Aviation Week and Space Technology

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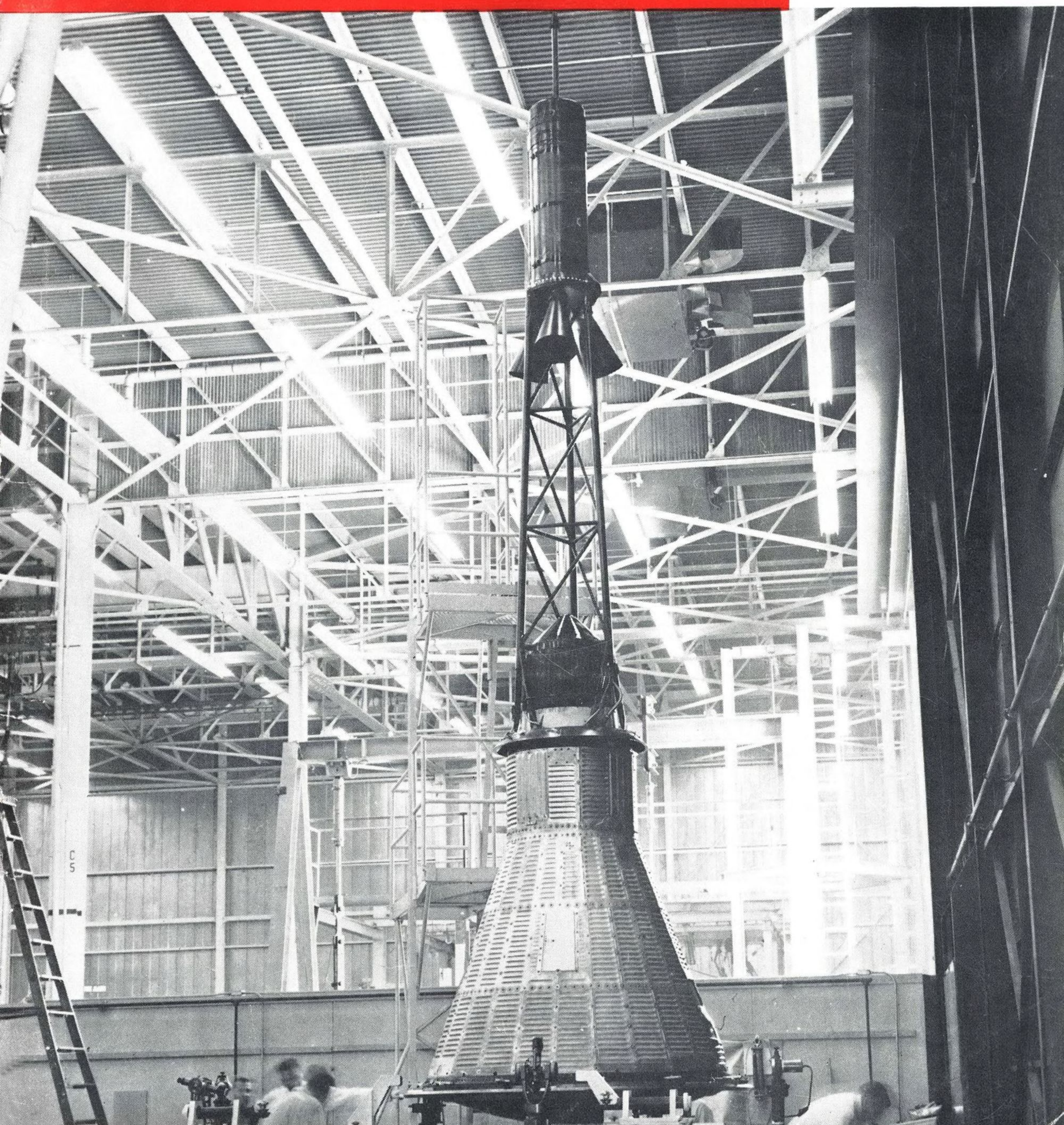
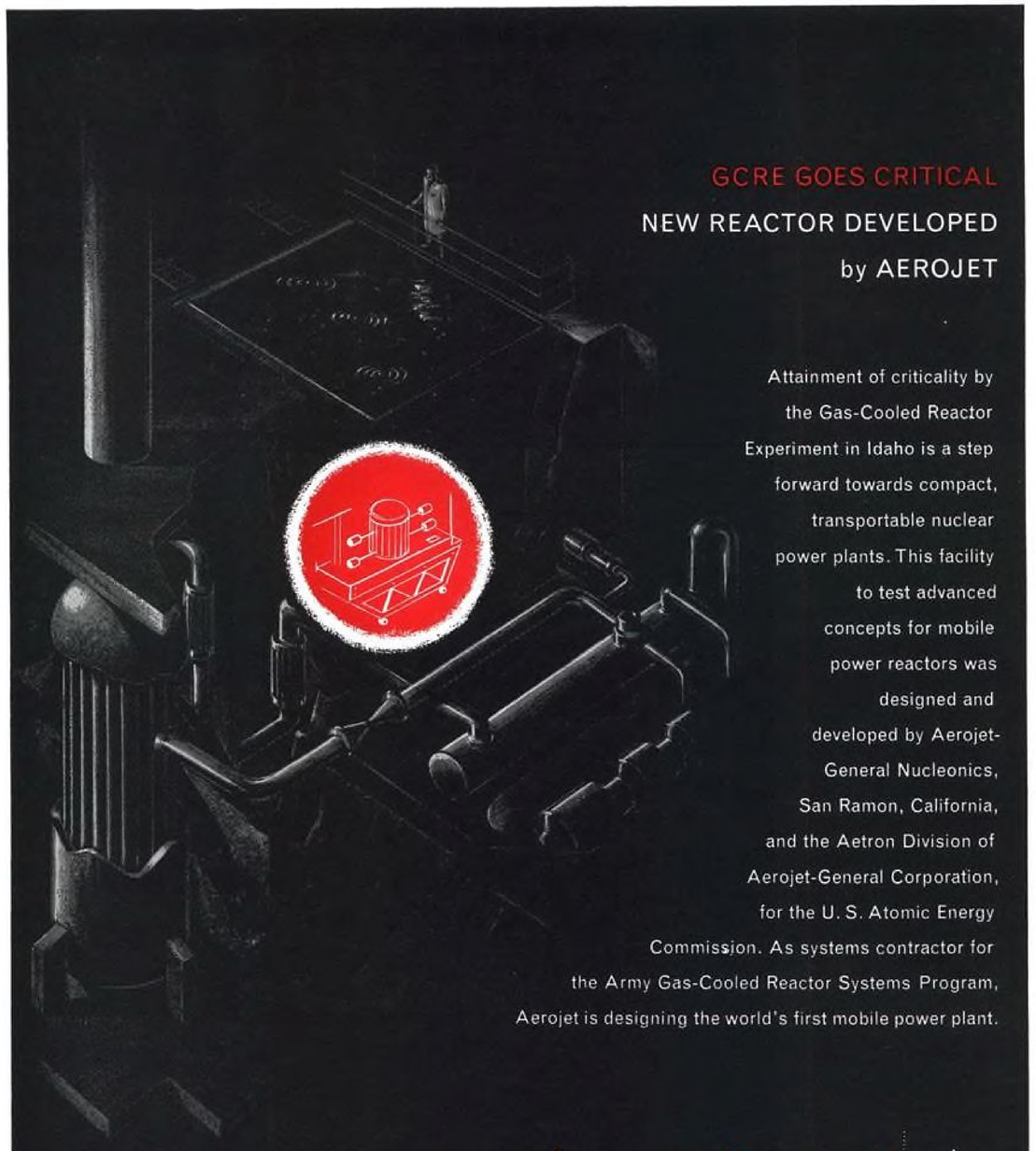
April 18, 1960

Hercules Tests Large-Scale Solid Rockets

First McDonnell Mercury Capsule





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- Ground support equipment for missiles and missile launchers
- Temperature control systems
- Equipment for high pressure, high temperature applications
- Direct operation valves to replace pilot operated valves
- Transistorized control boxes
- Electrical test and checkout equipment
- Rocket propulsion systems equipment
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AVIATION CALENDAR

Apr. 24-May 3—1960 German Aviation Exhibition, Hanover Airport, Germany.
Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.
Apr. 28-29—18th Annual Meeting, Aeronautical Training Society, Mayflower Hotel, Washington, D. C.
Apr. 28-29—Regional Quarterly Meeting, Assn. of Local Transport Airlines, Warwick Hotel, Philadelphia, Pa.
Apr. 28-29—Symposium on "Closed Circuit Respiratory Systems," Wright Air Development Division, Wright-Patterson AFB.
May 1-4—1960 Annual Meeting and News Conference, Aviation Writers Assn., Los Angeles, Calif.
May 2-4—National Aeronautical Electronics Conference, Biltmore and Miami Pick Hotels, Dayton, Ohio. Sponsor: Institute of Radio Engineers.
May 2-5—Sixth National Flight Test Symposium, Instrument Society of America, San Diego, Calif.
May 3—Spring Meeting, Eastern Division-Society of Aerospace Materials and Process Engineers, Massachusetts Institute of Technology, Cambridge, Mass.
May 4-6—"Properties and Application of Materials in Aerospace Vehicle Design," Symposium, Park Lane Hotel, Denver, Colo. Sponsor: The Martin Co., Denver.
May 9-11—31st Annual Meeting, Aerospace Medical Assn., Americana Hotel, Bal Harbour, Miami Beach, Fla.
May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Microwave Theory and Techniques, Hotel del Coronado, San Diego.
May 9-12—Semi-Annual Meeting and Astronautical Exposition, American Rocket Society, Ambassador Hotel, Los Angeles.
May 9-13—Second Southwestern Metal Congress and Exposition, American Society

(Continued on page 6)

AVIATION WEEK and Space Technology

April 18, 1960

Vol. 72, No. 16

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Engineering notes from the

SMI REPORTER

BY STANLEY M. INGERSOLL, *Capabilities Engineer*

Report No. 4

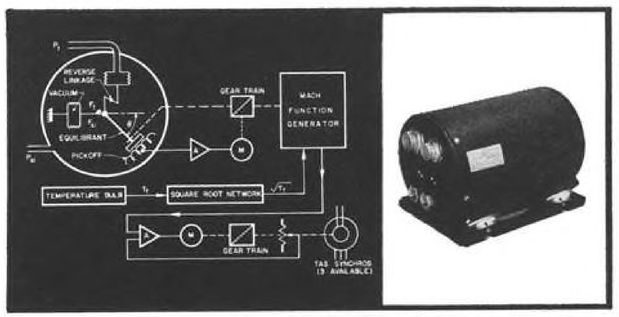
AXC 620 Miniature True Airspeed Computer (Minitas)

Exceptional accuracy and small size are key features of SMI's new Miniature True Airspeed Computer. Any one of three true air speed operating ranges and accuracies can be supplied to meet the requirements of high-performance aircraft, patrol planes, helicopters, artillery-directing aircraft, and missiles. The MINITAS consists of an extremely sensitive and accurate force balance Mach transducer, a passive resistance network, and a follow-up servo. The transducer is made up of a pressure ratio sensor – which is the heart of the system – a servo, and an electrical function generator. All servo amplifiers use silicon transistors for uniform reliability in severe environments. The MINITAS is capable of operation in a 125°C. environment and requires only 20 watts of 115 vac, 400 cps power. Without shockmounts, the computer measures 5" dia. × 8¼" and weighs 6.5 lbs. The MINITAS conforms to MIL-E-5400 and MIL-E-5272.

Typical Performance Specifications

TYPE NO.	TRUE AIRSPEED RANGE (KNOTS)	ALTITUDE (FT.)	ACCURACY (KNOTS)
AXC 620	70 – 450	0 – 20,000	± 4¾
	70 – 125	0 – 20,000	± 1¾
	125 – 450	0 – 12,000	± 1¾
	125 – 450	12,000 – 20,000	± 2¾
AXC 620-1	100 – 200	0 – 10,000	± ¾
AXC 620-2	300 – 1500	0 – 80,000	± 12

NOTE: These are standard accuracies. Increased accuracies are available over restricted ranges upon request, and special ranges and output forms are also available. AXC 620 and AXC 620-1 are capable of operation up to 40,000 ft. with reduced accuracies.



FUNCTIONAL SCHEMATIC—AXC 620 Miniature True Airspeed Computer

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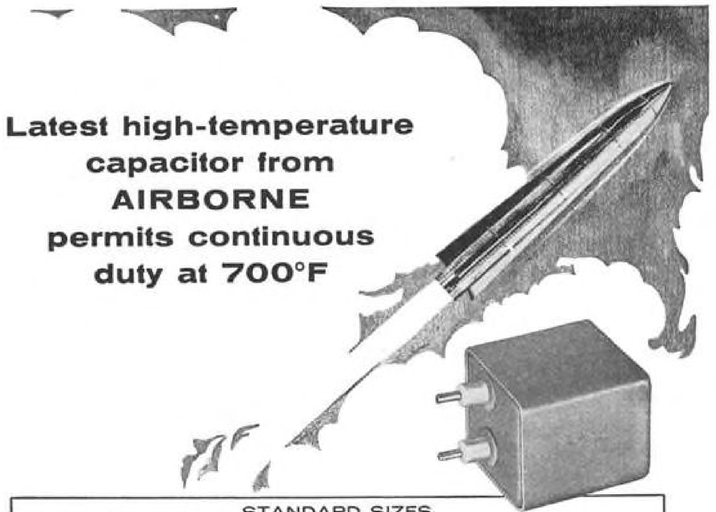
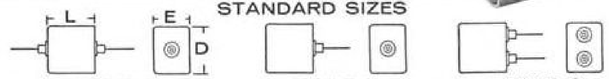


Latest high-temperature capacitor from AIRBORNE permits continuous duty at 700°F

STANDARD SIZES



PART No.	MFD	L	E	D	STYLE
E-8196-1M	.01	1.50	.625	625	A, B
-2M	.1	1.50	.875	.875	A, B, C
-3M	.25	.750	1.687	1.687	A, B, C
-4M	.5	1.625	1.437	2.00	A, B, C
-5M	1 0	1.625	2.125	2 125	A, B, C
-6M	2.0	1.625	2.750	2.750	A, B, C

Designed for integration with high-temperature aircraft/missile components, this newest addition to Airborne's line of miniaturized capacitors offers a working temperature range of –65 to +700°F—without voltage derating and with low capacitance variation.

As a dielectric for this new Airborne capacitor, we use a ribbon of thin, pure mica—because mica maintains its characteristics at temperatures well above 700°F. The conductor is aluminum foil, and the completed winding is encased in a stainless steel can for maximum corrosion resistance. A new copper spray technique has also been developed to provide high-temperature end connections. For terminals a special ceramic is used. These and other refinements provide the characteristics listed in the column opposite.

If you have requirements in high-temperature miniaturized capacitors, consult Airborne. Besides mica construction, we offer metallized Mylar* and Teflon† types—noted, as are all Airborne capacitors, for their electrical and mechanical reliability. Mylar is recommended to 300°F; Teflon to 400°F. Contact any of our offices or write for Product Bulletin PS-6A.

STANDARD CHARACTERISTICS—AIRBORNE HIGH-TEMPERATURE MICA CAPACITORS

Temperature: -65 to +700°F
Rated voltage: 300 VDC
Life: 250 hr. min. @ 340 VDC and 700°F
‡Capacitance tolerance: 10% Std.
Dissipation factor @ room temp.: 10,000 megohm/mfd @ 25°C

*Du Pont's TM for its polyester film
†Du Pont's TM for its tetrafluoroethylene resins
‡Closer tolerances on special order

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AVIATION CALENDAR

(*Continued from page 5*)

for Metals, Sheraton Dallas Hotel and State Fair Park, Dallas, Tex.

May 9-13—Annual Conference, Society of Photographic Scientists and Engineers, Miramar Hotel, Los Angeles, Calif.

May 10-12—1960 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers' Professional Group on Component Parts; American Institute of Electrical Engineers; Electronic Industries Assn.; Western Electronic Manufacturers Assn.

May 11-14—16th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 15-18—Annual Convention and Business Meeting, American Assn. of Airport Executives, Waldorf-Astoria, New York.

May 16-20—Aviation Fire Safety Seminar, National Fire Protection Assn., Queen Elizabeth Hotel, Montreal, Canada.

May 18-20—National Meeting, Society for Experimental Stress Analysis, Hotel Severin, Indianapolis, Ind. Theme: Stress Analysis of Propulsion Systems.

May 22-29—Fourth Annual Reserve Navigation Competition, Ellington AFB., Tex.

May 23-25—12th Annual Meeting, German Society for Rocket Engineering and Space Flight Research, Heidelberg, Germany.

May 23-25—1960 National Telemetering Conference, Miramar Hotel, Santa Monica, Calif. Sponsors: Instrument Society of America; American Rocket Society; American Institute of Electrical Engineers; Institute of the Aeronautical Sciences; Institute of Radio Engineers.

May 24-26—1960 Convention, American Society for Quality Control, San Francisco, Calif.

May 25-27—National Specialists Meeting on Guidance of Aerospace Vehicles, Institute of the Aeronautical Sciences, Hotel Somerset, Boston, Mass.

May 26-27—"Psychophysiological Aspects of Space Flight," symposium, Hilton Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine, USAF Aero-Space Medical Center (ATC), and arranged by Southwest Research Institute. Unclassified, but by invitation.

June 14-16—35th Meetmg, Aviation Distributors and Manufacturers Assn., Queen Elizabeth Hotel, Montreal, Canada.

June 23-25—16th Annual Meeting, Institute of Navigation, U. S. Air Force Academy, Colorado Springs, Colo.

June 27-29—Fourth National Convention on Military Electronics, Institute of Radio Engineers, Sheraton-Park Hotel, Washington, D. C.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

At The Ramo-Wooldridge Laboratories... integrated programs of research & development of electronic systems and components.

The new Ramo-Wooldridge Laboratories in Canoga Park provide an environment for creative work in an academic setting. Here, scientists and engineers seek solutions to the technological problems of today. The Ramo-Wooldridge research and development philosophy places major emphasis on the imaginative contributions of the members of the technical staff. ■ There are outstanding opportunities for scientists and engineers. *Write* Dr. Richard C. Potter, Head, Technical Staff Development, Department 10-D.

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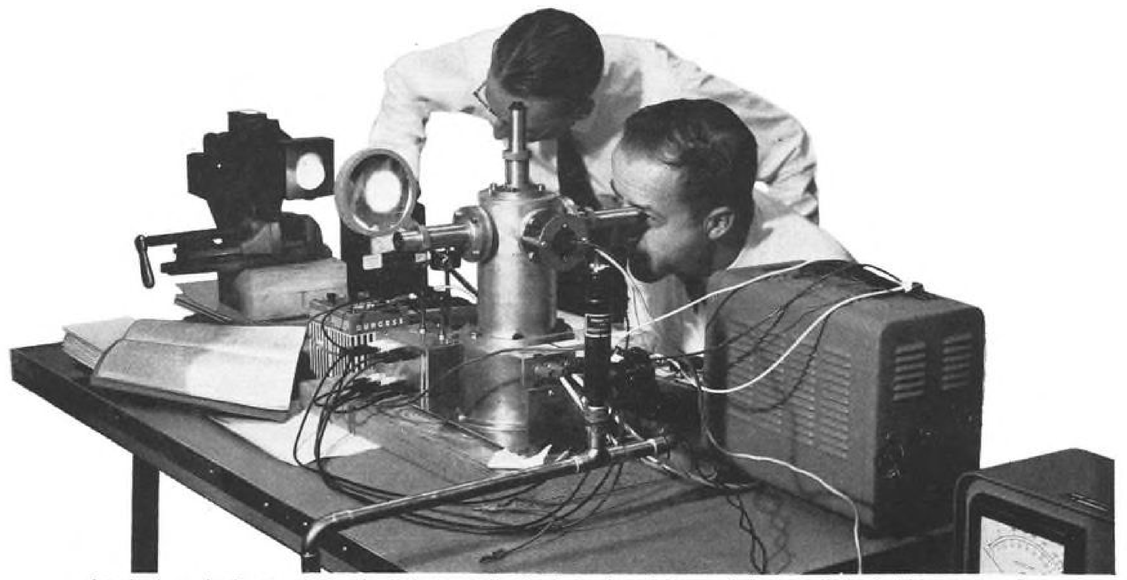

An electron device permits scientists to study the behavior of charged dust particles held in suspension.

Barber-Colman temperature control systems help assure business travelers complete comfort aboard the newest in corporate craft

All of these advanced additions to the nation's business aircraft fleet — Aero Alti-Cruiser, Beechcraft Queen Air, Fairchild F-27, Grumman Gulfstream, Lockheed JetStar — have this in common: *the cabin temperature control system is by Barber-Colman.* And several use Barber-Colman controls for other functions such as anti-icing, cockpit temperature control, and pressure or air regulation. In addition to the aircraft shown here, many conversions of the B-26, DC-3, D-18, Lodestar, and other aircraft also incorporate Barber-Colman temperature control systems. Thus, whenever and wherever businessmen fly on today's newest corporate craft . . . as well as commercial airliners . . . most likely they are traveling on Barber-Colman equipped airplanes that provide living-room comfort every mile of the way.

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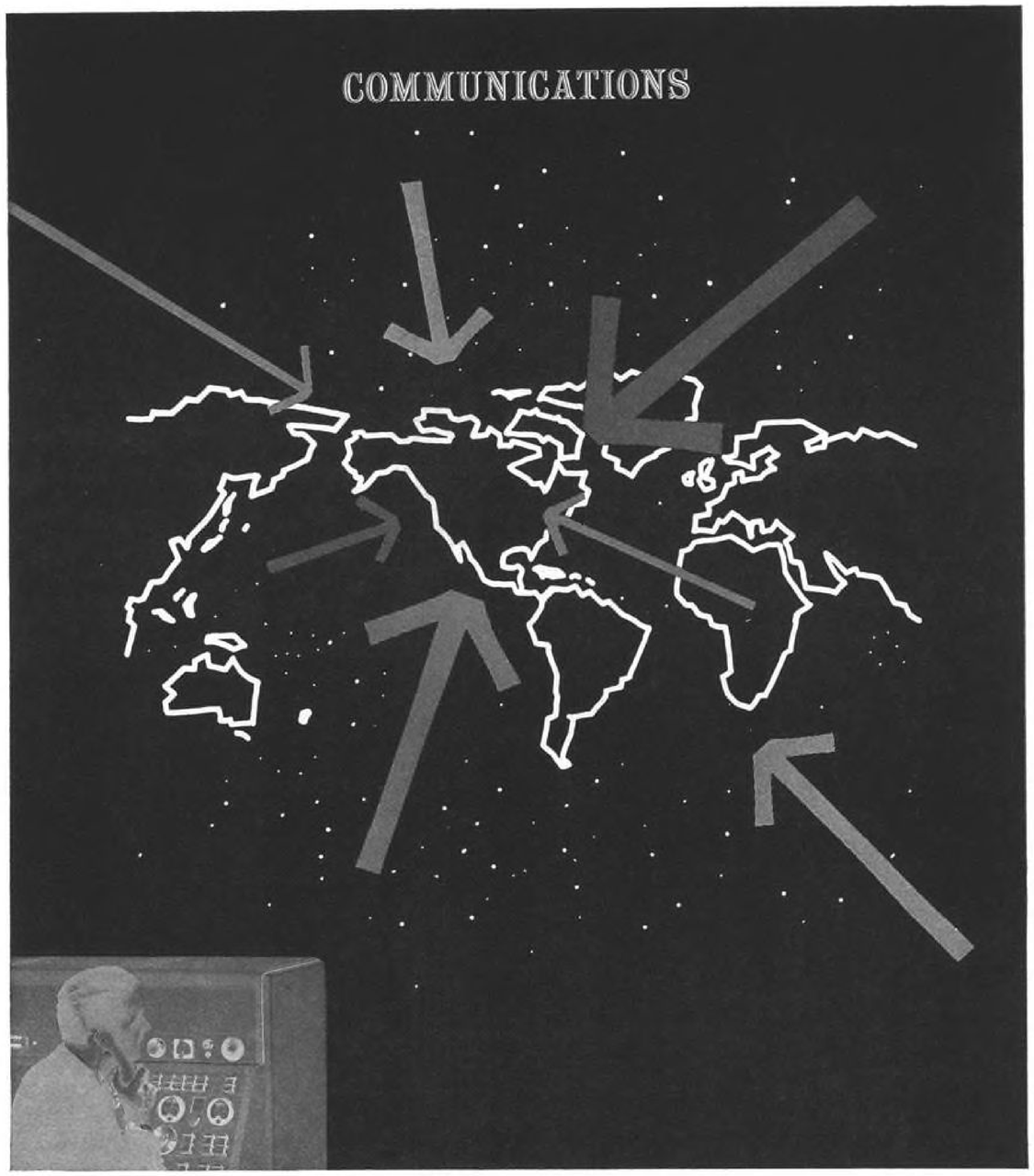

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SILICONE NEWS from Dow Corning

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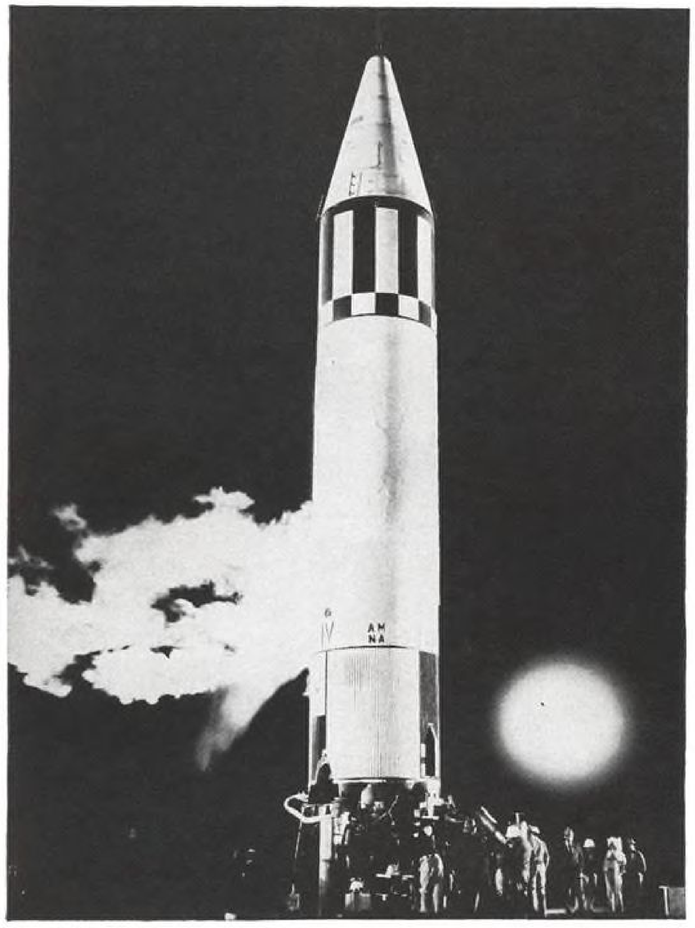

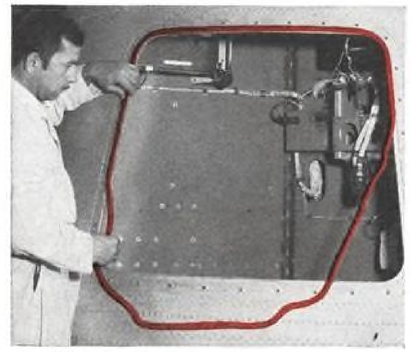

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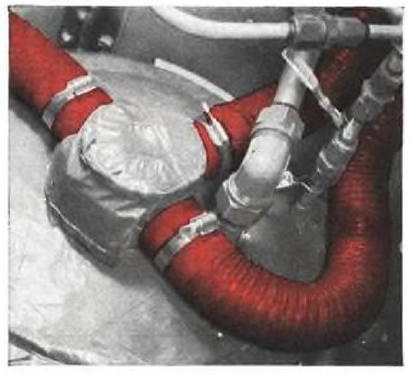
In the cooling system for Jupiter's instrument compartment, low pressure liquid nitrogen vapor is carried by these ducts. Made of Silastic and glass cloth, they're light in weight, and are designed to meet specs of —75 to 600 F performance.



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Why Silastic? In the first place, of course, because this material has excellent resistance to extremes of temperature. From below —130 to 500 F, it remains rubbery and flexible. Re-entry temperatures far exceed 600, but Silastic survives for the brief period of time involved, whereas conventional rubber wouldn't.

Also, Silastic resists the effects of storage and weathering. Sample parts have withstood 9 years weathering at Florida test stations without measurable change of properties. This is equivalent to over 26 years of exposure under average storage conditions. Other reasons why missile designers specify Silastic include resistance to moisture, ozone, corona, many fuels and chemicals.

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220,000 psi

Characteristics of the LWB 922:

- Tensile strength—220,000 psi, minimum
- Endurance limit—80,000 psi at 10,000,000 cycles
- High retention of strength at temperatures to 900°F
- Hi-R thread form for increased fatigue resistance
- Threads fully formed by rolling after heat treatment
- Continuous grain flow in head and shank
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- 100% magnetic particle inspection
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900° F

For complete technical data on the LWB 922 and the FN 922 ask for new Bulletins 2593 and 2613

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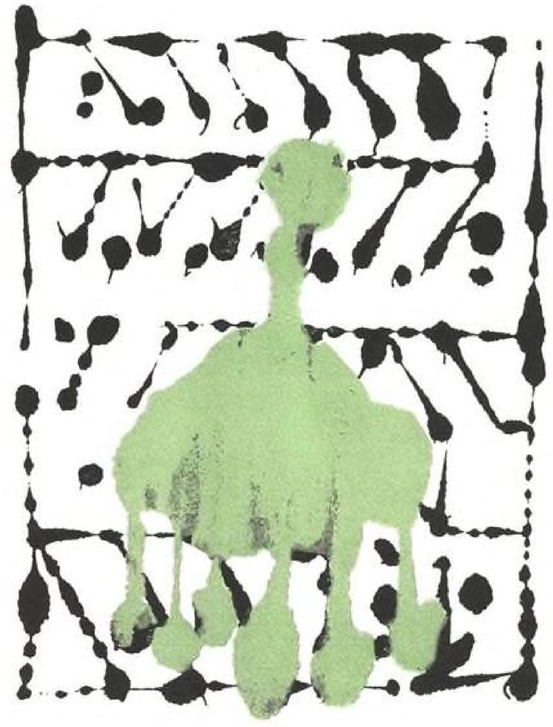

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Space cold

Re-entry hot

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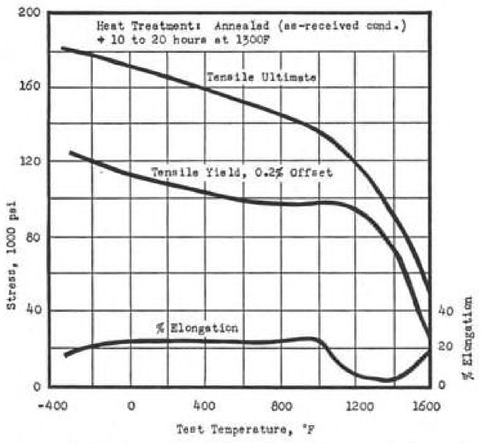
when you want sheet with range



Typical tensile properties of age-hardened Inconel "X" alloy sheet. Note strength at high and low temperatures. Much higher strengths are the additive effects of cold work and age-hardening.

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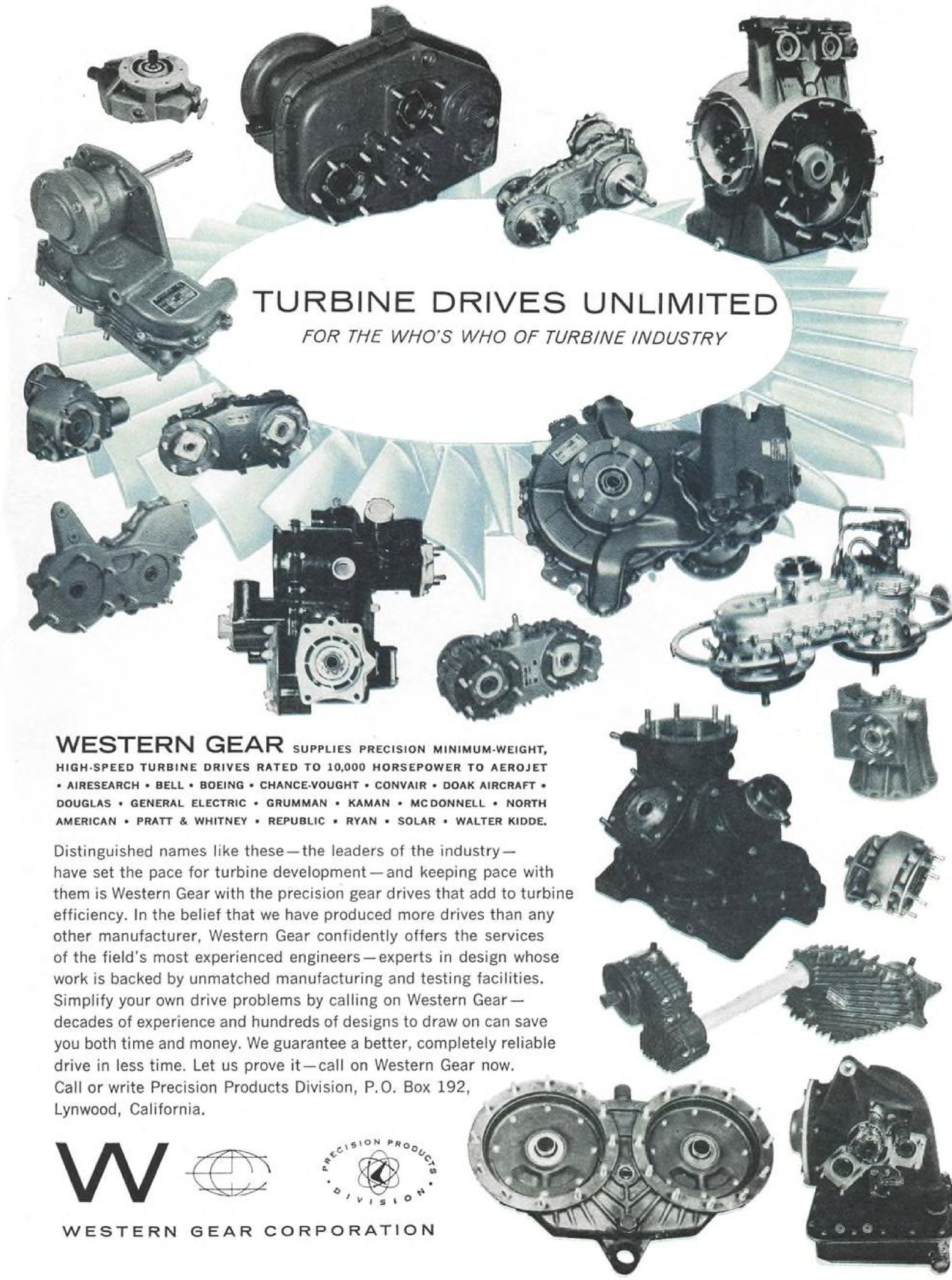
INCONEL "X"



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DIVISION OF GENERAL MOTORS, INDIANAPOLIS, INDIANA

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It must be compact—essential communication, weather, photographic or other instrumentation puts a premium on room . . .

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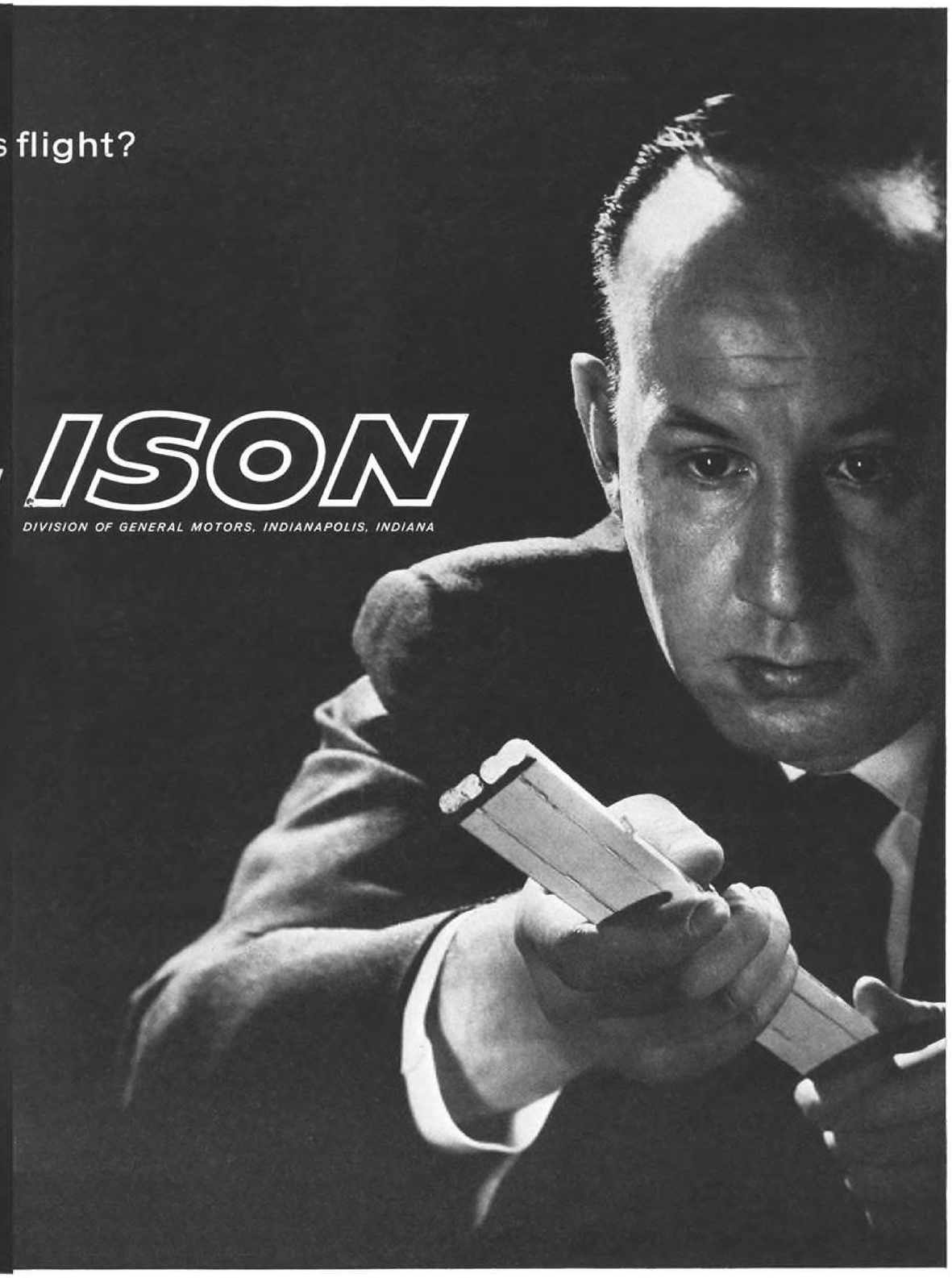
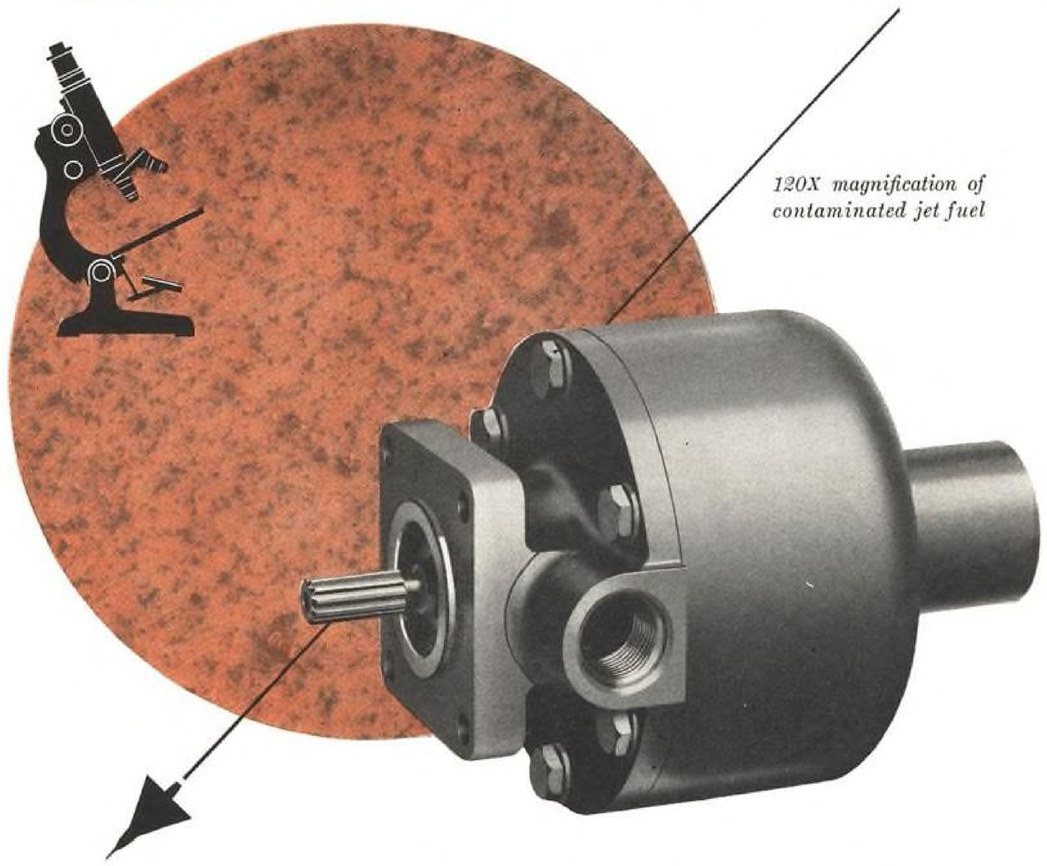
Illustrated is an experimental thermoelectric generator module for the direct conversion of solar heat to electrical energy. A special bonding technique effects the thermoelectric junction between iron and lead telluride.



NEW VANE-TYPE FUEL PUMP



120X magnification of contaminated jet fuel

. . . . Gives longer service life when pumping contaminated jet engine fuels at high volumes and pressures

Vickers balanced-vane type jet engine fuel pumps designed to meet stringent MIL-E-5009B and MIL-E-8595 contaminant tolerance requirements are available in a size range of 500 to 50,000 PPH, develop up to 1000 psi and operate at speeds up to 6000 rpm. Pumps can be provided for speeds as high as 20,000 rpm and pressures above 1500 psi, where required. The housing configuration is adapted to specific installations.

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Designed for a service life of 1000 hours, the new Vickers vane pump was proved in more than 3400 hours of rigorous testing over the last two years (see Bulletin A-5242). Wear compensating parts and new material combinations extend service life.

Write for Bulletin A-5242 for more details.

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April 18, 1960

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► New blast effects data shows explosion at takeoff could mean year delay; facility to cost $30 million.

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► $11.9 million in past Viscount payments demanded; airline's turboprop, piston fleet could be seized.

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► Two additional 1-million-lb.-thrust static test stands have been completed by Hercules Powder Co. at Magna, Utah.

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COVER: First Project Mercury space capsule is completed at McDonnell Aircraft Corp., St. Louis, Mo., and is ready to be delivered to National Aeronautics and Space Administration's Wallops Station, Va. (AW Apr. 11, p. 27). Capsule is 9 ft. high and has a base diameter of 6 ft. It is instrumented for escape system tests, to be conducted by NASA's Space Task Group and McDonnell. Escape system, on top of pylon above capsule, has high-impulse rocket to carry capsule away from booster if malfunction occurs in prelaunch or early lightoff stages.

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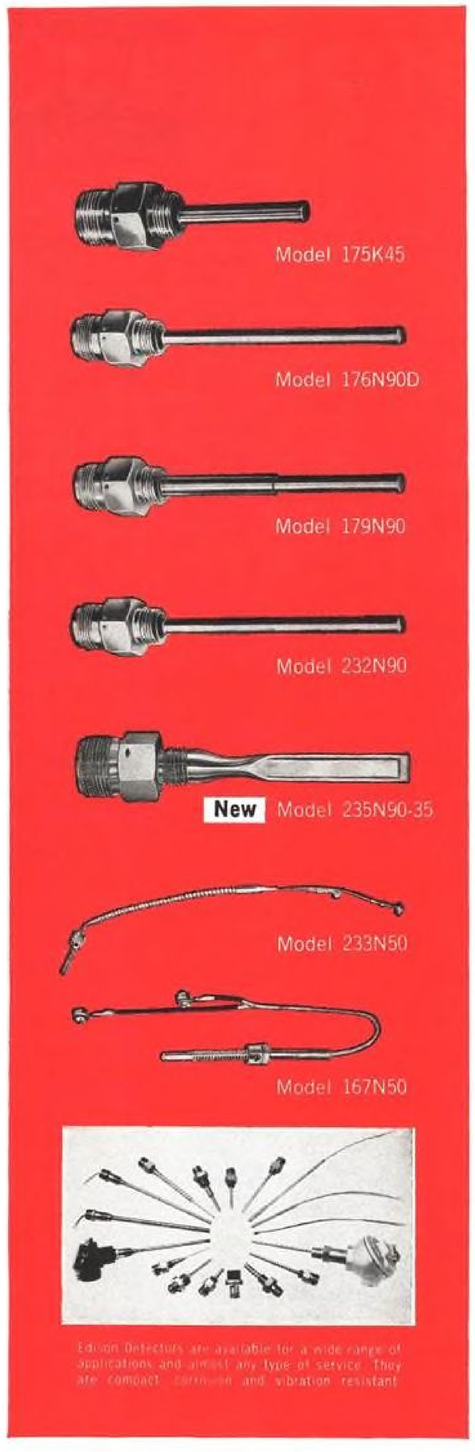

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EDITORIAL

Pentagon White Paper

In response to the consistent and apparently effective public criticism of its defense program, the Pentagon has belatedly drafted a comprehensive statement of its position and is circulating it quietly among about 600 leaders of American public opinion. This Pentagon White Paper is in the form of a 17-page document replying to questions asked by Carter Burgess, president of American Machine & Foundry Co., who was formerly an Assistant Secretary of Defense in the Eisenhower Administration and is now active in American Legion defense policy groups.

This document is represented as embodying "the combined thinking of the Secretary of Defense and his principal military and scientific advisers," and it also has been strained through Murray Snyder's security review. It is signed, not by Secretary of Defense Thomas Gates, who would normally be the Administration policy spokesman on defense, but by Oliver Gale, who came to the Pentagon from Procter & Gamble with Neil McElroy and has not yet followed his boss back to Cincinnati.

This Pentagon White Paper is a useful contribution to the great national debate now raging over the adequacy of our military posture. For this is the first time the Administration has come out from behind its "father-knows-best" attitude and attempted to debate its military policy on specific matters. It is on public debate of this type that democracy depends for its survival. Without full public debate on the defense issues, it is difficult for the American people, who are the ultimate judges of these policies, to render an effective verdict. In the Pentagon White Paper the public now has its first inkling of how the Administration views its defense program.

Because of the importance of this document in the defense debate, and despite the fact that we disagree with most of its contentions and challenge the accuracy of many of its statements, AVIATION WEEK will publish the full text of this document next week. We believe it should be read and studied by many more Americans than the 600 selected by Mr. Gale. In this space we can challenge only a few fallacies expressed in this document and point out only some major inaccuracies of fact.

Perhaps its most fundamental error is the premise that the defense debate has been confined to a single weapon—the intercontinental ballistic missile—and that defense critics contend our national security depends wholly on matching the USSR in numbers of these missiles.

Actually, the defense debate has ranged along a far broader front, including the shocking lack of modern weapons for ground troops, inadequate military airlift, neglect of anti-submarine warfare developments, production stretchout of the heavy bomber and jet tanker programs and inadequate research and development, as well as the gross underestimate of ICBM requirements for the next four years.

The White Paper ignores completely the most frequent charge that the defense program is artificially tailored to a budget ceiling rather than realistically molded to meet the changing military threat and then costed accordingly. The White Paper contends that, while ICBMs are an ideal weapon for the USSR, they are not a good weapon for this country, and we should place primary reliance on manned bombers.

The paper then paints a rosy picture of our manned bomber fleet, which ignores all of the budget-dictated actions in the past few years that have whittled down our real potential in this field.

It ignores the major cutback in the over-all B-52 bomber and KC-135 jet tanker programs that will leave Strategic Air Command with only about two-thirds of its requirement in this area. It ignores the production stretchout on these two aircraft that has significantly delayed the date when SAC will reach its currently authorized B-52 and jet tanker strength. It ignores the obsolescence of the B-47 fleet, which is still the main SAC force, and it fails to mention the stretchout and cutback on the B-58 program that is dawdling this weapon system along at a rate that threatens to impair its eventual effectiveness.

In discussing the airborne alert problem, the paper states flatly that funds are no problem and that present procedures will give us an airborne alert capability when we need it. This is at variance with the testimony of the men who have responsibility for really producing an airborne alert capability.

The paper's statement that there are always some SAC aircraft in the air with nuclear weapons, while technically correct, is aimed at creating a false impression of an airborne alert capability that does not now exist and will not exist unless the current defense program is expanded to build it. In its apologia for the B-70 program cutback, the paper labels this obviously multi-purpose weapon system as being simply too competitive with the Atlas, Titan, Minuteman and Polaris to do "a single purpose mission." The flexibility provided by the B-70 type manned system is completely ignored despite the earlier protestations that this country should depend on manned systems rather than ICBMs.

Perhaps the most glaring technical error in its B-70 discussion comes from the bland observation that a Mach 3 bomber will present no appreciably more difficult problem to an air defense system than a Mach 2 airplane. We suggest that the USSR air defense planners might have a radically different view of this problem.

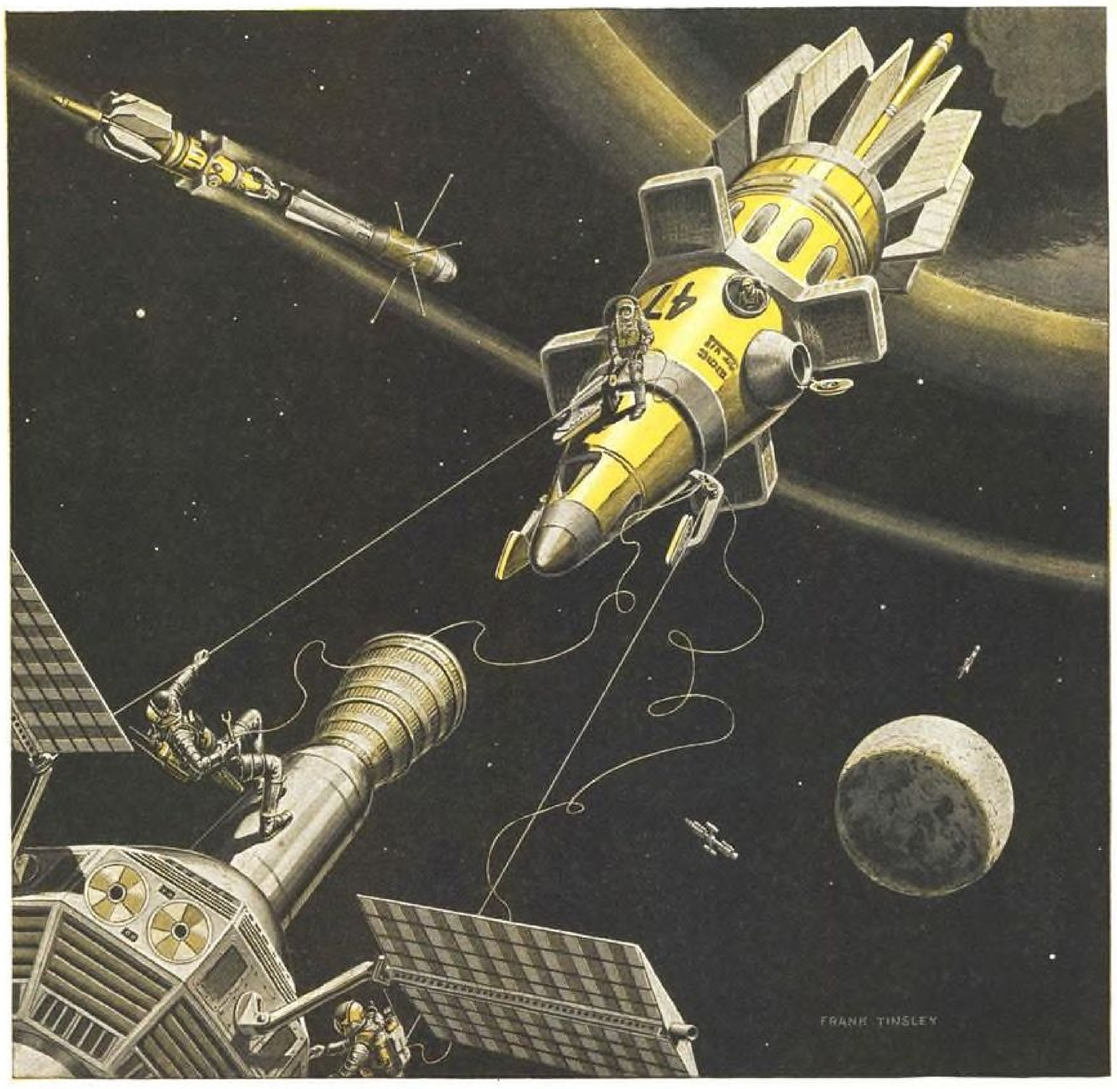
It also is interesting to note the type of logic that runs through the entire paper in this particular situation. It says we are cutting back the B-58 program because there is supposedly not much requirement for a Mach 2 bomber, and then we are all but eliminating the Mach 3 bomber on the grounds that it won't be much better than the Mach 2 bomber that we aren't getting in any significant quantity either.

In the ICBM discussion, the logic gets even more tortuous. The paper admits we could have built many more Atlas and Titan missiles for the critical 1961-64 period if we desired. It says "sound strategic reasoning led us to choose not to produce as many of these first-generation liquid-fueled, fixed-site missiles as we estimated the Soviets could produce." In view of the recent actions by the Pentagon to increase the Atlas and Titan programs twice within the last six months, the soundness of this "strategic reasoning" that determined the original minimum ICBM program may be open to dispute.

The paper also slides over the current lack of ICBM operational capability with the notation that "operational Atlas missiles are ready for launching from the West Coast." Conveniently omitted is the fact that this capability currently stands at from one to six missiles, depending on circumstances.

After careful study of this White Paper and comparison of its many claims against the factual record, it is easier to understand how the Defense Department gets so tangled in its planning and execution. It also stirs the thought that, if this White Paper really represents top-level Defense Department thinking, we are in worse shape than previously imagined.

—Robert Hotz



STEPS IN THE RACE TO OUTER SPACE

Breaking a Space Traffic Jam

By 1970 our solar system will be filled with expended satellites—whirling aimlessly in space with dead batteries and electronic equipment, their missions long since completed.

As space traffic increases, these derelicts will have to be captured and broken out of orbit to keep flight paths clear. For this task, special towboats will be designed and crews trained.

Here, step by step, is an account of such satellite capture and destruction:

1. The towboat, driven by electro-particle propulsion, rockets into space at speeds reaching 25,000 m.p.h. Its reversible engines enable it to slow as it approaches the radar-located satellite, and match the derelict's speed as it moves into orbit behind it.

2. Crewmen attach lines to the satellite (as in illustration). Then they haul the towboat forward and its nose cone is clamped to the satellite's rocket nozzle.

3. The towboat's engines are then switched to full reverse and the linked machines gradually lose momentum, nosing into a spiral path toward the Earth below.

4. When a safe point is reached, the towboat automatically releases the satellite and it is consumed by friction as it plunges into the heavier atmosphere. The towboat, regaining its speed, moves on to its next assignment—breaking a traffic jam in some other congested point in space.

ARMA, now providing the inertial guidance system for the ATLAS ICBM and engaged in advanced research and development, is in the vanguard of the race to outer space. For this effort, ***ARMA*** needs scientists and engineers experienced in astronautics. ***ARMA***, Garden City, New York. A Division of American Bosch Arma Corporation.

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Fred J. Beisecker and **Thomas P. Robertson**, vice presidents, Braniff International Airways. Also: **Roger Barrier** and **O. Roland Frost, Jr.**, assistant vice presidents.

Russell C. Galbraith, vice president-administration, Lockheed Electronics Co., Plainfield, N. J.

Don R. Berlin, a vice president of Boeing Airplane Co. and vice president-general manager of the Vertol Division, Morton, Pa.

Sir Reginald Verdon Smith, chairman of Bristol Aeroplane, and **C. H. Chichester Smith**, chairman of Fairey Aviation, directors of Westland Aircraft, Ltd., Yeovil, England. Also: **E. C. Wheeldon**, managing director of Westland, appointed a joint deputy chairman; **D. L. Hollis Williams** and **W. Oppenheimer**, assistant managing directors; **A. R. B. Hobbs**, secretary.

Robert E. Dryden, vice president-engineering, Pearce-Simpson, Inc., Miami, Fla., and head of the company's new Research and Development Division.

Garrett M. Schmoeller, vice president and general sales manager, American Latex Products Corp, Hawthorne, Calif., a division of The Dayton Rubber Co.

Z. W. Pique, vice president-marketing, Hoffman Electronics Corp., Los Angeles, Calif., and **Donald C. Bright**, general manager of the new Industrial Electronics Division.

John B. Kelley, assistant to the executive vice president, Burns and Roe, Inc., New York, N. Y.

Capt. H. D. Mitman, Mauler project director, Air Defense Branch, Research and Development Division, U. S. Army Ordnance Missile Command, Huntsville, Ala.

Dr. Hubertus Strughold, Dr. Roland B. Mitchell, and **Dr. Hans G. Clamann**, civilian scientists at the Aerospace Medical Center, Brooks AFB, Tex., have been given special promotions by the Secretary of the Air Force under Public Law 313. Public Law 313 positions do not have a GS (General Service) designation, and single the men out as deserving of special recognition.

Andrew F. Pitas, air traffic control specialist, Air Navigation Traffic Control Division of the Air Transport Assn., Washington.

Col. V. J. Adduci (USAF, ret.), assistant on legislative matters for the Aerospace Industries Assn., Washington, D. C.

Honors and Elections

Henry Ross, manager of military and government transportation for Delta Air Lines, has been named chairman of an industry-wide Military Traffic Committee, an agency of the Air Traffic Conference of America, Washington, D. C.

Dr. Ernst J. Opik, director of the Armagh Observatory in Northern Ireland, has been awarded the National Academy of Sciences' J. Lawrence Smith Medal for outstanding investigations of meteoric bodies.

(*Continued on page 151*)

INDUSTRY OBSERVER

► National Aeronautics and Space Administration Atlas Able V lunar-orbit vehicles are now scheduled for launch from Cape Canaveral, Fla., on Aug. 25 and Nov. 14. Payload structure and weight—372 lb.—remains essentially the same as that originally planned, but very low frequency radio signal detection experiment has been substituted for a Space Technology Laboratory scintillation experiment and a plasma probe. Air Force's Ballistic Missile Division-Convair Atlas ICBM will serve as the booster. Upper staging is Aerojet liquid-propellant AJ10 and Allegany Ballistic Laboratory's solid-propellant ABL-248.

► **Centaur Jr., an 8-ft. diam. hydrogen-oxygen rocket stage using one Pratt & Whitney XLR 115 engine, has been proposed for use on top of Atlas-Centaur and Saturn space vehicles. Stage would offer some advantages over conventionally-fueled Agena-B. Full sized Centaur, built by Convair for NASA and USAF, uses two XLR 115s. Several airframe companies are interested in building Centaur Jr.**

► Soviet Mil-4 helicopter which has been brought to this country will undergo a very complete flight evaluation at Air Force Flight Test Center, Edwards AFB, Calif., within the near future. Machine already has been completely torn down and all parts, components and systems thoroughly analyzed from design, manufacturing and service standpoints. The helicopter has now been reassembled for the flight program.

► **Army Ordnance plans to develop a short-range direct-support missile tentatively designated "Auto-Met" because its guidance system is expected to automatically compensate for local meteorological conditions and enable the vehicle to fly a pure ballistic trajectory. New missile is a successor to Missile "A," tactical system on which industry bid. Army, however, never awarded a contract. General Electric is favored to get the contract for development of "Auto-Met" missile airframe, and perhaps the guidance.**

► Chance Vought Aircraft has proposed a plan to Navy for conversion of 107 F8U-1P aircraft to Mach 2-plus speeds through airframe modifications and installation of new engines. Company says it can complete the conversions at the same cost as that quoted by McDonnell Aircraft for 30 F4H Mach 2-plus all-weather fighters.

► **Japan's Maritime Self Defense Force has contracted with the U. S. to obtain Navy's Convair Tartar surface-to-air missile systems for its shipborne guided missile program (AW Feb. 15, p. 35).**

► Air Force has requested approximately 15 companies to submit estimates of their capabilities of supplying hydrazine in quantity through 1963 in connection with Martin Titan ICBM operational and stockpile requirements.

► **Concern over certain areas of the U. S. that could be hit by Soviet ICBMs without their being detected by the BMEWS radars in Greenland or Alaska is responsible for Air Force request for an additional $42.5 million to expedite construction of the third BMEWS radar site in Britain to fill the present void. There also is increasing speculation that Soviet's extremely long-range ballistic missiles may prompt the U. S. to seek additional BMEWS sites in Africa and Australia to protect the southern approach.**

► Curtiss-Wright Propeller Division has received a $3 million contract from Wright Air Development Division for development and flight test of an all-mechanical flight control system. Power for the system is taken from an engine pad through a spring wind-up mechanism and transmitted mechanically to the aerodynamic control surfaces. System will be flight tested on a North American F-100.

► **Limited experiments on behavior of fluids under zero gravity indicate that diaphragms or bladders of some type may be necessary to push fuels from tanks into fuel lines when rocket engines are under weightless conditions in space.**

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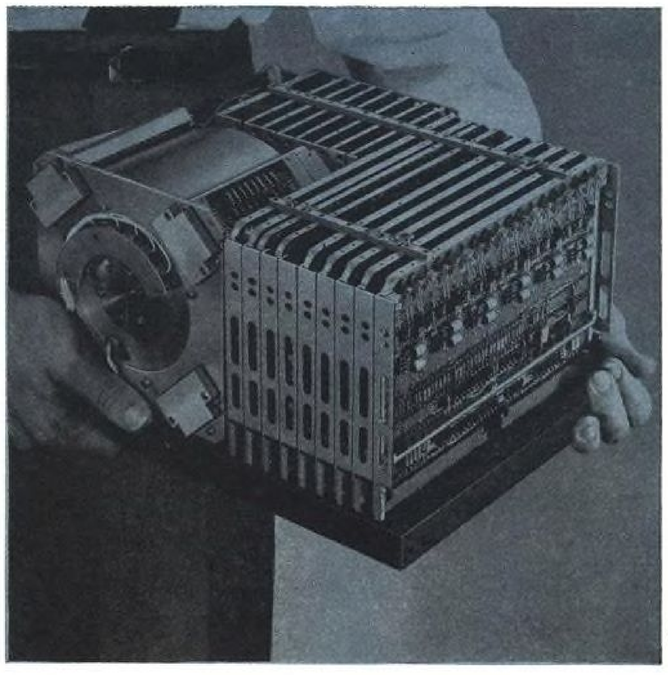


Washington Roundup

Defense Budget

House Appropriations Committee is expected to substantially boost the $90 million proposed by President Eisenhower in the Fiscal 1961 budget for long lead-time items for a Strategic Air Command airborne alert, lean more closely toward the accelerated policy advocated by SAC commander Gen. Thomas S. Power. Vote on Fiscal 1961 defense budget is scheduled for Apr. 29.

Otherwise, the committee probably will generally follow Administration requests now that a revised program has been submitted for acceleration of Air Force's Convair-Atlas ICBM and Navy's Polaris fleet ballistic missile (AW Apr. 11, p. 33).

There is still strong opposition within the committee to Air Force plans to boost the thrust and warhead potential of the Martin-Titan ICBM, pushing the operational dates of eight of the 14 squadrons into 1962-63 era of the solid-propellant Minuteman.

Rep. George Mahon (D.-Tex.), chairman of the Defense Appropriations Subcommittee, says, however, that the "Air Force insists they want the program, and I hesitate to impose my judgment."

Horner Replacement

Watch for replacement for Richard E. Horner as number three man at the National Aeronautics and Space Administration to be selected from outside the agency. Horner is expected to leave for an industry job about July 1, and his successor probably will be given only an acting appointment.

NASA Administrator T. Keith Glennan, who intends to return to the presidency of Case Institute of Technology after the November elections, will give his successor the option of naming a permanent associate administrator.

Horner, former assistant secretary of the Air Force for research and development, had planned to go to industry before accepting the NASA post last summer, finally agreed to serve with the agency for one year.

Rate of decline in aeronautical research by National Aeronautics and Space Administration (AW Apr. 11, p. 32) continues to accelerate. Ratio of research on manned aircraft was 66% two years ago, 50% a year ago. Now, it has declined to approximately 25% of the manpower, time and money being expended at NASA's three main research centers—Lewis, Ames and Langley.

Saturn Secrecy

Meanwhile, **most closely held secret since NASA was created has been the winner of the S-4 airframe competition and the 200,000-lb.-thrust hydrogen engine competition for the Saturn space vehicle.** Airframe and rocket engine companies all need business, all want the prestige connected with these important space contracts.

This means, as in the past, intense industry rivalry, a maximum of political kibitzing from the sidelines. Airframe winner could easily win airframe contracts for two other larger Saturn stages. Engine winner will produce a total of six engines for each final version of the Saturn (see p. 26).

Source selection boards and NASA headquarters personnel have been extremely careful to prevent premature leaks. Contractors in the main have cooperated.

"Institutional time lag" in relating scientific, other technological developments to defense and foreign policy will highlight hearings late this month by a Senate subcommittee on national policy machinery. Subcommittee, headed by Sen. Henry Jackson (D.-Wash.), complains that military planners are too slow in recognizing the impact of new technological discoveries, State Department too lax in offering guidance as to the type of military program needed to best implement foreign policy.

Durfee Replacement

White House will name a member of its own staff to fill out the unexpired term of Civil Aeronautics Board Chairman James Durfee when he moves out to accept a judgeship on the Federal Court of Claims. Term is due to expire Dec. 31, shortly after the November elections, just before a new President moves in.

Senate, meanwhile, is now scheduled to vote on Durfee's Court of Claims appointment sometime this week. His main antagonist, Sen. William Proxmire (D.-Wis.) claims to have mustered the support of several other senators in his opposition to Durfee, but the Senate is expected to vote favorably on the appointment.

Action on the appointment has been delayed thus far primarily by the civil rights battle.

Signs that the time-honored General Passenger Fare Investigation may be heading for a phase in its four-year life when a final decision is forthcoming are increasing. Best estimates now place the date of decision at sometime next month.

—Washington Staff

Second Saturn Launch Complex Planned

New blast effects data shows explosion at takeoff could mean year delay; facility to cost $30 million.

By Evert Clark

Washington—Acceleration of the Saturn 1.5-million-lb. thrust space vehicle and new information on blast damage from vehicles that explode during launch is forcing National Aeronautics and Space Administration to build a new $30 million Saturn launching complex at Cape Canaveral, Fla. First complex is to be completed this year.

NASA now plans to launch the Rover nuclear rocket engine as a third stage of Saturn in 1964 or 1965 to test it in orbit. But the decision to build a new complex apparently was made exclusive of any special safety considerations that may grow out of potential nuclear hazards.

Later versions of the Saturn are to have its eight 188,000-lb.-thrust booster engines uprated to a total of 2 million lb. thrust. Blast studies have established that the booster fuel load of 750,000 lb. has an explosive force equal to 75,000 lb. of TNT, and that damage to the launch pad and other facilities from an explosion such as this would put the pad out of use for approximately one year.

Pad damage from missile explosions at launching had not been a particular problem at the Air Force Missile Test Center until last summer. A Titan explosion put a pad out of commission for several months. In September, the explosion of an Atlas-Able damaged a pad so severely that it was not ready for use again until the middle of March. Since that time, two Atlas explosions—one early in March and the other early in April—have put Pads 11 and 13 out of use until next June 1. These two were being used for most military Atlas launchings, with the other two Atlas pads phasing into use for military and NASA space vehicles.

Recent Testimony

Recent NASA testimony before Congress indicated that the 75,000 lb. of explosive force referred only to the Saturn booster, which uses kerosene and liquid oxygen as propellants. Upper stages of later versions will use highly flammable liquid hydrogen as fuel. The new pad will be located north of the current Saturn site (see map, AW Aug. 24, p. 56).

Performance studies have shown that a nuclear stage could be used as a second or third stage, but the Rover engine definitely will be tested as a third stage, since two lower stages will be required to put it into the proper orbit.

Aside from use of a nuclear stage, Saturn plans are aimed at producing three vehicles—the three-stage C-1, the four-stage C-2 and the five-stage C-3. Bottom stage, or booster, and top stage—basically the Centaur, with two 20,000-lb.-thrust hydrogen engines—remain the same in all three basic vehicles. A 200,000-lb.-thrust hydrogen engine, for which development is about to begin, will be sandwiched into a two-barrel configuration to form the second stage of the C-2. Still later, four of these engines will be clustered and sandwiched in just above the booster to form the second stage of the C-3 vehicle.

Complete flight test schedule that will take the program through development of all three vehicles calls for only 16 or 17 launchings. Under present plans, it would proceed this way:

- **First flight booster** and dummy stages will be in 1961. Second and third flights are scheduled for 1962.
- **Fourth flight in the latter part** of 1962 will test the booster and the cluster of four 20,000-lb. engines. Two more tests of this configuration will follow in early 1963.
- **Seventh shot** in the third quarter of 1963 and eighth and ninth in the last quarter of that year will be full-fledged tests of the three-stage C-1 vehicle, with the top stage being the Centaur, which should have been used frequently by then as an upper stage for Atlas.
- **Tenth shot** in the first quarter of 1964 will be the final developmental shot of C-1. An operational shot will follow in the second quarter.
- **First flight** of the new 200,000-lb. engine for the C-2 is tentatively scheduled for around the end of 1964, with two complete vehicles to be fired in 1965.
- **Since all engines** will have been tested by the time the C-2 flights are over, only two test vehicles of the five-stage C-3 are planned.

Current plans contemplate use of a contractor for at least assembly or assembly and test of Saturns after the first 10 are assembled and checked at NASA's Marshall Space Flight Center, at Huntsville, Ala., and there is some consideration of having the manufacture of first stages done by contractors as well. This most probably would be as a second source, with Huntsville continuing to build Saturns.

Estimated cost of the development through the first 10 vehicles is now $886 million. Extensive alterations and additions to facilities at Huntsville, including a second static test stand, are called for in NASA's Fiscal 1961 budget. These will give Huntsville a capability of building boosters, adding contractor-built stages and checking out the vehicles at the rate of six a year. It is obvious from expansion plans at Huntsville and Cape Canaveral that NASA intends to use a large number of Saturn vehicles.

Saturn Payloads

Saturn is expected to give the U. S. about twice the payload capability that Russia has demonstrated thus far. Soviet boosters used until now are estimated to have a thrust of 600,000 to 800,000 lb. Payloads planned for Saturn vehicles are:

- **C-1.** With only two stages, payload is 24,700 lb. in a 100-mi. orbit or 22,000 lb. in the 300-mi. orbit. Using all three stages, which gives the vehicle earth escape capability, payload is 4,500 lb. in a 24-hr. orbit or 2,400 lb. for a lunar landing.
- **C-2.** For low orbital flights, only three stages are needed. Payload almost doubles, reaching 45,000 lb. in the 100-mi. orbit. Four stages would be used for other missions. It could send 15,200 lb. outside the earth's gravitational field, put 9,000 lb. in a 24-hr. orbit and 5,000 lb. for a lunar payload. Dr. Wernher von Braun, director of Marshall, testified that the four-stage C-2 would be sufficient to put two men around the moon and back or place "a rather sizable automatic radio relay station down to the surfaces of Venus or Mars."
- **Nuclear upper stage.** Payload increases to 72,000 lb. in a 300-mi. orbit, 45,000 lb. for escape missions, 32,000 lb. for a 24-hr. orbit and 14,800 lb. for a soft landing on the moon. This would make it possible to fly part of the vehicle back to earth with lunar samples, von Braun said.

Missions for the C-1 as NASA now outlines them are to send large payloads to the moon and near planets, place several tons of payload in an equatorial orbit and place a manned spacecraft such as Dyna-Soar in an earth orbit.

Still another possible use for Saturn is to develop oribital refueling techniques. Von Braun said two vehicles might bring liquid hydrogen as payloads in their upper stages to a third vehicle, coasting in orbit with a burned out third stage and perhaps an empty fourth stage. Transfer to the coasting rocket would allow it to fly to the moon, land and have enough fuel to return to earth.

"In this fashion, it is feasible to use even the Saturn . . . to land people on the moon and bring them back," von Braun said.

Recovery techniques for Saturn boosters will be practiced with the Redstone boosters to be used in upcoming Mercury manned satellite tests. The larger Saturn boosters will go through a 200-mi. trajectory, enter the atmosphere at about Mach 5, and be lowered by a cluster of parachutes. A contact fuse hanging downward on a 100-ft. line will hit the water ahead of the booster and trigger eight solid retrorockets ringed around the booster's base. These will lower the booster into the water at a theoretical speed of zero and it will float on its own tankage.

Engine Recovery

Von Braun said recovery equipment and operation will cost about $250,000 per booster. He said recovery of the engines alone would be worth much more than that.

Static tests of the booster engine went so well when two and then four were fired (AW Apr. 11, p. 33) that plans are to skip firing of six engines and fire the whole cluster of eight on the next test.

Saturn program costs in the Fiscal 1961 budget requests include $57.5 million for development and fabrication of boosters; $42.3 million for development and fabrication of upper stages; $12.8 million for guidance, controls and instrumentation; $9.7 million for ground service equipment, and $12 million for direct material.

Rover Bids

Washington—Seven companies have bid on development of a flight-weight, liquid hydrogen-cooled rocket nozzle for use in the National Aeronautics and Space Administration-Atomic Energy Commission Rover nuclear rocket project (AW Apr. 4, p. 28).

Contract will call for delivery of about half a dozen nozzles by next April and will total about a quarter of a million dollars. Nozzle will be approximately four feet long and three feet across its opening. Greater cooling capability than that provided by the Pratt & Whitney XLR 115 chemical hydrogen-oxygen engine nozzle will be required because of the higher temperatures at which the Rover test reactors will operate. Some test objectives in the Kiwi ground reactor tests for the Rover project may be combined, shortening the test cycle. Nozzle produced by this competition might be usable in first flight tests.

Bidders were Rocketdyne, Aerojet, Pratt & Whitney, Reaction Motors, Bell Aircraft, Martin and General Electric.

York Says Useful Nuclear Plane May Not Be Flown Before 1970s

By Ford Eastman

Washington—Dr. Herbert F. York, Defense Department director of research and engineering, has told the House Defense Appropriations Subcommittee that "a nuclear-powered bomber with suitable operational characteristics probably lies beyond 1970."

In testimony in support of the Defense Department's Fiscal 1961 budget requests for research, development, test and evaluation funds which was released last week, York told the subcommittee members that "many very difficult engineering and developmental problems remain."

But York said General Electric and Pratt & Whitney Aircraft Division of United Aircraft Corp. have made steady progress in their respective approaches toward development of direct and indirect cycle nuclear powerplants.

Asked if policy reasons or technological problems has slowed progress in the program which began over 14 years ago, York replied:

". . . In our view, which other people regard as too extreme, to be sure, but in our view the program has been plagued in the past by attempts to find a shortcut to flying soon where flight was defined as getting off the ground for any arbitrarily short time.

"It was our view that this approach to the problem was one of the contributing factors to having delayed it this long and that there was no time like the present to start doing it right, which was to get on with the development of a powerplant that could have growth potential to something that could be useful."

Earliest possible flight date under the present program, York said, will be 1965 at the earliest "and I do not say that it will fly then."

York also told the subcommittee:

- **Maximum effort is being given** to development of helicopters for minesweeping and high resolution sonars to detect mines.
- **He is personally confident** that Minuteman solid-propellant intercontinental ballistic missile will become operation in early 1963. "Considering how much is now known about all of the problems that have to be solved—the guidance, ground control equipment, solid propellants, things we have learned from other programs, and particularly the Polaris program—there is no reason why it should not be available in 1963 if the program is run correctly."
- **BMEWS missile early** warning system is "not very good against one missile" probably could provide some warning in a mass attack but is not sufficiently free from the influence of spurious signals to warrant a retaliatory attack on its word alone.
- **"From a technical point of view,** the North American B-70 Mach 3 bomber represents a big step and is a starting point for further progress. The [Convair] B-58 represents an ending point in progress for another type of airplane." York, however, did not advocate restoration of any funds to accelerate B-70 development beyond the two prototypes now planned.
- **His office and the Air Force** have been studying ways and means of adapting present aircraft to a substitute for the canceled Mach 3 F-108 interceptor. B-58 is one of several possibilities, he said, but the most expensive. He said Defense also is considering improving the Century-series aircraft, providing them with improved air-to-air missiles and better search equipment.
- **There may be a place** in the future for large liquid rockets such as the Convair Atlas and Martin Titan as well as smaller solid-propellant systems "in the same way we have several kinds of aircraft today." York said he does not see the Minuteman as a replacement for either the Atlas or Titan for many years. This, he said, is one of the reasons he feels that it is sound to put improvements in both the Atlas and Titan (AW Apr. 4, p. 34; Apr. 11, p. 34).
- **Operational Army Nike Zeus** ballistic missile defense system would cost about $15 billion and could only protect an area occupied by about 40% of the population.

York also told the subcommittee that of the total Defense Department Fiscal 1961 requests for research, development, test and evaluation funds, $535.2 million is scheduled for the military sciences; $446.2 million for aircraft and related equipment; $1,481.6 million for missiles and related equipment; $318 million for military astronautics and related equipment; $151.5 million for ships, small craft and related equipment; $177.5 million for ordnance, combat vehicles and related equipment; $460.5 million for other equipment;

$231 million for program-wide management and support and $150 million for Defense Department's emergency fund.

Earlier, Defense policy adopted in Fiscal 1960 of placing test and evaluation items in the research and development budget category drew a strong protest from Rep. Harry R. Sheppard (D.-Calif.), third-ranking Democratic member of the full Appropriations Committee.

The policy, Sheppard charged, was "an effort to make somebody or something look good" and that its adoption in Fiscal 1960 provided a record that indicated "to the uninformed something like a doubling of the R&D effort."

Sheppard's criticism was prompted by the remarks of Vice Adm. J. T. Hayward, deputy chief of naval operations for development.

Adm. Hayward said that, by lumping research and development, and test and evaluation funds into one category, a "distorted" picture of the research and development effort is presented. "For instance," he said, "three years ago when we came before this committee, our R&D effort was in the neighborhood of $525 million. Now, today in 1961, the budget is $1,169 million, but a great portion of that is test and evaluation. The basic effort has not changed."

Adm. Hayward presented a table which showed that in Fiscal 1959, actual research and development funds for the Navy amounted to $872.0 million, test and evaluation funds $302.3 million, for a total of $1,174 million. In Fiscal 1960, R&D amounted to $845.8 million, a decrease of $26.2 million from the previous year, and T&E amounted to $410.9 million for a total of $1,256.7 million. R&D funds requested for Fiscal 1961, he said, are $819.4 million, a $26.4 million drop from Fiscal 1960. T&E funds are $349.6 million, making a total of $1,169 million.

Highlights of the Advanced Research Projects Agency testimony, presented to the subcommittee by ARPA director Brig. Gen. A. W. Betts included:

• **The $215 million requested** for Fiscal 1961 is adequate to fund the missions assigned to ARPA with the exception of the Vela program to develop a system to detect nuclear explosions. Vela, he said, was assigned to ARPA after budget determinations were made. Ways of funding the program are now being considered.

Highlights of Air Force testimony included:

• **Lt. Gen. R. C. Wilson,** deputy chief of staff for development, said the Air Staff does not presently feel it is worth the estimated $2.5 billion needed to produce three wings of an all-supersonic follow-on version of the B-58A (see p. 64) "because the airplane adds another type to the inventory, with all the complications of the additional type. The plane does have better performance than the B-58A, but it is still not an intercontinental airplane and still has to have tankers or advanced bases."

• **Joseph V. Charyk,** Air Force Under Secretary, said the $75 million requested in Fiscal 1961 for the B-70 program will only partially fund the building of one prototype and the beginning of another.

Highlights of Army testimony:

• **Maj. Gen. Robert J. Wood,** deputy chief of Army research and development, said that at present the flying crane concept has a low development priority in relation to other important aviation projects because of limited number of these machines required and the cost involved in developing them.

• **The 10 companies who have** the greatest share of Army research and development business, according to Gen. Wood, are Western Electric Co., with $173.6 million; Martin Co., with $79.3 million; Sperry-Rand Corp., with $37.5 million; Raytheon Co., with $31.9 million; Republic Aviation Corp., with $26.8 million; Radio Corp. of America, with $19.2 million; Fairchild Engine & Airplane Corp., with $14.3 million; Sylvania Electric Products, with $14.1 million; General Electric Co., with $10.7 million, and Minneapolis-Honeywell Regulator Co., with $10.3 million.

Highlights of Navy testimony included:

• **Defense Department has formed** a new VTOL/STOL advisory ad hoc committee composed of Air Force, Army and Navy representatives to develop a uniform long-range program with particular emphasis on guidance for the 1961-62 period, to provide continuous evaluation of various service research programs and dissemination to industry and to prepare feasible procedures to handle joint service projects.

• **Total cost of putting the Navy's** proposed Missileer aircraft-Eagle missile defense system into operation would be about $2.7 billion. In Fiscal 1961, $19.5 million has been requested for the development of a new turbofan engine to get maximum range with low specific fuel consumption.

B-52 Hound Dog Test

Washington—Strategic Air Command Boeing B-52 bomber last week made a 10,800 mi. nonstop flight from Florida to the North Pole and back carrying two North American Hound Dog missiles, and then fired one missile on a 26-min. several-hundred-mile course over the Atlantic Missile Range.

Flight was made by the 4135th Strategic Wing, based at the Air Proving Ground Center, Eglin AFB, Fla. The flight tested bomber and missile guidance at temperatures as low as minus 75F over polar regions and made the first air-to-air refuelings of a SAC bomber carrying two Hound Dogs.

Same crew, under aircraft commander Capt. Jay L. McDonald, launched two Hound Dogs from a B-52 on one flight last Feb. 29. Last week's flight took the aircraft from Eglin to the North Pole to Key West to Cape Canaveral, Fla. The missile was programed to take evasive action before impacting. The B-52 returned to Eglin with the other missile aboard. Final testing of Hound Dog is under way at Eglin by a SAC-directed Joint Test Force composed of the 4135th, tl.e Air Proving Ground Center and North American personnel.

British Blue Streak Development Stopped

London—British government has decided to abandon development of the de Havilland Blue Streak intermediate range ballistic missile as a military weapon, leaving its space role open to question.

Defense Minister Harold Watkinson last week told the House of Commons that the decision was made "in light of military advice." Two major considerations, he added, were:

• **"Vulnerability"** of fixed-site missiles due to improved missile guidance systems.

• **"Established practicality"** of mobile-launched missiles.

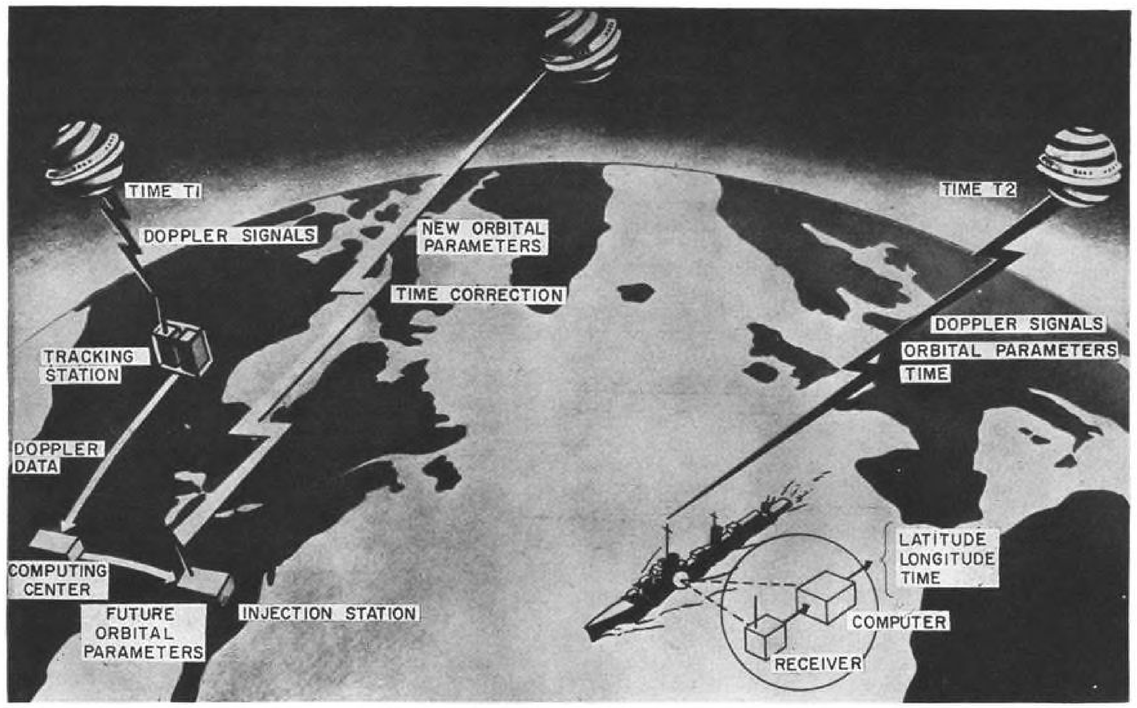
He said further development of the Blue Streak as a space satellite booster would be considered as a "matter of urgency." Blue Streak has been mentioned as a space booster in combination with the Black Knight test vehicle (AW Mar. 7, p. 276).

Watkinson said the cost of the Blue Streak program to date is $182 million and contended the total cost of bringing it to military effectiveness would be from $1.4 billion to $1.7 billion.

Britain, the minister continued, is determined not to give up its independent contribution to the free world's deterrent, and that therefore some other vehicle would in "due course" be needed in place of Blue Streak to carry British-manufactured nuclear warheads.

Watkinson observed that there are several possibilities, but he stressed the promise of prolonging effectiveness of V-bombers by buying Douglas Skybolts from the U.S.

Watkinson has said a look at Skybolt and Lockheed's Polaris will be a major purpose of his visit to the U.S. probably late next month.



AFTER LAUNCHING of Transit IB the satellite's doppler signal is picked up by receiving station (time phase 1), which reduces it to digital form and transmits it to Central Computer Center at Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Md. Staff at computing center, using doppler data, is able to predict future paths or orbital parameters of Transit I. These are relayed to injection station and then transmitted back to Transit I. Satellite stores the data and transmits it to earth intermittently (time phase 2). Ship navigators with receiver-computer equipment combine position information of satellite with current doppler shift data to determine their position on earth.

Space Technology

Navy Tests Transit Navigation Potential

By Cecil Brownlow

Washington—Navy this week will attempt to retard the spin rate of the first U. S. experimental navigation satellite, the Transit IB, and begin ground and shipboard tests to plot the probable accuracies of a more advanced operational system now under development.

The Navy and Johns Hopkins University's Applied Physics Laboratory, which has technical direction of the program, hope to obtain navigation fixes from Transit IB with accuracies on the order of one-half mile, equal to about the best that can be obtained from present conventional systems.

By the time the operational satellite phases in in early 1962 and its top-priority customer—the Polaris fleet ballistic missile submarine—begins to appear in numbers, Navy hopes the error factor will be reduced to within one-tenth of a mile (AW Mar. 28, p. 26).

Last week's successful launch of Transit IB from Cape Canaveral, Fla., by an Air Force Ballistic Missile Division crew included the first known in-flight shutdown and restart of a space vehicle engine—the 7,890-lb.-thrust Aerojet-General AJ10-104 Able-Star second stage.

In an effort to guide the 265-lb., 36-in.-dia. payload into a circular orbit with the two-stage Thor-Able-Star launch vehicle, the second stage was preprogramed for an initial 4.3-min. burning period, an engine shutdown and an attitude-controlled coast period of 19 min. Then, an altitude restart was made for an additional 13 sec. to inject the satellite into orbit. Near-circular orbit of National Aeronautics and Space Administration's Tiros I weather reconnaissance satellite (AW Apr. 11, p. 28) was accomplished with a three-stage Thor-Able launch vehicle.

Initially, control of second-stage burning was to have been accomplished by a mobile tracking station located in Erding, Germany, site of a large U. S. Army training center. Later, however, it was decided that, under the present state of the art, greater reliability could be obtained by preprograming the burning periods before launch. Able-Star stage was developed by the Ballistic Missile Division with Aerojet and Space Technology Laboratories responsible for subsystem design and fabrication.

The actual orbit attained was substantially more elliptical than planned but not enough so, according to the Applied Physics Laboratory, to prevent the satellite from accomplishing its mission. Apogee is approximately 749 mi.; perigee 233 mi. Inclination to the equator is about 51 deg., and orbit time is 96 min.-plus. Lifetime of the vehicle is estimated at 16 months, far short of the 50 years estimated for a 500-mi.-altitude circular orbit.

Development of the Transit system has been conducted by the Navy under the direction of the Defense Department's Advanced Research Projects

Agency. Navy will be awarded operational control of the system, and last week's launch probably will accelerate the transfer date, which may be made within the next two months.

Spin Deceleration

Spin rate of the Transit IB vehicle is scheduled to be slowed to a near stop this week, seven days after its Apr. 13 launch, by two weights located diametrically opposite one another along the sphere's mid-section.

The weights, their attaching cables wound around the sphere in a direction opposite that of the satellite's induced spin, will be automatically ejected by a decelerating timing device scheduled to operate during the seventh day of orbit. Upon unwinding, the weights will introduce a counter-force to retard the satellite's rotation. Present spin rate is about 3 rps. Once the rate is slowed, the vehicle's rotation will be measured by an infrared scanner contained in the payload.

In operational versions of the Transit, spin of the satellites will be retarded almost immediately after orbit is attained. The present vehicle is being permitted to continue its spin for a one-week period to accommodate a "piggy-back" experiment to probe the infrared albedo level of the earth. Experiment may be designed to provide additional data pertaining to the earth's heat balance.

The IB vehicle is the first of three 265-lb. test vehicles Applied Physics Laboratory scientists believe they need to put into orbit before the final operational system of at least four 50-lb. satellites can be effectively placed in orbits at the same time.

Primary missions of the IB will be to determine the effects of ionospheric refraction of radio waves in connection with the doppler shift measurements that will be used in obtaining precise navigational fixes, and to improve the accuracy of geodetic measurements of the earth's shape and distances between land masses.

The payload contains two ultra-stable oscillators housed in Dewar temperature-resistant flasks, each of which is transmitting on two frequencies at one-minute intervals. Power for one of the oscillators transmitting at frequencies of 54 and 324 megacycles is being supplied by a double band of solar cell banks around the center of the satellite. The second oscillator receives its supply from nickel-cadmium batteries and transmits at 162 and 216 mc. It is needed in the test vehicle to provide more precise data for the refraction studies.

It will not be used, however, in the operational systems where two frequencies are sufficient to measure doppler shift.

The Transit IB is now being tracked by six stations. Locations are Applied Physics Laboratory near Washington; the University of Texas; University of Washington; University of New Mexico; Argentia, Newfoundland, and the Royal Aircraft Establishment at Lasham, Hants, England.

By early 1962, when the initial operational satellites are launched, Navy hopes sufficient answers will have been found to questions concerning the refraction effects of the ionosphere and the gravitational forces to which the vehicle will be subjected to permit the navigational system to be monitored by five doppler tracking stations located within the continental U. S. An additional station to correlate data received from the satellites and to correct the orbit information stored in the vehicles' miniaturized digital memory units also will be required. All six stations will work round-the-clock.

Additional Tests

First of two additional test vehicle launches now planned probably will be made sometime in May. Orbits and missions of the two vehicles are:

- **High-altitude orbit** in the northern latitudes to study the effects of the Aurora Borealis on frequency transmissions and to verify theories that corrections can be made to compensate for the refraction effects of the ionosphere.
- **Low-latitude orbit** inclined close to the equator to study the exact gravitational forces to which a satellite is subjected and to gain improved data on the shape of the earth. This information must be known before all tracking stations can be housed within the continental U. S. To aid in the geodetic measures, Navy and Applied Physics Laboratory hope to establish a network of 10 data-collecting stations at scattered points around the earth within the next 12 months. However, negotiations for their establishment are still under way with the nations involved.

Navy and Applied Physics Laboratory scientists do not believe the program to scale down the satellite's size from the present 265 lb. to approximately 50 lb. will present serious problems.

The operational versions will be completely powered by solar cells, and the relatively heavy chemical batteries that power the expendable oscillator in the test versions will be removed. The vehicle also will be completely transistorized. In addition, the test satellites also contain a quantity of backup equipment that can be eliminated.

Once the weight reduction is achieved, Navy will switch from the heavy Thor-Able-Star booster, which has a first-stage thrust of 150,000 lb., to a lighter, relatively less-expensive system, probably a version of the NASA Scout under development by Chance Vought Aircraft, Inc.

Under present planning, four of the operational Transit satellites will always be in orbit—two at an inclination of 67.5 deg. to the equator but 180 deg. apart; two at minus 22.5 deg. inclination and also 180 deg. apart. All four will be launched from Cape Canaveral.

Such a system would permit surface vessels to obtain navigational fixes approximately every hour and a half and would cover all areas of the earth except those in the extreme polar regions and in the immediate vicinity of the equator.

To provide complete coverage, Navy scientists are "seriously thinking" of requesting funds for an additional two satellites—one with a polar orbit, the other circling the equator.

Optimum altitude for the satellite stations will be approximately 500 mi., according to Dr. R. B. Kershner, head of the Transit project at Applied Physics Laboratory.

Such an altitude is high enough to minimize the effects of the earth's gravitational pull yet low enough to keep the satellites below the bands of the Van Allen radiation belts.

Dr. Kershner says the transmitters of the operational satellite systems should ultimately attain a lifetime of about five years. If this expectancy is achieved, the Navy will be required to place roughly one new satellite a year into orbit to maintain the ratio of four transmitting vehicles.

With the four satellites in orbit, annual cost of maintaining the four tracking stations and the headquarters facility is estimated at approximately $3 million a year.

The satellites will be automatically queried twice a day as to their exact orbits. This information will then be relayed back to a memory unit within each satellite which, in turn, will transmit its orbit position and a time signal on a once-a-minute basis as it circles the earth.

Necessary computers to obtain accurate fixes to within one-tenth of a mile probably will be too heavy to be incorporated into any existing aircraft, according to Dr. Kershner. He says, however, that aircraft should be capable of carrying a computer system that would provide a "low accuracy" that is still superior to that obtainable with present systems.

If the system proves out, the Navy probably will retrofit the majority, if not all, of its surface ships with the computer systems needed to obtain precise measurements. Cost of the system is estimated to be near that of present Loran equipment.

The frequency changes in the signals of the Transit IB are being checked automatically by an Applied Physics Laboratory station against a time and frequency standard. The information is then teletyped to an APL computer center where the satellite's position can be accurately plotted by a Univac 1103-A high-speed digital computer. Since doppler shift is a direct measure of the rate of change of distance between the transmitter and the receiver at a known location on the ground, future positions of the satellite can be calculated because its orbit is governed by orbital mechanics.

Transit IB does not contain the memory system, which is still under development by Applied Physics Laboratory, and, because of the difficulty in obtaining the necessary miniaturization, it probably will not be available until time for the launch of the third test vehicle later this year.

The Aerojet-General Able-Star second stage includes a number of subsystems designed, built and integrated into the stage by Space Technology Laboratories, including the restart, electrical, telemetering, range safety, guidance and attitude control units; a programmer and an accelerometer.

The payload spin and separation mechanisms, also produced by STL, are mounted directly on top of the second stage and also serve as the payload attaching device.

Weight of the second stage is over 1,000 lb.; length 14 ft. 10 in.; diameter 4 ft. 7 in. Fuel and oxidizer used by the Able-Star are inhibited red fuming nitric acid and unsymmetrical dimethyl hydrazine.

Attitude control during non-powered flight is accomplished through eight small jet nozzles which control pitch, roll and yaw.

Last week's launch was the second attempt to put a Transit test vehicle into orbit. Transit IA, launched last Sept. 17 from Cape Canaveral (AW Sept. 21, p. 30), did not go into orbit when the third stage of the Thor-Able booster failed to ignite.

The satellite reached an altitude of 400 mi., however, and its four transmitters were monitored during the 25 min. of flight. Data from the short flight, according to the Navy, led to preliminary determinations that refraction corrections are feasible.

Typhon Missile System

Los Angeles—Long-range radar for Navy's Typhon advanced air defense missile system will be developed and produced by Westinghouse Electric Corp. under a $38.5 million Bureau of Weapons contract for operational service after 1965.

Phased array Typhon radar was conceived at Johns Hopkins University's Applied Physics Laboratory. Fixed, electronically scanned antenna of the powerful radar will be enclosed in a very large radome. The system will be installed aboard destroyers, frigates and cruisers. Eventually, ships will be designed from the keel up for Typhon systems.

A single Typhon radar can handle multiple airborne targets without pencil beam tracking radars. A Navy spokesman said that the Typhon system is not planned to defend against incoming ICBM warheads but will be useful against lesser ballistic missiles and high performance aircraft.

Typhon is regarded as a second generation shipboard missile system and the first important step beyond the "bumblebee" family—Talos, Terrier and Tartar. No contract has been let for any other part of the system. The missile itself is to be ramjet powered and smaller than Talos.

Plasma Arcjet, Ion Competitions

Washington—Contracts for the first plasma arcjet and ion engines for use in spacecraft are due to be awarded within the next few weeks by National Aeronautics and Space Administration. Thirty-one bids from 16 companies are being evaluated in three separate competitions. They are:

- **Half-pound thrust plasma arcjet engine for use with the 30-kilowatt and 60-kilowatt versions of the Snap 8 nuclear power system (AW Apr. 4, p. 26) for propulsion on deep-space missions. Winner was due to be selected late last week. Contract was to be on the order of $450,000 for one year's work, at which time a decision would be made as to whether to produce the engine. Bidders were Rocketdyne, Westinghouse, Aerojet, General Electric, Avco, Republic, Marquardt and Plasmadyne.**
- **One-hundredth-of-a-pound thrust plasma arcjet engine for use with the three-kilowatt Sunflower solar power system. This engine would use about one kilowatt of the system's power and would be used for attitude control and station keeping. Contract would be about $200,000 for the first year, with decision on production then. Bidders were Curtiss-Wright, Westinghouse, Rocketdyne, Republic, Avco, General Electric, Aerojet, Plasmadyne, Marquardt, American Machine and Foundry and Convair.**
- **Ion engine of about 1/100th-lb. of thrust, for use with Snap 8. These would be clustered, probably in a group of 10, to provide about ⅒th lb. thrust and probably would fly before the plasma arcjet engine. Smaller size lessens heating problems. Bids were presented on Mar. 24 and oral presentations are being made this week. Bidders were Thompson Ramo Wooldridge, Raytheon, Rocketdyne, Goodrich, Pratt & Whitney, Convair, General Electric, Aerojet, Hughes Aircraft, Curtiss-Wright, Armour Research Foundation and International Telephone and Telegraph.**

Douglas Develops ASW Computer

Santa Monica, Calif.—Douglas Aircraft Co. is developing an airborne computer system designed to give a submarine detection capability to fighter and attack aircraft which do not normally carry ASW search and localization equipment.

The system, still in the early design stage, is being developed under a $1.5 million Bureau of Weapons contract as an adjunct to Julie sonobuoy units which are used to pinpoint a submarine's position once its general location is known.

Designated JASDA for Julie Automatic Sonic Data Analyzer, the system would be carried externally in pod form to receive and interpret echoes from Julie sonobuoys, discarding spurious signals and computing location.

In the Julie concept, a ring of active sonobuoys is laid in a suspect area from low-flying aircraft. The planes then drop a series of small bombs in the area, and the return echoes from the detonations are transmitted from the sonobuoys to the search aircraft. In conventional ASW search and patrol aircraft, the echoes are interpreted by a trained sonarman. JASDA, also known as SUBPAK, is designed to take the place of the sonarman in attack and fighter aircraft.

JASDA is as good at interpreting underwater sounds as a top sonarman but no better, according to Edward H. Heinemann, Douglas vice president-combat aircraft systems. Potential superiority of JASDA is in cost, availability and its ability to give a detection capability to one-man aircraft.

Several dozen semiautomatic Julie ASW systems, designated ASA-31, are now being turned out for use in carrier-based aircraft by Grumman Aircraft Engineering Corp. and its subcontractor, Loral Electronics Corp., under a crash Navy program. Like JASDA, the Grumman-Loral system aims at replacing the sonarman with a computer and special Loral plotting board tested extensively by the Navy last year.

House Passes Mild 'Lobby' Penalty Bill

By Katherine Johnsen

Washington—House of Representatives has passed by an unrecorded vote legislation answering widespread allegations of a "munitions lobby" that requires that the employment of former military officers by defense contractors be publicized.

Its sponsors, Rep. Carl Vinson (D.-Ga.), chairman of the House Armed Services Committee, and Rep. Paul Kilday (D.-Tex.), say they consider it a "strong" measure. Opponents called it a "milquetoast."

Two Key Provisions

The two key provisions of the measure—which had general support—are:

- **Former military officers** employed by defense contractors will be required to register in a public file in an "Office of Enrollment" to be established by each of the military services.
- **Defense contractors** will be required to attach a list of all former military officers in their employ to contract proposals.

The penalty for failure to file would be loss of retirement pay for the officer or suspension of contract payments for the contractor until the information is furnished. Vinson explained:

"Our objective is to deflate influence, publicize its availability, lessen its marketability and yet preserve human dignity and the defense effort."

The two-day controversy on the House floor—including a split in the leadership of the Armed Services Committee—centered around what penalty should be imposed on ex-officers or contractors for doing what.

A third provision of the Vinson-Kilday legislation makes it "unlawful" for a former military officer within a period of two years after severance from service "to engage in any transaction, the purpose of which is to sell or to aid or assist in the selling of anything" to the Department of Defense or one of the armed services. The penalty spelled out in the legislation would be loss of two years' retirement pay.

General Confusion

General confusion was expressed in the debate as to the meaning of "transaction" and "selling" and as to whether loss of retirement pay would be a deterrent to selling by high-salaried former officers employed by defense firms.

Vinson and Kilday gave House members different interpretations of a selling transaction under the legislation. Vinson took the view that it meant "a personal contact with the man in the Department of Defense who has the obligation and the authority to enter into a contract."

Kilday said selling would not be limited to the activities of "a traveling salesman with a sign on his back" and would include, for example any corporation president, because "the president of a corporation who cannot aid or assist in selling is going to be an ex-president." He conceded that "it is going to be very difficult for individuals to know whether or not they are engaged in sales transactions."

Rep. Jaime Whitten (D.-Miss.), a member of the House Appropriations Committee, charged that in the Vinson-Kilday measure "we are playing around with peanuts." He said the billion-dollar defense spending decisions are not characterized by weapon selling but are developed on "a social occasion" where the theme of conversation between military chiefs and contractors is "how best to handle our over-all defense."

Rep. Edward Hebert (D.-La.), chairman of the Armed Services Investigating Subcommittee which had the task of investigating charges of influence by former military officers in defense procurement a year ago (AW Aug. 4, p. 33) called for an "all inclusive" definition of "selling."

Skepticism Voiced

While Vinson and Kilday argued that the "unlawful" stipulation implied court martial for violation, other congressmen were skeptical that a military service would ever prosecute one of its former high ranking officers on a hard-to-define matter of "influence peddling." Rep. A. Paul Kitchin (D.-N. C.), a member of the Armed Services Committee, asked: "Who is going to call a court-martial? Who is going to sit on the court to court-martial a three-star general? . . . In order to convene the court they must admit that someone within their own circles—the Defense Department—has been susceptible to this peddling of influence. That is going to be a deterrent against calling the court in the first place. In the second place, who is going to prosecute a retired general or admiral before the court martial?"

Charging that the Vinson-Kilday provision has only "baby teeth," Hebert unsuccessfully fought for the imposition of criminal penalties—up to a year in prison, a $10,000 fine or both—on the former officers who violate the selling ban and their employers. He said the court martial, if it is ever held, would be "just an old class reunion."

Before passage of the Vinson-Kilday legislation, the House leadership sided with Vinson and blocked consideration of three substitute proposals that would have established the criminal penalties sponsored by Hebert on the parliamentary technicality of "not germaine."

Another substitute measure offered by Rep. Alfred Santangelo (D.-N. Y.), which would have made it unlawful for a flag or general officer or an officer handling procurement matters before leaving the service, from accepting any position with a defense contractor for two years was defeated 70 to 101.

Hebert told the House that, by Vinson's tactics, "you have been denied the right to vote" and announced that he would introduce his proposals as new legislation for consideration by the Judiciary Committee.

Originally, both Vinson and Hebert sponsored legislation milder than the Vinson-Kilday measure. It would have banned selling for two years by former officers but would not have made it "unlawful" with the possibility of a court martial. The lone penalty would have been loss of pay for the period during which the officer was engaged in selling.

Hebert first repudiated this proposal. On the eve of House floor action as sentiment in favor of a strong measure mounted and posed a threat to the original Vinson-Hebert proposal, Vinson and Kilday drafted their proposal adding stronger penalties.

Vinson indicated at one point that he did not believe any legislation is actually required. The extensive investigation and hearings by the Hebert subcommittee, he declared, "did not disclose a single instance in which an officer, retired from the military service, had exercised influence on someone in government to the extent that the product manufactured by his company was selected.

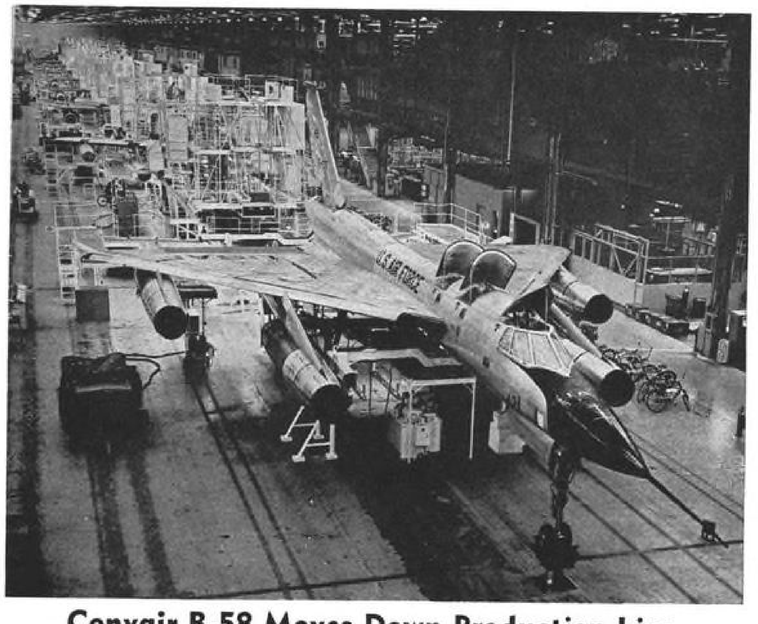
"No evidence of improper influence was disclosed.

"Notwithstanding this, everyone seems to be in accord that 'improper influence' either exists or comes so close to existence as to be identifiable . . ."

Vinson complained that when the matter of a retired officer employed by private industry is raised "rumors begin to fly throughout the width and breadth of Washington concerning the alleged influence these officers have on the procurement of defense items." He said "the allegations have increased almost in direct proportion to the increase in the defense budget."

Passage of his measure, Vinson later concluded, "will accomplish something worthwhile by stopping, at least, all of this conversation and newspaper talk that something crooked or improper is going on in the Pentagon."

Kilday differed with Vinson. "The fact that you are not able to prove the existence of influence does not prove that it does not exist," he commented. Noting that of the 1,400 retired officers who reported to the Hebert subcommittee only six said they were engaged in selling activities, Kilday observed that "I am not that naive to believe that there were only six of them . . . not more than eight or 10 are drawing big money, and they have reflected on every one of their fellows. . . ."



Convair B-58 Moves Down Production Line

Convair B-58 Hustler jet bombers, surrounded by mobile work platforms, move down the production line at the Forth Worth, Tex., plant of Convair Division of General Dynamics Corp. Aircraft move on rails about 8 ft. above the floor of the 4,000-ft.-long building; plane is lowered to floor at end of line by hydraulic jacks (AW Sept. 7, 1959, p. 134). For further details of proposals for three new B-58 versions, see p. 64.

First Photo Shows Atlas ICBMs Erected at Warren AFB

Half of the first Convair Atlas ICBM squadron at Warren AFB, Cheyenne, Wyo., is in final stages of checkout. Photo shows a "soft, horizontal" complex—each missile is raised to a vertical position from a concrete "coffin." Three Atlas squadrons will ultimately be stationed here. Later squadrons will be more hardened and more widely dispersed. First Atlas missile squadron may achieve an initial operational status before the end of next month, depending upon the readiness of ground support equipment and facilities.

Bristol, Saunders-Roe and Fairey To Become Divisions of Westland

London—Bristol, Saunders-Roe and Fairey Aviation, Ltd., lose their identities in the new Westland helicopter organization (AW Feb. 8, p. 36). Each company is relegated to division status, and all aircraft previously manufactured by the three companies will now bear only the Westland name.

Total integration of these companies at all levels from design to administration is expected within two years.

Implementation of this drastic integration policy is expected to be accompanied by a critical reconsideration of all Westland's newly acquired helicopters—including the Rotodyne—with a view to their development and production continuing.

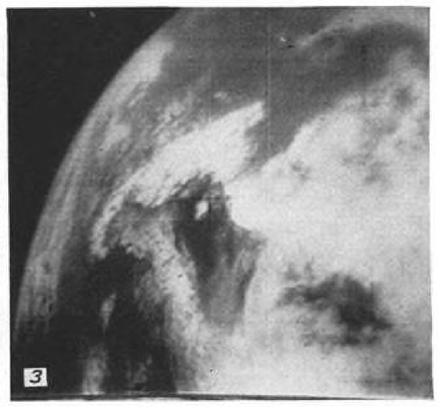
It is becoming increasingly evident that the company intends to concentrate on its own single-rotor concept, using Sikorsky rotor heads made under license, and General Electric engines made under license by de Havilland.

Further development of the Bristol 192 twin-rotor helicopter beyond the military aircraft now in production is thought to be unlikely, and its attitude to the Rotodyne, according to well-informed observers, is considered cool.

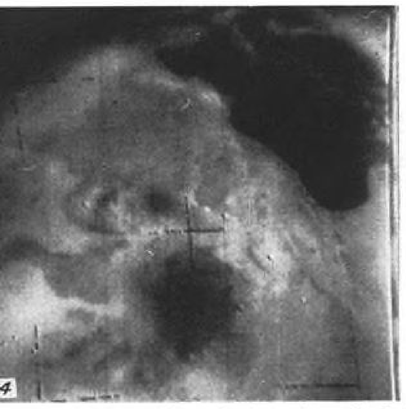
One Westland spokesman said the company will make its own appraisal of the Rotodyne before coming to any firm policy decision.

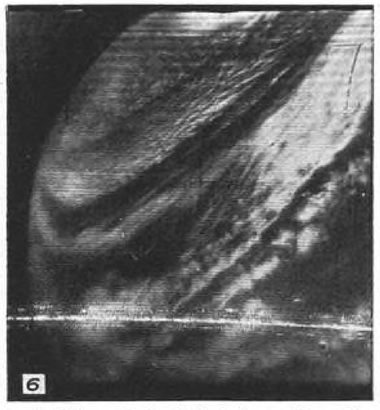
Westland's immediate sales policy will be centered on the Wasp (Saunders-Roe P .531) and the Sikorsky S-55 (Whirlwind) and the S-58 (Wessex).

Westland is expecting delivery of a Sikorsky S-61 which will be re-engined with twin Napier Gazelle turbines. This is the aircraft in which British European Airways has expressed interest. Westland does not expect any further missile or fixed-wing aircraft contracts, and further interest in the Saunders-Roe Hovercraft seems doubtful.



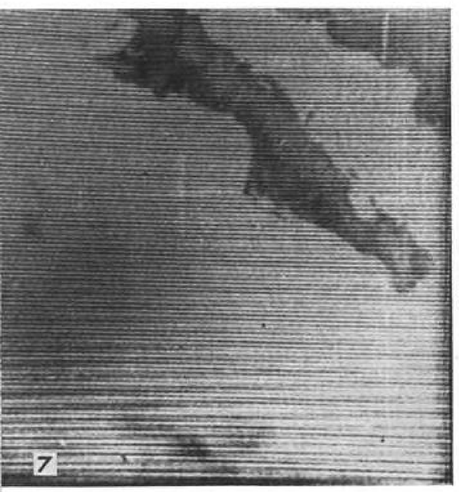
Wide angle camera in Tiros I satellite (AW Apr. 11, p. 29) recorded these three photos and relayed them to earth. Narrow angle camera has not been able to record since day after launch but relays direct images. (1) is French West Africa from Cape Blanco to St. Louis. (2) is Kurile Islands from Russia's Kamchatka Peninsula to Japan's Hokkaido Island. (3) shows Italy.

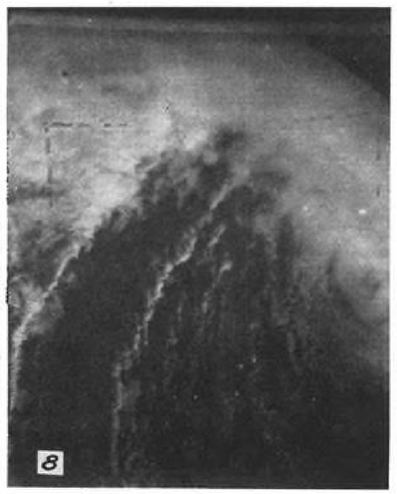




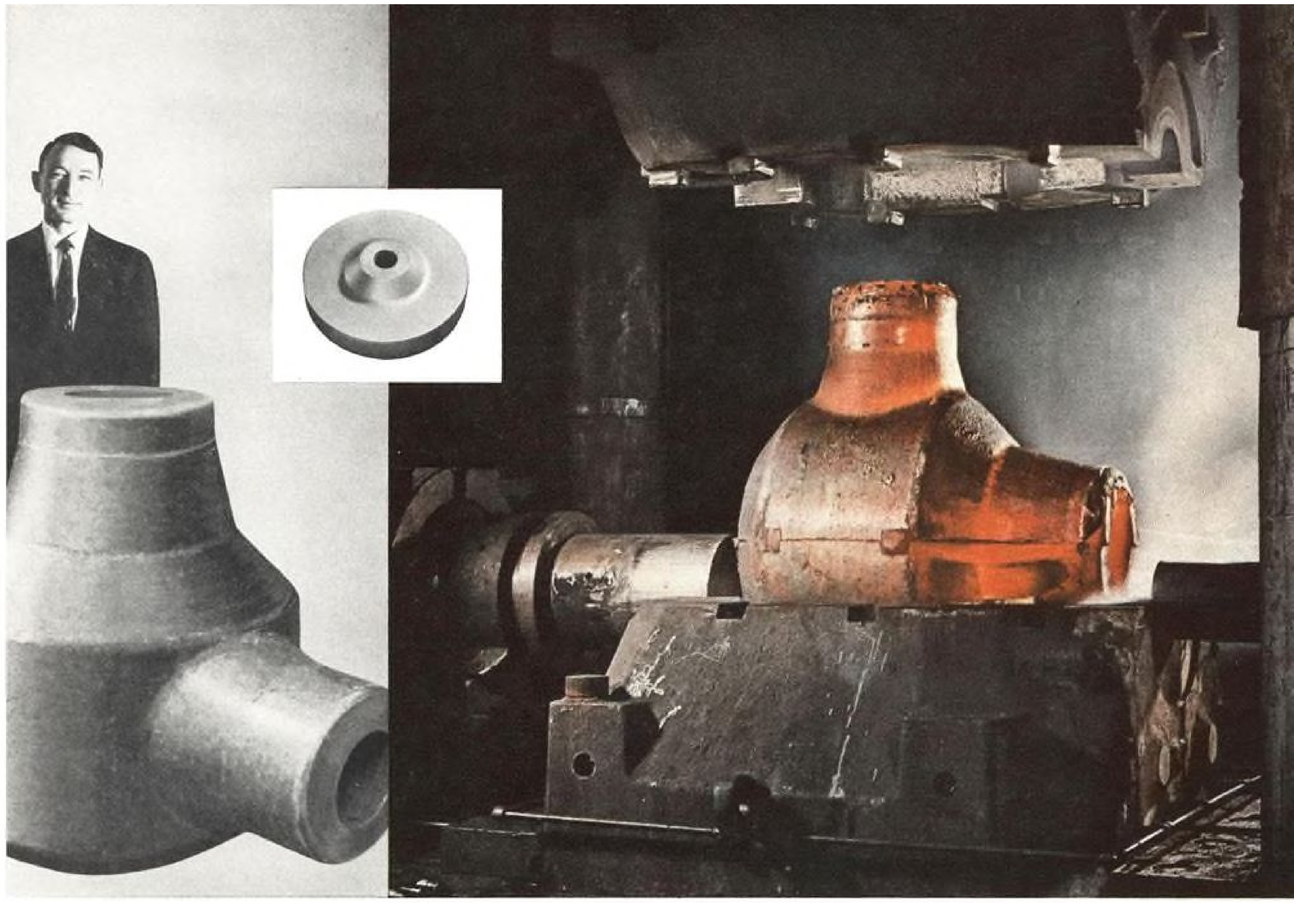
More wide angle shots show (4) Sudan, Gulf of Sidra, hole in clouds over Kufra Oasis in Libya. Lake Baikal in southern Russia (5) was recorded from 450 mi. altitude and relayed to Kaena Pt., Hawaii. Direct image (6) discovered largest cyclonic flow ever known to exist. It extends for thousands of miles over Central Pacific, shows great value of even an experimental weather satellite.

Tiros Defines Weather Systems, Land Areas





Potential of photographic satellites for mapping and military reconnaissance is demonstrated by low-resolution picture of lower California and Gulf of California (7). High orbit, poorer quality of pictures from early passes indicate possibility for considerable improvement, both for weather and other uses. Discovery of cyclonic area and first observation from space of a typhoon (8) already have proven usefulness to meteorologists. Typhoon photo, taken by low-resolution camera, shows storm's eye. High-resolution photos, not shown, gave detail of cloud structure within storm area. Storm was located off Australia. Other photos have shown shoals off Bermuda, an atoll in the Pacific, and ground features that appear to be sand dunes. Low contrast of experimental equipment now makes differentiation between snow cover and clouds difficult but improvement is expected as equipment, techniques are refined.



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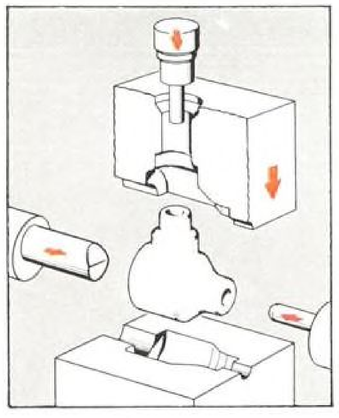

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Contractor Operation Is Favored For Atlantic Missile Test Range

Washington—Investigative staff of the House Defense Appropriations Subcommittee has concluded that civil servants could operate the Atlantic Missile Range at "a somewhat lower cost" than contractors achieve, but that no change should be made in the arrangement at this time.

Chairman George H. Mahon (D.-Tex.) said in congressional hearings released last week that the staff found that "the present management was effective and, since very substantial costs as well as temporary disruption of range operations would result from any attempt to transfer the range to direct government operation, no change should be made at this time."

Staff Study

The staff study was conducted last fall, before a decision was made to transfer a number of range engineers to the principal range contractor, Pan American World Airways, Inc., from its technical subcontractor, Radio Corp. of America (AW Apr. 11, p. 26).

Mahon's committee has paid particularly close attention to the Atlantic range operation for some time, and has included this in general criticism of the Air Force for contracting for services that it might do itself.

In the testimony released last week, USAF Under Secretary Joseph V. Charyk said it would be "extremely difficult" to use USAF or civil service personnel to run the range. He cited "flexibility that a contract relationship affords," the "large reservoir of talent" that a contractor can attract, and the fact that USAF has no similar requirements, as reasons for turning to a contractor.

Pan American's range division, with Bell Aircraft as a subcontractor, also will install and operate the new environmental test facility and drone range at Army's Electronic Proving Ground at Ft. Huachuca, Ariz. (AW Mar. 21, p. 37).

The process of contractor selection for the Huachuca contract was similar to that used on the AMR contract. In 1957, after three years of study, the Army Electronic Proving Ground at Ft. Huachuca was directed to develop final plans for an electromagnetic test facility. The agency concluded a contractual effort would be necessary.

Negotiations with industry began in January, 1959, and attracted 385 conferees to a pre-solicitation conference in Tucson, Ariz. Late in July of last year, 450 persons representing 127 industrial firms registered for a pre-bidders conference.

Twelve Phase I technical proposals, without cost estimates attached, finally were submitted, many of them from teams of contractors. Prime contractors for the 12 bids were Chance Vought, Cook Electric, General Electric, Hughes Aircraft, Lockheed Aircraft Service, Melpar, Pan American, Philco, RCA, Ramo-Wooldridge, Sylvania, and Vitro Laboratories.

Seven Categories

Proposals were broken into seven categories—systems concept, radar and communications, instrumentation, surveillance and drones, facilities support, research and development management, and over-all capability. What the Army called "top individuals from U. S. Army Signal Corps resources" formed a voting panel. A non-voting working panel heard half-day briefings, reviewed the proposals and reported to the voting panel.

The four bidders having the highest technical evaluations—based on quality and completeness of plan, experience, and quality of personnel who would staff the program—were then asked for price proposals. They were Cook Electric, Pan American, Sylvania Electric and Vitro Labs Division.

Price quotations were received by Nov. 12 of last year. From Nov. 15 to Dec. 15, pricing and final negotiations were conducted, followed by a complete pricing analysis and re-examination of technical proposals.

Although Pan American and Bell will do the data collection on the range, Army itself will handle data analysis and evaluation. Army's budget for the program is $14 million for Fiscal 1960, $8.7 million for Fiscal 1961 and an estimated $10 million for Fiscal 1962.

Budget Cuts Proposed

Washington—Cuts totaling $89.3 million were recommended last week by the House Appropriations Committee in Fiscal 1960 budget requests of the National Aeronautics and Space Administration, Federal Aviation Agency and Civil Aeronautics Board. Another $31.6 million was cut from the National Science Foundation budget requests.

The committee slashed NASA's $915 million request to $876 million, a cut of $38.9 million. Reductions of $19.2 million were made in research and development, $15.5 million in construction and equipment and $4.2 million in salaries and expenses.

For CAB, the committee recommended $67.2 million of the $76.5 million asked, a reduction of $9.2 million. Subsidy payments to air carriers was cut by $8.9 million, salaries and expenses by $315,000.

Biggest recommended cut was made in the FAA budget, which was reduced by $41 million—from $713 million to $671.9 million. Expenses were cut by $17.7 million, requests for establishment of air navigation facilities by $21.5 million, research and development by $1 million, operation and maintenance at Washington airports by $6 million. Construction requests at Washington National Airport also was cut $500,000.

USAF Plug Nozzle Plan

Washington—Air Force is planning a development program, possibly in conjunction with National Aeronautics and Space Administration, for a plug nozzle, hydrogen-fueled rocket engine that could be clustered to form a 20-million-lb. booster.

NASA itself has programed $3.4 million for investigation of plug nozzle designs in Fiscal 1961, a manyfold increase over Fiscal 1960 funds. USAF is now in the process of formulating a development plan for such an engine. Plug nozzle offers performance advantages over conventional nozzles, allows engine to be designed, built and tested in small segments (AW Feb. 1, p. 16).

News Digest

Boeing Bomarc IM-99B made its first successful flight last week. Missile was launched from Santa Rosa Island at the Air Proving Ground Center, Eglin AFB, Fla., and flew 170 mi., tracking limit of the Gulf range, before it was destroyed. Ramjet fuel control failures aborted five earlier flights. A sixth flight aborted when the missile failed to level off and climbed until it ran out of air. A seventh missile was destroyed by a pad fire that preceded launching. All seven failures occurred at the Atlantic Missile Range, where one more flight was scheduled before testing shifted completely to Eglin.

Raytheon Co. last week signed an agreement with Societe Europeanne de Teleguidage (AW Apr. 6, 1959, p. 34) for eventual European production of the Hawk surface-to-air missile for NATO countries.

USAF pilot Maj. Robert White made his first familiarization flight in North American's X-15 last week. He attained 1,400 mph. on the 9 min. flight.

Vickers Foreclosure Threatens Capital

$11.9 million in past Viscount payments demanded; airline's turboprop, piston fleet could be seized.

By L. L. Doty

Washington—Capital Airlines, staggered by heavy deficits and a critical cash position (AW Apr. 4, p. 47), received another jolt last week when it was threatened with foreclosure on notes covering its fleet of 56 Vickers Viscount turboprop transports.

In a surprise move—apparently completely unanticipated by Capital officials—Vickers-Armstrongs, Ltd., British manufacturer of the Viscount and chief creditor, sent the airline a cable from London on Apr. 12 declaring the notes in default and demanding payment by midnight of Apr. 15 of the $11.9 million which it said was past due. If payment had not been made by that time, Vickers-Armstrongs officials said a second cable would be sent the carrier demanding that the outstanding balance of $33.8 million on the notes be paid within three days.

As of late last week, no court action had been instituted. However, since the notes are secured by chattel mortgages, failure to make payment could result in seizure of the airline's entire fleet including its Douglas DC-3s and DC-4s and Lockheed 049s as well as the Viscounts.

Vickers-Armstrongs officials said they were hopeful that a "sound plan" can be worked out to avert such action. Initial steps taken by the manufacturer thus far are in accordance with the terms of the chattel mortgage which provides that, even though the airline may be behind in payments, the notes are not in default until the loans are called. This was accomplished by the cable. Capital is about 12 months behind in its payments.

The action by Vickers-Armstrongs followed by four days a Civil Aeronautics Board order turning down Capital's petition for a temporary subsidy rate (AW Apr. 4, p. 47). Although the Board has called for a hearing on the request at the "earliest" practical date, the decision closes one more escape hatch for the carrier from its shaky financial plight.

In February, Capital announced a refinancing program with U. S. banks and insurance firms designed to bring about $59.2 million of new indebtedness and refinance the British chattel mortgages. This program has been deferred indefinitely because declining traffic prevents the airline from meeting certain conditions under which the new loans were to be underwritten. As a result, Capital is presumably without any firm plans for raising funds immediately through borrowings.

As a consequence, most observers here feel that the airline has no solid or attractive solutions to its current problem.

Obviously, Capital will take any measures necessary to block seizure of its aircraft.

This could be achieved by filing for reorganization under the Bankruptcy Act to enable the airline to operate in the hands of a receiver. Such steps could be taken by Capital itself or by any of its competitors including Vickers-Armstrongs. It is understood that fuel suppliers are among the company's largest creditors.

Cessation of operations could draw the CAB into the picture to determine whether public interest was being harmed by failure to operate. Recommendations for merger or dismemberment of the airline's franchised routes could result.

Revenue Decline

The seriousness of Capital's present situation is shown by these statistics:

- **Revenue passenger miles** dropped 15.7% in January, 7.7% in February and 15% in March. Trunkline industry revenue passenger miles climbed 17% in January, 12% in February but declined about 1% in March.
- **Operating performance** was the lowest since 1947 in March, lowest in 10 years in February. Bad weather is attributed as the main cause for this poor showing.
- **Load factor** has hovered around 52% as compared with a normal 58% at this time of the year.
- **Cash position** was $5.8 million at the end of 1959, dropped to $3.5 million at the end of February—enough cash to cover about two weeks of operating expenses. It is the lowest level reached since 1956 when $12 million in convertible subordinated debentures were issued to increase working capital.
- **Stock holders' equity** was $10.8 million in 1959 and had fallen to $6.9 million in February. If estimated first quarter losses of $7.4 million are correct, this figure could topple to around $3 million by the end of this month.

Capital's View

Capital attributes its difficulties to severe operating weather, a series of major accidents, delayed CAB action in the General Passenger Fare Investigation, the Board's decision in the Toledo Adequacy of Service Case in which Capital was required to increase coach service in Toledo, and the short-haul nature of its routes.

Many observers here feel that the economic burden of the five-year notes, originally totaling close to $69 million, also play a large role in its red ink operation. These notes carried an interest rate of 1¾% per annum in excess of the Bank of England interest rate but were not to exceed 6¼%.

In July, 1958, notes due during four months of the year were deferred and replaced by new notes payable during the last two months of 1958 bearing interest of 2¾% in excess of the Bank of England interest rate (5%) without any ceiling.

These notes, as well as notes due in December and November of 1958 totaling $5 million, were not paid during the year.

In 1959, Capital paid $5.1 million on the debt plus $2.3 million derived from insurance on destroyed aircraft and the sale of aircraft during the year. All interest due on the notes was paid through Dec. 31, 1959 according to the airline's annual report.

Lord Knollys, chairman of Vickers, Ltd.—parent company of the Vickers group, in Washington when the cable was received by Capital—met with the airline President David H. Baker behind closed doors in a session that reportedly was conducted in an atmosphere no more strained than that existing between any major creditor and debtor.

Vickers' Position

Vickers officials, acting upon the advice of the British Embassy here, also met with Civil Aeronautics Board members to explain the move. Vickers' position was explained this way by Vickers-Armstrongs Chairman, Major-General Sir Charles Dunphie, in a statement here:

"Vickers is taking this action with extreme reluctance . . . [We] recognize the position Capital occupies as a major trunk carrier and public interest in its continued operation and would, of course, be willing to cooperate in a sound plan which makes adequate provision for the notes and for the solution of Capital's financial problem."

Capital's problem represents a major challenge to the Civil Aeronautics Board. It stresses both the high costs carriers have undertaken in making the transition from piston-engine aircraft to turbine transports and the depressed load factors that a number of carriers will inevitably experience from the multiple competition policy the Board has applied during the past five years in making route awards.

Board Consideration

Undoubtedly, a number of these issues will be aired when the Board opens hearings on Capital's petition for subsidy since it has announced it will probe these factors involved in the case:

- **Disparity between Capital's** financial position of the past several years and that of other comparable domestic trunklines.
- **Basic question of subsidizing** trunk carriers which compete directly with non-subsidized airlines. It also will analyze Capital's period of subsidy-free operation.
- **Need for development** of a complete record with respect to the financing and equipment program of Capital, and the relationship of that program to its statutory need under honest, economical and efficient management.

TWA Finance Plan

Los Angeles—Howard Hughes will undertake a $340 million financing program to cover the cost of turbine equipment being purchased for Trans World Airlines. Principal features of the program are:

- **Total of $190 million will be raised through loans with banks, insurance companies and institutional lenders. Dillon, Read & Co., Lazard Freres & Co. and Lehman Brothers will handle this phase of the program.**
- **TWA stockholders will be offered $100 million of subordinated income debentures with detachable common stock purchase warrants. Hughes Tool Co. will purchase its pro rata portion of $78 million plus any balance not taken up by others. Stockholders will be asked to increase the authorized number of common shares from 10 million to 15 million.**
- **Hughes will provide whatever sum of money may be required—up to $50 million—to make good any amount by which TWA may fall short of its needs from its own cash flow.**

House Unit Backs MATS Stand; Little Traffic Transfer Foreseen

By Robert H. Cook

Washington—House Armed Services Subcommittee concluded public hearings on Military Air Transport Service airlift needs last week on a strong note of support for MATS' proposed modernization program and with little indication that it will recommend a large-scale transfer of more military traffic to commercial airlines.

Cost of operating MATS under its present system, as opposed to the higher costs expected from any significant shift of additional business to the airlines, has been a guiding factor behind the subcommittee hearings (AW Apr. 11, p. 41). Having already recommended a $350 million appropriation for MATS modernization to the House Appropriations Committee, the subcommittee also has clearly indicated it expects MATS to justify the use of its new equipment for "hard core" airlift.

Emphasizing his belief that MATS "hard core" requirements "should and will be increased, not decreased," subcommittee chairman Rep. L. Mendel Rivers (D.-S. C.) noted:

"It is obvious that the degree to which they [the requirements] may be increased will simply compound the deficiencies which already exist in the MATS fleet. To those in the civil industry who may be somewhat alarmed by that statement, I must again emphasize that we are again confronted with meeting a military requirement and we must meet that requirement, even if the aircraft stand idle until the time of need."

Running counter to the subcommittee's reluctance to boost the costs of MATS commercial airlift are major findings of a seven-member Reed committee appointed by the Air Force to determine the most practical means of realigning MATS operations to provide more revenues for commercial carriers.

Committee was headed by Gordon W. Reed, chairman of the Board of Texas Gulf Producing Co., New York City.

A large part of the Reed report released last week calls for a progressive phase-in of MATS passenger and cargo traffic to commercial airlines. Passenger traffic, it contends, could be transferred at a faster pace than cargo because of the number of modern jet transports now in use, while a cargo switch should proceed at a slower rate, because of the scarcity of commercial cargo capacity.

Noting that these and other recommendations would increase the cost to the government, Reed committee members pointed out that the increased revenues which could be realized by the airlines if the recommendations were implemented would encourage them to invest in specially designed cargo aircraft needed to improve the national airlift capacity.

However, both the House subcommittee and the Reed committee appear to agree on several matters that could ultimately result in certificated airlines gaining significantly more military revenue, although their total share of the transferred traffic may not be as large as they had hoped for, according to industry spokesmen. Discussion of these issues by the Air Force and the House subcommittee on Apr. 21 is expected to have a significant influence upon the final national airlift legislation which the subcommittee hopes to introduce later this year.

MATS' need for a five-hour daily fleet utilization, which has come under attack from every airline witness to appear before the subcommittee, bears a direct relation to the amount of MATS traffic that can be diverted to commercial airlines. Industry witnesses have collectively failed to impress the subcommittee that this utilization should be cut. Subcommittee members have consistently defended this rate on the basis of military figures which show that only 1.9 hr. of the 5 is devoted to movement of civil traffic civil carriers could handle.

The Reed report also supports the MATS utilization rate and says that, even when civilian carriers reach a high level of cargo capacity, "MATS worldwide training exercises should be continued to the degree necessary to maintain a high state of readiness."

Terming the utilization rate as the "activity of a group of military specialists training for their wartime mission," the report says that "the effectiveness of MATS' wartime operations must not be jeopardized by an arbitrary cut in training hours. Experience gained during the Berlin and Korean airlift operations indicates that the airlift force must be maintained at a relatively high rate if it is expected to surge rapidly to a higher rate and sustain this higher rate for any reasonable period of time."

Recommendations made by the Reed committee on MATS' procurement procedures and the selection of proper car-

riers for the military contracts, closely follow the thinking of House subcommittee members and point to the direction a continuation of the airlift hearings will take.

The special report recommends that MATS abolish its present system of competitive bidding for contracts and would narrow the field of eligible airlines to certificated carriers meeting these conditions:

- **Civil Reserve Air Fleet** membership.
- **Carriers with firm orders** for modern cargo aircraft.
- **Sufficient fleet on hand** to handle the commitments at the time requirements for procurement are published.
- **Good financial, operational** records.

Each of these points was explored by the House subcommittee, which has criticized MATS' present competitive bidding system as having contributed nothing toward the building of national airlift capability. At the same time, the subcommittee has shown definite interest in the possibility of MATS procurement of commercial airlift at tariff rates approved by the Civil Aeronautics Board as suggested by the Reed report. Such an alternative plan already has been submitted to the Defense Department by Northwest, Pan American, Trans World and Seaboard and Western Airlines.

Major portion of the recommendations is aimed directly toward elimination of Part 45 aircraft operators from MATS business. Airline witnesses contend that these operators are capable of capturing a large share of MATS' business at low rates since they are not hampered by much of the expenses and responsibilities carried by certificated carriers subject to Civil Aeronautics Board authority.

House subcommittee hearings have shown that a number of Part 45 operators own no aircraft but have successfully bid on contracts for which they would later lease the needed equipment. Volume of Part 45 operations accounts for a high percentage of the 94 carriers currently eligible to bid for MATS business, according to airline witnesses. On one contract last year they accounted for 10 of 26 bids.

A point of contention among the airlines has been the House subcommittee's continued reference to the possible need for legislation that would place the Civil Reserve Air Fleet under direct military control in "wartime." The Reed report also takes this stand and says CRAF contracts should contain assurances from the carriers that they will operate wherever directed by the military during "general war, limited war or periods of heightened tension" as determined for contract purposes by the Secretary of Defense.

Supplemental Carriers Protest Court Ruling on CAB Authority

Washington—Supplemental airlines are seeking congressional aid in their battle to offset a U. S. Court of Appeals decision that has ruled that the Civil Aeronautics Board exceeded its authority in granting 23 supplemental carriers operating authority more than a year ago.

Decision of the court stemmed from complaints by eight major trunk airlines who protested that a CAB decision in January, 1959, violated sections of the Federal Aviation Act. The Board's decision granted operating authority to the supplemental carriers without naming specific routes over which they should operate. It contained a proviso, however, stipulating that the carriers could not exceed 10 trips a month in the same direction between any two points.

The appeal to the CAB action was filed by United, Eastern, Pan American, Trans World, American, Delta, Northwest and National Airlines and the Atcheson, Topeka & Santa Fe Railway Co.

Calling attention to Section 401(e) of the Federal Aviation Act, the three-judge tribunal ruled that, "it seems plain beyond possibility of debate that a blanket authorization to operate between any two points in the United States is not a specification of the terminal points and the intermediate terminal points, of the operation.

"The certificates issued here also contained a limitation of the operation to 10 flights each calendar month in the same direction between two points. Section 401(e) of the act contains this provision: 'No term, condition, or limitation of a certificate shall restrict the right of an air carrier to add or change schedules . . .' Failure of these certificates to observe this prohibitive restriction seems clear."

Directing that the CAB order granting operating authorities of three to five years for the supplementals be "set aside and the proceedings remanded," the court also criticized the Board for granting such authority when, it said, many of the airlines involved lacked the financial resources necessary to undertake operations "of the scope authorized by their certificates."

The court did not take issue with CAB's stand that the certificates were granted on the basis of public interest but said that "the courts cannot rewrite plain statutory terms, unless the inadvertant result of plain wording is absurd when applied to certain facts."

The supplemental carriers affected, represented by the Independent Airlines Assn., already have met with CAB officials and Sen. Mike Monroney (D.-Okla.) to discuss the impact of the court order.

While further action of the IAA will await additional talks with the Board, spokesmen for the association say they plan to file for a legal stay of the court order and a possible review of the Appeals Court decision by the U. S. Supreme Court. Legal maneuvering in the case probably will extend over several months, supplemental spokesmen say, to permit time for hoped-for legislation to amend the Federal Aviation Act.

Sandys Scores FAA's Test of Decca Mk. 10

London—Conclusions drawn by the U. S. Federal Aviation Agency in its report on operational tests of the Mk. 10 Decca navigation system in a Convair C-131 (AW Jan. 11, p. 33) cannot be accepted as valid, according to United Kingdom Minister of Aviation Duncan Sandys.

Sandys, replying to written parliamentary questions, gave the text of a letter sent to the secretary general of International Civil Aviation Organization, dated Mar. 14 and signed J. H. Riddoch, U. K. representative on the ICAO council.

The letter alleges there were serious biasing factors in the trial dealt with in the report, which had not been given due weight either in design of the pilots' questionnaire or analysis or results.

It was therefore unwise to draw firm conclusions, the letter adds.

"Serious biasing factors" present in trials are alleged as follows:

- **Large proportion** (approximately half) of the route mileage flown was in areas of coverage and accuracy where the Decca Mk. 10 system is not, and has not been claimed to be, entirely satisfactory for navigation of all air traffic control procedures.
- **"Type of questionnaire** used does not permit statistical examination because there is no discrimination between operationally significant and insignificant faults.
- **"Tests were conducted** on low power chains in conditions of relative high background noise level. The radiated power was less than normally provided from other operational chains and appears to have been inadequate for the purpose of the trials.
- **"Design of the flight log** charts was in some instances unsuitable for the declared purpose of the trials."

La Guardia's Jet Future Is Uncertain

By Glenn Garrison

New York—Operational future of La Guardia Airport is clouded with uncertainties despite a $56 million rehabilitation program now under way at the field and the recent decision to provide a second ILS for instrument Runway 4-22.

It now appears questionable whether any of the current short-medium haul jets—Boeing 720, Sud Caravelle, Convair 880 or Convair 600—will be able to operate practicably at La Guardia. One major restriction is runway length. Under present plans, Runway 4-22 will still be 5,000 ft. long when the rehabilitation is completed next year, and Runway 13-31 will remain at 6,000 ft.

La Guardia, long one of the world's busiest airports, handled 5,409,844 passengers last year. Six scheduled airlines serve it, among them American, which expects to receive Boeing 720s within a few months and Convair 600s next year. Regarding the question of turbojet or turbofan operation at La Guardia, American told AVIATION WEEK it is not in a position yet to answer. No real performance criteria are available at this time, an airline spokesman said.

United Air Lines has ordered the twin-jet French Caravelle, with deliveries scheduled to begin next spring, and the airline reports that Caravelle operation at La Guardia looks "marginal." Trans World Airlines, soon to get 880s, would like to operate them at the airport, "which has a great future in TWA's plans." TWA said its plans for future procurement of aircraft would consider La Guardia operation.

880 Use

Capital Airlines, whose 880 order now is uncertain because of its financial troubles (AW Apr. 4, p. 47), believes the airplane could be operated at La Guardia on short-haul routes, but probably would use it at Idlewild instead because of expected Port of New York Authority anti-noise restrictions. Northeast Airlines, expected to order the 880, also would use it at Idlewild and not at La Guardia.

The remaining La Guardia user airline, Eastern, has not yet ordered any short-haul jet equipment. Eastern now operates turboprop Lockheed Electras at La Guardia, as does American. Northeast and Capital serve the field with turboprop Vickers Viscounts.

The Port Authority told AVIATION WEEK that no airline has yet requested permission to operate jets at La Guardia. On the other hand, two have asked to serve Newark Airport with the Convair 880. The first request, from TWA, was "informal." Delta Air Lines has formally asked permission and has submitted the required flight profiles for a Port Authority analysis of noise characteristics.

The Port Authority, whose consultants previously had taken noise data on the 880, is evaluating the Delta flight profiles in relation to the noise data. This process should be complete within a few days, but a policy decision will take considerably longer, the agency said.

TWA has not submitted flight profiles. Trans World also informally asked to operate its Boeing 707-120s, which occasionally go into Newark after weather diversions from Idlewild, on revenue flights out of Newark, but permission was denied.

These two requests, the Port Authority said, are the only ones so far concerning any jet operations at Newark.

La Guardia is popular with passengers because of its proximity to New York City, but is considerably less of a favorite with airline pilots who fly into it. One outstanding reason for pilot complaints has been the necessity of making a back course ILS approach to Runway 22. This end of the instrument runway is separated from Flushing Bay by the dike which rims most of the constantly sinking airport.

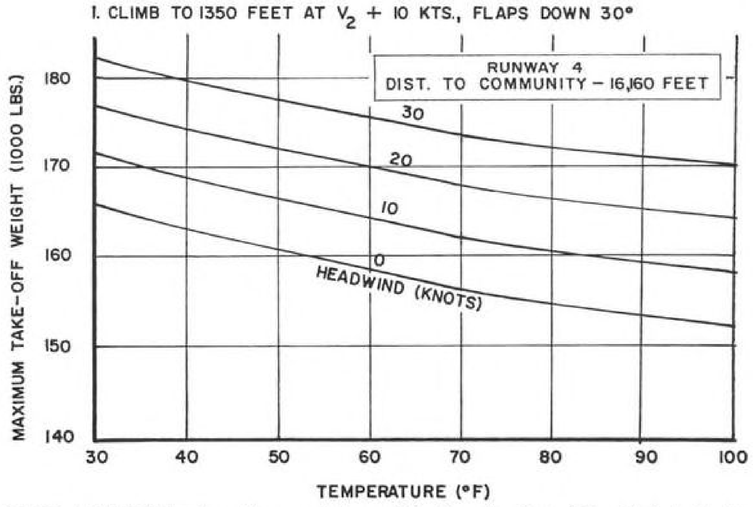
There are no approach lights at this end and back course approaches are made with the aid of the ILS localizer on the fully-instrumented 22 end of the runway. Condenser discharge lights were added to threshold lights of Runway 22 and Runway 13-31 last year and evaluated by an AVIATION WEEK pilot (AW Feb. 23, 1959, p. 37). These are not approach lights, however, and merely serve to identify runway ends.

Minimums for Runway 22 are 400 ft. and 1 mi. which are expected to go down to 200 ft. and one-half mile with installation of an ILS. The presently instrumented Runway 4 has the 400 ft., ¾-mi. limits and will continue to be because of obstructions in the approach path.

FAA Funds

Funds from Federal Aviation Agency for installation of Runway 22 approach lights and ILS have been available to the Port Authority for several years. A problem has been the conflict a standard 3,000-ft. line of approach lights, set on pilings out into the water, would create with a ship channel now used by certain deep-draft vessels principally hauling oil and coal. A standard installation would mean getting U.S. Army Corps of Engineers approval for some plan to provide, at Port Authority expense, a substitute for the channel.

Lack of approach lights and instrumentation for Runway 22 has been the subject of considerable criticism and has been linked with the crash of an American Electra into the East River in February, 1959, during a back course instrument approach to the runway. Air Line Pilots Assn. President Clarence N. Sayen last January contended factors causing the accident, in the view of airline pilots, included the marginal



DELTA AIR LINES has formally requested permission from the Port of New York Authority to serve Newark Airport with the Convair 880, and has submitted the required flight profiles, such as this one for Runway 4, for analysis of noise characteristics.

TWA SuperJets
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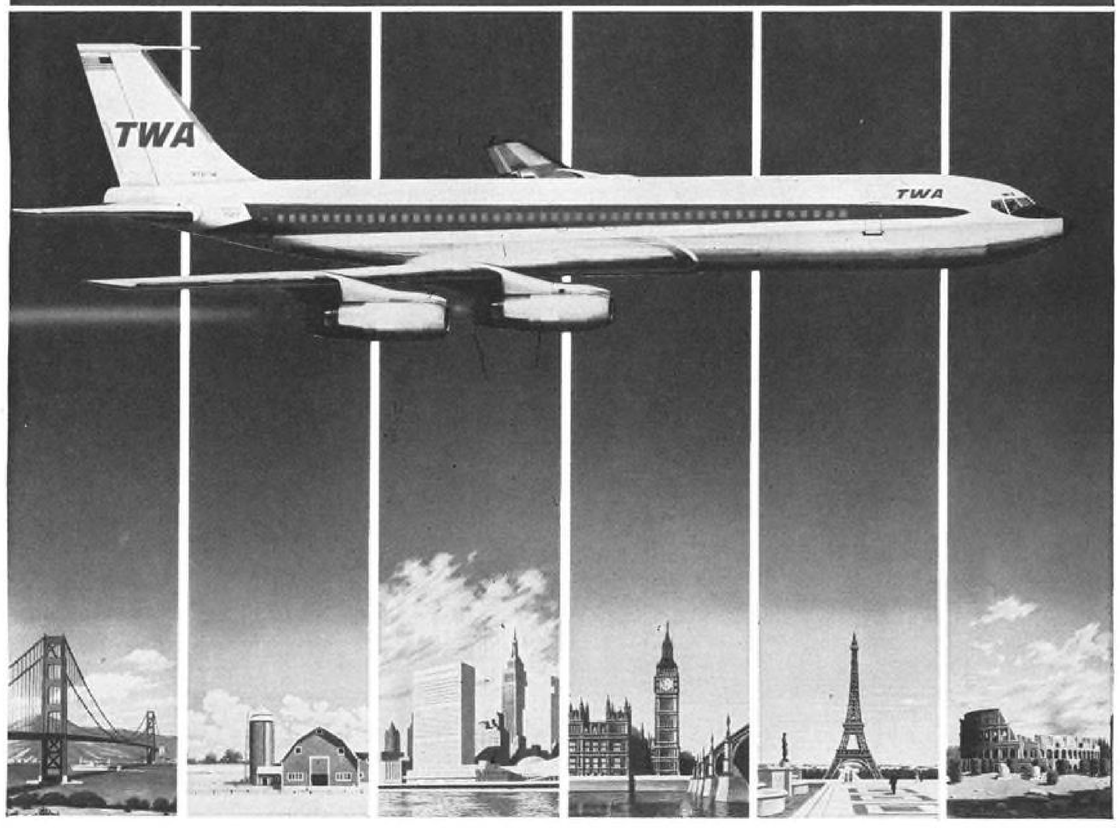

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weather and lack of aids for the runway.

Civil Aeronautics Board's report on the accident, however, found the probable cause to be attributable to crew error. The report did mention, as contributing factors, marginal weather in the approach area and sensory illusion resulting from visual reference ". . . to the few lights existing in the approach area."

The Port Authority and FAA last month jointly announced a decision to go ahead with a second ILS for Runway 4-22, installing the standard 3,000 ft. of lights and then the other landing aids.

Channel Substitute

According to the Port Authority, the timing of this decision depended on completion of an FAA-Port Authority study of possible alternatives to providing a substitute for the channel. These alternatives included leaving a 500-ft. gap in the line of approach lights to free the channel, or shortening the entire system to 1,000 ft. or so. The study ruled out these possibilities, the Port Authority said, and then it was decided to go ahead with the channel substitute method.

Announcement of the ILS plan was made under the names of FAA Administrator E. R. Quesada and Port Authority Chairman S. Sloan Colt.

Some FAA officials, however, told Aviation Week that the facts are the same as they have been for several years —i.e., that the FAA would never have approved anything but the standard configuration of 3,000 unbroken feet of approach lights. No studies were necessary, FAA sources said, to back the need for using the channel except routine surveys to determine location and the like. FAA, it was said, has been waiting for the Port Authority to clear the project.

Pilot Pressure Cited

Some sources have suggested that the Port Authority's decision to go ahead with the expensive project was triggered by pilot pressures, with the Electra accident serving as a catalyst.

It would be unfair to single out La Guardia as the only target of pilot criticism. Sayen, testifying before the Senate Aviation Subcommittee, lashed out at approach facilities "at a large number of our airline airports" (AW Feb. 8, p. 108). Last month ALPA councils in the Dallas-Ft. Worth area severely criticized approach and landing facilities at Love Field, Dallas (AW Mar. 28, p. 43).

La Guardia Airport actually is unlikely to get its second ILS for three to five years from now. That amount of time, in the Port Authority's estimate, will be required to complete plans, get them approved by New York City and the Corps of Engineers, and do the actual work. Pile clusters for 1,000 ft. of lights, however, will be installed by approximately November of this year, a period during which Runway 4-22 will be shut down in the rehabilitation program. FAA will then install the lights.

No ILS equipment will be installed until the full 3,000 ft. of lights is in operation.

The Port Authority has three alternatives to work with in substituting for the ship channel.

It could build a new channel, possibly by cutting straight through Rikers Island to provide access to the area northwest of the airport; deepen a shallower channel already in existence on the west side of the island, where rock bottom would add greatly to the cost; or provide some other means of moving the coal and oil, possibly pipelines or conveyors.

The present channel, which brings ships around the east side of the island for westerly passage past the north end of the airport, is about 30 ft. deep and 400 ft. wide in the area where the approach lights would intrude.

No estimate of the cost of providing a channel substitute, plus pile clusters for FAA to install the landing aids on, is available from the Port Authority. That agency initially will bear the expense, but will pass it along to the airlines according to its formula for landing fees and other charges. Unlike the airport rehabilitation project, which required airline approval and was under negotiation for a long time, the channel project requires only Port Authority high-level approval.

The Port Authority explained it to Aviation Week this way in referring to the channel project costs: "Those expenditures which a prudent airport operator would make for public aircraft facilities are reflected in the fees payable by the users. In such cases, prior airline concurrence, while desirable, is not required."

Some airlines told Aviation Week that the decision was news to them and required further study before comment.

Additional Improvement

Another proposed improvement to La Guardia Airport—and one that seemed to most industry sources an important one—was extension of Runway 4-22 by 1,000 ft. or so into the bay to provide at least 6,000 ft. of instrument runway. Various estimates placed the cost of such an extension at from $5 to $10 million.

However, the Port Authority and airlines have failed to agree on how the project would be paid for. Airlines reportedly split among themselves on whether the extension was worth the expense. Some thought the Port Authority's formula for recouping the investment was unfair to the airlines. In any case, some sources believe it is a false economy to spend $56 million on the rehabilitation, plus whatever the second ILS will cost, and to withhold the relatively small additional expense of the runway extension.

707s Flying Los Angeles-Paris

Los Angeles—Air France, French national airline, has begun the first jet service between Paris and Los Angeles with Boeing 707s, bringing the airline's total unduplicated routes to a figure of 204,500 mi.

Two flights per week in each direction now are scheduled between the two cities, and plans call for four flights per week each way next year.

Air France now has 17 of the Boeing Intercontinental jets on order, with 11 scheduled for delivery by September. Probability is that the airline will order more of the aircraft to augment its intercontinental service, which provides for 90 seats in the economy-class cabin and 32 seats in the first-class compartment, plus a "promenade bar" for out-of-seat cocktail service.

Interim stop initially is at Montreal for refueling. Los Angeles-Paris passengers will be allowed stopover privileges for a successive flight. The airline also will be permitted to embark passengers originating at Montreal for Paris. On the Paris-Los Angeles run, stopover will be allowed at Montreal, where the airline also will be allowed to disembark passengers. No passengers traveling only between Los Angeles and Montreal will be carried.

At Los Angeles, Trans World Airlines will perform turnaround maintenance for Air France. In Montreal, maintenance probably will be handled for the airline by the Bristol Aeroplane Co. of Canada, Ltd.

Estimate is that for Air France to perform its own maintenance at these locations, an initial investment of about $200,000 to $300,000 would be required for equipment.

In addition to its U. S.-France jet services from Los Angeles, Chicago and New York, and the only jet service from Paris to Anchorage and Tokyo, Air France operates Caravelle jets from Paris to 20 principal cities in Europe, Africa and the Middle East. Air France will soon introduce Caravelle service from Paris to Copenhagen, Stockholm, Warsaw and Moscow. By year-end, the airline will be serving by Caravelle 42 cities on its jet-to-jet routes.

GOES LONG
GOES STRONG
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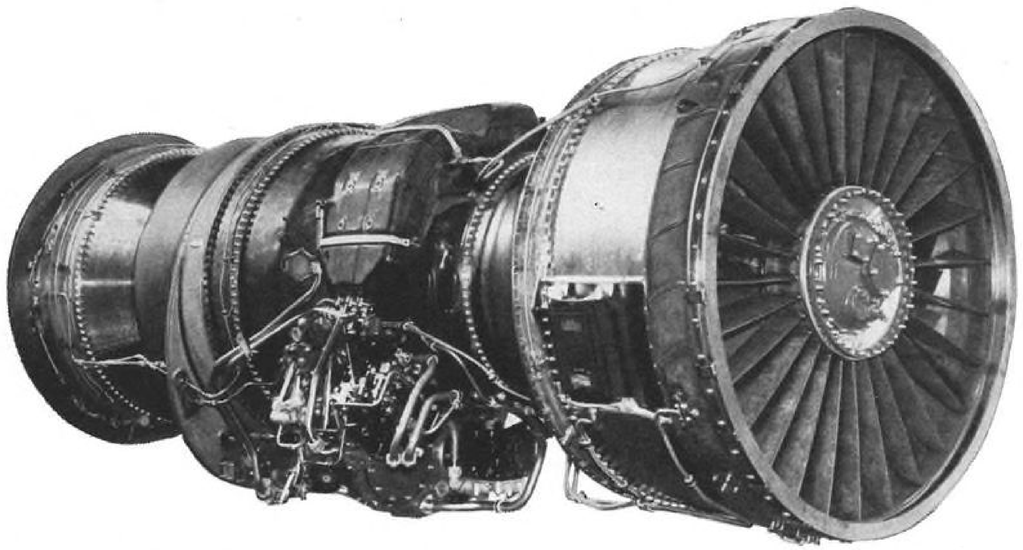

PRATT & WHITNEY AIRCRAFT'S NEW JT3D TURBOFAN ENGINE INHERITS THE EXTRAORDINARY RELIABILITY OF ITS PREDECESSOR, THE J-57 TURBOJET, PROVEN IN 6 MILLION HOURS OF FLIGHT. AT THE SAME TIME, IT SETS A NEW HIGH IN THRUST AND A NEW LOW IN FUEL CONSUMPTION.

The new JT3D turbofan has the same basic design as the JT3 (J-57) and JT4 (J-75) turbojets powering 9 out of 10 Boeing 707 and Douglas DC-8 jetliners and many military jet aircraft. Functionally, the difference is the addition of the fan and provision for a secondary flow of air. The reliability has not changed because the basic engine design has not changed. But the addition of the fan has effectively increased the thrust and decreased fuel consumption for greater operating efficiency. It is simply a case of the most reliable jet engine in its class getting even better.

By comparison with its predecessor, Pratt & Whitney Aircraft's new JT3D turbofan raises take-off thrust by 42%, boosts climb thrust by 23%, and pushes maximum cruise thrust up 13%—all this while cutting down cruise TSFC by 13%.

The JT3D, flying since July, 1959, has met or exceeded all performance guarantees and estimates and has successfully completed its 50-hour military test. Military prototype deliveries have been made. Military production deliveries start in June, commercial in July.

PRATT & WHITNEY AIRCRAFT
East Hartford, Connecticut
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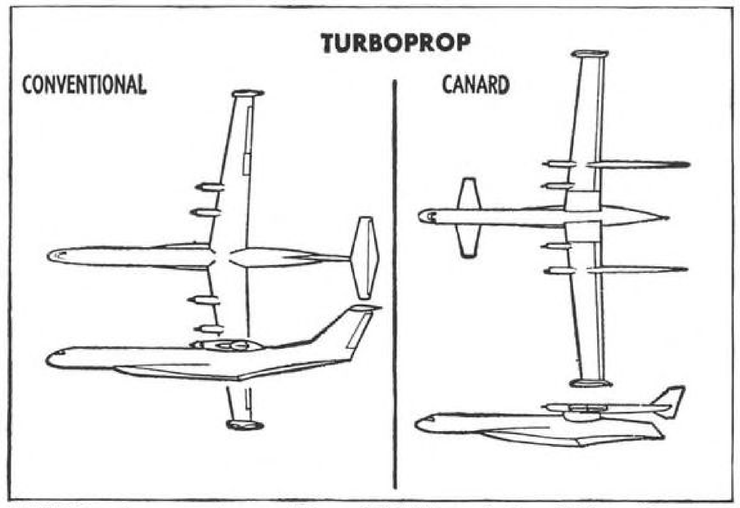
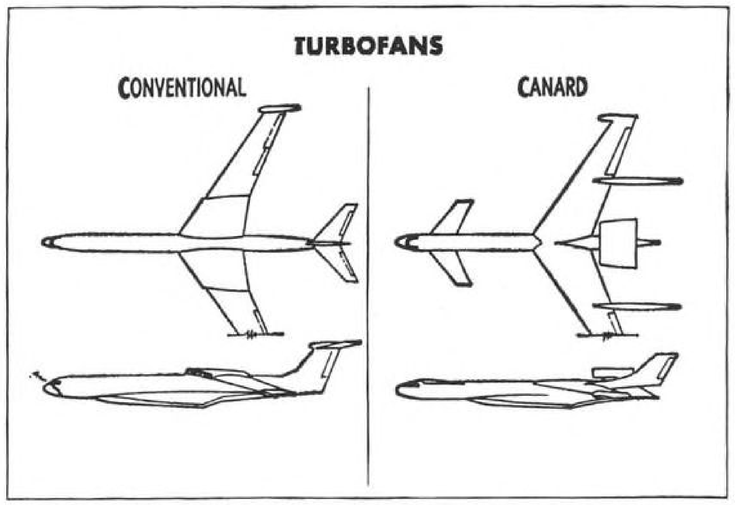
Nuclear-Powered Cargo Planes Proposed

New York—Nuclear-powered cargo aircraft can pay their own way in commercial competition if the payload is large enough and the routes attractive, according to J. F. Brady, an engineer for Convair Division of General Dynamics Corp.

Brady and other speakers at the recent Society of Automotive Engineers' National Aeronautic Meeting here—in what appeared to be an attempt to stimulate the aircraft nuclear propulsion program—discussed the technical and commercial feasibility of nuclear aircraft and generally agreed that further studies and investigations in this area were warranted. (See page 106 for other SAE National Aeronautic Meeting reports.)



NUCLEAR turboprop seaplanes would carry 100,000-lb. payloads at 360 kt. cruise.



NUCLEAR turbofan seaplanes would carry 100,000-lb. payloads at 500 kt. cruise.

Interesting Ideas

Other engineers at the meeting found many of the ideas offered by the speakers interesting but felt that it was still too early to attach much significance to the relatively sparse data now available on the subject of nuclear-powered aircraft.

Brady believes that data developed by U. S. Navy in its studies of nuclear-powered, military logistic aircraft are relevant and applicable to commercial cargo planes, since the former were low speed, low radiation type aircraft. It is this Navy data, modified for commercial application, that Brady uses as the basis for his present study.

Seaplane Design

The nuclear-powered cargo aircraft proposed by Brady would be about 300 ft. long, have a 300-ft. wingspan and would weigh about 1 million lb. including approximately 400,000 lb. in payload. To eliminate potential runway problems and hazards, it would be designed as a seaplane. Its primary advantage would be endurance. Its large payload capability is as much an essential requirement as it is an asset. Initially, at least, nuclear-powered airplanes will have to carry heavy reactors and shielding. Fuel consumption will be negligible, so weight will remain relatively constant. Thus, to ensure an economic payoff, payload will have to be large (for a favorable payload-to-gross weight ratio) and distances will have to be great.

Cost-per-ton-mile remains fixed for the nuclear-powered cargo aircraft regardless of range and will run from approximately three to eight cents per ton mile. Brady figures that 3,500 naut. mi. is the crossover point in range at which the nuclear-powered cargo plane begins to look more attractive than the chemically-fueled aircraft.

Among the assumptions on which Brady bases his estimates are the following:

- **Aircraft life will be 10 years;** aircraft utilization, 4,380 hr. per year.
- **Aircraft depreciation** will range from $33-$50/lb. of airframe weight (empty weight less engines, propellers, reactor and electronics).
- **Reactor depreciation,** exclusive of nuclear fuel costs, will be between $33-$50/lb.
- **Indirect costs are figured** as 50% and 75% of computed direct costs; and no development costs are assumed.
- **Aircraft is unit shielded** (that is, shielding is around reactor only), and the crew radiation dose is such as to allow 1,500 flight hours per year.
- **Cruise altitude** is 25,000 ft. and aircraft block speed is 350 kt.

For propulsion, Brady believes that the nuclear-powered turbofan and the nuclear-powered turboprop will both serve equally well from an economic standpoint. In the speed range considered, under Mach 1, the turbojet, he says, does not compete. For the same payload weight, the turbofan aircraft will weigh 100,000 lb. more than the turboprop aircraft in gross weight but its cruise speed will be approximately 500 kt. against 360 kt. for the turboprop and so will be able to make more trips in the same time.

But perhaps the most important factor in the actual choice of the power-

PRATT & WHITNEY AIRCRAFT APPROVED IT...

DOUGLAS AIRCRAFT APPROVED IT...

Texaco Synthetic Aircraft Turbine Oil

Another leading airline—United—has swung into domestic jet service. And Texaco Synthetic Aircraft Turbine Oil 15 is being used to lubricate the Pratt & Whitney Aircraft JT-3 and JT-4 engines on United's new DC-8 Jets.

Why Texaco? First, because every lubricant characteristic essential to jet service is found in Texaco Synthetic Aircraft Turbine Oil 15. Second, because Texaco refining skill and packaging and handling care assure that the SATO 15 is wholly uncontaminated and free from foreign matter. Third, because Texaco quality and aviation engineering service have kept Texaco overwhelmingly first choice in aircraft lubrication for the past quarter century.

Texaco Inc., *Aviation Sales Department,* 135 East 42nd Street, New York 17, N. Y.

Texaco Synthetic Aircraft Turbine Oil 15 has been approved for: Pratt and Whitney Aircraft JT-3 and JT-4 engines used in Boeing 707s, 720s and Douglas DC-8s.

TUNE IN: Texaco Huntley-Brinkley Report, Mon. Through Fri.-NBC-TV

TEXACO
LUBRICANTS
AND FUELS

FOR PURE JET, TURBO-PROP AND PISTON-ENGINE AIRCRAFT

plant, as Brady points out, will be the decision of the military in this field. The nuclear aircraft powerplant which the military decides to build will decide the type of powerplant that will be used in a commercial cargo aircraft. It won't necessarily be used as is, he said, but at best only minor modifications can be tolerated.

Supporting Conclusions

Additional support for many of Brady's conclusions was provided at the meeting by Douglas Aircraft engineers D. P. Lalor and W. C. Schmill. Using data from a Douglas study on the choice of an engine for a nuclear-powered, multi-purpose aircraft (sized primarily for logistic missions), Lalor and Schmill reached the following conclusions:

- **Maximum productivity** (payload times speed divided by takeoff gross weight minus payload) is obtained with the nuclear-powered turboprop aircraft flying at Mach 0.6.
- **Both turboprop and turbofan** engines develop much more thrust per pound of engine airflow during takeoff than the turbojet and so would be subject to fewer runway restrictions.
- **Dose rate in an aircraft** with a unit-shielded reactor would allow crew utilization of 30 hr. per week.
- **On a relative scale** on which the productivity of the nuclear turboprop is rated at 1.0, the turbofan and the turbojet are rated respectively at approximately .95 and .85 and both reach their peak productivity at Mach 0.8.
- **On a productivity-per-megawatt** (of reactor power) basis, the turboprop has approximately twice the maximum productivity of the turbofan and four times the maximum productivity of the turbojet aircraft.
- **Increases in cruise altitude** for nuclear aircraft result in serious decreases in productivity—as much as 25%, for example, when the altitude is increased from 25,000 ft. to 35,000 ft. For a multi-purpose nuclear aircraft, Lalor and Schmill said, altitudes of 20,000 ft. to 25,000 ft. are an acceptable compromise between maximum productivity and the ability to stay above most of the weather for flight safety.

Goodyear Proposal

From Goodyear Aircraft's Leo Jurich came a proposal to use nuclear power to propel an airborne early warning or anti-submarine warfare type of airship. The airship, he said, has certain unique characteristics that can be used to advantage with nuclear propulsion, namely, low power requirements and large potential separation distances between crew and reactor.

The specific vehicle considered by Jurich would have an airship displacement volume of 4.5 million cu. ft. and an operational altitude of 10,000 ft. Cruise requirements would run from 30 to 50 kt. and open Brayton cycle turboprop engines would be used for power conversion. Assuming an over-all efficiency of 15% for the conversion of reactor heat to shaft horsepower, Jurich figured reactor powers of only 6 to 7 megawatts would be sufficient. Reactors this small, which would be unit shielded, also would provide a comparative weight saving in the required shielding.

Reactions to these nuclear propulsion proposals were mixed. Some engineers favored them; others felt that the ideas were still too far in the future at this time to even merit serious consideration. As one scientist from General Electric's aircraft nuclear propulsion project explained, the primary problem right now is just getting a nuclear engine into an airplane and making it work, and it may take another five years just to do this. After this, he added, the system must still be refined to the point where it might be made feasible for commercial applications.

Right now, there is no real demand for a commercial nuclear-powered aircraft, either for cargo or personnel transport, a Lockheed engineer pointed out.

Industry must look first to military use, he said; and what effort is currently under way here is mostly on engine development.

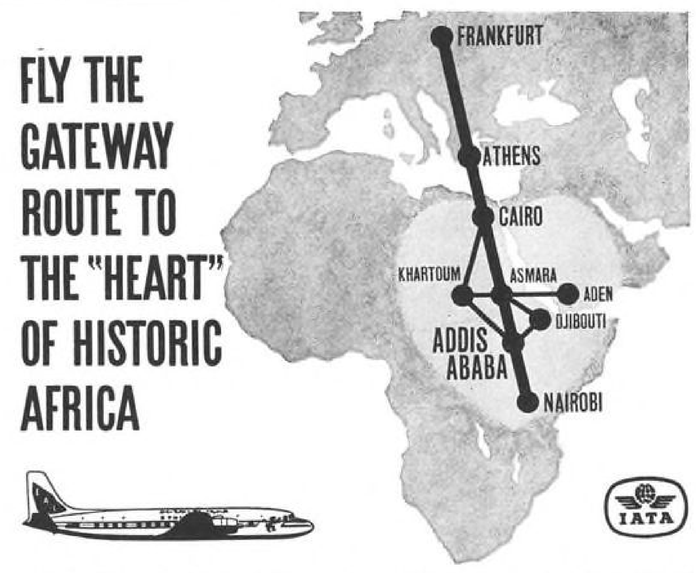
Engaged rather heavily at one time in the development of a nuclear aircraft, Lockheed has cut back its effort in this area. At this point, said the Lockheed spokesman, engine development is the governing factor in the over-all nuclear aircraft program. Six to nine months after the engine becomes available, it can be airborne (assuming that the go-ahead on airframe development was given about 36 months before). Taking other factors into account, it was felt that five years from now would actually represent an optimistic minimum time for getting a prototype nuclear aircraft into the air.

Commercial Applications

From this point, as far as commercial applications are concerned, it will be another year before any meaningful data is developed. It will be even longer before a fix on maintenance requirements is obtained or sufficient data is available for establishing insurance rates.

The Lockheed engineer noted it would be interesting to find out how technicians would handle, say, a situation in which the aircraft—already on the runway and with reactor running—developed a flat tire.

FLY THE GATEWAY ROUTE TO THE "HEART" OF HISTORIC AFRICA



Fly the route of history via Ethiopian Airlines! See Cairo . . . the Red Sea . . . and Ethiopia, Land of the Queen of Sheba. Africa offers today's *greatest business potential, newest travel adventure.* Fly overnight in luxurious DC-6B's from Frankfurt (now 3 flights weekly) to Greece, Egypt, Sudan, Ethiopia and Kenya. Incomparable service.

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ETHIOPIAN AIRLINES
THE WONDERLAND ROUTE

Airline Income and Expenses—Year 1959

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Federal Subsidy	Total Operating Revenues	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	332,367,210	7,640,756	3,803,485	21,753,263	.....	370,935,635	346,417,570	31,907,829
Braniff	60,112,699	1,734,932	751,880	2,220,949	.....	66,223,773	60,840,176	5,349,120
Capital	101,785,121	2,281,862	1,329,473	1,481,683	.....	108,488,656	108,237,776	−1,757,425
Continental	42,828,402	679,206	304,475	789,587	.....	45,983,531	42,130,389	2,895,306
Delta	94,828,528	2,011,870	1,184,922	3,969,708	.....	104,098,282	98,690,192	5,409,090
Eastern	254,041,169	4,668,738	2,270,089	4,516,157	.....	271,921,543	259,932,518	9,379,125
National	61,069,698	1,210,689	359,345	1,946,119	.....	67,101,443	67,552,693	−912,160
Northeast	29,595,435	469,097	221,811	528,478	.....	31,450,234	37,158,149	−7,061,984
Northwest	76,183,847	2,402,630	1,180,564	4,491,996	.....	85,915,098	81,953,499	4,500,583
Trans World	251,438,501	5,934,307	3,172,880	7,332,456	.....	273,571,135	247,261,238	26,094,441
United	273,373,621	10,323,958	4,137,731	16,799,467	.....	314,049,471	295,246,605	23,913,377
Western	55,012,510	1,216,384	440,691	1,197,362	.....	58,869,837	47,953,083	10,380,100
INTERNATIONAL								
American	5,750,343	43,803	2,249	567,229	.....	6,765,987	6,875,511	−107,687
Braniff	6,843,935	153,753	.....	491,077	.....	8,034,457	8,216,163	−265,239
Caribbean Atlantic	2,720,896	31,435	.....	96,172	.....	2,983,218	2,482,738	−499,406
Delta	4,717,271	54,368	.....	131,885	.....	5,108,853	5,389,382	−310,675
Western	24,337,151	357,398	.....	409,235	.....	26,406,486	22,907,072	2,790,240
Mackey	1,794,970	.....	3,890	27,343	.....	1,873,784	1,723,523	153,800
National	3,429,902	39,840	24,976	131,948	.....	3,758,280	3,975,670	−217,615
Northwest	24,457,309	7,771,331	57,161	4,801,679	.....	38,822,539	33,602,252	4,959,241
Pan American Combined	273,579,685	19,374,381	.....	36,744,700	.....	354,980,390	339,851,792	14,240,418
Alaska	3,287,200	191,963	.....	434,471	.....	4,056,198	5,400,199	−1,340,081
Atlantic	130,840,341	9,045,544	.....	12,725,634	.....	161,471,390	144,002,080	18,072,091
Latin America	75,507,229	2,428,035	.....	13,773,581	.....	98,129,026	104,638,270	−6,146,101
Pacific	63,944,915	7,708,839	.....	9,811,014	.....	91,323,776	85,766,825	6,049,582
Panagra	14,025,242	557,796	.....	2,104,483	.....	18,612,429	19,406,608	−1,172,135
Resort	26,338	.....	.....	5,605,476[2]	.....	5,652,566	5,007,613	327,471
Trans Caribbean	3,836,614	.....	.....	585,446	.....	4,811,145	4,890,779	3,117,530
Trans World	50,199,664	6,141,961	.....	3,857,722	.....	74,685,390	82,500,781	−7,915,614
United	14,999,359	582,685	8,804	283,634	.....	16,106,280	13,079,954	2,880,917
Western	4,181,253	44,312	.....	48,920	.....	4,384,134	4,170,289	136,556
LOCAL SERVICE								
Allegheny	7,039,190	142,108	123,544	230,029	3,831,068	11,473,756	11,381,306	16,264
Bonanza	3,814,884	43,503	22,026	60,393	2,428,851	6,528,673	6,358,017	46,266
Central	2,261,393	90,857	25,258	91,202	2,745,412	5,319,151	5,409,084	−101,281
Frontier	5,318,671	153,402	115,045	38,356	6,019,146	12,165,033	11,735,216	255,637
Lake Central[1]	.....	.....	.....	.....	.....	.....	.....	.....
Mohawk	8,256,574	107,335	104,316	164,976	1,974,810	10,867,767	10,653,412	−13,552
North Central	11,388,135	315,429	216,725	116,667	5,846,705	18,339,891	18,162,572	−140,252
Ozark	6,794,425	143,422	103,367	220,018	3,024,752	10,437,472	10,429,443	−46,330
Pacific	5,914,854	134,919	55,049	46,588	2,366,588	9,232,660	8,996,396	99,839
Piedmont[3]	7,367,429	116,345	78,997	108,951	3,076,006	11,207,252	11,773,751	−723,572
Southern	3,247,748	105,179	53,147	100,852	2,525,815	6,138,405	6,085,321	31,896
Trans-Texas	4,438,880	144,083	55,439	181,733	2,927,155	7,967,160	7,638,138	284,303
West Coast	4,603,789	69,039	25,143	76,433	3,629,982	8,507,533	9,064,171	−815,093
HAWAIIAN LINES								
Aloha	3,524,975	21,528	.....	67,505	.....	3,733,681	3,551,990	98,687
Hawaiian	5,951,173	39,854	.....	764,686	168,200	7,865,538	7,718,543	7,250
CARGO LINES								
AAXICO	.....	15,842	28,838	8,045,423[2]	.....	8,258,210	7,059,622	1,450,874
Aerovias Sud Americana	.....	.....	.....	1,304,635	.....	1,536,994	1,532,937	−33,452
Flying Tiger	.....	194,448	219,917	29,022,722[2]	.....	29,352,313	28,438,457	539,136
Riddle	.....	37,110	107,636	7,368,575[2]	.....	7,658,990	9,193,626	−1,147,023
Seaboard & Western[1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	9,221,890[2]	.....	9,667,246	8,658,933	687,889
HELICOPTER LINES								
Chicago Helicopter	1,207,096	37,115	.....	.....	1,749,611	3,008,250	2,504,583	485,139
Los Angeles Airways	245,813	141,049	105,722	.....	922,926	1,422,860	1,343,978	87,418
New York Airways	856,982	48,883	26,176	39,314	2,242,355	3,329,337	3,262,283	40,945
ALASKA LINES								
Alaska Airlines[1]	.....	.....	.....	.....	.....	.....	.....	.....
Alaska Coastal	962,310	112,638	.....	93,222	755,293	2,033,856	2,044,898	−28,714
Cordova	147,645	118,498	.....	75,246	448,044	1,190,763	1,162,133	26,855
Ellis	643,947	61,715	.....	69,949	422,924	1,281,551	1,189,607	87,991
Northern Consolidated	853,017	494,749	.....	367,921	916,440	2,950,129	2,890,740	28,604
Pacific Northern[1]	.....	.....	.....	.....	.....	.....	.....	.....
Reeve Aleutian[1]	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	1,127,384	590,109	.....	335,683	1,069,004	4,662,293	4,905,448	−383,971

[1] Not available [2] Freight and charter due to large portion of income being charter [3] Airline Division only

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

Varig Boeing 707-420 Makes First Flight

Maiden flight of Varig Airlines' first Boeing 707-420 (AW Mar. 14, p. 45) is made from Renton Airport, near Seattle, Wash. The Brazilian airline has ordered two 707-420s with Rolls-Royce Conway turbojets and will fly the New York-Rio de Janeiro route in June.

Russia Launches Campaign to Fill Growing Aeroflot Cargo Capacity

Moscow—Soviet Union has launched a nation-wide drive for more air mail, parcel post and perishables to help fill the sharply-increased cargo capacity provided by Aeroflot's fast-growing fleet of turbine-powered transports.

Success of the Soviet carrier's campaign for more post office business appears assured by recent government action cutting air mail letter rates by 40%—from one ruble to 60 kopeks. The latter is equal to 15 cents at the official rate of exchange, or six cents at the more realistic tourist rate of conversion.

Starting in January, air parcel post tariffs also were cut to half the rate of ordinary air cargo. It now costs the same to send a package 2,600 mi. from Moscow to Irkutsk in central Siberia by plane as it costs by train.

Aeroflot officials expect their total air mail load to more than double in 1960 alone. To implement the campaign for more mail by air, they are publicizing the fact that "workers can send a letter at almost the same speed as a telegram from Moscow to Sverdlovsk, Leningrad, Novosibirsk and a number of other cities."

An important part of the air mail load will consist of daily papers published in Moscow and other Soviet republic capitals. Aeroflot has set a goal of delivering metropolitan newspapers to most main regional centers and large population points, including those several thousand miles away in eastern Siberia, on the day they are published.

Specially-designed mail and cargo containers will be introduced "on a mass scale as quickly as possible" to facilitate mechanized loading and unloading. The containers, tried out initially in the Ukraine, are said to offer "great promise" for increased efficiency.

New cut-rate contracts have been signed with a number of economic regions, departments and industrial plants to increase the amount of fruit, vegetables, berries and "valuable items" moved by air. Large cold storage warehouses are to be built at Adler, Tbilisi and Krasnodar airports to facilitate shipment of perishables from southern growing areas to Moscow, Leningrad and other northern industrial centers.

The Russian airline concedes that it failed to make full use of payload capacity on its jet and turboprop aircraft during 1959. On the Moscow-Khabarovsk run alone, twin-jet Tu-104As could have handled an additional 15 metric tons of mail and cargo daily.

"By the most modest estimates," Aeroflot laments, "loading these planes to capacity would have provided the government with an additional 12-15 million rubles income annually. And that's not counting the favorable results which could ensue by fast delivery of mail and cargo to industrial establishments, construction projects and private citizens."

Cargo capacity of new, four-turboprop Il-18s and An-10s now entering Aeroflot's scheduled services in large numbers exceeds that of Tu-104s and Tu-104As. The even-larger Tu-114 scheduled to begin regular passenger flights this spring can handle over 35,000 lb. of cargo in its two lower deck holds.

Passenger Squeeze

Moscow—Aeroflot, Soviet state-owned airline, is continuing its efforts to cram more passengers into obsolete transports in order to boost plane mile revenues.

Latest move in this direction is the introduction of a 13-passenger version of the An-2 single-engine biplane which usually accommodates 10 passengers. Plans for 14-to-15 passenger An-2s also are being studied.

Late last year, Aeroflot flying personnel complained that boosting the maximum gross weight of twin-engine Li-2 (Russian version of the DC-3) above 23,593 lb. created safety problems. Aeroflot also is engaged in an extensive program of converting 18 and 24-passenger Il-14s and Il-12s to 32-seat configurations.

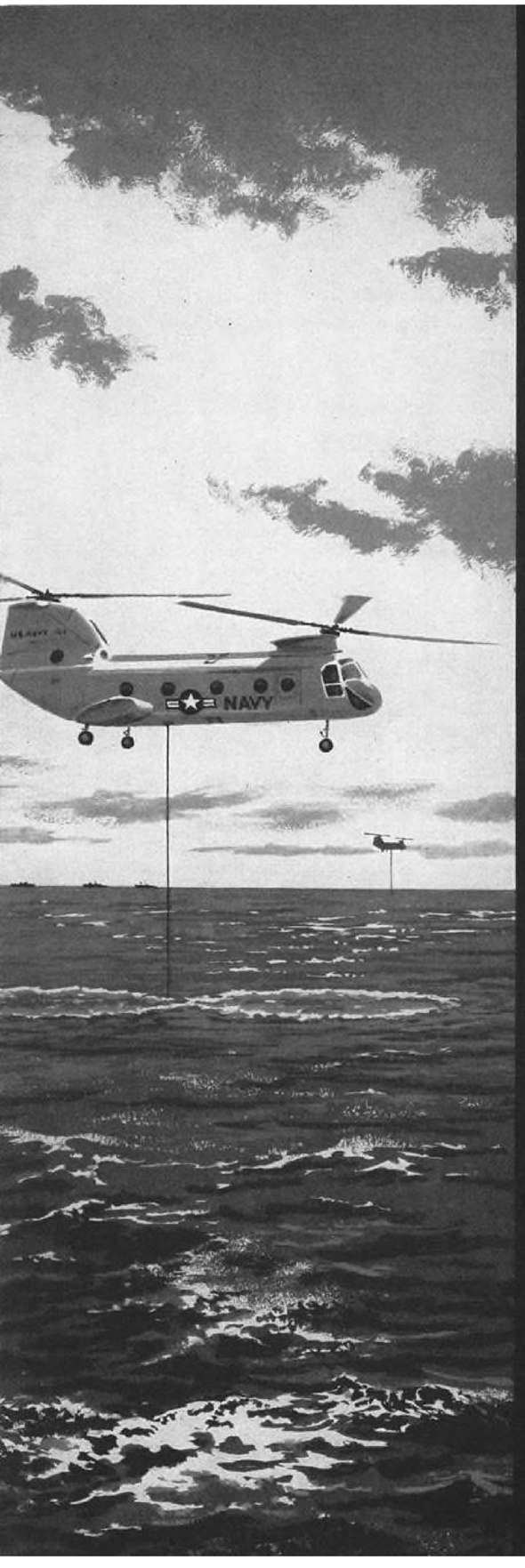
Cargo Conversions Of DC-7 Total 24

Los Angeles—Douglas Aircraft Co. will convert eight additional DC-7 series airliners to all-cargo carriers under three new contracts totaling over $2,300,000.

The contracts increase to 24 the number of DC-7 cargo conversions thus far scheduled or redelivered to airline customers. American Airlines has ordered five more of its DC-7Bs converted in addition to the 10 now being modified. KLM has signed for the changeover of two DC-7Cs, the first of this series to be converted by Douglas. A single DC-7B will be refitted for Pan American-Grace Airways.

Basic factory conversion consists of:

- **Removing all passenger facilities.**
- **Installing large cargo doors** and jambs.
- **Replacing the entire floor,** floor beam structure with new, heavier structure.
- **Removing windows.**
- **Installing glass fiber-laminate** lining on the inside fuselage walls.



NEW "QUICK PUNCH" FOR MARINE ASSAULT MISSIONS

The twin-turbine powered YHC-1A is the perfect partner-in-mobility to today's fast-striking Marine Corps units. This swift, multi-mission aircraft can be launched from a carrier, fly to the battle area and set down on virtually any terrain — including rivers and streams. Its unique rear-loading ramp and unobstructed payload compartment permit men and equipment to be loaded and unloaded in minimum time. Tactical loads can be transported internally which permits concealment of mission objectives and offers personnel and equipment protection from weather. Carried externally, pre-packaged loads can be hooked to the cargo sling by a crewman inside the cabin and precisely dropped by the flick of a switch on the pilot's stick.

Equally adaptable to Marine and/or Navy operations, this all-weather helicopter can perform missions ranging from ASW and mine-sweeping to ship-to-ship transfer. This adaptability, together with all-around superior performance, make the YHC-1A the most advanced helicopter in the air . . . a logical transport for the fighting Marines.

VERTOL DIVISION BOEING
MORTON PENNSYLVANIA

AIRLINE OBSERVER

► Trunkline common stocks began to show some slight strength last week following a long period of heavy selling which set new 1960 lows for a majority of airline listings. During the early part of last week, several trunklines showed strong gains in the face of a declining market.

► Japan Air Lines is considering the purchase of Sud Caravelle turbojet transports and a cargo version of the Douglas DC-8.

► Watch for Federal Aviation Agency to propose a ruling that would limit to 8 hr. the flight deck duty for two-pilot crews on piston engine aircraft of U.S. international carriers. Under the proposed ruling, three-pilot crews could be scheduled for a maximum of 16 hr. on-duty time including 12 hr. aloft. Purpose of the ruling is to hold actual flight time duty to a maximum of 8 hr. per pilot rather than the 12 hr. period now authorized.

► United Air Lines will install a proximity warning indicator adapter for airborne weather radar on one of its regular line aircraft in the near future to obtain operational experience with the device. Recent tests by United indicate that the small adapter developed by Radio Corp. of America may enable airborne weather radar to detect other aircraft in the forward region and automatically alert the pilot (AW Apr. 11, p. 40). Adapter is expected to sell for about $5,000 in quantities.

► Russia is improving its frequently-criticized weather reporting system for foreign air carriers operating into the USSR. First teleprinter service to exchange meteorological and aerological data has been installed between Moscow and Delhi as a direct aid to both Air India International and Aeroflot, state-owned Russian airline.

► Hawaiian Airlines will undertake a financing program involving up to $49 million if it is awarded the transpacific routes it has requested from the Civil Aeronautics Board. Equity financing calling for a $9.5 million to $13.5 million stock issue will be included in the program.

► Eastern Air Lines has equipped its Douglas DC-8B turbojet transports with "flying stockrooms" located in forward cargo compartment to backstop terminal stockrooms for en route maintenance. Total of 240 parts valued at $110,000—including generators, pumps, washers and lamps for passenger cabin—are stored in the stockroom measuring 4 ft. deep, 3 ft. wide and 8¼ ft. high.

► Federal Aviation Agency has contracted with Raytheon Co. for the purchase of eight ARSR-2 long-range radars at a cost of $5.9 million. ARSR-2s will be equipped with an improved high-gain antenna system, improved moving target indicator system and a more efficient receiving system for the radar echo signal than that incorporated in the ARSR-1 radar now in operation. Transmitter power is approximately eight times that of the ARSR-1. Program is now under way to increase power of the ARSR-1s to same power as ARSR-2s.

► Airline traffic, which fell off sharply in many major markets during March, appears to have made a strong recovery during the opening weeks of April. Although the late upward swing is generally attributed to a surge of Easter holiday traffic, most observers feel that last year's rising traffic trend has been restored now that the threat of bad weather is diminishing. Poor showing in March has been laid to weather and the impact of accidents.

► Five additional megacycles of radio frequencies have been allocated to the Federal Aviation Agency for air traffic control communications. New frequencies, from 126.825 to 128.825 mc. and 132.025 to 135.0 mc., will be effective July 1 and will add 100 channels to the air traffic control system. Additional megacycles enabled FAA to develop a frequency deployment plane which will relieve congestion and interference on very high radio frequencies.

SHORTLINES

► **Allegheny Airlines** inaugurated a new service into the New England area last week with flights from Washington to Baltimore, Bridgeport and Boston on a three round-trip-per-day basis, with one of the three stopping at New Haven. The local service carrier last week also began three daily round trips between Pittsburgh, Philadelphia, Providence and Boston. Convair 440 aircraft are being used on all flights until Allegheny's fleet of Convair 540 turboprop aircraft are ready for service.

► **Bonanza Air Lines** reports that it flew almost 145,000 passengers with its fleet of six Fairchild F-27 turboprop transports during their year of operations. Bonanza says the F-27s now carry approximately 85% of the passengers flown over its routes.

► **Irish International Airlines** flew 22,000 passengers over its transatlantic routes during the fiscal year ending Mar. 31, an increase of almost 50% of the total for the first 11 months of the previous fiscal year. The Irish airline also reports that it carried over 195,000 passengers on its European routes in Fokker F-27 Friendship turboprop aircraft during the year. Officials hope to place the airline's three Boeing 707-048 (720) turbojet transports in service on transatlantic routes before Christmas.

► **Pan American World Airways** has received Air Force and Civil Aeronautics Board permission to use Ladd AFB, Alaska, in the operation of its Boeing 707-321 turbojet service between Seattle and Fairbanks.

► **United Air Lines** has signed contracts with all 16 major league baseball clubs to travel aboard chartered United aircraft. Eight of the teams will use United service exclusively. The Milwaukee Braves, Cincinnati Reds and Chicago White Sox have made arrangements to fly to the West Coast in chartered first-class sections of United's Douglas DC-8 turbojet airliners on regularly scheduled flights. Teams will travel 277,492 mi.—12,487,140 revenue passenger mi.—on 444 chartered flights.

► **Western Air Lines,** Sabena Belgian World Airlines and Boeing Airplane Co. have ordered Waste King Corp. flight data recorders, bringing to nine the number of firms that have ordered the system. The recorders report and preserve operational flight information for study and engineering analysis and are designed to provide early warning of possible malfunctions. Total orders to date are worth $1.7 million.

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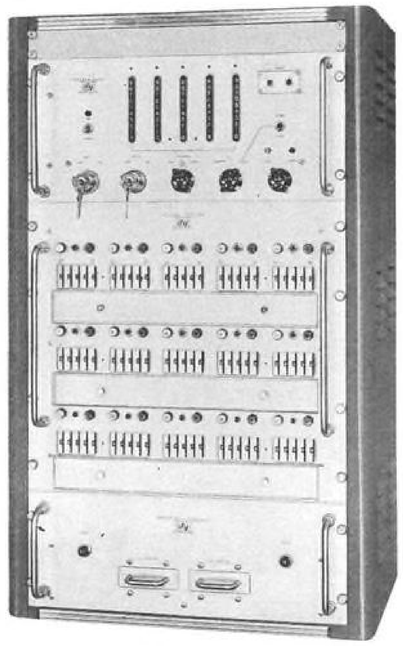

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The DY-5175 consists basically of a 5-decade preset counter with digital comparators, and 15 channel control circuits. At time-zero, the counter begins counting a crystal-controlled reference signal; when the count reaches the 5-digit number representing program elapsed time for each channel, the comparator initiates operation of that channel. Control functions can be started or stopped at any predetermined time setting. Signal lights indicate operation of the channel circuits and the output control relays. A built-in Safe/Armed test circuit permits making a "dry-run" prior to an actual countdown operation.

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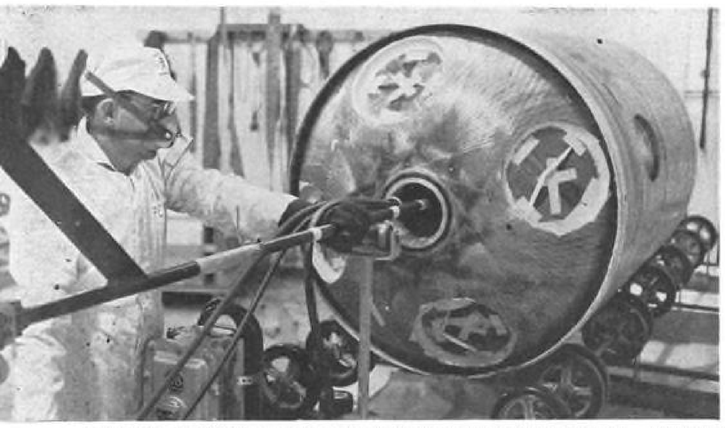
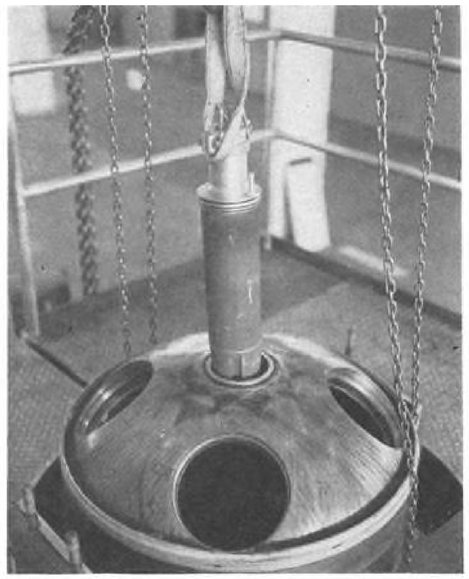
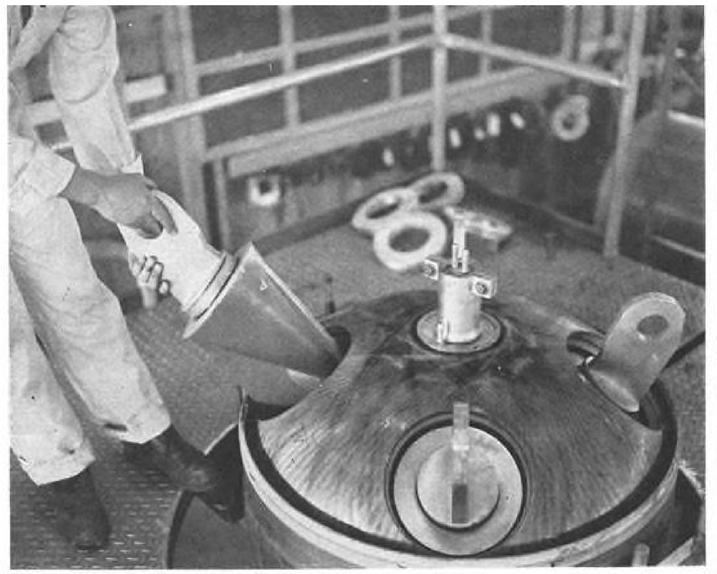




ROCKET CASING is coated and rotated to ensure uniform interior. Center core is inserted first and assembled, followed by wing cores.



WING CORES are inserted in four nozzle openings. With core assembly in place, skirts and harness attached, case is ready for casting.

Hercules Increases Motor Test Facilities for Minuteman

By Michael Yaffee

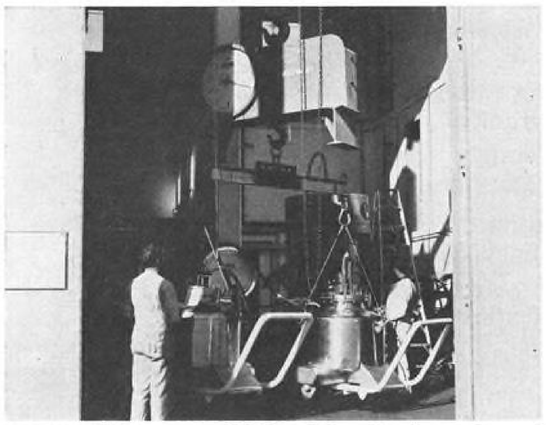
Magna, Utah—Hercules Powder Co. has strengthened its bid to produce the third stage motor of the Minuteman intercontinental ballistic missile, with completion last week of two additional 1-million-lb.-thrust static test stands at its new Chemical Propulsion Division facility here.

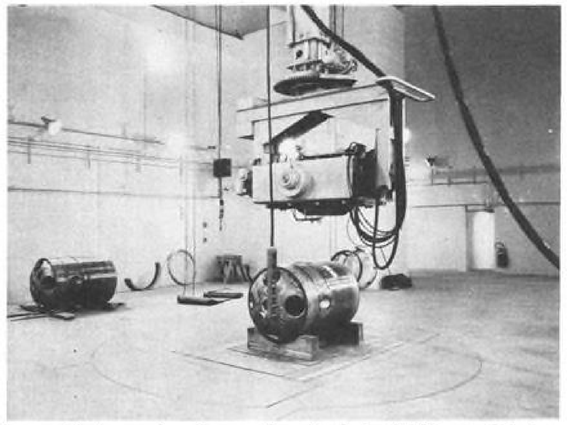
At present, Hercules and Aerojet-General both hold development contracts on the Minuteman third stage motor, and Air Force is expected to decide on the production contractor by late summer or early fall. Meanwhile, the new test stands, able to accommodate large solid propellant rocket engines in both horizontal and vertical firings, complete the current construction program at Hercules' wholly owned solid propellant complex here and will play an important part in its drive for major roles in future missile programs.

Designed for R&D

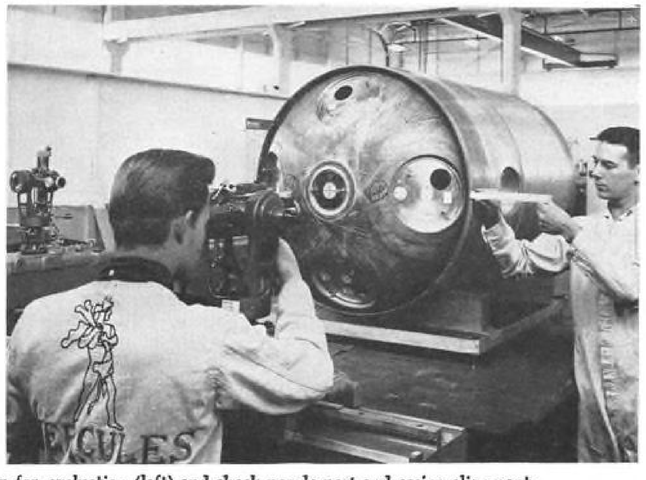
Set up in 1958 next to the company's old Bacchus (Utah) dynamite line, the solid propellant works is designed primarily for research and development of large rocket engines. Here the company carries out research, development, production and evaluation of its advanced double-base propellants. Nozzles from outside contractors and filament-wound plastic rocket casings from Hercules' Young Development Division in N. J. are evaluated, sometimes along with new propellant formulations, in the static firing of different Minuteman third stage motor test configurations.

Other complete solid propellant rocket engines such as Hercules' ABL-248, used in the Pioneer V and other

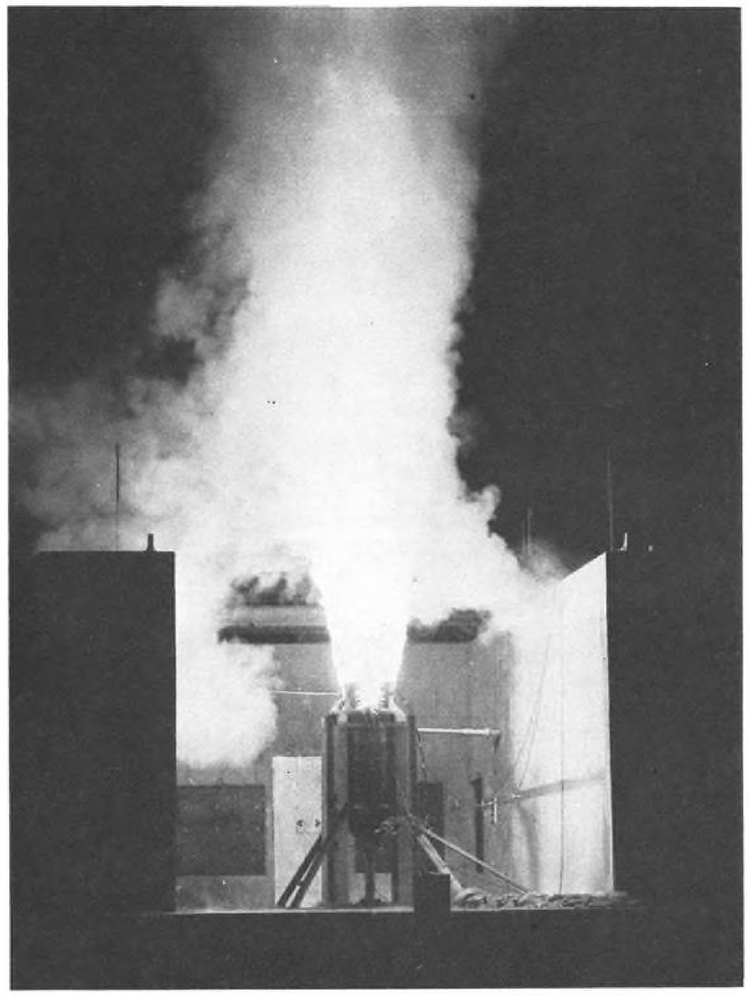




SOLVENT MIX is pressure-fed through hoses into base grain powder in case. Casings and motors are then checked with 25 mev. betatron.



HERCULES TECHNICIANS carefully examine nozzles sent in for evaluation (left) and check nozzle port and casing alignment.



PAYOFF for all the development work, production and quality control effort comes in the static thrust stand where solid propellant rocket motors are fired.

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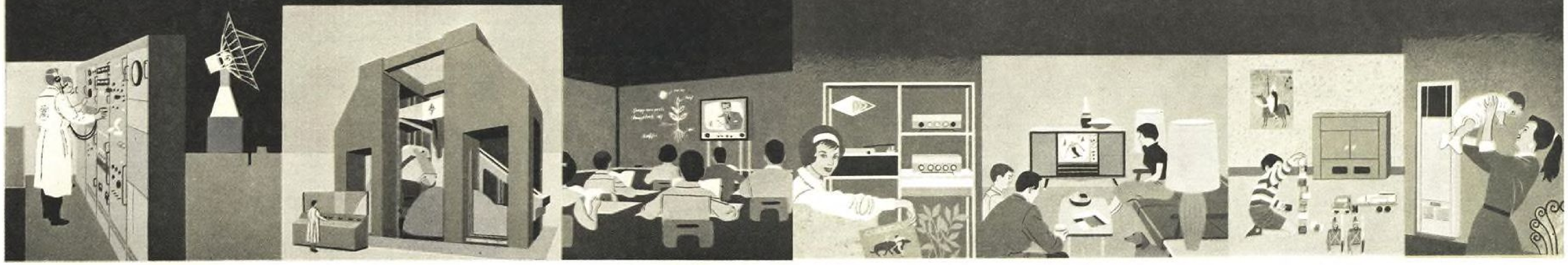

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space probes, also are static fired.

At this point, the company is unable to say much about actual Minuteman third stage research and development work under way here. It is known that the company has successfully fired full scale, third stage test motors and that Hercules scientists and engineers are still evaluating nozzles and insulation materials.

As one of the first two Minuteman stages (AW Apr. 4, p. 23), the four nozzles on the final configuration of the third stage are expected to be movable and possibly will be made of plastic with metal inserts. The need for better case insulation, according to one propellant expert, is due to the higher impulse and, hence, higher combustion temperature of the advanced double base propellants and not to the use of reinforced plastic cases.

Hercules has successfully bonded its propellants to the filament-wound plastic cases and does not anticipate any trouble in storage of its new double base propellants. Problems of thrust termination and core configuration are believed to have been satisfactorily solved.

As far as propellant performance goes, Hercules chemists feel that they already have come close to the limits attainable with high energy binders and are concentrating their work on the development of hotter additives which they believe hold greater promise at this point for improving over-all performance.

Although research and development is the primary activity here at this time, the Magna complex was designed for the ultimate production of large solid propellant rocket engines. In all, Hercules' plant here employs 695 persons and occupies 2,500 acres. Of the total acreage, approximately 314 are allocated to administration and dynamite manufacturing, 40 to housing and 96 to solid propellant facilities. From the remaining 2,050 acres, Hercules has tentatively allocated 654 to future solid propellant manufacturing facilities and 1,020 to storage.

High Energy Propellants

Principal production activity here at present is the manufacturing of high energy, cast double base rocket propellants.

More of a hybrid than a true double base (AW June 23, 1958, p. 47), these advanced propellants are sometimes termed composite modified double base propellants. They are, in effect, composite propellants with high energy, double base binders that reportedly give them a specific impulse 7-8 sec. above that of a conventional composite propellant.

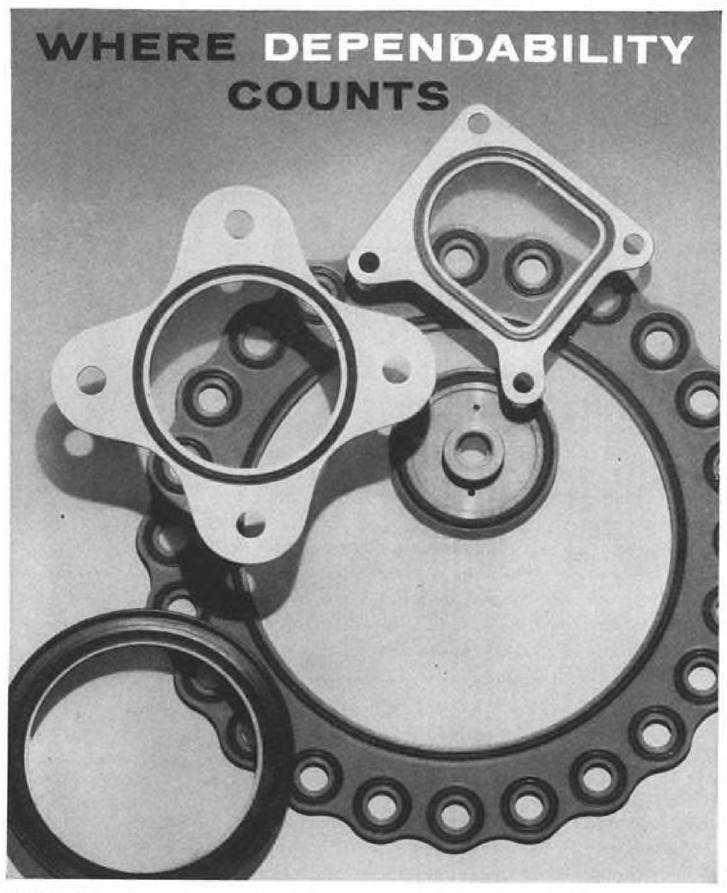
The new double base propellants are somewhat temperature sensitive, (that is, their burning rate and performance are affected by ambient or storage temperature) but this also is believed to be the case with some of the advanced, composite rocket propellants. For missiles such as the Minuteman and Polaris, which will be fired from protected or environment-controlled launch sites, this is not considered a significant problem.

Principal ingredients of Hercules' new composite modified double base solid rocket propellants are base-grain powder, nitroglycerin, triacetin and 2-nitrodiphenylamine. The base-grain powder consists of two explosive bases, nitrocellulose and nitroglycerin; stabilizers such as 2-nitrodiphenylamine and diethyldiphenylurea; graphite; powdered metal (probably aluminum) burning rate modifiers, and an ammonium perchlorate oxidizer.

It is made at Hercules' Kenvil, N. J., plant and at the company-operated Radford Arsenal and shipped to Utah. At present, the nitroglycerin, which the company takes from its adjacent Bacchus dynamite line, is the only thing made at the Utah plant. Sometime in the future, Hercules may make the casings and other motor ingredients here.

Basic steps in the cast double-base process, now in operation here, by which Hercules takes propellant constituents and hardware and turns them into finished solid propellant rocket motors are as follows:

- **Case preparation.** After the rocket cases arrive at the Magna plant, they are inspected and cleaned. Then, while rotating around their horizontal axes, they are sprayed with an epoxy resin and coated internally with a nitrocellulose or cellulose acetate bonding agent.
- **Mold assembly.** Mold sets—consisting of cores, base plates, top plates, handling harnesses, mold loading fixture and casting assemblies—are assembled in and around the cases. To ensure that the final propellant will be within specified web tolerances, technicians carefully inspect the final assembly.
- **Loading.** In one method—forced air loading—the base-grain powder is blown into the case through a series of tubes or concentric rings. Either before it is loaded or after, the powder is evacuated to remove moisture and to create a partial vacuum in the interstitial area of the base grain which will increase the rate of gelation after casting.
- **Solvent preparation and evacuation.** While the case is being prepared and loaded with base-grain powder, triacetin (a plasticizer) and 2-nitrodiphenylamine (a stabilizer), are mixed under heat in an aluminum kettle. The mixture is weighed into a clean stainless steel desiccator and transferred to the nitroglycerin storehouse where a measured amount of nitroglycerin is added. The mix is moved to the solvent evacuation building, sampled, and put under vacuum to remove all traces of water.
- **Casting.** In the operating building, the solvent is transferred through a hose and under pressure to the case with the base-grain powder. When casting is completed—as indicated by a continuous flow of solvent out of an opening in the opposite end of the case—the motor is transferred to a curing bay.
- **Curing.** Temperatures in the curing building are generally maintained somewhere between 100F and 140F. The motor is kept here until the propellant turns from a liquid-solid system into a completely solid grain. This may take from one to 30 days.
- **Disassembly and machining.** From the curing bay, the motor moves to the rocket machining building where the mold set is removed and the motor machined to its final configuration.
- **Inspection.** The motor is given a final control check. Among other things, this may mean undergoing ultrasonic scanning and X-raying to detect foreign objects and possible faults in the grain. In its non-destructive test building, Hercules has a 25-million-electron-volts betatron for inspecting large rockets and



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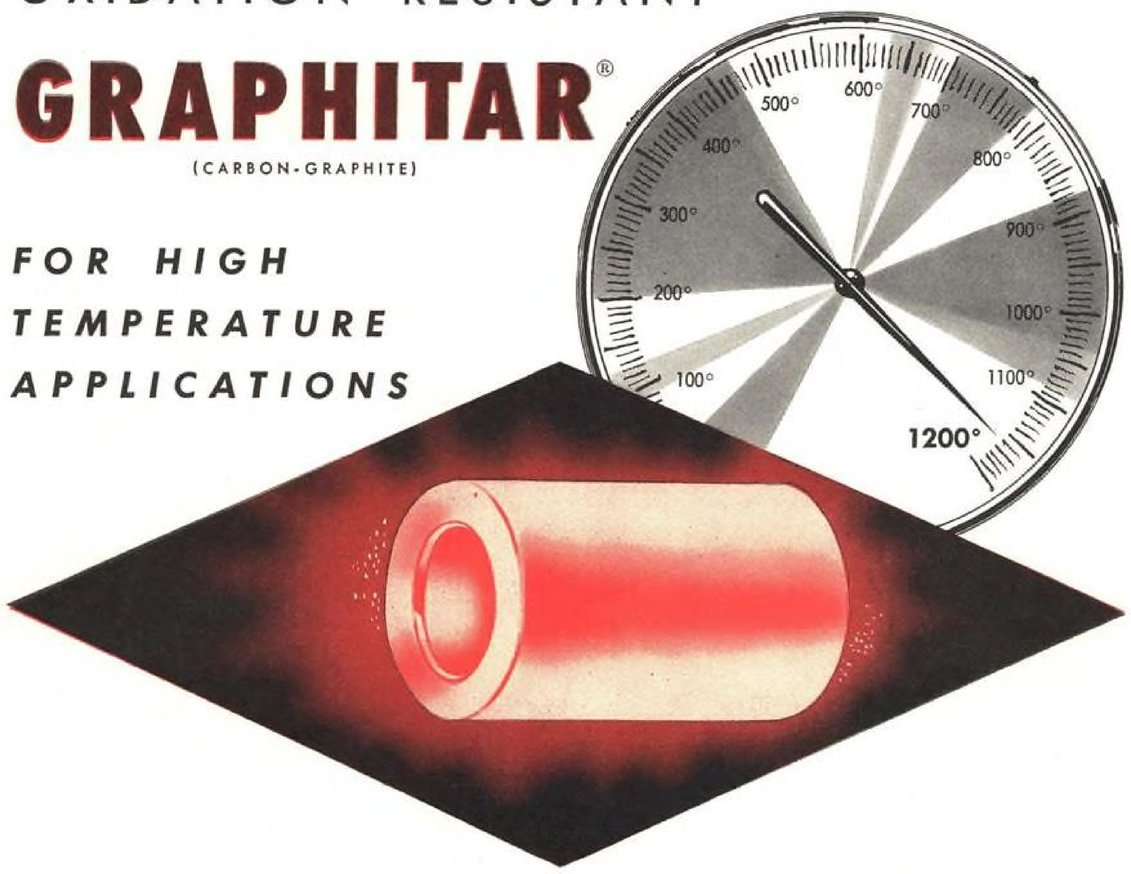

Culminating five years of intensive research, engineers of The United States Graphite Company have developed a new oxidation resistant GRAPHITAR. In exhaustive tests, GRAPHITAR parts were exposed in an oxidizing atmosphere (air) at 1200 degrees F and after 200 hours, the GRAPHITAR showed a weight loss of less than six percent!

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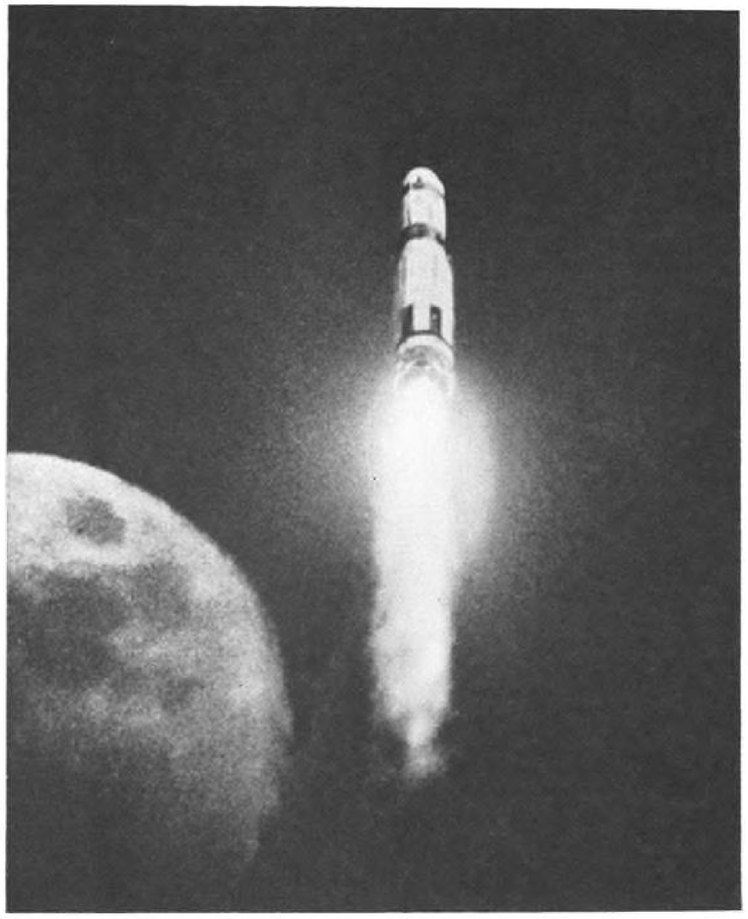

Titan ICBM Appears to Pass Moon

Air Force-Martin Titan intercontinental ballistic missile appears to be passing the moon in this photo, made from a tracking sequence during a recent firing. As camera panned upward, following the missile, it caught the moon in the background.

a 300-kilovolt X-ray machine for testing small rockets and components. Small test motors made from the same propellant as the large engines also may be sent to the igniter and sample machining building where sample specimens are cut off and prepared for further control and laboratory testing of their chemical and physical properties.

• **Rocket assembly.** If the motor comes through its final inspection satisfactorily, it then is moved to the rocket assembly building. Here, nozzles, igniters, safe and arm mechanisms, and all other required hardware are added. The unit is checked for roll moment and center of gravity. Then it is either crated and shipped to the user or transferred to a Hercules test bay where it is static-fired.

Hercules already has static-fired some full scale Minuteman third stage test engines at Magna. Company says only that it is "pleased with the results."

J69's Afterburner Burns Pyrophoric Fuel

Pyrophoric-fueled afterburner developed for Continental's J69 jet engine used in Ryan's Firebee target drone is designed to give the Mach .85 engine supersonic, high-altitude capability.

Afterburner system, developed by Continental Aviation and Sperry Gyroscope, has passed engine qualification endurance testing and awaits a contract from the military to go into production.

Unusual feature of the afterburner is its short length. Designed to replace the tail cone now used on the J69, the short afterburner requires no alteration in airframe design. To keep the afterburner short and simple, Continental engineers designed the unit to use fast burning, pyrophoric fuels such as triethyl aluminum (AW May 25, p. 85).

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THE ASTROTUG

Tugboat for Space: Spaceborne scientific laboratories and platforms for further exploration into space are an accepted concept based on established engineering techniques. Components would be fired as individual units into space, on precalculated orbits, and there assembled. To solve the major problems of how men are to live and work in space during the assembly process, Lockheed has prepared a detailed engineering design of an astrotug—a manned vehicle housing a crew of two or three. Missile-launched, the astrotug will be capable of supporting its crew for a number of days in an environment of suitable atmosphere, artificial gravity, and with provisions for exercise, relaxation, bathing facilities, medical care, illumination and adequate food and water.

The Lockheed astrotug is a completely independent working vehicle. Personnel need not leave it in space suits in order to work on the project of assembling the space station components. As shown in the diagram, the tug consists of two double-walled pressure vessels approximately 20 feet long overall and 9 feet in inside diameter. Swivelling rocket nozzles are arranged for maneuvering. On the forward end, extending out are four mechanical manipulator arms with interchangeable "hands" for such specialized functions as gripping, welding, hammering, cutting, running screws, etc. "Hands" can be changed by remote control from inside. Viewing ports provide uninterrupted observation. Radar antennas, searchlights, and other equipment necessary to the tug's work are mounted externally. Main controls and instruments including radar, radio, infrared, computers and navigation consoles are duplicated in each of the two major compartments as a safety measure.

Men working in single units afloat in space suits would have little applicable force and could work for very limited periods of time. With the Lockheed astrotug, personnel could carry on the work in relative safety and comfort with maximum efficiency. A special reentry vehicle, separate from the astrotug, has been conceived for ferrying to and from earth. Tugs themselves would remain floating in orbit indefinitely, being reprovisioned and refurbished as fresh crews arrive in relief.

Space vehicle development is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology—from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics; computer research and development; electromagnetic wave propagation and radiation; electronics; the flight sciences; human engineering; magnetohydrodynamics; man in space; materials and processes; applied mathematics; oceanography; operations research and analysis; ionic, nuclear and plasma propulsion and exotic fuels; sonics; space communications; space medicine; space navigation; and space physics.

Engineers and Scientists: Such programs reach far into the future and deal with unknown and stimulating environments. It is a rewarding future with a company that has an outstanding record of progress and achievement. If you are experienced in any of the above areas, or in related work, we invite your inquiry. Please write: Research and Development Staff, Dept. D-17, 962 W. El Camino Real, Sunnyvale California. U.S. citizenship or existing Department of Defense clearance required.

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Multi-Mission B-58 Proposal Detailed

Washington—Unusually rapid improvement in the aeronautical state-of-the-art during the past few years is aiding the Air Force in its efforts to obtain more versatile aircraft.

The unexpected spurt in aeronautical knowledge over the last half of the 1950s, which was discussed in detail by the National Aeronautics and Space Administration in its second semiannual report to Congress (AW Mar. 28, p. 29), prompted USAF Chief of Staff Gen. Thomas D. White to discuss the possibility of development of an acceptable multi-mission aircraft for two or more of his three major commands —strategic, tactical and air defense.

Three B-58 Versions

Specific example of the use one manufacturer has made of new technical developments to meet the multi-mission goal is the Convair B-58. Three new versions of the B-58 have been proposed to the Air Force, each of them tailored for the mission of one of the major commands.

Physically, there is little difference between these new design proposals and the B-58A now flying with the Strategic Air Command, but all of them are designed for greater range than the B-58A and to fly continuously above Mach 2, a speed which the subsonic cruise B-58A can fly for only a short time.

Proposals for all-supersonic versions of the B-58 include the B-58C as an advanced SAC bomber, the B-58D as a long-range interceptor and a substitute for the now-canceled North American Aviation Mach 3 F-108 for the Air Defense Command and the B-58E as a Tactical Air Command bomber.

Substantial cost savings could be realized if all three commands operated the same basic aircraft, cutting down the number of aircraft types maintained by the Air Force. Production costs would be decreased through larger numbers of aircraft produced, and spares costs would come down through reduction of the numbers of parts in the inventory.

Flight test data from the B-58A and development progress in the last three years or so have shown that a significant performance improvement can be obtained simply through the use of Pratt & Whitney J58 engines and replacement and redesign of approximately the first foot of the wing chord.

The four General Electric J79 engines on the B-58A each supply about 18,000 lb. thrust with afterburner; the J58 powerplant produces approximately 30,000 lb. thrust with afterburner.

The all-supersonic B-58 series also includes a Mach 2.4, 52-passenger transport using the B-58C wing and vertical tail with a large fuselage and horizontal tail (see picture on p. 65).

Convair believes that this transport could make its first flight two and one-half years after detailed design was begun and that it could be certified less than a year and a half after that. Gross weight of this aircraft would be 190,000 lb., or slightly heavier than the B-58A.

It would have a range of 2,525 naut. mi. with fuel reserve. It could operate from 9,500-ft. runways and has an estimated direct operating cost of 2.2 cents per seat mile.

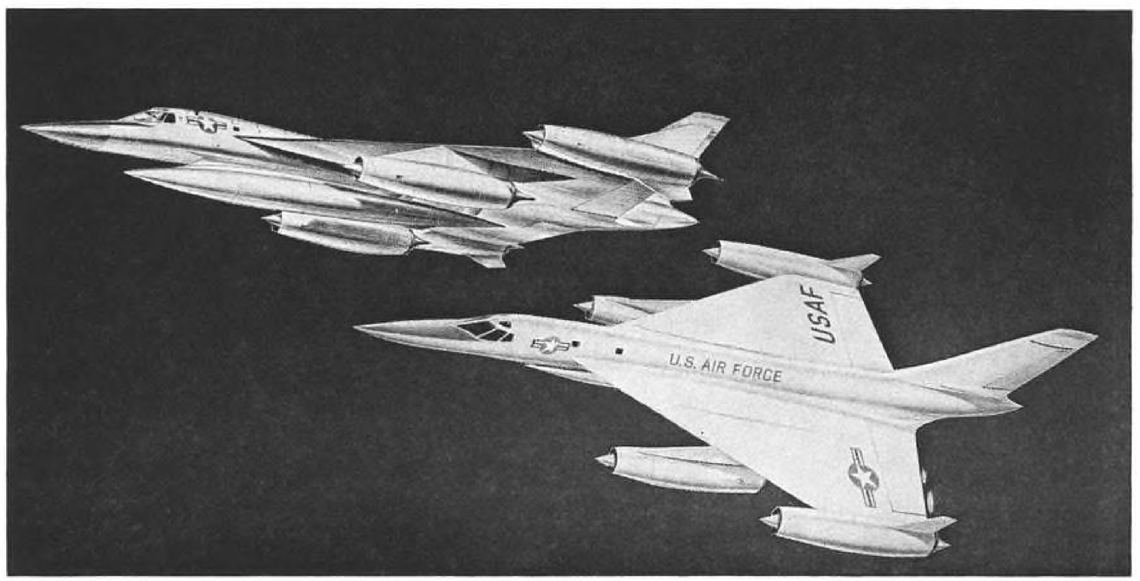
Cruise Speed

Cruise speed of Mach 2.4 was determined to be the highest that could be maintained in continuous service with the construction materials of the B-58 wing. Convair tests totaling more than 3,000 hr. on the B-58 structure at elevated temperatures plus state-of-the-art research from all sources were the basis for setting the Mach 2.4 limiting speed. Although the B-58 uses a large amount of steel honeycomb, it is still considered to be an aluminum aircraft so far as aerodynamic heating.

Convair sales efforts for this aircraft to U.S. military and civil aviation authorities, who are convinced of an impending national prestige and commercial crisis in this area, have stressed that the promise of certification within the next four years is about the best hope the U.S. could have for becoming the first nation to operate supersonic transports.

Soviets are generally reported to have been working on a Mach 2 transport for the past two years.

Cost of the Convair transport is estimated at $10-$15 million, depending upon the quantity purchased.



CONVAIR B-58C, above, an improved version of the B-58A strategic bomber, will cruise constantly above Mach 2. The B-58A cruises around Mach 0.9 with short-time dash capability above Mach 2. Four Pratt & Whitney J58 engines with plug nozzles power the B-58C.

TRANSPORT VERSION of the B-58 has been proposed to military services and the airlines by Convair. Aircraft would cruise at Mach 2.4 and carry 52 passengers.

Flight Efficiency

Improved flight efficiency of the all-supersonic B-58 series stems primarily from the fact that these aircraft are designed strictly for flight around the Mach 2.4 regime and no compromises have been made in an effort to provide good subsonic cruise performance at Mach 0.9 as was done on the B-58A. The B-58A configuration was fixed early in the 1950s when engine and airframe technologies were being stretched to provide high subsonic cruise over long distances with a half an hour or so of Mach 2-plus dash from the Soviet early warning line to major targets.

To meet this requirement at the time, it was necessary to initiate a new engine design simultaneously with the B-58 airframe rather than mate it with an engine that was far enough along in its development cycle to be a known quantity. This engine, the General Electric J79, met its design specifications and was able to operate effectively at both subsonic and supersonic speeds, but its performance, like that of the B-58A airframe, was necessarily compromised and could not be the optimum at either speed range.

Converting the basic B-58 aircraft to the completely supersonic mission through engine and wing changes was accomplished as follows:

• **Engine.** The J58 is one of the first turbojet engines in the U.S. designed for continuous supersonic operation. It has a low compressor compression ratio in contrast to the J79, which needed a comparatively high pressure rise compressor for good fuel consumption at Mach 0.9.

Specific Fuel Consumption

Specific fuel consumption of the J58 without afterburner at Mach 2 is in the neighborhood of 1.35 lb. of fuel per lb. of thrust per hour. This figure for the J79, which required afterburner operation to push the B-58 at Mach 2, is around 2.3 lb./lb. of thrust/hr. at that speed. This major improvement in specific fuel consumption is largely responsible for the long range of the improved B-58 models at supersonic cruise.

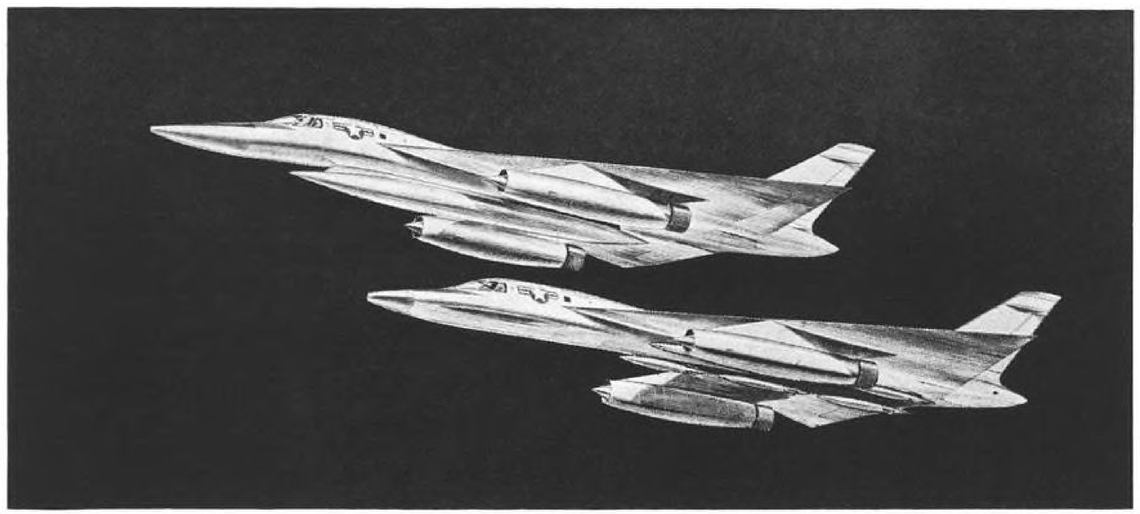
Fuel consumption figures for the J58 are fairly solid at this point since the complete engine has been under test for about two years.

• **Wing.** Leading edge of the B-58A wing has a large conical camber which starts at the wing root and becomes progressively more pronounced toward the wing tip. The primary benefit of conical camber is to reduce drag at high subsonic Mach numbers.

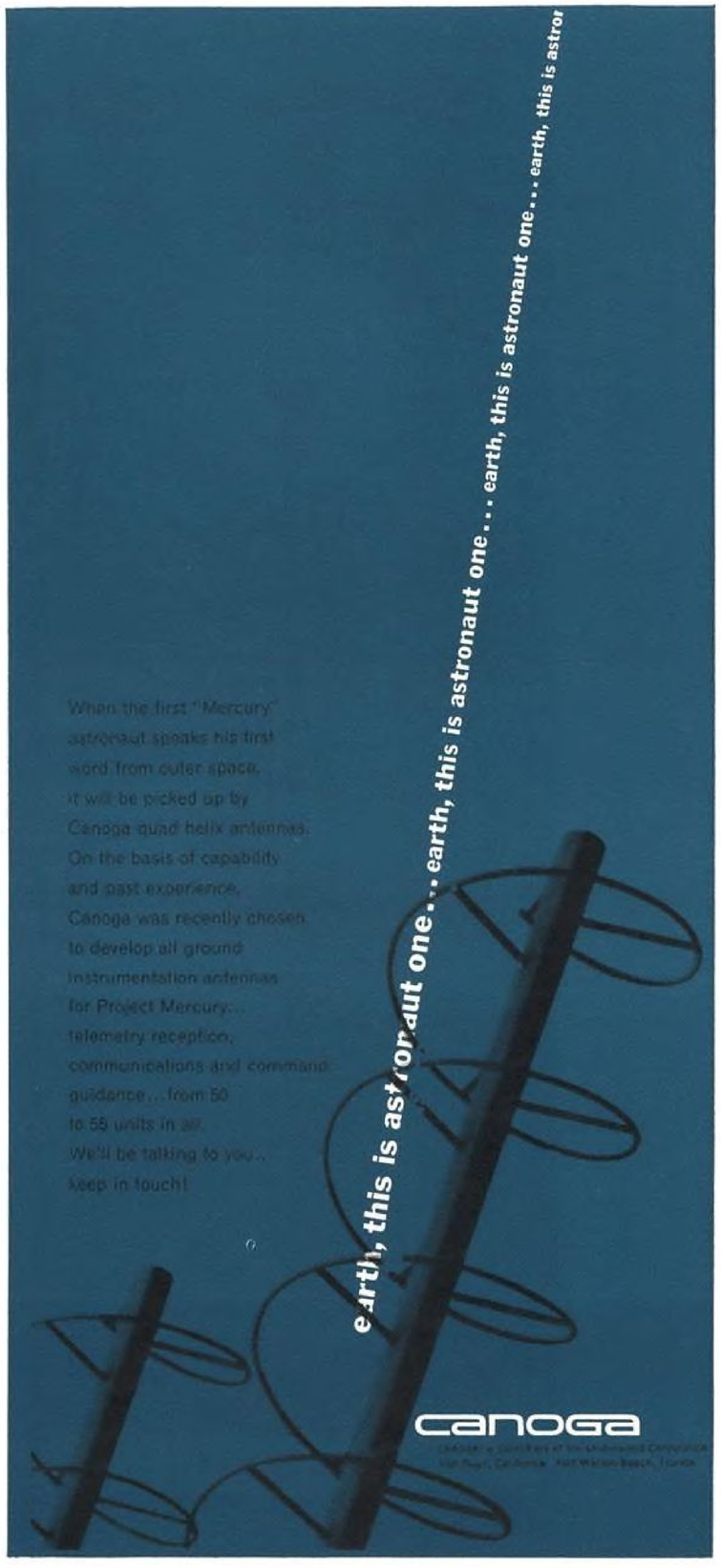
On the all-supersonic B-58 models, conical camber has been abandoned, and a sharp, straight leading edge designed for approximately Mach 2.4 has been substituted. Change resulted in about a 50% increase in supersonic lift-drag ratio from a value of about three to four for the B-58A to almost six with the new models.

Pod Engine Mountings

Relatively simple structural changes in the original B-58 to achieve the all-supersonic performance can be attributed largely to its pod-type engine mountings that can easily accept larger



LONG-RANGE INTERCEPTOR, B-58D (top) has been proposed for Air Defense Command. This aircraft and the B-58E (bottom) tactical bomber are powered by two Pratt & Whitney J58 engines with afterburner and they cruise constantly above Mach 2.



diameter engines. Another of the original design features that is paying off in mission versatility today is the concept of carrying all weapons externally in a large belly pod that is area-ruled into the airframe design. This eliminates the problem of providing internal storage in bomb bays, etc., for weapons and equipment over a wide size range.

Wind tunnel tests have been run on each of the new versions of the B-58, and this data is included in the proposals to the Air Force on the aircraft. All of them are limited in top speed by skin temperature, although they have an excess of available power.

Multi-Mission Proposals

Purpose and general capability of each of the new B-58s which have been proposed are:

• **Strategic bomber, B-58C.** This aircraft would be equipped with four non-afterburning J58 engines that would provide more power than the four J79 engines with afterburners on the B-58A. It would have a range of more than 5,500 naut. mi. when refueling from an accompanying Boeing KC-135 tanker. This would be suitable for many SAC missions that call for aircraft of this range capability to leave their U. S. bases, strike almost any target in the Eastern Hemisphere and make one landing for refueling in friendly territory before returning to the Western Hemisphere. Speed of the B-58C during its entire mission would be around Mach 2.4, the same speed as the transport B-58, and its operating altitude would be above 70,000 ft. Gross weight of the original B-58 was approximately 160,000 lb., and it was sized specifically so that one in-flight refueling from a large tanker could completely fill its tanks. A margin was left in the design, however, so that the fuel capacity of the aircraft could grow, and an ideal single in-flight refueling would still fill its tanks. The B-58C gross weight is around 200,000 lb. and uses up this margin.

• **Long range interceptor, B-58D.** Proposals call for this aircraft to be powered by two J58 engines with afterburner. Its gross weight would be substantially lower than that of bomber versions of the aircraft. Primary reason for this is to raise the load factor so that the structure can withstand more than the approximately 3g it was designed to take as a bomber. The acceleration loading that the structure can withstand increases as the gross weight is reduced.

Weight of the B-58D has been reduced to a point to bring this capability much nearer to the 7g of average fighter aircraft. The B-58D would use the Hughes fire-control system developed for the F-108 (AW Apr. 4, p. 30). The system is still under development by the Air Force as a state-of-the-art project. It would use up as many as six GAR-9 missiles, the number originally intended for the F-108. These missiles in combination with the F-108 fire control system reduce much of the requirement for an interceptor to make high acceleration maneuvers. The B-58D would operate above 70,000 ft. and from this altitude, the GAR-9 is designed to hit a target at levels from 100,000 ft. to sea level. The aircraft's operational radius is estimated at more than 1,000 naut. mi.

• **Tactical bomber, B-58E.** Two J58 engines with afterburners would power this aircraft, which has been proposed to TAC. It would have the ferry range to make Europe nonstop, carrying enough equipment to support itself through two missions, and it could fly to Indochina at Mach 2.4 with only one refueling. Foot print pressure of the B-58E would be about the same as that of a C-54 transport, and it could take off in approximately 3,000 ft. However, it could not meet the TAC requirement for long range at sea level at Mach 1.2. The B-58E could make the required range at Mach 0.9, but its redline dynamic pressure would be exceeded at Mach 1.2 on the deck.

Earlier Proposal

A B-58B model was under development for some time by the Air Force, as was a new version of the J79—the J79-9 powerplant.

Gross weight of the B-58B had been increased by about 20,000 lb. over the B-58A and it was to have carried more sophisticated navigation equipment to permit all-weather flight at sea level.

An equal trade-off in range between high altitude Mach 2 flight and sea level operation at Mach 0.9 was a feature of early models of the B-58.

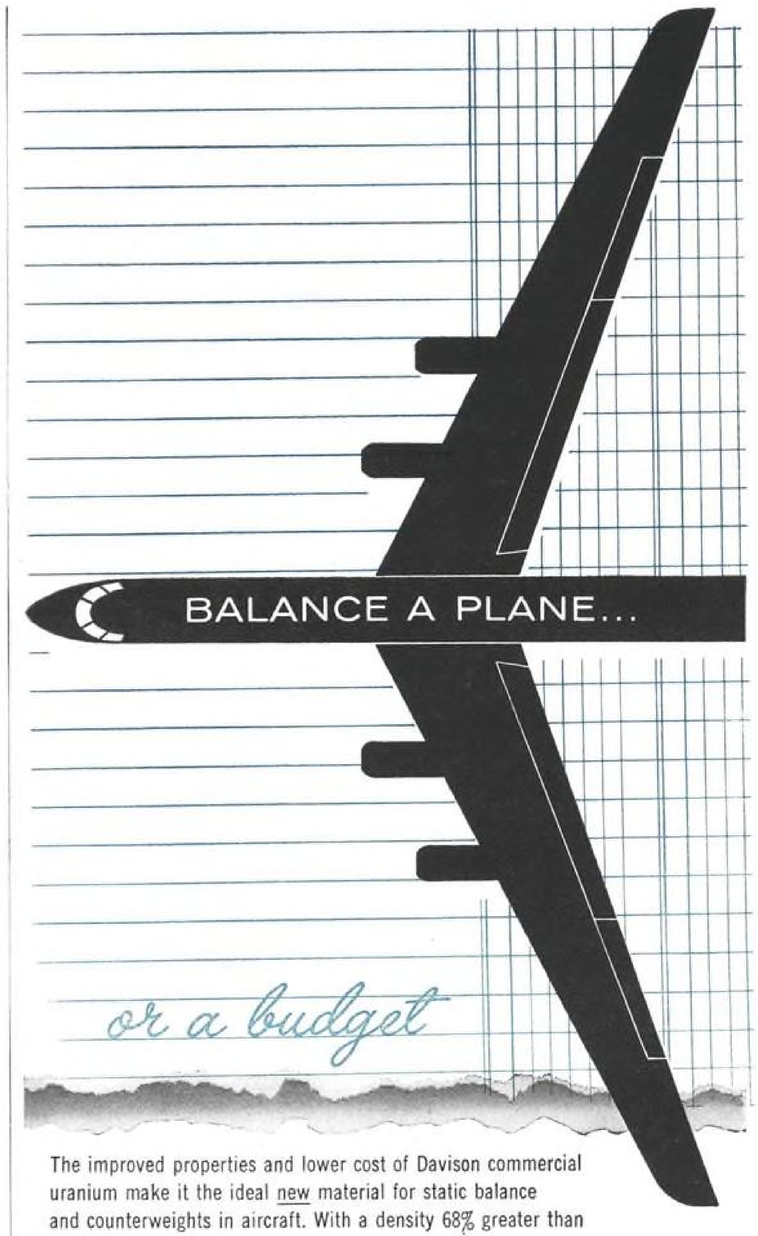
The crew could elect either mode of operation at any point during the approach to target after passing the enemy early warning line.

The B-58B was canceled last year along with the J79-9.

Weapon Configurations

Various pod and weapon arrangements that have been flown on the B-58A include:

• **Pod configuration** to test the missile and the fire control system for the F-108. This pod is still being flown.
• **Air-launched ballistic missile** which was successfully launched in flight.
• **Photo reconnaissance pod.**
• **Radar reconnaissance pod** with a roughly cigar shape, the first pod shape flown on the B-58A.
• **Very large radar reconnaissance pod.**
• **Pod containing two fuel tanks** as well as a nuclear weapon.



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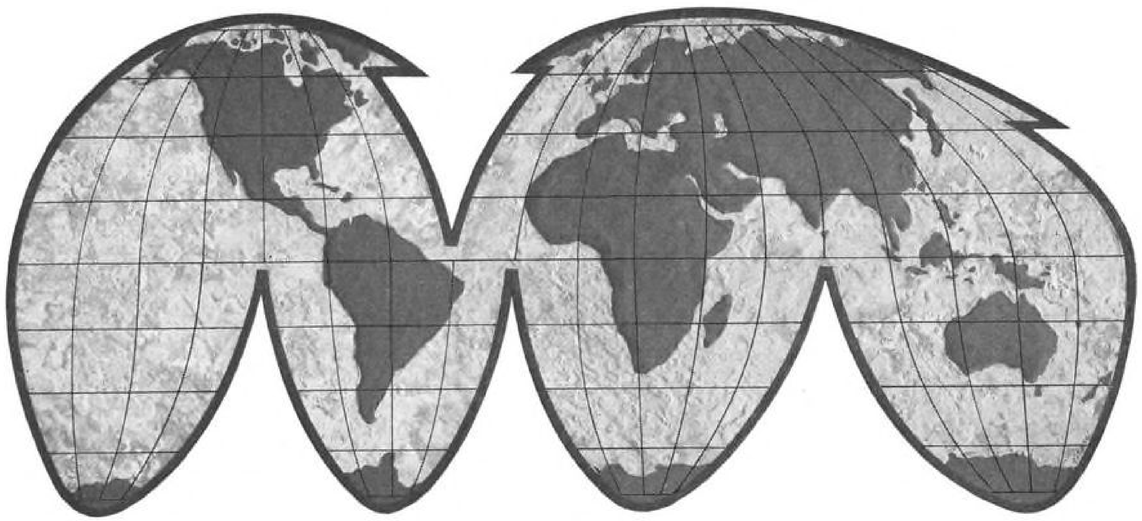

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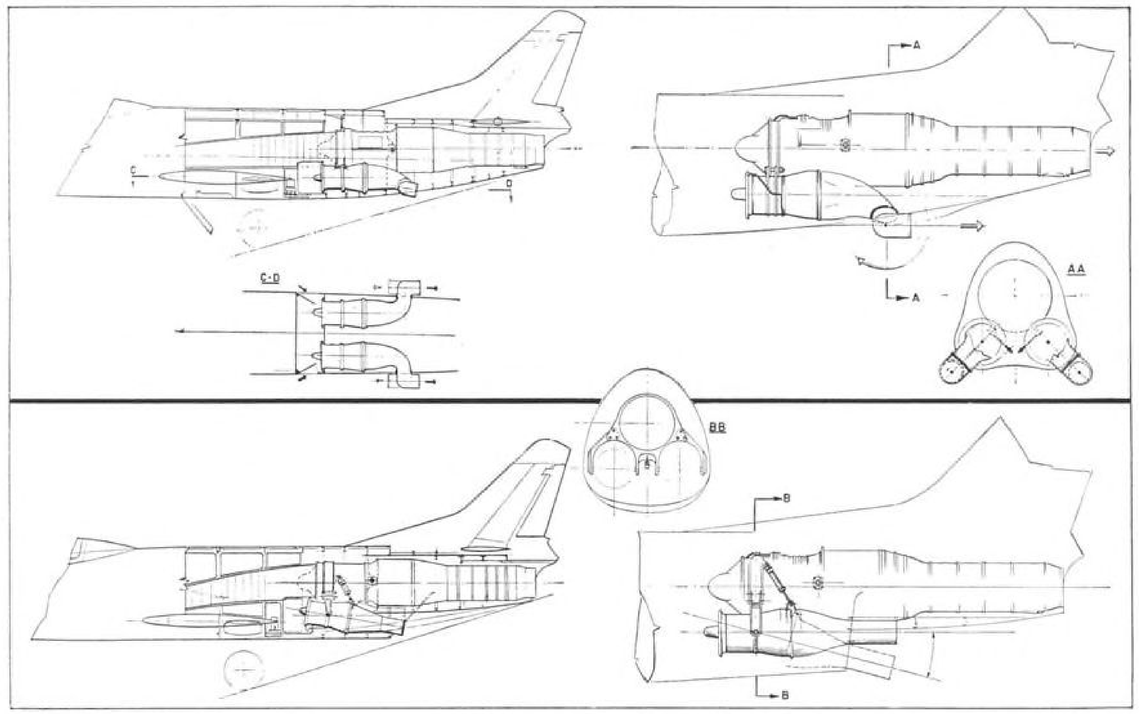


INSTALLATION DRAWINGS for compound propulsion system based on Fiat G.91 lightweight strike fighter show paired auxiliary turbojets with swivel nozzles giving increments of thrust from full aft to full forward (top). Second arrangement, which visualizes engines improving takeoff performance only, mounts the engines to a swing through a 15-deg. angle downward from thrust line (bottom).

Short-Takeoff Version of G.91 Studied

By David A. Anderton

Turin, Italy—Fiat G.95 is the designation for a design study of a compound propulsion system applied to the airframe of the G.91 lightweight strike fighter. Study is currently being evaluated by Mutual Weapons Development Team.

Major purpose of the compounded system, which uses a pair of auxiliary turbojets of very high thrust-weight ratio, is to improve the short takeoff and landing characteristics of the G.91.

Typical calculations using the G.91 as the base show that takeoff and landing distances could be reduced to approximately 500 ft.

Fiat patent drawings for the compound propulsion system are based on the structure of the G.91. They show a pair of small turbojet engines slung one on each side below the main Bristol Orpheus turbojet powerplant. In one form of the patent, these engines are fixed and have swiveling exhaust nozzles to direct the jet blast at any angle between full aft and full forward. In a second arrangement the engines are trunnion-mounted to move through an angle of about 15 deg. down, measured parallel to the thrust line.

Fiat's aviation division chief Prof. Giuseppe Gabrielli, who devised the compound scheme, envisions the use of the auxiliary engines strictly in the low-speed and low-altitude flight regimes. For this reason, the engines can be designed to less rigorous requirements for life and time between overhauls, so that the thrust-weight ratio can be increased.

Gabrielli believes that ratios as high as 16 can be reached with engines properly designed for the job.

Specific figures used to illustrate the potential of the system are based on the G.91 using a Bristol Orpheus 12 rather than its current Orpheus 8 engine. Gabrielli assumes that the thrust-weight ratio for the entire airplane would have to be about unity in order to make the plane a true STOL performer. Installed thrust of the Orpheus 12 in the Fiat G.91 would be about 60% of the aircraft weight, leaving the remaining 40%—or about 5,000 lb.—to be matched by the thrust of the two light engines.

Small turbojets in that thrust category now exist; one of the best-known examples is the Rolls-Royce RB.108 engine used in the Short SC.1 VTOL research aircraft. That engine has been further developed to the RB.145, a powerplant rated at about 2,750 lb. thrust and developed specifically as a high thrust-weight ratio engine.

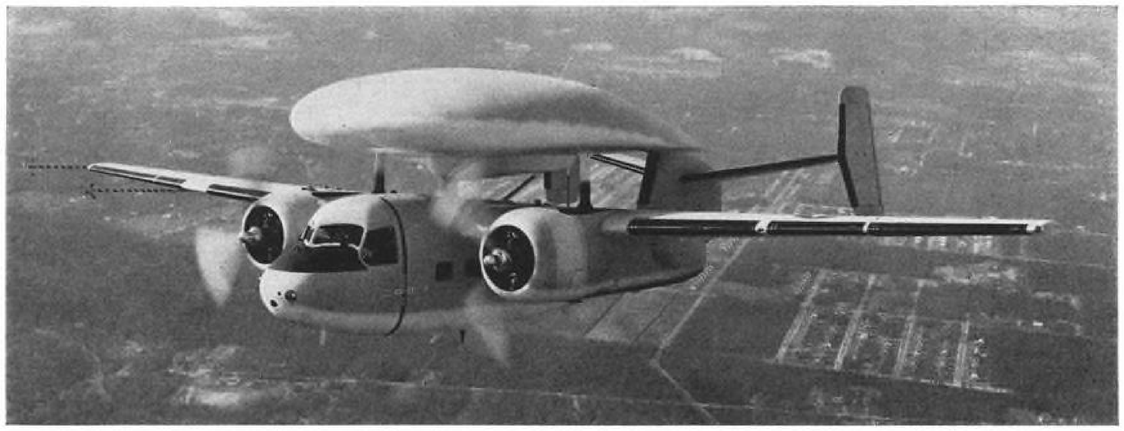
For the Orpheus 12, thrust-weight ratio is better than six at the normal static thrust rating of the engine, not using the afterburner. With reheat, the thrust-weight ratio or takeoff increases to 7.3.

Thrust-weight ratio of the Rolls-Royce engines is believed to be considerably higher than six.

The engines shown on the Fiat patent drawings are obviously not Rolls-Royce powerplants, and in fact, resemble the centrifugal-compressor turbojet engines that Fiat has been developing during the past few years.

One of these engines, designed specifically for the auxiliary requirements laid out by Gabrielli in his patent application, could be the type of powerplant used ultimately in the compound system for the G.95.

Auxiliary engines shown in the Fiat drawings are approximately 22 in. in maximum diameter and on the order of 50 in. long, measured from the in-



GRUMMAN'S "SAUCER-TOPPED" WF-2 TRACER, early-warning airplane for Navy carrier operation, carries long-range radar detection equipment.

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SIKORSKY HSS-2, designed for long over-water flight and low-altitude hovering—even alighting on water—during sonar anti-submarine missions.

Sud Voltigeur Tactical Support Plane

Sud SE 117-03 Voltigeur tactical support plane prototype is powered by two Turbomeca Bastan turboprop engines producing 750 eshp. each. Rear fuselage section has been slightly enlarged from the configuration of the -02 model, which crashed about a year ago.

let flange to the normal exhaust plane. Installed engines would be longer, because the tailpipes would be modified to take either swiveling nozzles or extensions to make the blast more unidirectional.

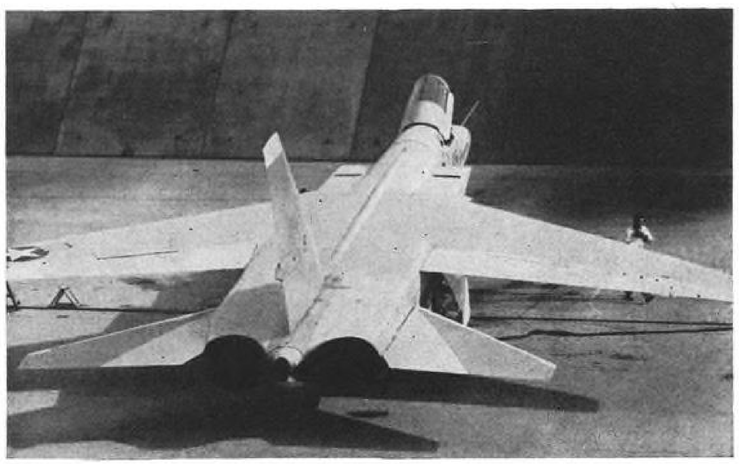
Gabrielli says the compound propulsion system is more attractive over-all than using auxiliary rockets, or afterburners, or the installed thrust necessary to get the airplane off vertically.

He says that the main powerplant can be chosen on the basis of thrust required for maximum or cruising speed performance in level flight, and the auxiliary powerplants can be picked for best performance during takeoff and landing regimes. This allows optimizing both portions of the powerplant system, and yields much better specific weights for the installed engines.

Both sets of engines use the main aircraft fuel, and do not require any auxiliary systems for fuel, instrumentation or accessories. Separate controls must be provided and possibly separate inlet systems.

Current status of the G.95 project is a paper study, with considerable weight of calculations behind it. Evaluation is being done by the Mutual Weapons Development Team, and the future of the project depends on their assessment.

Based on the G.91 design, the compound propulsion system would maintain the current load-carrying and high-speed performance of the plane while increasing substantially its takeoff and landing performance.



A3J-1 Rearward Ejector Capped by Tail Cone

Tail cone fairing covers opening for rearward ejection of weapon stores from the Navy-North American A3J-1 twin jet interceptor. Activation of the system triggers latches that release the fairing with the store (AW Jan. 11, p. 23) with no aerodynamic penalty.

PUMP PRIMERS
ARTHUR A. NICHOLS

GEROTOR aircraft pumps offer extremely compact, flexible design

Few pump designs offer such extraordinary flexibility in accommodating themselves to the structures in which they are housed or mounted as does the Gerotor type.

The Gerotor is a form of internal gear pump consisting of only two moving parts: an inner toothed element and an outer, meshing toothed element. The inner element has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet port to the outlet. (See Figure 1). Pump capacity is measured by the volume of the "missing tooth" multiplied by the number of driver teeth and RPM.

FIG. 1

▶ The designer thus has the advantage of several variables to secure a given capacity within his space limitations: *Gerotor diameter* – which governs the area of the pumping chamber–*Gerotor thickness* which, taken with area, determines chamber volume – *Gerotor RPM*, since this is a positive displacement pump. Thus, it is possible to vary the diameter, the length and the speed of the pump within certain overall limits to secure the wanted capacity.

▶ **Unlike conventional gear pumps the Gerotor needs only a *single shaft* – both elements are substantially concentric to it. These are mated to provide continuous, fluid-tight engagement without the crescent structure necessary in other internal gear pumps. Further, Gerotor elements can be stacked along a single shaft and mounted on a single AN pad to perform multiple pump functions: lube, scavenge, boost, etc. (See Figure 2). Such compactness allows the pump to be "submerged" in a gear box or sump and frequently the sum may be part of the pump housing.**

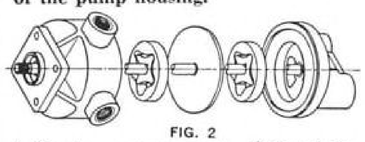


FIG. 2

▶ Gerotor pumps are lightweight, valveless, provide high volumetric and mechanical efficiency and offer exceptional performance at high altitudes.

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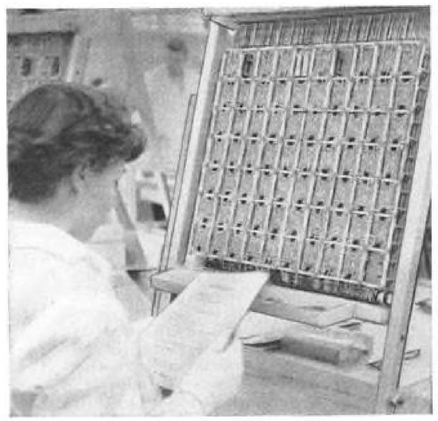
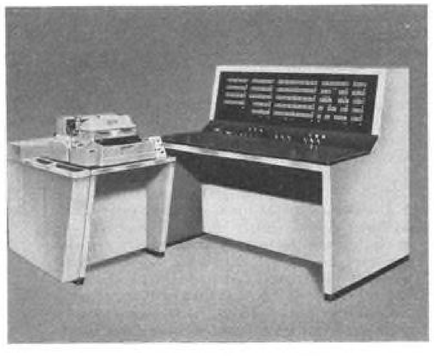


A technician follows the wiring diagram produced by the Univac Scientific. This application of mechanized design greatly facilitates the production of reliable automatic data processing equipment.



A significant achievement of mechanized design is the BOGART computer, produced by Remington Rand Univac, for the U.S. Navy. Intensive preliminary testing of the projected system made it possible to reduce the size of the computer while materially increasing its reliability through the use of transistors and printed circuitry.

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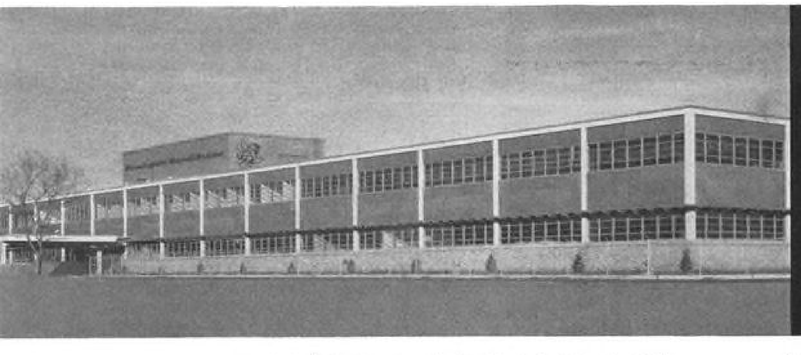

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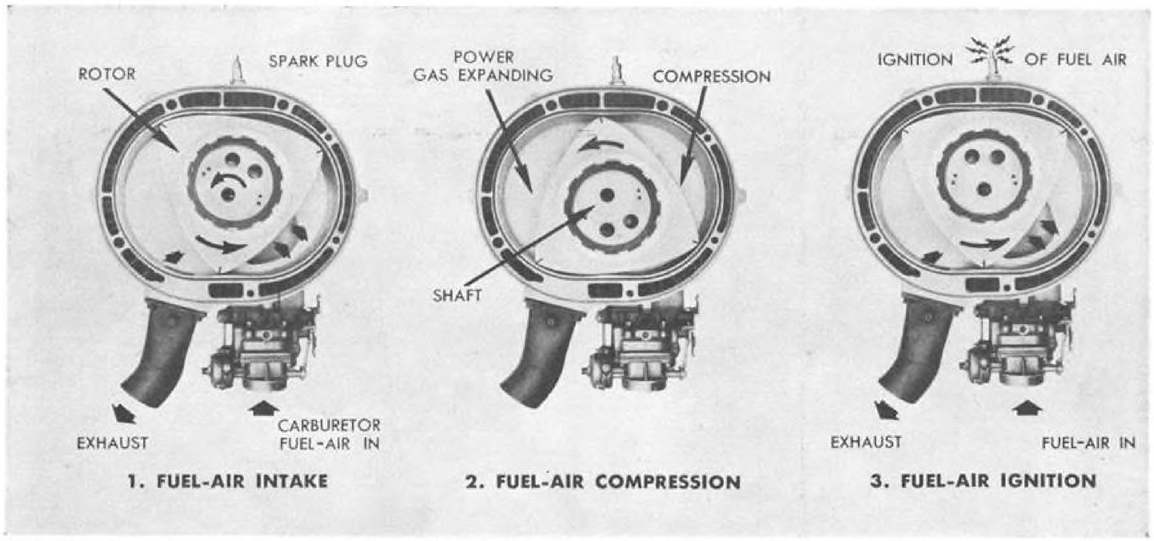


ROTATING combustion engine duplicates the strokes of a four-cycle engine with one rotation of the trochoid rotor.

Curtiss-Wright Proposes Business VTOL

By Barry Tully

New York—Curtiss-Wright is designing a six-place executive VTOL aircraft powered by a German-designed rotating combustion engine it has licensed and a new propeller the company is proposing for VTOL uses.

The propeller, of lightweight steel and glass-fiber construction, is designed to produce a lift force as well as thrust when turning in a plane perpendicular to the line of flight. The VTOL vehicle will rely on this lift during forward flight with vertical takeoff and landing thrust achieved by tilting the four engines. Additional marketing plans for the rotary engine include aircraft, marine, industrial and automotive powerplants (AW Nov. 30, p. 33).

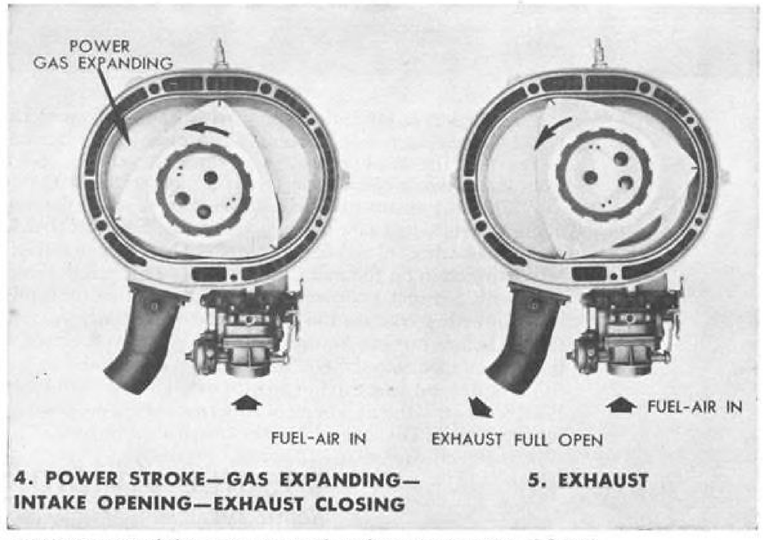
Plans for the propellor and VTOL vehicle were disclosed in Curtiss-Wright's 1959 annual report (AW Feb. 29, p. 34). Other projects mentioned in the report as possible sources of new business include an aerial platform, a ground-effect Air-Car and flight simulator developments. No mention was made of any turbine or rocket engine.

Wright Aeronautical Division is currently in production with its J65 turbojet engine as well as radial reciprocating engines. Overhaul and spare parts business for engines as the Turbo Compound R3350 and R1820 is expected to remain substantial for some years.

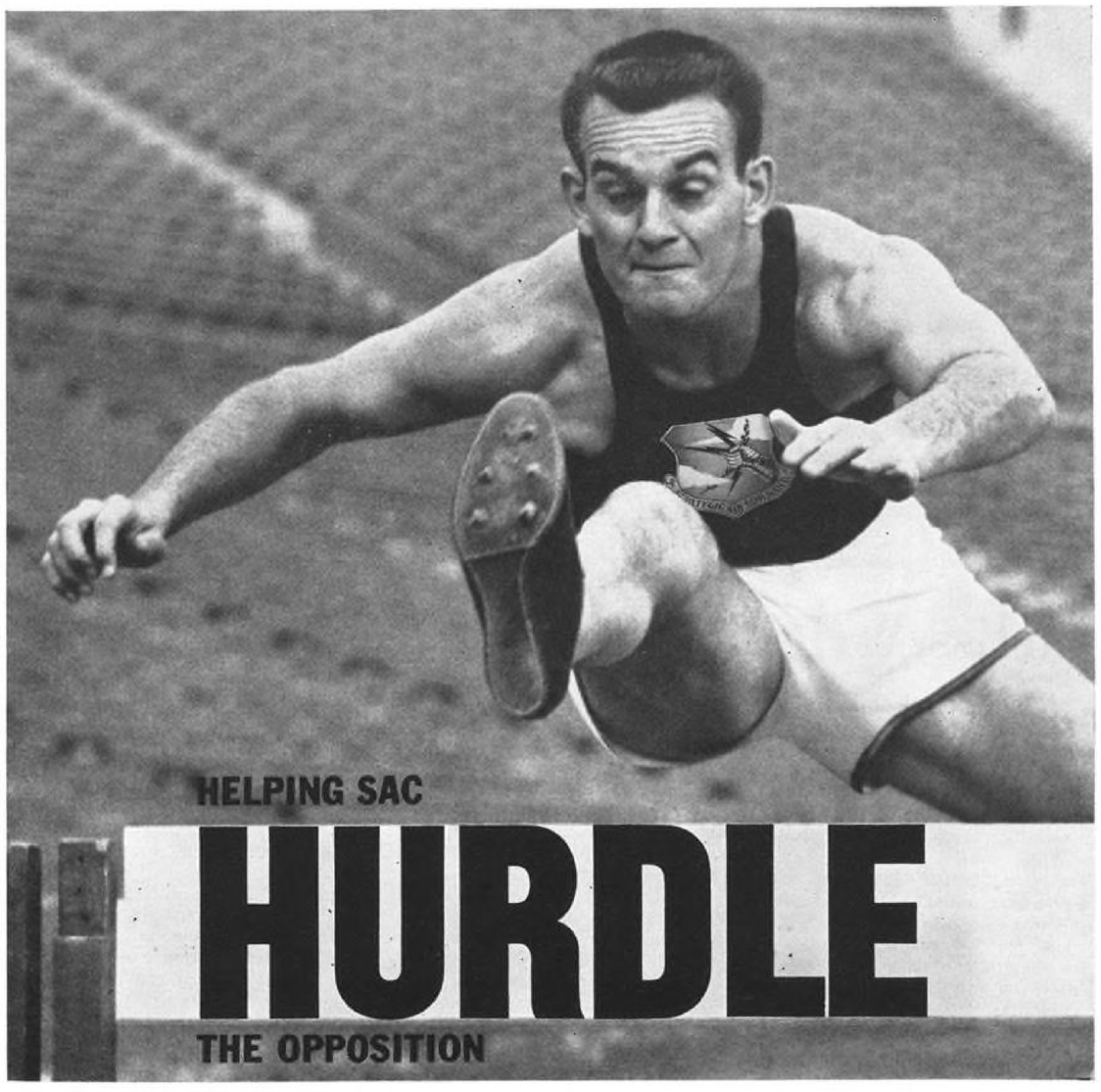
Roy T. Hurley, president of Curtiss-Wright, told the Society of Automotive Engineers at New York that the corporation's diversification and development effort was aimed at the economic and technological needs of 1965. Hurley described the rotating combustion engine in detail in an effort to answer many questions about the design.

The rotating combustion engine is known in Germany as the Wankel engine. Felix Wankel, designer of a successful rotating exhaust valve used in German in-line aircraft engines during World War II, sold the rights to his engine design to NSU Werke in West Germany. Following further development, Curtiss-Wright purchased licensing agreements from NSU in 1958. The German firm reportedly is more conservative than Curtiss-Wright regarding production of the rotating engine. NSU lists mid-1961 as its target date for volume production; Curtiss-Wright says it plans 1960 production.

The rotating combustion engine duplicates the strokes of a four-cycle reciprocating engine with one eccentric rotation of a trochoid rotor within an epitrochoid chamber. Thus, each of the three combustion chambers formed by the rotor fires once during one rotor ro-



CRANKSHAFT of the engine is geared to the rotor at a ratio of 3 to 1.



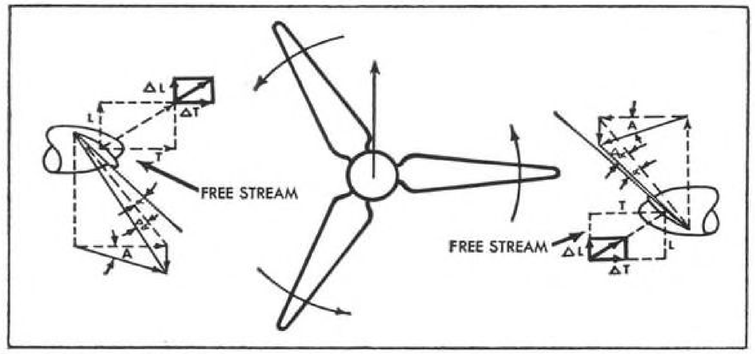
SAC is now off and running with its new Hound Dog missile. With the supersonic GAM-77 missile, the B-52 bomber can more easily hurdle ground defenses on the way to a target. In the short span of just 30 months, the Hound Dog air-to-surface missile grew from the drawing board to a powerful member of SAC's deterrent team.

Silencing enemy ground defense centers while the mother ship speeds on toward the main target is just one of the jobs of the versatile GAM-77 missile. Slung beneath the swept-back wings of a B-52, a pair of GAM-77's can either clear a path for the bomber, or be sent right in on the main target itself. This triple-threat capability lets a single B-52 command a target approach corridor over a thousand miles wide.

To further confuse the enemy, these inertially-guided missiles can feint at pseudo-targets before turning toward their real objectives. Speed and altitude variations can also be programmed into the GAM-77's target approach.

The Hound Dog missile greatly extends the useful life and striking power of SAC's B-52 bombers—the backbone of America's strategic power. The GAM-77 is being produced by the Missile Division of North American Aviation.

MISSILE DIVISION
NORTH AMERICAN AVIATION, INC.
Downey, California



STEEL AND GLASS-FIBER propeller is designed to produce lift as well as thrust.

tation. The geometry permits the three apexes of the rotor to seal the combustion by maintaining contact with the periphery of the chamber. The rotating unit is mounted on a crankshaft which creates the eccentric rotation and gears the speed down to one-third that of the driven shaft. Thus the rotating combustion engine provides one power sequence for each crankshaft revolution, two times that of a single-cylinder four-cycle reciprocating engine. Additionally, the power sequence of the rotating engine covers a wider crank angle than that of a reciprocating engine, the ratio being 3 to 2.

The rotating combustion engine is valved by means of simple intake and exhaust ports. As the chamber expands over the open intake port, the fuel-air mixture is forced in. The moving rotor than seals the combustible mixture and compresses it beneath the spark plug which fires the charge for the power sequence. Contraction of the chamber over the open exhaust port discharges the combustion products. Ports may be located either on the sidewall or on the periphery of epitrochoid chamber.

Pressure lubrication of the engine is provided by means of lines within the rotor to friction points. Curtiss-Wright reports using SAE 5 viscosity oil to lubricate its test engines. Early German engines successfully employed a two-cycle type fuel/oil mixture for lubrication; however, this was deemed impractical for larger displacement engines due to the dirty exhaust products.

Liquid- and air-cooled rotating engines are planned. Development models employ liquid cooling but Curtiss-Wright says that the housing may be finned to any degree necessary for air-cooling. The engine is not hot-running. Curtiss-Wright says that the hottest part reaches 200-300F. The elimination of exhaust valves decreases the possibility of detonation. The company reports that even with low-octane fuels, detonation is virtually unknown.

Fuel injection has been employed successfully on some development models. Wright says that the engine is well suited for fuel injection but in the interests of simplicity, standard automotive carburetors have been used on most of the Wright engines. The company reports that supercharging also is possible with the engine and that supercharged models are under development.

The major portion of Curtiss-Wright's development work with the rotating combustion engine has been with a 60-cu.-in., 100-hp. single-chamber engine called the IRC6. All engineering data released by the company concerns this engine.

The 100-lb. IRC6 engine employs a 7.5 to 1 compression ratio and turns to 7,000 rpm. (Wright has run the engine to 8,000 rpm. and NSU has operated smaller engines at 17,000 rpm.) The torque curve is fairly flat from 2,000 to 6,000 rpm. at about 100 ft. lb. Best specific fuel consumption is .47. The engine delivers 100 hp. at 5,500 rpm., equivalent to 1.67 hp. per cu. in. with a side port intake. The same engine with a peripheral intake port developed 124 hp. at 6,500 rpm., equivalent to 2.05 hp. per cu in. Wright reports engine starts easily with an automotive starter even at cold ambient temperatures.

The rotating combustion engine will be competitive with conventional engines, Curtiss-Wright reports. The engine has two main moving parts and only the rotor and combustion chamber have to be precision-machined. Normal

C-W Management Changes

Recent changes in Curtiss-Wright management involved the resignation of Nicholas Dykstra, executive vice president, and the appointment of a six-man executive committee. The committee, composed of Roy T. Hurley, board chairman, and five division managers, will plan corporate budgetary and policy matters. Formation of the committee, an economy measure, resulted in the reassignment or termination of employment of 39 staff members.

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engineering tolerances will suffice for the other engine components.

Against these advantages for the rotating combustion engine are some problems, which up to now have hindered development of the Wankel design. These design problems and Curtiss-Wright's answers to them include:

• **Sealing the combustion chambers** at the apexes of the trochoid rotor has been a chief development problem. Sealing is performed by blade-like metal seals which seal the rotor apexes against the peripheral wall of the epitrochoid chamber. Wright says that it has developed a more rugged seal which has proved satisfactory. The key to the seal problem was the development of a tough, resilient metal seal, the makeup of which Wright considers proprietary. The company reportedly ran one of its 100-hp. models for 300 hr. under load, then inspected the components and ran it for another 100 hr.

• **Ignition of the engine** represents another design problem. The single spark plug in the rotary combustion engine is firing almost continuously, leading to shortened plug life, fouling and gap erosion. This would be a serious problem in aviation applications of the engine but Curtiss-Wright says that its ignition system is satisfactory.

• **Chamber distortion** is another possible weak point in the design. The problem is that combustion is constantly taking place at one point in the precision-machined chamber. NSU has developed metallurgical treatment to harden chamber walls sufficiently to withstand the temperatures and pressures. The endurance tests of Curtiss-Wright tend to disprove this as a design flaw, at least in the 100-hp. model.

• **Scaling the engine upward** in size, while not a known problem area, is venturing into the unknown. NSU in Germany is working with small rotary engines in the area of 125 cc. (8 cu. in.) displacement. Curtiss-Wright's development work has been centered around a 60-cu.-in., 100-hp. displacement engine. Two ways of increasing output power of the rotating engine are by increasing the displacement of a single chamber or by stacking the combustion chambers along a common crankshaft. Curtiss-Wright intends to do both. The company reports that it is designing a 1,000-hp. single-rotor engine as well as a 5-hp. air-cooled industrial engine.

Curtiss-Wright has released little data on its radial lift force propeller. The propeller, now undergoing static tests, will require a minimum of wing area. The company says that its VTOL aircraft will be capable of rising to 20,000 ft. in vertical flight and to 36,000 ft. in forward flight, according to engineering studies. The company reports no estimated date when its VTOL vehicle will make its first flight.

27 million jet flight hours

. . . demonstrate General Electric's leadership in the design and manufacture of jet engines.

From the historic moment in 1942 when twin General Electric I-A engines powered the first jet flight in America, G-E engines have logged 27 million jet flight hours. And, G-E jets like the J33, J35, J47, T58, J85, J79, and CJ-805 have consistently set new standards of performance and reliability.

Today, a General Electric engine:

- Powers the aircraft which has possessed the world's speed, altitude and time-to-climb records all at the same time—an unprecedented triple crown.
- Shares in the Collier Trophy for "the greatest achievement in aviation in America" . . . during 1958.
- Has been chosen to power the world's newest and fastest commercial jetliners and the first American turbine-powered commercial helicopters.

GENERAL ELECTRIC

27 million jet flight hours mean

Reliability

for air-breathing weapon systems

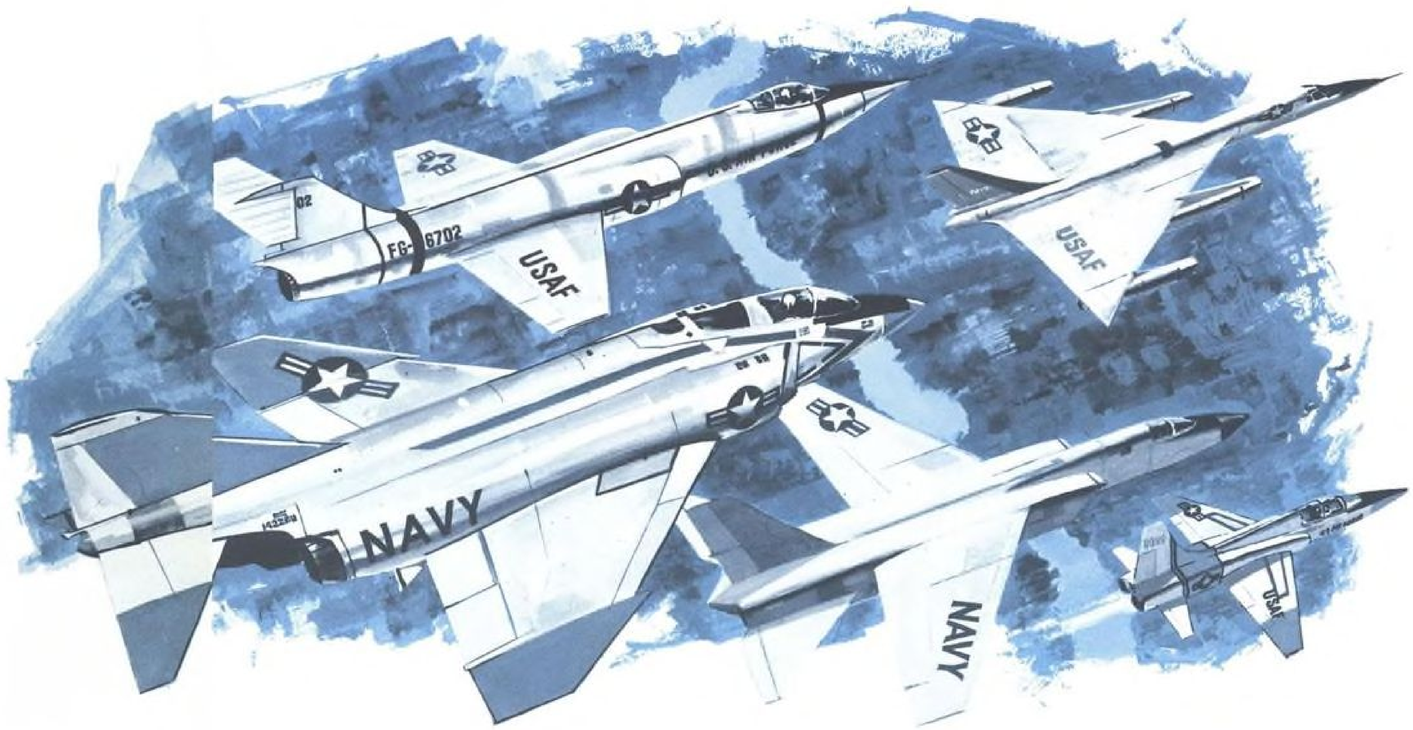
For almost two decades jet thrust has been increasing rapidly. G.E. has helped lead the way. Each new G-E engine has added to a remarkable record of reliability. Today, the J79-powered Lockheed F-104 has established an outstanding in-commission rate with USAF.

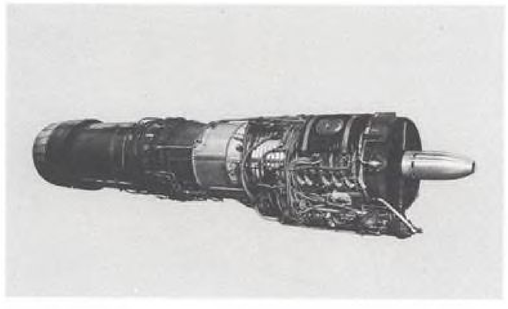
Sea forces will soon be strengthened by the McDonnell F4H and the North American A3J—the fastest, highest-flying aircraft in Navy history.

USAF's fastest, highest-flying bomber, Convair's B-58, is J79-powered. And, USAF's J79-powered Lockheed F-104 has held simultaneously the world's speed, altitude, and time-to-climb records—an unprecedented triple crown.

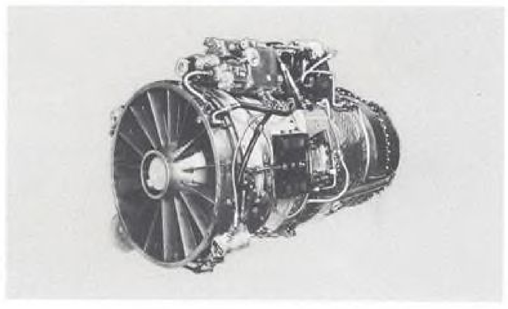
At the other end of the flight propulsion spectrum, G-E small gas turbines will soon enter operational service with the Air Force and Navy. The Navy's newest ASW and utility helicopters will be powered by the T58, which has demonstrated its reliability in thousands of demanding test hours.

The high performance J85 turbojet will soon enter USAF service powering McDonnell's GAM-72 decoy missile and Northrop's T-38 jet trainer.

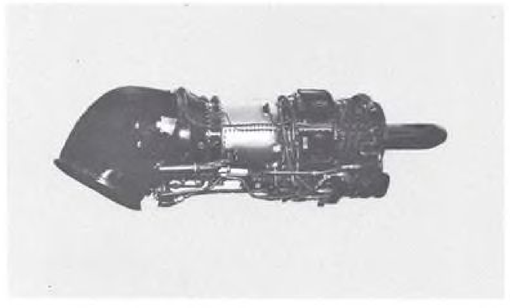




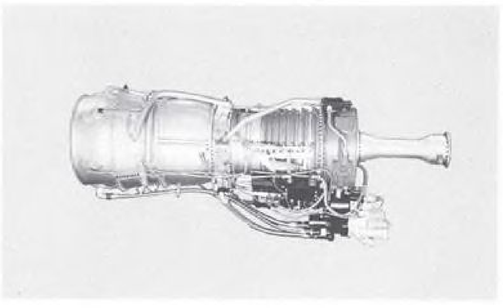
J79 After more than three years of production, G.E.'s J79 remains the most advanced U.S. production turbojet. The record-breaking J79 provides more than 15,000 pounds of thrust, yet some models weigh as little as 3200 pounds. J79-powered aircraft have logged considerably more than half the world's Mach 2 time. Six Mach 2 air weapons are J79-powered: McDonnell F4H Phantom II, North American A3J Vigilante, Convair B-58 Hustler, Lockheed F-104 Starfighter (all pictured in main illustration), Grumman F11F-1F Super Tiger, and Chance Vought Regulus II missile.



J85 Advanced aerodynamic and mechanical design make G.E.'s J85 turbojet the highest thrust-to-weight ratio powerplant in its class. Weighing just 525 pounds and delivering 3850 pounds thrust, the reheat J85-5 powers Northrop's T-38 Talon supersonic trainer (pictured in main illustration) and N-156F Freedom Fighter (right). Another J85 version (above), which weighs 325 pounds and produces 2450 pounds thrust, is in production for the McDonnell GAM-72 decoy missile (right).



T58 The T58 brings important benefits to helicopters—increased payloads or range, faster cruising speeds, greater endurance. Engines shipped have averaged significantly better than guarantees of 1050 shp, 0.64 SFC, and 271-pound weight. A 1250 shp growth version enters production this year. T58 has been flight tested in single and twin engine helicopters including Sikorsky's HSS-1F, HSS-2 (left), and S-62; Kaman's HU2K (left); and Vertol's YHC-1A and H-21D.



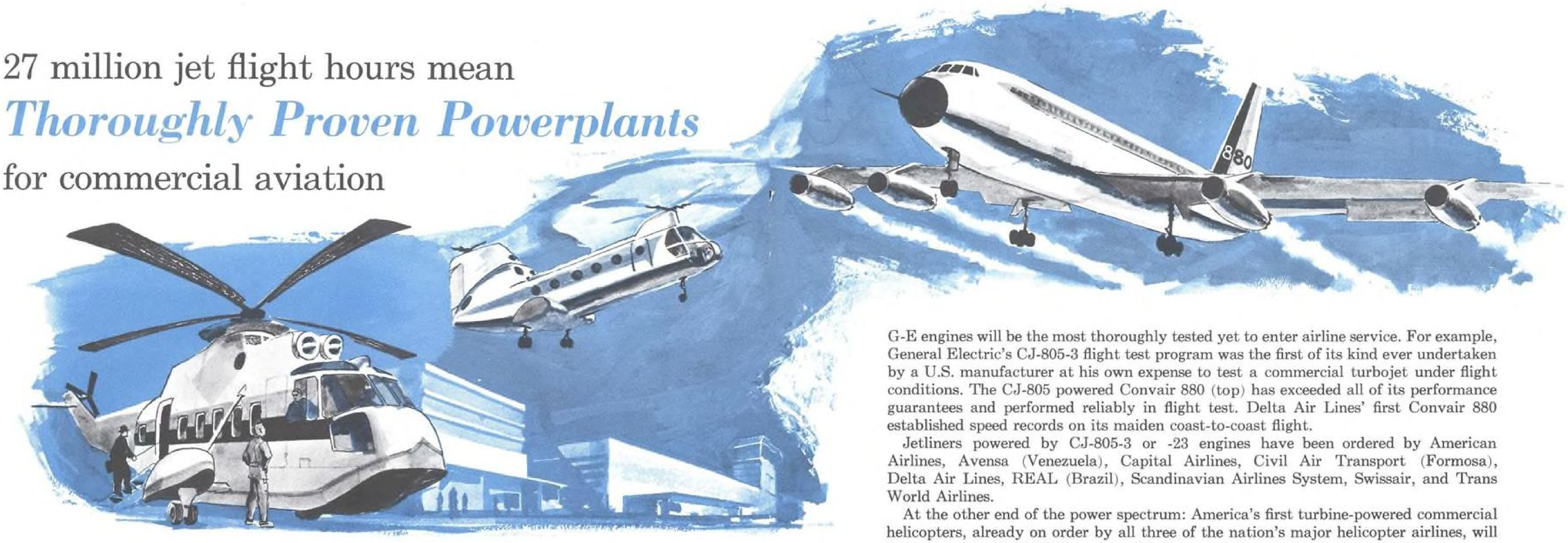
T64 Low SFC and attractive power-to-weight ratio make G.E.'s versatile T64 turboprop/turboshaft ideally suited for a variety of aircraft. Among them: helicopters and fixed wing designs (right), skycranes, new VTOL/STOL designs. Turboprop configurations, with gearbox above or below centerline, deliver 2570 eshp at .522 ESFC. Turboshaft versions produce 2650 shp at .506 SFC. All models have common power sections, differ only in gearing and accessories.

GENERAL ELECTRIC

27 million jet flight hours mean

Thoroughly Proven Powerplants

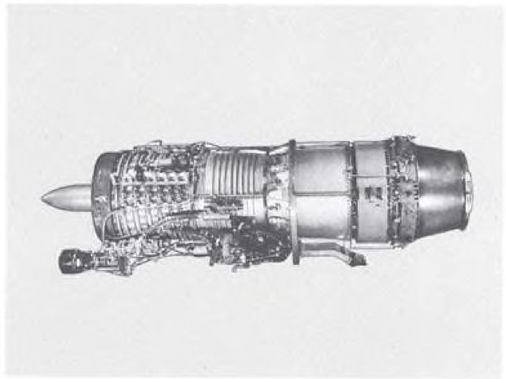
for commercial aviation



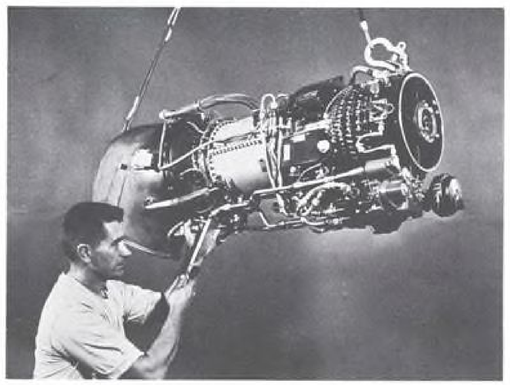
G-E engines will be the most thoroughly tested yet to enter airline service. For example, General Electric's CJ-805-3 flight test program was the first of its kind ever undertaken by a U.S. manufacturer at his own expense to test a commercial turbojet under flight conditions. The CJ-805 powered Convair 880 (top) has exceeded all of its performance guarantees and performed reliably in flight test. Delta Air Lines' first Convair 880 established speed records on its maiden coast-to-coast flight.

Jetliners powered by CJ-805-3 or -23 engines have been ordered by American Airlines, Avensa (Venezuela), Capital Airlines, Civil Air Transport (Formosa), Delta Air Lines, REAL (Brazil), Scandinavian Airlines System, Swissair, and Trans World Airlines.

At the other end of the power spectrum: America's first turbine-powered commercial helicopters, already on order by all three of the nation's major helicopter airlines, will be powered by G-E CT58 engines. Next natural step: turbinization of helicopters and transports owned and operated by industry.

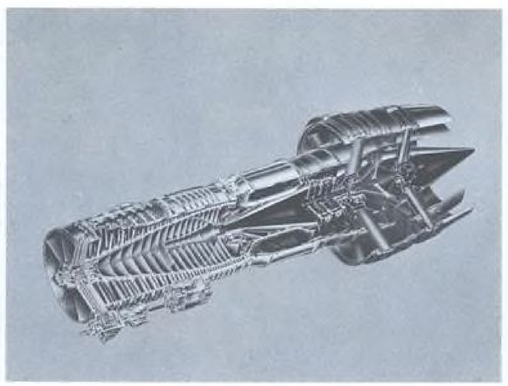


CJ-805-3 G.E.'s first commercial engine, the CJ-805-3, enters airline service this spring. It will provide the power to carry passengers in Convair 880 jetliners at 615 miles per hour. The CJ-805 weighs 2800 pounds, delivers more than 11,000 pounds of thrust. It is 110 inches long, 32 inches in diameter.

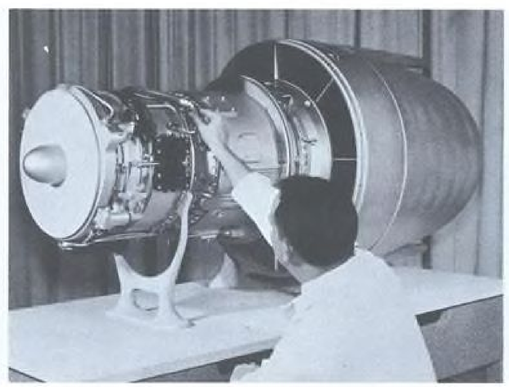


CT58 The CT58 is the first U.S. turboshaft to be FAA-certificated. It will power the twin-turbine Sikorsky S-61 and Vertol 107 (both in main illustration above) which begin passenger service next year. Sikorsky's CT58-powered single-engine S-62 is being offered to helicopter operators and corporations.

GENERAL ELECTRIC



CJ-805-23 General Electric is flight testing its leased B-66 with aft-fan CJ-805-23 engines. When tests began, it marked the first time an engine manufacturer had test flown a turbofan engine as the primary powerplant of an aircraft. The twin aft-fan engines are performing reliably—proving themselves prior to airline service. CJ-805-23 engines will power the Caravelle VII and Convair 600.



CF700 Compared to turbojets in its class, the CF700 turbofan will provide higher thrust per dollar, greater range, shorter take-off, and less noise. The CF700 will combine the proven J85 gas generator and a scaled-down version of the CJ-805-23 aft-fan to produce 4000 pounds sea level thrust at 0.69 SFC. Flight-worthy CF700's are scheduled for April, 1961, with FAA-certificated engines available in February, 1962.

27 million jet flight hours mean

Greater Capability

for tomorrow's aerospace missions

Twenty-seven million jet flight hours form a solid foundation upon which General Electric research and development can build to meet the needs of the near and distant future.

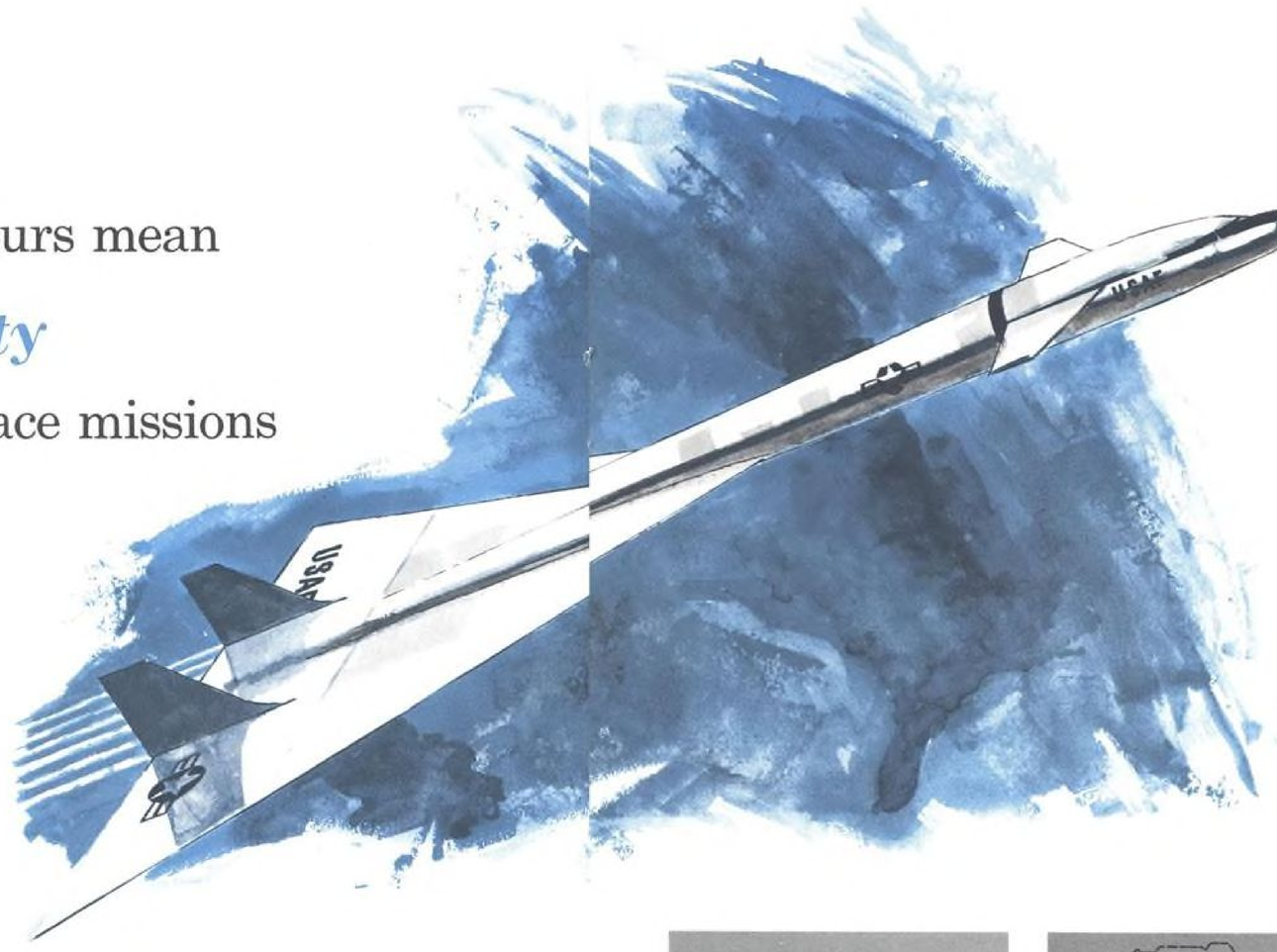
The Mach 3 North American B-70 Valkyrie bomber, for example, represents the next stride forward for manned aircraft. G.E. is developing the highly advanced J93 engines which will power it.

General Electric, under contract with USAF and the AEC, is developing a nuclear propulsion system for America's first nuclear-powered aircraft, as revolutionary as the B-70.

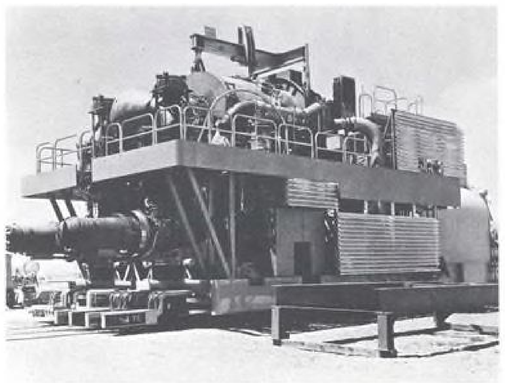
In rocket, VTOL, and space power and propulsion, systems now being investigated at General Electric will help make propulsion progress.

To achieve the challenging objectives of the present and the future, G.E. applies its knowledge and experience, and marshals R&D facilities among the most complete in the nation.

G.E.'s more than 100 research laboratories strive for new basic knowledge which can be applied to aerospace progress. For example, at the pioneering General Electric Research Laboratory, basic research is leading to advances in metallurgy, cryogenics, and other sciences vital to aerospace progress. These activities supplement the direct efforts of extensive aircraft gas turbine R&D facilities at Evendale, Ohio, and Lynn, Massachusetts.

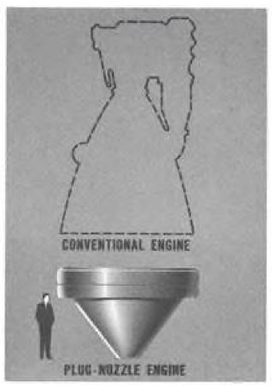


J93 The General Electric Mach 3 J93 will power the North American B-70 Valkyrie to cruising altitudes above 70,000 feet and speeds of more than 2000 mph.

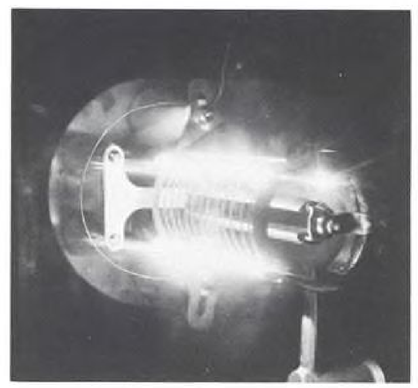


NUCLEAR PROPULSION
This special test assembly was designed and built by General Electric under contract. It consists of a nuclear reactor, shield, controls, and two modified J47 engines. General Electric first successfully operated a turbojet on nuclear power in 1956. Development progress is continuing.

TOMORROW'S VTOL
Currently under development, General Electric lift fan engines hold promise for a new generation of aircraft which can take off straight up, hover, and move forward at high speeds.



ROCKET POWER
Development concepts at G.E. include plug nozzle engines (below) which are markedly smaller than conventional engines of the same thrust.

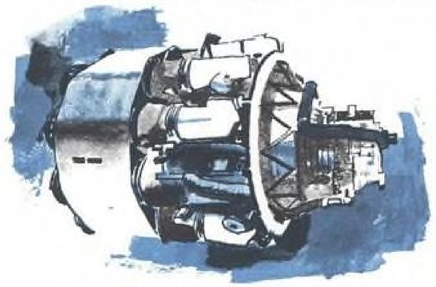


ION ENGINES
In the void of space, a few ounces of thrust can control vehicle flight paths. One way to achieve this thrust: electrical propulsion. G.E. is investigating an ion engine which electrostatically accelerates mass, such as cesium ions, to produce thrust.

GENERAL ELECTRIC

Milestones

in General Electric's 27 million jet flight hours



In 1942, the first jet flight in America was General Electric powered. Twin I-A engines (above) powered the Bell P-59 at 450 mph.

The J47 powers Boeing B-47 Stratojet bombers, backbone of America's deterrent strength during the past decade.

North American's F-86 Sabre Jets, powered by General Electric J47's, scored a 14-1 victory ratio in Korea.

America's first Mach 2 engine, the J79, won accolades for performance and reliability. Vice President Nixon (center) presented the Collier Trophy to (left to right) USAF pilots Major Walter Irwin and Lt. Col. Howard Johnson, G.E.'s Gerhard Neumann and Neil Burgess, Lockheed's Clarence Johnson for F-104/J79 design and flight. (186-38)

GENERAL ELECTRIC ENGINES POWERING THESE AIRCRAFT HAVE FLOWN MORE THAN 27 MILLION JET FLIGHT HOURS

BELL XP-59A	CONVAIR XP-81	LOCKHEED P-80	NORTH AMERICAN F-86H	REPUBLIC XP-84
BELL XP-83	DOUGLAS RB-66A	LOCKHEED F-104	NORTH AMERICAN XFJ-1	REPUBLIC XF-84J
BOEING B-47	DOUGLAS XA-26F	MARTIN XB-48	NORTH AMERICAN FJ-2	REPUBLIC XF-91
BOEING KB-50	DOUGLAS XB-43A	MARTIN XB-51	NORTH AMERICAN A3J-1	RYAN FR-1
CHANCE VOUGHT REGULUS II	DOUGLAS XB-53	McDONNELL F4H-1	NORTH AMERICAN XT-39	RYAN XF2R-1
CHASE XC-123A	DOUGLAS XF4D	McDONNELL GAM-72	NORTHROP N-156 F	SIKORSKY HSS-1F
CONVAIR B-36	DOUGLAS D-558	NORTH AMERICAN B-45	NORTHROP T-38	SIKORSKY HSS-2
CONVAIR B-58	GRUMMAN F11F-1F	NORTH AMERICAN F-86	NORTHROP XF-89	SIKORSKY S-62
CONVAIR 880	KAMAN HU2K	NORTH AMERICAN F-86D	NORTHROP YB-49	VERTOL H-21D
CONVAIR XB-46				VERTOL YHC-1A

FLIGHT PROPULSION DIVISION

GENERAL ELECTRIC

CINCINNATI, OHIO AND LYNN, MASSACHUSETTS

Officer Cites Proposal Improvements

By Philip J. Klass

New York—Suggestions for cutting the cost of preparing engineering proposals for the military services and increasing their effectiveness were described here by Capt. F. W. Evans, Jr., Office of Naval Materiel, during the recent Institute of Radio Engineers Convention.

The ABCs of successful proposals, Evans said, are accuracy, brevity and clarity, and these must be supported by technical honesty and design simplicity.

Capt. Evans made these general recommendations for improving the effectiveness of technical proposals:

• **Eliminate padding and repetition:** "Sales talk and company propaganda clutter the proposal and sell no one," Evans said. Because individual sections of a proposal frequently are written by different persons, there often are discrepancies, inconsistencies and/or redundancy.

• **Improve clarity:** Use brief, sharply focused sentences and paragraphs, with precise, accurate, definitive descriptions. Greater clarity means less chance of misinterpretation by military proposal evaluating personnel.

• **Restricted use of color:** Expensive overlays and use of color should be limited to situations where they contribute to presentation clarity and not used merely as "window dressing or camouflage" which may actually detract from the engineering proposal, Evans said.

"Spend only the amount of funds necessary to convey your technical and management message . . . in a simple, easily understood manner," Evans said. "In no case should a company spend more than it can afford to lose."

Choice of Contractor

In evaluating technical proposals, the military services are seeking end products which meet or exceed all of the specification, technical performance and reliability requirements and which achieve a significant advance in the art, Evans said. The services also want delivery on schedule plus realistic and reasonable costs.

In addition, Evans said, the services prefer to work with a company that has:

• **Outstanding technical capability** in the specific branches of science involved in the program.

• **Adequate facilities on hand,** or the willingness to invest in such facilities, needed for research, development, testing and production, if the latter is required.

• **Demonstrated capability** in product engineering, production control and management.

• **Quality control organization,** staffed with competent personnel, that reports to a top management official who is not directly responsible for engineering or production.

In addition, Evans said, "there is a distinct advantage to contracting with a company having a management which is not only competent and experienced, but also is familiar with and actively interested in the program for which a proposal is submitted." One indication, Evans said, as to whether a company's management has this familiarity and interest, is whether senior management and engineering representatives participate in proposals or whether third and fourth tier personnel are sent.

One of the most important sections in a technical proposal, Evans said, is the initial summary because it is read by more persons in positions of authority than any other part of the proposal. Its objective must be to convince the prospective customer that the company is fully able to meet his needs. The summary should be brief, preferably a single page, but no more than two or three.

Writing the Summary

The summary should include the following, according to Evans:

• **Clear, concise statement** of technical requirement which the proposal fulfills, or in the case of an unsolicited proposal, the particular problem area involved.

• **Brief analysis** of the problem which proposal will solve.

• **Company's proposed method** of solution.

• **Relation of proposed solution** to

Astracon Amplifier Multiplies Electrons

Ultra-sensitive light amplifier, called the Astracon, employing five stages of electron multiplication, makes visible individual electrons released by photo-sensitive surface when hit by a single photon, according to Westinghouse Electric, which developed the device. Five stages of multiplication increase single electron to 3,000 electrons which are accelerated by 20,000 volts to release more than 20,000 photons of visible light when they impact on fluorescent material at output end of the tube. Astracon is useful for photo reconnaissance, astronomy and nuclear physics.

3M Materials Memo

News of materiel for the aerospace industry—from the 27,000 products of the 3M Company

■ GOT A DIRTY BIRD?

You needn't have. Missile "raincoats" made from 3M's new 4222 coated fabric protect against not only the ravages of the weather, but the attack of solvents and fuels, as well. This new polyester coating, available on nylon, Dacron, glass cloth, or other types of fabrics, is by no means a fair weather friend. It takes the punishment of wind and salt spray, has abrasion resistance greater than all other commonly used coatings, and offers excellent resistance to mildew. It's no slouch either when skies are blue. It has superior sunlight and ozone resistance. At temperatures as low as −80°F, it retains its flexibility and it's still in there pitching at 375°F. What's more, this low temperature flexibility is permanent. There are no plasticizers to bleed out upon aging.

The fuel and solvent resistance of this versatile fabric is a story in itself. It's quite at home with aromatics, aliphatics, ketones, and esters, as well as jet fuels, synthetic ester oils and hydraulic fluids. These characteristics have literally revolutionized the thinking in storage of fuels. For example, by today's standards, do you know the difference between a fuel tank and a hole in the ground? The answer is 4222 fabric of course! Spread out as a fuel resistant layer over the surface of an excavation, the hole becomes a cheap, safe storage well for jet fuels, diesel fuels, or oils. The finishing touch is another layer of 4222 to provide a cover.

Armed with these remarkable properties and your imagination, even the sky's no limit for you and 4222. For more information, either check below or see your ELECTRICAL PRODUCTS representative.

■ A BRIGHT IDEA!

Ever think of getting your illumination by the gallon? As farfetched as it may seem — such a thing is possible now, thanks to 3M's "CODIT" reflective liquid. Night handling and launch operations need no longer hold any qualms for you, if you take advantage of "CODIT'S" unique retro-reflective properties.

"CODIT" has been "showing up" on the electrical connectors in many of today's missile systems. A quick glance with a portable light shows you in an instant whether these vital connections have been properly made. Even the security people are praising the virtues of "CODIT" in its ability to quickly show whether enclosures are open or closed, fences have been cut, or a piece of equipment has been moved or taken from a storage area.

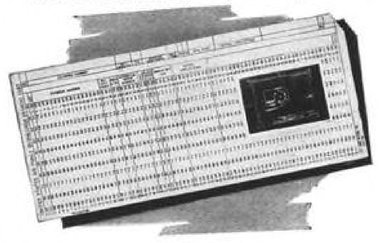
"CODIT'S" suspension of special reflective elements in a solvent dispersed vehicle returns light directly back to its source about 60 times as bright as any white paint could. Furthermore, it reflects at all angles, too. You still get reflectance when your viewing angle is almost 90° with respect to the normal of the coated surface. This is particularly important on rounded or complex shapes.

"CODIT" can be applied by spraying, brushing, hand rolling, or silk screen printing to most clean, dry surfaces. It even takes concrete, rough metal, and wood in its stride. Having a durability comparable to a high grade of exterior enamel, it can be used for exterior applications provided the surface is weatherproof or suitably treated. There is more information to be had from your REFLECTIVE PRODUCTS representative or clip the coupon below.

■ THE HOLE STORY

Want to know what's in a missile? Chances are you can find out from a "Filmsort" Aperture Card, a product of THE FILMSORT COMPANY, one of the divisions of 3M. The engineering drawings for the components of a missile go into these "Filmsort" Aperture Cards. It's no trick to put an engineering drawing as big as 34 x 44" into a standard punch card. All you do is microfilm the 34 x 44" drawing first. The "Filmsort" Aperture Card is simply the winning combination of microfilm and punch cards.

What does The Filmsort Company do? It produces the aperture cards that make microfilm standard, simple and practical.



Several agencies and their prime contractors for missile systems use these "Filmsort" Aperture Cards to keep up with the pace of the space age. These cards have something to do with time — not the time in space, but the time in our everyday world. Seems that in less than 90 seconds, you can put your hands on any one of these cards out of thousands in a file. Then, simply take the "Filmsort" Aperture Card to the *Thermo-Fax* "Filmac 200" Reader-Printer. Now, you can take a look . . . or, take more than a look, take a copy. That's all it takes to get a print these days.

If you'd like to learn more about these "Filmsort" Aperture Cards and expect to be in New York April 19-21, see a demonstration at the National Microfilm Convention in the Statler-Hilton Hotel. If you're chained to the desk then The Filmsort Company will be glad to send you the hole story if you'll so indicate below.

■ ABOUT "MIL"

3M's Missile Industry Liaison is a service staffed by technical personnel experienced in rocket propulsion and other phases of space technology. Their job is to translate problems of the aerospace industry to those 3M specialists best qualified to solve them. If you have questions on any of the items mentioned here, or would like to know what else 3M makes—or could make —for your needs, mail coupon.

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broader over-all weapon systems with which it will operate.

- **Description of hardware** which contractor proposes to furnish.
- **Conservative estimate** of its performance.
- **Realistic estimate** of program timetable.
- **Honest estimate** of program costs.
- **Indication of company's willingness** to devote its resources to proposed work with appropriate diligence.

The program presentation section of a proposal which follows the summary should provide an accurate and clear technical description of the proposed system and/or hardware, including drawings or sketches of proposed configurations along with block diagrams where appropriate. This section of the proposal should also include:

- **Program planning chart,** which indicates mileposts of specific technical accomplishments expected to be achieved during the project, with provision for periodic review and evaluation at these intervals. For a program which will extend more than a year, Evans advised a company to try to make the major program phases coincide with government fiscal periods to prevent subsequent delays due to funding problems.
- **Description of novel ideas** or technical approaches.
- **Statement of major technical** problems which must be solved, with an indication of amount of effort which company plans to devote to each.
- **Discussion of technical approaches** to be explored and why the company's approach can be expected to accomplish desired results. Also include a brief discussion of alternate solutions which the company has explored and rejected, and the reason for their rejection.

Honest Appraisal

Capt. Evans urged contractors to be honest and candid in their appraisals on such things as the following:

- **Performance requirements** which the company believes are unrealistic or unreasonable should be identified. "We are aware of the more difficult requirements and expect you to recognize them too, and to frankly state that there is a possibility that they will not be met," Evans said. The company should give as much detail as practicable concerning how it proposes to meet performance requirements never before achieved.
- **Excessive costs or time delays** which will be required to meet certain specification performance requirements should be clearly pointed out. "Under no circumstance should you assume in a research and development specification that the service has infallible justification for calling out each performance figure," Evans said. The company should indicate the price that must be

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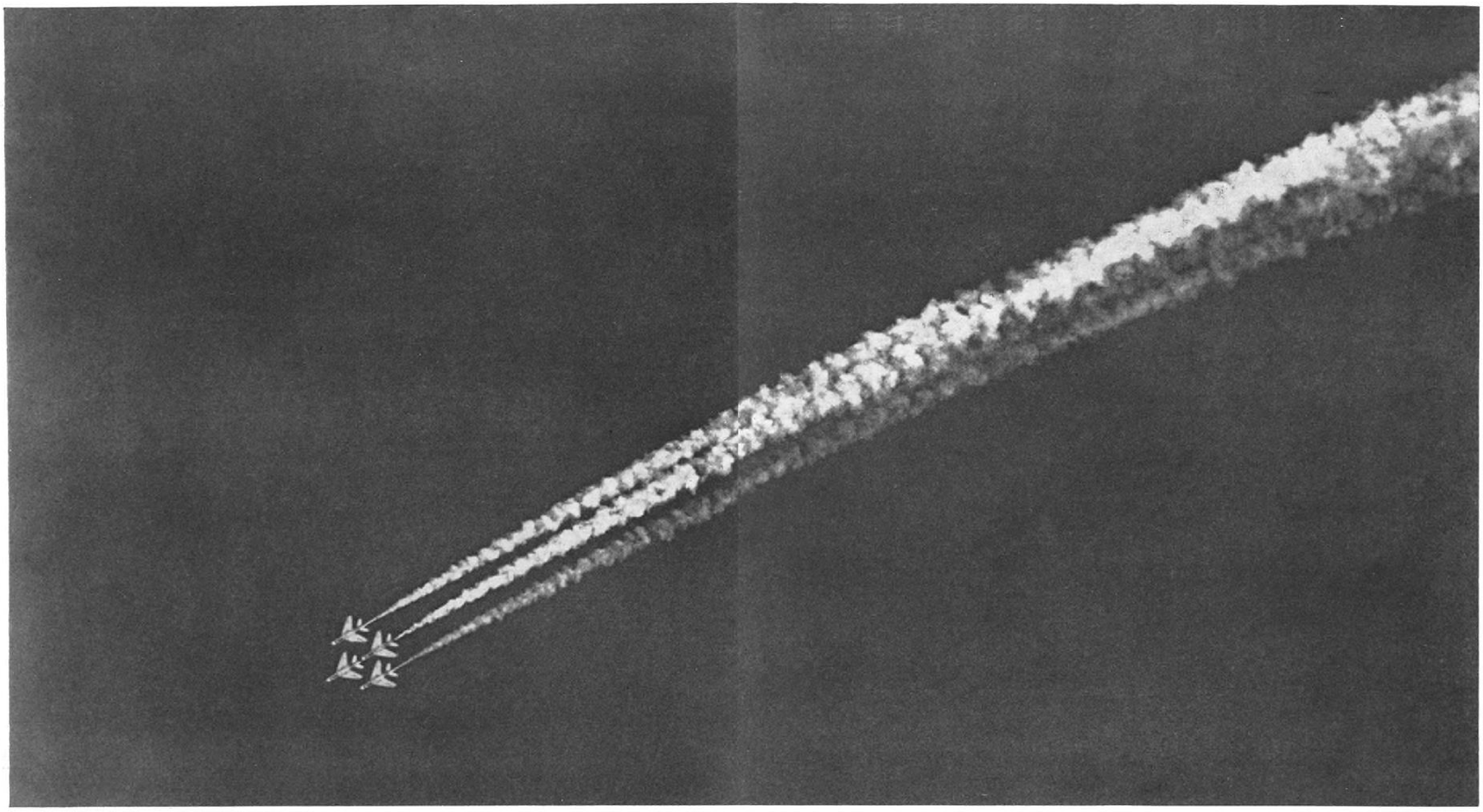

electrical energy for the needs of motion

While the prime moving forces change as man moves his vehicles from the highway to the sky and on into space, the all-important auxiliary power continues to be electricity. Jet, rocket and missile contractors who are in need of reliable units for the accurate release, transformation and control of vital electric energy can turn to Delco-Remy for certain on-time delivery, whether the quantity be measured in tens or ten thousands.

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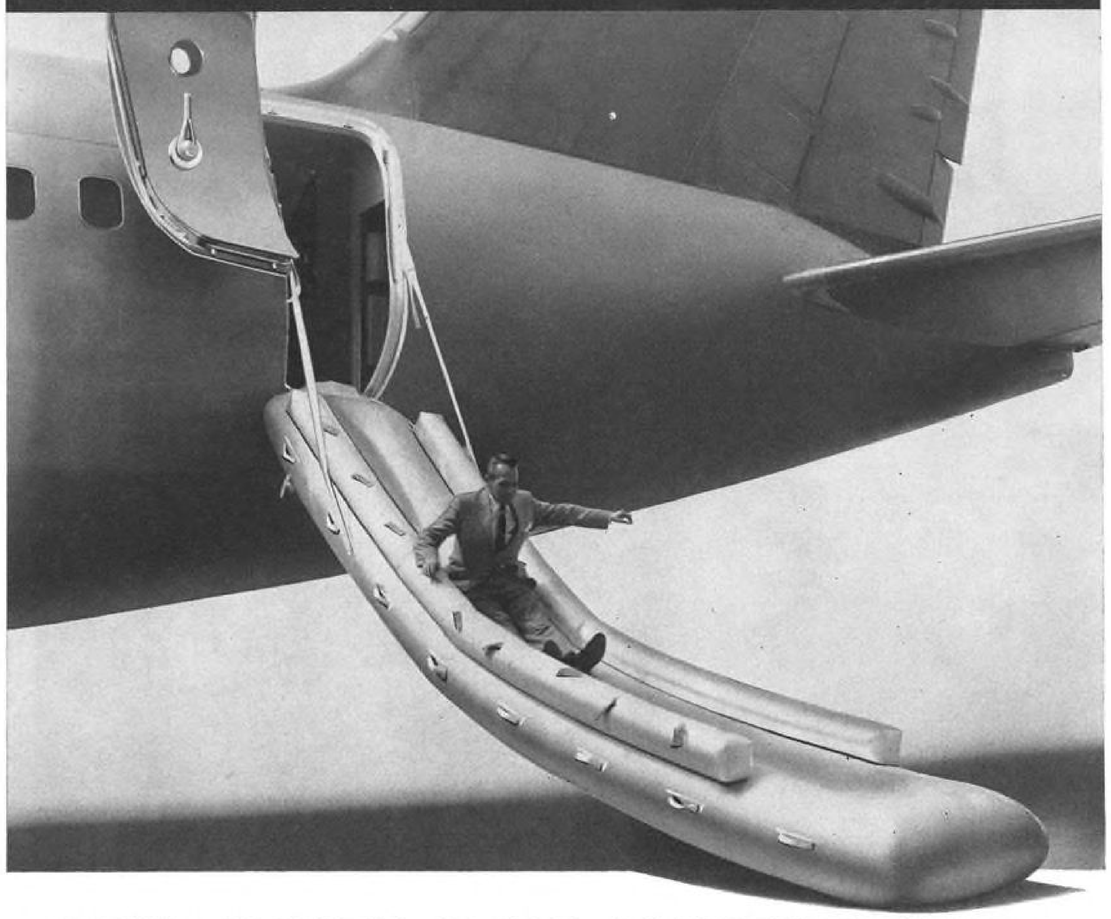

NEW ESCAPE SLIDE SAFETY FEATURE

This flexible escape slide developed by Air Cruisers for jet airliners provides rapid and safer emergency evacuation of passenger aircraft, particularly at extreme aircraft attitudes.

The passenger's speed of descent is automatically reduced by his own body weight bending the last portion of the flexible slide closer and closer to a horizontal attitude as he nears the ground. Rate of descent is virtually stopped as the passenger eases off the final few feet of slide resting parallel on the ground.

Simple to operate, Air Cruisers escape slides are standard equipment on many turbine-powered military and commercial aircraft.

The Air Cruisers jet pump, which produces rapid inflation vital to the fast, dependable operation of escape slides, is yet another contribution toward better survival equipment by America's most experienced fabricator of inflatables from rubberized nylon materials.

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paid in dollars and time so that the initiating office can carefully re-examine the specifications and decide whether to alter the requirements. "It can be disastrous to learn these facts only after thousands of man-hours and millions of dollars have been expended," Evans added.

The detailed presentation also should state where company expects to deviate from established military specifications, indicating to what degree and why it is considered necessary or desirable. Presentation should give an estimate of maintenance procedures and schedule required for the system and to what extent special test and/or support equipment will be required.

If the company must develop new components for use in the proposed system, it should so state and explain why existing components cannot be used. Evans warned that companies should not give the appearance of proposing new component developments because of a "not-invented-here" attitude. Any unusual or unique component reliability requirements exceeding that normally obtained from conventional components should be described and justified.

Where hardware is to be supplied, the company should indicate whether it will be suitable for production or whether partial or complete re-engineering effort would be needed before design could be placed in production.

Capt. Evans suggests that a company indicate when its proposed hardware is related to existing or previous programs which the company has done for other customers, indicating the customer, project identification and funds already spent on the previous program. If the company proposes to use any proprietary information or techniques, it should be listed.

Estimates by company scientists as to the likelihood of the program resulting in usable hardware can be helpful to the military evaluators, but such appraisals should be clearly identified as estimates.

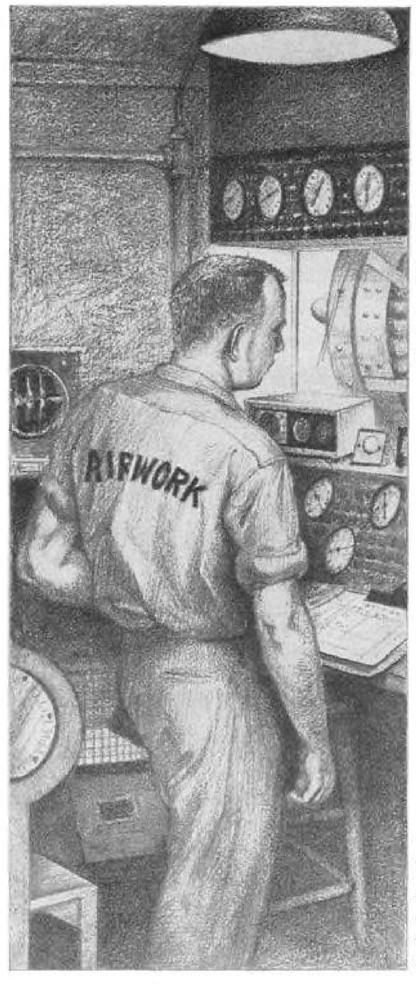
Military proposal evaluators are interested in learning what type of organization will be employed on the proposed program, i.e., will a special group be formed or is company-wide participation planned? If a special group is to be formed, its position in over-all company organization, the limits of its authority and responsibility should be stated. If no special group is to be formed, the proposed method of operation within the over-all company structure should be described.

Capt. Evans cautioned that companies should only list technical personnel expected to be assigned to the specific program, identifying their particular technical qualifications for the project involved.

In describing facilities, a company

New Electron Gun

New electron gun for klystron tubes permits major increase in power of radar by providing an electron beam five times more powerful than previously, according to Sperry Gyroscope Co. which developed the device. Gun can provide electron beams of more than 200 megawatts power and 1,000 amp. current for high-power tubes. Gun also is expected to extend tube life.



The Hours Here Are The Most Critical

Run-in is the most critical time in the life of an engine. Run-in burnishes the parts, guarantees, to an amazing degree, the successful life of the engine. More care in the test cell means more long term protection for your pocketbook.

Here's four typical Airwork Test Cell Extras that make sure your engine is ready for maximum service:

Oil pressures and temperatures are read in many different parts of the engine — helping us pinpoint possible malfunctions before they occur. The volume of oil moving through the engine is measured, too.

Ignition systems are checked with a Scintilla ignition analizer. This makes sure every component is interacting properly.

Oil consumption and fuel consumption are checked by extremely accurate instruments. We don't depend on dip stick tests.

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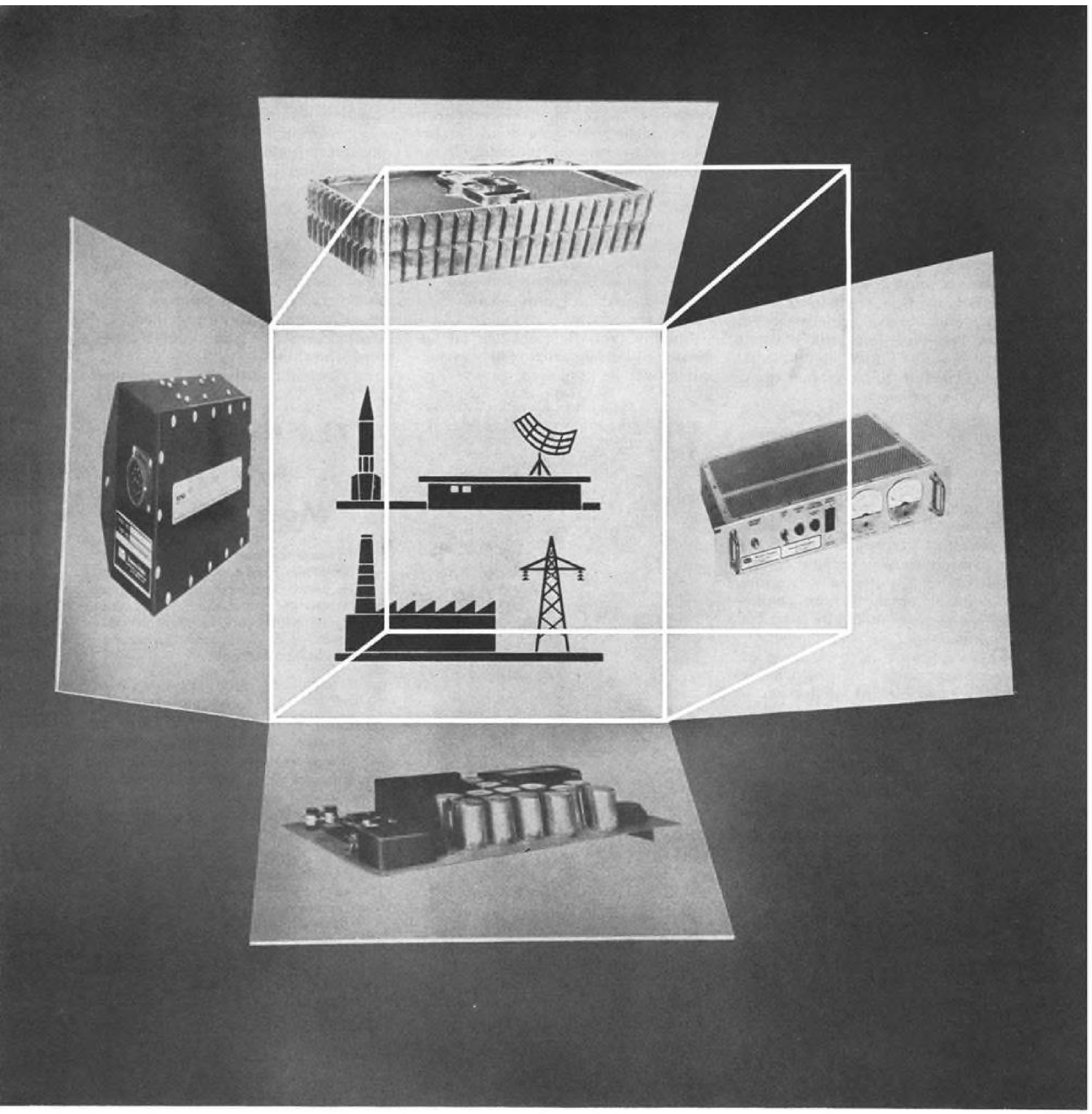

The Many Sides of Solid State Power

There are many examples of Western Design solid state power supplies . . . regulated multiple-outlet units with a maximum of 3% distortion, less than 1° phase shift and regulation as tight as ± .5V at 130V, 400 cps . . . economy-priced single-outlet units regulated to .3%, with extremely low heat-generation and 100 microsecond response. ■ Features such as these are typical of Western Design's power conversion capability in airborne, ground support and industrial applications. Backed by long, complementary experience in the electro-mechanical field . . . strong corporate financial back-up . . . excellent field service . . . no one offers quite so reliable a package of solid state power as Western Design. ■ For detailed information, contact your Western Design representative or write us for Data File AW-1020-1

USI **Western Design**

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SANTA BARBARA AIRPORT, GOLETA, CALIFORNIA

should list those available which it plans to use for research, development, production and testing, with a description and estimate of cost and delivery of any new facilities which the company proposes to procure for the program. Evans says a firm also should give a summary of its test equipment and calibration program.

Capt. Evans cites the following as the most frequent shortcomings of proposals received by the military services:

- **Oversimplification** of the technical problem or requirement.
- **Misinterpretation** of the specifications, or failure to comply with them.
- **Lack of understanding** of the technical requirement.
- **Proposed engineering program** is not technically feasible in the available timetable.
- **Over-optimism in performance** estimates of proposed equipment.
- **Insufficient detail** in cost and pricing information.
- **Lack of realism** with respect to how proposed equipment can be integrated or made to work with other planned or existing equipment or operational philosophies.
- **Proposal contains vague generalities** and/or sweeping statements which reflect the philosophy: "We understand your problem, just give us a contract and leave it up to us."

Capt. Evans said that unsolicited proposals frequently are rejected for the following reasons:

- **Funds not available** for such a program at the time it is received.
- **Weapon (aircraft, missile, ship)** for which new development is proposed will soon be phased out of service.
- **Proposed program timetable** is too far out of phase with research and development timetable of weapon with which it would be used.
- **Need for proposed equipment** is not established, or it offers too little improvement to justify cost and effort.

Capt. Evans said that a company does its country as well as itself a disservice when it comes up with a basically excellent and vitally needed idea, but fails to sell the military services because of a poor proposal.

Infrared Tracker System Tests Readied at WADD

USAF's Wright Air Development Division soon will begin evaluation tests on prototype model of the AN/AAR-21 infrared search-track system for interceptor use, developed by International Telephone & Telegraph Corp. System employs two infrared tracking heads to provide both target bearing and range information. WADD does not disclose the type of infrared detector used, but says it is cooled to liquid nitrogen temperature.

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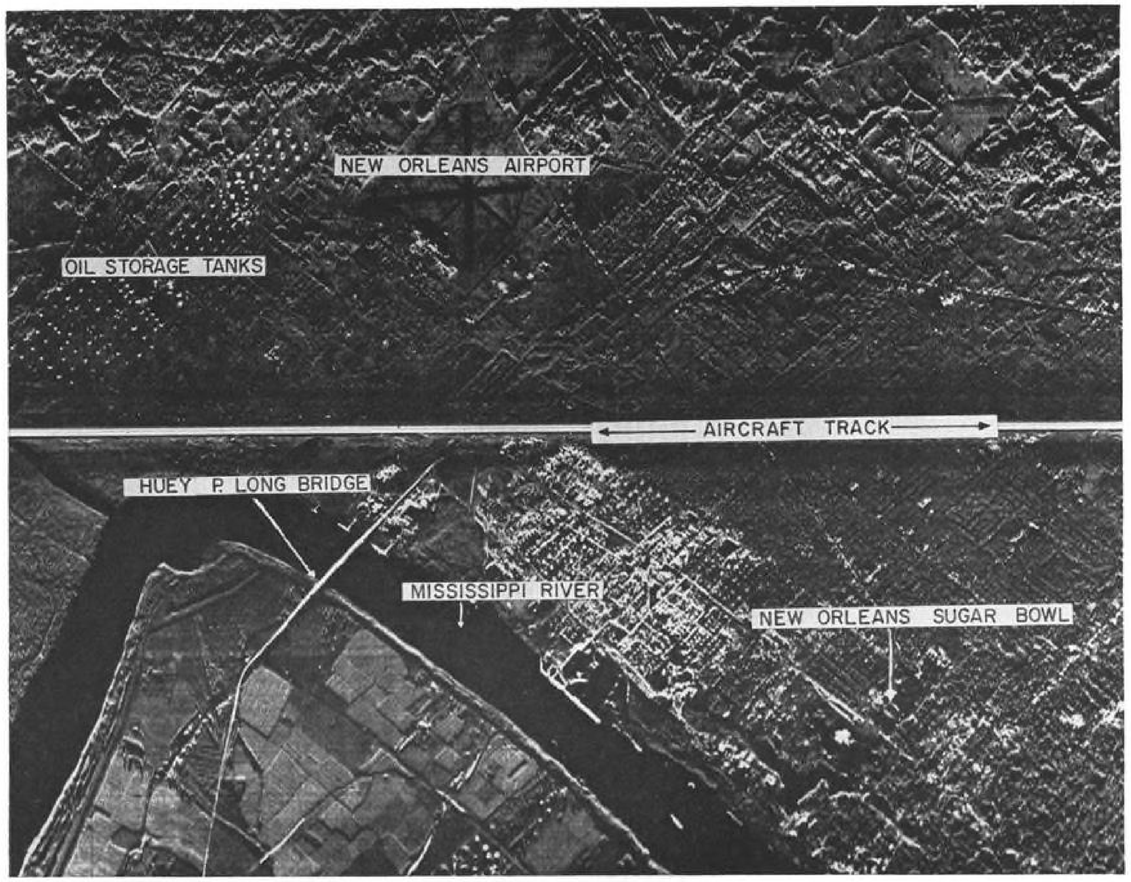


RADAR PHOTO of New Orleans from 3,000-ft. altitude was taken by AN/APQ-55 side-looking radar developed by Texas Instruments for USAF. Side-looking radar enables aircraft to approach target without alerting enemy reconnaissance receivers when aircraft still is several hundred miles away as with conventional forward-looking radar. Photo, made with X-band radar, shows a barge moving along river (right to left). White band caused by aircraft track results from side-looking radar blind spot.

Side-Looking Radar Takes Aerial Photos

Dallas—Side-looking radar mapping system that can provide high-resolution aerial photographs for tactical information on a round-the-clock basis and can penetrate camouflage, rain or fog with little or no degradation of images has been developed for the Air Force by Texas Instruments, Inc.'s, Apparatus Division here.

A small number of production units have been delivered to USAF's Tactical Air Command and further contracts are now being negotiated.

The X-band system, designed AN/APQ-55 (XA-1), is designed to map from piloted or unmanned reconnaissance aircraft at groundspeeds from 200 to 800 kt., simultaneously recording strips of terrain 3 to 6 mi. wide on either side of the aircraft. A later version can handle 10-to-20-mi. widths, and another modification will have the capability of mapping at groundspeeds of up to 2,200 kt., according to Texas Instruments.

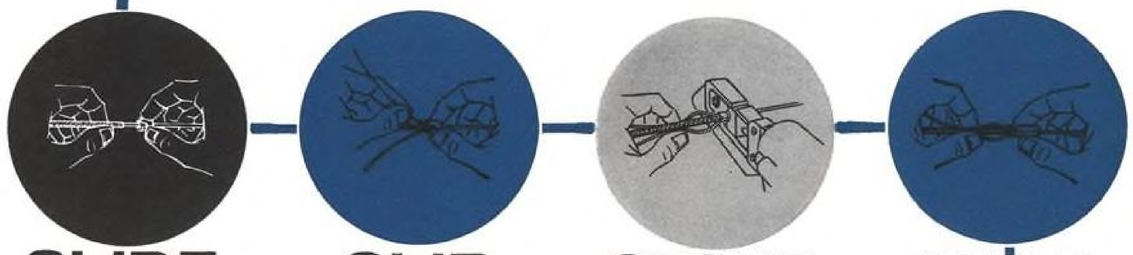
System is designed for operation at altitudes of 1,000 to 5,000 ft. Weight is approximately 350 lb., and its modular makeup permits major components to be located in various portions of an aircraft, if necessary, because of weight-and-balance limitations. Transistors are extensively used. A Texas Instruments-developed electronic switching device permits use of a single radar equipment to look alternately from either side of the aircraft through side-looking back-to-back linear slotted array antennas measuring 8, 10 or 12 ft. long.

Another design feature is that objects at the edge of the photos are maintained at the same scale as at the center, whereas on conventional aerial photography, ground distances tend to become compressed in perspective as the distance to the camera increases.

The Texas Instruments radar system can scan a constant ground area independent of altitude and cover a wide area at low altitude to record detail without perspective distortion, according to the company. A moving target indication also permits isolation of targets to reveal the amount of activity in an area. Radar "shadows" thrown by the side-looking radar permit precise measurements of heights and depths of objects on the ground.

Radar returns are displayed as a single modulated trace on the cathode ray tube and recorded on film. A Texas Instruments-developed film-pulling mechanism carries the five-inch-wide film past the trace on the tube face proportional to groundspeed and altitude, thus providing a continuous high-resolution strip. Film magazine is easily removed and reloaded or replaced to provide considerable mapping coverage during a

WHEN IT COMES TO SHIELDED WIRE



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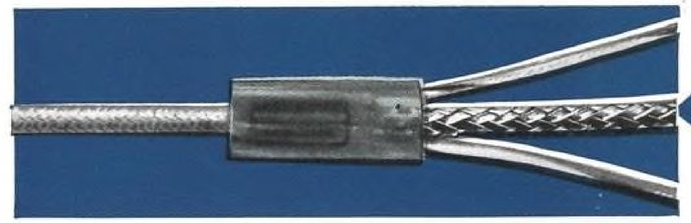

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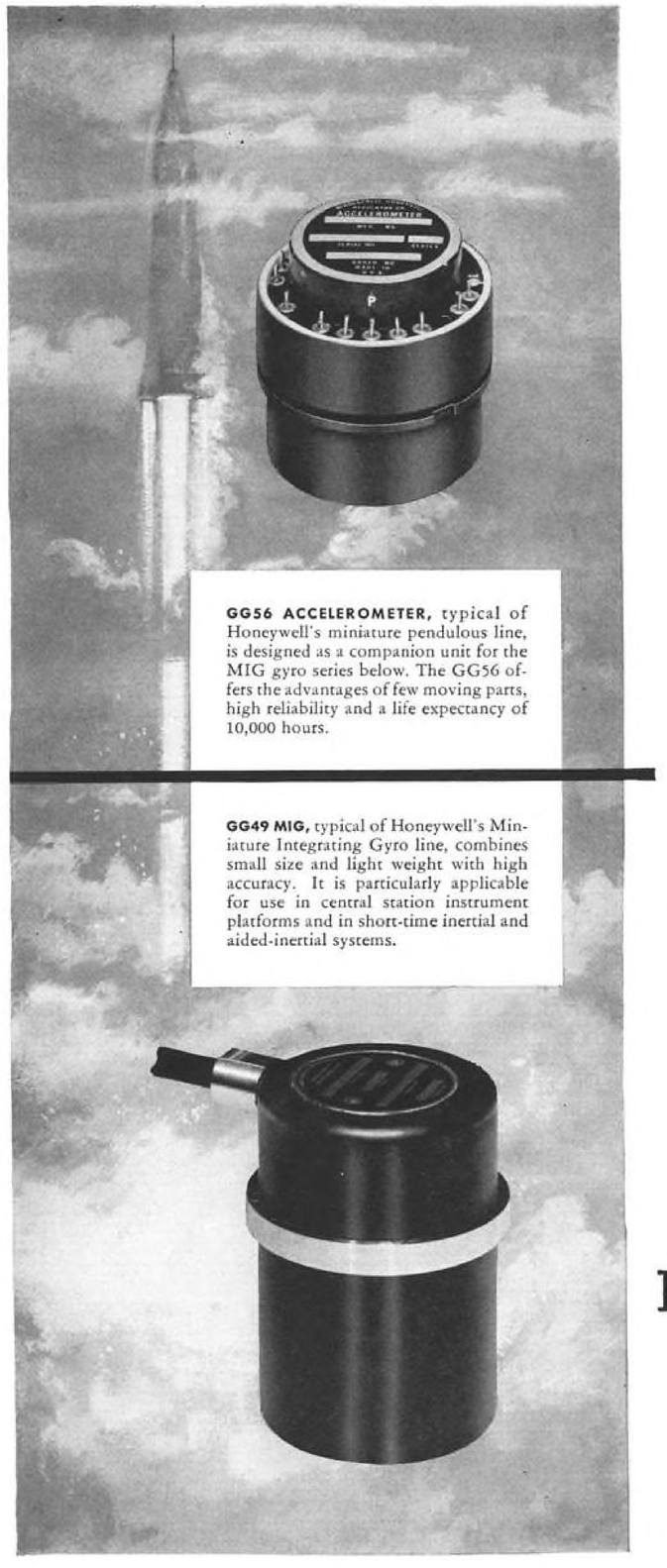

GG56 ACCELEROMETER, typical of Honeywell's miniature pendulous line, is designed as a companion unit for the MIG gyro series below. The GG56 offers the advantages of few moving parts, high reliability and a life expectancy of 10,000 hours.

GG49 MIG, typical of Honeywell's Miniature Integrating Gyro line, combines small size and light weight with high accuracy. It is particularly applicable for use in central station instrument platforms and in short-time inertial and aided-inertial systems.

It's only natural that Honeywell, world's largest producer of gyros, should have produced more miniature integrating gyros and more precision miniature accelerometers in the last four years than any other manufacturer. But what does this mean to you, the customer? Just this: the experience Honeywell has gained in building over 30,000 floated gyros and over 18,000 accelerometers has been directly applied to our MIG line and our precision miniature accelerometers.

Although the GG49 Miniature Integrating Gyro was introduced by Honeywell four years ago, it has been continuously improved in accuracy and dimensional stability. New models have been added to meet various performance requirements so that Honeywell now has the most complete line of Miniature Integrating Gyros in the industry. These rugged MIGs are especially tailored to meet your requirements for advanced fire control systems, gyro reference systems, inertial navigation systems, radio-radar navigation systems, and missile tracking systems.

Honeywell precision miniature accelerometers also reflect Honeywell's gyro and accelerometer experience. Honeywell miniature accelerometers, precision-balanced to insure optimum reliability, are now available in angular, linear and integrating types.

Honeywell is eager to work closely with your systems engineers—incorporating gyros and accelerometers into your systems and developing modified or entirely new inertial components to meet your special needs. For further information, write Minneapolis-Honeywell, Dept. AW-4-110, 2600 Ridgway Road, Minneapolis 13, Minnesota.

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H HONEYWELL *Military Products Group*

THE GRAND CENTRAL REPORT

RESEARCH INGENUITY — AND NITRASOL

That wonderful American ability to fix almost anything with a piece of baling wire often seems lost among the complexities of an age in which almost any problem requires a nine-figure budget.

That this "baling-wire" ingenuity is an unalterable American heritage was re-established recently by Dr. Leon Foreman, former college chemistry professor, now in Grand Central Rocket Co.'s Research Department.

A very interesting new solid propellant, Nitrasol, was being developed at GCR. It had great promise. But there was no economical way to schedule a test batch in one of Grand Central's large complex mixers.

Dr. Leon Foreman was given this problem to study. Before anyone realized the significance of what he was doing, he had bought a polyethylene waste basket at the dime store, attached an air-driven shaft and propeller, and, with this equipment costing $150, mixed the first test-size batch of Nitrasol. It was cast and fired—with complete success.

So efficient was Dr. Foreman's wastebasket mixing technique that GCR scaled up the batch size to a one-ton-a-day capacity in constructing the nation's first commercial pilot plant for Nitrasol. With typical team aggressiveness, GCR personnel built the new plant in eight weeks. During the first three weeks of operation, thirty-five Nitrasol rocket motors were mixed, cast, and successfully tested.

Today the Nitrasol mixed in this new plant—revolutionary in its simplicity and low cost—offers a new promise to America's future in propulsion.

Positions open for chemists, engineers and solid rocket production specialists.

Grand Central Rocket Co.

P. O. Box 111 Telephone: PYramid 3-2211
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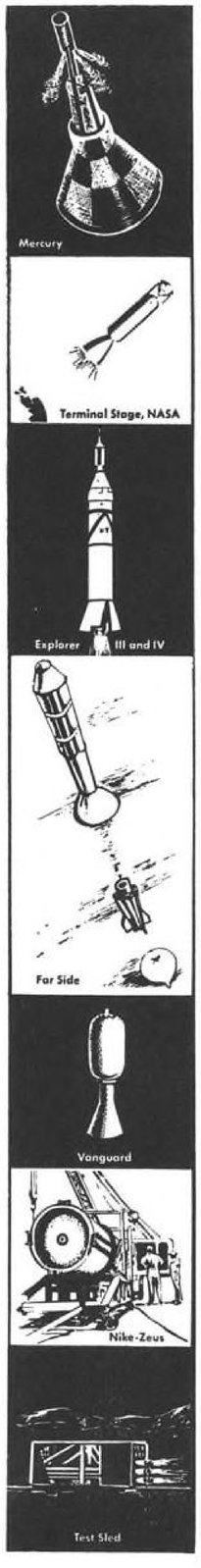


single flight. Actual image width is three inches, the remainder being given to recording time, altitude and other pertinent data simultaneously with ground image recording.

System also provides for simultaneously transmitting radar mapping surveillance imagery to ground bases, using microwave data link communications equipment developed here.

Applications of the AN/APQ-55 family have included a mission flown for the Coast Guard during a critical iceberg period when weather conditions rendered other methods of studying the menace impossible. By means of the AN/APQ-55 equipment, the Coast Guard was able to map through the dense fog and get up-to-date interpretation of the iceberg size and flow and determine break-up times.

Further developments of equipment now under way here include capability of providing maps of remote terrain movements within moments after the aircraft makes its pass to give moving target indication, with mapping data also transmitted directly via data link. Another advanced system provides long-range high-altitude capabilities with system resolution that is independent of range.

FILTER CENTER

► **New Semiconductor Microwave Modulator**—New type of modulator, consisting of germanium rods or slabs placed in a waveguide, which achieves 50% modulation of microwave power with little or no change in frequency or phase, was described by Army Signal Research and Development Laboratory scientists at the recent national IRE convention. Semiconductor material has small alloyed junctions located along its sides to inject minority carriers required for modulator action. The report was prepared by Harold Jacobs, Frank A. Brand, Michael Beranti and Richard Benjamin.

► **Solar Relay Appears Doubtful**—Use of the sun as a passive communications relay appears possible but not too feasible, at least at present, according to a study made by Radio Corporation of America's Donald J. Blattner. Because of the distance to the sun and the strong radio noise generated by the sun itself, extremely slow data rates would be required, Blattner indicated, as well as extremely large antennas. Added objection is the 15 min. transit time required to bounce a signal off the sun. Optimum frequency would be about 40 mc., RCA studies indicate.

► **FAA To Test New Radar**—Evaluation tests of a new terminal area radar developed by Bendix Radio, the AN/FPN-34, which offers more than double the range of existing Federal Aviation Agency terminal area radars, will begin shortly at the National Aviation Facilities Experimental Center (NAFEC) in Atlantic City. Radar, originally developed for the Air Force, is one of two experimental models built to date. NAFEC will evaluate radar's performance as a terminal area aid and also use it as a terminal-transition radar input for newly developed data processing system.

► **Granger To Build New Dischargers**—Granger Associates, Palo Alto, Calif., has been licensed by Stanford Research Institute to manufacture and market the new corona static dischargers developed by SRI's Robert L. Tanner (AW Mar. 14, p. 52.)

► **Radiation Resistant Transformer Report**—Significant progress in the development of power transformers and inductors capable of resisting temperatures of 500C and nuclear radiation is described in new report, "Ultra High Temperature Power Transformers and Inductors," PB 161046, now available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. The 576-page report, based on a program sponsored at General Electric by Wright Air Development Center, is priced at $7.00.

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

• **Raytheon Co.**, $10.5 million in contracts from Army Ordnance for continued research and development on Hawk missile system.

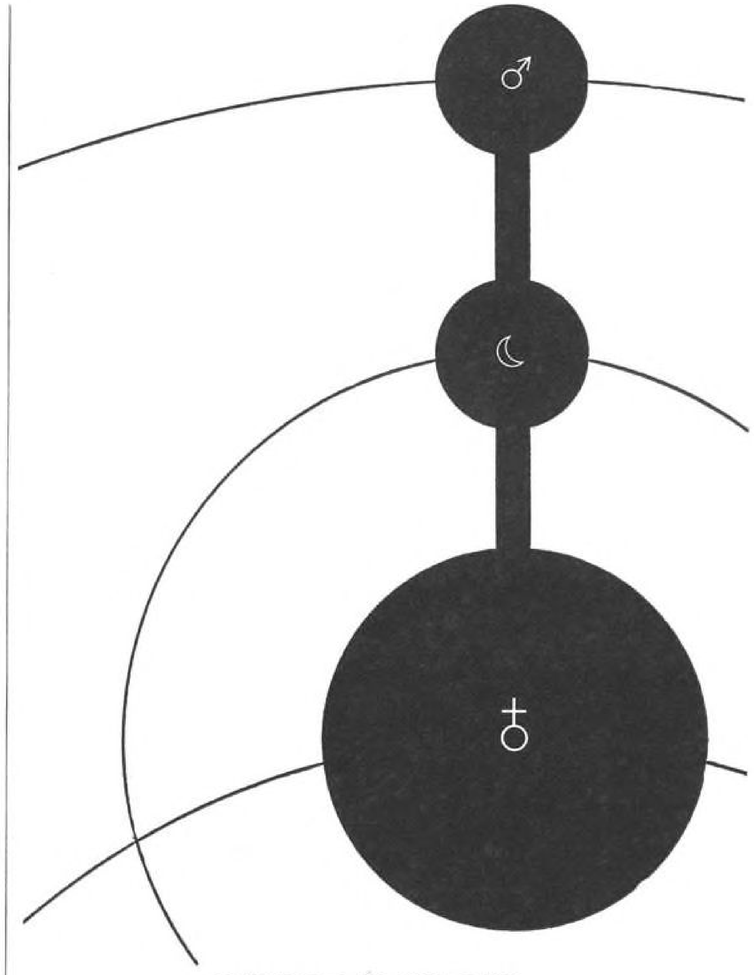
• **Northrop's Nortronics Division**, contracts totaling $22.6 million for continued production and engineering work on Hawk missile.

• **Chicago Aerial Industries**, Melrose Park, Ill., $1.25 million Navy award for KA-30 cameras to be used on supersonic jet aircraft. Also, USAF contracts totaling $500,000 for production of reconnaissance testing equipment.

• **Lear, Inc.**, Santa Monica, Calif., $2.25 million additional funding from Bell Telephone Laboratories, for gyro reference unit to be used in Nike Zeus anti-ICBM missile. New contract bring's Lear's total awards for Nike Zeus to $9.3 million.

• **Beckman Instruments, Inc.**, Fullerton, Calif., will deliver 15 atmosphere analyzers to the Navy for use in nuclear submarines under two awards, totaling $445,115, from Navy.

• **International Telephone & Telegraph's** Federal Division, Clifton, N. J., will supply beacons, antennas and test equipment associated with Tacan to the Navy Bureau of Ships under contracts totaling more than $2 million.



SYMBOLS IN THE SKY

The Moon (☾) ... Mars (♂) ... and other planets are getting closer to our doorstep (♁).
A great American team ... the huge complex of industry, science, military and civilian workers, are building the vehicles which will soon make the planets our next door neighbors.
California General ... fabricators of assemblies for rockets and missiles ... is a significant part of this team.
California General salutes this industrial and scientific complex ... and its contribution to the conquest of space ... the 20th century miracle.

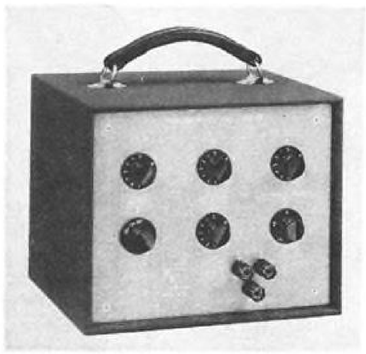
CALIFORNIA GENERAL, INC.
P.O. Box 565, Dept. A, Chula Vista, California

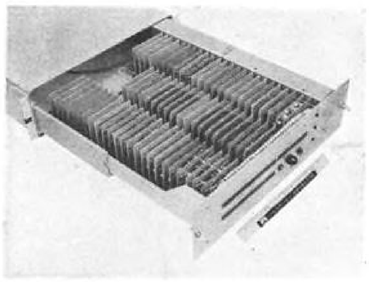
NEW AVIONIC PRODUCTS

Test Equipment

• **Oscilloscope,** Type 401-B, a general purpose, low-frequency scope which boasts synchronization performance comparable to high-priced, medium frequency scopes, is available at $430 from the manufacturer, Allen B. Du Mont Laboratories, Inc., Clifton, N. J. Internal and external sync includes d.c. coupling, trigger leveling, single sweep, and automatic sync. Characteristics include sensitivity of 10 mv./cm. with identical horizontal and vertical amplifiers, bandwidth of 300 kc. at 3 db. points, gain and pattern stability better than 2% over 8 hr. and drift averaging less than 5 mv./hr.

• **Voltage reference source** for calibration of telemetry, data reduction and laboratory equipment is available in portable and rack-mounted models which weigh 8 lb. Basic unit is a 4 decade, direct-reading device with full scale of ±11.111 v. in 1 mv. steps. Other characteristics, itemized by the firm, are less than 100 mv. inherent noise, drift and ripple, less than 50 milliohms output impedance and factory preset maximum output current to prevent damage from direct short of output terminals. Unit's price is $555, f.o.b. factory, Electronic Development Corp., 423 West Broadway, Boston 27, Mass.

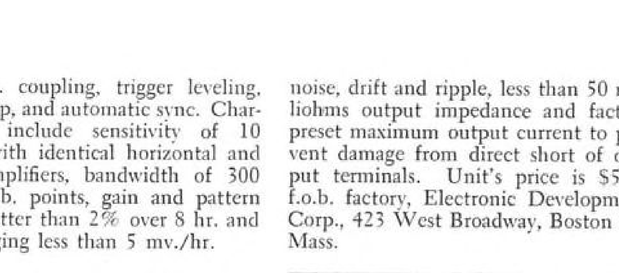




• **Memory core tester,** which verifies the operational status of a 19-bit, 4,096 address core memory, is available for standard relay rack mounting. Core memory test can be made on selected addresses and bits or in sequence on all addresses with every combination of the 19 bits. Test may be started, stopped or restarted from any address with any word pattern. Tester requires 105 to 125 v. a.c. 50/60 cps. and is priced at $10,500. Packard Bell Computer Corp., 1905 Armacost Ave., Los Angeles 25.

Monadnock self-locking CLIP-ON NUT to replace standard nutplate

Eliminates costly riveting in structural and non-structural installations. Applied where suitable edge margin exists or through cut-out hole in center of panel, Clip-On Nut quickly slips onto panel or structure and locks firmly in bolt hole. Available for .020" to .150" application thicknesses. No tools required. As integral part of a sub-assembly, Clip-On Nut eliminates additional drawings, part numbers and installation in final assembly traditional with conventional locknuts. One airframe manufacturer reports a savings of 32c each time a Monadnock Clip-On Nut is used in place of nutplate. Clip-On Nut reduces inventory; simplifies design changes, field rework, repairs. Meets MIL-N-25027—120,000 psi class. Write for bulletin.



Drawn eyelet locates Clip-On Nut assembly in application hole. Controlled radius edges developed on eyelet (see arrows) insure smooth installation action.

Clip-On Nuts securing floor panels of Boeing 707 jetliner. Replace riveted nutplates where thickness of upper leaf is not objectionable and suitable edge margins can be provided.

Clip-On Nut mounted through cut-out hole in center of panel when edge margin is excessive.

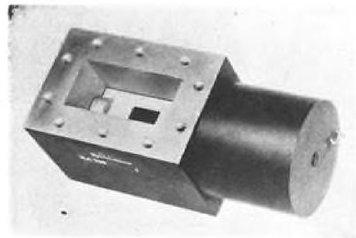
AIRCRAFT DOT FASTENERS · MONADNOCK MILLS · SAN LEANDRO, CALIFORNIA

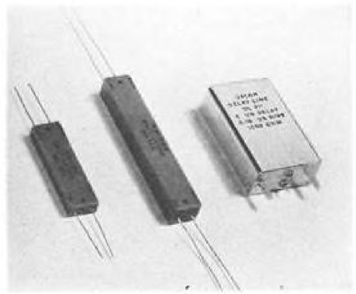
SUBSIDIARY OF UNITED-CARR FASTENER CORP., BOSTON, MASS.

OFFICES: ATLANTA, BOSTON, CHICAGO, CLEVELAND, DALLAS, DETROIT, LOS ANGELES, NEW YORK, PHILADELPHIA, SYRACUSE

Components & Devices

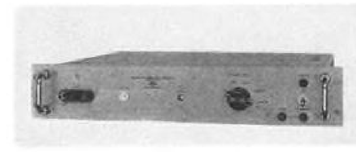
• **Rotary waveguide shutter,** MA-788, is available for use in RG-48/U S-band applications. Operating voltage is 20 to 29 v.d.c.; current at 28 v. is 560 ma. and coil resistance at 25C is 50 ohms. In closed position, the shutter provides 25 db. attenuation; in open position insertion loss is 0.2 db. max. and vswr is a max. of one. Unit will operate under 5g vibration (at 50 to 500 cps.) and in −40 to 100C temperature range, according to firm, Microwave Associates, Inc., Burlington, Mass.





• **Delay lines,** in which 150 lumped constant sections are packaged in a cubic inch, are available with delays of 0.1 to 20 microseconds, 100 to 2,000 ohms impedance, 100:1 delay to rise time ratios and attenuations as low as 0.008 db. Delivery from stock to two weeks is offered by manufacturer, Valor Instruments, Inc., 13214 Crenshaw Blvd., Gardena, Calif.

• **Voltage-to-frequency converter,** Models 2211A/B, permit d.c. and analog voltages to be measured under operating conditions with accuracies of better than 0.03 and 0.04% respectively for the two units assuming calibration once a day. The count of output pulses from these converters represents the true integral of the input voltage over the measured integral. The A and B models produce 10,000 pulse/sec. for full scale input of 1 v. and 100,000 pulse/sec. full scale respectively. Both units are priced at $1,250 f.o.b. Palo Alto, Calif. Dymec Division of Hewlett-Packard Co., 395 Page Mill Road, Palo Alto.



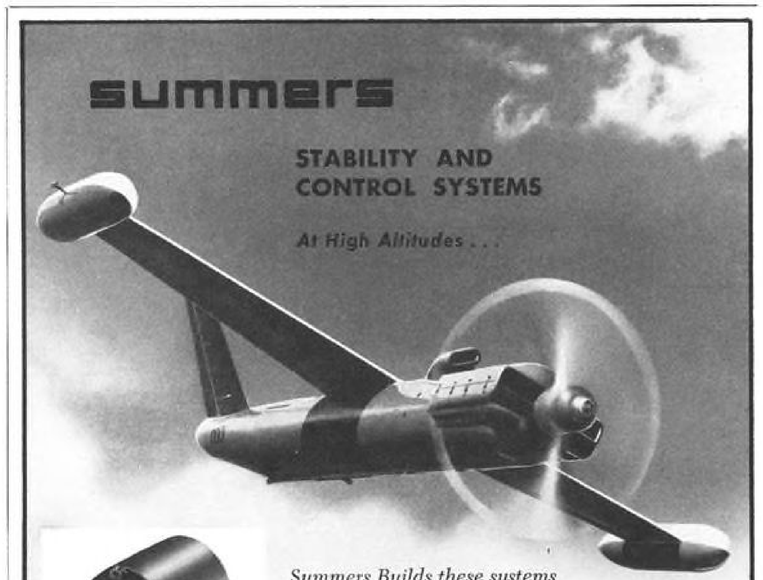
• **Self-calibrating accelerometers,** which permit calibration before and during flight of missile or aircraft are available with side mounted connectors (AS 1025) and with top mounted connectors (AS 1030). Units have an acceleration range of 0.2 to 500g and a frequency response of 3 to 5,000 cps. The AS 1025 weighs 21 grams, measures 1.13 in. in length and 0.88 in. in diameter Accelerometers use dial seismic system with one element as the driver and the other the sensor to obtain the self-calibrating action. Sensitivity and capacitance of the output seismic element are rated at 7.5 mv./g minimum and one nanofarad while the calibrating seismic element has 4.5 mv./g minimum sensitivity and ¼ a nanofarad minimum capacitance. Gulton Industries, Inc., 212 Durham Ave., Metuchen, N J.

• **Trimmer potentiometer,** Model W-51, has resistances ranges from 10 to 100,000 ohms with ±10% tolerance. Atohm Electronics, 7648 San Fernando Road, Sun Valley, Calif.

summers

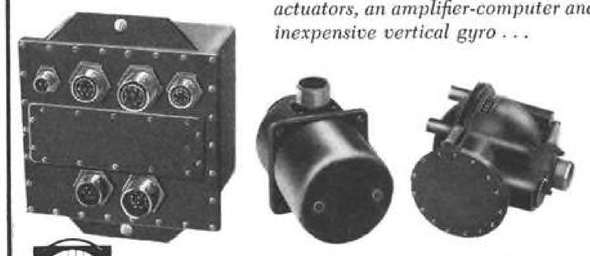
STABILITY AND CONTROL SYSTEMS

At High Altitudes . . .



Summers Builds these systems for the KDB-1, Military Target missile constructed by Beech Aircraft Corporation . . . A vital defense training device at bases around the world . . .

Summers components of the system include a tilted, position-and-rate (PAR) Gyro, with single sensor; two high-performance actuators, an amplifier-computer and an inexpensive vertical gyro . . .



summers GyroScope Company

2500 BROADWAY, SANTA MONICA, CALIFORNIA

DAYTON, OHIO WASHINGTON, DC

THE ALL NEW

AERO COMMANDER 500A

first of a brilliant series featuring the

SPEED-LINE NACELLE

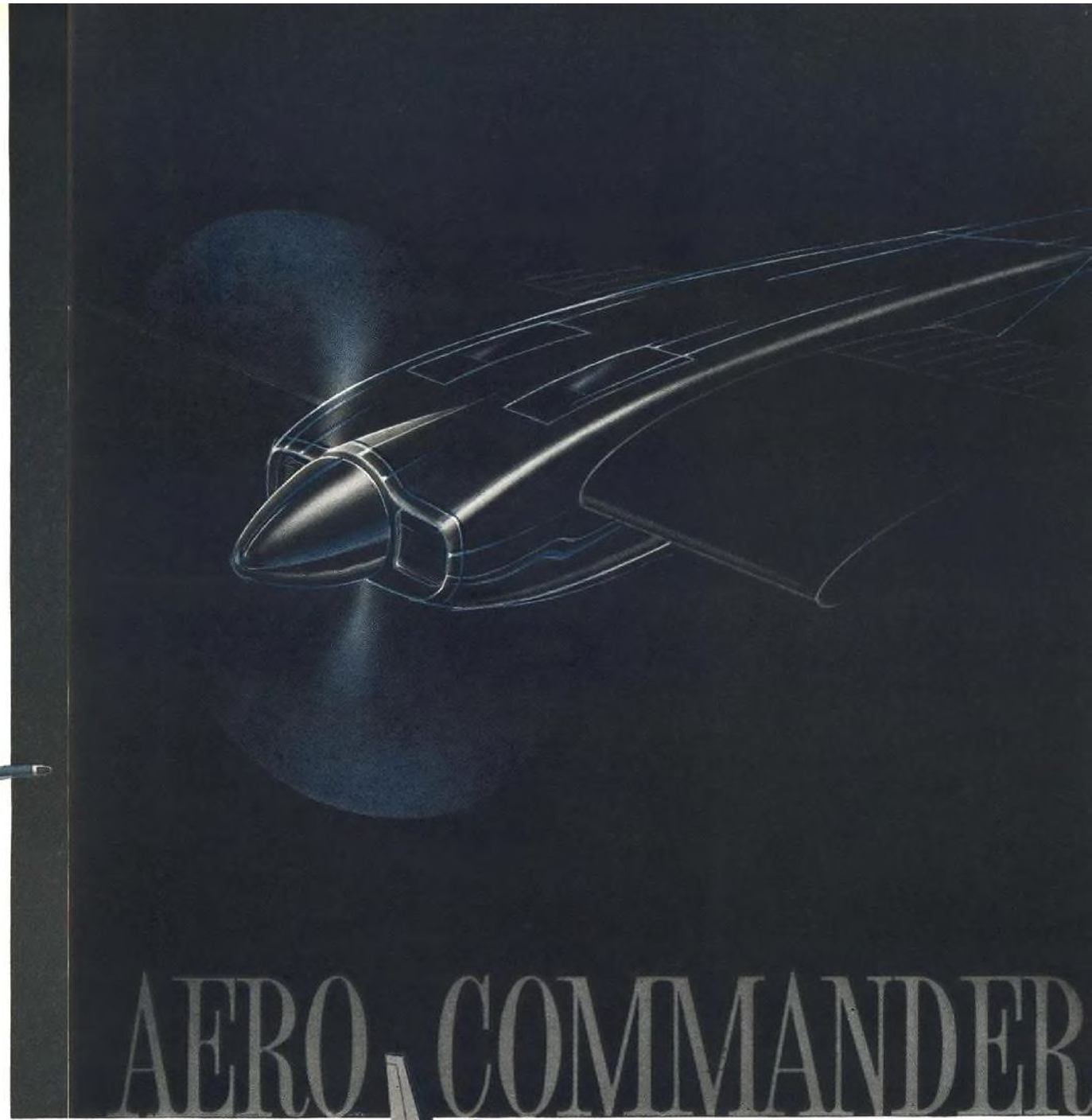
a new, compact design that

INCREASES SPEED and PERFORMANCE

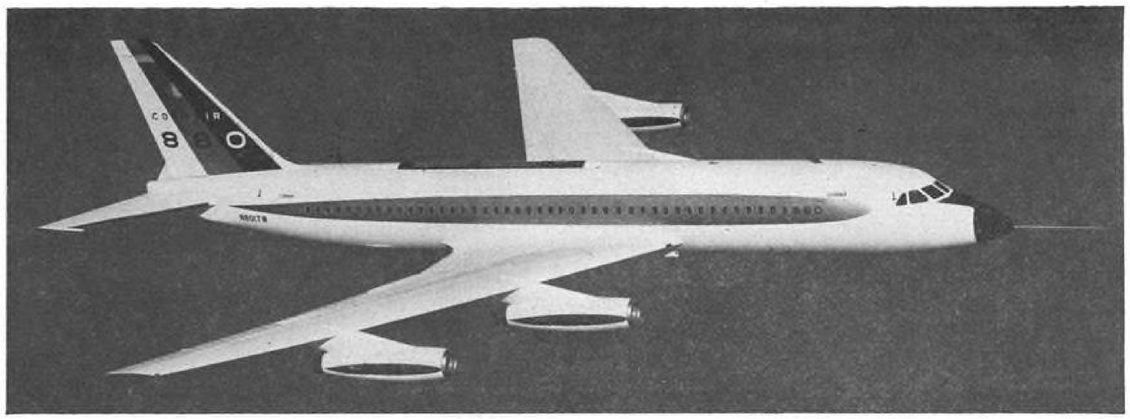
The sleek, new *SPEED-LINE* version of the *AERO COMMANDER 500A* so minimizes the frontal area that drag is substantially reduced! *FULLY RETRACTED GEAR* is totally recessed within the nacelle. There's *NEW POWER*, too. The 260 hp Continental engines feature *FUEL-INJECTION!* And the *500A* is capable of speeds up to *230 MPH!*

The new design releases exhaust above the high wing making the *CABIN WHISPER-QUIET.* And the trim *SPEED-LINE* compactness provides *FULL-SWEEP VISION.*

The new *INTERIOR ELEGANCE* of the *500A* features a rich blend of fine fabrics and genuine leather in your choice of beautiful colors. Call WHitney 9-5674 for complete details about the all-new *AERO COMMANDER 500A*, first of a brilliant, new series featuring the *SPEED-LINE NACELLE!*

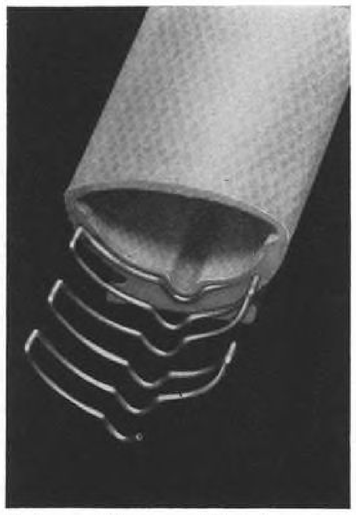


AERO DESIGN & ENGINEERING CO. • BETHANY, OKLAHOMA • A Subsidiary of ROCKWELL-STANDARD Corporation

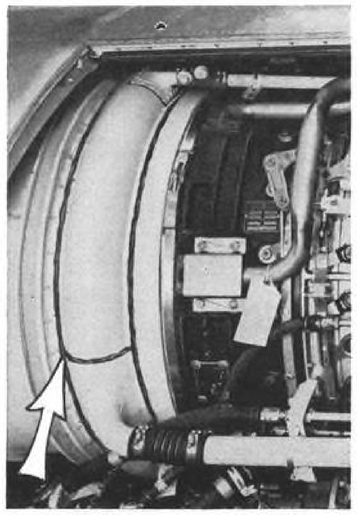


Flex-support door seal designed by Convair is typical of advance design features of the 880. General Electric silicone rubber—with its outstanding resistance to temperatures, ozone and aging—is used extensively on the General Dynamics Convair 880.

General Electric silicone rubbers meet rigorous requirements of new Convair 880



Unique silicone rubber door seal incorporating spring steel flex-support, a fail safe feature that eliminates the danger of seal collapse. General Electric SE-555, with twice the strength of regular silicone rubber, easily withstands flexing of integrally molded steel support. Over 600 wiping action and pressure cycling tests prove seal will meet all operational requirements.



G-E RTV high-temperature sealant is used extensively in pylon and pod assemblies which hold G-E CJ805-3 jet engines. Liquid RTV (room temperature vulcanizing) silicone rubber is easily applied and cures without heat. RTV has excellent bond strength, good physical properties, plus resistance to temperature extremes (600°F and above), ozone, weathering, moisture, aircraft fuels and solvents.

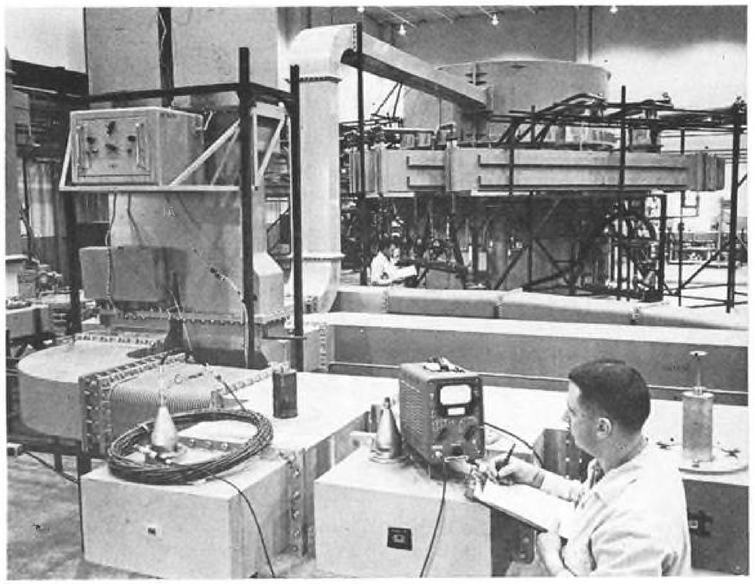
Now available: New G-E Silicone Rubber Selector. This guide will help you quickly select the right silicone rubber to best meet your application requirements. In it you will find important data on applications, primary classes, typical properties and specifications. Tells how to specify the grade you want by AMS, ASTM or military specifications. Write for your free copy.

GENERAL ELECTRIC

Sector J411, Silicone Products Department, Waterford, N. Y.

BMEWS Radar Components Tested

High power klystron tube (above), one of several used in AN/FPS-50 BMEWS surveillance radars, is 9 ft. high. Black cylinders surrounding the tube are focusing coils; tube is made by Eitel-McCullough. Below are duplexers and scanning switch for AN/FPS-50s, shown under test at General Electric's Heavy Military Electronics Department, Syracuse, N. Y. Duplexers (foreground) blank out sensitive receiver units when transmitter is radiating. Scanning switch, housed in large tank at rear, rotates antenna's beam.



BASIC BUILDING BLOCKS FROM KEARFOTT

FLOATED RATE INTEGRATING GYROS

Specifically designed for missile applications, these Kearfott miniature gyros operate efficiently at unlimited altitudes. Their outstanding accuracy and performance make them superior to any comparably-sized units on the market. Hermetically sealed within a thermal jacket, these gyros are ruggedly designed and completely adaptable to production methods. Performance characteristics that are even more precise can be provided within the same dimensions.

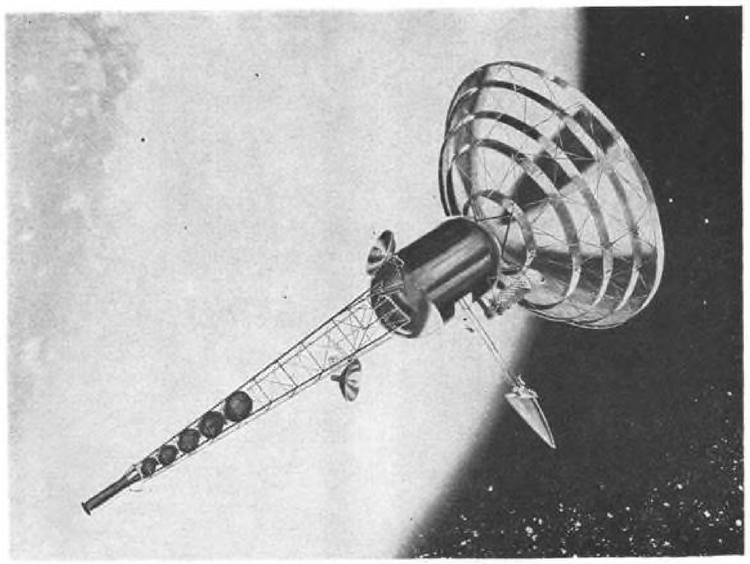
TYPICAL CHARACTERISTICS

Mass Unbalance:
Along Input Axis: 1.0°/ hr maximum untrimmed
Standard Deviation (short term):
Azimuth Position: 0.05°/hr
Vertical Position: 0.03°/hr
Drift Rate Due to Anisoelasticity
Steady Acceleration:
.015°/hr./g² maximum
Vibratory Acceleration:
.008°/hr./g² maximum
Damping:
Ratio of input angle to output angle is 0.2
Characteristic Time:
.0035 seconds or less
Weight: 0.7 lbs.
Warm-Up Time:
10 minutes from −60°F
Life: 1000 hours minimum

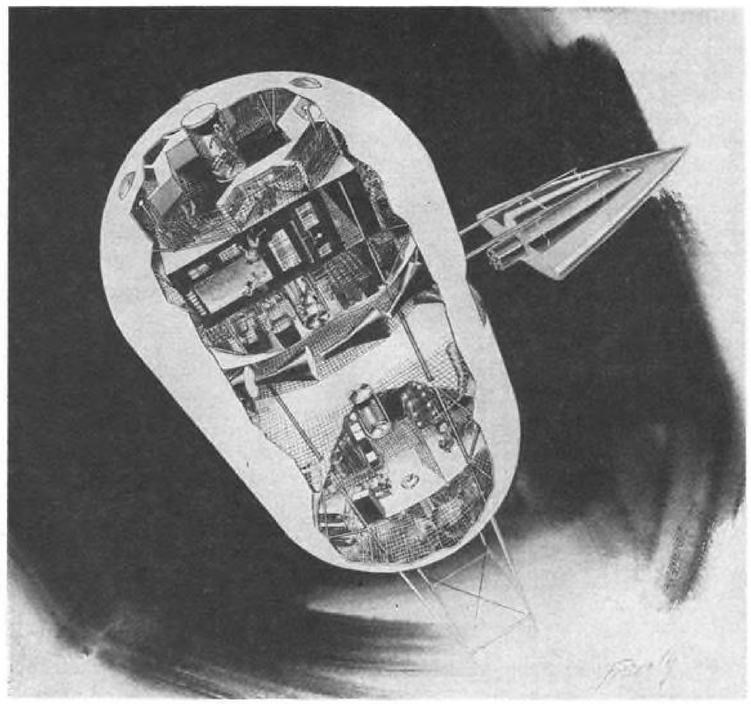
Write for complete data.

KEARFOTT DIVISION
GENERAL PRECISION INC.
LITTLE FALLS, NEW JERSEY

Boeing Plans Space-Exploring Missions



MODEL 854-1001 space vehicle advanced by Boeing for a manned earth satellite observatory has nuclear power source located at end of boom.



GENERAL PURPOSE space capsule envisioned by Boeing designers consists of two pressure vessels joined by an airlock or hangar deck. Capsule, 74 ft. long over-all, is divided into seven functional levels by nylon nets.

New York—Boeing Airplane Co., now on the threshold of space exploration with the Dyna-Soar project, plans to move into this field with a long-range research program designed to stay in advance of present U.S. activities.

Details of this plan, prepared with apparently the same preciseness that characterizes the government's own space-age program, were presented here at the Society of Automotive Engineer's National Aeronautic Meeting.

Taking its name, PARSECS (Program for Astronomical Research and Scientific Experiments Concerning Space), from the astronomical unit of distance, the Boeing program presently has eight different missions. For each mission, the company has defined the vehicles and systems required to accomplish mission objectives. Mission VIII is not to be considered the end of the program, according to Boeing Senior Vice President W. E. Beall, but rather, this is as far as the company's studies have progressed to date.

The eight missions are defined as follows:

• **Manned earth satellite observatory.** Research objectives for Mission I are better observation in the visible spectrum, observation in that part of the spectrum presently invisible from earth, advanced geophysical research, weather observation and control, and establishment of a communication facility and research station. Boeing's current vehicle concept (Boeing Model 854-1001) for carrying out this mission is based on a general purpose, cylindrical space capsule, with a nuclear power source at the end of a long boom on one end of the cylinder and a parabolic antenna-like structure on the other.

• **Moon colony.** Primary reason for going to the moon, Beall reports, is that almost all the functions of the satellite observatory can be carried out there under more favorable conditions. A moon colony would provide a more stable base for astronautical full-spectrum instrumentation, permit exploration of the lunar surface, and would serve as an experiment station for empirical research in advanced space technology and as headquarters for International Selenophysical Year activities.

A recent Boeing study, Beall reports, indicates that the moon colony actually may precede the satellite observatory, in which case Mission I objectives would probably be re-evaluated. Earlier, Boeing made a definitive study titled, "Lunar Observatory," for the USAF Ballistic Missile Division and Air Research and Development Command.

• **Counter-moon.** Proposed as one of the most effective means of measuring the magnetohydrodynamics of the solar corona, the counter-moon would be a satellite observatory established directly opposite the moon and at the same distance from earth to provide, in effect, a stereoptical view of the sun. It would also aid in the development of full-spectrum interferometric astronomy and of a Loran-type deep space navigation device which would have a base leg of 480,000 stat. mi.

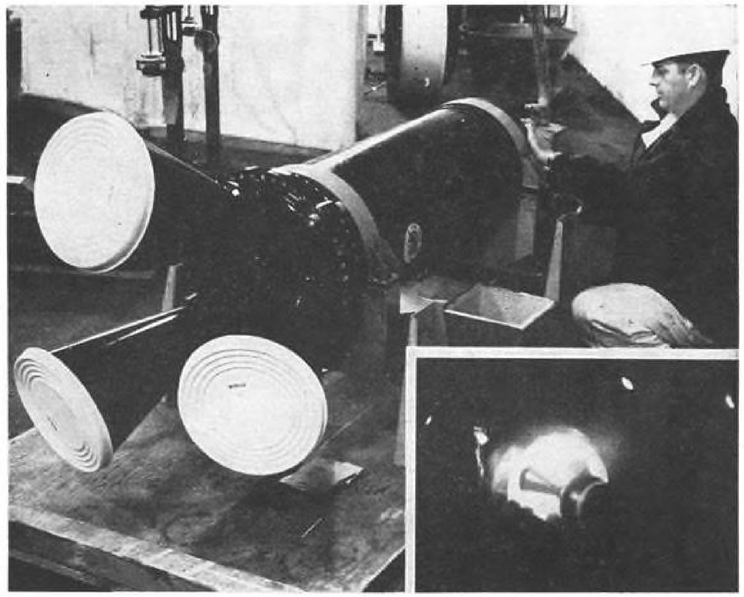
The Mission III vehicle concept, Boeing Model 854-2001, is again designed around the company's general-purpose space capsule, this time with four booms extending from the capsule at right angles to each other. An array of solar cells serves as the power source, and four ion rockets provide thrust for stabilization and orbit maintenance.

• **Interplanetary probes.** Research objectives of Mission IV are acquisition of physical and surface data from planets, study of radiation intensity versus solar distance and study of spacial matter distribution versus solar distance. For this mission, company engineers have designed a vehicle called the Boeing Martian Explorer (Model 855-4001) which, according to Beall, will depend upon the existence of manned geo-orbital facilities and will be adaptable for all terrestrial planets. It is a self-propelled, self-guided, round trip vehicle which will use solar cells or, for more distant trips, probably a nuclear reactor as the power source. Ion rockets will be used for propulsion.

• **Close solar orbit.** Mission V would be devoted entirely to solar research, says Beall, but at this time it would be presumptuous to list a set of research objectives. Boeing's solar probe is designated Model 855-0001 and, in one concept, it would make a series of passes in a heliocentric orbit with a perihelion of approximately 10 million stat. mi.

• **Trojan-point observatories.** Primary purposes of the Trojan-point observatories (satellites in stable positions 60 deg. ahead of and behind the earth in its orbital path and at the same radial distances from the sun as the earth) are to provide a very long base leg for full-spectrum interferometric astronomy, a long base leg for space navigation aids, simultaneous views of solar phenomena, and communication links for general space exploration. Model 856-6001, Boeing's space vehicle design for this mission, is very similar to the vehicle concepts for Mission VII and VIII, with all three built around the general-purpose space capsule.

• **Out-of-ecliptic orbit.** As in Mission VI, this mission will enable scientists to conduct meaningful deep space operation without the additional complexities of orbital or impulsive maneuvers near the planets and without having to make



AEDC Tests Mercury Escape Rocket

Reliability of a 60,000-lb.-thrust escape rocket for the Project Mercury manned space capsule has been tested at a simulated altitude of 105,000 ft. at Arnold Engineering Development Center's Engine Test Facility (inset). Rocket motor is made by Grand Central Rocket Co. and uses solid propellant fuel.

BASIC BUILDING BLOCKS FROM KEARFOTT

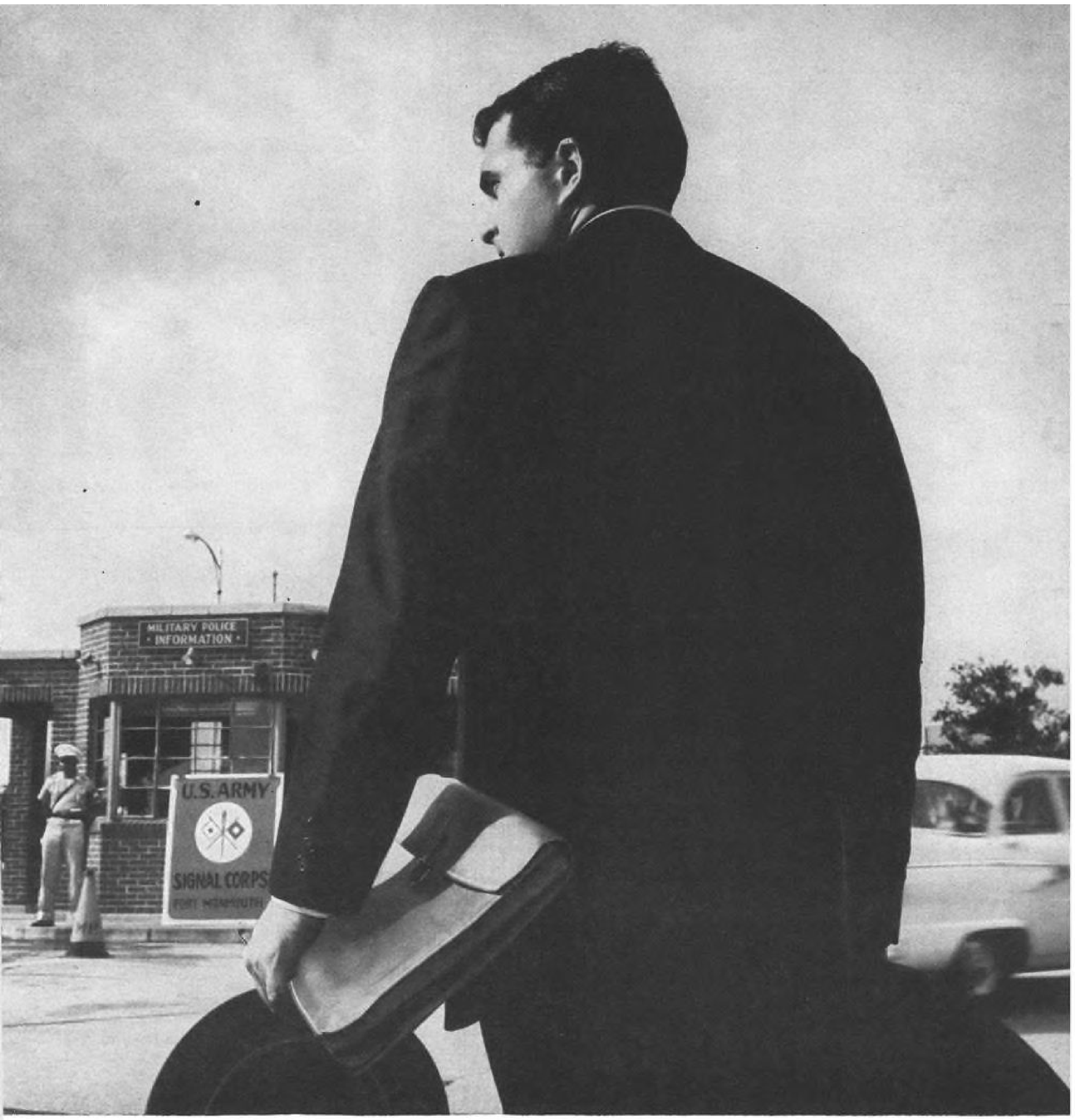
20 SECOND SYNCHRO

This synchro, just one of a broad line offered by Kearfott, provides the extreme accuracy required in today's data transmission systems. Kearfott synchro resolvers enable system designers to achieve unusual accuracy without the need for 2-speed servos and elaborate electronics. By proper impedance, matches up to 64 resolver control transformers can also operate from one resolver transmitter.

TYPICAL CHARACTERISTICS	SIZE 25	
	Transmitter	Control Transformer
Type Resolver		
Part Number	Z5161-001	Z5151-003
Excit. Volts (Max.)	115	90
Frequency (cps)	400	400
Primary Imped.	400/80°	8500/80°
Secondary Imped.	260/80°	14000/80°
Transform. Ratio	.7826	1.278
Max. Error fr. E.Z.	20 seconds	20 seconds
Primary	Rotor	Stator

Write for complete data.

GP KEARFOTT DIVISION
GENERAL PRECISION INC.
LITTLE FALLS, NEW JERSEY



WHAT WAS SINGER DOING AT FORT MONMOUTH? In this instance, Singer was working with U.S. Army Signal Corps engineers to advance the state of infrared art. At Fort Monmouth, and other idea-bastions of American defense, representatives of the Singer Military Products Division, are in constant—and productive—liaison. A division of The Singer Manufacturing Company, SMPD is composed of the Singer-Bridgeport, Diehl Manufacturing Company and HRB-Singer. A comprehensive brochure describing these engineering and production facilities is yours for the asking.

SINGER MILITARY PRODUCTS DIVISION
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2160

landings. Mission VII vehicle will be established in a heliocentric orbit with the same radius as the earth's orbit but inclined to the ecliptic plane by somewhat more than 10 deg. This will allow researchers to enter into the true void of space, probe the depth and content of the solar corona and to obtain a polar view of the sun and the solar system.

• **Planetary exploration.** The four broad objectives of this mission are acquisition of planetary physical data, study of the planets' natural resources, cosmological research and colonization. Interplanetary exploration is certainly far enough away in time, according to Beall, to provide a challenge for all our skills for many years to come.

At the heart of Boeing's PARSECS program is the company's current design concept of a general-purpose space capsule-vehicle around which most of its interplanetary research vehicles are designed. This structure, which is to be assembled in a geocentric orbit, is essentially a "rubber design" that can be expanded or compressed to suit the requirements of different missions.

From the outside, the capsule looks like a large cylinder with convex ends. Based at least initially on the concept of dual reliability, it actually consists of two separate pressure vessels (each a 20-ft.-radius hemisphere joined to an ellipsoid with a semiminor axis of 10 ft.) joined by the cylindrical housing for the central air lock or hangar deck. Over-all length of the capsule is 74 ft. and the air lock is 14 ft. high at the vehicle centerline.

The interior of the capsule is divided into seven levels, three in each hemisphere and the airlock. These levels are control, astrogation, functional stores, hangar deck or airlock, living, rest and recreation, and biophysical stores. Because the vehicle is generally in the weightless state, nylon nets are adequate to separate the levels, according to Beall. Crew complement is 20 men. Each hemisphere is capable of housing the entire crew in the event that repairs have to be made on the other hemisphere.

Modification of the basic structure for different missions generally entails the altering or addition of the boom attachments which hold the power and propulsion devices. The boom structure, Beall pointed out, has been the subject of applied research in the Boeing structures staff. It is constructed of thin-wall, axially-corrugated members which give an extremely lightweight structure adequate for the low load applications considered here while at the same time providing the necessary surface area and plumbing for cooling and transmitting the power system working fluid.

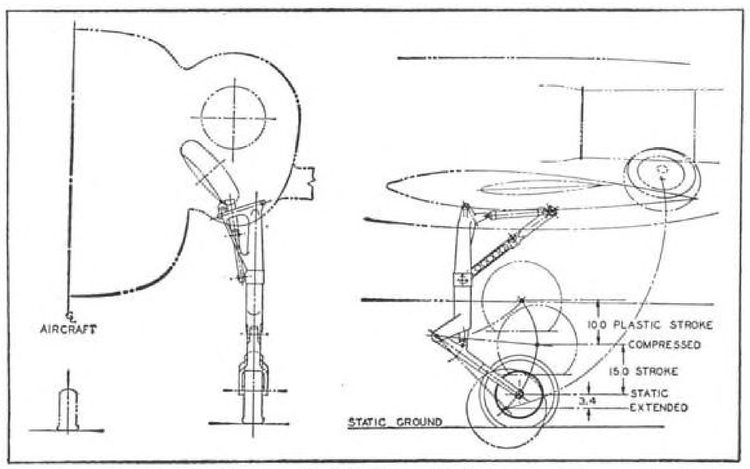
Other SAE Reports

High energy absorption landing gear, a plastic deformation concept, has been proposed to increase the safety and reliability of jet-powered VTOL aircraft. Aim is to increase the minimum operating altitude within the slow-speed flight regime and to eliminate the "extreme caution zone" (dead man's curve) characteristic of rotorcraft.

By use of such a device, that would not rupture during abnormal landing, power failure altitude capability above the terrain can be increased to such an extent that the aircraft could operate during transition from vertical to horizontal flight without traversing an "extreme caution zone."

Proposal was made to the National Aeronautic Meeting of the SAE by Charles L. Wharton, Jr., senior dynamics engineer, Lockheed Aircraft's Marietta, Ga., Division.

Today's rotorcraft, by comparison,



LOCKHEED described landing gear for VTOLs at SAE's National Aeronautic Meeting.

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avoid operation at a combination of low altitude and airspeed where, in event of power failure, a pilot must react with minimum delay to effect a landing without damage to the vehicle or possible injuries to personnel.

Plastic deformation of landing gear structure differs from the progressive failure concept in that the structure deforms plastically but does not rupture; the gear itself would be the first part of the airframe to fail in event of abnormal loads.

With a conventional gear, stated Wharton, a severe enough landing to exceed limit load will usually result in primary structural damage.

As part of the design concept for VTOL aircraft, Wharton suggests a combination of plastic deformation with either a conventional air-oil strut or a liquid spring gear; a combination that would neither sustain a weight penalty nor penalize the performance of the aircraft.

Proposed landing gear installation was assumed for a jet-powered high-performance VTOL airplane with these properties: maximum vertical takeoff weight, 7,300 lb.; minimum flying weight, 4,500 lb.; maximum vertical thrust (two engines), 7,665 lb.; limit maneuver load factor, 7.5g. Landing gear data: maximum elastic stroke, 1.25 ft.; maximum load factor during elastic stroke, 5.0g; load stroke energy absorption efficiency, elastic stroke, 80%; maximum plastic stroke, .833 ft.; maximum gear load factor during plastic stroke, 8.0g; load-stroke energy absorption efficiency, plastic stroke, 90%.

Design conditions for the elastic energy absorption device, which is housed within the main vertical member, were selected as follows: 15 fps. rate of sink capability; 80% gear efficiency factor; maximum stroke 15 in. (excluding tire deflection).

Above conditions would yield a 5g orifice force peak and a 3g liquid compression spring peak. For a design landing velocity of 15 fps. rate of sink the maximum elastic stroke is approximately used up; for a rate of sink of 30 fps. the total elastic plus plastic stroke is used up. Dynamic analysis shows a 30 fps. complete power failure rate of sink capability for the 7,300-lb. aircraft. This would correspond to a complete power failure altitude of 13.1 ft., said Wharton.

For this particular application the total landing gear weight, including tire, wheels and brakes, amounted to only 3.5% of design gross weight. By comparison, most conventional landing gears for military fighter-class aircraft run in excess of 4%, and the light observation class airplanes run in excess of 7%.

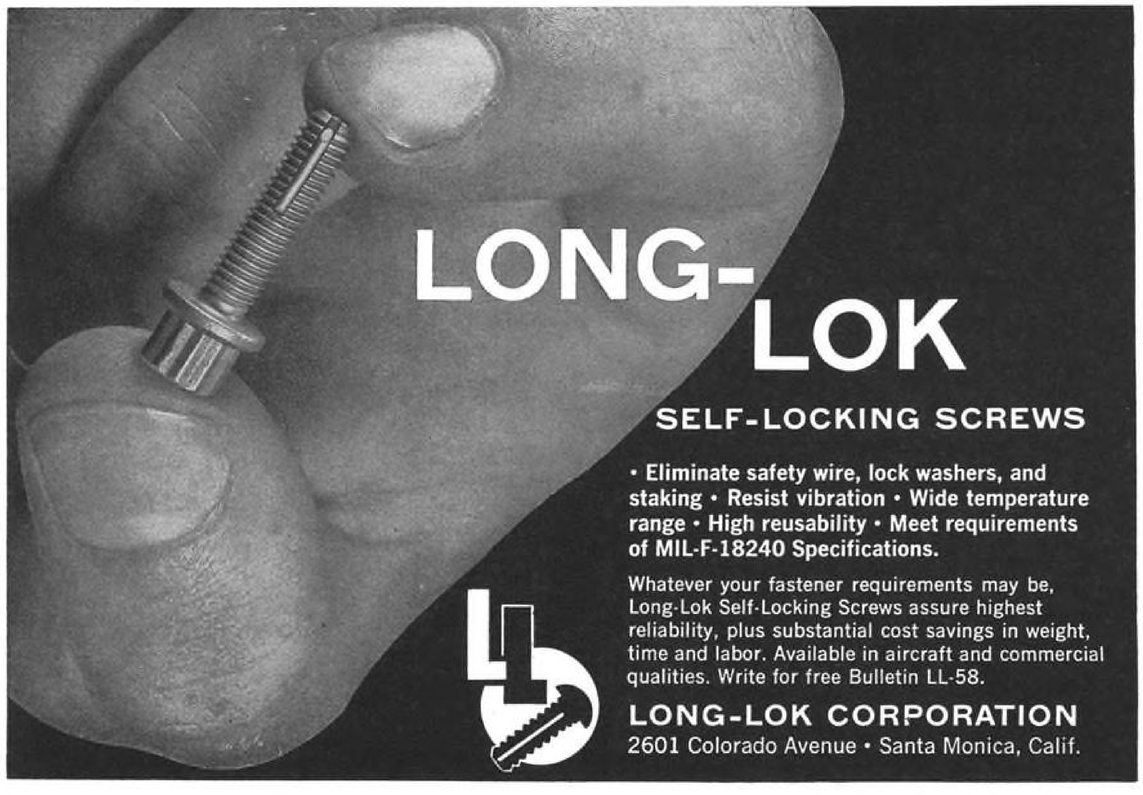
SAE Transport Reports

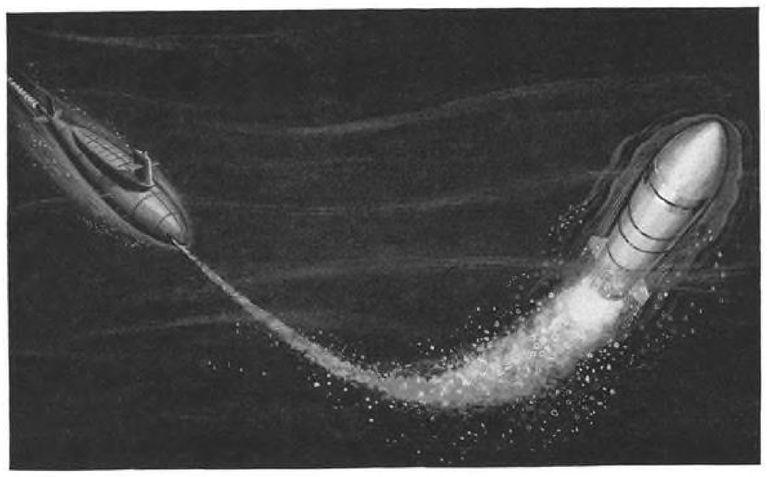
Supersonic transport reliability can be enhanced by designing the airplane's systems for monitoring by an airborne computer, according to C. L. Blake, transport systems development manager of Convair Division of General Dynamics Corp.

A limited version of such a computer already has been used in flight-testing the Convair 880 jet transport, Blake told the Society of Automotive Engineers meeting here.

An instrument called the "Advisor," jointly developed by Convair and the John Oster Manufacturing Co., has been operating in the 880 since the first test flight, Blake said. Built around a computer, the instrument uses a small arrowhead "bug" driven by the computer. The bug moves around the periphery of the airspeed indicator and advises the pilot of the status of his takeoff run. If the takeoff is proceeding satisfactorily, the bug stays ahead of the airspeed needle; if the bug falls behind, the pilot aborts his takeoff. The computer senses parameters such as engine performance, fuel consumption and outside air data.

The Advisor has been further developed to advise the 880 pilot of his best climb speed, and such cruise information as remaining range and time at his





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5-123

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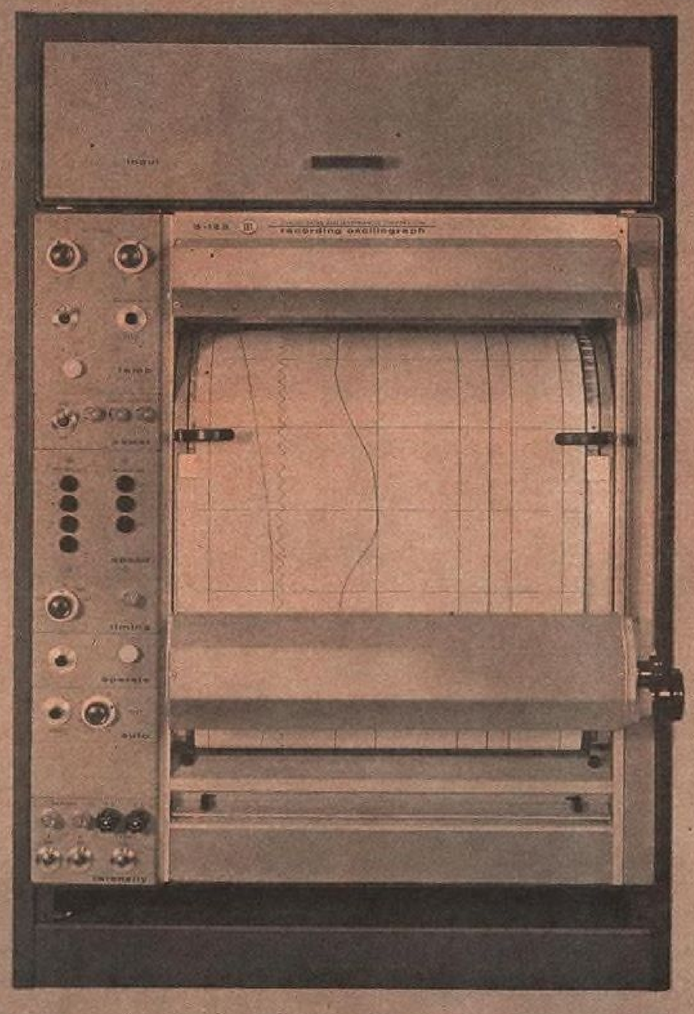

Model 5-123, the new look

in oscillography from:

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present speed and altitude. It can tell the pilot the optimum speed and altitude he should fly for maximum range or for maximum endurance. In the event of an engine failure, the pilot can reset the Advisor for the new condition. It also gives him his optimum approach condition.

Blake said the economics of supersonic transport operation depend on high utilization of the airplane and schedule delays will be critical. Mechanical reliability, therefore, is even more important than with present aircraft and the high-speed electronic computing machine offers a means of assuring reliability. With the plane's systems designed to provide the computer with information, automatic checkout can be accomplished during flight. Further, it might be possible ultimately to carry out continuous computer checkout of the entire airplane and to eliminate unscheduled maintenance. Maintenance on the basis of statistical flight hours or experience also might be eliminated.

In connection with Convair's B-58 bomber program, Blake said, "a full-scale, multimillion-dollar, systematic assault on reliability" has been made. This involves a full systems management program, with computer simulation of all components, subsystem and systems of the aircraft.

A possible means of easing the shock wave noise or sonic boom associated with supersonic transport operation was suggested in another report to SAE members by three Boeing Airplane Co. scientists, L. L. Rhyming, Y. A. Yoler and Y. Aoki. Wind tunnel experiments have borne out the possible use of aerodynamic interference to reduce or suppress the boom effect, they reported. In effect, this involves designing the fuselage and wings, which are the two sources of sonic boom, so that their shock waves tend to cancel each other out.

A case against the Mach 3 speed regime as the next transport development was made by B. S. Shenstone, chief engineer of British European Airways. An aircraft of the Mach 1.3 category, Shenstone told the SAE members, can be produced by extrapolation of present aircraft, with either a simple swept wing or an M-wing.

On the other hand, a jump from subsonic to even Mach 2 aircraft would be enormous, Shenstone said, and both aerodynamically and in terms of structural materials it is a "step into the unknown." Airlines, the BEA official said, cannot afford to bring any supersonic aircraft into service before the early 1970s, and then they should reach no further than Mach 2. He suggested that manufacturers who talk of Mach 3 and higher-speed transports may be waging a "huge public-relations and 'deceiving-the-enemy' battle" to divert the competition into "the more impossible Mach numbers so that they can quietly and quickly produce a highly satisfactory Mach 2 aircraft in light alloy, with the minimum of extra problems and a life long enough for any airline."

Alperin Heads New Space Systems Firm

Space Systems and Industrial Automation, Inc., has commenced operations at 4421 Riverside Drive, Burbank, Calif., for research, analysis, and development services in a wide field dealing with the physical, biological, engineering and man-machine aspects of space technology.

President and technical director of the new company is Dr. Morton Alperin, who formerly was director of aeronautical sciences and advanced studies for the Air Force Office of Scientific Research. At AFOSR, he was responsible for monitoring advanced research programs on the upper atmosphere, space physics and propulsion as well as in the development of space simulation techniques and facilities.

Associated with Dr. Alperin are a nucleus of scientists with experience in space systems analysis and design, including operations research, hyperenvironmental analysis, life support technology, and human engineering, as well as in the more conventionally recognized technical areas of the physical and biological sciences.

U.S., Italy to Launch Atmospheric Probes

Washington—U. S. and Italy will conduct joint sounding rocket studies of the upper atmosphere under the latest in a series of bilateral space exploration pacts negotiated by National Aeronautics and Space Administration.

NASA has agreed with the Space Commission of the Italian National Research Council to join in a series of launches from the island of Sardinia, probably in September. NASA will furnish the instrumented payloads, and the Italian group will supply the sounding rockets and launch facilities.

U. S. also has reached agreement with Spain on the construction of a Mercury tracking station in the Canary Islands. The station will cost $1.5 million, and construction is under way. Tracking telemetry and communications activity will be conducted in conjunction with the Instituto de Technica Aeronautica, agency of the Spanish Air Ministry.

Agreement also has been reached with Australia for Mercury tracking stations at Perth and Woomera.

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Rotor Recovery Proposed for Boosters

By Erwin J. Bulban

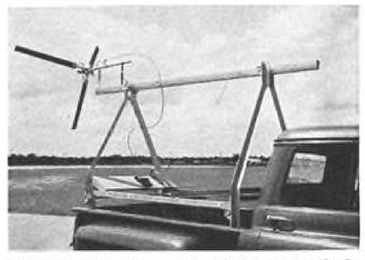
Hurst, Tex.—Workable rotary wing recovery system for large space vehicle and missile boosters could be obtained at a research and development cost that would be paid for with the first successful recovery of one such booster, Bell Helicopter Corp. engineers here contend.

U. S. Air Force, interested in such a system because of the savings of millions of dollars in valuable reusable boosters it could provide, recently asked industry to submit proposals on designs for a rotor recovery system for boosters and the Mercury-type manned space vehicle, leading to building testbed configurations. Indications are that it plans to program such development initially with Fiscal 1960 funds.

Ground Rig Tests

Bell Helicopter engineers are particularly intrigued by the system because of their strong rotary wing background. They have tested ground rigs of scaled configurations to obtain data on such a recovery system, utilizing folding rotor blades that would initially serve to brake the speed of a returning booster, then fully open for slow final descent. In its more sophisticated form, the recovery system would be tied to ground-based guidance to provide accurate spot landings in areas where the boosters would be least susceptible to impact damage or pose hazards to populated zones.

The booster recovery system studied here envisions landings in the near zero-speed regime, similar to manned helicopters. As regards weight, it is considered the lightest of all the several methods studied, including fixed and folding wing glider configurations and a parachute, plus impact-absorbing bag systems. The rotor recovery system is designed to handle an empty booster and would be approximately 10% of the booster's empty weight or 1-2% of the entire vehicle and powerplant system.



ROTOR TEST RIG mounted on truck by Bell Helicopter Corp. engineers has been used successfully in studying opening, closing, drag buildup characteristics, and control of rpm. by collective pitch. Models showed it was possible to prevent rotors from turning by collective pitch control, to start the rotor in a pre-selected direction, then stop it and start it turning in the opposite direction.

Ability to provide an extended glide radius in the lower atmosphere is an inherent characteristic of the system; from an altitude of 25,000 ft. to 50,000 ft., a glide radius of some 15 mi. to 30 mi. is possible, Bell Helicopter engineers estimate, providing sufficient margins for accurate navigational recovery procedures. Incorporation of a sonic-type altimeter would make it possible to institute an up-collective signal at 30 ft. altitude to provide a soft touchdown. It is estimated that such a simple system would provide approximately 75% reliability in the trial stages of prototype systems and could be further improved.

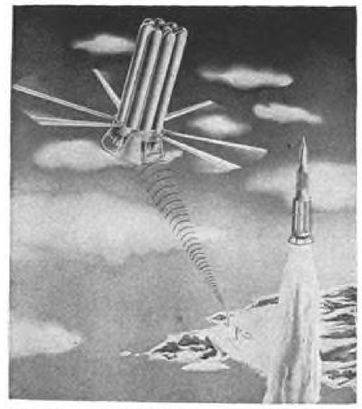
System accuracy could provide landing the booster in an area the size of a ballpark from approximately 25,000 ft., Bell believes.

Studies thus far by Bell Helicopter engineers indicate that a rotor can be controlled at supersonic and hypersonic flight velocities in the axial-flow and skewed flight paths and that lift/drag ratios approaching those of fixed wing configurations can be obtained for rotors in hypersonic flight. Folding rotor concept considered here would keep the blades stowed until after the re-entry maneuver; deploying them at any altitude from 200,000 ft. to 20,000 ft. and at velocities from Mach 3 at the higher altitudes to Mach 0.5 at the lower altitudes.

Rotor blades would automatically cone sharply or fold under high drag conditions into a lower drag configuration, providing a high ratio of maximum to minimum drag, this variation in drag compensating for the change in atmospheric density experienced in a re-entry maneuver and permitting deceleration to be spread over a long time and distance. This characteristic would permit toleration of steeper re-entries with accelerations tolerable even to a human crew more successfully than a fixed-area body, Bell notes.

Also favoring the rotary wing system is the fact that centrifugal force employed to hold the blades extended against the airstream permits making blades narrower, more flexible and lighter than fixed surfaces which must be designed with beam-bending type structure to withstand airstream stresses.

Rotor blades also are easier to protect against aerodynamic heating, since rotation tends to equalize temperature rise over surfaces also, centrifugal action of the blades can again be utilized to aid pumping coolant fluids through them.



ROTOR RECOVERY system for Saturn-Nova-class booster is visualized by Bell Helicopter Corp. artist. Spent booster, left, is guided to soft recovery landing by ground-based radio guidance.

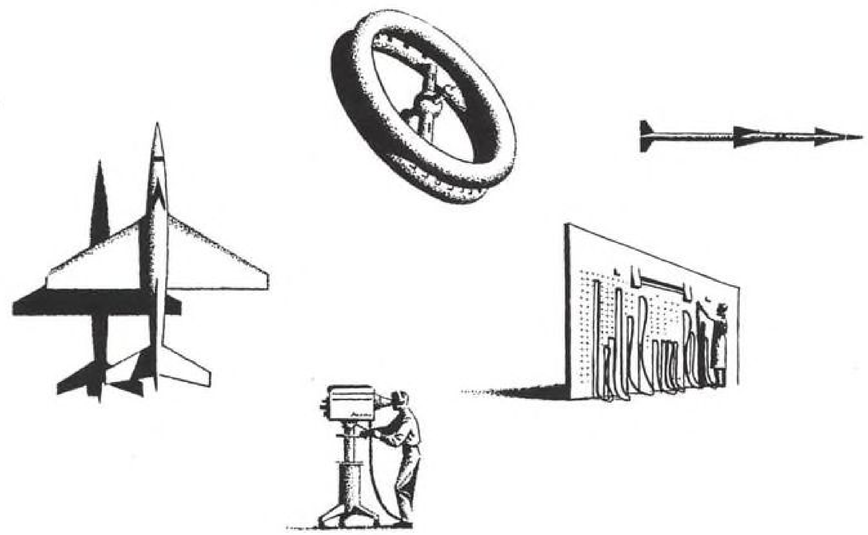
Blade Feathering

It is understood that the blade feathering required to trim a rotor in a high lift/drag ratio attitude differs considerably from action used in a conventional helicopter. Diagonal two-per-revolution cyclic blade feathering would be used for trimming pitching moments, and produce rolling precession of the tip path plane, and fore-and-aft two-per-revolution cyclic blade feathering would be used for trimming rolling moments and produce pitching precessions to replace the lateral and longitudinal one-per-revolution cyclic pitch feathering used in a conventional helicopter rotor.

This difference arises from the fact that velocity distribution over a rotor in skewed hypersonic flight reverses the air flow relative to the blade almost everywhere on the retreating side of the blade rather than in just a restricted region on the retreating blades of a conventional rotor blade.

Two-per-revolution feathering could be accomplished simply by kinematic arrangement of the control system, Bell points out.

Aerodynamic analysis indicates that less severe aerodynamic performance problems are expected to be experienced in design of a re-entry rotor than earlier anticipated, since rotor rpm. control can be readily accomplished by varying blade collective pitch setting by means of a simple mechanical governor.



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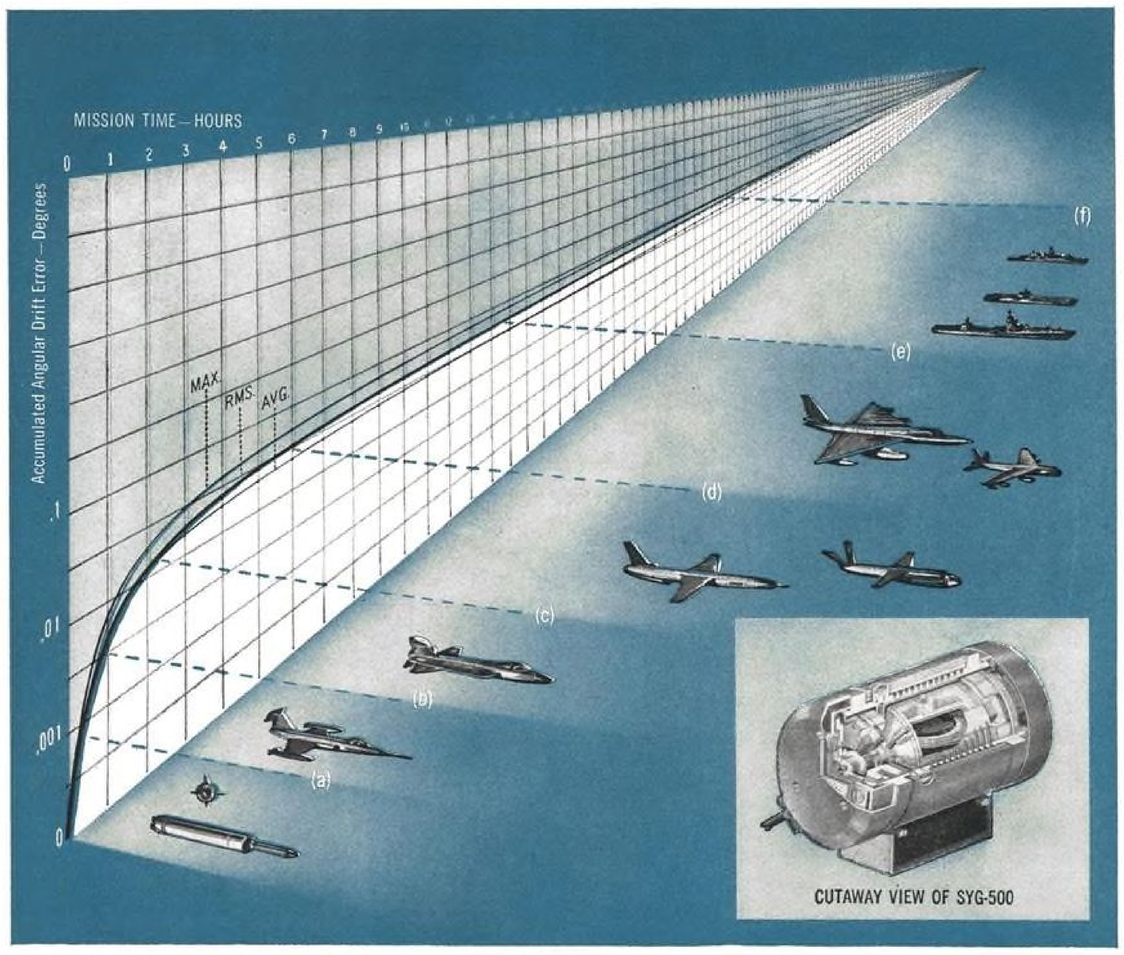

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Helium May Cool Boost-Glide Vehicles

By Richard Sweeney

Pasadena, Calif.—Injecting helium into the boundary layer as insulation to protect structures during high aerodynamic heating periods may enable space vehicles to be designed with conventional high lift wings for atmospheric flight maneuvering and landing.

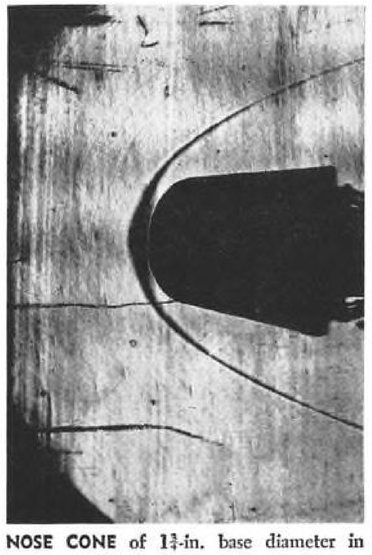
Current concepts, such as the hypersonic boost-glide transport recently described by Bell Aircraft Corp.'s Leston Faneuf (AW Apr. 4, p. 49), have been designed mostly with low lift (thin) wings combined with various structural techniques to solve heating problems which downgrade flight and landing characteristics.

The advantages of helium injection in boundary layer were indicated to California Institute of Technology researchers studying re-entry phenomena, including gas insulation and ablation processes and their relation to boundary layer heat transfer. Cal Tech's investigations now seek to establish:

• **Phenomena underlying** helium's efficient insulation characteristics. Research indicates that under steady state flight conditions which normally would produce 2,000F to 2,500F skin temperatures, helium insulation may reduce these values by as much as 40%.

• **Relationships in the ablation** process, resulting from combinations of re-entry shapes and materials.

This work is being supported by the U. S. Army Ordnance Command.



NOSE CONE of 1¾-in. base diameter in hypersonic wind tunnel with air flow at Mach 5.8 and tunnel temperature 250F. Small jet of helium injected into boundary layer through nose orifice pushes shock wave slightly away from blunt shape.

Injection of helium into the boundary layer through nose or leading edge orifices at a rate of flow which does not disturb normal air flow causes the gas to remain in the boundary layer and act as an insulator. Relatively small quantities of helium produce very good cooling effects.

Helium's efficiency as an insulator is getting thorough study because efficiencies of other gases as insulators are not comparable. Comparison of helium with nitrogen shows that helium has a considerably higher specific heat, but comparison of other properties indicates that nitrogen should be equally efficient. Helium has high thermal conductivity compared with nitrogen, and it has the highest diffusivity rate of any gas except hydrogen, considerably above that of nitrogen. Viscosity relationship also would indicate a theoretical superiority for nitrogen.

While Cal Tech researchers believe that the dominant factor in helium's efficiency as a coolant is its high specific heat, future experiments will include measurements of helium concentration and temperature in the boundary layer. Measurements will be made of skin temperature with variations in helium injection rate and temperature at injection, to compare values with free stream stagnation temperatures. These data may give a clue to factors responsible for helium's superior cooling efficiency over the gases.

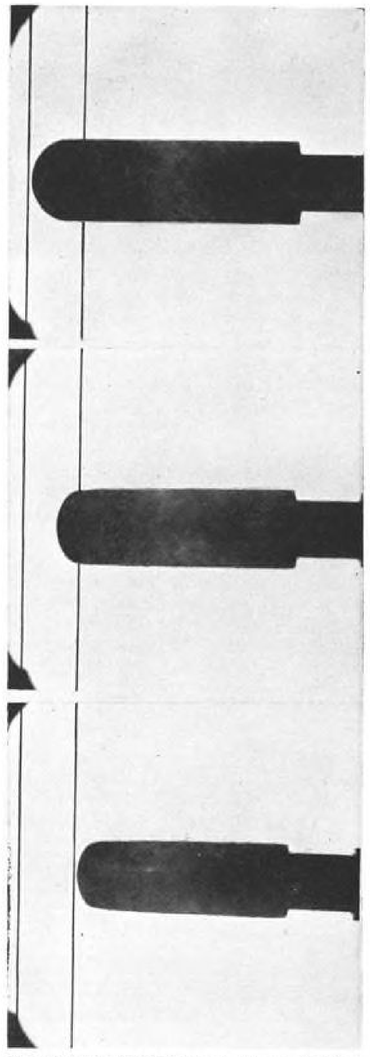
Test shapes used so far have been bodies with a 0.7-in. nose radius, 1.7-in. diameter body and 2-in. length.

In heat transfer processes, at some point back along the body, the boundary layer airflow temperature reaches the equilibrium temperature of the free air stream. Calculations by Lester Lees, Cal Tech professor of aeronautical engineering and director of the current research work, and his associates, indicate that the buildup rate of boundary layer temperature is slower than that calculated by National Aeronautics and Space Administration, which is used as a standard. This rate of buildup to the equilibrium temperature, which is close to the free-stream stagnation temperature, may play a part in heat transfer processes related to the efficiency of a gas as a coolant.

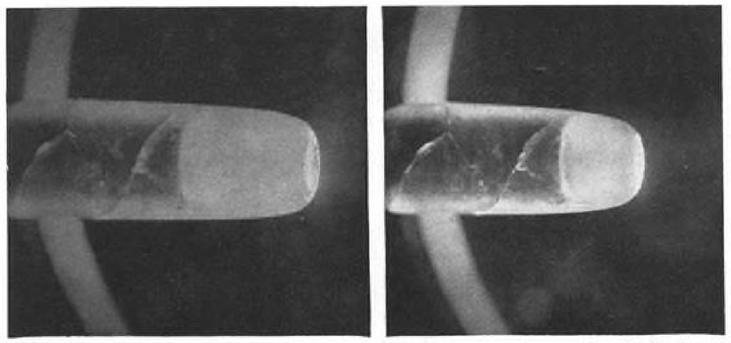
In the ablation process investigation, researchers have used ice and camphor models as materials which vaporize at lower temperatures and permit study of the process as it occurs.

Research is being conducted in two constant-flow hypersonic wind tunnels at Cal Tech, one capable of Mach 8, with a free-stream temperature of 900F and maximum Reynolds number of about 200,000 in its 7-in. x 7-in. test section. The second tunnel works at a maximum of Mach 6, 300F free-stream. Cal Tech test results on ablation rates have shown good agreement with theoretical predictions of other researchers, leading to a high confidence factor in the methods by which these predictions were made.

Measurements of rate of shape change, supported by sequence photos, have been made on both the ice and



SEQUENCE PHOTOS show, top to bottom, a 1-in.-dia. camphor model as it changes shape during ablation. Photos were taken 3 min. apart. Tunnel conditions were free air stream moving at Mach 5.8 at 300F.



ICE MODEL photos were taken about 5 min. apart in hypersonic tunnel at Mach 8 and 900F. Note slightly concave nose cone in left photo. It has been ablated in the photo at right, as has much of the rest of the model's surface.

camphor models, with thermocouples imbedded in the models to measure internal temperatures during the process.

An ice model 5-in. long, 1-in. in diameter, has lasted for 30 min. at a 300F free-stream stagnation temperature. At 800F to 900F stagnation temperatures, models last 10 to 20 min. at Reynolds numbers equivalent to altitudes approximating 200,000 ft.

The ablation studies seek to determine the physical parameters and their relationships, including heat of sublimation of the material and evaporation rate.

Predictions Verified

Cal Tech researchers have verified predictions that the effective heat of evaporation increases with the rate of evaporation. This rate of increase depends on the molecular weight of the vaporized material—the lighter the weight, the more efficient the cooling. Thus, Teflon is efficient because of the low molecular weight of the vaporized constituent materials.

Ice has a high heat of sublimation, and since the tunnel operates at low pressure (hence ice-model low surface temperature), the rate of evaporation is low. Since rate of evaporation is low, the rate at which the gas (product of evaporation) is introduced into the boundary layer is likewise low, and any possible effect of the gas in the boundary layer is lost.

However, using camphor models, high rates of surface evaporation are achieved, producing the blowing effect into the boundary layer, and the process can be studied in detail over a period of time. Camphor was selected after a search for materials with high vapor pressures (napthalene also was considered), and model sizes were the same as those used with ice. While internal temperatures of ice models were about —40F, internal temperatures for camphor models ran about 200F, while stagnation air temperature at the surface ran about 300F. Reynolds number approximated 70,000 for this experiment. Camphor models lasted about half the time of the ice models. One object of this study was to obtain higher rates of evaporation as an end in itself.

Another phase of the study involves determination of equilibrium shapes—shapes which remain relatively constant during the ablation process or, after a preliminary change during initial ablation, attain equilibrium shapes.

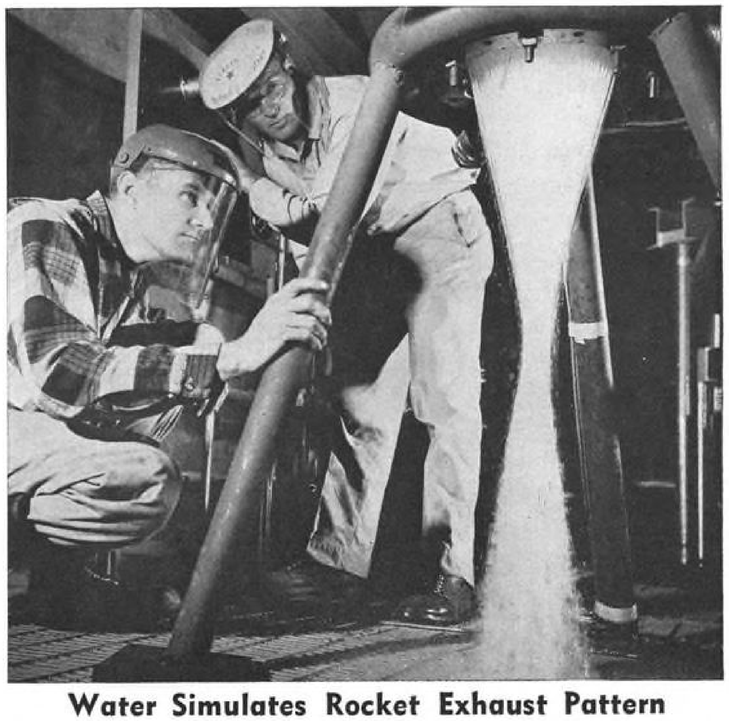
In one experiment, a camphor model with a relatively blunt nose and high fineness ratio for the afterbody was run for one hour in the tunnel, and reached a quasi-equilibrium shape.

One limitation Cal Tech researchers have encountered with temperatures and densities obtainable in their facilities is the inability to effect a chemical reaction in the boundary layer, a process occurring at many re-entry temperatures.

They now seek a material which would undergo a chemical reaction in the boundary layer at the temperatures and densities available in the Cal Tech tunnels. Densities in these experiments have been in the order of .001 of an atmosphere or lower.

The object is to produce the chemical reaction, see what occurs, and establish relationships of the chemical reaction to the other processes involved in ablation. Such chemical reactions are important to the long-time-at-high-heat situation, which would occur in space vehicle re-entry. Without this chemical reaction, researchers feel they do not have the complete or true picture of the entire ablation process.

Researchers at Avco and General Electric have reached many of the same findings as the Cal Tech researchers, but primarily in nose cone investigations involving very high heat for short time exposure. These findings have been general, while the Cal Tech results are detailed.



Water Simulates Rocket Exhaust Pattern

Water test of 20,000-lb.-thrust rocket injector is made at NASA's Lewis Research Center, Cleveland, Ohio, to visually check the uniformity of spray while instruments measure flow and pressure. Water makes about the same pattern as an actual live firing.

Subsidiary Shift Improves GPE Earnings

New York—Stronger centralized management that includes tighter cost control and integration of subsidiaries were major reasons for General Precision Equipment Corp.'s improved 1959 earnings, Chairman James W. Murray told the New York Society of Security Analysts.

Earnings of $304,267 in 1958 on sales of $168 million amounted to only .18% profit margin and failed even to cover preferred stock dividends. Last year, after a management reorganization, the corporation earned $4,198,200 on sales of $215 million.

Murray, who became chairman in the management reorganization a year ago, described the tighter integration that called for combining GPE's 12 principal subsidiaries into six. Four formerly autonomous subsidiaries—General Precision Laboratory, Kearfott, Librascope and Link—became four divisions of General Precision, Inc., an operating company formed to coordinate their research and development, engineering, production and sales.

A board of directors was formed for the new operating company consisting of Murray, Donald W. Smith, president of GPE; Dr. Raymond L. Garman, vice president-engineering and research for the parent company; and two officers of each division. It meets bimonthly or oftener to decide over-all policy and to promote closer company integration and cross-fertilization of ideas.

"As separate subsidiary companies they were inclined to deal with each other at arm's length," Murray said. "This we can prevent. We also believe that members of this board should be fully acquainted with the problems as well as the successes of each division. Previously this has not been so.

"Division managements are responsible for profit. As the full impact of this takes hold, we also are achieving better cost control in the other subsidiaries."

Murray said that the new management is attempting to develop a new philosophy for the company and its subsidiaries. He described it as a simple one of watching expenses and costs, and of getting a good organizational team that will pull together toward an acceptable return on funds used.

For 1960, GPE has a profit goal of 3% on sales after taxes. Over the longer term, the company seeks a pretax return of 15-20% on funds invested. This would include equity capital and long term debt.

Video Sonics Programs Studied

General Precision, Inc., is investigating Video Sonics, an audio-visual technique for training production employes and speeding production output. It is proposing equipment for both the Hughes Aircraft system (AW Jan. 4, p. 75) and another system being planned by Donald E. Stewart, now head of Applied Communication Systems (AW Feb. 29, p. 84), previously in charge of Video Sonics development at Hughes.

To study applications, appropriate methods and flexibility of Video Sonics, General Precision is installing a trial system in its Graflex Division and pending the results of this, may market complete systems.

"Profits," Murray said, "depend on the right kind of controls on every function from research and development to sales. When it comes to preparing budgets for expenses and capital items, we want our people to think things through as though they were spending their own money. Would you do it if it were your own business, would you spend it if it were your own money? It is surprising how many imperative situations become optional when you consider them in this light."

Present Volume

GPE's present military-commercial volume is about 70-30%. The company hopes to increase defense business, but also increase its commercial business that much more to gain a 50-50 split. To do this may require some acquisitions, Murray said.

As to the possibility that GPE itself might be acquired by the Martin Co., which has been acquiring GPE stock on the open market for the last six months, Murray expressed no opinion. GPE's directors have discussed giving Martin representation on the board, since, Murray estimated, Martin now owns about 14% of the total common stock, but no action has been taken so far.

Murray said that as far as he knew none of Martin's executives hold GPE stock in their own names. GPE's own board now holds almost as much stock as Martin, he said.

Other points touched on by Murray:

• **Jet transport simulators** delivered by Link last year were sold at a loss. Deliveries this year will not return a profit but will not be sold at a loss either.

• **Bomarc cutback** as projected now would not affect GPE (Kearfott supplies guidance equipment) until 1962. Cuts beyond those now proposed would be felt in 1961.

• **B-70 equipment** contracts with General Precision Laboratory were canceled when the program was drastically cut back, but have been reinstated to allow GPL to complete prototypes it had begun.

New Offerings

Electrada Corp., Beverly Hills, Calif., organized in March, 1959, as Rhoads Electrodata Corp. and primarily engaged, through one or more of three separate subsidiaries, in the design, development, manufacture and sale of pressure vessels fabricated from titanium and used principally in missiles, aircraft and other airborne devices; interior components for commercial jet aircraft; pressure, hydraulic and electrochemical switches and allied components, and data acquisition antennas and systems and allied electronic components for utilization in radar, communications and telemetry systems. Offering is 400,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment.

The company contemplates the purchase of all the outstanding stock of Stillman Rubber Co. and certain affiliated corporations, after which it will also be engaged in the design, development, manufacture and sale of rubber sealing devices, primarily for use in aircraft and allied industries, and other molded and extruded rubber products.

Proceeds will be used for payment of the cash portion of the purchase price of the Stillman and affiliated company stocks; for payment of the portion of the notes constituting a portion of such purchase price; for payment of the balance of the purchase price of the stock of Airtite Products, Inc. (acquired in October, 1959); for repayment of bank borrowings; the balance for payment of other notes, advances to a subsidiary, and other purposes.

Dalto Corp., Norwood, N. J., organized in July, 1958, to act as the exclusive sales agent for the Dalto visual flight simulator which was then in the process of development and manufacture by Doman Helicopters, Inc., (see p. 124). Offering is 134,739 shares of common offered for subscription by common

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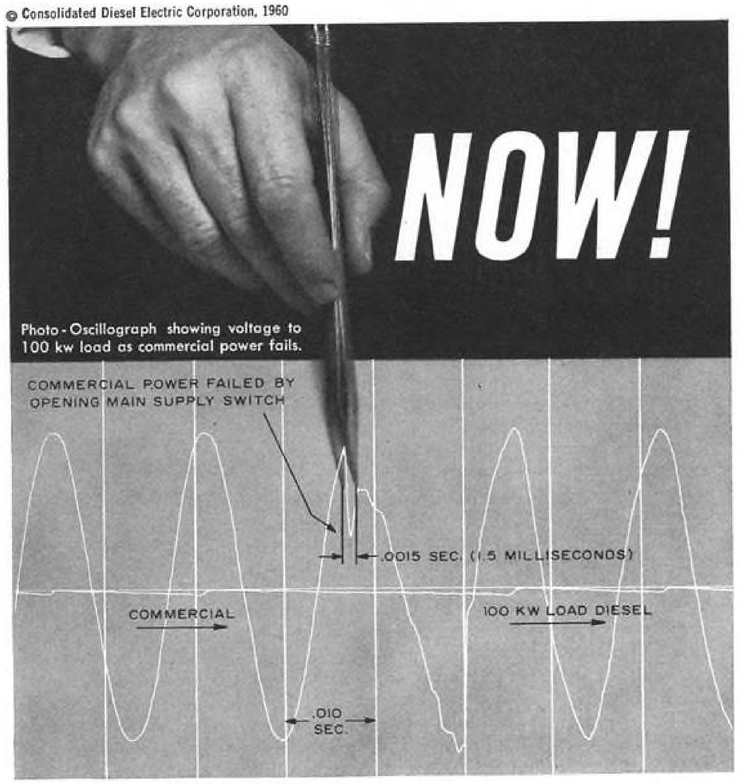

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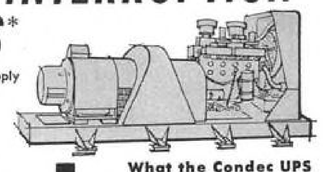

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stockholders of record May 2, 1960, at the rate of one new share for each two shares then held; subscription price to be supplied by amendment.

In October, 1958, Dalto Corp. acquired the proprietary rights to the flight simulator and simultaneously granted exclusive U.S. manufacturing rights to Doman. In February, 1960, the company, by its acquisition of the equity ownership of Avitronics, Inc. (to which Doman had assigned such manufacturing rights), became engaged in the manufacture of the flight simulator.

Proceeds will be used for the retirement of 6% debenture notes in the amount of $82,000; $20,000 will be applied to the cost of acquiring additional capital equipment and the expense of moving operations into a new plant in Norwood; the balance for additional working capital to finance production.

Microdot, Inc., South Pasadena, Calif., engaged in the design, development, manufacture and sale of precision microminiature connectors, miniature cable and transformers and other components and assemblies. Offering is 204,000 shares of capital stock; 60,000 shares to be offered for public sale by the company and 144,000 shares, presently outstanding, to be offered for sale by the holder thereof. Public offering price and underwriting terms to be supplied by amendment. Proceeds will be used to retire bank loans incurred for working capital purposes; to pay in full promissory notes; for the purchase of machinery and equipment; for property additions and improvement; for working capital.

Simmonds Precisions Products, Inc., Tarrytown, N. Y., (formerly Simmonds Aerocessories, Inc.), produces electronic, hydromechanical and mechanical systems, instruments, controls and devices for use in connection with missiles, military and commercial aircraft. Offering is 112,500 shares of common stock; 100,000 shares for public sale by the company, and 12,500 outstanding shares by the president; offering price and underwriting terms to be supplied by amendment. Proceeds of the 100,000 shares will be added to the company's working capital, thereby reducing the amount of funds required to be borrowed under its revolving credit agreement and putting the company in a more favorable position to secure, through borrowings, such additional funds as required from time to time.

F X R, Inc., Woodside, N. Y., engaged in the design and manufacture of precision microwave equipment and related instrumentation. Offering is $2,000,000 of convertible subordinated debentures, due 1970, for public sale; offering price, interest rate and underwriting terms to be supplied by amendment. Proceeds will be used to repay short-term notes; up to $375,000 will be invested in Micromega Corp., a new corporation formed by a group of engineers and scientists in Los Angeles to develop and produce microwave components complementary to the company's products; remainder will be used to acquire new facilities in connection with the company's program for expanding its production and engineering capacity, to maintain additional inventory necessary to meet current and anticipated sales requirements, to supplement working capital and for other general corporate purposes.

Haloid Xerox, Inc., Rochester, N. Y., engaged in the manufacture and marketing of products for xerographic and photocopy reproduction and for photographic use. Offering is 333,213 shares of common stock to be offered for subscription by the company's common stockholders at the rate of one new share for each 10 shares held; the record date, subscription price and underwriting terms to be supplied by amendment. Proceeds will be used to retire bank note indebtedness of $4,000,000, and the balance will be added to general funds to be used primarily for increased inventories of xerographic equipment for leasing.

Straza Industries, El Cajon, Calif., engaged in manufacturing component parts and assemblies for missiles and jet engines; the company also performs chemical milling services on a variety of raw materials and parts. Offering is 230,000 shares of capital stock to be offered for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be used to discharge sundry and short-term indebtedness and long-term indebtedness; to provide facilities and initial operating funds for an electronics operation; to consolidate production facilities by transferring machinery and equipment from a leased plant to the company's main plant and by providing a building therefor; for expansion of the chemical milling facilities and to cover initial expenses of establishing a separate research and development department; the remainder for working capital.

Laboratory for Electronics, Inc., Boston, Mass.; principal business the research, development and production of electronics equipment for aviation and other military use. Offering is 75,000 shares of common stock; these shares are issued or issuable on conversion or redemption of the outstanding 5½% convertible subordinated debentures due 1973, which are to be called for redemption in May, 1960. An underwriting group has agreed to purchase from the company at $20 per share any shares reserved for issue on conversion of debentures not converted on or before the redemption date. The company believes it will be advantageous to raise new capital in the near future to finance expansion and to reduce bank loans; it contemplates the filing of a new registration statement in April, 1960, covering an offering of new common stock, which will be offered for subscription by stockholders.

Acquisitions And Mergers

Avien, Inc., Woodside, N. Y., will acquire Colvin Laboratories, Inc., and Pressure Elements, Inc., through an exchange of stock. Colvin manufactures electro-mechanical instrument for missiles and aircraft; Pressure Elements makes pressure capsules for transducers. Both firms are located in East Orange, N. J.

Kollsman Instrument Corp. has acquired Richardson-Allen Corp., College Point, L. I., manufacturer of electrical equipment, for an undisclosed cash sum. The firm will be operated under its name as a wholly-owned subsidiary of Kollsman.

United States Underseas Cable Corp. has been organized by Phelps Dodge Corp., Northrop Corp., Page Communications Engineers, Inc. (a Northrop subsidiary), and Felton & Guilleaume, of West Germany. New firm will design and install underwater cable systems. Herbert H. Schenck, former vice president-engineering at Page, is executive vice president and general manager.

Shareholders of Control Data Corp. and Control Corp. have approved a stock exchange plan under which Control Corp. becomes a subsidiary of Control Data. All of the 113,581 shares of Control Corp. stock will be exchanged for 68,149 shares of Control Data common, at a ratio of five shares of Control Corp. for three of Control Data.

Litton Industries will exchange an undisclosed amount of its common stock for 100% of the outstanding stock of Western Geophysical Co. of America. Western Geophysical, a privately-held Los Angeles company, had sales of $15 million last year. The company employs 900 persons and is engaged in geophysical exploration and electronic instrumentation development and manufacturing. Western Geophysical will operate as a Litton subsidiary with management and organizational structure unchanged.

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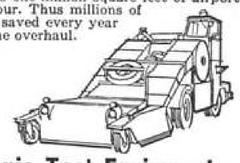
The pioneer in the field, Consolidated Diesel's Aircraft Equipment Division designs and builds a wider variety of specialized ground support equipment than any other company. One such product is the all-weather, multi-purpose servicing unit illustrated. It tows aircraft and provides a source of A-C and D-C power for ground maintenance and starting . . . one of thousands in service around the world.

More than 100 of these runway vacuum sweepers have been built by the Aircraft Equipment Division. Each cleans one-million square feet of airport surfaces an hour. Thus millions of dollars are saved every year in jet engine overhaul.



Electronic Test Equipment

Automatic multiple circuit analyzers similar to the one shown have been built by Consolidated Avionics for major electronics and missile manufacturers. They search more than 2,000 points in a system and point out wiring errors and doubtful connections. It is one of many highly specialized electronic units produced by Avionics. Other products include data reduction systems and a complete line of transistorized power supplies.

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Consolidated Controls produces instrumentation and control devices and systems for liquid level, temperature, pressure, speed and flow applications. Typical is this gas-filled thermometer which measures temperatures of jet engine air intakes. It provides one-second response and needs no electrical connection.

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The Lima Electric Motor Co., Inc., Lima, Ohio

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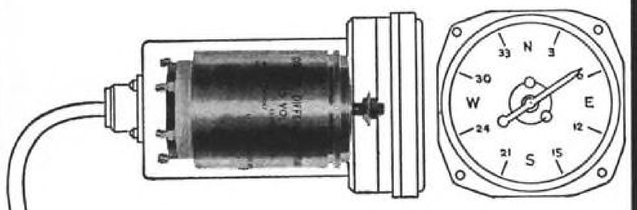

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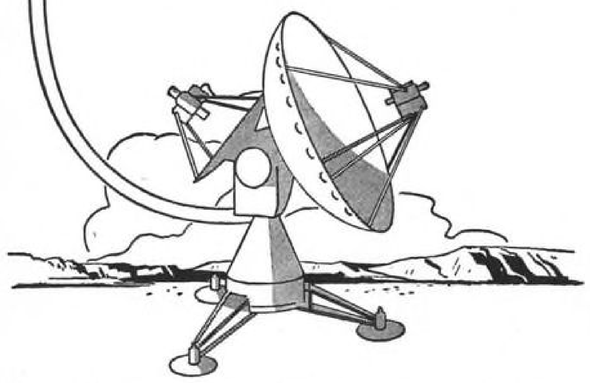

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Financial Briefs

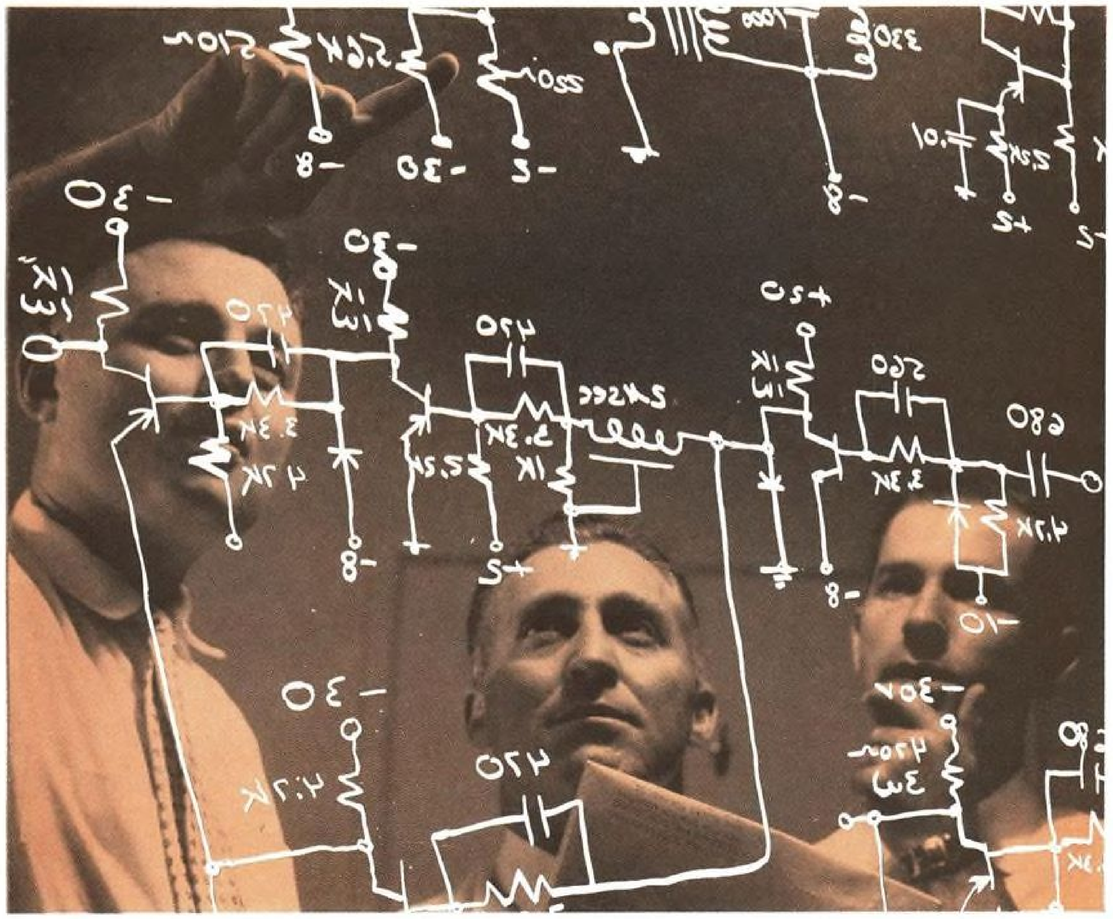
Dayton Rubber Co., Dayton, Ohio, has filed a registration statement with the SEC seeking registration of 38,604 shares of common stock, which the company proposes to offer in exchange for shares of the outstanding common stock of Metal Hose & Tubing Co. at the rate of one share of Metal Hose stock for three shares of Dayton Rubber.

Dayton Rubber proposes to change its name to Dayco Corp. The corporation and its subsidiaries are engaged in producing mechanical rubber products, foam cushioning products, other plastics and chemical products, and equipment for the aircraft industry. Metal Hose, located in Dover, N. J., is engaged in the manufacture and sale of gasoline, oil hose and couplings.

Doman Helicopters, Inc., has filed a petition for arrangement under Chapter 11 of the Bankruptcy Act, to achieve a settlement with its creditors. Chapter 11 is a debtor plan under which Doman will seek to pay off liabilities of about $1 million without going through formal bankruptcy procedure Company plan carrying proposals to pay off the creditors will be filed in U.S. District Court. Company also has filed a debtor-in-possession petition to continue operations at Danbury, Conn., and retain its 35 employes. Glidden S. Doman, president, said company is discussing merger possibilities with "three or four concerns."

Altamil Corp., El Segundo, Calif., has filed a registration statement with the SEC seeking registration of 626,036 outstanding shares of its common stock (254,313 shares owned by W. H. Brown, former board chairman, and 371,723 by Pryor Manufacturing Co.).

In August, 1959, Altamil purchased all the business and assets of the Twigg Industries Division of Pryor Manufacturing Co. for 400,000 shares of Altamil stock and $300,000 in cash. Pryor Manufacturing proposes to distribute a total of 202,866 shares to Huyler's in consideration of the latter's cancellation of indebtedness represented by certain debentures in the sum of $1,217,196.45; the balance of the stock will be distributed by Pryor Manufacturing to its stockholders in pro rata proportions upon dissolution of Pryor Manufacturing. M. H. Pryor and G. L. Canfield, et al, are understood to be affiliates of Pryor Manufacturing, and the Altamil stock to be distributed to them is being registered even though the company has no evidence that they may redistribute the stock. Only 371,723 of the 400,000 shares are being registered, as the stockholders and debenture holders of Pryor Manufacturing



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- Pressure Ratio Transmitters
- Pressure Ratio Indicators
- Gas Pressure Systems
- Digital Control Systems
- Mark Sensing Equipment
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- Communications Equipment
- Airborne Terrain Clearance Systems
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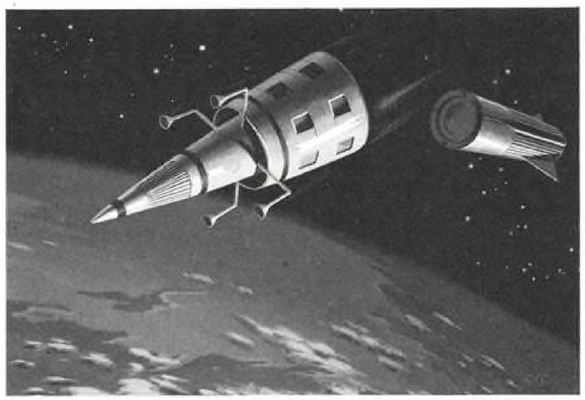

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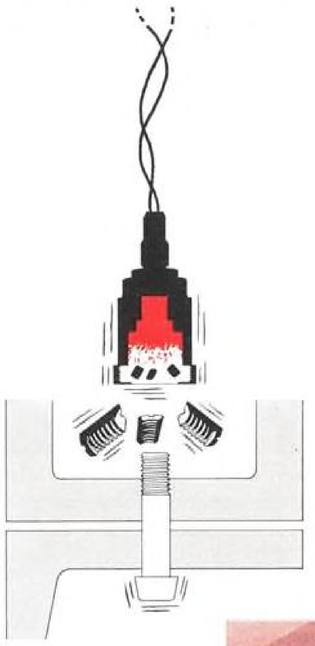

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The Separation Nut is unique because its controlled separation is a highly reliable mechanical function activated by a very small explosive charge.

By using the Nut's small explosive charge rather than the "brute force" explosive techniques so commonly used to fail high strength material in explosive bolts, the Separation Nut can substantially reduce a potentially hazardous condition to installation crews and to the vehicle itself.

More compact joints can be designed since Separation Nuts are used in combination with standard diameter, high strength bolts used at full allowables.

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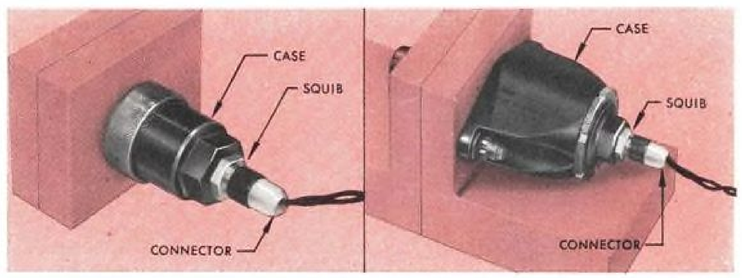

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who will receive the balance of 28,277 shares have indicated no intention to redistribute them.

Motorola, Inc., earnings for 1959 were $14,171,237, up 92% over 1958's earnings of $7,356,213. Net sales were $289,529,444, as compared with $216,590,325 in 1958.

Servomechanisms, Inc., reported a fourth quarter profit of $51,000, compared with a loss of $150,000 in a similar period a year ago. Year's sales of $15,100,000 and a loss of $195,000 compare with sales of $17,300,000 and a loss of $43,000 in 1958.

Ling-Altec Electronics, Dallas, Tex., which currently has a $50 million backlog, earned a net income of $1.8 million on 1959 sales of $48 million.

Flexible Tubing Corp., Guilford, Conn., reported 1959 net income of $107,097 on sales of $4,046,413. Comparable figures for 1958 were net income of $86,741 on sales of $3,864,319.

Corning Glass Co. last year earned $24,335,899 on sales of $204,887,424, an earnings increase of 41.8% over the previous year's total of $17,163,543.

Tenney Engineering Co., Union, N. J., reported 1959 sales of $4,731,660, compared with $4,501,735 the year before. Income after taxes was $180,692.

Silicon Transistor Corp., Carle Place, N. Y., operated at a profit of $13,000 on sales of $113,000 during the last quarter of 1959. Backlog of orders exceeds $200,000.

American Machine and Metals, Inc., net sales for 1959 were a record $51,003,417 compared with $43,612,896 for 1958. Net earnings for 1959 were a record $3,055,639, compared with $2,246,612 for the previous year. Backlog on Dec. 31 was $18,500,000. It was $16,800,000 at the beginning of 1959.

Gabriel Co. reports a net loss of $536,906 for 1959 on net sales of $28,836,253, compared with a net gain of $545,066 in 1958 on net sales of $22,825,684.

Loral Electronics Corp. set record sales of $10.5 million for the first nine months of 1959 and earned record net income of $379,000, compared with $5.3 million net sales for the first three quarters of 1958 and net profits of $89,000. Earnings per share for the nine months in 1959 were 75 cents on about 508,000 shares outstanding. Earnings were 30 cents per share on about 300,000 shares in the 1858 period. Backlog of orders was $30 million on Jan. 1.

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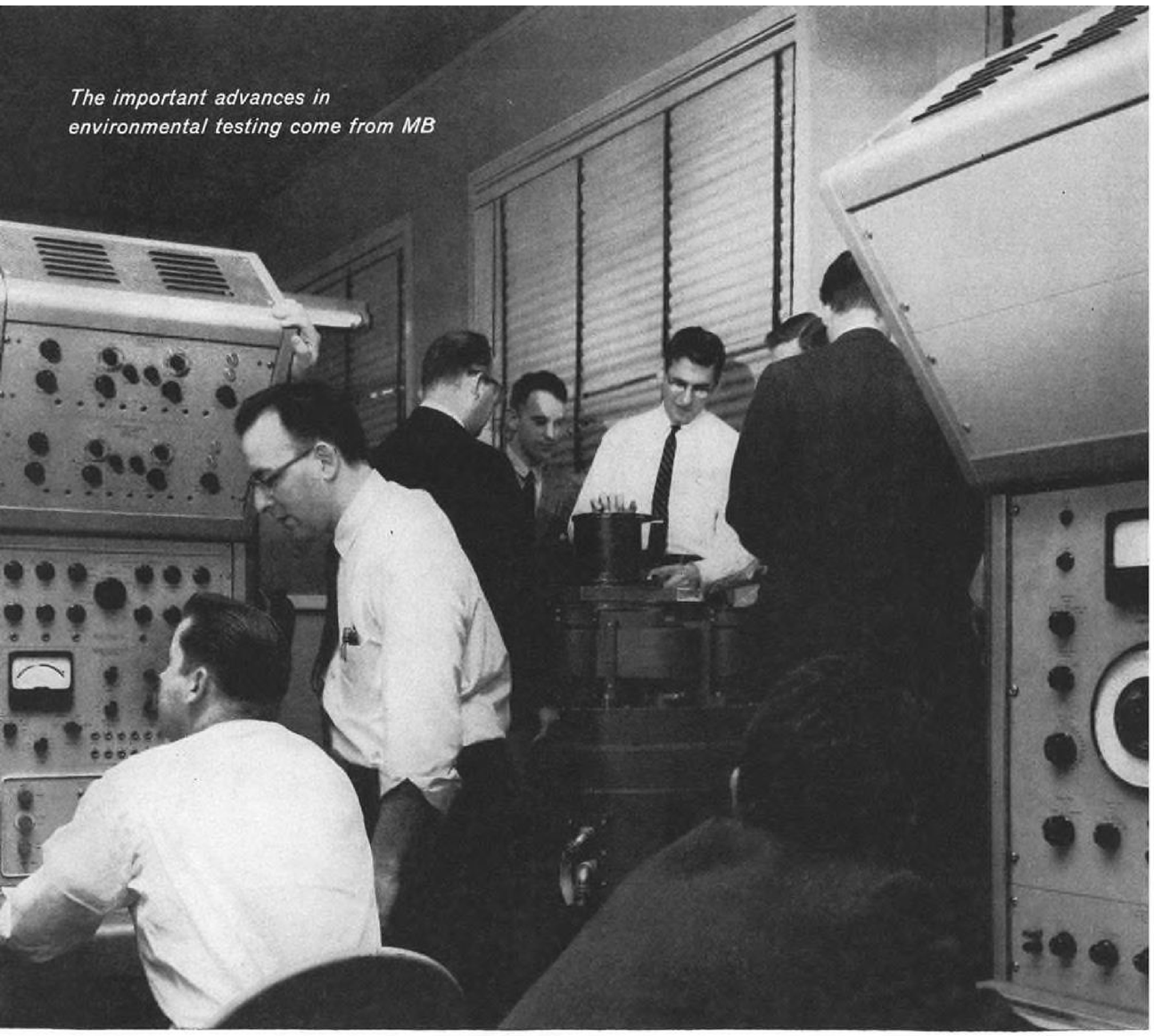
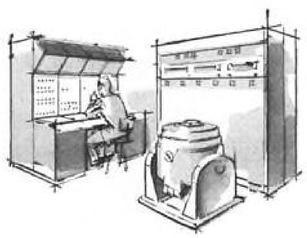


NEW seminar series in practical vibration testing starts April at MB



EVERY month 12 students "graduate" from MB's seminar in Complex Vibration Practice.

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These well-known seminars were inaugurated by MB to familiarize engineers and technicians with the theory, design and operation of complex test equipment.

Results of these valuable training courses have been so successful that MB is pleased to announce a new series to run concurrently with the seminar on theory. The new seminar, starting this April, will emphasize practical application of test equipment.

The initiation and continuance of these seminars is another demonstration of MB's leadership in the field. They are good reasons why *more and more engineers look to MB for continuing progress in the field of environmental testing.*

Attendance at MB seminars is limited to 12 students per session in order to provide all with ample opportunity to enter discussions and receive full benefit of laboratory equipment.

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC., 1078 State Street, New Haven 11, Conn.

Low Frequency Unit Has Omni Properties

By David H. Hoffman

Boonton, N. J.—A computer and compass system that telescopes the problems posed to a pilot flying a low frequency instrument approach into a "turn toward the needle" signal has been developed by Aircraft Radio Corp.

Designated the Type CD-4 Course Director, the new ARC system lends the properties of a visual omnirange to non-directional homing beacons—furnishing them, in effect, with radials.

Navigating in an area without VOR airways, a pilot using the CD-4 may tune in any LF transmitter and track to or from it by following an omni-like display on his instrument panel. In an approach, the precision of the CD-4 coupled with an LF station comes close to matching that offered by omni.

The CD-4, in addition, feeds steering information to the pilot, enabling him to turn toward and automatically assume optimum headings to intercept pre-selected radials. Deflection of the course indicator's vertical needle tells the pilot the direction of the radial from his aircraft.

Slaved Gyro

Containing its own slaved gyro for heading information, the system operates through most conventional low frequency and VOR receivers now in use. Failure of the CD-4 computer section, however, will not affect normal operation of the VOR/localizer or ADF equipment installed in the aircraft; conventional letdowns using the aural signals of an LF range, VOR or the ADF pointer still can be executed.

Flight evaluation of the CD-4 conducted by AVIATION WEEK proved that a pilot—by selecting a desired course, tuning his receiver to a ground station, selecting the system's proper operating mode and flying to center its needle—can solve a wide variety of navigational problems with the CD-4 without changing procedures.

To be placed on the commercial market in July at an initial price of about $3,200, the completely transistorized ARC system combines these six major units:

• **CA-14A Computer Amplifier.** Key component of the system, the computer amplifier consists of an aluminum frame with five plug-in modules. It slaves the CD-4's directional gyro and compass transmitter to furnish stabilized heading information. The computer also generates a d.c. voltage equivalent to the difference between aircraft heading and desired track. This is combined with a second d.c. voltage taken from an LF-VOR/localizer transmitter, which indicates angular displacement from the selected course. These two voltages are translated into steering information by the computer and presented to the pilot as a signal to fly left or right.

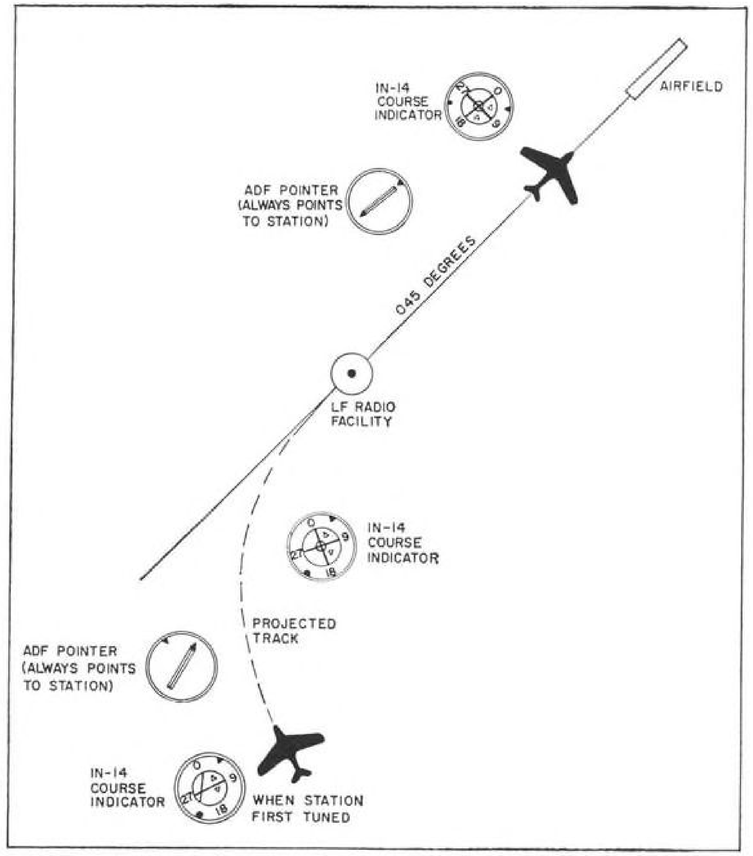

CHART illustrates an ADF approach in an aircraft equipped with the CD-4 Course Director, an LF receiver and appropriate radio facility charts. Pilot's procedure is to tune station frequency, set course indicator to runway heading, position mode selector of control unit to CD ADF and fly aircraft to center vertical needle.

• **IN-14 Course Indicator.** The IN-14 is a microammeter equipped with a vertical and horizontal pointer. It serves as a deviation indicator, course selector and to-from instrument. When the computer section is engaged, the vertical pointer supplies steering information to intercept and maintain a selected track. With computer disengaged, the vertical pointer shows only track displacement.

• **C-92A Control Unit.** The control unit's six-position rotary selector switch links the system's steering computer to, or isolates it from, the station tuned on the aircraft's receivers. Depending upon selector switch position, either steering or track displacement information is displayed by the vertical pointer. In addition, a two-position NORM-REV switch will reverse the polarity of the vertical pointer circuit, enabling into-the-needle turns on headings reciprocal to the course selected.

• **G-14A Slaved Gyro.** The slaved gyro replaces the vacuum operated directional gyro installed in most instrument equipped aircraft. It represents 5 lb. of the system's 18.2 lb. total weight.

• **CT-10 Compass Transmitter.** The CT-10 is a magnetic compass that transmits heading data to the slaved gyro

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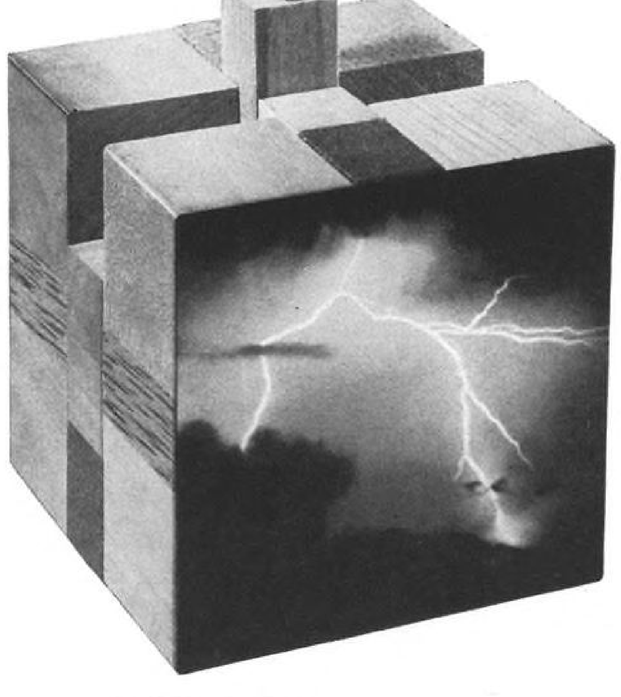

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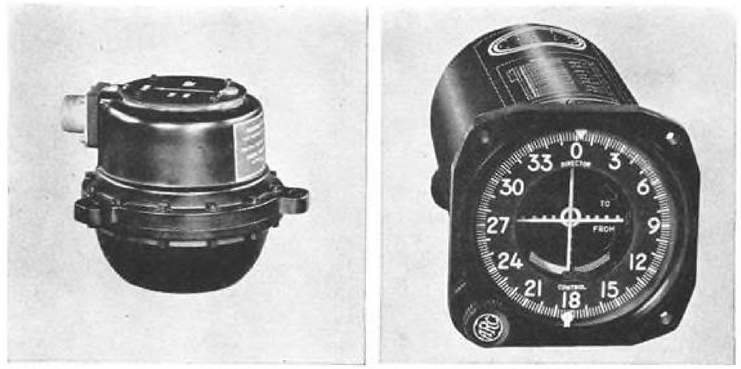
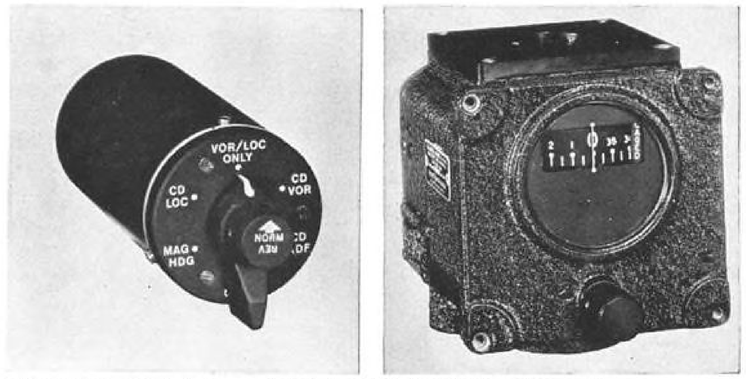


SYSTEM components include CT-10 Compass Transmitter (left), IN-14 Course Indicator.



C-92A Control Unit is shown at left; at right is G-14A Slaved Gyro Compass.

through a self-contained synchrotel.

• **IN-11 Slaving Meter.** Mounted in a 1-in. diameter hole on the aircraft instrument panel, the slaving meter is a zero-center (6-0-6) milliammeter used to monitor the gyro slaving current.

AVIATION WEEK observed the CD-4 on a simulated IFR flight that took Aircraft Radio Corp.'s Twin Bonanza from La Guardia Airport, N. Y., to Bridgeport, Conn., to MacArthur Field at Islip, N. Y., and then back to La Guardia.

Flight Evaluation

With the CD-4's mode selector on MAG HDG (magnetic heading)—in which the vertical needle shows only displacement from the pre-selected heading—an instrument takeoff was simulated on Runway 31 at 11:31 a.m. The vertical needle had been centered and the ADF receiver tuned to La Guardia LF Range while the plane was in takeoff position. Course indicator read 312 deg. Wind was out of the northwest at 15 mph.

On his takeoff roll, ARC's test pilot G. V. (Mike) Smith kept the needle centered with small rudder corrections. Angling gently toward the left, the Twin Bonanza broke ground about 15 ft. from the runway's centerline.

At 1,000 ft. over the Bronx and under departure control's radar surveillance, the CD-4's mode selector was switched to ADF ONLY, rendering its computer section inoperative. To determine the most direct course to the range, the knurled ring around the course indicator was turned until the vertical needle centered. Triangular index of the course indicator showed that the range, located about 3 naut. mi. northeast of Runway 31's takeoff end, was on a track of 095 deg. from the aircraft.

While the Twin Bonanza was still on runway heading, climbing, the CD ADF mode was selected, engaging the CD-4 steering computer. Full deflection of the vertical needle called for a turn to the right and indicated that the 095 deg. track to the La Guardia Range was north of the aircraft.

Centering of the needle—the signal to roll out—was received on a heading of 010 deg. The computer initially asked for an intercept angle of 085 deg., but as the desired track was approached, this angle was decreased by a series of turn right signals that brought the Twin Bonanza gradually onto course.

Erratic swinging followed by momentary displacement of the vertical needle, in the exact manner of an omni cross-

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pointer, marked station passage.

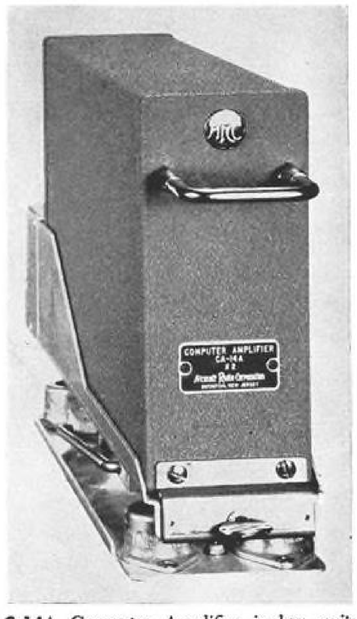
Outbound on the east leg of the range, magnetic course 094 deg., the computer called for wind corrections of between 6 deg. and 9 deg. left. Aural signal of the range, monitored as a cross-check, showed the aircraft on course and compensating correctly for drift.

Flight plan was to turn northeast at Huntington, the intersection of La Guardia's east leg and the southwest leg of the Bridgeport LF Range (052 deg. inbound), proceed to Bridgeport and there execute a range and an omni approach with the CD-4.

But tuning the LF receiver to Bridgeport with the computer operative and flying to keep the needle centered would have moved the aircraft immediately off course on a shortcut heading to intercept the Bridgeport range leg. The arc of the plane's flight path would have curved inside Huntington.

The problem of pinpointing LF intersections such as Huntington is solved on the CD-4 by holding compass heading, tuning the aircraft's LF receiver to the second station, switching to the ADF ONLY mode and dialing the intersecting radial on the course indicator. When the vertical needle centers, the aircraft is over the intersection and ready to turn inbound.

About 10 mi. from Bridgeport, clearance for the two approaches—range to Runway 24 and omni to Runway 6—was obtained from the tower. Range transmissions again were cross-checked aurally over the Twin Bonanza's speaker system, but the primary flight instru-



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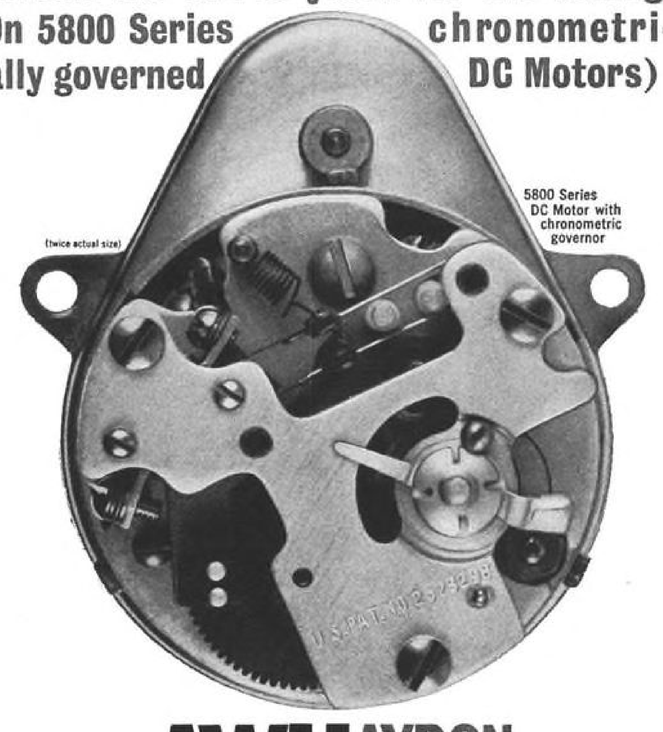

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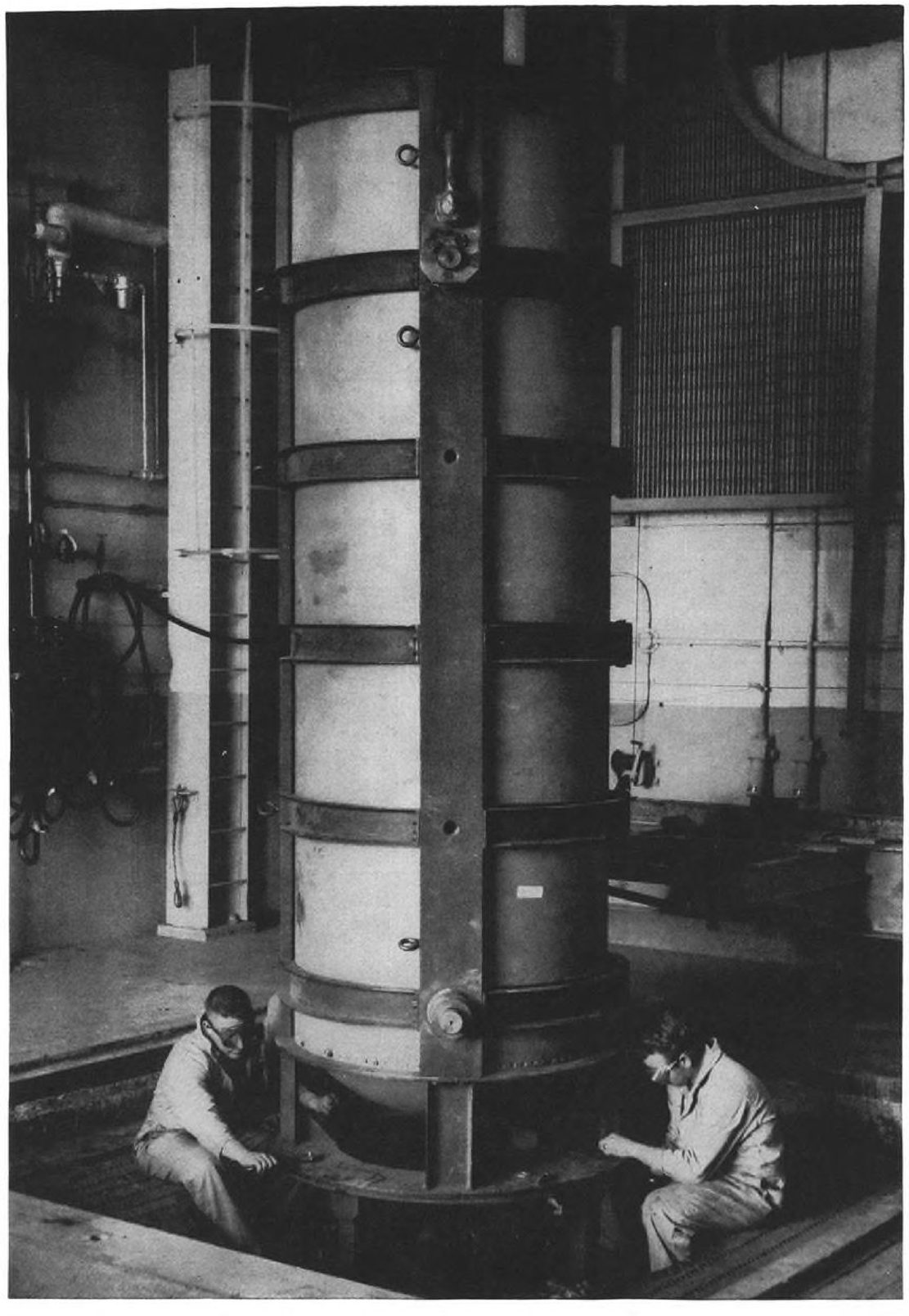

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We have called upon the pressure vessel industry to whom metals for strength are second nature to get rocket casings combining light weight and high tensile strength.

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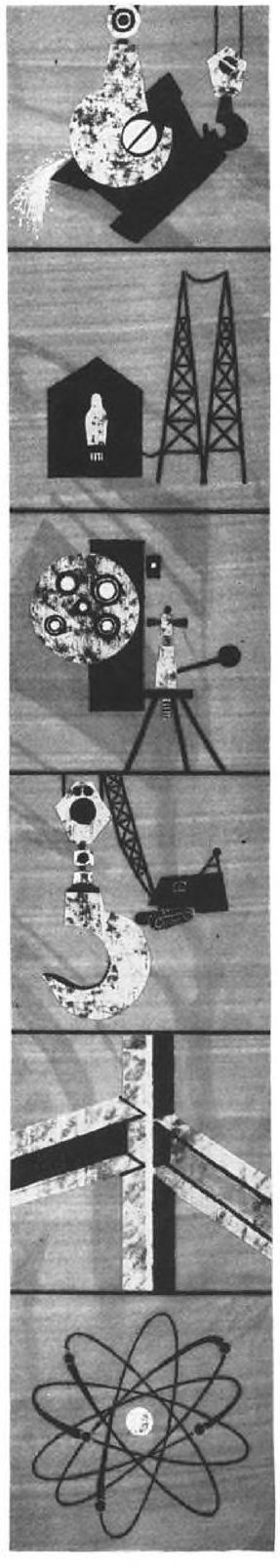

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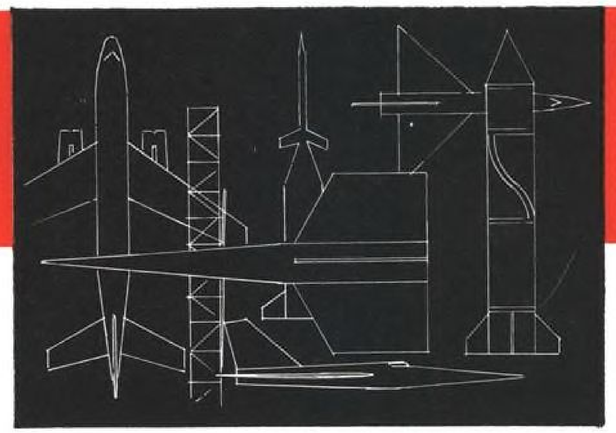

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ment throughout the approach was the CD-4 course indicator.

At high cone, the inbound course to the range, 232 deg., was dialed and the mode selector switched to CD ADF, REV, to permit into-the-needle turns while outbound on the maneuvering leg. Half way through the 180 deg. type procedure turn to the east, the reverse polarity switch was returned to NORM.

First portion of the procedure turn was based upon heading and time. Inbound, however, the CD-4's vertical needle was centered, resulting in a heading of 262 deg., or an intercept angle of 30 deg. to the northeast leg of Bridgeport.

The computer, in effect, preferred less than the standard cut of 45 deg. in returning to course—a characteristic noticed on two subsequent procedure turns. Intercept angle as determined by the computer is based upon distance from the station and prevailing wind, varying from situation to situation.

After low cone, the Twin Bonanza described a gentle westerly arc en route to the field, 3.5 naut. mi. southwest of the station. Although flight path diverged about 400 yd. from the range leg, the plane crossed the northeastern airport boundary near its midpoint.

According to ARC's test pilot and company engineers, Bridgeport's loop range, which lacks a center tower to permit precise ADF tracking and simultaneous voice transmissions, is the least desirable LF station to be used in conjunction with the CD-4. This uncommon range installation is also one of the least desirable LF transmitters to use for conventional ADF letdowns.

In the VOR approach that followed, the Twin Bonanza was flown outbound on the 245 deg. radial of Bridgeport omni. Procedure turn was to south.

When first inbound on procedure turn, computer called for a heading of 030 deg. to intercept the 065 deg. course to Runway 6. Approaching this course, as indicated by the omni pointer, a monitor button on the plane's steering column momentarily was depressed to disengage the computer without destroying the approach problem. The vertical needle showed that the aircraft's position was still south of the 065 deg. course, heading 045 deg. After its interception, the plane flew a direct track to the runway's threshold.

At MacArthur Field, two approaches were executed, the first utilizing all components of the ILS system—the outer and middle fan markers, the glide slope and localizer, and the compass locater at the middle marker. CD-4 mode selector was positioned in CD LOC, keeping the steering computer engaged.

Coming out of the procedure turn,

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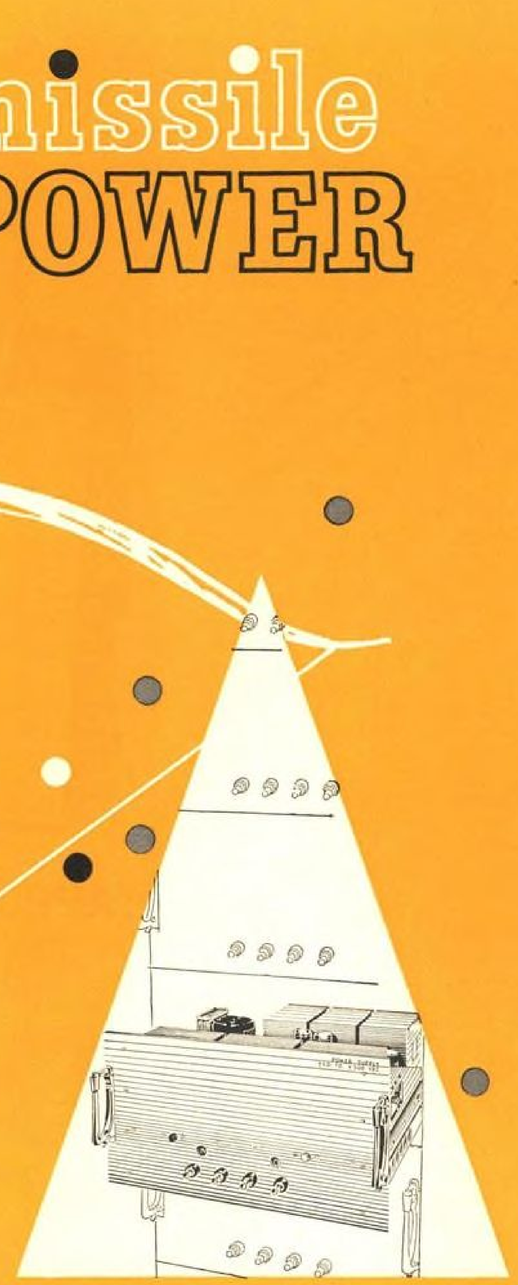

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aircraft overshot the 057 deg. final approach course by about 300 yd. before the vertical needle began displaying fly right corrections. As the outer marker was reached, however, the course was pinned down. At minimums, the plane crossed the runway with its right wing tip over the centerline.

The second approach at MacArthur was executed with the CD-4 mode selector in CD ADF and with the LF receiver tuned to the middle marker compass locater. Horizontal needle of the course indicator displayed the plane's path down the ILS glide slope.

After overshooting the approach course, this time by about 400 yd., the aircraft returned to the desired track and maintained alignment with the runway until seconds before the middle marker. Here the characteristic indications of LF station passage on the CD-4 —swinging of the needle and abrupt displacement—forced the pilot to shift his attention from the course indicator to the ADF pointer.

At minimums, the vertical needle's directional property returned. The aircraft, at the bottom of the approach, was about 40 ft. left of runway center.

ARC foresees wide tactical application of the CD-4, especially in areas where helicopter and light fixed-wing aircraft must operate at low altitudes, out of line-of-sight range of VHF navigational facilities. Company says the CD-4 concept represents "a potential battlefield omni system."

If a pilot is forced to fly evasive maneuvers along a combat course, ARC adds, the CD-4 needle will continuously inform him of the direction and best means of re-intercepting his track to target or to home station.

In addition, ARC feels that the CD-4 will lend precision to helicopter navigation at low altitudes in congested metropolitan control zones during low ceiling, marginal visibility weather. With the CD-4, helicopter pilots could intercept and follow prescribed tracks to rooftop landing pads equipped with small homing beacons.

Essentially, the CD-4 system is an adaptation of ARC's earlier CD-1 Course Director. The CD-1 system, first engineered in May, 1956, had all of the CD-4's capabilities except that it could not obtain steering and tracking information from LF transmitters. Development of the CD-4 was spurred by an Army request for a compass-computer system that would broaden the usefulness of these beacons.

Although no firm orders for the CD-4 have been placed with ARC, the Army Aviation Board has completed service testing of the system on fixed wing aircraft at Ft. Rucker, Ala. The CD-4 is now undergoing environmental and engineering tests at the Signal Corps Proving Ground in Ft. Monmouth.

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Standard 19" amateur-notched panels have the necessary permanent wiring to accommodate any standard EECO Germanium circuit module, and all other circuit interconnections are made by patch cords or plugs, **with unique, prepunched circuit cards to guide you.** No soldering is required, and experimental arrangements of T-Series circuits can be quickly patched up, changed, or taken down without waste of time or materials.

Bottom half of breadboard suitcase is compactly laid out to store all necessary T-Series circuit modules, circuit cards, patch cords, and compatible power supplies.

EECO T-Series breadboard equipment is available in both suitcase and rack-mounted types. Breadboard Kits of any degree of complexity can be built up in stages, according to the specific panels and number of circuits incorporated. Compatible interconnections between racks or suitcases further enable the designer to expand the equipment into a complete systems development console. Compatible solid-state, convection-cooled power supplies are also available in two different models: ZA-720 is a dual 12-volt, 5-amp supply; ZA-721 is a 12-volt, 1-amp plug-in power supply.

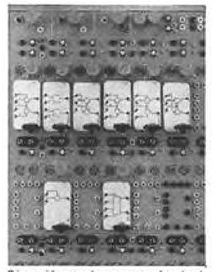
FEATURES

- **Permits rapid formulation of digital electrical systems.**
- **System may be operated slowly to permit inspection of its mode of operation, or over-speed to indicate system derating.**
- **Operation may be analyzed with a minimum of test equipment.**
- **Provides a means for rapidly building and testing alternate ways of formulating a system.**
- **Minimizes wiring errors and the inclusion of defective parts.**
- **Circuit cards provide a means for rapidly visualizing the system, and facilitate drawing a circuit diagram.**
- **Circuit cards enable the designer to determine the elements involved, as well as the cost of the system.**

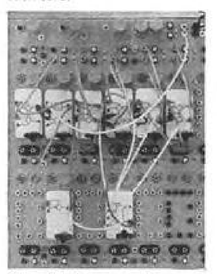
A request, on your company letterhead, will bring detailed information on the flexibility of the EECO T-Series Breadboarding equipment, and a demonstration if desired.

ENGINEERED ELECTRONICS Company

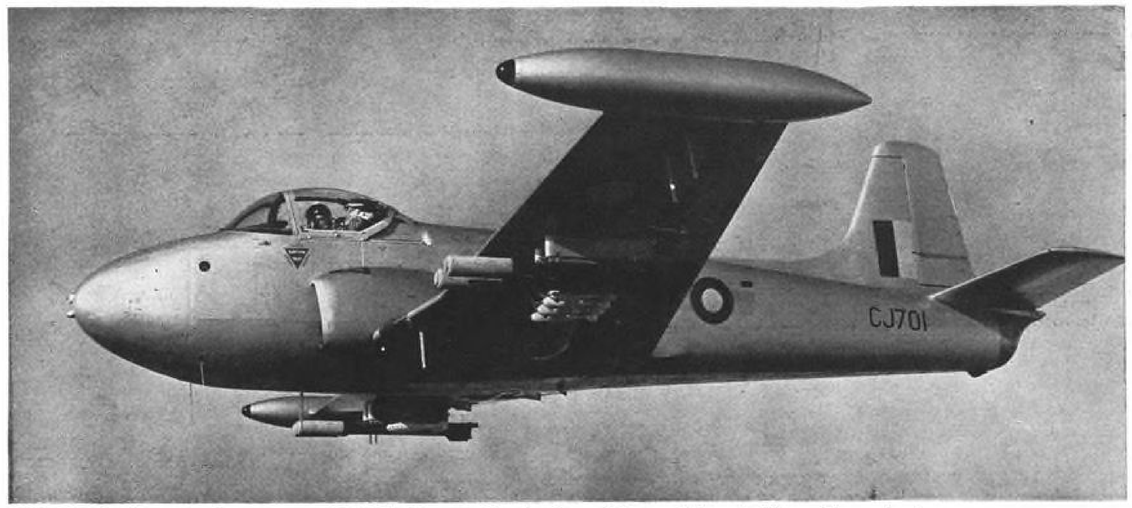
ENGINEERED ELECTRONICS COMPANY
1441 East Chestnut Avenue • Santa Ana, Calif.



Circuit cards are selected according to the system it is desired to breadboard and placed on the panel in alignment with the jack pattern. Corresponding T-Series circuit modules are plugged in above each card.



Circuit interconnections are made by patching through holes in the circuit cards. Resulting pattern of symbol cards and patch cords shows a schematic and bill of materials for the system, once it is checked out



HUNTING Jet Provost trainer armament includes four practice bombs and two rocket projectiles under each wing.

British All-Jet Class Nears Graduation

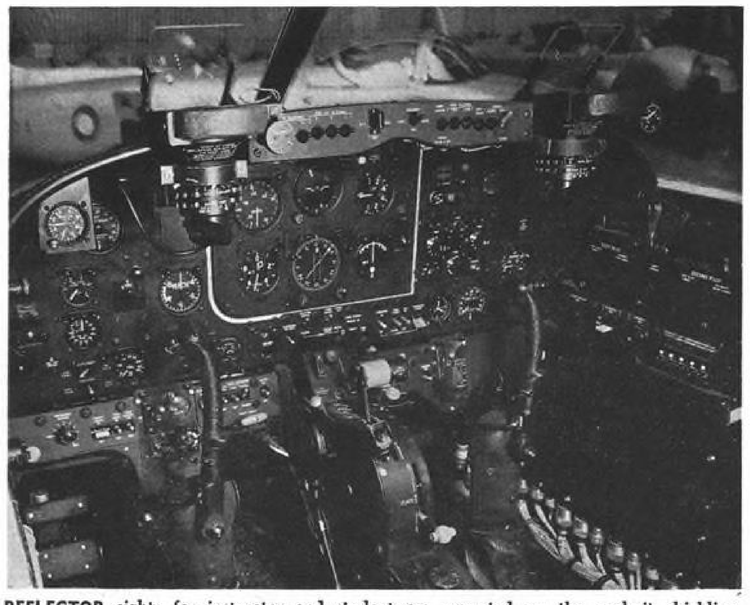
By John Tunstall

London—First all-jet-trained pilot course to be phased into Britain's training pattern will be completed in June at No. 2 Flying Training School, Syerston, England.

Graduate pilots will get their "wings" without first having flown a piston engined or tail-down aircraft. The average time to solo on the basic Hunting Jet Provost Mk. 3 jet aircraft of just over 11 hr. still compares with the piston-engine pattern.

A similar U.S. Air Force trainee program, called Project All-Jet (AW Nov. 24, 1958, p. 115), involved a 38-student class flying Cessna T-37A twin-jet planes at Bainbridge AFB, Ga.

The station now has received most of its full complement of 49 aircraft. The Mk. 3 variant is the latest production aircraft and is the first British aircraft to carry UHF radio instead of the current VHF equipment. It is powered by a Bristol-Siddeley Viper engine producing 1,750 lb. thrust and is of simple design, having been developed from a full-throttle engine designed for expendable target aircraft.



REFLECTOR sights for instructor and student are mounted on the cockpit shielding.

No Accidents

Since the course started last October there have been no accidents involving injury or serious aircraft damage.

Availability also is reported to have been extremely good and the planned availability target of 65% has been achieved. Minor troubles which were expected with the new aircraft have been overcome. Mostly these were associated with micro-switches in the landing gear system, air start routines, and the radio equipment. None of them has caused the aircraft to be grounded.

Tire life has even been pushed to 400 landings per set, which is four times the figure achieved on the de Havilland Vampire advanced jet trainer which will be ultimately superseded by a later version of the Provost with an uprated Viper producing 2,500 lb. thrust.

Latter Version

This later version of the aircraft will be used for gunnery, bombing and rocket firing training and, when it becomes available, will enable a pilot to be trained up to squadron standard on one basic aircraft at a saving of $250 an hour.

The decision to switch to an all-jet training program was taken in October, 1957. It followed two experimental evaluation courses in 1955 using the original Mk. 2 Provost jet trainer, during which time a new program was developed and aircraft modifications initiated.

These included the need for more thrust, a shorter landing gear (it had the same struts as the piston engine Provost, which required propeller ground clearance) and the abandonment of the drooped inboard leading edge which had introduced variations in the stalling characteristics between different aircraft, due to the sharp lift coefficients obtainable.

Servicing has been planned on a centralized basis and is a major innovation in the Royal Air Force. It is claimed to have greatly increased flexibility of the 300-man maintenance staff.

New to the Royal Air Force is the employment of maintenance teams working with mobile tool and component kits. This arrangement facilitates tool checks at the end of each day and prevents tools and components, particularly nuts, bolts and washers, from being left in aircraft. Also introduced is a forward supply system which automatically schedules part replacements.

Provost Trainer

The Provost trainer is a realistic jet aircraft, with the power-to-weight ratio of the Vampire and the performance of the wartime Spitfire fighter.

The all-metal aircraft has an hydraulically-operated nose wheel gear, two-position flaps, speed brakes, wheel brakes, Mach meter, oxygen system and ejector seats. Cockpit arrangement provides for side-by-side seating with full dual control and a centralized instrument flying panel. Radio aids besides UHF include the Rebecca Mk.8 which provides distance measuring and bearing facilities, or a radio compass.

The aircraft has a lively rate of roll (170 deg./sec.) and is not much heavier than the North American T-6 to loop. It is particularly light and responsive. Lowest stalling speed is 65 kt. and the aircraft has to be firmly held into a spin. The stall is straight, and steep turns pulling 4g lead to buffeting at the stall.

Maximum speed of the Provost is 299 kt. at 30,000 ft., range is 570 naut. mi. with tip tanks, and endurance is three hours. The Provost gross weight is 7,150 lb. with full tip tanks, and takeoff distance to clear 50 ft. is 2,250 ft.

The flight training program consists of 79 hr. of dual instruction and 41 hr. of solo and progresses through high altitude familiarization and takeoffs and landings, to forced landings and low flying. The student continues with instrument flying, navigation, night flying and formation flying.

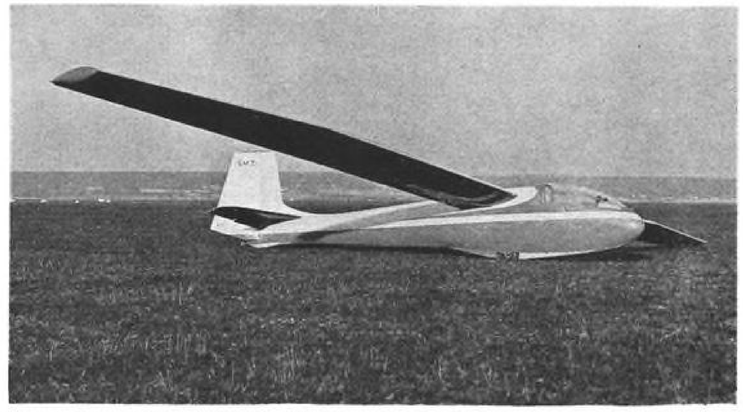
For the first week at Syerston the student attends ground school full-time, and then spends half of each day there for the 28 weeks remaining before final basic examinations, the other half being spent in the air. Ground instruction, totaling 223 hr. is given in aerodynamics, technical subjects, airmanship, aviation medicine, meteorology, navigation and signals.

Integrated with instruction in these airmanship subjects is 177 hr. of instruction in officer training and fitness subjects which, with flying, make a total of 520 hr. of training during the entire 36-week period. Four months of instruction precedes the flying course.

There currently are four classes of pilots at Syerston, each class having up to 36 students. Total strength of the station is 689. One of the main differences between the old piston and the jet training routines is the much greater emphasis on airmanship, instrument flying and radio navigational disciplines. This reflects on the higher ratio between dual and solo flying. Two-thirds of the pilots' 120 hr. flying time up to graduation now is dual, against the 50/50 basis with piston engine training.

Pilots after only about 30 hr. of flying are able to fly above the overcast, a feature which ensures flying continuity in bad weather which was not possible with the old routine.

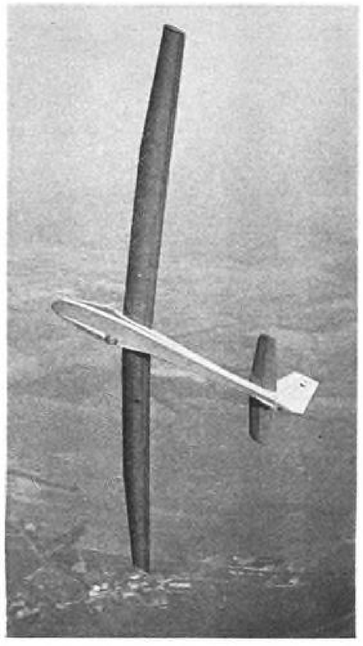
Air traffic control is a major problem. Movements total up to 1,000 a day, many of them involving students with little flying experience. With overcast conditions, up to 10 aircraft are allowed in the air at any one time.



French high performance SM-31 Glider has a 59 ft. wingspan; wing surface is 194 sq. ft.

French SM-31 Glider Undergoes Tests

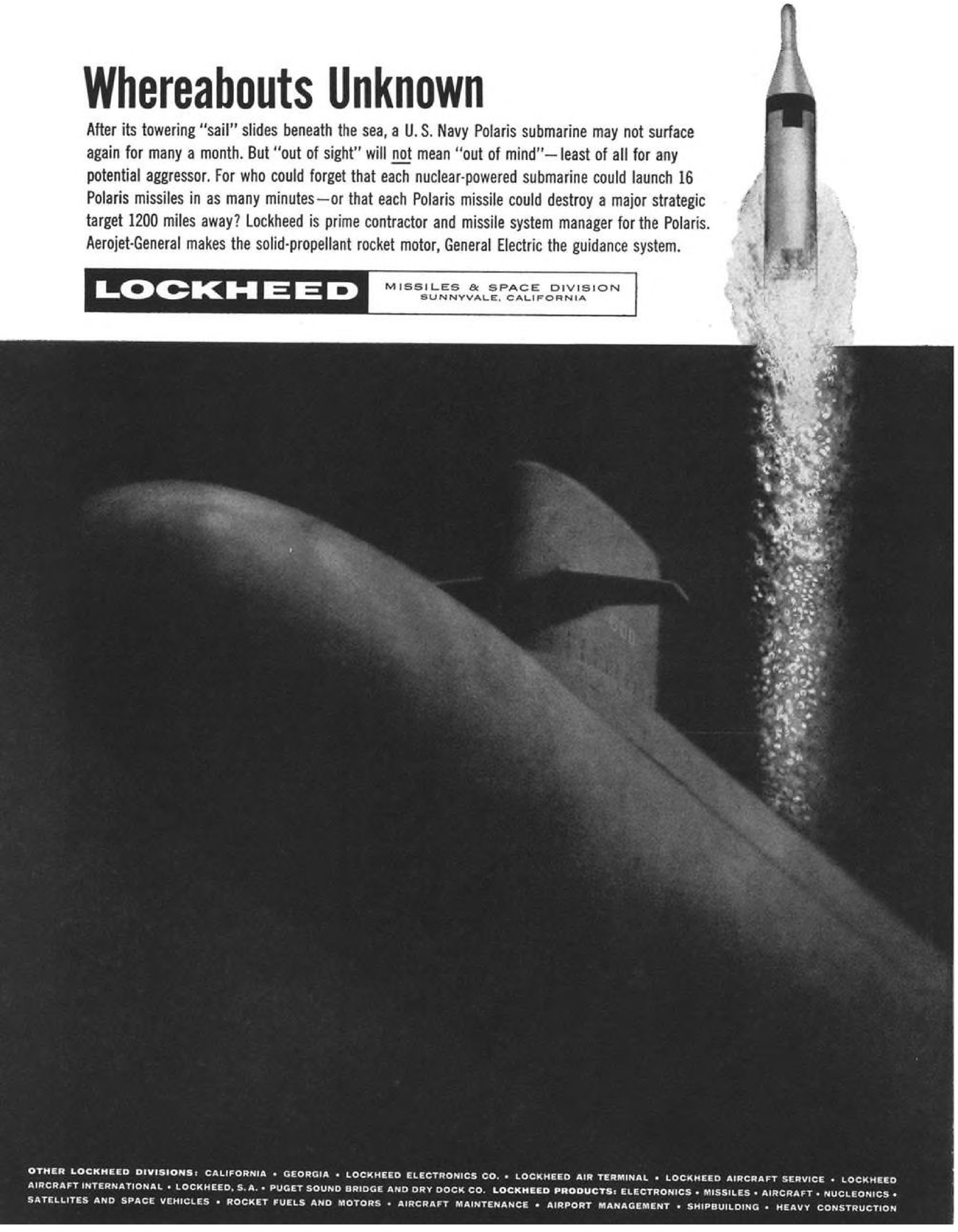
French SM-31, a new high performance glider built by the Merville Co., is winding up its initial flight tests and may participate in the 1960 World Gliding Championships at Cologne, Germany, this June. The prototype was constructed with French government funds and no production plans have been disclosed as yet. The single-seat glider is derived from the earlier high performance French glider, the AIR 100. Its immediate predecessor was the SM-30 experimental glider first flown in 1957. The SM-31 made its first flight last Jan. 11. Merville contends that French glider pilot Camille Labar may fly the SM-31 in open class competition at Cologne; French officials admit this may be a possibility and that their entry choice is between the SM-31 and an improved version of the high performance glider, the Breguet 901. The SM-31 features a laminar flow wing with an aspect ratio of 18. Minimum sinking speed is 2.5 fps. Sinking speed at 62 mph. is 3 fps. and, at 93 mph., 7.9 fps. Builder says the maximum glide ratio is 34. The SM-31 uses a camber flap plus ailerons for control. Merville claims cockpit construction and flight equipment will permit flights up to 40,000 ft. Gross weight is 1,014 lb.



Whereabouts Unknown

After its towering "sail" slides beneath the sea, a U. S. Navy Polaris submarine may not surface again for many a month. But "out of sight" will not mean "out of mind"—least of all for any potential aggressor. For who could forget that each nuclear-powered submarine could launch 16 Polaris missiles in as many minutes—or that each Polaris missile could destroy a major strategic target 1200 miles away? Lockheed is prime contractor and missile system manager for the Polaris. Aerojet-General makes the solid-propellant rocket motor, General Electric the guidance system.

LOCKHEED MISSILES & SPACE DIVISION SUNNYVALE, CALIFORNIA



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BOEING B-17G bomber, converted into a transport for tropical fish, taxis to the ramp at Westchester County Airport, N. Y.

Converted B-17 Transports Tropical Fish

By Herbert J. Coleman

Vero Beach, Fla.—Tropical fish, a highly perishable commodity, are being successfully air-transported to the U. S. from South America in a wartime Boeing B-17G bomber, converted into a flying aquarium.

Long range capabilities of the airplane solved an important timing and space problem for Paramount Aquarium, Inc., of Vero Beach, which, for the past 11 years had used multi-engine planes ranging from Consolidated PBY Catalinas to Lockheed Lodestars.

Using the B-17, which is fitted with auxiliary tanks in outboard sections of the wings, Paramount can make the trip back from South American fish collecting points in 26 flying hours. A normal collection run, made about once a month, takes approximately four days for station calls and return.

F. Cochu, Paramount's president and a 26-year veteran of the tropical fish business, says the B-17 carries 2,800 gal. of fuel and consumption has been running about 185 gph. W. P. Moody is chief pilot and heads a crew of usually four men, one of whom is an expert on care of tropical fish. All are rated pilots.

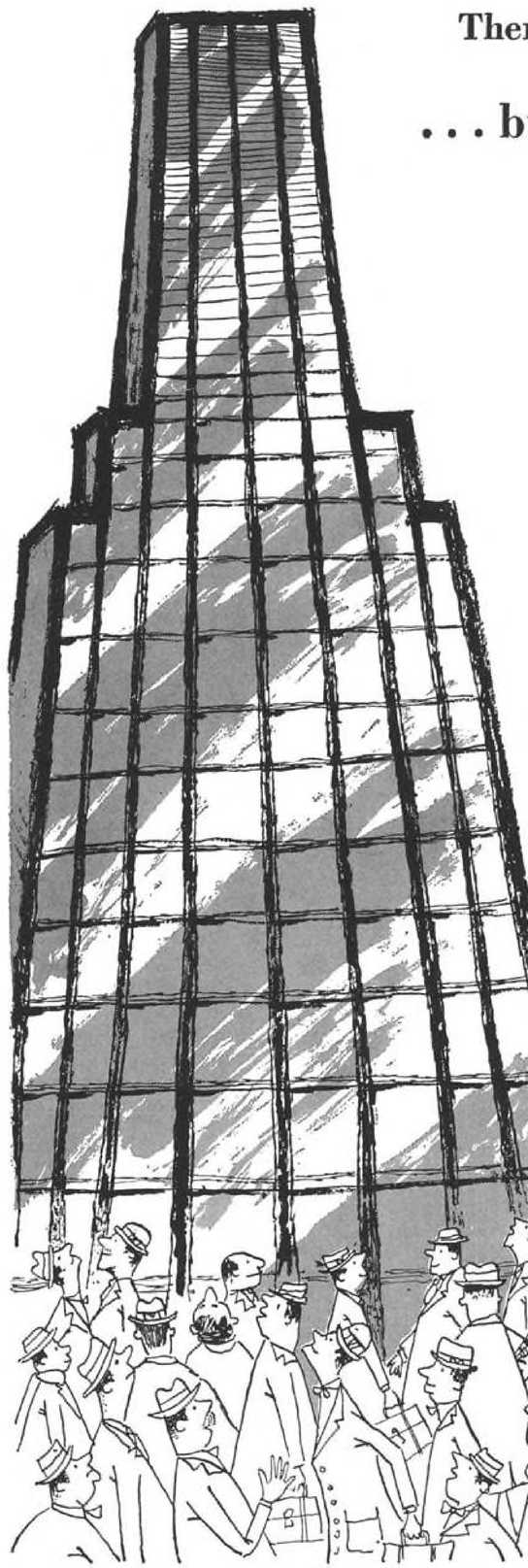
Paramount operates its own fish collection stations at various locations in Peru, Colombia, British Guiana and Brazil and the firm devised a technique of packing the delicate fish for air transit.

First, Cochu said, the fish are carefully placed in water-filled plastic bags. Air is then withdrawn from the bags and 100% oxygen is substituted; the bag then is sealed. Next step is to place the bag in a plastic carton for reinforcement and the cartons are stacked in the waist section of the plane and secured. Mortality rate after the 26 hr. flight home is quite low, Cochu explained.

The bags are sealed by twisting the tops and sealing the opening with rubber bands. If and when additional oxygen is needed during the flight, it is fed into the bags from one of two high pressure bottles carried in the cargo section.

The tropical fish are segregated in separate bags by various varieties. On occasion, Cochu said, the plane will

TROPICAL FISH, packed in plastic bags and cartons, are unloaded for shipment to dealers. Note fish insignia on tail. The truck will deliver the fish to Ardsley, N. Y., where Paramount Aquarium operates a distributing facility.



There's plenty of room at the top

. . . but there's lots more room at the bottom

Look around you. How many men do you see at about your job level and income? Know them pretty well, don't you? Are they smarter than you are? Do they work any harder? Do they possess some "something" that you don't have?

No, of course they don't. And yet, five years from now, some few of you are going to be lots closer to the top of your company. There's lots of room up there — management needs able-brains as never before. But, warning! There's still lots more room at the bottom!

Is there a shorter, surer route to that better job, that bigger paycheck, that pride of achievement? There is, but it's no Easy Street. You still have to supply the energy and effort. How? By digging in zealously with a more intensive, regular reading of the magazine you're holding in your hand right now. Look ahead, read ahead, get ahead.

McGraw-Hill editors write it exclusively for you. Nobody else. It's all about you and your job and your problems. Nothing else. News, fact, trends — today's tasks and tomorrow's opportunities. As inspiring as it is informative. Reads lively. Keeps you on your toes. Makes important people notice you. What's more — you'll enjoy it . . . for it's just about as personal as any publication could ever hope to be.

McGRAW-HILL SPECIALIZED PUBLICATIONS

The most interesting reading for the man most interested in moving ahead

Houston Firm Doubles Beech Sales Facilities

Business Aircraft, Inc., of Houston, Tex., new Beech distributor for Texas and Louisiana, has doubled its sales facilities. New hangar occupies about 60,000 sq. ft. at Houston International Airport. Nick Petkas, company president, said the firm expects to reach a Beech sales volume of about $2 million this year (AW Feb. 22, p. 97). Plane at center is Beech's Queen Air.

haul tiny and vicious toothed piranha fish which will attack other fish—or humans—instantly. These are sold only to public aquariums.

On some hauls from the South American stations, he added, the B-17 has carried up to 500,000 tropical fish back to Vero Beach.

B-17 Modifications

Modifications for the fish run were fairly comprehensive. First, Cochu said, two 200,000 Btu./hr. Janitrol heaters were installed to keep cabin temperature at a constant 80F for fish survival. One is used normally and the other backstops it. Heaters can be operated on the ground during unloading operations.

In addition, the plane was completely insulated with 4 in. of glass wool between the fuselage and a new aluminum inner skin; both waist gun windows were faired over for this modification and a 5 ft. x 5 ft. cargo door was installed.

Nose section of the B-17, once used by the navigator and bombardier, now has become living quarters, with double bunks installed on a bulkhead and facilities available for in-flight preparation of meals. Bunks also have been installed in the former radio room, aft of the bomb bay and forward of the waist gunner's section.

The B-17's chin turret, which contained twin .50 caliber machine guns, has been removed and faired over, as has the ball turret on the belly and the flight engineer's upper gun position, just aft of the flight deck. The tail gunner's position is relatively unchanged, except for gun removal, of course.

Navigation Equipment

Because of its long overwater mission, the Paramount B-17 carries considerable radio and navigation equipment, but radar has not been installed although it is part of Paramount's future plans. Radio equipment includes two automatic direction finders, two ARC-15 omnis, two ARC-1 transceivers (50-

PROBLEMATICAL RECREATIONS 10

Suppose a passenger rocket leaves Earth for Planet X every day at noon. At precisely the same time a rocket leaves Planet X for Earth. Each trip lasts exactly 192 hours (8 days). How many rockets from Planet X will the Nth rocket from Earth meet?

—adapted from an ancient problem

Our airborne tactical data system for carrier-based AEW aircraft is the smallest, most complete, transistorized digital system of its type. Engineers interested in creating circuit designs for digital and analog computers and associated input-output devices for these systems are invited to write Mr. Ron McNiven.

ANSWER TO LAST WEEK'S PROBLEM: If X equals John's wife's present age and John's former age, and Y equals the interval of time elapsed and difference between the two ages, the solution X=18 can be obtained easily.

LITTON INDUSTRIES
Electronic Equipments Div.
Beverly Hills, California

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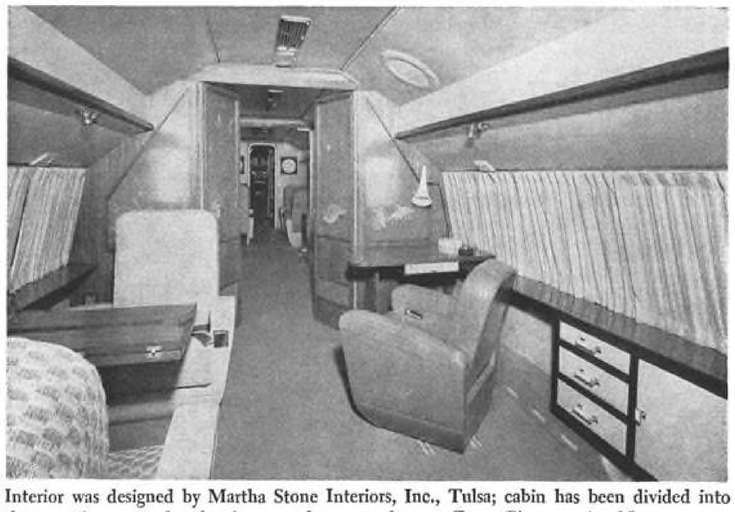
. . . with Skydrol-resistant cover

Construction: Fluoroflex®-T tube, AISI Type 304 stainless steel wire braid, specially impregnated asbestos shield which resists hydraulic and cleaning solvent fluids. Dash 4 through –24Z with swaged type or Seal-Lock*reusable fittings. *Trade Mark

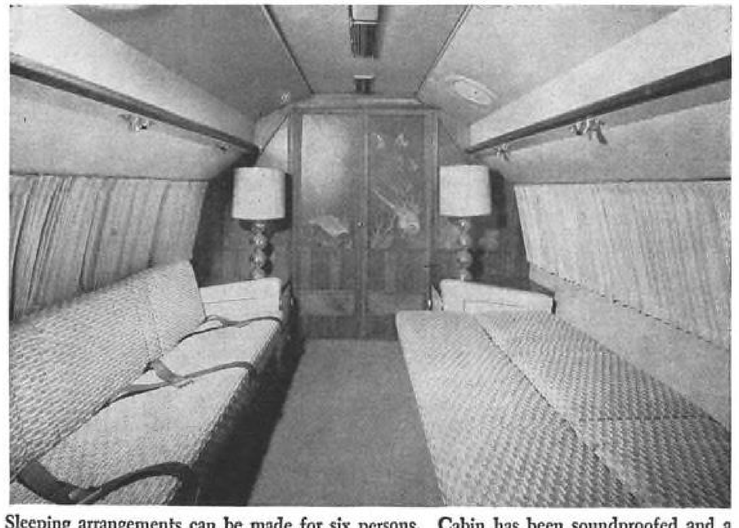
dept. 310 **RESISTOFLEX** Corporation,
Roseland, N.J.

Spartan Aircraft Co.'s Aviation Division, Tulsa, Okla., has converted this ex-Trans World Airlines Martin 404 as an executive airliner for Max Houston, Wichita, Kan., lumberman.

Spartan Aircraft Converts Martin 404



Interior was designed by Martha Stone Interiors, Inc., Tulsa; cabin has been divided into three sections, one for sleeping, one lounge and one office. Plane carries 15 passengers.



Sleeping arrangements can be made for six persons. Cabin has been soundproofed and a front cargo door was removed. Spartan completed the entire conversion in 60 days.

channels each), a glide slope and localizer and a radio altimeter.

Paramount purchased the B-17G as a surplus aircraft at Tucson, Ariz., where USAF had mothballed it after only 1,300 hr. of flight time. The modification was completed at Tucson by Hamilton Aircraft.

Hamilton also replaced the engines with four new Curtiss-Wright R1820-97 supercharged engines, and, after completion of an 8,000 hr. airframe inspection, the plane went into service.

It operates on a Federal Aviation Agency limited certificate, since its only use is for single-cargo and Paramount is the only user. It cannot be leased or used for passenger hauling.

Paramount is based at Vero Beach Airport and occupies a large hangar, half of which is used for maintenance and the other half for aquariums. Cochu said Paramount has 2,000 separate aquariums for fish storage, pending shipment to jobbers. On the East Coast, Paramount flies its fish to Westchester County Airport for its Ardsley, N. Y., facility where the fish are sent to dealers.

Later this year, Cochu said the company will extend its operations to Africa and as far east as Singapore, to obtain more exotic varieties of tropical fish. The B-17 will be used for these runs, but no firm date is set, pending more experience on the long hauls to South America, Cochu pointed out.

Rotorwing Aircraft Builds New Autogyro

Low-cost two-place autogyro has been built by the newly-formed Rotorwing Aircraft Co., Birmingham, Ala.

Rotorwing reports that it expects to sell a certificated version of the all-metal autogyro for $5,600 minus a trailer, instrumentation and radio. The Continental 85-hp. engine is placed, pusher-fashion, behind the side-by-side enclosed cockpit.

Prototype has a rotor blade diameter of approximately 24 ft. and fuselage length is 12 ft. Empty weight is given as 750 lb. and takeoff weight as 1,200 lb. Estimated performance includes 95-mph. cruise speed, 19-mph. stall speed, 1,100-fpm. initial rate of climb and flight endurance of four hours.

The aircraft has been designed and built by Pelham H. Anderson, a U.S. engineer and John Gear, a British engineer.

PRIVATE LINES

Southwest Airmotive Corp., Dallas, Tex., has renewed for the 10th consecutive time, a six-months engine overhaul agreement with TACA Corp. (TACA International Airlines) covering overhaul of Pratt & Whitney R-2000 powerplants for the carrier's DC-4s. Since Southwest has started overhauling these engines, allowable time has increased from 1,250 hr. to 1,500 hr. and an extension is currently being requested to permit 1,700-hr. of operation.

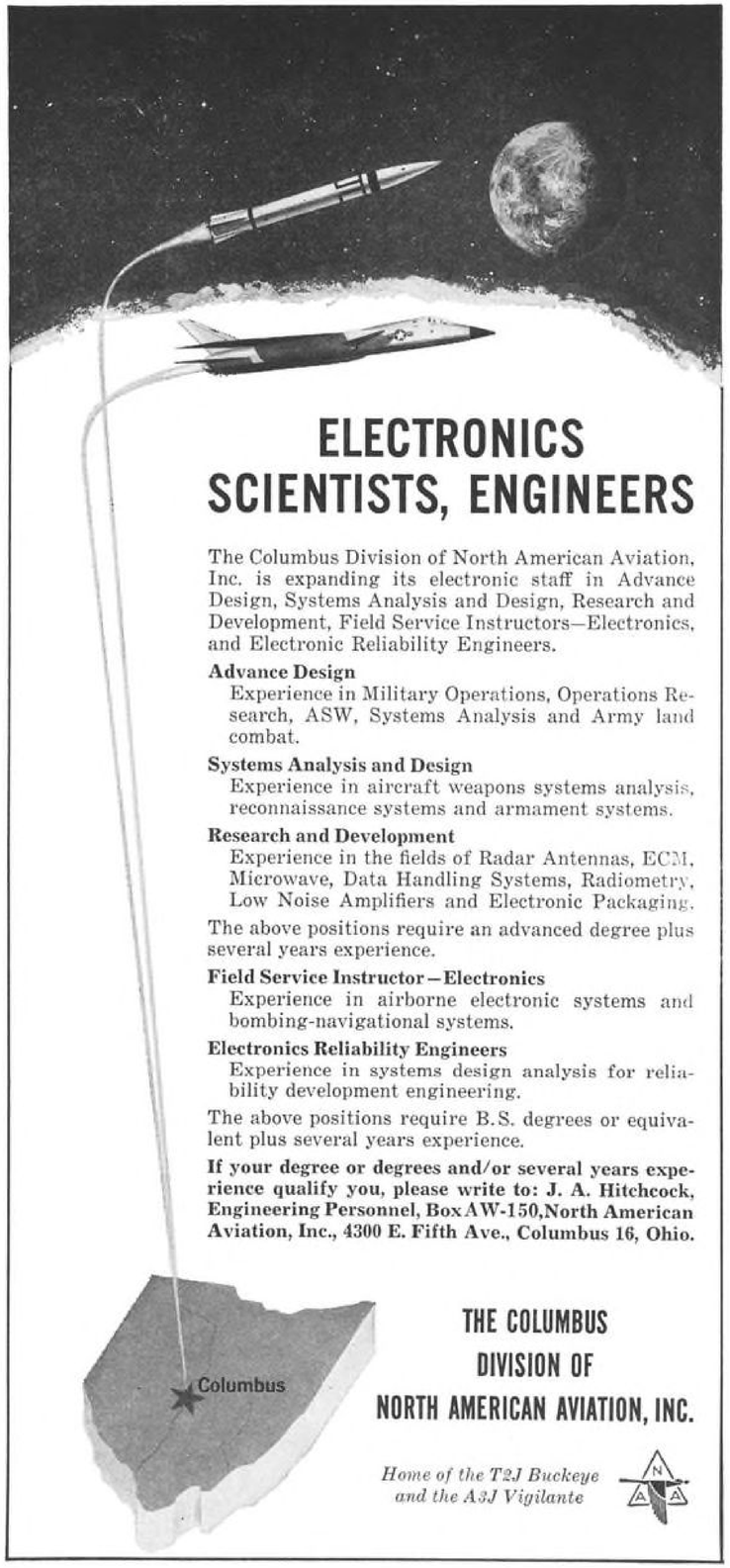
Second prototype M.222 Flamingo four- to five-seat business and sport plane built by Simmering-Graz-Pauker A.G. (AW Nov. 30, 1959, p. 89) made its first flight last month. First prototype crashed last year, killing pilot and mechanic. Company expects certification for the second prototype soon, and will show the plane at the Hanover, Germany, air show from Apr. 23-May 3.

Piper Aircraft Corp. deliveries for March totaled 280 planes having a total manufacturer's net billing value of $4,181,183.80. Included were 23 PA-18 and 9 PA-18-A Super Cubs, 62 PA-22 Tri-Pacers and Caribbeans, 2 PA-23 Apaches, 44 PA-23 Aztecs, 42 PA-24 Comanche 180s, 56 PA-24 Comanche 250s and 42 PA-25 Pawnees.

Average of eight to 15 engines monthly are being delivered by Southwest Airmotive Corp., Dallas, Tex., to private plane operators as a result of its engine exchange program, which provides flat rates for major overhauls including accessories. Prices run $4,750 for Beech E50 and F50 Twin-Bonanza Lycoming GSO-480-B1B6; $3,450 for Aero Commander Lycoming GO-480-B; $2,000 for Beech Bonanza E-185-11; $2,500 for Cessna 310 Continental O-470-B or -M; $2,650 for Beech 18 Pratt & Whitney R-985; $3,450 for Beech C50 Twin-Bonanza Lycoming GO-480-F6, -F1A6; $3,650 for Lockheed Lodestar Wright R-1820-56A, -66A and -72A, and $3,750 for Douglas DC-3 Pratt & Whitney R-1830-92 engines.

Consolidated sales for Pacific Airmotive Corp. and subsidiaries' first quarter ended Feb. 19, totaled $6,875,772 compared with $5,096,081 for the same period last year. Net loss of $46,055 for the first quarter compares with a net profit of $5,938 for the same period in 1959. PAC reports that outlook is optimistic because of increased sales. It has delivered the initial Rolls-Royce Dart turboprop engine from this overhaul program; has eight turboprop-powered Super Convair conversions in production or being flight tested with a ninth scheduled for delivery to the overhaul firm this month, to be followed by seven additional planes that have been sold to date.

Pacific Missile Range will sponsor its second annual civilian pilot fly-in June 11 at its Pt. Mugu, Calif., headquarters.



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The Columbus Division of North American Aviation, Inc. is expanding its electronic staff in Advance Design, Systems Analysis and Design, Research and Development, Field Service Instructors—Electronics, and Electronic Reliability Engineers.

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Experience in Military Operations, Operations Research, ASW, Systems Analysis and Army land combat.

Systems Analysis and Design
Experience in aircraft weapons systems analysis, reconnaissance systems and armament systems.

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Experience in the fields of Radar Antennas, ECM, Microwave, Data Handling Systems, Radiometry, Low Noise Amplifiers and Electronic Packaging.

The above positions require an advanced degree plus several years experience.

Field Service Instructor—Electronics
Experience in airborne electronic systems and bombing-navigational systems.

Electronics Reliability Engineers
Experience in systems design analysis for reliability development engineering.

The above positions require B.S. degrees or equivalent plus several years experience.

If your degree or degrees and/or several years experience qualify you, please write to: J. A. Hitchcock, Engineering Personnel, Box AW-150, North American Aviation, Inc., 4300 E. Fifth Ave., Columbus 16, Ohio.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

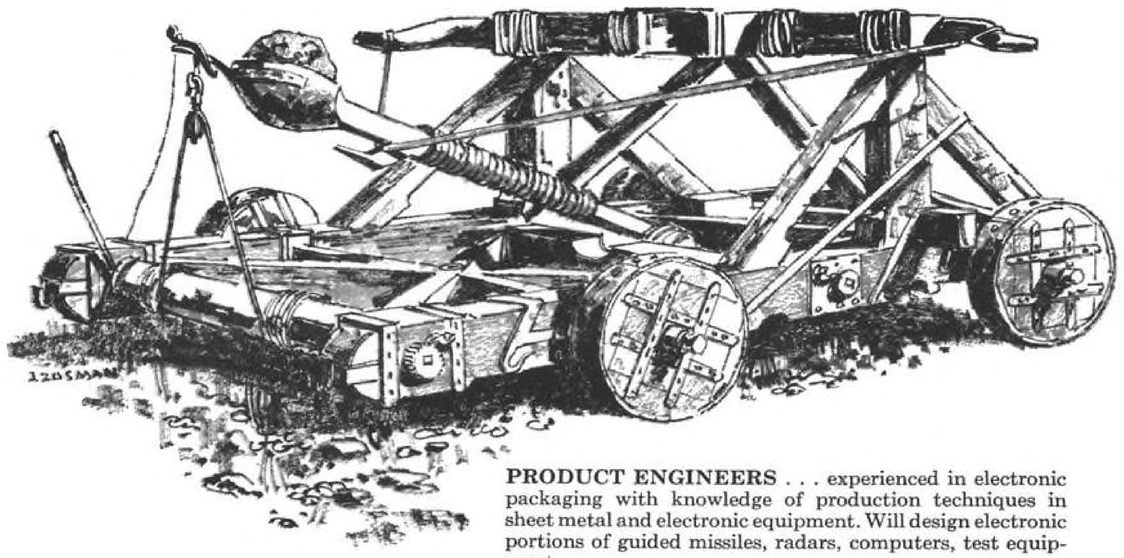
Home of the T2J Buckeye and the A3J Vigilante

Catapults like this hurled darts and iron ball missiles from castle strongholds. Medieval knights considered these the most formidable defense weapons in their arsenal.

Missiles have become greatly more sophisticated since these crude catapults guarded kingdoms. As a vital part of one of the world's largest purely electronics companies, Raytheon Missile Systems Division is making great advances in this field. The exciting new Pin Cushion Project for the selective missile identification and the continually being improved Navy's air-to-air SPARROW III and Army's HAWK are examples of their outstanding creative work.

We are now seeking talented, qualified people to maintain Raytheon's leadership in this constantly advancing field. Raytheon's Missile Systems Division creates a climate for much talent — perhaps your talent.

MISSILE LAUNCHER 14th CENTURY



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Please send detailed resumés or letters to: Mr. Robert T. Hodges, Employment Manager, Missile Systems Division, Raytheon Company, Andover Plant, Andover, Mass.

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January 1960

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560E	4	
680E	8	
Beech 18S	8	$3,394,000
65 Queen Air	1	
33 Debonair	20	
35 Bonanza	31	
50 Twin-Bonanza	11	
95 Travel Air	11	
Cessna 150	27	$5,008,000
172	51	
175 & Skylark	57	
180	27	
182 & Skylane	59	
210	55	
310D	29	
Champion 7EC Traveler	3	$112,000
7FC Tri-Traveler	12	
7GC Tri-Trac	0	
DX'er	6	
Mooney Mk. 20	30	$357,000
Piper PA-18	20	$2,837,000
PA-18-A Super Cub	24	
PA-22 Tri-Pacer & Caribbean	72	
PA-23 Apache 160	8	
PA-23 Aztec 250	4	
PA-24 Comanche 180	59	
PA-24 Comanche 250	43	
PA-25 Pawnee	19	
Totals	704	$12,979,000

January 1960 totals, units and dollar values, are higher than the same month last year when 638 aircraft having a total manufacturer's net billing value of $9,796,000 were delivered. In the period 1950-1959, U. S. business and utility aircraft manufacturers delivered 46,998 aircraft with a total net billing value of more than $643.2 million.

Sailplane Has Metal Laminar-Profile Wings

Set of metal covered laminar-profile wings has been developed for the Libelle sailplane built at VEB Apparatebau Lommatzsch in East Germany. Wings are dimensionally interchangeable with two sets developed earlier for the same sailplane, which gave it versatility in performance. Purchaser could start with short-span wings and progress to a high-performance sailplane by simply buying another set of wings. Third set now available is built in the conventional manner around a laminar-flow airfoil section. Panels are covered with plywood in the usual manner, and then a thin sheet of aluminum foil is bonded to the plywood, giving a wrinkle-free surface of very low drag. Glide angle has been increased from 31 to 36 with the new wings, even though the gross weight of the sailplane has increased from 726 to 835 lb. Optimum sink rate with the new wings is 2.1 fps. at a glide speed of 47.2 mph. Wingspan of the Libelle with laminar-flow surfaces is 54.1 ft., over-all length is 21.6 ft., and height is 6.95 ft. Wing area is 158.5 sq. ft., and aspect ratio is 18.35. Weight empty is 616 lb. Wing loading at maximum weight is 5.3 psf.

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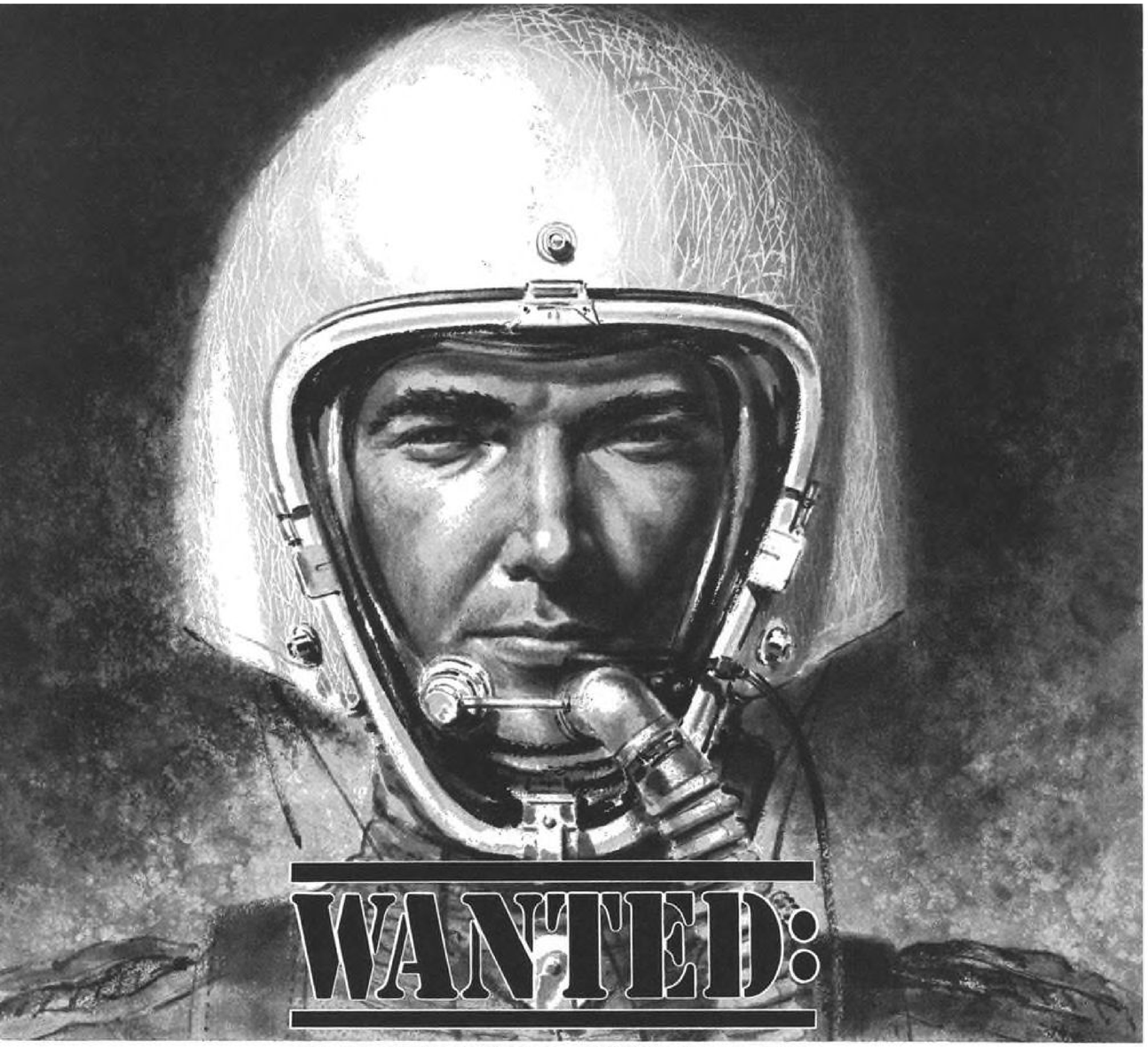

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RYAN ELECTRONICS
DIVISION OF RYAN AERONAUTICAL COMPANY, TORRANCE, CALIFORNIA, SAN DIEGO, CALIFORNIA

WHO'S WHERE

(Continued from page 23)

Changes

Alden F. Smith, chief-engineering operations, Connecticut Aircraft Nuclear Engine Laboratory, Middletown, Conn., which is operated by Pratt & Whitney Aircraft Division of United Aircraft Corp.

Harold Cooperman, manager-customer service, Rheem Semiconductor Corp., Mountain View, Calif., and **Sidney Wiesner,** quality control manager.

Eldon M. Bloyd, manager-sales training, Beech Aircraft Corp., Wichita, Kan.

Stuart G. Whittelsey, Jr., assistant to the general manager, Litton Industries' Electron Tube Division, San Carlos, Calif., and **Roy E. Woenne,** director of manufacturing. Also: **George S. Stuart**-production manager, Magnetron Product Line; **John V. Lyddane**-production manager, Traveling Wave Devices Product Line; **Allen C. Ashley**-project engineer, Magnetron Product Line.

D. S. Stevenson, military export sales director, Lockheed Aircraft Corp., Burbank.

Dr. Earl A. Weilmuenster, assistant manager, Propellant Development Branch of the technical staff of United Research Corp., Menlo Park, Calif., a subsidiary of United Aircraft Corp.

William L. Carolla, general sales manager, Van Dusen Aircraft Supplies, Teterboro, N. J.

J. H. Irving, assistant director of the Advanced Systems Planning Division, Space Technology Laboratories, Inc., Los Angeles, Calif.

Dr. Harald T. Friis has been named consultant to Wheeler Laboratories, Inc., Great Neck, N. Y., a subsidiary of Hazeltine Corp.

Martin B. Bloch, chief engineer, and **Francis J. Cheli,** production manager, Electronics Division of Bulova Watch Co., Inc., Woodside, N. Y.

Robert A. Wagner, manager-helicopter engineering department, Hughes Tool Co.-Aircraft Division, Culver City, Calif.

Dr. Howard S. Seifert has joined the technical staff of United Technology Corp., Sunnyvale, Calif.

Milton G. Hagen, supervisor of Division Field Engineering activities of Sylvania Electronics Systems, a division of Sylvania Electric Products, Inc., Waltham, Mass., on the Air Force's Convair B-58 Hustler program.

Brooks F. Brickley, manager of foreign operations for General Electric Co.'s Flight Propulsion Division, Cincinnati, Ohio.

Bernard W. Peterson, resident gas turbine installation engineer for The Garrett Corp., Geneva, Switzerland.

C. Towner French, manager of the Washington (D.C.) office of the GPL Division of General Precision, Inc.

Adolph Fibel, marketing director, Air Associates, Inc., Teterboro, N. J. Mr. Fibel will also be in charge of the company's newly-formed Air Associates International Division.

Arthur MacArthur, manager of engineering, Military and Industrial Products Division, Breeze Corporations, Inc., Union, N. J.

David M. Conrad, manager of administration, Space Technology Operations at Aeronutronic, a division of Ford Motor Co., Newport Beach, Calif.

Talos missile, prime armament of the missile-age cruisers, blasts off from the U.S.S. Galveston.

Bendix Talos—
on target for your future!

Talos was on target from the start. The Navy credits it with consistently high accuracy and effectiveness. As a result, Talos was installed directly aboard first line cruisers, rather than auxiliary ships.

The established success of Talos by Bendix Missiles, its prime contractor, not only assures permanence to the present program but has opened the door to other advanced missile projects that offer new and challenging job opportunities in design, development, testing, and manufacturing.

Bendix Missiles, in addition to its direct responsibility for Talos and other advanced missile projects, is a key division of Bendix Aviation Corporation. The corporation-wide activities of Bendix cover practically every phase of advanced technology with particular emphasis on systems design and development. Participation in this highly diversified corporation effort is your further assurance of a more secure future.

Enjoy living in the Midwest and find unmatched job opportunities with Bendix Missiles. Grow professionally as well as financially. Take the first step today. Mail the coupon for your copy of the interesting booklet "Opportunities Abound at Bendix Missiles."

Bendix PRODUCTS DIVISION Missiles — Bendix AVIATION CORPORATION

PRIME CONTRACTOR FOR THE TALOS MISSILE

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Immediate opening for Shop Supervisor with expanding aircraft repair and overhaul company located in Eastern Canada dealing with military and commercial contracts. Applicants must have previous experience in supervising sizeable repair and overhaul facility. Salary commensurate with experience. Replies will be kept confidential. Our employees are aware of this ad. P-3730, Aviation Week.

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Wanted Pilots: Vacancies for pilots/copilots with airlines and other organizations in Europe, North Africa, Middle East. Limited openings for Navigators/Engineers and A+P mechanics. Apply immediately to: American Overseas Aviation Services, Inc., 31 Weser Str., Frankfurt/M. Germany. Europe's Largest Flight Crew Employment Service.

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Technical Personnel Supervisor

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U. S. Citizenship Required

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P-4197, Aviation Week
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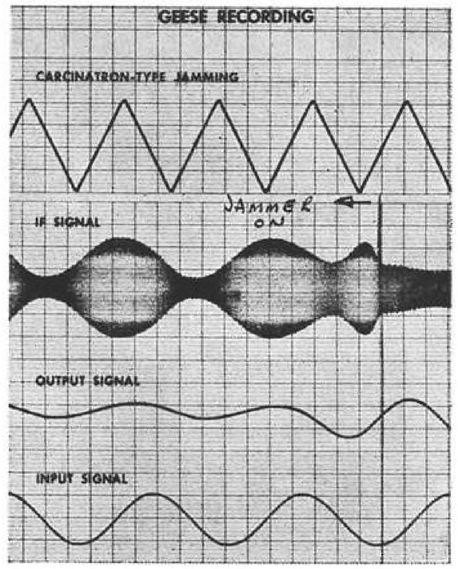

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AND DEVELOPING THE TOOLS THAT SPEED THEIR DESIGN CYCLE

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A recent contribution by Defense Systems Department in this technological area is GEESE (General Electric's Electronic System Evaluator). Utilizing advance computer techniques, it enables systems engineers to accurately predict, optimize and synthesize system performance prior to design.

GEESE is indicative of the scope of Defense Systems Department's involvement in the systems technology. Many programs offer systems-oriented engineers and scientists an opportunity to participate in new areas of long-term importance.

Senior members of our technical staff would welcome the occasion to discuss personally and in detail the career positions available with this growing organization. Address your inquiries in professional confidence to Mr. E. A. Smith, Box 4-B.

DSD **DEFENSE SYSTEMS DEPARTMENT**
A Department of the Defense Electronics Division

GENERAL ELECTRIC

Northern Lights Office Building, Syracuse, New York

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Parallel Expansion in Diverse Areas

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This has led to major staff expansion requiring a whole new organizational structure, in which a multiplicity of R&D Design and Production operations are now grouped in four main Divisions: the SYSTEMS, GYRODYNAMICS, ELECTRO-MECHANICAL and PRECISION COMPONENT DIVISIONS.

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Why not study the areas of opportunity now open—then see what Kearfott can offer YOU!

VICE PRESIDENT & GENERAL MANAGER

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" 2— 1 ea. Stand Assy Vacuumpump Greer HA 113-1 7CAD737650,
" 3— 3 ea. Rectifier, stocknumber 8100-631095,
" 4— 4 ea. Test Stand Air Valve GE 1C855, stocknumber 7CAD733990,
" 5— 5 ea. Cleaner Parts 8100-676500,
" 6—12 ea. Kit Hand Tool Ecl. 1042-1,
" 7— 3 ea. Kit Hand Tool Ecl. 1042-3,
" 8— 1 ea. Pitot Static Checker North American T-295091,
" 9— 1 ea. Vacuum Cleaner North American 160-2970,
" 10— 1 ea. Polisher 8100-145.000,
" 11— 1 ea. Theodolite 8TAA-906.000,
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" 16— 2 ea. Multimeter 0-05000 MW T5585A/U 7CAC-567.851,
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Sale, Use, Lease or Assignment of any goods or service
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Franchises being offered in new angle of aerial photography. For a minimum investment secured in equipment and brief training, you can net $15,000 yearly for the next five years. Write for free details and availability of area. State Aerial Farm Statistics, 1752 Broadway, Toledo 9, Ohio.

FOR SALE

PBY SA. Two amphibians converted for 2 crew—cargo—passenger use, FS-3404, Aviation Week.

Two S-55 Sikorsky Helicopters, complete except engines and instruments. $25,000 each. New and major overhauled spares available at 50% off list prices. Stinson Field Aircraft, Box 1738, San Antonio, Texas. CA 4-8434.

B-17 Engines as follows: one new 1820-97 at $1,000 and 7 NTSO at $750 each. Each engine sealed in steel container. Complete records. Stinson Field Aircraft, Box 1738, San Antonio, Texas. CA 4-8434.

For sale, progressively available 1st April 1960, fleet of 8 Heron Series II Aircraft, being withdrawn airline service. Full radio, all essential modifications embodied, good condition, including large backing stock of spares and spare engines. Preferably package deal. Available for inspection at Lagos, Nigeria, at any time. Offers as is. Specification available. Apply to Liquidator, West African Airways Corporation, Marian House, P.O. Box 549, Lagos, Nigeria.

Bell Helicopter 47G-2, Serial 2234 never damaged, clean. R.R. Stuart, Jr., Betsy Ross Bakeries, Inc., P.O. Box 1070, Bluefield, W. Va., phone: DA 7-6151.

Grumman Goose G-21-A, low time, perfect condition, hydramatics. FS-4173, Aviation Week.

1958 Bell Helicopter 47G2, fully equipped, ready to fly. TT620, 600 inspection done. Blades factory reconditioned. J-W Helicopters, Arcata, Airport, Calif. TE 9-2216.

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AIRWORK CORPORATION 91
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ALLIED RESEARCH ASSOCIATES 130
ALLISON DIV., GENERAL MOTORS CORP. 16-17
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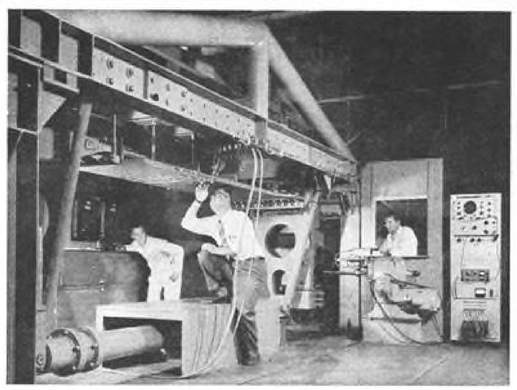

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LETTERS

Vital Issues

From time to time our politicians and governmental officials become sufficiently specific to go on record regarding their positions relative to matters pertaining to our military space efforts. With elections forthcoming, I was caused to wonder whether it would be feasible for you to summarize and publish the position of these people on vital issues. It would be of great assistance to me in deciding in which square to put an "X." I continue to enjoy AVIATION WEEK; please keep up the good work.

A. N. BAXTER
Palos Verdes Estates, Calif.

(Aviation Week plans to do so.—Ed.)

Defense Costs

Re the Jan. 25 issue, "President Asks $41 Billion for Defense," on p. 28 you state that "Thirty Convair B-58s are being bought in 1961 at a cost of $3.097 billion."

Roughly, I read then, that my tax dollars are being squandered at the rate of plus $100 million each for these short ranged, functionless, pea shooters that never should have been ordered beyond the prototype stage. SAC currently depends on the B-52 for its striking arm. I'll wager that I could buy not less than a dozen of the latest model B-52s with 10,000 mi. range, plus refueling capabilities, for $100 million.

My daughter's son will be paying taxes for this damned foolishness. Maybe Ike does have a "faithful" trustworthy Secretary of Defense—he looks like something that would make a drunk sailor look like a Scotchman from here. H. E. MCDONALD
Topanga, Calif.

(Because of limited production, cost is $3.097 billion. However, if a decision is made to order B-58As or Cs in quantity, unit costs will drop considerably—Ed.)

Customer Service

I have read your March 28 letter (p. 118) and believe E. F. Gallagher, in his letter "SPABOAPOA—Society for the Preservation and Betterment of Air Line Passengers of America," is speaking either in jest or else he just can't be pleased.

I have been flying on the airlines of America on business almost continually since 1945, and have logged over 300,000 mi. as a passenger. This amount of flying has taken me in and out of all the major passenger terminals, and a great many of the smaller ones across the country. It has put me on all of the major trunk airlines and most of the smaller feeder lines; and has included flying in all weather conditions and exposed me to all types of airline personnel and passenger service.

In view of this experience, I feel that I can speak with some authority, and would like to comment briefly on "those areas of personal interest to the customer" that Gallagher mentions in his letter.

"Meeting the schedule"—I'll go part way with Gallagher, sometimes they don't; but a great percentage of the time they do. Anyhow mother nature doesn't give a darn about airline delays, and doesn't schedule the weather to suit the passenger. It's a cinch, if the captain doesn't think the weather is safe to fly in, I sure don't either.

"Terminal facilities"—not so bad, and they are getting better. Have you seen the St. Louis, Cleveland, Washington National, or Miami International lately? I have never seen too much human suffering at any of them. As far as the terminal facilities at the off-beat stops, or "pumpkin center" airports, serviced by the feeder airline is concerned, you can't expect it to be like the lobby of the Waldorf, the traffic just won't bear it.

"Airborne drinking"—well, what about it? I can take it or leave it, and I think most people can.

"Airborne eating"—certainly not like the Ritz, I agree, but it's reasonably palatable, and it will keep you alive the hour or so that you are in the air.

"Radarless aircraft and flight safety"—I am with Gallagher, nobody could sensibly argue against radar equipment and flight safety.

"Indifferent personnel"—service is the only real product the airline has to sell, of course, including safety which should go without saying. I have found the indifferent or discourteous airline employe in any catagory, very much a rarity. Of course, the flight line crew chief might not have the time to sit down and discuss the history of "power flight" with you; but most of the time the airline personnel, whose job it is to contact the public, do a dandy job. This is saying a lot considering the demands of some of the flying public. If you think "indifference" is bad on the airlines, try the conductor on most any railroad.

"Unwarranted delays"—how do you know they are unwarranted? The airlines are professionals at their jobs and they can't make any money with a $3-4 million airplane sitting on the ground. They will do any thing possible, within FAA and airline safety limits, to prevent delay. There are delays surely, for mechanical failures, weather, no turnaround equipment available because of weather at the other end of the route, but these delays are due to unavoidable causes that certainly cannot be classified as unwarranted.

If Mr. Gallagher wants "service," he will get it from the airlines. Hardly anything is done by the airlines without customer service as a prime factor. They have highly paid vice presidents in charge of nothing but service. Yes, there is room for improvement, and they are improving.

At Chicago O'Hare Field for example, United has a power-operated, self moving ramp so the passengers can walk directly from the terminal to the airplane without being touched by the "terrible outside air," or being forced to walk up one single step.

The airlines have hired some of the foremost industrial designers in the world, at fancy prices, to make the interior of the airplane beautiful and breath-taking just for the passenger. In fact, they are so beautiful you are not sure if you are going to get your nails done or fly somewhere.

On some of the super-duper jet express flights, the only thing left for added service is for each passenger to be carried on board by two 6' 5" Nubian slaves and carefully placed in a seat equipped with a self-propelled slowly moving peacock feather fan to assure proper air circulation and atmosphere.

I personally like good service as well as the next man, and I certainly feel that I am getting my money's worth 95% of the time, when I fly with the commercial airlines. If Gallagher is really serious about the areas of personal interest that he mentioned in his letter, I think a well directed letter of constructive criticism to the proper authority of subject airline or airlines, would do more to help the situation than this SPABOAPOA organization he speaks of could ever accomplish.

Cordially Yours,

E. D. PARKS
1864 Revere Road
Akron 13, Ohio

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

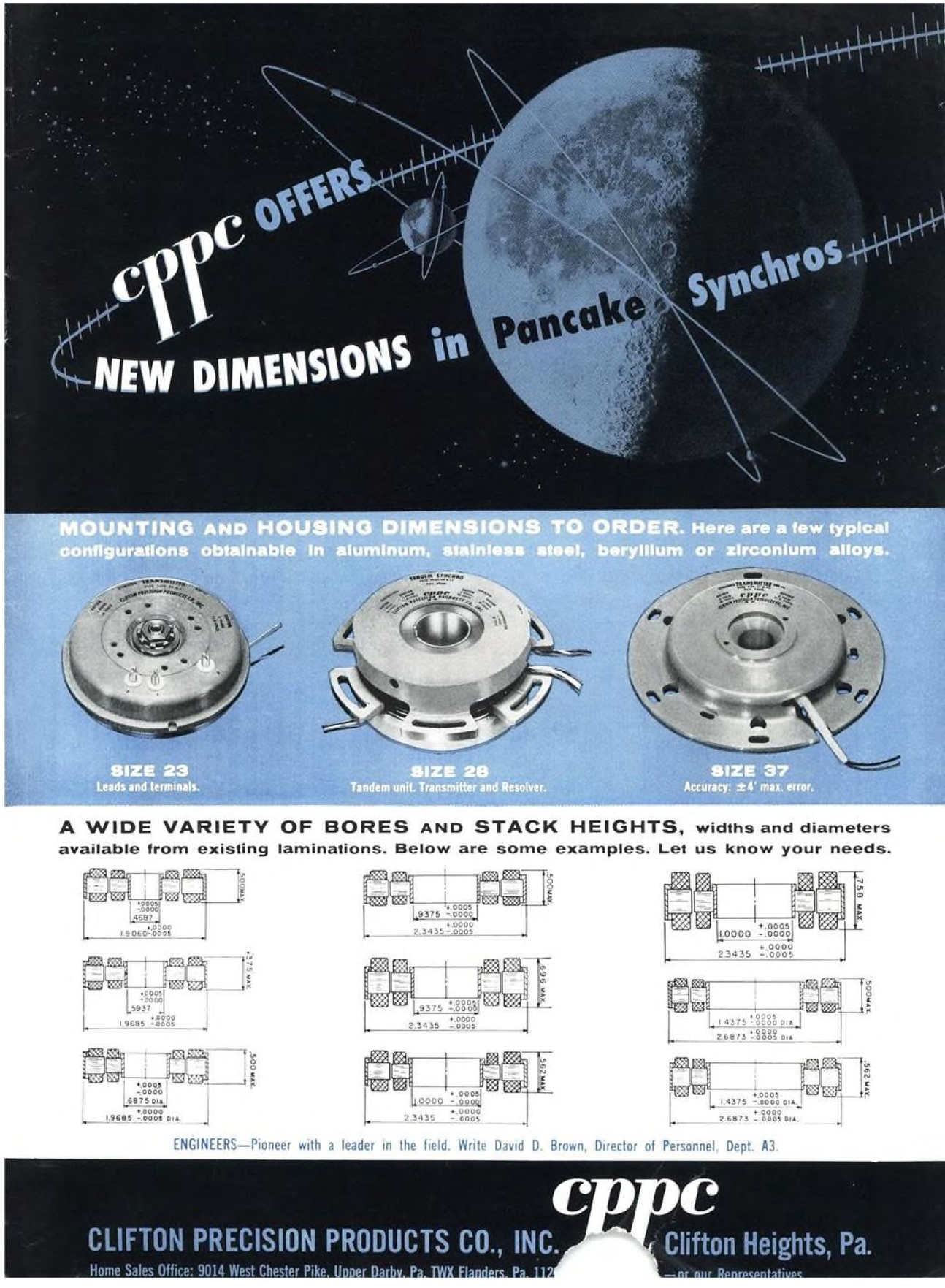
Aerojet JATO

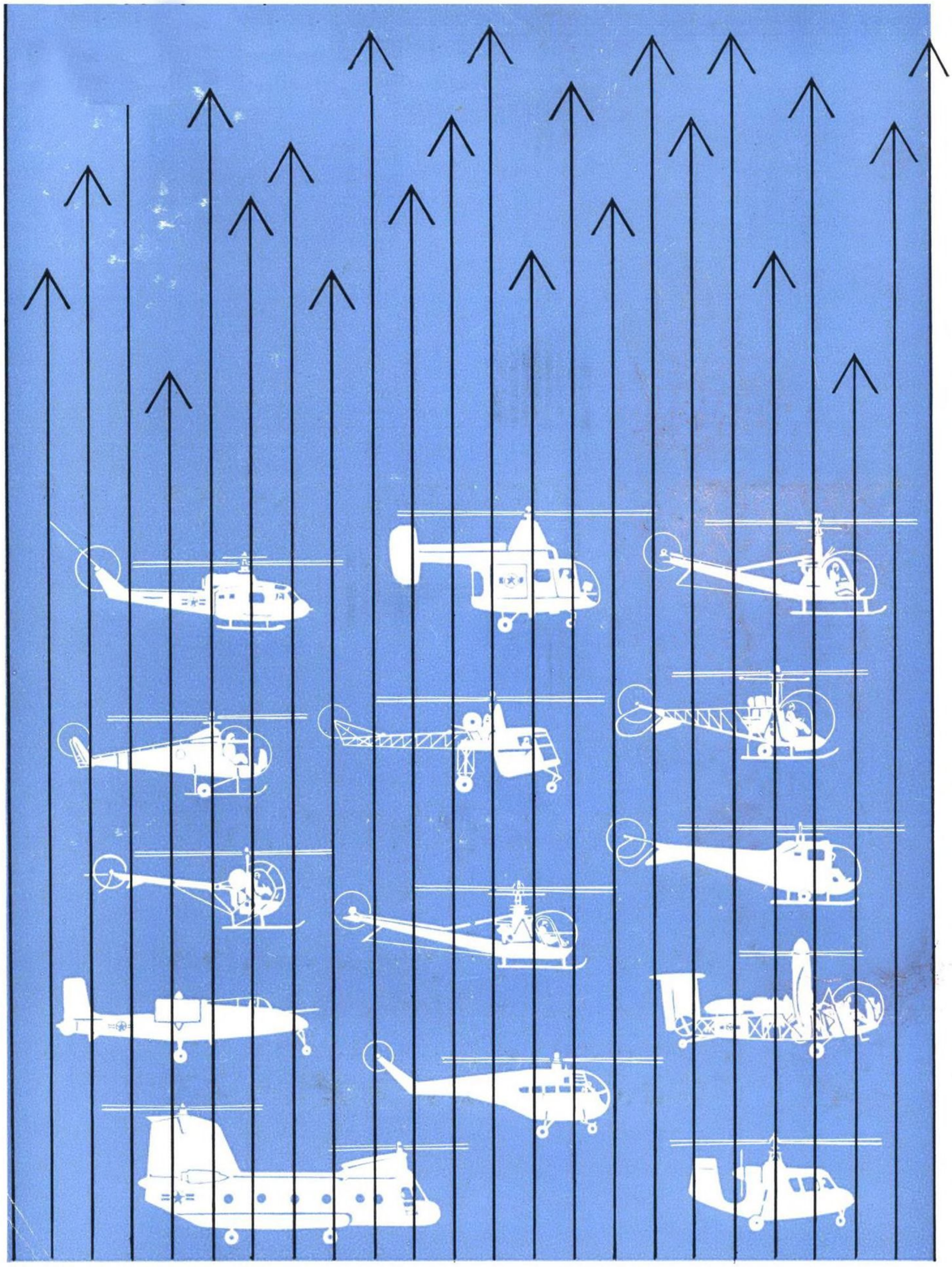
In Herbert J. Coleman's article on the Beech Super G18 in the Feb. 1 issue (p. 86), the final paragraph reads as follows: "For short field performance, the Super G18 can be fitted with Aerojet 15NS-250 jet assisted takeoff (JATO) units, at an extra cost of $2,960. The weight penalty is 100 lb."

We greatly appreciate the mention of the optional Aerojet 15NS-250 rocket engine installation in the article. However, we should like to correct the impression that these rocket engines are intended as jet-assist-takeoff units for short field operation. They are installed to provide reserve of about 200 hp. available at the flick of a switch for any takeoff, in-flight or landing emergency. They greatly enhance the operating versatility of the airplane by permitting it to be operated safely with full loads from short or unimproved fields from high altitudes, and under high temperature conditions.

Also, there is no weight penalty from the installation of these standby rocket engines in the Super G18 Beech. Because of the additional power which is available to the pilot, the airplane has been certificated with an increase in gross weight of 100 lb. to cover the installed weight of the rocket engines. We would appreciate it greatly if your readers could be advised of these points so that they might serve to correct false impressions which might otherwise be gained from this paragraph.

G. E. RICE, MANAGER
Commercial Sales
Aerojet-General Corp.
Azusa, Calif.





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