Aviation Week & Space Technology

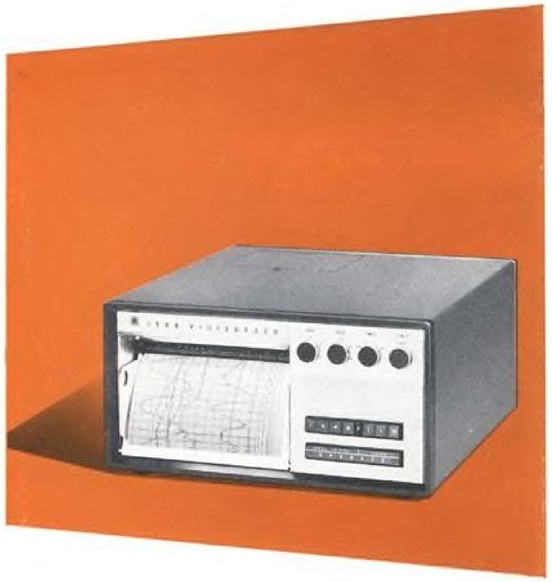
75 Cents

A McGraw-Hill Publication

May 28, 1962

Reliability Of Space Vehicle Avionics Gaged

Potez-Heinkel CM-191



In your case, or in ours

The new 1508 Visicorder should be your next oscillograph

The Model 1508 Honeywell Visicorder has been specifically designed to quickly and easily slide into your data reduction system. There it will serve as a direct information read-out device, recording DC to 5000 cps on from one to 24 channels; or it may serve as a monitor on other components in your system; or it may do both jobs, simultaneously if you wish.

You have no "data reduction system," as such? Then consider the trim, convenient 1508 as a bench instrument. Its push-button controls, selection of 12 chart speeds (metric, if desired), 8″ paper width, and direct writing speeds exceeding 50,000 in./sec. will help to make it one of your most useful tools. Its rigid, cast base assures constant alignment of optical components regardless of external stress on the instrument.

In your case . . . the 1508 needs only 7″ of rack height. In ours . . . it arrives ready to go to work as a convenient, portable instrument. In *any* case, be sure to see the new 1508 Visicorder before you order your next oscillograph. Write for Catalog HC-1508 to Minneapolis-Honeywell, Heiland Division, 5200 East Evans, Denver 22, Colorado.

Honeywell

First in Control

COMPUTER AND SERVO ANALYZER, both developed and built by Vickers engineers, are used for detailed studies of design and performance of new miniature servo valve.

CAPABILITY
is spelled
r-e-l-i-a-b-i-l-i-t-y
in servo systems

Attaining maximum reliability in aerospace servo systems requires complete control over all design and manufacturing variables. Only Vickers manufactures all the elements needed by a complete system—servo valves, power supplies, actuators, pumps and motors—assuring development of a matched, packaged system. The direct result of centralizing this responsibility is a tailored system providing maximum response, highest horsepower-to-weight ratio and the ultimate in reliability.

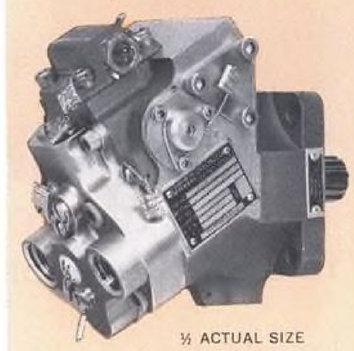
A high response miniature flow-control servo, an integrated servo-motor and a high flow servo valve (150 gpm) for thrust vector control of a rocket engine are examples of recent Vickers developments. Servo valves can be provided for operating temperatures to 1000°F and covering all fluids normally encountered.

Complex servo system problems get fast, practical solutions because Vickers has both solid state Univac digital, and analog computers manned by engineers who understand fluid power technology. For more details on how the combination of experience, facilities and technical skills can be applied to your servo system problem write to Vickers Incorporated, Detroit 32, Michigan, for Bulletin 6006.

VICKERS
DIVISION OF SPERRY RAND CORPORATION

PROGRAMED POWER IN:

POWER TRANSMISSION
POWER CONVERSION
FLUID TRANSFER



½ ACTUAL SIZE

½ ACTUAL SIZE

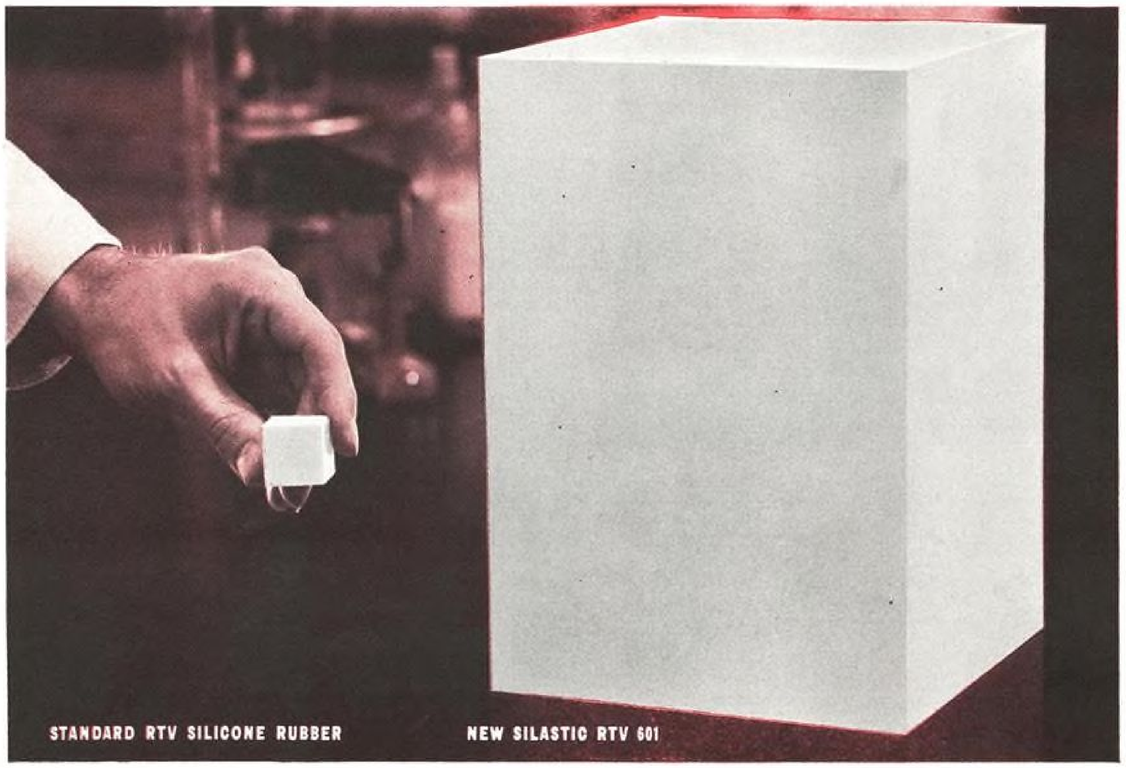
INTEGRATED SERVO MOTOR (left) utilizes new hydraulic motor designed specifically for optimum compatible operation with servo valves. MINIATURE SERVO VALVE (above) offers high response, minimum weight (5.5 oz.) and exceptional static performance.

MAGNETRON TUBE SERVO TUNING SYSTEM is designed and built by Vickers. The high response servo actuator (encircled) permits tuning at a variable rate or locking at any desired position.

1206

SILICONE NEWS from Dow Corning

New fluid silicone rubber



New Silastic RTV 601 pours easily, cures in any thickness in 24 hours!

That's right . . . Dow Corning research has developed a free-flowing silicone rubber that vulcanizes in unlimited thickness at room temperature. We call this new rubber Silastic® RTV 601. Engineers who have evaluated this material call it a major breakthrough in the science of room-temperature-vulcanizing silicone rubbers.

In the space allowed here, it's near-impossible to describe in words the significance of this development. So we decided to forgo words and use a photograph to tell the story. To cure a one-inch cube of ordinary RTV silicone rubber requires from several days to weeks depending on the application. The general rule of thumb is to allow 24 hours curing time for each ¼" of thickness. Compare this with the large 725 cubic inch block of Silastic RTV 601 which vulcanized in just 24 hours at room temperature. Note that you could pour a block of RTV 601 as big as a house and it, too, would cure in just 24 hours.

With such a major improvement you might expect changes, even sacrifices, in properties. Not so with RTV 601. Like all other Silastic RTV silicone rubbers, it retains good physical and electrical properties over a temperature service range of —100 to 500 F.

Silastic RTV 601 may well be the material to help you perfect new engineering concepts or to overcome a tough design or production problem. If you'd like more information and a free evaluation sample, write today on your company letterhead to Dept. 1405, Dow Corning Corporation, Midland, Michigan.

For technical data and free evaluation sample, write on your company letterhead.

first in silicones

Dow Corning

AEROSPACE CALENDAR

June 4-7—1962 Nuclear Congress, Statler Hilton Hotel, New York, N. Y.
June 6-7—Symposium on Standards for Filament-Wound Reinforced Plastics, Naval Ordnance Laboratory, White Oak, Md.
June 6-8—Eighth Annual Radar Symposium (classified secret), Institute of Science and Technology's Radar Laboratory, University of Michigan, Ann Arbor.
June 7-9—Pacific Northwest Metals Conference, Benjamin Franklin Hotel, Seattle.
June 8-9—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.
June 11-13—Sixth National Conference, National Aviation Education Council, Seattle, Wash.
June 13-15—Annual Meeting, Heat Transfer and Fluid Mechanics Institute, University of Washington, Seattle, Wash.
June 17-22—Summer General Meeting, American Institute of Electrical Engineers, Denver Hilton Hotel, Denver, Colo.
June 18-19—Vacuum Metallurgy Conference, American Vacuum Society, New York University, New York, N. Y.
June 18-Aug. 10—Advanced Subject Matter Institute on Nuclear Rocket Propulsion, University of Florida, Gainesville, Fla. Sponsor: National Science Foundation.
June 19-21—39th Meeting, Aviation Distributors and Manufacturers Assn., Ambassador Hotel, Los Angeles.
June 19-22—Summer Meeting, Institute of the Aerospace Sciences, Ambassador Hotel, Los Angeles, Calif.

(Continued on page 7)

AVIATION WEEK and Space Technology
May 28, 1962
Vol. 76, No. 22

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator; Daniel F. Crowley, Vice President and Controller. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

Available only by paid subscription. Publisher reserves the right to refuse non-qualified subscriptions. Subscriptions to Aviation Week solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription orders forwarded to address shown in box below.

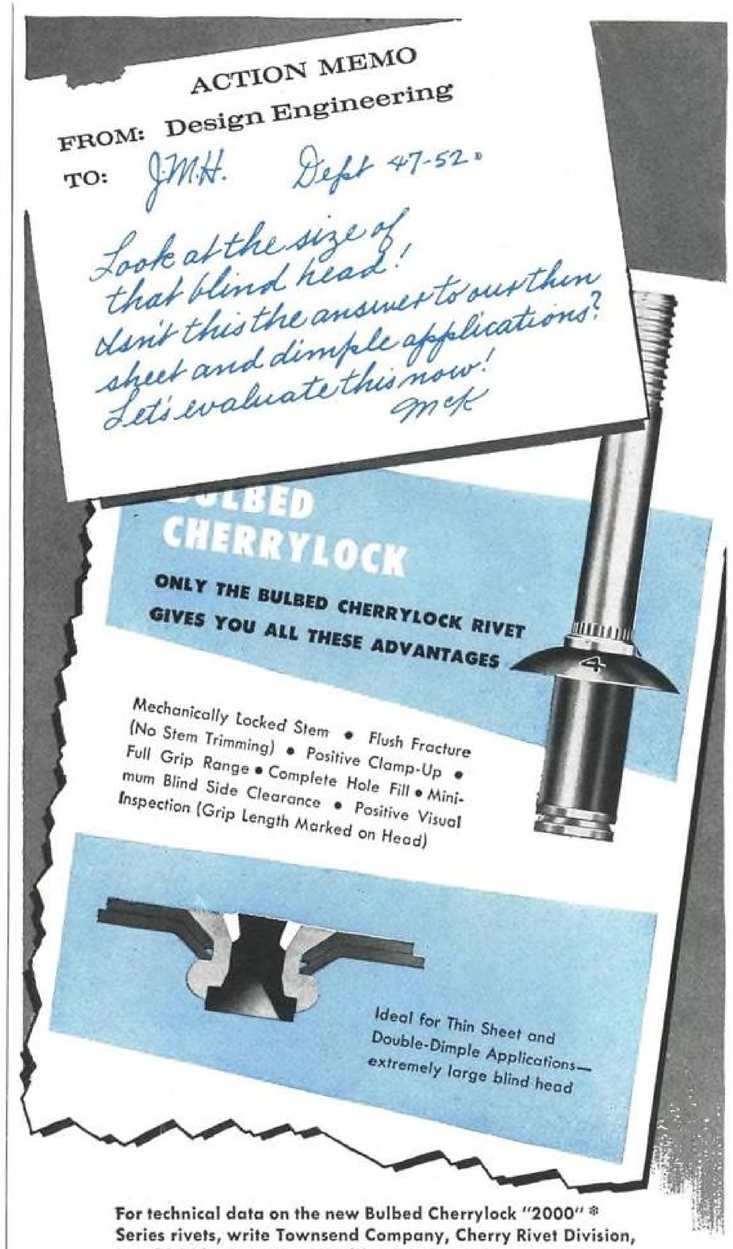
Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada, $8 one year. All other countries, $20 one year.

Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher, upon written request, agrees to refund the part of the subscription price applying to the remaining unfilled portion of the subscription—if service is unsatisfactory.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.
©Copyright 1962 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK and SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Aviation Week and Space Technology, 330 West 42nd Street, New York 36, N. Y.



For technical data on the new Bulbed Cherrylock "2000" * Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157 N, Santa Ana, California.

*Patent Pending

See our specifications in V·S·M·F Vue Microfilm Catalog File

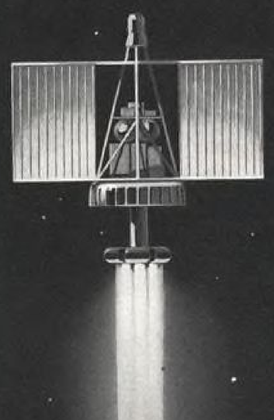
Cherry Rivet Division
Santa Ana, Calif.

Townsend Company
ESTABLISHED 1816 • BEAVER FALLS, PA. • A textron COMPANY

• In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario

SNAP-8

RELIABLE POWER FOR ELECTRIC PROPULSION



A major advance in space power plants, the SNAP-8 Electric Generating system will deliver 30 kw of electric power for 10,000 hours... Result: for the first time space vehicles will be capable of long-term orbital and extraterrestrial missions... Additional SNAP-8 applications: continuous communication, data gathering and mapping, and life support.

The SNAP-8 system is being developed by the Power/Equipment Division of Aerojet-General. SNAP-8 is a joint AEC-NASA program.

POWER / EQUIPMENT DIVISION

Aerojet-General®

CORPORATION

Azusa, California

A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY

THE GENERAL TIRE

Engineers, scientists: investigate outstanding opportunities at Aerojet.

AEROSPACE CALENDAR

(Continued from page 5)

June 20-22—Annual Convention, Airline Ground Transportation Assn., Barclay Hotel, New York, N. Y.

June 24-29—Annual Meeting, American Society for Testing and Materials, Statler Hilton Hotel, New York, N. Y.

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

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

June 26-28—Aviation Conference, American Society of Mechanical Engineers, University of Maryland, College Park, Md.

June 26-28—203rd National Meeting, American Meteorological Society, University of Alaska, Fairbanks, Alaska.

June 26-29—Third International Symposium on Rarefied Gas Dynamics, University of Paris, Paris, France. Sponsors: AFOSR; ONR; NASA. (Open meeting.)

June 27-28—Ninth Annual Symposium on Computers and Data Processing by the University of Denver's Denver Research Institute, Elkhorn Lodge, Estes Park.

June 27-29—Joint Automatic Control Conference, Institute of Radio Engineers, New York University, New York, N. Y.

June 28-29—Fourth National Symposium on Radio Frequency Interference, Institute of Radio Engineers, Town House, San Francisco, Calif.

July 7-11—16th Annual All-Woman Transcontinental Air Race from Oakland, Calif., to Wilmington, Del.

July 12-13—12th General Assembly, NATO Advisory Group for Aeronautical Research and Development, Paris, France.

July 17-19—Lunar Missions Meeting, American Rocket Society, Pick Carter and Statler Hilton Hotels, Cleveland, Ohio.

July 24-Aug. 2—National Soaring Championships, El Mirage, Calif. For information: National Soaring Championships, P. O. Box 997, Victorville, Calif.

Aug. 1-5—Experimental Aircraft Assn. Fly-In, Rockford Airport, Rockford, Ill.

Aug. 8-10—1962 Standards Laboratory Conference, National Bureau of Standards' Boulder Laboratories, Boulder, Colo.

Aug. 10-11—IAS National Specialists Meeting, Man-Machine Competition, Olympic Hotel, Seattle, Wash.

Aug. 13-16—Pacific Energy Conversion Conference, Fairmont Hotel, San Francisco.

Aug. 14-16—Cryogenic Engineering Conference, University of California of Los Angeles, Los Angeles, Calif.

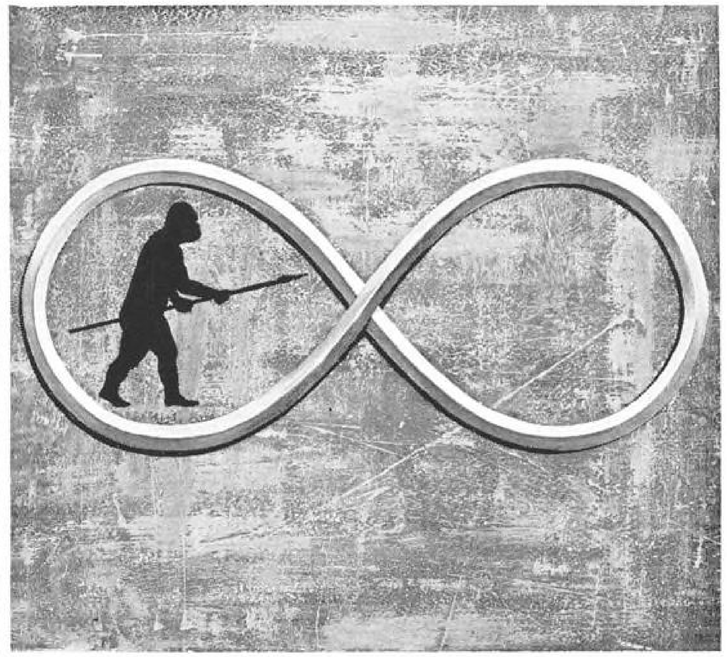
Aug. 14-16—International Conference on Precision Electromagnetic Measurements, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

Aug. 15-17—Nuclear Propulsion Conference, Monterey, Calif. Joint Meeting: Institute of the Aerospace Sciences; American Rocket Society; American Nuclear Society.

Aug. 15-17—Third International Electronic Circuit Packaging Symposium, University of Colorado, Boulder, Colo.

(Continued on page 9)

Involvement: ***LIFE***



GROWTH...

In this era of startling scientific and mechanical progress, the significance of human vitality and growth is sometimes minimized. As it relates to man—individually and collectively—growth is the human drive toward advancement. And... advancement is the result of directing specialized talents toward the goal of making an enduring contribution to mankind through the exploration and eventual conquest of the unknown.

Stanley Aviation Corporation is dedicated to such a philosophy.

This progressive firm, recognized for its leadership in the design and development of aircraft escape and survival systems, has a continuing need for additional outstanding scientists and engineers who share its own deep interest and enthusiasm in the importance of man's growth... and survival.

Excellent opportunities exist for qualified specialists in Aerodynamics, Computer Engineering, Design Engineering, Physics and other similar areas of a technical or scientific nature.

Direct your confidential inquiry to:
F. E. Wright, Personnel Manager

Stanley AVIATION CORP.

2501 DALLAS STREET
DENVER 8, COLORADO

An equal opportunity employer

Tattletale.

Force washers—unique transducers invented by Lockheed—measure load and clamping force minute-by-minute

Born of Lockheed's aerospace developments is a remarkable family of measurement devices that is being adopted by industry everywhere. Simplest of these is the force washer. Shaped like the common washer it replaces, it instantly measures and reports clamping force and load to special, Lockheed-developed readout equipment.

Today these force washers are being used in testing of automobiles to help produce squeak-proof designs, as well as by manufacturers of gaskets to determine correct torquing sequence for proper sealing. The Lockheed force washer is also in use in the missile industry, building construction, and farm equipment manufacturing for a variety of load tests.

Lockheed Electronics' *inventive designers* have developed a complete family of unique transducers for science and industry: load cells to simplify weighing up to 100 tons, velocimeters to measure the speed of sound in water, and position transducers to measure velocity and time of separation of missile stages and remotely control rate of rise and fall of missile silo elevators.

Lockheed's *practical packagers* have mass-produced these instruments in dozens of sizes, configurations and pressure ranges.

Lockheed Electronics' *engineering follow-through teams* work with industrial and military customers to assist in transducer applications and to solve special problems.

The Avionics and Industrial Products group of Lockheed Electronics Company, located at 6201 E. Randolph St., Los Angeles 22, Cal., invites you to investigate the use of these revolutionary transducers in the development and testing of your products.

LOCKHEED ELECTRONICS COMPANY

PLAINFIELD, NEW JERSEY

A Division of Lockheed Aircraft Corporation

AEROSPACE CALENDAR

(*Continued from page 7*)

Aug. 19-25—Annual Meeting and Conference, Airport Operators Council, Princess Kaiulani Hotel, Honolulu, Hawaii.

Aug. 21-24—Western Electronics Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.

Aug. 21-Sept. 17—14th Session, International Civil Aviation Organization Assembly, Rome, Italy.

Aug. 23-24—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Westward Hotel, Anchorage, Alaska.

Aug. 23-24—Conference on Thin Films, Colorado Hotel, Glenwood Springs, Colo. Sponsor: Solid State Electronics Laboratory, University of Denver's Research Institute.

Aug. 27-29—AIME Technical Conference on Advanced Electronic Materials, Benjamin Franklin Hotel, Philadelphia, Pa.

Aug. 27-29—Symposium on Ballistic Missile and Space Technology, Statler Hilton Hotel, Los Angeles, Calif. Sponsors: U. S. Air Force; Aerospace Corp.

Aug. 27-Sept. 1—Third International Congress, International Council of the Aeronautical Sciences, New Congress Hall, Stockholm, Sweden.

Aug. 28-30—Fourth Conference on Maintainability of Electronic Equipment, Electronic Industries Assn. (in cooperation with Department of Defense), University of Colorado, Boulder, Colo.

Sept. 3-7—National Advanced Technology Management Conference, Institute of Radio Engineers, Seattle, Wash.

Sept. 3-7—International Symposium on Information Theory, Institute of Radio Engineers, Brussels, Belgium.

Sept. 3-9—1962 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 10-14—Annual General Meeting, International Air Transport Assn., Dublin.

Sept. 17-18—Hydrofoil & Air Cushion Vehicles Meeting, Institute of the Aerospace Sciences, Shoreham Hotel, Washington, D. C.

Sept. 18-23—16th National Convention & Aerospace Panorama, Air Force Assn., Las Vegas, Nev.

Sept. 19-20—Operations & Maintenance Symposium, Airwork Corp., Millville, N. J.

Sept. 19-22—Second International Agricultural Aviation Congress, National Superior Agronomy School, Grignon, France.

Sept. 24-28—13th International Astronautical Congress, American Rocket Society, Sofia, Bulgaria.

Sept. 25-28—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.

Sept. 28-29—Society of Experimental Test Pilots' Sixth Annual Awards Banquet & Symposium, Beverly-Hilton Hotel, Beverly Hills, Calif.

Oct. 29-31—Symposium on Dynamics of Manned Lifting Planetary Entry, Philadelphia, Pa. Attendance limited; for information: Sinclaire M. Scala, General Chairman, Room M7023A, General Electric Co., MSVD, Valley Forge Space Technology Center, Box 8555, Philadelphia 1, Pa. Co-sponsor: AFOSR.

GIANNINI CONTROLS CORPORATION

LOOKING FORWARD

by Julian Hartt

BERWYN, PA.—Next to freedom itself, Americans traditionally and instinctively treasure human lives, time, and money, quite likely in that order. When one comes upon a single device that can accomplish all three objectives to a dramatically measurable degree while contributing to freedom's preservation, it is indeed thrilling.

Such a device is a product of project MODEL FLY, developed here at the Astromechanics Research Division of Giannini Controls.

Absolutely unique in itself, project MODEL FLY provides the Air Force with a new technology to slash dollars and danger from significant portions of transonic and supersonic flight test programs.

It does it by taking flight test maneuvers out of the skies and into the wind tunnels; now at the University of Michigan wind tunnel and later in much larger transonic and supersonic tunnels. In these tunnels MODEL FLY will yield valid flight test answers for dynamic loads, stability, flight control and dynamic response.

Heading these efforts is Division Manager, Mel Zisfein, whose unofficial slogan, "Research for Fun and Profit," sets the tone for camaraderie and zeal among Astromechanics' small group. Zisfein grins and says, "We don't pretend for a moment that we will come close to putting the test pilots out of business; that's completely unrealistic. It's unlikely that we will ever be able to simulate certain maneuvers in a wind tunnel. But about half the more elementary specified maneuvers we can perform without even being tricky.

"We can save some percent, 20% is an absolute certainty and possibly as much as 70% of the flight test time and costs and in the process make flight testing itself safer."

How does it work?

MODEL FLY'S trapeze-like dynamic mount has its own servo-wings which respond to sensing masses and move to an angle of attack that cancels out the inertial forces of the mount.

"Consequently," Zisfein explains, "the mount feels weightless, the flexible, remotely controlled model up forward on the sting can maneuver up and down as much as it wants, feeling only thrust as if it has a powerplant. It doesn't know it's got that dynamic mount back there and it behaves accordingly."

What exactly can MODEL FLY save?

Mel Zisfein has some impressive figures on that. The structural load survey and demonstration flight programs for a Century Series fighter run to about 10 million dollars.

"If we save just 20% of that (we haven't talked about dynamic response, stability, and control), it would amount to 2 million dollars," Zisfein says, adding, "that's more than the MODEL FLY program will cost the Air Force when all is said and done."

A grimmer example was a supersonic bomber lost during high-Q maneuvers in a flight loads survey program. That cost two lives and the heavily instrumented aircraft halfway through the program. The dollar loss ran to eight figures.

As to the ultimate savings, Zisfein says, "Just extrapolate these examples over the things MODEL FLY is being designed to test; airplanes, helicopters, V/STOLs, re-entry gliders, boosted packages in wind shears. Frankly, I've never been connected with a research program that could make a better cost case for itself." Then with a still broader grin, "And our Air Force sponsors say that these savings are peanuts compared to the really big development time savings that they expect from MODEL FLY. You know, obsolescence costs are highest of all."

This Giannini Controls Division, little more than a year old, has amply displayed the earnestness with which it pursues its "fun and profit." As a consequence of winning eight of eleven proposals submitted, its other activities include space structures, basic flight dynamics, and pneumatic systems.

The near future?

Zisfein is looking hard for capable people at all levels of experience and he eagerly awaits completion of new quarters in this Main Line suburb area of Philadelphia which will house and stimulate a growing number of scientists and engineers who are keenly . . . Looking Forward.

Giannini Controls Corporation

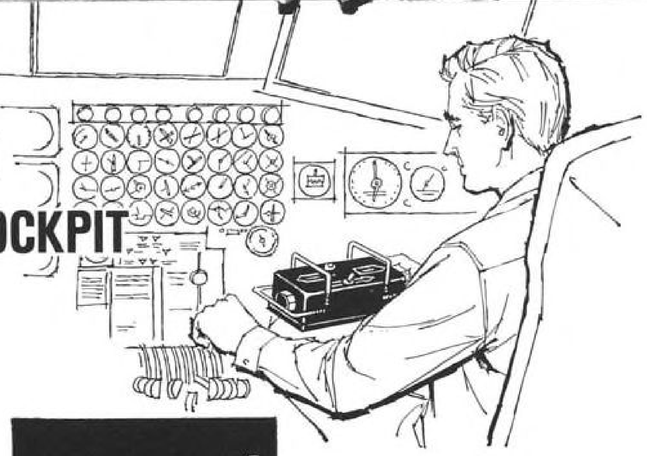
1600 South Mountain Avenue, Duarte, California

Instrumentation & Systems for Aerospace & Industry.

LEAR

CHANGES JET FUEL TRIMMING FROM ALL THIS

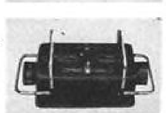
TO ONE MAN IN THE COCKPIT



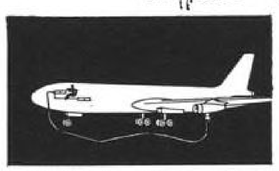
ADAPTERS—A simple clamp-on device that aligns automatically. Units are available for most combinations of engines and airframes.

SERVO—Designed to be integral with the adapter, the servo utilizes a reversible DC motor and a highly accurate electro-magnetic brake to drive a series of LEAR magnetic particle clutches.

LEAR MAGNETIC CLUTCH—of advanced design and proved performance, the LEAR MAGNETIC CLUTCH is a key component in achieving the accuracy and reliability of the trimming system.



CONTROL BOX—A portable device, the control box is designed to be simple and easy to use. One man—in the cockpit—can rapidly make all adjustments—IDLE STOP, MILITARY POWER and WATER INJECTION.



LEAR'S JET FUEL TRIMMER SYSTEM is operated by one man instead of three...no hazards of heat or intense noise.

And with these features, the job can be done *faster and more accurately* than trimming at the engine! A self-aligning clamp-on adapter permits rapid attachment to the fuel control head—the only installation necessary. Engineering assistance for any jet engine application is immediately available from LEAR—or arrangements can be made for an actual demonstration on your present equipment.

SEND FOR FURTHER INFORMATION—ASK FOR GR-305. AND IF YOU WANT TO BE KEPT CURRENTLY INFORMED ON TRIMMING CONTROLS AND OTHER REMOTE CONTROL SYSTEMS, ASK TO BE ADDED TO THE MAILING LIST FOR "TRIMMER TIPS."

ELECTRO-MECHANICAL DIVISION
110 IONIA AVENUE N.W., GRAND RAPIDS 2, MICHIGAN

LEAR

EM-10

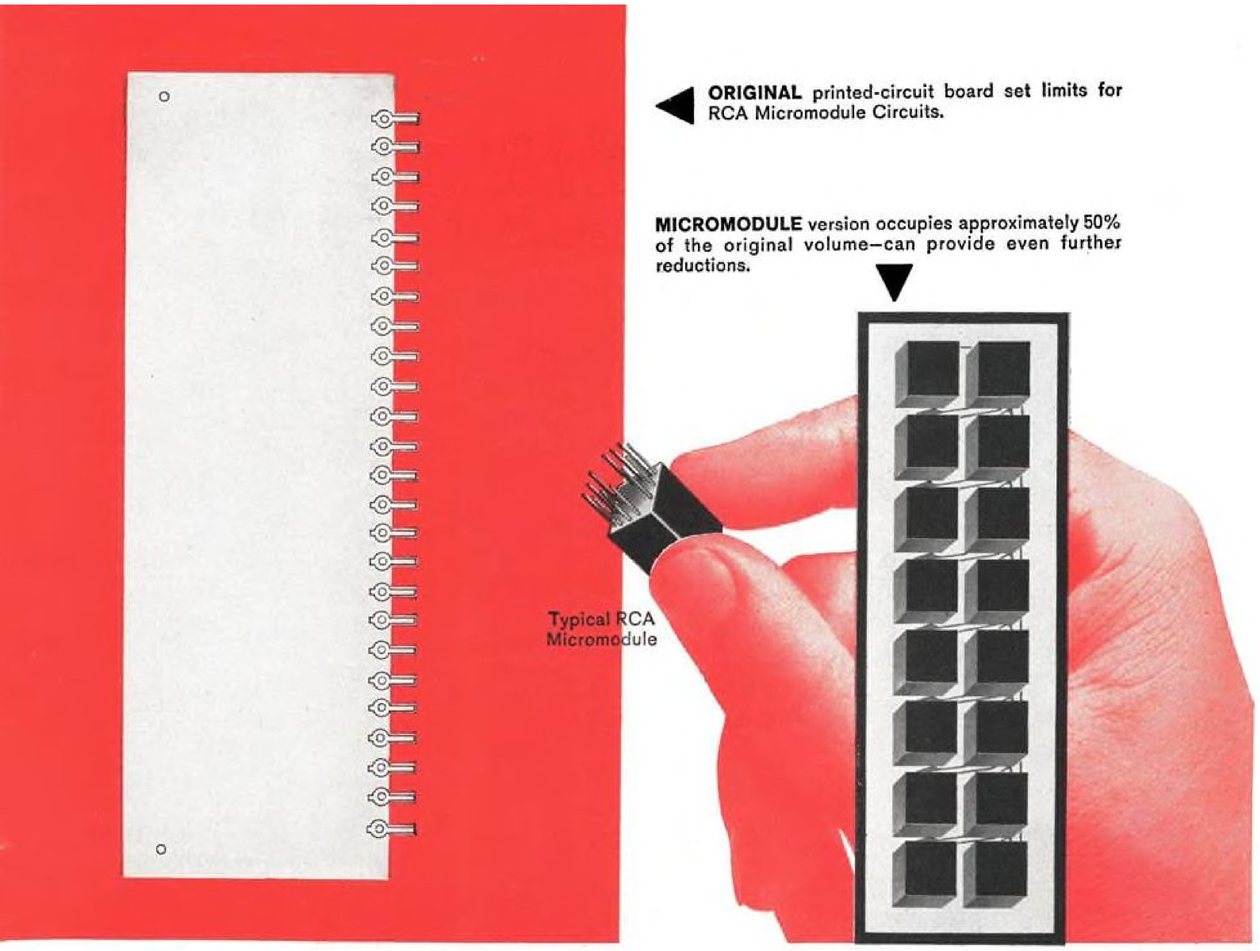
Take the Monkey Business Out of Connector Assembly with the Rugged MDR

No need to monkey around with delicate inserts found in so many electrical connectors today now that the new Deutsch Rigid is available. This rugged design with its solid plastic insert makes multiple contact connector assembly easy as falling out of a tree. And look at all the features the MDR has inherited from its space age relatives: crimp-type contacts that snap in and stay in, a reliable Deutsch ball-lock coupling mechanism that just needs an easy push to connect and gentle pull to disconnect, plus interchangeability with other Deutsch connector series. But for complete facts on this little beauty, contact your local Deutschman today or write for Data File R-5.

DEUTSCH

Electronic Components Division
Municipal Airport • Banning, California

ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS



MICROMINIATURIZED IN 76 HOURS! with RCA Micromodules

...and backed by 55,000,000 element hours of life-test experience

...THAT'S THE BREADBOARD-TO-OPERATION RECORD RCA ACHIEVED FOR THIS AVIONICS ASSEMBLY WITH RCA MICROMODULES.

In just 76 hours, RCA engineers—utilizing the broad flexibility of RCA Micromodules and the wide range of available microelements—made the complete conversion from conventional printed board construction to working Micromodule circuits. Here's the background of proof that makes RCA Micromodules today's answer to microminiaturization:

PROVED RELIABILITY: Over 55,000,000 element-hours of testing have been logged under the RCA Micromodule Reliability Program. Operating life tests demonstrate a mean time between failures for RCA Micromodules greater than 560,000 hours for a ten-part Micromodule or a failure rate per part of less than 0.018%/1,000 hours. (All modules were subjected to a series of military-grade temperature-cycling tests.)

BROAD CIRCUIT CAPABILITY: Under RCA's broad experience in Micromodule production over 200 basic circuits have been designed, built and tested. And new circuits are constantly being added. For example, five new computer Micromodules utilizing silicon transistors and diodes are now available for evaluation. The RCA Micromodule concept is highly compatible with anticipated advances in microminiaturization.

WIDE APPLICATION: RCA Micromodules have been designed into military FM receivers, a general-purpose automatic data processor, airborne digital computers, an inertial guidance platform, a digital differential analyzer, pulse-code modulation telemeter equipment and classified military applications.

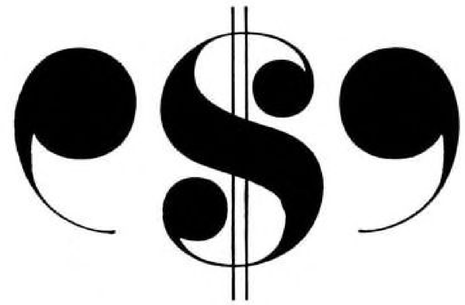
LOWER COSTS: If you are looking for cost reductions as well as microminiaturization, RCA Micromodules can now show you the way.

CALL TODAY: Like to know how fast your circuits can be converted to Micromodules? Call your local RCA Office today for details on RCA Micromodules (and the RCA Micromodule Laboratory Kit for building prototype Micromodules in your own plant). For literature, write RCA Semiconductor and Materials Division, Commercial Engineering, Section E-112-NM-4, Somerville, N. J.

RCA Minimodules—miniature packaged circuits utilizing conventional components and transistors—can be supplied in large volume, in the form you need. Consider RCA your packaging headquarters for miniaturized circuits utilizing transistors, rectifiers, diodes. Practically any component you require can be packaged to your specifications by RCA Engineers.

RCA SEMICONDUCTOR & MATERIALS DIVISION FIELD OFFICES... EAST: Newark, N. J., 744 Broad St., HU 5-3900 • (Camden-Philadelphia Area) Erlton, N. J., 605 Marlton Pike, HA 8-4802 • Syracuse, N. Y., 731 James St., Rm. 402, GR 4-5591 • Baltimore, Md., EN 9-1850 • **NORTHEAST:** Needham Heights 94, Mass., 64 "A" St., HI 4-7200 • **SOUTHEAST:** Orlando, Fla., 1520 Edgewater Dr., Suite #1, GA 4-4768 • **EAST CENTRAL:** Detroit 2, Mich., 714 New Center Bldg., TR 5-5600 • **CENTRAL:** Chicago, Ill., Suite 1154, Merchandise Mart Plaza, WH 4-2900 • Indianapolis 5, Ind., 2132 East 52nd St., CL 1-1405 • Minneapolis 16, Minn., 5805 Excelsior Blvd., WE 9-0676 • Denver 11, Colorado, Continental Terrace Bldg., Suite 301, 2785 N. Speer Blvd., 477-1688 • **WEST:** Los Angeles 22, Calif., 6801 E. Washington Blvd., RA 3-8361 • (San Francisco Area) Burlingame, Calif., 1838 El Camino Real, OX 7-1620 • Seattle 4, Wash., 2250 First Ave. S., MA 2-8816 • **SOUTHWEST:** Dallas 7, Texas, 7905 Carpenter Freeway, ME 1-9720 • **GOV'T:** Dayton, Ohio, 224 N. Wilkinson St., BA 6-2366 • Washington, D. C., 1725 "K" St., N.W., FE 7-8500 • **RCA INTERNATIONAL DIVISION,** 30 Rockefeller Plaza, N.Y.20, N.Y. Cable Address: RADIOINTER, N.Y.

RCA The Most Trusted Name in Electronics



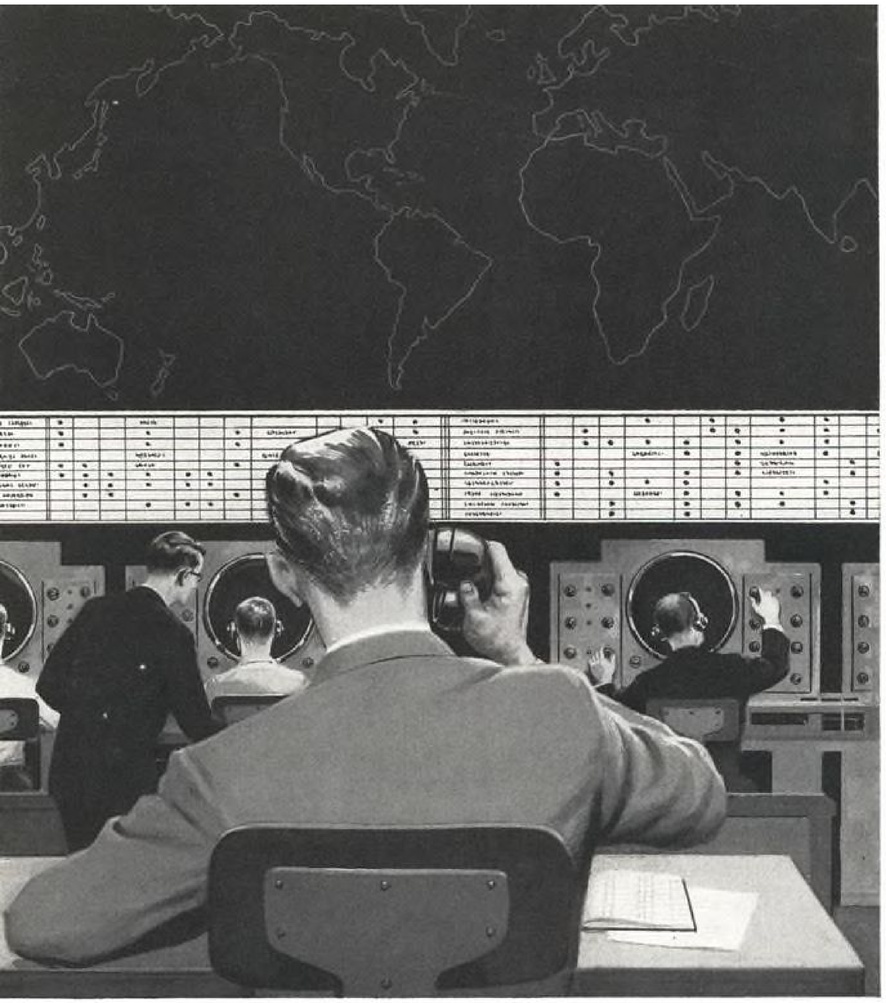
OTHER COMPUTERS WERE DESIGNED FOR BUSINESS MEN!

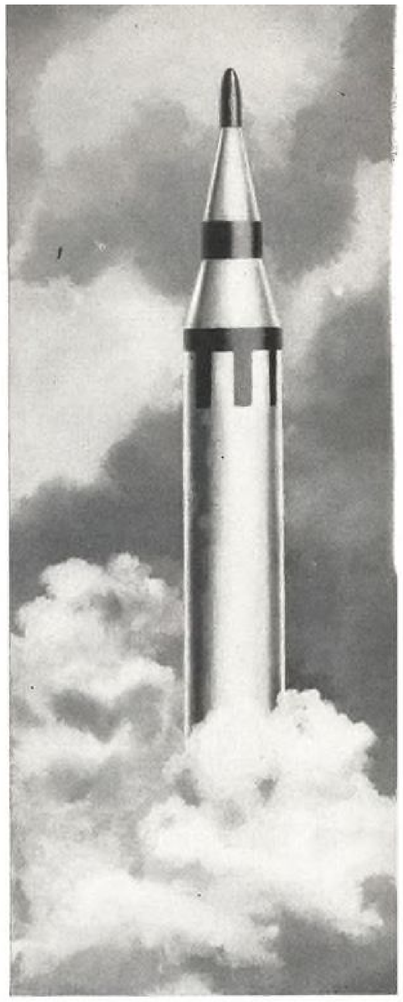
THE LGP-30 WAS CREATED FOR ENGINEERS AND SCIENTISTS.

What does an engineer or a scientist respect most? Answer—sheer brainpower. The LGP-30 packs more brainpower than any computer in its class. 4096 word memory—2000 more than its nearest competitor. And alpha-numerical input-output via keyboard or punched paper tape. ☐ Then comes—independence. The LGP-30 is the easiest computer to program and operate. If you know algebra—you can achieve programming competence in hours or days. Even non-technical personnel can master it. You'll never have to be dependent upon computer programming specialists. And you can set it up right in your own office or any other point of use. No expensive installation—just plug it into conventional outlet. ☐ Right now—scientists and engineers, in addition to businessmen, in hundreds of universities and corporations are using the LGP-30. Therefore, the LGP-30 is able to offer you the use of the most extensive Program Library in its class. No doubt, the program you'll need is ready now—and that's a big saving in time and money. You also benefit from membership in the computer industry's largest, most active information-swapping (POOL) of users. ☐ Cost? Well, let the businessmen in your organization worry about that. And there's mighty little worrying to do, for a computer with comparable capacity would cost twice as much. The LGP-30—a complete system—rents for only $1100 per month. For more information about the LGP-30, write Commercial Computer Division.

GP GENERAL PRECISION

COMMERCIAL COMPUTER DIVISION / GENERAL PRECISION, INC. / BURBANK, CALIFORNIA





COMMAND AND CONTROL

The nation's deterrent posture is based on a tightly controlled retaliatory force capable of immediate action through the proper commands. The survivability of the command and control structure and the security of its communications are vital elements in overall national defense.

The design of such a command and control system demands consideration of the politico-military structure, and of the deployment and use of a wide variety of weapon systems of overwhelming power. To this must be added a proven capability in modern electronic technology.

Raytheon's Missile and Space Division has developed truly unique concepts by applying an integrated "weapon system" approach to the command and control problem. Raytheon is applying these concepts to the problems of survivable national communications, as well as control of strategic aircraft and missiles, mobile ballistic missile systems, and field army weapons.

Engineers or scientists interested in these vital and challenging areas are invited to contact Mr. W. F. O'Melia, Raytheon Company, Missile and Space Division, Bedford, Massachusetts.

RAYTHEON COMPANY

MISSILE AND SPACE DIVISION

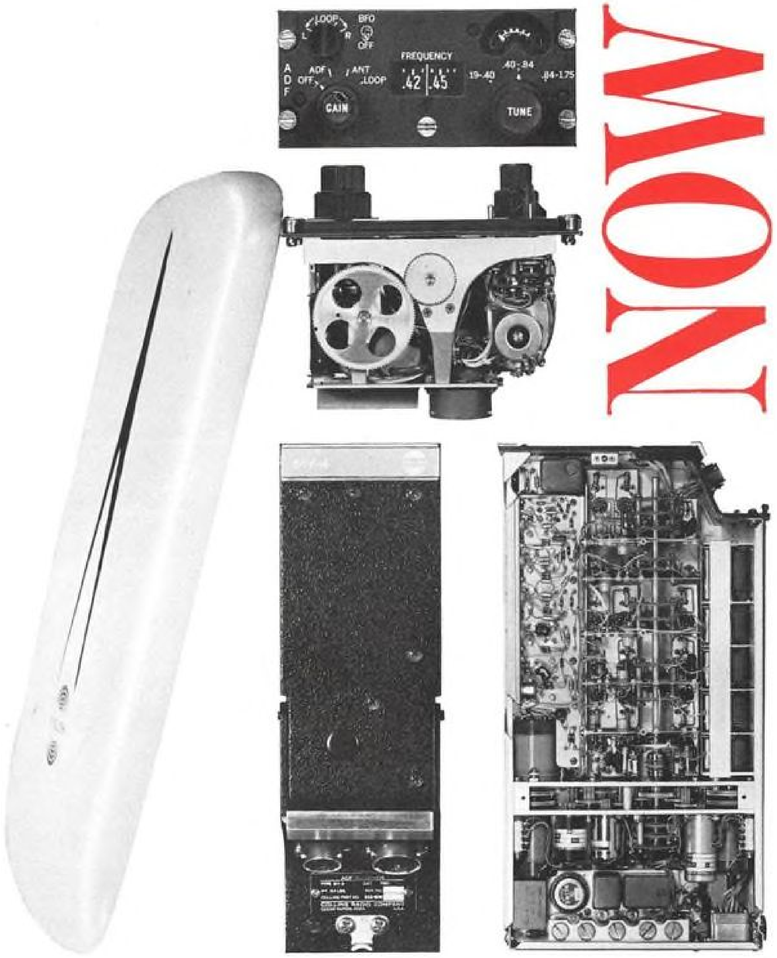
RAYTHEON

DF-203

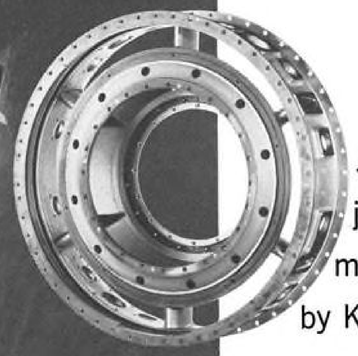
COLLINS

Years ahead in design and performance, the Collins Solid State, DF-203 Automatic Direction Finding System is available now. □ Completely transistorized, the 51Y-4 Receiver, 137A-4 Loop Antenna and 614L-8 Control Unit combined weigh only 15.4 lbs. □ The fixed loop antenna is available for either flush or semi-flush mounting, and since it contains no moving parts, requires virtually no maintenance or service. □ The control unit, measuring only 5¾″ x 2⅜″, lends itself to a variety of space-saving installations. Precision, servo amplifier tuning and an analog type frequency dial with large numerals make tuning both fast and accurate. □ Contact us today for complete information about this new ADF — the one by which all others will be judged for years to come.

COLLINS RADIO COMPANY • Cedar Rapids
Dallas • Los Angeles • New York



NOW



J-85
jet engine
main frame
by Kelsey-Hayes

The Northrop T-38 . . .
world's first supersonic trainer
. . . is powered by twin General
Electric J-85 engines.
The all-important main
frame for the J-85
is produced by Heintz Division
of Kelsey-Hayes.

Stamped from Chromaloy,
welded through electronic
resistance and then subjected to
Zyglo, x-ray, magnaflux and
other special tests, this
weldment is typical of the jet
engine components that we
produce in our huge Philadelphia
plant. Here, we have the
floor space, machines and
experience to make any type of
stamping or weldment
required by aero-space
technology. Heintz Division,
Kelsey-Hayes Company,
Front St. & Olney Ave.,
Philadelphia 20, Pa.

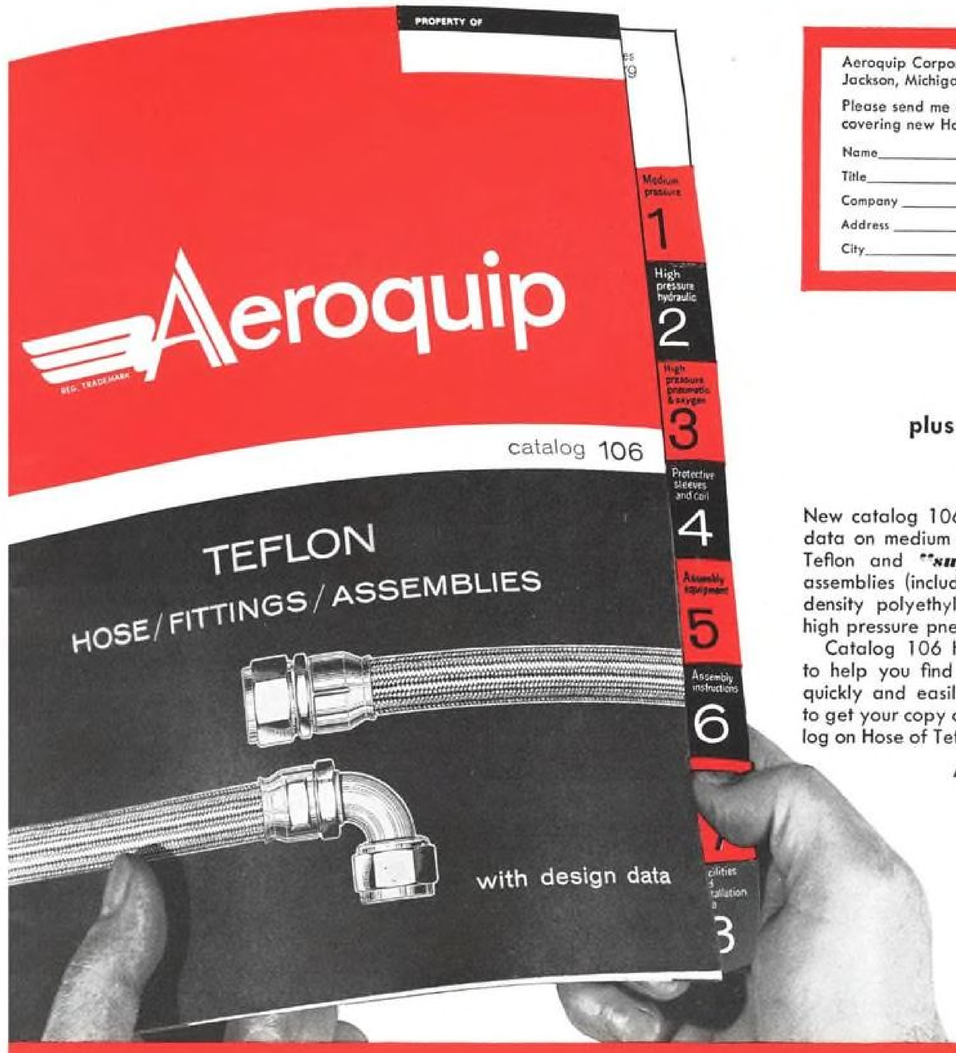
Other jets powered by the J-85 include Lockheed Jetstar and Northrop N-156-F.

KELSEY HAYES COMPANY

OPERATIONAL PLANTS:
Detroit, Jackson and Romulus, Michigan; Los Angeles, California; Philadelphia, Pennsylvania; Springfield, Ohio; Utica, New York; Davenport, Iowa; Rockford, Illinois; Windsor and Woodstock, Ontario, Canada.

Automotive, Aviation and Agricultural Parts
Hand Tools for Industry and Home

Now Available! NEW Catalog 106 Covering Aeroquip's New Hose of Teflon



RETURN THIS COUPON

Aeroquip Corporation
Jackson, Michigan
A.W.528

Please send me a copy of New Catalog 106 covering new Hose of Teflon.

Name_____
Title_____
Company _____
Address _____
City_____ Zone___ State_____

Contains complete product information plus valuable engineering and application data

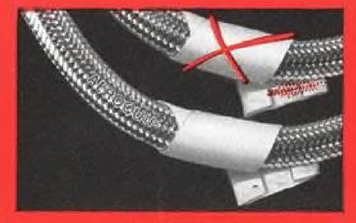
New catalog 106 contains complete design data on medium and high pressure hose of Teflon and ***"super gem"*** Fittings; hose assemblies (including firesleeved); and high density polyethylene hose and fittings for high pressure pneumatic applications.

Catalog 106 has a rapid index feature to help you find the information you want quickly and easily. Send the coupon today to get your copy of the really complete catalog on Hose of Teflon, assemblies and fittings.

AEROQUIP CORPORATION
Jackson, Michigan

Use Aeroquip's New Hose Lines of Teflon for Superior Performance

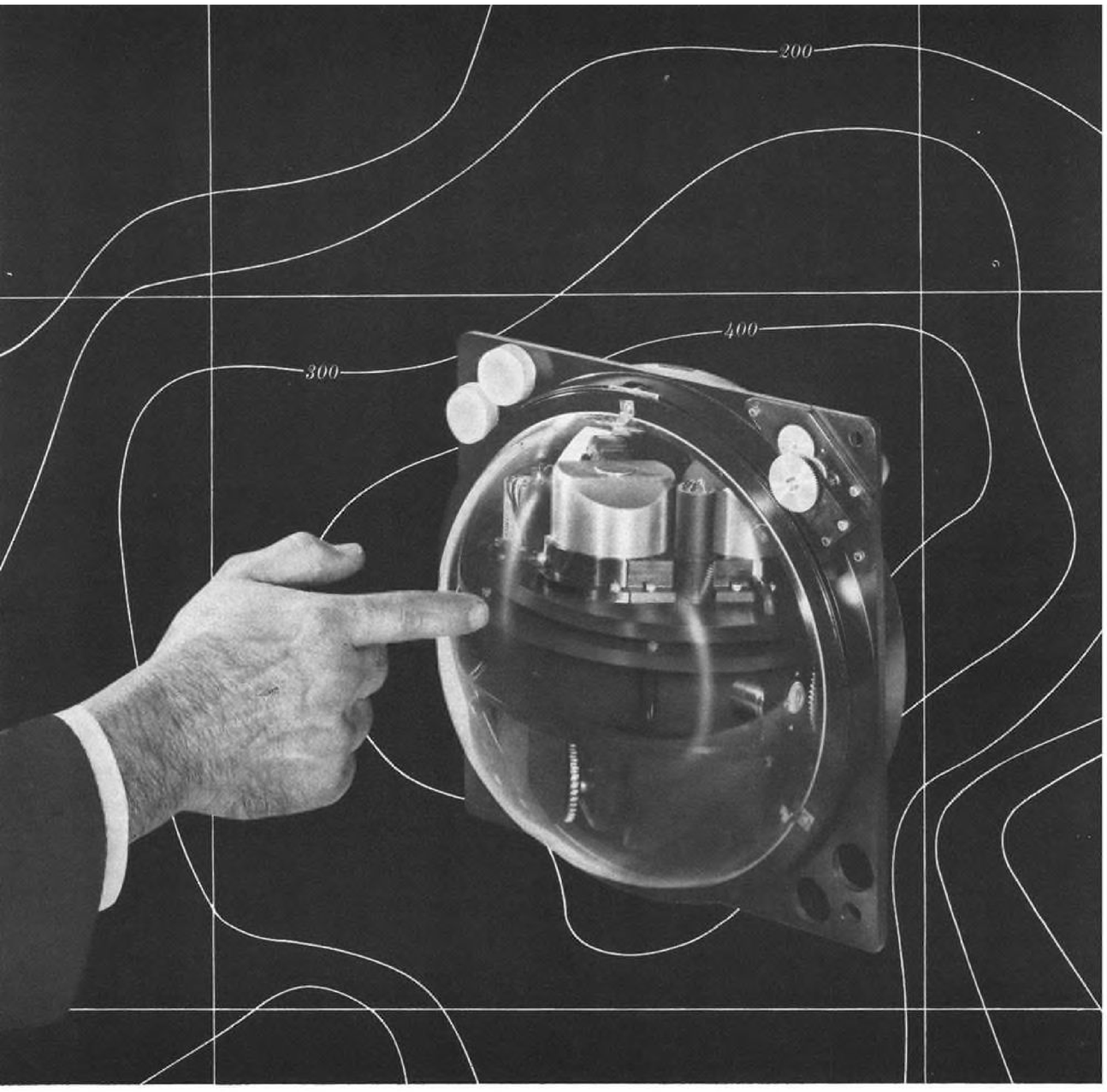
PATENTED EXTRUSION PROCESS
Improved characteristics are achieved by counter rotation of elongated granules of Teflon during extrusion of the tube.



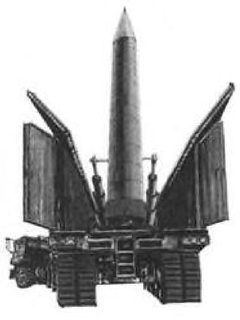
NO WEEPAGE
The "red dye" test proves new Aeroquip Hose of Teflon will not weep carrying Type III fuel and other low viscosity liquids.

SUPERIOR DESIGN
Superiority of the reusable ***"super gem"*** Fitting design has been recognized in new Specification MIL-F-27272.

"super gem" is an Aeroquip Trademark. TEFLON is a DuPont Trademark for tetrafluoroethylene resin. Aeroquip Products Are Protected By Patents In U.S.A., Canada and Abroad.



How to put your finger on precise location



Pinpointing precise location anywhere on the world's surface: that's the task performed with scrupulous reliability by the Ford Instrument-120 Inertial Stable Reference & Position Unit. It presents continuous digital readout in North-South, East-West grid coordinates. Consuming low power and totally self-contained, FSP-120, including digital computers, occupies less than a cubic foot of space —only 10" x 10" x 16". Rigorous shock-testing has assured its capability to withstand severe shock and vibration. FSP-120 is another extraordinary development of Ford Instrument's creative engineering talents and management depth. Your Ford Instrument representative will furnish additional details upon request. 2.9

FORD INSTRUMENT CO.
DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, New York

CREATIVE ENGINEERING PLUS EXPERIENCE = RELIABLE SYSTEMS FOR CRUCIAL MISSIONS

May 28, 1962

Aviation Week & Space Technology

Vol. 76, No. 22
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) **Washington 4, D. C.**—National Press Bldg., Phones: NAtional 8-3414 REpublic 7-6630 **Los Angeles 17**—1125 West Sixth St., Phone: HUntley 2-5450 **Dallas 1**—1712 Commerce St., Phone: RIverside 7-9721 **European Office**—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63 **London**—34 Dover St., London W.1, England, Phone: Hyde Park 1451

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory
TECHNICAL EDITOR.....David A. Anderton
EUROPEAN EDITOR.....Cecil Brownlow

BUREAU CHIEFS
WASHINGTON.....Evert Clark
LOS ANGELES.....Irving Stone
DALLAS.....Erwin J. Bulban
LONDON.....Herbert J. Coleman

DESK EDITORS.....Harry Raven, Arnold Sherman, David A. Brown, Richard G. O'Lone
AVIONICS EDITOR.....Philip J. Klass
ASSISTANT.....Barry Miller
TRANSPORT EDITOR.....L. L. Doty
ASSISTANTS.....Robert H. Cook, David H. Hoffman, Ward Wright
ENGINEERING.....Russell Hawkes, William S. Reed
SPACE TECHNOLOGY.....Edward H. Kolcum, George Alexander
MILITARY EDITOR.....Larry Booda
BUSINESS FLYING.....Erwin J. Bulban, Andrew A. Keil
CONGRESS.....George C. Wilson, Katherine Johnsen
EQUIPMENT.....James D. Hendricks
ART EDITOR.....Lawrence J. Herb
ASSISTANT.....Mary Wilkins
EDITORIAL PRODUCTION.....Frank Miazga
ASSISTANT EDITORS.....Edith Walford, Ann Dunphy
EDITORIAL ASSISTANTS.....Marjorie Todd, Madge Hammond
LIBRARIAN.....Theresa V. Maggio

FOREIGN NEWS SERVICE
EDITOR.....John Wilhelm
PARIS.....Robert E. Farrell
MOSCOW.....Stewart Ramsey

DOMESTIC NEWS BUREAUS
ATLANTA 9.....1375 Peachtree St., N.E.
CHICAGO 11.....645 No. Michigan Ave.
CLEVELAND 13...1164 Illuminating Building
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....W-724 Prudential Bldg.
SAN FRANCISCO 11.....255 California St.

SALES
ADVERTISING SALES MANAGER
E. P. Blanchard, Jr.
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO.....J. S. Costello
ST. LOUIS.....D. C. Jackman
CLEVELAND.....T. H. Hunter, Jr.
DALLAS.....John Grant
DENVER.....John W. Patten
DETROIT.....M. Hulburd
HOUSTON.....J. Page
LOS ANGELES.....C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK.....M. J. Storz, R. Wallace, J. D. Warth
PHILADELPHIA.....J. D. Willis, D. Farris
PITTSBURGH.....J. R. Pierce
SAN FRANCISCO.....R. R. Butera
PROMOTION MGR......C. C. Gersna
EUROPEAN MARKETING DIRECTOR
Fulvio Piovano
RESEARCH & MARKETING
Rosalie Christesen, Patricia W. Abrams
MERCHANDISING.....J. R. Gerardi

BUSINESS
BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
ASST. BUSINESS MANAGER...W. V. Cockren
PRODUCTION MANAGER.....F. A. Dube

MA-8 Shot May Be Extended to 7 Orbits..... **26**
▶Results of Carpenter's three-orbit MA-7 flight will determine whether next mission is expanded.

CAB Staff May Urge Transatlantic Shuttle..... **38**
▶Proposal expected during hearings on structure of routes to Europe; monopoly plan stirs controversy.

Space Payload Failure Data Analyzed..... **55**
▶Detailed study of orbital performance of 16 satellites shows need for improved avionics reliability.

SPACE TECHNOLOGY
MA-8 May Be Extended to 7 Orbits... 26
Design Review of USAF 624A..... 29
Highest Re-entry Speed Recorded.... 29
Atlas-Centaur Tracked to Destruction 32
Inadequate Priority Cited in Centaur 33
Physiological Details of Vostok..... 67
NASA Contracts 71

AERONAUTICAL ENGINEERING
Supersonic Transport Study Contracts 28
FAI Verifies Soviet E-166 Record..... 35
Auxiliary Surfaces Boost STOL Control 89
USAF to Resume B-47 Deactivation.. 91
Prototype 707 Still Serving as Testbed 92
Production Briefing 93

AVIONICS
Microcircuits for Space Studied..... 36
NASA Thin-Film Solar Cell Plans..... 55
Space Payload Failure Data Analyzed 55
Decision Filter Classifies 3D Objects. 58
Electronic Components Shipments.... 61
Advent Antenna Tested..... 62
Filter Center 62

BUSINESS FLYING
Beech Turboprop Modifications..... 35
CM-191 Provides Easy Transition.... 103
U. S. Business & Utility Shipments... 106
Bolkow Junior Production Models... 113
Musketeer to Be Available This Fall.. 115

SAFETY
Pilot Authority Urged in Safety Study 99

AIR TRANSPORT
Transatlantic Shuttle Urged..... 38
TWA, Pan Am Merger Strategy..... 38
Mexican Carrier Consortium Plan.... 39
Carriers Cite Merger Savings..... 41
FAA Airport Evaluation System..... 41
Air Travel Tax Cut Backed..... 41
Argosy Sale Hinges on Logair..... 41
Jet Crew Ruling 43
U. K. Charter Action 43
Airline Traffic—January 45
Third S-61 Delivered to LAA..... 50
Soviet An-24 Design Details..... 52
Rolls Reports 1961 Profit Decrease... 53
Airline Officers Salaries..... 97
Airline Observer 49
Shortlines 49

MANAGEMENT
Secrecy Rule Hits Overseas Stations.. 30
Lockheed Rift Management..... 30
Sen. Hayden Backs USAF on RS-70... 31
Vance Named Secretary of Army.... 33
Umbaugh Financing Revealed..... 34
Incentive Type Contracts Criticized.. 36
Stack Leaves NASA for Republic Post. 37
Industry/Government Relations..... 73
Aerospace Industry Net Sales..... 82
USAF Contracts 85
Industry Observer 23
Who's Where 23
Washington Roundup 25
News Digest 37

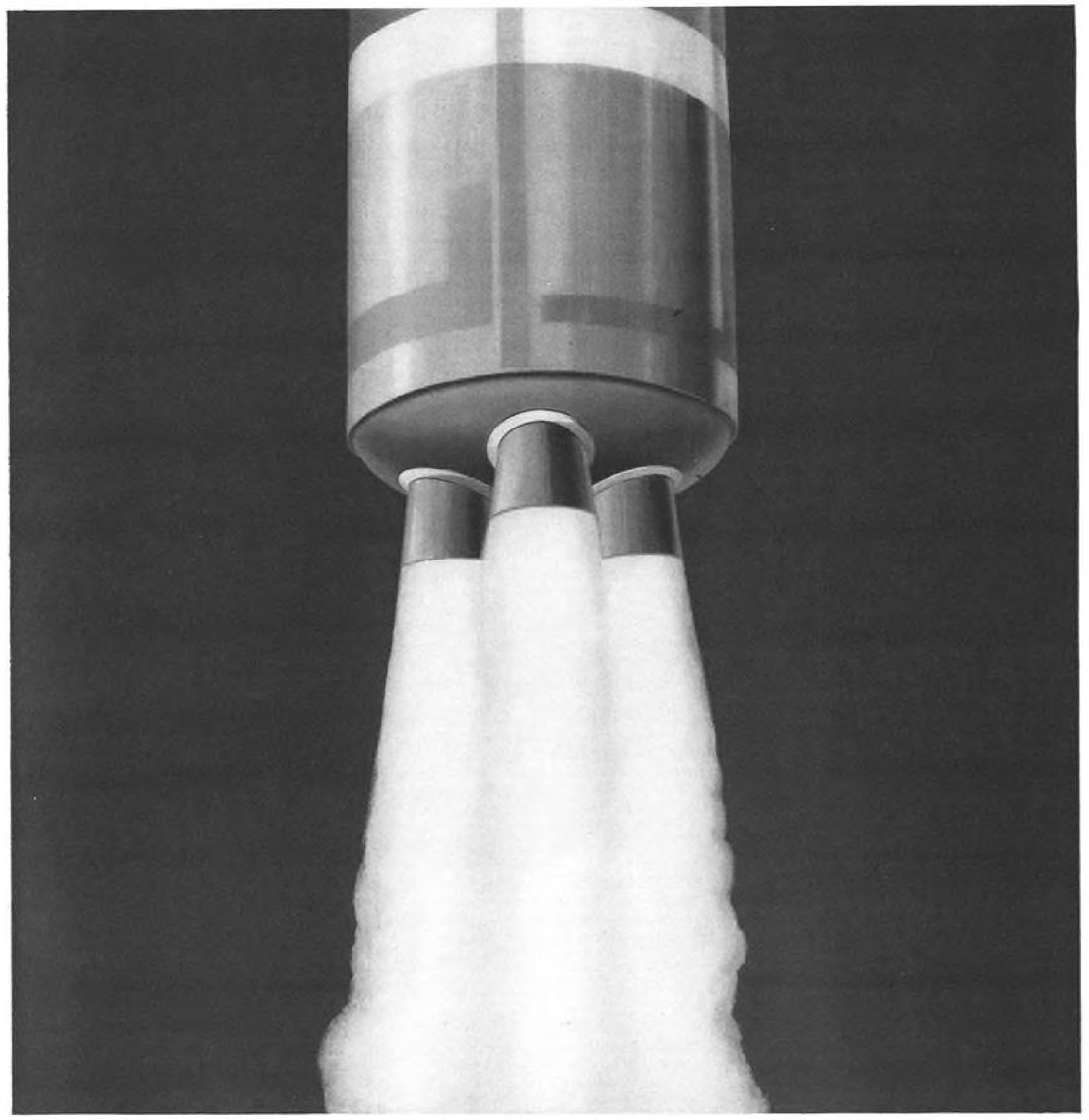
Aerospace Calendar 5
Letters 126

EDITORIAL
Profits, Costs and Controls..... 21

COVER: Potez-Heinkel CM-191 four-place executive jet (AW Apr. 23, p. 102) is shown shortly after takeoff from the airport at Hanover, Germany, where it was demonstrated publicly for the first time at the Hanover Air Show (AW May 14, p. 125). Aircraft is manufactured by the French-German industrial team as a development of the Fouga Magister jet trainer. Powerplants are two Turbomeca-Marbore 6 turbojets delivering 1,060 lb. static thrust each. For pilot report on the CM-191, see p. 103.

PICTURE CREDITS
Cover—Ron Appelbe; 31—Chance-Vought; 32—NASA; 35, 115—Beech Aircraft; 50—Sikorsky Aircraft; 58, 61—Astropower, Inc., of Douglas Aircraft Co.; 62, 75—Bendix; 62 (bottom)—General Precision, Inc.; 71—Nippon Electric Co.; 73, 93—Boeing; 77—Aerotec Industries; 89, 91—Skycraft; 103, 113—Ron Appelbe; 115—Beech.

87,933 copies of this issue printed.



RUBBER CONTAINS 5000-DEGREE INFERNO

These unique rubber liners, produced by B.F. Goodrich, protect Polaris second stage glass filament wound rocket cases from the high erosion and flow of expanding gases in the 5000 degree F. temperature range. Without the liners, the cases themselves would have to be designed much heavier to withstand this pressurized inferno.

In addition to protecting the cases from heat, the liners, being flexible, serve to "couple" case and propellant —materials of different expansion characteristics. This provides an essential structural function.

Rubber is a material you might not consider for containing such high temperatures. But in view of the time dimensions involved, rubber often does the job better than any other material. And B.F. Goodrich does the job of precision manufacture of rubber and rubber-like products for a wide range of aerospace requirements.

B.F.Goodrich
aerospace and defense products

For information on BFG capabilities in heat-resistant materials, products, and structures write *B.F.Goodrich Aerospace and Defense Products, a division of The B.F.Goodrich Company, Dept. AW-5B, Akron, Ohio.*

EDITORIAL

Profits, Costs and Controls

(Among the many clear, frank analyses of industry-government relationships in defense contracting given to the Air Force Systems Command Management Conference was one by Irving Roth, vice president-finance for Northrop Corp. Because of its coverage of broad areas of significance to industry, Aviation Week and Space Technology *is publishing major excerpts below.)*

A bold and fresh approach to the system governing military procurement is . . . needed on the part of defense contractors, the Defense Department and the Congress if we hope to arrive at a lasting solution to our present problems. Everyone agrees that profit motivation must be harnessed to produce significant reductions in the cost of our defense programs. To really do this, however, we must be willing to do more than just pay lip service to the need for a reasonable profit fairly related to contractor performance. . . .

. . . The rapid advance in technology has . . . led to the adoption of the cost-plus contract. This, in turn, made it necessary for the government to devise ways and means of insuring that the costs the government was being asked to absorb were reasonable and properly allocable to the work involved.

A whole body of procurement law, regulations and procedures has had to be devised to protect the government's interests. In effect, a Frankenstein monster has been created which makes virtually impossible the creation of any incentive for private industry to reduce costs. The very existence of all the government's checks and balances represented by the countless reports, reviews, etc., requires contractors to expend more and more energy to justify past actions rather than to concentrate on the development of ingenious, economical solutions to tomorrow's problems. So, the core of the problem is to find ways and means of eliminating cost-plus contracts as a form of contractual relationship in the development and procurement of defense materiel. Until this is done, a need for a post mortem of contract costs will remain because the government must be satisfied that only valid payments were made under such an arrangement.

In this connection it is most encouraging to note the progress that has been made to date by the DOD in moving in the direction of cost-plus-incentive-fee contracts as contrasted with cost-plus-fixed-fee contracts. The fact remains that this is still the first step and not the solution to the problem.

The cost approach has given birth to an ever-increasing need, on the part of the government, for reports and regulations, in short, second-guessing management at every turn. This way of procurement life will remain with us so long as the method of procurement is based on an attempt to minimize both financial risk and profits.

If the military establishment is really seeking to buy management skill from industrial contractors, then it must be willing to allow industry to make management decisions. And it follows that both the buying agency and the industrial contractor "must be prepared to live with the results." . . .

The Department of Defense directive which established the function of the DOD audit coordinator includes among the functions assigned to the DOD contract audit coordinator the responsibility "to act as a contact point for discussions with top management officials of the contractor on such matters as management policies and practices, including proposed changes thereto." If this responsibility were to be literally interpreted, the DOD contract audit coordinator would become a key member of each company's top management team. No action, in theory, would be taken without prior consultation and approval of the government auditor. Quite obviously, if implemented in this fashion, a company's authority for independent action would soon disappear.

Another example of over-management is the continued demand for detailed management reports including detailed items of information that in commercial enterprises the customer is not entitled to have. Examples from the field of financial management have their counterpart in other fields of operation:

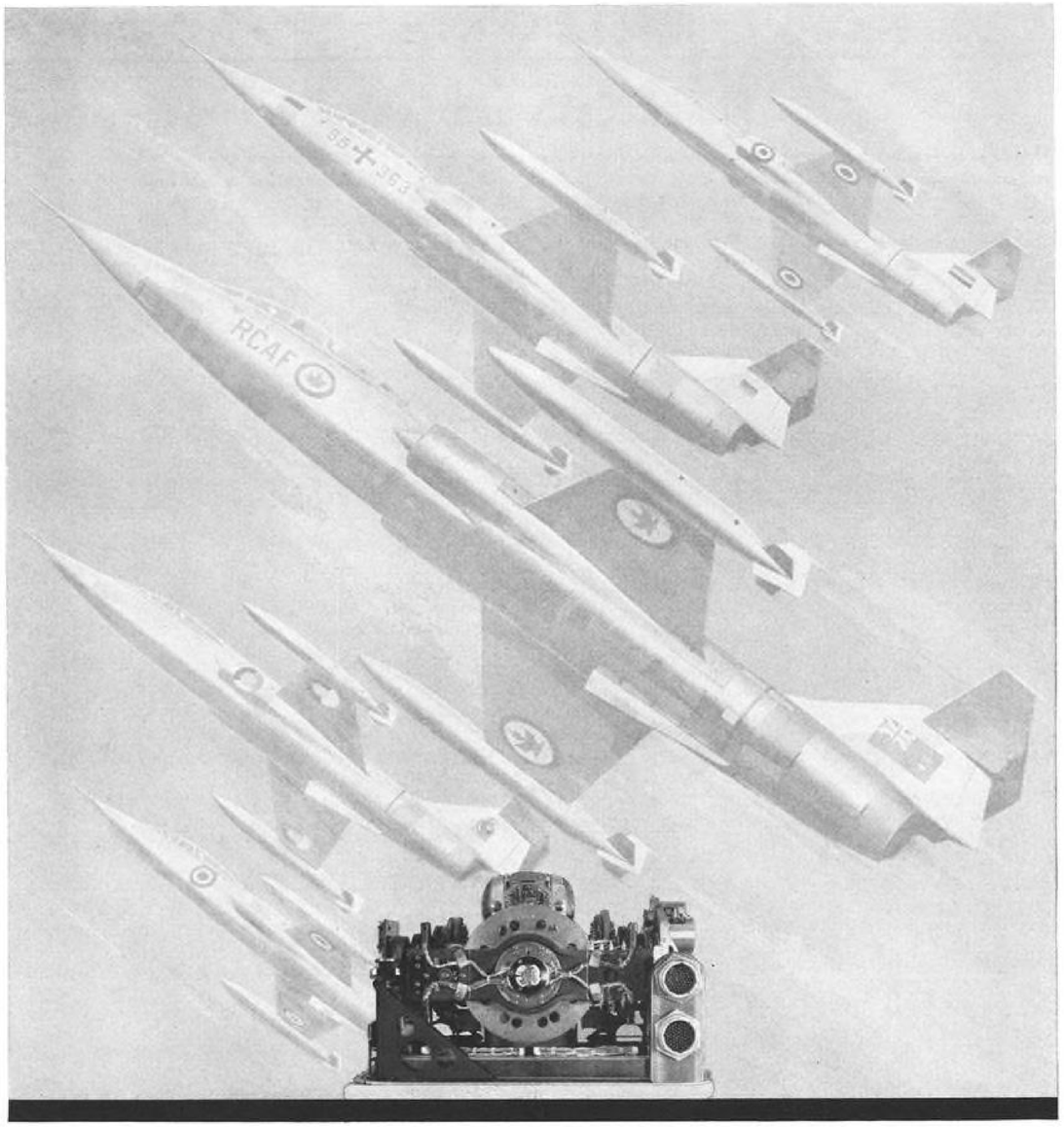
- **Unnecessarily detailed and elaborate specifications,** whereas if performance specifications only were used they would provide industrial management both the flexibility and the challenge to use ingenuity in cutting costs and still achieve the desired performance.
- **Unnecessarily detailed prescription** of how contractors should maintain purview of quality assurance organization and activities.
- **There appears to be a continuing attempt** to use production performance yardsticks which were suitable to an environment when mass output of manned aircraft was typical, but are of doubtful utility in today's environment which is characterized by large R&D activity, shorter production runs, and heavy use of advanced elements such as electronics.
- **The apparent importance which appears** to be placed by government negotiators in their review of systems proposals upon the organization of project administration by the company.
- **Detailed requirements** for use of specified managerial techniques.
- **Detailed reporting and** data requirements.

Both the customer and the contractor experience adverse effects of the tendency to over-manage the industrial supplier. Some of the adverse results are these:

- **Delays**—while decision-making is referred to diffused authority.
- **Dilution and dissipation of solutions** through processes of review, negotiation and compromise.
- **Confusion of authority** for decisions and accountability for results.
- **Absence of effective incentives** to achieve optimum solutions to defense problems.
- **Increased costs**—both at the contractor level and by the government in reviewing and monitoring operations of the customer.

The new approach suggested here is one that we recognize cannot be adopted through unilateral action on the part of the defense establishment. As a matter of fact it requires a recognition by the Congress that adequate profit margins are to be encouraged, not just tolerated. Congressional, as well as executive action, is also needed to clear away the morass of procurement legislation, administrative decisions, procurement regulations, etc. . . .

For its part, industry must be prepared to accept the concept of maximum fixed-price contracting coupled with adequate profit motivation in the area of weapons systems development for which prior experience may not exist. This requires courage, inventiveness, and ability on the part of the defense contractor. If the defense contractors want to participate in higher profits, they must be willing to take the risks.



OUT FRONT

The P-200 platform. Developed for the Flight Control Laboratory of Aeronautical Systems Division, Wright-Patterson AFB. Heart of the LN-3 Inertial Navigation System. Providing pin-point guidance to hundreds of friendly fighter pilots from Free-World nations. Self-contained. Non-jammable. Precision-crafted for extreme accuracy and reliability—development of Litton's Guidance and Control Systems Division for the Lockheed F-104 Starfighter. At the vanguard of the defense effort—advancing the defense posture of the Free World.

Engineers who can implement Newtonian principles of inertia as ingeniously as has been done in the P-200 platform will find ability-matching opportunities at Litton. An Equal Opportunity Employer. Send resume to Department 01.

A further advancement in Litton precision guidance and control equipment—the P-300 miniaturized inertial platform for missiles, orbital vehicles, space craft.

LITTON SYSTEMS, INC.
BEVERLY HILLS, CALIFORNIA
A DIVISION OF LITTON INDUSTRIES

Technologies: Advanced Guidance and Control • Communication and Data Recording • Command and Control • Computers • Electronic Countermeasures • Space Science

WHO'S WHERE

In the Front Office

Remy L. Hudson, vice president-general manager of Douglas Aircraft Co.'s newly established Aircomb Division, Santa Monica, Calif.

Frank G. Goble, president, D. B. Milliken Co., Arcadia, Calif., succeeding **D. B. Milliken,** now board chairman and director of research.

Leonard J. Corti, a vice president, Allied Research Associates, Inc., Boston, Mass. Also: **Raymond E. Zelenka,** chief engineer; **Dr. Samuel Koslov,** chief-physical sciences.

Parsons Corp., Traverse City, Mich., has announced the following vice presidents in the Aircraft Division: **C. J. Slivinsky** for engineering and marketing; **D. G. Kipley** for operations. **F. L. Stulen** continues as vice president for research and development.

Arthur L. Malcarney, group executive vice president, Radio Corporation of America, New York, N. Y. Also: **Theodore A. Smith,** executive vice president, corporate planning; **Walter G. Bain,** vice president, defense electronic products.

Dr. Willard Matheson, a vice president, Acoustica Associates, Inc., Los Angeles, Calif., and general manager of the Advanced Systems Division.

Belock Instrument Corp., College Point, N. Y., has announced the appointment of the following vice presidents: **Arthur J. Minasy** for operations; **Lawrence J. Levine** for research and development; **Andrew Georgia** for planning; **Charles G. Patterson** for general services. Also: **Jeremy Taylor,** executive assistant to the president and acting director of programs.

Clement G. Maloney, vice president-government operations, Kollsman Instrument Corp., with offices in Washington, D. C.

Arthur M. Horst, vice president-maintenance, Reading Aviation Service, Inc., Reading, Pa.

System Development Corp., Santa Monica, Calif., has announced that **Dr. C. West Churchman** will assume the duties of **Vice President Dr. Launor F. Carter** while he is serving as Air Force Chief Scientist for one year beginning July 1. Dr. Carter is SDC's research director. Dr. Churchman is Professor of Business Administration, University of California, Berkeley.

Richard A. Derus, vice president, Alto Scientific Co., Palo Alto, Calif.

Charles L. Banks, vice president-planning and development, Airborne Freight Corp., New York, N. Y.

Thomas E. Vail, vice president, National Astro Laboratories, Inc., Pasadena, Calif.

John E. Ebert, vice president-research, development and engineering, Weinschel Engineering Co., Kensington, Md.

Edward C. O'Brien, vice president-defense products sales, Altamil Corp., Indianapolis, Ind.

William L. Strong, financial vice president, Packard Bell Electronics Corp., Los Angeles, Calif.

Leon Himmel, an assistant vice president, ITT Federal Laboratories, Nutley, N. J., a division of International Telephone and Telegraph Corp.

(Continued on page 118)

INDUSTRY OBSERVER

► North American Aviation Space and Information Systems Division already has completed three wooden Apollo mockups and has seven more on the assembly line at its Downey plant. They will be used for developing techniques and systems in such areas as human factors, compatibility, handling, servicing, coloring and lighting development.

► **Douglas Aircraft Co. recently briefed National Aeronautics and Space Administration on details of a company-funded analysis of recoverable, multi-engine, single-stage booster using liquid propellants to place payloads of substantial tonnage into 250-300 naut. mi. earth-orbit. Addition of a second stage would boost the payload to escape velocity for direct-ascent lunar or planetary trajectories.**

► Circular error probability in targeting of the mobile medium-range ballistic missile, deployed from transporter-launcher, may be reduced to an average of one foot for every nautical mile of range on the basis of expected MMRBM guidance state-of-the-art.

► **USAF is not allowing direct application by Air Force pilots to NASA to volunteer for manned space flight programs. USAF is conducting preliminary screening to retain pilots for possible military space missions. Many volunteers include experienced, highly qualified experimental test pilots who were considered along with the current seven astronauts in the original Mercury program screening in 1959.**

► Test program on the Northrop F-5A (N-156F) will be conducted under the established joint test force concept. Limited Category (contractor/Air Force) tests have started but will proceed slowly until a second prototype is completed in January.

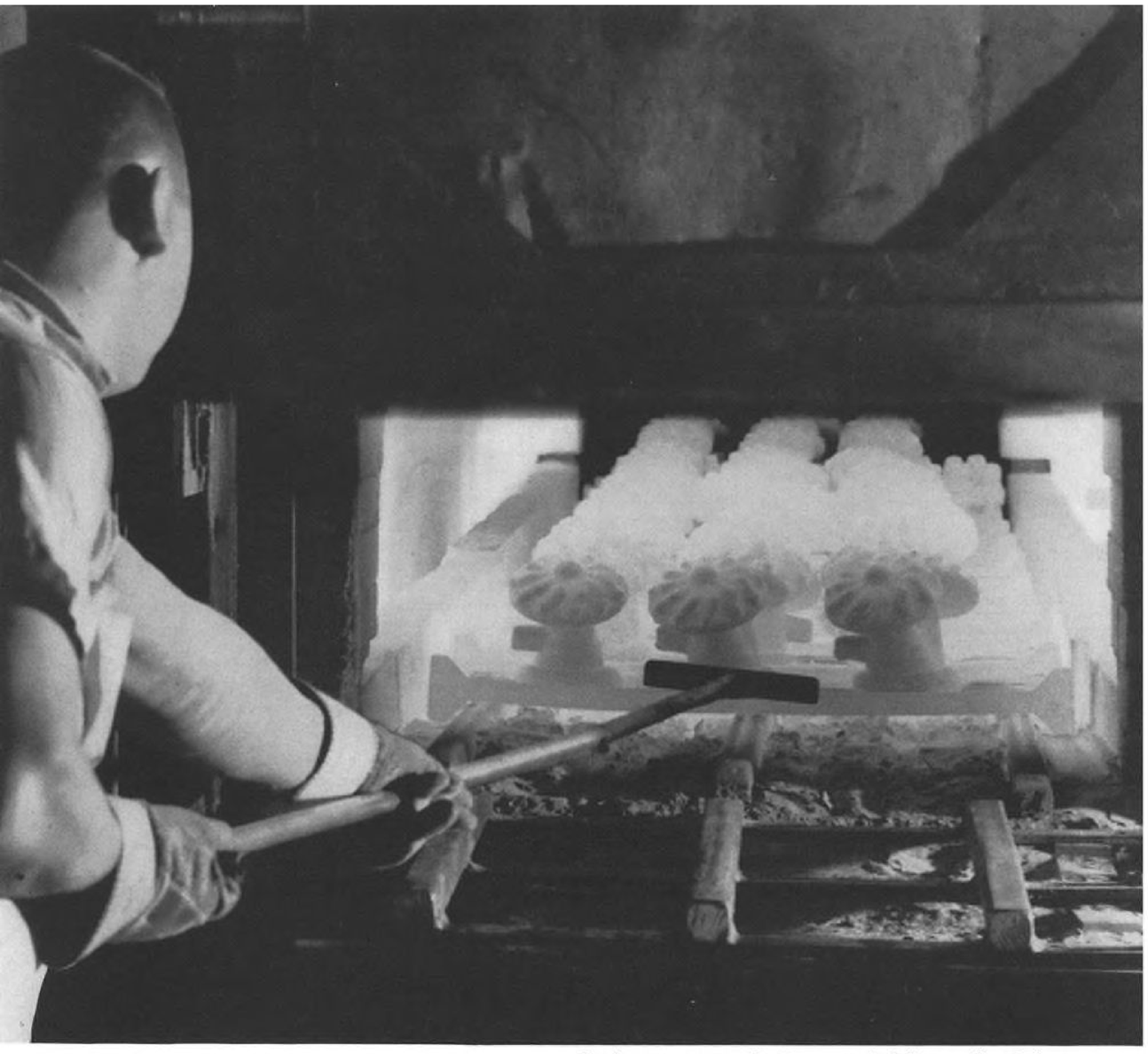
► **Two different types of active electronic countermeasures systems, designed to be carried in small cylindrical packages aboard the Navy's Polaris intermediate-range ballistic missiles for the purpose of confusing enemy radars, will be evaluated later this year by Lockheed Missiles and Space Co. One system, being developed by Raytheon Co., would employ a General Electric voltage tunable magnetron as a generator of electromagnetic energy. The other, under development at Lockheed Electronics Co., will use a barratron (CW magnetron) made by the Electron Tube Division, Litton Industries.**

► NASA's flight research center at Edwards, Calif., is developing plans for a lunar landing simulator to augment the simulator research facility planned at Langley Research Center, and the training simulator planned at Manned Spacecraft Center, Houston, Tex.

► **Earth-launched emergency space command system, called Project Beanstalk for its ability to "climb" into space, was scheduled for initial launch in a modified Blue Scout vehicle from Vandenberg AFB last week. Blue Scout was modified to include Lockheed Propulsion Co.'s M-18 high mass ratio motor as the fourth stage. The system is intended to provide an emergency means of communicating to Strategic Air Command bombers in the event normal communications are disrupted. Bendix is supplying the communication package, Chance Vought the boost vehicle, and Aerospace Corp. technical assistance for the Air Force Space Systems Division program.**

► Requirements for the Midas missile early warning satellite automatic checkout (AW Jan. 8, p. 19) called SCORE (Satellite Computer Operated Readiness Equipment), were presented to industry last week by Lockheed Missiles and Space Co. SCORE is to be capable of factory as well as launch checkout with a probability of operating without failure for 3 hr. Industry proposals for one or more of three SCORE subsystems—computer and associated equipment, ground handling and support equipment and RF equipment—are due June 22. Lockheed will handle systems integration.

► **Savings in weight on the order of 45% have been achieved for the second stage of the Minuteman solid propellant intercontinental ballistic missile by fabricating the casing of welded titanium instead of tool steel.**



Burning out wax patterns for HAYNES ceramic shell-cast turbine wheels.

Intricate in shape—yet strong at 1700° F

Cast turbine wheels from this batch of ceramic shell molds will meet the most exacting performance standards of a quality-conscious industry. They're made to withstand steady operation at high loads and at temperatures up to 1700 deg. F and higher.

This is just one of many advanced foundry processes used by Haynes Stellite to produce castings. For a closer look at others, write for the booklet "HAYNES Alloy Castings and Fabricated Parts."

Remember: Haynes Stellite can always supply you with the right alloys—including those that are vacuum-melted and vacuum-cast. And, complete design and tooling service; production; routine or special finishing. Any part, size, shape, quantity.

Outline your problem and write to: Haynes Stellite Company, 270 Park Avenue, New York 17, New York.

HAYNES ALLOYS

HAYNES STELLITE COMPANY

Division of
Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

"Haynes" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

Washington Roundup

Advent Reorganization

Defense Department is considering dividing the Advent military communications satellite project among the services rather than keeping it under the Army. Eugene Fubini, Defense deputy director of research, is heading the reorganization effort (AW Apr. 16, p. 25).

Army leaders are fighting the reorganization, partly by pointing to past studies of Advent which recommended more centralization of management authority—not less. This recommendation was made last year by the study group within the office of Cyrus Vance, then Defense Department general counsel.

Advent is the Army's major space program and represents the service's best chance of filling the military space communications role. Army leaders fear dividing Advent management will deny them this role and perhaps result in the cancellation of the whole project.

Navy's navigational satellite role, in contrast to Army's space troubles, is broadening. Defense last week announced the establishment of the Navy Astronautics Group at Pacific Missile Range headquarters, Pt. Mugu, Calif. The new command—under Cdr. James Quillin—will operate the navigational satellite system which Navy is developing for the Defense Department.

Eventually, the command will encompass a satellite command and injection station, computer center, operations control center and satellite tracking facility at Pt. Mugu as well as other tracking facilities at Winter Harbor, Me.; Minneapolis, Minn., and Wahiawa on Oahu Island in Hawaii. Capt. Robert Tolleson of the Navy's astronautics branch will succeed Quillin as commander of the group in August.

Navy also plans to enlarge the ANNA geodetic satellite program it manages to include four operational satellites. National Aeronautics and Space Administration recently urged this approach rather than follow the Defense Department's plan to delay expanding the program until after the first ANNA satellite is placed in orbit and its performance evaluated (AW May 21, p. 27).

Soviet GEM Readied

Russia plans to launch its first passenger-carrying ground effect machine this summer. Soviet sources report the vehicle will be 57 ft. long, 21 ft. wide, weigh 26,455 lb. and have a top speed of 43 mph. Aircraft engines in the bow and stern will drive the propellers to create the air cushion while a third engine and propeller behind the 38-place cabin will propel the vehicle. The GEM is being assembled in the Marine Transport Engineers Institute at Leningrad. U.S. military officials are showing considerable interest in GEMs (AW Dec. 4, p. 34).

Dr. Hiden Cox, botanist hired by NASA to improve the image of the U.S. space program, will leave his post of assistant administrator of public affairs within the next few weeks and return to his former position—executive director of the American Institute of Biological Sciences. His NASA appointment expires May 31, but he will remain on the job a few weeks beyond that date to work with his successor, who has not yet been chosen.

Comsat Prospects

Kennedy Administration's compromise communications satellite bill appears certain of passage in the Senate. Sens. Estes Kefauver and Wayne Morse will hold the floor for days in an attempt to defeat the measure, but congressional support is too strong to overcome. The measure passed the House 354-9, was unanimously approved by the Senate space committee and last week cleared Senate commerce committee by a 15-2 vote (AW May 7, p. 26). Only Sens. E. L. Bartlett and Ralph Yarborough voted against the bill.

Representatives of the Commerce, Justice and Labor departments and the President's Council of Economic Advisers this week will meet to draft guidelines to help the Attorney General decide when airline mergers are in the public interest. Clarence Martin, under secretary of commerce for transportation, will head the interdepartmental group.

TFX Decision Nears

Defense Department is promising to choose within the next few weeks the contractor to build the Air Force-Navy F-111A (formerly TFX) tactical fighter. The Boeing Co. and a team of General Dynamics and Grumman Aircraft Engineering Corp. are the two contenders. Secretary of Defense Robert McNamara last week heard the evaluation of the two proposals by the Source Selection Board of the Air Force Aeronautical Systems Division. Navy, despite its participation in the evaluation, has prepared a position paper explaining its objections to the Boeing proposal. The selection is being made amid Pentagon reports that the cost of developing the fighter may go as high as $1 billion.

Air Force, the service responsible for implementing the Defense order which makes even the names of military satellites secret **(see p. 30),** **displayed a big sign** at the National Aerospace Electronics Conference in Dayton, Ohio, May 14-16 naming the Midas early warning satellite and describing its missions.

—Washington Staff

MA-8 Shot May Be Extended to 7 Orbits

Results of Carpenter's three-orbit MA-7 flight will determine whether next mission is expanded.

Cape Canaveral—Prospects for extending the Mercury manned space flight program objectives to include a seven-orbit mission this summer hung in balance last week as result of Lt. Cdr. Scott Carpenter's MA-7 three-orbit flight were being analyzed here.

Mercury officials had been considering extending the next manned orbital flight mission—MA-8—to seven orbits if sufficient confirming data were obtained on systems performance from Cdr. Carpenter's MA-7 flight, the second successful three-orbit mission in the Mercury program. MA-8 had been scheduled for only three orbits, with the major advance planned for the 18-orbit Mercury flight early next year.

Cdr. Carpenter landed at 12:41 p.m. EST May 24, 200 mi. downrange from planned impact point and spent several hours in his survival kit life raft after getting out of his floating capsule in mild seas about 135 mi. northeast of Puerto Rico.

He was assisted by a USAF paramedic team that parachuted from a Douglas SC-54 rescue plane and was picked up by a twin-turbine Sikorsky HSS-2 helicopter from the USS Intrepid. A Grumman SA-16 amphibian had landed on the water and was ready to make the pickup but the helicopter arrived first. Total MA-7 flight time was 4 hr. 56 min. Carpenter's capsule and raft were first sighted by a Navy Lockheed P2V patrol plane that homed in on the Sarah beacon carried in the Mercury capsule.

The extra length of the re-entry portion of the flight could have been caused either by delay in firing the retrorocket sequence or in an improper capsule attitude at the beginning of the re-entry process or a combination of both. The USSR lost two orbital capsules during the re-entry process because of improper capsule orientation just prior to attempting re-entry into the atmosphere.

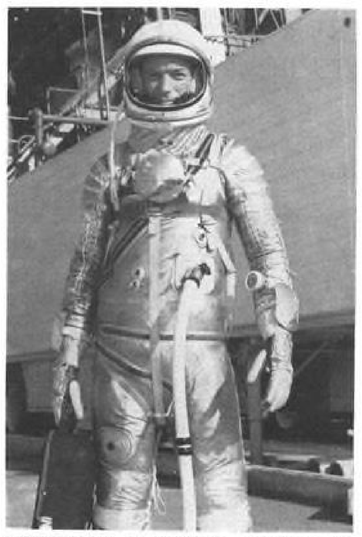
Cdr. Carpenter was launched from here at 7:45 a.m. (EST), May 24 as pilot of the Aurora 7 Mercury capsule after one of the smoothest countdowns ever conducted at the Cape. There were no technical holds during the final 6-hr. count. The only interruption was a 44-min. weather hold caused by fog and haze shrouding the Complex 14 launch pad, with two thin cloud layers overhead.

Because of the excellent condition of all launch vehicle and capsule systems during the countdown, Walter C. Williams, Mercury operations director, decided to launch through the thin cloud layers. The USAF-General Dynamics/Astronautics Atlas booster hurled the capsule into an orbit extremely close to preplanned flight path.

Major difficulty experienced during the flight was the extremely high fuel consumption of the reaction control system, particularly in the automatic flight control system. Consumption was so great in the automatic mode that the astronaut was forced to fly much of his mission on manual control and the fly-by-wire system.

Lt. Col. John H. Glenn, Jr., also experienced automatic control system difficulties during his MA-6 flight, when he flew the last two orbits on fly-by-wire and manual control systems (AW Feb. 26, p. 26). Following Glenn's flight, the 1-lb. hydrogen peroxide control jets were re-designed with a larger feed orifice and the replacement of stainless steel screens with a platinum filter.

Bell Aerosystems, which developed the Mercury reaction control system, was unable to explain the high fuel consumption during the MA-7 flight but offered the possibility that the 24-lb. control jets were being used excessively.



ASTRONAUT CARPENTER geared in his pressurized flight suit, is carrying portable air conditioning unit in his right hand which cools suit when he is outside the capsule.

Other difficulties included a tendency for Carpenter's pressure suit to overheat by 10-15F, and voice communication lapses in some parts of the Mercury communications network.

Carpenter had to continually increase the water coolant flow from the capsule's environmental system to keep his suit temperature within a comfortable 68-72F range.

If the National Aeronautics and Space Administration considers the difficulties encountered in MA-7 do not have major engineering significance, plans will be developed to extend the MA-8 mission objective to seven orbits. This mission can be accomplished with a minimum of additions to the consumable items in the Mercury capsule. For example, most of the reaction control fuel is used for orienting the capsule to a blunt-face-forward position at injection into orbit and for maintaining the proper re-entry angle. Thus, not much more fuel would be required for a longer orbital mission.

Recovery area for a seven-orbit mission would be in the Pacific Ocean between Hawaii and Midway. This calls for re-positioning the trained recovery units from the Atlantic Fleet, or will require training new ones in the Pacific.

Aerospace Corp. has conducted some preliminary trajectory analyses for the longer seven-orbit mission.

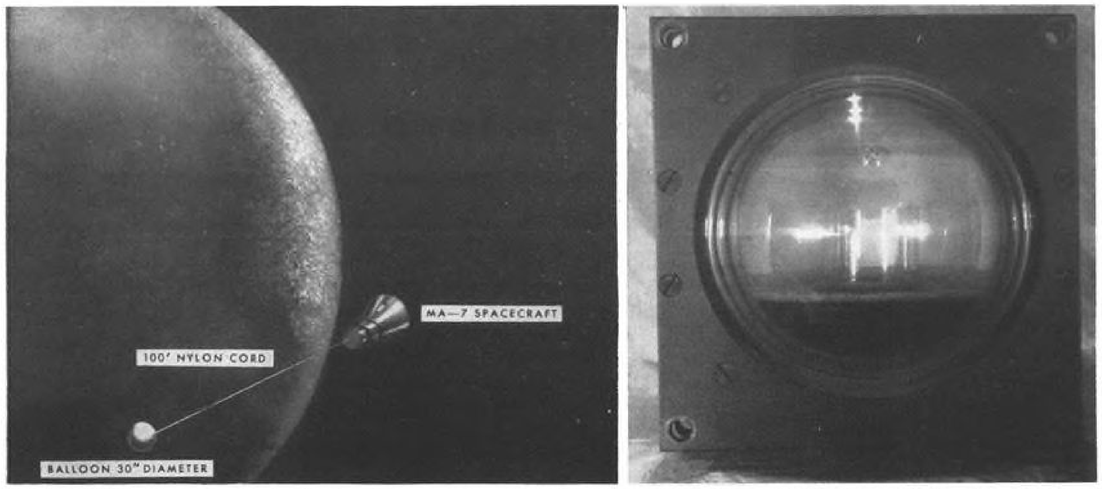
Atlas booster 113D, assigned to the MA-8 mission, is in its final factory checkout phase at San Diego, Calif. Next milestone will be a composite test which normally precedes delivery to the Cape by 4-6 weeks.

The insulating bulkhead which leaked in Glenn's MA-6 Atlas booster was retained in Carpenter's launch vehicle, which was Atlas 107D. This bulkhead was not installed in the MA-8 Atlas.

Cdr. Carpenter was launched into an orbit with an apogee of 160.16 stat. mi., a perigee of 96.32 mi. and a period of 88.2 min. This orbital pattern was extremely close to that of Glenn's MA-6 flight. Velocity at cut-off was 17,532 mph.; launch inclination was 32.5 deg.

After booster separation, Carpenter turned his capsule around manually on the fly-by-wire system in order to conserve fuel. Almost immediately after injection into orbit, a faulty telemetry signal showed his body temperature had risen to 102.4F.

Actually, his suit temperature had reached 82F early in the first orbit, and he reduced this to about 70F by increasing the amount of water coolant



MA-7 CAPSULE released a vari-colored Mylar-aluminum sphere from its antenna section during orbital flight so reflection characteristics of different colors could be evaluated. The balloon is made of five segments, colored orange, white, silver (aluminum), yellow and phosphorescent. The tethered balloon was also used for study of aerodynamic drag and stability when deployed at end of 100-ft. cord. Also, as the balloon is inflated by a nitrogen bottle, multi-colored ¼-in. disks of Mylar will be dispersed from the folds of the balloon so visual effects and behavior can be analyzed. Small metal beam instrumented with a strain gage will measure drag. Zero-gravity experiment (right) is installed in MA-7 cabin so it can be photographed inside capsule and observed through hand mirror by Carpenter. Under zero-g, an aqueous solution is expected to rise in a capillary tube within unit because of surface tension, rather than floating in globules.

entering the environmental system.

Carpenter's scientific program was considerably more ambitious than Col. Glenn's. It called for these tasks:

• **Visual acuity and drag** in the space environment using a 30-in.-dia. Mylar sphere. Carpenter deployed the balloon from the capsule neck at the start of the second orbit at 9:43 a.m. (EST), but he was unable to jettison it, and it was carried with the capsule until it burned up on re-entry.

This sphere was made of different-colored gores to determine what colors are easiest to ascertain when tethered at the end of a 100-ft. line. Carpenter reported the orange and silver colors were easiest to discern. A strain gage was used to measure aerodynamic drag of the sphere. Carpenter reported that the balloon behaved erratically and oscillated through 180 deg. and at times the towline became loose enough to form loops.

• **Photographic spectrum** for the Weather Bureau, in which photographs were to be taken through five lenses—three in the visible range, one infrared and the other cloudy glass. No voice report was made on this experiment during flight. But results are expected to contribute to the design of lenses for weather satellites.

• **Zero gravity experiment,** in which a clear flask containing water and green dye was observed and photographed by Carpenter to gather data on fuel flow during zero-gravity conditions.

The astronaut tasted solid food but did not eat much of it because it crumbled and the crumbs floated around the capsule. He drank water several times, the last time in considerable quantity to ease his high suit temperature.

In addition to his scientific observations, Carpenter monitored and reported on his capsule systems and consumable stores. A flare experiment to check visibility from space was planned as he passed over Australia, but this experiment could not be completed because of cloud cover.

During his first orbit, Carpenter reported that he caught in his hand a washer which was floating around his capsule. The problem involving fuel depletion in the reaction control system became apparent on the second orbit when the capsule had only 51% of its automatic fuel supply remaining and 86% remaining in the manual fuel tanks.

At this similar point in Col. Glenn's mission, the automatic system tanks were at 80% of capacity and the manual at 100%. As the capsule approached Hawaii during the second orbit, Mercury Flight Director Christopher C. Kraft warned Carpenter that the mission would have to be terminated after two orbits unless the pilot switched to manual control system from the automatic mode. The automatic mode is the most desirable for re-entry and requires a 35% fuel capacity remaining for the re-entry maneuver.

Cdr. Carpenter reported observing luminous particles which were first reported in orbital flight by Col. Glenn and have since become known as the Glenn Effect. However, Carpenter reported seeing only a few of these particles which he said looked like snowflakes. Glenn reported observing considerable numbers of these particles.

Carpenter also reported seeing a haze layer, over the horizon between the atmosphere and space. But his only analysis during voice reports in flight simply indicated it was quite different from the haze layers observed by Glenn.

Communications during MA-7 were generally good in telemetry and radar tracking, but voice communications experienced periodic difficulties during some portions of the Mercury tracking communications network. Kano UHF system went out of operation after the second orbit but no other major network difficulties were reported.

Tight valve in the reaction control system, aneroid barometer in the parachute recovery system and a strip heater in the autopilot of the Atlas booster caused three postponements of MA-7 on May 17, 19 and 22, respectively.

Excessive friction in the valve controlling the flow of hydrogen peroxide to the two yaw jets in the manual proportional control system of the Mercury capsule caused the first delay of the flight, originally scheduled for May 17.

The valve was removed and a new one inserted into the system. The procedure, including a system check with the new part installed in the system, took two days, and the flight was rescheduled for May 19.

But the date slipped again, this time

to May 22, when a review of the electrical circuitry which activates the capsule's drogue parachute led to a decision to modify the wiring on May 18.

The MA-6 pilot, John H. Glenn, Jr., had experienced difficulty with the system during his flight last February, when the drogue deployed prematurely at 30,000 ft., instead of at the preplanned 21,000 ft.

The drogue is a 6-ft.-dia. chute used after re-entry to stabilize the spacecraft just prior to main ring-sail parachute deployment. It is activated by a pre-set aneroid barometer, or barostat, although the pilot can effect deployment by manually overriding the system.

NASA project engineers say that the drogue can be deployed safely up to 45,000 ft. Glenn reported that he was reaching for the override switch at about 30,000 ft. to damp unexpectedly heavy oscillations of his capsule when the drogue deployed by itself at that altitude. NASA wanted to be certain that the drogue on Carpenter's MA-7 capsule did not deploy during boost, orbital or re-entry phases of his flight, and so decided to modify circuitry.

On Glenn's MA-6 capsule, both the drogue and main chutes were connected by separate electrical lines to the primary and secondary batteries. Between the batteries and the chutes were an open switch and a barostat, in that order, on each line. When closed, the switches armed the system for deployment when the barostats passed through the correct altitudes, 21,000 ft. for the drogue and about 11,000 ft. for the main ring sail.

On MA-6 the switches were kept open during the boost phase of the flight by another circuit connected only to the switches. This circuit was routed through the escape tower, making it in effect a circuit breaker. When the tower was jettisoned 20 seconds after booster engine burnout, this circuit was broken and the switches closed, thus arming the system.

To prevent premature deployment of the drogue chute on MA-7, NASA project officials decided to add another barostat to the system as a parallel circuit to the wiring which kept the switches open. Passing through 12,000 ft., as MA-7 climbs along its powered trajectory, decreased pressure causes this new barostat to expand and plug into the switch restraining circuit. Then, when the escape tower is jettisoned, the added barostat closes the circuit and prevents the arming switches from closing until after re-entry.

Drogue deployment procedures also were changed for MA-7. Carpenter was called upon to manually activate the drogue by pushing the override button, which connects the drogue directly to a battery, at 21,000 ft. altitude. Glenn's flight plan called for automatic deployment of the drogue with manual override to be used for alternative or emergency activation.

Had Carpenter failed to deploy the drogue himself, the added barostat would have been forced by increasing pressure at about 12,000 ft. to pull itself out of the circuit and allow the switches to close. The drogue would then have been ejected almost immediately, followed 2 sec. later by main chute deployment.

Main ring-sail parachute deployment procedures remained the same for MA-7 as on MA-6 with the 63-ft.-dia. chute automatically spilled out by a barostat at an altitude between 10,000 and 11,000 ft. Carpenter could have activated main chute deployment whenever he wished by means of another manual override.

Because of this modification to the parachute recovery system, the launch date slipped three days to May 22.

On May 19, a routine system check of the Atlas booster revealed a 50F temperature rise in a strip heater surrounding a yaw gyro in the booster autopilot. Although it could not be immediately determined whether the heater or the heater's thermostat was faulty, and although the temperature rise would not have been great enough to cancel a flight test of the Atlas as a weapon system, it was felt that for pilot safety the gyro should be removed and replaced with a new one. New gyro canister was flown in from General Dynamics/Astronautics plant at San Diego.

FAA Lets $2.6 Million in Contracts For Supersonic Transport Studies

Washington — Federal Aviation Agency announced last week that it has spent the first $2.66 million of the $11 million awarded by Congress at the start of Fiscal 1962 for studies to determine whether the U.S. should subsidize a civil supersonic transport.

Negotiated by Aeronautical Systems Division of Air Force, the six initial contracts awarded in the FAA-directed program break down as follows:

- **Propulsion.** General Electric's Flight Propulsion Division was awarded a $1,122,000 letter contract in anticipation of a total contract effort worth $2.8 million. A $308,864 contract went to Curtiss-Wright Corp., with $463,736 to follow.
- **Aerodynamics and structures.** Douglas Aircraft Co., which teamed with McDonnell Aircraft Corp., was awarded a package of seven cost-sharing contracts toward which FAA is contributing $956,640. Half of the balance, $890,043, will be spent by each contractor.
- **Acoustics.** North American Aviation received a $138,109 contract under which one of the company's RS-70 Mach 3 prototype reconnaissance-strike bombers will be instrumented to collect data on boundary layer noise and its role in inducing metal fatigue.
- **Flight controls.** Cornell Aeronautical Laboratory received a $111,250 contract to study feasibility of a system that would sense and damp out aerodynamic forces that might cause structural damage to the aircraft.

In addition, FAA awarded the National Bureau of Standards here a $25,000 contract to study problems associated with the use of glass in supersonic transport windshield construction.

FAA has over-all responsibility for the U.S. supersonic transport program, but draws upon National Aeronautics and Space Administration for research and technical support and Defense Department for administrative and technical support. The agency has delegated to Air Force the task of administering contracts awarded under the program.

According to an agency spokesman, Administrator N. E. Halaby supervised the operation of a small Supersonic Transport Program Management Office within FAA during his year-long search for a deputy for planning and development. The office itself was under Air Force Col. Lucian S. Rochte.

Organizationally, Col. Rochte now reports to Melvin Gough, who became the first director of FAA's new Aircraft Development Service on May 1. Gough reports to Robert Shank, deputy FAA administrator for development, who reports to Halaby.

This chain of command will award the $25 million FAA has requested for supersonic transport research in Fiscal 1963, should Congress furnish the money. Assisting FAA in the program will be four additional groups composed of airline, manufacturing and government representatives. At the top is the steering group headed by Halaby and including NASA and DOD representation. Next is the advisory group under Gen. Orval R. Cook, USAF (Ret.), which was set up to inject technical advice into the program. In addition, there is a working level task group headed by Col. Rochte and an airline advisory group consisting of two airline vice presidents.

The results of these first study contracts will be circulated freely among industry. To infer that they identify the contractors who ultimately will build the supersonic transport's engines and airframe would be erroneous, an FAA official told Aviation Week.

Study Group Recalled on 624A Problem

By Larry Booda

Washington—Director of Defense Research and Engineering last week recalled a special committee to review design data of the transfer stage for USAF's 624A Standardized Space Launching System—formerly called the Titan 3.

The move was due to the need for rapid development of the propulsion package and vehicle imposed by an early deadline for first firing of the entire system. George Brady of the Institute for Defense Analyses is chairman of the committee.

The committee reconvened on a note of urgency because the transtage is the only portion of the 624A system for which the Phase 2—development—contractor has not yet been chosen. The schedule calls for a first firing by November, 1963, and operations beginning in 1965. United Technology Corp. was selected to develop 120-in. solid propellant boosters (AW May 14, p. 33), two of which would be strapped to a Titan 2 storable propellant first stage which is made by Martin Marietta.

The transtage would propel a payload, such as the Dyna-Soar boost-glide vehicle, from an elliptical orbit to a circular orbit. A restart capability would give it versatility beyond this, however, enabling it to perform a variety of tasks with different payloads.

No funds for Phase 2 will be released by the Secretary of Defense until the design specifications are approved for the entire booster.

Specifications for the transtage, 250 pages in length, were written by the Aerospace Corp. from general guidelines set by the Golovin Committee which met last fall to determine what configuration would best meet the needs of the military and the National Aeronautics and Space Administration for an all-purpose booster through 1975. The strap-on solid propellant booster-Titan 2 core combination was the committee's choice.

The specifications call for a total minimum thrust of 16,000 lb. There would be two nozzles to avoid the need for using small attitude correction jets on the payload vehicle during the power phase. With two full gimbaling nozzles, the vehicle could be rotated about its thrust axis in addition to having the direction of thrust changed.

The engine would use a storable propellant combination, nitrogen tetroxide and a 50-50 blend of hydrazine and unsymmetrical dimethyl hydrazine (UDMH). This is the same combination used by the Titan 2 core.

A relatively simple system for delivery of the fuel to the nozzles by means of gas pressure has been specified. This system eliminates complex pumping combinations. Ablative instead of regenerative cooling of the nozzles is also specified. This involves cooling by having portions of a nozzle melt away during burning rather than having the liquid propellant flow through a jacket space inside the nozzle to cool it. Specific impulse must be 315 and burning time 440 sec.

As written by Aerospace Corp., the specifications call for a separate engine proposal, with tankage, framing and the actual stage shell being designed and fabricated by Martin Marietta.

It is this portion of the specifications which are believed to have been the principal cause for reconvening the Brady committee. Some officials have contended that vehicles that already have been developed are available for use as the transtage. For instance, the Agena C vehicle which was designed to power Discoverer, Samos and Midas satellites into orbit after initial boost by Thor and Atlas D rockets is one possibility.

Agena C is powered by a storable propellant engine. It is designed with a pumping system, however, and uses regenerative nozzle cooling. The Agena vehicle, which is made in a variety of lengths, could be cut down to the squat size specified for the transtage, 10 ft. in diameter and 6 ft. high.

It was indicated that the guidance, vehicle and propulsion subcommittees of the Brady committee were instructed to further justify their stand on the transtage specifications so that the time schedule would be met without affecting the performance parameters.

Despite its simplicity, the pressure fed system with ablative cooling suffers from decay in thrust as the pressure drops in the tank due to the increase in gas space as fuel is used. A pump system, on the other hand, maintains constant pressure and can deliver fuel at a much greater rate.

The following companies have been invited to bid for the propulsion package: Aerojet-General, Bell Aerosystems, Pratt & Whitney, Rocketdyne and Thiokol. Each bidder is limited to 150 pages in its proposal. The development phase contract is expected to amount to $16 million. Since no over-all program has been set, no estimate of total production can be made, but the winner will be assured of production through 1970.

The guidance subcommittee is made up of Dr. Michael Waters, chairman, John Kirk, Massachusetts Institute of Technology, Lt. Cdr. John Scull, Maj. John Howland, USAF, and Roger Woodbury of MIT, consultant.

Members of the propulsion subcommittee are Dr. Walter Jones, chairman, William Sheehan, DDRE, William Cohen, NASA, William Schnare, Space Systems Division representative at Edwards AFB, and Vincent Keenan, consultant. Vehicle subcommittee is composed of George Brady, chairman, Dr. Harold de Groff, Purdue University, William Neighbors, NASA Marshall Space Flight Center, Fred Orazio, USAF Aeronautical Systems Division, Alfred M. Nelson, NASA consultant.

Col. Joseph S. Bleymaier, as deputy of SSD and system program director for the 624A project, met with the Brady committee members. Other Systems Command officers also participated.

The 624A system includes not only the booster but a three-launch-pad complex and transport facility at Cape Canaveral and static test facilities at Edwards AFB. It will be the first Air Force system to use incentive fee type of contracts from its inception. Program will be controlled with PERT time-cost techniques. NASA is considering 624A for boosting the Gemini.

The Titan 2 core will be strengthened to withstand the tremendous thrust of the 120-in. boosters. In operation, the Titan 2 core would probably be started first, with the solid propellant boosters fired within milliseconds. If time between firings is too great, the Titan 2 could overcome the resulting asymmetrical thrust using its gimbaling nozzle steering system.

Re-entry Record

Washington—Artificial meteoroid made of steel attained what National Aeronautics and Space Administration believes to be the highest re-entry speed ever recorded for a man-made object—47,000 fps.—after being launched to a height of 200 stat. mi. by a Trailblazer 2 rocket.

High-energy, trajectory return of a capsule from planetary flight would entail velocities less than those achieved by the meteoroid. The object, slightly larger than a dime, was launched May 6 from NASA's Wallops Island facility and was tracked by ground-based optical equipment. It appeared as a thin, bright trail in the southeast sky from points in Virginia and North Carolina.

Six-stage, solid-fueled Trailblazer 2 that launched the meteoroid was equipped with two extra stages. Peak altitude was reached on the thrust of the first two stages, while power produced by the last four was used to accelerate the meteoroid downward.

Secrecy Rule Affects U.S. Stations Abroad

By George C. Wilson

Washington—Defense Department, in implementing its new space secrecy policy, will not only restrict the release of information in the U.S. but will reorganize ground support stations in foreign countries to deny foreigners access to what is now considered secret data.

Defense officials who wrote the space secrecy directive issued Mar. 23 expressed surprise it was causing widespread confusion (AW May 21, p. 26). They said the Air Force, Army and Navy would issue guidelines soon designed to explain to industry the security requirements imposed by the directive.

But an AVIATION WEEK check indicated concern about the new secrecy directive was mounting. Major findings were:

• **Ground support stations.** U.S. military officials charged with the operation of foreign communication and tracking stations for space satellites fear the implementation of the directive will disrupt operations. The directive restricts military space information to those persons Defense decides have a need-to-know. The directive also cloaks in secrecy details about military space satellites including their names and date and number of launchings. Military officers fear a literal interpretation of these restrictions would require the replacement of foreigners who now run many of the ground support stations. This might require training U.S. citizens to do the work and stationing them in foreign countries. Besides the added expense, military officers contend, foreign governments might be offended by the new security policy.

Top Defense officials said steps will be taken to keep foreigners from handling space information now considered secret. An Air Force policy maker said: "We won't have foreigners manning stations where information affecting national security is obtained." But how extensive a reorganization of ground stations will be required has not been determined.

• **Contractors' problems.** Industry sources report they are finding it more difficult to get space information cleared for release by the military. One industry official said that because of the directive, the Navy refused to let his company re-issue space pamphlets and advertisements previously published. When the company representative explained the material already was in the public domain, the Navy officer replied: "How do we know the Russians read it?" Another company officer complained "the Pentagon is trying to rewrite history" by refusing to clear material on early military satellite programs.

When told of these conditions, Defense officials conceded military security officers perhaps are "over cautious" in deciding what information can be cleared about space programs. They said the intent of the directive is "to secure security in public information;" not to impose drastic restrictions on what contractors can say about their work. About the only new restrictions intended, they said, concern the names of military satellites and the dates and number of times they have been launched. Defense hopes "to confuse the opposition" by not identifying a specific shot with a specific project.

• **Need-to-know.** Defense has imposed both need-to-know and must-know requirements on persons seeking military space information. The must-know classification is new. It will be given only to those top officials who require knowledge about an entire space project, not just a facet of it. The need-to-know certification will entitle the person only to information about specific aspects of military space projects.

The Air Force, the service named to implement and manage the new security policies stemming from the directive, will keep the master list of those who need-to-know and those who must-know. The Air Force also will assign numbers to military satellites and keep changing the numbers.

The need-to-know restrictions imposed by the new directive are especially worrisome to space contractors. They fear the military officers charged with implementing the directive will make it extremely difficult for contractors to exchange technical information with each other and to obtain technical assistance from the military services. The need-to-know restriction applied to all military space projects. Air Force intends to put persons with need-to-know certification in subdivisions based on their area of interest, presumably to restrict their access to information to within their specific technological field.

Defense officials denied the broad need-to-know requirement would lead to more duplication of effort because of the barriers placed between space scientists working at different places but in the same technical field.

• **Scientific organizations.** Several groups are concerned about what effect implementation of the directive will have on their meetings—especially those where military space projects are discussed. One fear is military officials will clamp down on the public release of scientific papers. But the scientific organizations have not filed any formal complaints with DOD about the directive; they are taking a wait-and-see stance.

Defense officials said the directive will affect such meetings "only in a minor way." As in the case of contractors, the organizations could not release papers giving details about military space payloads or the number and dates of launchings.

In a related development, the general counsel's office within the Defense Department put the finishing touches on a draft proposal to establish a director of classification management who would tighten the enforcement of security regulations and extend the classification to fewer people. A spokesman in the general counsel's office said the proposal was designed to implement some of the recommendations made by USAF Lt. Gen. Joseph F. Carroll, Defense Intelligence Agency director, after a detailed study of the Defense Department's security system. A spokesman in the general counsel's office said the proposal would be sent to the Secretary of Defense within two weeks.

Another development was a meeting scheduled for late last week between Rep. Olin E. Teague (D.-Tex.), second ranking Democrat on the House Science and Astronautics Committee, and White House officials. Rep. Teague requested the meeting to discuss the amount of information the National Aeronautics and Space Administration is releasing. He feels much of the information is valuable to the Russians and should not be released.

Rift Management

Lockheed Missiles and Space Co. has organized a Nuclear Space Program Division which will be responsible for design, development and assembly of the Rift (Reactor-In-Flight Test) vehicle. National Aeronautics and Space Administration and the Atomic Energy Commission recently awarded Lockheed a $180-million contract for the Rift work (AW May 21, p. 30).

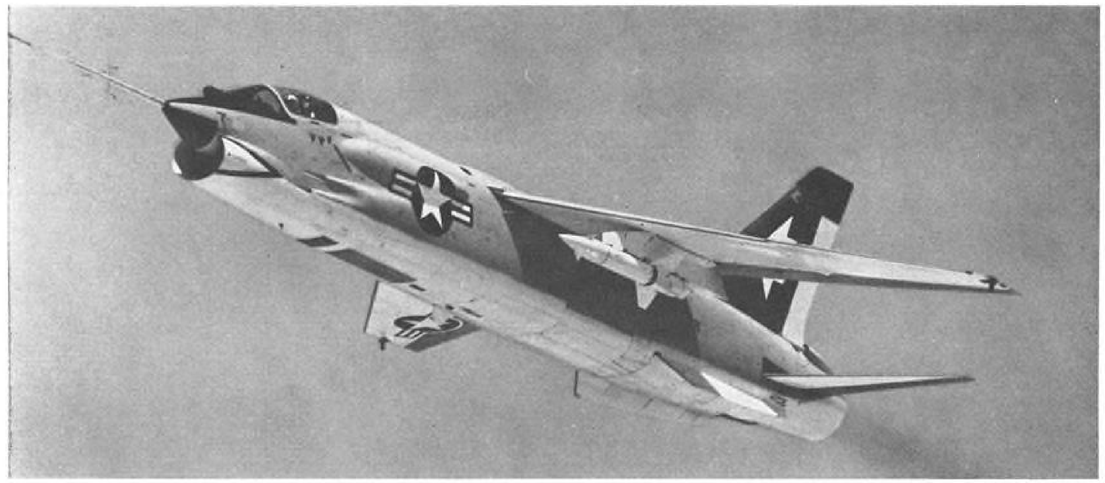
Dr. Roy Smelt has been appointed a vice president and general manager of the new division, which will be based at Sunnyvale, Calif. Smelt formerly served as the company's chief scientist. Malcolm C. Williams, who was administrative director for Lockheed Missiles and Space Co., is assistant general manager of the new division. Dr. Harold F. Plank will be program director. Elmer P. Wheaton will serve as Lockheed vice president-space programs, responsible for all NASA-directed company programs. Wheaton was elected a Lockheed vice president last month (AW Apr. 30, p. 23); he came to Lockheed in March after resigning from Douglas Aircraft Co., where he was vice president-engineering (AW Jan. 1, p. 25).

Space Funds Approved

Washington—House last week by a 342-0 vote passed a bill authorizing $3.7 billion for Fiscal 1963 and $71 million for Fiscal 1962 for the National Aeronautics and Space Administration. The unanimous vote indicated continuing enthusiasm for the expanded space program President Kennedy initiated May 25, 1961 (AW May 21, p. 38).

Chairman George P. Miller (D.-Calif.) of the House Science and Astronautics Committee warned during discussion on the bill that "we will have to accept losses in this [space] field. It is inevitable that one of the brave astronauts who will go into space will meet disaster . . ."

Rep. James G. Fulton (R.-Pa.), second ranking Republican on the House space committee, urged a broad space program tied to long-range goals, declaring otherwise "our space methods will be looked upon as Egyptian pyramids by the generations of the future—a fine idea, a monumental task but how useful and how productive to the progress of mankind?"



Vought F8U-2NE Equipped With Bullpup Missiles

Bullpup As are carried by Vought F8U-2NE equipped with underwing stores pylons for the first time. Wing pylons also can be fitted with Bullpup Bs or twelve 250-lb. bombs, four 500-lb. bombs, two 1,000-lb. or 2,000-lb. bombs or six pods containing four Zuni air-to-ground rockets each in addition to racks on each side of the fuselage carrying six Zunis. This rocket/bomb ground attack capability is complemented by the aircraft's four 20-mm. cannons. Flight test program has included initial firing of Bullpup missiles.

Key Senator Supports Air Force On RS-70 Development Program

Washington—Likelihood of Congress appropriating the $491 million Air Force wants for its Fiscal 1963 RS-70 reconnaissance-strike aircraft program increased last week with the appearance of Sen. Carl Hayden (D.-Ariz.) before the Senate appropriations subcommittee on the armed services.

Hayden, who is also chairman of the full appropriations committee, urged the subcommittee to appropriate the full amount requested by Gen. Curtis LeMay, USAF chief of staff (AW May 21, p. 39). The House has approved $223 million—$52 million more than the $171 million requested by the Administration.

Other Changes

On other changes made by the House in the Administration's Fiscal 1963 defense budget, Defense Secretary Robert S. McNamara, testifying before the Senate subcommittee, had this to say:

• **Dyna-Soar.** He approved a $42-million addition by the House, making a total Fiscal 1963 Dyna-Soar program of $157 million.

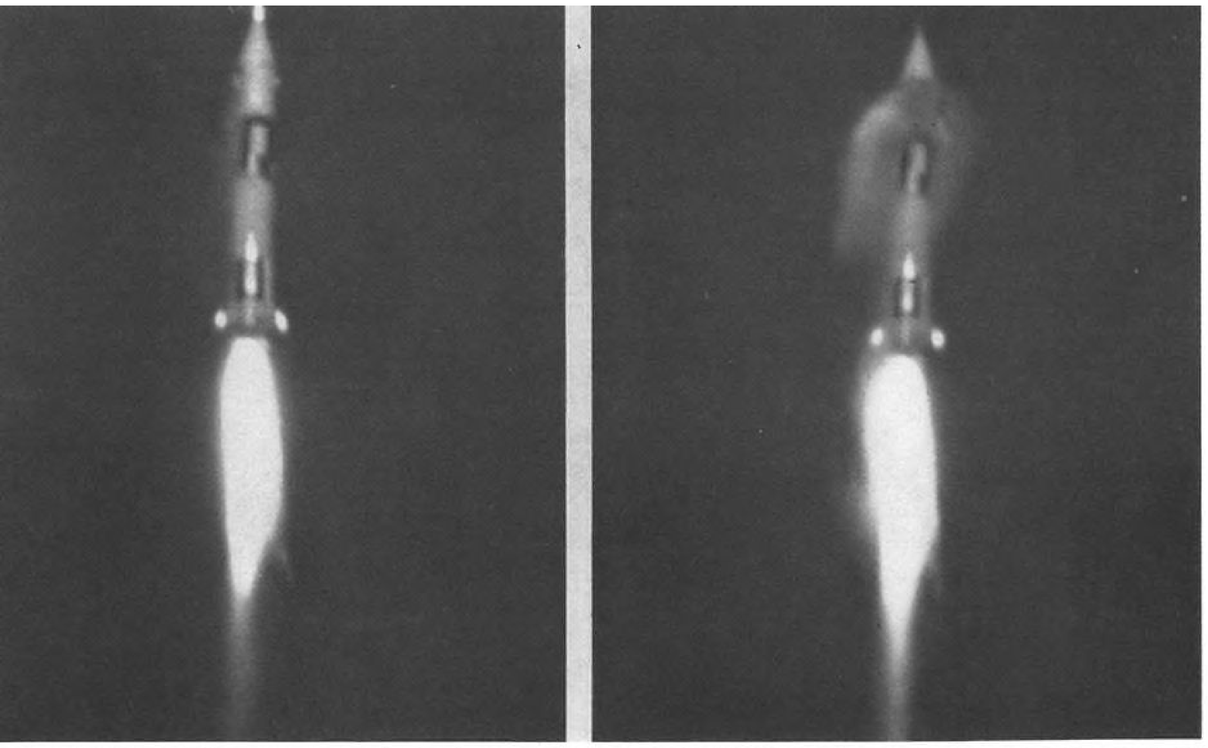
• **Mobile medium-range** ballistic missile. McNamara accepted a $20-million cut made by the House in the Administration's request for $100 million.

• **North American T3J.** McNamara supported the program voted by the House for purchase of 36 of the trainer aircraft by the Navy at a total cost of $35.1 million during Fiscal 1963. The Administration originally proposed a buy of 16 at a cost of $18.1 million.

• **Raytheon Sparrow.** McNamara protested a $5-million cut in Navy funds for the air-to-air missile. He noted that it was made by the House on the assumption there would be a substantial Air Force purchase in Fiscal 1963 bringing down the unit cost. McNamara reported the USAF purchases for the McDonnell F4H fighter will not start until Fiscal 1964.

• **Helicopters.** McNamara accepted a $2.1-million reduction made by the House in the $14.1 million originally asked by the Administration for helicopter logistic support for missile bases. McNamara concurred with the House that the requirement for this task is not yet known with precision.

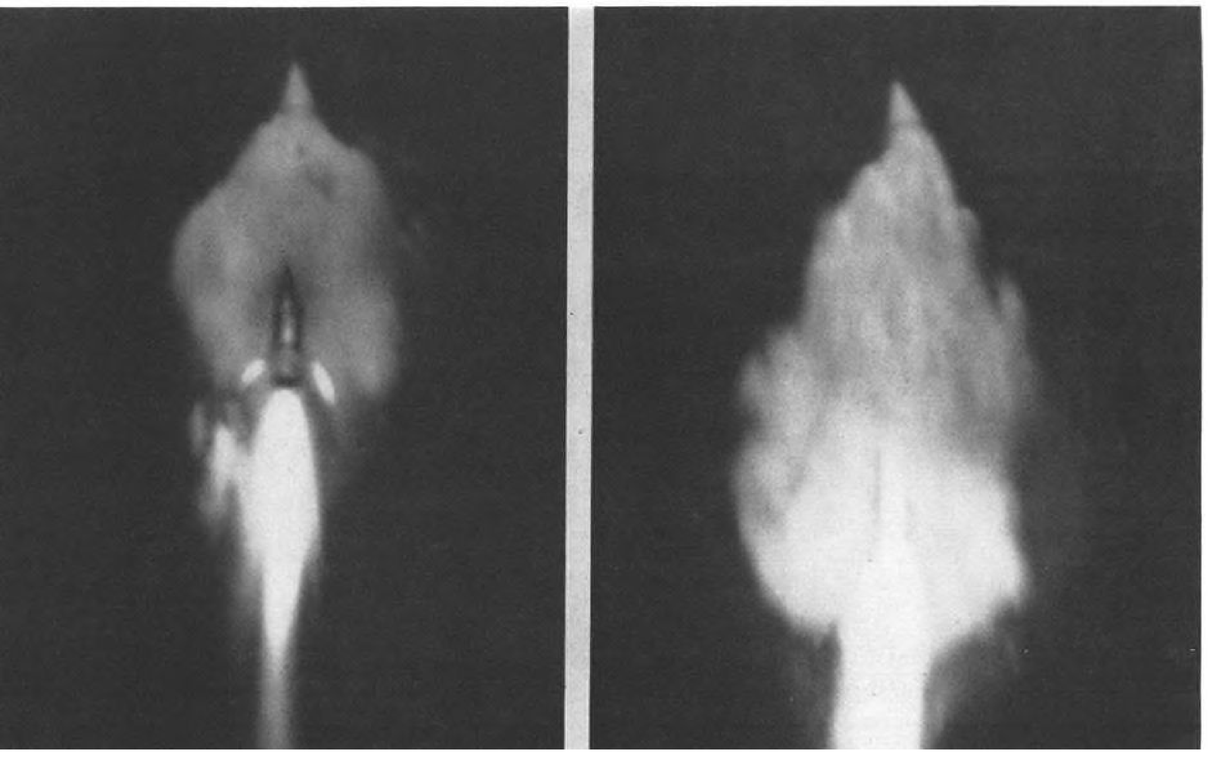
• **Lockheed C-141.** McNamara urged restoration of a $10-million reduction against the C-141 cargo aircraft program, made with the objective of forcing the company to share in development costs. When commercial production of the C-141 is started, McNamara pointed out, Lockheed Aircraft Corp. will be required to make a rebate to the government for development costs. "However, commercial production is not contemplated before Fiscal 1965," he added. "It is, therefore, entirely premature to anticipate savings in the 1963 program . . ."



Atlas-Centaur photo sequence was taken by 70-mm. tracking camera provided for National Aeronautics and Space Administration by Air Force Missile Test Center. Photos indicate the first malfunction may have been caused when a weather shield, located between the top of the insulation panels and the bottom of the nose fairing broke away (left). Malfunction occurred at about 20,000 ft. Breakup of the Centaur stage occurred (right) while the Atlas booster continued to drive forward (AW May 14, p. 36).

Atlas-Centaur Tracked to Destruction in Sequence

Destruction of Centaur continued (left) until the entire vehicle was engulfed in flames (right). Optical tracking coverage was a major source of determining the exact cause of the mission failure, according to NASA.



Inadequate Priority Cited in Centaur Lag

Washington—Failure to accord Atlas-Centaur a priority that would place it on a par with Saturn, Mercury and Apollo has slowed development of the hydrogen-fueled space vehicle, according to General Dynamics/Astronautics, its prime contractor.

In testimony before the House space science subcommittee (AW May 21, p. 28), GD/A's Centaur program director contended that eight major subcontractors feel they could not give proper service to Centaur because of competitive projects possessing higher national priorities.

Krafft A. Ehricke, director of advanced studies at GD/A and the Centaur's prime architect, and GD/A Vice President Grant Hansen, the present program director, urged that Centaur be given a DX priority—the nation's highest—to remedy this situation.

First Launch Failure

On Centaur's first launch, which took place May 8 although originally scheduled for January, 1961, the vehicle exploded 55 sec. after liftoff from the Atlantic Missile Range (AW May 14, p. 36). A second launch tentatively is scheduled this October at AMR. GD/A and National Aeronautics and Space Administration are convinced that the failure was the result of what Hansen described as "an engineering mistake."

Because of this mistake, airflow over the ridge around the base of the Centaur's nose cone achieved supersonic speed before the vehicle had exceeded Mach 1. A shock wave resulted. It, in turn, produced an area of negative pressure.

The outward thrust of ambient air within the Centaur stage combined with this negative pressure to dislodge a strap that secured the insulation around the vehicle's liquid hydrogen tank.

When a portion of this was ripped away, the hydrogen was exposed to the heat of aerodynamic forces. The supercooled fuel then began to vaporize at a rate that led to the explosion, according to the General Dynamics hypothesis.

Airflow Prediction

To predict this airflow pattern in wind tunnel tests was next to impossible, Hansen told the subcommittee. However, should such a condition prove responsible for the May 8 explosion, a fix probably can be devised "in a couple of weeks," he said.

Under questioning, Hansen said that NASA's Marshall Space Flight Center pursued a "somewhat more conservative" design philosophy than did GD/A. Asked to cite an example, he said that GD/A's original design criteria for the Atlas booster called for a structural strength safety margin of 25%, but that MSFC demanded a margin of 35%.

Hansen said that GD/A was at times willing to take "a little more of a gamble to achieve a significant result." But in combination, GD/A's boldness and MSFC's caution in approaching technical problems complemented each other, according to Hansen. MSFC, he added, can always win any argument by directing the contractor what to do.

Inspection Techniques

Quality control standards used in the fabrication of Atlas intercontinental ballistic missiles and space boosters were applied to the fabrication of Centaur, Ehricke said.

Inspection techniques that could detect cracks larger than 0.0001 in. were used in examining the bulkhead between Centaur's "cold" hydrogen and "warm" oxygen tank for any imperfections.

Later, it was discovered that liquid hydrogen, but not liquid oxygen, could penetrate cracks as small as 0.0001 in. It thus could penetrate and destroy the cryogenic vacuum induced between the two layers of the bulkhead. The heat transfer that resulted could boil away significant quantities of any hydrogen that was not used promptly.

According to Ehricke, GD/A will now have to install a thicker intermediate bulkhead weighing about 35 to 60 lb. more than the one now in Centaur. It will also eliminate the second restart of the Centaur's two Pratt & Whitney RL10A-1 engines and substitute a third stage in order to accomplish its primary mission—the injection into orbit of the Advent military communications satellite.

Larger Tank Proposed

In addition, Ehricke disclosed that MSFC was considering a GD/A proposal to lengthen Centaur's liquid hydrogen tank, thus providing for extra payload. Although this will increase the weight of the stage, Centaur still can be boosted by Atlas and extra payload will more than compensate for the weight increase, he said.

Exploring the problems encountered in the lagging Centaur program, Hansen cited frequent delays between the time NASA ordered technical changes and the time it made contractual changes required by GD/A before the contractor could begin implementing the changes.

To illustrate, when the F-4 Centaur mission was revised, it took almost 16 weeks for NASA administrators to issue amended contracts reflecting the technical changes, he said.

"A considerable amount of unwarranted criticism" has been directed at the Centaur program, Hansen said. Some have done better, but others have done worse in terms of accomplishment versus dollars spent, he said. Centaur's accomplishments, as listed by Ehricke, include the following:

- **Techniques to measure** density of liquid hydrogen in large—as opposed to laboratory—quantities, and to observe its distribution under zero-g conditions.
- **Television system** capable of taking and transmitting pictures of liquid hydrogen as it reacts to zero-g conditions within its tank while in flight or on the ground.
- **Special valve** to vent a liquid hydrogen tank without losing any fuel and techniques to tank and de-tank the propellant in large quantities.

Cyrus Vance Named Secretary of Army

Washington—Cyrus R. Vance, Defense Department general counsel, was nominated last week to be Secretary of the Army by President John F. Kennedy. Vance would succeed Elvis J. Stahr, Jr., who has resigned effective July 1 to become president of Indiana University.

Vance, a Navy veteran of World War 2, will be replaced by John T. McNaughton, who has served as deputy assistant secretary of defense for arms control since last October. He is a former newspaper columnist and Harvard University professor.

Vance served as special counsel to the Senate Armed Services Preparedness Subcommittee, whose chairman was the then Sen. Lyndon B. Johnson. He also acted as consulting counsel of the Senate Special Committee on Space and Astronautics, in connection with drafting of the National Space Act and the hearings on that act. He became Defense general counsel in January, 1961.

It was the office of organizational and management planning under Vance, headed by Sol Horwitz, that was the moving force behind the radical reorganization of the Army which Stahr planned and initiated. Army technical services dating back to 1776 were either abolished or changed in character. Their research and development functions were centralized under one command, which also took over all logistics activities of the service. The Army is now implementing this reorganization (AW Apr. 16, p. 120).

Umbaugh Hearings Reveal U-18 Financing

By David A. Brown

Baltimore, Md.—First specific details of the amounts spent by Umbaugh Aircraft Corp. in development, certification and sales of the Umbaugh U-18 gyroplane and the amounts paid in by distributors, dealers and customers were revealed during court hearings here.

The latest balance sheet of Umbaugh, prepared as of Oct. 31, 1961, revealed that Umbaugh Aircraft and its dormant sister company, Umbaugh Manufacturing Corp., received approximately $2.5 million in deposits on U-18s and spent between $1.5 and $2 million on development and certification of the aircraft from Aug. 1, 1957, to the date of the statement.

These specific amounts were listed:

- **Cost of research,** development and certification was $1,593,179.05, listed as an asset.
- **Sales promotion costs** were $316,-804.50, listed as an asset.
- **"Appraisal increase,"** was listed as an asset of $406,820.95.
- **Deposits from dealers,** distributors and retail customers were $2,435,183.96, listed as a credit to income.

The appraisal increase item was inserted as an asset on the company's balance sheet on the basis of a preliminary appraisal of the value of the U-18 type certificate made by Justin Haynes, a Denver, Colo., appraiser. Subtraction of the development costs from the $2 million preliminary estimate by Haynes produced the appraisal increase total.

The figures, prepared by Wallace Dunn, Ocala, Fla., certified public accountant for the company, were introduced in evidence during hearings in a Baltimore court on charges by Raymond E. Umbaugh, Umbaugh Aircraft Corp. president, that certain dealers and distributors of his firm were interfering in its operation.

The dealers have alleged, in countercharges, that Umbaugh practiced fraud in inducing them to invest large sums of money into the project and assured them that money deposited on the U-18s would not be used to finance research and development of the aircraft.

They are asking the court to declare the company insolvent and appoint a receiver (AW Apr. 2, p. 18).

Also introduced at the hearings were balance sheets and income and expense statements for Umbaugh Aircraft Corp. and Umbaugh Manufacturing Corp. through May 31, 1961. These statements were prepared by C. Robert Belt, CPA of Coffeyville, Kan., directly from the books of the company and were not certified.

They show that during the period from June 1, 1957, to May 31, 1961, Umbaugh Aircraft Corp., the sales organization, received $19,509.50 in income, all from the sale of Benson Gyrocopter aircraft in 1957-58. Company listed sales and promotion expenses during four-year period as $512,-559.95, for a $493,050.45 deficit.

Umbaugh Manufacturing Corp., the research, development and manufacturing company, showed income during the four-year period of $1,439,990.74, all in fees from Umbaugh Aircraft.

Expenses of the manufacturing company also totaled $1,439,990.74. Largest items of expense listed included material and freight, $901,057.15; engineering salaries, $301,010.18, and engineering expense, $103,873.65.

The Oct. 31, 1961, balance sheet of Umbaugh Manufacturing Corp., which is no longer operative although still in existence, showed the firm had assets and liabilities of $134,620.17.

Umbaugh testified that the audit prepared by Belt was not correct and did not reflect accurately the financial status of the two companies. He said the figures on the statements prepared by Dunn were correct, but added that they might not give an accurate picture of the two corporations' financial standing due to their arrangement.

Earlier, Umbaugh testified that dealers and distributors of the U-18 were told when they signed their agreements with Umbaugh Aircraft Corp. that their deposits on aircraft would be used to finance U-18 research and development.

Umbaugh said cost studies indicated that he could produce and sell the U-18 for a retail list price of $10,000 and amortize research and development costs from the sales, provided he sold 10,000 aircraft per year.

In conformance with his sales plan, Umbaugh said he divided the United States into zones and allotted a percentage of the programed production run of 10,000 aircraft to each zone.

Distributors, when appointed, were required to forward to Umbaugh deposits of $1,000 each for the aircraft allotted their areas, whether they had actually sold the aircraft or not. Further, Umbaugh testified, deliveries of the aircraft were to be made only "on order," or when the balance of the $9,995 purchase price was received.

(Thus, a distributor whose territory had been allotted 100 of the 10,000 programed aircraft—1% of the total—was required to forward to Umbaugh $100,-000 as deposits on all 100 aircraft within a stipulated period of time.)

Umbaugh said he considered that if a distributor made a deposit on any number of aircraft, it was a deposit on all aircraft allotted to that distributor's territory. In this manner, he reported that he had received firm orders for large numbers of aircraft.

Umbaugh introduced into evidence an agreement between Umbaugh Aircraft Corp. and Distributors Council, Inc., (DCI) a group of dissatisfied distributors. The agreement, dated July 6, states that all parties understand that money forwarded to Umbaugh was to be used to promote and develop the U-18. Three of four respondents in the Maryland case were DCI members.

DCI succeeded in getting Umbaugh to appoint five of its members to the Umbaugh Aircraft Corp. board of directors in mid-1961. Umbaugh testified that several days before the first board of directors meeting which the DCI members were to attend, John T. Potter of Dinella, Fla., a distributor, purchased controlling interest of 52 shares of stock in the company for $520 from stock authorized but not previously issued.

The change of control of the firm was not announced at the directors meeting in Hagerstown, Md., July 29, 1961, and three days later, Umbaugh repurchased the stock from Potter for $520, returned it to the company and had the certificates canceled.

Umbaugh testified that he did not receive advance authorization from the board of directors to sell the new stock.

Total equity capital in Umbaugh Aircraft Corp. is $1,020, Umbaugh testified. Majority of stock, totaling 51 shares, is owned by Umbaugh and his wife.

Umbaugh testified that he and his wife have drawn an average of $29,000 per year total in salary from Umbaugh Aircraft Corp. during the past five years. He said that during 1957 they received only $5,000, but that during 1960 and 1961 they drew a total of $36,000 annually. In addition, he testified Umbaugh Aircraft Corp. paid for his home, which he valued at more than $90,000 and that he leased it from the corporation for a time for a sum he could not recall. Later, he said, he purchased the home and a five-acre tract valued at $25,000 on which it is located by giving the company a mortgage for $125,-000 to be paid over a 25-year period at 5% interest.

The company purchased a Cadillac automobile in 1960 in order for Umbaugh to accompany the prototype U-18 on demonstration tours and later traded the car in on a Lincoln Continental currently used by Umbaugh.

In initial cross examination, Umbaugh estimated his tangible net worth at the time he entered the U-18 project at $180,000.

MODEL of Beech's turboprop executive transport shows modifications to original design.

Beech Turboprop Transport First Flight Scheduled for Late 1963

First flight of Beech Aircraft Corp.'s new six-passenger turboprop-powered executive transport now is scheduled for late 1963 and deliveries of certificated production airplanes to customers the following year.

Full-scale mockup, completely furnished with interior and instrumentation, is being constructed and should be ready for inspection by prospective customers within 60-90 days at the company's Wichita, Kan., plant.

Preliminary design specifications (see box) just released by the company apparently are based on the use of 900-plus-shp. French-designed Turbomeca Bastan engines, which the company states are being "seriously considered" after evaluation of all possible engines available. This indicates management still retains flexibility in making the final choice. Sources close to the program have indicated that of the various engines suitable for the mission, the Bastan was considered a favorite largely on the basis of cost compared with competitive powerplants.

Beech Vice President Leddy Greever emphasized that the airplane is still in development and that performance and configuration may still vary some from the current specifications. Some variations already are evident since initial scanty details and wind tunnel model configuration were revealed last December. These include extension of the top portions of the engine nacelles to the wing trailing edges—they formerly terminated bluntly just aft of the wing mid-chord.

The balanced rudder evident on the earlier wind tunnel configuration has been replaced by a straight hinge line and the cockpit side windows apparently have been lengthened slightly providing improved rear vision. A second series of wind tunnel model tests at the University of Washington is said to have been successful in confirming the configuration.

Cabin pressurization system will be capable of providing a 5.5 psi. differential—giving the equivalent of 8,000-ft. altitude while the airplane is at 25,000 ft., or sea level pressure while flying at 12,500 ft.

Passenger cabin will be 11 ft. long, have an internal maximum width or more than 5.5 ft. and a height of better than 5 ft. inside the circular-cross section fuselage which will be 75-in. in diameter.

Although few engineering details are yet available, it is believed that consideration is being given to permitting steep-angle approaches and landing gear will be fitted with dual-wheels on main gears and designed for operation from sod fields, if necessary.

High-aspect ratio wing to provide moderate span loading with minimum wetted area will be featured—the wing having integral fuel tanks with sealant maintaining leak-free integrity for the airplane's life, Beech notes. To minimize drag, all external riveting will be flush and some bonded assemblies will be used to obviate riveting and to maintain smooth contours. Wing will utilize multi-spar construction with wing skins being principal load-carrying members. Multi-spar technique will also make possible maximum use of automatic riveting in assembly.

Beech Turboprop Transport

(Preliminary design data)

Span	54 ft.
Length	42 ft. 2 in.
Height	15 ft. 7 in.
Wing area	266 sq. ft.
Design takeoff weight	12,000 lb.
Design landing weight	11,400 lb.
Empty weight (equipped, but minus electronics)	7,360 lb.
Maximum cruise speed at 25,000 ft.	300 mph. plus
Maximum range, with allowances (460 gal.)	1,500 mi. plus
Maximum range, with auxiliary fuel	1,800 mi. plus
Range with 8 people and baggage at maximum cruise (including allowances and 45-min. reserve fuel)	1,000 mi.
Rate of climb (two engines, maximum weight)	1,900 fpm. plus
Rate of climb (one engine, hot day)	470 fpm. plus
Absolute ceiling (gross weight)	30,000 ft. plus
Takeoff distance over 35-ft. obstacle	under 2,700 ft.
Landing distance over 35-ft. obstacle	2,500 ft.

Soviet Speed Record For E-166 Approved

Federation Aeronautique Internationale has certified that a Russian E-166 jet fighter has set a new world speed record (AW Oct. 23, p. 30), surpassing the previous mark held by the McDonnell F4H-1 Phantom 2.

The FAI also certified several speed, altitude and altitude-with-payloads records the Russians had claimed for their Beriev M-10 jet seaplane.

The E-166 record was set last fall by A. Fedotov, who flew a 100-km. closed course at 1,491.9 mph. on Oct. 7. The F4H-1 flew the course at 1,390.24 mph. in Sept. 1960.

An altitude record for Class C-2, Group 1 seaplanes without payload was set in the M-10 by Gueorgui Bourianov Sept. 9 when he reached 49,087.83 ft. A straightaway speed record of 566.68 mph. in same type aircraft without payload was set by Nicolai Andrievsky Aug. 2. Bourianov set a 1,000-km. closed-course record of 543.23 mph. Sept. 3.

Bourianov also set the following altitude records with payloads on Sept. 8: 1,000 kg., 46,134.08 ft.; 2,000 kg., 46,134.08 ft.; 5,000 kg., 46,134.08 ft. On Sept. 11, with 10,000 kg., he reached 41,774.85 ft. and on Sept. 12, with 15,000 kg., he reached 39,360.16 ft. For a speed record over a 1,000 km. closed course with 1,000 kg. and 2,000 kg. payload Bourianov flew at 543.23 mph. Sept. 3. For the greatest weight lifted record, he carried 33,524.2 lb. to an altitude of 2,000 meters Sept. 12.

McClellan Airs Incentive Contract Issue

By Katherine Johnsen

Washington — Strong congressional movement to discourage incentive-type contracting for new weapons systems, in cases where neither design specifications nor costs are known with accuracy, was launched last week at hearings of the Senate Permanent Investigating Subcommittee, headed by Sen. John McClellan (D.-Ark.).

McClellan and subcommittee counsel Jerome Adlerman made their opposition clear. They were supported by testimony from representatives of the General Accounting Office.

Where there is a backlog of production experience, McClellan and Adlerman maintained, incentive type contracts may achieve their objective of giving the contractor a stimulus to reduce costs by sharing savings.

Where these factors are not known, McClellan said, "the incentive contract really offers two incentives to the contractor. The first is to set the target price as high as possible, and the second is to earn a high profit by reducing this unrealistic target price in performance."

GAO View

General Accounting Office witnesses called for a requirement that incentive-type contractors be required to show concretely that cost reductions are due to their effort or efficiency before they are given "bonus" type profits.

After noting that Defense Department now requires contractors to certify the accuracy of cost data on incentive contracts, Charles M. Bailey, deputy director of GAO's defense accounting and auditing division, told the subcommittee:

"We believe that incentive-type contracts should further provide that any additional fees or profits for reductions of costs below negotiated targets be limited to those reductions which are attributable to some effort on the part of the contractor. . . . Under present contract provisions a contractor is in a position to share in all reductions, regardless of how generated, except those which are a result of initial targets having been based on inaccurate, incomplete or noncurrent cost data, and such facts are subsequently discovered by the contracting officer. In other words, the contractor shares in all cost reductions whether or not attributable to his effort or efficiency, unless the government demonstrates that he is not entitled to share in such cost reductions. . . . It should be incumbent upon the contractor to demonstrate his entitlement to additional incentive fees or profits."

GAO witnesses testified that incentive-type contractors have been guilty of both knowingly presenting inaccurate cost information and of including excessive amounts to their estimates for contingencies.

Excess Profits Recovered

Seventeen cases investigated by GAO, Bailey said, showed that excessive estimates by contractors—compared with cost information available at the time of negotiations—totaled over $38 million. He reported that all but $1 million of the excessive profits of $11.8 million paid to contractors as a result of these over-estimates has been recovered by Defense Department.

In cases where costs are uncertain and there is the probability of change orders, Bailey reported, GAO would favor the use of the cost-plus-fixed-fee contract rather than the incentive-type contract. He added that, when costs are ascertainable with accuracy, "incentive contracts can be of real benefit both to the government and to the contractor. . . ."

Adlerman claimed that cost underruns, largely due to padding for contingencies, were the general rule on incentive-type contracts and that the cost under-run is "a rare bird."

GAO noted an Air Force report showing that on 171 incentive-type contracts totalling $6.3 billion, there was only one instance where the target price was exceeded, and then only by $87,000.

"In the Navy, of 47 contracts for $2.5 billion only one contractor exceeded the ceiling price and that was by the amount of $54,000 on a $4 million contract," Bailey added.

Bomarc Program Cited

Subcommittee calculations showed that on three incentive-type contracts with the Boeing Co. under the Bomarc air defense missile program the Air Force would have saved approximately $14 million in profits had the contracts been cost-plus-fixed-fee. There was no production experience on which to base costs on these contracts, it was developed.

On at least two of the three contracts, Air Force entered into the incentive-type arrangement against the judgment of Boeing, according to subcommittee staff testimony.

The contracts analyzed were:

- **Production of 78 Bomarc A** missiles on which there was a profit of $12 million, or 14.5% on a total cost of $82.7 million. The basic profit was $9.5 million and the incentive profit $2.5 million. Boeing had proposed a cost plus 6% fixed fee contract. Taking the highest cost estimate at the time of the initiation of negotiations—$114 million—the subcommittee staff estimated that at 6%, Boeing's profit would have been only $6.8 million. This would have been $5.2 million less than the $12 million the company received under the incentive contract.
- **Production of 168 Bomarc As** on which there was a profit of $14.9 million—$11.9 million basic profit and $3 million incentive profit—on total costs of $112 million. Boeing originally asked for a letter contract with postponement of negotiations until cost data was developed. The subcommittee staff estimated a maximum profit, under a cost-plus 8% fixed fee type contract of $11.9 million, or $3 million less than the amount received by Boeing under the incentive contract.
- **Production of 116 Bomarc B** missiles on which there was a $20.9 million, or 11% profit. Boeing had wanted a cost-plus-fixed-fee of 6.7%. At this fee, the subcommittee estimated, the profit paid by the Air Force would have been $5.9 million less than the $20.9 million actually paid under the incentive contract.

Other points highlighted at subcommittee sessions last week on Boeing were:

- **On Bomarc subcontracts,** totalling $524 million invoiced to Boeing, Boeing made mark-ups totalling $41.6 million in billing the Air Force. McClellan contends that these increases were arbitrarily made, reflected no effort on Boeing's part, and, in effect, were "hidden" profits. The subcommittee has similarly analyzed subcontract mark-ups on the Nike and Atlas programs (AW Apr. 23, p. 24).

After the subcommittee session, R. W. Tharrington, assistant general manager of Boeing's aerospace division, commented that "there is no meaningful basis for attributing portions of Boeing's total profit on the Bomarc program to any specific subcontractor." He emphasized that Boeing's total profit on the program amounted to 3.6% of the sales price, compared with an over-all industry average profit of 7.8% of sales.

- **Boeing's profit** on government business averaged 35.7% of stockholders' equity, after taxes, over the past ten years, compared with an average of 10.7% for all manufacturing industries, according to a subcommittee staff presentation. This also showed that on total business Boeing averaged 19%, after taxes, of stockholders' equity, or almost double the 10% averaged by Douglas Aircraft Co. over the past decade.
- **Although Boeing's sales** to the government mounted from $334 million in 1951 to $1.4 billion in 1961, the percentage of the company's government business declined from 99.2% of total business to 77.6%.
- **Boeing's profit,** before taxes, on government business has ranged between 36% of net investment to 109% of net investment over the past decade.
- **The company grew** from capital stock and retained earnings of $53.9 million in January, 1951, to $259 million in December, 1961.

Microcircuits for Space

Washington—Department of Defense may soon launch a program to accelerate the development and application of thin-film and semiconductor types of integrated microcircuits and to evaluate their reliability for space vehicle use.

Plans for the program, now in the formative stage, were revealed here at the National Telemetering Conference by James M. Bridges of the Office of the Director of Defense Research and Engineering. Bridges said that he hopes the National Aeronautics and Space Administration will join the Defense Department in the new program.

Titan Explosion

Titan I missile exploded underground in one of the launchers at Beale AFB near Chico, Calif., May 24, during a propellant unloading exercise. Twenty-four minor casualties were reported, mostly from smoke inhalation. Silo doors were closed at time of blast, which followed a demonstration countdown as the missile was at the bottom of its silo. The other two launchers and control center were not damaged. Blast is believed to have been caused by an explosion of liquid oxygen.

The Titan 1 squadron at Beale AFB is one of four remaining to be turned over to the Strategic Air Command before the end of the year. Two Titan 1 squadrons recently were turned over to SAC at Lowry AFB, Denver, Colo.

Stack Leaves NASA For Post at Republic

Washington—John Stack, director of aeronautical research for the National Aeronautics and Space Administration, resigned last week to become vice president and director of engineering for Republic Aviation Corp.

Stack has served 33 years with NASA and its predecessor, the National Advisory Committee for Aeronautics. He was noted principally for spearheading advances in high speed aerodynamics.

Informed sources indicated that his departure, effective June 1, was due to disagreements over NASA policies regarding research for supersonic and hypersonic aircraft and funding for aeronautical research. Stack is known to be an enthusiastic supporter of the supersonic transport and the Aerospace Plane hypersonic orbital vehicle.

No successor has yet been named to his post, which is under NASA's Office of Advanced Research and Technology.

News Digest

Visual Instrumentation Subsystem (VISS) hardware development industry proposals for the Surveyor lunar orbiter will be requested by Jet Propulsion Laboratory this week.

Continental Air Lines Boeing 707 jet transport crashed May 22 near Centerville, Iowa, while flying through an area of extreme air turbulence. All 45 persons aboard were killed—the first fatalities in Continental's 28-year history. The transport, bound for Los Angeles from Chicago via Kansas City, was in an area of winds up to 75 mph. and possible tornadoes, CAB said.

Federal Aviation Agency is proposing a rule under which high performance aircraft in the 6,000 to 12,500 lb. gross weight class would be required to meet the standards of airworthiness laid down for larger transports. Drafted to cope with twin-jet executive aircraft now being built, FAA's proposal would apply only to those seeking type certification in the future. Such aircraft, if they could exceed 25,000 ft. altitude or Mach 0.65, would have to satisfy criteria in Part 4B of the Civil Air Regulations.

Rolls-Royce is being sued for $150 million by Societe Rateau, Paris, for alleged patent infringements involving Spey and Conway bypass engines. Rolls is preparing defense and counter-claim for hearing in High Court at London.

British Air Registration Board has ordered operators of British-registered Douglas DC-6 and DC-7C aircraft to inspect elevator trim tabs for side play that could allow jamming. Order followed investigation of Caledonian Airways DC-7C which crashed recently on takeoff at Douala and killed 111 persons. Investigators said the aircraft's elevator spring tab may have jammed.

Maj. Robert A. Rushworth achieved a speed of Mach 5.1 in a May 22 X-15 flight to study local air flow effects. Programed airspeed was 3,500 mph.; aircraft clocked 3,477 mph., according to preliminary data. Burning time on the Thiokol XLR-99 engine was 79 sec.

Lockheed 60 production may cease in both Mexico and Argentina, with concentration of production of the light utility airplane at Milan, Italy. Sales of the joint Lockheed-Azcarate-manufactured airplane in Mexico have been disappointing and parts production already has stopped.

Thiokol Chemical Corp.'s Reaction Motors Division, Denville, N. J., was directed by the New Jersey State Supreme Court last week to pay $25,000 in actual damages to residents of 15 homes near the division's rocket engine test station for structural damages caused by static testing of the X-15 rocket engine in 1960 (AW Nov. 28, 1960, p. 30). No further appeal is planned by Thiokol.

Vickers VC.10 aft fuselage was slightly damaged last week when oleo on tail jack collapsed, shifting center of gravity and bending a fuselage frame. Frame can be straightened and first flight is still scheduled for early in June.

Martin-Marietta Corp. has received a $225,000 USAF contract to study electronic command and control systems for use in directing limited war forces.

British Royal Navy has ordered 14 Hiller 12E helicopters and associated equipment for use in training fleet helicopter pilots at Culdrose Naval Air Station in Cornwall, England. Dollar value was slightly over $1.1 million. The new VTOLs will replace the Royal Navy's Hiller HTE-2s, in use since 1952.

Space Technology Laboratories is conducting an accelerated study of the relative advantages of direct ascent as opposed to orbital rendezvous for the Apollo program under NASA contract. Study will be completed by mid-June.

New MATS Rate Plan

Washington—New standard mileage rule for setting Military Air Transport Service rates in transpacific charter operations has been adopted by Civil Aeronautics Board to become effective July 1.

The new rule, designed to eliminate inequities between mileage now used for rate making and mileage actually flown, has dual standard mileages for rate making purposes. Carriers will bid on MATS transpacific charters via either a basic north-Pacific or a mid-Pacific route.

CAB has prescribed 15 standard routings via mid- or north-Pacific points between the U. S. and six far Eastern and four intermediate destinations. The new standard routings should allow carriers to operate more profitably over long Pacific mileages by allowing operators of shorter range aircraft to charge for a more realistic routing reflecting mileages flown.

CAB Staff May Urge Transatlantic Shuttle

Proposal expected during hearings on structure of routes to Europe; monopoly plan stirs controversy.

By L. L. Doty

Washington—High-density airline shuttle service between New York and London, Frankfurt, Paris and Rome appears to be one of the chief aims of the Civil Aeronautics Board staff in its recommendations for a revised transatlantic route structure (AW May 14, p. 38).

Although the staff study does not mention the shuttle service, it now appears certain that such a plan will be proposed by Bureau Counsel during the forthcoming hearings in the Transatlantic Route Renewal Case. The study, which has already become one of the most controversial documents issued by the CAB, is the basis of a Board order instituting an investigation of transatlantic routes.

One of the chief criticisms of the study is the recommendation that the continuing loss of U. S. carriers' share of North Atlantic traffic can be halted by awarding Trans World Airlines monopoly routes to Paris and Rome and giving Pan American a monopoly on routes to London and Frankfurt. Critics charge that this arrangement will serve only to weaken the two carriers competitively by dividing the European market they now hold and, thus, cause further cuts into gross revenues.

The fact that several foreign flag carriers have reacted to the study with near elation indicates there is some agreement with one airline official who commented that the proposal "splits our side within the enemy's camp." In addition, it is estimated that Pan American alone would lose about $45 million annually if it ceased its Paris operation.

An analysis of the study reveals a number of weaknesses in the staff proposals and several instances where major issues are touched upon only lightly. However, these lapses suggest that the text may not reflect the complete recommendations of the staff and leaves these clues as to which direction the staff may move during the hearings:

• **Shuttle operation.** With foreign flag carriers offering equipment and services similar to those of U. S. carriers, Pan Am and TWA no longer hold the competitive advantage over airlines of other nations they once enjoyed. In fact, there are some who feel that U. S. airlines are easily outmatched in service standards by Europeans. Thus, U. S. carriers should compete in the field in which they excel: mass production of air transportation.

• **Emphasis on Third and Fourth** freedom traffic. This move would ease the Fifth Freedom problem—long a major issue in dealings with foreign flag carriers. Third and Fourth Freedom traffic is that moving from one country to a second country. Fifth Freedom traffic is that moving from one country to a second and then beyond to a third.

The study stresses that certification of separate routes for Pan American and TWA would ". . . encourage U. S. carriers to exploit their authority to the fullest and thereby recapture as large a portion of the market as possible." It fails to explain how this is to be achieved but the inference is that, if the two carriers are relieved of the burden of competing with one another, they will compete more effectively with foreign flag carriers. It also implies that, since the U. S. has been unable to reduce the volume of foreign competition, it must reduce the competition between its own carriers.

Opposition Certain

It is doubtful whether the staff position could withstand strong argument in hearings and it certainly will be attacked, particularly by Pan American—one of the most violent opponents of the study. However, the staff would substantially strengthen its position if it introduced the shuttle recommendation.

An air-shuttle is most successful on monopoly routes or on routes where a competitive type of service is not anticipated. It is doubtful that Eastern would have introduced its Air-Shuttle service on the New York-Washington-Boston route had it expected the service would be matched by another large carrier.

Main drawback to the shuttle would be in the renegotiation of bilateral agreements, but since most traffic handled in this service will be Third and Fourth Freedom traffic, the Bermuda principles, in their broadest interpretation, would not be violated. The staff anticipated a problem in the handling of bilateral agreements in their proposal for monopoly routes.

They state that the adoption of the proposal would have "a far reaching effect upon our bilateral agreements with foreign governments." But the sole example given of the "far reaching effect" is this: "It would, for example, constitute a modification of multiple designation by the United States in the Atlantic."

Multiple designation is the least of the problems the U. S. will face in the renegotiation of any bilaterals. No European nation operates more than one flag carrier to the New York gateway, so chances are strong that there will be no objections to the U. S. doing the same. In addition, the creation of monopoly routes reduces the number of U. S. carriers serving major European gateways, which is not likely to cause much discord abroad.

The staff recognizes its proposal would prevent Fifth Freedom operations from London and Frankfurt to Paris and Rome. It justifies its position in this manner:

"However, we have never obtained the necessary rights to serve London-Paris, London-Rome or Paris-Frankfurt through negotiations with foreign governments involved; consequently, the step might well be termed realistic rather than regressive."

To surrender so easily to issues that have been the source of contention and negotiation for so many years suggests that these routes are unessential to the staff's over-all plan. Again, the staff takes a similar attitude with respect to Pan American's certificate between San Juan and Madrid by concluding simply that "we doubt that entry of PAA into Madrid could be obtained without some compensatory action."

Because the U. S. has been unable to obtain rights for Pan American in Madrid from the Spanish government, the staff proposes to withdraw the route leaving the middle Atlantic without any U. S. carrier participation. The issue is finally dismissed on grounds that the route may not be economically profitable in "the near future." Only high density traffic routes are suitable to the shuttle principle.

It is not generally known that Iberia Airlines of Spain has proposed a joint working agreement with Pan American which could include an equipment exchange and possibly give Pan Am entry into Madrid. Pan American would willingly accept the agreement but can do nothing without the approval of the U. S. government.

Conclusions reached in the agreement are premised almost entirely on these two factors: U. S. carriers' share of North Atlantic traffic has dwindled steadily during the past two years, and the rate of return on investment of both TWA and Pan Am has fallen to a dangerously low level.

With respect to the first point, the staff study may be undermined by another study now being prepared for the White House which is due to be sent to President Kennedy in mid-August. One firm conclusion reached by the White House study group is that percentage of participation should no longer be considered a factor in the establishment of a U. S. international civil aviation policy. The study will recommend that profitability—not share of traffic—should determine the relative strength of U. S. carriers in international markets.

U. S. participation in air passenger traffic on international routes has been consistently used as a device by both the industry and the Civil Aeronautics Board to support some form of control over capacity offered by foreign flag carriers serving the U. S.

The U. S. Chamber of Commerce last week lent its support to this cause with a wide distribution of a pamphlet stressing that the share of traffic carried by U. S. airlines in world markets had decreased from 75% in 1950 to 55% in 1960.

In response to the pamphlet, Alitalia pointed out that these same figures show that, during the 10-year period, the number of passengers carried by U. S. international airlines rose from 818,000 to 2.5 million—an increase of 300%.

TWA, Pan Am Plan Merger Strategy

Management of Trans World Airlines and Pan American World Airways have agreed upon a stock exchange plan which they feel will overcome the biggest obstacle to the proposed merger of the two companies—the controlling 78.2% interest of Hughes Tool Co. in TWA (AW May 7, p. 47). The plan is designed to lower the percentage of the Hughes' holdings in the merged company.

The basic plan is to have TWA acquire Pan American. TWA, as the surviving company, will then issue a large block of common stock in the name of the merged company. This stock will be offered to Pan American interests and stockholders which, coupled with Pan American stock already outstanding, would reduce the ratio of the Hughes holdings to a minority status.

TWA legal authorities and lending institutions claim that the terms of the voting trust, under which Hughes' stock is being held, are absolute and that the trust holds complete authority, including the right to approve the merger. Hughes attorneys disagree with this view. One possible result might be a Hughes suit against the trustees charging violation of their fiduciary obligations in failing to protect Hughes' interests.

Meanwhile, Juan Trippe, Pan American president, disclosed at the firm's annual stockholders meeting last week that staff studies of the merger are being made and committees have been appointed to work out the merger plan. TWA has also undertaken committee work on the merger.

The proposed merger is now considered to have been a factor in the resignation of A. V. Leslie, former TWA senior vice president-finance and treasurer. Hughes Tool Co. sent a telegram to Ernest Breech, TWA board chairman, protesting the resignation and raising a number of specific questions as to why the action was permitted.

Mexican Carrier Consortium Plan Is Key to CMA Financial Dilemma

CMA Mexican Airlines is pinning its hopes for solution of financial problems, aggravated by a recently concluded 47-day strike, on early agreement by the government and the country's three major airlines to form a consortium.

Resumption of talks between the parties involved and government officials will start June 1. Details of the agreed-upon decision will be submitted to the Mexican treasury department and then go to President Mateos for approval. CMA officials appear confident that the consortium will be approved well before the end of the year.

A feature of the arrangement will be that it will be retroactive to Jan. 1, 1962, which will take into account a settlement of debt problems.

The consortium, which will be called Aero Mexico, S. A., actually will be a holding company which will take over and rent the members' equipment to the three participating Mexican carriers—Aeronaves de Mexico, Guest Aerovias Mexico and CIA Mexicana de Aviacion (Mexican Airlines). Initially at least, administration, operation and promotion activities will be handled by the three carriers' current management.

CMA's financial problems resulted in the carrier defaulting to de Havilland on quarterly payments on its three Comet 4Cs on Jan. 1 and Apr. 1, following a default Oct. 1, 1961. The October default was made up Nov. 18, on Mexican government's guarantee.

On Apr. 1, CMA's pilots went out on strike in protest against the airline's layoff of 52 pilots it claimed were excess to its needs. The carrier resumed operation after settlement of the dispute May 17, by starting domestic service the following day and was in full operation in Mexico and U. S., May 21.

Personnel in its U. S. offices were furloughed during the strike, but under Mexican law, the carrier was required to carry its domestic staff on the payrolls. Cost of the strike is estimated by CMA as approximately $2 million.

Settlement was made by CMA backing down from its original layoff plan and reducing the number of pilots separated to 32. The carrier had 203 pilots, representing approximately 25% of the carrier's payroll.

Agreement included the equivalent of a 9% increase in salary and fringe benefits for pilots, according to CMA. Separated crew members will receive the equivalent of seven months' salary as severance pay. They also are being offered up to three Douglas DC-3s at what is termed a "favorable price" and finance terms to engage in a route segment operation in the Guadalajara area which CMA would like to discontinue.

They also will have a priority on being re-hired by the airline if it should increase its pilot roster in the future.

According to CMA, the de Havilland action to embargo the airline's assets was a precautionary measure to prevent the carrier from diverting assets through sale of equipment or other disposal and using this money for purposes other than payment to de Havilland.

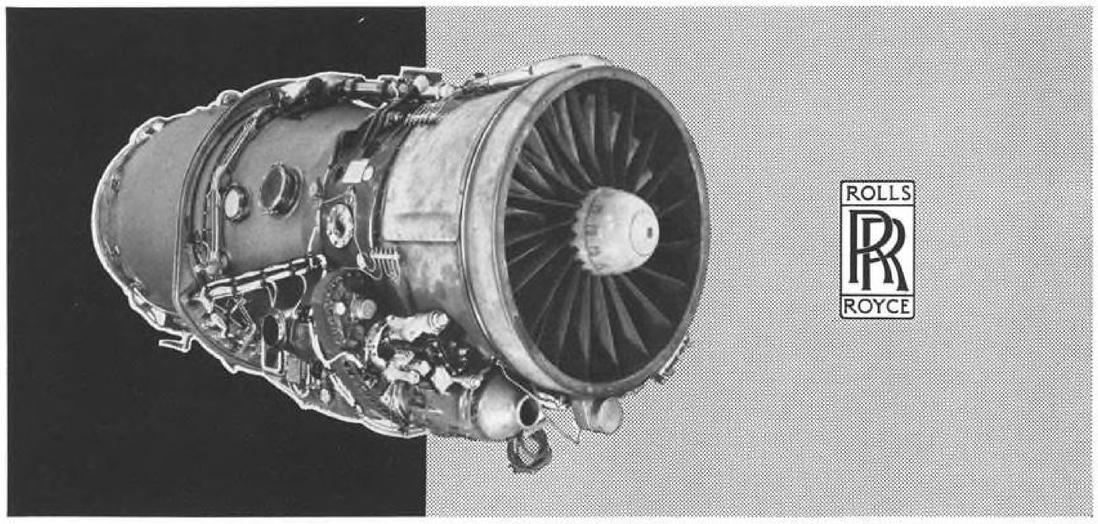
Alfredo Sesma, a certified public accountant for the Bank of the City of Mexico, has been named as "intervenor," or referee, to hold the company's assets and assure that all of its ordinary and necessary expenses are met, with surpluses to be used for payment of the debt to de Havilland.

Indications are that with the losses the airline has been accumulating, there will be little or no surpluses for use in making payments on the airplanes and that de Havilland is awaiting developments on the consortium talks.

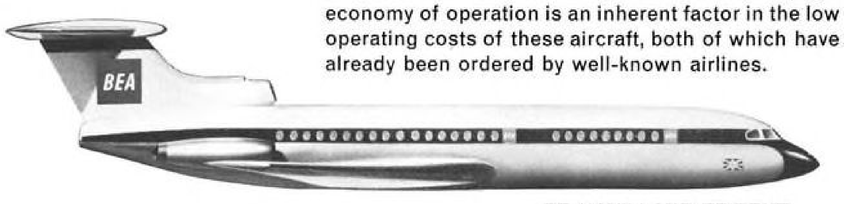
CMA has no plans at the moment for refinancing to handle its debt situation.

ROLLS-ROYCE
SPEY
BY-PASS JETS

powering short and medium haul airliners



The Spey, based on twelve years of Rolls-Royce experience with by-pass (turbofan) jets, is now flying in the de Havilland Trident and has also been selected to power the new BAC One-Eleven. The Spey's economy of operation is an inherent factor in the low operating costs of these aircraft, both of which have already been ordered by well-known airlines.



DE HAVILLAND TRIDENT

BAC ONE-ELEVEN

ROLLS-ROYCE OF CANADA LIMITED, BOX 1400, ST. LAURENT, MONTREAL 9, P. Q.

ROLLS-ROYCE LIMITED, DERBY, ENGLAND

AERO ENGINES • MOTOR CARS • DIESEL AND GASOLINE ENGINES • ROCKET MOTORS • NUCLEAR PROPULSION

FAA to Define Safety Standards For Self-Evaluation by Airports

Washington—Federal Aviation Agency has decided against any rule that would force airport operators to abide by a set of safety standards and have their performance graded by the agency. But FAA will publish a National Airport Evaluation System, enabling such operators to rate themselves voluntarily.

Many airports have self-imposed standards that are higher than those proposed in the evaluation system, but others are deficient, FAA Administrator N. E. Halaby said last week. Unless the delinquents take corrective action, the agency must do so, he said.

Applying only to airport facilities that could compromise safety, the guide divides these into eight categories—runways, taxiways, aprons, obstructions, lighting and marking, ground safety, aircraft fire protection and medical. Almost all the newly published standards, except those dealing with medicine and fire, may be found in the current Airport Design Manual.

Rating Formula

However, the section covering fire protection defines a numerical point rating system based on the number of passengers, aircraft and tanked fuel moving through a given airport. How much fire fighting and rescue equipment each airport needs would be based on its point total.

The top three airport classifications under this system would require at least two fire suppression vehicles, one or two rescue vehicles, and one or two supporting water tankers. The higher the airport classification—FAA lists six in all—the greater should be the capacity and performance of these vehicles.

The anti-fire section of the system also offers guidelines on the development of accident emergency plans, the training of fire-fighting personnel and recommended drill procedures.

Under the new medical provisions, facilities for administering first aid are defined in terms of the passenger capacity of aircraft types that normally use the particular airport. Medical facilities that can continue treatment begun by the first aid technician should be within 15 min. driving time from the airport and be capable of handling all passengers who may be on board the largest transport serving that terminal.

Each airport should appoint a safety officer, the medical section states. He would draft, test and revise a "medical annex" to the airport's emergency plans and assume responsibility for the airport's first aid program.

The Project Horizon task force, whose report defined national aviation goals during the next decade, said FAA should give consideration to a system of airport classification under which it would "establish and promulgate standards and rate airports according to how well or how badly these standards are met."

The reason FAA did not elect to "promulgate" such standards as a formal rule is that many airports have stepped up the pace of their crash and fire protection programs, according to Halaby. Last year, he said, more fire-fighting equipment was sold to airports than ever before and there was an estimated 100% increase in the sale of fire and rescue trucks.

BUA Acquisition

London—British United Airways, largest independent airline in the United Kingdom, last week acquired Jersey Airlines and its fleet of Handley Page Heralds, Douglas DC-3s and de Havilland Herons.

Deal followed shortly after BEA divested itself of a holding in Jersey Airlines, on the grounds that ownership in an independent would lead to a conflict of interest in route allocations.

Jersey operates out of the Channel Islands into London-Gatwick, Bournemouth, Exeter, Coventry, Manchester, Glasgow, Paris, Nice and Amsterdam.

Argosy Sale Hinges On Logair Contract

Washington—Final contract between Capitol Airways and Whitworth-Gloster for the purchase of Riddle Airlines' seven Argosy 650 turboprop freighters (AW May 21, p. 25) appeared by late last week to hinge on Capitol's getting a Fiscal 1963 Logair contract for oversized cargo.

Capitol's president, Jesse Stallings, told AVIATION WEEK that his airline had signed a contract to purchase the seven Argosys from Whitworth-Gloster, the financial agent for the manufacturer. A Whitworth-Gloster spokesman said that "completed negotiations" was a better description of the status of the transaction.

Meanwhile, Whitworth-Gloster has sent an eight-man ground school team to Capitol's base in Wilmington, Del. to train Capitol personnel for the Argosy. Capitol also has three maintenance foremen currently undergoing training at the Rolls-Royce engine school in Montreal in anticipation of the purchase.

Stallings said that while Capitol had a firm contract for the purchase of the seven Argosys, if it did not get the Logair oversized cargo contract for Fiscal 1963, it might not need all the aircraft. The Argosy configuration enables it to transport items too bulky for conventional freighters.

House Unit Approves Air Travel Tax Cut

Washington—House Ways and Means Committee last week approved a bill to cut the airline transportation tax to 5%, but declined to act on the Kennedy Administration's proposals for a system of user taxes for the airline industry (AW Apr. 16, p. 41).

The measure would drop the tax from the present 10% to 5% on Jan. 1, 1963 and eliminate the tax entirely the following July 1.

Ways and Means Committee members expressed doubts that Congress will act this year on the President's recommendations that part of the cost of operating the federal airways system be met by levying taxes on turbojet fuel, along with a 5% tax on airline tickets and airfreight waybills.

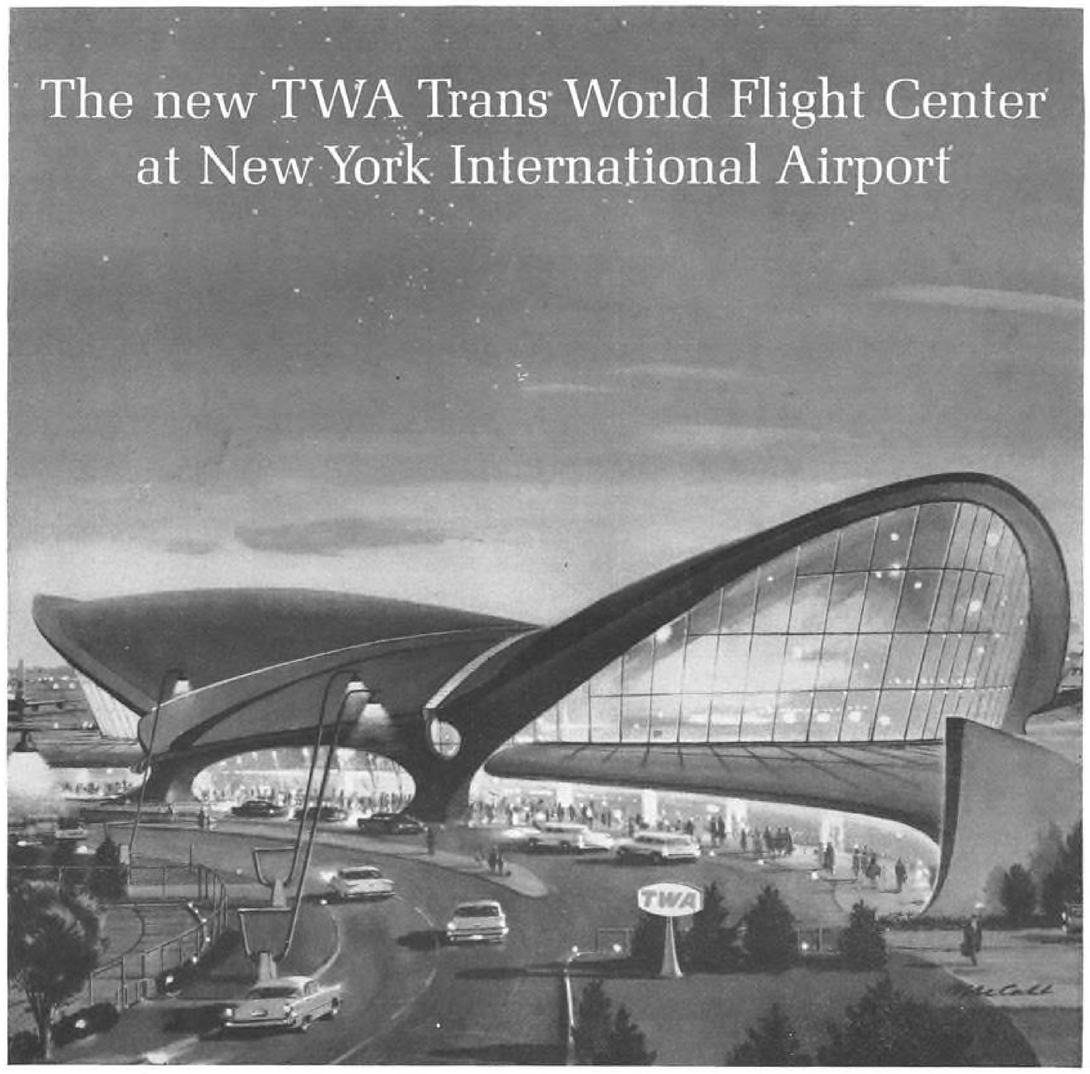
Merger Saving Cited By American, Eastern

Washington—Civil Aeronautics Board hearings in the American-Eastern Merger Case continued last week with witnesses for the two carriers emphasizing the cost savings that will be made possible through the merger. Hearings are expected to continue for another three weeks.

Robert L. Turner, Eastern executive vice president, testified that if the merger had been in effect since the beginning of 1962, a total of $10,750,000 would have been saved by year's end through combining service facilities at common station points. He said that on a short-term basis, employment might be reduced, but on a long-range basis, employment opportunities will increase.

Marion Sadler, American vice president and general manager, told CAB Examiner Ralph Wiser that Eastern and American have firm contracts for a total of 65 Boeing 727 transports and that the merged carrier would either sell six of them or request the manufacturer to cut the order by that amount.

Cross-examination of American and Eastern witnesses continued to be almost monopolized by counsel for Delta Air Lines (AW May 21, p. 41).



"TO EXPRESS THE EXCITEMENT OF TRAVEL"

...EERO SAARINEN

This is the new Trans World Flight Center in New York. Architect Saarinen designed it to express the special excitement of jet travel. Its soaring roof and sweep of glass enclose a hundred new ideas to speed your departure and arrival—like TWA's fast new jet check-in and boarding, and automatic baggage delivery. International shops are here. Comfortable lounges. Glamorous restaurants. One other fact makes the Trans World Flight Center entirely unique: it's the only airline terminal where routes from 70 cities in the U.S. are linked to routes in Europe, Africa, and Asia. One world under one roof.

Nationwide Worldwide depend on TWA

Early Action Unlikely on Jet Crew Ruling

By Robert H. Cook

Washington—Implementing terms of an arbitration agreement on the jet crew complement issue, signed last week by Pan American World Airways and the Air Line Pilots Assn., may prove so difficult and costly that major trunk carriers may retain four-man jet crews for the immediate future.

Although the agreement is binding on both parties, it provides no deadline for implementing its terms, which call for a three-man jet crew and extensive pilot training for the flight engineers. The agreement generally follows the lines of the Feinsinger Commission recommendations (AW Oct. 23, p. 35), but calls for more extensive engineer pilot training.

The high cost of this training, plus strong opposition from the Flight Engineers International Assn. which could lead to strike, may induce Pan American to postpone indefinitely a switch to three-man crews. Other carriers would most likely follow Pan American's lead.

Crux of the problem is elimination of the third pilot position. ALPA favors a three-man crew, providing the flight engineer is pilot-qualified. Airlines involved also favor a three-man crew, but are concerned over the transition costs. FEIA objects to any change in qualifications for its members and contends that a crew reduction should be accomplished by the abandonment of the present third pilot position.

FEIA's objection to a National Mediation Board ruling, in which ALPA was given the right to represent both pilots and engineers at United Air Lines, led to a strike against six major carriers in early 1961. The union agreed to return to work pending a report by the presidentially-appointed Feinsinger Commission.

Failure of ALPA and Pan American to agree on the method of crew reduction, as suggested by the Feinsinger Commission, resulted in the arbitration proceeding, which began in mid-April. The Arbitration Board was composed of George W. Taylor of the University of Pennsylvania, chairman, AFL-CIO President George Meany and Edgar F. Kaiser, president of Kaiser Industries.

FEIA officials generally agree that the arbitration terms penalize the engineers to a greater extent than would the Feinsinger recommendations. They feel that pilot training for engineers would result in absorption of FEIA by ALPA.

Noting that the union did not participate in the arbitration and is not bound to honor its provisions, an FEIA spokesman emphasized that the union will be legally free to strike Pan American by the end of this week.

Meanwhile, all other labor negotiations between ALPA and FEIA and the airlines have been at a standstill, pending the final settlement of the crew complement issue at Pan American. Most observers agree that a settlement of this question at Pan American will set the pattern for similar settlements on other airlines.

Pan American withheld comment on the arbitration agreement until a detailed analysis can be made.

However, there are strong doubts within the industry that the agreement will settle the controversial crew complement issue in the near future. Many observers note that the high initial costs of transitioning to a three-man turbojet operation, as suggested by the Feinsinger Report, would be even higher under the arbitration terms. Most observers also point out that while the agreement provides a detailed blueprint of exactly how the National Mediation Board feels the transition should be accomplished, there is no demand, stipulation or suggestion of a deadline to begin such a program.

This decision was left to the airlines, with the major proviso that Pan American must first recall 150 of 224 pilots currently on furlough, and may not furlough any more pilots unless it can be proven that the additional layoffs are not connected with the transition to a three-man crew.

Once these requirements have been met, the agreement states, transition can be accomplished either through normal attrition or by reassignment of pilots to piston aircraft on non-flying jobs, with a proviso that those reassigned will be protected by a no-furlough rule and will not suffer any loss of earnings.

In tracing the background of the crew complement issue, the Arbitration Board emphasized that while Pan American argued that flight engineers meet all requirements of the Civil Air Regulations and should not be required to take pilot training in order to occupy the third seat on turbojets, such regulations specify only the minimum qualifications from the standpoint of safety. The board added that pilots are "clearly entitled" to negotiate for working conditions that exceed the minimum safety standard.

Basic terms of the arbitration agreement include the pilot qualification recommendations made by Feinsinger for occupancy of the third seat by a flight engineer, plus two hours of flight training in any four-engine aircraft and one hour of flight training in a turbojet aircraft. These provisions would apply only to incumbent flight engineers.

Thereafter, the Board said, third seat positions will be filled from the ranks of present third pilots employed by the airline. Each flight engineer currently employed will be offered a choice of one of these options:

- **No qualifications** other than a flight engineer certificate. Assignment to a three-man turbojet crew would not be authorized under this choice.
- **Basic pilot training** provisions called for by the Feinsinger Report, plus the additional flight training called for in the arbitration agreement. This would qualify engineers for a three-man crew, but would not permit advancement to a pilot assignment. Those selecting this choice must so indicate within 60 days of the signing of the agreement.
- **Third pilot training** as specified in the present contract between Pan American and ALPA. This more extensive training, which includes the ability to land and take off aircraft, would be in addition to the other suggested pilot training and would have to be accepted within 30 days of completion of the basic pilot training.

Once the turbojet flight crews are reduced to three men, one of whom is a qualified flight engineer with third pilot training, the present 8-hr. limit on daily flight hours should be increased to 10 hr. within any 24-hr. period, the agreement stated. ALPA objected to this, but the Arbitration Board pointed out that retention of the present limitation would "substantially reduce the economic advantage of shifting from a four to a three-man crew."

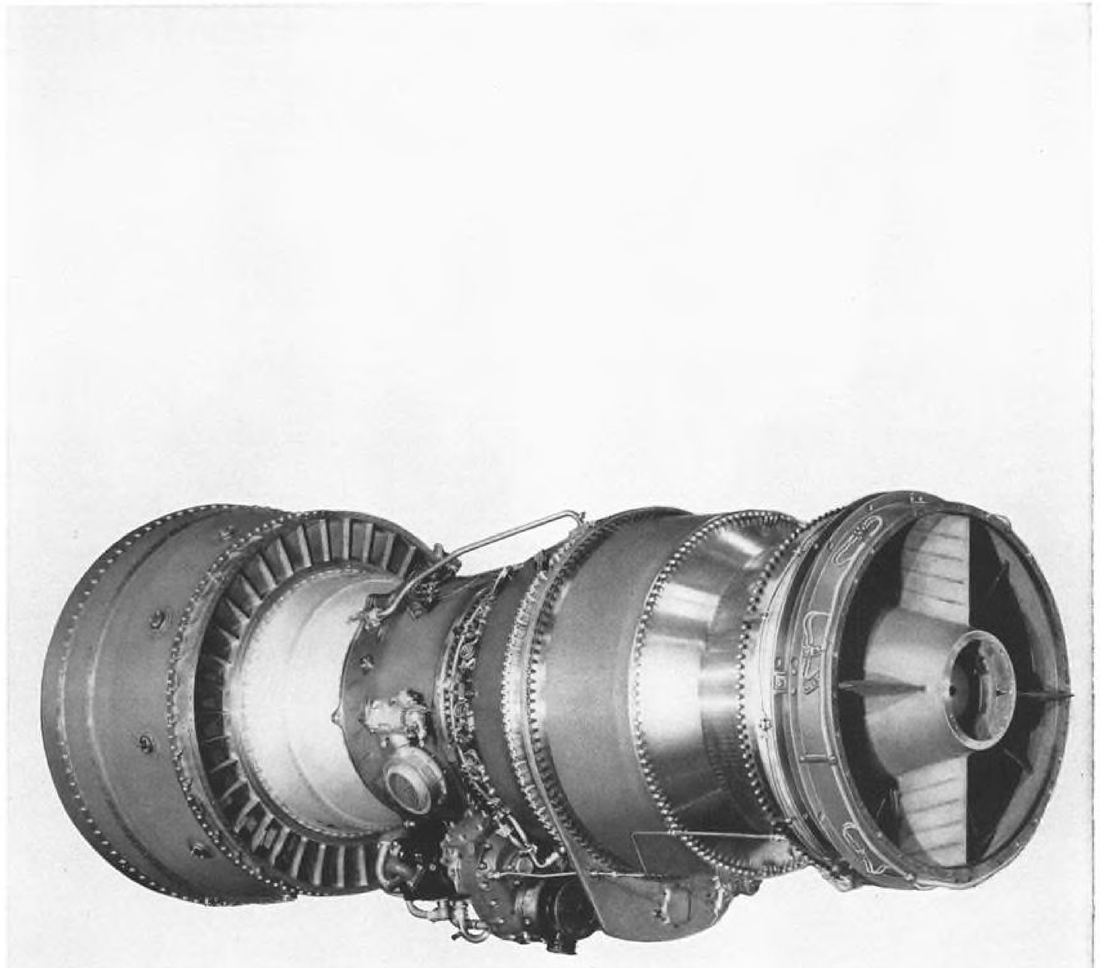
Agreement also stipulated maximum scheduled daily duty time for pilots on three-man jet crews will be 16 hr.

U. K. Charter Action

London—British government has put a June 15 deadline on allowing U. S. charter operators to fly into Great Britain, pending a review of reciprocal agreements between the two countries.

The cutoff date was set after a series of closed sessions in London between the British government and a U. S. State Department team headed by Henry Snowdon, of the civil aviation branch.

The possibility of restrictive action by Britain arose after the Civil Aeronautics Board refused to allow Cunard Eagle Airways, a London corporation, to fly charters from the United Kingdom to New York, by applying the route mileage limitation to Cunard's scheduled subsidiaries in Bermuda and the Bahamas (AW May 14, p. 47). CAB later approved charter rights for Caledonian Airways, of Scotland.



New turbofan has 21,000 pounds thrust

When Pratt & Whitney Aircraft introduced the TF33-P-3 engine, the design was rated at 17,000 pounds thrust. As the nation's first operational turbofan, it helped the Boeing B-52H set 11 world speed and distance records.

For Boeing's four-engine C-135B, more thrust was needed. So Pratt & Whitney Aircraft produced the TF33-P-5, a growth design developing 18,000 pounds thrust.

The newest member of this expanding family is the TF33-P-7. Selected for Lockheed's new C-141 jet cargo transport, this engine is rated at 21,000 pounds thrust.

Thrust growth is only one advantage of Pratt & Whitney Aircraft turbofan design. Compared to J57 turbojet performance in transport operation, fuel consumption has been cut 15 per cent; specific weight reduced more than 20 per cent. As a result, turbofan-powered jets can lift greater payloads, operate from shorter fields, and fly farther than their turbojet counterparts.

Today, these high-performance engines power the majority of the free world's turbofan aircraft—another achievement that continues a long-standing Pratt & Whitney Aircraft tradition of world leadership in flight propulsion.

Pratt & Whitney Aircraft

UA

DIVISION OF UNITED AIRCRAFT CORP.

EAST HARTFORD, CONN.

Airline Traffic—January, 1962

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U.S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-All Revenue Load Factor
DOMESTIC TRUNKS								
American	663,727	522,816	59.1	2,604,316	1,121,157	10,910,591	64,734,457	53.3
Braniff	196,823	95,921	57.1	455,935	194,697	986,627	10,832,292	46.3
Continental	116,329	79,146	49.5	310,781	135,562	607,477	8,648,230	41.0
Delta	317,750	205,245	58.5	768,744	370,244	1,826,622	22,698,088	49.5
Eastern	739,424	403,902	51.4	1,422,152	553,691	2,478,412	43,426,866	38.9
National	163,396	123,084	55.5	464,628	98,043	1,360,387	13,810,797	45.8
Northeast	121,313	65,334	48.9	151,159	65,060	270,507	6,758,016	40.7
Northwest	155,161	107,062	47.8	700,557	297,667	1,368,174	12,654,956	41.1
Trans World	396,624	361,079	53.6	1,573,592	744,507	4,916,795	41,872,529	44.6
United	887,713	567,286	53.2	3,716,628	1,234,839	9,044,818	68,300,610	47.9
Western	157,139	92,911	53.4	355,133	115,740	419,340	9,768,945	43.3
INTERNATIONAL								
American	9,608	10,264	62.9	5,384	483	169,699	1,240,829	65.7
Braniff	8,681	11,820	50.1	60,775	----	186,937	1,482,937	44.6
Caribbean Atlantic	45,057	3,214	69.9	2,468	----	19,583	323,475	67.5
Delta	1,258	1,675	40.6	809	----	9,604	188,235	37.0
Eastern	44,559	66,970	61.0	143,033	2,753	311,557	6,912,179	55.0
Mackey	7,540	1,272	30.8	----	238	7,433	132,841	27.8
Northwest	16,098	28,351	41.7	1,725,337	2,876	699,333	5,460,195	47.8
Pan American								
Alaska	3,493	3,593	34.7	47,466	3,576	206,965	636,347	41.0
Atlantic	109,970	136,427	45.0	2,791,579	----	5,249,399	22,382,036	47.4
Latin American	120,313	162,531	63.0	564,191	2,664	3,894,908	21,477,279	62.4
Pacific	35,622	142,902	57.2	3,679,606	14,277	2,991,040	21,445,214	55.6
Panagra	11,413	20,331	67.0	88,608	----	659,567	2,920,051	63.8
South Pacific	100	273	21.9	602	----	474	29,046	22.5
Trans Caribbean	8,461	12,829	62.7	----	3,062	91,188	1,179,331	56.4
Trans World	18,164	61,993	46.9	1,986,890	----	2,143,620	10,536,301	52.2
United	14,701	36,557	56.6	359,290	10,811	153,516	4,254,464	49.4
Western	7,000	10,844	74.5	8,817	----	26,337	1,149,761	63.4
LOCAL SERVICE								
Allegheny	71,321	14,841	42.3	29,179	49,838	87,392	1,582,766	46.6
Bonanza	31,792	8,087	55.4	7,330	3,499	14,968	802,058	56.4
Central	23,724	4,974	37.8	16,664	8,100	25,075	526,409	36.2
Frontier	28,334	7,696	35.9	22,416	10,592	58,975	832,260	38.3
Lake Central	34,897	5,440	36.9	11,235	25,039	22,137	578,810	38.6
Mohawk	83,347	16,572	45.8	28,813	42,667	52,131	1,708,612	47.2
North Central	80,706	14,718	40.7	43,943	54,510	66,503	1,562,719	42.4
Ozark	49,127	8,885	45.0	20,589	27,258	35,063	932,300	49.0
Pacific	34,241	8,080	45.1	16,009	4,504	9,615	801,836	45.7
Piedmont	44,114	8,398	42.1	14,274	17,269	23,911	860,563	43.6
Southern	33,986	6,428	33.3	21,351	15,834	25,700	678,772	34.3
Trans-Texas	26,881	6,396	37.0	18,777	11,362	41,197	685,939	37.9
West Coast	30,003	7,156	39.4	14,357	4,939	18,643	721,356	39.8
HAWAIIAN LINES								
Aloha	24,773	3,623	58.8	2,823	----	3,872	297,639	51.7
Hawaiian	33,964	5,004	52.7	4,771	----	151,770	559,225	56.9
CARGO LINES								
Aerovias Sud Americana	----	----	----	----	----	249,054	249,054	69.5
Flying Tiger	636	3,093	57.5	13,783	40,720	17,835,600	18,199,414	78.7
Riddle-Domestic	----	----	----	29,986	100,924	5,563,044	5,693,954	68.4
Overseas	2,267	14,305	96.9	18,951	536	1,517,826	2,967,858	85.2
Seaboard World	762	3,104	97.2	809,100	----	4,810,769	5,938,933	64.5
Slick	587	5,722	83.2	----	----	6,593,896	7,132,690	85.7
HELICOPTER LINES								
Chicago Helicopter	16,936	296	41.6	1,888	----	----	30,151	37.3
Los Angeles Airways	2,663	94	52.5	4,545	2,519	----	16,124	62.1
New York Airways	11,095	230	50.1	268	805	634	23,731	51.4
ALASKA LINES								
Alaska Airlines	6,645	5,918	38.1	58,872	2,273	346,270	1,004,350	54.8
Alaska Coastal	2,792	305	51.7	3,163	----	4,508	38,917	63.6
Cordova	1,893	246	42.9	4,650	----	27,345	57,600	50.0
Ellis	3,133	166	51.9	1,665	----	1,616	20,449	54.4
Kodiak	538	51	41.8	545	----	511	4,334	47.6
Northern Consolidated	1,722	527	34.5	54,925	----	49,426	163,022	59.6
Pacific Northern	7,520	6,580	38.9	150,994	9,643	356,069	1,230,767	56.6
Reeve Aleutian	724	752	26.9	66,991	----	57,180	207,165	51.4
Western Alaska	798	34	67.0	562	----	729	4,540	60.0
Wien Alaska	2,063	473	24.8	51,616	----	60,735	161,499	45.2
Avalon	4,785	312	43.8	543	----	213′	30,380	44.9

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board. ′ Includes excess baggage

The five firsts of Sikorsky's S-61

With Sikorsky's proven S-61, actions speak louder than words. For example, the S-61 helicopter is:

- First to hold five world speed records
- First to achieve 1,000 hours time between overhaul on its dynamic components
- First twin turbine in military operation
- First twin turbine to be certified by the Federal Aviation Agency
- First to feature Sikorsky's Blade Inspection Method (BIM) which provides positive blade inspection in only 10 seconds

To these performance and reliability firsts, add another advantage: versatility. The S-61 can operate from almost any surface—including water, ice, snow and mud—to perform a variety of aerial bus, VIP transport, utility, drone or capsule recovery, and cargo transport missions. It has both cargo hook and rescue hoist, Doppler navigational system, and automatic stabilization equipment. In addition, all necessary ground training aids and tech orders are available.

Sikorsky's S-61 is in volume production. It is ready now to meet an expanding range of military needs.

Sikorsky Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION

STRATFORD, CONNECTICUT

Above left: *64′ Package: London to Paris.* New Paris supermarket urgently needed a 64′ elevator to carry shopping baskets between floors. The two-ton elevator was broken up into two 32′ x 6′ x 4′ 6″ sections and loaded into an Argosy in less than 40 minutes without special equipment. A 6 ft. long jet engine was also carried.

Above right: *Shoemaking machines: Manchester to Paris.* A Leicester firm's machinery was urgently required in Paris. There was not time to pack the 6½ ton load for normal shipment so the machines were covered with polythene and secured to pallets for air freighting. They were loaded into an Argosy by the Rolamat system on Friday and delivered in Paris the same night. Engineers installed the machines over the weekend, ready for use on Monday morning.

OVERCAPACITY? ...NOT FOR THE ARGOSY OPERATOR

Airlines may have excess passenger capacity but there is still a shortage of freight space! The right sort of freight space — outsize, unobstructed, easily accessible Argosy space. It's a big space to fill but, as these examples of recent Argosy flights prove, the big loads *are* available. Airlines *can* provide extra capacity *and* fill it if they buy Argosies and, with them, a share in the profitable business of outsize freight.

Glider: Copenhagen to London. Two-seater Swedish glider with trailer was shipped by Argosy from Copenhagen to London. The Argosy easily accommodated the 32′ x 7′ x 6′ 6″ glider and trailer.

HAWKER SIDDELEY AVIATION

32 Duke Street, St. James's, London, S.W.1.

NEW! ON WESTERN AIRLINES

NEW! Fastest nonstops between Portland and San Francisco. Only one-plane service, Portland to Mexico City. Both via 720B Fan/Jets

NEW! Nonstop service between San Francisco and Las Vegas

NEW! The only one-plane thru-service from Seattle/Tacoma and Portland to Las Vegas

NEW! Fastest nonstops between Los Angeles and Sacramento, via Jet/Prop Electra II's

NEW! Fastest daily flights between Los Angeles and Reno, via Jet/Prop Electra II's

NEW! Fastest flights between Reno, Sacramento and San Diego, via Jet/Prop Electra II's

NEW! Fastest flights and lowest fares between Sacramento and Reno

NEW! Daily nonstops from San Diego to San Francisco

NEW! Only nonstop flights between Long Beach and San Francisco

SHORTLINES

► **Aeronaves de Mexico** has taken delivery on the first of two turbofan-powered DC-8 jet transports authorized by the Mexican government. The aircraft will be used on the New York-Mexico City route beginning June 15.

► **Braniff Airways** has taken delivery on a new Boeing 720 and a new Lockheed Electra 2. The new equipment brings Braniff's pure jet fleet to eight aircraft and its Electra fleet to nine.

► **Flying Tiger Line** and Seaboard World Airlines have received first Military Air Transport Service contracts for Fiscal 1963. Contract values are more than $17 million for Flying Tiger and $11.2 million for Seaboard World.

► **Revenue of Slick Corp.'s** airways division—formerly Slick Airways—totaled $4.2 million for the first quarter of 1962, compared with $2.1 million for the same period last year. Net profit for the first quarter totaled $105,292 compared with a first quarter 1961 profit of $4,122, the airline said.

► **South Pacific Air Lines** is now serving American Samoa on all north and southbound Honolulu-Tahiti flights. Passengers may take a complimentary tour of the island during the 3-hr. layover or remain there for a few days or more without extra charge.

► **Timmins Aviation, Ltd.,** of Montreal has completed modification of five Seaboard World Airlines' CL-44 air freighters to convertible passenger configuration. The converted aircraft have galleys, lavatories, hat racks and weather radar.

► **Western Air Lines** earned revenues totaling $19.4 million during the first quarter of 1961—an $8.6-million increase over the same period last year. First quarter profit was $1 million, including $290,000 on the sale of aircraft, Western said.

► **World Airways,** a U.S. supplemental airline, has ordered two Boeing 707-320C convertible cargo-passenger jet aircraft for delivery in the summer of 1963, and has an option to buy a third for delivery in 1964. Total investment in the three aircraft including spare parts will be $25 million. The airline will use the aircraft for Military Air Transport Service contracts in the Pacific, supplemental cargo services, and transatlantic passenger charter service.

AIRLINE OBSERVER

► Economic stagnation in the area surrounding Chicago's Midway Airport, resulting from the shift of virtually all flights to O'Hare Field, has forced anti-noise groups to reverse their position against operation of jet aircraft into Midway. A vigorous anti-noise campaign was an important factor in banning all jets from Midway, which started the mass transfer of flights to O'Hare. The anti-noise groups are now working hard with the city of Chicago to lure flight operations back to Midway, which, until recently, had been the nation's busiest airport.

► **U. S. government agencies will be instructed to give stronger support to the Visit U. S. A. program, which, thus far, has failed to lure any substantial volume of European tourists to the U. S. (AW Feb. 12, p. 47).**

► Russia and Japan have resumed talks on air service between Tokyo and Moscow. Russia is now willing to consider operation of airlines of both countries between Tokyo and Khabarovsk, but is still opposed to allowing Japanese aircraft to fly over Russian territory beyond Khabarovsk into Moscow. Negotiations also included consideration of the formation of a joint Soviet-Japanese airline.

► **Eastern Air Lines has again operated a second section of an Air-Shuttle flight to accommodate a single passenger unable to find a seat on the original flight. It is the second time that the airline has been forced to fly a Lockheed 1049 Constellation with one passenger aboard on the Boston-New York-Washington shuttle service.**

► Trans World Airlines will not pay semi-annual interest due June 1, on its 6½% subordinated income debentures. Interest is cumulative, will be payable later when earnings permit.

► **Aeroflot's summer timetable features new, long-haul Il-18 operations including Leningrad-Krasnoyarsk-Khabarovsk, Karaganda-Kuibyshev-Kiev and Moscow-Kemerovo flights. New An-10 service will be provided to Kaliningrad, Kishinev and Minsk. Reduced group tariffs have been offered to trade unions which organize "mass excursions" this summer.**

► British European Airways last week began phasing its Vickers Viscount 701 series aircraft out of service, putting three of its 22 airplanes up for sale. Phaseout will be complete by next spring. BEA's 39 Viscount 800 turboprop transports will remain in service. Last of its Douglas DC-3s will be withdrawn from service in July.

► **United Air Lines has launched an advertising campaign against the sale of liquor aboard coach flights. The carrier charges that the consumption of liquor among people in close proximity in coach sections creates an "objectionable atmosphere" for many passengers. United, which sells no liquor on any of its coach flights, apparently seeks a Civil Aeronautics Board ruling banning such service on domestic coach flights of all scheduled carriers.**

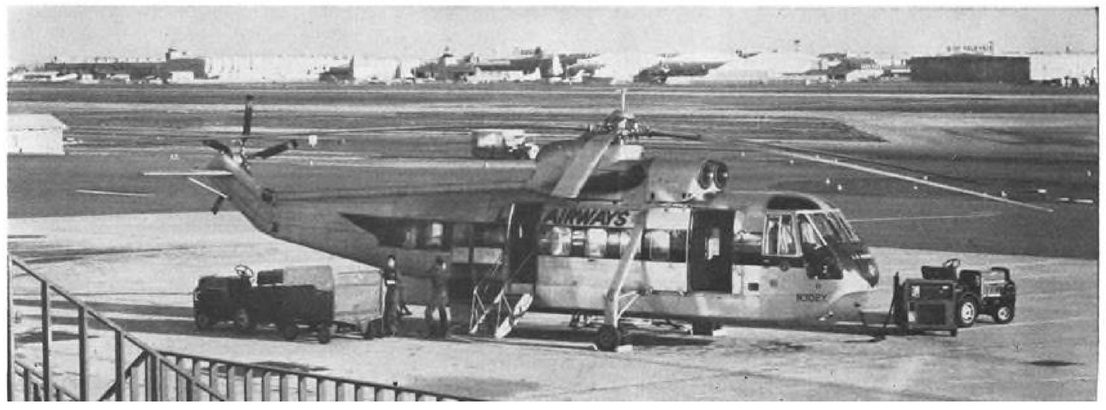
► Third level commuter service will be operated on an experimental basis during June in northern New England. The service is being established by the New England Council; aeronautics commissions of Maine, New Hampshire and Massachusetts; the National Executive Flight Service of Westwood, Mass., and the Aero Commander Co. Aero Commander 680Fs contributed by the manufacturer will be used for the test. The operation, to be called the New England Feeder Service, will include two round trips a day on a five-day schedule linking Boston with Fryeburg, Maine, and Whitefield, Berlin and Concord, N. H.

► **Rift between Lewis B. Maytag, president of National Airlines, and George T. Baker, the airline's board chairman, developed with the resignation of Robert E. Weiland, vice president, and J. C. Brawner, executive vice president. Baker, who sold Maytag a large block of his National stock last month, charged Maytag with forcing the two officials to resign and added that the action deprives National of experienced people who know how to run an airline.**

Los Angeles Airways now has three Sikorsky S-61 twin-turbine helicopters in service over the longest segments of the helicopter carrier's route structure. Third aircraft was delivered May 7; a fourth is expected later this year. The turbine helicopters have a capacity for 28 passengers plus a crew of three. S-61s use an auxiliary power unit to start the General Electric CT58 turbine engines.

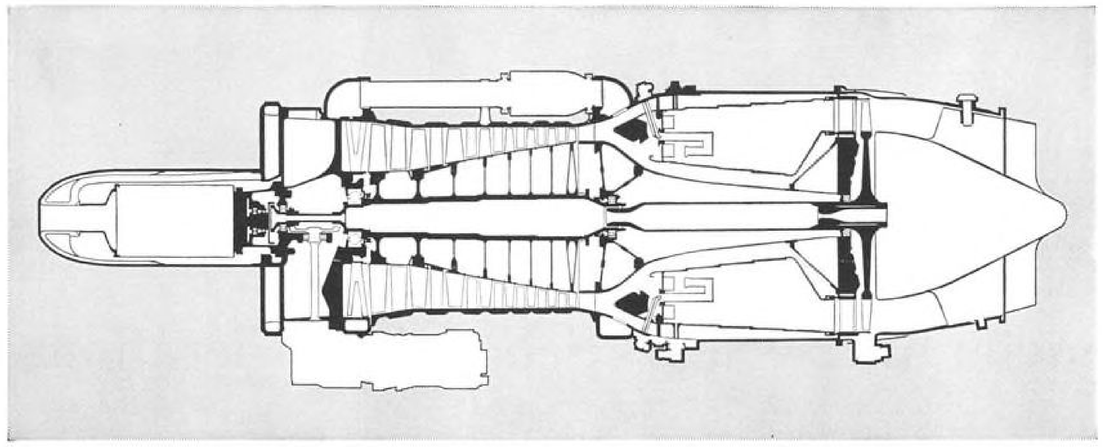
Third S-61 Delivered to Los Angeles Airways

Landing on United Air Lines apron at Los Angeles International Airport, proximity of the S-61 helicopter to the Douglas DC-8 transport in the background demonstrates increased ease of mobility afforded passengers landing at the airport.



BS
AERO POWER

New Viper provides reliable, low-cost power for executive jets



The Bristol Siddeley Viper 20 is now at an advanced stage of development for the next generation of light executive transports. This new version is basically a Viper 11 with a "zero" stage added to the compressor which gives a 20% increase in mass flow, a reduced turbine entry temperature and an improved specific fuel consumption. Like all its predecessors, the Viper 20 retains the basic design concepts of a simple, reliable engine with high thrust at high altitude and *low first cost*.

Delivering 3,000-lb thrust at take-off for a sea-level specific fuel consumption of 0.985 lb/lb/hr, the Viper 20 has potential for development to still higher thrusts and lower specific fuel consumptions.

Piaggio/Douglas 808 executive transport.

SELECTED FOR TWO NEW EXECUTIVE JETS

The Viper 20 has already been selected as the power unit for both the De Havilland 125 and the Piaggio/Douglas 808 "Vespa-Jet" executive jet aircraft.

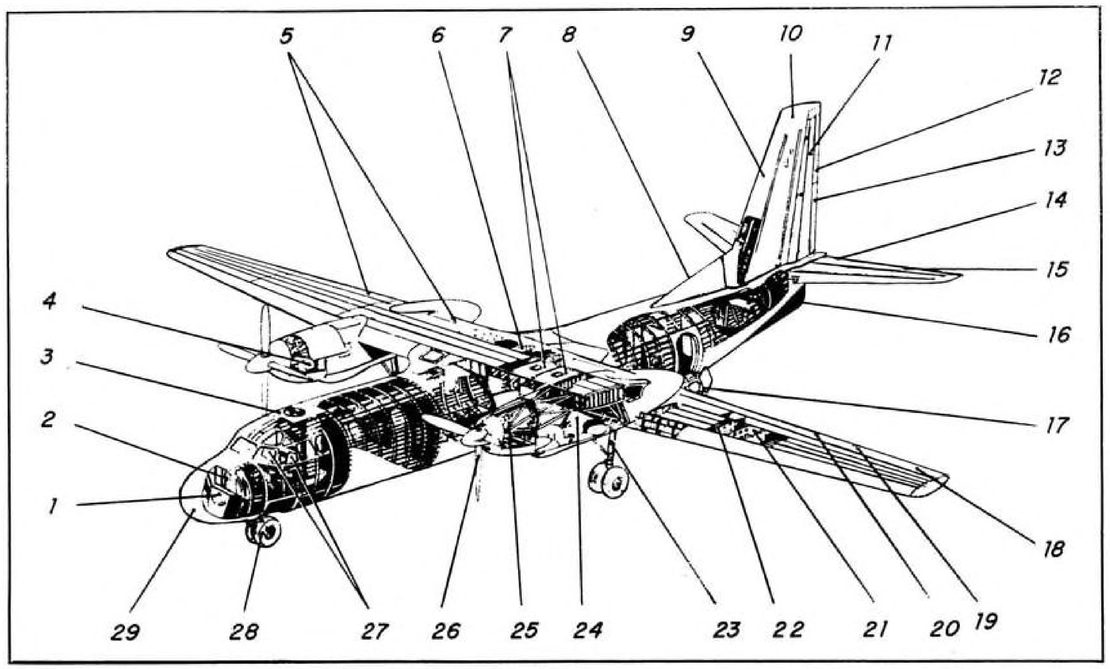
PROVEN POWER

Ranging from 1,640 to 3,000-lb thrust, the Viper series of turbojets has now been flying for over 8 years and has proved itself under a wide variety of strenuous operational conditions. Over 1,000 engines have been ordered and Vipers currently power three aircraft types in service—Hunting Jet Provost, Macchi MB 326 and Jindivik target drone.

BRISTOL SIDDELEY ENGINES LIMITED

AERO-ENGINE DIVISION, PO BOX 3, FILTON, BRISTOL, ENGLAND.

TURBOJETS · TURBOFANS · TURBOPROPS · PISTON ENGINES · RAMJETS
ROCKET ENGINES · MARINE AND INDUSTRIAL GAS TURBINES · MARINE, RAIL AND INDUSTRIAL DIESEL ENGINES · PRECISION ENGINEERING PRODUCTS



ARRANGEMENT of An-24 aircraft's main structural elements: 1—radar antenna; 2—fuselage bulkhead; 3—astro hatch; 4—oil radiator; 5—wing flap; 6—rib shank; 7—fuel tanks; 8—dorsal fin; 9—vertical fin; 10—vertical fin fairing; 11—rudder; 12—rudder trim tab; 13—spring servo tab; 14—elevator tab; 15—elevator; 16—ventral fin; 17—folding entrance stairs; 18—aileron; 19—aileron servo tab; 20—aileron trim tab; 21—wing rib; 22—fuel tank; 23—main landing gear strut; 24—engine exhaust pipe; 25—engine; 26—propeller; 27—pilots' seats; 28—nose landing gear strut; 29—antenna fairing.

Soviet An-24 Nears Scheduled Operations

Aeroflot has revealed additional design details and revised performance data on its high-wing, twin-engine An-24 feederliner, which is scheduled to go into regular service this year.

The Antonov-built, all-metal turboprop aircraft (AW Aug. 15, 1960, p. 39) is Russia's first large, modern short-haul transport. It apparently made its initial flight in 1959 but was not unveiled publicly until the spring of 1960, when it was exhibited along with the twin-jet medium-range Tu-124.

Since then, the Tu-124 has taken the publicity spotlight in the Russian press while the An-24 seemed, at times, to be ignored deliberately.

Powered by 2,000-eshp. Ivchenko AI-24 engines with four-bladed, automatically-feathering propellers, the An-24 is especially suited for operation on unpaved runways. It carries its own folding passenger stairs for use at poorly equipped airports.

The An-24 is 77.2 ft. long and has a 95.8 ft. wing span. Wing area is 760 sq. ft., and height is 27.3 ft.

Propellers clear the ground by 3.77 ft., while the entrance door's threshold is only 5.1 ft. above the ground.

Maximum takeoff weight is 42,328 lb., and payload is 8,818 lb.

Cruising speed is listed at 295 mph., practical ceiling 29,855 ft., maximum range 1,282 mi., takeoff run 1,476-1,640 ft., and landing run 1,312-1,640 ft.

Cruising altitude is 13,124-26,248 ft. The airplane reportedly is capable of extended stable flight on one engine.

Basic configuration carries 44 passengers in 11 rows of seats. Space between the reclining seats is 30.7 in. Other configurations accommodate 40 and 36 passengers.

A removable bulkhead installed in the forward part of the An-24's cabin can easily be shifted rearward to permit carriage of more cargo and fewer passengers. The aircraft can also be quickly converted for all-cargo operation.

The semi-monocoque fuselage is designed to form the arcs of two circles with different radii. The upper arc is the smaller of the two. Floor of the passenger cabin is on the line of the common chord of the two circles.

Antonov's design team believes this cross-section configuration reduces weight, provides a better distribution of forces in the structural elements, and permits more efficient use of the fuselage space.

Fuselage has emergency doors on both sides. Cargo and baggage doors (43.3 in. x 47.2 in. and 55.5 in. x 29.5 in., respectively) on the right side of the fuselage facilitate loading and unloading without interfering with passenger disembarkation.

Passenger cabin has eight circular, slightly-convex, double-pane, non-sweating windows 15.4 in. in diameter on each side. Passenger door on the left side behind the wing is 55.1 in. x 29.5 in.

Cabin is carpeted and has fluorescent dome lights. There are sockets in the baggage racks above the seats in which the steward will put an individual lamp at the passenger's request.

Seat for the steward and his container of cold drinks is in the cockpit just behind the pilots' seats.

Walls of the pressurized passenger cabin are covered with easily-removable panels. Hard plastic is used for the area from the floor to the bottom of the windows, and soft, decorative fabric for the remainder of the walls.

The An-24 has a tapered wing consisting of the wing stub, two center sections and two outer wing panels. The wing caisson is formed by spars and skin panels.

The two wing center sections are airtight fuel compartments. There are four flexible fuel tanks in the wing stub.

Fuel system capacity is 5,550 liters (1,466 gal.). Oil system capacity is 53 liters (14 gal.), including 10 liters (2.64 gal.) for propeller feathering.

Each of the wing's two center sections has two flaps. The outer wing panels have two aileron sections each.

The flaps are double slotted. Each consists of the flap proper, baffle and two carriages which, with the help of needle bearings, move along monorails fastened to the wing.

Each aileron section consists of a spar, a rib and skin. The ailerons have a mass balancer, trim tab and servo tab.

The transport has dual controls. Elevator control is rigid, employing wheels in front of the pilots' seats. Elevator trim tab control is by cable, using two wheels on the central panel. Autopilot control mechanism is an integral part of this system.

Aileron control is rigid and differential. Aileron trim tab control is single and by electric remote control.

Rudder control is rigid and dual. Rudder trim tab control is single, using electric remote control.

Flaps are hydraulically operated, using an electric, remote-control switch.

Control switches for flaps and trim tabs, flap position indicators, and neutral position lights for the trim tabs are located on the central panel.

The controls have cable locking systems operated by a common locking lever located on the central panel. The lever is interlinked with the throttle control, thus eliminating the possibility of takeoff with locked controls. The autopilot's electric control mechanisms are an integral part of the rudder and aileron control systems.

Horizontal stabilizer and the vertical fin are of two-spar construction with stressed duralumin skin.

The An-24 has a tricycle landing gear. Main struts retract forward into the engine nacelles, and the nose gear forward into the fuselage nose.

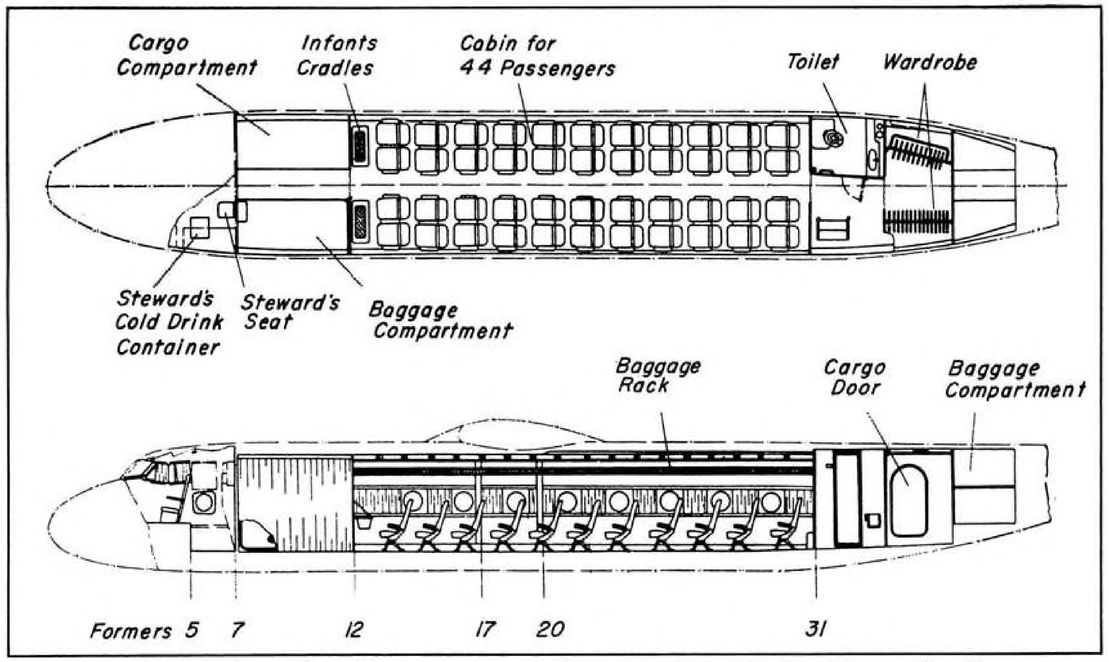
Each strut has double wheels. The wheels on the main struts have disk brakes but the controllable nose wheels do not have brakes.

If the landing gear is not lowered during the landing approach, a siren interlinked with the engine throttles is activated. Anti-icing system which bleeds hot air from the engine compressors is employed to protect the wing, vertical fin, horizontal stabilizer and air intakes.

There is an icing warning device on the leading edge of each wing and air intake. On the panel in front of the copilot there are three orange warning lights. The middle one warns of wing icing, and those on either side warn of engine air intake icing.

Electric heating is used to prevent icing of the propeller blades and spinners, pitot-static tubes, the pilots' windshield, clocks, batteries and astrocompass.

Electric power supply systems are 28.5-volt d. c.; single-phase, 115-volt, 400-cycle a. c.; and three-phase 36-volt, 400-cycle a. c.



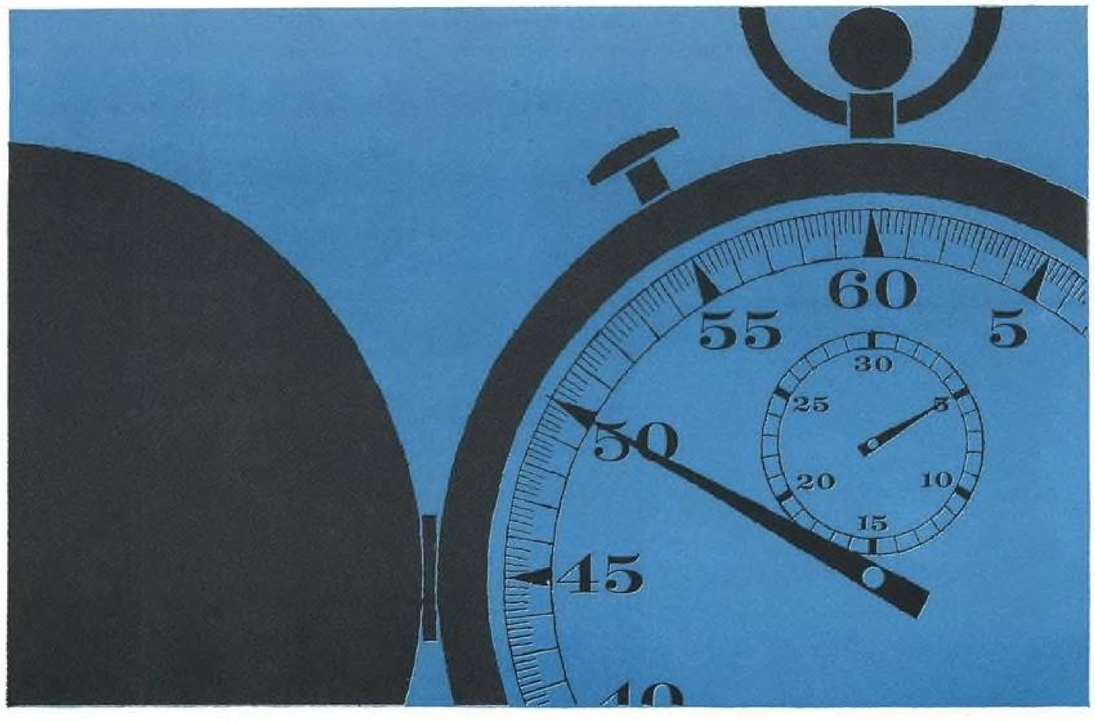
BASIC CONFIGURATION of Aeroflot's An-24 transport cabin seats 44 passengers, but can be changed to seat 40 or 36 passengers, or converted to an all-cargo configuration, by moving the bulkhead between passenger and cargo compartments. An-24 carries own stair-door. Lower sections of cabin walls are covered with removable hard plastic panels; upper portions of the cabin walls are covered with removable fabric panels. The pressurized cabin is carpeted and has fluorescent overhead lights, with individual lamps available.

Rolls-Royce Reports 1961 Profit Decrease

London—Rolls-Royce, Ltd., last year spent nearly $30 million on research and development, largely in its Aero Engine Division, and has charged nearly $8 million against profits on what it called "teething problems" with the Tyne turboprop engine (AW Sept. 4, 1961, p. 52).

Corporate profits, which include the Automobile Division, in final breakdown were $7 million in 1961, a drop of about $4 million from the previous year. Total sales reached $370 million compared with $440 million the year before.

Officials said manufacturing and selling costs last year rose by $42 million. Rolls recently laid off 3,000 employes in its Aero Engine operations and last week predicted new orders from civil airlines would be lower than in the past due to the need for airline evaluation of new equipment and future requirements.



IN JUST UNDER SIX MINUTES, UTC PROVED THAT SEGMENTED SOLID PROPELLANT MULTIMEGAPOUND ROCKET MOTORS ARE NOW STATE-OF-THE-ART

January, 1960: UTC fires the first segmented solid propellant rocket motor, under company-sponsored research program. Motor develops 1,100 pounds of thrust. Burning time: **7 SECONDS.** December, 1960: UTC test-fires flight-weight, segmented, solid propellant rocket motor. Three-segment motor develops thrust of 15,000 pounds from high-energy solid fuel developed at UTC. Burning time: **60 SECONDS.** January, 1961: UTC fires second 15,000-pound thrust solid propellant rocket motor. Burning time: **60 SECONDS.** February, 1961: Third straight successful firing of flight-weight, segmented rocket engine is announced by UTC. Burning time: **60 SECONDS.** August, 1961: UTC fires nation's first booster-size, segmented, solid propellant rocket motor for NASA. Motor develops 250,000 pounds of thrust. Burning time: **80 SECONDS.** December, 1961: United States Air Force flight-weight segmented solid propellant rocket booster motor is successfully test-fired by UTC. Countdown begins at 10:59:50 a.m. There are no holds. The motor is fired at 11:00:00 a.m., the precise time set months earlier. The giant motor produces nearly half a million pounds of thrust. All objectives attained, all desired data obtained. (Similar evidence of reliability was demonstrated in all other earlier UTC firings.)

Two years of development and more than 500 sub-scale segmented motor firings of various sizes were climaxed by the 300+ seconds of burning time described above. The tests have proved that solid propellant segmented rocket motors, with multimillion pound thrust levels, can be economically built, assembled under field conditions, and operated with efficiency and reliability.

UTC

United Technology Corporation

UA

SUBSIDIARY OF UNITED AIRCRAFT CORPORATION

Space Payload Failure Data Analyzed

By Philip J. Klass

Washington—First extensive data on the reliability of space vehicle avionics, obtained from a detailed analysis of the in-orbit performance of 16 different satellites, was reported here during the recent National Electronic Components Conference.

Included in the several reports presented on microcircuit technology was one by International Business Machines Corp. engineers which suggests that multiple-transistor packages may offer equipment designers many of the advantages of microcircuits without the constraints of circuit standardization.

Satellite failure data presented was based on an analysis made for the Advanced Research Projects Agency by Arinc Research, Inc., and should prove useful in evaluating the economic and operational feasibility of proposed military and civil space systems based on existing state-of-the-art.

The data presented by Charles F. Willard of Arinc Research points to the need for at least an order of magnitude improvement in avionic reliability for most applications.

The Arinc Research analysis indicates that any one of the many "operational functions" in a satellite payload has a 95% probability of operating without failure for only 25 hr. in orbit if it is the cyclic on-off type (commanded) function. An operational function which is on continuously in orbit has a 95% probability of operating for about 2,000 hr. before failure.

Payload such as the Navy Transit navigation satellite, for example, has approximately a dozen such operational functions, while the latest versions of the Tiros meteorological satellites have more than 30 such functions.

The 80:1 difference in times-to-failure between commanded and continuously operating functions does not represent a corresponding difference in their reliabilities since the commanded type functions operate for only a fraction of the time in orbit.

In making the analysis, Arinc Research studied satellite telemetry data from each pass over a station to determine when failure occurred and which function failed when malfunction did occur. To aid in this deduction process, telemetry tapes were analyzed in successive passes to discover the first evidence of degradation in function performance. When failure occurred at or near the time when primary battery supply was expected to give out, it was assumed that loss of power rather than payload malfunction was the cause of loss of function—unless telemetry data indicated to the contrary, Willard said.

The foregoing data was then analyzed on a finer-grain basis to provide information with which space vehicle equipment designers can estimate the expected reliability of their equipment. Using circuit schematics of payload equipment, Arinc Research developed time-to-failure for what it terms "active element groups," abbreviated AEG, a term it has used in earlier reliability studies (AW May 22, 1960, p. 75.). Each active element group consists of one transistor, three resistors, two capacitors and two diodes, plus fractional assignments of other components.

On the average, each of the 40 commanded functions studied employed 317 active element groups, while the 152 continuously operating functions had an average complexity of 95 AEGs.

Treating each of the active element groups as if it had the same probability of failure, which is not strictly the case, Arinc Research came up with the following failure rate data:

- **Commanded function:** 2.16 failures per million hours.
- **Continuous function:** 34.6 failures per million hours.

An interesting aspect of the reliability data for operational functions, evident from Willard's curves, is the sharp break which occurs at about 20 hr. use time for commanded functions and at 2,000 hr. for continuous functions. Thereafter the curves fall off sharply.

The results of an investigation by International Business Machines Corp.'s research center suggest an attractive alternative to the constraints of circuit standardization which appear to be inherent in the semiconductor integrated microcircuit.

It is generally agreed that use of semiconductor integrated microcircuits of the type made by Texas Instruments and Fairchild Semiconductor will im-

NASA to Start Thin-Film Solar Cell Program

Los Angeles—Program aimed at developing thin film, large-area photovoltaic (solar) cells capable of supplying space vehicles with high power per unit weight at reasonable costs will be initiated soon by the Space Power Technology Office of the Office of Advanced Research and Technology, National Aeronautics and Space Administration. Industry proposals for the $150,000 one-year program are due on June 4.

Objective of the NASA program is to investigate and construct experimental thin film solar converters for space flight. The process and material selected by the contractor are expected to be suitable for constructing large area solar cells (one foot square), although the construction of cells this large is not required under the anticipated contract.

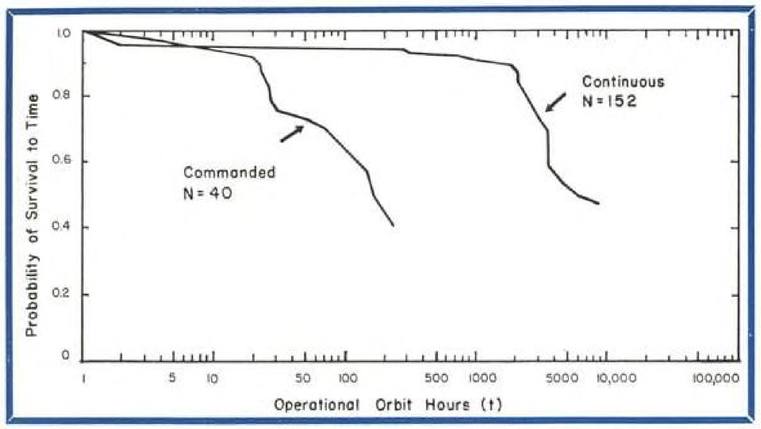
Conventional solar cells generally are about 1 by 2 cm., and have a minimum thickness of about 20 mils determined by minimum depth to which crystal slices can be lapped before breaking. Since the conversion of sunlight into electrical energy occurs in at most the first few mils of the illuminated surface, substantial weight and semiconductor material savings would be realized if cells only a few mils thick could be fabricated from thin films.

Large area cells also might increase the reliability of solar converters since they would reduce the number of solder connections among cells for equivalent-sized solar panels. Thin-film solar cells offer other advantages including greater flexibility and possibly higher resistance to radiation.

The contractor selected by NASA will be expected to choose the best semiconductor material for making large area solar cells with a minimum efficiency of 3%. Conventional cells today have laboratory efficiencies of about 12 to 14%. Higher power density (power/lb.) and cost savings of thin film solar cells may more than compensate for this substantial difference in efficiency.

In addition, the contractor will select an acceptable process for making the films and will study processes for making junctions, forming light and dark side contacts and supporting structures. Sample thin film solar cells, no more than 10 in number, will be submitted during the course of the program.

Companies which may submit proposals probably will include those listed as being active in this field last year by Aviation Week (AW July 31, p. 62). These are Clauser Technology, General Electric, Harshaw Chemical, Heliotek, Hoffman, Lear, Merck, Minneapolis-Honeywell and Radio Corp. of America.



FIRST SATELLITE failure data analysis, based on in-orbit performance of 16 satellites, shows that continuously operating functions have 95% probability of operating for about three months, but cyclic (on-off) functions can be expected to operate for total of only 25 hr. in orbit, according to a study by Arinc Research, Inc.

pose some degree of circuit standardization on the equipment designer if the microcircuit manufacturer is to achieve the large volume production needed to bring costs down. The consequences of this circuit standardization, and the willingness of equipment designers to accept this constraint, are hotly debated questions.

One advantage claimed for the semiconductor integrated microcircuit is that it contains a significant portion of the required circuit interconnections internally, thereby reducing the number of external connections which must be made by the equipment manufacturer. Because soldered joints are a major cause of failure, this feature is expected to improve over-all reliability.

But the result of an IBM investigation, reported here by Rex Rice, suggests that much of this potential advantage is lost in practice if the equipment designer must use standardized circuits instead of having the freedom to tailor each circuit to the required function.

While it is true that digital computers and data processors can be built from a few types of standard circuits, Rice said, past experience shows that a large number of types of devices and types of circuits are actually used to obtain good system performance at optimum cost.

As an alternative, Rice proposed the use of multiple-transistor devices, consisting of several identical transistors in a single package with all internal connections brought out to provide complete circuit application flexibility. The multiple-element devices could be fabricated by mounting a group of conventional transistors on a suitable substrate or by fabricating the required group on a single crystal, when process control reaches the point that semiconductor manufacturers can obtain economic yields of such clusters.

These multiple-element devices, each in a single package, would then be mounted on interconnection boards on which resistors and capacitors have been mounted or fabricated. The entire interconnection board and its passive components might, for example, be fabricated by thin-film deposition.

To compare the component and interconnections required for the multiple-element transistor approach with that of standardized microcircuits, IBM designed and built a small digital computer. The microcircuit version used standard logic circuitry, but the multiple-element transistor version used a series-parallel "tree-network" consisting primarily of transistors with a minimum of diodes.

Subsequent analysis showed that the number of external circuit board connections and the number of internal connections to the semiconductor crystals were practically identical for the two approaches.

The question of comparative cost is more difficult to resolve with presently available data, Rice indicated. However, assuming that the yield of acceptable semiconductor devices decreases as their surface area increases, Rice believes that the multiple-element device should cost appreciably less to produce than the semiconductor integrated microcircuit of the Texas Instrument or Fairchild type. Rice's report was coauthored by Robert B. Seeds.

Other reports at the conference described these developments:

• **Deposited chromium-silicon** monoxide resistors produced by IBM have exhibited less than 3% drift after 3,500 hr. of MIL-STD-202 temperature-humidity-power cycling tests, at powers from zero to 11 watts per square inch. The resistors are made from a mixture of approximately 70% chromium, 30% silicon oxide with a tiny amount of colloidal silicon dioxide. After storage at temperature of 300C for 1,000 hr., the resistors exhibited an average drift of less than 3%, according to R. L. Bullard and M. Beckerman.

• **Peltier cooling of transistors** by forming the cooling junction as an integral part of the transistor during its fabrication, was proposed by Donald K. Allison, consulting engineer. For example, the collector of a junction transistor could be bonded electrically and thermally to thermoelectric material with the electrical connection to the collector made through the thermoelectric material. In this way increases in collector current would produce increased Peltier cooling. However, this arrangement requires that the signal through the thermoelectric material be direct current and that the material used be selected so that the direction of current flow produces cooling and not heating.

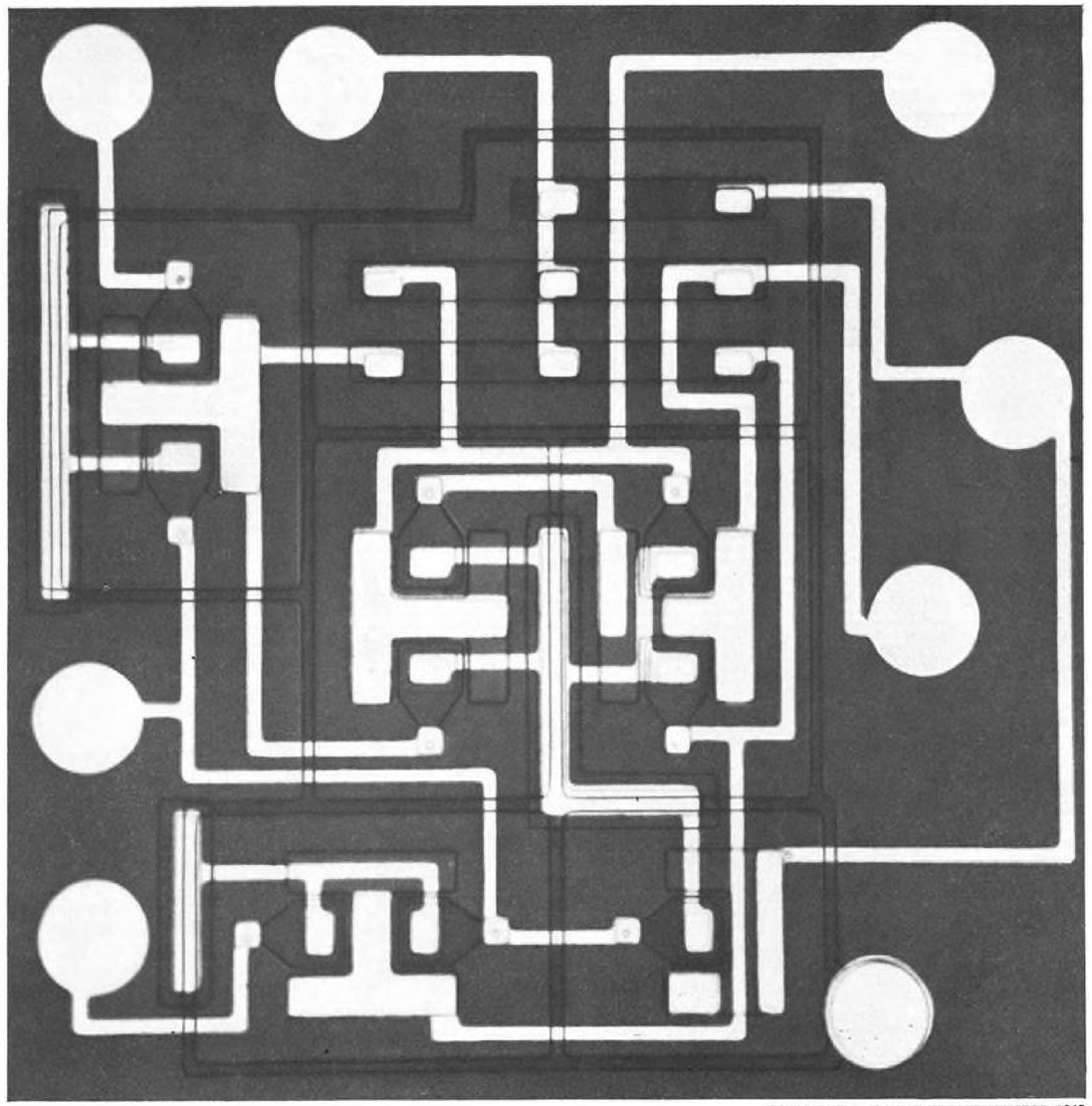
• **Cartridge type fuzes** are a substantial reliability risk, particularly when operated close to their rated values, Marvin A. Dean reported. For equipment where reliability is important, fuzes should be operated at half their rated value, Dean said, but pointed out that this means they will then protect only against short circuits and not against slight overloads. However, conservative ratings of other components and wire used should accommodate slight overloads. He added the fuze manufacturers should either devise more reliable soldering techniques or change over to mechanical crimping.

• **Micro-module reliability tests** indicate that digital-type circuit modules (containing 10 components) have a mean-time-between-failure of 213,480 hr., and communication circuit type modules have an MTBF of about 79,117 hr., Donald T. Levy of Radio Corp. of America reported. Out of 233 digital type modules placed on test, half of which have now operated for more than 10,000 hr., there have been only three catastrophic type failures and no degradation type failures, Levy said. A total of 179 communication type circuit modules were placed on test early in 1961. Of this number there have been seven catastrophic failures and four degradation failures, he said.

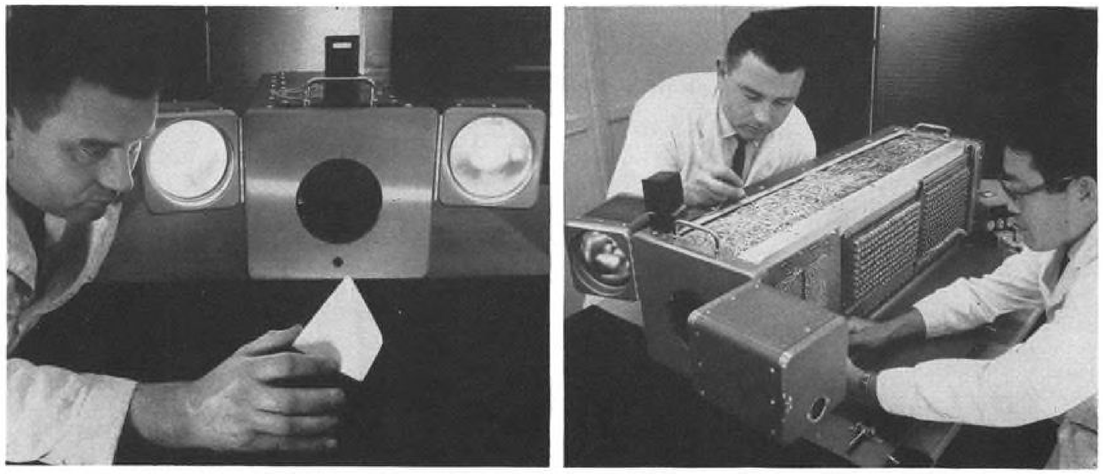
• **Fiber optic vernier pickoff,** for measuring either angular or linear motion, without disadvantages inherent in synchros and potentiometers, was described by E. D. Grim of Radio Corp. of America. The fiber optic pickoff can be designed to provide special coding from input to output end to perform special functions. Additionally, it avoids problems of wiping contacts and quadrature null voltage, associated with potentiometers and synchros.

You are looking at an incredible achievement by Fairchild Semiconductor: the world's first successful integrated semiconductor circuit. It has nine transistors, five resistors—and it takes the place of a whole boardful of components in a computer.

Oh, and one more thing...



COPYRIGHT FAIRCHILD SEMICONDUCTOR 1962



OPTICAL DECISION FILTER can classify four types of three-dimensional objects: pyramids, spheres, cubes and ellipsoids. Filter was taught to recognize and classify these objects through process of self-organization. Concept could have application to variety of aerospace applications, including photographic interpretation, ballistic missile decoy discrimination and sonar target signature analysis. Machine was built with 20,000 parallel logic elements, randomly connected from input photo cell sensors. Connections which provided correct indications were strengthened, others weakened; then logic elements which did not contribute significantly to target classification were removed, leaving only 400 logic elements. Large numbers of wired interconnections appear at top of filter (right), on which logic elements and sensor output amplifiers can be seen mounted on sides.

Decision Filter Can Classify 3D Objects

By Barry Miller

Costa Mesa, Calif.—Working model of a self-organizing machine that can rapidly recognize and classify three-dimensional objects like spheres, cubes, pyramids and ellipsoids without regard to their size or orientation was demonstrated here recently by Astropower, Inc., a subsidiary of Douglas Aircraft Co.

In more sophisticated forms, machines of this type may help to discriminate ballistic warheads from decoys, pinpoint missile launch pads in the course of space surveillance and orient and guide aircraft and space vehicles.

The machine, which is called an optical decision filter, is an effort to verify mathematical theories in the new field of bionics and to reduce these theories to practical hardware for military and space applications. The filter has been taught to recognize simple three-dimensional objects and to properly classify similar objects it has not previously seen.

It has a parallel logic memory composed of many simple threshold logic units, frequently used in this field which bear some resemblance in their operation to the human brain's neural networks. Logic of this type is rapid, unlike the sequential logic of digital computers, which becomes more time consuming with increasing complexity of problems to be solved.

In its present form, the filter consists of a lens and a matrix of photo cells arranged 20x20 serving as retina of system, the associative memory logic system, an abstraction or response logic network, and a conventional digital logic network which selects indicator lights to show the type of object being viewed. The arrangement resembles that pioneered in the Cornell Aeronautical Laboratory Perceptron.

Images of objects being viewed by the filter appear on the retina, causing signals to be generated to the threshold logic units of the associative memory. The memory logic provides signals which are abstracted down as summing inputs for two response units, a combination of which identify four possible types of objects.

Self-Organization

In developing the machine through the process of self-organization, outputs from each of 400 photocell sensors, after they had been amplified individually, were randomly connected to 20,000 threshold majority logic units. The connections are made randomly to assure that there is no preselected arrangement in the interconnections.

Since it was desired to have the machine respond in certain fashion in the presence of given objects, connections were strengthened or weakened, depending on whether they aided or did not aid in realizing desired performance. Thus, the machine's ability to respond when viewing interested objects was altered by weighing the inputs to the response units. That is, resistors at the inputs to the response units were decreased or increased in value, thereby affecting the unit's response.

Each logic unit in the associative memory and in the response units is a differential amplifier and emitter follower circuit capable of accepting a multiple number of inputs. The circuit will assume one of two states if the product of the sum of its inputs and a factor proportional to input conductance exceeds the unit's threshold value.

After the weighing process was completed, Astropower engineers went back to the filter and removed those associative units which they found did not contribute significantly to the classification of objects. This elimination of redundant logic units in the filter's memory made possible a paring of the 20,000 units down to 400 in number, a reduction by a factor of 50. This is what Astropower refers to as the process of natural selection.

There remains in the decision filter, however, according to Astropower engineers, a sufficient degree of redundancy to ensure proper classification of objects in the event of component failure or opening of some interconnection wires. The machine operated satisfactorily when it was assembled despite the fact that 58 of 400 photocell signal amplifiers failed to work, according to Dr. Peter M. Kelly, manager of the Electronics Systems Division here.

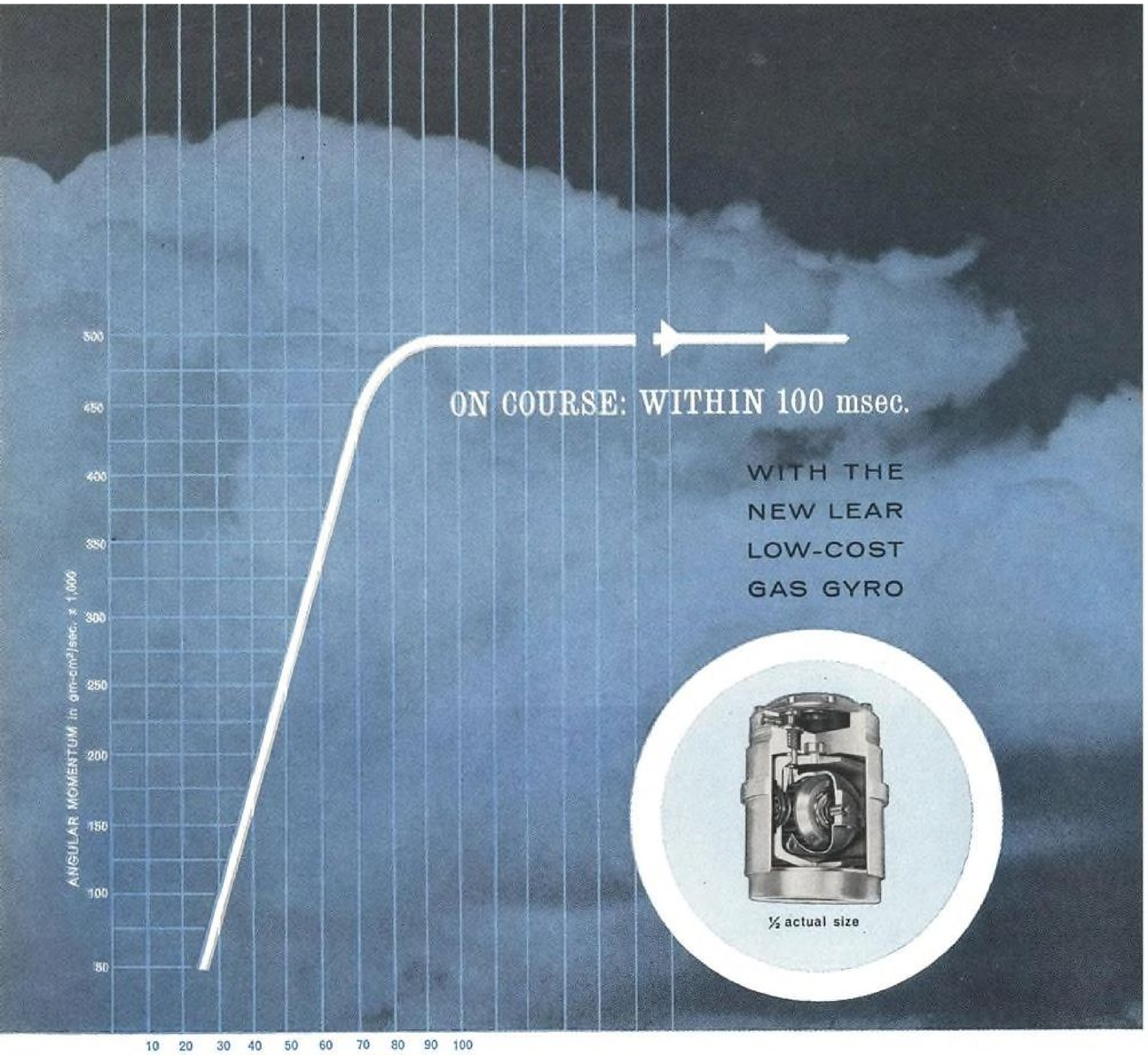
Because of the use of the self-organizing process, and the degree of redundancy in the system, lower quality com-

this is its actual size:

■

FAIRCHILD
SEMICONDUCTOR

FAIRCHILD SEMICONDUCTOR/545 WHISMAN ROAD, MOUNTAIN VIEW, CALIFORNIA/YORKSHIRE 8-8161/TWX: MN VW CAL 853/A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

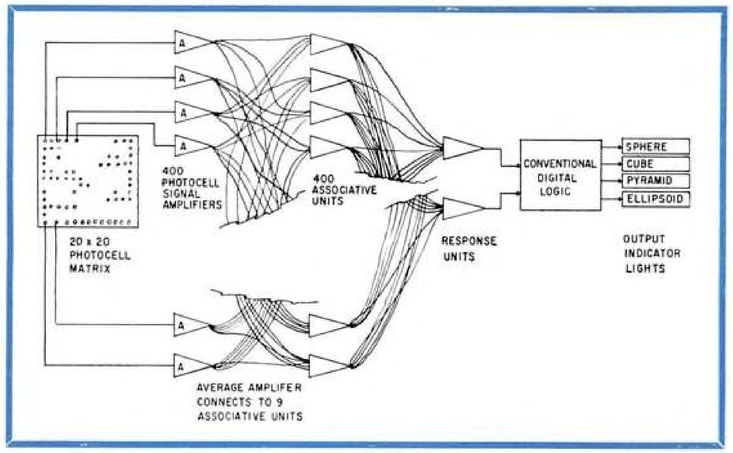


The Task: Provide a low-cost, reliable, quick run-up reference gyro for short duration missile applications consistent with the "round of ammunition" concept.

The Solution: A simply designed hot-gas-driven two-degree-of-freedom displacement gyro which is fully operational within 100 milliseconds after firing.

In a planned return to simplicity, the Lear 1091 "Genie Jr." gas-driven gyro combines the accuracy and reliability of conventional gyros within the simplicity and ruggedness required for expendable missile reference systems. Now being tested for use in Tarter, Typhon and TOW, the "Genie Jr." has had thorough environmental testing, including shock testing in excess of 300 g. The 1091 is available for immediate customer evaluation on new missile programs or missile retrofit programs. With only 4 moving parts, "Genie Jr." incorporates unique construction, the direct result of simple rotor run-up and gimbal uncaging concepts, another of Lear's products to do things that have never been done before, so well.

LEAR INSTRUMENT DIVISION • 110 IONIA AVE. N. W., GRAND RAPIDS, MICH. ID-8



OUTPUTS from 400 photocell signal amplifiers, illustrated in block diagram of optical decision filter, are connected randomly to 400 threshold majority logic, or associative, units. The outputs of these provide additive inputs to similar threshold response units. When top response unit is on, sphere or cube is present, while sphere or ellipsoid is present when bottom one is on. Both units off, when object is in viewing plane, indicates presence of pyramid. Combination of the two response units offers four possible indications.

ponents can be and were in fact used throughout the filter. This is an unusual twist for military equipment where stress is placed on high-reliability parts to protect against equipment malfunction. Entertainment type transistors were used, no effort was made to match them, and deliberate efforts were made to secure loose tolerance resistors. In fact, Astropower engineers say, they had difficulty in locating components, particularly resistors, sufficiently lax in tolerance values, to show that a reliable machine could be made from components with non-critical tolerances.

This ability to use unreliable components, as well as the use of large numbers of identical logic circuits in the machine, makes possible the adoption of integrated circuits for operational equipment, thereby providing a considerable size and weight and possibly cost reduction. The machine requires resistors, the tolerances of which can be relaxed to 20 or 30%, well within the reach of tolerances that can be realized in semiconductor integrated circuits. Astropower says that it might take a complete production run of integrated circuits, including what might normally be drop outs, because many of the faulty circuits would be eliminated in the natural selection process.

No efforts were made to miniaturize the present model of the decision filter. Most of the internal volume of the present machine, shown in accompanying photographs, is consumed by the empty space between the lens and retina matrix. Photocell amplifiers are attached to boards, 200 to a board on either side of the machine. Logic elements are similarly mounted.

The entire design approach is unusual for avionic equipment in which each amplifier and logic unit might be expected to be checked out individually.

A relationship between redundancy and reliability, derived by R. David Joseph of Astropower, provides a measure of the performance of a machine of this type as a function of reliability of individual components, size of the machine and difficulty of the problem to be solved. Correct pattern classification is directly related to component reliability and the number of associative units in the system. This allows a tradeoff—boosting the number of associative units as the component reliability factor decreases. The latter figure incorporates component tolerance, decreasing as component tolerance relaxes.

Component reliability factor also shrinks as the number of non-operable threshold units increases.

Hence, poor or unreliable components are compensated by using more associative units for problems of the same complexity. As the recognition problem becomes more difficult, a larger machine is required. For complex military machines, which could become inordinately large, Astropower suggests combining logic—using both high-speed parallel logic and the more time consuming sequential logic. Part of the size problem would be overcome as associative units are removed in the natural selection process after the machine proves capable of recognizing desired objects.

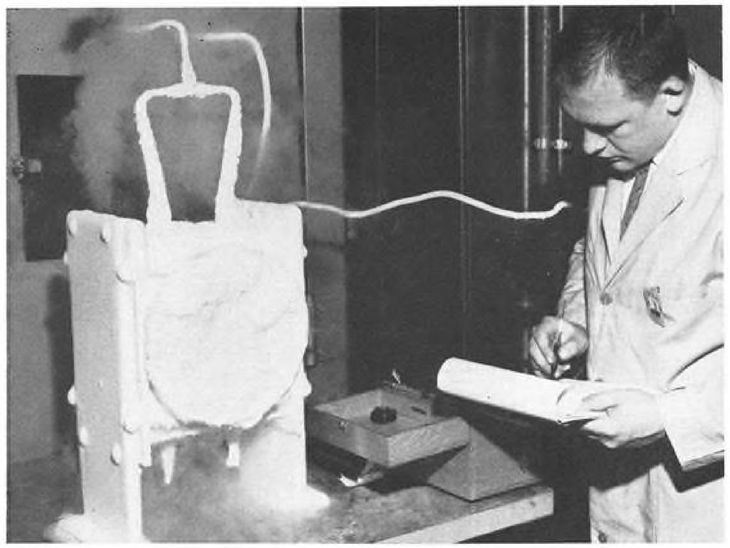
If a decision filter of this type were to be applied to aerial or space surveillance, and taught to recognize missile sites or missiles, rather than simple three-dimensional shapes, it probably would have a high false alarm rate on the warning side. Located in a surveillance satellite it might scan photographs, pick out those of interest or possible interest, discard the remainder. This might offer an enormous service both in pre-culling recon photos and in easing the burden on the satellite transmission system, its power sources, etc. A second ground-based filter might further pare down the number of photos of interest, thereby speeding the evaluation of surveillance information and relieving humans of tortuous burden.

Astropower is proposing various ver-

Electronic Component Shipments (Fourth Quarter—1961)

Category	Quantity (in thousands of units)		Value (in thousands of dollars)	
	Total	Military	Total	Military
Capacitors	441,501	44,086	$84,698	$26,409
Complex Components	15,902	1,792	11,526	7,464
Connectors	31,743	15,893	54,263	33,192
Quartz Crystals	2,260	684	8,395	1,841
Relays (For Electronic Applications)	8,124	2,015	50,622	21,932
Resistors	722,785	84,880	80,997	31,533
Transformers and Reactors	9,362	2,102	50,273	19,011
Power and Special Purpose Tubes	2,221.7	803.7	80,927	57,200
Receiving Tubes	89,819	6,608	77,228	11,708
Television Picture Tubes	3,356		71,018	*
Semiconductor Devices	146,172	33,765	144,837	53,006
TOTALS	1,473,245.7	192,628.7	$714,784	$263,296

* An insignificant quantity and value of shipments of TV picture tubes for military applications are combined with nonmilitary shipments to avoid disclosure of proprietary information.
Source: Department of Commerce.



Advent Antenna Undergoes Operations Testing

Advent satellite's communication antenna is shown undergoing operations testing at Bendix Laboratory's Ann Arbor, Mich., facility. In order to test operation of the antenna in an environment similar to that of outer space, the antenna is frozen to the equilibrium temperature of liquid nitrogen (—195C). Advent is a DOD research and development program to demonstrate feasibility of the 24-hr. satellite system.

sions of the decision filter to military agencies for applications like photo interpretation, starfield recognition and decoy discrimination. The self-organizing process might be useful not only in distinguishing between targets and decoys, but in actually finding a basis for distinction if one exists. The machine might ease the task of seeking the basis for discrimination.

Among the ideas being proposed is a multi-sensor unit that could accept inputs from several sensors, such as radar, infrared and optical devices.

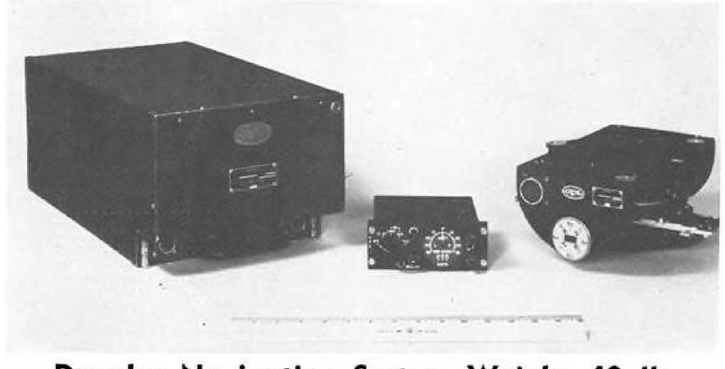
Astropower was organized less than two years ago to conduct advanced research and development in rocket, power, hypervelocity, avionic and other systems. Several engineers were responsible for the decision filter activity—R. David Joseph contributing much of the mathematic analysis and Sam S. Viglione having responsibility for the hardware.

FILTER CENTER

► **Survivable Air Defense Systems**—Air Force is showing increased interest in strengthening its defense against air-breathing vehicles which might launch a second-wave attack against the continental United States after an initial ballistic missile attack in the event of war. One idea receiving serious attention is to keep airborne large aircraft, such as the KC-135, equipped with high-power, long-range sensors and acting as an air-to-air missile carrier. Some time ago, Bendix Systems proposed such a concept, called Aerie, meaning literally the nest of a bird of prey, as it envisions a large aircraft carrying 30 or 40 Eagle missiles. Air Force's Aeronautical Systems Division recently has shown interest in unusually high-capability airborne sensors, such as a 500-mi. radar, which might be suitable for such applications. Impending Air Force procurement of the backup interceptor control, Buic (AW Jan. 22, p. 34), that would provide control of Bomarc and Nike surface-to-air missiles is another indication of the desire to strengthen defense against hostile aircraft.

► **Radiation Vulnerability Reduced**—Technique for reducing radiation damage to hydrocarbon liquids such as fuels, lubricants and coolants has been reported by a Shell Development Company chemist. Vulnerability can be greatly reduced by mixing as little as 2% of an aromatic compound with the hydrocarbon liquids, and 85% protection can be achieved if two compounds are joined together in the same molecules, Shell's Milton M. Wald reported at recent meeting of American Chemical Society in Washington.

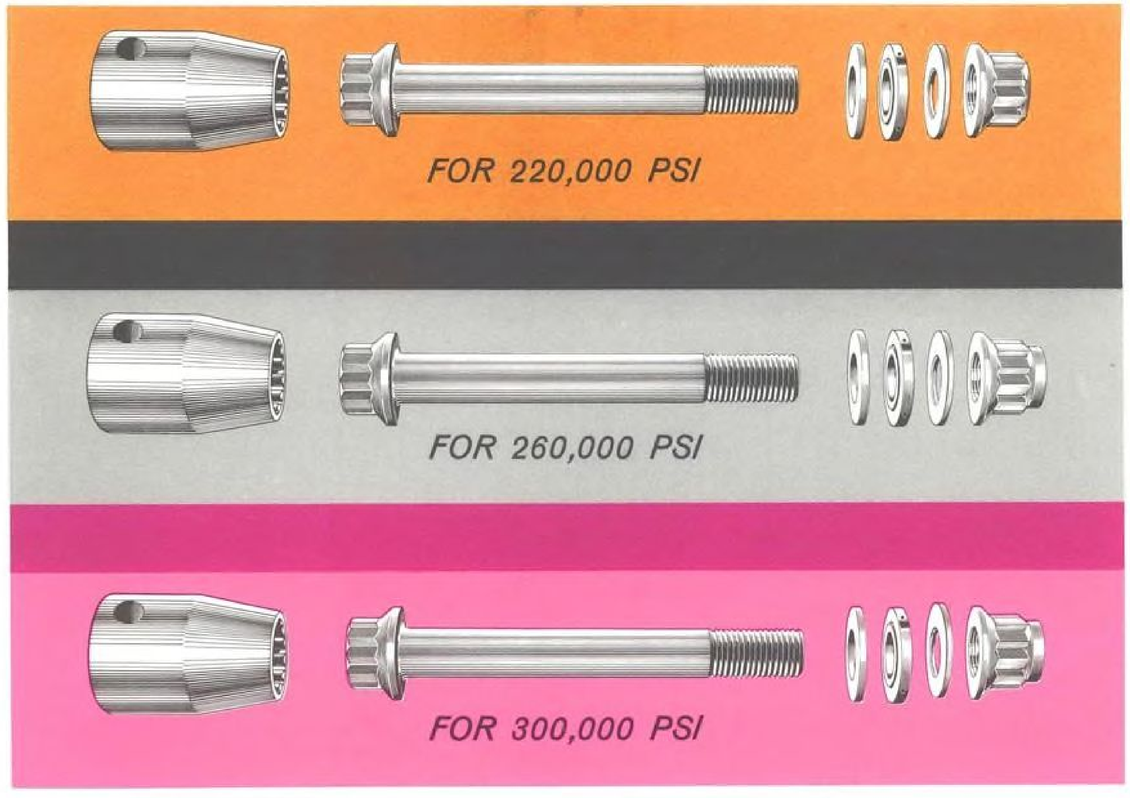
► **USSR Tests Confirm Einstein Theory**—Soviet scientists report an experiment with pi-mesons which they say confirms the retardation of time at very high velocity which is predicted by the theory of relativity. USSR scientists first measured the half-life of pi-mesons at rest, found it to be 17 nanoseconds. During a 17 nanosecond interval a pi-meson normally travels at a velocity such as to cover a distance of about five meters. Two scintillation counters, separated by a distance of five meters, were set up with one at the start of the pi-meson ray. With the first counter measuring 1,000 mesons per minute, the second might have been expected to measure 500 due to decay of half of the particles, but in fact it counted 840 mesons per minute. This, Soviet scientists say, demonstrates the retardation of time at near relativistic speeds at which mesons travel. The experiment is reported in Znaniye-sila, No. 12, 1960; p. 30.



Doppler Navigation System Weighs 40 lb.

New lightweight k-band Doppler navigation system, GPK-1000, weighs only 40 lb., operates at 13,325 mc., a higher frequency than present commercial Doppler equipments. Ground speed measurement is accurate to within 0.15% plus 0.35 kt., and drift angle accuracy is quoted at 0.17 deg. System includes transmitter/receiver (l.), control-indicator (c.) and antenna (r.) System is a pulsed, self-coherent type Doppler radar which does not require precise frequency control or vertical reference. Manufacturer: GPL Division, General Precision Inc., Pleasantville, N. Y.

NOW FROM SPS: COMPLETE FASTENING SYSTEMS



Above 200,000 psi the bolt alone is not enough. Design must go beyond it, must include foolproof means of developing proper preload, of maintaining that preload, of eliminating fatigue. Short of this you jeopardize the hard-won design advantages of threaded fasteners capable of tensiles in the 200-300,000 range. In terms of weight and bulk, these are advantages not lightly dismissed.

How can you insure getting the full design benefits of current SPS superbolts? One way is to detail the entire joint yourself, calling out companion nuts, washers, installation torques, etc. The other way is to utilize the certified fastening systems painstakingly developed by SPS in pushing back the effective tensile barrier to the point where steel now equals titanium in strength-to-weight ratio.

We frankly urge the latter. As psi levels climb, each detail of the fastened joint becomes proportionally more critical. And in many instances, only SPS has the facilities to properly evaluate performance of nuts, washers and wrenches at extreme tensile levels.

This is not "me-too" hardware. Rather, each component of each system directly reflects SPS design criteria for threaded joints at the given strength level—220-, 260- and 300,000 psi. And the capability of each component has been laboratory proved by destructive testing that goes far beyond service probabilities. With the price of weight today—and with the dollars that can ride on the reliability of a single threaded joint—we strongly recommend the SPS systems concept as a positive method of eliminating the variables from fastening.

PHYSICAL PROPERTIES OF SPS HIGH-STRENGTH TENSION BOLT AND LOCKNUT ASSEMBLIES (IN 1000's PSI MINIMUM)

Property	LWB 22 Bolt & FN 22 Locknut	EWB 26 Bolt & FN 26 Locknut	EWB 30 Bolt & FN 30 Locknut
Tensile strength	220	260	300
Shear strength	132	156	180
Fatigue strength at 65,000 cy. avg.	115	135	155

220-, 260- and 300,000 psi mark SPS breakthroughs that have pushed steel to a point comparable to titanium in strength-to-weight ratio. To insure practical realization of listed properties, SPS urges use of its complete fastening systems.

SPS high-strength fastening systems

Thread Size	Tension Bolt	Companion Locknut	Preload Indicating Washer	Countersunk Washer	Shear Bolt	Shear Nut	Socket Wrench for	
							Tension System	Shear System
220,000 PSI								
#10-32	LWB 22-3	FN 22-1032	PLI L22-3-2.8	WCL 22-3	EWSB 22-3	EWSN 22-3	DS-8	DS-8
¼-28	LWB 22-4	FN 22-428	PLI L22-4-5.0	WCL 22-4	EWSB 22-4	EWSN 22-4	DS-10	DS-10
5/16-24	LWB 22-5	FN 22-524	PLI L22-5-8.1	WCL 22-5	EWSB 22-5	EWSN 22-5	DS-12	DS-12
3/8-24	LWB 22-6	FN 22-624	PLI L22-6-12.4	WCL 22-6	EWSB 22-6	EWSN 22-6	DS-14	DS-14
7/16-20	LWB 22-7	FN 22-720	PLI L22-7-16.7	WCL 22-7	EWSB 22-7	EWSN 22-7	DS-16	DS-16
½-20	LWB 22-8	FN 22-820	PLI L22-8-22.7	WCL 22-8	EWSB 22-8	EWSN 22-8	DS-18	DS-18
9/16-18	LWB 22-9	FN 22-918	PLI L22-9-28.7	WCL 22-9	EWSB 22-9	EWSN 22-9	DS-20	DS-20
5/8-18	LWB 22-10	FN 22-1018	PLI L22-10-36.4	WCL 22-10	EWSB 22-10	EWSN 22-10	DS-22	DS-24
¾-16	LWB 22-12	FN 22-1216	PLI L22-12-53.3	WCL 22-12	—	—	DS-26	DS-28
7/8-14	LWB 22-14	FN 22-1414	PLI L22-14-72.9	WCL 22-14	—	—	DS-30	DS-32
1-12	LWB 22-16	FN 22-1614	PLI L22-16-97.9	WCL 22-16	—	—	DS-34	DS-36
1⅛-12	LWB 22-18	FN 22-1812	PLI L22-18-122.9	WCL 22-18	—	—	DS-40	DS-42
1¼-12	LWB 22-20	FN 22-2012	PLI L22-20-154.8	WCL 22-20	—	—	DS-42	DS-46
1⅜-12	LWB 22-22	FN 22-2212	PLI L22-22-190.3	WCL 22-22	—	—	DS-46	DS-50
1½-12	LWB 22-24	FN 22-2412	PLI L22-24-229.5	WCL 22-24	—	—	DS-52	DS-54
260,000 PSI								
#10-32	EWB 26-3	FN 26-1032	PLI 26-3-3.4	WC 22-3	EWSB 26-3	EWSN 26-3	DS-8	DS-12
¼-28	EWB 26-4	FN 26-428	PLI 26-4-6.3	WC 22-4	EWSB 26-4	EWSN 26-4	DS-10	DS-14
5/16-24	EWB 26-5	FN 26-524	PLI 26-5-10.1	WC 22-5	EWSB 26-5	EWSN 26-5	DS-12	DS-16
3/8-24	EWB 26-6	FN 26-624	PLI 26-6-15.6	WC 22-6	EWSB 26-6	EWSN 26-6	DS-16	DS-18
7/16-20	EWB 26-7	FN 26-720	PLI 26-7-21.0	WC 22-7	EWSB 26-7	EWSN 26-7	DS-18	DS-22
½-20	EWB 26-8	FN 26-820	PLI 26-8-28.5	WC 22-8	EWSB 26-8	EWSN 26-8	DS-20	DS-24
9/16-18	EWB 26-9	FN 26-918	PLI 26-9-36.3	WC 22-9	EWSB 26-9	EWSN 26-9	DS-24	DS-28
5/8-18	EWB 26-10	FN 26-1018	PLI 26-10-46.0	WC 22-10	EWSB 26-10	EWSN 26-10	DS-26	DS-30
¾-16	EWB 26-12	FN 26-1216	PLI 26-12-67.3	WC 22-12	—	—	DS-30	—
7/8-14	EWB 26-14	FN 26-1414	PLI 26-14-92.0	WC 22-14	—	—	DS-36	—
300,000 PSI								
#10-32	EWB 30-3	FN 30-1032	PLI 30-3-3.9	WC 22-3	EWSB 30-3	EWSN 26-3	DS-8	DS-12
¼-28	EWB 30-4	FN 30-428	PLI 30-4-7.3	WC 22-4	EWSB 30-4	EWSN 26-4	DS-10	DS-14
5/16-24	EWB 30-5	FN 30-524	PLI 30-5-11.7	WC 22-5	EWSB 30-5	EWSN 26-5	DS-12	DS-16
3/8-24	EWB 30-6	FN 30-624	PLI 30-6-17.9	WC 22-6	EWSB 30-6	EWSN 26-6	DS-16	DS-1β
7/16-20	EWB 30-7	FN 30-720	PLI 30-7-24.2	WC 22-7	EWSB 30-7	EWSN 26-7	DS-18	DS-22
½-20	EWB 30-8	FN 30-820	PLI 30-8-32.9	WC 22-8	EWSB 30-8	EWSN 26-8	DS-20	DS-24
9/16-18	EWB 30-9	FN 30-918	PLI 30-9-41.8	WC 22-9	EWSB 30-9	EWSN 26-9	DS-24	DS-28
5/8-18	EWB 30-10	FN 30-1018	PLI 30-10-53.1	WC 22-10	EWSB 30-10	EWSN 26-10	DS-26	DS-30
¾-16	EWB 30-12	FN 30-1216	PLI 30-12-77.6	WC 22-12	—	—	DS-30	—
7/8-14	EWB 30-14	FN 30-1414	PLI 30-14-106.2	WC 22-14	—	—	DS-36	—

NOTE: While SPS strongly recommends use of these complete fastening systems where applicable, it also recognizes that your design requirements may call only for specification of the bolt or the bolt-locknut combination. All components of the above systems are of course available individually.

COMPONENTS

SPS high-strength 12-point wrench features scalloped configuration that grips fastener wrenching drive on the flats rather than on the vulnerable crests. Permits high torquing without reaming the wrench or defacing the bolt or nut. Adaptable to standard power drives.

SPS high-strength bolt—heart of the fastening system. Advanced fabrication techniques include threads rolled after heat treat; thread form with controlled root radius tangent to flanks at 75% thread depth per MIL-S-8879; coldworking of head-to-shank fillet. Result: aircraft/missile bolts stronger than any heretofore produced.

Countersunk washer has chamfered ID to accommodate head-to-shank fillet of SPS high-strength tension bolts. Assures proper distribution of high psi loads in applications where assembly tolerances are tight and mating hole is not chamfered. Must be used in blind-hole applications where PLI Washer is inserted under head of bolt rather than under locknut.

Preload Indicating (PLI) Washer assembly is SPS answer to the often unpredictable man with the wrench. Two concentric rings—the inner one thicker than the outer—are sandwiched between two flat washers. Tightening deforms the inner ring until the entire assembly binds at ±10% of 80% of bolt yield strength—optimum for maximum clamping force and fatigue resistance (and readily checked by visual inspection).

Companion locknuts for SPS EWB 26 and EWB 30 systems feature precision-tolerance bearing face held to 0° 15′ of perpendicularity to the thread pitch diameter. Such dimensional fidelity is essential at high psi levels, where even a small angularity can cause bending of the bolt threads, accompanied by stress concentrations and premature fatigue failure.

All SPS Locknuts exceed the requirements of MIL-N-25027

SUPER STRENGTH SHEAR BOLT AND LOCKNUT COMBINATIONS—COMPLEMENTARY PARTS OF SPS HI PSI FASTENING SYSTEMS

Companion to SPS high-strength tension fastening systems are SPS high-strength shear bolts and locknuts. Qualifying as systems in their own right, they offer strength-to-weight advantages comparable to those of their tension counterparts. At the same time they also reflect SPS research criteria calling for complete threaded fastener complexes at 220-, 260- and 300,000 psi.

Three types of shear bolts are offered:

SFH 100° flush head with Hi-Torque® recess drive
SFT 100° flush head with Torq-Set® recess drive
EWSB protruding head with 12-point external drive

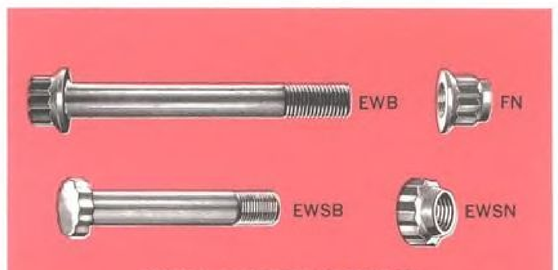
The shear nut (EWSN) provides more than ample properties to induce full load capacity of the bolts.

PHYSICAL PROPERTIES OF
SPS HIGH-STRENGTH SHEAR BOLT AND LOCKNUT ASSEMBLIES
(IN 1000's PSI MINIMUM)

Property	EWSB 22 Bolt & EWSN 22 Locknut	EWSB 26 Bolt & EWSN 26 Locknut	EWSB 30 Bolt & EWSN 30 Locknut
Tensile strength	155	180	210
Shear strength	132	156	180
Fatigue strength at 65,000 cy. avg.	80	85	94.5

APPLYING THE SYSTEMS CONCEPT TO HIGH-TEMPERATURE FASTENING

Along with its dynamic program of raising the strength-to-weight ratio of threaded fasteners, SPS has also been the industry pioneer in rolling back the heat barrier. Heat being so obviously the wave of the future, it is only natural to offer the advantages of the systems concept in the form of high-temperature systems as well—for service to 900°F. Each of the three systems discussed is available in these high-temperature variants, and the table indicates the performance you can expect. Use the coupon to obtain more information on these or other SPS fastening systems or write on your letterhead to AIRCRAFT/MISSILE DIVISION, SPS, STANDARD PRESSED STEEL CO., JENKINTOWN 3, PENNSYLVANIA • SANTA ANA, CALIFORNIA.



PHYSICAL PROPERTIES AT 900°F OF
SPS HIGH-TEMPERATURE BOLT AND LOCKNUT ASSEMBLIES
(IN 1000's PSI MINIMUM)

Property	LWB 922 Bolt & FN 922 Locknut	EWB 926 Bolt & FN 926 Locknut	EWB 930 Bolt & FN 930 Locknut
Tensile strength	170	200	240
Shear strength	100	120	144

Patent numbers. Socket wrench: U.S. pat. no. 2,969,250. Hi-Torque: U.S. pat. nos. 2,677,985 and 2,745,120 (and other U.S. patents; also foreign); Torq-Set: U.S. pat. no. 2,847,894 (and other U.S. patents; also foreign).

AIRCRAFT/MISSILE DIVISION, SPS
STANDARD PRESSED STEEL CO., JENKINTOWN 3, PA.

Please send more data on SPS high-strength tension-shear fastening systems.

☐ 220,000 psi ☐ 260,000 psi ☐ 300,000 psi
☐ Room temperature ☐ Elevated temperatures

Name_____ Title_____

Company_____

Address_____

City, zone, state_____

SPS

where reliability replaces probability

JENKINTOWN, PA. • SANTA ANA, CALIF.

Atlanta, Ga. • Dallas, Tex. • San Diego, Calif.
Seattle, Wash. • Tuckahoe, N.Y. • Wichita, Kans.
IN EUROPE: Elektro-Metall Export G.m.b.H., Düsseldorf, West Germany

Soviets Give Vostok Physiological Details

(Medical details on manned orbital flights of Soviet spaceships Vostok 1 and 2 were summarized by Russian scientists V. V. Parin and O. G. Gazenko at the recent Third International Space Science Program held in Washington, D.C., under sponsorship of the Committee on Space Research (Cospar). Reports on earlier Soviet satellite biological experiments appeared in the May 21 issue, p. 59.)

The first flights of the astronauts were made in paths already tested in launchings of space ships with animals aboard. Animals in this case were specific indicators of danger. Close investigation of animals during flight and after recovery to Earth enabled us to conclude that there are no considerable changes dangerous for life and health of cosmonauts. Thus, the first manned space flights were realized in the order of the logical succession when each step is the natural consequence of the previous one.

The life-sustaining systems of ships-satellites "Vostok" were tested in numerous laboratory experiments and then tested practically in a series of flight biological experiments with animals.

A combination of physiological methods and the corresponding medical research apparatus was used in order to make studies of the influence of space flight factors on the cosmonaut's organism. The information was telemetered to Earth, processed rapidly and closely analyzed. In choosing the methods of investigations and the telemetry measurements program specific conditions of flight experiments should be taken into account.

During Gagarin's and Titov's flights physiological methods were used chiefly for the purposes of physician's control. Methods of electrocardiography and pneumography were selected. Special medical apparatus on semiconductors worked out for these flights was at first tested in flight experiments aboard ships-satellites 4 and 5.

Gagarin's Flight

Before the launch, at all the portions of the flight trajectory and after it the astronaut's health was satisfactory. Exceptional self-control, calmness and adequacy of reactions attracted the attention of those who observed him. It is very characteristic that 30 min. before the lift-off the heart rate amounted to 66 beats per minute, the respiration rate was 24 per minute. Three minutes before the launching Gagarin was calm and concentrated; however, some emotional strain was revealed in the pulse increase to 109 beats per minute, the respiration was smooth and calm. After lift-off during the gradual increase of velocity of the ship the heart rate increased to 140-158 beats per minute, the respiration rate was 20-26.

The changes of physiological indices at the boost stage were within permissible limits. No pathological symptoms were revealed. The powered portion of the flight was endured by the spaceman satisfactorily. He maintained radio communications with the Earth, successfully fulfilling the flight program. By the end of this period the heart rate decreased to 109 beats and the respiration rate reduced to 18 per minute.

In the transition to weightlessness and during the flight in this state the indices of cardiovascular system and of respiration gradually approached the initial values. Yuri Gagarin pointed out some unusual sensations under conditions of zero-gravity, though no disorders of functions were observed, he felt and performed his program well.

At the present stage at the retardation of the vehicle when, as at the boost stage of the flight, overloads again took place, short-term, rapidly disappearing periods of the respiration rate were observed. However, when he approached the Earth his respiration became not frequent, smooth and calm. In three hours after landing indices were fixed characteristic of the normal, calm condition of the space pilot.

While analyzing physiological data some changes of individual indices were observed characteristic of each of the stages of the flight. All these changes do not go out of the limits of the variations of indices observed in the course of the trainings of the astronaut and cannot be considered pathological. It is rational, however, to conduct more detailed analysis of the revealed changes which can be useful for elucidating the influence of the mechanisms of physiological reactions on the action of space flight factors.

Attention should be focussed on the most expressed changes of individual physiological indices, such as:

- **At the prelaunching stage**—the pulse increase, the decrease of PQ, QRS and QT intervals, the increase of the systolic index.
- **At the beginning of the boost stage**—the pulse increase, the decrease of intervals PQ, QRS, QT, the increase of the wave P_2, the decrease of the wave R, the decrease of respiration, the increase of the amplitude of the pneumogram.
- **At the end of the boost stage**—the decrease of the pulse and respiration, the increase of the interval, the decrease of waves P_2 and T_2, the increase of the wave R_2, the decrease of amplitude of the pneumogram.
- **At the beginning of the orbital flight**—the gradual decrease of the pulse, the lengthening of the intervals PQ, QRS, QT, the increase of T, the increase of P_2, the gradual increase of the respiration amplitude.
- **At the end of the orbital flight**—the decrease of PQ and also the decrease of P_2 and T_2.
- **At the beginning of the descent portion**—the increase of the pulse, the lengthening of PQ, QRS and QT intervals, the increase of the systolic index. Changes of the pulse rate of the respiration frequency and amplitude, changes of the amplitude of the waves of the electrocardiogram are the most essential. The dynamics of the time intervals of the electrocardiogram apparently is connected with the dynamics of the pulse frequency and is determined by extracardiac nervous-reflex effects. The lengthening of the time intervals of the electrocardiogram at the beginning of the descent draws one's attention.

Scientific results of the first manned space flight were as follows:

- **The orbital space flight** which lasted for 108 minutes (including the portions of the boost stage and descent) did not cause any physiological deviations harmful to the cosmonaut's health and life.
- **All physiological changes** are connected with the direct action of the combination of factors and with nervous emotional strain. They had in the main the character of adaptation reactions. Similar though less definitely expressed reactions were observed during training in the centrifuge and other stands.
- **At all stages of the flight** no disturbances of the space pilot's working capacity and health conditions were observed.

Titov's Flight

Since the program of the flight experiment was designed for 24 hours it was necessary to increase the number of objective methods for investigating the cosmonaut's condition in flight. The use was made of a number of methods to estimate the reactions of the vestibular apparatus, some psychophysiological tests were conducted, and also the technique was used for investigating the mechanical functions of the heart—the cynetocardiogram.

The dynamics of the pulse frequency and the respiration rate at the boost and descent stages did not differ considerably from the data obtained during training.

Under conditions of orbital flight the indices of the pulse and respiration frequencies in average approached the initial prelaunching values, but were characterized by greater variability. Some changes of the mechanical function of the heart were observed, however, these data require further analysis.

The space pilot in general felt well. He fulfilled the flight program fully, maintained communication with the Earth, performed operations connected with the ship orientation, carried out cinema shooting and other kinds of activity. No noticeable disorders

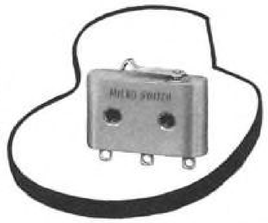
Tiros Relay

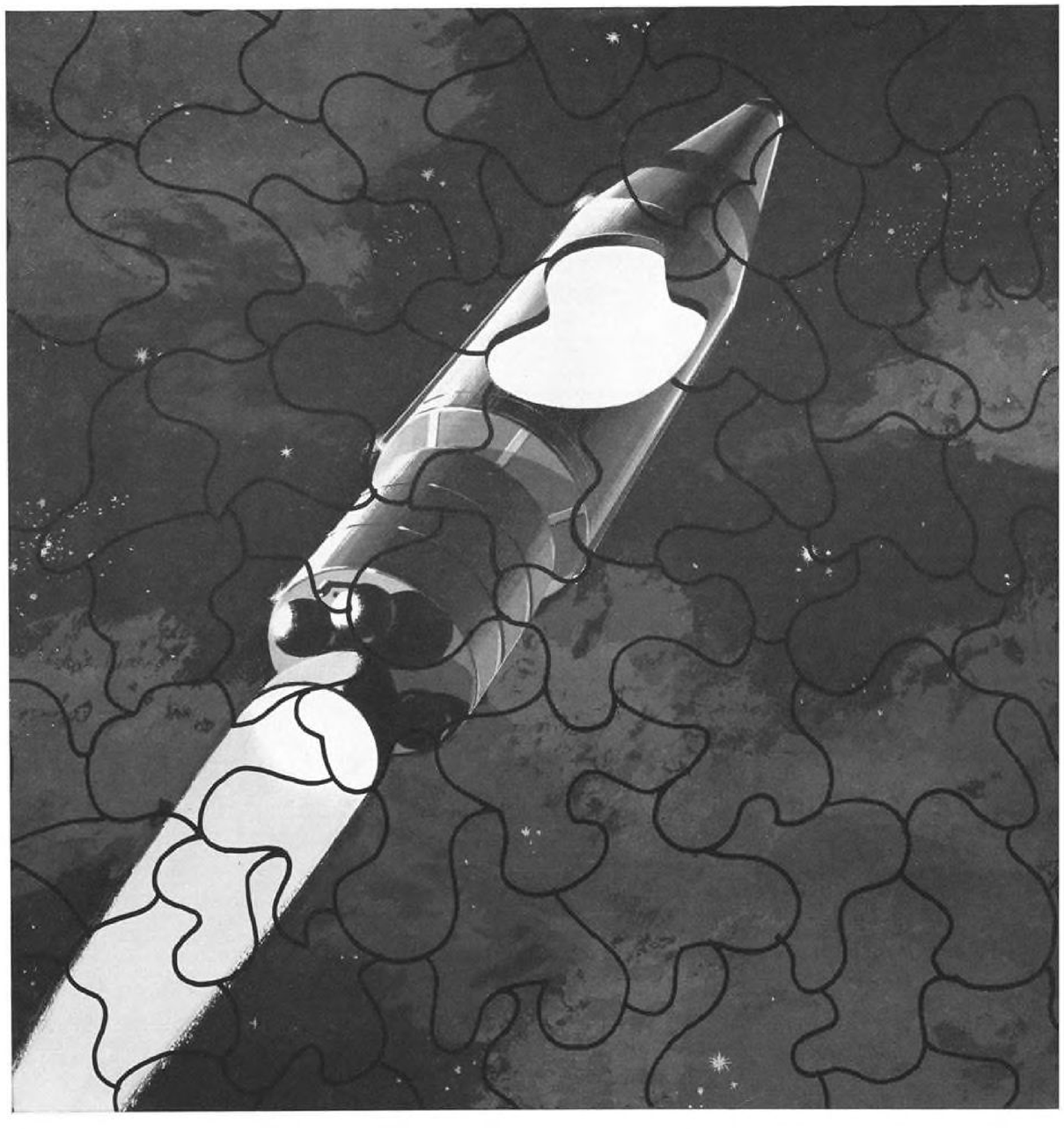
U. S. Weather Bureau has begun experimental radio facsimile broadcast of Tiros weather pictures overseas. If successful it will enable any country within range to have Tiros cloud analyses that are now available only in the U. S.

Formerly, foreign countries could receive Tiros data only in coded form by radioteletype, however, coding reduced information content considerably.

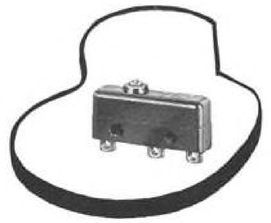
In another Tiros development, U. S. Weather Bureau awarded a contract to Geophysics Corp. of America to study and explain the formation of vast bands of "cloud streets" in the upper atmosphere.

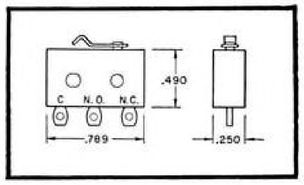
NEW! HERMETICALLY-SEALED SUBMINIATURE SWITCH





INTERCHANGEABLE WITH EXISTING SUBMINIATURE SWITCHES (MS 25085-1)





The new MICRO SWITCH "HM" Series was developed primarily for military applications, such as missiles, rockets, spacecraft and electronic equipment. It is interchangeable with existing (MS 25085-1) subminiature switches in size, mounting, and characteristics. Designed for use with standard auxiliary actuators and in push-button, toggle and rotary-actuated switch assemblies. Meets explosion-proof requirements of MIL-E-5272.

Temperature Range: *The case is welded or high-temperature brazed to assure reliability and long life of the switch in temperature ranges from —300°F to +250°F.*

Hermetic Seal: *The seal at the actuator diaphragm and around the mounting holes is by metal-to-metal fusion. The terminals seal is glass-to-metal. This provides a true hermetic seal. The switching element chamber is evacuated, filled with inert gas, sealed, then checked by a mass spectrometer.*

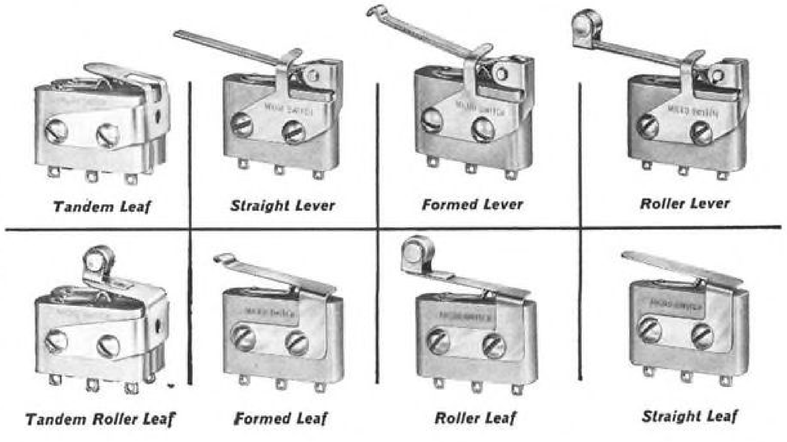
Corrosion Resistant: *Stainless steel construction of all exposed parts meets corrosion resistant requirements of MIL-S-6743.*

Circuit: *Contact arrangement is single-pole double-throw.*

Rating: *Electrical rating is 3 amps inductive and 5 amps resistive at 28 vdc. Especially suitable for low-energy or "dry" circuits and for long shelf-life requirements. Minimum mechanical life is 25,000 operations.*

MICRO SWITCH manufactures a complete line of sealed switches. For details, call your nearby MICRO SWITCH Branch Office. Or write for Catalogs 77 and 78 and Data Sheet 192.

SELECT FROM 8 DIFFERENT AUXILIARY ACTUATORS
(same as designed for Subminiature "SM" Series)



MICRO SWITCH
FREEPORT, ILLINOIS
A DIVISION OF HONEYWELL

IN CANADA: HONEYWELL CONTROLS LIMITED, TORONTO 17, ONTARIO

MAY 2, 1923 LONG ISLAND, N. Y.

Yesterday—Overloaded, with a shuddering roar the Fokker T-2 dragged west across Long Island's treetops. For two Army fliers inside, each minute was eternity.

Crossing Dayton at dusk, they plunged on through a night of drizzling clouds and guessed a glow in the ooze was St. Louis. It was.

Down through clear dawn they saw the adobe huts of Tucumcari's Indians. Then the desert gave way to Imperial Valley's cool green. Over the last mountain, they swooped on San Diego.

Non-stop. Coast to coast. Noon to noon. With Standard Red Crown Aviation Gasoline.

Today—A nonstop transcontinental flight is the shortest distance between lunch and supper. An epic told in six digits on the schedule page.

The engines flying today have a different sound and smell. But they still spin under the thrust of burning fuel. It may be Chevron Aviation Turbine Fuel, used in many of the nation's busiest, fastest jet transports.

Light plane piston engines, too, are logging more transcontinental hours. With Chevron Aviation Gasoline. In jet or piston engine aircraft, Chevron Aviation Fuels provide clean, dependable power under all flight conditions.

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

STANDARD OIL COMPANY OF CALIFORNIA

in the coordination of motions were observed.

At the same time after the active portion of the flight ended and at the transition to the state of weightlessness, Titov marked a short time illusion of turning "the head down" position. Then when the flight continued under weightlessness unpleasant sensations appeared and then increased. These sensations resembled the motion sickness (giddiness, nausea).

These phenomena increased at sharp movements of the head.

Restless Sleep

The sleep was at first restless, the appetite decreased. The paste-like food and water by means of special tube were taken without any difficulties. Urination was free, the technical devices functioned normally.

There are reasons to believe that giddiness, nausea, the decrease of the appetite were the results of the change of the activity of nervous regulatory mechanisms which appeared under zero-gravity due to the interaction of a number of afferent systems.

At present special theoretical and experimental studies of this problem are being made.

When Titov limited head movements and took an initial concentrated position, these phenomena decreased and almost disappeared.

They reduced considerably after sleep and disappeared completely after the beginning of the action of overloads while recovering to the Earth.

The main scientific outcome of Titov's flight is the establishment of practical possibility of the stay in outer space during 24 hours without disturbances of the working capacity and the state of the main physiological functions.

The flight experiments with animals and the first manned space flights have made it possible to conclude that the general direction of scientific investigations aimed at utilization of outer space was correct. At present the following problems should be investigated in the first place: the effect of long-term radiation, the action of overloads after the stay under zero-gravity and the influence of the whole combination of factors on the organism including the state of emotional strain.

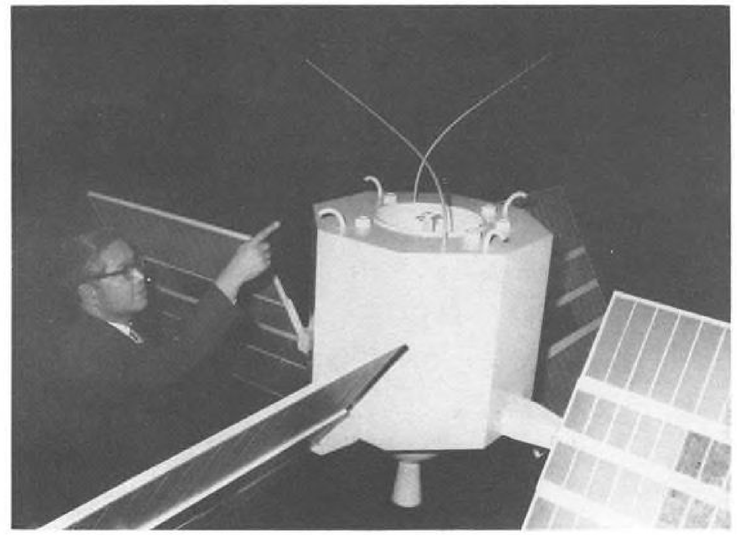
Space Path Choice

It should be pointed out that new space paths should be chosen on the basis of scientific data stored to the present time as a result of flight experiments with animals and first manned space flights.

Different biological objects should be used as indicators of possible harmful actions in outer space.

While interpreting the biological and genetic data obtained aboard satellites and space ships it should be kept in mind that the organisms and the environment present the inseparable unity. Therefore, it is necessary to try to reveal hereditary changes and adaptive phenomena which always accompany the evolution process wherever it takes place.

Further biological investigations of outer space, the collection of new materials and correct theoretical analysis of them will be the important condition of successful solution of numerous problems of space biology and medicine.



Japan Plans 1964 NEC-1 Launching

Several Nippon Electric Co. (NEC) satellites are being timed for completion in 1964 to be launched during Olympic Games that year in Japan. NEC is prime contractor, with Mitsubishi Electric Co. providing telemetry gear and Mitsubishi Shipbuilding supplying navigation equipment. NEC-1 will be an active repeater satellite with eight solar batteries built into both sides of four paddles. Paddles will extend when satellite is outside earth's atmosphere. Scout or Thor-Delta will be booster, with National Aeronautics and Space Administration to select launch vehicle for the satellite.

NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

Geophysics Corp. of America, Bedford, Mass.—$126,000 for development of inflatable rigidizing satellite fabricated from expanded aluminum mesh.

General Dynamics/Astronautics, San Diego, Calif.—$69,000 for study of vertistat orientation.

Epsco, Inc., Cambridge, Mass.—$1,094,000 to construct data collection and analysis system facility.

Motorola, Inc., Scottsdale, Ariz.—$850,000 for Goddard range and range rate system.

Marshall Laboratories, Torrance, Calif.—$97,000 for dust particle measurement instrumentation.

Minneapolis-Honeywell Regulator Co., Denver, Colo.—$74,000 for visicorder, amplifier, galvanometer and relay mounting racks.

Hallamore Electronics Division, Anaheim, Calif.—$138,000 for six-channel subcarrier oscillators and related equipment.

Consolidated Electrodynamics Corp., Arlington, Va.—$79,000 for recorder/reproducer system, direct, wide band magnetic tape.

Marshall Laboratories, Torrance, Calif.—$98,000 for micrometeorite analyzer system.

Western Electric Co., New York—$95,000 for operation of Relay ground station.

Standard Steel Corp., Lowell, Mass.—$64,000 for liquid nitrogen double walled storage tank.

Evans Construction Co., Salisbury, Md.—$170,000 for roof protection for building A-65, additions to buildings D-15, D-40 and D-55 and modifications to building E-2 at Wallops Station, Va.

Reeves Instrument Co., Garden City, N. Y.—$62,000 for spare parts for NASA spandar range system.

Grumman Aircraft Engineering Corp., Bethpage, N. Y.—$96,000 for feasibility study of surface-to-air retrieval techniques by fixed wing aircraft.

Corporation for Economic & Industrial Research, Houston, Tex.—$200,000 for computer services, Manned Spacecraft Center, Va.

Ampex Acceptance Co., Redwood City, Calif.—$59,000 for recorder-reproducer.

Bendix Corporation, Teterboro, N. J.—$600,000 for design and documentation of ST-124 stable platform to be used on Saturn rocket system.

Brown Engineering Co., Huntsville, Ala.—$64,000 for environmental qualification tests on electrical and electromechanical parts and components for space vehicles.

Cadillac Gage Co., Warren, Mich.—$50,000 for hydraulic package assemblies.

Goodyear Aircraft Corp., Akron, Ohio—$120,000 for research and development of materials for heat shield curtains to be used on Saturn rocket system.

International Business Machines Corp., Rockville, Md.—$994,000 for ASC-15 computers for Saturn project.

Noble Co., Oakland, Calif.—$321,000 for specialized maintenance, repair, modification and minor construction work at Saturn launch complex 34 and general area.

Dynatronics, Inc., Orlando, Fla.—$301,000 to design, develop and fabricate pulse code telemetry playback station.

Avco Corp., Nashville, Tenn.—$138,000 for engineering, fabrication and related services for Saturn project.

Chrysler Corp., Detroit, Mich.—$1,500,000 for preparatory work for Saturn S-1 stage.

Hayes Corp., Birmingham, Ala.—$353,000 for fabrication, assembly and test of restraining and support arms for Saturn.

MSA Research Corp., Callery, Pa.—$50,000 for research and development of propellant feed system for ion engines.

Sperry Rand Corp., Bristol, Tenn.—$73,000 for synchronizer system Model 2 output inverter for Saturn.

Minneapolis-Honeywell, Huntsville—$76,000 for Saturn three axis gyro package.

Motorola, Inc., Scottsdale, Ariz.—$67,000 for radio receiving set and power regulator for Saturn.

Bourns, Inc., Riverside, Calif.—$70,000 for pressure transducers for Saturn project.

Bechtel Corp., Vernon, Calif.—$204,000 for conceptual studies for nuclear rocket stage static test facilities.

TROUBLE-FREE POWER FOR
TROUBLE-SEEKING NEPTUNES

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

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

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

Red Bank Division THE Bendix CORPORATION

Industry/Government Relations Analyzed

(A penetrating analysis of the state of the aerospace industry's relations with its principal customer—the U.S. government —was given to top industry and Air Force Systems Command officers at AFSC's recent management conference at Monterey, Calif. (AW May 14, p. 26), by William M. Allen, president of the Boeing Co. Because of clear enunciation of industry's fundamental approach to the business of defense, AVIATION WEEK & SPACE TECHNOLOGY *is publishing his analysis.)*

. . . What is the principal challenge confronting the management of an industrial concern that is engaged in the performance of military work for our government? In my opinion, that challenge is: Should the government use private industry to design, develop and build its weapon systems?

Now you may immediately say: Why pose this as a challenge? The answer is, of course, that the government should rely on private industry. That is the way we operate in this country.

But let us not jump readily to such a conclusion. If the government-industry relationship is to produce satisfactory results, certain ingredients essential to that relationship must be present. I seriously question whether these ingredients are all present, at least to the degree that is required to bring about the results which our security demands. What are some of the conditions that are so necessary if the government-industry relationship is to work as it should and could? Let us look at certain of the ingredients which the customer, the government, should contribute.

In the first place, the government must recognize and believe in the benefits to be derived from the use of private industry, and must encourage the development of the factors that make these benefits possible. I should make clear that when I refer to "government," I am talking primarily of the Legislative and Executive branches of our government.

Take the Legislative branch—the Congress. I suppose if our federal legislators were polled, the great majority would say that they favor the use of private industry as our weapons producers rather than design and production by government arsenals. But, in a true sense, would they all really mean what they say?

Permit me to illustrate. We know that one of the most powerful reasons for relying on private industry is to reap the benefits of that all-important element of competition. But we are also quite familiar with the pressures and public statements of certain of our legislators designed to influence the placing of military business on the basis of need for employment or geographical distribution. There is no better means of destroying the benefits to be gained through reliance on private industry than to award military business on a basis other than merit. I make the point that the legislator who espouses pork barrel philosophy in the award of military business doesn't really believe in the use of private industry to design and build our weapon systems. And I might add that the contractor who stimulates such activity is in a very real sense participating in the elimination of private industry in the defense effort. Take another example. We see isolated transactions being used before congressional committee hearings which create the impression with the public that the government has been gouged by the military contractors, when, in reality, the over-all result from the standpoint of the government has been good.

Believe me, I am not offering a defense of deliberate misfeasance. However, there is a vast difference between a transaction involving a calculated wrongdoing and one entered into in good faith, with the always-present pressure of getting an important job done, and with the responsible government service fully cognizant of the responsibilities, conditions and objectives of the procurement. To use profit rates based on only a portion of costs, gives profit rates like no one has ever used before. Publicizing such rates without adequate description or standards for comparison creates impressions with the public that are completely unjustified.

It is perhaps unnecessary to state that investigators do not point out transactions where low profits or losses are incurred, or evidence of the over-all economic results of the weapon system industry, or of individual contractors showing, as compared with industry generally, extremely low profit margins. From the headlines that are made available to the public, only one conclusion is encouraged, namely, that our government and the American people are getting a very bad deal from private industry engaged in providing our weapon systems. Emotional and political pressures are generated which impede the proper utilization of private

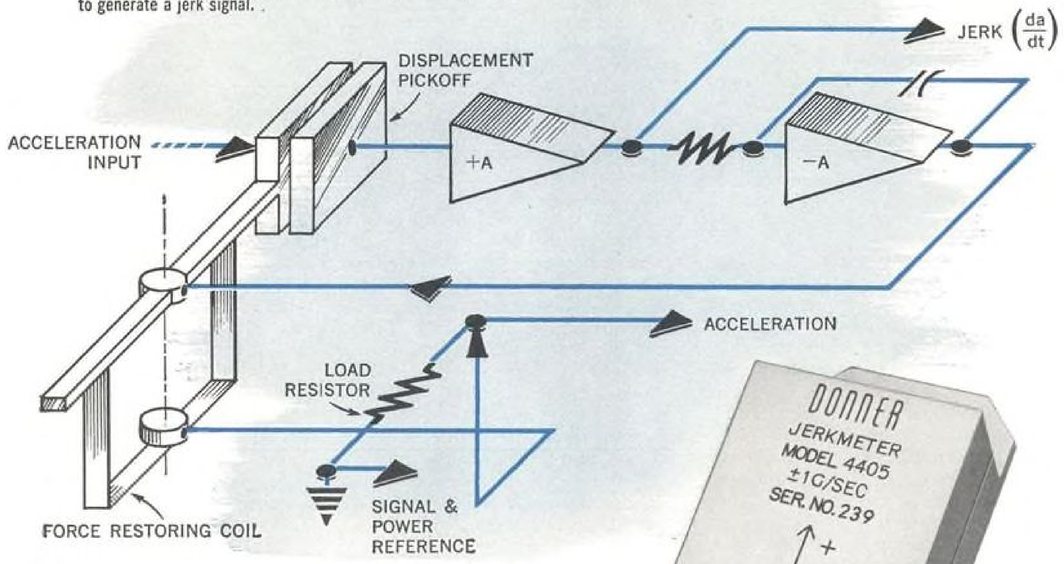
His long experience as a lawyer makes it a natural step for William M. Allen to speak as advocate for the entire aerospace industry as well as for the Boeing Co., whose president he has been since 1945. His summation in 1956 of the case for industry before the House Armed Services Committee (AW Mar. 5, 1956, p. 20), where specific issues such as profit margins were of prime concern, makes a significant comparison with his Monterey speech where even more fundamental issues are analyzed. Allen's career with Boeing since he took over the presidency at the age of 45 has covered many industry crises

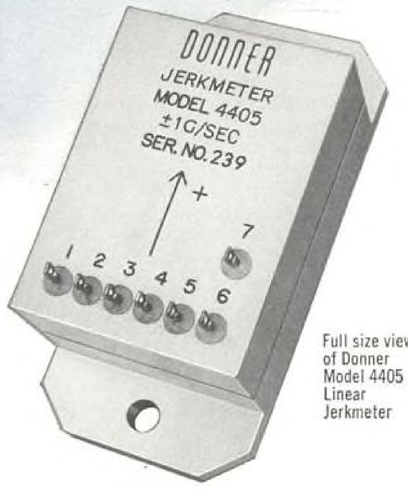
After 20 years in law practice and as adviser to Boeing as company counsel, Allen was thrust into the role of decision-maker almost the moment he assumed the Boeing presidency when wholesale terminations of World War 2 contracts stopped virtually all work at Boeing plants. His response then was to put Boeing into the commercial transport business, a decision that foreshadowed Boeing's building of the 707.

A native of Lolo, Mont., and a graduate of Harvard Law School, Allen entered law practice in Seattle with the firm of Donworth, Todd and Higgins, which later became Holman, Sprague and Allen. Through the firm, counsel for Boeing, Allen participated in organization of Boeing Air Transport, Inc., and in the creation of Boeing Airplane Co. when the United Aircraft and Transport Corp. was ordered dissolved by the government in the mid 1930s. As a significant footnote on the subject of industry-government relationship, Allen drew up the first cost-plus-fixed-fee contract at the time of industry mobilization for World War 2, a contract which later became a model for this type of procurement.

WILLIAM M. ALLEN

Functional diagram of Donner Linear Jerkmeter. This unique instrument operates as a subminiature servo-system of the force-balance type which is responsive to jerk along the sensitivity axis of the linear unit and about the sensitive axis of the angular unit. Basically, the system consists of a transistorized accelerometer with an integrator inserted into the servo-loop to generate a jerk signal.





Full size view of Donner Model 4405 Linear Jerkmeter

HOW TO MEASURE $\frac{da}{dt}$

New Donner precision Jerkmeters measure linear and angular jerk to ±0.5% or better.

If your measurement and control problem requires accurate measurement of jerk or the rate of change of acceleration, Donner Scientific's new line of precision angular and linear jerkmeters can help.

These new instruments are the only truly accurate device of this type ever made. They are designed to meet the most demanding applications. Both angular and linear jerkmeters provide an output voltage proportional to jerk which in turn can be used to instigate compensatory control forces or other actions. *An acceleration analog output voltage is also available.*

Typically, a jerkmeter installed in a jet aircraft will provide an instantaneous output proportional to the rate of change of g's. This signal can be used to predict impending disaster conditions.

Other applications include use wherever constant acceleration is required. Here, the Donner jerkmeter provides a "velocity-damping" term. The jerkmeter also provides a third order term for stabilizing displacement devices. It can also be used as an inertial indicator of first motion.

KEY SPECIFICATIONS for Model 4405 Linear Jerkmeter

RANGES
Acceleration: ±1 g full range to ±30 g full range
Jerk: ±0.5 g/sec full range to ±20 g/sec full range

OUTPUT FULL SCALE
Accelerometer: ±7.5 v dc
Jerk: ±7.5 v dc

RESOLUTION
0.1% full scale or better

LINEARITY
0.1% full scale or better

HYSTERESIS
Less than 0.1%

POWER
+15 v dc at 10 ma and −15v dc at 10 ma

SIZE
3" long, 1½" wide, 1⅝" high

WEIGHT
7.5 ounces

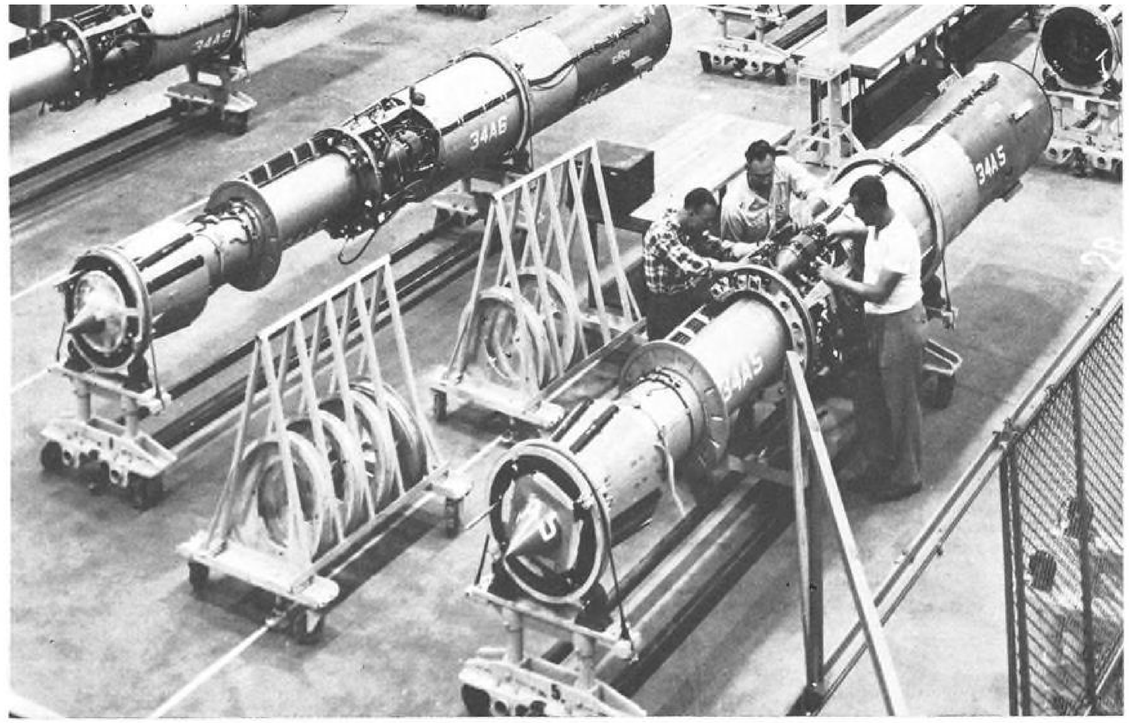
WANT MORE INFORMATION? *The new Donner Jerkmeter is another product from a firm specializing in the manufacture of accurate fixed and general purpose analog systems designed to analyze, measure, and control inputs interlocking time, acceleration, jerk, velocity, and other dynamic inputs. Complete technical information can be obtained by calling your nearby Donner engineering sales representative or writing.*

DONNER SCIENTIFIC DIVISION

SYSTRON-DONNER Corporation

CONCORD, CALIFORNIA

22



Talos Produced for Nuclear-Powered Cruisers

Navy/Bendix Talos surface-to-air missiles, in production as primary armament for nuclear-powered cruisers, are built around a central hollow body which ducts the air from the spiked inlet to the ramjet powerplant. Missile on holding fixture in foreground has a covering plate over its nose inlet to protect the sharp leading edges. Ring frames divide the annular body into bays for equipment; three workers are at the section which mounts the Talos movable lift/control surfaces. The nearly empty bay forward on the missile carries the annular warhead. Section forward of that is presumably for engine controls. Fixed tail fins clamp to the four stub fittings which can be seen near the exit of the combustion chamber. Exhaust nozzle section has not been installed on the missiles shown here.

industry in providing defense equipment.

So much for the Legislative branch of our government. How does the Executive branch feel about private industry designing, developing and building our weapon systems? I include within the Executive branch, the military as well as civilian executive departments and administrative groups such as the Renegotiation Board.

Here again, I believe that a majority of those who constitute the Executive branch of the government would state that they favor the procurement of our weapon systems from private industry. But again, I ask the question: Does this majority favor all of the necessary ingredients required to make the government-industry relationship work as it should? I would at least question whether this majority has a proper understanding of these essential elements.

Perhaps I can best illustrate my question by discussing a subject which, unfortunately, has come to have an almost evil connotation. One only uses the word in a dark alley, and then, in muted tones. I refer, of course, to the very cornerstone of our private enterprise system—profits. For without adequate profits, no business—and this is certainly true in the defense business—can survive over a substantial period of time. Not only will the owners of the business withdraw their support, and invest where a reasonable return is forthcoming, but the enterprise, through inability to engage in research and development and to improve or acquire new facilities, becomes moribund, loses its vitality, and dies.

Profits Must Work

From what I have just said, I am sure you understand that I am talking about profits only as an essential element in achieving objectives. Money in industry is only of value if it is used as a working tool. In a talk last February, Gen. Bernard A. Schriever AFSC commander said, "The goal of all our efforts, both military and civilian, is the emergence of a peaceful world community of free and independent states." To this statement I wholeheartedly and completely subscribe. The General has stated the objective. I am discussing profits as an essential element in the achievement of the objective, if private industry is to be relied upon in the design and production of our weapon systems.

I often think of this matter of a proper understanding of the function of profits as applied to our own employes or the public—the man on the street. They see, for example, that a defense contractor had sales in excess of a billion dollars, with a net profit of $25, 30 or 35 million.

"That is a lot of profit," they say. "The stockholders are certainly getting rich."

They do not know that the owners of the business get only 30% of the earnings, and that the remaining 70% is plowed back into the business, being used primarily for research, new facilities and working capital. If this were not done, the company would wither on the vine. Even with this high retention of earnings—industry generally retains around 45%—defense contractors must rely extensively on long-term indebtedness and bank borrowings, with interest to be paid from earnings.

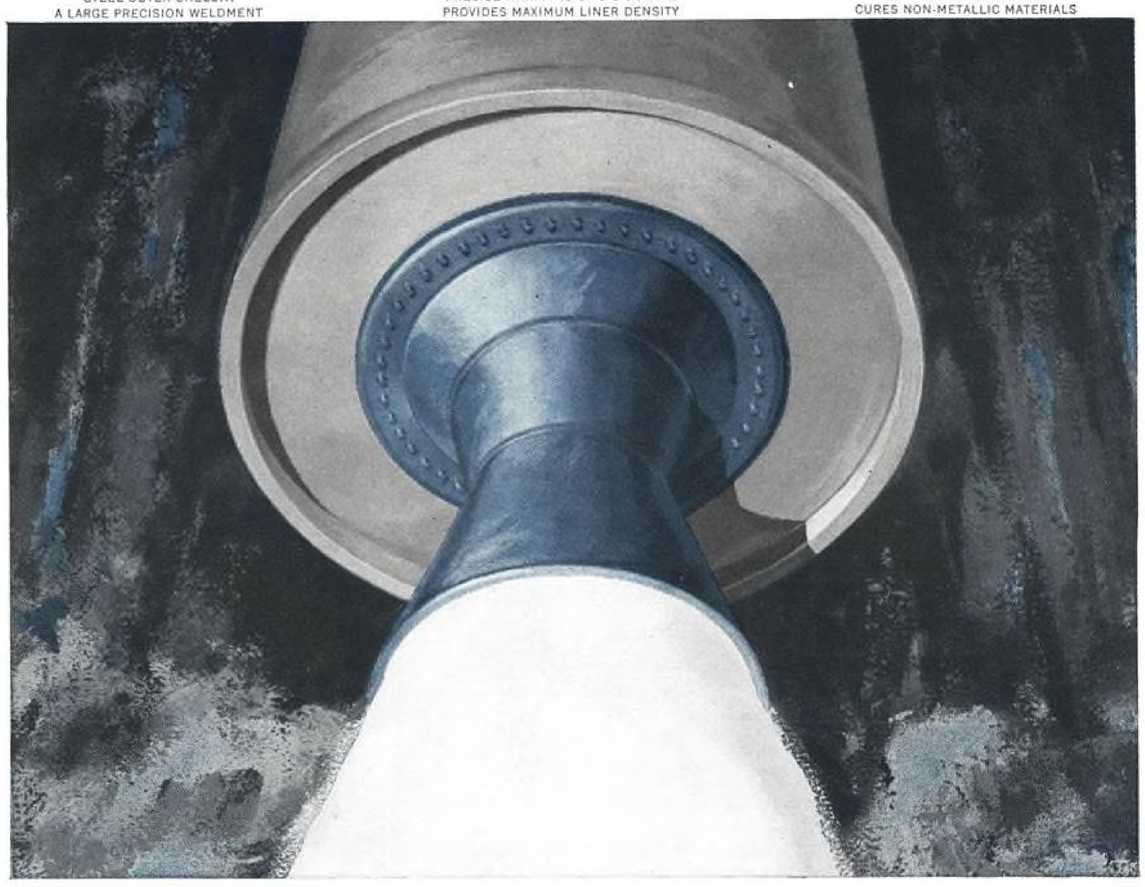
The companies in our industry live in a specific economic environment. They operate in a private enterprise economy in which each unit competes for the resources—human, physical and monetary—with all other enterprises in the total economic environment.

But our particular industry, in providing military and space equipment, differs from other industry in that it has a single and very powerful customer which is in a position to dictate the

STEEL OUTER SHELL...
A LARGE PRECISION WELDMENT

PRECISE WRAPPING OF SILICA TAPE
PROVIDES MAXIMUM LINER DENSITY

NEW ROHR HYDROCLAVE
CURES NON-METALLIC MATERIALS



Rohr nozzle beats the heat! 6000 degrees for 120 seconds

during the historic test firing of the nation's largest solid rocket motor by Lockheed Propulsion Company

Working to Lockheed specifications, Rohr translated requirements of the nozzle into materials and production processes... designed and installed special machines... and delivered on schedule in 120 days. It's the largest nozzle of its kind ever built... another result of the years of Rohr experience in precision steel weldments and extensive research and manufacture in the field of non-metallic materials. The solid booster nozzle is a logical extension of the Rohr product line... a follow-on to the fabrication of filament wound rocket engine cases and other rocket and missile components. For additional information concerning Rohr capabilities address Marketing Manager, Dept. 112, Rohr Corporation, Chula Vista, California.

Main Plant and Headquarters: Chula Vista, Calif./Plant: Riverside, Calif./Assembly Plants: Winder, Ga.; Auburn, Wash.
Offices in Washington, D.C. and Huntsville, Ala.

ROHR CORPORATION

amount of earnings the contractor will be allowed to obtain or retain. These earnings, in turn, determine how successful that company, or industry, can be in competing with the rest of the economy for the needed human, physical and monetary resources. If it cannot command the necessary resources, its abilities will suffer. Yet the international competition in which we are engaged does not permit our industry to apply anything less than top ability to the job before us.

An important industrialist recently said, "profit and the prospect of profit are the only energizers of the investments that create new self-sustaining productive jobs." In my opinion, this irrefutable economic fact is not understood or believed by a large segment of the American people. And to these in government, I ask the question: How thoroughly do you believe it? . . . Irrespective of where the fault lies, the government-industry relationship is not what it should be, lacking much of the confidence and mutual respect that are essential to produce the best results.

You are certainly aware of the erosion that has taken place in recent years in the degree of reliance that the military has placed upon industry. Clearly, the supervision we now experience of every minute detail of our operations is not consistent with any great degree of confidence on the part of our military customers in the way we run our business. In fact, there has been a substantial lessening in recent years in the degree of reliance that the military places on industry. This I do not like, nor do I believe it is good for the country, assuming—and I emphasize this assumption—proper performance on the part of industry.

So we must pull back and ask ourselves: How much of this deterioration —and in my view that is an accurate

MATS C-135 Seats

Aft-facing passenger seats capable of withstanding loads up to 16g have been developed for Military Air Transport Service/Boeing C-135 jet transports by Aerotherm Division of Aerotec Industries, Inc., Bantam, Conn. Welded steel chassis has irreversible energy absorber in rear vertical leg assembly which can absorb 3,180 ft. lb. of energy.

No other switch package can stand such vibration

Strong claim? Yes! But we've been told that the KLIXON® AT-28 Switch Package has far more vibration resistance than the next best thing.

The test? Random scramble at 97G's 0-2000 cps vibration . . . the most severe test any switch package has ever been asked to pass. Yet, AT-28 performs throughout the test without circuit interruption of its 5 amp load. It must pass the test because its function is to indicate the position of propellant valves in one of our most vital missiles.

The switch? Inside this rugged package is the smallest hermetically sealed snap-acting switch in the world . . . The KLIXON AT1. . . . . reliability-proved in switch packages in many missile, satellite, aircraft applications. Weight—less than a gram. Ambient temperature range: -65° to +275°F. Shock resistance: 200G's. Operating life: 25,000 cycles. In addition, the plunger that actuates the switch has ice-breaking properties and is environment free. Bulletin PRSW-11 gives all the facts.

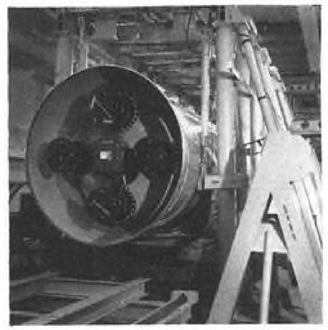
Fast-response engineering of special KLIXON switch packages designed to meet your specifications is available at no extra cost from our packaging facility. Let us know what your switch problems are today.

KLIXON AT1
HERMETICALLY SEALED
SNAP-ACTING SWITCH
(actual size)

METALS & CONTROLS INC.
2805 FOREST ST., ATTLEBORO, MASS.
A CORPORATE DIVISION OF
TEXAS INSTRUMENTS
INCORPORATED

Minuteman test flight

Missile assembly



Dynamics test

Ground support, transporter-erector

Minuteman electronics assembly

Base-Construction Surveillance

Management techniques: PERT

Electronic circuit inspection

Weapon system assembly at sites

MINUTEMAN

Minuteman system integration—by Boeing Aero-Space Division

From electronics to the latest business systems and techniques, Boeing's Aero-Space Division employs a wide range of capabilities as Minuteman weapon system integrator.

The Division is responsible for Minuteman missile assembly, test, launch control and ground support. Working with the Air Force Systems Command, Aero-Space coordinates the work of associated contractors and exercises surveillance over base construction. It also assembles at base sites the final weapon system, including support and launch systems. Prominent among the latter are Boeing-designed and built electronic systems.

The Division has more than 4,000 employees wholly engaged in electronics engineering, manufacturing or in the support of these activities.

Minuteman has been described as "an economical breakthrough" in terms of procurement and maintenance costs. This Strategic Air Command weapon system will be operational late this year, a year ahead of original schedule.

BOEING
AERO-SPACE DIVISION

name for it—can be properly laid at the door of industry, and what can industry do about it? That we sho ld bear a portion of the blame, I have no doubt. I believe the instances of deliberate misfeasance are rare. The area, of course, where we can principally contribute is through improved performance. I will not presume to speak for industry, but in our company, we never do a job but that, in retrospect, we see instances where we could have performed better —more efficiently. . . . However, I first am compelled to state that I am not at all sure that the degree of reliance to be placed upon defense industries can be substantially increased through improved performance.

It would appear that the direction in which we have been moving in recent years in the defense business is consistent with changes that have been taking place in the American way of life—a greater participation by government, a continuing movement toward a managed economy. I do not propose to argue the pros and cons of this immense subject, and I only mention it because I do not want to leave the impression that I believe that our industry has wholly within its power the determination of its own destiny. It doesn't. Nevertheless, we must do what we can, and herein lies, in my opinion, the most important management challenge confronting our industry.

Of first importance is the necessity that we constantly endeavor to improve our performance. Every management tool that we can devise to reduce costs and improve the quality of our products must be employed.

Suffice for me to say that we cannot expect our government to fully rely upon industry to design and build our weapons systems unless industry justifies this reliance by a top-drawer performance. But, important as it is, excellent performance is not in itself sufficient. In addition, industry must do its best to convince our government and the American people that, through the employment of the true principles of the free enterprise system, we will gain the greatest measure of security. I refer, particularly, to the great benefits derived from competition and the motivation provided by our profit system. As I have endeavored to make clear, there is every indication that these benefits are either not understood or believed by important segments of our government and the American people.

In my view, the government-industry relationship in our defense effort provides a severe test of the survivability of the elements of free enterprise. Government is the sole customer, with authority to allocate the total job between government agencies and private industry, to determine who shall get business —and why—and for how much. Obviously, the elements from which flow the benefits of free enterprise, competition and profits, will flourish only to the extent that they are permitted and encouraged by the government. The temptation is great to ignore or temper these essential elements and thereby give the appearance that the interests of the American people are fully protected. It takes strength and courage within government to adhere to the principles and objectives that will get us weapons systems of the highest quality, economically and on schedule.

I firmly believe that our security requires a strong and effective participation by private industry in our defense effort. Accepting its challenge, industry can and must do better. The means at our disposal to improve our performance are many. They must be utilized. Our best will be none too good. On the other hand, if the great benefits obtainable through free enterprise are to be realized, the essential ingredients of the system must be recognized and encouraged by our government and the American people. In my view, the results achieved through competitive effort and the profit system are not obtainable by any other system as yet devised by man.

LYCOMING'S T53 FUEL NOZZLE

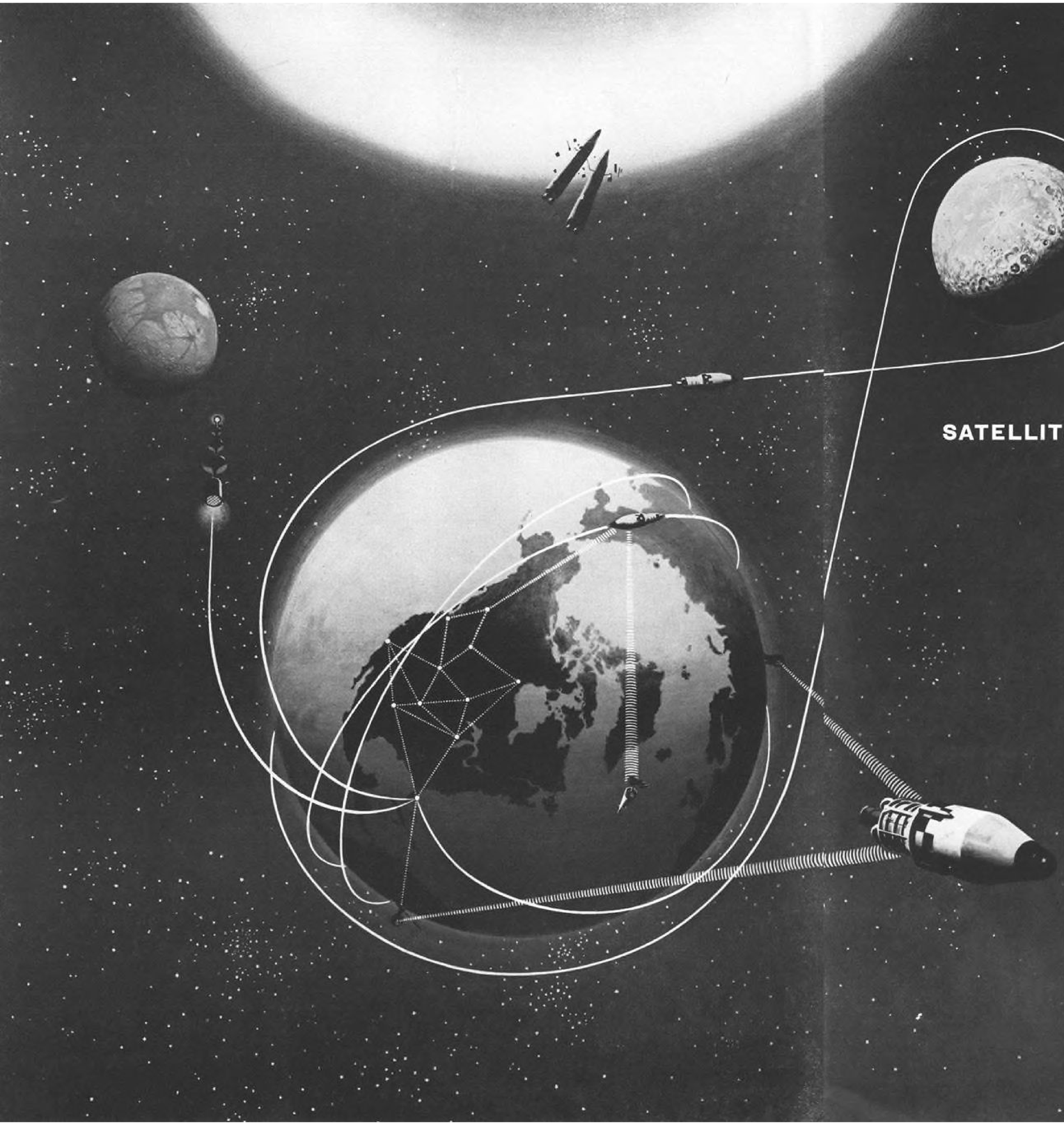
A PRODUCT OF DELAVAN EXPERIENCE

The Lycoming T53 small gas turbine engine is currently in use on helicopters, observation aircraft and in Marine and industrial applications. This is the fuel injection nozzle developed by Delavan for the T53.

If one word were chosen to sum up the reason for Delavan's success on this fuel nozzle program, that word would have to be experience. Experience in designing highly functional, reliable fuel delivery and metering devices; experience in large scale manufacturing of the intricate and precise parts that make up a fuel nozzle, and experience in controlling the quality and performance of these devices on a mass scale.

Add this experience to Delavan's willingness to react quickly to the urgent needs of a dynamic industry and the results are always the same . . . excellent quality, a good delivery record, and reasonable prices. Be sure Delavan is a part of your engine program.

DELAVAN
Manufacturing Company
WEST DES MOINES, IOWA



SATELLITE AND SPACE SYSTEMS SPECIALISTS

Here at Lockheed Missiles and Space Company, satellites and spacecraft are a specialty. From research to the reaches of space, the whole scope of space technology is being carefully investigated.

All aspects of research, systems analysis, design, development and operation are handled by outstanding engineers and scientists at Lockheed's Research Laboratories in Palo Alto, and in the development headquarters in nearby Sunnyvale, California.

Typical of Lockheed's complete capability is the DISCOVERER series. This, with its recoverable capsule, is used to gather research material. Other military and commercial satellites and spacecraft under study, under development, or in operation, include:

An infrared missile defense alarm system • Sophisticated orbiting biomedical capsules • Lunar probes • Interplanetary exploration programs A space rendezvous system • Nuclear and other advanced propulsion systems Communications satellite systems

It is clear that the projects at Lockheed Missiles and Space Company are challenging. Moreover, its location on the beautiful San Francisco Peninsula adds gracious living and perfect climate to the many rewarding opportunities available to creative engineers and scientists.

For further information, please write: Research and Development Staff, Dept. M-32 **G,** 599 Mathilda Avenue, Sunnyvale, California.
An Equal Opportunity Employer.

LOCKHEED *MISSILES & SPACE COMPANY*

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

Systems Manager for the Navy POLARIS FBM and the Air Force AGENA Satellite in the DISCOVERER and MIDAS programs. Other current programs include SAINT, ADVENT and such NASA projects as OGO, OAO, ECHO, and NIMBUS.

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA • CAPE CANAVERAL, FLORIDA • HAWAII

Aerospace Industry Sales, Backlog Reported for 1961

Aerospace industry sales rose and backlog fell in 1961, according to Bureau of the Census tabulations. However, expanded coverage of the new Census figures means that the 1961 figures (chart at right) are not strictly comparable with those of previous years. The table below shows net new orders for the industry, broken down by quarters and into prime and subcontract categories. Net new orders, which are orders received during the year less terminations during the same period, represented 96% of total end-of-the-year backlog. At the end of 1961, backlog was divided into complete aircraft and parts, $5,669 million, 8% below 1960; aircraft engines and parts, $1,545, a 4% drop, and missile and space vehicle systems and parts, $3,844 million. No previous comparison is available for the last category.

(All figures in millions of dollars)

Year	Backlog Jan. 1	Net new orders during year[1]	Net sales during year	Backlog Dec. 31
1961	15,462	[2] 13,428	14,940	13,950
1960	12,120	11,373	10,997	[3] 15,462
1959	13,171	10,204	11,255	12,120
1958	14,531	10,110	11,470	13,171
1957	18,350	7,947	11,766	14,531
1956	15,705	12,141	9,496	18,350
1955	14,852	9,323	8,470	15,705

[1] New orders received during year less terminations during year.
[2] Includes prime contracts of $12,140 million and subcontracts of $1,288 million.
[3] The backlog figure as of Dec. 31, 1960 differs from that previously published due to (a) increased number of companies now within the scope of the survey and, (b) revisions to previously reported data.

Value of Aerospace Industry Net New Orders—1961

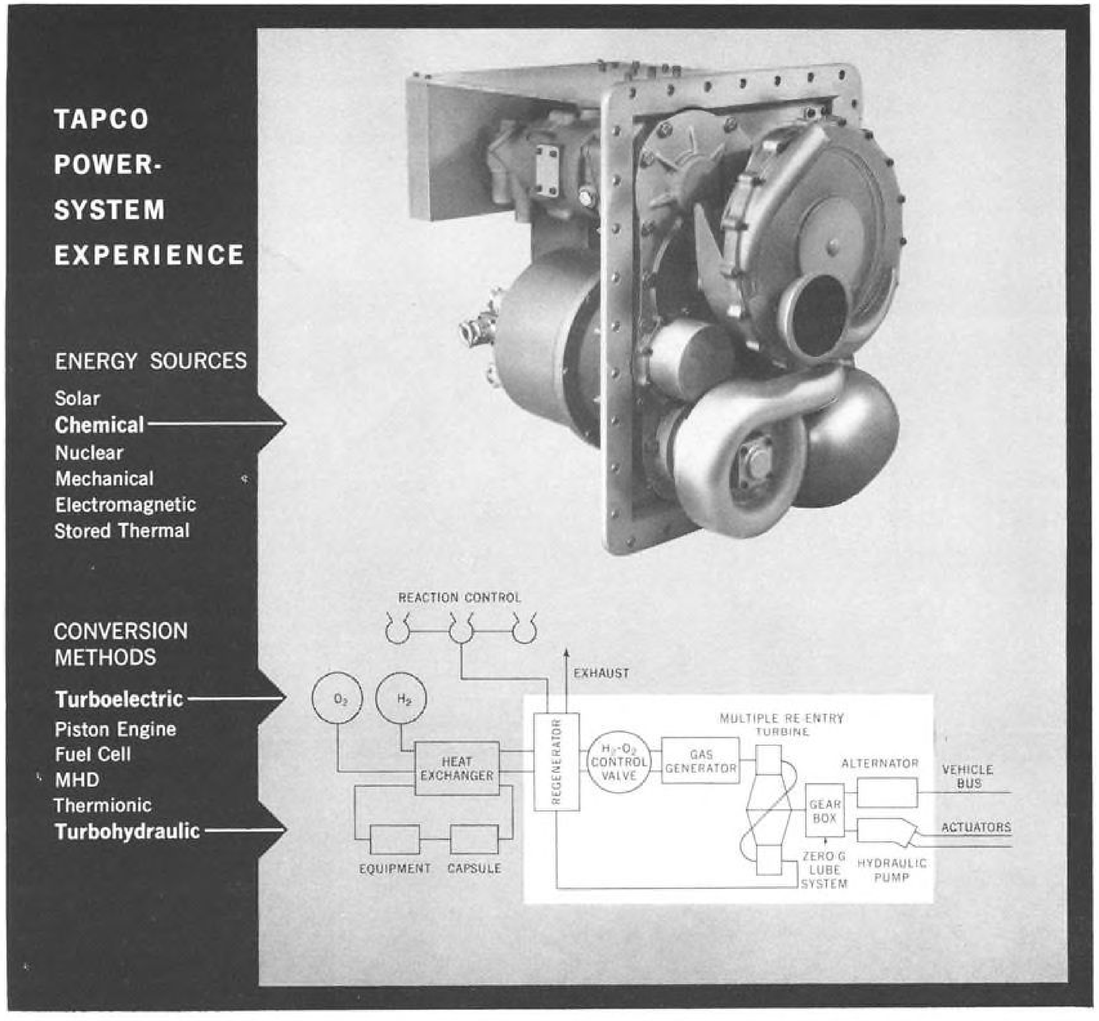
(All figures in millions of dollars)

Product	Total		First Quarter		Second Quarter		Third Quarter		Fourth Quarter	
	Prime contracts	Subcontracts	Prime contracts	Subcontracts	Prime contracts	Subcontracts	Prime contracts	Subcontracts	Prime contracts	Subcontracts
	1961									
TOTAL[1]	12,140	1,288	2,531	293	3,098	255	3,115	410	3,396	330
United States Government	10,476	xxx	2,249	xxx	2,455	xxx	2,708	xxx	3,064	xxx
Other customers[2]	1,664	1,288	282	293	643	255	407	410	332	330
Complete aircraft and parts, total	3,786	181	634	27	1,039	24	1,140	75	973	55
United States Government	2,875	xxx	464	xxx	622	xxx	940	xxx	849	xxx
Other customers	911	181	170	27	417	24	200	75	124	55
Aircraft engines and parts, total	1,410	21	276	3	316	3	277	5	541	10
United States Government	948	xxx	213	xxx	171	xxx	153	xxx	411	xxx
Other customers	462	21	63	3	145	3	124	5	130	10
Missile and space vehicle systems, engines, propulsion units and parts, total	4,054	317	1,035	93	969	100	1,019	71	1,031	53
Missiles and space vehicle systems and parts:										
Missile systems	2,619	62	557	6	616	21	815	22	631	13
Space vehicle systems, United States Government, military	761	26	289	3	170	11	187	8	115	4
Engines and/or propulsion units for missiles and space vehicles (including parts), United States Government, military	569	129	185	25	142	58	79	23	163	23
Space vehicle systems and their engines and/or propulsion units, United States Government, nonmilitary	105	100	4	59	41	10	−62	18	122	13
Other aircraft, space vehicle and missile activities, total[3]	1,694	563	296	115	530	86	317	216	551	146
United States Government	1,638	xxx	289	xxx	513	xxx	294	xxx	542	xxx
Other customers	56	563	7	115	17	86	23	216	9	146
All other products and services, total[4]	1,196	206	290	55	244	42	362	43	300	66
United States Government	956	xxx	241	xxx	177	xxx	300	xxx	238	xxx
Other customers	240	206	49	55	67	42	62	43	62	66

[1] New orders during quarter less terminations during quarter; data for terminations are not shown separately to avoid disclosing figures of individual companies.
[2] Includes some reported values, primarily those associated with subcontracts, shown under "Missile and space vehicle systems, propulsion units, engines, and parts" even though such values were reported as United States Government orders.
[3] Includes all conversions; modifications; site activities; other aerospace products (including drones) and services not included above; and receipts for applied research and development on items such as drones, etc. Receipts for other applied research are included with figures for the respective reporting categories.
[4] Includes all nonaircraft, nonspace vehicle, and nonmissile products and services; and all basic research.

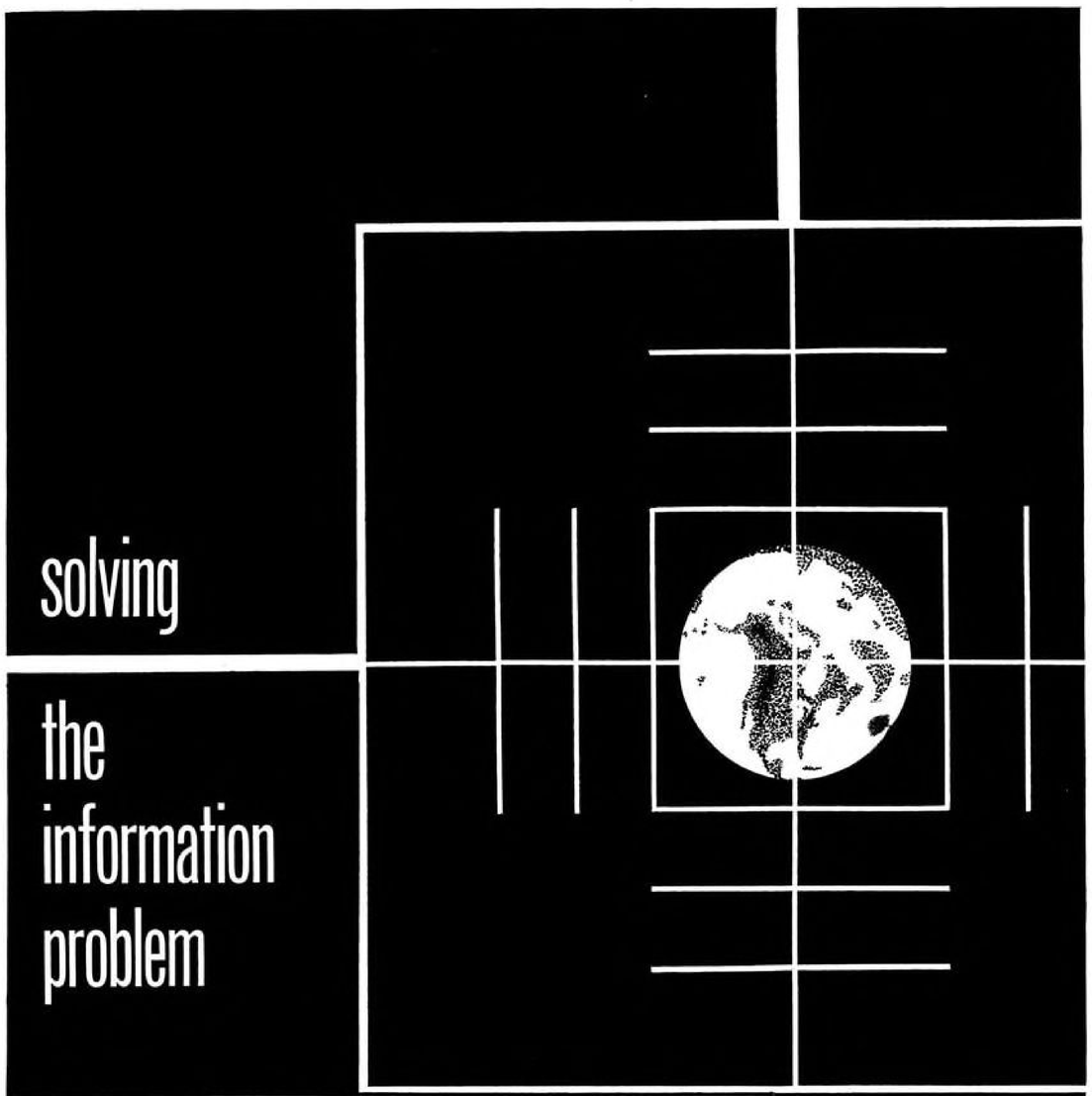
TRW TAPCO
Thompson Ramo Wooldridge Inc.

POWER SYSTEMS BY TAPCO — Combining extensive energy-conversion experience with a high degree of interface-systems intelligence, Tapco insures that trade-off studies will yield the most practical power system in terms of specific weight, reliability and operational flexibility.



Cryogenic Regenerative APU: Chemically fueled, open-cycle, dynamic system integrated to provide electric and hydraulic power, reaction control and environmental cooling aboard manned space vehicles on moderate-duration missions. System is readily adaptable for outputs to 100 kw electric and 20 gpm hydraulic. Nucleus of system is unit shown above containing multiple reentry turbine, alternator, hydraulic pump, lubrication and control subsystem. Turbine utilizes liquid H_2 and O_2 as energy source. By using H_2 as coolant, and exhaust regeneration, very low specific propellant consumption is achieved. Integration of energy source also provides all payload cooling, i.e., equipment and capsule. Performance of all system elements has been demonstrated. TAPCO, a division of Thompson Ramo Wooldridge Inc., 23555 Euclid Avenue, Cleveland 17, Ohio.

DESIGNERS / MANUFACTURERS FOR SPACE, MISSILE, AIRCRAFT, ORDNANCE, ELECTRONIC, NUCLEAR INDUSTRIES



. . . FROM INNER TO OUTER SPACE Itek applies a blend of skills in Information Technology to the management of critical data. A novel panoramic-photographic technique for seismological recordings . . . a tracking camera with a 20-foot focal length for aerospace instrumentation . . . a high-resolution, display system for long-distance transmission and manipulation of graphic/digital information . . . a comb-filter spectrograph for ultra-precise analysis of Doppler effects . . . a thermodynamic analysis of environmental disturbances for high-acuity, aerospace photo/optical systems . . . these are but a few of the programs in the current spectrum of Itek activity. May we apply this advanced capability for research, design, development, and precise fabrication to your information problem?

Write for: "a blending of skills in information technology", **to Dept. AV-120**

Itek

Itek Corporation
10 Maguire Road
Lexington 73, Massachusetts

Aerospace Industry Net Sales—1961-1960

(All figures in millions of dollars)

Product	Total	First quarter	Second quarter	Third quarter	Fourth quarter	Total	First quarter	Second quarter	Third quarter	Fourth quarter
	1961					1960				
TOTAL[1]	14,954	3,588	3,875	3,635	3,856	10,997	2,727	2,836	2,593	2,841
United States Government	11,531	2,754	2,913	2,860	3,004	(NA)	(NA)	(NA)	(NA)	(NA)
Other customers[2]	3,423	834	962	775	852	(NA)	(NA)	(NA)	(NA)	(NA)
Complete aircraft and parts, total	4,387	1,014	1,150	1,098	1,125	5,099	1,277	1,340	1,249	1,233
United States Government	2,945	648	753	766	778	3,333	857	865	802	809
Other customers	1,442	366	397	332	347	1,766	420	475	447	424
Aircraft engines and parts, total	1,455	350	371	314	420	1,330	359	344	277	350
United States Government	1,021	257	265	212	287	913	239	241	183	250
Other customers	434	93	106	102	133	417	120	103	94	100
Missile and space vehicle systems, engines, propulsion units and parts, total	5,214	1,290	1,327	1,283	1,314	(NA)	(NA)	(NA)	(NA)	(NA)
Missiles and space vehicle systems and parts:										
Missile systems	3,655	939	946	901	869	(NA)	(NA)	(NA)	(NA)	(NA)
Space vehicle systems, United States Government, military	551	128	130	138	155	(NA)	(NA)	(NA)	(NA)	(NA)
Engines and/or propulsion units for missiles and space vehicles (including parts), United States Government, military	796	191	200	190	215	(NA)	(NA)	(NA)	(NA)	(NA)
Space vehicle systems and their engines and/or propulsion units, United States Government, non-military	212	32	51	54	75	(NA)	(NA)	(NA)	(NA)	(NA)
Other aircraft, space vehicle and missile activities, total[3]	2,669	651	714	638	666	(NA)	(NA)	(NA)	(NA)	(NA)
United States Government	1,798	415	464	453	466	(NA)	(NA)	(NA)	(NA)	(NA)
Other customers	871	236	250	185	200	(NA)	(NA)	(NA)	(NA)	(NA)
All other products and services, total[4]	1,229	283	313	302	331	4,568	1,091	1,152	1,067	1,258
United States Government	788	184	194	192	218	(NA)	(NA)	(NA)	(NA)	(NA)
Other customers	441	99	119	110	113	(NA)	(NA)	(NA)	(NA)	(NA)

NA Not available.

[1] Totals for 1961 not exactly comparable with 1960 because of expanded data on missiles.

[2] Includes some reported values, primarily those associated with subcontracts, shown under "Missile and space vehicle systems, propulsion units, engines, and parts" even though such values were reported as United States Government orders.

[3] Includes all conversions; modifications; site activities; other aerospace products (including drones) and services not included above; and receipts for applied research and development on items such as drones, etc. Receipts for other applied research are included with figures for the respective reporting categories.

[4] Includes all nonaircraft, nonspace vehicle, and nonmissile products and services; and all basic research. Figures for 1960 include some values of missile and space vehicle systems, engines propulsion units and parts. The 1960 figures also include values for propellers and parts which were not collected separately for 1961.

USAF Contracts

Air Force Office of Scientific Research recently awarded the following grants and contracts to universities and non-profit and industrial research laboratories:

University of Oregon, Eugene, Ore.—$40,419 for study of microwave and optical properties of crystals.

Olin Mathieson Chemical Corp., New Haven, Conn.—$61,486 for study of superoxidizers.

Georgetown University, Washington, D. C.—$24,470 for research on vibrational energy levels of diatomic molecules.

General Electric Co., Knolls Research Lab., Schenectady, N. Y.—$72,076 for continued study of interactions of gases with non-metallic surfaces.

ARA, Inc., Studio City, Calif.—$38,789 for research on energy absorbing structures.

Westinghouse Electric Corp., Baltimore, Md.—$34,535 for continuation of analytical solutions to problems in orbital mechanics.

Lockheed Aircraft Corp., Lockheed Missiles & Space Co., Sunnyvale Calif.—$57,370 for continued development of a theory of steady and unsteady combustion of solids.

Stanford Research Institute, Menlo Park, Calif.—$35,000 for study of detonation characteristics of low density granular materials.

Aerochem Research Laboratories, Inc., Princeton, N. J.—$39,520 for contributions to the theory of interfacial rate processes in flow systems.

Thiokol Chemical Corp., Reaction Motors Division, Denville, N. J.—$65,863 for continued study of acceleration of heavy particles.

General Applied Science Laboratories, Inc., Westbury, N. Y.—$96,728 for continued research on hypersonic combustion.

Republic Aviation Corp., Farmingdale, N. Y.—$147,809 for continued study of electromagnetically induced chemical reactions.

Atlantic Research Corp., Alexandria, Va.—$43,960 for a study of the hydrogen-fluorine reaction.

Librascope Division, General Precision Inc., Glendale, Calif.—$25,075 for continued analytical simulation of neural behavior; $4,320 for continued development of association theory in data processing.

University of Georgia, Athens, Ga.—$30,000 for continued analysis of biosciences research.

Bolt Beranek and Newman, Inc., Cambridge, Mass.—$23,828 for study of transmission and coding of information in auditory nervous system.

Thomas J. Watson Research Center, Yorktown Heights, N. Y.—$24,988 for mathematical studies of non-linear circuits.

Syracuse University, Syracuse, N. Y.—$12,000 for continued research on problems in meromorphic functions.

Budd Electronics Division, Budd Co., Inc., Long Island City, N. Y.—$12,375 for pictorial data analysis concepts and techniques.

University of Southampton, Southampton, England—$12,600 for stereo-chemistry of Coordination No. 5.

Training Center for Experimental Aerodynamics, Brussels, Belgium—$12,660 for study of laminar separation in supersonic flow.

Technion Research & Development Foundation, Ltd., Haifa, Israel—$18,981 for research on buckling of conical shells under external pressure and combined loading.

Agricultural University, Wageningen, Holland—$12,000 for physical and chemical studies of chlorophyll systems.

University of Oslo, Oslo, Norway—$12,900 for study of functional significance of limbic, cerebral and cerebellar structures.

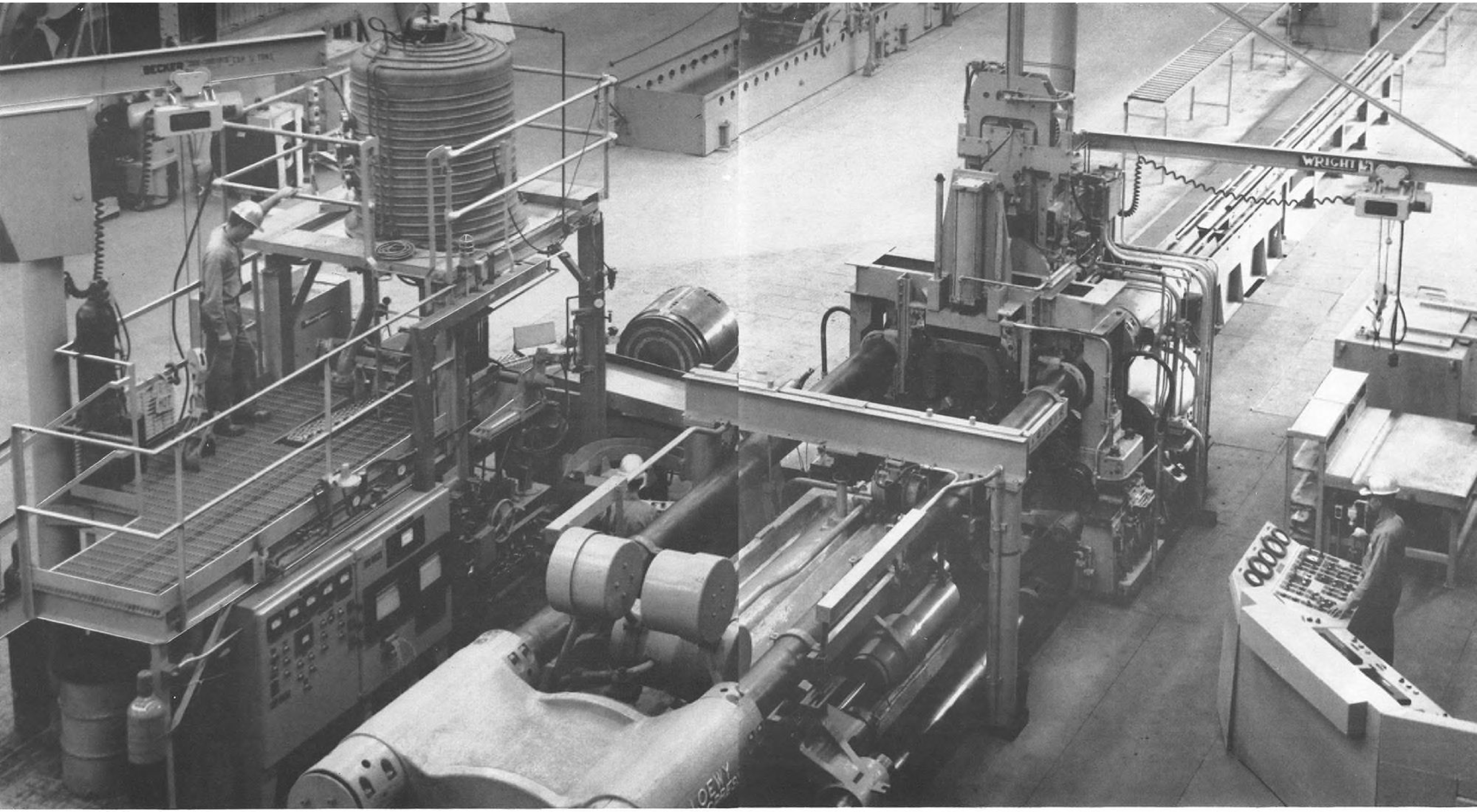
University College, Galway, Ireland—$6,323 for structural and biosynthetic studies of the phycobilins.

University of Oxford, Oxford, England—$8,000 for study of metabolism of C_3 compounds by micro-organisms; $11,480 for research on neural mechanisms, evaluation, genetics and behavior in certain diptera.

Centre National de la Recherche Scientifique, Gif Sur Yvette, France—$15,000 for study of nucleic acids and protein synthesis in micro-organisms.

Weizmann Institute of Science, Rehovath, Israel—$34,000 for study of mechanochemistry of coupled contractile and chemical rate processes; for research on biological significance of high molecular weight polypeptides; $48,262 for theoretical studies of many particle systems.

University of Erlangen, Erlangen, Germany—$11,000 for research in complex analysis.



Here's another reason why

The Du Pont Metals Center

is the only refractory metals plant of its kind

You won't find another extrusion press like this in the U. S. It's the only one designed expressly for columbium and other refractory metals.

It's unique in many ways.

The induction furnace on the left provides contamination-free heating of the billets prior to extrusion.

A specially designed rapid transfer mechanism quickly shuttles the billets to the extrusion press, minimizing contamination and heat loss.

The press itself is a high-speed 2750-ton unit with maximum ram speed of 10″ to 15″ per second at 2300 tons and 7″ per second at 2500 tons.

This is just part of the remarkable Du Pont Metals Center, the only refractory metals plant of its kind—specially developed from top to bottom for the production of refractory metals.

Du Pont produces ingots, billets, bars, sheet, strip, plate, tube hollows and shaped extrusions. At the Metals Center we are currently producing Du Pont-developed D-14, D-31, D-36 and other columbium alloys. The Center can also handle conversions for *other* makers of refractory alloys and super-alloys.

If you are a prime contractor to military and government agencies, or involved in projects requiring applications for refractory metals, we invite you to discuss your needs with one of Du Pont's experienced metallurgical engineers. For a Data Sheet on Du Pont Metal Products, write to Du Pont, D-2058, Wilmington 98, Delaware.

THE DU PONT METALS CENTER

Better Things for Better Living . . . *through Chemistry*

DU PONT

COLLINS CALL

FOR SCIENTISTS & ENGINEERS

EQUIPMENT DEVELOPMENT

BSEE — Elec. Eng. — 3 yrs. exp. HF or VHF (CR)
BSEE — Elec. Eng. — 3 yrs. exp. Automatic Test and Checkout (CR)
BSEE — Elec. Eng. — 6 yrs. exp. Power Servo Design (CR)
BSEE — Elec. Eng. — 3-5 yrs. exp. UHF (CR)
BSEE — Elec. Eng. — 3 yrs. exp. Command Control Systems (CR)
BSEE — Elec. Eng. — 3 yrs. exp. Radar Beacon Work (CR)
BSEE — Elec. Eng. — 3 yrs. exp. Television Transmission (CR)
BSEE — GSE Supervisor — 5 yrs. exp. Equipment Development (CR)
BSEE — GSE Eng. — 3 yrs. exp. Ground Support (CR)

SYSTEMS

MSEE — System Analyst — 5 yrs. exp. Modulation Technique (CR)
MSEE or equiv. — System Analyst — 5 yrs. exp. Tracking and Ranging (CR)
MSEE — System Analyst — 5 yrs. exp. Communications (CR)
BSEE minimum — GSE Integration Supervisor — 5 yrs. exp. Ground Support (CR)
MS or equiv. in Physics or Mechanics — System Analyst — 3 yrs. exp. Classical or Celestial (CR)
BS — Field Supervisor — 5-10 yrs. exp. Airborne Electronics and Communications (CR)
BS or equiv. in EE — Field Eng. — 3-5 yrs. exp. Com. (CR)
BSEE minimum — GSE Layout Eng. — 3 yrs. exp. Layout (CR)
BSME or equiv. — Mech. Eng. Supervisor — 8-10 yrs. exp. Management and Administration (CR)
BSME or equiv — Mech. Eng. — 3-5 yrs. exp. Packaging Designs (CR)
MSME — Mech. Eng. — 3-5 yrs. exp. Thermal Design and Evaluation (CR)
BSME or equiv. — Mech. Eng. — 3-5 yrs. exp. Environmental Test and Procedures (CR)
BSEE — Elec. Eng. — 4 yrs. exp. Circuit Design and Com. (D)
BSEE — Elec. Eng. — 3-5 yrs. exp. Microwave Systems (D)
BSEE — Elec. Eng. — 3 yrs. exp. Tropospheric Scatter (D)
BSEE — Elec. Eng. — 2-7 yrs. exp. UHF, Scatter, Microwave Systems Design (D)

GENERAL

BSEE or higher — Resident Eng. — 3-5 yrs. exp. Communications (CR)
BSEE or higher — Senior Staff Asst. — 8-10 yrs. exp. TV Theory (CR)
BSEE — Test. Eng. — 3-5 yrs. exp. Communication Design, Testing (CR)
BSEE — desirable — Logistics Eng. — 2-3 yrs. exp. Space Program Logistics (CR)
BSEE desirable — Logistics Supervisor — 3-5 yrs. exp. Space Program Logistics (CR)
BSEE or higher — R&D Eng. — 1-5 yrs. exp. Antenna Systems (D)
BSEE — Elec. Eng. — 1-5 yrs. exp. Design Review and Prediction (D)
BSEE — Project Test Eng. — 1-5 yrs. exp. Quality Assurance (D)
BSEE — Telephone Eng. — 4-7 yrs. exp. Central Office (D)
ME or IE — Staff Eng. — 2 yrs. exp. in MTM (D)

DATA

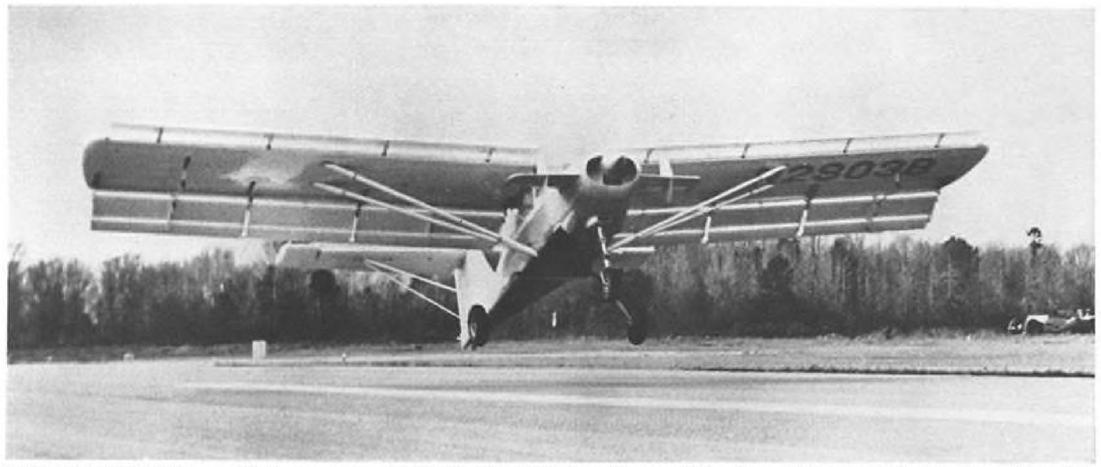
BSEE or higher — Senior Staff Asst. — 8-10 yrs. exp. Digital (CR)
MS or PhD — Applied Math — 10 yrs. exp. Business Computing (CR)
BSEE — Elec. Eng. — 5-8 yrs. exp. Digital Data Design (D)
Applied Math — Computer Programmer — hvy. exp. with Large Computers (D)
Applied Math — Business Programmer — ext. exp. Business Data Processing (D)
Applied Math — Scientific Programmer — ext. exp. Scientific Data Programs (D)
Math PhD — Logic Program Designer — ext. exp. Planning, Preparing Programs (D)

PLEASE NOTE

On listings marked (CR), send resume to L. R. NUSS, COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

On listings marked (D), send resume to C. P. NELSON, COLLINS RADIO COMPANY, DALLAS, TEXAS

COLLINS



SKYCRAFT SKYLARK leaves Ft. Rucker runway in flight test for U. S. Army Transportation Research Command to determine effects of its ULS system for low-speed flight control. Auxiliary control surfaces are mounted just behind the plane of the propeller.

Auxiliary Surfaces Boost STOL Control

By David A. Anderton

Auxiliary control surfaces mounted just behind the propeller plane on a conventional single-engine STOL aircraft may solve the problem of lack of control power at very low airspeeds.

Flight tests performed by Skycraft, Inc., of Ft. Worth, Tex., for the U. S. Army Transportation Research Command (Trecom) have shown that these surfaces increase control powers around all three axes more than 2½ times at a flight speed of 40 mph. Another result of the installation is that the minimum speeds with flaps down have been reduced, in the full-deflection case going from 40 mph. to 20 mph.

The auxiliary surface consists of a short-span stabilizer and elevator, with vertical fins and rudder surfaces mounted outboard. This unit is installed on the nose of the "Skylark," a single-engine protoype STOL aircraft developed under the direction of Skycraft's president, James L. Robertson.

Purpose of the installation is to avoid deterioration of control power as flight speeds decrease. In many cases, minimum speed of an aircraft is limited by controllability; the pilot runs out of control power well before the airplane would stall. This has caused many V/STOL aircraft to be rebuilt with ever-increasing control surface areas, particularly on the vertical tail.

The reason is that conventional tail-mounted controls are operating in an airstream with velocity equal to that of the aircraft's forward speed. There is no available velocity increment from propeller slipstream because the tail is either too far behind or too far above the combined slipstream and wing downwash flow pattern.

But auxiliary controls at the nose remain in the slipstream under all powered conditions of flight, and retain their effectiveness right down to the point where the engine is cut.

The ULS (Ultra-Low Speed) system, patented by Skycraft, was tested by Trecom to determine its effects on stability, controllability, performance, handling characteristics and maintenance. There were essentially no changes in any of these characteristics between the original Skylark and the ULS-Skylark, except at the minimum-speed end of the performance curves.

The ULS system gave a 50% reduction in minimum speed with 50-deg. flaps, a 100% increase in the approach flight path angle, 50% decreases in both takeoff and landing ground runs, and a 30% reduction in total landing distance over a 50-ft. obstacle (see box for complete performance figures).

Robertson told AVIATION WEEK there was no discernible difference in airplane stability with the ULS system installed or not installed. At 40 mph. flight speed, he said, the pitch control

Skycraft ULS System Performance

Item	Basic Airplane	ULS Airplane
Max. speed, sea level, 100% power	168 mph.	168 mph.
Max. speed, 10,000 ft., 100% power	202 mph.	202 mph.
Cruise speed, s.l., 75% power	140 mph.	140 mph.
Cruise speed, 10,000 ft., 75% power	168 mph.	168 mph.
Speed for minimum power, flaps 0 deg.	80 mph.	80 mph.
Speed for minimum power, flaps 30 deg.	50 mph.	50 mph.
Speed for minimum power, flaps 50 deg.	40 mph.	40 mph.
Minimum speed, flaps 0 deg	55 mph.	55 mph.
Minimum speed, flaps 30 deg	45 mph.	35 mph.
Minimum speed, flaps 50 deg	40 mph.	20 mph.
Rate of climb, sea level	1,150 fpm.	1,150 fpm.
Angle of approach, s.l.	10 deg.	20 deg.
Takeoff distance, ground run	168 ft.	85 ft.
Takeoff distance to clear 50-ft. obstacle	440 ft.	435 ft.
Landing distance, ground run	70 ft.	35 ft.
Landing distance over 50-ft. obstacle	410 ft.	288 ft.

ANOTHER SPECTACULAR SATURN LAUNCHING!

. . . with flex-metal tubing and ducting from Flexonics

Now the world has witnessed another highly successful launching of the mighty Saturn developed by National Aeronautics and Space Administration—the United States' biggest space vehicle, producing more than 1,300,000 pounds of thrust. Vital to this consistent performance are a total of 119 Flexonics propellant and other lines that supply fuel and oxygen to the cluster of eight Rocketdyne engines, as well as Flexonics interconnect and pressurization lines, and high-performance metal hose.

Engineers from Flexonics and George C. Marshall Space Flight Center, Huntsville, Ala., worked together in the designs of these components, just as they are now at work on future Saturn configurations. Teams of design and fabrication specialists adapted Flexonics precision-forming methods to the unique requirements of the Saturn. Exhaustive qualification tests, under simulated flight conditions, proved the soundness and reliability of design before the countdown of the first flight.

To simplify and expedite resolution of *your* next ducting problem, call on Flexonics.

Write for your copy of the big new Flexonics Engineering Guide and catalog of aerospace components.

Two of the Flexonics propellant lines mounted with the engine that they supply.

Close-up of one of the Flexonics 4" GOX "Y" collector high pressure manifolds.

Flexonics

DIVISION OF CALUMET & HECLA, INC.
232 East Devon Avenue • Bartlett, Illinois

FLEXIBLE METAL HOSE • BELLOWS
EXPANSION JOINTS
SPECIAL TUBULAR ASSEMBLIES

In CANADA
FLEXONICS CORPORATION OF CANADA, LTD.
BRAMPTON, ONTARIO

A-450R

MOVABLE CONTROL SURFACES mounted near the nose of Skycraft's test STOL Skylark airplane increased control power more than 2½ times at 40 mph. airspeed, and shortened both landing and takeoff distances.

power increased 256%, the roll power increased 250% and the yaw power increased 280%.

Control response was immediate, and hinge moments were linear, just as they would be in good conventional design, Robertson added. He pointed out that the control friction was too high in roll, but said that was a mechanical design problem that could be corrected and was not inherent in the basic layout of the ULS system.

He said that Army reported no maintenance problems with the unconventional surfaces.

The Skylark aircraft was originally developed as an STOL design by Robertson. It uses full-span, double-slotted flaps and leading-edge slots to obtain high lift coefficients at high angles of attack.

Work on the project as a conventional airplane is continuing; these tests were initiated to demonstrate the ULS system only.

Air Force to Resume Deactivation of B-47s

Washington—Phasedown of B-47 jet bombers will be resumed this summer by the Air Force after it was interrupted last year due to the Berlin crisis. One wing will be deactivated this summer and five more will follow between January and June of 1963.

From the present 17 wings of 45 aircraft each, plus spares, the active B-47 strength will drop to 11 wings, or 495 aircraft. Present planning calls for complete phaseout of the six-jet Boeing's by June, 1965. This could be speeded, however, if the Air Force intercontinental ballistic missile systems become operational in substantial numbers. B-47s have been operational since 1951.

As a result of the phasedown, the 4347th Combat Crew Training Wing at McConnell AFB, Kansas, which operates in support of B-47 operations, will reduce its activity. Its number of operational aircraft will be reduced from 90 to 45 by June of this year.

The 388th Tactical Fighter Wing, operating North American F-100 aircraft, will be formed at McConnell to use facilities made available by the 4347th Combat Crew Training Wing. Eventually, two Titan 1 ICBM missile squadrons will be assigned in the McConnell AFB area.

Lowering Device

"Sky Genie," a metal device weighing less than a pound, is being used in tests to lower troops to earth from a hovering helicopter. Friction controls rate of descent.

Wright/Sperry

Temperature Compensated Servo Motor Tachometers

Now available are servo motor tachometers which operate reliably over a wide ambient temperature range. For example, from 0°C. to 85°C., this Size 11 will maintain a speed sensitive voltage to within 0.3%, a phase shift to within 1°, and a tachometer linearity of 0.07% from 0 to 3600 rpm.

Write For Data Sheet 20C673

WRIGHT MACHINERY COMPANY
Division of Sperry Rand
Durham, North Carolina
Telephone 682-8161

Prototype 707 Still Serving as Testbed

Seattle, Wash.—Retrofitting with Pratt Whitney turbofan engines has made Boeing's 707 prototype a powerful performer. Gross weight of the aircraft normally runs from 135,000 to 140,000 lb. and thrust from the four prototype TF33 engines is rated at about 70,000 lb., thereby affording a one-two thrust/weight ratio.

Officially designated Boeing Model 367-80, the prototype is referred to by Boeing crews as the "dash Eighty" and now that the fan engines have been installed, the unofficial title with test crews is "dash Eighty B" after the B designation which has been applied to all 707 versions fitted with the 40% more powerful turbofans.

The dash 80, while it has only 1,500 airframe hours, has provided much valuable data and still is used extensively in the flight data gathering program for the 727 tri-jet transport. The following tests were recently being run on the dash 80:

- **Triple slotted flaps** were tested which will enable the 727 to use very slow approach speeds. Boeing test pilots recently flew the dash 80 at an airspeed of 87 kt. with flaps and slats extended.
- **Drag measurements** were obtained from a 727 configuration landing gear fairing door bolted in place on the left main gear. Neither landing gear nor flaps were retractable.
- **Rudder control system** prototype for the 727 was tested.
- **Air conditioning** and pressurization exhaust vent on underbelly patterned after one being tested for the 727 was being evaluated.
- **Proportional braking system** which featured a separate system for each of the eight main landing wheels was studied. System worked well but the cost and complexity did not seem to justify the expense. Very short landing rolls were achieved with maximum braking.
- **Stability augmentation system** incorporating aileron control feed-in with the yaw damper made the aircraft a true two-control machine. Turns were demonstrated in flight with the system both on and off and coordinated turns could be made without the use of rudder pedals.

The aircraft was put into layup Mar. 1 for installation of wing leading edge devices and the addition of a new aft fuselage section. Increased empennage area will result from the addition of a tail section from the Intercontinental series of transports. This will provide better control at low speed and permit more flexibility of operation.

The higher-powered fan engines cannot be used to full advantage as the aircraft now is operating because insufficient rudder area is available for engine-out operation and too little stabilizer and elevator area is available to overcome the destabilizing effects of increased power.

In the configuration flown just prior to layup, the dash 80 virtually leaps into the air after a very short takeoff roll. Attitude at liftoff is very flat and almost no rotation is required to become airborne. Attitude on approach is very flat despite an approach speed of 115 kt. with triple-slotted flaps extended to 40% and no leading edge devices installed.

Further testing of the powerplant ducting and nacelles for the P&W JT8D-1 engine for the 727 will take place by reinstalling the fifth engine on the dash 80. (AW June 5, 1961, p. 79). Some preliminary testing of the engine/duct combination has been done by mounting the assembly on the aft cargo door of the dash 80. "Rear fuselage was beefed up by addition of an auxiliary bulkhead.

Boeing also has scheduled tests on several automatic low approach and landing systems in the aircraft. An Autonetics-developed unit is installed now but had not been cleared by engineering for operation at the time of the last flight prior to layup because final checkout of the unit had not been completed.

The dash 80 is the forerunner of 530 military tankers and transports and 280 commercial transports already built. An additional 150 military and 174 commercial models are on order.

BOEING 707 PROTOTYPE is shown at Renton, Wash., site of Boeing's Transport Division manufacturing facility. The aircraft is powered by four Pratt & Whitney TF33 turbofan engines, and is being used to compile data for the 727 triple-turbojet transport program. The prototype first flew on July 15, 1954 and now has about 1,500 airframe hours.

Production Briefing

General Electric Co.'s Atomic Power Equipment Department at San Jose, Calif., will engineer and manufacture a flux scanner system for Atomic Energy Commission's Experimental Gas-Cooled Reactor (EGCR), under construction at Oak Ridge, Tenn. GE contract totals $200,000 from H. K. Ferguson Co., EGCR construction contractor.

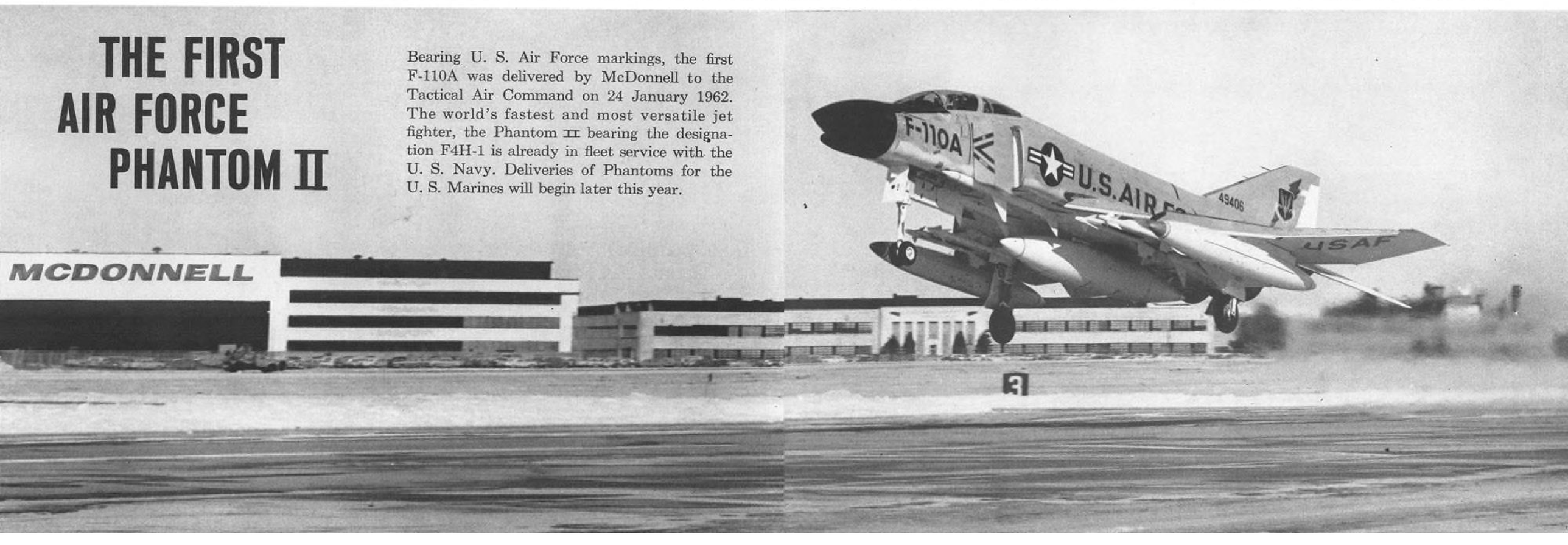
Lockheed Aircraft Corp. will produce malfunction detection and recording systems and related equipment for B-52 jet bombers under a $1.7-million USAF contract.

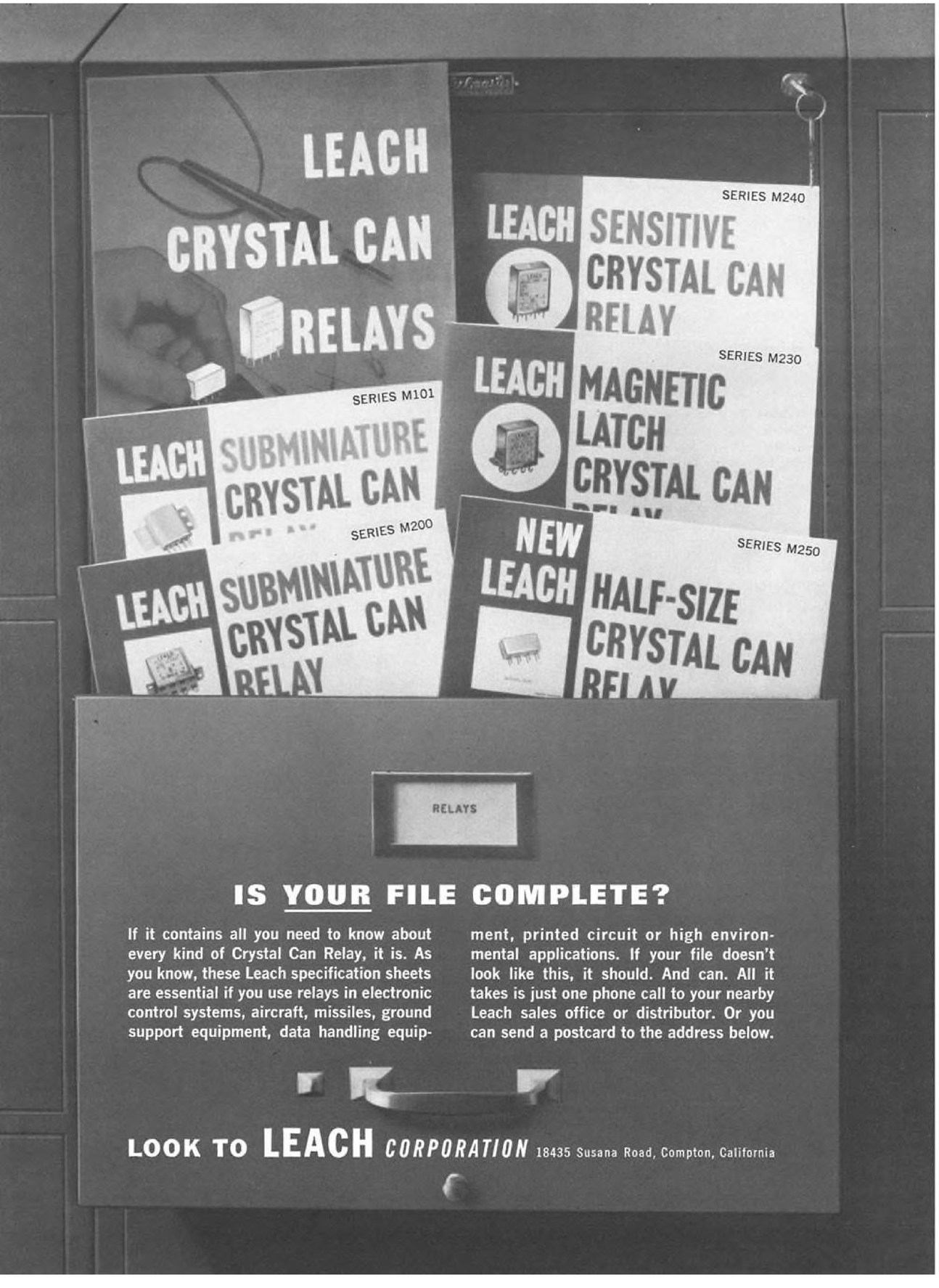
Thiokol Chemical Corp.'s Longhorn Ordnance Works at Marshall, Tex., has received a $6.9-million supplementary Army contract to produce additional rocket motors for that service's Sergeant, Pershing and Nike Hercules missiles.

Brooks & Perkins, Inc., Detroit, Mich., will provide the light metal structure housing the Minuteman ICBM's inertial guidance computer and navigation system under a $600,000 contract

THE FIRST AIR FORCE PHANTOM II

Bearing U. S. Air Force markings, the first F-110A was delivered by McDonnell to the Tactical Air Command on 24 January 1962. The world's fastest and most versatile jet fighter, the Phantom II bearing the designation F4H-1 is already in fleet service with the U. S. Navy. Deliveries of Phantoms for the U. S. Marines will begin later this year.





IS YOUR FILE COMPLETE?

If it contains all you need to know about every kind of Crystal Can Relay, it is. As you know, these Leach specification sheets are essential if you use relays in electronic control systems, aircraft, missiles, ground support equipment, data handling equipment, printed circuit or high environmental applications. If your file doesn't look like this, it should. And can. All it takes is just one phone call to your nearby Leach sales office or distributor. Or you can send a postcard to the address below.

LOOK TO LEACH *CORPORATION* 18435 Susana Road, Compton, California

from Radio Corp. of America, Minuteman guidance system contractor.

Bendix Corp.'s Pacific Division, North Hollywood, Calif., will design and manufacture servo actuators supplying control power for turning nozzles on Dyna-Soar's acceleration rocket. Contract from Boeing totals $450,000.

General Motors' Allison Division has hydrotested a four-nozzle, glass filament-wound rocket engine case to destruction point at burst strength of 126,500 psi. The 44½-in.-dia. case, 132 in. long, demonstrated a girth strength 1.7 times greater than possible with an equivalent weight of steel, Allison said.

E. W. Bliss Co., Canton, Ohio, has received a $2,282,647 Navy contract for improvement of aircraft catapult launching system used in Marine Corps' short airfield tactical support program.

Sylvania Electric Products, Inc., Reconnaissance Systems Laboratories has received a $1.2-million contract from USAF Ballistic Systems Division to develop and produce a miniature electronic security system for Minuteman program and to test and provide system field support at Minuteman sites.

Ryan Electronics, San Diego, Calif., has received an initial $1.8-million contract from Army Signal Supply Agency to provide Doppler navigation sets for Grumman AO-1 Mohawk observation aircraft. Work may reach $3.5 million.

North American Aviation's Space and Information Systems Division will use former Naval Ammunition Depot facilities at Seal Beach, Calif., as the prime manufacturing plant for the S-2 Saturn second stage. Florida interests tried unsuccessfully to have the plant located at Eglin AFB.

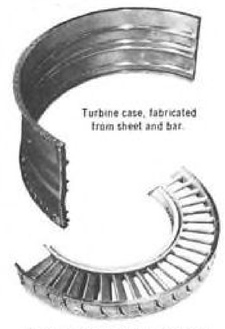
Kongsberg Vapenfabrikk of Norway has been chosen to be the prime contractor to produce the Bullpup air-to-ground missile in Europe for the North Atlantic Treaty Organization (NATO) under a coordinated program initiated by the U. S. Defense Department (AW Apr. 9, p. 84). The U. S. Navy will be responsible for administration and technical support. The Martin Co., developer of the missile, will supply technical assistance in setting up a production line similar to the one at Martin's Orlando, Fla., plant.

Radio Corp. of America will manufacture electronic command network equipment for the first wing of Air Force Minuteman ICBMs being established in Montana under a contract valued at $35.5 million from the Boeing Co. The contract supersedes a letter order of last year.

Wide gap brazed turbine nozzle assembly.

Jet engine turbine case, machined from a forging and a companion welded nozzle diaphragm.

Combination glass tape and cloth arc interrupter tube to withstand 2240 psi.


Turbine case, fabricated from sheet and bar.

Nozzle diaphragm segment fabricated and machined from raw stock.

Missile vector control pressure vessel fabricated from H-11 tool steel.

High temperature brazed titanium honeycomb shroud section.

One Source for All Your Aerospace Propulsion Components

. . . You'll save time and costs by investigating the complete services and facilities of the Special Products Division of I-T-E Circuit Breaker Company.

Special Products offers you an engineering staff capable of interpreting today's highly specialized space effort design and development requirements. These engineers are complemented by skilled craftsmen and unique equipment capable of producing any component or complete assembly to the extreme limits in tolerance demanded today.

Hard-to-work titanium, molybdenum, many of the exotic alloys, and even non-metallic materials of the space age readily lend themselves to forming, welding, high-temperature brazing, high-pressure molding and precision machining processes at I-T-E. Wide-gap brazing and honeycomb machining are specialties of the Special Products Division, while hydroclave forming produces superior insulation linings and ablative structures. Quality control procedures are stringent, assuring full conformance to even the most rigid specification standards.

I-T-E's complete engineering and production facilities assure you a single source for *all* your propulsion component requirements. For further details write: Sales Department, Special Products Division, I-T-E Circuit Breaker Company, Dept. **AW**,601 Erie Avenue, Phila. 34, Penna., or call GArfield 6-5700.

I-T-E CIRCUIT BREAKER COMPANY
SPECIAL PRODUCTS DIVISION

AEI MASS-PRODUCES INTEGRATING MOTOR TACHS TO CUT COSTS —SPEED DELIVERIES

Mass-Production Means Off-The-Shelf Deliveries

American Electronics, Inc. applies the big idea of mass-production to the making of Size 11 Temperature Compensated Integrating Motor Tachometers. This highly sophisticated approach lowers the cost to you. Besides economy, AEI can keep pace with the demand. You order what you need. AEI delivers with speed—off-the-shelf.

Temperature Compensated Design Means Sure Control

AEI's temperature compensated design performs over a wide temperature range without the increased error that occurs when ambient temperatures vary. The design employs thermistor-resistor networks which hold speed-sensitive voltage variations to within fractions of a percent across an ambient temperature range of 0° to 90°C. Across the broader range of −55°C to 125°C, variations are held to 1%.

Furthermore, phase shift is held to less than 1%. Linearity with speed is less than 1/10th of 1%. And the networks are so designed that little or no warm-up time is required. The neat part of the trick, of course, is mass-producing precision miniatures that are only knee-high to your first knuckle—and making them reliable. AEI's approach is mass-production, but the assembly line is still in a clean room. Calibration is so precise an ordinary voltmeter isn't sensitive enough. AEI had to invent its own test console, shown at the right, for quality control. Incidentally, AEI also produces the test console for sale, too.

AEI is equally proud of its Size 15 and Size 18 Integrating Motor Tachometers. A testimonial to their fine performance is written into the shipping record. Thousands have been delivered to prime and sub-contractors in the U.S., Canada, and Europe.

Data on Two of AEI's Size 11 Integrating Motor Tachometers

INPUT	Model 11A22C-11S	Model 11A26C-01K
Volts	26	115
Freq.	400	400
Current (Amps)	.080	.071
Power (Watts)	1.3	5.6
Power Factor	.63	.59
R (Ohms)	205	956
XL (Ohms)	250	1300
Z (Ohms)	325	1600
R eff (Ohms)	520	2740
OUTPUT		
Output (volts/1000 rpm)	1.3	2.75
Phase Shift	0° ± 20′	0° ± 20′
Null voltage (volts)		
RMS	.020	.020
Fund.	.015	.015
Output Imp. (Ohms)	2500 + j5500	4400
Linearity (to 3600 rpm)	.07%	.07%
Var. of output with temp. 0° to 90°C	.25%	.25%
−55° to 125°C	1.0%	1.0%

AEI Has Many Big Ideas for Aerospace

Progressive thinking dominates AEI's approach to all its products for aerospace. The evidence? Most of the nation's missile and satellite projects employ one or more AEI products. For a look at what AEI can do for you, write for our comprehensive brochure.

Engineering Opportunities

Qualified engineers who are looking for new horizons, and a stimulating environment in which to grow, are invited to write AEI, too.

Address inquiries to American Electronics, Inc., Dept. AW-562A, 1594 East Ross Ave., Fullerton, Calif., Phone TRojan 1-3020, TWX FUL CAL 8110 • WUX.

AEI TRADEMARK AMERICAN ELECTRONICS, INC.
FULLERTON, CALIFORNIA

Manufacturers of PRECISION RESOLVERS ■ MOTOR TACHOMETERS ■ STEPPER MOTORS ■ SERVOS ■ PRECISION POWER SUPPLIES—STATIC & ROTARY ■ ACTUATORS ■ SUBSYSTEMS

FINANCIAL

Airline Officers Report Salaries, Holdings and Expenses for 1961

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, 1961, as reported to the Civil Aeronautics Board:

Bonanza Air Lines, Inc.—E. C. Converse, president and chairman of the board, $30,000 salary, $1,682 expenses, 211,761 shares of common stock; **G. R. Henry,** executive vice president and director, $25,000 salary, $3,089 expenses, 300 shares of common stock; **M. W. Reynolds,** vice president-operations, $23,000 salary, $1,428 expenses 100 shares of common stock; **R. J. Sherer,** vice president-finance and treasurer, $20,000 salary, $5,811 expenses, 600 shares of common stock; **R. O. Hawkins,** general counsel and secretary (died Dec. 6, 1961), $16,250 salary, $1,381 expenses; **T. J. Van Bogart,** controller and assistant secretary, $337 expenses, 200 shares of common stock; **L. Decker,** vice president-traffic and sales (since Mar. 1, 1961), $11,955 salary, $4,884 expenses; **D. R. Neilson,** assistant secretary (since Sept. 1, 1961), $11,000 salary, $1,201 expenses, 1,000 shares of common stock; **E. E. Jochim,** assistant secretary (resigned Aug. 31, 1961), $9,966 salary, $1,489 expenses; **W. C. Burt,** assistant secretary, $20,352 salary, $1,644 expenses, 100 shares of common stock; **F. W. Beer,** director, $700 salary, 6,080 shares of common stock; **R. Converse,** director, 16,500 shares of common stock; **C. M. Glass, Jr.,** director, $700 salary, 1,000 shares of common stock; **J. D. Moyle,** director, $800 salary, $229 expenses, 1,000 shares of common stock; **W. D. Pabst,** director, $600 salary, 1,000 shares of common stock; **G. L. Vargas,** director, $600 salary, 7,885 shares of common stock; **W. T. Waggoner, Jr.,** director, $100 salary, 33,943 shares of common stock.

The following firms were paid $5,000 or more for services rendered during 1961: **Koteen & Burt,** legal services, $36,691; **A. F. Grisard,** legal services, $12,528; **Peat, Marwick, Mitchell & Co.,** auditing, $7,510; **Gotch & Crawford,** traffic research and consultation, $13,128.

Central Airlines, Inc.—K. Kahle, president, $19,200 salary, $7,573 expenses, 34,404 shares of common stock; **F. E. Howe,** executive vice president and treasurer, $17,899 salary, $747 expenses, 925 shares of common stock; **R. L. Wageneck,** vice president-operations, $17,002 salary, $721 expenses, 500 shares of common stock; **A. S. Aldridge,** vice president-sales, (resigned Jan. 16, 1962), $13,699 salary, $1,714 expenses, 1,196 shares of common stock, eight shares of preferred stock; **C. E. Lundstrom,** secretary and assistant treasurer, $10,600 salary, $604 expenses, 553 shares of common stock; **F. K. Johnson,** chairman of the board, $8,000 salary, 138,239 shares of common stock; **W. G. Mitesch, Jr.,** vice president and assistant to the chairman of the board (since June 20, 1961), $5,500 salary, 1,000 shares of common stock; **J. A. Cooper,** assistant vice president of economic research for the company (since June 20, 1961), $12,000 salary, $184 expenses.

The following firms were paid $5,000 or more for services rendered during 1961: **Pogue & Neal,** legal services, $41,257; **Mueller & Mueller,** labor consultants, $10,600; **Hudson, Keltner, Jordan, Smith & Cunningham,** legal services, $17,671; **Billups, Arnn & Mascho,** auditing, $6,625; **Marin A. Krieger,** advertising, $10,085.

Frontier Airlines, Inc.—G. R. Woody, executive vice president, $33,000 salary, $975 expenses; **M. E. O'Neil,** director of flight operations, $19,989 salary, $376 expenses.

The following firms were paid $5,000 or more for services rendered during 1961: **Bowen & Rasenburger,** legal services, $43,363; **Sanford B. Hertz,** legal services, $12,622; **Marti, O'Gara, Dalton & Sheldon,** legal services, $5,158; **Rippey, Henderson, Buchmuneo,** advertising, $124,063; **Tool & Armstrong,** advertising, $56,298; **Colin Hugh McIntosh,** air transportation consultant, $10,273; **Ernst & Ernst,** auditing, $6,500.

Lake Central Airlines, Inc.—Dr. R. B. Stewart, chairman of the executive committee and director, $6,700 bonus and indirect compensation, 1,500 shares of common stock; **J. J. O'Connell,** chairman of the board, $4,800 salary, $1,200 bonus and indirect compensation, $395 expenses, 2,166 shares of common stock, 800 shares of preferred stock; **G. Hicks,** president and director, $22,500 salary, $3,101 expenses, 6,532 shares of common stock, 1,000 shares of preferred stock; **L. W. Hartman,** executive vice president and director, $25,000 salary, $1,348 expenses, 5,400 shares of common stock, 400 shares of preferred stock; **W. H. Krieg,** secretary and director, $1,050 bonus and indirect compensation, 2,000 shares of common stock; **R. W. Clifford,** vice president and director, $20,000 salary, $937 expenses, 2,339 shares of common stock, 100 shares of preferred stock; **J. D. Peterson,** director, $1,500 bonus and indirect compensation, 200 shares of preferred stock; **C. A. Berry,** director (died Dec. 8, 1961), $500 bonus and indirect compensation, 10 shares of preferred stock; **H. Goff,** director, $19,117 salary, $476 expenses, 1,500 shares of common stock, 250 shares of preferred stock; **D. S. Getchell,** vice president, $17,500 salary, $668 expenses, 133 shares of common stock; **J. L. Cory,** treasurer and assistant secretary, $13,000 salary, $642 expenses, 3,800 shares of common stock, 100 shares of preferred stock.

A. F. Grisard, assistant secretary, 4,181 shares of common stock; **J. R. Carr, Jr.,** assistant secretary, 509 shares of common stock; **R. P. West,** assistant secretary, 533 shares of common stock; **E. Blair,** director, $700 bonus and indirect compensation, $588 expenses, 16,700 shares of common stock, 4,100 shares of common stock held by Mrs. Blair; **W. Chope,** director, $200 bonus and indirect compensation, 500 shares of common stock; **W. W. Brown,** director, $300 bonus and indirect compensation, $137 expenses, 2,000 shares of common stock, 700 shares of preferred stock; **T. Mikita,** director, $15,280 salary (for flight captain duties), $674 expenses, 400 shares of common stock; **Dr. M. Ersselcuk,** director, $600 bonus and indirect compensation, $1,720 expenses, 19,669 shares of common stock, 1,000 shares of common stock held by Mrs. Ersselcuk; **H. Taft,** director, $400 bonus and indirect compensation, 2,000 shares of common stock; **S. Sutphin,** director, $400 bonus and indirect compensation, 7,332 shares of common stock in addition to 1,000 shares of preferred stock.

The following firms were paid $5,000 or more for services rendered during 1961: **Albert F. Grisard,** legal services, $19,422; **Krieg, DeVault, Alexander & Capehart,** legal services, $13,328; **Ernst & Ernst,** auditing, $6,250; **Wm. Blair & Co.,** underwriting fees (preferred stock issue), $260,000; **Wm. Blair & Co.,** designing debt program, $25,000; **R. R. Donnelly & Sons,** composition and survey (preferred stock), $9,992.

VIBRATION TESTING TAKES EQUIPMENT

New at Aerotest Laboratories is an MB Model C210 vibration system capable of testing the very largest electronic packages . . . including complete space vehicles. Incorporating all latest design improvements in shaker, compensation consoles, amplifier and controls, it is one of the largest vibration testing systems available at any independent laboratory.

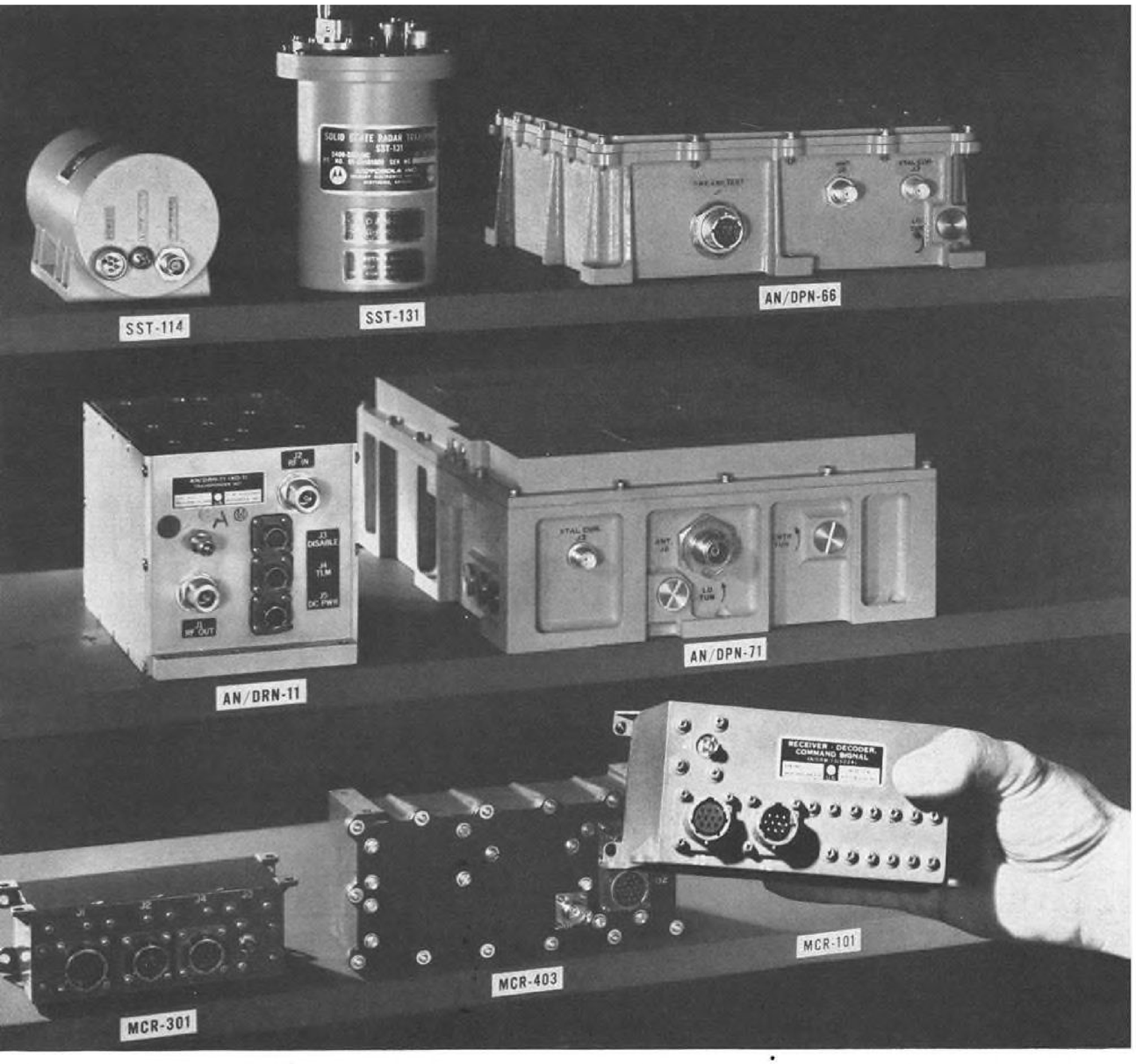
Random peak force is 84,000 lbs.—over 200 g's. Frequency range is 5-2000 cps. Maximum aptitude is one inch D.A. Associated equipment includes tape transport system with automatic wave analyzer capable of simulating any random vibration pattern...including those received by telemetering missile or rocket launchings.

Additional shock, vibration and acceleration equipment is available for performing a full range of reliability or qualification tests on smaller sizes and types of aerospace packages or components. Aerotest's facilities include complete equipment for simulating both natural and induced environments; pyrotechnic testing equipment; LOX cleaning; complete gas dynamics and propellants labs for exotic and cryogenic fuels and oxidizers.

For additional information, contact:

aerotest LABORATORIES, INC.

Comac Road, Deer Park, Long Island, N. Y.



at your command... **MOTOROLA'S QUALIFIED INSTRUMENTATION**

A complete line of command receivers and radar transponders is now available from Motorola for off-the-shelf delivery. Designed and built to meet the control and tracking requirements of a wide variety of missiles, rockets, drones, manned aircraft and space vehicles, this compact instrumentation is setting new standards of performance and reliability. Motorola Command Receivers satisfy the most rigid physical and electrical specifications, and are constructed for ease of installation with a maximum saving in space and weight. These extremely reliable receiver-decoder units are being used or specified for command and destruct functions in most of today's second generation missiles. If you are interested in complete performance specifications on any of Motorola's qualified command receivers or transponders, write to our Instrumentation Products Group today.

Military Electronics Division **MOTOROLA**

8201 East McDowell Road • Scottsdale, Arizona

MCR-100 Series Radio Command Receiver
Channels: 10. Sensitivity: 5 μV
Range: 406-450 mc. Weight: 2 lbs. 15 oz. (max.)

MCR-300 Series Radio Command Receiver
Channels: 3. Sensitivity: 5 μV
Range: 406-450 mc. Weight: 2 lbs. (max.)

MCR-400 Series Radio Command Receiver
Channels: 4. Sensitivity: 5 μV
Range: 406-450 mc. Weight: 3 lbs. 13 oz. (max.)

AN/DPN-66 Superheterodyne Transponder
Power: 500 watts. Sensitivity: −70 dbm
Size: 200 cu. in. Weight: 10.8 lbs.

SST-131 Microminiature Superheterodyne Transponder
Power: 400 watts. Sensitivity: −65 dbm
Size: 40 cu. in. Weight: 3 lbs.

AN/DPN-71 High Power Superheterodyne Transponder
Power: 20 Kilowatts. Sensitivity: −75 dbm
Size: 0.3 cu. ft. Weight: 28 lbs.

SST-114 Subminiature Crystal Video Transponder
Power: 50 watts. Sensitivity: −42 dbm
Size: 55 cu. in. Weight: 3.5 lbs.

AN/DRN-11 UDOP (UHF Doppler) Transponder
Power: 3 watts. Sensitivity: 5 μV
Range: Input 430-470 mcs (Output 2x) Weight: 10.5 lbs.

SAFETY

More Pilot Authority Urged in Safety Study

San Francisco—Flight safety record achieved by corporate-owned transport aircraft in 1961 might possibly be compromised unless complete authority over all factors affecting safety is given to the pilots of the aircraft, Jerome Lederer, managing director, Flight Safety Foundation, told the Seventh Annual Business Aircraft Safety Seminar here.

Lederer said that in 1961, there were no fatalities in transport-category aircraft operated by professional pilots for corporations. However, such a record may not continue if direct or indirect executive pressures are brought to bear on flight crews in order to force them to fly when conditions warrant delaying or diverting a flight.

He said complete authority must be vested in the pilot where flight safety is concerned regarding weather factors, aircraft loading and other operating considerations. Lederer cited the example of one corporate pilot who resigned his position because company executives repeatedly pressured him into flying an overloaded twin-engine aircraft from Alabama across the Gulf of Mexico to Cape Canaveral, Fla.

The lack of understanding of the consequences of unsafe operation frequently places the corporate pilot in the position of complying with the boss' wish with the result that the pilot may lose his license, or have an accident.

Regulations governing the operation of corporate and business aircraft are not strict by comparison with those regulations governing airlines. One answer to eliminating the problem of determining when it is safe to fly would be to place stricter government regulations into effect on the operation of corporate aircraft although Lederer said he is reluctant to recommend this.

Gerard Bruggink of the Aviation Crash Injury Research Division of the Flight Safety Foundation presented statistics pointing out the advisability of proper restraint systems for both pilot and passenger in the event of emergency. Use of shoulder harnesses and lap belts fastened snugly was cited as the main factor in surviving many bad crashes. However, in several accidents investigated by the Flight Safety Foundation it was discovered that safety harnesses had been worn properly by the occupants but had failed.

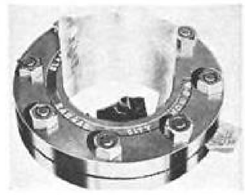
Many failures were discovered in the anchoring devices used to secure the harness to airframe. It was recommended that more care be used in designing and manufacturing these items.

CRA*

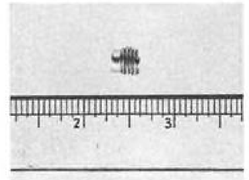
***means Controlled Rupture Accuracy!**

But what does it mean to you?

It means that if you have an application which includes either over pressure protection or operational pressure relief, the BS&B Safety Head can provide the answer. Thousands of safety heads are now in use, functioning as quick opening valves or over pressure devices. Lox equipment, jatos, hydraulic power supply, and water quenching are just a few uses. Safety heads are available for temperature ranges from minus 420 to plus 900 degrees F. and in sizes from ⅛" (weighing less than one ounce) to 44".

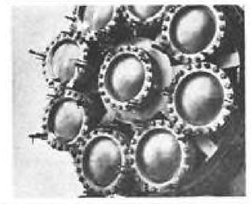


Photograph shows a safety head with full throated opening for instantaneous release of pressure. Lightweight construction, fixed dimensional openings, together with compact design, make this unit ideal for the missile and aircraft industry.



The safety head shown here in this tiny fitting protects against over pressure in a missile's hydraulic system.

Rupture disc acts as a quick opening valve in the nozzle of "Jato Bottle"—retaining thrust until the propellant develops a specified pressure.



Large diameter (in this case 24") Safety heads are fitted in a manifold to provide over pressure protection on this engine test chamber.

BS&B BLACK, SIVALLS & BRYSON

KANSAS CITY • OKLAHOMA CITY • TULSA • EDMONTON • THE HAGUE

Flight Propulsion NEWS

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

USAF Selects Modified J79-8 Engine to Power McDonnell F-110 Fighter

CINCINNATI, Ohio—A slightly modified version of the General Electric J79-8 turbojet engine was recently specified to power future F-110A and RF-110A aircraft, the United States Air Force tactical and reconnaissance fighter versions of the Navy F4H Phantom II.

To be designated the J79-15, the General Electric engine was chosen by the Air Force for the Mach 2-plus aircraft built by McDonnell Aircraft Corporation.

Development activities to incorporate the minor design changes are now under way at General Electric's Cincinnati plant.

The Air Force plans to receive a limited number of the new fighters over the next year. It expects to procure "a substantial quantity" thereafter, and will use the aircraft to complement the Republic F-105 in all areas of tactical warfare capability.

The United States Navy's two most advanced Mach 2 aircraft went to sea aboard the nuclear-powered USS *Enterprise* recently during her shakedown cruise in the Atlantic. The North American A3J Vigilante attack bomber (foreground) and the McDonnell F4H Phantom II all-weather fighter (left), both powered by twin General Electric J79 turbojet engines, are now operational with the huge carrier. Although the A3J Vigilante had previously completed carrier suitability trials aboard other fleet carriers, this was the first A3J squadron to operate as a unit with the fleet. The record-shattering F4H was deployed earlier this year aboard the USS *Forrestal*.

One of the Air Force's new McDonnell F-110's arrives at Langley AFB for evaluation. A two-man team—pilot and pilot/radar operator—will man this USAF version of the Navy's F4H Phantom II.

Two USAF F-110 aircraft (powered by twin General Electric J79-8 turbojets) are currently touring Tactical Air Command bases for orientation and evaluation studies. The program began early this year when they were delivered to TAC headquarters at Langley AFB, Virginia.

The G-E-powered F-110A, as an air superiority fighter, will carry both Sparrow and Sidewinder missiles. For close air support it will carry over 13,000 pounds of ordnance.

The aircraft's Navy version—the F4H Phantom II—is already operational with the U.S. Navy's Atlantic and Pacific fleets. The F4H currently claims more world speed and time-to-climb flight records than any other U.S. jet aircraft.

J85-Powered N-156 Is New MAP Fighter

WASHINGTON, D.C.—Northrop Corporation's N-156 jet fighter has been designated by the Defense Department as the new Military Assistance Program all-purpose fighter.

The supersonic N-156, powered by twin General Electric J85-5 turbojet engines, will be supplied to selected nations who need a high-performance fighter to replace older aircraft which are becoming obsolete.

An up-front tactical weapon system, the N-156 can provide flexible, versatile air power for any potential combat environment. The aircraft is intended for close support of troops, interception of enemy aircraft, swift attacks on communication and supply lines, and armed reconnaissance missions over enemy territory.

Noted for its high performance capability, the N-156 can fly at more than Mach 1.4 in level flight. It can climb at 34,000 feet per minute at sea level, and has a service ceiling at 55,000 feet. The aircraft can take off in approximately 1700 feet; and, using a drag parachute, can land in approximately 1800 feet.

General Electric J85-5 engines deliver more than 4000 pounds of thrust each, more power per pound than any other jet engine in production today. On one engine alone, the N-156 can take off, climb to altitude, complete a mission, and return to base safely.

The versatile N-156 weighs only 12,000 pounds with full internal fuel. Because of its light weight, relative simplicity and low fuel consumption, it operates with minimum support and maintenance. Its G-E engines can be changed by three men in only 20 minutes, and each is so light it can be changed by hand if necessary.

F4H Sweeps Climb Records

PT. MUGU, Calif.—The Navy's McDonnell F4H Phantom II fighter now holds claim to all eight world time-to-climb records after recently smashing the 20,000, 25,000, and 30,000 meter marks.

Five other international speed-climb marks fell to the F4H in March when the J79-powered fighter set new records for 3000, 6000, 9000, 12,000, and 15,000 meters, erasing records set only a few weeks earlier by an Air Force Northrop T-38 jet trainer.

The new F4H time-to-climb records (timed from brake release to altitude under National Aeronautic Association supervision) are: 3000 meters, 34.52 seconds; 6000 meters, 48.79; 9000 meters, 61.63; 12,000 meters, 77.16; 15,000 meters, 114.55; 20,000 meters, 178.5; 25,000 meters, 230.44; and 30,000 meters, 371.43 seconds.

T-38's Expected to Cut Combat Readiness Cycle as First Class Graduates

RANDOLPH AFB, Texas—The USAF's first class of cadets to complete basic training in the Northrop T-38 Talon here is expected to reach combat readiness faster than any previous class, Air Force officials said during graduation exercises.

The Air Force spokesmen attributed this fast cycle to the T-38's high performance, which they said will simplify the cadets' transition to the Century series fighter aircraft they will fly next. Previous classes have faced a time lag in becoming familiar with actual tactical aircraft and their weapon systems following assignment to units, they said.

In contrast to previous jet trainers, the J85-powered T-38 embodies many handling traits of on-line, tactical aircraft, including high-sink rate, high climb rates, high altitude/true air speed navigation, and supersonic formation flight.

The USAF cadets began formal supersonic work five hours after the start of training in the Talon. Average student time-to-solo was 14.5 hours. A total of 30 hours solo time was included in the 108-day course.

Formation flying, totaling 38.5 hours, took up the largest part of the 140 hours of flight training. Instrument flying involved 33.5 hours; navigation, 27.25 hours; and the T-38 ground instrument trainer, 27 hours. Flight indoctrination totaled 23 hours.

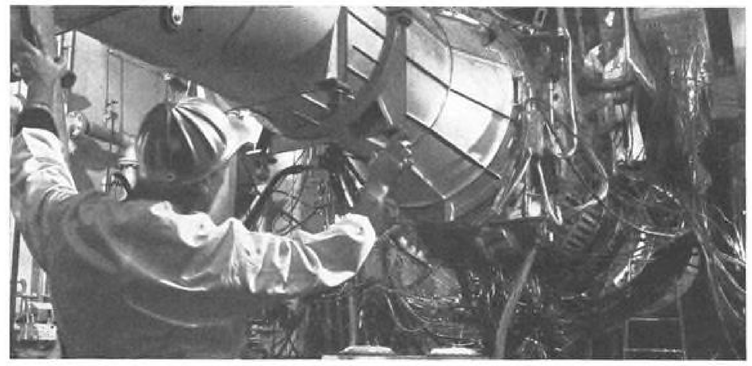
As the first T-38 class was graduated here, the other ATC training bases were gradually switching over to the new trainer. Webb AFB is scheduled to complete its T-38 complement sometime this month.

FAA Grants G-E CT58 Engine 30-Minute Contingency Rating

LYNN, MASS.—The Federal Aviation Agency has approved a 30-minute contingency power rating for General Electric's CT58-110 gas turbine engine.

The new rating will add an extra margin of safety to twin turbine helicopter operations by enabling the pilot to use the 1250 horsepower take-off power setting as required up to 30 minutes if power is lost on one engine.

In addition, the new regulation will enable Los Angeles Airways and New York Airways to operate at higher payload factors. The airlines will also realize substantial savings in maintenance under the new rules because the old regulations made overhaul mandatory for any CT58 operated at the take-off setting in excess of five minutes. Under the new procedure, only a routine inspection is required.



Portions of the General Electric J93 turbojet PFRT program were completed recently in G.E.'s specially-built ram test facility at Cincinnati, Ohio. The engine is completely enclosed so that high-velocity, high-temperature ram air can be forced into the engine, simulating speeds up to 2000 miles per hour and altitudes of up to 90,000 feet.

J93 Completes Rigorous PFRT

CINCINNATI, Ohio—General Electric's J93 engine—advanced turbojet destined for the Mach 3 North American XB-70—has completed a Preliminary Flight Rating Test after undergoing the most severe pre-flight testing of any engine in U.S. aviation history.

A significant aspect of the J93's PFRT schedule was that it represented the first time a military jet engine has demonstrated endurance capability at its design flight speed, prior to first flight. In the past, the U.S. Air Force has required a 50-hour PFRT consisting of testing at sea-level static conditions only.

The J93's schedule, however, called for 68 hours of endurance test, plus additional performance demonstrations in the Rocket Test Facility at the Arnold Engineering Development Center, Tullahoma, Tennessee.

During 18 hours of the endurance test, the G-E turbojet was subjected to Mach 3 inlet conditions simulating those it will encounter in flight at 2000 miles per hour at an altitude of 65,000 feet.

In addition to the simulated Mach 3 flight, the J93 turbojet underwent about ten times more afterburner operation than earlier jet engines.

Officials of the Aeronautical Systems Division are currently evaluating test results of the PFRT engine.

Design principles of the J93 turbojet, six of which will power the USAF XB-70, are based largely on those of the proven General Electric J79. These include compressor design, lightweight construction, single shaft, and converging-diverging exhaust nozzle.

The jump in speed capability from Mach 2 to Mach 3, however, created for General Electric a number of new challenges, particularly in the approach to high temperatures. To solve these problems, G.E. cooperated with the USAF and U.S. industry to make greater use of new high temperature alloys and honeycomb structures.

Although the J93 cycle was optimized for efficient long-range cruise, it also favors good take-off and acceleration performance.

The extremely stringent requirements involved in the J93's PFRT were necessitated by the mission profile of the long-range XB-70 aircraft, which is designed to cruise at some 2000 miles per hour. The first XB-70 is to be readied by North American for flight test around year's end.

SEND COUPON FOR FREE BROCHURES

For free bulletins on the G-E engines and propulsion systems discussed above, just check below and send coupon to General Electric, Section A206-48, Schenectady, N. Y.

- ☐ GED 4450A "T38/J85"
- ☐ SAE 120A "T58 Engine"
- ☐ GED 4114 "J79-Powered Record Holders"
- ☐ GED 4516.2 "G-E J79-8 Power for F4H and A3J"

Name_____

Title_____

Company_____

Address_____

GENERAL ELECTRIC

New Sperry SP-50 Flight Control System

An automatic flight control system affording 200 to 300 percent increase in reliability—with unexcelled accuracy and performance—that's the new Sperry SP-50, selected over heavy competition for the forthcoming Boeing 727.

Selection of the SP-50 for the short-to-medium range 727—a jet transport which demands the ultimate in reliability for everyday operations in and out of small airports—emphasizes the fact that the SP-50 solves the most pressing problems of second-generation jetliners: it is compatible with the fully automatic landing systems of the future; it is designed for routine ILS operations with automatic letdowns for landings under very low ceiling-visibility conditions; it features *channelized* design, separating automatic control equipment for all axes of flight to facilitate maintenance; and it provides dual yaw dampers, with provisions for "dualizing" all functions if desired.

These and other design and performance advantages in the new SP-50 spell superior *command reliability* today . . . assure readiness to meet tomorrow's demands. Superior support of this new system in the field, meeting Air Transport Association requirements, also is being "designed in" by Sperry.

SPERRY

SPERRY PHOENIX COMPANY, *DIVISION OF SPERRY RAND CORPORATION, PHOENIX, ARIZONA*

POTEZ-HEINKEL CM-191 executive jet displays low profile during flight at Hanover. Profile simplifies taxi at high speeds. Fin on top of fuselage is UHF antenna. Jet exhausts are mounted close together to minimize engine-out yaw effects.

Aviation Week Pilot Report:

CM-191 Provides Easy Transition to Jets

By Herbert J. Coleman

Hanover, West Germany—Potez-Heinkel CM-191 executive jet, a four-place, maneuverable aircraft, should pose no severe checkout problems for pilots who are new to jet power.

Midwing jet, built by Ernst Heinkel Flugzeugbau GmbH, Speyer, and currently being flight tested by Etablissements Henry Potez at Toulouse, is a development of the successful Fouga Magister jet trainer (AW Apr. 23, p. 102). In its civil role, it will sell for about $220,000.

Despite its immediate future as a military trainer for the West German Defense Ministry, with a potential production order for 100 airplanes, both Potez and Heinkel are strongly pushing the CM-191 as an executive transport capable of operating in any world climate, under comparatively rough field conditions.

First Showing

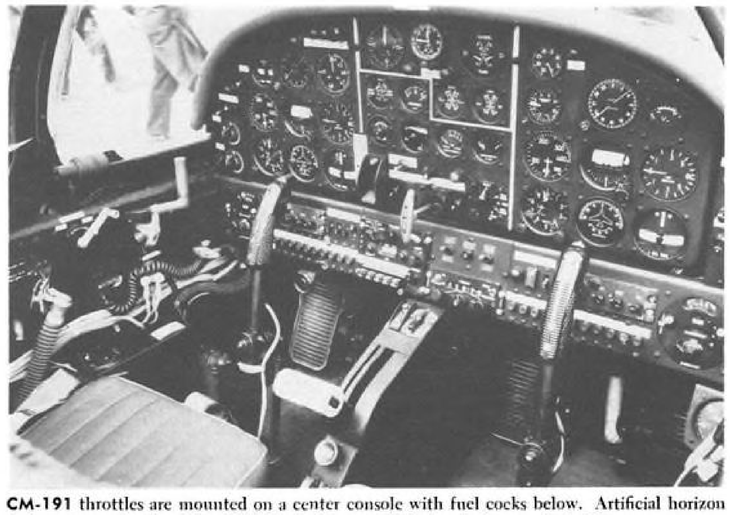
With this in mind, both companies agreed to show the CM-191 publicly for the first time at the annual Hanover Air Show (AW May 14, p. 125), but despite strenuous objections from Potez and Heinkel, West German authorities imposed these flight restrictions:

- **No more than two persons** aboard during a flight demonstration, with the second person holding a license as a mechanic, engineer or pilot.
- **No more than two flights** per day, of 30 min. duration each.
- **Maximum airspeed limited** to 250 kt. and no flypasts allowed.

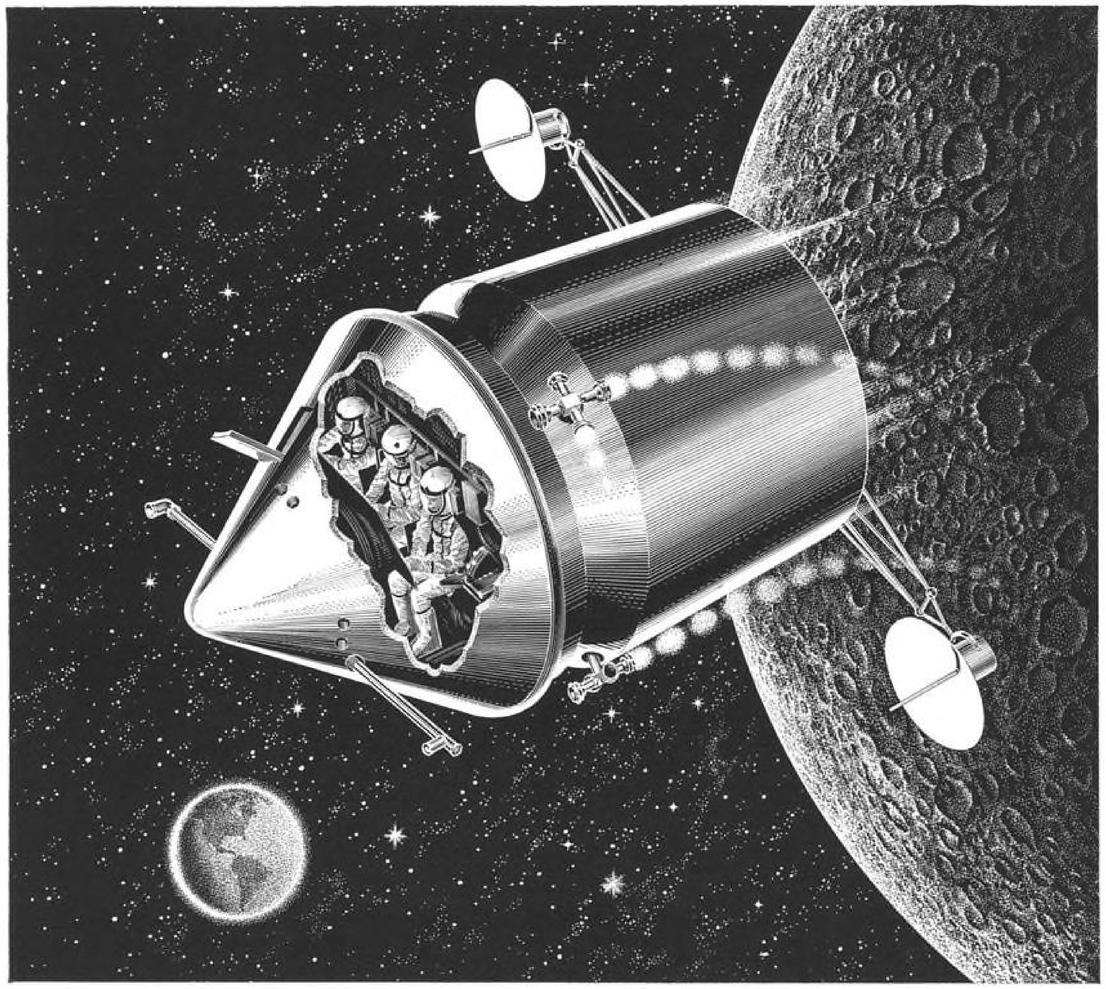
Germans said the restrictions were placed because the airplane, with 35 hr. flight time on arrival, was considered by them as "highly experimental." The CM-191 has experienced no serious technical or flight problems in a test program described by Potez Chief Pilot Jacques Grangette as "intensive." Grangette said the CM-191 has been flown at 35,000 ft. at Mach .68 and handling characteristics at that altitude were good.

Airplane flown at Hanover by this AVIATION WEEK pilot was D-IHAM, the No. 1 prototype. Second airplane is scheduled to roll out soon: West German Defense Ministry has ordered three for flight test and another two for static testing. Demonstration pilot for the flight was Alain Hisler.

In general, the CM-191 is quite easy to fly, although it is stiff on aileron control, since no power boost is supplied. Stall characteristics are good, in recovery, but warning is limited to a buffet noise not quickly recognizable



CM-191 throttles are mounted on a center console with fuel cocks below. Artificial horizon is drum type developed by SFENA in France. Stick-top button controls trim.



IN AEROSPACE, MARQUARDT MEANS...

Reaction control engines for Project Apollo

Marquardt has been selected by North American Aviation to supply the reaction control rocket engines for Project Apollo—America's initial manned expedition to the moon. Marquardt engines will be used in the crew's command module and the service module of the spacecraft as part of the flight and stabilization control system. In the service module the engines will supply attitude control and stabilization enroute to the moon and back and during lunar and earth orbit, while command module engines will provide stabilization and attitude control during re-entry into the earth's atmosphere.

Marquardt has successfully designed and built advanced control systems for aerospace vehicles for nearly two decades. Absolute reliability and precise accuracy are necessary for satellite rendezvous, station keeping, orbit control, landing and lift-off from distant planets. Reaction control systems by The Marquardt Corporation are relied on to do these vital jobs.

Engineers and scientists interested in joining Marquardt on Apollo and other significant aerospace projects are invited to direct résumés to Professional Personnel at address below.

Dedicated to Keeping The United States First in Technology

THE Marquardt CORPORATION

CORPORATE OFFICES, VAN NUYS, CALIFORNIA

AN EQUAL OPPORTUNITY EMPLOYER

as the entry to a stall condition, particularly to a pilot who is not expecting one.

Regarding the control aspect, Grangette emphasized that stiffness has been built into the system for executive uses, to improve long range-flight weariness ordinarily brought on by jets with "touchy" controls. However, control feel can be supplied to the customer's preference by stretching linkage on the control arms, he said.

Over-all design aim, he continued, was to build a four-place executive airplane that would retain all the Magister characteristics of safety, high visibility and single engine performance.

Latter requirement is perhaps the most impressive aspect of flying the CM-191. At one point, without warning to this pilot, Hisler shut down the starboard engine during a steep turn. Resultant aerodynamic forces were nil; there was no yaw or slip, the turn continued smoothly at about a 30 deg. bank, and the airspeed fell off only slightly.

Engine was restarted and port engine pulled back to idle during level flight at about 230 kt. indicated airspeed. With the exception of a 10-15 kt. loss in speed, there was no adverse reaction to continued level flight and no trim was necessary.

Low profile of the CM-191 makes entry and exit from the cockpit fairly simple, with foot positions provided in two step points on the side of the fuselage. Cockpit has been widened from Magister's tandem configuration to allow side-by-side seating both front and rear.

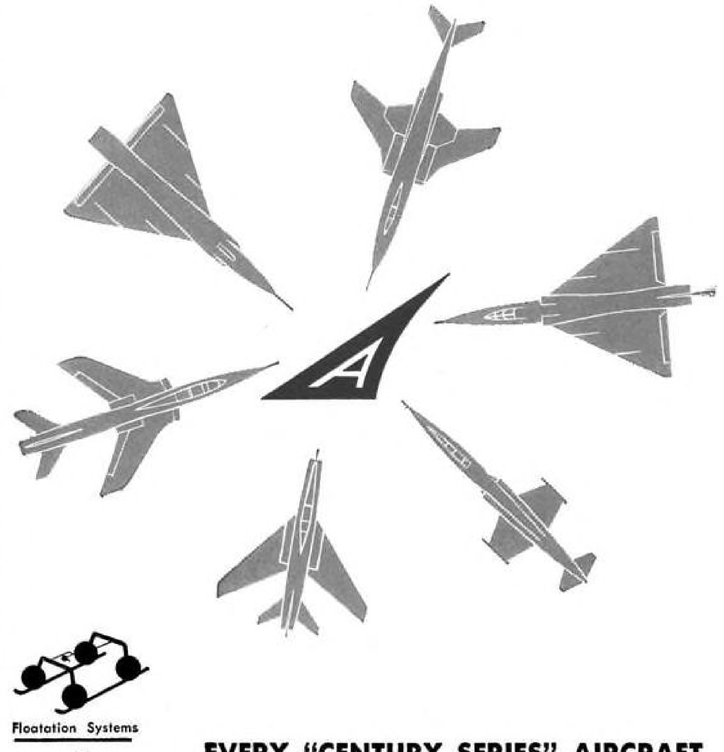
Starting the two Turbomeca Marbore 6 turbojet engines also has been simplified. Operation involves only a master and ignition switch, energized by batteries, with starter motor turning the Marbore turbine to 1,000 rpm. before fuel cock, a push-pull lever on aft console, is opened. Sequence is the same for the starboard engine.

Marginal Weather

Weather for this flight was approaching marginal conditions, although West German control allowed a visual flight rules takeoff. Wind was 11 kt. from 270 deg. and temperature was 58F.

Low profile also contributes to ease of taxiing; nose wheel is steerable by tapping brakes on the rudder pedals and airplane can be turned sharply even at fairly high taxi speeds. Takeoff on Hanover's Runway 28 was made after full-flap check and tailpipe temperature check (600C maximum). Flaps are lowered to 15 deg. for takeoff and throttles run up to 21,500 rpm. with brakes kept on most of the way up the power surge.

CM-191 has a high rate of initial acceleration, and the airplane was rotated at about 100 kt., less than half way down the 9,000 ft. runway. Climbout,



Floatation Systems

Pitot Disconnects

Valves

Float Switches

Composite Disconnects

Pressure Switches

EVERY "CENTURY SERIES" AIRCRAFT FLIES WITH AEROTEC EQUIPMENT

Specified on aircraft of every "century series", Aerotec equipment plays an important part in the operation of these fighters.

If your requirements include valves, disconnects, pressure switches, flow indicators or float switches, Aerotec can supply them.

These components, as well as complete systems, are providing dependable service on hundreds of applications in the aircraft, missile and nuclear industries.

The men whose imagination helped solve many of these requirements can help you with your unique problems. Their capabilities are proven. Call them in on your next development. Write Aircraft Equipment Division, Aerotec Industries, Inc., Greenwich, Conn. In Canada: T. C. Chown Limited, Montreal & Toronto.

AEROTEC INDUSTRIES, INC.
AIRCRAFT EQUIPMENT DIVISION, DEPT. W, GREENWICH, CONN.

Other Divisions: **AEROTHERM DIVISION** Aircraft Lounges, Passenger and Crew Seating
INDUSTRIAL DIVISION Dust Collecting Systems, Gas Scrubbers, Fans, Stacks and allied equipment.

U.S. Business & Utility Aircraft Shipments

March 1962

Make & Model	No. of Units	Net Billings
Aero Commander 500A, B	7	
560F	1	$770,000
680F	1	
Beech 18 Super	4	
33 Debonair	21	
35 Bonanza	18	
50 Twin-Bonanza	4	$3,226,000
55 Baron	19	
65 Queen Air	1	
80 Queen Air	2	
95 Travel Air	2	
Cessna 150	26	
172, Skyhawk	41	
175 Skylark	6	
180	12	
182, Skylane	119	$5,150,000
185 Skywagon	25	
210	44	
310	19	
320 Skyknight	6	
Lake LA-4	1	$20,000
Mooney Mark 20	34	$480,000
Piper PA-18-150 Super Cub	17	
PA-22-108 Colt	43	
PA-23-160 Apache	5	
PA-23-250 Aztec	34	
PA-24-180 Comanche	12	$3,594,000
PA-24-250 Comanche	32	
PA-25-150 Pawnee	11	
PA-28-150 Cherokee	6	
PA-28-160 Cherokee	66	
Totals	639	$43,240,000

Note: March data brings shipments to date this year to 1,772 units having a total factory billing value of $36,423,000 compared to 1,813 units shipped with a total factory billing value of $35,134,000 in the same period last year. Shipments in March, 1961 totaled 627 units having a billing value of $12,064,000.

This announcement appears as a matter of record only.

May 17, 1962

$7,500,000

ALLEGHENY AIRLINES, INC.

$3,000,000 Secured Notes due June 30, 1967
$4,500,000 Secured Notes due June 30, 1971

$5,500,000 of the above Notes were sold on May 14, 1962, $1,000,000 will be sold on June 5, 1962, and the balance of $1,000,000 will be sold prior to December 31, 1962, all to institutional investors.

Auchincloss, Parker & Redpath

at a shallow angle, was kept at 150 kt. to the airport boundary and then allowed to increase to 250 kt., producing a climb rate of 2,000 fpm. Flight ceiling was limited to 4,700 ft. for this evaluation to conserve maneuvering time, considering the restrictions laid on by West Germans.

Disregarding the deliberate stiffness of the controls, the CM-191 rolls easily into turns and reacts quickly when brought back to level flight, although a firm pressure is needed from the pilot. Visibility is excellent through the wraparound canopy, and nose section, although enlongated, droops enough to provide the necessary forward visibility.

First stall made was in clean configuration starting at 250 kt. with power pulled off and gear and flaps up. The buffet started at a little over 105 kt., and could not be felt on the control stick, until the stall occurred at 95 kt. IAS. Result was a sharp falloff to the left and the start of a tight turn into the left wing. Recovery was normal, made by holding opposite rudder and forward stick, and altitude loss was kept to a few hundred feet.

Stall with gear down and flaps lowered to 40 deg. gave more warning through buffet noise and control surface shaking. In this configuration, the airplane stalled at 80 kt. and the reaction was similar to the clear stall; the left wing fell off sharply. Recovery was complete within 1,000 ft.

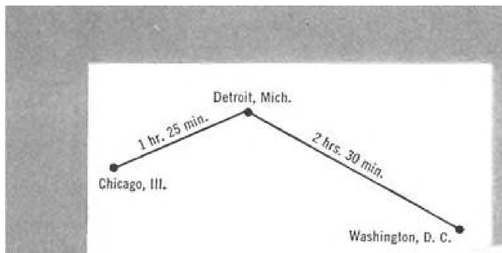
It was on the climbout from this stall, and during a sharp turn, that Hisler shut down an engine at about 190 kt. airspeed. There was no indication of yaw or drag, mostly due to tailpipe placement for the thrust flow.

Both Marbores are installed close together and the thrust exits are only 3 ft. apart.

Aerobatic Restriction

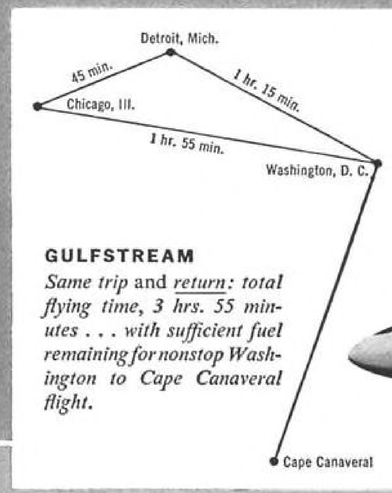
CM-191 is restricted from aerobatics during the test flight program, but this regime probably follows the Magister's ease of handling in unusual attitudes. Turns past 30 deg. do no more than tumble the gyros; pilot control is limited to continued back pressure on the stick to maintain altitude, much as that experienced in a piston-engine airplane. Control technique is the same for a single-engine steep turn into the dead powerplant, although manipulation of the electrical "thumb-button" trim control on the stick helps.

On return to Hanover, we experienced heavy gusts of rain and turbulence but the airplane remained easy to fly even when speed was reduced to 140 kt. preparatory to landing. Downwind leg, stretched because of lightplane traffic beating the storm to Hanover, was kept at 140 kt., reduced to 120 kt. after turning final. Gear was dropped on base leg and final was flown with full flaps



C-47
Washington to Chicago, via Detroit: total flying time, 3 hrs. 55 minutes.

GREAT OLD WORKHORSE



GULFSTREAM
Same trip and *return: total flying time, 3 hrs. 55 minutes . . . with sufficient fuel remaining for nonstop Washington to Cape Canaveral flight.*

GREAT NEW WORKHORSE

The turboprop Gulfstream—available now without major modification for high-priority personnel (24), cargo, airways checking, navigational training. Cruising speed: 350 mph to 30,000 feet altitude. Range: transcontinental. Payload: 10,000 lbs. Lands, takes off from virtually any military airfield. Not a "stopgap" airplane. The Gulfstream has been designed to fit long-range logistics planning for the next 20 years. Utility, performance, low operating costs. That's why nearly 90 Gulfstreams are now in operation with worldwide corporations and the Federal Aviation Agency.

Grumman

GRUMMAN

AIRCRAFT ENGINEERING CORPORATION
Bethpage • Long Island • New York

National Aeronautics and Space Administration Issue

Today's most timely aerospace industry subject — The National Aeronautics and Space Administration — will be featured in AVIATION WEEK & SPACE TECHNOLOGY's July 2, 1962 issue.

This massive editorial effort will present, for the first time, a complete analysis in depth of NASA:

1. Current & future plans and programs
2. Expansion of operations & facilities
3. Budgets
4. Management changes
5. New procurement policies

. . . as well as a long-range forecast of NASA's future in our industry.

How to do business with the fastest expanding part of the aerospace market, scheduled to award contracts exceeding Three Billion Dollars in Fiscal 1963 is a subject that will command the attention of key buying influences and open the door to countless sales opportunities for thousands of manufacturers throughout the country. As an example, in the Mercury project alone over 4,000 sub-contractors participated. The NASA man-in-space program is projected toward a $20 to $30 billion total over the next decade.

AVIATION WEEK & SPACE TECHNOLOGY has achieved an international reputation for presentations of this type with the Systems Command Issue, "Forging Military Spacepower" (1961); the Strategic Air Command Issue, "SAC in Transition" (1960); the NASA Issue, "Next Decade in Space" (1959); and the Air Research and Development Command Issue, "Research for Space" (1958).

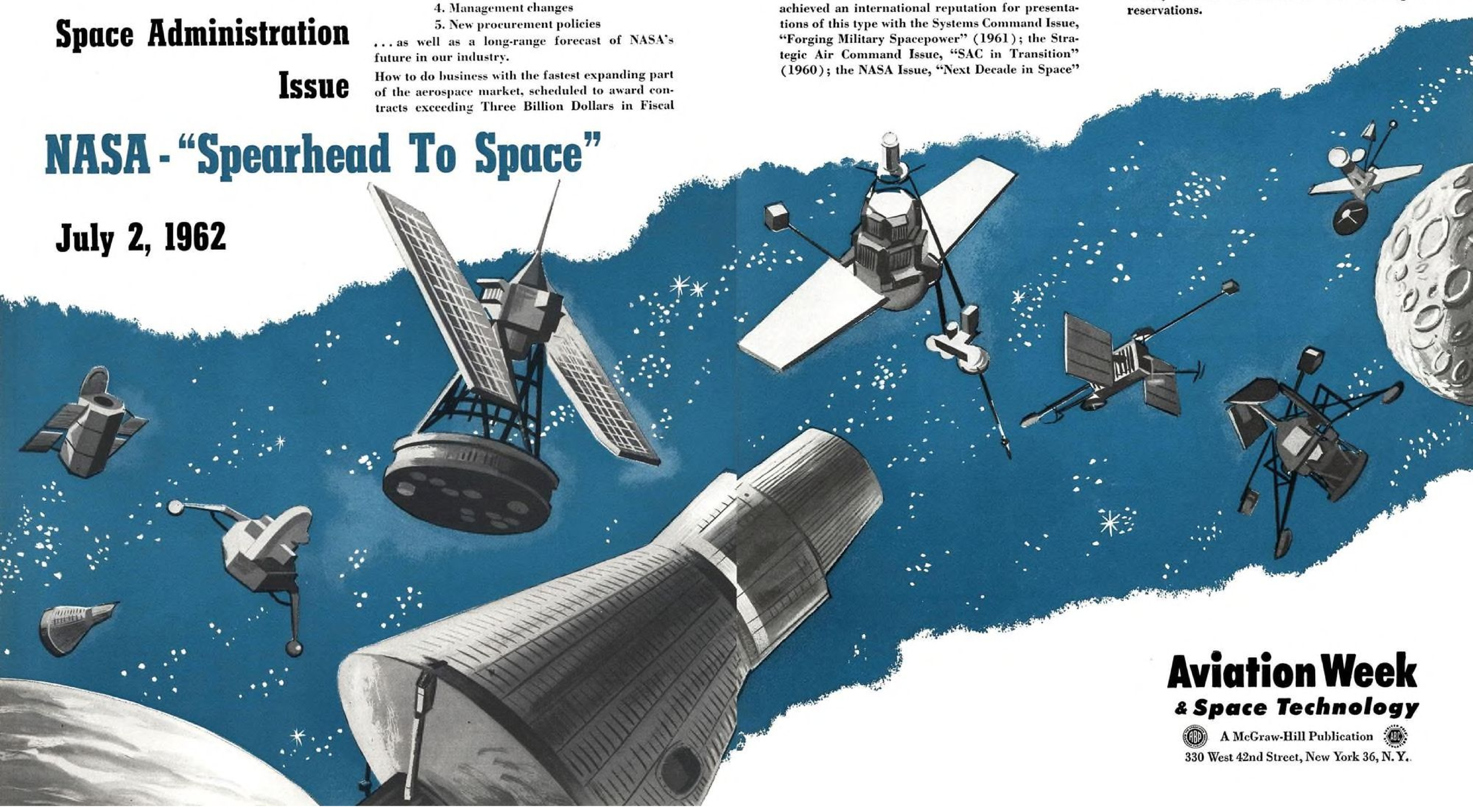
Teams of AVIATION WEEK & SPACE TECHNOLOGY editors are now carrying out assignments covering NASA operations and bases throughout the nation.

We urge your company's participation by advertising its products, capabilities and facilities in the most important aerospace issue of 1962.

Write, wire or call collect for immediate space reservations.

NASA - "Spearhead To Space"

July 2, 1962

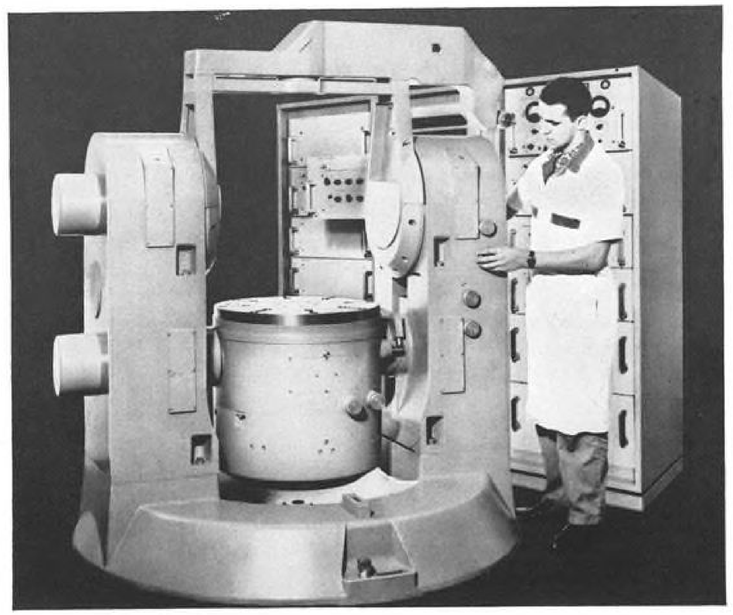


Aviation Week
& Space Technology

A McGraw-Hill Publication

330 West 42nd Street, New York 36, N. Y.

Model 107



Model 252 Test Table

NEW—Accurate and Versatile Gyro and Guidance Test Tables

Model 107 AUTOMATICALLY TESTS and CALIBRATES complete 3 axes inertial and stellar guidance systems, star trackers, accelerometers, gyros and systems components. An automatic autocollimator controllable to an accuracy of 3 seconds a resolution of 0.36 seconds is part of the completely automated test instrument which contains an independent system for self test and calibration of mechanical and electrical tolerances.

The table positioning transducer has a resolution of ±0.02 seconds of arc with ±0.25 seconds repeatability. The table can be positioned manually at the system console or remotely by punched tape.

Position readout in steps of 0.36 seconds of arc (.0001°) is electro-mechanically translated to digital code and has an accuracy of 1.5 seconds of arc.

The modular design of the Model 107 permits alternate configurations to suit many test needs. Modular construction also permits rapid test and isolation of circuit malfunctions and ease of maintenance.

This instrument is a most versatile and accurate automatic guidance test system.

Model 252 AIR BEARING table accurately tests gyros in the .0001°/hr drift rate class. Table diameter of 26 inches and capacity of 500 pounds makes it most suitable for tests of complete guidance systems as well.

To obtain extreme accuracy and reproducibility, all stiction causing elements have been eliminated in the design. The table has an air bearing rather than a liquid film bearing; a-c direct drive torque motor in place of d-c torque motor or gear drive; servo driven slip ring assembly mounted on its own bearing.

The modular design permits you to choose features suited to your test and readout requirements. *The tilt axis* can be driven manually or by torque motors for testing 2 axis gyros; accurate *tilt axis readout* is available either visually to an accuracy of 2 arc seconds, or in digital form to an accuracy of 1 arc second. *Table axis readout* can be digital or analog as well as visual with an accuracy of 1 arc second and a resolution of 0.5 arc seconds. Visual readout on the Model 252, and on the Model 107, is accomplished conveniently by means of fixed position eyepieces.

For more information on these instruments or for assistance with your guidance systems test requirements, write to J. W. Fecker Division, American Optical Company, 4709 Baum Blvd., Pittsburgh, Pennsylvania.

J. W. FECKER DIVISION
American Optical
COMPANY

and speed brakes out. Speed brakes are slotted and pop up vertically from the upper wing surface.

By this time the rain was severe, but the combination of a 120 kt. final and the curved canopy kept visibility clear all the way. Touchdown on the wet runway was smooth and the airplane rolled most of the length, mostly to test braking on wet surfaces. There was no tendency to skid, or for the brakes to grab because of the water.

Under normal circumstances with VFR weather, the final would be flown at about 100 kt. with touchdown at 80 kt. Flareout at this landing was made at about 105-110 kt. Engine shutdown is merely by pulling the two center fuel cocks and cutting master and ignition switches.

Important sales point in the future of the CM-191 as an executive jet, air taxi plane or a sports plane will be the availability of parts, based on wide acceptance and use of the Magister. In Germany, for instance, maintenance will be performed by Ernst Heinkel AG, Stuttgart, which is Turbomeca's general representative for the Federal Republic of Germany.

Design concept was to keep structural maintenance to a minimum; thus, the cantilever wing and V-shaped rudder-elevator tail. Trapezoidal wing has an aspect ratio of 7.67 and the leading edge is swept back, with the trailing edge straight.

Monocoque fuselage includes oval frames connected by four longerons. Both Marbore 6 engines are partially embedded in the sides of the fuselage with the wings attached to intake bulges. Cabin is pressurized and air-conditioning system can be controlled by pilot or copilot.

Emergency oxygen system includes a supply for 3 hr. flight time for all four occupants.

Landing gear is hydraulically actuated; main gear retracts inward to the belly and nose gear aft into the nose section. Gear may be operated manually by a cockpit hand pump. Flaps and speed brakes also are hydraulically operated.

Aircraft flown here was fitted with tip tanks which feed automatically into the two main tanks in the fuselage center section, aft of the cockpit. If additional range is desired, rear seats may be removed and an auxiliary fuel tank installed.

Marbore 6 engines produce 1,060 lb. thrust each, developing a cruise speed of 380 kt. at 20,000 ft. Engine is a more powerful derivative of the Magister's Marbore Mk. 2 powerplant (880 lb. thrust) and is manufactured under license in the U.S. and other countries. Engine includes a single stage radial compressor with an axial flow turbine; maximum turbine rotation is 21,750 rpm.

Radio gear in the CM-191 prototype included an ARC-34 UHF transceiver and a Lear ADF-20 direction finder.

U.K. Aviation Ministry To Buy Beagle 206s

London—Ministry of Aviation last week said it will order two Beagle 206 executive twins for evaluation purposes. It is the first sale of the airplane since its unveiling at last September's Farnborough flying display.

Meanwhile, Pressed Steel, Ltd., Beagle's parent corporation, confirmed that British Army has ordered a Beagle-Wallis WA.116 autogyro for field evaluation (AW Feb. 5, p. 69).

Pressed Steel's chairman, Alex Abel Smith, said the ministry order gives rise to hopes for a substantial production order. The prototype Beagle 206 has been flying for certification, and a second, somewhat larger, is nearing completion at Shoreham production facility.

Smith added that Pressed Steel has written off $2.3 million development and design costs for the Beagle line. He described the writeoff as "prudent . . . pending an evaluation of Beagle's earning capacity."

LEAK DETECTION

Vacuum Carousel Method
Non destructive—NO tracer gas
Measures 0.63 cc of Leak Per Year [2 x 10^{-8} cc/sec] IN UNDER 30 SECONDS!

Sensitivity—with time and care equal to any known method, down to 0.5 x 10^{-9} mm Hg x 1/sec

Reproducibility: 2,500 units tested on original equipment up to ten times over three years with a correlation of 90% to previous tests.

Write today for relevant data

NUCLEAR Enterprises Ltd.

550 BERRY ST., WINNIPEG 21, CANADA
Associate Co.: Nuclear Enterprises (G.B.) Ltd., Edinburgh, Scotland

PROBLEMATICAL RECREATIONS 120

In any gathering of six people prove that either three are mutually acquainted or three are mutually unacquainted. —*Contributed*

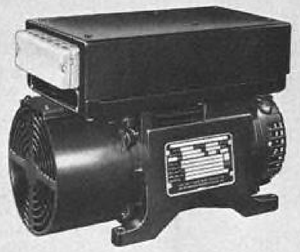
Encounter new directions in computer-oriented research at our Data Systems Division where an expanded research program calls for engineers with new approaches. Experience may be in electromagnetic theory, optics, high-speed circuitry, new memories, analysis, design or interconnection of mechanisms, information theory, systems concepts, logic, electrochemistry, or integrated circuits. Meet with Mr. Harry Laur if you wish to research the matter further.

ANSWER TO LAST WEEK'S PROBLEM: From P draw a line, L, to the opposite vertex, say A. Now construct a line parallel to L from the midpoint of BC, intersecting the side of the triangle at Q. The line PQ divides the triangle into two equal areas.

An Equal Opportunity Employer
LITTON SYSTEMS, INC.
Data Systems Division
Canoga Park, California

Inverters

Static Regulation



These new Leland inverters use completely static regulating devices to control frequency and output voltage. Semiconductors are used for rectifiers and amplifiers, for field control and for sensing—they completely eliminate carbon pile amplifiers and tubes.

Inverters shown on this page are designed to conform with appropriate MIL specs and drawings. We welcome the opportunity to propose on **your** high performance missile or aircraft inverter. We're geared to move quickly.

Should you wish to modernize your existing Leland inverters, we can make available static regulation conversion kits for these units. For specific information please advise us of the quantity, model numbers, and serial numbers of the units you have on hand. Request Bulletin INV from Leland Airborne Products Division of American Machine & Foundry Company, Vandalia, Ohio.

NEW STATIC REGULATED INVERTERS

Leland Model	3 Phase, 1 Phase VA Rating	Spec Drawing	Weight lbs.	Dimensions in Inches Length	Height	Width
MGE 93-200	100/60	E-1616-3	7.6	6.88	5.00	5.26
MGE 159-100	250/250	MS-21983-1*	13.8	9.24	6.25	4.25
MGE 23-400	2,500/2,500	MS-25097-2	45.0	13.94	9.50	7.13
MGE 130-200	2,500/2,500	MS-16062-1*#	48.0	13.98	9.62	7.24

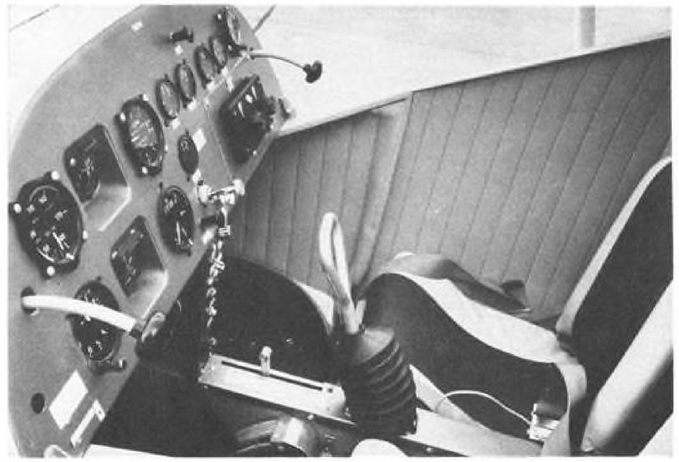
*SUPERSEDES MS 25093, MS 16058, E-1617, 51A1A9 AND E-5109 #SUPERSEDES E-1725 AND E-1737

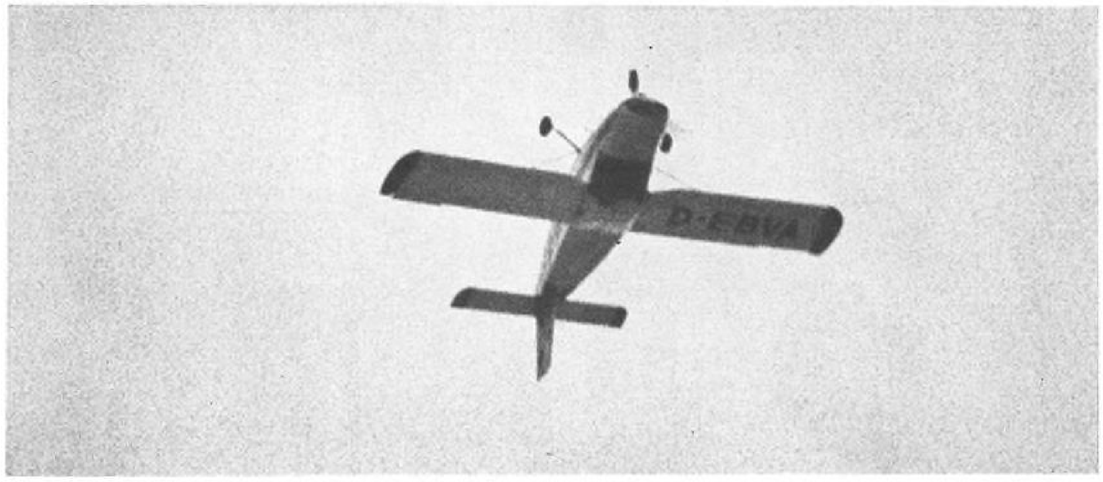
LELAND AIRBORNE PRODUCTS

Bölkow Junior, two-place sport airplane demonstrated at the Hanover Air Show, is being produced in West Germany and Sweden.

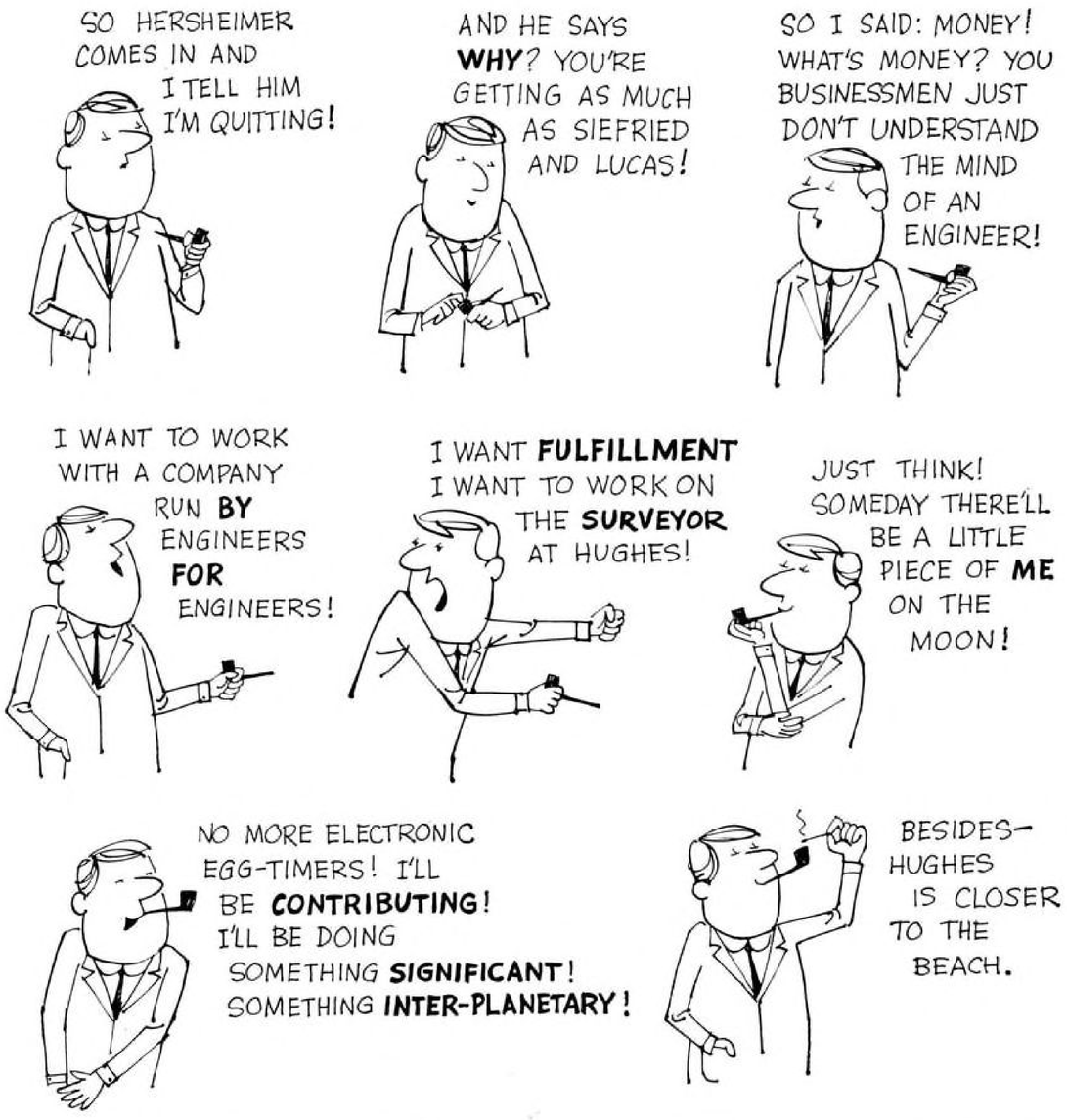
Bolkow Junior Production Models Demonstrated

Four production models of the Bölkow Junior, two-place, single-engine sport aircraft were shown at the recent Hanover Air Show. Aircraft features high, single-strut braced wing with large flaps covering approximately three-fourths of the trailing edge. Unique instrument and control layout (right) has single control stick centered on the armrest between the pilot and passenger seats. Magnetic compass and needle-ball are recessed into panel so they will be vertical in level flight. Other instruments are mounted flush on the canted panel. The airplane was designed by Bjorn Andreasson, a former Convair engineer. It is being built in Sweden by A. B. Malmo Flygindustri. Bölkow builds it in West Germany under license from Malmo. Production aircraft are different from prototypes since they have a wider cockpit and the canopy is hinged at the rear instead of the front.





Low-level loop, performed at approximately 200 ft. altitude, demonstrates aircraft's acrobatic capabilities.



Hughes is hiring! Numerous opportunities now exist in a variety of advanced projects and studies. Examples include: The SURVEYOR—which will soft land an instrumented payload on the moon. ARPAT—terminal anti-missile defense system. VATE—automatic test equipment for ballistic missiles. SYNCOM—synchronous-orbit communications satellite. BAMBI—ballistic anti-missile booster intercept. Positions are open at all levels for specialists with degrees from accredited universities.

Please airmail your resume to:

Mr. Robert A. Martin
Head of Employment
Hughes Aerospace Divisions
11940 W. Jefferson Blvd.
Culver City 43, California

CONTROLS ENGINEERS. Concerns airborne computers and other controls related areas for: missiles and space vehicles, satellites, radar tracking, control circuitry, control systems, control techniques, transistorized equalization networks and control servomechanisms.

CIRCUIT DESIGNERS. Involves analysis and synthesis of systems for: telemetering and command circuits for space vehicles, high efficiency power supplies for airborne and space electronic systems, space command, space television, guidance and control systems, and many others.

INFRARED SPECIALISTS. To perform systems analysis and preliminary design in infrared activities for satellite detection and identification, air-to-air missiles AICBM, infrared range measurement, air-to-air detection search sets, optical systems, detection cryogenics and others.

SYSTEMS ANALYSTS. To consider such basic problems as: requirements of manned space flight; automatic target recognition requirements for unmanned satellites or high speed strike reconnaissance systems; IR systems requirements for ballistic missile defense.

Creating a new world with Electronics

HUGHES

HUGHES AIRCRAFT COMPANY
AEROSPACE DIVISIONS

An equal opportunity employer.

MODIFIED MUSKETEER prototype has nose landing gear moved 15-in. forward as it will be on production models. Side windows do not incorporate curvature of their top lines to follow fuselage top contour as will be case on production versions.

Beech Musketeer to Be Available This Fall

By Erwin J. Bulban

Retail price of $13,300 has been established for the new four-place Beech Model 23 Musketeer business plane, which will be delivered from the company's Wichita, Kan., production lines to dealers and distributors beginning this fall. Price includes basic instrumentation and navigation/communication radio package.

Detail changes will distinguish the production Musketeer from its prototype configuration (AW Dec. 4, p. 94) as a result of an extensive flight test program which began Oct. 23. These and some later considerations on improving styling are in part responsible for the price finally arrived at. The airplane was originally conceived as a fairly austere product in order to maintain the lowest possible price—Beech was aiming at the $12,000 range.

Minor performance changes also are evident, including reduction of two to three miles per hour in maximum and cruise speeds, compared with earlier data, which were preliminary estimates.

Production Musketeer will feature these improvements, some of which have been incorporated in prototype:

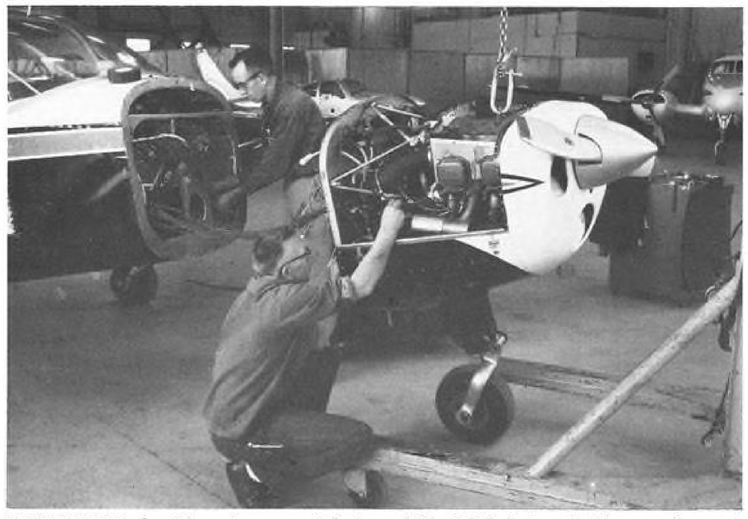
• **Addition of six** J-section spanwise stringers in the wings forward of the main spar to strengthen the bonded forward portion of the wings and reduce "oil canning" effects when the structure is loaded. Initial structure forward of the main spar, which utilizes one-inch-thick truss-grid ribs made up of eight layers of corrugated aluminum honeycomb bonded to the skin, formerly had no stringers. Testing indicated that the structure, as initially developed, came too close to the FAA requirement of 5.8g, whereas company engineers were aiming at a comfortable margin by having the structure capable of handling more than 7g.

Although the structure was adequate, the "oil canning" effect loads would introduce might create an unfavorable impression on customers and probably would also limit future weight increases in the airplane's growth cycle, so the decision was made to incorporate the improvements early in the production line.

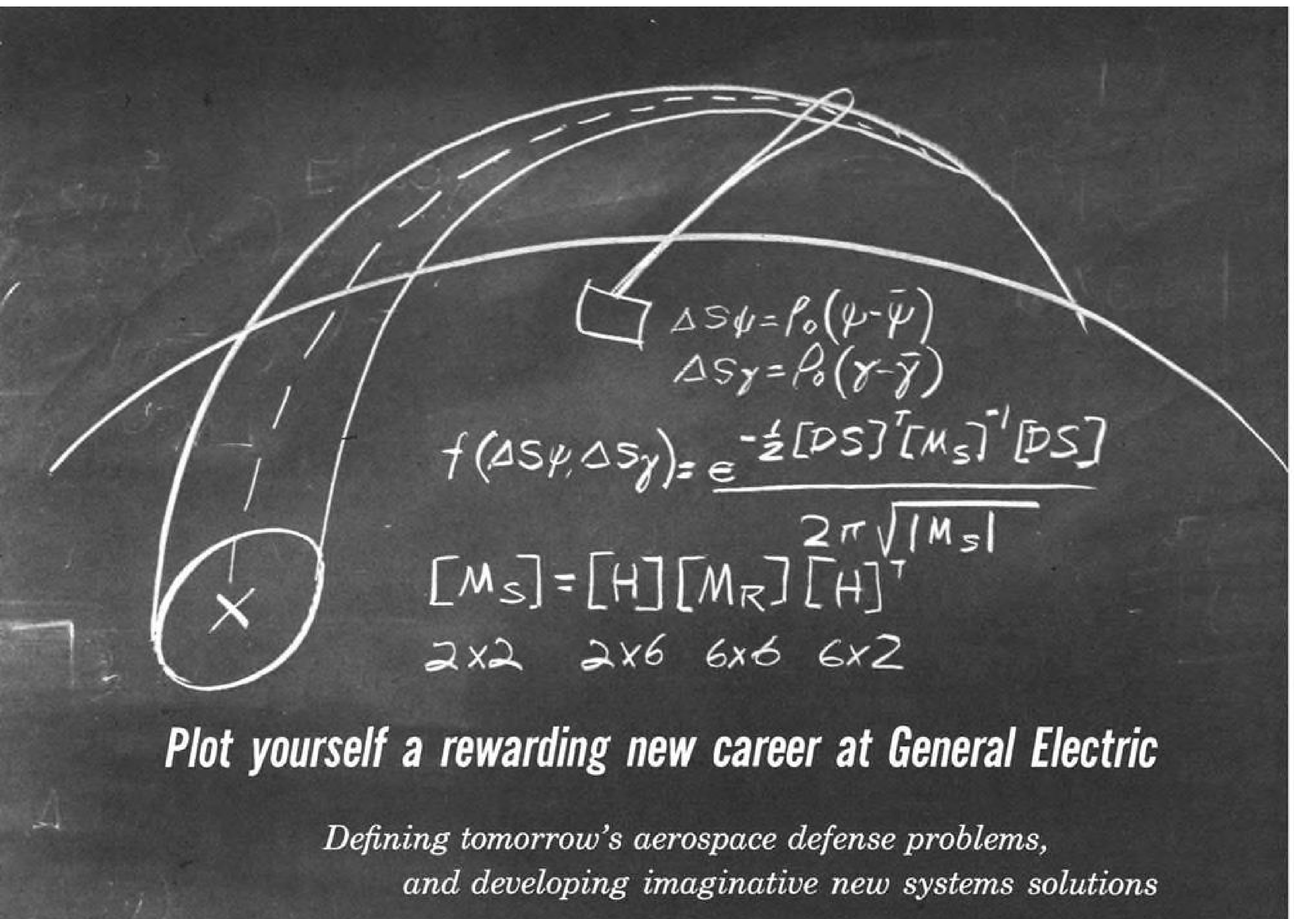
• **Nose landing gear** is moved forward 15-in. from its original position, providing a longer wheel base and improved ground handling characteristics with braking force at the main wheels being more effective. Nose gear strut is attached to steel tube structure welded in as part of the engine mount, maintaining the feature of quick detach of the complete engine section, with mount forward of the firewall.

• **Initial straight** top lines of the side window panels will be modified to embody a slight upward curve that will more closely match the fuselage top line, for a more pleasing effect.

• **Interconnected control system**, providing ability to make coordinated turns



FIRST PHOTO of quick-engine removal feature of Beech Musketeer details ease of accessibility afforded to powerplant and cockpit controls areas of new four-place business plane. Entire power section can be removed by two men in less than 20 min.



Plot yourself a rewarding new career at General Electric

Defining tomorrow's aerospace defense problems, and developing imaginative new systems solutions

This is the specialized challenge of a select group of scientists and engineers at General Electric's expanding new Systems Operation. They are engaged in the development of extremely advanced, large-scale electronics defense systems, from initial threat analysis through over-all systems design.

And we need more like them, now:

Engineers, Physicists, Mathematicians . . . men with a high degree of technical skill, keen analytical ability and systems-oriented backgrounds . . . creative men who want to broaden their professional experience in a field offering some of today's most exciting technical challenges, and some of tomorrow's greatest potential.

Key positions are now open involving advanced work in systems analysis, systems synthesis and technical systems management. Basic qualifications include a BSEE, Physics or Math degree, preferably an advanced degree, and at least three years' experience in one or more of the following: • Radar • I/R Optics • Guidance • Data Processing • Computer Systems • Programming • Re-entry Physics • Propagation • Threat Analysis • Communications • ASW • Interceptors.

You'll find stability, challenge and diversified opportunity at General Electric. This comprehensive new listing of current openings will provide the details. We'd like to send you a copy. Simply drop us a card. Or, send your resume in confidence to Mr. D. S. Brown, Systems Operation, T-16, Heavy Military Electronics Department, General Electric Co., Court St., Syracuse, New York. (*An equal opportunity employer.*) 177-06

GENERAL ELECTRIC

using the ailerons only, similar to Bonanza and Debonair systems, have been added to simplify piloting.

• **Addition of sound-deadening** material —similar in effect to automobile undercoating—to the interior cabin skinning, topped by complete glass fiber matting on sidewalls and overhead, provides improved sound levels. Headliner will be a one-piece contoured polyurethane foam.

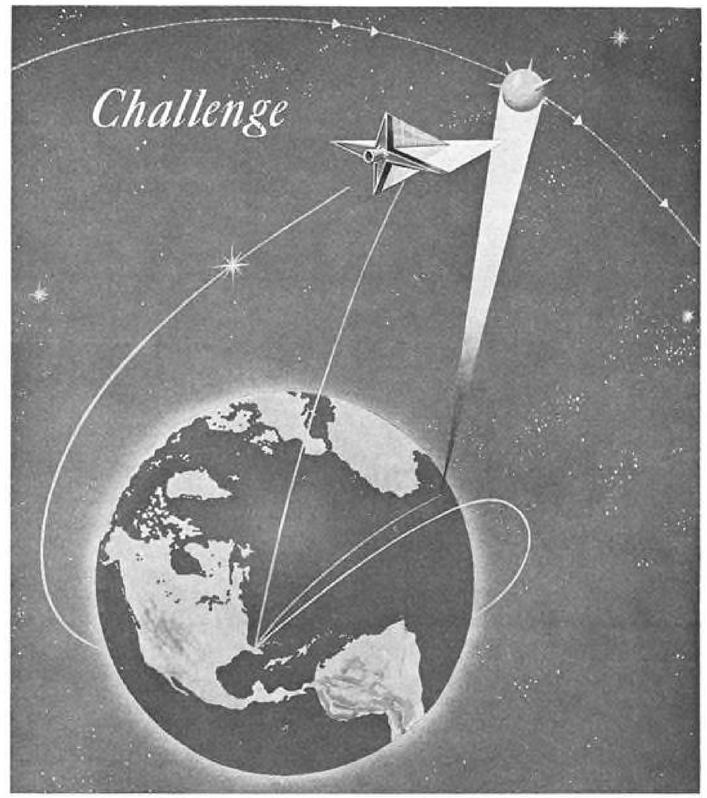
Standard Musketeer electronics package consists of a separately tunable 90-channel crystal-controlled transceiver in the 118-126.9-mc. range with a five-watt transmitter output, a separately tunable 100-channel crystal-controlled omni-localizer receiver covering 108-117.9 mc. and a built-in omni-localizer converter and indicator. Instrumentation comprises airspeed, sensitive altimeter, rate-of-climb, turn-and-bank, outside air temperature, eight-day clock, magnetic compass, oil pressure, oil temperature, fuel pressure, two fuel gages, recording tachometer and ammeter.

Dynafocal mounts have been added to the airplane's 160-hp. Lycoming O-320-B powerplant system to reduce vibration transmission.

Beech 23 Musketeer

Max. speed at sea level (2,700 rpm.)	144 mph.
Cruise speed @ 75% power @ 7,000 ft.	135 mph.
Cruise speed @ 65% power @ 10,000 ft.	128 mph.
Cruise speed @ 55% power at 10,000 ft.	114 mph.
Stall speed, landing (power off—30-deg. flaps)	62 mph.
Cruise range (with 45-min. reserve):	
75% power @ 7,000 ft. (60 gal.)	803 mi.
75% power @ 7,000 ft. (40 gal.)	507 mi.
65% power @ at 10,000 ft. (60 gal.)	873 mi.
65% power @ 10,000 ft. (40 gal.)	549 mi.
55% power @ 10,000 ft. (60 gal.)	913 mi.
55% power @ 10,000 ft. (40 gal.)	573 mi.
Gross weight (utility category)	1,960 lb.
Gross weight (normal category)	2,300 lb.
Empty weight (minus standard equipment)	1,250 lb.
Empty weight (standard equipment)	1,300 lb.
Rate of climb (gross weight, sea level)	710 fpm.
Service ceiling	13,500 ft.
Absolute ceiling	15,600 ft.
Takeoff distance over 50-ft. obstacle	1,420 ft.*

*Calculated data.



Employment opportunities with

PAN AM

at Cape Canaveral

Scientific Advisory Staff
Advanced Planning
Range Instrumentation Planning & Systems Design
Program Management
Operations
Facilities Planning
Facilities Engineering

Pan American, as prime contractor to the U.S. Air Force, has fulfilled the responsibility for planning, engineering, operating and maintaining Cape Canaveral and the Atlantic Missile Range since 1953.

Pan American scientists and engineers have participated intimately in all stages of the national programs since early V-2 tests through Project Mercury's series of manned space flights.

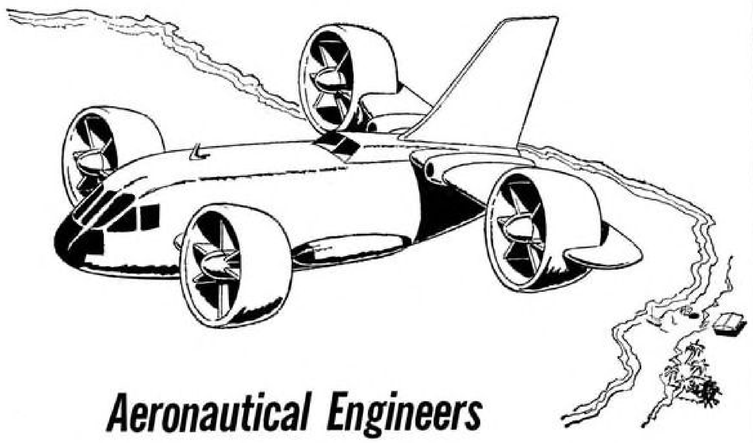
With Pan American, technically respected people have freedom to choose career positions with unlimited opportunities for pro — fessional development.

In addition to normal company benefits, Pan Am offers the unique advantage of a 90% world-wide air-travel discount.

You are invited to send your resume in confidence to David F. Bruner, Personnel Manager, Guided Missiles Range Division, Pan American World Airways, Inc., P.O. Box 4336, Patrick Air Force Base, Florida.

An Equal Opportunity Employer.

PAN AM GUIDED MISSILES RANGE DIVISION
CAPE CANAVERAL, FLORIDA



Aeronautical Engineers to help create ADVANCED Naval Aircraft

The Bureau of Naval Weapons (combining the original functions of Aeronautics and Ordnance) needs aeronautical engineers with varying degrees of background and experience, but a common desire to broaden their professional capabilities and assume wide-ranging responsibility for the creation and evaluation of subsonic and supersonic aircraft, helicopters, and V/STOL vehicles.

We cannot promise you the moon, but we can promise important and interesting work unusually free from restraint, the finest facilities and equipment, the opportunity to advance professionally on the job and do advance degree work . . . and freedom from the usual "ups and downs" of the defense industry.

Flight Performance Engineers—to evaluate flight and wind tunnel data, derive performance criteria and predict mission performance capabilities.

Senior Structural Dynamics Engineer—to establish aircraft requirements as to vibration, flutter and divergence . . . to evaluate new designs, and sponsor and administrate research studies to advance the state of the art.

Stability & Control Engineers—to be Project Engineers on research investigations as they may apply to all kinds of Naval aircraft.

Structures & Materials Engineers—to administer and control the structures and materials phases of airborne weapons systems programs, including the critical review of stress analyses, approval of test plans, evaluation of test results to incorporate structure improvements into production and service aircraft. Other Engineers are required to prepare specifications and requirements for flight demonstrations, critically review results and set up structural operating limitations of the Fleet.

All these positions are at Naval headquarters in Washington, D. C.—fast becoming the scientific capital of the nation. Starting salaries $8,340 to $12,210, plus the exclusive benefits of Career Civil Service.

Write or Call Mr. H. T. Jackson

bureau of naval weapons

(DCP-31)

Washington 25, D. C. OXford 6-4603 Area Code 202

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Dr. Charles Stark Draper, head of the Department of Aeronautics and Astronautics at Massachusetts Institute of Technology, has been selected as the recipient of the 1962 National Society of Professional Engineers Award for his "outstanding contributions to the military affairs of the country . . ."

Richmond P. Boyden has been named 1962 winner of the Institute of the Aerospace Sciences' $8,300 Flight Test Engineering Fellowship. Mr. Boyden, a civilian with the U.S. Army Headquarters Director of Engineering, St. Louis, Mo., will spend two years in advanced study at Princeton University. **Gene J. Matranga,** research engineer at the NASA Flight Research Center, Edwards, Calif., and **Maj. James C. Wayne,** U.S. Air Force pilot, Bellevue, Neb., runner-up candidates, also will attend Princeton at the invitation of the Aeronautical Engineering Department.

Changes

James S. Conley, Apollo program manager for Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., and **Geno J. Andreini,** deputy program manager.

Alfred M. Mayo, who has resigned as chief of the Directorate of Bioresearch and Technology of NASA's Office of Advanced Research and Technology, will join Chance Vought Corp. as manager of the Advanced Systems Engineering Department.

Dr. Herbert Sukenik, chief of space medicine, Life Sciences Department, Martin Co.'s Space Systems Division, Baltimore, Md.

Dr. Solomon L. Miller has joined the Central Research Staff at Varian Associates, Palo Alto, Calif., as a senior research scientist.

L. M. Pease, director of business planning, Ordnance Operation of Avco's Electronics and Ordnance Division, Richmond, Ind.

Gordon S. Humphrey, general manager, Leach Corp.'s Controls Division, Azusa.

W. J. Davis, manager, Electrical Insulation Department, Permacel, New Brunswick, N. J.

Robert E. Boyden, director of engineering, Adams Rite Manufacturing Co., Glendale, Calif.

Gerhard H. De Witz, chief engineer, Magnetic Research Corp., Hawthorne, Calif.

Seymour Golub, supervisor, Design and Advance Packaging, United Aerospace Division of United ElectroDynamics, Inc., Pasadena, Calif.

J. Rene Champion, head, Operations Staff, Lexington (Mass.) Division of System Development Corp.

A. Waller Howard, marketing manager, General Electric Co.'s Large Jet Engine Department, Evendale, Ohio.

Lt. Col. Paul C. Gauger, Jr., deputy district engineer, Army Corps of Engineers' Jacksonville, Fla., office.

Harrie Richardson, former technical director for Air Force Flight Test Center, Edwards AFB, now senior engineer for Radio Corp. of America at the Atlantic Missile Range, Patrick AFB, Fla.

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc. Look in the forward section of the magazine for additional Employment Opportunities advertising.

Positions Vacant
Positions Wanted
Part Time Work
Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered
Employment Agencies
Employment Services
Labor Bureaus

RATES

DISPLAYED

The advertising rate is $60.20 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising Inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

UNDISPLAYED

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Position Wanted Ads are ½ of above rate.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to
Classified Advertising Div. of AVIATION WEEK
P.O. Box 12, N. Y. 36, N. Y.

ENGINEERS
SCIENTISTS

A NEW DIRECTION IN AEROSPACE TECHNOLOGY THRU

CRYOGENIC RESEARCH

Opportunity on staff of Republic's Paul Moore Research & Development Center to advance cryogenic techniques for liquid hydrogen fuel requirements of hypersonic and space vehicles. Work pertains to several new R&D contracts. Facilities for investigations include Cryogenic Test Apparatus, Space Environment Chamber and extensive computer support. Requires: MS with 7 years experience.

Write to Mr. George R. Hickman,
Technical Employment Manager, Dept. 1E-4

REPUBLIC
AVIATION CORPORATION

Farmingdale, Long Island, New York
An Equal Opportunity Employer

first in VTOL aircraft

at SIKORSKY

new areas of space age challenge and growth to qualified

PROPULSION RESEARCH ENGINEERS
RELIABILITY ENGINEERS
ELECTRONIC GSE
AIRFRAME DESIGNERS
POWERPLANT INSTALLATION DESIGNERS

Do you welcome demanding assignments . . . work best in an atmosphere of stimulating challenge? Then Sikorsky Aircraft could well be your career choice for the space age future. The assignment—that of building and further developing the most successful VTOL vehicle systems in the industry to meet the demands for even more sophisticated systems in the exciting future ahead.

If yours is an active, seeking mind, we welcome your investigation of these opportunities. Please submit your resume, including minimum salary requirements, to Mr. Leo J. Shalvoy, Personnel Department.

Sikorsky Aircraft DIVISION OF UNITED AIRCRAFT CORP.
STRATFORD, CONNECTICUT An Equal Opportunity Employer

New Avenues in Space Technology at AVCO/RAD

Flight Technology

Putting "man among the stars" through the design and development of a new generation of space vehicles plus a multitude of advanced space-oriented programs at Avco/RAD have created broad vistas of professional advancement for qualified engineers and scientists.

Needed are aerodynamicists, thermodynamicists, systems evaluation engineers and trajectory analysts. Responsibilities involve parametric studies of the aero/thermo environments and demonstration of advanced systems performance leading to the interpretation and analysis of flight test data.

Other challenging assignments include analytical studies leading to the generation of optimum flight test concepts, formats and matrices; as well as planning and conduct of flight test operations.

Also, experienced electrical and optical systems engineers with an interest in test range technology are needed for new missile and space projects.

The Division is located in a superbly equipped $23,000,000 laboratory facility in the Boston suburbs. At Avco/RAD you will find a liberal benefits program including educational assistance.

Send resume to
Mr. J. Bergin, Dept. AW

Avco/RAD is presently associated with Apollo, Titan, Atlas, Minuteman, Nike-Zeus and other classified space projects.

Avco
Research & Advanced Development
A Division of Avco Corporation
201 Lowell St., Wilmington, Mass.

An equal opportunity employer

TO R&D MEN WHO SEEK A CHALLENGE . . . RAYTHEON OFFERS THIS!

Right now, Raytheon's Bedford R&D Lab has openings for experienced personnel who relish the opportunity to imaginate, create, innovate in the many varied fields of electronics. You'll be working — exploring — in such challenging and virtually uncharted areas as advanced missile systems for aircraft . . . space rendezvous guidance . . . advanced command and control techniques for missile and space applications . . . penetration systems . . . stellar and inertial and re-entry guidance systems.

Positions offering unlimited professional development are available now at the Bedford R&D Lab as a result of expansion in long-range programs.

Radar Digital Data Processing
Bandwidth Compression for Digital TV
Pattern Recognition and Advanced Digital Techniques
Test Equipment Design
Heat Transfer
Aerophysics Engineering
Space Technology
Control Systems
Structures Engineering
Product Design Engineering (Senior Level Openings)
Aerodynamics
Circuit Design Engineering
Radar Transmitter
Microwave Engineering
Operations Research (Weapons Systems Requirements)
Reliability Engineering
Communications Engineering

If you would enjoy working with experienced pioneers and innovaters — whose successes already include the HAWK and SPARROW Missile Systems, breakthroughs in decoy sorting radar techniques and AICBM and tactical ballistic missile defenses, please send your resume or phone collect to Mr. William O'Melia, CRestview 4-7100, Ext. 2138, Raytheon Company, Missile & Space Division, Bedford, Massachusetts (suburban Boston).

RAYTHEON MISSILE & SPACE DIVISION

BEDFORD, MASSACHUSETTS

An Equal Opportunity Employer

Aviation Writer

Collins Radio Company has an opening for an energetic creative writer to assist in national advertising programs for airline, general aviation and military avionics products. The man who qualifies has a background as a pilot or avionics specialist and as a writer. He will have challenging assignments in the development of literature, external magazines, direct mail, sales aids and magazine advertising. Please send resume and writing samples to:

T. L. Huebsch
Advertising Department

COLLINS RADIO COMPANY
Cedar Rapids, Iowa

An equal opportunity employer.

ADDRESS BOX NO. REPLIES TO: Box No.
Classified Adv. Div. of this publication.
Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

POSITIONS VACANT

Helicopter Maintenance Chief for established operation. Must be willing to prove capabilities. Top pay for right man. Extensive commercial experience on Bell Helicopters required. Agricultural background desirable. P-8965, Aviation Week.

Helicopter Pilot—Vice Presidency and general managership potential for right man. Must have extensive commercial experience on Bell Helicopters with agricultural background. P-8966, Aviation Week.

Co-Pilot—Mechanic Opening on Beechcraft based in New England. Require commercial & instrument rated pilot, aircraft & power plant rating with minimum 4 years experience—send resume. P-9028, Aviation Week.

POSITIONS WANTED

Pilot—Air Force career pilot—maintenance officer desires position in corporate flying. Resume on request. PW-9012, Aviation Week.

ATR qualified DC-3, CV-240-340-440 qualified pilot single, aged 39, 14,500 hours, 14 years airline experience desires permanent corporation or private position as pilot. Resume on request. PW-9058, Aviation Week.

NASA's Office of Manned Space Flight, which directs this nation's manned space flight programs, invites Senior Aerospace Engineers with Experience in: Systems Analysis and Studies • Systems Engineering • Spacecraft and Flight Missions • Reliability Assessment • Launch Vehicles and Propulsion • Systems Integration and Checkout

TO ACCEPT A SIGNIFICANT ROLE IN MANKIND'S GREATEST CHALLENGE
THE CONQUEST OF SPACE

If you possess these attributes: 6-10 years progressively responsible professional engineering and scientific experience • Three years or more comprehensive aerospace experience • Shirtsleeve initiative, drive, and perseverance • Maturity, professional integrity, sincere enthusiasm and outstanding capability and talent • The courage to trade salary for significant responsibility

Inquire in confidence to—
Director of Manned Space Flight
Dept. 131
National Aeronautics and Space Administration
Washington 25, D. C.

We as a nation are resolved that a free society can meet such a challenge. We at NASA are determined to continue to attract our country's best engineering and scientific talent by offering: Unlimited Opportunities for Professional growth, achievement, contribution, and recognition • Unequaled Resources and Environment conducive to research and development • Significant responsibilities • Outstanding and stimulating professional colleagues

All qualified applicants will receive consideration for employment without regard to race, creed or color, or national origin. Positions are filled in accordance with Aero-Space Technology Announcement 252-B.

GARRETT-AIRESEARCH

has immediate openings

for work on

SPACE ENVIRONMENTAL SYSTEMS

For major programs now under way, including project Apollo environmental system, AiResearch immediately needs preliminary design, creative board-type designers and hardware development engineers at all levels, with backgrounds in the following disciplines:

Thermodynamics
Fluid Mechanics
Heat Transfer
Controls

Stress and Vibration
Systems Engineering
Cryogenics
Test Engineers

Here is an opportunity to participate in a major expansion of a company which pioneered the space environmental field. Specific experience in space environmental controls is desirable but not necessary. Education requirements are B.S. and up. Garrett is an "equal opportunity" employer.

Please send complete resume to Mr. Tom Watson, Dept. 2

GARRETT

AIRESEARCH MANUFACTURING DIVISION

9851 So. Sepulveda Blvd., Los Angeles 45, California

ELECTRIC THRUST CONTRACT MANAGEMENT

Physicists and engineers with one or more years experience with electric thrust devices (ion rockets, MHD rockets, and arc jets).

Needed for immediate employment in technical supervision of research and development contracts with industry.

Applicants please write to:

NASA Lewis Research Center
Manager, Research Staffing
21000 Brookpark Road
Cleveland 35, Ohio

All qualified applicants will receive consideration for employment without regard to race, creed or color, or national origin.

NASA

Positions are filled in accordance with Aero-space Technology Announcement 252-B.

OPERATIONS ENGINEER

Aeronautical Engineer with recent multi-engine pilot experience. Position requires training in or aptitude for airline operations engineering work. Opportunity for rapid advancement and career with established Far East Airline. P. O. Box 3567, Washington, D. C.

Constellation Crews
PILOTS - CO-PILOTS - FLIGHT ENGINEERS - NAVIGATORS
Contact: Chief Pilot
CAPITOL AIRWAYS
Wilmington, Delaware
Phone, COLLECT, East 8-4161

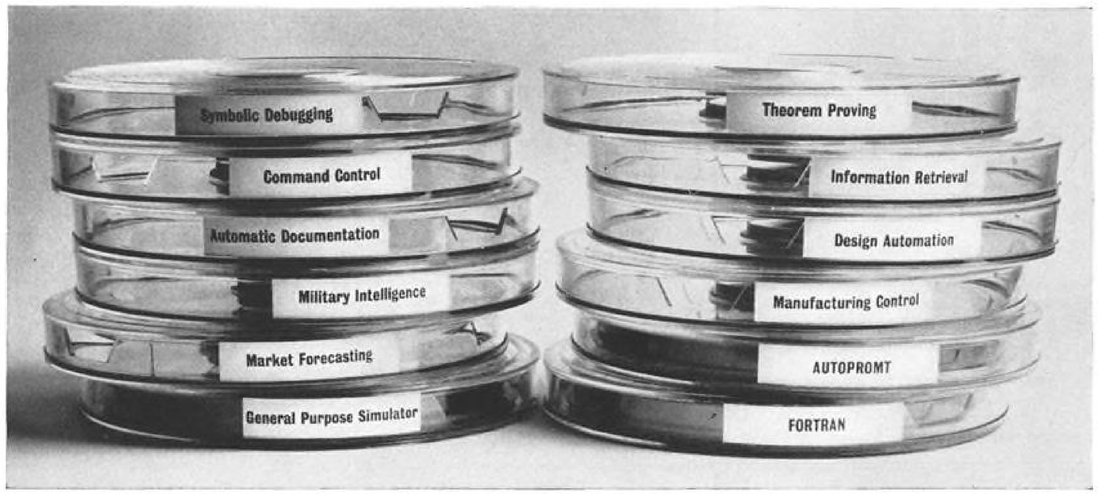
Need Engineers?

Contact them through this

EMPLOYMENT OPPORTUNITIES section

IBM extends the range of programming

Are you interested in exploring the capabilities of the computer?



Some of the most important programming developments are taking place now at IBM.

The broad scope of work underway at IBM offers important advantages to members of our professional programming staff. They have the opportunity to work on projects taken from the broad range of programming. They are face to face with the frontiers of applied, scientific and administrative programming. For example, what advanced programming techniques interest you the most: multiprogramming systems . . . compilers . . . problem-oriented languages and processors? Programmers at IBM are exploring these techniques and many more.

Here are some other areas you might work in if you were a programmer at IBM: theory of computing . . . artificial intelligence . . . simulation systems . . . scheduling methodology . . . communications control systems . . . space systems . . . and the design of total computer systems.

At IBM, you would find yourself in the kind of atmosphere that encourages accomplishment. You would help to design new hardware systems. You would work side by side with men of eminent professional stature: scientists, engineers and mathematicians who pioneer in the research and development that make new computing systems possible.

What's more, you would be able to give your projects the time they deserve. Time for thinking. Time for achievement.

The scope of programming at IBM stimulates professional growth. It offers possibilities which merit serious consideration whether you are a master of the skills of programming or a relative newcomer to the field. Salaries and benefits at IBM are excellent. If you have experience in scientific or commercial programming, we would like to acquaint you with the wide range of responsible positions on our programming staff.

Programming facilities are located in San Jose, Calif.; Washington, D. C., area; Lexington, Kentucky; Rochester, Minnesota; Omaha, Nebraska; and New York, Endicott, Kingston, Owego, Poughkeepsie and Yorktown Heights, New York. IBM is an Equal Opportunity Employer.

For further details, please write, outlining your background and interests, to: Manager of Professional Employment, IBM Corporation, Dept. 524R4, 590 Madison Ave., New York 22, N. Y.

ENGINEERS
SCIENTISTS

A NEW DIRECTION IN AEROSPACE TECHNOLOGY THRU

ENVIRONMENTAL CONTROLS RESEARCH

A knowledge of closed ecological systems is required for this post at Republic's Paul Moore Research & Development Center. Projects involve design of environmental systems for aerospace, orbiting and lunar vehicles and space suits. Work is outgrowth of new R&D contracts. Center's facilities for project include 30' space environment chamber with exospheric capability. MS with 8 years experience.

Write to Mr. George R. Hickman,
Technical Employment Manager, Dept. 1E-4A

REPUBLIC
AVIATION CORPORATION

Farmingdale, Long Island, New York
An Equal Opportunity Employer

WHERE TO BUY

Featuring additional products, specialties & services for the aviation field

HIGH TEMPERATURE FASTENERS
Engineering Catalog Number 286 on request
Manufacturers AN—N.A.S.—M.S. 6 Digit Hardware
SPECIALS TO YOUR SPECIFICATIONS
Mercury air parts co., inc.
9310 West Jefferson Blvd., Culver City, Calif.
Telephone—UPton 0-5923—Teletype—CVR CY 4138
TOUGH SPECIALS 10 DAY DELIVERY
MANUFACTURERS OF PRECISION HARDWARE

Save with DISPOSABLE Pillowcases • Headrest Covers
Feels like cloth! . . . Economy, convenience of paper! Snap-on and Velcro attachments. White and decorative colors.
ACME PAPER PRODUCTS CORP.
139 SPRING STREET, NEW YORK 12

Your Inquiries to Advertisers Will Have Special Value . . .
—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information on more products or better service—more value—to YOU.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES EQUIPMENT - USED or RESALE

FOR SALE
LEASE OR LEASE-PURCHASE

Specially engineered, long range, high payload

1049H SUPER CONSTELLATION AIRCRAFT

- Most economical long-range, high-payload aircraft available
- Special engineering on aircraft permits payloads of 45,000-pound cargo or 120 passengers for 2500 mile range
- Either in cargo, passenger or convertible configuration
- Financing available

Don't buy any large transport aircraft until you have looked at these aircraft for flexibility, payload capacity and economy in operation.

ALSO
SPARE PARTS INVENTORY
for
C-46, DC-4, DC-6, 1049H Constellation Aircraft
and
Wright Compound 3350-EA-3 Engines

Fred Benninger
Executive Vice President
THE FLYING TIGER LINE INC.
Burbank, Calif.

Tel.: TRiangle 7-3411 Cable: Flytiger

Let Us Move Your Mobile Home

Across the street or across the nation, National Trailer convoy makes moving your mobile home as easy as calling a taxi. National Trailer has more than 150 terminals in strategic cities across the nation and the industry's only central dispatch system. Call Central Dispatch collect at TEmple 5-8441, Tulsa, Okla., or your nearest NTC terminal, listed in the Yellow Pages under "Trailer Transporting" or "Mobile Homes—Transporting".

SAFE SWIFT SURE

National Trailer Convoy, Inc.
Tulsa, Okla.

FOR SALE
IMMEDIATE DELIVERY
PERFECT CONDITION

C47 DC3 . . . . . $50,000
32 Passenger Cargo Door
Low Time TSO

CW20T $55,000
58 Passenger Air Stair Door
Low Time TSO

Trans-Global Airlines
2735 East Spring Street, Long Beach, Calif.
Phone GArfield 4-8588
Write for specifications.

ADDRESS BOX NO. REPLIES TO: Box No.
Classified Adv. Div. of this publication.
Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

FOR SALE

Executive DeHavilland Dove—zero time engines—low time airframe—all mods completed. New interior-exterior. FS-8421, Aviation Week.

1960 Super G. Beechcraft—total time 600 hours—convertible executive—5 seat to 9 place high density seating. FS-8424, Aviation Week.

Grumman G44 Super Widgeon—total time 2,589. Offers invited. FS-8428, Aviation Week.

Contact us first for Grumman Gooses & Super Widgeons, also 9200# Gross Weight Kits for G-21A Goose, wrap around windshield, auxiliary gas tanks, picture windows and many others. Super Widgeon Conversion Kits, increase gross weight kits, auxiliary gas tank kit and many others. McKinnon Enterprises, Inc., Route 1, Box 520, Sandy, Oregon.

Immediate delivery — Twin Beech Bonanza E-50 Serial No. EH-30; corporate owned in first class condition. Re-licensed Apr. 14, 1962; total time since new, airframe 2,228 hrs. Props Hartzel 3 blade full feathering. Engines TSO, 301 hrs. both. Lycoming GSO-480 B1B6 supercharged. Full radio equipped for IFR operations, ARC, CD1 course director. Approx. 85,000 in spare parts. $35,000 for the lot. FS-9056, Aviation Week.

WANTED

Engines wanted: Pratt & Whitney R2800-83AM10. New or zero time since major preferred. Contact Bob MacFarland, Northern Pump Co., Minneapolis 21, Minn.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, MAY 28, 1962

AEROJET-GENERAL CORPORATION 6
AEROQUIP CORPORATION 17
AEROTEC INDUSTRIES, INC., AIRCRAFT EQUIPMENT DIVISION 105
AEROTEST LABORATORIES, INC. 97
AMERICAN ELECTRONICS, INC. 96
AUCHINCLOSS, PARKER & REDPATH 106
AVIATION WEEK & SPACE TECHNOLOGY 108-109

BENDIX RED BANK DIVISION, THE BENDIX CORPORATION 72
BLACK, SIVALLS & BRYSON, INC. 99
BOEING COMPANY, THE—AERO-SPACE DIVISION 78
BRISTOL SIDDELEY ENGINES LIMITED 51

CHERRY RIVET DIVISION, TOWNSEND COMPANY 5
COLLINS RADIO COMPANY, CEDAR RAPIDS DIVISION 15, 88

DELAVAN MANUFACTURING COMPANY, FUEL INJECTION DIVISION 79
DEUTSCH COMPANY, THE—ELECTRONIC COMPONENTS DIVISION 11
DONNER SCIENTIFIC DIVISION, SYSTRON—DONNER CORPORATION 74
DOW CORNING CORPORATION 4
DU PONT DE NEMOURS & COMPANY, INC., E. I., METALS CENTER 86-87

ELASTIC STOP NUT CORPORATION OF AMERICA ..... 4th Cover

FAIRCHILD SEMICONDUCTOR, A DIVISION OF FAIRCHILD CAMERA & INSTRUMENT CORPORATION 57, 59
J. W. FECKER DIVISION, AMERICAN OPTICAL COMPANY 110
PLEXONICS DIVISION OF CALUMET & HECLA, INC. 90
FORD INSTRUMENT COMPANY, DIVISION OF SPERRY RAND CORPORATION 18

GENERAL ELECTRIC COMPANY, FLIGHT PROPULSION DIVISION 100-101
GENERAL ELECTRIC COMPANY, HEAVY MILITARY ELECTRONICS DEPARTMENT 116
GENERAL PRECISION, INC., COMMERCIAL COMPUTER DIVISION 13
GIANNINI CONTROLS CORPORATION 9
B. F. GOODRICH AEROSPACE & DEFENSE PRODUCTS, A DIVISION OF THE B. F. GOODRICH COMPANY 20
GRUMMAN AIRCRAFT ENGINEERING CORPORATION 107

HAWKER SIDDELEY AVIATION LIMITED 47
HAYNES STELLITE COMPANY, DIVISION OF UNION CARBIDE CORPORATION 24
HUGHES AIRCRAFT COMPANY 114

I-T-E CIRCUIT BREAKER COMPANY, SPECIAL PRODUCTS DIVISION 95
ITEK CORPORATION 84

KELSEY HAYES COMPANY, HEINTZ DIVISION 16

LEACH CORPORATION 94
LEAR, INCORPORATED, ELECTRO-MECHANICAL DIVISION 10
LEAR, INCORPORATED, INSTRUMENTS DIVISION 60
LELAND AIRBORNE, PRODUCTS DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY 112
LITTON SYSTEMS, INC. 22, 111
LOCKHEED ELECTRONICS COMPANY, A DIVISION OF LOCKHEED AIRCRAFT CORPORATION 8
LOCKHEED GEORGIA COMPANY, A DIVISION OF LOCKHEED AIRCRAFT CORPORATION 125
LOCKHEED MISSILES & SPACE COMPANY, A DIVISION OF LOCKHEED AIRCRAFT CORPORATION 80-81

MARQUARDT CORPORATION, THE 104
McDONNELL AIRCRAFT CORPORATION 92-93
METALS & CONTROLS, INC., A CORPORATE DIVISION OF TEXAS INSTRUMENTS INCORPORATED 77
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, HEILAND DIVISION ..... 2nd Cover
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, MICRO SWITCH DIVISION 68-69
MOTOROLA, INC., MILITARY ELECTRONICS DIVISION 98

NUCLEAR ENTERPRISES LTD. 111

PAN AMERICAN WORLD AIRWAYS 117

RADIO CORPORATION OF AMERICA, SEMICONDUCTOR & MATERIALS DIVISION 12
RAYTHEON COMPANY, MISSILE & SPACE DIVISION 14
RESISTOFLEX CORPORATION ..... 3rd Cover
ROHR CORPORATION 76
ROLLS-ROYCE LIMITED 40

SPERRY PHOENIX COMPANY DIVISION OF THE SPERRY RAND CORPORATION 102
STANDARD OIL COMPANY OF CALIFORNIA 70
STANDARD PRESSED STEEL COMPANY, AIRCRAFT MISSILE DIVISION 65-66
STANLEY AVIATION CORPORATION 7

TAPCO, DIVISION OF THOMPSON RAMO WOOLDRIDGE INC. 83
TRANS WORLD AIRLINES, INC. 42

UNITED AIRCRAFT CORPORATION, PRATT & WHITNEY AIRCRAFT DIVISION 44
UNITED AIRCRAFT CORPORATION, SIKORSKY AIRCRAFT DIVISION 46
UNITED STATES NAVY—BUREAU OF NAVAL WEAPONS 118
UNITED TECHNOLOGY CORPORATION, A SUBSIDIARY OF UNITED AIRCRAFT CORPORATION 54

VICKERS INCORPORATED DIVISION OF THE SPERRY RAND CORPORATION 3

WESTERN AIRLINES 48
WRIGHT MACHINERY COMPANY, DIVISION OF SPERRY RAND CORPORATION 91

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

WHERE TO BUY
Acme Paper Products Corp. 124
Mercury Air Parts Co., Inc. 124
EMPLOYMENT OPPORTUNITIES 119-123
EQUIPMENT
(Used or Surplus New)
For Sale 124

ADVERTISERS INDEX

Avco Corp. 119
Capital Airways 122
Collins Radio Company 120
Flying Tiger Line Corp. 124
Garrett Corp., The 122
IBM Corp. 123
NASA 121, 122
National Trailer Convoy Inc. 124
Raytheon Co., Missile & Space Div. 120
Republic Aviation Corp. 119, 124
Sikorsky Aircraft Division of United Aircraft Corp. 119
Trans-Global Airlines 124

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION
Where, a recent national survey shows, there's MORE of what MORE people want MORE of • in progress, challenge, working and living.

ENGINEERS . . . . . INTERESTED?

Write: Hugh L Gordon, Professional Employment Manager, Lockheed-Georgia Company, 834 W. Peachtree St. N.E., Atlanta 8, Ga. *An equal opportunity employer*

LETTERS

Jet Noise Abatement

The article on airport area noise problems in the Apr. 16 issue of AVIATION WEEK (p. 36) was a timely and judicious analysis of the question of how far the airlines, the Federal Aviation Agency, pilots and airport operators can go in developing noise abatement procedures without in any way compromising safety. It is essential that we continually examine what we are doing and what we might do so that our high safety standards will not be eroded away. I can assure you that the airlines have always so looked at noise abatement procedures, and that they welcome an objective discussion of the subject, toward which your article contributed.

Your editorial in the same issue, however, went far beyond what the facts, as presented in your article and elsewhere, would warrant by incorrectly asserting that some noise abatement procedures are ". . . beyond the real limits of safe operating procedure."

The airlines would not propose or accept any procedure that, for noise abatement or other purposes, would endanger their passengers or people on the ground. The various noise abatement procedures now in effect do impose severe economic penalties on the airlines, but they do not represent any compromise with safety. They have been developed by the Federal Aviation Agency, with the participation of the airlines, the aircraft and engine manufacturers, the Air Line Pilots Assn. and airport operators, all of whom have accepted them as safe. There is nothing, in brief, either in how noise abatement procedures have been developed or in our experience in operating in accordance with these procedures to justify either the concern or the claims of your editorial.

S. G. TIPTON
President
Air Transport Assn.
Washington, D. C.

Your editorial of Apr. 16 has quite properly pointed out that a better technical solution to the aircraft noise problem must be found. In addition to the better noise performance obtainable on takeoff with turbofan engines (which we publicly advocated in October, 1959), we believe that high-lift devices (such as boundary layer control, leading edge flaps, slotted wings, and other leading edge and trailing edge devices) are essential to satisfactorily improve the landing as well as takeoff noise characteristics of jet aircraft.

Your comments about safety, however, are not supportable by the facts.

The David Hoffman story on aircraft noise in the same issue of AVIATION WEEK is a thoughtful analysis of a very complex problem. Mr. Hoffman's article makes it clear that all flight procedures, including those for noise abatement, have been carefully developed by the airline pilots, the airlines, the manufacturers, and the Federal Aviation Agency—with safety given first priority.

The FAA's Red Book—"Noise Abatement (Flight) Procedures"—makes this abundantly clear.

In light of the facts, your statement that ". . . the harassing tactics of some airport authorities that have already forced airline pilots to dip below minimum safety operational requirements. . ." is a disservice to the public and should be retracted.

E. THOMAS BURNARD
Executive Vice President
Airport Operators Council

The Port of New York Authority requests that you immediately retract your erroneous editorial comment in AVIATION WEEK of Apr. 16 that major airport operators ". . . are content to scuttle air transport safety. . ." and that The Port of New York Authority "handled the noise problem with . . . high-handed autocracy. . ."

The anti-noise procedures you speak of were not, as your editorial states, "airport authority-imposed." They were, as Mr. Hoffman's article in the same issue correctly points out, evolved by the airlines and pilots and approved by the Federal Aviation Agency, which is legally responsible for safety standards. In addition, the Federal Aviation Agency is responsible for and has promulgated regulations controlling the flight of aircraft including takeoffs and landings. Your editorial should be corrected to conform with David Hoffman's article, which states:

1. ". . . there are 57 air carrier airports with FAA-approved anti-noise procedures."
2. "Each calls for maneuvers based on standards set forth in FAA's 'Red Book' on noise—a pamphlet that emerged from an Apr. 20, 1960, meeting attended by airline, pilot and manufacturer representatives."
3. ". . . line captains representing ALPA took part in the technical discussions that led to their formulation."
4. ". . . the disputed noise procedures are identical to those proposed by Pan American World Airways in October, 1958. . ."
5. ". . . they found their way into the trunklines' FAA-approved operating manuals."

We are shocked at your charge that airline pilots are deliberately risking their lives and those of their passengers by consenting to use flight procedures which they allegedly deem unsafe, and that airline officials are permitting them to do so.

JOHN R. WILEY, Director of Aviation
The Port of New York Authority

(The Port of New York Authority has independently banned Idlewild airport jet takeoffs at night from all except "over-water" runways to reduce noise. It has threatened to deny airlines permission to use the airport's longest runway if FAA decides to scrap, for reasons of safety, a low-level turn that steers aircraft away from a nearby village. It has installed receivers on top of telephone poles around the airport, using them to gather data on pilots who make more noise than the Port Authority thinks proper. It sends such report cards to airline managements and to the political heads of communities surrounding the airport. It has established an elaborate preferential runway system which pilots must use in the absence of "specific permission" from the airport manager.

(It has gone to court to compel obedience when one airline indicated an intention not to abide by the Port Authority's anti-noise rules. It also refuses to allow a jet or turboprop aircraft to land or take off from Idlewild without Port Authority permission.

(When FAA issued its own anti-noise rule for Idlewild, it said the rule would reduce noise "to the extent consistent with safety." But the Port Authority took issue with this thesis and urged FAA to slap a ceiling on the amount of noise an airline could legally make and adopt other measures to make the rule more stringent. A strong faction in the Air Line Pilots Assn. believes that the Port Authority's preferential runway system and its inflexible 112 PNDB noise limit generate pressure that compromises safety during those critical moments after a jet is first airborne (AW Mar. 19, p. 42; Apr. 16, p. 37; Apr. 23, p. 43; and May 7, p. 38). The way the Port Authority wields its alleged power represents "perhaps the most fully developed application of the theory of the airport landlord's right to exercise control over aircraft operations," according to the Airport Operators Council, of which the Port Authority is a member.

(These are some of the "harassing tactics" which, as the Apr. 16 editorial pointed out, "have already forced airline pilots to dip below minimum safety operational requirements." These facts should be repeated, not retracted.—Ed.).

I read with great interest and admiration your editorial entitled "Noise Versus Safety" in the Apr. 16 issue of AVIATION WEEK. Similarly, I found Mr. Hoffman's paper in the same issue most informative.

As one of the group of people who spend a considerable amount of time aboard one or another of the scheduled airlines in this country, I am obviously heartily in accord with Capt. Carroll's position relative to the importance of resisting further steps, in the interest of noise abatement, which threaten the safety standards which have been so important to the development of air transport in this country. Both in St. Louis, where I formerly lived, and here in Denver, as well, I have seen people buy homes immediately adjacent to the airport. They obviously do so of their own volition, and I have little sympathy for them when they shortly begin to protest against aircraft noise.

The scheduled airlines in this country have made a tremendous contribution to the growth of all sort of endeavors, commercial, educational and otherwise. Without the convenience, comfort and safety of air travel, many of these activities could not have developed as they have. Now we are faced with the situation where, on one hand, the burgeoning air traffic (much of it involving ill-equipped aircraft and inadequately trained pilots) constitutes an ever increasing hazard and, on the other hand, continued harassment of the airlines by such things as noise abatement procedures constitute severe, unwarranted threats.

It seems to me that your editorial pointed up the problem most effectively and also suggested an approach to its solution.

May I add a word of appreciation for the excellent quality of your publication which I enjoy tremendously and find most educational.

ROBERT J. GLASER, M. D.
Vice President for Medical Affairs
University of Colorado

Information About Hose Made of Teflon From The People Who Invented It

No. 1 in a series

SIGNIFICANCE OF COLOR

Resistoflex originated and in 1953 introduced hose assemblies made of Teflon* via gas turbine applications. Since then millions of assemblies have gone into service in all areas of the aero-space industry, and an outstanding record for performance and reliability has been compiled.

You have undoubtedly observed hose tubing made of Teflon in many colors, with black being predominant. Black is the color of the hose developed and manufactured to this day by Resistoflex. In fact, Resistoflex and its licensees, here and abroad, manufacture black hose ONLY.

The black color is a result of a carbon black component being added to the Teflon extrusion compound by a process covered by Resistoflex Patent No. 2,752,637. The purpose of the carbon black is to act as a moderator for the large liquid extrusion-lubricant fraction of the Teflon resin mix. Its excellent absorption characteristic and fine particle size provide millions of microscopic lubricant reservoirs uniformly dispersed throughout the mix. Despite the most exacting controls, Teflon resin displays a wide range of lubricant retention capability. Hence, the carbon black particles, in their function as a moderating agent, serve as suppliers of additional lubricant or receivers of excess lubricant during the passage of the resin mix through the vital constricting throat of the tubing extrusion dies. For this reason black tubing has consistently shown uniformity of structure.

Some have assumed carbon black was merely a color coding for identification. Some have even thought coloring was to hide defects. Some colorings used, because of their poor dispersal characteristics, have resulted in serious agglomeration problems and unreliable structure. Uncolored hose, while not aggravated by the improper use of pigment, continues to be plagued by structural defects resulting from the variation in resin lubricant absorption capability.

Therefore, Resistoflex will continue to manufacture black hose by the same methods that have been so well proven in field service.

Resistoflex markets its hose made of Teflon under the trade name FluoroflexT.

†Resistoflex T.M. *Dupont T.M.

RESISTOFLEX
RELIABILITY

ANAHEIM · ROSELAND · DALLAS

SALES OFFICES: Atlanta • Chicago • Cleveland • Dayton • Detroit
Hasbrouck Heights • Houston • Jacksonville • Kansas City • Miami • Philadelphia
San Diego • San Francisco • Seattle • Syracuse • Washington

MAY 29 1962

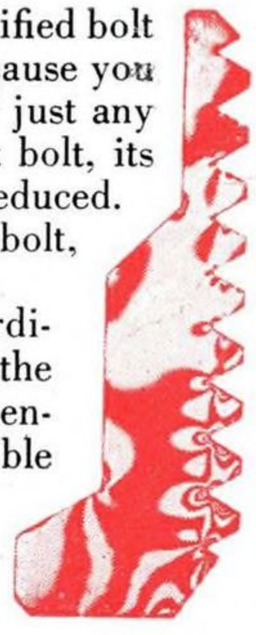
NOW...on the new LOCKHEED JetStar...

16 ESNA® DD* NUTS APPLIED TO NAS630 ENGINE MOUNT BOLTS

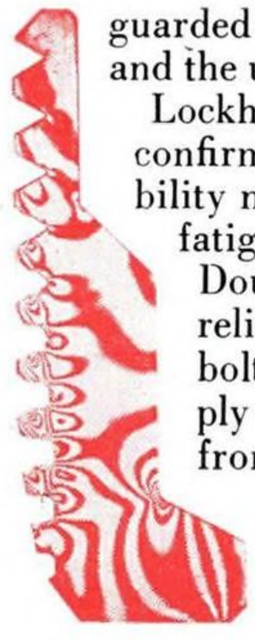
...give unparalleled reliability to critical power plant attachments

When you specify a high-tensile fatigue qualified bolt for a high-stress application, it's usually because you want to insure a reliable connection. But, if just any ordinary high-tensile nut is applied to that bolt, its reliability under dynamic loading may be reduced. It may perform no better than an ordinary bolt, despite the price paid for greater reliability.

The stress photos here show why. In an ordinary locknut the load is concentrated on the lower three threads of the nut. This load concentration can accelerate bolt fatigue—and possible failure. But with an ESNA Double/Durability* nut—featuring the revolutionary EQUA-STRESS thread pattern—the stress load is re-distributed over *all* the threads. The reliability of the bolt is safeguarded because the bolt is more uniformly loaded and the unit load per thread is reduced!



OLD



NEW

Lockheed engineers design for reliability, and tests confirmed ESNA data showing that Double/Durability nuts could be depended upon to increase the fatigue life of the JetStar power plant attachments.

Double/Durability nuts can provide the kind of reliability insurance you want for your critical bolted connections. In fact, they actually multiply the fatigue endurance of high-tensile bolts from 2 to 30 times! Write for Design Manual 5930—with complete photoelastic studies and data. Dept. S61-525, Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

ESNA®

LH3393T, (220,000 psi)
LHEB220T, (220,000 psi)

LH2577T, (180,000 psi)
LH3220T, (220,000 psi)

EBT,(180,000 psi)

LH3489T, (180,000 psi)