen. Jack as Director of Aviation.

## Engineers: work in dynamic science

North American's Columbus Division, home of the T2J jet trainer, FJ-4 Fury Jet and A3J attack weapon system, is rapidly expanding its Dynamic Science Section. New aircraft, missile, and research contracts have created excellent career opportunities in these fields:

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DYNAMIC TESTING: You'll be engaged in testing models in laboratory and wind tunnel, determining the effects of ground and flight vibration on complete systems, and measuring flight vibration in reproduced environments.

DYNAMIC ANALYSIS: Perform studies on the effect of gust, blast, and carrier operations on the structural system transient load. Apply a generalized harmonic analysis to random disturbance on rigid bodies. Ascertain the effects of flexibility on structural response characteristics.

ANALOG COMPUTING: Work on the development of analog techniques, circuits, methods...combine analog-digital operations by applying differential analysis techniques.

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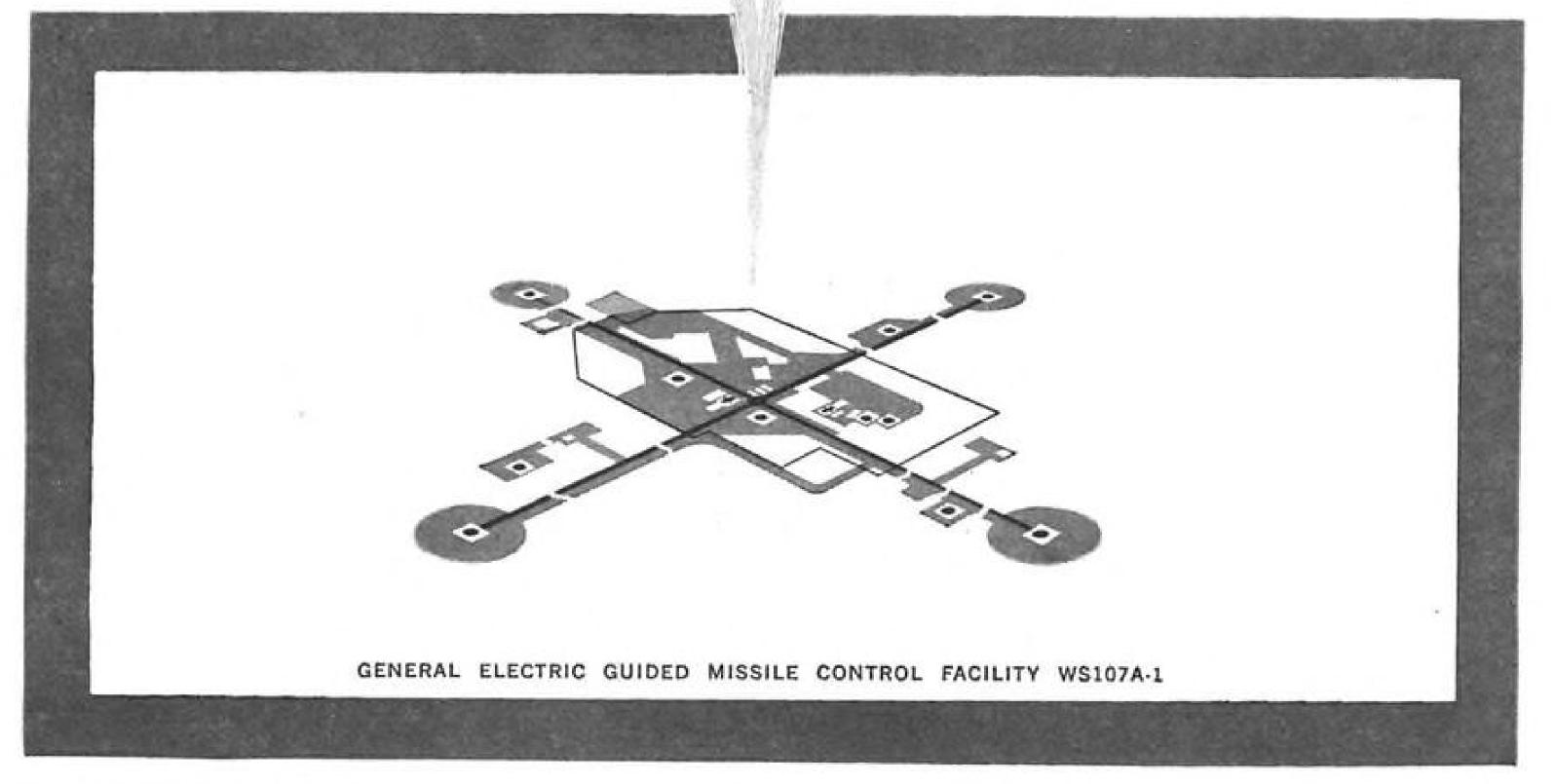
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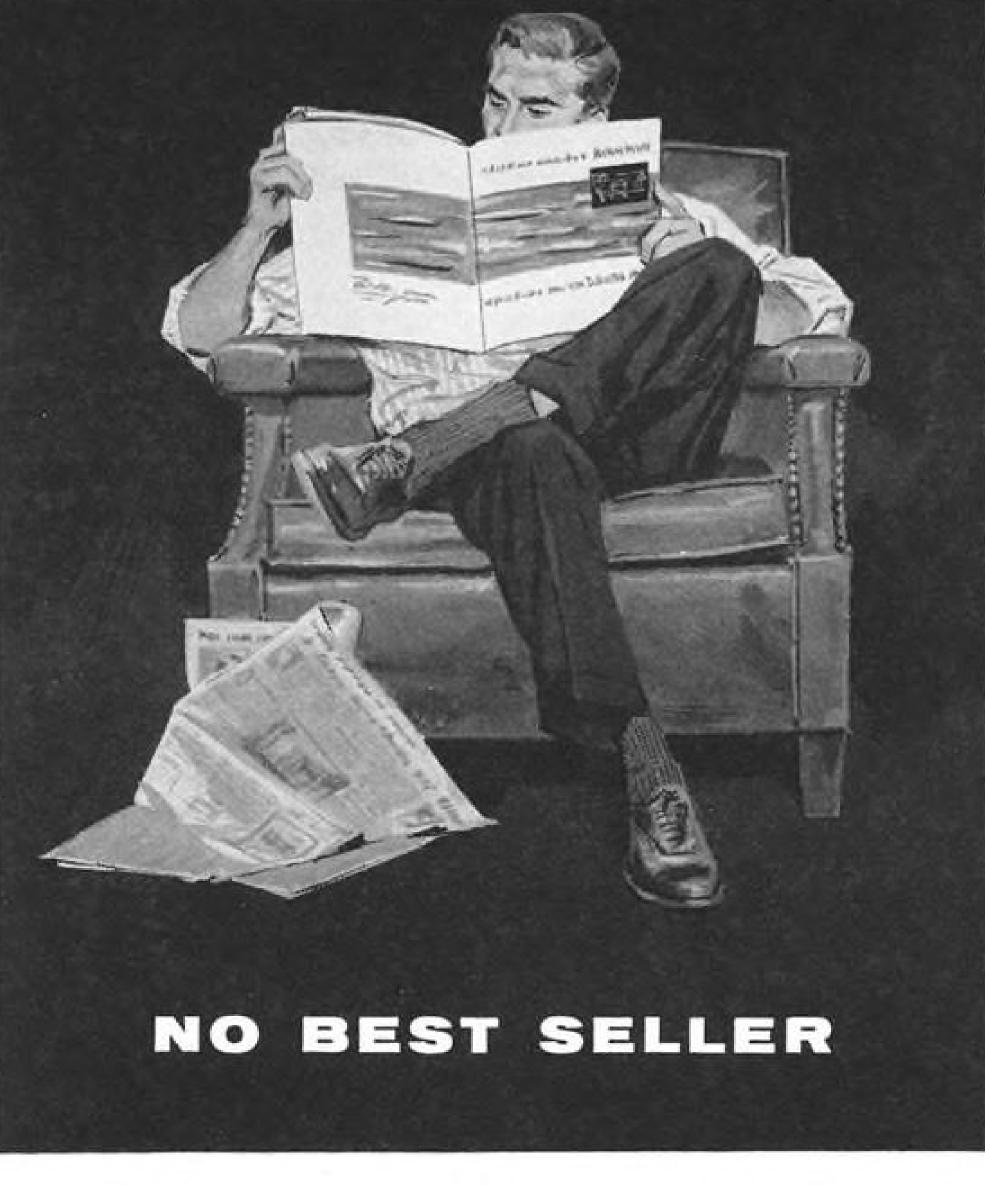
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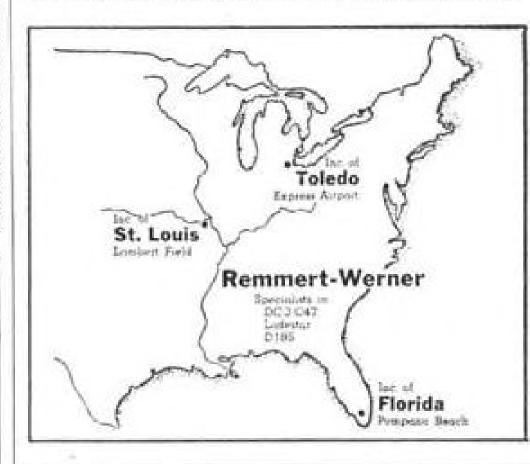
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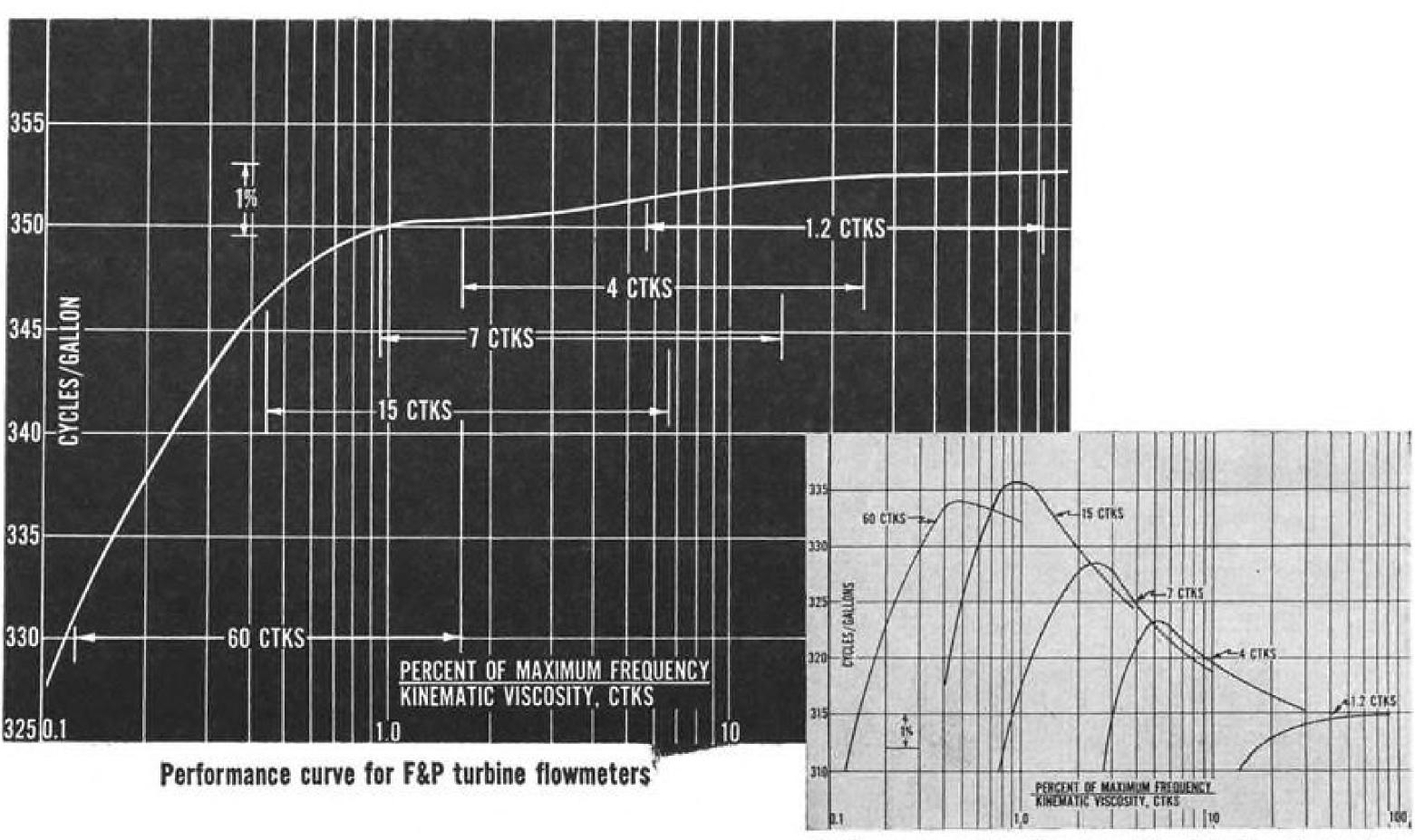
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### LETTERS

### Helio "Courier"

Your otherwise excellent article of March 17 (p. 85) on the Dornier Do.27 men tioned that the airplane uses a layout similar to STOL airplanes of the past—Fieseler "Storch", Ryan "Dragonfly", etc., but unaccountably omitted mention of the Helio "Courier" which has been in use since 1953 and is now giving service in 13 countries, including our own, in uses too varied to list here.

ROBERT L. DEVINE, JR. Chief Technical Engineer Helio Aircraft Corp. Norwood, Mass.

### Safety Responsibility

An air disaster, the mid-air collision ot a P2V and a C-118 over Norwalk, Calif., has imbued me with a desire to share my thoughts on air safety with those in avia-

I believe the aircraft industry, as the creator of the aircraft, must share in the responsibility for safety of human lives, and cannot simply conform to minimum government regulations.

There has been much talk and many board committees formed to discuss plans for an air traffic system to cope with the problems of the "jet age". Now the jet age is upon us and it is obvious that the same government agencies that were unable to cope with the problems of the "piston age" still have the ball. Shall we stick our heads in the sand and say that it strictly a government responsibility?

I would like to congratulate the Avionics Industry on the excellent progress made in communications, radar, proximity warning, and other equipment which greatly increase the safety of flight. It is obvious that stringent traffic control systems must be developed and utilized. The structural integrity and reliability of our aircraft have been developed in a magnificent manner. But one very important link, the human element, has remained, and can be expected to remain, relatively static.

When electronics are 100% reliable, then and only then, can the pilot be removed. Until that time, progress must also be made in improving the pilot's visibility and simplifying his tasks so that he can devote a reasonable amount of time to watching out the windows. Real progress has been made in military aircraft—jet fighters in particular, in cockpit visibility. The B-47 is an excellent example of this visibility in a large aircraft. What advances have been made in cockpit visibility of transports since the DC-3? In grand old tradition, we should have kept the buggy whip! Transport aircraft have a mission, too-delivering the passengers safely at their destinations, Speed and comfort must be secondary. Why not give the pilot the integrated, simplified display being developed for the mili-

I would like to applaud AVIATION WEEK on the excellent articles on air safety, and

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. 42 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.

tion after the Grand Canvon disaster. The facts have been presented and are obvious to private pilots like myself. I believe the airlines themselves must require design of safer transports. They have probably not required bubble canopies or rear-ward facing seats to keep the public unaware of

The public is aware of the Grand Canyon and the Norwalk disasters. We, as the industry promoting aviation, must retain a moral responsibility for human life if we expect to sell aviation to the human race.

A. KEITH SMITH Fullerton, California

### Reserve Cuts

During the many past weeks of reading my AVIATION WEEK, one subject which might be worthy of reflective comment has not been mentioned: namely, the reduction in force within the armed forces of many technically qualified reserve officers who have spent a large percentage of their working lifetimes in the service of their country only to be released from active duty during their more difficult re-employment years without any of the security benefits which normally accrue to service personnel at the termination of a satisfactory period for active duty retirement.

Since the necessity for retaining technically trained personnel has been documented by the President of the United States, Senate and House investigating committees and all the heads of the armed services, this action is impossible to logically understand. Responsible public officials throughout the free world have indicated that our very survival does and will depend on an increasing requirement for a technically superior military establishment. The Congress is now favorably considering a new pay bill to carry out the primary requirement of retaining skilled personnel in the armed forces. Large numbers of students are being subsidized by federal appropriations to fill the urgent need for technically trained people, yet behind the scenes reductions in force of electronics engineers. special weapons officers and aeronautical engineers have taken place to satisfy a pre-Sputnik, Wilsonian order to cut defense expenditures by reducing the personnel allowances within the officers' designations.

The effect on service morale, the severe induced hardships upon forcefully released personnel, the obvious loss of valuable and experienced officers, the distressing family dilemmas-none of these resulting circumstances have shaken the Pentagon or the White House from their viewpoints that this action is sensible and consistent with the emphatically expressed need for the especially the transport visibility investiga- greatest possible retention of trained tech-

nical people. Even Rep. Carl Vinson through the House Armed Services Committee has failed to convince the Pentagon of its error.

As an interested citizen in this wrongful administrative action, it seems that your publication might be interested in casting the spotlight of common sense public opinion upon this slap at the reserve forces and perhaps to some degree favorably support the hearings now scheduled to commence within the House Armed Services Committee following the Easter recess. Let's return these officers to duty immedi-

> KEMPTON J. PERRY St. Albans, Vt.

### Whitewash

The ALPA protest against the findings of the CAB in the case of the Rikers Island crash (AW April 14, p. 109) seems to be an attempt to whitewash Capt. Marsh's failings as an instrument pilot.

Capt. Marsh states his primary concern was airspeed, rate of climb, and direction. The three instruments inferred by this statement certainly cannot be classified as representing a proper instrument scanning pat-

I am not familiar with the instrumentation of the DC-6, but as a rule the so-called 'primary flight instruments' are usually air driven or read from pitot static. I can still hear my instructors chanting "needle, ball, airspeed, altimeter."

With proper reference to these three instruments and the gyro horizon (if operable), this crash could have been averted.

H. F. SWEITZER, JR. Lt., U.S.N.R. Wakefield, Mass.

### Relative Motion

Having noted the difficulties involved in the development of the Collision Warning Systems, it appears that one important area is being overlooked.

This is the lack of relative motion of the other aircraft as viewed by the pilot, i.e., aircraft on collision courses will retain their angular displacement as viewed by the pilot, and grow in size. This lack of motion appears to be the reason why a maneuvering aircraft will be seen at a much greater distance than one whose position is relatively

Now if recent methods of screening nonmoving targets from radar screens could be reversed to delete the moving (in bearing only) targets, there would be left a presentation of possible collisions.

This would delete ground areas below but indicate hills directly ahead as it would also show heavy rain areas when directly on

This system would have some limitations such as aircraft flying on parallel course within range of the system and aircraft flying circular flight paths.

> BRUCE L. CLARK Lakeland, Fla.



Versatile: Combines advantages of a permanent fastener with the utility of a nut and bolt

Lightweight: Within .02% of lightest high strength permanent fastener

High Strength: Tension head fatigue and static tensile performance from a shear-type head Shear Strength: 95,000-140,000 psi depending on materials used

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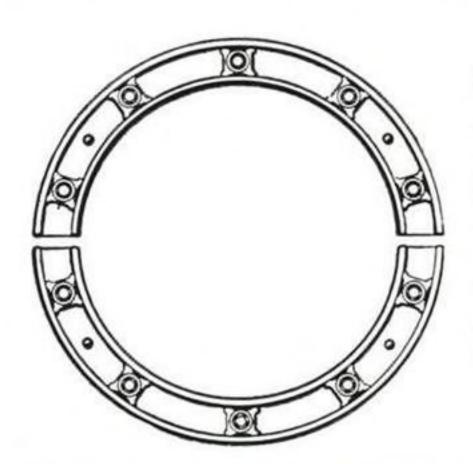
Fastbolts and Fastnuts are available in a wide range of materials including alloy steels, several titanium alloys, stainless steels, super alloys, chrome die steels and aluminum alloys.



the Fastbolt Gun

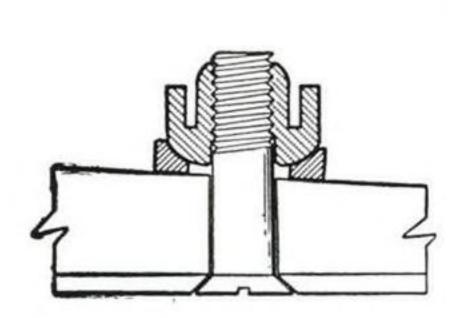
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## How ESNA® solves 7 typical aircraft fastening problems



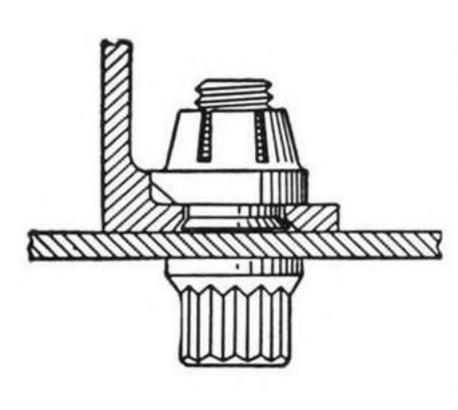
### Speedier installation of access panels

ESNA gang channel nut strips eliminate the costly, time consuming installation job of riveting individual nuts. Available in straight or curved sections and even complete rings, custom designed for applications such as access doors or inspection covers.



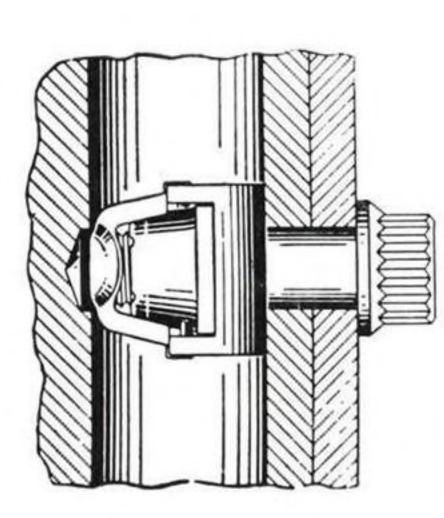
### Bolting non-parallel surfaces

No more costly spot facing, step milling or hand selecting tapered shims! ESNA's counterbored, self-aligning types include one lug, two lug, gang channel, standard hex and high tensile types. Ball-and-socket relationship of nut and special base allow an 8° tilt in any direction from centerline to compensate for draft angle or tapered sections.



## Fastening stressed joints subject to temperatures up to 1300°F.

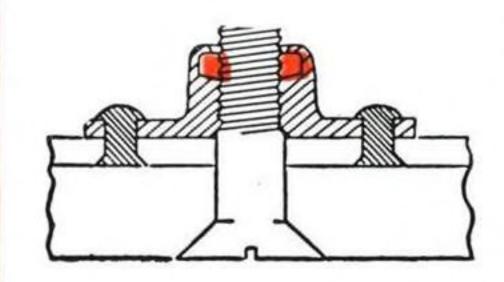
For really "hot" applications such as jet engine flange assemblies or fire wall sections, where fastener dependability is critical, ESNA offers the "long-beam" locking device. The full cantilever of these sections assures protection against failures related to relaxation, creep and similar problems caused by the effects of extremely high temperatures upon metals. (Ask for ESNA Bulletin No. 5715 Design Manual for High Temperature Self-Locking Nuts.)



## Simplifying major substructure joining

An ESNA barrel nut doesn't have to be held for wrenching. . doesn't need precisely mated bolt holes. The barrel-shaped fastener is simply finger-pressed into a drilled or reamed hole until the special clip snaps into position at the bolt hole location. The .030" float of the nut section of this fitting avoids misalignment problems and the bathtub recess for wrenching area is eliminated. New NAS 577 barrel nut (180,000 psi) now available. Also 160,000 and new 220,000 psi series.





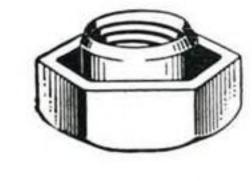
## Applications requiring guaranteed high reusability through more than 50 on-off cycles.

Where repeated tear-down and re-assembly or frequent readjustment is required, the exceptional elastic "memory" and non-galling characteristics of ESNA's standard nylon locking insert guarantees long lasting locking torque and fastening dependability. Available in all sizes and configurations of standard aircraft type nuts. Parts can also be designed to order and in any standard configuration, with guaranteed re-use factors as high as 300 on-off cycles.



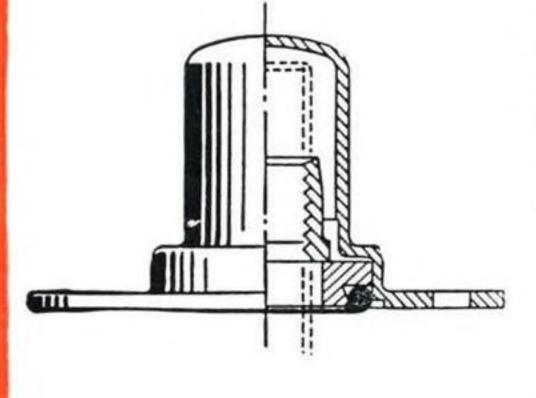
## Attaching components in areas with limited wrench clearance.

Miniaturized insert-type hex nuts with across-the-flats dimensions as small as .109 in the 0-80 size . . . or all metal (550°F.) nuts to AN365 or NAS 679 performance specifications with internal wrenching hexagon faces (which permit use of smaller wrench sizes) are available for use at locations where space and weight limitations are paramount. Complete lines of NAS miniature anchor nuts in carbon steel and A286 stainless steel are also in production. Ask for your copy of the NAS/ESNA Conversion Book.



### Sealing against fuel tank leakage

No danger of highly volatile fluids leaking past bolt threads with ESNA's self-sealing, floating anchor cap nut! The one piece cap unit is provided with "O"-ring seal around its base which seals immediately the nut is riveted to the surface. The self-locking nut enclosed within the cap has .025" float to compensate for misalignment. Also available in gang channel nut strips.



	WHAT	ARE YOU	R FAST	ENING	PROBL	EMS?
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2330 Vo	uxhall	Road, Un	ion, N.	J.		
Plea	se send	me details	on the f	ollowing	:	

Firr	n					
Na	me		Title			
	Bolting non-parallel surfaces		Bulletin No. 5715 High Temperature Design Manual			
	Fitting in limited space		NAS/ESNA Conversion Book			
	Sealing against leakage		Assuring high re-usability			
	Installing access panels		Simplifying substructure joining			
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