Aviation Week

Including Space Technology

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October 20, 1958

Design Details Of Pratt & Whitney JT12 Turbojet

Piasecki Aerial Jeep



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PLAN

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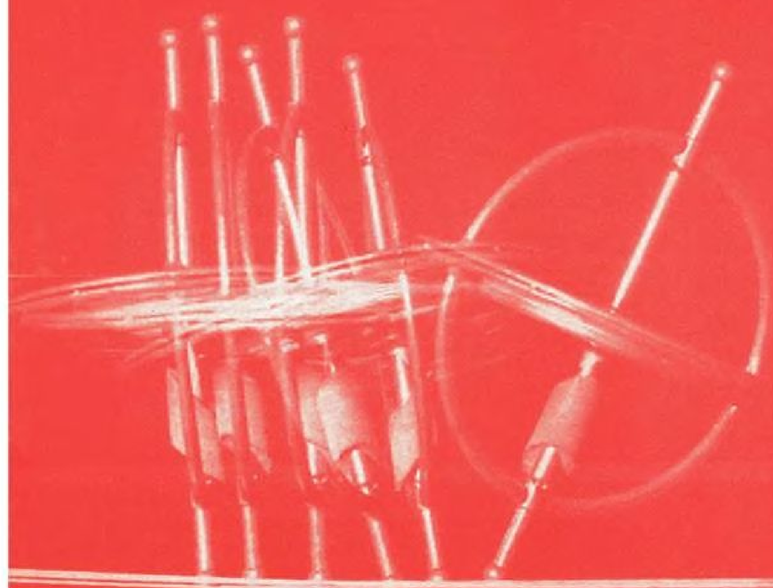
First to offer Convair 880 or 600 Jet-Liner service will be TWA, DELTA, TRANSCONTINENTAL (Argentina), REAL-AEROVIAS (Brazil), and AMERICAN

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Significant new developments at Hoffman have created important positions for scientists and engineers of high calibre. Please address inquiries to Vice-President, Engineering.

From Sanders Associates, Inc., Nashua, New Hampshire . . .

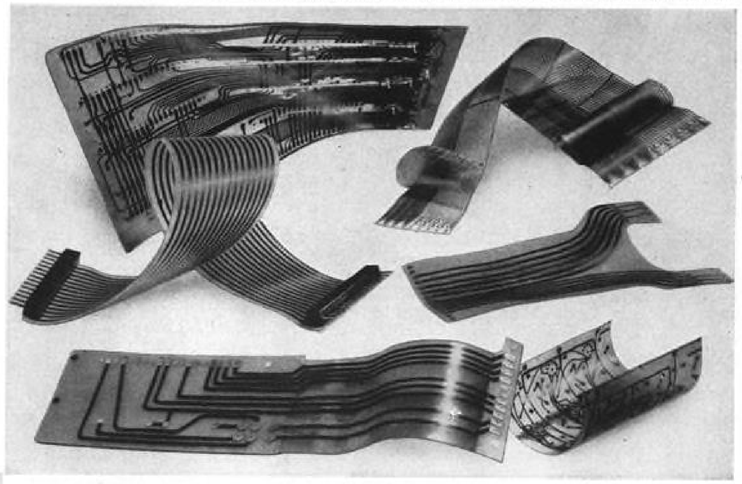
RELIABILITY-PROVED COMPONENTS FOR AIRCRAFT, MISSILES, SPACECRAFT

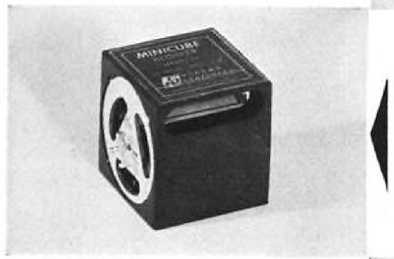
FLEXIBLE PRINTED WIRING

Sanders *Flexprint*Ⓣ Printed Circuit Cables and Harnesses sharply reduce the weight, space and cost of electronic and electrical assemblies . . . eliminate wiring error. Conductors are permanently bonded in thin sheets of flexible plastic: vinyls, polyethylenes, polyesters, silicones, Kel-F or Teflon.

Meets military reliability requirements.

Ⓣ TRADEMARK — SANDERS ASSOCIATES, INC.



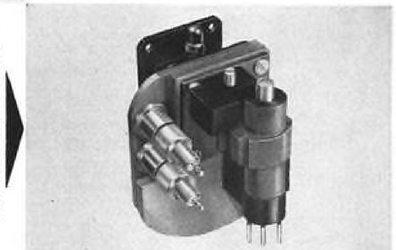


SUBMINIATURE BLOWER

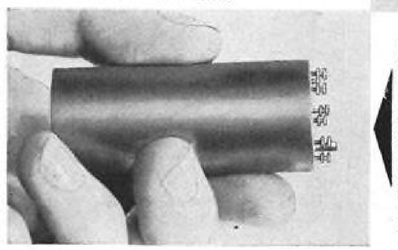
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KEY COMPONENTS PRODUCED BY SANDERS ASSOCIATES offer advantages of unfailing dependability . . . savings in space and weight . . . superior performance for your guidance, control, and detection systems. They are available in production quantities and may be readily adapted to meet special requirements. Sanders also offers complete creative engineering, design, development, and production services with highly specialized experience, skills, and manufacturing facilities in electronics, hydraulics, and electromechanics. Sanders can produce individual components or complex packaged systems capable of meeting extreme environmental and performance requirements.



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Sanders *Tri-Scanner*® Conical Scan Antenna provides three-times the information rate of conventional fire control antennas. In use on a major missile system, it is lightweight and statically and dynamically balanced, and offers unusual anti-jam features. Sanders also manufactures photoetched slot and spiral antennas for flush-mounted arrays, beacons, and communication systems.

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AVIATION CALENDAR

Oct. 26-31—1958 Fall General Meeting, American Institute of Electrical Engineers, Penn-Sheraton Hotel, Pittsburgh, Pa.

Oct. 27—14th Annual General Meeting of The International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 27-31—National Metal Exposition and Congress, Cleveland Public Auditorium, Cleveland, Ohio.

Oct. 28-29—AGARD Eighth General Assembly, Copenhagen, Denmark.

Oct. 29-30—Fifth Annual Computer Applications Symposium, sponsored by Armour Research Foundation, Morrision Hotel, Chicago, Ill.

Oct. 29-31—Air Traffic Control Assn., Annual Business and Council Meeting, Marriott Motor Hotel, Washington, D. C.

Oct. 30-31—1958 Electron Devices Meeting sponsored by Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Oct. 30-31—15th Annual Display, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 3-7—Fifth Institute on Electronics in Management, American University, Washington, D. C.

Nov. 6-7—13th Annual Symposium on Applied Spectroscopy, Hotel New Yorker, New York, N. Y.

Nov. 6-7—Quarterly Regional Meeting, Assn. of Local & Territorial Airlines, Honolulu, Hawaii.

Nov. 6-7—Fifth Annual Meeting, Institute of Radio Engineers Professional Group on Nuclear Science, Villa Hotel, San Mateo, Calif.

(Continued on page 6)

AVIATION WEEK Including Space Technology

October 20, 1958

Vol. 69, No. 16

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TRANS-SONICS

REG. T.M.

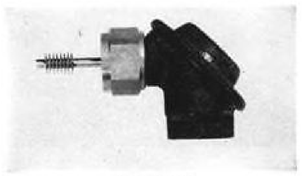
PLATINUM TEMPERATURE TRANSDUCERS

for measurement, telemetry, and control

- TEMPERATURES FROM −425 TO +1832 F.
- PRECISION CALIBRATION
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- 5 VOLT OUTPUT
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1300 Series



Type 2135

BULB TYPE for corrosive gases and liquids

1300 Series transducers are available in ranges from −400 F to +1832F, feature 1% accuracy, stainless-steel construction, and a time constant of less than 2.5 seconds in agitated liquid. Many standard and special bulb lengths are available.

Type 2135 has ±0.25 F accuracy and interchangeability over a range of 0 to +125 F. The platinum element is enclosed in a nickel-plated bulb, and the unit will withstand a working pressure of 4500 psi.

OPEN TYPE for non-corrosive gases and liquids



1350 Series

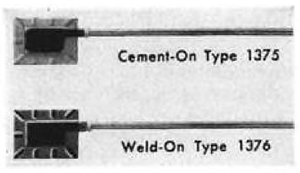


Type 1321

1350 Series transducers are available in ranges from −300 F to +600 F, with an accuracy of ±1% full scale. The platinum sensing element comes in direct contact with the gas or liquid being measured, resulting in a typical response time of 0.2 second in agitated liquid.

Type 1321 is designed for extreme low temperature measurements, with special calibrations to −425 F. Operating interval is 30 F in ranges up to +250 F, with ±1% accuracy. A perforated shield protects the platinum sensing element from high flow rates.

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A five-point resistance-temperature calibration certificate at 0, ¼, ½, ¾, and full scale temperature is supplied with each transducer. Custom designs for all temperature transducers are available on special order with accuracies to 0.1 F. Write to Trans-Sonics, Inc., Dept. 00, Burlington, Mass. for Condensed Catalog on Platinum Temperature Transducers.

TRANS-SONICS

Precision Transducers

AVIATION CALENDAR

(*Continued from page 5*)

Nov. 6-7—National Specialist Meeting on Dynamics and Aeroelasticity, sponsored by Institute of the Aeronautical Sciences, Texas Section, Texas Hotel, Ft. Worth.

Nov. 9-12—13th Annual Convention and Logistics Forum, National Defense Transportation Assn., Sheraton-Jefferson Hotel, St. Louis, Mo.

Nov. 10-12—International Conference, Physics and Medicine of the Atmosphere and Space, sponsored by the School of Aviation Medicine, San Antonio, Tex.

Nov. 10-13—11th Annual International Air-Safety Seminar, Flight Safety Foundation in cooperation with Airways Modernization Board's National Aviation Facilities Experimental Center, Atlantic City, N. J.

Nov. 10-21—12th Air Transportation Institute of the American University, Washington, D. C.

Nov. 11-14—19th Annual Convention, National Trades Assn., Pfister Hotel, Milwaukee, Wisc.

Nov. 12-14—Eighth Aircraft Hydarulics Conference, sponsored by Vickers, Inc., Park Shelton Hotel, Detroit, Mich.

Nov. 12-14—1958 Annual Meeting, Society for Experimental Stress Analysis, Hotel Sheraton-Ten Eyck, Albany, N. Y.

Nov. 16-21—Conference on Scientific Information, Mayflower Hotel, Washington, D. C. Co-sponsored by USAF Office of Scientific Research, National Academy of Sciences, National Science Foundation and American Documentation Institute.

Nov. 17-18—Sixth Annual Aircraft and Missile Division Conference, American Society for Quality Control, Biltmore Hotel, Dayton, Ohio.

Nov. 17-21—13th Annual Meeting and Astronautical Exposition, American Rocket Society, Hotel Statler, New York, N. Y.

Nov. 17-21—Eighth National Plastics Exposition, International Amphitheatre, and Plastics Conference, Hotel Morrison, Chicago, Ill.

Nov. 19-20—Notheast Electronics Research and Engineering Meeting, Mechanics Hall, Boston, Mass.

Nov. 19-21—32nd Meeting, Aviation Distributors and Manufacturers Assn., Statler Hilton Hotel, Dallas, Tex.

Nov. 21-22—Third Symposium on Magnetohydrodynamics, Lockheed Missile Systems Division's Research Laboratory, Palo Alto, Calif. Attendance by invitation.

Nov. 28—Fourth Convertible Aircraft Congress, the Franklin Institute, Philadelphia, Pa.

Nov. 28-30—Snowbird Soaring Meet, Harris Hill, Elmira, N. Y.

Nov. 28-Dec. 4—First Electronic Computer Exhibition and Symposium, Olympia, London, England.

Dec. 2-4—Third Conference on Reliable Electrical Connection, sponsored by Electronic Industries Assn., Dallas, Tex.

Dec. 3-5—Second National Symposium on Global Communications, sponsored by the Institute of Radio Engineers and American Institute of Electrical Engineers, Colonial Inn, St. Petersburg, Fla.

Dec. 3-5—Eastern Joint Computer Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.



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WG — WHITTAKER GYRO Leading producer of electrically driven and spring-wound free gyros, rate and floated rate gyros for advanced missile systems—rate of roll, pitch, and yaw indicators for manned aircraft—bank and turn indicators.

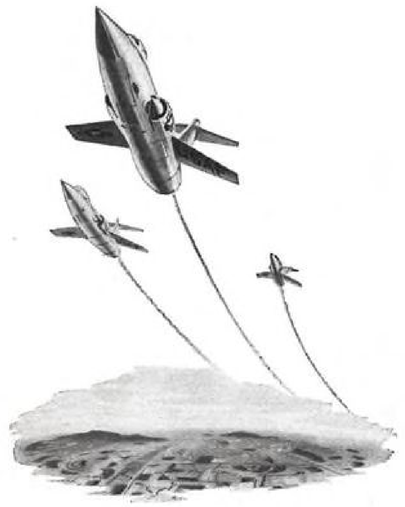
DI — DATA INSTRUMENTS Pioneers in equipments for fast and accurate analysis of test data, with automatic recording of punched cards, tapes, or printed lists—for aircraft and missile flight tests, industrial and scientific applications.

ES — ENGINEERING SERVICES Specialists in rapid, accurate reduction and evaluation of military and commercial data. Currently handling data reduction for daily missile firings at Holloman Air Force Base.

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NI — NUCLEAR INSTRUMENTS Designers and builders of high quality, reliable equipments for prelaunch checkout and testing of nuclear special weapons.

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VG 700 Starter-General Assembly — 30 volt, 200 Amps.

High Performance Starter-Generators by BREEZE

For critical applications in jet aircraft, these units serve the dual purpose of starting the jet engine and providing the electrical power necessary to charge the ship's batteries and operate the electrical equipment.

These units are designed to military aircraft standards, have radio noise filters and are either blast cooled or self cooled. Vibration dampeners may be incorporated when required.

Our engineers will be pleased to furnish information on the listed units upon request and will submit engineering proposals for special units.



BW-125 Direct Cranking Starter — 24 volt systems D.C. Compensated overload clutch at 60 lb. feet maximum setting. Weight, 20 lbs.

STARTER-GENERATORS — 30 VOLT, D.C.				
Part No.	Rating	Speed Range Full Output	Reduced Output from	Weight
VG600	100 AMPS	4700/8000 rpm	3800 rpm	33 lbs.
VG700	200 AMPS	4200/8000 rpm	3700 rpm	38 lbs.
VG770	200 AMPS	3000/8000 rpm	2500 rpm	45 lbs.
VG840	100 AMPS	7300/12000 rpm	6500 rpm	14 lbs.
VG460	75 AMPS	5000/10000 rpm	4000 rpm	29 lbs.

GE-5 Brushless Generator — 400 Amps, 30 volts, speed 3,000 to 10,000 rpm, weight 58 lbs. Available with static (transistorized) voltage regulator. Weight 5 lbs.

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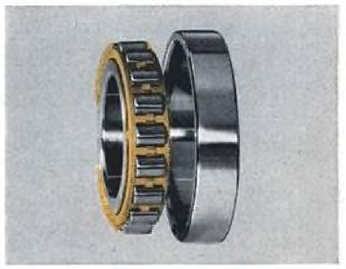
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You swing into your final approach. At precisely the right instant the Landing Signal Officer flags you to cut your power—and you're aboard! ☆ Such skill and precision is indicative of that which is required today in *every* phase of the aircraft industry. The bearings in modern jet turbines, for instance, must be held to accurate tolerances measured in millionths of an inch. That's why the leading jet turbine manufacturers specify Bower aircraft bearings first. Their exceptional high quality and unerring precision allow Bower bearings to stand unbelievable turbine speeds and temperatures—that match the supersonic speeds of today's jet aircraft—*with a minimum of lubrication.* ☆ Whatever *you* produce, if it uses bearings, specify Bower! Choose from a complete line of tapered, straight and journal roller bearings for every field of transportation and industry.

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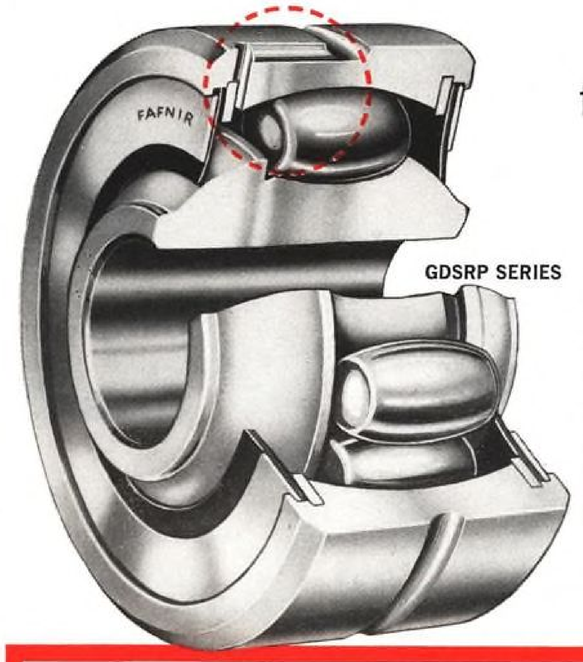


IDEALLY SUITED TO HIGH-SPEED OPERATION

Built to hold their precision indefinitely, these aircraft bearings are recommended wherever superior quality and high-speed operation are required. For some applications, a special alloy steel—developed jointly by Bower and several aircraft companies—is used.

BOWER ROLLER BEARINGS

NEW DESIGN PERMITS RELUBRICATION OF FAFNIR HIGH-CAPACITY CONTROL BEARINGS



GDSRP SERIES

Fafnir DSRP control bearings, featuring "most capacity for weight and size," now offered in new GDSRP relubricatable series

An outer ring groove and ports for bearing relubrication have now been designed into Fafnir high-capacity control bearings. With these added features, bearings will be identified as the GDSRP Series. Bearing dimensions, features, load ratings and life factors are the same as the DSRP Series. Detailed information on the new relubricatable series is available. Write for bulletin. The Fafnir Bearing Company, New Britain, Connecticut.

Here is what the new Fafnir GDSRP Control Bearings offer you . . .

1. Relubrication — Grooves and ports permit access of lubricant to rollers and raceways. Ports are drilled outside of bearing load zone-do not affect load-carrying capacity.

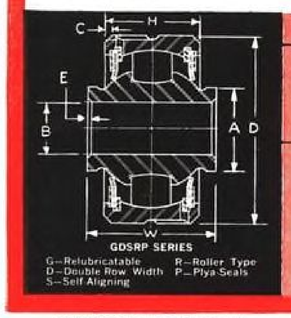
2. Balanced Design —"Excess baggage" eliminated, to bring bearing components into perfect balance with bearing capacity. One piece inner and outer ring design saves space, weight.

3. High-Capacity Construction — Full complement of barrel-shaped rollers; large roller-to-race contact areas; no retainer.

4. Hardened Back-Up Rings — provide positive shoulder stops independent of the seal rings...prevent seal damage in event of severe misalignment.

5. Removable Fafnir Plya-Seals — Seals are securely anchored in outer ring grooves — provide maximum protection against dirt, moisture and abrasive contaminants.

6. Exposed surfaces cadmium plated to withstand corrosive conditions. Snap rings are stainless steel.



GDSRP SERIES
G—Relubricatable R—Roller Type
D—Double Row Width P—Plya-Seals
S—Self Aligning

BEARING NUMBER	B BORE +.0000 −.0005 INCHES	D O.D. +.0000 −.0005 INCHES	W WIDTH INNER RING +.000 −.005 INCHES	H WIDTH OUTER RING +.000 −.005 INCHES	A SHOULDER DIAM. INNER RING (APPROX.) INCHES	E CORNER CHAMFER X 45° INNER RING BORE +.015 −.000 INCHES	C CORNER CHAMFER X 45° OUTER RING O.D. +.015 −.000 INCHES	ROLLERS NO.	ROLLERS DIAMETER INCHES	RADIAL LIMIT LOAD RATING (POUNDS) †	WEIGHT POUNDS (APPROX.)
GDSRP4	.2500	.9014	.625	.464	.404	.005	.032	12	.1514	3025	.06
GDSRP5	.3125	1.2500	.812	.656	.515	.015	.032	11	.2303	7350	.16
GDSRP6	.3750	1.4375	.937	.750	.564	.015	.032	11	.2681	9600	.24
GDSRP8	.5000	1.6875	1.000	.812	.775	.015	.044	12	.3023	12500	.36
**GDSRP10	.6250	1.9375	1.125	.937	.869	.015	.044	14	.3016	17700	.55
**GDSRP12	.7500	2.3750	1.312	1.125	1.350	.015	.044	13	.3900	26900	—

Permissible misalignment 10° in either direction

All dimensions in inches. Bearings interchangeable dimensionally with AN206 DSP Series Bearings

**Will be made as demand justifies tooling

†Thrust limit equal to 30% of radial limit load rating

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AIRCRAFT BEARINGS
FIRST at the turning points in aircraft design



. . . means lightning fast in-flight reprogramming of airborne electrical/electronic circuitry . . . obsoletes fixed circuit connectors and other systems requiring hours or days to rewire . . . and offers these unusual features:

THE NEW LIGHTWEIGHT A-MP "240" PATCHCORD PROGRAMMING SYSTEM

- removable patchboards to permit complete reprogramming in seconds
- 3¼ pounds to minimize weight . . . miniaturized to conserve space
- rugged shock and vibration-resistant construction with high strength aluminum alloy
- shock-resistant seating of patchcord plugs in removable board
- AMP's patented wiping action that pre-cleans contacts for top electrical performance
- 240 contacts for greatest versatility in circuit combinations or program arrangements

For more information on this new airborne wiring technique, AMP's Patchcord System Catalog is available on request.

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GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

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FLIGHT CONTROLLER
Compact flight controller contains ON-OFF switch, "push-to-turn" control, pitch and roll trim knobs.

MODE INDICATOR
Simple "push-to-test" lights provide ready reference to autopilot status.

Newest additions to the growing list of Lear Autopilot users are the Army's versatile de Havilland DHC-4 "Caribou" and the Beechcraft L-23 "Bonanza."

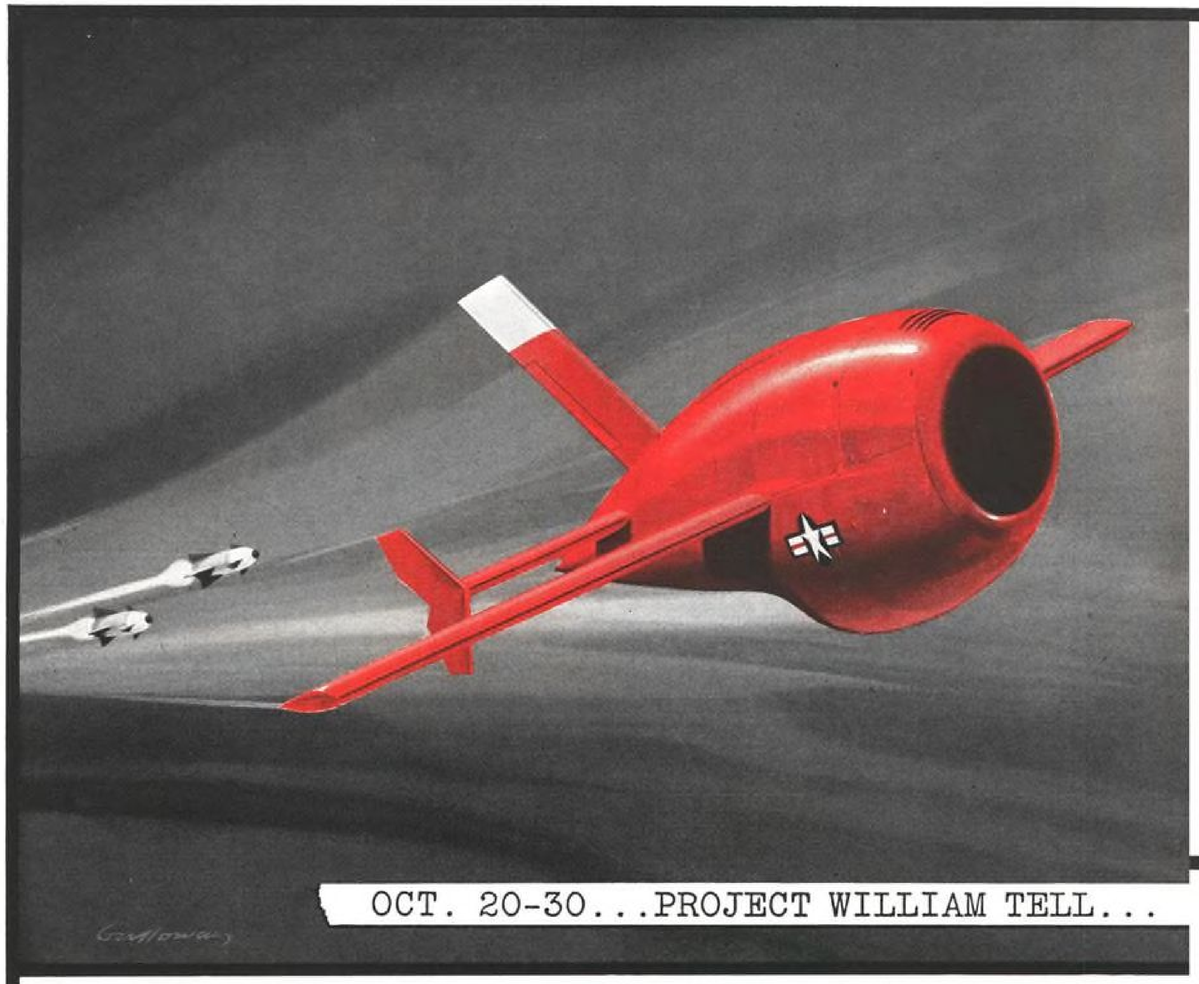
Basically the same autopilot as the F-5 which proved its reliability and accuracy in jet fighters, this installation (Army designation ASN-22) in the flying Army's fleet of fixed-wing aircraft is dramatic proof of the system's versatility. The Army has also selected a modified version of the F-5 (Army designation ASN-23) for automatic stabilization of the H-34 "Choctaw" rotary-winged aircraft.

The system weighs less than 70 pounds—lighter by far than any comparable autopilot. It is ruggedized for extremes in environment, operating with equal efficiency in tropical climates, sub-zero cold or extreme altitude. This modification of proven Lear equipment will bring greater utility, higher in-flight efficiency, and greater economy to Army aviation.

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RYAN FIREBEES TEST AMERICA'S AIR DEFENSE IN FIRST WEAPONS MEET TO USE JET TARGETS

Ryan Firebees are the exclusive flying "bull's-eyes" for the Air Force Project "William Tell"—first weapons meet to use free-flying jet targets. 100 Firebee jet drones will test the pilots, planes, and missiles of America's air defense system under the most realistic "combat" conditions ever achieved.

Firebees will not only draw the fire of the nation's crack Air Force pilots: they will score the results in mid-air with a new electronics system. A running record of hits, misses, and near-misses will be instantly transmitted from Firebees to scorekeepers on the ground. Other Firebees will photograph missiles boring in—or streaking away if they don't score a "hit."

Pitted against the Firebees in this world-wide weapons meet will be the top Air Defense Command squadrons, flying Convair F-102, Northrop F-89J and North American F-86L interceptors. They will fire deadly Falcon guided missiles, and Genie and "Mighty Mouse" rockets.

Only the Firebee—the most advanced target drone—has the high performance, reliability, and extended duration needed for realistic weapons evaluation. In service with the Air Force, Navy, and Army, Firebees are flying in greater numbers and for more hours than any other jet target drone.

The Firebee is another outstanding example of Ryan skill in blending aerodynamics, propulsion, and electronics knowledge to produce a superior product.



DOUGLAS DC-8 JETLINERS FLY WITH RYAN JET ENGINE PODS AND PYLONS

To build the jet pods and pylons for each Douglas DC-8, Ryan fabricates 14,000 parts—almost half of them from tough titanium.

Quickly demountable, each pod is a precision-made power unit—capable of operating on its own—interchangeable between Jetliners.

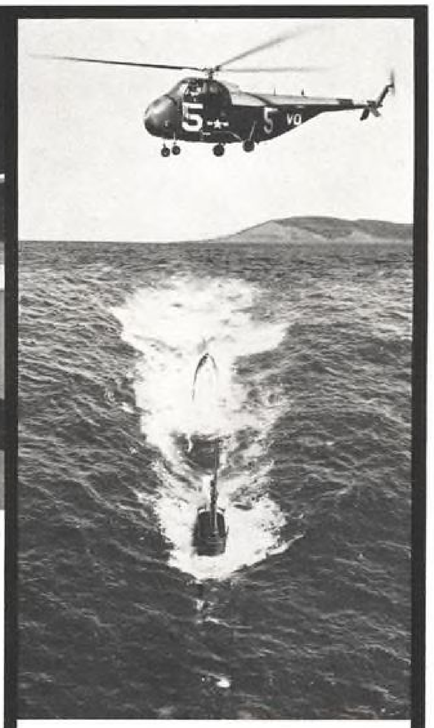
Ryan was selected to build these major DC-8 assemblies because Ryan is skilled in the engineering and production of high quality aircraft structures. This is the same quality of workmanship which has built a world-wide reputation for Douglas aircraft.



RYAN BUILDS ATOMIC ENGINE PARTS FOR G.E.

Ryan is building huge aircraft atomic engine components for the Nuclear Propulsion Department of General Electric Co. Details cannot be disclosed but it can be said that the components must be built with extreme precision and designed for very high temperatures.

Ryan has been handling such exacting projects for twenty years. That's why Ryan today has the skill, facilities, and experience to build single parts or complete systems for atomic, turbojet, rocket, or ramjet propulsion.



RYAN RADAR HELPS NAVY HELICOPTERS FIND SUBS

Now Navy anti-submarine helicopters can hover motionless under all weather conditions, while they probe the sea to put the finger on enemy undersea boats.

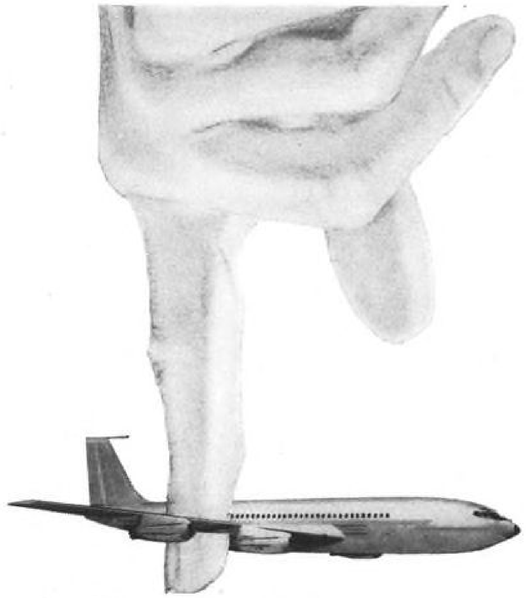
With Ryan's continuous wave Doppler radar systems (AN/APN-97), now being installed in the Navy's Sikorsky ASW Helicopters, pilots can hover, automatically, without relying on visual ground reference. This was previously impossible.

Hovering is essential to anti-submarine missions so that sonar detectors can lie motionless while they are dipped under the sea. Based on Ryan's leadership in CW radar applications, this unique new equipment is the lightest, simplest, most compact, and most reliable of its type.

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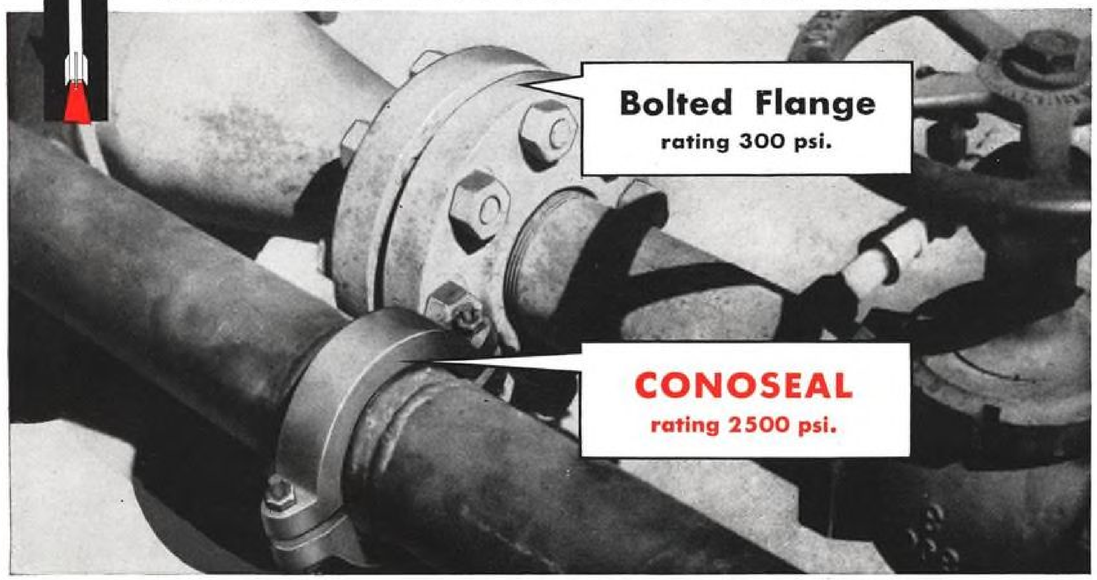
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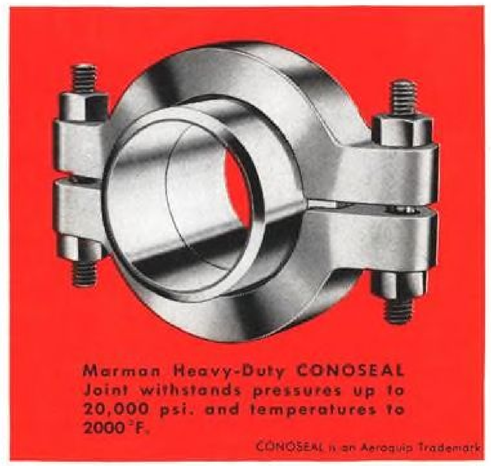


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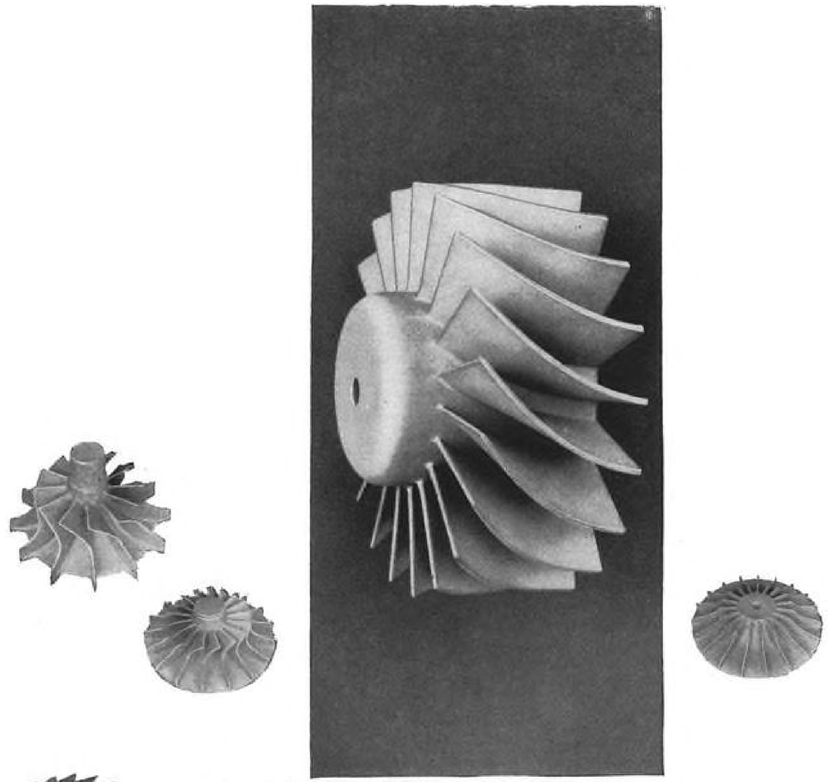
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COVER: Flight tests of Piasecki Model VZ-8P aerial jeep, designed and built by Piasecki Aircraft Corp., are under way at Philadelphia International Airport, with emphasis on hovering in ground effect and forward flight. p. 30). Frank Piasecki, designer, is at the controls. Aircraft is being developed for Army's Transportation, Research and Engineering Command.

PICTURE CREDITS

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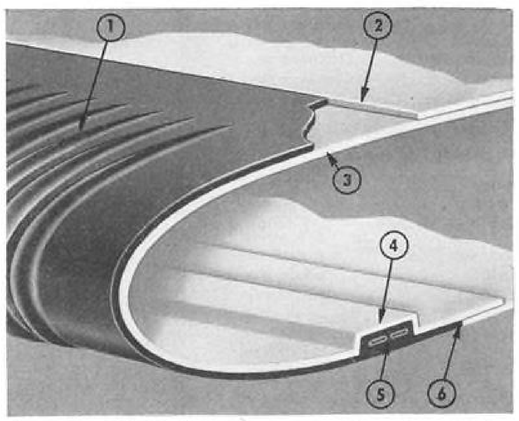
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EDITORIAL

Aviation's Modernization Problem

Aviation was born with a modernization problem that has plagued it steadily, from the sands of Kitty Hawk to the infinity of outer space.

For an industry that has gone from spruce, wire and doped canvas to titanium forgings, stainless steel honeycomb and beryllium in its first half century of existence, the goad of a galloping technology has made modernization a routine problem of survival.

Today, the problem is more acute than ever because of the blistering post-war technical pace of both military and civil aviation. Details on the problems of modernization posed by the addition of supersonic speeds, long-range missiles and space exploration to the manufacturing industry are covered by AVIATION WEEK's Washington bureau chief, Cecil Brownlow, on page 95. The impact of the jet transport era on civil aviation and the myriad modernization problems it imposes are the subject of an article on page 38 by AVIATION WEEK's chief transport editor, L. L. Doty, who is now on a round-the-world survey of airline operations, including coverage of the International Air Transport Assn.'s historic jet fare debate at Cannes and the IATA annual general meeting in New Delhi.

Even with its continuously developing technology of the first 50 years of aviation, the modernization problem was relatively simple compared to the prospects now facing the industry. For, even through the gas turbine era, the development line was pretty straightforward. But now a series of major technical breakthroughs have opened an entirely new spectrum of development that fans out in all directions as far as the liveliest minds in the business can see.

First comes the problem of mounting a research program of a size and scope that is unparalleled in either technical or national history. Second comes the problem of developing new materials and manufacturing processes to attain the tremendous performance goals unveiled by the basic research program. There is not a company in the aviation manufacturing industry that is serious about its economic survival that has not made tremendous investments of private capital in new research facilities and organizations during the past few years to grapple with the problems of the space age. Unfortunately, government policy in this area has not kept pace with private initiative in providing sufficient rewards for the enterprises and sharp enough penalties for the failures.

There is another factor that adds a sharper spur to technical progress than ever before. This is the rise of the Soviet Union as a serious competitor in the entire scientific-industrial spectrum encompassing modern aerial delivery systems and space exploration. How well we fare in the future will be determined largely by how well industry and government both solve the myriad problems of modernization required to maintain the technical pace and provide world leadership for this country and its allies of the free world.

In the transport field, the advent of gas turbine power has again broken off the single, straightforward line of development that characterized the birth of commercial air transport in the 1920s and its fantastic growth in the post-war era. The subsonic jet airliner is just making its first probes into scheduled passenger operations, yet transport designs capable of twice and three times the speed of sound already are on the drawing boards of every major manufacturer who competes in this market.

The jet transport modernization program to which U.S. airlines are firmly committed to the tune of $2.8 billion of private capital is imposing stresses and strains on the entire airline industry, from sales to operations, that are unique in its experience. The jet transport offers great potential. Operated efficiently and filled, with another major penetration into the mass transportation market, it can be the biggest money maker the airlines have ever seen. Operated inefficiently, with a load factor limited by present ticket sales levels, it could produce economic disaster.

These are the problems of modernization that the aviation industry and its related technologies are facing during the next few years with a new series of problems already on the horizon stretching as far as the mind can project. But few people who are dedicated to this industry would have it any other way. From the constant spur of this galloping technology has come the drive that has lifted aviation from a few serious experiments at the turn of the century to the dominant, pace-setting technical force in the industrial structure of the country as the half century mark slipped by.

Comet Comeback

There is no more traditional British characteristic than dogged determination to push on toward a goal despite any and all adversity that appears along the way. There is no better example of this British determination than the reappearance of the de Havilland Comet in the livery of British Overseas Airways Corp. on the world airlines after an absence of several years. The New York-London flights of the Comet 4 on Oct. 4 with just enough fare paying passengers to make a legitimate claim to being the first commercial jet operation across the Atlantic were indeed a bold stroke that provided British aviation morale a much needed boost. Everybody in aviation who has followed the Comet's early triumph and tragic interlude must be impressed with de Havilland's determination to stick with the project and strive mightily for ultimate success. A winter on the North Atlantic should provide a good testing ground for operations of the Comet 3 and 4 over the rest of the far-flung BOAC and BEA networks. The fact that its Rolls-Royce Avon turbojet engines go into initial commercial service with an overhaul interval of 1,000 hr. is another achievement that should not be overlooked as a significant milestone in the jet transport era.

—Robert Hotz

New 25-man raft for turbojets inflates in only 9 seconds with Kidde Inflatair!



3000 psi air from steel bottles (not visible) passes through INFLATAIRS; draws in free air and inflates raft.

Escape chutes, drone and missile recovery cushions, lifting bags, and *now* this 25-man life raft—all inflatable in an instant thanks to Kidde's INFLATAIR!

Available for use on all DC-8's, Convair 880's and Boeing 707's and 720's on overseas flights, the new 25-man raft uses two INFLATAIR units, is completely inflated in just 9 seconds. Each raft is fully equipped with rations, water, anchor, flares, first aid equipment and accessories for survival at sea.

Employing air bottled at 3000 psi, Kidde INFLATAIR aspirates free air at a ratio of as high as 20 to 1, insures fast, sure inflation for all types of aircraft emergency equipment. Also saves up to 20% in weight over conventional carbon dioxide inflation systems.

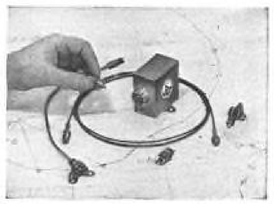
It is this kind of air safety research that has made Kidde the leader in its field for more than thirty years. For more information on INFLATAIR, or any of the many other items of Kidde safety equipment, write to Kidde today.

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As an example of its never-ending research for the latest air safety equipment, Kidde recently developed and supplied the protection devices used in full-scale Aircraft Crash Fire Prevention tests.



Portable Fire Extinguishers
First in Portable Aircraft Fire Extinguishers, Kidde offers you a complete line, brings you a standard of quality and dependability that has been second to none for more than 30 years!

WHO'S WHERE

In the Front Office

Dr. Robert F. Bacher, head of the Division of Physics, Mathematics and Astronomy at California Institute of Technology, a director, Space Technology Laboratories, Los Angeles, Calif. Also: **W. Stewart Hotchkiss,** controller.

Dr. John H. Buck, vice president-engineering, BJ Electronics, Borg-Warner Corp., Santa Ana, Calif.

Albert P. Gagnebin, a vice president, and **Joseph M. Weldon,** an assistant vice president, The International Nickel Co. Inc., New York, N. Y.

Maj. Gen. W. Preston Corderman (USA, ret.), a vice president, Litton Industries, Inc., Beverly Hills, Calif.

Hilliard W. Paige, general manager, Missile and Space Vehicle Department, General Electric Co., Philadelphia, Pa.

Walter T. Bonney, director of the Office of Public Information of the newly established National Aeronautics and Space Administration. Mr. Bonney formerly was assistant to the executive secretary of NASA's predecessor, the National Advisory Committee for Aeronautics.

William T. Welsh, vice president and sales manager, Cook Electric Co., Chicago, Ill.

Dr. William O. Davis, executive head of overall operations, Turbo Dynamics Corp.'s space technology laboratories, Minden, Nev.

Aeronutronic Systems, Inc., Los Angeles, Calif., subsidiary of Ford Motor Co., announced the following appointments: **Dr. Ernst H. Krause,** vice president and general manager, Aeronutronic Computer Division; **Dr. Montgomery H. Johnson,** director, Office of Advanced Research; **Dr. Joseph V. Charyk,** general manager, Space Technology Division; **Roy P. Jackson,** general manager, Tactical Weapon Systems Division; **Arthur C. Haines,** assistant to the president.

Honors and Elections

American Ordnance Assn. honored the **National Aeronautics and Space Administration** by presenting the Rice Memorial Medal for contributions in missilery to **Dr. Hugh L. Dryden,** deputy director of NASA. The AOA also presented the Crozier Gold Medal, awarded for distinguished service to armament preparedness on land, on the sea, and in the air, to **Maj. Gen. John Bruce Medaris,** Commanding General, U. S. Army Ordnance Missile Command, Huntsville, Ala.

Dr. Theodore von Karman has been named a recipient of the American Society of Mechanical Engineers' Timoshenko Medal for "his contribution to the mechanics of fluids and solids, particularly those leading to major advancements in aeronautics." Also named recipients of the Timoshenko Medal, awarded for outstanding work in the technical field of applied mechanics, are **Dr. Arpad L. Nadai,** former consulting mechanical engineer for the Westinghouse Research Laboratories, and **Sir Geoffrey Ingram Taylor,** former Yarrow Research Professor of the Royal Society. The awards will be presented by society in December in New York City.

(Continued on page 125)

INDUSTRY OBSERVER

► Problem of detecting and tracking an enemy ballistic missile nose cone in the arctic region may be even more difficult than previously thought because of reflection and refraction of radar signals by auroral disturbances. These ion clouds also cause Doppler shift of the received signal which further complicates problem of discriminating between moving nose cone and false targets.

► **Ramo-Wooldridge is developing ground-based equipment that will analyze electro-magnetic radiation (radio and radar signals) detected and recorded by USAF's Sentry reconnaissance satellite. Ramo-Wooldridge's contract is with Rome, N. Y., Air Development Center.**

► First launching in the Air Force-North American Rise Project (Research in Supersonic Environment) was made last month. More are due soon. Rise uses the former Navaho booster and the former X-10 test vehicle to study environmental conditions applicable to the F-108, B-70 and the Hound Dog air-to-surface missile.

► **Last aircraft in the Douglas DC-6, DC-7 series has rolled off the line. The aircraft was the 1,041st of the series; the 121st DC-7C. No new aircraft are being constructed at the Santa Monica plant, with most of the area being used for storage.**

► Research and development contract for high precision orbit determination has been awarded Aeronutronic Systems Inc. by Army.

► **Boeing entry in Air Force competition for a new early warning aircraft (AW Oct. 13, p. 28) is a turboprop version of its C-97 tanker.**

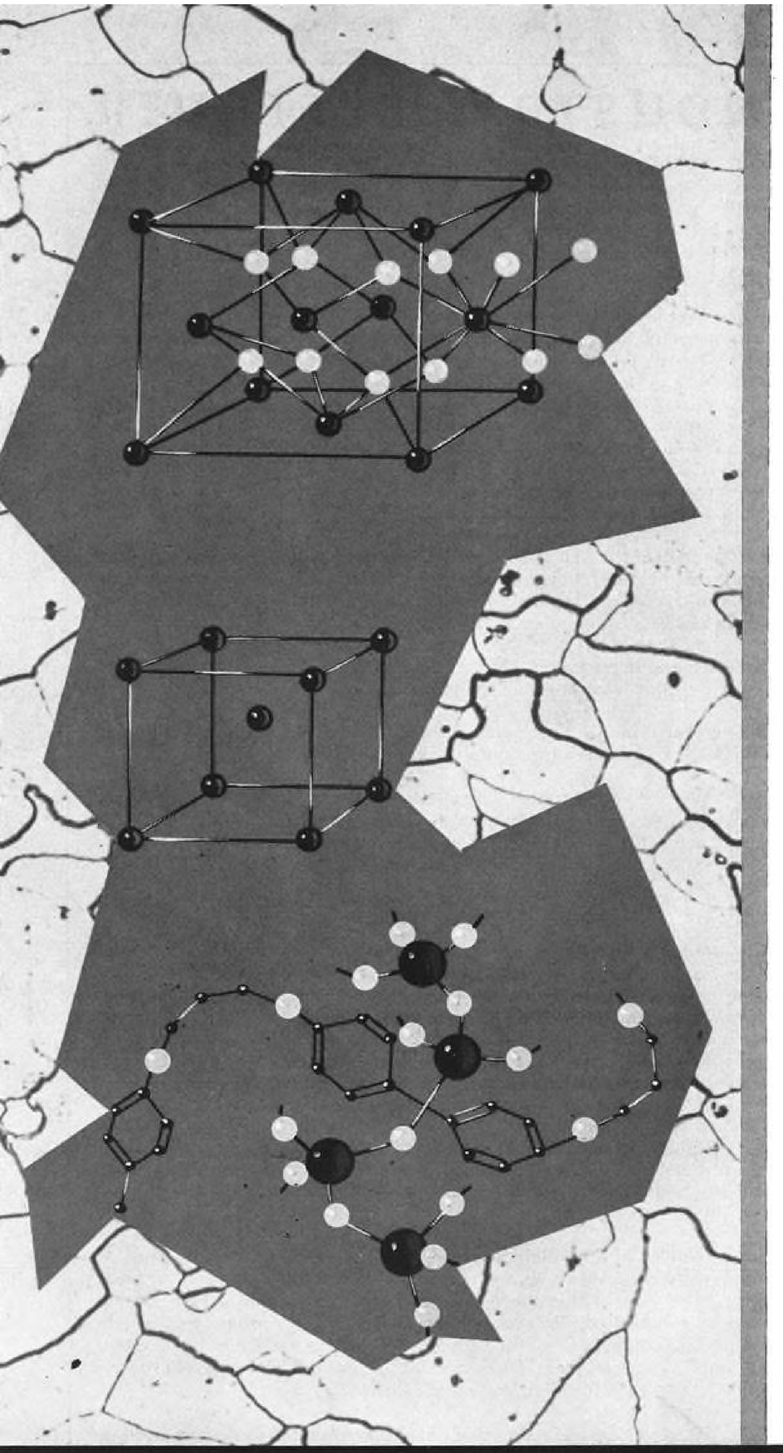
► Air Force is expected to name a contractor shortly for its 456-L electronic supporting system program to provide quick fixes and develop long-range improvements for its Global Communications System. Major contenders include American Telephone & Telegraph Co. and a team headed by International Telephone & Telegraph Co., which includes Radio Corporation of America, Hughes Aircraft and Hoffman Electronics.

► **Communist China's new and growing aviation industry recently turned out its first jet trainer, first seaplane and a new eight-passenger, twin-piston engine transport. Jet trainer, now being flight tested, reportedly has a top speed of approximately 620 mph. and a ceiling of over 45,900 ft. The four-place, single-engine seaplane, designated the Feiloon-1, is scheduled to go into quantity production next year. The transport, designated Peking No. 1, was reportedly designed and built in 100 days (AW Oct. 13, p. 32).**

► Polaris fleet ballistic missile will be fired to the surface by itself without use of a capsule under present planning. Launching tube inside submarine contains a second tube, or liner, into which the missile is sealed. Breaking of the seal and propelling of the missile to the surface are both accomplished by air pressure.

► **Soviet Union, in its exploitation of Russian technological gains, plans 26 motion pictures devoted to Soviet science in the conquest and exploration of outer space within the next three years. Films will include "Scouts of the Universe," dealing with Soviet rocketry; "Automatons in the Cosmos," describing the use of high-altitude rockets for scientific investigation, and "Television from Earth Satellites," outlining the possibilities of employing earth satellites for long-range television.**

► Borg-Warner Corp. has received an Air Force contract to develop a pump for fluorine propellant. Bidding was restricted to companies not already involved in the fluorine program. Need for a pump to handle corrosive oxidizer which attacks seals, lubricants and most conventional materials is still a major drawback to full-scale fluorine motor. Bell Aircraft and Rocketdyne Division of North American Aviation reportedly are avoiding the problem by using pressure feed. In regard to lubrication, one promising approach is to let the fluorine also serve as the lubricant.



NEW APPROACH TO "OLD" MATERIALS

By today's standards, the "old" refractory metals are outdated. The ultimate in high-temperature studies of 10 years ago is several generations behind in terms of modern aircraft and missile development.

Today's material requirements surpass anything envisioned 10 short years ago. Molybdenum and beryllium, for example, are still exciting metals with much promise for space vehicles and ultra-high-speed aircraft. It now appears, however, that the full promise of such metals may be fulfilled when they are used, not alone, nor as alloys, but when combined with other materials to form totally new types of structural materials.

Such a "marriage" of metals, ceramics and plastics is a promising approach to high-temperature problems that is being vigorously pursued at Avco. It opens new potential applications for many exotic combinations.

These bold steps forward are possible at Avco, where materials research includes concurrent basic studies and applied research, plus developmental programs that extend through the solution of processing and testing problems.

The search for new knowledge goes forward simultaneously with the creation of advanced technology at Avco's Research and Advanced Development Division. The creative man, whether he is interested in basic studies or practical problems, finds his effort enhanced by the stimulus of interdisciplinary contact and feedback from other related fields.

Research and Advanced Development is more than a descriptive title at Avco. It is a concept that promotes creativity.

Avco

Research and Advanced Development division

For information on unusual career opportunities for exceptionally qualified scientists and engineers, write to: Dr. R. W. Johnston, Scientific and Technical Relations, Avco Research and Advanced Development Div.; 201 Lowell Street, Wilmington, Mass.

Washington Roundup

Military Contracting

Industry is vigorously protesting a comprehensive set of revisions to armed services procurement regulations stiffening the terms under which contractors must operate. Representatives of Aircraft Industries Assn., Electronics Industry Assn. and the National Security Industrial Assn. presented their opposition to Defense Department at Pentagon meetings last week. The revisions are scheduled to become effective on Dec. 18.

USAF Chief Scientist

Leading candidate late last week to succeed Dr. George Valley as chief Air Force scientist was Dr. Joseph Kaplan, University of California, Los Angeles, physicist and chairman of the U. S. National Committee for the International Geophysical Year. Dr. Valley has completed his term as chief scientist and has joined Melpar Inc., Arlington, Va., as director of development planning.

In Congress

Developments on Capitol Hill during the congressional recess include:

• **House Government Operations' staff** is looking into the research and development program of National Aeronautics and Space Administration and other civilian agencies. The committee plans hearings next year. In a report this year, based upon extensive hearings, the committee urged the Defense Department to put more emphasis upon research and to encourage competitive projects (Aug. 1, p. 23).

• **House Appropriations Subcommittee** on the Armed Services has expanded its study of the reliability of military equipment into a major investigation (AW July 7, p. 25). A group of scientists and engineers have been retained as consultants, including K. T. Keller, formerly Defense Department director of guided missiles, and Clifford Furnas, former assistant secretary of defense for research and development.

• **House Armed Services Investigating** Subcommittee headed by Rep. Edward Hebert (D.-La.) plans to begin hearings Nov. 15 on the utilization of government-owned plants for military production. Communities have complained that the services have closed government plants and then financed new privately-owned facilities in other locations.

The subcommittee also will give aircraft engine manufacturers an opportunity to testify on their military contracts if they want to. In March, 1957, the subcommittee began an investigation of engine procurement with much fanfare. The replies of manufacturers to a questionnaire were published in a 2,500-page volume and the investigation dropped. Planned hearings on procurement under the weapon system concept probably will not be held until next session.

• **House Subcommittee on Information** headed by Rep. John Moss (D.-Calif.) has tentatively scheduled hearings for Nov. 12 and 13 on Defense Department's refusal to release data on the ballistic missile procurement program to the General Accounting Office. GAO says it has indications that the program has been "mismanaged" and has been attempting to obtain access to classified data since April. Defense Department also has refused to release the data to congressional committees.

• **House Space Committee's staff** is evaluating the relative position of the U. S. vis-a-vis Russia in the fields of liquid and solid rocket fuels. Hearings with representatives of the petroleum and chemical industries may be held in November after the election.

Research Study

Defense Department has submitted a long-range research and development program—extending through Fiscal 1965—to Dr. James R. Killian, specal presidential assistant for science and technology. Report was drawn without consideration to financial limitations (AW July 28, p. 28). National Aeronautics and Space Administration is still working on a similar project. Killian has asked all government agencies for similar reports, in an effort to determine what the nation's scientific resources are, could be and should be.

Dr. Alan T. Waterman, director of the National Science Foundation, is coordinating and administering the project.

Space Reports

Four additional staff reports on problems connected with space exploration are scheduled by the House Select Committee on Astronautics and Space Exploration. Besides the report on international cooperation released today (see page 33), others planned include an over-all review of the national space program, a survey of the accomplishments of the International Geophysical Year with special reference to the space sciences, a study of the immediate and future need for better fuels and propulsion systems in the U. S. rocket program and a survey of the legal problems that will evolve as the space age advances.

Rate of Return Debate

Outcome of the Local Service Rate of Return Case is beginning to take shape with qualified observers predicting a Civil Aeronautics Board decision adopting the 9.5% rate recommended by its bureau counsel. Apart from the unyielding position of the bureau and the Board's alacrity in applying the rate to final mail rate applications, the observers regard subsidy payments as a stumbling block in the locals' efforts to obtain a higher rate of return.

Small Business Directive

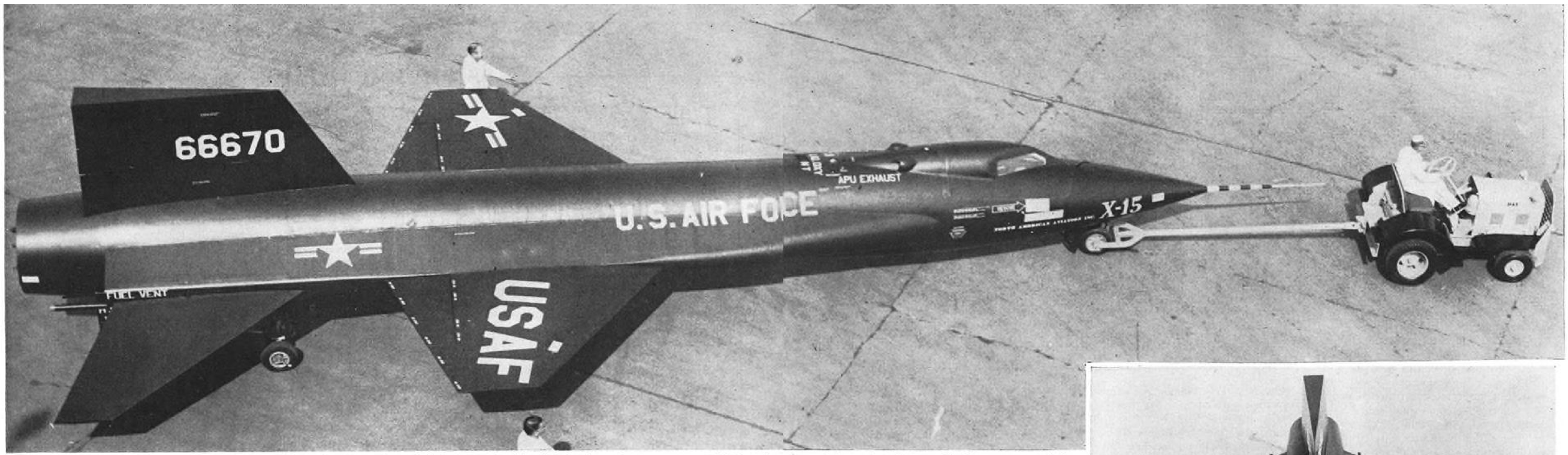
Air Force is taking new action to increase the participation of small businesses in its procurement programs. A new directive has:

• **Directed all installation commanders** to put more emphasis upon small business contracting and to give "their personal attention to the ensuring that the status of the small business office within their organizations is such as to provide maximum performance."

• **Elevated the Office of Small Business** in the hierarchy at USAF headquarters.

The Office of Small Business will be directly under the Deputy Chief of Staff for Materiel. Previously, it reported to the Deputy Chief through the Director of Procurement and Production. The office also has been made an adviser to the Deputy Chief of Staff for Development and to the Assistant Secretary of the Air Force for Materiel.

—Washington staff



X-15 side view (above) and plan view (right) show design details: aerodynamic bulges on each side of the fuselage; short span trapezoidal shaped wings; wedge shaped vertical surface with blunt trailing edge a foot thick (AW Feb. 3, p. 26). Two vents for auxiliary power units are on the rear of the cockpit fairing; a liquid oxygen vent is in the fuselage just behind the cockpit.

X-15 Rolls Out; Capability for Mach 7 Is Visualized



PILOTS who will fly the X-15 inspect aircraft's nose section; note ports for jet control system. From left are Joseph Walker, National Aeronautics and Space Administration; Scott Crossfield, North American Aviation, and Capt. Robert White, U. S. Air Force.

By Irving Stone

Inglewood, Calif.—North American Aviation's X-15, hypersonic research aircraft which will probe the approaches to true manned space flight was rolled out here last week, two weeks ahead of the date which was scheduled three years ago.

Generally attributed with a capability of 100-mi.-altitude, and 3,600 mph. speed, indications are that this out-of-atmosphere plane may be pushed to Mach 7 before it finishes its projected program of research flights. A .0667-scale model of the craft, used to determine heating characteristics and load distributions, has been tested at Arnold Engineering Development Center's B Minor tunnel to Mach 7—roughly equivalent to 4,600 mph.

Schedule pinpoints the first flight of the X-15 for February of next year. Pilot will be North American's Scott Crossfield. This will be the beginning of North American flight test which will demonstrate structural integrity and performance of the propulsion and control systems, according to Brig. Gen. Marcus F. Cooper, Commander, Air Force Flight Test Center, Edwards AFB. Demonstrations, he said, will be conducted within known flight envelopes.

After these demonstrations have been accomplished to Air Force's satisfaction, the X-15 will be accepted and turned over to X-15 flight test steering committee for the research program.

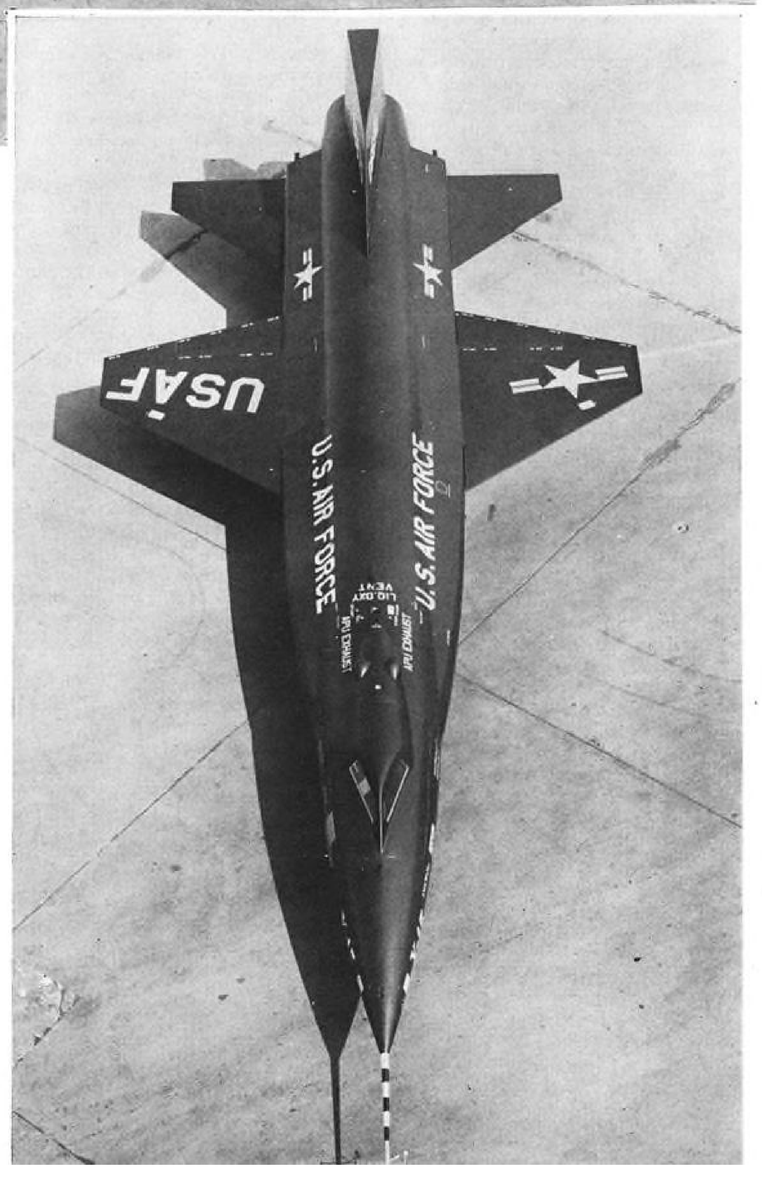
Primary responsibility for the research program will rest with National Aeronautics and Space Administration, which will coordinate efforts with the Air Force. In addition to these two organizations, both the Navy and the aircraft industry are participating in the joint X-15 endeavor.

By the end of 1959, three X-15s will have been funneled into the program. The second and third aircraft, which will be identical with the first vehicle, are scheduled for delivery in February and July, respectively.

Research Program

Research program will be of long duration, and "type of flights which excite the imagination and make newspaper headlines are many, many months away," Gen. Cooper declared. He emphasized that the approach to manned flight into areas still unexplored is cautious and painstakingly detailed because each thing learned will contribute to the following step—"and we will not move forward until we are completely satisfied that everything is right."

Major problems will be explored by the X-15's flight aerodynamic heating as it affects structure, since major problems which will be explored by the X-15 include free flight aerodynamic heating as it affects structure, since



questions remain as to exact flow conditions as well as the actual manner in which heat is transferred to structural components.

Problems of stability and control at altitudes where aerodynamic forces and damping are lacking also will be checked in the free flight testing program.

Other prime considerations include investigation of weightlessness conditions and exit and entry conditions at varying degrees of severity. Bulk of the research measurements will be made with on-board equipment, according to Walter C. Williams, chief of NASA's High Speed Flight Station, Edwards AFB. There will be measurements of airspeed and altitude from both pressure sources and the inertia system as well as angle of attack and sideslip.

Other parameters measured will include those required to determine airplane motions as well as pilot motions which cause or accompany these. Information directly concerning pilot will be obtained, such as pilot's body surface temperatures and electrocardiographic data. Measurements of structural temperature, over-all surface loads and detail surface pressures will be made, Williams said.

Typical mission of an X-15 will start with an air-drop from a Boeing B-52 mother ship at an altitude as high as it can be toted. Pilot will be in the test plane cockpit from time the mother ship leaves the ground. Time from drop to touchdown will consume about 20 min. Burning time during powered flight will be only about 90 sec. Approach speed for landing will be approximately that of the Lockheed F-104. The flight will be tracked over a precision radar range running approximately from Wendover, Utah, to Edwards AFB, a distance exceeding 400 mi.

During rocket burning there will be very high acceleration. In the portion of the flight out of the atmosphere, aerodynamic controls will be ineffective and the pilot will rely on reaction type controls. Between burning phase and re-entry, the pilot will be subjected to zero-G conditions. During the re-entry phase, the load factor builds up and aerodynamic heating starts. At this point, leading edges and other portions of the X-15 structure will reach temperatures in excess of 1,000F, according to Harrison Storms, North American's Los Angeles Division chief engineer.

Nose of the X-15 has a cruciform arrangement of small rocket engines—reaction controls—and wing-tips are equipped with the same type of engines. These engines, which will use hydrogen peroxide and a catalyst as a propellant, were designed and built by Bell Aircraft Co. When the nose rockets are actuated, they will pitch the X-15 up or down or yaw the aircraft from side to side, as required. Wing tip rockets will give roll motion.

X-15 Cockpit

X-15 cockpit, which was not open for inspection during rollout, has three control sticks—center control stick as in conventional aircraft, plus right- and left-hand controllers—Storms revealed. The right-hand controller will be used when the pilot is under a high load factor, and in the atmosphere during boost and re-entry. Pilot's arms will be restrained and the load factor on his body will not give him inadvertent control motion.

As the pilot leaves the atmosphere, there are still acceleration considerations and the space controller is put on the left, so that pilot's left arm can be braced to negate effects of the load factor, Storms explained.

After re-entry has been completed and the X-15 is gliding as a normal aircraft, the pilot may then use a conventional control stick if he desires.

Test indications to date have shown that transition between various control sticks appears normal and satisfactory to pilots who have been tested.

Directly aft of the cockpit is the instrumentation bay. In this area, scientific data, gathering equipment will record information on various research phases of the flight. Instrumentation has been designed and supplied by NASA.

Included in this bay is an inertial reference platform, designed and built by Sperry Gyroscope Co., which gives the pilot his indications of direction and attitude.

Auxiliary Power

Located adjacent to this area, is the auxiliary power unit which supplies energy for both electronic and hydraulic systems throughout the mission. This unit is a small steam turbine, also operated on hydrogen peroxide and a catalyst, which was designed and constructed by General Electric's Accessory Division.

From this compartment aft, the fuselage is filled primarily with liquid oxygen, ammonia and helium pressure tanks, Storms said. The engine, designed by Thiokol Chemical Corp.'s Reaction Motors Division, will deliver a static thrust of over 50,000 lb. This engine, known as the XLR-99, will be available for the X-15 program next year. Meanwhile, two Reaction Motors XLR 11-5 rocket engines of the type used throughout the X-1 and D-558-II programs have the advantage of proven engines for this phase of the program.

The liquid oxygen and liquid ammonia propellants for the XLR-99 RMI rocket engine, to be brought into the program later, will be fed by a pressure system causing flow in excess of 10,000 lb. per min. This compares with a rate of fuel flow in a modern jet fighter with afterburner—such as the North American F-100—from 30,000 to 40,000 lb. per hour, which means that the X-15 will gulp propellants about 20 times as fast. Decomposed hydrogen peroxide provides a high temperature gas used to drive a turbine-propelled pump to boost the liquid oxygen and ammonia to engine manifold pressure. Helium gas is used for tank pressurization and liquid expulsion.

Large side fairing and vertical tail arrangement differ considerably from conventional type aircraft exteriors. Side fairings house propellant, control lines.

Vertical tails—above and below the fuselage—are wedge-shaped. This configuration was selected as a result of extensive tunnel tests for maximum directional stability with lightest weight attainable. The all-movable upper and lower vertical surfaces should give very good directional control throughout the X-15's speed range. Bottom half of vertical tail will be jettisoned prior to landing to prevent ground interference at touchdown. On upper and lower vertical tails, the aft portion near the fuselage will be actuated as dive brakes.

Hydraulic system powering the all-movable horizontal and vertical tails, speed brakes and landing flaps consists of two separate 3,000 psi. systems operating in parallel. Hydraulic system is driven by a piggy-back combination of pumps and total system weight is less than counterpart used in F-100C.

Landing gear includes two steel skids located on the aft section below horizontal stabilizers. Dual nose wheels also are used to give directional stability during high speed landing. Both landing skids and nose wheels are manually retractable into fuselage, and are extended by mechanical means which utilizes gravity and the airstream.

Liquid nitrogen is used for air conditioning and pressurization system, which weighs 150 lb. and has cooling capacity of 27,000 Btu.

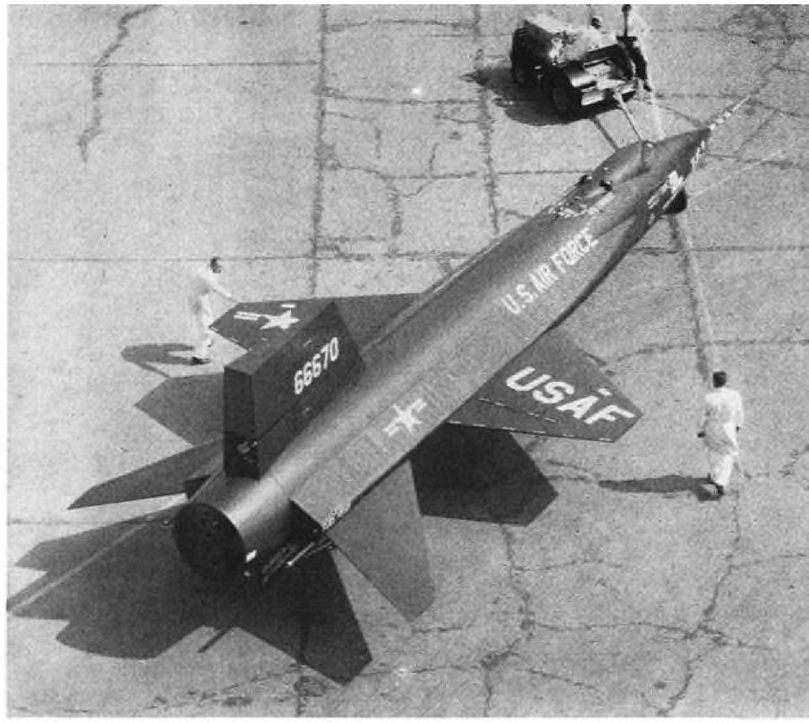
International Nickle Co.'s Inconel X is the predominate material in the X-15, and was selected for its high strength and elevated temperature characteristics. The material was considered a weldable alloy but no detailed experience with it, as a welded aircraft structure, was available, Storms said. Development work had to be done by North American in forming, welding and other joining of this material to make a practical aircraft.

Special techniques for contouring skins were developed, involving use of hot and cold machining, ovens, freezers, cutters, slicers and rollers. One special tool fixture required for the control of contour during a heat treat cycle for a wing skin weighs 4,300 lb., while the skin it holds weighs 180 lb., Storms added. About 80% of the skins and attachments in the X-15 are welded and about 20% is riveted.

Another development was a brazed sleeve tubing joint, required by extreme temperatures, use of chemicals and gases difficult to contain, and extreme reliability requirements. A relatively simple arrangement of an electrical resistance clamshell holding tool permits brazing of the sleeves while in place. Torch and induction methods are also used in some applications.

Metals other than Inconel X are also used. A primary structure of titanium and stainless steel will resist heat that soaks through the nickel alloy outer covering.

Aluminum alloy is used externally where high heat and high loads are not a problem.



LARGE SIDE fairings on X-15 fuselage house liquid propellant and control lines. Two four-barreled XLR 11-5 rocket engines are mounted top-and-bottom, will be used on initial flight.



STRIPED stabilizing fins are fitted to X-15 pilot seat. Dummy is dressed in pressurization suit and is in ejection position.

X-15 Specifications

DIMENSIONS

Length	50 ft.
Span	22 ft.
Height	13 ft.

WINGS

Swept-back C/4	25 deg.
Area	200 sq. ft.
Box Type Construction	Main Spar
No Movable Surfaces in Wing.	
Inconel X Nickel Alloy Material (welded) Throughout, with Solid Nose Section Providing Heat Sink.	
Maximum Gross Takeoff Weight	31,275 lb.
Landing Gear	Dual Nose Wheel, Steel Skids for Main Gear.

POWERPLANT

Basic	One XLR-99 RMI Liquid Rocket.
Interim	Two XLR 11-5 Reaction Motors Liquid Rocket Engines.

Polaris Malfunction

Cape Canaveral, Fla.—Second stage of a Polaris fleet ballistic missile test vehicle ignited prematurely last week, separated and left the first stage sitting on the launch pad and finally was destroyed after it had gained a few hundred feet altitude. By late last week, Navy officials had not isolated the cause of the malfunction.

The Lockheed test vehicle, designated the AX-2, was to have been the second in a series of tests of in-flight separation of the first and second stage boosters, the flight control system, the aerodynamic structure of the missile body and the solid propellant motors.

NASA-Army Battle

Washington—National Aeronautics and Space Administration faced its first open battle last week as Army fought to block its efforts to assume at least part of the space activities of Army's Ballistic Missile Agency and California Institute of Technology's Jet Propulsion Laboratory (AW Oct. 13, p. 25).

NASA proposal—which, if accepted, might involve the transfer of a number of scientists from ABMA to the new civil space agency—reportedly is being disputed by Army at top Administration levels.

Both the Defense Department and NASA admitted that such a transfer was under discussion but declined further comment. From ABMA headquarters in Huntsville, propulsion expert Dr. Ernst Stuhlinger was quoted as saying that he and a number of other scientists would resign if assigned to NASA or if the ABMA development team was broken up.

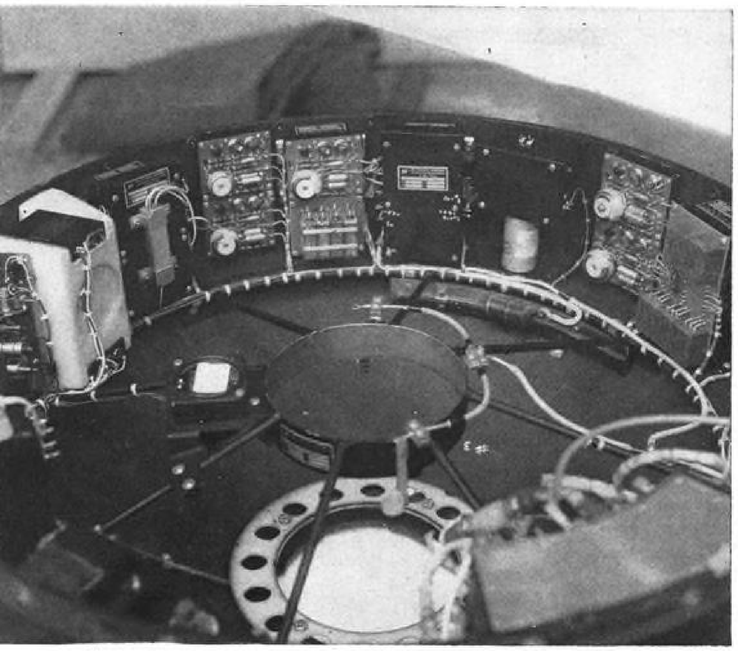
Minuteman Contract

Washington—Air Force has given Boeing Airplane Co. responsibility for the assembly and test of the Minuteman multi-purpose, solid-propellant ballistic missile.

Air Force said the decision to award the contract to Boeing was made upon the "unanimous recommendations" of the commanders of the Air Research and Development Command, Air Materiel Command and Ballistic Missile Division.

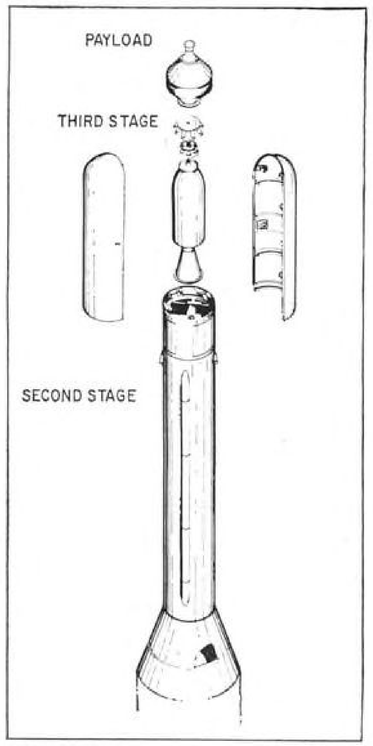
Other Minuteman contractors already announced (AW July 28, p. 27) include Avco Manufacturing Corp., nose cone; Autonetics Division of North American Aviation, guidance; Thiokol Chemical Corp. and Aerojet General Corp., engines.

Air Force management of the Minuteman program will be handled by the Ballistic Missile Division with technical advice supplied by Ramo-Wooldridge Corp.





PIONEER INSTRUMENT package (left) is shown being attached to top of third stage (right) with vernier rocket cluster. Television driver and optical unit are mounted over skanning window in heavy frame at left of instrumentation photo. Doppler receiver is at bottom right.



PIONEER lunar probe includes three propulsion stages; fourth stage retardation rocket is mounted in payload instrument package.

Pioneer Indicates Restricted Radiation

By Evert Clark

Cape Canaveral, Fla.—Firing of the second Able-I lunar probe to a distance of some 80,000 mi. from the earth has provided encouraging preliminary information in lethal high-intensity radiation and greatly increased chances that the same basic vehicle will be used for more radiation studies and possibly for shots at Venus and Mars.

"Quick-look" data telemetered to earth tracking stations in the Pioneer's 43-hr. flight indicated that the intense radiation threatening manned space flight exists in a relatively narrow band and does not extend to the sun, as some theories had suggested.

Data reduction still is far from complete. But levels measured by an ion chamber and telemetered during flight were four roentgens at 5,000 mi., three roentgens at 10,000 mi., two roentgens at 17,000 mi. and one-half roentgen at 60,000 mi.

The 5,000 mi. figure is somewhat lower than intensities found by Explorer IV at 1,200 mi., but this was not unexpected because Pioneer's trajectory took it through higher geomagnetic latitudes where intensity is known to be lower.

Explorer data had indicated that intensity doubled approximately every 60 mi.

Experiments already are planned for extensive study of the critical region between 2,000 and 10,000 mi. from the earth, possibly using another Thor-Able vehicle.

In addition to three lunar probes originally authorized for use by the USAF Ballistic Missile Division-Space Technology Laboratories team, use of at least two more Thor-Able research vehicles was approved by Advanced Research Projects Agency last August. One was believed to be an interplanetary probe to be launched toward the vicinity of Venus.

Mission of the two extra probes and of future use of Thor-Ables for more moon shots is in doubt, chiefly because of the transfer of cognizance over such space research from ARPA to National Aeronautics and Space Administration. But work probably is far enough along on the two ARPA-authorized vehicles that NASA will let it continue.

Next USAF lunar probe is expected to be launched Nov. 7 if modifications based on the Oct. 11 firing can be made.

Although the Pioneer satellite missed its goal of the moon by two-thirds of the distance, it was considered an extremely important success, both scientifically and as a contribution to missile technology.

The 88.1 ft., four-stage rocket was launched only 13 sec. after its target time of 4:42 a.m. EDT after a 24-hr. countdown that included several planned holds and mechanical problems that were distributed throughout the period.

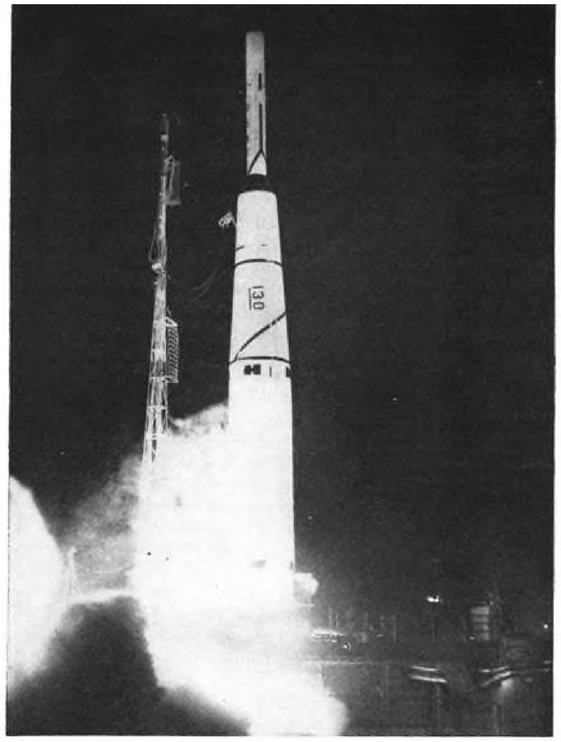
Douglas Aircraft Co. was test conductor. Launch crew included the overall project director, Space Technology Laboratories Division of Ramo-Wooldridge Corp.; Douglas; the Rocketdyne Division of North American Aviation Inc., and Aerojet-General Corp.

Countdown Experience

Previous experience with this countdown was limited to one mock run before the unsuccessful Aug. 17 lunar shot, and the August shot itself.

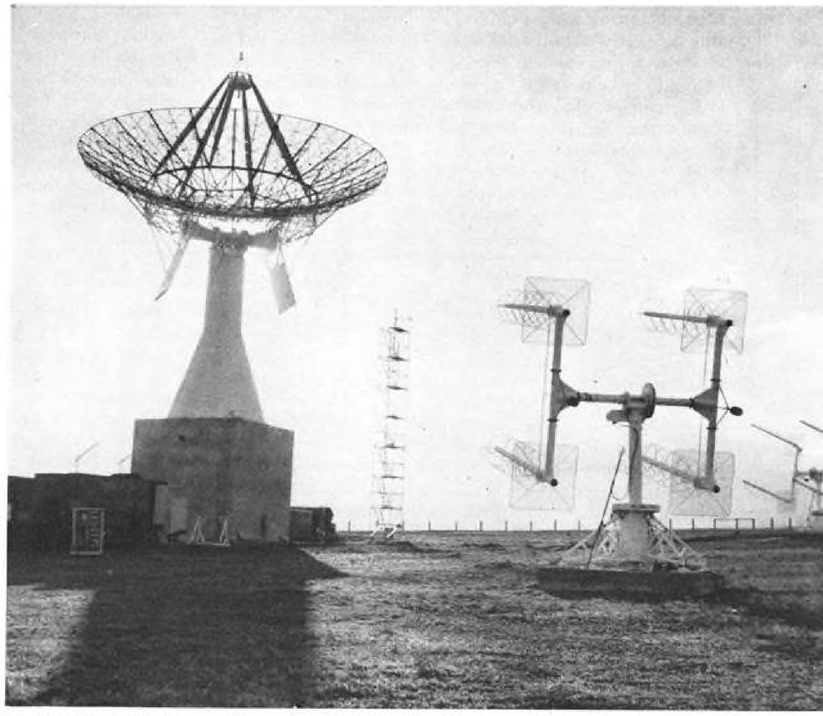
Moon was 223,700 mi. from the earth at the time of firing. It would have been 222,500 mi. away 2.61 days later, when it was hoped Pioneer would intercept its orbit.

Error that kept Pioneer from going the full distance apparently was in the first-stage autopilot, which lofted the trajectory 3.5 deg. too high. Desired velocity was 35,250 fps., short of the 36,900 fps. needed to escape the earth's





FOUR-STAGE vehicle leaves launching pad (left) at 4:42 a.m. EST, Oct. 11, only 13 sec. after target time. Time exposure (right) shows path of the lunar probe shortly after it was launched on 43 hr. flight reaching an altitude of nearly 70,000 naut. mi.



LUNAR PROBE tracking station at South Point, Hawaii, is one of three throughout world, others are in Singapore, and near Manchester, England. Parabolic tracking antenna is 60 ft. dia., smaller helical antennas receive telemetry signals.

Lunar Probe Stages, Flight Plan

Cape Canaveral, Fla.—Pioneer lunar probe fired Oct. 11 was a four-stage, 88.1-ft. Able-I vehicle designed, developed and tested by Space Technology Laboratories from existing hardware.

It was the third vehicle built for an Air Force moon shot. First vehicle exploded after 77 sec. of flight (AW Aug. 25, p. 20). The second was diverted to Project Bravo (Able-II project), a further study of the feasibility of using Thor plus an Aerojet Vanguard engine as an intercontinental range missile.

Stages and flight plan for the rocket were:

• Booster. Standard Douglas Thor with inertial guidance removed to save weight and a transition section fitted at the top in place of a nose cone. Thrust is approximately 150,000 lb.; weight more than 100,000 lb. Vehicle was launched vertically. Autopilot was programmed to roll the rocket between 2 and 9 sec. after liftoff to its proper azimuth of 71 deg. Thor was to fly the missile to a constant attitude trajectory by 140 sec. but a slight malfunction caused a 3.5 deg. error in trajectory. Rocketdyne engine from the Canoga, Calif., plant, incorporating modifications previously made on similar engines in Jupiter, Thor and Atlas missiles, burned to cutoff at about 157 sec. Cutoff initiated separation of first stage but, for several seconds, Thor's vernier engines continued to propel the first stage to maintain a positive pressure head on the second stage propulsion system, in order to assure ignition.

• Second stage. An Aerojet-General AJ-10 liquid propellant engine, highly modified from the form it takes in the Vanguard rocket. STL increased thickness of the skin to carry weight of the third and fourth stages and installed a control section at the top of the stage containing autopilot and precision accelerometer cutoff. Thrust was about 7,500 lb., weight 4,000 lb., burning time about two min. Accelerometer cuts off engine after integrated thrust acceleration of 28,000 fps. is reached. Fiberglas fairing covering third and fourth stage is split away by explosive bolts and eight vernier rockets on third stage are fired, spinning the vehicle to approximately 120 rpm. for stabilization. Separation of second stage and ignition of third stage are simultaneous.

• Third stage. Allegany Ballistic Laboratory's solid propellant ABL-248 engine, also developed for Vanguard. STL modified the nozzle to fit atop the second-stage control section and redesigned the nose to connect with the fourth stage. Thrust is about 2,500 lb., weight about 4,000 lb. Following burnout at about seven and one-half sec. after liftoff, third stage is separated from terminal stage by springs.

In the latest firing, 10 sec. of burning time were left in the ABL engine. Use of this would have helped correct the error in trajectory, but no command control from the ground was possible. This will be corrected in future firings.

• Fourth stage. This is the Space Technology Laboratories' designed and built instrument package, consisting of a biconical Fiberglas shell slipped over a modified 3,000 lb. Thiokol Falcon terminal rocket. Rocket nozzle faces in the opposite direction from the nozzle of other stages. Had the package reached the vicinity of the moon, rocket would have fired at an angle to the trajectory, accelerating the package relative to the moon and slowing it down relative to the earth. Eight vernier rockets also are attached to the terminal stage to be fired as needed to correct velocity. All eight were fired in this launch to gain as much velocity as possible.

After verniers separate, package weighs 75.3 lb. After burnout of the Thiokol rocket, which was not accomplished in this case, weight would be 51.1 lb. Instrument package weight is 39.6 lb. Construction is Fiberglas honeycomb between Fiberglas skins. Diameter is 29 in., depth is 18 in. Center section band, where instruments are attached, is six in. wide, and slant surfaces on top and bottom are 12 in. wide.

Double antennas 16 in. long and $\frac{3}{8}$ in. in diameter emerge from the flat section of the payload. Instruments included a magnetometer capable of measuring moon's magnetic field to a minimum of 5 microgauss; ion chamber capable of measuring radiation intensity up to more than 1,000 roentgens/hr.; microphone for measuring micrometeorite impact; temperature-variable resistors to measure temperature inside the package through the life of the batteries; infrared-television scanner for taking facsimiles to a resolution of 1 milliradian.

Lifetimes of the measurements if the payload had achieved the hoped-for orbit of within 40,000 mi. from the moon would have been intermittent operation for three complete orbits for the scanner; about 10 days for the temperature sensors; about 4 days of continuous operation for the 63-transistor Doppler command receiver.

gravitational pull. Actual velocity after burnout of the first three stages was about 34,425 fps. at 480 sec. after launch, all eight vernier rockets on the final payload stage were fired by a signal from Cape Canaveral in an attempt to increase velocity. This gained about 160 fps., far short of that needed to send the Pioneer to the moon on its less desirable trajectory.

Ten seconds of burning time in the second stage engine went unused because there was no ground command control to override the precision accelerometer cutoff. Command control will be included in the next probe. Use of the remaining burning time would have provided up to 1,500 fps. more velocity—probably enough to correct the trajectory sufficiently to put the satellite into the moon's gravitational field if it could have been controlled well enough and certainly enough thrust would have been available to carry it farther than the 79,212 mi. initially announced as apogee. Speed at the farthest point was approximately 1,118 mph.

A few hours after launching, calculations indicated that apogee might be between 90,000 and 100,000 mi., and that if the terminal rocket in the fourth stage could be fired precisely at apogee, an eliptical orbit with a perigee of 20,000 mi. or more might be achieved.

Temperature Drop

A number of attempts were made to fire the rocket by command signal, both from Cape Canaveral and from an STL station near Naalehu, Hawaii.

Because the temperature inside the satellite was dependent upon its orientation to the sun and to controlling paint decals inside the payload, the incorrect trajectory allowed the temperature to drop from the 71F at takeoff to 35F, and batteries in the satellite would not provide enough current to obey the command signals. Batteries will operate at 40F and probably would have at 37F. Decals controlling the entrance of heat into the payload casing are arranged differently for each firing.

The Hawaii station "saw" the Pioneer plunge into the atmosphere over the South Pacific at 11:46 p.m. EST Oct. 12, to be destroyed by friction.

Pioneer's radiation measurements indicate a band with maximum intensity at 5,000 to 6,000 mi., tapering off to about one tenth that intensity at 60,000 mi. The one-half roentgen measured at 60,000 mi. is about twice the maximum safe weekly dosage recommended by Atomic Energy Commission.

Early findings tend to support the theory advanced by Dr. Fred Singer (AW Sept. 1, p. 21) of the University of Maryland. Singer believes the rays are neutrons produced by cosmic ray bombardment of the earth's atmosphere, and trapped by earth's magnetic field.

Singer had predicted maximum intensity at about 6,000 mi. altitude.

Because Pioneer uses a different type of radiation measuring device than the Explorers, it will be impossible to make direct comparisons, although some correlation is possible.

Both the Geiger counters carried by Explorers and the ion chamber carried by Pioneer measure radiation by means of the ionization it produces in a gas. But the Geiger counter produces an output pulse for every radiation particle, whereas the ion chamber output represents the average level of ionization produced at any instant by all impinging radiation. Whereas any radiation particle that penetrates the Geiger counter produces an identical output signal, in an ion chamber the low-energy, slow-moving particles produce more ionization than a high-energy, fast-moving particle.

In this respect, the ion chamber gives an indication of the biological hazard involved since lower-energy particles can destroy more tissue than high energy particles. Ion chamber also can operate over a wide range of radiation intensities (million to one), and was selected for Pioneer to assure that it would not be swamped in event radiation intensity continued to increase with altitude.

Future space probes will be outfitted with other types of radiation instrumentation in order to track down type of particles involved, their energy levels, and direction of movement—an indication of their possible source. Two or three identical radiation counters will be mounted, mutually perpendicular, to establish direction of movement of the radiation.

International Space Unit Urged

By Ford Eastman

Washington—Creation of an international organization initiated and supported by the U.S. to encourage cooperation in space exploration is being urged by the staff of the House Space Committee in a report released today.

Need and desirability of such an organization was outlined in the report as part of a suggested seven-point program forwarded to the House Select Committee on Astronautics and Space Exploration for submission to Congress. The report also recommended that the proposed program be implemented by the new National Aeronautics and Space Administration.

The report said the U.S. should accept leadership of the international space effort during its infancy. It added that the Soviet Union should be extended an invitation to join in the cooperative effort, but that the free world should not hesitate in moving ahead to create an international partnership regardless of the Soviet position.

Staff recommendations are:

• **"That the new space agency** (NASA) consider establishing some form of permanent liaison facilities devoted to the encouragement of cooperative arrangements with other countries.

• **"That the agency strive to catalog** on a comprehensive scale the work projects and talents of both teams and individuals . . . where a desire to cooperate in the peaceful development of space technology has been demonstrated.

• **"That the agency consider** the establishment in this country of facilities for the evaluation of foreign proposals to assure the fullest benefits from the Free World effort.

• **"That the agency use the authority** granted it by law to contract with public and private groups, overseas as well as in the U.S. to carry on studies and actual construction of components or to perform other operational tasks.

• **"That specific plans be developed** for the exchange of scientific personnel among those countries willing to cooperate in a common effort.

• **"That there be an expansion** of training facilities in the space sciences required to meet growing needs for scientists and technicians as the American program for the peaceful use of space develops. Such plans include opportunities for foreign students to compete for fellowships. As talented students of all countries decide on careers in the space sciences, the U.S. and not the Soviet Union should be the place to which they will turn for training. Congress may wish at its next session to implement such a plan.

• **"That Congress and the President** give continued encouragement and financial help to the work of the International Geophysical Year. The IGY has been too beneficial to the scientists of the world and the cause of good political relations to be allowed to expire with the end of 1958. Some progress has already been made by the scientific community in carrying this work into the future, but government aid might prove invaluable."

Each step, the report said, is a necessary step toward working out an international approach to the space effort but that, by themselves, they are merely stopgaps.

"These steps," the report said, "will only realize their maximum effectiveness if they are taken in the context of a new international astronautical organization, initiated and supported by the U.S. with the cooperation and contributions—both in personnel and material resources—of nations like Britain, France, Germany and Japan whose scientists have already demonstrated their ability in this field."

Governmental interest in this body, the report added, should be made explicit, although it should be clearly stated that the resources of the organization are readily available to help any scientist of competence regardless of nationality, as well as to foster the development of promising scientific talent in this field regardless of national origins. The governing council, it said, should be composed of representatives of participant governments, as well as representatives of scientific organizations.

The space committee staff said that such an organization would undoubtedly extend its scope of endeavor further than that possible through the coordinated space research activities of the International Council of Scientific Unions (see p. 49). It would, however, incorporate the aims of the council and integrate the work in international space cooperation already accomplished by the council.

Regarding Soviet participation, the committee staff said the USSR already has made such progress in space science that it now exhibits a certain scorn for what others can do. It added that Russia sees only limited reason for cooperating in those areas which can pay off in military strength or promise opportunity for spectacular developments politically useful in shaping world opinion.

"Whether the Soviet Union would be willing from the outset to become a full-fledged partner, opening its own research centers to world scientists, is very uncertain," the report said.

The staff also said that both the governments and industry in Western Europe have shied away from space technology, apparently in many cases because the expenditures involved are too great. Individual scientists and technicians, on the other hand, are eager to take a more active part.

Actually, the staff reported, work is under way in Europe that could be of great benefit if coordinated. Much of this work, it added, is hampered by lack of equipment or financial support. In addition, it said, limitations on the exchange of data also have led to retracing the ground already covered by the U. S. or Soviet Union.

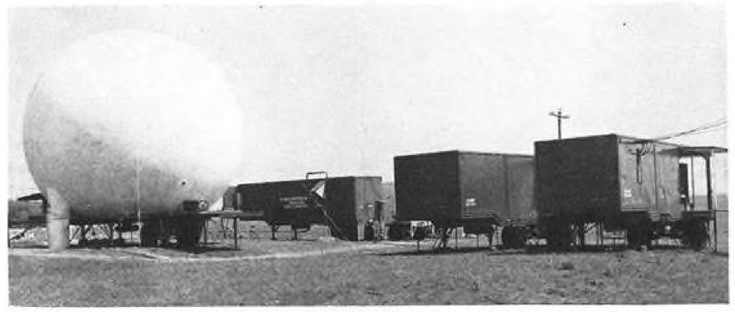
The report said that, while there appears to be a growing disposition on the part of foreign scientists to work on the space effort under U. S. auspices, there also is a certain reluctance on the part of some. U.S. insistence on watertight security in scientific matters, some of which may only be remotely concerned with military interest, has become an object of wide criticism, it added.

Three-Dimensional Radar Demonstrated

Washington—New three-dimension surveillance radar that provides information on target height as well as bearing and range using an electronic vertical scanning technique was unveiled here last week by Hughes Aircraft Co. and Army Signal Corps.

The new radar was demonstrated in a mobile version that Army is service testing for use with Missile Monitor, a mobile field Army air defense system for assigning targets to individual Nike and Hawk batteries. Radar, originally developed by Hughes under Navy sponsorship, also is scheduled for use on new guided missile cruisers. Airways Modernization Board also has indicated a desire to test a three dimensional radar in the terminal area to evaluate its usefulness.

In the past, two separate radars have been used to obtain target azimuth, range and height information, with one antenna rotating in azimuth while the other nodded up and down in elevation. In the Hughes frequency scanning radar, or Frescanar as it is called, the antenna rotates only in azimuth while its beam is simultaneously caused to sweep up and down by a variation in the frequency of the radar transmitter.



ARMY'S MPS-23 three-dimensional mobile radar system developed and manufactured by Hughes Aircraft Co. includes plastic radome (left) housing 15-ton antenna which transmits to radar van on its right. Trailers at right house diesel generators; one is kept as standby.



TARGET RANGE and bearing are displayed on left scope; altitude on right scope. Three-dimensional system requires only one antenna and one master console. Antenna rotates only in azimuth while beam is swept up and down by variation in transmitter frequency.

The antenna dish is illuminated by a series of individual sources of radar energy located in a vertical "fin" which protrudes from the center of the dish. Rapid variation of the radar transmitter frequency causes a change in the relative phase of energy at each source, causing the resulting radar beam to sweep back and forth in a vertical plane.

Use of this electronic scanning technique permits the beam to sweep at a vertical speed of "several thousand degrees per second," very much faster than would be possible if the antenna structure itself had to be oscillated to perform the beam deflection, according to Dr. N. A. Begovich, director of engineering for Hughes' Ground Systems Group.

The rapid vertical scan permits use of a pencil beam instead of the broad secant-squared beam required with conventional two dimensional surveillance radars in order to obtain coverage from low to high altitudes.

Increased concentration of radar energy in the pencil beam gives Frescanar 20 to 50% more range than a conventional 2-D surveillance radar, according to Begovich. Voltage tunable klystrons are used to power the radar transmitter, and relatively low-noise voltage tunable traveling wave tubes are employed in the radar receiver.

Army's version of Frescanar is installed on four trailers. Two of the trailers contain diesel power generators, one for standby. The antenna itself is quickly erected on its own trailer, then enclosed in an air-inflated balloon to protect it from the elements. Fourth trailer contains the radar equipment and two consoles, one of which is a conventional plan position indicator (PPI) that displays targets in azimuth and range coordinates; the other is a range-height indicator.

By setting an electronic cursor on any desired target displayed on scope, the operator can read off its altitude, range and bearing on digital counters.

For use with Army's Nike-Hawk batteries, data on each target's bearing, range and height will be converted to digital form, then transmitted to weapons monitoring center, battalion operations centers and weapons battery terminal equipment, all part of the Missile Monitor.

Several other radar manufacturers are known to be developing three dimensional radars employing electronic scanning techniques.



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Operating speed: 0.3 inches per second at 3300 lbs. load on 28 volts DC.
Weight: 12 pounds 6 ounces.
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2. Adjustable load limit switches.
3. Non-jamming end stops.
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Ballistics is making good use of the ductility, toughness, and very low densities achieved by alloying lithium with magnesium and aluminum. In gages under 1" it has proved to be effective as armor plate, absorbing energy and preventing fragmentation. More important, 1" of magnesium-lithium-aluminum alloy can replace ¼" steel—yet is ⅓ lighter. Dow Chemical's interest in the cubic structure of magnesium-lithium alloy led to modifying the basic binary system by the addition of a third element—aluminum—producing a very high strength-to-weight ratio.

ALCOA — ALUMINUM COMPANY OF AMERICA

Jet aircraft traveling 1600 mph at operating altitudes develop "skin" temperatures of approximately 350° F. Conventional aluminum alloys employed in aircraft construction begin to lose physical properties in the 250-350° F. range, limiting their usefulness to speeds below 1300 mph. Stainless steel and titanium are alternate solutions but add immensely to cost and weight of airframe structures. Alcoa's new X2020 aircraft alloy utilizes the rare-earth element lithium to push ahead the thermal barrier in supersonic aircraft by about 100° F. Not only does it serve to maintain aluminum's strength at high temperatures, but this aluminum-lithium alloy is 3% lighter and has 8% greater modulus of elasticity which adds to structural stiffness.

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United Forms Research Corp.

East Hartford, Conn.—United Aircraft Corp. expanded its operations on two widely separated fronts last week to create a new research organization in California and a helicopter manufacturing facility in West Germany.

Details on these projects include:

• **United Research Corp.** was formed as a wholly owned subsidiary of United Aircraft Corp., with Lt. Gen. Donald L. Putt, retired USAF deputy chief of staff for development, as president. Gen. Putt, who was a long-time pioneer in Air Force research and development efforts and is a former commander of the Air Research and Development Command, will establish a small headquarters for United Research Corp. in Menlo Park, Calif., near San Francisco. It will operate primarily on a contract basis with other research organizations with the assistance of a five-man scientific advisory board.

• **Inside track on the German** Army helicopter procurement program for United's Sikorsky Division was indicated by the corporation's purchase of 43% of the stock of a West German aircraft firm, the Weser Flugzeugbau with headquarters in Bremen. Weser will manufacture and market Sikorsky-designed helicopters and is expected to become a basic German production source. Initial German procurement, probably of S-58s in German Army company size batches of 21, would be from Sikorsky's U.S. plants. Weser was founded in 1934, operates three plants and is rated by German sources as the fourth largest aircraft manufacturing facility in the western zone. This marks the second major stride by Sikorsky designs into the European market. The division previously had a licensing agreement with Westland Aircraft Ltd. in England for manufacture and sale of Sikorsky designs.

Creation of United Aircraft Research Corp. is aimed initially at getting the Pratt & Whitney Aircraft Division and the newly-created Missiles and Space Systems Division into the field of high-energy fuel developments required for missile and space vehicle propulsions systems.

William P. Gwinn, United Aircraft president and also chairman of the new subsidiary corporation, said its first effort would be support on a contract basis of advanced propellant research by the Stanford Research Institute. Gwinn emphasized that the contract with Stanford is only the first of a series of similar specific agreements being planned with research institutes, and indications are strong that these agreements will extend to foreign organizations.

Gen. Putt also will serve as assistant director of research for United Aircraft Corp., John Lee, research director for UAC, will serve as a director of the new corporation along with Gwinn, Perry W. Pratt, UAC chief scientist, and William Robbins, United controller. Officers in addition to Gen. Putt and Gwinn will include: vice president, Wright Parkins, who is also vice president of UAC's missiles and space division; treasurer, Donald Culver, and secretary, Charles Chatfield, also UAC secretary.

The scientific advisory board will consist of:

• **Dr. Richard C. Soderberg,** dean of engineering at Massachusetts Institute of Technology who has long been associated with United in consulting capacities.

• **Dr. Guyford Stever,** Soderberg's assistant at M.I.T. and former Air Force chief scientist.

• **Dr. Isador Rabi,** of Columbia University, 1944 Nobel Prize winner in physics.

• **Dr. Bernard Lewis,** of Combustions and Explosives Research Inc., Pittsburgh, Pa.

• **Dr. Allan Kline,** nuclear physicist and patent attorney and president of Sierra Metals Corp.

ARDC Consolidates Research Management

Washington—Air Force consolidated its basic and applied research work last week under the direction of a single commander in an effort to improve the planning and coordination of the complete program and to give research increased stature in the over-all research and development picture.

Air Research and Development Command altered its management establishment and appointed Maj. Gen. Leighton I. Davis Deputy Commander for Research.

Along with the creation of this new post to give greater attention to research problems, ARDC discontinued the Office of Deputy Commander for Research and Development which Davis had headed. Direction of development programs will continue to come primarily from the project organizations established to handle each weapon.

Establishment of a Deputy Commander for Research was recommended by the ad hoc Stever Committee of the USAF Scientific Advisory Board in its report on Air Force research and development management published last summer (AW July 14, p. 29). Officials at ARDC headquarters indicated last week, however, that the Stever recommendation was not the sole impetus behind the creation of the new office and that a move of this type had been under consideration for some time.

Exact organization and function of the Office of Deputy Commander for Research as presently planned does not follow the Stever suggestions in several respects. The Stever Committee, for instance, felt strongly that any man made responsible for a specific area of activity should have complete control over the money, facilities and personnel that he needed to carry out his assignment.

In line with this basic principle, the committee recommended that the Deputy Commander for Research should have jurisdiction over many of the Air Force research centers and laboratories. These included the Air Force Office of Scientific Research, the Aeronautical Research Laboratory of the Wright Air Development Center and the Brussels' office of the ARDC.

As the situation now exists, these facilities with their personnel, like all others in the Air Force, stay under a center commander who reports to the commanding general of ARDC. The new research head only has cognizance over the various research programs, monitoring and coordinating them.

The Stever Committee also recommended that the Office of the Deputy Commander for Research should be oriented toward civilian leadership and not be made to conform with the normal military command formula. To date, two chief assistants to the research head have been named. They are Brig. Gen. Ralph L. Wassell, commander of the Applied Research Division, and Col. Lester M. Taylor, assistant deputy commander for operations.

News Digest

Entry into military liaison and business aircraft markets is planned by Kellett Aircraft Corp., Willow Grove, Pa., next year with two versions of the pre-war jump takeoff Kellett KD-1 autogyro. A civil model, named the Volette, would seat four and be slanted toward the Cessna 180 market.

Brig. Gen. H. F. Gregory, commander of the Air Force Office of Scientific Research, Air Research and Development Command, will retire Oct. 31 after 30 years of services. His successor will be Col. Benjamin G. Holzman, assistant deputy commander for research at ARDC headquarters. In another change, Col. Frank N. Moyers, now vice commander of OSR, will become special assistant for policy in the Directorate of Development Planning at ARDC.

Airlines Begin Transition to Jet Aircraft

Largest modernization program in history of U. S. lines calls for capital outlay of $2.8 billion.

By L. L. Doty

Washington—U. S. airlines this week will launch the largest modernization program in their history—a program calling for a capital outlay of more than $2.8 billion and the introduction of 488 turboprop and turbojet aircraft into scheduled service during the next four years.

This capital expenditure program, which will mark the first industry-wide transition from piston engine to turbine engine power, will represent a greater increase over 1957 investment for the airlines than that made by any other major industry. During the next four years, U. S. airlines will spend more money per employe and have already planned more expenditures per dollar of 1957 sales than any other industry except gas and electric utilities.

Beyond the amount the airlines themselves are investing in jet operations is another $220 million that will be spent by allied industries and agencies in ground facilities and other equipment necessary to handle the high-speed aircraft. In all, a total of $3 billion will be expended during the next four years to bring turbine power to U. S. airways.

This large-scale program, with more than five years of intensive research, planning and development behind it, will begin Sunday when Pan American introduces the first of its Boeing 707 turbojet transports on North Atlantic routes, and Jan. 11 when American Airlines begins the first jet transcontinental service with the same model.

By the end of 1959, six domestic trunklines will be operating turbojet equipment. All 12 trunklines are planning to place either turboprop or turbojet equipment in active service on all major routes during 1960.

Airline Challenge

Within the airline industry, there is a general optimism that the ambitious program will materialize as planned despite the obstacles already evident even in this early stage of transition. This optimism, however, is tempered by a growing concern among more than a few airline officials and outside observers that certain phases of the program are not economically realistic nor technically practicable at this time.

The most pessimistic of this group see sweeping changes in the present structure of the airline system unless stringent measures are taken to counteract the problems jet service will create. Some have gone so far as to suggest that mergers or even bankruptcies are not unlikely and one top-level official told Aviation Week that it is possible three of the 12 trunklines now holding franchises may be out of the airline picture within the next four years.

How successful the airlines will be in meeting this challenge is, of course, pure conjecture. However, this much is known:

The airlines already have been forced to make revolutionary breaks from traditional operating procedures to meet the high cost of jet service. Even further and more drastic changes will be necessary if the industry is going to be asked to juggle with the anomalous task of dovetailing jet operations into the regulatory pattern set for piston engine service by the Civil Aeronautics Board.

Lease Expansion

Lease of aircraft and engines, interchange of equipment, farming out of maintenance and overhaul work are either planned or being talked about and most observers look to a broad expansion of such programs as more turbine planes are introduced.

Generally, the Civil Aeronautics Board has been singled out by the industry and Wall Street as the largest stumbling block to moving into jet operations easily and efficiently. Such criticism is based upon the Board's failure to recognize the need for fare adjustments to bolster the industry's flagging revenues and the agency's insistence upon imposing "excessive" competition within the present route structure.

Whatever the cause, the fact remains that the financial health of the industry is not as strong as it might be. Expenses continue to climb, rate of revenue growth has fallen sharply during the past 12 months, and profits of the industry are headed for a new low.

Already, two airlines—Delta and National—have been forced to cut back on their initial orders for Douglas DC-8 turbojet transports well before the aircraft moved onto the manufacturer's production line.

Several airlines have been unable to obtain satisfactory long-term financing to back their orders. All but a few of those carriers that have completed long-term financing are relying heavily upon retained earnings, a dismal prospect in view of the current profit squeeze, and funds from the sale of old equipment, an unpromising money source in a dwindling used-plane market—two significant means of filling out their total financial requirements.

Complex Problems

Beyond the financing of the jet equipment are other problems, equally as complex, which face the airlines in their drive to make a smooth transition to turbine power. These include:

• **Declining rate of traffic growth.** During the latter part of 1957, and thus far in 1958, passenger traffic has fallen far short of its historic growth pattern. A rapid increase in available seat miles can be expected if the proposed fleets of the trunkline carriers are operated at peak efficiency. Failure to generate sufficient traffic—or maintain a normal 10-13% annual rate of traffic growth—to fill these seats can only depress load factors and boost utilization costs.

• **Airlines are warning that** Civil Aeronautics Board's failure to approve Continental Airlines' recent "package" tariff request may suggest the Board does not intend to recognize Dr. Paul Cherington's report to the White House as a guide in rate making. Cherington pointedly noted in the report that ". . . it is possible that some increase in first-class fares would leave the carriers in a better revenue and earnings position." He added that there is "ample opportunity" to introduce additional promotional fares at reduced rates. The Continental fare petition, according to most observers, followed these recommendations to the letter.

• **Air traffic control problems** are still unresolved, will become intensified as turbojets are introduced in present traffic patterns keyed to the slower piston-engine aircraft. The newly organized Federal Aviation Agency, to be implemented Jan. 1 with Elwood Quesada as its administrator, is looked upon by the industry as the key solution to the problem, but no airline official is expecting a miraculous, overnight cure to the over-crowded airways situation.

• **Airport development is lagging** behind the development of aircraft. Only a limited number of airports will accept the larger turbojets; the nation's capital, for example, will be served by the Baltimore airport until the new Chantilly, Va., airport is available in 1960 to handle the large aircraft for Washington traffic. On a smaller scale, Trans-Texas Airways has pointed out it would "have to forfeit a large percentage of total passengers" now handled if the carrier operated the turboprop Fairchild F-27 transport "because many of the airports served by Trans-Texas cannot accommodate aircraft larger than a . . . Douglas DC-3."

• **Ground facilities costs** are looming higher than originally estimated because of the immediate need for re-tooling and newly designed plants. Delta Air Lines, for example, is investing $10 million in a new jet overhaul base at Atlanta scheduled for completion in 1959. United Air Lines is expanding its maintenance facilities at San Francisco at an estimated cost of $12 million. Pan American has moved into a new $15 million facility at New York and is constructing an $8 million passenger terminal for its New York International Airport traffic. Total ground facilities now on order or planned by U. S. airlines total $247 million and probably will climb higher as the jet program is expanded.

Immediate Need

The immediate need of the airlines, however, is to accept delivery on and pay for the new turbojets and turboprops as now scheduled if the modernization program is to meet any kind of a test. As Dr. Cherington pointed out in his report, the ability of the industry to carry out this program is not only of interest to the airlines but is "of concern" to the engine and aircraft manufacturers, the government and the economy as a whole.

Dr. Cherington said manufacturers stand "to suffer serious financial losses if the airlines' present and contemplated purchases are not consummated." He pointed out that the government has a "direct stake in the maintenance of healthy economic conditions of the airline industry . . ." and emphasized the effect the loss of private investment and employment would have on the general economy if the modernization program were to fail.

As a first step toward launching the program, the trunkline carriers generally plan to raise initial funds for their jet equipment from five principal sources: long-term borrowing, new equity capital, retained earnings, depreciation and the sale of old equipment.

Several attempts already have been made to dispose of piston engine equipment but very little success has been realized because of a growing softness in the used-plane market first reported by Aviation Week (AW July 7, p. 26). At least two carriers—United and Northwest—have persuaded Douglas and Lockheed to accept piston-engine equipment as trade-ins on turbine aircraft but the trend is not likely to be general, particularly if the manufacturers are no more successful in selling the old planes than the airlines have been.

At present, there is a market for piston engine aircraft, but it is expected to be fully saturated within the next four years as more surplus planes are offered for sale. However, even today, most carriers are having difficulty finding customers who are willing to pay the asking price.

A case in point, is a report submitted by Northeast Airlines earlier this year during the Civil Aeronautics Board's General Passenger Fare Investigation. At that time, Northeast was looking for surplus equipment but received no offers that the carrier considered adequate for its needs.

Offer Rejected

The carrier first turned down an offer from American Airlines to buy five DC-7s and similarly rejected an offer to lease the same five aircraft for five years because the aggregate rental fees would exceed purchase price. Subsequent bids from Riddle, Los Angeles Airways, Alaskan Airlines and Slick were considered to be "excessive" and the airline reported it received one offer for a DC-6A at a $300,000 markup over the original purchase price.

An offer from Seaboard and Western to lease a fleet of Lockheed 1049s operated by Seaboard and Western crews was turned down because Northeast figured cost per mile would call for a break-even load factor in excess of 70%. The airline also decided against an offer of Northwest Airlines to buy the latter's entire fleet of Boeing 377 Stratocruisers with Northwest buying three of Northeast's DC-6Bs.

Closely tied-in to the problem of selling used aircraft in raising funds for the



American Airlines' First 707 Flies

American Airlines' first Boeing 707 jet transport, shown taking off on its maiden flight at Seattle, will begin scheduled service Jan. 11 between New York City and Los Angeles. American has 25 of the Boeing 707s on order, several of which are on final production line. New York-Los Angeles service will be extended between New York and San Francisco on Jan. 25; by mid-summer of 1959, the airline plans 707 service in Dallas, Boston, Baltimore and Washington, D. C., with service to the latter from Baltimore Friendship Airport.

purchase of new equipment is a Civil Aeronautics Board formula for figuring depreciation. The Board's ruling that a seven-year, straight-line service life with a 15% residual value will apply on all aircraft has drawn protests from a number of airlines who want to see more flexibility and more management decision in determining depreciation rates.

American Airlines has admitted that, when it ordered its DC-7s, it did not expect that commercial jets would be available at such an early date as 1958. However, since implementation of jet transports has necessitated a quick turnover of piston engine equipment, the carrier says it cannot be held to a fixed depreciation formula.

American has estimated that a seven-year service life would increase its "exposure to retirement loss" on its piston engine aircraft by over $17.8 million.

In supporting its position that managerial decision should fix depreciation rates, American points out that its fleet of DC-6Bs were originally entered on the books with a five-year service life with a 10% residual value. In 1954, after experience had indicated the aircraft would remain in scheduled operation longer than expected, depreciation life was raised to seven years.

In another case, American's 25 DC-7s acquired in 1953 and 1954 were given a seven-year depreciation life. However, the 33 DC-7s delivered between 1956 and 1958 were depreciated on a four-to-five year life basis in order to establish a common retirement date of 1961 for the entire fleet, the date American expects its DC-7s to be superceded by jet transports.

Profit Decline

Most financial observers are not optimistic over the industry's ability to raise funds for the purchase of jet equipment from retained earnings and, at the same time, maintain a dividend program. Earnings have declined substantially since mid-1956, and this year profits may hit an eight-year low unless a sizable upsurge in the volume of traffic is reported for the last quarter of 1958.

Within the last two years, three carriers have eliminated cash dividends, and one large carrier made a large cut in the amount of its dividends in 1957. The problem was poignantly stated to the Civil Aeronautics Board by Northwest Airlines during the fare investigation when the airline noted that, after 30 years of operation, net worth of the company was only $33 million as of December, 1957. It compared this amount with the estimated peak loan requirement of $80 million it anticipates by 1961.

The airline said that, although it had paid a 20 cent quarterly dividend on common stock since 1955, shareholders were without any dividend for eight years—from 1947 to 1954. In emphasizing its "formidable financing problem," it pointed to a debt-equity relationship which restricted the total credit line in planning for long-term borrowing.

Although a number of airlines have completed arrangements for long-term financing of the jet equipment, the industry still requires more than $700 million in financing that has not yet been arranged.

For example, Braniff Airways told the Board it had commitments for five Boeing 707-227 transports powered with Pratt & Whitney JT4A turbojets at a total cost of $31.8 million and nine Lockheed Electras at a cost of $23 million. The company's long-term financing consists of $35 million plus an optional $5 million principle amount of 4¾% Equipment Mortgage Sinking Fund bonds underwritten by seven insurance companies.

Even for those carriers that have completed long-term financing, there is no guarantee that the money will be available to the airlines when it is needed because of the covenants that are incorporated into most agreements.

For example, United Air Lines has arranged with three insurance companies for $120 million of Series D Debentures.

Covenants of the loan agreement require that there will be no adverse changes in the business properties or financial condition of the company if the loan is to be consummated. These covenants also require the airline to maintain an asset ratio that would not prevent the airline from undertaking contractual obligations or from paying dividends and further specify that failure to maintain asset ratios above 100% constitutes "default" at which time all debentures are due and payable.

A bank credit of $130 million with 37 banks has a similar asset ratio restriction plus a condition that limits total debt of the company to a figure of one and three-fourths times net worth up to Dec. 31, 1962, and to one and one-half times net worth after that date.

Delta Air Lines told the Board it will require $95 million through June, 1961, during testimony at the Civil Aeronautics Board. At that time, it estimated it would realize $13 million from the sale of equipment and will get $62 million by depreciation, deferred income taxes, sale of equipment and amortization of deferred charges.

Delta has not completed its long-term financing program and has placed on option two of the eight DC-8s it has on order. Other airlines reportedly not finished with all financing plans are Trans World Airlines, Northeast, Capital, Continental, National and Northwest.

Airlines that actually have canceled orders for turbine aircraft are National—three DC-8s; Capital—15 Vickers Viscounts, and Northeast—five Bristol Britannias.

Fear is being expressed generally within the industry and among investors that the financial problems of the airlines are being compounded rather than simplified because of the Civil Aeronautics Board's failure to work out an economic relationship between jet operations and the airline route structure.

Traffic Dilution

Most carriers are protesting that heavy competition built up by the Board on high density traffic routes is diluting traffic available to the individual airlines. However, as one Wall Street analyst recently pointed out, the carriers themselves have never turned down an opportunity to open a new route but, to the contrary, have fought hard to win new route awards.

Nevertheless, the Board has no legal right to withdraw routes from any scheduled airline, either by encouraging mergers or by actually rescinding a certificate of convenience and necessity. As a result, the heavy competition fostered by the Board may by itself take a heavy toll in airline operations as carriers are faced with an increasing problem of underwriting the modernization program which also has the Board's blessings.

Meanwhile, as Dr. Cherington pointed out in his report, there is no study under way by any government agency to find an economical route structure that will permit jet transports to offer the best service to the public at a profit to the airline industry.

"Such a study would appear to be highly desirable at the present juncture," Dr. Cherington concluded.

CAB to Investigate Stock-Lease Plan

Washington—Civil Aeronautics Board last week asserted its authority over the Pan American-National Airlines stock exchange and equipment lease proposal (AW Sept. 29, p. 30) and ordered an immediate investigation of the much debated plan.

The Board, however, indicated that it might approve the lease of Boeing 707-121 jet transports by Pan American to National for the next two winter seasons beginning Dec. 10 if the carriers offer assurances that they will not carry out the stock exchange or option provisions of the agreement pending completion of the investigation.

In addition, the CAB stipulated that a decision on the short-term lease also was dependent upon the proviso that neither airline operate through service between points on the other's routes.

In a review of the agreement, the Board discussed objections raised by Eastern, Northeast, Braniff and Delta Air Lines, which it named as intervenors and directed the parties to show cause, by today, why the CAB should not issue a restraining order against Pan American and National to preserve the status quo until further Board order and prevent the carriers from carrying out the stock and long-term lease phases of their proposal.

Taking a firm stand on the question of their jurisdiction over the proposal, Board members observed that provisions of the agreement, if carried out prior to a notice and hearing by the CAB, could violate several parts of Section 408 of the Civil Aeronautics Act and result in a "serious frustration of the Board's regulatory powers" as well as injury to the public interest and other carriers.

Long-term mutual lease Boeing 707 and DC-8 jet transports between the carriers from 1960 to 1970 was questioned by the Board because of the large sums of money involved and the wording of the agreement which makes possible an "open-end" clause with respect to the number of planes that could be leased.

Although Pan American and National contend that the proposal involves only two aircraft, the CAB said the "open-end" wording could result in eventual use of more planes, possibly constituting a substantial part of either carrier's fleet.

In light of this possibility, the Board said the long-term lease could come under Section 408 requiring prior Civil Aeronautics Board approval.

In particular, the Board scored the possibility of Pan American's possible control of National by means of an exchange of 400,000 shares of stock and a later option for the purchase of 250,000 more.

Acquisition of 650,000 shares of National stock by Pan American would give the latter carrier 36% of National's outstanding stock, a procedure that requires prior approval of the Board.

Beyond the question of control, the CAB members said they feared the effect the agreement might have on competitors in the New York-Florida market, as well as the Miami-Havana market, and the opportunity that the proposal would offer to intensify competition with Braniff and Delta in the Latin American service.

The Board discounted a stand taken by Pan American and National that placing of the stock in the hands of a trustee for an eight-year period would lessen the danger of control, even though the parties later amended their agreement to place the shares in trust at the express direction of the Civil Aeronautics Board.

Labeling the move an attempt to escape Board jurisdiction, the CAB said that, while Pan American could not vote the stock held in trust, the carrier's powerful influence as the largest stockholder in National, could cause adoption or defeat of any proposal placed before National stockholders.

Refusing to concede that it would lack legal power to force a return to the status quo, if the three-part agreement were carried out without its approval, the Board pointed out that it "need not permit the creation of a situation in which it could face recalcitrant carriers and a possible court test of its power when it has the alternative of ordering the preservation of the status quo."

Jets Demand Unprecedented Utilization

By J. S. Butz, Jr.

Miami Beach, Fla.—U.S. airlines must keep their new jet transports in the air an unprecedented percentage of the time if the aircraft are to become an economic success.

Airlines and the aircraft manufacturers estimated that the large turbojet transports will have to be operated between 10 and 11 hr. per day if they are to make money. This figure corresponds to present utilization rates of about nine hours per day for the Douglas DC-7 and approximately eight hours for the DC-6.

Economics of jet operation are such that one Douglas DC-8 jet transport on the ground with mechanical trouble is roughly equivalent to three DC-6s out of service as far as earning capacity for the airline is concerned. It also is roughly equal to five DC-6s in capital investment.

Spread Overhauls

To meet this demand for more time in the air and more regularity of service, airline maintenance officials and the aircraft manufacturers have devised programs which spread overhauls out to the point where aircraft probably will not be in a shop for scheduled maintenance for more than eight to 10 hr. at any one time. This continuous maintenance system has evolved gradually from the early days of the DC-3 in the 1930s when a major overhaul required taking an aircraft out of service for 30 to 40 days.

Last formal discussions of maintenance plans before the airlines begin to operate U.S.-built jets in large numbers were held here at the annual Air Transport Assn. Engineering and Maintenance Conference.

U.S. airlines are scheduled to take delivery of 233 turbojet and turboprop aircraft in the next 15 mos., with 53 of them arriving before the end of the year. Preparations to handle this rapid influx of new equipment have been under way for more than a year.

Eastern Plan

Eastern Air Lines, it was reported at the meeting, was the first carrier to complete a continuous maintenance program and have it approved by the Civil Aeronautics Administration. The Eastern overhaul system for the Lockheed Electra calls for the aircraft to be in the shop for no more than eight hours a day except for a two day period every 10,000 hr. when the interior furnishings are removed for a thorough cleaning.

American Airlines also has a continuous maintenance program for the Electra pending before the CAA. Other plans for equipment that will be delivered after the Electra are in the final stages of preparation.

While maintenance groups handling jet aircraft will assume an even greater responsibility for economic airline operation, there appears to be several bright spots in their immediate future. Military experience as reported to the maintenance conference by some of the manufacturers has shown that the jets in many cases require fewer man hours for both line and overhaul maintenance after personnel have completed the initial learning period.

Boeing indicated that line maintenance per day for its KC-95 piston engine tankers is about 28 man hours per day.

However, the KC-135 jet tanker requires only 18 man hours. Boeing estimates that engine line maintenance for jets is 20% lower than that for the reciprocating engines and 50% less for major overhaul.

Engine Accessibility

Engine manufacturers pointed out that the essential simplicity of the jet engine and the accessibility of the vital components will reduce maintenance time with only a few minutes being required for a daily check. Trouble shooting a malfunctioning also is simpler with a jet than with a reciprocating engine.

Jet engine replacement can be effected in about two hours under proper conditions. Some manufacturers expressed the belief that it may not be necessary to reschedule an aircraft if

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Three Pan American 707s Near Service Date

Three Pan American World Airways' Boeing 707-120s are serviced on Boeing Airplane Co.'s preflight line at the company's commercial delivery center, Seattle, Wash. Nearest and furthest 707s have not yet been delivered to PanAm; 707 being serviced in middle was delivered in September. The airline expects to begin transatlantic service with the 707 Oct. 26. B-52 is in background.

it loses an engine on the flight line since it will be possible to change engines so quickly.

Primary problem with turbojet engines as predicted by all manufacturers will be damage from foreign objects. According to military sources and a separate study by Curtiss-Wright Corp., approximately 40% of all premature overhauls of jet engines are due to foreign object damage. Some of these overhauls cost about $35,000.

Primary sources of foreign object damage in the past have been tools, fasteners, bolts, etc., either left in air duct or shaking loose during engine operation. Ingestion of ground debris has been found to be a small source of premature engine overhaul when runways are kept properly cleaned. General Electric reported that, in one Air Force bomber unit that had 180 installed engines, approximately 60 of these were removed in one month due to damage from foreign objects. An intensive education program for the maintenance personnel, with a system for keeping close check on all parts that were removed from the engine in the vicinity of the main engine air inlet, reduced the number of engine removals from 60 to three within one month.

Maintenance of practically all of the systems in a jet transport are similar to the main powerplant in that they require relatively few man hours to maintain. The parts replacement costs, however, are well above those found on piston transports.

To keep parts replacement low, the airlines have been engaged for the past year in extensive training programs for their maintenance personnel. However, the general feeling among the manufacturers and maintenance officials at the ATA conference apparently was that even more training will be necessary if the full economic potential of the jet transport is to be realized.

One example of the problem of costs in switching to the new equipment, as related by American Airlines, was that the a.c. generator in a jet transport costs about $11,000, while the d.c. generator in the current transports is worth around $600. All of the manufacturers felt that one of the big transitions that will have to be made by the airline personnel will be the shift from the d.c. to the a.c. electrical system.

Skin maintenance will be more critical than ever due to the two-fold increase in flight speed with the new transports. Dented and gouged skin could cause major increases in fuel consumption due to increased drag at 550-600 mph.

Several committees that were established by the Air Transport Assn. to conduct special studies made reports.

One of the committees is developing a universal system for reporting flight discrepancies and failures that would make use of modern computers to record and analyze the data. The system should be invaluable to airline maintenance personnel by giving them—after a short initial period of operation with new equipment—a day-by-day estimate of the parts that they will have to replace and the work they can expect.

It also will give the aircraft manufacturers a source they do not now have for analyzing the fatigue properties of the components in their aircraft.

Another of the ATA committees is working on other improvements in the maintenance planning procedures that are now available to the airlines. This committee also is centering its work around the use of digital computers. The main problem is to take the great effort required to give an aircraft a major overhaul and to break it down into approximately eight-hour segments so that the most economical use of men and material is achieved. The planning effort naturally varies with each airline according to its peculiarities of route structure, equipment, etc.

American's Earnings

Washington—American Airlines last week reported third quarter net earnings of $13,324,797 after taxes on total revenues of $238 million as compared with $10.1 million for the same period of 1957.

Heavy gain in the carrier's earnings reflected a profit of $2.4 million of the sale of equipment along with $3.3 million resulting from a change in its depreciation policy, as directed by the Civil Aeronautics Board, and $700,000 as capitalized interest on deposits held by manufacturers for the purchase of new equipment.

Trunk Carrier Fares

Washington—Civil Aeronautics Board last week indicated approval of domestic trunk carrier plans to eliminate discount fares and reduce family fare plan discounts and permitted a refiling of the tariffs. Airlines can put the adjusted fares into effect as early as today. Cutoff date for implementation under the CAB order is July 31.

The Board's order to suspend and investigate the tariffs carried the added notation that the action was taken with the expectation that the carriers would develop and submit new fares designed to promote additional traffic.



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CAA Objects to Bilateral Idlewild Pact

By Glenn Garrison

New York—National Air Transport Coordinating Committee, and not the Port of New York Authority alone, should make anti-noise rules for jet transport operation at Idlewild Airport, the Civil Aeronautics Administration believes.

Regional CAA Administrator Joseph D. Blatt told AVIATION WEEK that present Port Authority procedures for dealing with jet noise may be setting a restrictive pattern which could lead to intolerable traffic delays. Early stages of the operation, involving only a few Pan American World Airways' Boeing 707s and British Overseas Airways Corp. de Havilland Comet 4s, won't cause much cumulative traffic delay, Blatt said. But with the entry of additional carriers and greater numbers of jets, delays could affect all types of aircraft using the field.

What Blatt objects to is the principle of "bilateral agreements" between the Port Authority and individual airlines for operating specific aircraft. There is already a preferential runway system in use at Idlewild established on an industry-wide basis through NATCC, the CAA official points out. Imposition of another system, and perhaps still others in the future, is bound to create traffic problems.

CAA is "completely sympathetic" to the Port Authority's objectives, Blatt said, "I receive as many complaint letters as John Wiley (Port Authority dirictor of aviation), and will bend every effort to try and reduce noise."

But, the regional administrator added, CAA is not sympathetic to the bilateral method of establishing procedures.

Best way, in Blatt's view, would be development of a single, integrated preferential runway system for all aircraft, piston and jet alike. NATCC, an industry-wide group formed to deal with noise problems, is the proper mechanism for the job, Blatt said.

"We should expect, even demand, that NATCC be given the job," Blatt said. While jet operation at Idlewild was on a test basis, it would have been difficult for NATCC to take over, the CAA official pointed out. But now that the planes are actually in operation, "it specifically becomes an NATCC problem."

Present procedures represent a bilateral agreement as far as BOAC and the Port Authority are concerned, but actually would seem to be unilateral in Pan American's case. The carrier was in effect told by the Port Authority how it was to operate its 707s.

These procedures, Blatt said, even in the early stages will cause some inconvenience to his traffic controllers and will lead to some delays to the jet operator. For example, departure from runway 13R is inconvenient from an air traffic control standpoint because it interferes with pairing of landing and takeoff runways. But if a jet transport pilot requested 13R as his departure runway, in order to comply with the Port Authority jet rules, CAA would accommodate him, Blatt said. It might, however, mean a delay to the departing aircraft.

In any event, safety standpoint clearances will be granted on the basis of safety whether in accordance with the Port Authority rules or not, Blatt said. CAA has no objection from its safety standpoint to procedures called for in the rules regarding flap settings, bank angles, power reductions, and certain turns. But, Blatt said, "to my way of thinking, all these are decisions that can only be made in one place—that is the cockpit of the aircraft. We can't take any authority away from the pilot in this."

No operating agreement, Blatt said, should create a situation which might lead the pilot to abdicate his responsibility in trying to follow the rules.

CAA is not unaware of the noise problem, Blatt said, or "callous toward the neighboring communities. Consistent with safety, CAA will try to cooperate with the Authority. There is no real controversy between Blatt's office and the Port Authority views."

But, the regional administrator added, "We have no desire to police or enforce any bilateral agreement."

In another development, the Port Authority objected to a remark by Elwood P. Quesada, new Federal Aviation Agency administrator, that he hoped authority jet transport restrictions would be lifted (AW Oct. 13, p. 37).

Donald V. Lowe, Authority chairman, in a telegram to President Eisenhower, contended that "General Quesada's comments clearly expressed the reaction of a passenger inside an airplane, and not that of people living just off runways and under the flight path of the jet aircraft." Quesada made his comment after a flight in a Pan American 707.

Lowe said that Austin Tobin, Authority executive director, and John Wiley, director of aviation, attempted to meet with Quesada at International Airport "to advise him fully on the grievous jet aircraft noise problem which has prompted the adoption by our commisisoners of jet aircraft flight restrictions at the airport."

Quesada, however, declined to meet with them. The Port Authority last week wrote BOAC and Pan American that 20 of the first 25 jet takeoffs at Idlewild were made on Runway 25 and 22 overwater. The Authority commended the airlines and the CAA for their cooperation, adding that observations of jet aircraft movements would continue.

Boeing 707 Cleared for London Operations

London—Boeing 707 jet airliner has been provisionally cleared for London Airport landings and takeoffs following noise tests here by the Ministry of Transport and Civil Aviation.

Pan American World Airways is scheduled to start 707 service from New York to London Nov. 16 and from New York to Paris Oct. 26. Procedures will be:

- Takeoff technique "acceptable to the United States Civil Aeronautics Administration" will be employed to reduce ground noise to a minimum and enable the 707 to reach a height of not less than 1,000 ft. over the nearest built-up area along flight path. Ministry noted that PanAm has given assurance that "save on very exceptional occasions, they expect the aircraft to achieve a minimum height of 1,200 ft."
- Aircraft must maintain approach path of at least three degrees, or not below that prescribed for precision approach radar facilities or instrument landing systems for the runway concerned. The Ministry said takeoffs will be "carefully watched" for effects of smoke, since smoke test results made at London Airport have not been completely analyzed.

In New York, a Pan American spokesman said the airline is "exceedingly happy" with the provisional clearance and its terms, which are considerably less stringent and involved than those imposed by the Port of New York Authority at Idlewild.

"The takeoff height restriction," he said, "is 200 ft. better than the Port Authority's." Under an Authority edict, the 707 must reach not less than 1,200 ft. of altitude over any community.

The airline so far has more than 3,000 confirmed seats in advance winter bookings for London, Paris and Rome, for 707 service.

CAB Reviews Qantas' Application

By Robert H. Cook

Washington—Qantas Empire Airways' bid to gain a foothold in the U. S. domestic market is being reviewed by State Department and Civil Aeronautics Board with renewed vigor as a result of diplomatic notes received from the Australian and British embassies, both of them pressing for approval of the airline's application.

Department of State officials recently forwarded both notes to Civil Aeronautics Board Chairman James Durfee, stating that they are "concerned" over implications that the U. S. in past statements of policy may already have committed itself to grant the Qantas application. Requesting a legal interpretation of Section 6(b) of the Air Commerce Act as it would apply to the foreign carrier's filing, State Department said its official position on the application would be offered at a later date for Board consideration.

The Australian carrier seeks authority to carry local traffic between U. S. points on international flights and asks that this right apply even though such traffic is carried from or to the U. S. by another foreign or international airline.

In practice, Qantas specifically asks CAB approval to carry San Francisco-London passengers from San Francisco to New York, where they might connect with another carrier, such as British Overseas Airways, for the final London leg. On a return-through ticket from London, the carrier wants a pick up right in New York, with delivery of the passenger in San Francisco for termination of continuing travel on another airline.

State Department spokesmen say they see little grounds for approval of the Qantas bid, based on the arguments offered by Australia and Great Britain, although the British diplomatic note flatly stated a "hope that the Secretary of State will intervene with the CAB" to obtain a favorable decision.

Pressing the issue still further, the British communication advised that, if the CAB should hand down an adverse decision, "the United Kingdom would have to review its policies as far as the U. S. is concerned."

Backing the claim of its nationally-owned airline, Australia contends that Article 2 of the 1957 bilateral agreement with the U. S. can be interpreted to allow approval of the Qantas request under a "Fifth Freedom" classification. The U. S., it says, "intimated" as much when it answered a 1955 International Civil Aviation Organization questionnaire and indicated agreement that "stop over" privileges at international points would not constitute a "break" in itinerary, which could alter his rights as an international traveller under the freedom classification. In addition, the British note mentions the existence of records dating back to 1946 of conversations between Sir George Cribbett, British officials and James Landis, then chairman of the CAB in which Landis allegedly subscribed to the philosophy now being urged by Qantas.

Crucial issue before the Civil Aeronautics Board is whether the Qantas filing comes under the jurisdiction of a foreign air carrier permit or the hazy principle of cabotage. Literally, cabotage restricts air transportation within a country to its domestic carriers, but attorneys point out that this principle has never been legally clarified.

On this point, the British call attention to the 1946 Bermuda agreement which, they contend, made no provisions for the reservation of cabotage rights to any domestic airlines.

CAB spokesmen readily admit that approval of the Qantas application could result in a flood of similar filings from 14 other foreign carriers authorized to serve 18 pair of U. S. cities on their international routes. Although Qantas and BOAC have transcontinental authority between San Francisco and New York, the Board has attempted to avoid this by awarding two U. S. points on either coast, as opposed to transcontinental rights.

Informed observers, however, point out that this practice does little to hamper foreign competition, should the Qantas application be approved, since the city pairs now served by the other foreign carriers include such heavy market areas as New York-Miami, New York-Chicago, New York-Detroit, Chicago-Miami and New York-Boston.

Gen. Tunner Explains MATS Role

New York—Military Air Transport Service and the commercial airlines are not duplicative or competitive, but are complementary, Lt. Gen. William H. Tunner, MATS commander, said last week at a Wings Club meeting here.

Replying to airline critics of MATS (AW July 14, p. 38), Gen. Tunner said that MATS' real reason for existence is its D-day mission. The civil air fleet is mainly directed toward the passenger market while MATS' fleet consists basically of military cargo aircraft such as the Douglas C-124 and C-133.

Utilizing MATS' airlift capacity to move a portion of Defense Department military personnel and cargo traffic adds little in cost to an operation which must exist in any case, he said, and the remainder of this Defense Department traffic may then be contracted to the commercial carriers.

"The alternative is to fly the MATS fleet empty and contract all peacetime airlift requirements," Gen. Tunner said. "This would produce two immediate results: it would detract appreciably from the value of our training, and it would throw a substantial extra burden on all of us as taxpayers."

MATS must fly a rate in peacetime that will be high enough to allow for quick acceleration in the event of war; at the same time, it cannot be so high as to impose an unnecessary burden on the economy, Tunner said. The rate has been set at six hours per day.

"Six hours do not give us the capability to airlift all military cargo and personnel," Tunner said; "that portion which is beyond our peacetime capability is carried by the commercial airlines under a contract augmentation.

"It was the desire of the Congress . . . that we spend at least $80 million for commercial airlift during the current fiscal year. Actually, we are now buying commercial airlift at a rate that will make the figure about $100 million.

"Whether that rate will continue, of course, remains to be seen."

Contracting by the Defense Department for airlift in support of all military agencies is expected to be about $126 million this year, and the bill for air common carriage about $174 million, for a total of roughly $300 million. This represents 57% of a total of about $530 million for Defense Department airlift business this year, Tunner said.

MATS recently issued invitations to commercial airlines to bid for additional airlift contracts and, in all, some 25 airlines participated in this bidding, according to Tunner. This summer MATS purchased almost $17 million of commercial airlift in support of the Far East and Middle East operations in addition to $6 million already contracted for on fixed contracts, he said.

"We actually drained the commercial airline resources during this operation. We went out with invitations to bid 205 times and came to the point where 10 invitations to bid received no response because no commercial airlines had aircraft that could be made available to us," Tunner said.

"There were a few instances of their pricing their services beyond the realm of practicality—but I assume this was against the background of a rush operation involving call contracts, the most costly form, and premium payments for short notice," Tunner said.

SHORTLINES

► **Flying Tiger Line** reports net income and special items figure of $1,307,782, equal to $1.28 per share on 983,635 shares outstanding common stock, for the fiscal year ending June 30. Revenues for the fiscal year were $33,860,549, up 37% over Fiscal 1957 revenues of $24,651,146. Net income from operations was $1,399,573 compared with a loss of $1,017,450 last year. Flying Tiger also began nonstop air service from New York to Los Angeles and San Francisco on Oct. 13. In addition, the carrier has revised its Boston-Los Angeles service by eliminating a connecting flight at Chicago to provide a direct flight to the West Coast and the elimination of a Chicago stop on the Cleveland-Detroit-Los Angeles flight to provide nonstop services from Detroit to Los Angeles.

► **Northwest Airlines** reports that it flew 131,227,000 revenue passenger miles on its domestic and international routes during September for a 12.6% gain over September, 1957. During the period, the airline carried 140,644 passengers on its domestic routes, an 11% gain over the same period of last year.

► **Pacific Northern Airlines** flew 36,285 passengers during July and August for an increase of 2,784 over the same two months of 1957. Revenue passenger miles totaled 30,137,000 as compared with 29,445,000 last year. Total revenue ton miles showed a 117,000 increase at 3,118,000, and cargo ton miles reached a new high of 661,422 for the carrier. Pacific Northern reports load factor for the two months of 71.2.

► **Pan American World Airways** carried 696,806 lb. of air cargo on its eastbound transatlantic routes during September. This represents a 23% increase over last September's figures of 567,000 lb.

► **Seaboard & Western Airlines** flew 4,275,578 ton miles of transatlantic air freight during the quarter ending Sept. 30, a 68.5% gain over the same period of 1957. The total brings Seaboard's nine month figure for transatlantic air freight to 9,441,707 ton miles, 20.8% increase over the 7,814,609 ton miles carried in the same period of last year.

► **United Air Lines** reports the following September figures: freight, up 31% at 6,701,000 ton miles; 2,428,000 ton miles of air and first class mail, up 6%; 472,162,000 revenue passenger miles, up 2%; express, up 3% at 997,000 ton miles; revenue airplane miles up 4% at 12,280,000.

AIRLINE OBSERVER

► **Watch for Braniff Airways to announce signing of a contract with Allison Division of General Motors covering overhaul of turboprop engines on airline's order of nine Electras. Contract also covers an undisclosed number of spares. Combined with Braniff plans for overhaul of its Pratt & Whitney JT4 turbine engines by Southwest Airmotive, the Allison deal will allow the carrier to eventually retire from the overhaul business.**

► Failure of British aviation manufacturers to produce commercial jet transports comparable to the intercontinental Boeing 707 is being cited by British Overseas Airways Corp. to justify its purchase of American-built aircraft to compete with American international carriers. BOAC has ordered 15 Boeing 707s to fill the gap until British interests can produce a competitive aircraft for this market and recently discounted rumors that it intends to cancel the order. With deliveries scheduled to begin next year, BOAC says the 707s are needed to combat the "formidable" American nonstop competition on the North Atlantic route. The company indicated it is pinning its hopes for a competitive British aircraft on an order for 35 Vickers VC-10 jet transports with delivery scheduled for 1963.

► **Business aircraft flying topped the domestic scheduled airlines by more than one million hours in 1957, according to a general survey by the Civil Aeronautics Administration. Representing a 250% increase since 1947, total flight time for business planes last year reached 4.9 million hours as compared with the scheduled airline total of 3.6 million hours.**

► High cost of new turboprop equipment combined with increased availability of modern piston engine aircraft as a result of jet deliveries to major carriers, is turning many local service carriers to serious study of turboprop conversion plans. Local carriers favor the turboprop aircraft because of its economical operation and flexible flight characteristics, but in some instances, the price tags on the new aircraft are too high. North Central Airlines typifies the thinking of many and is purchasing five Convair 340s from Continental Air Lines. Officials of the local service airline say the aircraft will be delivered from January through July, 1959, and that discussions are under way on the possibility of converting the 340s to turboprops at a later date.

► **Section 408 of the Civil Aeronautics Act governing the question of possible control of one air carrier by another or by an allied aviation industry, is fast becoming the most discussed provision of the act as a result of increasing lease and sale applications filed with the Civil Aeronautics Board. Broad in concept, the section's seven subheads can make or break the plans of any carrier, forcing them to proceed with caution or else arrange agreements to avoid any possible application of Section 408. Most recent example involves engine and propeller lease agreements between American Airlines and the General Motors Corp. GM has established a subsidiary known as Al-Am to independently handle the lease of 162 engines and 150 propellers for American's Electra fleet during the next three years.**

► Noise suppression on commercial jets is proving to be a costly problem. Pan American World Airways estimates that installation and maintenance costs for suppressors on its 23 Boeing 707s will exceed the $2 million mark. Current studies by the carrier indicate a cost of between $75,000 and $100,000 per aircraft with the most expense coming in 1960 when Pan American is scheduled to receive the balance of its Boeing order.

► **Scheduled airlines serving Washington, D. C., found some unexpected and official support last week in their reluctance to transfer 10% of their Washington flights to nearby Baltimore as recommended by a Civil Aeronautics Board examiner in the Washington-Baltimore Adequacy of Service Investigation. Bureau counsel for the Board voiced what carriers have been reluctant to say—Baltimore's close proximity to the capital makes it a poor revenue producer. The Bureau recommended instead that airlines be permitted to retain present service at Washington International but transfer any planned new service for the city to Baltimore, pending completion of a new jet terminal at Chantilly, Va.**



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World Group to Continue IGY Program

By Evert Clark

Washington—First meeting of the new international Committee on Space Research (COSPAR), which will continue coordination of International Geophysical Year space and satellite programs through 1959, is expected to be held in London early next month in conjunction with the Royal Society's space symposium.

Convener of the first meeting, still to be named, is expected to be Dr. Homer E. Newell, Jr., newly-appointed assistant director for basic sciences of the National Aeronautics and Space Administration.

Dr. Newell has been program coordinator for the Vanguard satellite program at Naval Research Laboratory and executive secretary of the Technical Panel on Rocketry of the U. S. National Committee for the IGY.

U. S. delegate to the COSPAR meeting, in addition to Dr. Newell, probably will be Dr. W. A. Noyes, chairman of the international relations field committee of the National Academy of Sciences' new Space Science Board.

COSPAR was formally created here earlier this month at the eighth general assembly of the International Council of Scientific Unions. In the satellite and space field, COSPAR assumes the international coordinating function that has been fulfilled in this and other fields by the international Special Committee for the IGY.

COSPAR was directed by the International Council of Scientific Unions to suggest means for continuing international scientific cooperation on space research beyond 1959, either through continuation of the committee itself or through a new organization.

Strong desire by the scientific community to be certain that political differences do not adversely affect world-wide cooperation in space exploration was a dominant theme at the ICSU assembly.

Both Soviet and U. S. space scientists have long favored an extension of the IGY work. A Soviet proposal to continue the IGY itself, so that no new organization would be needed, was rejected at the IGY assembly in Moscow late last summer.

This desire for cooperation also is evident in the 16-man Space Science Board, which was created by the National Academy of Sciences-National Research Council early in August to act as focal point for all NAS-NRC space research and to coordinate work with the National Aeronautics and Space Administration, the National Science Foundation, the Advanced Research Projects Agency and with foreign groups.

After the IGY ends on Dec. 31, this board will be roughly analogous to the current U. S. National Committee for the IGY. It already has held a number of meetings.

Possibility of joint U. S.-Russian space exploration vehicles is inherent in the task assigned to Dr. Noyes' international relations committee—that of "coordinating with ICSU and national scientific bodies on problems in international sharing of payloads, international cooperation in space activities and advice on the formulation and effects of regulatory policies."

Need for coordination—and cooperation—in space exploration was emphasized at the ICSU meeting by the presentation of a report from the Committee on Contamination by Extra-Terrestrial Exploration (CETEX).

This committee was formed by ICSU last spring on an emergency basis to study and report on the possibility that space probes would contaminate the moon or the planets to such a degree that further scientific exploration would be hampered or impossible.

It was done at a time when Russia already had attempted to impact a rocket on the moon and some U. S. scientists had advocated using dye markers or possibly a nuclear explosion

Space Science Board Organization

Washington—Committees and members of the Space Science Board, created recently by the National Academy of Sciences' National Research Council and chaired by Dr. Lloyd V. Berkner of Associated Universities Inc. are:

- **Geochemistry of Space and Exploration of Moon and Planets—Chairman, Dr. Harold C. Urey, professor of chemistry, University of California. Vice-Chairman, Dr. Harrison S. Brown, professor of geochemistry, California Institute of Technology.**
- **Astronomy and Radio Astronomy—Chairman, Dr. Leo Goldberg, chairman of the Department of Astronomy, University of Michigan.**
- **Future Vehicular Development (beyond vehicles immediately available and including possible space stations and interplanetary vehicles for scientific research)—Chairman, Dr. Donald F. Hornig, professor of chemistry, Princeton University.**
- **International Relations Field (coordination with International Council of Scientific Unions and other national scientific bodies on problems in international sharing of payloads, international cooperation in space activities and advice on the formulation and effects of regulatory policies)—Chairman, Dr. W. A. Noyes, dean of the College of Arts and Sciences, University of Rochester.**
- **Immediate Problems (space laboratories, orbits, currently feasible research projects, and liaison with U. S. IGY Technical Panel on the Earth Satellite Program during terminal phases of IGY)—Chairman, Dr. R. W. Porter, chairman of the panel and consultant, General Electric Co.**
- **Space Projects (analysis of advanced space research proposals and long-range planning)—Chairman, Dr. Bruno B. Rossi, professor of physics, Massachusetts Institute of Technology.**
- **Ionosphere (experiments pertaining to auroral and ionospheric effects, including whistlers and special propagation phenomena)—Chairman, A. H. Shapley, physicist, National Bureau of Standards.**
- **Physics of Fields and Particles in Space—Chairman, Dr. John A. Simpson, professor of physics, University of Chicago. Vice-Chairman, Dr. James A. van Allen, Department of Physics, State University of Iowa.**
- **Future Engineering Development Beyond Available Facilities (telecommunications, telemetry, guidance, environmental conditions and advanced laboratory requirements)—Chairman, Dr. O. G. Willard, Jr., professor of electrical engineering, Stanford University.**
- **Meteorological Aspects of Satellites and Space Research—Chairman, Dr. Harry Wexler, director of meteorological research, U. S. Weather Bureau.**
- **Psychological and Biological Research—Chairman, Dr. H. Keffer Hartline, biophysics section, Rockefeller Institute for Medical Research. Vice-Chairman, Dr. S. S. Stevens, professor of psychology, Harvard University.**

A committee on geodesy will be chaired by a member still to be selected.

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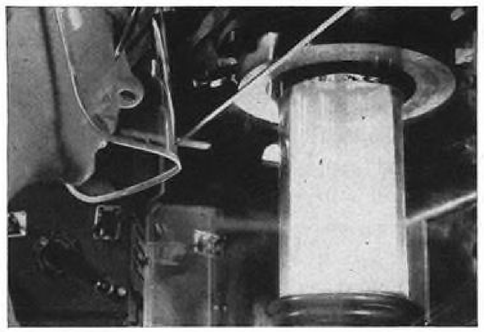
The chain of Research, Development, Manufacturing and Field Evaluation is also evident in other Hughes activities. The commercial products activity performs all these functions in the areas of electron tubes, semiconductor devices, and industrial systems and controls. The Ground Systems Division performs all phases on protective radar systems.

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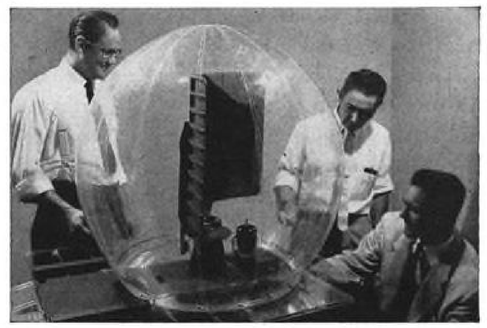
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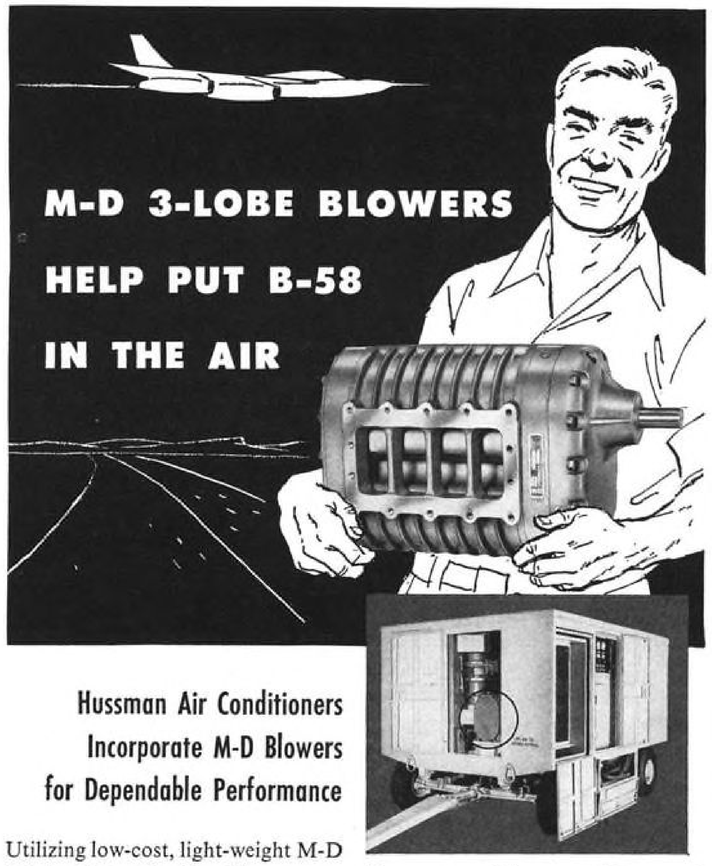


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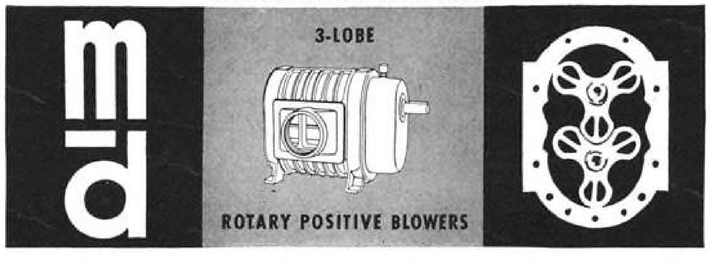
Hussman Air Conditioners Incorporate M-D Blowers for Dependable Performance

Utilizing low-cost, light-weight M-D 3-Lobe Rotary Positive Blowers specifically designed for ground support equipment, Hussman Aircraft Div., St. Louis, build mobile air conditioners for Convair's new B-58 Delta-wing bomber. Hussman's MA3 unit furnishes 100#/min. of 45° air at 3½ psig thru an 8" flexible duct for cooling the complex instrumentation and guidance systems on the B-58.

M-D's new model M100, smaller, lighter, lower in cost than any other blower, can deliver a minimum of *100#/min. (1333 scfm) up to 8 psig*, and meets all government-specified altitude and temperature conditions. The M-100 is ordinarily run at 3450 rpm with either electric or gas engine drive.

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in order to record a moon landing. The committee urged caution and called for drafting of a specific code of conduct that would "achieve a reasonable compromise between the perfectly proper ambition to start lunar–and possibly planetary–exploration at the earliest moment and the need to safeguard future research."

CETEX will meet soon in Moscow to draft the code, basing it on detailed papers prepared by "interested and expert parties" of all countries.

Formation of the contamination committee is an example of ICSU's ability "to act promptly and effectively on a problem of great importance and considerable urgency," according to Dr. Lloyd V. Berkner, president of Associated Universities, Inc., who heads the new Space Science Board.

COSPAR's duties require it to stay informed on other international space activities, such as those proposed to the United Nations by the U. S. and Russia and that proposed by the International Astronautical Federation. This obviously requires COSPAR to stay abreast of disarmament plans that might affect rockets and space vehicles.

Membership of the space committee will consist of:

- **Representative from each country** engaged in earth satellite launchings and major rocketry programs.
- **Three representatives, rotating** their membership, from among countries actively engaged in tracking and other aspects of space research.
- **Representative from each of nine** scientific groups that are members of ICSU.

Executive committee will consist of five elected members from satellite-launching countries.

The International Astronautical Federation asked ICSU for membership during the assembly.

But because of the federation's interest in fields outside science, such as space law, it was suggested that IAF either modify its charter or form a sister body called the Union of Space Science.

Partly as a result of Soviet government refusals to let Nationalist Chinese delegates attend the recent IGY meeting in Moscow, the ICSU assembly declared that its meetings and those of its member bodies and special committees should be held only in countries where all members could be admitted and where the "free and prompt dissemination of information" is permissible.

This also was aimed at Russian delay of transmission of U. S. reporters' stories on a Japanese paper attributing to Russian explosions most of the nuclear fall-out recorded in Japan and to U. S. State Department restrictions against attendance of some foreign delegates to scientific meetings held in the U. S.

Space Strategy Hinges on Time Factors

Dallas—Significance of strategic space operations of the future lies in the compression of time for action and reaction to the point where the time factor will become a new fourth dimension in military strategy.

This expansion from the present concept of three-dimensional warfare was described by Gen. Thomas S. Power, commander of the Strategic Air Command, at the Air Force Assn. convention here. He said it will be a type of warfare in which "the operational relationship between space and time will become the most critical factor."

From the standpoint of military operations in space, Gen. Power said that the four-dimensional concept helps to emphasize that military forces will be operating far beyond the present regime of aerial warfare when they start dealing with distance from the earth instead of altitude above sea level.

"Of course, no one can really tell where the one ends and the other begins," Gen. Power said. "This aspect, however, is entirely a matter of semantics or definition which has no bearing on operational principles and should, therefore, have no bearing on questions of organization and responsibilities."

The present military space effort is at about the same stage as the military air effort was in the days of hot air reconnaissance balloons, Gen. Power said. Then as now, man faced a hostile environment he knew little about, military use of the new medium was initially thought of in terms of support operations and it was impossible to predict where the first steps would lead.

First strategic use of space will come when ballistic missile capability is achieved. Gen. Power predicted that this new weapon will initiate the era of four-dimensional warfare, "a new regime of strategic operations in which utilization of the space medium will place a fantastic premium on action and reaction times."

Describing SAC's flexibility in adapting to new weapons while maintaining its present combat-readiness, Gen. Power said the ballistic missile capability build-up is progressing rapidly and smoothly despite unprecedented requirements for integrating a radically new family of weapons that have not yet been proven operationally.

The SAC commander discussed the need for highly advanced support facilities for ballistic missile operations, and he cited as an example the missile trajectory center at SAC headquarters, Offutt AFB. This facility will be equipped with the latest electronic computers to calculate the vast number of intricate trajectories which must be supplied to all ballistic missile squadrons.

"This is probably the first time in military history that an operational unit in a combat organization will be staffed by mathematicians and physicists," he said.

The next major step beyond ballistic missiles in the strategic use of space will be in a different direction, according to Gen. Power. One possibility lies in the trend to the "manned missile." Forerunner of such a weapon could be the North American B-70, a bomber with greatly advanced performance over the Boeing B-52, but still considerably short of ballistic missile performance.

Current studies concerning development of a manned missile could possibly lead to a vehicle that might exceed ballistic missile performance, Gen. Power said, citing the Dyna-Soar project as an example. He said that such an orbiting skip-glide vehicle would repre-

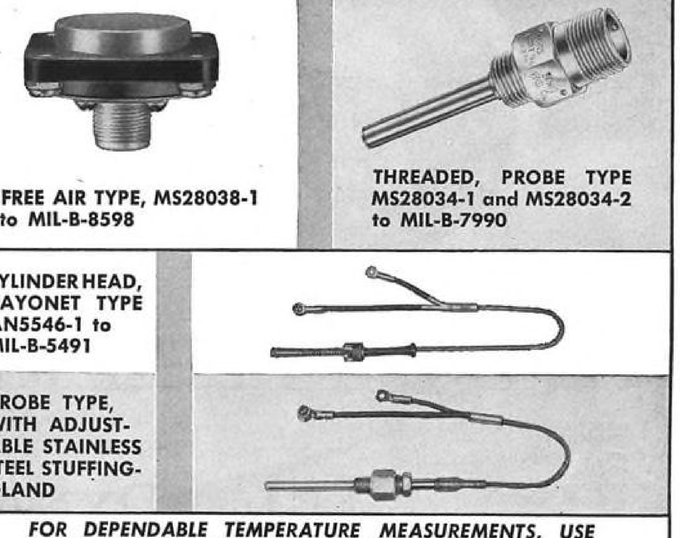
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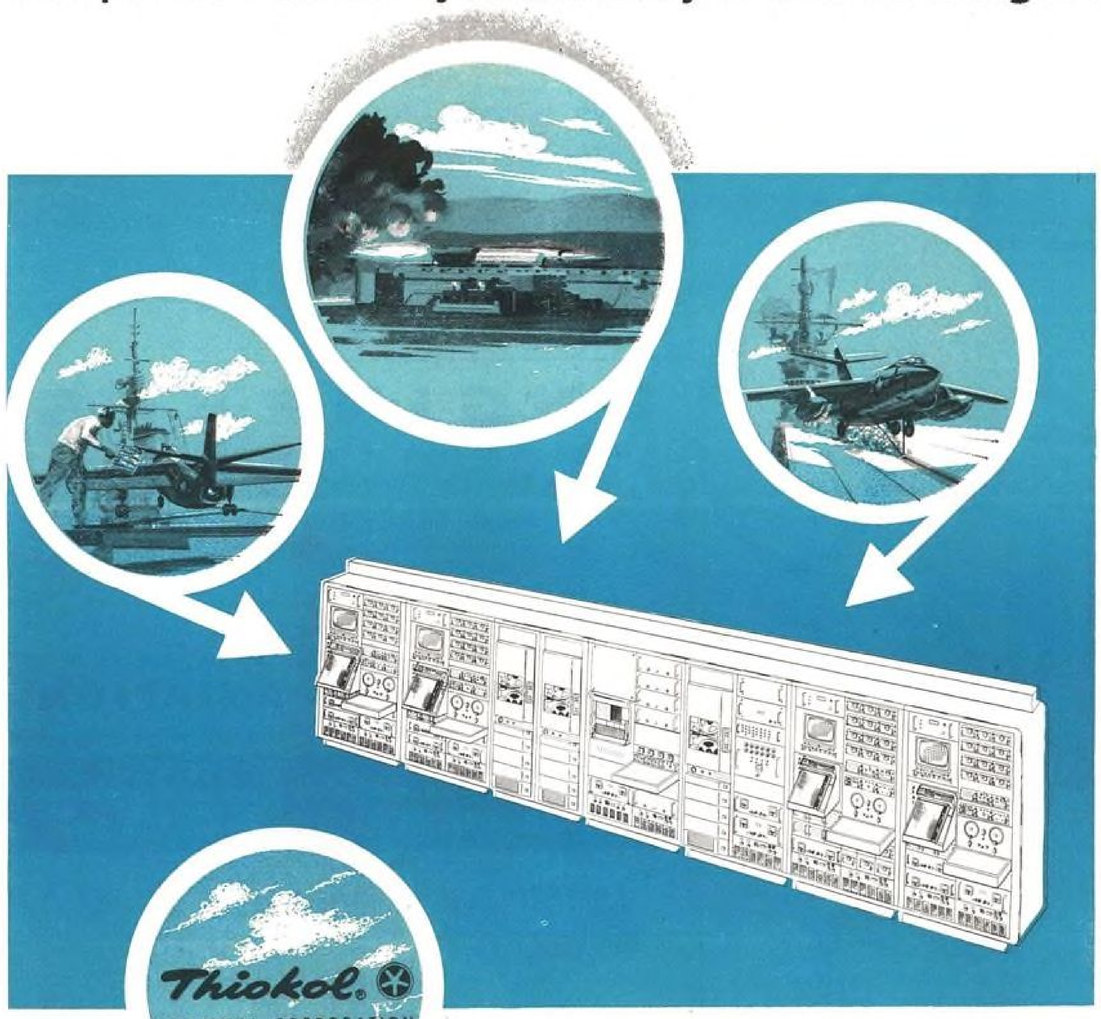
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sent the first true manned strategic space craft.

In another direction, there is considerable discussion of the use of military satellites, and Gen. Power suggested thorough study of the political and military problems created when the U. S. and the Soviet Union are sending potentially or actually hostile satellites over each other's territory.

"This question could well come up in peace time," Gen. Power said. "In case of war, of course, the strategic value of a military satellite would be such as to necessitate both offensive measures against the enemy's satellites and protective measures for one's own satellites. What these measures would be and how they would manifest themselves is still a matter of conjecture. But this much is certain—whatever these measures might be, they would constitute the first instance of actual warfare in space."

Discussing present satellite operations, Gen. Power said that their most important contribution probably lies in teaching the U. S. that our knowledge is even more limited than we thought. That knowledge may be sufficient to encourage and support various theories on space warfare, "but we should be realistic enough to always remember that military planning must be based on a more solid foundation than theories," he added.

"In analyzing the potentialities of military operations in space we should, therefore, bear in mind that the state of the art has to be advanced in many areas and along a broad front before we can expect increasingly sophisticated space weapon systems in the future to attain sufficient utility and reliability to warrant their integration into the operational inventory of a combat organization such as the Strategic Aid Command," he said.

In a panel discussion of the problem of getting man into space, Maj. Gen. Don Flickinger, director of life sciences for the Air Research and Development Command, estimated that for a vehicle orbiting 24 to 36 hr., all biological problems have an available engineering solution. He pointed out that the radiation band doesn't build up until an altitude of 600 mi. is reached and that initial manned satellites will orbit at a much lower altitude.

Using the type of equipment envisioned for the first satellite flights, Gen. Flickinger said that developments over the next few years will stretch orbiting capability to about two weeks. Beyond that, it appears that a large technological step will have to be taken to a completely closed, self-contained ecological system.

Types of equipment which will support man in his early satellite flights were discussed by Dr. Paul Webb, chief of the environment section of the Aero Medical Laboratory of Wright Air Development Center.

For short flights, Dr. Webb described a system developed at the Aero Medical Laboratory which can supply a man in a sealed pressure suit or a small sealed cabin for 12 hr. In one application, this system appeared as a small box with a large hose leading to the helmet of a pressure suit.

The system measures 2 ft. x 2 ft. x 8 in. and weighs about 50 lb. It contains equipment to supply pressure and oxygen to support life in a vacuum, and it removes carbon dioxide from the atmosphere. The system ventilates the man carries off heat and water vapor and provides cooling. Dr. Webb said that two systems which are direct descendants of this device have been designed to support a man for 48 hr.

Originally designed for the next generation beyond the Lockheed F-104 aircraft category, the system described by Dr. Webb is about three years old. Newer systems based on it are being developed, and General Electric and North American Aviation have contracts for such projects.

Dr. Webb observed that there are a number of systems to be designed that will fit between the short term system he described and the ultimate self-contained environment. Present systems get heavier with time because of stored water and oxygen and because of non-renewing absorbents for carbon dioxide. With a system designed for 10 or 20 man days, water must be saved and recycled and a means must be found to dump carbon dioxide into space.

Longer flights will have to conserve oxygen by recycling at least some carbon dioxide back into oxygen, Dr. Webb said. Dehydrated food can be stored rather cheaply, but eventually even this will have to be recycled, which leads to the ultimate biological solution.

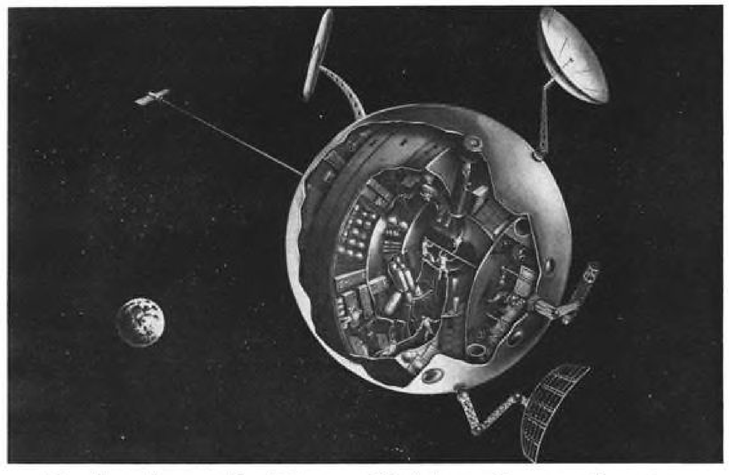
Commenting on the factor of weightlessness in space operations, Lt. Col. Rufus R. Hessberg, chief of the Aeromedical Field Laboratory at the Air Force Missile Development Center, said "we know it isn't a great big monster waiting out there in space."

Studies of the transition between zero gravity and high positive G forces show that it is harder on a man to go from zero gravity to 4G than to go from 4G to zero gravity. This would indicate that the transition in the re-entry phase will be more rigorous than in the initial acceleration phase.

Capt. C. H. Kratochvil, chief of the department of physiology-biophysics at the USAF School of Aviation Medicine, noted that only very limited techniques are available for studying isolated animals in space research. He described some recent developments in instrumentation for biological space research and said that these developments now are under test in prototype animal capsules and are being flight tested for human application.

Among them is an oxygen sensor which operates on polarographic principles. It weighs very little and has operated successfully for 15 days.

Commenting on radiation problems, Col. John E. Pickering, director of research at the School of Aviation Medicine, said that knowledge is being formed on a radiation syndrome. Researchers now can plot curves in the cycle of reaction to radiation and are able to search for safe dosages and to look for protective chemicals.

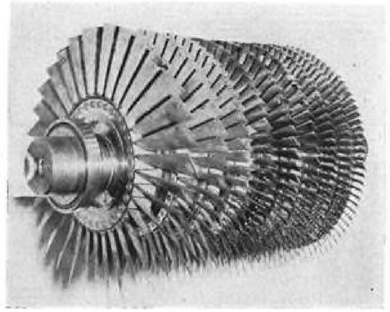


Rocketdyne Envisions 50-Man Space Station

Development of million-pound thrust chemical rockets and nuclear rocket engines could lead to launching of space stations weighing as much as this 250,000 lb. vehicle, according to Rocketdyne Division of North American Aviation, Inc. Station would orbit at 22,300 mi. altitude and carry a crew of 50 men in its 60 ft. diameter.



SMALL JT12 turbojet weighs less than 430 lb., its guarantee weight.



FRONT view of compressor rotor assembly.

JT12 Design

By Robert I. Stanfield

East Hartford, Conn.—First design details of Pratt & Whitney's new entry into the small turbojet engine field point up the ruggedness, simplicity and proven engineering methods woven into the high performance, medium pressure ratio JT12.

Single-spool, nine-stage axial flow engine weighs somewhat under 430 lb., its guarantee weight. Thrust-to-weight ratio is 6.75 to 1. Takeoff static thrust developed in prototype engine is 2,900 lb.; thrust specific fuel consumption is .93. Commercial normal rated figures are 2,300 lb. and .895, respectively (AW Sept. 29, p. 21).

Rating of the production engine for manned application, which will be available in October, 1960, is expected to be 3,000 lb. thrust. Cost will be less than $50,000.

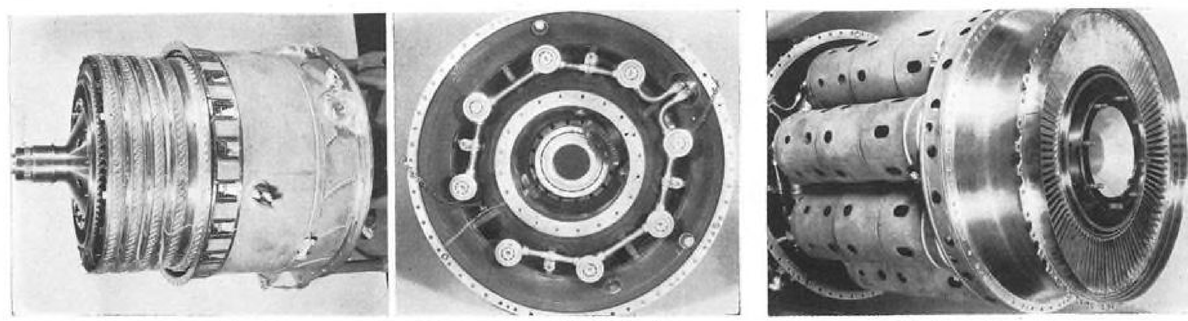
About one year after getting into production, Pratt & Whitney expects further to increase the takeoff rating of the JT12 to about 3,300 lb. This without any new state of art as far as materials are concerned—the increase will be accomplished via the same materials now in the engine.

Running Time

More than 200 hr.—in just over four months' time have been put on the JT12 to date. Two engines, the X-299 and X-300, have been run. The third, X-303, is completed and ready to go, and the fourth will be built by December.

Prototype engines for unmanned application, qualified in 15 hr. test, will be available in July, 1959. Same engines for manned application (experimental purposes in prototype aircraft), qualified in 50 hr. test, will be available in October of that year. Production engines for unmanned application will be available in June, 1960.

The company expects to be using the JT12 in two B-45 test beds early in 1959. Bailed USAF aircraft, also used



LEFT: compressor assembly. Center: rear view, diffuser case assembly. Right: burner cans, nozzle case assembly first turbine rotor.

Geared to Permit Early Production Date

in the development of the J57, J75 and J52, reflect the service's interest in this program.

Engine is particularly applicable for installation on military-transport aircraft such as the Lockheed Jetstar, McDonnell UCX and North American Sabreliner. In addition to its suitability for commercial-military aircraft, the JT12 has missile, drone and helicopter application.

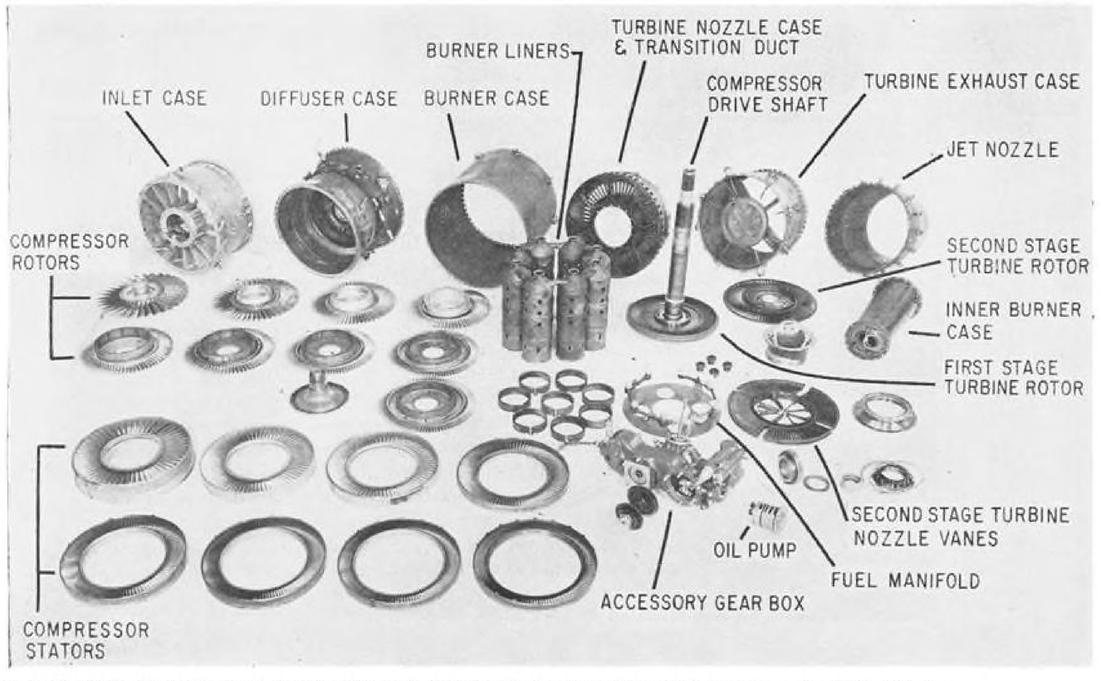
Republic Aviation Corp. has selected the engine for an advanced drone now under development for the U. S. Army (AW Oct. 6, p. 23). Sikorsky Division of United Aircraft Corp. also is considering the JT12 for use in the turbine-powered version of its S-60 flying crane (AW Oct. 13, p. 29).

Until recently all Pratt & Whitney engineering energies were tied up in developing larger engines for the military. But the de-emphasis in use of the large gas turbines—due to the military money trend to rockets and non air-breathing engines—enabled the company to turn its efforts to the development of a small engine that would be:

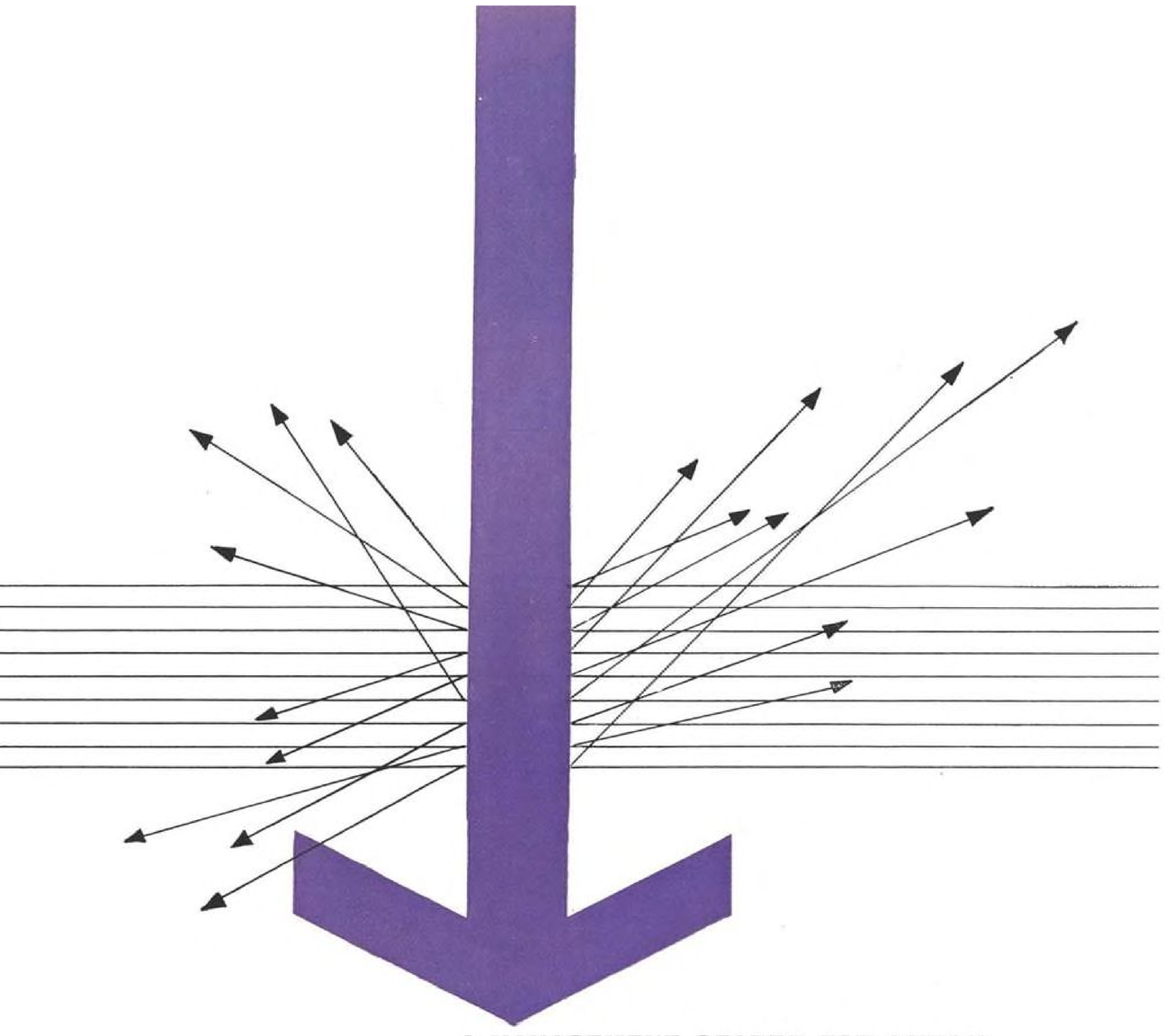
• **Modern in every sense.** Aim was to ensure performance at low weight, yet involve no risks inherent with new developments and untried component types. Company, for instance, stayed within its previous background on compressor airfoils; no new manufacturing techniques were necessary to make blades already available. Airfoils are not too small. The shortest blade—in the ninth stage—has an airfoil length of 1.2 in. The largest blade—in the first stage—is 4.5 in.

• **Adaptable to fast production.** First engine ran in May of this year. Guaranteed thrust and fuel consumption was demonstrated the end of June. A company 15-hr. missile category test was run in July and a company preliminary 50-hr. flight rating test was made in August.

Original prototype and production scheduling dates for December of 1959



BREAKDOWN of major parts of Pratt & Whitney's JT12-A1 experimental engine X-300 points up simplicity of design.



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and 1960 respectively, were moved up to the month of October in these years. Unmanned availability date, also originally set for December of 1959 and 1960 (for prototype and production engines, respectively), was moved up to July of 1959 and June of 1960.

The JT12, with its nine-stage, axial flow compressor, utilizes can annular combustion section with eight combustion chambers. Turbine is two-stage.

The engine itself is steel, with these exceptions: rotating blades in first three compressor stages are titanium (disks are steel); first three stages of stators in inlet case are aluminum and the accessory gear box housing is magnesium.

Pratt & Whitney feels that further reduction in engine weight, if desirable, can be made by increased use of titanium, and without excessive cost penalty because of a reduction in metal price.

Engine inlet case supports the front roller bearings. Ball thrust bearing is behind the compressor and another roller bearing is in front of the turbine.

JT12 is mounted via two supports, one on each side, located on the horizontal centerline on the diffuser case. These take all thrust and weight. The rest of the mounting system consists of a steady mount—on the inlet case or on the turbine case—for stabilization. Engine utilizes two complete low-tension ignition systems with igniters in two of the eight burner cans.

Gear Box

The accessory drive gear box mounts below the diffuser case, with a pad on gear box for the starter-generator. Fuel control is mounted in front of the fuel pump. Tachometer drive pad sits on top of the gear box. To the rear is a pad for hydraulic pump (fluid power pump).

Located in the gear box are all oil pumps—four in all, in one unit: a pressure pump and three scavenger pumps —and an oil strainer.

JT12 Ratings

Commercial:	(Sea Level Static) Thrust	TSFC
Takeoff	2,900	.930
Max. continuous	2,400	.895
Normal rated	2,300	.895
Max. cruise	2,140	.890

(Engine weight: 430 lb.).

Military:	(Sea Level Static) Thrust	TSFC
Military	2,900	.930
Normal rated	2,400	.895
90% normal rated	2,160	.890
75% normal rated	1,800	.890
At 35,000 ft. Mach 1.8*	993	1.17

* Operation beyond Mach 2.0 is anticipated.

JT12 Development Calendar

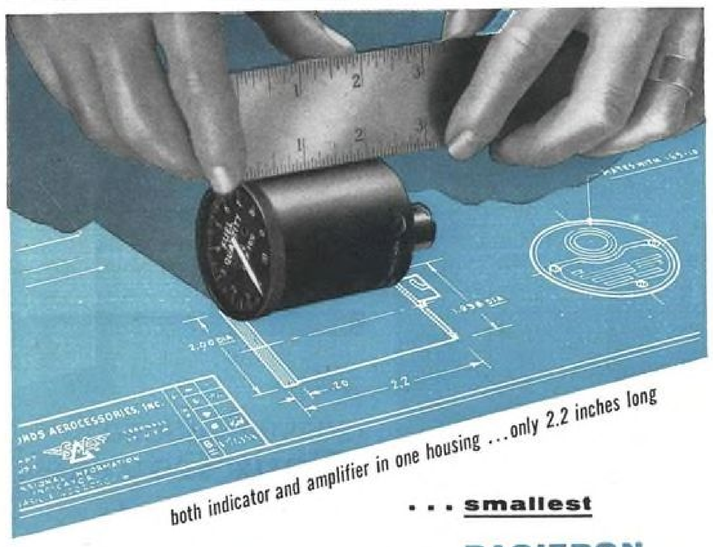
Design studies begun	July, 1957
Detailed design begun	Sept., 1957
Detailed drawings released	Jan., 1958
First engine run scheduled	July, 1958
First engine actually run	May 16, 1958
50-hr. endurance test completed	Aug. 16, 1958

Compressor stators are shrouded. Stator leakage is controlled by labyrinth seals. The first two compressor stages have pin-jointed blade attachment. Pin has considerable clearance, allowing the blade to rock, for blade vibration control.

Remaining stages employ single-dovetail fastening. Shape of the slots is the same on the rest of disks, so they can be broached with the same tool.

JT12 inlet case extends rearward to cover the forward half of the compressor (there is no separate compressor case). Vanes are sheet metal, as is the bulk of the case which is put together by dip brazing. The diffuser case, containing the last stage stator, extends forward to cover the rearward half of the compressor.

The first three stators have a box



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Complete information on all the above systems is available on request.

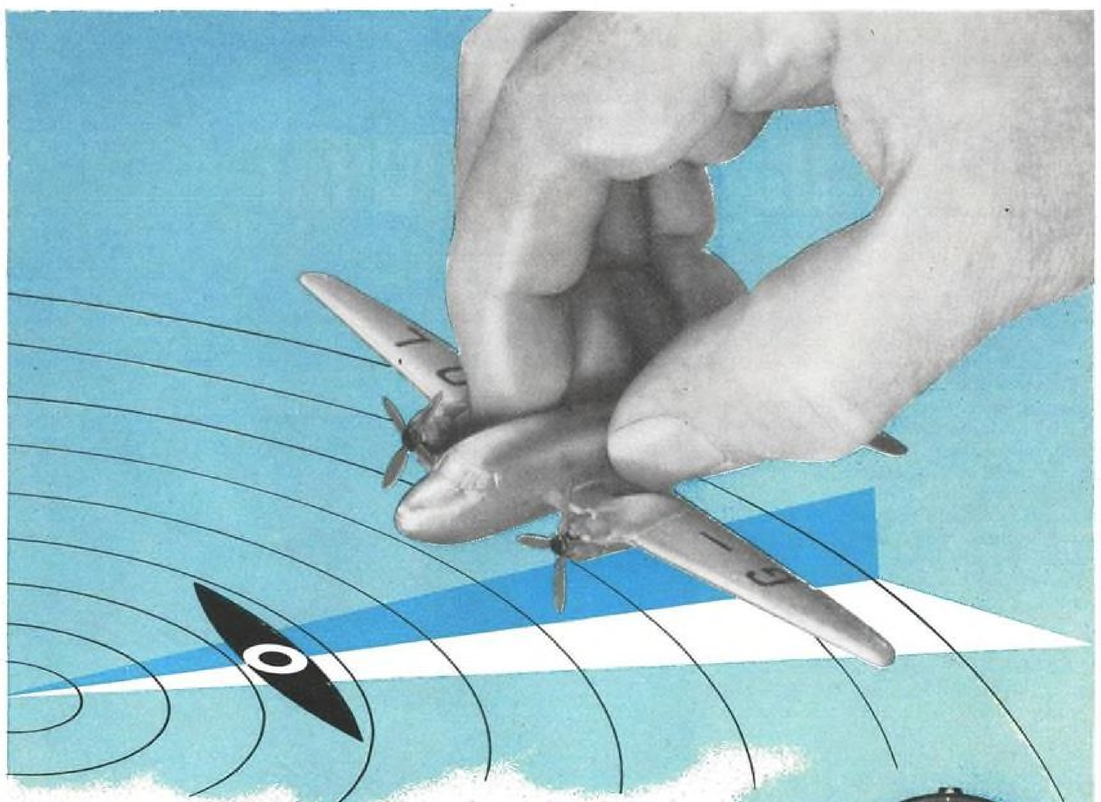


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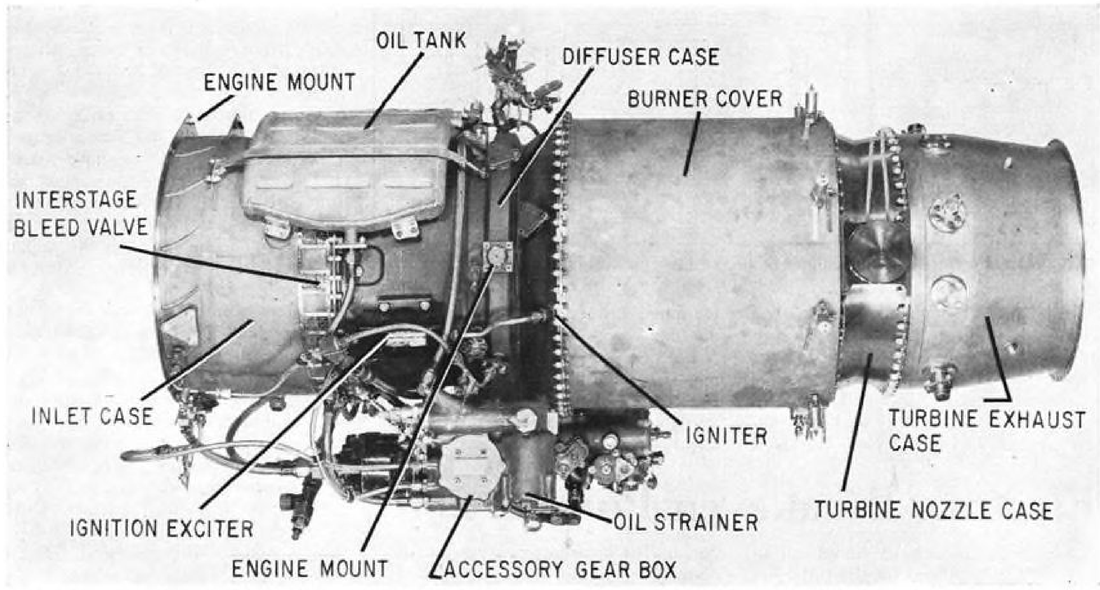
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JT12 EXPERIMENTAL engine X-299, showing the left side of engine assembly and key external parts.

outer shroud with precision forged vanes dip-brazed in pre-punched slots in outer shroud and riveted through the inner shroud.

Remaining stators–steel–have a box outer shroud. Vanes are made from rolled strip stock and silver brazed to both inner and outer shrouds.

Diffuser case incorporates air bleed manifold for cabin air supply and supports the thrust bearing. Beveled gear mesh drives an accessory gear box tower shaft.

Fuel manifold is mounted inside the diffuser case and is supplied through a pressurizing and dump valve on the outside of diffuser case.

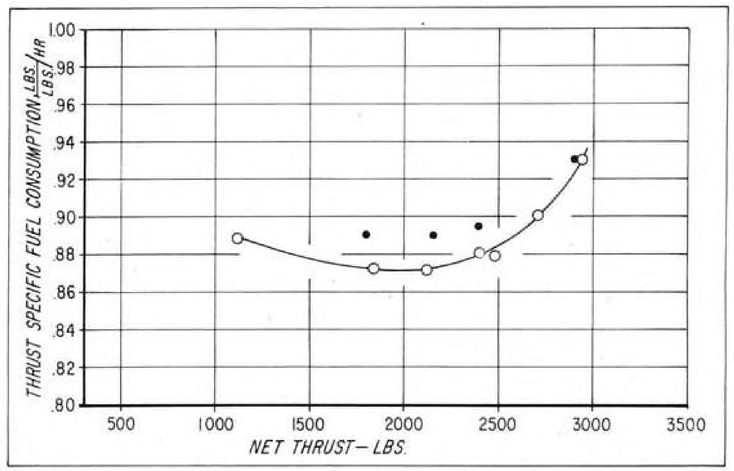
Combustion Air Swirlers

Combustion air swirlers are integral with fuel nozzle retaining nuts. Burner liners are connected to fuel nozzle nuts by a split ring. Liners of the eight burner cans are louver cooled.

The first stage turbine rotor has unshrouded blades. The shaft has an extension for the bolting of the second stage rotor, which is a shrouded rotor. The second stage turbine nozzle diaphragm incorporates a labyrinth seal.

The turbine case is machined from a contoured forged ring. Case supports both first and second stage turbine nozzle vanes. The inner burner case is bolted at the forward end to the center body of the diffuser case and at the rearward end to the transition duct. The rear bearing is mounted in aft end of inner burner case.

Compressor involves no variable geometry, though it incorporates inter-



SEA LEVEL calibration of engine X-299, with data corrected to standard atmospheric conditions. Black dots indicate JT12 guarantee.

stage air bleed (sleeve valve) at its fourth stage. The fuel pump is two-stage–one centrifugal booster stage and one gear stage. Fuel control is hydro-mechanical.

All bearing compartments are sealed with carbon contact seals which, in addition to sealing oil in compartments, prevent entry of hot gases.

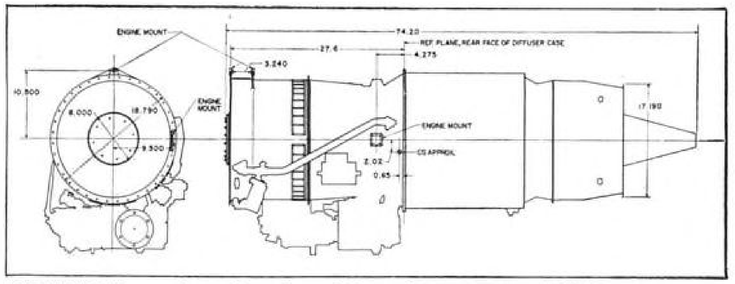
Maintenance on the JT12 is simplified.

Bottom-of-engine adjustments require access to but one area of the engine, that incorporating gear box.

To get at burner cans for removal, the burner cover can be slid back over the rear end by removing about 60 bolts at each end. Fuel nozzles can then be taken out, and whole fuel manifold removed. One work shift can remove and replace burner cans and button up engine.

With burner cans out, the transition duct can be slid forward, giving access to the first stage turbine nozzle vanes which then can be removed. With nozzle vanes out, the first stage turbine rotor is open for inspection.

Second stage nozzle vanes cannot be removed without further disassembly, but can be inspected by looking through the first stage rotor, and by looking



CUTAWAY diagram shows dimensions of the medium pressure-ratio JT12.

(from back) through the second stage rotor. Latter can be exposed completely by pulling off turbine exhaust case.

Compared with older and bigger engines, sectional assembly and disassembly of the JT12 is rapid. Complete teardown can be accomplished within one day.

Pratt & Whitney anticipates no problem with any production demands on the JT12. Fabrication facilities are available; company needs but jigs and fixtures.

Electra's Breakeven Point is 200

Los Angeles—Current volume of orders for the Lockheed Electra turboprop transport, "although substantial," fall short of the breakeven point, Robert E. Gross, Lockheed Aircraft Corp. board chairman, told stockholders last week.

Lockheed puts the Electra breakeven point at 200 airplanes. Current orders are for 161 airplanes, costing a total of about $340 million.

In a letter, Gross pointed out that the company writeoffs so far against profits, because of Electra development expenses, total $50 million over a three and one-half year period, resulting in reduced earnings during those years.

"Our confidence in the Electra has never wavered," he said. "Yet I would not be honest if I did not tell you that our current volume of orders, though substantial, is short of the goal we must attain."

Gross said the Electra is "proving a worthy successor to the Constellation," explaining that 15 airlines have ordered 161 Electras. In contrast, eight airlines had ordered 102 Constellations at time of certification.

Electra backlog, thus, is the highest in Lockheed history for an airliner at certification time.

Electra was demonstrated here last week prior to leaving on a sales tour of Europe, Asia and the Middle East. At the controls were Herman Salmon, Lockheed chief engineering test pilot, and copilot Ray Crandall.

The Electra tour will cover about 60 days and will include visits in Amsterdam, Brussels, Copenhagen, Oslo, Stockholm, Cologne, Zurich, Vienna, Istanbul, New Delhi, Bombay, Athens, Rome, Paris, London and Dublin.

On ground runup and during taxiing for takeoff, no engine whine is heard and propeller noise drops very quickly as the plane taxis by. At the 4,799 ft. runway marker, the plane had attained 350 ft. altitude.

As the Electra cruised at 380 mph. at about 18,000 ft., rapid acceleration and deceleration was demonstrated, with control through blade pitch changes at constant engine and propeller rpm. While speedup and slowdown rates were substantial, transition was unusually smooth. No abruptness was experienced at the onset of acceleration or deceleration.

Fast response of the aircraft to emergency speed-change requirement was demonstrated in a planned wave-off. The aircraft approached in a normal pattern, then came in low over the runway with gear down for normal landing and, taking a wave-off, built up speed very rapidly in an appreciable climb. There was no throw-back into the seats with application of power after wave-off.

At touchdown, slowup through propeller pitch change was fast, smooth, and brake was applied only after a considerable roll.

Sound level decreases rapidly in the fuselage going aft from a point opposite the propellers. In the rear fuselage, propeller noise drops to a very low level.

PRODUCTION BRIEFING

Robinson Aviation, Inc., Teterboro, N. J., producer of vibration and shock mounts, has licensed Vibrachoc, GmbH. for the manufacture of Robinson products in West Germany.

Nuclear Products-Erco Division of ACF Industries, Inc., Riverdale, Md., will build flight simulators for the Republic F-105 under $2.3 million Air Force contract. Designed to train pilots of the F-105D all-weather version of the fighter, trainers are said to be capable of simulating bomb-navigation system, mapping system and in-flight refueling.

Telecomputing Corp., Los Angeles, Calif., will furnish U. S. Army Ordnance with nuclear warhead test equipment under $1,510,637 add-on contract. Company reports total sales on ordnance program now amount to $5,787,914.

Air Logistics Corp., Pasadena, Calif., ground support equipment producer, has granted exclusive Canadian sales and manufacturing rights to Canadian Curtiss-Wright, Ltd., Montreal.

Hughes Aircraft Co. plant at Culver City, Calif., may produce flight and armament control system for the Avro Arrow CF-105. Royal Canadian Air Force and Canadian Defense Production Department officials recently visited the Hughes facility. Canadian government has canceled orders for Astra Aircraft Corp. Ltd. flight and armament control system.

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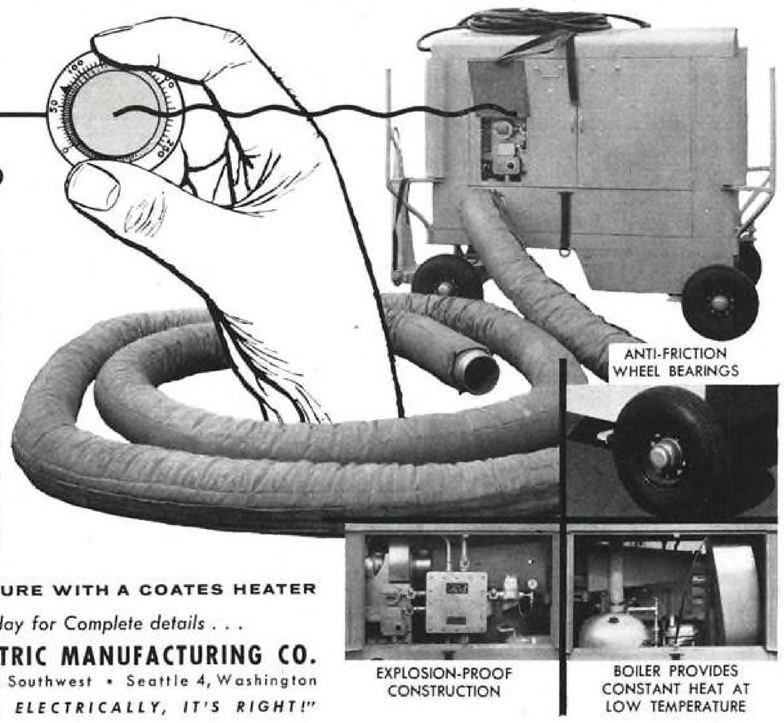
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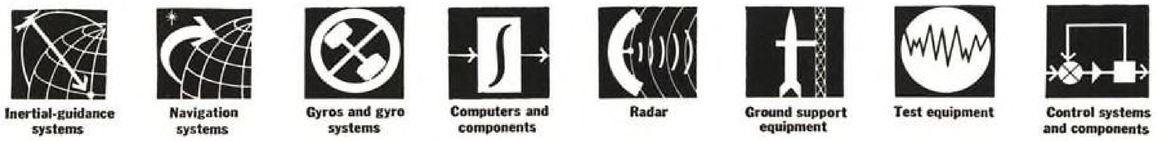
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British Develop New Helicopter Turbines

By David A. Anderton

London—Four turboshaft powerplants in the 1,000 shaft horsepower class are being developed in Britain for the next generation of rotary wing aircraft.

Armstrong Siddeley Motors Ltd. P.-181, Blackburn and General Aircraft Ltd. A.120, de Havilland Engine Co. Ltd. Gnome—which is a license-built General Electric T58 unit—and Napier and Son Ltd.'s Gazelle, Jr., are competing for prospectively big orders both at home and for export.

Early successes with such gas-turbine powered "small" helicopters as Saunders-Roe's P.531 five-place craft have held out the hope of future sales to Britain's export-conscious aircraft industry (AW Sept. 8, p. 59).

Early availability of powerplants in this category could lead to a program to re-engine helicopters such as Westland's Wessex, now powered by a single Napier Gazelle, or its Sikorsky equivalent, the S-58, now flying in one test version in the U. S. with two GE T58 units.

In addition there is a British Ministry of Supply requirement for a future helicopter design with a paired powerplant producing a total of about 2,000 hp., a job ideal for these engines.

Besides a common rating, all of these engines are about the same length, 5 ft. On diameters there is considerable difference from the quoted 16-in. "maximum flange diameter" of the Gnome to the 33-in. diameter of the Gazelle, Jr. Heaviest of the batch is the P.181 weighing in at 550 lb. installed weight, but including in that figure "certain items not always included in engine weights". Lightest is the Gnome at 325 lb.

For the moment, de Havilland would seem to be well out in front with the Gnome. First, it is a proven engine in the United States, where it has passed its 150-hr. flight qualification test and has racked up flight time in Sikorsky HSS-1 and Vertol H-21D testbeds. By comparison, the Blackburn A.129 ran in July; Armstrong Siddeley has not yet reported a successful start, and the Napier design still is untested.

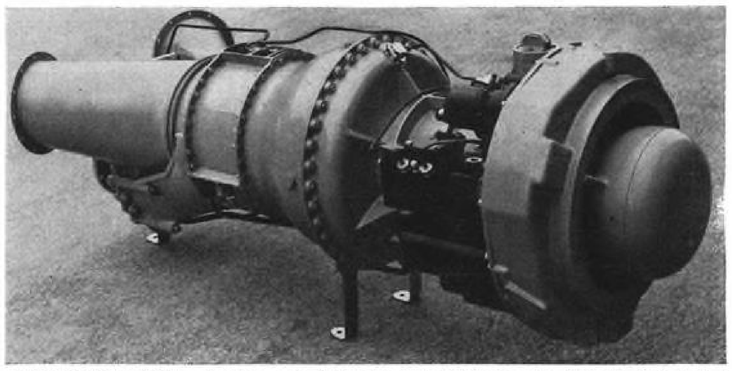
Second, the Gnome currently offers the lowest specific fuel consumption, lightest weight and highest power-weight ratio of the four.

Armstrong Siddeley P.181 is one of a pair of engines being developed in parallel to use as many common components as possible. Second engine of the duo is the P.182, a turboprop engine in the same category.

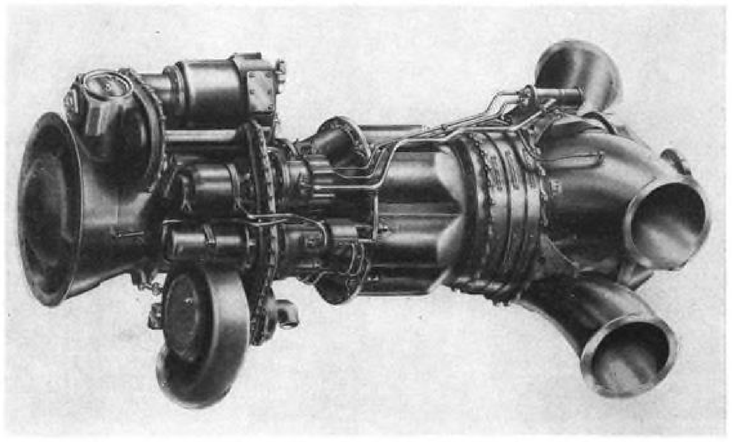
The compressor is a compound unit consisting of two axial stages followed by a single centrifugal stage. Air out of the compressor enters an annular combustion chamber designed to give a considerable amount of reverse flow to minimize chamber length.

Hot gases leaving the combustion chamber drive a two-stage turbine which absorbs power to drive the compressor, and a third-single-stage free turbine which drives the power output shaft.

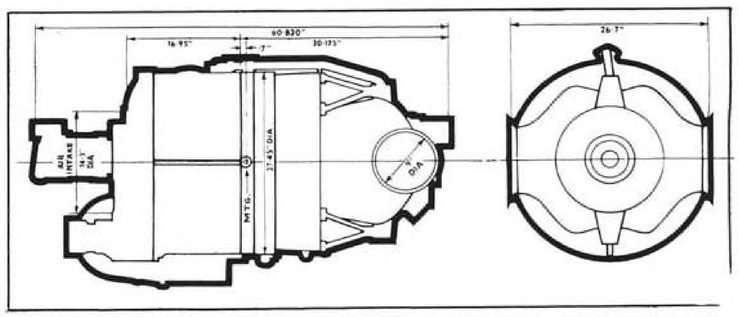
The P.182 turboprop engine and the front-drive version of the P.181 have reduction gearing housed in the center body of the air intake. The rear-drive version of the P.181 hangs the gearbox in the center of the exhaust ducting.



BLACKBURN A.129, a development of the license-built Turbomeca Artouste 600, is basically an Artouste with added transonic compressor and third turbine for power extraction.



NAPIER GAZELLE JR. (AW Feb. 17, p. 71) is being developed as a helicopter powerplant for new designs and for re-engining current single-engine types to twin-engine layouts.



ARMSTRONG SIDDELEY P.181 turboshaft engine, developed to meet design requirement of the prospective new helicopter market, is designed as an all-attitude engine.

The P.181 has been designed as an all-attitude engine to operate in any angular position between horizontal and vertical, either nose-up or nose-down. Normally available gear ratio is 4.95:1, but others can be supplied. There is some degree of flexibility allowed the aircraft designer in gearbox layout; the company says it can supply an offset gearbox, for example. There also is a choice of exhaust layout.

Both rotor governor and torque limiter controls have been designed and developed for the P.181. Manual override for emergency is possible. Other safety features on the engine include a free wheel assembly fitted between the two turbines which limits maximum power turbine rpm. to that of the compressor assembly.

Both axial and centrifugal compressors are shielded, the former by steel shroud rings and the latter by overlapping steel diffuser vanes. Should either compressor fail, the failure should be contained locally.

The turbine assembly is inside a double-layer steel turbine stator casing, designed to contain a turbine failure.

The company says small numbers of engines will be available by mid-1959 for prototype aircraft, and that production deliveries are expected to begin in the latter part of 1960. Purchasers of these engines will be given guarantees by Armstrong Siddeley covering operating, maintenance and overhaul costs.

Performance Figures

Two sets of performance figures are being quoted by the company. The first arbitrarily derates the engine to 800 maximum shaft horsepower and holds this power up to an altitude of 3,750 ft. on a hot day (ISA-International Standard Atmosphere-plus 30C). The second is the equivalent performance at sea level.

Under the first set of conditions, the engine can draw 800 shp. for 5 min., burning 575 lb. of fuel per hour at a specific fuel consumption of 0.72 lb./shp./hr. Excess tail pipe thrust is 155 lb.

Corresponding 60-min. ratings are 705 shp., 520 lb./hr., 0.74 lb./shp./hr. and 145 lb. thrust. Maximum continuous ratings are 665 shp., 498 lb./hr., 0.74 lb./shp./hr. and 130 lb. thrust.

These estimates include engine intake losses and Reynolds Number effects at altitude.

Equivalent sea level performance rates the engine at 1,200 shp. for 5 min., burning 727 lb./hr. at a specific fuel consumption of 0.71 and a thrust of 200 lb. The 60-min. ratings are 980 shp., 700 lb./hr., specific fuel consumption of 0.715 and gross thrust of 195 lb. Maximum continuous rating is 930 shp., 665 lb./hr., 0.72 specific



TAPCO RESEARCH TALENT

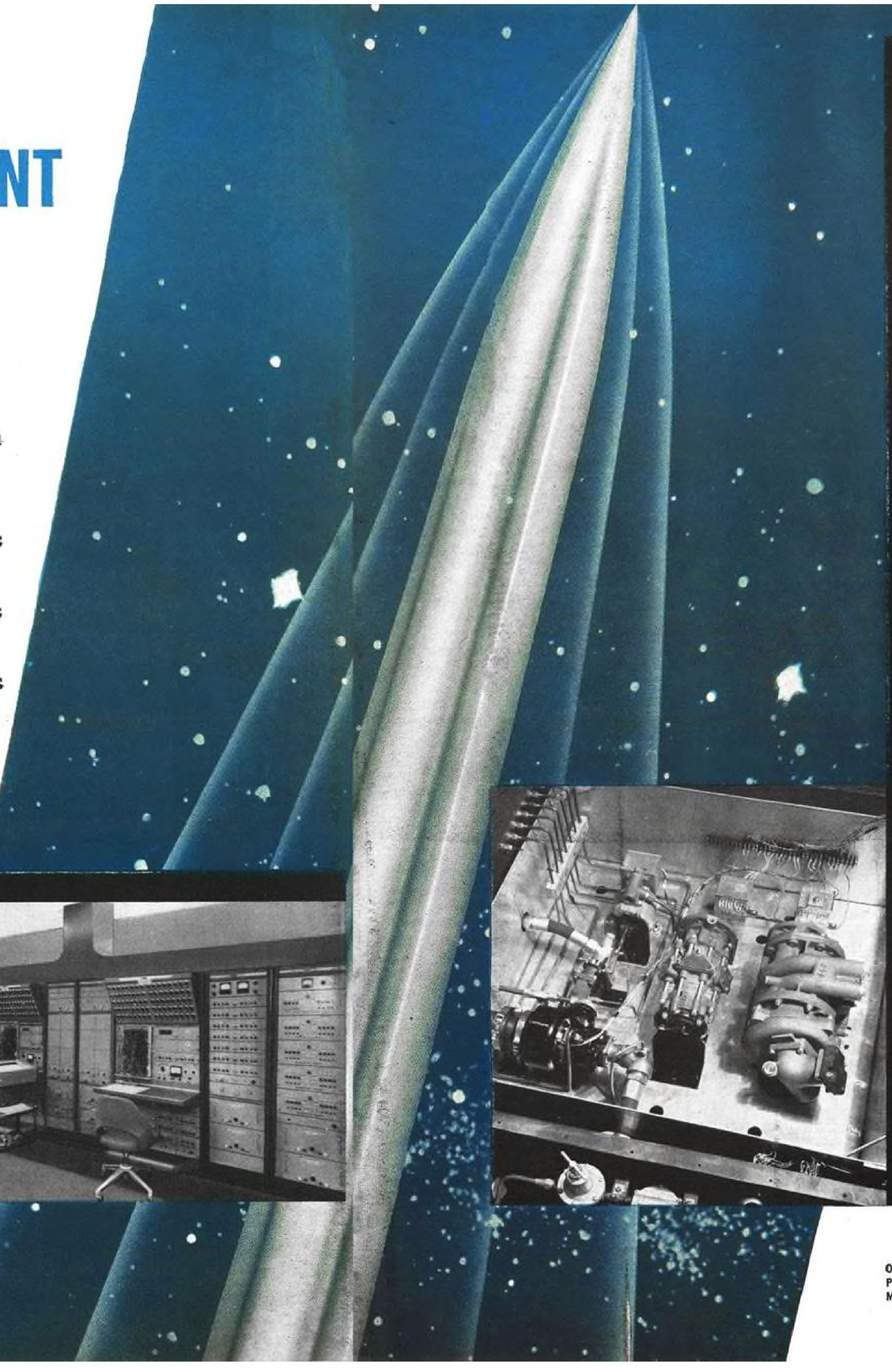
can handle your problems, from atomic to astronautic

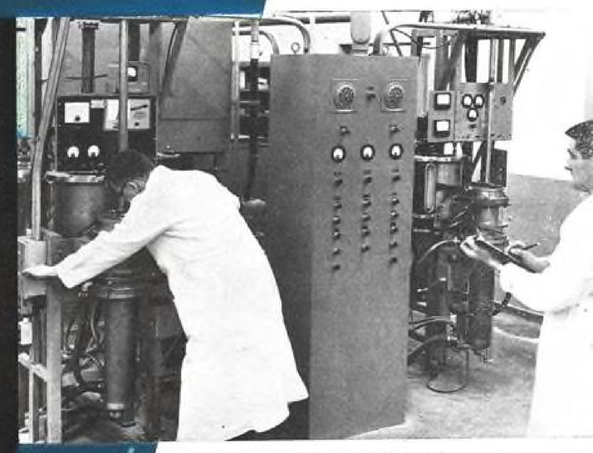
Within the complete Tapco research facilities there are people, machines, and instruments to handle virtually any problem . . . and translate the answers into production.

High-temperature behavior of metals, fuels and other materials is a continuing research program at Tapco . . . and has been for 50 years.

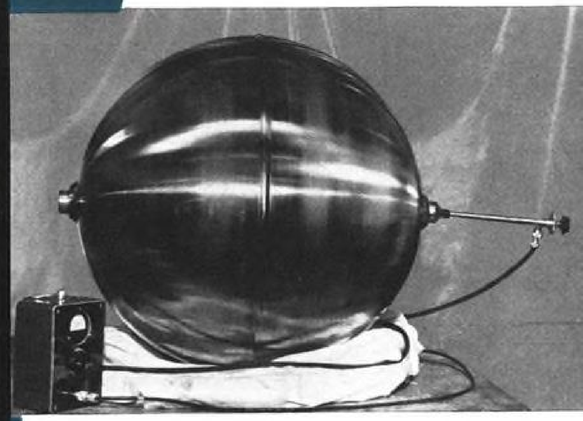
The flow of metals under various forming and forging operations is another Tapco area of research.

Investigation of electronic phenomena, of the physics of liquids and air at high pressures throughout a wide temperature range . . . all are continuing Tapco integrated research programs.



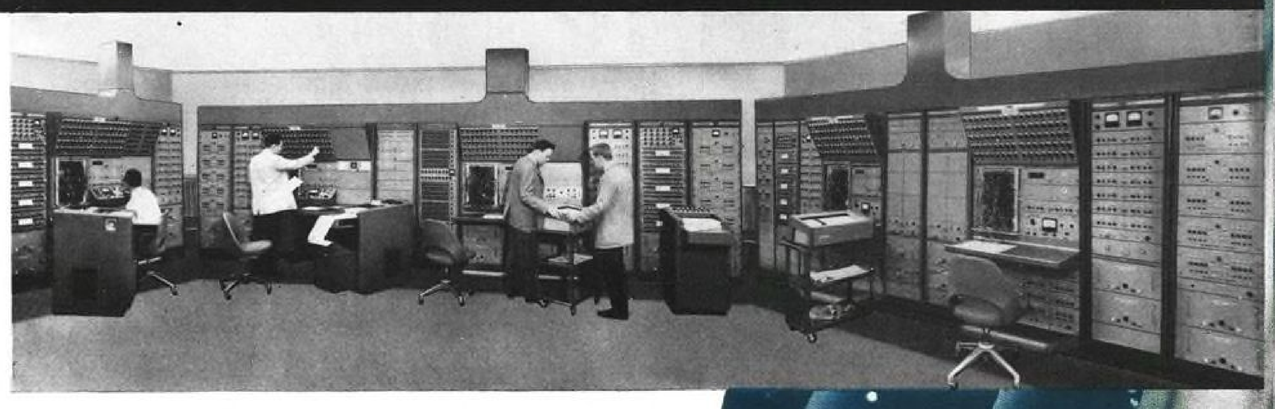


Niobium metallurgy is being investigated on these twin cold-hearth vacuum-melt arc furnaces in the Tapco Group to improve its properties as a high-temperature structural material.



Precision missile pressure vessels of titanium are designed and manufactured at Tapco. Many years of intensive research and development have resulted in unusual Tapco Group techniques for forming, welding and heat-treating such missile-age metals.

Nuclear power plant components developed by the Tapco Group are being tested to determine their action and reliability under radiation.



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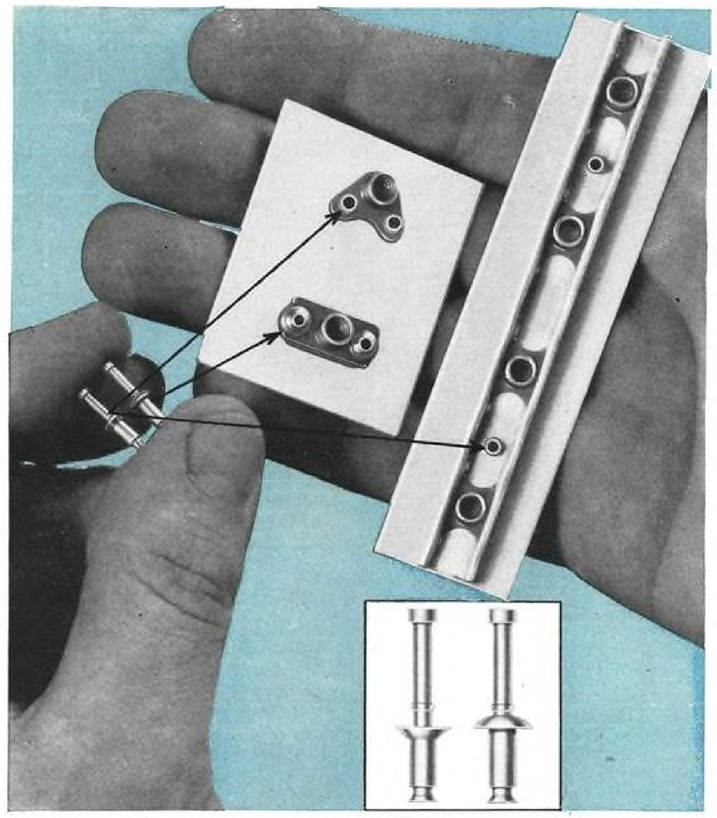
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The new 3/32" Monel Hollow Pull-Thru Cherry Rivet can be installed with all existing Cherry Rivet guns, including the G-25 Hand Gun.

For technical information write to Townsend Company, Cherry Rivet Division, P. O. Box 2157-N, Santa Ana, Calif.

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fuel consumption, and 182 lb. gross thrust.

Engine over-all length is 60.82 in., and maximum diameter is 27.45 in.

Basis for the Blackburn A.129 is the Turbomeca Artouste 600 gas turbine, being built under license by Bleakburn. Major purpose of the design was to break into a new power range; basic engines now on Blackburn's production line are on the order of 300 to 400 shp.

The A.129 starts its life at 840 shp., presumably a sea level equivalent rating. Development to a power of 950 shp. is planned. The engine also will be available as a turbojet, as an air-producer or gas-generator, as a fixed-shaft or free-turbine engine, fitting it for the wide variety of jobs now being done by the company's smaller engines.

Module for all these engines is the centrifugal compressor and single-stage turbine of the Palas 600, a small 328-lb. thrust turbojet. Given a new two-stage turbine, this engine became the Artouste 600, a turboprop of 414 shp.

Blackburn's Engine Division project team started with the Artouste 600 and added to it a two-stage transonic axial-flow compressor upstream of the centrifugal unit to increase the air mass flow. With this increased output, they added another turbine stage—presumably the free turbine for power output—to the two-stage turbine of the Artouste.

The result ran in July this year for the first time, and by Farnborough show time, the company had enough background on the engine to give it a first rating and to announce some of its development potential.

Only preliminary performance data are available. First details at Farnborough gave an engine rating of 690 shp., but pictures released of the A.129 showed an initial performance rating of 840 shp. Specific fuel consumption is given at 0.83 lb./shp./hr. Engine weight, including a two-stage gearbox, is estimated at 390 lb. Over-all length is 60 in. and maximum diameter is 19.75 in.

Both these figures do not allow for intake or exhaust ducting.

Suspended in a ring by thin cables, the de Havilland Gnome (T58) engine was one of the big attention-getters in the static display at this year's Farnborough show. De Havilland has been running Gnome engines on its test stands at the Stag Lane factory, getting calibration and performance data prior to production of the engine under the license agreement concluded as an extension of the seven-year old technical interchange agreement with General Electric Co.

De Havilland says the initial use of the engine in Great Britain will be for helicopters. There has been speculation that this could refer to a project to re-engine the Westland Wessex, now powered by a single Napier Gazelle of about 1,800 shp., 5 min. rating.

Early models of the Gnome probably will be identical to the T58; this resemblance will continue through the series as far as the basic layout of the engine goes. Complete technical details of the T58 were reported in AVIATION WEEK (Mar. 17, p. 52).

Performance of the Gnome probably will closely parallel the figures for the T58. Latest data for that engine gives a continuous cruise rating of 900 shp. with a corresponding specific fuel consumption of 0.67 lb./shp./hr. Military rating is 1,050 shp. with 0.64 specific fuel consumption.

Over-all engine length is 54.8 in., not including nose bullet. Maximum flange diameter is 16 in.

Napier Gazelle Jr. is designed primarily for the helicopter market, although a turboprop version will also be available. For conversion programs, the engine will also be built in a coupled form so that single-engined helicopters can be changed to a twin-engine layout for the increased operational safety required.

Basically a scaled-down Gazelle, the Gazelle Jr. has an axial-flow compressor driven by a two-stage turbine. Power output of the engine comes from a third stage free turbine through an epicyclic gear train incorporating a hydraulic torquemeter.

Napier also has developed the fuel metering unit for helicopter applications. It has a single-level control for power setting, prevents surge during rapid accelerations, compensates for variations in flight conditions, and controls engine overspeed, turbine inlet temperature and maximum torque.

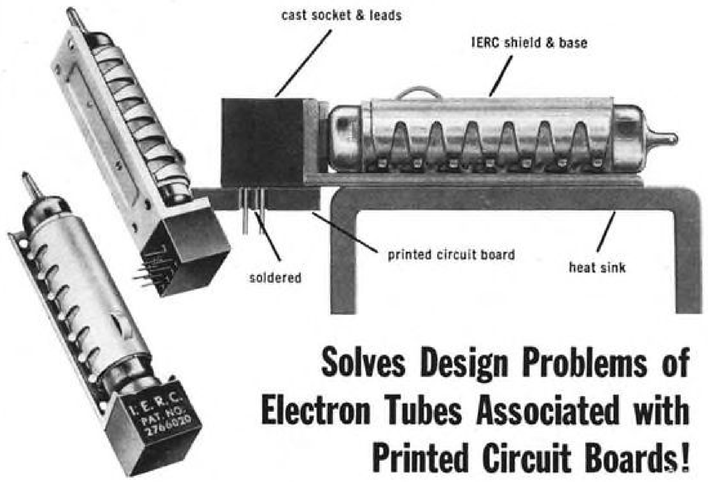
If there is a transmission system failure, the torquemeter senses the change and signals the engine for shutdown before the free turbine can overspeed. In a twin-engine installation, power of one engine is increased automatically if the other fails. These features are not new on Gazelle Jr. but were developed for the Gazelle.

Like its bigger brother, the Gazelle Jr. is an all-angle engine, with installation variations possible between horizontal and vertical upright. Left or right-hand rotation of the power turbine is available to suit rotor rotation.

Initial maximum continuous rating offered by Napier is 680 shp., with a corresponding one-hour rating of 765 shp. and a maximum power of 920. Development of the engine is estimated to increase these ratings to 800 shp. maximum continuous, 900 shp. for one-hour rating, and 1,070 maximum for 5 min.

Over-all length of the engine is 54 in., and maximum diameter is 33 in. Basic weight is 495 lb.

IERC Heat-dissipating "plug-in" Tube Shields for Printed Circuits!



Solves Design Problems of Electron Tubes Associated with Printed Circuit Boards!

IERC's latest heat-dissipating tube shields for round button and flat press subminiature electron tubes solve design and performance problems of tubes associated with printed circuit boards. Standard socket and an Epoxy resin are integrally cast to the shield base. Socket leads extend from the Epoxy casting 90° to plane of base permitting direct plug-in to printed circuits for hand or dip-soldering of connections. Bulb temperatures are maintained to within 5°C of the heat sink temperature per watt of heat-dissipation when shields are attached, as suggested, to a heat sink of proper thickness for conduction or hollow duct types permitting air or liquid circulation. IERC's patented design provides maximum cooling, excellent tube retention, shock and vibration protection under severe conditions. Pertinent dimensions are to .1 inch grid layout.

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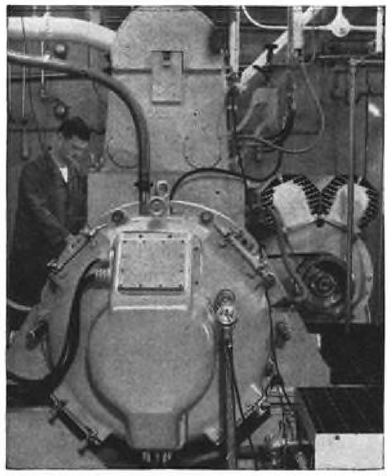
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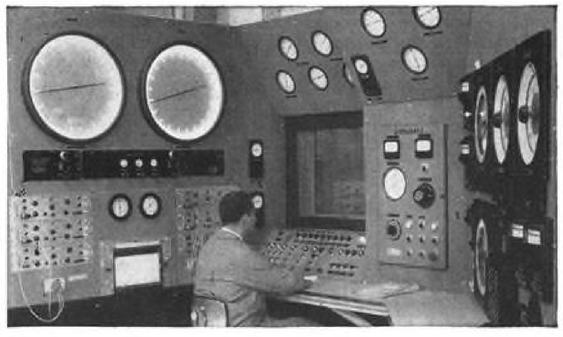


New Departure makes a complete line of jet engine, auxiliary turbine, and accessory bearings for the aircraft industry.



Test stand for running jet engine ball bearings at high speeds, high temperatures under heavily loaded conditions.

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Instrumentation and control console for test stand shown above, for testing full-scale mainshaft ball bearings.

Tomorrow's needs are today's concern at the aircraft ball bearing research facilities at New Departure. For, the future development of the ball bearing will be closely identified with future engine design trends. This means New Departure spares no effort in developing bearings to operate at higher speeds, heavier loads, and under higher temperatures with good bearing-life predictability.

As always, New Departure keeps pace with changing conditions in the industry. For New Departure's design and fabrication processes for current high-speed, high-temperature, heavily loaded ball bearings are major factors in the successful operation of today's jet engines, as well as auxiliary turbines and accessories.

For aircraft and accessory bearings, send for **CATALOG ABC.**

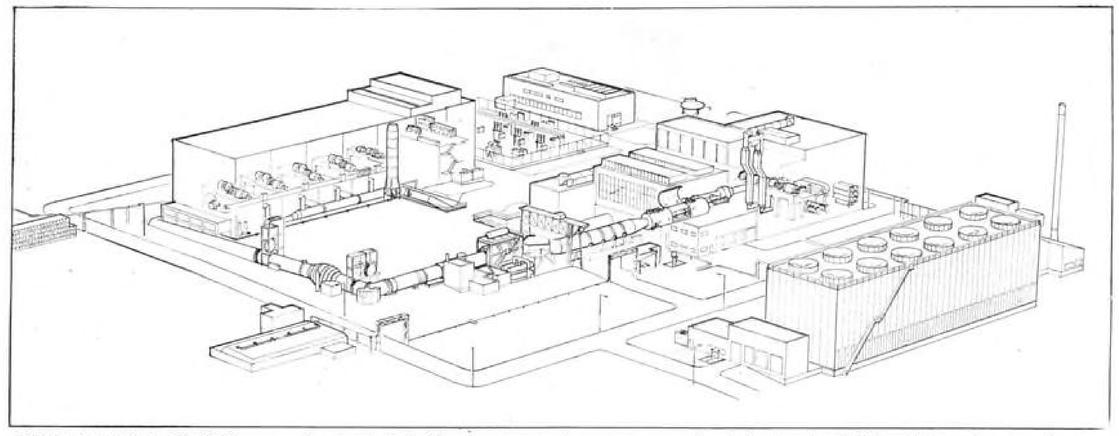
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1908–1958 GM FORWARD FROM FIFTY

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NOTHING ROLLS LIKE A BALL



OVER-ALL VIEW of Rolls-Royce engine test bed facility shows control room on upper level of exhauster building (left); primary cooler (center of drawing); secondary cooler (left of center between primary cooler and exhauster building). One engine test cell is visible at right of center. Cooling turbine, recuperating turbine, input compressors and 2,000 hp. motor are lined up (left to right) at right angles to, and behind, visible engine test cell. Drying plant, water-cooled heat exchanger and transformer are behind last-named components.

Engine Test Facility Design Cuts Costs

By John Tunstall

Derby, England—Flexible arrangement of new Rolls-Royce high altitude engine test bed facility is designed to slash capital and running costs and has made possible a control system which permits a complete flight plan from takeoff to landing to be automatically programmed.

Installation, formally opened in late September, has already logged 200 operational hours. Total cost of the plant does not exceed $16 million.

Plant can provide combustion air at a mass flow of 150 lb. per sec. at temperatures down to −90C and can simultaneously evacuate a test cell to 0.5 pounds per square inch absolute (75,000 ft. altitude). A maximum combustion air pressure of 55 psi. meets the Mach 2.5 requirement at any altitude above 36,000 ft.

Two Test Cells

Facility comprises two separate engine test cells (one having a dynamometer for testing shaft engines), a compressor test rig and a combustion test rig. Total installed horse power is only 132,000, which is generated by six identical synchronous motors of 22,000 hp. each.

The plant is capable of accepting any turbojet or turboprop engine envisaged within the next few years and of simulating any operational condition, Rolls-Royce said.

For the same facilities, cost of a conventional test plant would have reached $45-60 million, designers said.

Main reasons leading to the facility's low cost and flexibility are:

- **Use of constant** speed motors and compressors and extensive use of air turbine drives.
- **Manner in which** the six motors and compressors are compounded to provide high pressure combustion air (55 psia. to 1 psia.) to operate the compressor and combustion rigs, and to evacuate the engine test cells.
- **Use of recuperative** air turbines mounted on the compressor shafts which enable excess air in long-duration part-load tests to be used profitably.
- **Air expansion turbine** mounted on the combustion air compressor shaft which develops the low air temperatures (−90C) needed in the engine intake obviates need for a refrigeration plant. In addition, it also helps to recuperate up to 75% of the compressor power load.
- **Diffusion of engine** exhaust in the test cell which increases exhauster pump capacity by 25%.
- **Use of a 15,000 hp.** air turbine to drive the compressor rig, instead of variable speed compressors and a Ward Leonard control system.
- **Common primary** and secondary coolers which are shared by the two test cells.

Project was originally conceived by Harry Wood of Rolls-Royce and subsequently developed by Basil Wood, one of the senior members of Merz McClellan, consultant engineer firm.

Use of the 15,000 hp. expansion turbine, costing only a "few thousand dollars," instead of a conventional refrigeration plant, "alone saved nearly $6 million," Basil Wood told AVIATION WEEK. "But it proved controversial."

Apart from being one of the largest turbines ever built, he said nobody "would guarantee any material for work in these temperature conditions.

"Just about everybody frowned on the idea," Wood said. Among the objectors were experts at the National Gas Turbine Establishment where a much larger facility using a refrigeration plant is nearing completion.

Turbine is made from a high nickel alloy which offers high notch strength at low temperature. So do the austenitic steels which have no change point but these were too expensive.

Combustion air compressed to 55 psia., 190C, passes through a water-cooled heat exchanger, an ammonia refrigerating plant, centrifugal water separator and finally a chemical drying plant.

Temperatures Attained

Final temperature is 8C. Temperatures between 8C and 190C are obtained by mixing. Temperatures between 8C and −90C are obtained in the expansion turbine.

All turbines are of the impulse type and single stage but have twin blade rows with opposed nozzle entry, which lowers disk size and balances the thrust.

The expansion turbine is of the partial admission type with eight valves to vary the number of admission nozzles and so provide the temperature and pressure conditions required in the combustion air. When necessary the turbine is bypassed.

Several million dollars were also saved, Wood said, by using a 15,000 hp. air turbine to drive the compressor rig. This is powered by two

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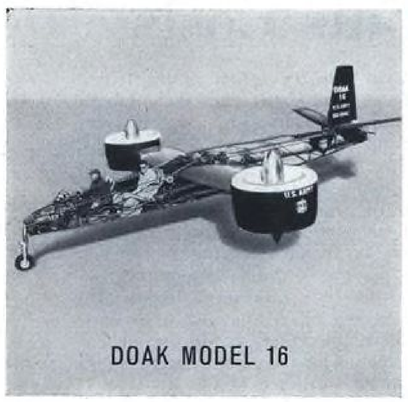
BRANTLY YHO-3



GRUMMAN AO-1



VERTOL VZ-2



DOAK MODEL 16



VERTOL YHC-1A



RYAN MODEL 92



HILLER H-23D



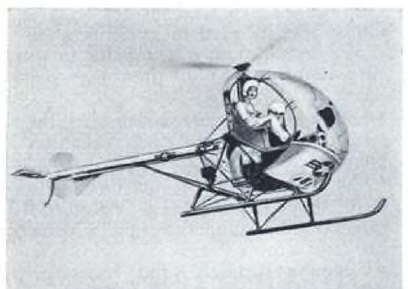
BELL H-13H



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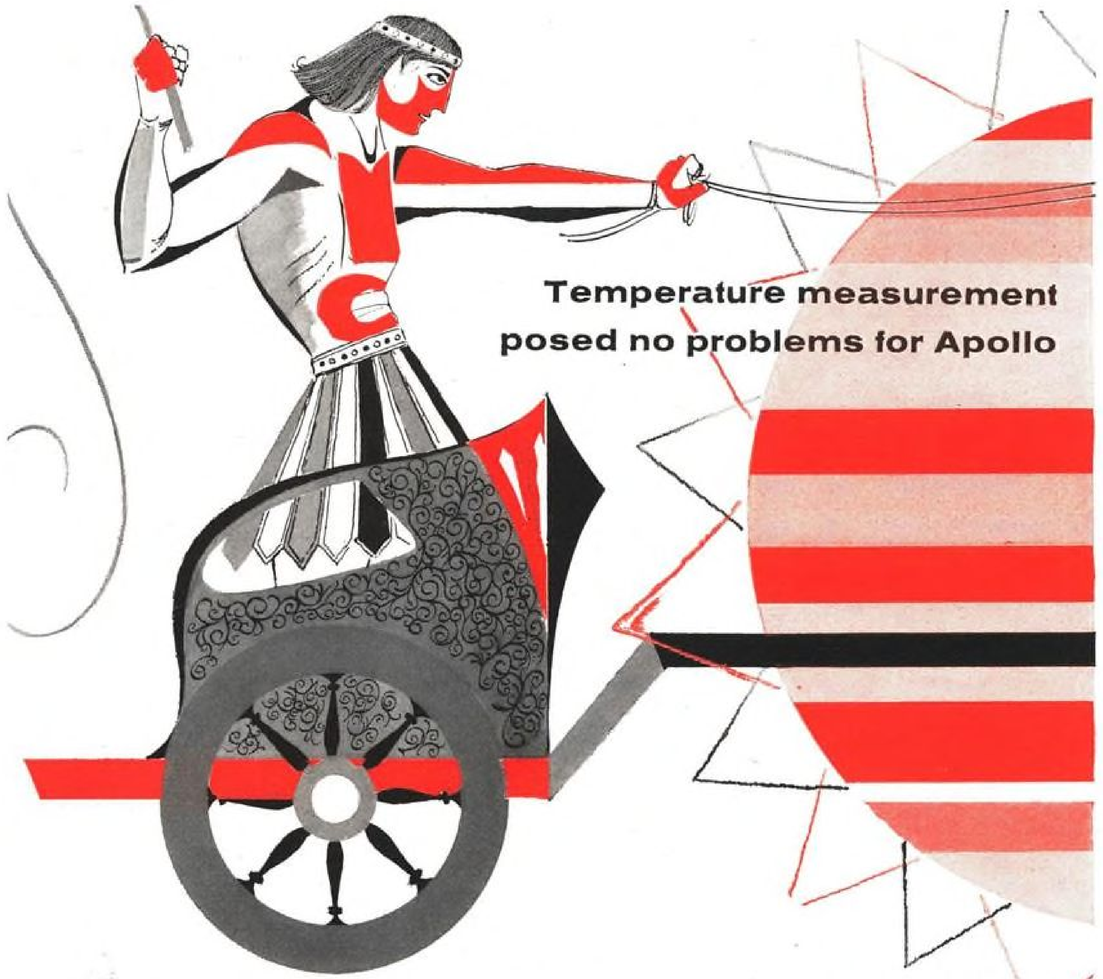
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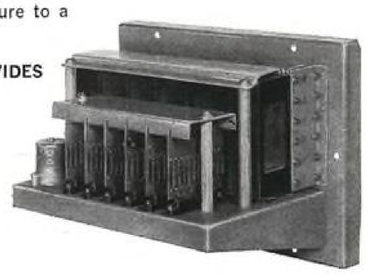


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When Apollo was ranging the heavens he had no temperature problems because he was God of the Sun. Today's missile engineers, being mortal men, have had to find the vital key to many temperature problems in the race to conquer space. Now...after years of development, Magnetic Research Corporation has solved these difficult problems with the Universal Temperature Measuring System. A system so reliable...so accurate...so versatile under all conditions, that it reduces the measurement of temperature to a routine procedure.

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of the exhauster compressors compounded to supply 200 lb. of air 155 psi. and 200C. Compressor speeds varying between 3,000 rpm. and 11,000 rpm. are obtained by throttling the air supply to the turbine.

The other three compressors remain available for simultaneous evacuation pumping.

Conventionally, a Ward Leonard system would have been used to control variable speed air compressors.

A recuperative turbine on one of the compressor shafts also accepts excess air during steady state part load tests.

All five of the exhausters are axial compressors having the same mass flow of 200 lb. per sec. (sea level intake), a compression ratio of 3.8. But the fifth is designed to pump upwards from sea level pressure and has only one-third volumetric capacity.

Axial compressors were chosen, Wood told AVIATION WEEK, because they were cheaper. But when compounded in parallel steep operating characteristics can lead to a surge condition which in spite of use of steel blades can cause blades of first set to melt. Instrumentation has been provided to look after this condition. "But if we did another," Wood explained, "we would use centrifugal compressors."

Test Program

Tests on Avon and Conway engines to date have examined steady state performance at various altitudes. System has been manually controlled as this is the most accurate for steady state testing. It also allowed testing to get underway while the instrumentation equipment was being commissioned.

Group Capt. G. E. Watt, who heads the facility, said, "In any case we are learning to walk first." Results to current tests have been compared with theoretical and flight performance records.

Tests have also been conducted in the facility at heights around 75,000 ft. for which no flight data exists. "So far we have proved no serious lack of agreement," Group Capt. Watt explained, "with flight data already collected."

Plant commissioning has now reached the stage where the control system can undertake transient power engine tests at various altitudes automatically.

But, according to the group captain, it will probably be two years before a complete flight schedule from takeoff to landing and including diving maneuvers can be automatically programmed with the control system.

One of the main control difficulties in automating the system has been the lack of data concerning the very large air valves used. These are much bigger than have ever previously been used

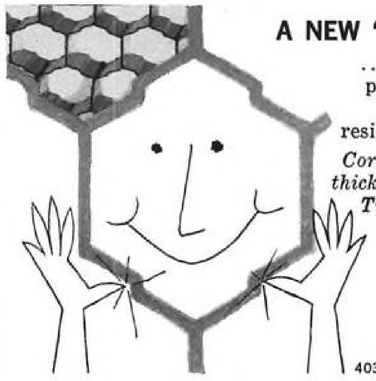
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XII

This is the twelfth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Vanadium Alloy Steels and Their Uses

Though the beneficial effects of vanadium in alloy steels have been known for many years, the ore was at one time a comparative rarity. Vanadium is still rather expensive because of the care required in processing the ore; however, there are now ample supplies for present-day applications.

Vanadium is a highly valuable alloying agent. It is an extremely powerful deoxidizer, though seldom used primarily for that purpose. Vanadium also tends to form stable carbides in steel—carbides that do not go readily into solution when heated above the critical temperature for quenching. The grain-growth-inhibiting effect of vanadium promotes a fine-grained structure over a fairly broad quenching range, thus imparting strength and toughness to the heat-treated steel. Moreover, the carbides are not prone to agglomerate during the tempering operation.

Vanadium is used in constructional steels, not only to refine the grain, but to improve the mechanical-property balance. Generally speaking, the amount of vanadium in constructional steels ranges from approximately 0.03 to 0.25 pct, though larger quantities are required in tool steels and special analyses.

A list of products containing vanadium would include certain types of spring steels, plates, gears, high-temperature steels; forged axles, shafts, and turbine rotors; and other items requiring impact- and fatigue-resistance.

You are invited to consult with our staff whenever you need information about vanadium steels. Bethlehem metallurgists will gladly advise you regarding analyses, heat-treating, machining, and anticipated results. Please remember that the services of these technicians are yours for the asking, and that no obligation is implied.

And may we point out, too, that Bethlehem makes all AISI standard alloy steels, as well as special-analysis steels and the full range of carbon grades. Call upon us for your alloy steel requirements; now and always, we will endeavor to meet your needs promptly.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

in this type of work. Several are over four feet in diameter and had to be made in Germany as no British company had experience with the size.

Early troubles involved damage to the valves due to the fast reaction rates needed.

One of the throttle valves used in the exhauster ducting has multiple vanes in the venetian blind arrangement.

Due to the high vacuum, leakage past the valves could seriously waste the exhauster capacity. Water seals were inadmissible.

Compressor and turbine sets were provided by Brown Boveri, Ltd., and the automatic control system is based on a much smaller wartime plant which this Swiss company developed for the Swiss army. Main difference in the British test facility control system is the use of magnetic amplifiers.

Provision has been made for re-heat testing but a cooling capacity restriction will impose limitations on the test program envelope. According to Basil Wood, the Rolls-Royce test facility can accommodate ramjet tests but this was not given emphasis in view of the ramjet facility now in operation at Bristol Aeroplane Co.

The facility has been built of brick without windows to effect noise attenuation. It is lined with sound blocks.

Test cells 12 ft. in diameter meet the most stringent structural conditions in any test installation in Britain. Plenum chamber section of the test cell is fabricated from stainless steel plate up to 1½ in thick. The whole cell is supported on two roller-mounted trunnions which enable the cell to expand freely radially. Axial movement amounts to four inches.

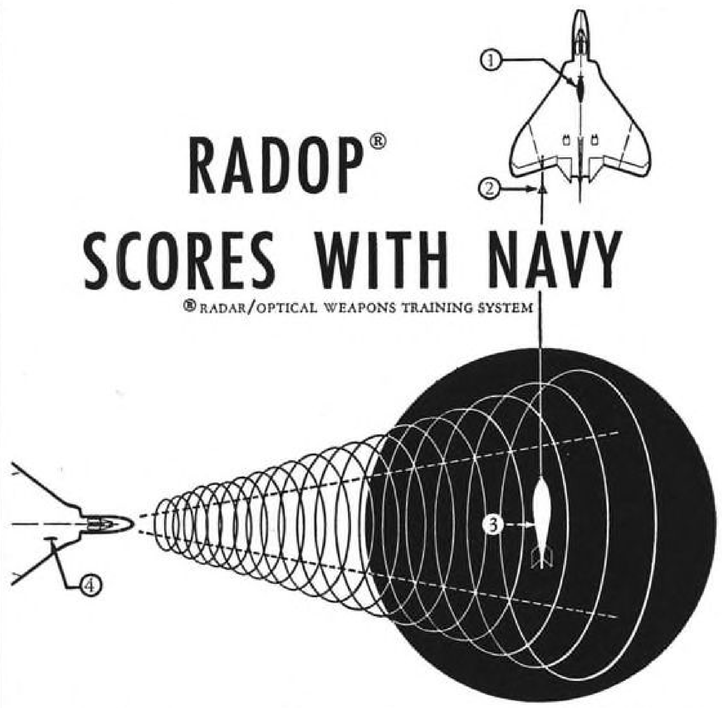
Apart from meeting the altitude intake condition of a pressure of 1 psia. it is stressed to stand a pressure of 100 psia. in the event of an explosion.

Some combustion air is fed through the bulkhead in the cell which separates the plenum chamber from the remainder of the engine and its jet pipe. This is to maintain the engine at temperature levels encountered in pod or wing.

Engine is mounted on a floating cradle connected to a thrust measuring machine. Engine exhausts into a water-cooled tube within the test cell. Engine is mounted on a dolly in a preparation room, which is a transportable part of the cradle and carries battery plates for the manometer and electrical connections. Most of the valves in the control system are hydraulically powered and actuated via magnetic amplifiers operating from pressure and temperature sensing elements. Magnetic amplifiers compare these signals against manually set values. Out of balance causes main valves to move until the error is canceled.

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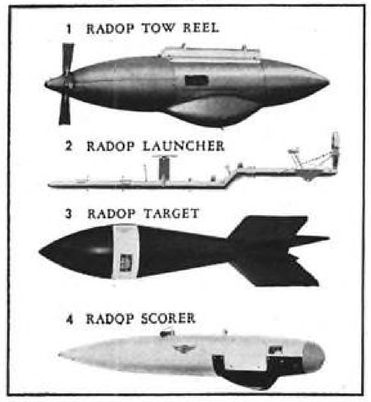


Del Mar Engineering Laboratories' *Radop Weapons Training Systems* are used extensively in the training of U. S. Navy Pilots. By firing rockets and missiles at inexpensive Radop Tow Targets and by using Radop Scorers to measure miss-distances in three-dimensions, the Navy saves U. S. taxpayers millions of dollars and introduces *a higher degree of realism* into training than is possible with other more costly systems.

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Four titanium alloys, said to be designed primarily for the aircraft and missile field, are now awaiting patent issue.

MST-2½ A1-16V, 2½% aluminum and 16% vanadium, has a 65,000 psi. yield strength and is said to be well suited for honeycomb structures. MST 821, 8% aluminum, 2% columbium and 1% tantalum, is said to have high temperature strength characteristics for use "farther aft" in jet engines. MST-3A1-2½V is designed especially for high strength tubing. Tubing from this alloy can be flared 50%, and age hardening can strengthen the tubing to 120,000 psi., the maker states. MST 185 is an experimental alloy designed to have high strength in the annealed condition. Age hardened, the alloy is said to have a tensile strength of 260,000 psi. With the exception of MST 185, alloys are available in standard mill shapes.

Mallory-Sharon Metals Corp., Niles, Ohio.

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Airport Derrick

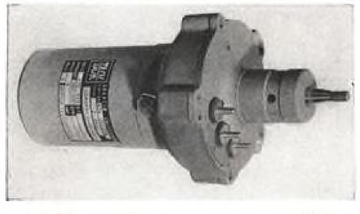
Truck mounted derrick is designed to service jet airliners and aid in hangar maintenance. Fully extended, the boom will lift a 600 lb. load to a height of 65 ft. With two of its three sections extended, the boom will support 2,000 lb. Hydraulic telescope-boom folds to within the wheelbase of a 2½ ton truck. Weight, including truck is 15,000 lb.

Truck Equipment Co., 3963 Walnut St., Denver, Colo.

Feathering Pump Motor

Continuous-duty feathering pump motor is said to be lighter in weight than existing motors which must be operated intermittently.

Model 424 motor weighs 7 lb., draws 19 amps, and may be operated in an ambient temperature range from −65 to

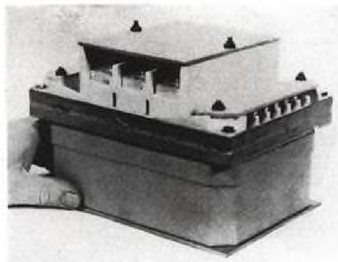


+165F. Under emergency conditions at −65F, torque is 92 in. lb. at a current of 65 amp., the maker states. Unit is lubricated and cooled by oil circulated through the rotor and stator by an internal pumping system.

Task Corp., 1009 E. Vermont Ave., Anaheim, Calif.

Aircraft Circuit Breaker

Circuit breaker for aircraft electrical systems is designed for operation in an ambient temperature of from −65 to



+600F and at altitudes of 75,000 ft.

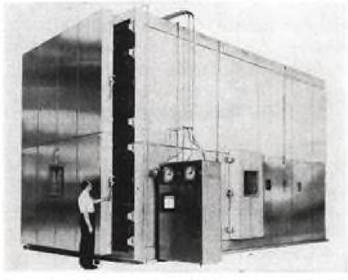
Latch-type breaker has an a.c. rating of 225 amp at 480v, 400 cycles, 3 phase. Adaptable to d.c. applications, the 18.5 lb. unit is designed to operate at 250v d.c. and carry 500 amp. for 15 min. Breaker life is said to be 1,000 hr. with 5,000 interruption at rated current. Contact closing time is 0.05 sec. or less, and trip time is 0.01 sec. or less.

Westinghouse Electric Corp., Lima, Ohio.

Environmental Test Chamber

Environmental test chamber is designed to simulate extreme atmospheric and environmental conditions at surface pressures. Unit is equipped to provide vibration tests of components and completed items.

Designed to test very large units the



chamber internal working area, 15 ft. high by 12 ft. wide by 25 ft. deep, permits trucks to be driven into the unit to unload heavy components. Temperature range is from −100 to +200F, with humidity simulation between 20 and 95% between temperatures of +35 and +185F.

American Research Corp., Farmington, Conn.

Borane Analyzers

Borane analyzers, both portable and non-portable, are designed to measure the amount of toxic boron hydride fuels in the atmosphere. Portable unit is a colorimetric spot test instrument. The number of pump strokes required to develop a color on the filter paper equivalent to that of a reference standard, is used as an index of borane concentration.

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1. Conventional type fuel pump pressurizes fuel.
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Dramatic and convincing proof of the system's superiority is the world record distance flight of Capt. M. L. "Pat" Boling, from Manila, P.I., to Pendleton, Ore.—approximately 7,000 miles—in a current production Beechcraft Bonanza J35, on which Continental Continuous-Flow Fuel Injection is standard.

Continental Motors, power specialists since 1902, present the Continental Continuous-Flow Fuel Injection System as the greatest advance in its field in many, many years. Designed, developed, and built exclusively by Continental, and proved in well over a million miles of trouble-free flight, it brings an entirely new concept of performance, safety, dependability and economy to flying, vastly broadening the usefulness of airplanes.

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★ BETTER ACCELERATION, with none of the characteristic flat spots just above idle. Fuel doesn't have to travel from a distant carburetor; it's right at the cylinder all the time.

★ FREEDOM FROM ICING. The engine icing hazard is eliminated entirely, because the refrigerating effect of vaporizing fuel at the carburetor has been removed.

★ REDUCED MAINTENANCE, resulting from extreme simplification. (See cut.)

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borane detectors is a boron analyzer for measuring boron content of liquid streams to within 1% by volume. Analyzer operates on the neutron absorption principle, in which detection is based on capture of thermal neutrons by the boron atoms of the compound.
Mine Safety Appliances Co., Pittsburgh, Pa.

WHAT'S NEW

Publications Received:

Russian-English Glossary of Guided Missile, Rocket, and Satellite Terms—Compiled by Alexander Rosenberg—Pub. Card Division, Library of Congress, Washington 25, D. C. $2.50; 352pp.

A Russian-English translation of all the most important technical terms of rockets and missiles.

Aircraft and Missile Propulsion, Volume II—by M. J. Zucrow—Pub. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $13.00; 636pp.

This the second volume in a three-volume series furnishing the engineer with technology pertinent to various propulsion engines.

British Naval Aircraft 1912-58—by Owen Thetford—Pub. Putnam & Co. Ltd., 42 Great Russell Street, London, WC1. $7.20; 426pp.

A first complete reference book of aircraft flown by the Naval Wing, Royal Naval Service and Fleet Air Arm.

C. F. S. Birthplace of Air Power—by John W. R. Taylor—Pub. Putnam & Co. Ltd., 42 Great Russell Street, London, WC1. $2.94; 222 pp.

This book gives the background and present history of the British Central Flying School.

The United States Air Force Report On The Ballistic Missile—Edited by Lt. Col. Kenneth F. Gantz—Pub. Doubleday & Company, Inc., 575 Madison Avenue, New York 22, N. Y. $4.00; 338pp.

A book compiled by the U. S. Air Force, concerning the production, development, and use of the ballistic missile.

Control System Components—By John E. Gibson, Ph. D. and Frank B. Tuteur, Ph. D. Pub. McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. $12.00; 493pp.

Methods of analysis and basic engineering principles are presented from the point of view of the system engineer. The basic aim of the book is the calculation of transfer functions for the device under consideration.

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Two unique CEC Pressure Pickups, the 4-316A and 4-317, now combine to offer a wide range of pressure measurements at extremely high temperatures. Designed for continuous operation at 600°F without cooling, both pickups operate on the unbonded strain-gage principle. Together they cover a pressure range of 15 to 5000 psi gage. The 4-316A is also available in differential (to ±25 psid) and undirectional differential models (0-150 psid). One-piece construction of diaphragm and case . . . machined from 416 stainless steel . . . assures that no foreign substances will come in contact with the measured media. Sizes are ⅜" and ½" nominal diameters for the 4-317 and 4-316, respectively . . . weights, 55 and 23 grams with mounting flanges. These features provide rugged, stable pickups for static and dynamic flight-load testing, engine studies, and supersonic tests where external cooling is not practical.
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USAF Proposes Satellite Relay Stations

By Philip J. Klass

Washington—Use of satellites as passive-type relay stations for transmitting voice, teletype and even television around the globe without the atmospheric interference that now plagues long-range radio communications, holds "tremendous potential for improving national defense," an Air Force spokesman reported here during the National Symposium on Extended Range and Space Communications. Symposium was sponsored by Institute of Radio Engineers and the George Washington University.

A paper presented by Maj. Edward N. Wright, chief of Communications Division, Air Research and Development Command headquarters, reveals that Air Force is studying the possibility of using four satellite relay stations that would orbit around the equator at an altitude of about 22,300 mi. so that they remain fixed relative to the earth as the latter rotates.

Signal Relay

Four ground stations, for example, located at 90 deg. longitude intervals around the earth near the equator, could bounce radio signals off the satellites to the next adjoining ground station. Signal could, if desired, be relayed completely around the world. Additional stations located in the north and south hemispheres could also use the satellites as a relay.

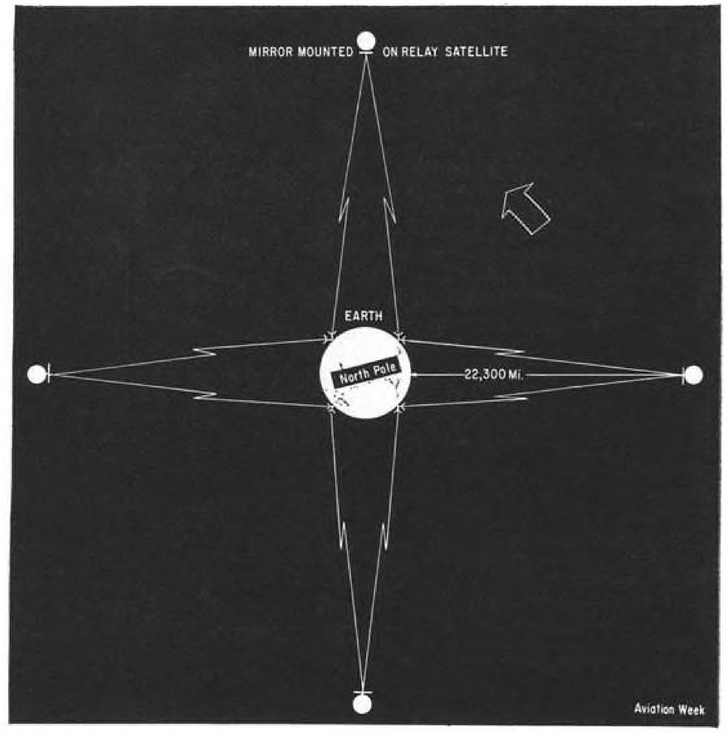
Problem of placing four satellite relays into an earth-synchronized orbit is far from easy, Maj. Wright emphasized, because each must arrive at precisely the correct position, altitude and orbital speed. Failure to achieve proper altitude and/or orbital speed will cause the satellite position to drift relative to ground stations.

Wright's statement that another extremely difficult requirement is that satellite attitude must be stabilized within one-quarter degree suggests that USAF is thinking of using a flat plate (mirror) type reflector rather than a simple sphere. Advantages of the flat reflecting surface relay include:

- **Increased bandwidth:** Compared with a simple sphere, a flat surface should provide increased bandwidth and permit transmission of video signals as well as voice and teletype.
- **Increased security:** Extreme directivity of signals reflected from a flat surface provides more privacy and makes the system less vulnerable to enemy countermeasures.
- **Lower power transmitters:** Greater gain of the mirror reflector over that obtainable from a simple sphere would permit use of lower power transmitters on the earth.

Wright did not rule out the possible use of powered satellite repeater stations, which would re-broadcast signals received from earth, but pointed to the problems of reliability and obtaining electric power for the satellite avionic equipment.

In a lightweight satellite, whose avionic equipment required 100 watts of



GLOBAL communication system, using four satellite relay stations at an altitude of 22,300 mi. so they orbit at the same speed as the earth rotates, maintaining them as fixed relative to earth-based relay stations, is under study by the U. S. Air Force.

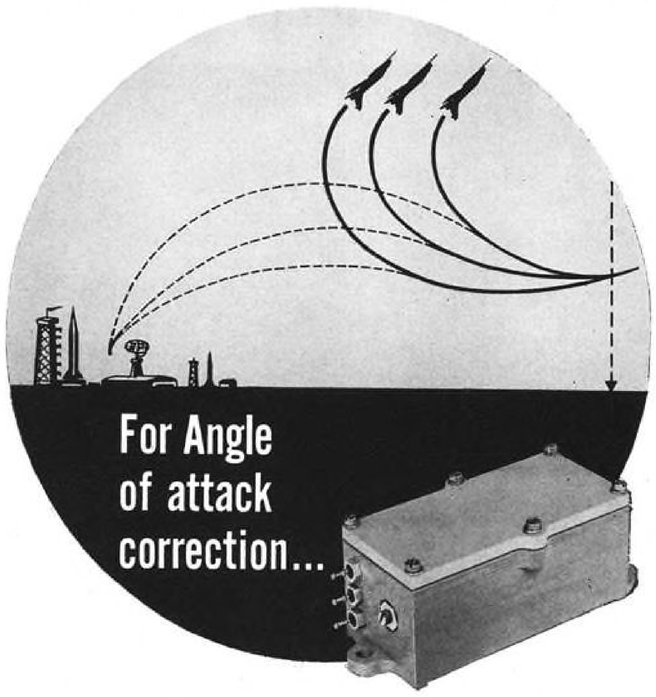
Moon Probe Television

Use of space vehicles as celestial observatories above the earth's atmosphere will open the way to using ultraviolet and X-ray radiations from celestial bodies, C. P. Sonett of Space Technology Laboratories pointed out. He predicted that X-ray and ultraviolet astronomy would become a serious competitor to radio astronomy for proving the heavens. To relay these and interplanetary probe observations back to earth will require that the satellite be equipped with a television system capable of transmitting information over a relatively narrow radio frequency passband.

To simplify the space vehicle's television equipment, Sonett described a system in which the spinning motion which is imparted to the vehicle to stabilize it also serves as a simple scanning arrangement for the television system. However, an internal viscous damper or other similar arrangement must be employed to damp out any motion of the vehicle about its other axes. Sonett described, and showed pictures of a miniature television system which Space Technology Laboratories developed, presumably for use in the Air Force's lunar probe. System weighs 2¼ lb. and transmits approximately one line per minute, each line consisting of 128 elements.

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When the prime contractor for the M-1 Toss Bomb System required a highly reliable miniature accelerometer for the bombing computer used in U.S.A.F. Tactical Bombers, Fairchild was called in. Fairchild's Sales and Customer Engineering Group working closely with the Contractor's Engineers developed the TA-100 pictured below.



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Overall accuracy	1.5%	1.5%	better than 1%

The TA-100 and TA-200 can be supplied with A.C. type or Fairchild's Nobl-Ohm infinite resolution Film Pot pick-offs on special order.

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power, approximately 70% of the total payload would be required for batteries or other power source, with only 5% available for the repeater communications equipment, Wright said. In another five years, with larger satellites having payloads of several thousand pounds and requiring power of around 1,200 watts, the power source may represent only 15% of the total payload, leaving more of the payload for primary communications equipment, Wright said.

Figures presented by Wright indicate that batteries are the most efficient source of satellite secondary power in terms of weight and size for periods of continuous operation up to about 10 days. Beyond that period, solar and nuclear powered sources appear to be more efficient, Wright said.

Unsynchronized Satellites

Because of the difficulty of achieving precisely synchronized satellite orbits, two other symposium speakers discussed the feasibility of using lower altitude satellite relay stations, each of whose positions is continuously changing relative to ground stations which must use steerable antennas.

Utilizing the statistical techniques of probability, it is possible to compute the number of randomly placed satellites that are needed along any selected orbital path in order to assure any desired degree of probability that at least one of them will be in view of two widely separated ground stations at all times.

Using these statistical techniques, Dr. John R. Pierce, Bell Telephone Laboratories, cited the following figures for the number of satellites required in a 3,000-mi. orbit to provide the percentage of visibility time shown, assuming the satellite could be tracked to the horizon:

- **Nine: Visible 90% of the time.**
- **12: Visible 95% of the time.**
- **19: Visible 99% of the time.**
- **28: Visible 99.9% of the time.**
- **37: Visible 99.99% of the time.**

In practice, it probably will not be feasible for ground stations to track a satellite all the way down to the horizon because of noise and interference, so that the number of satellites required would have to be increased, by 25 to 50%.

Dr. Pierce, director of research for Bell Telephone Laboratories Electrical Communications Department, who writes science fiction as a hobby, was one of the first to study and suggest the feasibility of satellite relay stations in technical papers presented nearly four years ago, three years prior to Sputnik I.

Several significant developments since Pierce's initial studies have further enhanced the feasibility of using satellite relay stations, he unequivocally said:

- **100-ft. inflatable sphere,** developed by National Aeronautics Space Administration, which NASA hopes to place in low-altitude orbit for atmosphere density studies, would make an ideal low-cost passive relay, Pierce says.
- **Maser,** newly developed extremly low-noise atomic amplifier, should make it possible to reduce transmitter powers by factor of 100 from those required if conventional tubes were used.
- **150-ft. steerable antennas,** being constructed for use in radio astronomy, could be used for bouncing signals off satellites.

Pierce said it was technologically possible with the existing state of development to provide world-wide transmission of television, if someone were willing to put up a sufficient number of NASA 100-ft. inflatable spheres.

Pierce said that use of eight currently available power tubes operating in parallel at 2,000 mc. would make it possible to generate 80 kw. power required for an earth-based transmitter. Improved operation might be possible at higher frequency, around 8,000 mc., but there are no high-power tubes presently available for continuous-wave operation at this frequency, although there is no basic reason why they cannot be developed, Pierce said.

Active vs. Passive

For military applications, the passive type satellite relay has several attractive advantages over the active (self-powered) repeater type, according to D. C. MacLellan of Lincoln Laboratory. Active repeater type must transmit with limited power, use a relatively small, low-gain, broad-beam antenna—at least for the immediate future.

With a passive type satellite relay, extremely large, narrow-beam antenna on the earth can achieve considerably more selective distribution of radio signals to desired destination—particularly if a flat (mirror) reflecting surface is installed on the satellite. Another advantage: ground-based transmitter can employ considerably more sophisticated anti-jamming techniques, can quickly change frequency.

Still another advantage is the fact that a variety of different signals at different frequencies can be bounced off a passive satellite relay, whereas an active relay would require a number of different receivers and transmitters.

Main point of a recently published report on "Tentative Evaluation of Transmission Factors for Space Vehicle Communications," prepared by Army Signal Radio Propagation Agency, Ft. Monmouth, N. J., were reported by Solomon Perlman of that agency:

- **Faraday rotation** of the plane of polarization of signals from a space vehicle with a directive antenna will be a prob-



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If you've been looking for an opportunity to explore new engineering territory, the positions now open in our electronics test equipment group may be right down your alley.

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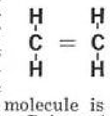
CABLE and WIRE LEADS

By HOWARD E. PENDERGAST
Technical Director, Rex Corporation

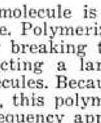
Comparative Properties of Insulating Plastics

Technological advances by manufacturers of electrical and electronic components and equipment are challenging the plastics industry to keep pace. The need for new polymers and copolymers that meet more critical performance requirements is constantly growing. Demands include increased operating temperature range, greater reliability, improved aging and stability, better chemical and radiation resistance and many others. An evaluation of currently available plastic insulating media reveals the progress being made to meet demands.

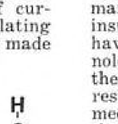
Polyethylene is the logical starting point for a comparative study of plastic insulating. It is one of the most commonly used. Here, the basic carbon-hydrogen molecule is in virtually perfect balance. Polymerization is accomplished by breaking the double bond and connecting a large number of identical molecules. Because of its electrical balance, this polymer is excellent for high-frequency applications. Greater use of polyethylene however, is restricted by its physical properties: relatively low operating temperature and abrasion resistance. These shortcomings have been overcome to some extent by the introduction of "linear" polyethylene with its more controlled orientation of the three-dimensional network.



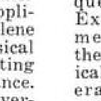
Polyvinylchloride (PVC) is a modification of the polyethylene structure with one chlorine atom replacing one hydrogen atom. This results in physical properties that surpass those of polyethylene: greater abrasion resistance, better dimensional stability, higher operating temperatures and decreased flammability. PVC is readily extrudable by conventional thermoplastic techniques. However, the electrical unbalance of this molecule precludes the use of PVC at elevated frequencies.



Monochlorotrifluoroethylene, more commonly known as Kel-F*, is a modification of PVC with fluorine replacing hydrogen. This substitution, though difficult to achieve, pays off in still-further improved physical properties. Fluorocarbons are more difficult to process than PVC and other carbon-hydrogen linkages. But both the resin manufacturers and the insulation fabricators have made great technological advances in the past two years. The result is an insulating medium offering excellent physical, thermal and chemical properties.



Tetrafluoroethylene, best known as Teflon**, is produced by the total substitution of fluorine for hydrogen in the polyethylene molecule. Like the carbon-hydrogen molecule in polyethylene, this fluorine-hydrogen molecule is in excellent electrical balance and, therefore, is well suited for high frequency applications.



Excelling other commercially available thermoplastics in chemical inertness and operating temperature range, it has singularly provided access to the solution of many different design problems.

Nylon is a readily extrudable complex polymer of nitrogen, carbon and oxygen. Its electrical unbalance and tendency to absorb moisture limit its use as a dielectric or insulating material. However, it is often used in the wire and cable field as a jacket over polyethylene and PVC to increase temperature stability and abrasion resistance.

Which insulation should you specify? Rex Corporation engineers will be glad to help you make the right selection. For an early get-together or technical data for your own evaluation, write today.

COMPARATIVE CHART

	PE	PVC	Kel-F	Teflon	Nylon
Density	.92	1.25-1.45	2.1	2.1	1.14
Abrasion	Poor	Good	Good	Poor	Excellent
Cold Bend	−70°C	−10°C to −70°C	Below 100°C	−90°C	−55°C
High Temp.	100°C	60°C to 105°C	150°C	200°C	105°C (Heat Stabilized Grade.)
Dielectric Const.	60 cycles 2.3 103 106 109 2.3	Depends on Compound	 2.27 2.38	2.0 2.0 2.0 2.0	5.3 — 3.5 —
Power Factor	60 cycles 103 106	Depends on Compound	 .0082	.003 .003 .003	.06 .05 .03
Stiffness	Flexible	Unlimited	Flexible lb/sq. in. 250 x 10^3	Flexible lb/sq. in. 50,000-90,000	Flexible To Very Hard

*Kel-F is a registered trademark of M. W. Kellogg Co.
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lem, particularly during a few hours before sunrise and during daylight hours. Rotation varies inversely with the square of operating frequency. Perlman suggested that it might be well to use circular polarization, despite the resultant 3 db. loss, to minimize this problem.

• **Auroral attenuation,** which varies inversely with the square of frequency, has been observed at altitudes ranging from about 40 to nearly 700 mi., but is most pronounced at lower altitudes. These ion clouds produce reflection and refraction and cause space vehicle signals to reach the earth from unexpected angles with a phase shift which will make it extremely difficult to use direction-finding techniques to pinpoint location of space vehicles.

• **Use of radar** to locate space vehicles is made difficult by the reflections from aurorae. Tests made at Fairbanks, Alaska, using a 400 mc. radar and 61 ft. circular antenna disclosed echoes that are 10 db. above the noise level from aurorae at distances of 450 to 650 mi. away at azimuth angles of 25 to 45 deg. Echoes were also detected at 800 mc., with Doppler shifts as great as several hundred megacycles. Rapidly varying amplitudes of aurorae echoes will sometimes broaden the frequency spectrum of a continuous-wave signal by several hundred cycles, Perlman reported.

Army Signal Radio Propagation Agency predicts that the frequency and severity of ionospheric storms will increase, reaching a maximum beginning September, 1959, and running through September, 1962, Perlman reported.

(Main points of other symposium papers, covering new developments in meteor burst, tropospheric and ionospheric scatter communications, will be reported in a subsequent issue of Aviation Week.)

Expansions, Changes In Avionics Industry

Convair Division of General Dynamics Corp. has formed Datafax Instruments project to design, develop and manufacture a line of specialized instruments and instrumentation systems coming out of the company's aircraft and missile developments. Instruments will include mechanical, a.c. and d.c. measuring devices and pressure and time transducers. Headquarters for Datafax is at 5660 LaJolla Blvd., LaJolla, Calif. Egon E. Muehlner has been named project engineer.

Other expansions, moves or changes announced by avionics manufacturers include:

• **Pacific Semiconductors, Inc.,** has added a fifth building to its Culver City, Calif., facilities at 10001 West Jefferson Blvd. which will be used to make production equipment to be used at new company plant under construction at 14520 South Aviation Blvd.

• **Interstate Electronics Corp.** has broken ground for new 15,000 sq. ft. engineering office building at Anaheim, Calif., which will increase company's total floor space to 71,000 sq. ft.

• **Raytheon Manufacturing Co.** will build $1.7 million flight test facility at Bedford, Mass., under Navy Bureau of Aeronautics sponsorship, to flight-



test missile and aircraft avionic components and systems. Facility will provide 36,000 sq. ft. of hangar area, 36,000 for shop and laboratory.

• **Beckman Instruments, Inc.,** has formed Shockley Transistor Corp. as a subsidiary company to expand development and manufacture of semiconductor devices originally developed by Beckman's Shockley Semiconductor Laboratory, formed in 1956. Dr. William Shockley is president, Maurice C. Hanafin is vice president and general manager.

• **Emerson Electric Manufacturing Co.,** St. Louis, will expand research and facilities of its Electronics and Avionics Division by almost 50% during the next year, company reports.

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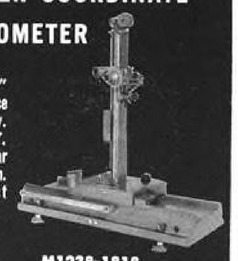
▸ **Defensive ECM for B-70**—Westinghouse Electric's Air Arm Division is competing against two industrial teams headed by General Electric and Radio Corp. of America for defensive electronic countermeasures system contract for North American's B-70 bomber. General Electric's team, headed by its Light Military Electronic Equipment Departments, includes Sylvania (which developed electronic countermeasures for Convair B-58) and Raytheon. RCA's team includes Sperry Gyro (developing ECM pod for Boeing B-52), Ramo-Wooldridge and Melpar. Despite this array of team competition, Westinghouse's proposal reportedly made favorable impression on North American Aviation selection board.

▸ **Electroluminescence Discovered**—Low intensity light emission from barium titanate when excited with a radio frequency voltage has been observed by National Bureau of Standards scientists. Barium titanate is widely used for miniature capacitors, transducers, and ultrasonics and computer storage elements. Discovery was made in the course of National Bureau of Standards investigation of surface effects by G. G. Harman and R. L. Raybold. Emitted light intensity jumps by factor of about 1,000 when barium titanate crystal is heated to its Curie point temperature, the bureau says.

▸ **Pick Your Stick Control**—Navy will flight test and obtain pilot evaluation of several different techniques of control-stick steering for maneuvering jet fighter through its automatic pilot. Tests, to be conducted on a Chance Vought F8U-1, will use multiple-mode system developed by Lear.

▸ **Want to Show Off?**—Manufacturers of data processing equipment and computers who would like to exhibit at the first International Conference on Information Processing, to be held in Paris June 15-21, 1959, should contact Dr. Eugene M. Grabbe, Ramo-Wooldridge Corp., 8820 Bellanca Ave., Los Angeles 45, Calif. Exhibit itself

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► **Come and Get It**—Polycrystalline yttrium-iron garnet, with crystal structure identical to natural garnet, suitable for use in parametric amplifiers, rotators, phase shifters and isolators, has been successfully synthesized by Kearfott Co., Clifton, N. J. Sample quantities are now available, company says.

► **New Honeywell LABS**—New low altitude bombing system (LABS), developed by Minneapolis-Honeywell, which incorporates automatic cross-wind correction and velocity control, will be demonstrated by two North American F-100Fs at forthcoming Air Force gunnery meet at Nellis AFB.

► **Speedy Silicon Diode**—Diffused silicon diode with switching time of only one milli-microsecond (one-billionth of a second) has been developed by Bell Telephone Laboratories. Other attractive characteristics for high-speed switching applications include low capacitance and forward dynamic resistance. Diode's d.c. reverse current is less than 0.01 microamps at 20 v. and breakdown voltage is greater than 40 v.

► **Radio Interference From Diodes**—Semiconductor diodes and rectifiers, which are finding widespread use in avionic equipment, may generate broadband radio frequency interference, James C. Senn of Convair, San Diego, reported at Western Electronic Convention (Wescon). Convair's studies indicate that diodes with relatively slow recovery times are the worst offenders. Delay in reverse recovery allows a sharp current pulse, limited in magnitude only by external circuit resistance, to flow through diode and produce large number of radio frequency harmonics. Interference effect is multiplied when slow-recovery diodes are used in three-phase rectifier circuits, Senn said. He described simple test circuit for selecting interference-free diodes.

► **Alaska, Anyone?**—Civil Aeronautics Administration is looking for electronic engineers to assist in expansion of its navigation aids in Alaska. CAA points out that recent college graduate can start at salary of $4,490 plus 25% ($1,125) tax-free cost of living allowance, with an additional $1,000 plus allowance for each year of additional professional experience. Top CAA grade is GS-14 with starting salary of $11,595 plus $2,898 living allowance.

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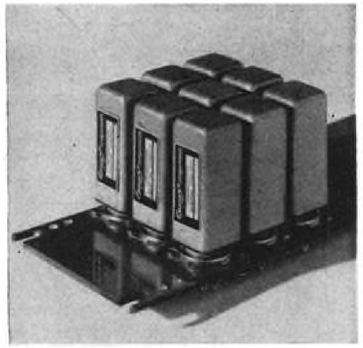
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vehicles was displayed by Marconi's Wireless Telegraph Co. Ltd. at Farnborough show. Basic equipment, which operates in X-band, covers speed range of 2 to 80 mph., but can be extended to 2,000 mph. or higher with addition of different oscillators. Marconi says EVA will operate with projectiles that have an effective radar reflecting area of only ⅛ sq. meter, is accurate to within one foot per second.

NEW AVIONIC PRODUCTS

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diode OR gates, NOR gates, parallel gates, cascade gates, inverter amplifiers, non-inverting amplifiers, emitter followers, power drivers, one-shot delays, pulse shapers, level converters, neon indicators, incandescent indicators, blocking oscillators, level shapers, 6, 12, 18-v. power supplies and clock pulse generators. Epsco Inc., 588 Commonwealth Ave., Boston 15, Mass.

• **Relay chatter monitor,** Model CCM-1 indicates when relay contact opens for more than selected time interval. Any contact opening time interval between 10 and 100 microseconds in 10 microsecond increments can be selected. Warning lamp lights to indicate defective relay. Mu Tronics, Inc., 1514 South LaCienega Blvd., Los Angeles 35, Calif.

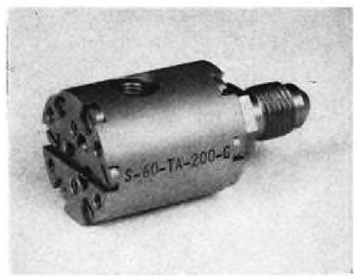
• **Low-frequency cut-off relay,** Model BS-5003, is actuated by drop in frequency of power supply to prevent damage to frequency sensitive equipment. Relay is designed for 115v., 400 cps. operation, has nominal cut-off



frequency of 370 cps., ± 10 cps. over ambient temperature range of −65C to 85C and voltage range of ± 5v. Device uses thermal relay time constants of 6 sec. to several minutes, as required to protect equipment. Other units designed for operation at any nominal frequency from 300 cps. up can also be supplied. G-V Controls Inc., 28 Hollywood Plaza, East Orange, N. J.

• **High power transistors,** with typical current gains of 40 and 75 at 10 amperes, and maximum collector ratings of 15 amp., are now in production at Bendix Red Bank Division. Units are available with collector-to-emitter breakdown voltages of 30, 40, 70 and 80v., with collector-to-base breakdown voltages 20v. higher, with soldering lugs, straight pins or flying leads. Address: 201 Westwood Ave., Long Branch, N. J.

• **Miniature pressure transducer,** Type S-60, single-coil, variable reluctance, diaphragm type for use in inductance and reactance controlled FM/FM telemetry systems, operates over tem-



perature range of −85F to 240F, has 1% linearity, measures ⅞ in. dia. x ⅞ in. long. Unit is very insensitive to shock, has a rise time of 75 to 150 microseconds. Ultradyne Inc., P. O. Box 3308, Albuquerque, N. M.

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F4H-1, F8U-3 Start Competition Tests

Flight tests are under way at Edwards AFB, Calif., on McDonnell F4H-1 (above) and Chance Vought F8U-3 (below) all-weather jet fighters. Both are competing for U. S. Navy production contracts. Second F4H-1, shown on takeoff, is carrying two Sparrow III missiles; note high visibility paint on aft section. F8U-3, in landing configuration, has airflow generator extended (under insignia) as guard against electrical failure at low speeds. McDonnell entry has two General Electric J79 engines rated at 10,000 lb. thrust each; F8U-3 has single Pratt & Whitney J75 producing 17,500 lb. thrust, and 26,000 lb. with afterburner.



Technology Raises Modernization Tempo

By Cecil Brownlow

Washington – Rapid technological strides and shifting procurement policies are forcing industry to accelerate its pace of modernization.

Specialized facilities, machine tools capable of forging state-of-the-art advances into hardware and basic management reorganization to fit the new era must be provided—and much of it must come from industry funds.

Government-owned high bay areas of World War II vintage and the government machine tool stockpile of the same generation, which industry has relied upon in the past, generally have become outmoded. The reasons are two-fold:

Mass-production facilities required in World War II are out of place and uneconomical in the advancing space age where fewer end items will be produced at relatively high cost. Secondly, the Administration has passed the word to the military services that as much of the procurement dollar as possible is to be channeled into privately-owned industrial plants.

Military-Industry Warnings

Warnings of what industry can expect, and what individual firms must do if they are to succeed, have come from both the military and from within industry itself.

Malcolm A. MacIntyre, Under Secretary of the Air Force, has warned, for example, that USAF expects industry to develop new production techniques that will improve the efficiency and accuracy of production and to "critically" take inventory of its facilities in order to phase out tools, high bay areas and warehouses in excess of present or planned production.

James R. Killian, Jr., special assistant to the President for science and technology, has added that many research institutions "face massive needs to modernize scientific facilities, both equipment and buildings. . . . It is increasingly clear that new scientific capital will be needed by both public and private institutions as we prepare to move ahead in these and other important scientific fields."

Lt. Gen. C. S. Irvine, USAF deputy chief of staff for materiel, has persistently warned aviation firms that they must modernize their facilities and thinking or face the possibility of losing out in the competitive battle for production and research and development dollars. Gen. Irvine recently said:

"On a long-range basis, industry must recognize that the trend in production of weapon systems is undergoing rapid transition. Long production runs will no longer be the pattern. Practice will be to buy fewer of a given item. This will permit superior items to be introduced sooner and at relatively less expense than would be the case if we modernized large quantities of obsolescent systems at one time.

"To meet this new set of circumstances, industry must direct its engineering staffs along three paths of effort simultaneously: One aimed at creating significant improvements in operational systems; one aimed at follow-on systems for the immediate future, and the third aimed toward design and development of space vehicles and accompanying support equipment.

Increased Efficiency

". . . It is also essential that industry put to use at the earliest possible date the new production techniques designed to increase the output as well as the efficiency and accuracy of production plants. This means numerically controlled machine tools, vastly improved extrusion presses, chemical milling processes and new metal-forming devices.

"At the same time, companies must inventory their production facilities and phase out those tools, high bay areas and storage warehouses that are excess. Lower production quotas and small quantity orders obviate the necessity for mass production capabilities like those experienced during most of the past 18 years.

"There is no use in paying maintenance, police and related costs to keep on standby status industrial real estate that is no longer needed."

Gen. Irvine also has told industry that its firms "will do more good for themselves and for the defense establishment if they diversify and do not become overly dependent on one program. They might prosper during its life-time, but the economic let-down when the program expires could be severe."

The hurdles industry must overcome have been well defined within industry itself.

J. L. Atwood, president of North American Aviation Inc., recently pointed out that industry is presently "experiencing something much more fundamental and consequential than the usual evolutionary changes of procedure and policy."

Significant trends cited by Atwood include the increasing intricacy of defense equipment, a growing specialization by firms or their subdivisions, increased emphasis on developmental aspects, a trend away from direct performance competition and toward competition based on managerial and technical capability and an increasing reliance upon each distinct line of development.

"Inevitably," Atwood said, "basic changes . . . are having substantial effects upon the structure and operation of defense industry."

The declining number of programs and the changing character of defense work, he added, "have made it necessary for organizations to step into unaccustomed roles in order to find ways of making the defense contributions of which they are capable . . . there is a new flexibility in most companies through which their resources can be applied in whatever area and manner may be most beneficial to the nation. A given firm may be a prime contractor on one program and a subcontractor on another."

Greater Decentralization

The needed flexibility in capability is pushing industry into greater decentralization of effort and management responsibility. A number of the major firms have established divisions with a single specialization and with the general managers in some instances bearing direct responsibility for his unit's profit and loss margins.

In addition, the complex weapon systems now on the planning boards and in initial production, coupled with the trend toward fewer prime contracts, are pushing individual firms gradually into a number of loose associations formed to bid on specific projects and disbanded when the programs are completed or the contracts lost to another group of contractors.

Within the association, each company carries part of the load of a particular contract and one firm acts as the over-all manager.

This trend also seems likely to portend a return to the shop-type construction similar to World War I days from the true mass production, assembly-line plant of World War II, where the raw material and subcontracted parts were pushed into one door and the completed aircraft pulled from the other.

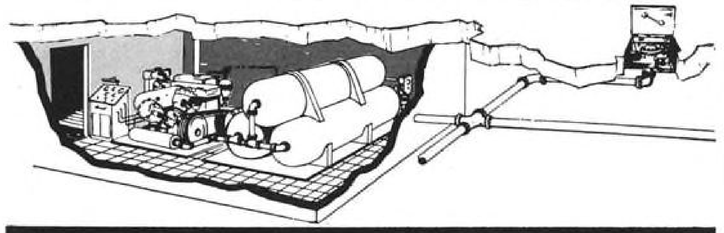
The difference in the shop-type construction assemblies needed today and those of World War I lies primarily in

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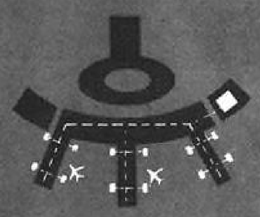


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the machine tools required to build the most efficient, lightweight equipment for use in space.

One example of the type of experimental shop needed for turbojet engines, ramjets and rockets is the new Pratt & Whitney facility in Florida where the United Aircraft Corp. Division has placed approximately $28 million worth of tools for experimental production use alone.

The need for better machine tools is one of the most critical problems industry faces today. Their development has failed to keep pace with the state of the art to the point where some industry officials closely associated with the problem believe that machine tool modernization should receive as much emphasis as that given new weapon system concepts. One official explains:

"The type of weapon systems we can have over the next several years is fairly well known. What we don't know is the type of machines we can get to do the job."

As a general yardstick, it requires three years from the time industry states a need for a particular type of machine tool before the defense agency involved gives the go-ahead to a manufacturer to build the unit.

Another 18 months is required for the tool to be built and installed.

As things new stand, the last generation of machine tools is being called upon to produce the next generation of weapon and space systems. And, in some instances, they simply cannot do it.

They are being asked to cut new materials—cermets, for example—that in some instances are tougher than the cutting edges of the machine tools, forcing producers to resort to jury-rig moldings, stretchings, etc.

Numerical Control

One method that apparently does hold considerable promise is the use of machine tools operated by numerical control, a technique that automatically feeds operating instructions to the tool.

In an evaluation of the process, a committee of the Aircraft Industries Assn. recently found that, in one test case, more than 100 hr. could be saved in the production of a single aircraft part.

Data to operate the machine tool was coded by an electronic computer and put on a magnetic tape in one-and-one-half hours. These 90 min. replaced the almost 98 hr. needed to make a template to operate a machine tool by the more conventional tracer method.

Actual machining could be done in one hour compared to four; office paper work could be cut from three hours to one by employing the numerical control system.

The committee reported that, "If the average part can be made at only half of those percentage improvements, manufacturing is on the threshold of new machine efficiency."

Advantages cited in use of the method included improved machine accuracies, lower production costs, reduced time in converting from engineering drawing to finished part and elimination of the tracer template storage problem.

The process is expensive and may require development of machine tools specifically designed to fit it, but its adoption on an industry-wide basis may be necessary if the needed tolerances, speed and efficiency are to be achieved.

In the acquisition of new-type machine tools in the future, Air Force, for example, probably will be willing to support the development of equipment until it reaches the point where it is ready for installation in production or research facilities.

Industry, however, will be expected to bear the cost of the machines and of their installation.

The facility and modernization needs, combined with Defense Department's announced policy to rely upon industry for more and more of the funding, will add substantially to the financial squeeze already imposed by the Administration's tight fiscal program that has resulted in lower progress payments and forced industry to finance a greater percentage of its research and development effort.

Defense Department Directive 4005.14 released last spring stipulates that reliance upon maintaining the industrial base will be placed primarily with privately-owned facilities and production equipment. Second in order of preference will be privately-owned facilities and associated government-owned production equipment not avail-



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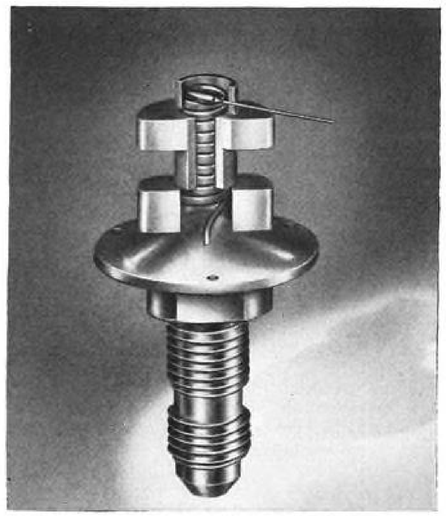
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able in the civilian economy and, finally, government-owned facilities and production equipment. The directive says the latter will be included in the industrial base "for the sole purpose of remedying known deficiencies in privately-owned capacity, when such action is in the best interest of national security."

An Air Force concept designed to ensure that maximum support comes from subcontractors and from privately-financed production capacity is in the final stages of formulation. Known as the "make-or-buy policy," the program will operate this way:

- **Bidders on contracts over $350,000** containing cost-reimbursement or incentive provisions or involving use of government facilities will have to submit "make-or-buy" structures as part of their proposals. This will include a list of major or critical components, assemblies or subsystems, running from 10 to 50 items and indicating whether a contractor is making maximum use of subcontractors' capability and whether this will be done in privately-capitalized subcontract sources.
- **Air Force will evaluate** the "make-or-buy" structure as part of the proposal and negotiate changes if necessary.
- **Agreed structure** will be incorporated in the contract, and the contractor must notify the administrative contracting officer in advance of any proposed changes. If USAF disagrees with a contractor's decision to increase his in-plant work, it can, in extreme cases, withhold the use of any government-owned facilities involved.

Army Plans Courses On Hawk Systems

New York—Army is readying courses to train sizable members of missile technicians in maintenance and operation of its Hawk surface-to-air missile system. Courses will begin early next year at Army Ordnance Guided Missile School, Huntsville, Ala. Group of 83 instructors has been added to school faculty in preparation for the courses.

Hawk missile, which gets its name from "Homing All the Way Killer," probably has Doppler-discriminating semi-active homing system, getting its homing signal from Doppler tracking radar. Use of Doppler technique both for tracking and homing systems would be to discriminate low flying targets from ground clutter.

Hawk is scheduled to supplement Nike ground-to-air defenses in this country and can be armed with a nuclear warhead.

Courses will be taught in the Surface to Air Division of the school where training presently is being given in the Nike Ajax and Hercules missiles.

AMC's Procurement, Production System Undergoing Realignment

By Craig Lewis

Dallas—Air Materiel Command is realigning its procurement and production organization in an effort to meet the management demands of increasingly complex weapon systems.

Policy and operational functions of the Directorate of Procurement and Production have been separated in a move which emphasizes integrated weapon system management, including procurement, supply, maintenance, transportation and other functions involved in logistics support.

Air Materiel Command Commander Gen. E. W. Rawlings told an industry group at the Air Force Assn. convention that the changes, which were effective last month, are not considered a reorganization, but merely a modification of an operable system to make it more responsive to the needs of the combat commands. But he also termed the changes significant and called them "a basic acknowledgment of new forces and necessities within the logistics mission."

Under the new plan, Maj. Gen. W. O. Senter continues on Gen. Rawlings' staff as director of procurement and production. Gen. Senter and his staff of procurement, production and readjustment personnel will move to the AMC headquarters building where they will be close to the directors of such functions as supply, maintenance and transportation.

Closer Intermeshing

Gen. Rawlings feels that this close physical proximity to these other staff policy areas "will contribute to a closer intermeshing of over-all policy for the logistics mission as a unified effort."

In his new status, the director of procurement and production will continue to provide policy and executive management for all procurement and production matters and will be the executive contact with industry on such matters. He will continue to approve contracts and will be responsible for delegation of procurement authority. He will be responsible for direction of procurement and production programs just as other directors are responsible for their functional areas.

At Wright Field, AMC Aeronautical Systems Center will be the operational element which will handle integration of operational activities relating to procurement, production, maintenance and supply during the development and production phase of aeronautical systems. This group will include the Weapon System Project Offices for the aeronautical systems.

Weapon System Project Offices will be grouped under three directorates: Strategic, Air Defense and Tactical and Support. Other groups will be included to provide propulsion, guidance and other government furnished subsystems and essential supporting services in industrial resources. Aeronautical Systems Center will be commanded by Brig. Gen. B. H. Warren, former deputy to Gen. Senter.

Directorates and Weapon System Project Offices of the Aeronautical Systems Center are not exclusively compartmented procurement - production units, according to Gen. Rawlings. They will be staffed with military personnel that are competently qualified as directors of materiel and civilian personnel qualified as weapon system integration officers.

Experienced supply and maintenance personnel are being transferred on permanent assignment to the WSPO, rather than serving on temporary duty in the WSPOs as in the past. Gen. Rawlings calls this switch to permanent supply and maintenance personnel "a major step toward a tighter functional alignment of the future logistics system.

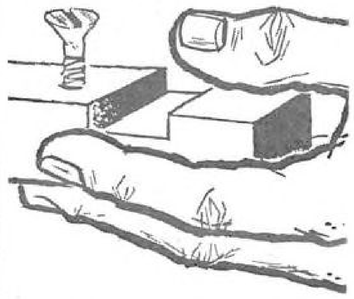
"For some time it has been apparent that one effect of the new weapons and the weapon system approach to them would be the gradual consolidation of certain functions which had grown up in the past as sharply differentiated areas of responsibility," Gen. Rawlings said. "The tendency has been accelerated by a number of factors—changing maintenance requirements for missiles, development of new techniques of direct support, the expanding use of electronic data processing equipment, which can be exploited to the best advantage when independent of organizational boundaries and arbitrary limitations."

In similar fashion, the Ballistic Missiles Office has been redesignated the AMC Ballistic Missiles Center. This unit is organized around the Weapon System Project Offices for the ballistic missiles and space vehicles under its jurisdiction.

Both the AMC Ballistic Missiles Center and the Aeronautical Systems Center will operate the same as the Air Materiel Areas and Air Force Depots. "Thus, with these streamlined channels of communication and decision making, we have more direct concentration



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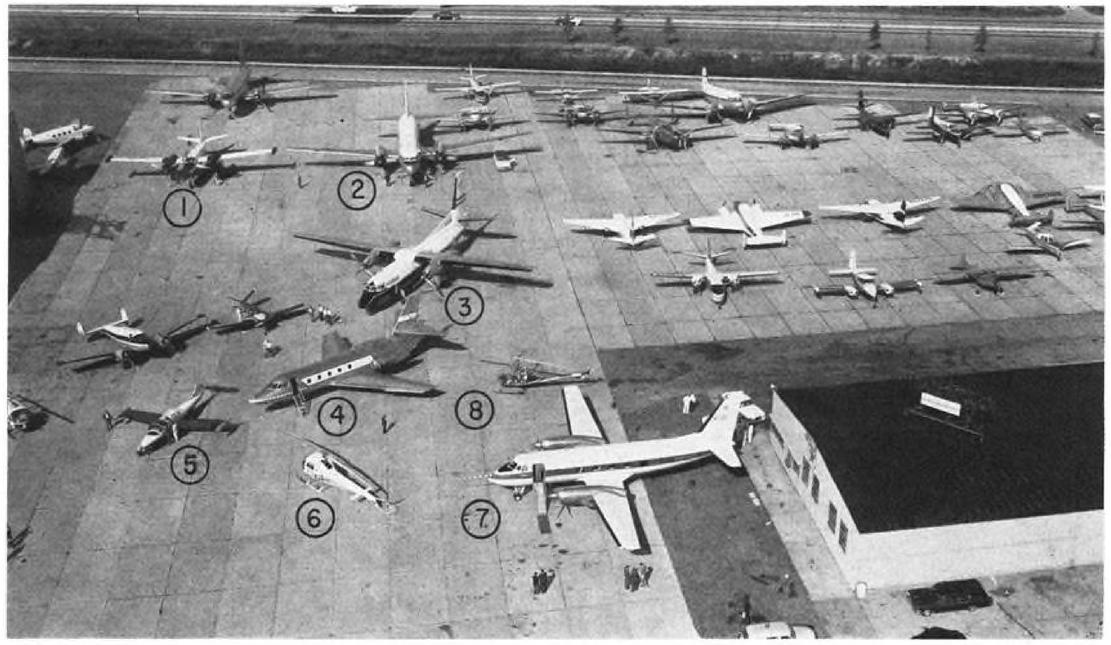
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Jet Age Aircraft Displayed for Businessmen

Jet age inclined businessmen are offered an increasing selection of turbine-powered transports, as evidenced in this collection of executive planes which portrays the latest models gathered for the first time. Pictured are (1) piston-powered L. B. Smith-converted seven-passenger Douglas B-26, (2) Allison T56-powered Convair YC-131C, which will be available as a conversion of Models 340 and 440, (3) Rolls-Royce Dart-powered Fairchild F-27, (4) Bristol Orpheus-powered Lockheed Jetstar, (5) twin-Turbomeca-powered Beech MS-760 four-seater, first of which has been delivered to Henry Timken, Jr., (6) 1959 version of Bell 47-J Ranger helicopter, (7) Rolls-Royce Dart-powered Grumman Gulfstream, and (8) latest version of Hiller executive helicopter, Model UH-12E. Planes were displayed during recent annual meeting of National Business Aircraft Assn. at Philadelphia International Airport.

of effort on total weapon systems management," Gen. Rawlings told the industry group.

AMC believes that both industry and the operating commands will find the new groupings easier to work with and more responsive to team effort.

Noting that separation of operating units from policy elements might appear to create an additional point of contact at AMC for contractors, Gen. Rawlings said that in actual practice, this sharply defined division of responsibility has been emerging for some time "and represents a functional sifting dictated by contractor and combat command relations as naturally as by considerations of internal management."

At the same industry session, Maj. Gen. Frank A. Bogart, AMC director, plans and programs, discussed the broad outlines of the logistic structure of the future. It will be not as large as it has been, since modern weapons are more efficient and fewer of them are needed. Emphasis is shifting from a mass logistic requirement to a need for a more precise, specialized type of logistics tailored to the complex, costly and constantly changing weapon systems of today.

Gen. Bogart detailed significant reductions in facilities and personnel stemming from this new pattern. Since 1952, USAF has canceled four depots which had been authorized for construction and which would have cost over a third of a billion dollars. Among existing depot level facilities, 23 have been closed since 1952 and another 18 will be closed by 1962. AMC has eliminated nearly 53,000 manpower spaces since 1952, and this reduction will total well over 65,000 personnel by 1962. Headquarters AMC personnel have been cut 56% since 1951.

Instant Response

This logistics structure is acquiring an ability for instant response as it passes through this transition to new techniques while reducing facilities and personnel. Gen. Bogart observed that the combat forces' need for constant operational readiness imposes a need for instant response on the logistic structure. Since combat forces must be operationally ready at all times, "the distinction between war and peace has disappeared for the logistician," he said.

Air Materiel Command is making some basic changes in its management structure to develop this precise, specialized, highly responsive logistics support. As weapon systems became more complex and as the weapon system concept developed integrated systems, much of the interchangeability between systems at component and subsystem levels began to disappear. This cut into the efficiency of generalized service depots.

Air Materiel Command's solution was to develop a form of weapon system management in which each system is assigned to a logistic support manager who will have the latest data processing and communication equipment and will have the authority over resources to enable him to supply effective support, Bogart said.

Various phases of its mission indicate different management approaches for AMC, Gen. Bogart told his industry audience. In dealing with the using commands, AMC finds the logistic support manager the best solution, but in dealing with industrial suppliers a management oriented by commodity rather than by weapon system is required.

In examining itself to determine how to maintain the technical competence necessary to the goals of flexibility and responsiveness, AMC finds its engineering capability lends itself to organization and management along subsystem lines such as propulsion or guidance and control.

With these three management ap-



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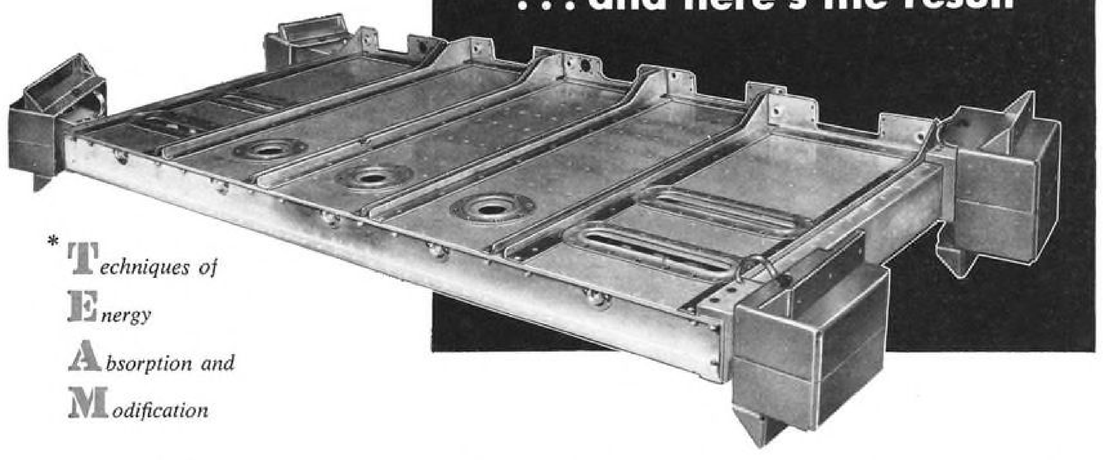
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proaches available, and none of them capable of managing the total logistic complex by itself, AMC finds it expedient to use all three.

Gen. Bogart drew a parallel with research and development work where the weapon system concept originated. There, basic research is concerned with broad aims and little specialization. In the development phase, work is organized in terms of major subsystems, and only in the final stages of development is weapon system management used to cut across these fields to produce a completely integrated weapon in the shortest possible time.

A similar pattern is emerging in the logistic structure. Commodity management, subsystem management and weapon system management are all used, each in the area where it is most effective. Gen. Bogart said that AMC is now engaged in delineating these management areas.

Contractors Advised on Funds Bill

New York—Some pitfalls for defense contractors in Public Law 85-759, passed by Congress in its last session and designed to limit annual accrued expenditures of government agencies, were pointed out by Elbert G. Bellows, vice president of the W. L. Maxson Corp., at a recent meeting here of the National Security Industrial Assn.

Whatever its effect, Bellows said, implementation of the act cannot be immediate, probably not until after Fiscal 1960, because it must await determination by the President that an adequate accrual accounting system has been established. When it is implemented one of the major foreseeable problems will be the availability of funds for unforeseen emergencies.

One hypothetical problem suggested by Bellows concerns provisions in the act that unused balances for projects lapse at the end of the fiscal year and would have to be covered in new appropriations for the succeeding year.

He suggested the case of a contractor whose deliveries were to begin at the end of one year and continue through another. Suppose, he said, 100 units were deliverable in June, the last month of the fiscal year, but a mandatory engineering change delays actual delivery until July.

Since appropriations already made for the following year do not include this delivery and this particular account is limited under the new law, and since funds for the previous year have lapsed, how does the contractor receive payment?

Although pointing out the need for clarification, Bellows granted the need for effective control of defense expenditures. However, sound fiscal control must come before expenditure control, he said, adding these opinions:

• **Contractors** will continue to face limited funding of programs and phase authorization of design, development and production.

• **Requirements** for continued accurate reporting of estimates and forecasts for future billings will exist. However, the present form 1097 calls for detailed data tremendously burdensome administratively and for so much crystal gazing it might defeat the purpose of the form.

• **Emergency fund** pool of some sort may be necessary with the new law to provide for unexpected but vital programs. Exemption of research and development funds from limitations in the law might be necessary.

• **Early planning and funding** of programs makes for greatest efficiency and economy.

• **Advance warning** and conference with contractors should be assured in cases of cutbacks or cancellations to provide the greatest economy and to provide for the government maximum benefits from the terminated project.

• **Cost principles** for cost plus fixed fee contracts are archaic and should be reconsidered. Robert B. Chapman III, vice president and assistant general manager of Aircraft Armaments Inc., discussed the Saltonstall bill to revise procurement procedures, generally favoring the legislation which has yet to be enacted by Congress.

Among his comments in connection with the bill:

• **True potential** of weapon system procurement has seldom been realized.

"In most cases," he said, "the military agency supervising the prime contractor has retained the right to review every decision of the prime. This has resulted in the establishment of another duplicating level of responsibility, authority and management and has lengthened rather than shortened lead time."

He also urged that the prime not be allowed to delay subcontracting parts of the system while he builds up his own facilities for it.

• **Legislation** can help small business receive its share of defense work, but is no substitute for small business offering the best service in the quickest time at the lowest price.

"The company which employs me," he said, "has spent several years in the category of small business and it has been our management policy to obtain our fair share of defense procurement by being competitive rather than by depending on the assistance of the Small Business Administration."

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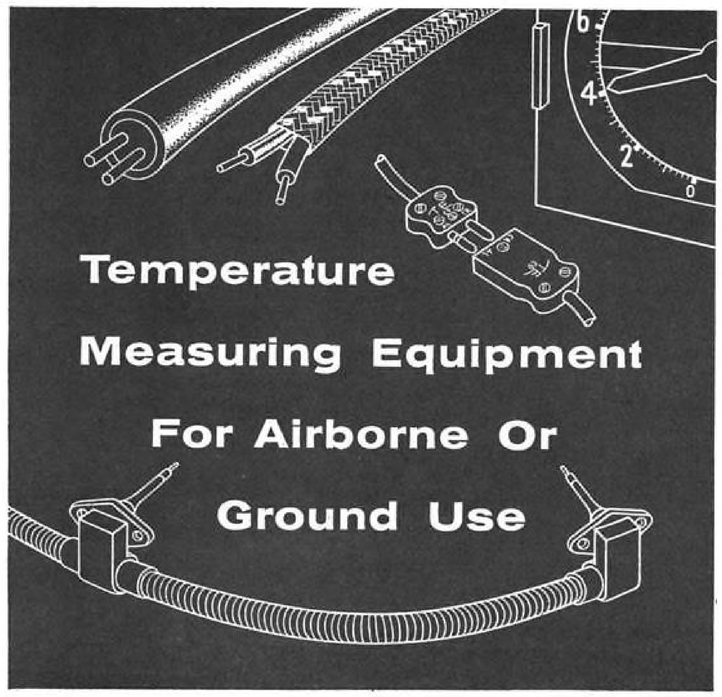
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Test Pilots Discuss Airspace Regulations

Los Angeles—Cautious unanimity on how to improve air-to-air visibility of aircraft until better collision protection techniques are developed marked a professional pilots' symposium on air space safety held here by the Society of Experimental Test Pilots.

Specific proposals on alteration of the military air space reservations and airway structures around Edwards AFB, Calif., Dallas-Fort Worth, Tex., and Texas bases of the Air Training Command met more resistance.

Al Blackburn, incoming president of the pilot's organization, told AVIATION WEEK that these questions were played down in the symposium's recommendations, since its purpose was to bring forth safety improvements rather than solutions to local problems.

Symposium members agreed with Air Force calculations showing that the see-and-be-seen concept of VFR traffic separation is invalid, but James T. Pyle, Civil Aeronautics Administrator and probable No. 2 man in the recently created Federal Aviation Administration, said that the see-and-be-seen rule will be a fact of life in aviation for some time to come because of long lead time needed to engineer a truly effective positive control system and late start due to earlier economy programs.

Pyle called on military, airline and other special aviation interests to develop workable solutions to airspace safety problems or they can expect to see politically powerful general aviation groups ram through changes which would be unacceptable to professionals. He said workable solutions demand recognition and that a conflict of interests exists between major airspace users, each with an undeniable right to the use of the nation's airspace.

However, unrestricted flight is no longer possible and each special interest can expect to sacrifice some of its rights in the cause of public safety, Pyle said. He added that as an important corollary to the sacrifices of air carriers, military services and manufacturers, "general aviation interests must be made privy to our councils in order that they, too, can share in shaping their future."

Describing the magnitude of the problem, Pyle pointed out that "it takes an astonishing 4,000 to 6,000 sq. mi. of sky 2,000 ft. deep to give a 600 mph. jet the reserved air-space required under normal IFR operations when separation is maintained by time and altitude and without distance measuring capability." Pyle reported that the federal navigation aid program to install about 1,200 Vortac stations with distance measuring equipment for all users will bring about a dramatic reduction in the size of the reserved air block around each aircraft needed to ensure safe separation.

Reduction would be from 3,000 sq. mi. to about 30 sq. mi. Advent of circular polarization in the next round of CAA surveillance radar purchases is expected to make it possible for them to identify aircraft in heavy weather without the assistance of transponders.

Pyle suggested the application of more ingenuity in solving the traffic control problem. "At the present," he said, "control areas are defined as reaching from 700 ft. to infinity. Let's change this old idea and put a floor on airways in some areas and slide restricted areas under them. In other places, a floor can be put under restricted areas and an airway can be put beneath it. Joint use of airspace is also a possibility. When the military needs it, they have it. When they don't, air traffic control will use it."

Pyle said the military services have an immediate responsibility to improve their airborne communications. More military aircraft need equipment with sufficient channels to communicate directly with air traffic controllers through CAA's peripheral communications system when operating under positive control. A military retrofit program to answer this requirement has begun.

Among the recommendations which



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Test Pilots Honored

Los Angeles—Honorary fellowships into the Society of Experimental Test Pilots were bestowed on four flyers during the annual meeting here. Honors went to:

- Eric Springer, former Douglas test pilot and retired Douglas vice president.
- Benny Howard, noted for his racing planes.
- Col. John MacReady, retired Air Force pilot, one of two men who made first nonstop transcontinental flight in 1923.
- Adm. William V. Davis, Jr., Navy test pilot.

Al Blackburn, North American Aviation, was installed as president, replacing outgoing president George Jansen of Douglas Aircraft Co.

Elevated to full fellowship in the society were members Scott Crossfield and James L. Pearce, both of North American, Roger Gardner, Curtiss-Wright, and Richard L. Johnson, Convair.

The Iven C. Kincheloe Award was presented to James R. Gannet, Boeing Airplane Co. engineering test pilot and Joseph J. Tymczyszyn, Civil Aeronautics Administration test pilot, for their outstanding achievement in obtaining certification for the first American turbojet powered commercial transport.

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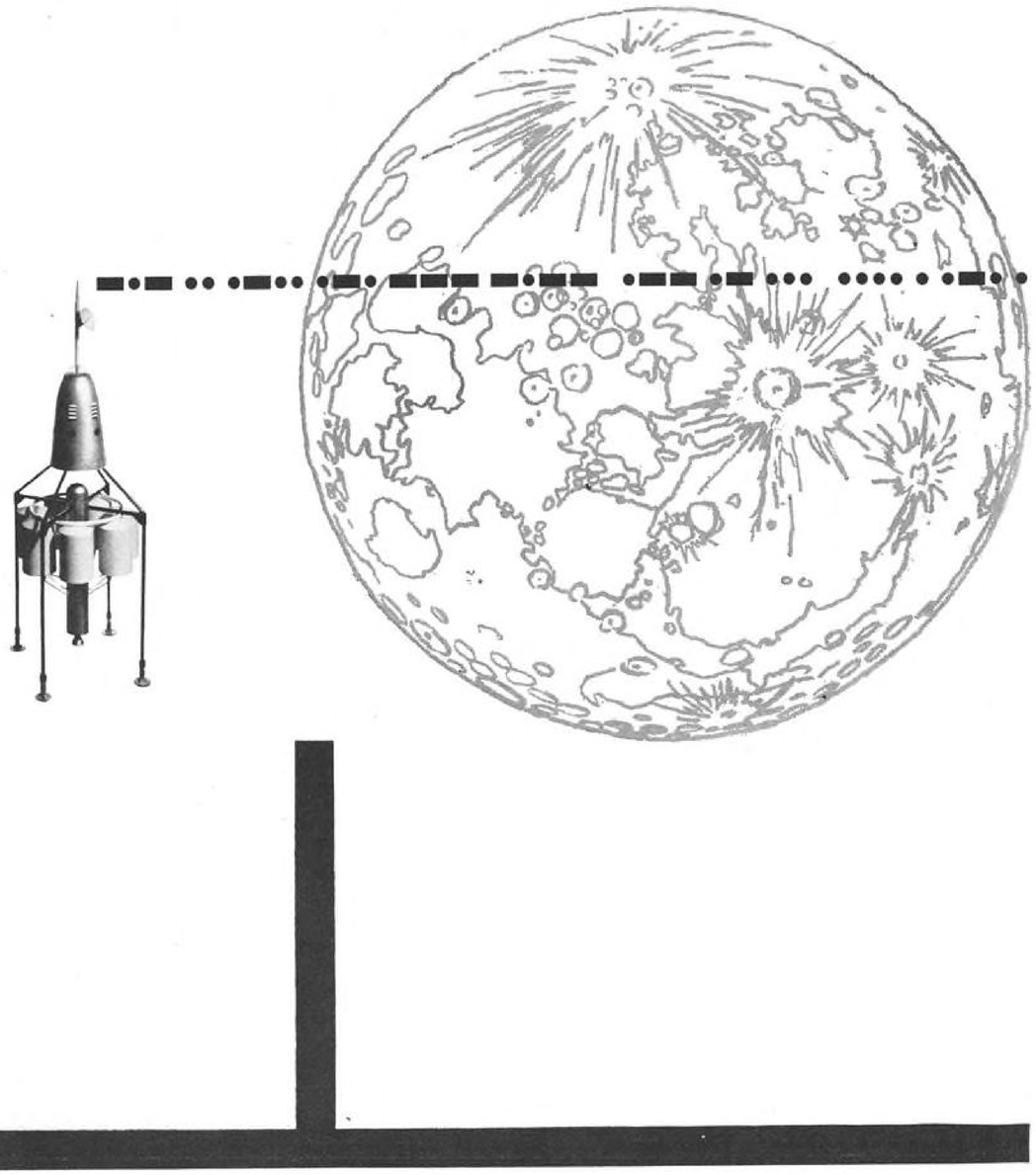
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the symposium has made to the civil, military and industry agencies responsible for air safety are these:

• **FAA should establish** minimum size and qualifications for crews of every type of aircraft. This recommendation was suggested by John Powers, chief pilot for International Business Machines Corp., Poughkeepsie, N. Y. Powers disqualified himself as representative of National Business Aircraft Assn. and said his views were his own. He justified the recommendation on the grounds that some corporation pilots are flying aircraft with performance comparable to that of airliners without copilots or engineers. He said that one man could not be properly vigilant when handling all cockpit routine single-handed.

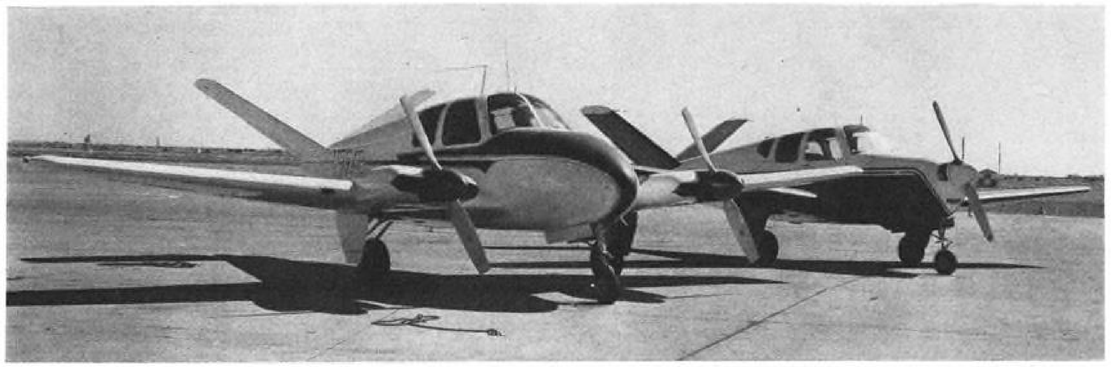
• **Responsible groups should be** aware of the desirability of cutting down cockpit paper work to increase crew opportunities to watch for other aircraft. In drafting its resolution, the committee concluded that this recommendation would probably have to await the development of automatic navigation systems.

• **FAA should study** the day and night use of high intensity condenser discharge lights to improve conspicuousness of aircraft. Installations capable of showing the heading and orientation of the intruding airplane would ease the job of collision avoidance for the crew of the protected airplane.

• **FAA should establish color** scheme standards for all civil and as many military aircraft as possible to increase conspicuity. Statistics from the Air Force and Naval Air Training Commands indicate that high reflector paint jobs produce a significant reduction in mid-air collisions. Some military air units cannot increase the risk of enemy detection by use of conspicuous color schemes but Strategic Air Command has announced its intention to paint the external fuel cells of its bombers with high reflector paint since these would be dropped before approaching enemy defenses. Bellies of the aircraft are painted radiation white which has proved to be visible of over fairly long ranges.

• **New aircraft designs** should offer rearward visibility comparable to that of an airplane with a bubble canopy and rear view mirrors should be installed.

• **An Army study presented to** the symposium showed that in airplanes and helicopters with wide angle visibility, the pilot seldom used all that he had. A movie sequence from the study showed that during the final approach, the pilot doesn't look around at all. Test pilots conceded the validity of the study but argued that the solution is maximum visibility and thorough training and supervision to ensure pilot vigilance.



ENGINE COWLS are kept to depth of only 17-in. in conversion (left) to minimize drag, particularly in engine-out configuration.

Super-V Bonanza Twin Starts Flight Test

Conversion rights to a twin-engine modification of the four-place Beech Bonanza business plane developed by David Peterson, Tulsa, Okla., have been acquired by Oakland Airmotive Co., Oakland (Calif.) International Airport. Oakland Airmotive expects to start rolling out production aircraft in January. Price will be approximately $16,000 with the customer supplying an airworthy Bonanza. Oakland reports it expects to supply Super-V Bonanzas one week from placement of the order.

Airplane is basically similar to the original version engineered by Peterson (AW Aug. 27, 1956, p. 80). Oakland has been flight testing two Super-Vs and has improved the fuel feed system, installing a Simmonds fuel pump right at the injector of the fuel injection system. Earlier Fiberglas manifold has been converted to metal construction.

Oakland says it will franchise distributors to perform conversions from complete kits it will manufacture for the field.

Main points of the conversion:

• **Single Continental engine** is replaced by two four-cylinder 170-hp. Lycoming O-340s fitted with Simmonds fuel injection system and oil scavenger pumps for dry sump operation. Engines are fitted with Hartzell hydraulically controlled propellers having Hamilton Standard full-feathering governors. Each engine will have a starter and 35-amp. generator with 50-amp. optional. Engines are enclosed in tight-fitting flat cowlings only 14 in. deep.

• **Fuselage is left intact** aft of the firewall and main wing spar. Former engine compartment is replaced by a Fiberglas nose section containing space for luggage and radio gear. Instrument panel will be modified to take dual indicators and controls with mixture, carburetor heat and cowl flap controls eliminated. Heater is replaced by a thermostatic 25,000-Btu. Southwind unit.

• **Wings are fitted** with strengthened main spars to take increased loads and leading edge integral tanks are installed. Leading edge skins are thickened.

Upon completion of modifications, the Super-V Bonanza will have a gross weight of 3,400 lb., empty weight of 1,900 lb. and carry a total of 108 gal. of fuel, two 34-gal. leading edge wing tanks and two 20-gal. inboard bladder cells. Baggage capacity, front and rear compartments, will total 300 lb.

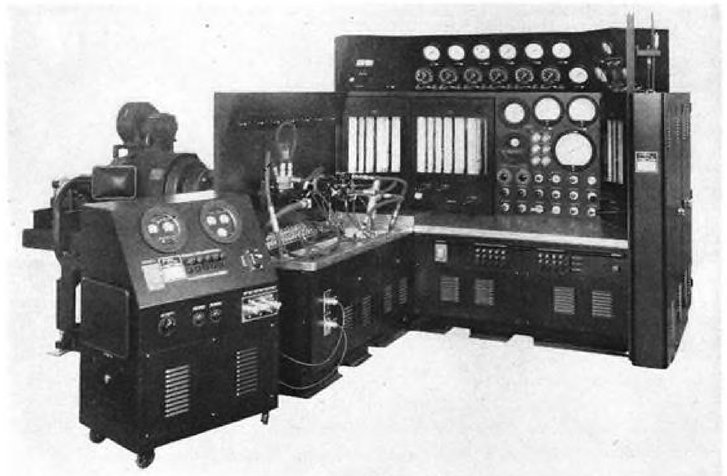
Oakland Airmotive currently employs approximately 40 persons and services business aircraft, private planes and airlines, averaging some 600 transient aircraft monthly. Company handles fueling for British Overseas Airways Corp., Japan Air Lines, Hawaiian Airlines and military planes. It recently completed conversion of a Lockheed PV-2 to its Centaurus configuration for executive use, and obtained CAA approval of the modification.

Super-V Bonanza

Maximum speed	218 mph.
Max. speed @ 75% power	206 mph.
Speed @ 55% power	184 mph.
Range @ 75% power	1,200 mi.
Range @ 55% power	1,400 mi.
Red line speed	252 mph. indicated
Two-engine rate of climb	1,550 fpm.
Single-engine rate of climb	400 fpm.
Two-engine service ceiling	23,000 ft.
Single-engine service ceiling	10,000 ft.
Stalling speed, flaps up	72 mph.
Stalling speed, flaps down	65 mph.
Minimum control speed, single engine	75 mph.
Takeoff distance, zero wind, 10-deg. flaps	750 ft.
Landing distance, zero wind, 30-deg. flaps	600 ft.



FIRST FLIGHT VIEW of Oakland Super-V Bonanza fitted with 170-hp. fuel-injection Lycoming engines and feathering propellers. Conversion price will be about $16,000.



JET FUEL CONTROL test stand, developed by Meriam Instrument for Airwork-Miami, has tolerance of plus-or-minus one revolution per minute at any setting from 400 to 4,000 rpm.

Airwork-Miami Keys Overhaul Unit To Turbojet, Turboprop Aircraft

Miami, Fla.—In a major expansion oriented toward operations of jet airliners on a large scale in coming months, as well as gradual introduction of turbine-powered airplanes in the executive fleet, Airwork Corp. recently opened a 10,000-sq.-ft. jet accessory overhaul shop bordering Miami International Airport.

Facility has been designed so that it can be quadrupled as the need develops; the company is also setting up an instrument shop here which will be capable of overhaul and adjustment of electronic equipment such as autopilots and ignition analyzers.

The initial operation concerns overhaul and test of complex jet aircraft fuel and electrical systems including pumps, controls, alternators, constant speed drives and similar equipment.

Airwork-Miami has installed specially built test stands, costing some $150,000, to its own specifications. Company says facility will not only be capable of handling current equipment but is also designed to take even higher tolerances that will be required in accessory overhaul in the next five years.

Featured are a Consolidated Diesel Electric Corp. fuel pump stand and a jet fuel control stand made by Meriam Instrument Co. Fuel pump test stand is designed to handle not only the pumps used in U. S. aircraft systems but also the static control systems installed in British planes. The usual gear box drive has been eliminated and replaced by three drive units: two 75-hp. fuel pump drives and a 5-hp. drive, installed in a separate area to reduce fire hazard. Fuel circulated through the drives is kept at a constant temperature by a heat exchanger that is fed by a water chilling unit.

System is expected to materially reduce test time. One reason, Airwork says, is that the fuel pump drive is slaved to the fuel control while on test, with the ratio between pump and control unit maintained automatically. Sensitive speed control compensates immediately for pressure changes.

Safeguards against damage to the pump include a system that prevents the test stand from working unless the boost pump is operating or if air pressure is off to prevent the unit under test from burning up. Dynamic brakes are used to quickly stop the 75-hp. motors.

Pumps can be tested at their working pressures—400-600 psi.—with the drive unit maintaining specified revolutions within one per minute. Stands are capable of handling flows of up to 36,000 lb. of fuel per hour, which is considerably in excess of today's requirements, Airwork-Miami notes.

Jet engine accessory business is expected to grow rapidly in the future due to the airlines' desire to conserve capital for profit-making operations rather than tie it up in expensive, highly specialized overhaul facilities of this nature, according to Francis Hine, Airwork president. Airwork-Miami's jet accessory overhaul volume is expected to exceed the current volume of piston engine accessory work done by Airwork in Millville, N. J.

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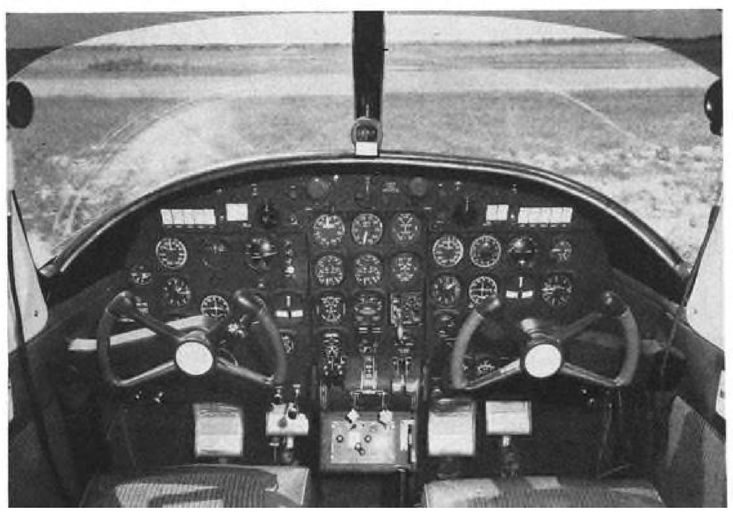
NEW MODEL 500 Aero Commander business plane is externally similar to higher priced versions, features low-cost interior.

Aero Commander Has Low Cost Interior



MODEL 680-E, with supercharged engines, also features longer span wing to improve range.

COCKPIT of Model 680-E includes complete instrumentation and "piano key" radio tuning.



Two new models of the Aero Commander twin-engine business transport are being delivered to customers, one featuring increased payload without effect on range, the other an "economy" version, available at lower price than the remainder of the firm's line, which now covers five variants of the same basic design.

Both airplanes have the long-span, 49.56-ft. wing that Aero Design initially introduced on its earlier Model 560-E, which was found to improve performance and payload capabilities materially due to greater effectiveness of higher aspect ratio than original airplanes.

Basic features of the new 680-E and 500 include:

• **Increased span** of the 680-E over the earlier Model 680 makes possible gross weight of 7,500 lb., approximately 500 lb. higher than the earlier airplane. With empty weight at 4,475 lb. useful load on the 680-E is 3,025 lb. compared with approximately 2,515 lb. on the 680. Model 680-E's basic price is $94,500. Plane has 340-hp. geared and supercharged Lycoming 340-hp. GSO480-B1A-6s.

• **Use of smaller engines,** the new Lycoming 250-hp. 0540 series with direct-drive, and lower cost interior (AW May 12, p. 23), has brought the Model 500 price to $64,750. Economy feature of this model is expected by the company to make it the leader over the other models in volume sales. Model 500 has a gross weight of 6,000 lb. and a useful load of 2,100 lb., the company reports.

Interior of the Model 680-E features sectionalized three-unit instrument panel, with all engine gages in the center and flight gages on both the pilot's and copilot's side. Panel is hinged at the bottom so that it can be opened outward to ease maintenance.

Control quadrant is located below the instrument panel. A full set of circuit breakers is at the base of the copilot's panel, and radio controls are across the top panel. Radio panel utilizes "piano key" tuning.

Passenger area will be available in four, five or six seat arrangements, with a three-position type seat having tuck-away armrests.

Model 500 is available in five-to-seven-seat versions. Cockpit has standard Aero Commander instrument panel and instrumentation and is finished in non-glare black and fitted with eyebrow lighting.

Aero Commander Specifications

Performance	Model 500	Model 680-E
High speed @ rated power	218 mph.[1]	255 mph.[2]
Cruise speed @ 70% METO power	205 mph.[2]	226 mph.[2]
Stall speed (gear down, flaps down 40 deg., power off)	63 mph.	71 mph.
Gross weight	6,000 lb.	7,500 lb.
Empty weight	3,850 lb.	4,475 lb.
Useful load	2,150 lb.	3,025 lb.
Range with 30 min. reserve @ 55% power	1,100 mi.[2]	1,400 mi.[3]
Usable fuel capacity	156 gal.[4]	223 gal.
Service ceiling (two engines)	21,375 ft.	25,360 ft.
Single engine absolute ceiling	8,150 ft.	14,300 ft.
Rate of climb (two engines)	1,400 fpm.	1,525 fpm.
Rate of climb (one engine)	310 fpm.	305 fpm.
Takeoff distance to clear 50-ft. obstacle	1,400 ft.	1,570 ft.
Landing distance over 50-ft. obstacle	1,350 ft.	1,625 ft.

[1] At sea level. [2] At 10,000 ft. [3] At 15,000 ft. [4] 67-gal. auxiliary fuel system optional on Model 500.



SMITH SUPER-26 bomber conversion seats seven passengers, cruises at more than 300 mph.

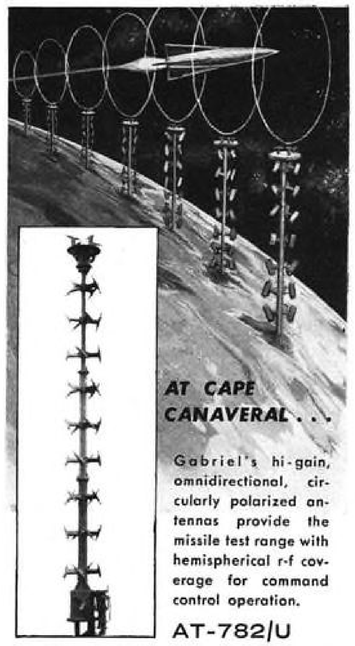
B-26 Converted for Business Use

Cruise speed of 325 mph. at 60% power and maximum range of 2,100 mi. are prime features of a new modification program on the World War II Douglas B-26 Invader developed recently by L. B. Smith Aircraft Corp., Miami (Fla.) International Airport.

Firm calls its new conversion the Smith Super-B-26 and premiered the seven-passenger executive transport at a recent National Business Aircraft Assn. annual meeting in Philadelphia. Teardown began on the prototype in February. Super-B-26 represents the second major conversion program initiated by L. B. Smith; first being its Super C-46C. Super-B-26 has received a limited category certificate from Civil Aeronautics Administration.

Remanufactured Super-B-26 utilizes twin 2,100-hp. Pratt & Whitney zero-time R2800-83AM3 engines turning Hamilton Standard three-blade 33E60/6899-20 propellers having Lockheed Constellation-type spinners and afterbodies.

Total fuel capacity of 1,330 gal. includes 200-gal. auxiliary tanks in



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Gabriel's hi-gain, omnidirectional, circularly polarized antennas provide the missile test range with hemispherical r-f coverage for command control operation.

AT-782/U

The AT-782/U antennas manufactured and designed by Gabriel provide null-free spatial coverage along the 5000 mile range. Part of the Ground Support Equipment (G.S.E.) at this missile test center, the all aluminum AT-782/U has increased directivity in the vertical plane and has a turnstile of dipoles for overhead coverage.

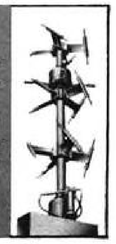
Other features:
Frequency .....400 to 500 mc
VSWR .....1.4 over band
Gain .....10 db
Power .....2 kw
Wind Loading .....120 knots
Pressurization .....3 psi
Input .....1⅝" coax line
Weight .....300 lbs.

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DRONE CONTROL ANTENNA

AT-781/U

Gabriel's smaller version of the AT-782/U for application where gain requirements are not as great. It has proven a very reliable drone command antenna because of its hi-gain, hi-power and null-fill-in characteristics.



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Anti-Collision Light

Starlighter anti-collision light is condenser discharge type providing intense flash of approximately 80,000 candlepower/seconds of daylight quality. Equipment consists of three units: two identical lamps and a power pack, the lights connected to the latter by a cable designed to carry 450 v.d.c. charge. Installation is designed to cover a wedge 15 deg. above and below the plane's flight path and in a 360 deg. arc. Manufacturer recommends installation of lights on vertical fin and below fuselage. Unit is made by Donald E. Hoskins, 4940 Marine Drive, Chicago 40, Ill.

outer wing panels and 330-gal. in external wingtip tanks.

Structural rework includes removing the rear wing spar where it enters the cabin to provide a longer cabin and replacing it with a steel circumferential frame. An electrically actuated main entrance door is located on the right side of the fuselage with a bottom step 10 in. from the ground when extended. Cabin is fitted with picture windows to improve passenger visibility. Longer nose is installed to provide room for baggage, radio racks and radar installation.

Communications equipment includes an Aircraft Radio Corp. T-22 20-channel VHF transmitter, ARC R-15 VHF tunable receiver, ARC F11A isolation amplifier, Dare DTR-360A 360-channel VHF transceiver, Bendix TA20 360-channel VHF transmitter, Bendix RA18C 360-channel VHF receiver. Also two Bendix MN85F omnirange systems and two ARC F21A ADF systems, Dare DGS-20 20-channel glide slope receiver and Dare DM-3 marker beacon.

Cockpit heater is a 100,000 Btu. Janitrol unit installed in the nose; cabin has a 40,000 Btu. heater. High-pressure oxygen system has Scott automatic regulators and outlets.

Interior, designed by Charles Butler Associates, includes two berth-type Aerosmith seats in the cabin center section and a double berthable seat in the aft section. Two single seats are located aft of the lavatory and buffet.

Specifications for the Super-B-26 include takeoff gross weight of 35,000 lb., landing weight of 31,000 lb. and estimated empty weight of 23,500 lb. Takeoff distance over a 50-ft. obstacle is given as 3,495 ft. while landing distance over the obstacle is 3,000 ft.

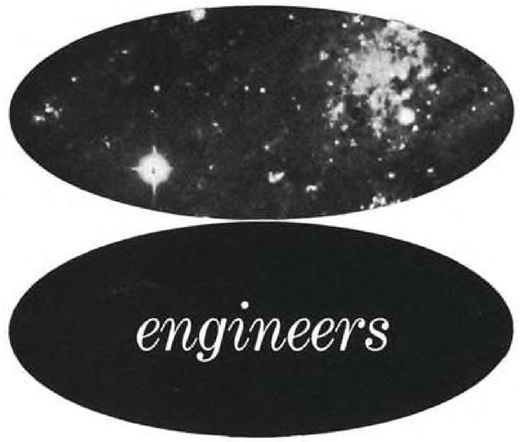
Male Pilots Outnumber Women Pilots by 40:1

Men pilots outnumber women pilots by 40:1 ratio according to CAA study which shows that U. S. total certificated pilot roster totals 809,349, the highest on record. Non-pilot categories (mechanic, parachute rigger, ground instructor, control tower operator, dispatcher, flight engineer and navigator) total 165,008. California leads the nation with 101,790 certificated pilots; when compared by population, Alaska takes first place with 4,151 certificated pilots out of an estimated population of 215,000. Breakdown of current certificates: 98,498 student pilots, 448,470 private pilots, 237,149 commercial pilots, 16,900 transport pilots, 472 helicopter-only certificates (in addition to 5,092 other ratings holding helicopter certificates), 627 glider-only (in addition to 3,360 other ratings holding glider certificates), 6,955 flight certificates and 277 other pilot categories.



Twin-Beech Radar

Installation of Radio Corp. of America lightweight AVQ-50 weather radar with 12-in. antenna dish is shown on the avionics equipment manufacturer's Beech Super 18 demonstrator. Army is currently evaluating an AVQ-50 in a Beech L-23D Twin-Bonanza and a Vertol H-21 helicopter.



The Boeing Airplane Company's Wichita Division offers engineers a number of long-range career opportunities in connection with advanced flight projects. These openings offer all the scope needed to employ your creative powers to the fullest.

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For further details, drop a note to R. J. B. Hoffman, Dept. CW1, P. O. Box 3822, Boeing Airplane Company, Wichita 1, Kansas.

BOEING

PLAN '59

How Modern Is American Industry?

A Report by the McGraw-Hill Department of Economics

THE U.S.A. is starting a new period of economic growth, as we leave behind the recession of 1958. This new period presents a challenge to the nation, to the business community and above all to the individual company – to grow *at a profit*.

By now it is clear that growth is the normal way of life for the U.S. Economy. Since 1947, our national product has been growing at a rate of 3.7% a year. And no recession, even the latest and most publicized, has interrupted the trend for long. Now the economy is growing again.

But the conditions of growth are far different from those that prevailed in the years 1947 to 1957.

Today growth in the economy does not mean pressure on capacity, for most industrial firms. It does not mean easy profits. Rather, this is growth under highly competitive conditions, with profits dependent on a firm's ability to hold down costs. **Is our plant and equipment modern enough to do the job?**

A New Survey

To find the answers to this question, the McGraw-Hill Department of Economics has just completed a special survey of business needs for modernization. **The survey shows that it would cost $95 billion to replace today's obsolete equipment.** And this is a priority job, if business is to get costs down for the years ahead.

This tremendous need for modernization presents a challenge to the U.S.A. as a nation. The Communist powers are making a strong and disciplined effort to demonstrate that they can out-produce us – that they can "plow us under" in a contest of industrial strength.

It is a challenge to American business. Our people expect a continuously rising standard of living. Our workers expect wage increases. And often their demands mean price inflation – unless we can achieve sharp gains in output. The public demands higher national income without inflation. This is the challenge to business as a whole.

It is a challenge to the individual firm. Growth in the economy no longer means an automatic rise in sales and profits for any particular company. There are no shortages; industrial capacity is ample. So to participate in growth, the individual firm must achieve better quality or lower costs than its competitors. Otherwise, there will be no profit in growth and no success story for the company.

Is business prepared today for these challenges? The answer, from our study, is clearly "No". The production and distribution facilities of the U.S.A. are not efficient enough to ensure our continuing superiority over the Communist world, to match every wage increase with higher productivity, to do business in a competitive economy at satisfactory profit to the individual firm.

This statement sounds shocking at a time when much industrial capacity is idle and the recession just behind us is being blamed on a surplus of capital goods. But the facts speak for themselves. Here is the record on the past decade of investment in new plant and equipment, and here is our new study of the job that still remains to be done.

THE MODERNIZATION JOB AHEAD: $95 BILLION

The McGraw-Hill Department of Economics asked a wide sample of manufacturing companies, and experts in other industries, "What would be the cost to replace all obsolete facilities with the best new plant and equipment?" Here is a summary of the estimates. (Details on next page.)

MANUFACTURING AND MINING	$34.3 Billion
PETROLEUM INDUSTRY	5.3
TRANSPORTATION AND COMMUNICATIONS	18.4
ELECTRIC AND GAS UTILITIES	12.0
FINANCE, TRADE AND SERVICES	25.0
TOTAL: ALL BUSINESS	$95.0 Billion

Decade of Expansion[1]

Since 1947, private business in the U.S.A. has invested $291 billion in new plant and equipment. Our manufacturing capacity has increased about 80%; electric power capacity, 145%; capacity for basic raw materials, by 55%. The distribution and service industries have increased floor space by roughly 50% in the decade. In 1957 alone, business spent $37 billion on new plants and equipment – more than the combined expenditure in all of Western Europe plus Canada.

[1] Figures on "Decade of Expansion" are for the years 1947-1957 inclusive, except where specific reference is made to preliminary data for 1958.

THE McGRAW-HILL SURVEY OF MODERNIZATION NEEDS

Conducted by the McGraw-Hill Department of Economics in August, 1958

INDUSTRY:	AGE OF MANUFACTURING CAPACITY Percent Installed: Prior to Dec. 1945	Dec. 1945 to Dec. 1950	Dec. 1950 to Dec. 1957	COST TO REPLACE OBSOLETE FACILITIES: Millions of $
Iron and Steel	47%	16%	37%	2,855
Nonferrous Metals	47	13	40	1,022
Machinery	41	21	38	3,224
Electrical Machinery	34	18	48	1,917
Autos, Trucks and Parts	42	11	47	2,204
Transportation Equipment (aircraft, ships, railroad equipment)	59	9	32	854
Other Metalworking	54	17	29	2,351
Chemicals	30	23	47	3,070
Paper and Pulp	49	17	34	2,655
Rubber	46	9	45	600
Stone, Clay and Glass	46	20	34	1,840
Petroleum Refining	45	26	29	1,499
Food and Beverages	58	19	23	3,443
Textiles	59	18	23	1,001
Misc. Manufacturing	51	21	28	6,236
ALL MANUFACTURING[1]	48	19	33	34,771

[1] Includes petroleum refinery companies listed under "petroleum industry" in previous table.

Our postwar capital investment has repaired the worst of the obsolescence accumulated during the depression and war years. But huge amounts of old equipment are still in use, as shown by the table above. This is based on a survey of the age of manufacturing capacity in several hundred companies, representing all of the major manufacturing industries. Almost 50% of our present capacity was installed before or during World War II. More than 65% was installed before Korea. Expert studies of the major non-manufacturing industries show that the age of equipment, in those industries, is even greater.

Thus, of all business plant and equipment, less than one-third is modern in the sense of "new" since 1950; two-thirds is pre-Korea.

This over-all figure is confirmed by a check on specific industries:

- Nearly two-thirds of our metalworking equipment was installed over 10 years ago, according to preliminary results of AMERICAN MACHINIST'S 1958 census.
- Over 65% of the freight cars on our railroads are more than 10 years old.
- Less than half the capacity to process chemicals, rubber or petroleum is new since 1950 – a period that has seen rapid development in such equipment as automatic controls for these process industries.

These examples take on a dollars-and-cents meaning when we recognize that the latest machine tools are about 40% more productive than 1948 models, and that a combination of new freight cars and modern freight yard equipment can reduce operating costs up to 50%. New instruments, that automatically direct the flow of a chemical (or other raw material) process, can often reduce processing costs enough to pay back the cost of the instruments in one year. These savings cannot be made in older plants. By using obsolete facilities, our industries accept a waste in labor and materials that totals many billions of dollars per year.

Why Productivity Must Rise

The U.S.A. can ill afford this waste. In the economic struggle between the free world and Communist world, our margin of superiority depends on the efficiency of our productive facilities.

For the growth of our own economy, we shall need a sharp rise in productive efficiency. During the next ten years, American business must provide the goods and services required for a population that will increase by 32 million. And the increased population will expect higher living standards. Furthermore, the population in ten years will include a higher proportion of dependent persons – children and retired people – and a smaller proportion of working age men. Thus, with a relatively smaller labor force, industry must provide more goods for more consumers.

At the same time, industry must strive to hold the line against rising costs. In an economy with a tight

labor supply, we cannot count on restraint in wage demands, however desirable such a development might be. In the past ten years, hourly wage rates have increased over 5% per year, nearly twice as fast as output per manhour. And this disparity may well continue – causing still more inflation–unless we make more rapid gains in productivity.

We can make these rapid gains – if industry goes all out to modernize its equipment. Output per manhour (in manufacturing) has increased only 2.5% per year since 1951. But this compares with gains of 4% a year in 1947-1950, and over 5% in the 1920s. Today the machines and techniques are available for us to equal, or exceed, these records – to raise output per manhour at least 5% per year. This is a job that can, and indeed must be done, to assure growth in the economy without inflation.

The Job Ahead

The dimensions of this opportunity are shown by the table on the previous page. In its survey on the need for modernization, the McGraw-Hill Department of Economics asked a wide sample of manufacturing companies how much it would cost to replace *all* their out-dated facilities with the best new equipment available. The Department also interviewed experts in each of the nonmanufacturing industries, to find answers to this question. The answers add up to a staggering bill for new plant and equipment.

Modernization of over-age facilities – replacing only what is really obsolete, by today's production standards – would require a total capital investment of $95 billion, or nearly $20 billion per year for the next 5 years.

Furthermore, new production techniques will soon make *today's* plants obsolete, in many cases. Thus, to keep pace with technical advance *from 1958 on*, will require continuing expenditures of $8 to $10 billion per year for modernization.[1]

The total expenditure to wipe out the backlog of obsolete facilities, and keep up with continuing technical advance between now and 1963, would be at least $135 billion.

The U.S.A. has never spent such a sum on the modernization of industrial facilities. Capital expenditures of boom dimension have, in the past, been associated only with the urgent expansion of capacity. **Some forecasters are now saying that because industrial capacity is adequate, the next few years will be a period of low capital investment. The figures above make clear that this would be a national calamity.** The opportunity is there–and the challenge–to invest record amounts of capital in the modernization of plant and equipment.

A National Problem

This also is a challenge to the U.S.A. as a nation. For 100 years, this nation has been looked to as the model of economic development by the rest of the world. For the first time, we face a serious challenge by another nation and another economic system that claims to be better. In a carefully documented 111 page study released in May, the U.S. State Department declared that "the most serious threat" to the U.S.A. today is the drive for economic supremacy by the Soviet Union.[2] Although a much smaller nation industrially than the U.S.A., the U.S.S.R. is today increasing its national output at a rate of 7% per year and its output per manhour by 4% per year.

The U.S.A. does not have to match these specific figures, which represent the results of forced labor in a country just starting to develop industrially. In the contest to win uncommitted nations, the statistics are not likely to be quoted exactly, in any case. But our over-all growth in national output and living standards must be so impressive as to leave no question of superiority. Our factories must be showplaces of modernization to the foreign visitor that will leave him unable to say "I saw much better" in Britain, or West Germany, or Russia.

This is the challenge to the nation –a political challenge to be sure. But it coincides with the challenge to the business community and the individual firm. And the way to meet it is the same: by thorough and rapid modernization of our plant and equipment – not by the slow and steady pace of recent years, but at an accelerated rate that reflects the greater pressure for output at lower cost.

Obstacles To Be Overcome

We must face up to the fact that real obstacles – both technical and financial–stand in the way of faster modernization. Some companies do not have the technical "know-how" required for the latest production techniques. Many more lack the financial resources. How can we overcome such obstacles, and speed up the replacement of old facilities?

In the course of its study, the Department of Economics obtained comments on these questions from many executives. One of the problems, as we noted above, has been the urgent pressure to expand capacity during most of the postwar period. In giving their attention to this problem, companies have sometimes overlooked the chance to modernize older plants.

In some cases, equipment has been kept in place because it was satisfactory, and the users were not aware of still newer designs. Some equipment users believe that equipment makers are not sufficiently aggressive in designing and demonstrating new models.

The biggest obstacle – and one that presents a persistent problem – is the shortage of funds in many companies that need and want to modernize. For all corporations, the cash flow from retained earnings and depreciation has increased by more than $5 billion from 1953 to 1958. But a number of key industries have failed to keep pace with the general trend. **These include some of the areas where the need for modernization is most urgent: the railroads, large sections of the textile industry, some mining industries and many small to medium-size companies in manufacturing generally.** The problem of these industries and companies has grown more acute in 1958 – since their profits have declined much more than the average for all business.

Any plan to step up the pace of modernization generally must deal with the special situation in these problem areas. Depressed industries and companies need outside help, if they are to modernize. Such help would include a stronger flow of technical information and advice (and occasionally, venture capital) from the more prosperous, inventive industries – as well as advice from equipment suppliers and distributors, industrial publishers and consultants. There is also a public responsibility to help in the problem areas–not with handouts of government money, but with technical assistance and help in finding private capital (like the efforts now being pursued by the Small Business Administration).

Certainly we should lose no time in reforming those provisions of the federal tax laws that now impede investment in modern equipment by hard-pressed firms – especially the outmoded and unfair restrictions on rates of depreciation for tax purposes. At present, the tax regulations require that depreciation be computed over relatively long periods of "useful life" for most types of equipment. And this is a primary reason for the lag in modernization. Machinery generally becomes obsolete long before the expiration of its "useful life" as specified in tax regulations. But it is difficult for companies – especially small companies – to set aside cash for rapid replacement, unless the full amount to be set aside is exempt from income tax. Canada and most European nations allow more rapid depreciation for tax purposes than does the United States.

A combination of self-help with technical help, and a fair break from the tax laws, would do much to reverse the spreading tide of obsolescence in depressed industries, and in many small companies.

PLAN '59

It is this combination that McGraw-Hill advocates as "PLAN '59", to help business modernize *now* for growth and profits. This is what it will take to make a start in 1959 on the $95 billion job of modernization, disclosed by the study we have just completed:

1. A better flow of technical information on where and how to modernize business plants and equipment.

2. Careful review by the individual company of its own opportunities to modernize at a profit – then action to replace obsolete facilities.

3. Reform of the tax laws, to allow more realistic deductions for depreciation, and permit more companies to finance adequate modernization programs from this source of funds.

Much of this program is already underway. The 34 McGraw-Hill Publications, and many suppliers and distributors of industrial equipment, have stepped up their information programs to start the modernization drive. Preliminary plans of manufacturing companies show a strong emphasis on capital spending for this purpose. In August, Congress passed a bill providing limited tax relief for small business.

But the real task of modernization still lies ahead. It is the greatest challenge, and the greatest opportunity, confronting American business as we move forward into 1959.

MODERNIZATION PAYS

Profits on modernization–like all business profits–have come down since 1955. However, modernization, in contrast to new capacity, still offers a relatively quick return on investment. Here are companies' answers to the question: "In cases where you are actually replacing old facilities with new plant and equipment in 1958–how soon do you expect these replacement expenditures to pay off?"

	PERCENT OF COMPANIES ANSWERING			
INDUSTRY:	1 to 2 yrs.	3 to 5 yrs.	6 to 8 yrs.	9 yrs. and over
Iron and Steel	11%	56%	11%	22%
Nonferrous Metals	29	71	0	0
Machinery	12	56	12	20
Electrical Machinery	29	57	7	7
Autos, Trucks and Parts	40	60	0	0
Transportation Equipment (aircraft, ships, railroad equipment)	7	53	20	20
Other Metalworking	38	33	10	19
Chemicals	10	53	21	16
Paper and Pulp	22	22	22	34
Rubber	33	33	34	0
Stone, Clay and Glass	0	57	36	7
Petroleum Refining	16	50	17	17
Food and Beverages	16	44	12	28
Textiles	37	47	5	11
Misc. Manufacturing	9	52	13	26
ALL MANUFACTURING*	18	50	14	18

**Note:* Answers to a similar question, in a 1955 McGraw-Hill survey, were as follows: 1-2 years: 17%, 3-5 years: 64%, 6-8 years: 11%, 9 years or more: 8%.

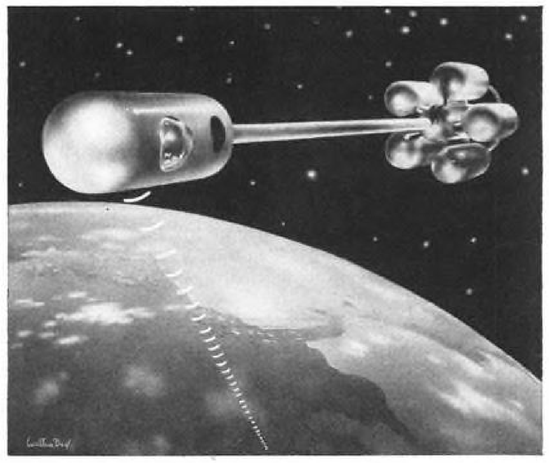
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[1] This estimate is based on technical developments reported by McGraw-Hill editors and current price trends for capital goods. It is consistent with the plans for modernization expenditures in 1958-61 reported by companies in a McGraw-Hill survey conducted in April, 1958.

[2] "The Sino-Soviet Economic Offensive in the Less Developed Countries" – U.S. Department of State, May, 1958.



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The man selected will have full responsibility for materials utilized in the development of advanced systems within the Boeing Systems Management Office. Salary, naturally, will match the education and experience qualifications of the key man we are seeking.

Write, in confidence, to Mr. Stanley M. Little, Department CM1, P.O. Box 3822, Boeing Airplane Company, Seattle 24, Washington.

BOEING

PRIVATE LINES

New ANT-1G antenna for lightweight Bendix RDR-1-D weather radar measures only 18 in. in diameter, simplifying installation in business planes. Earlier Bendix antennas, such as ANT-1B and ANT-1E, measured 22 in. and 30 in. respectively. New ANT-1G weigh 15 lb. compared with ANT-1B's 25 lb. and ANT-1E's 27 lb. ANT-1G antennas are now going into Fairchild F-27 turboprop, will be available to other users beginning in November. Complete RDR-1D system, including new antenna, in Beech 18 is estimated at $16,000, including installation.

Current production line positions held by corporations for executive version of Lockheed Jetstar is approximately evenly divided as regards installations of four types of engines available: Pratt & Whitney JT12, Wright TJ-37, General Electric J85 and Fairchild J83, according to Lockheed sources.

Electrically heated laminated sierracote windshields will be tested on Beech L-23 Twin-Bonanza this month by U.S. Army to evaluate its de-icing characteristics. Manufacturer, Sierracin, Burbank, Calif., is seeking to cover light-twin market with this equipment, currently available for larger types.

Lear, Inc. plans to bring all its light business aircraft avionics equipment to CAA Technical Service Order (559) standards, modifying certain items not now currently meeting this requirement, in line with CAA's recent 58-5 proposal.

Price of conversion of Convair 340s and 440s to take Allison 501-D13 turboprop engines will be approximately $490,000 including full soundproofing treatment. On basis of minimum run of 10 conversions, price will be $587,000 but rebate will be made to $490,000 price if 35 conversions are sold by mid-1961; if between 11-34 are sold, price would be adjusted between these two figures. Allison expects number one production configuration of Allison-powered Convair to be CAA-approved Nov. 1, 1959.

Aeronca Manufacturing Corp. recently made two major expansion moves: it formed a subsidiary in Los Angeles, called Aeronca-California Corp., and signed an agreement to acquire Pastushin Aviation Corp.'s 60,000-sq. ft. plant, which is turning out B-52G 700-gal. auxiliary fuel tanks and pylons; Middletown, Ohio, firm also leased 84,367 sq. ft. of factory building from Armco Corp., to house operations Aeronca has been handling in its Plant 2 and Plant 3.

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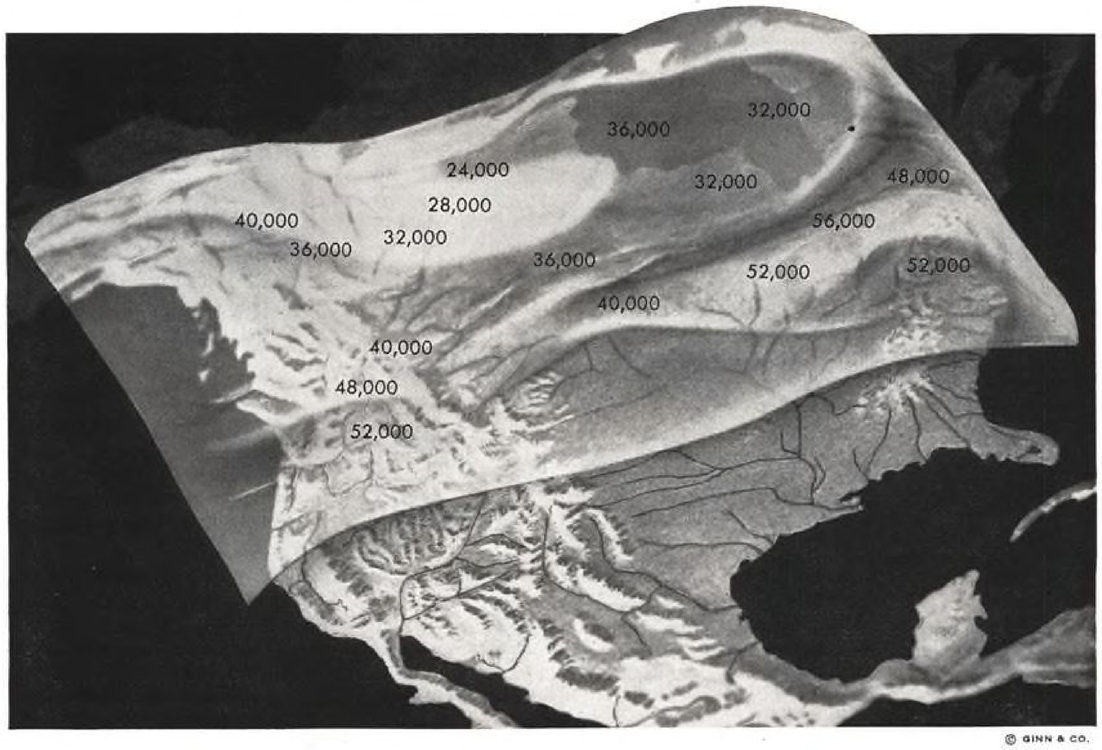
FLY WEATHER-WISE — Mobil

These weather items prepared in consultation with the United States Weather Bureau

THE TROPOPAUSE

With the introduction of turbo-prop and turbo-jet aircraft the location of the tropopause assumes greater importance. Technically, the tropopause is that point in the atmosphere where the normal decrease of temperature with altitude ceases. It is the coldest layer in the atmosphere encountered by turbine-powered aircraft. It also indicates the level of maximum winds which are always found within a few thousand feet of this tropopause layer.

As the illustration shows, the height of the tropopause varies across the United States from 30,000 ft. to 56,000 ft. In some places it slopes down almost vertically, especially over the cold side of jet streams. Notice when flying from North to South, the average range of the tropopause varies almost 100% and temperatures vary sharply under such flight conditions.



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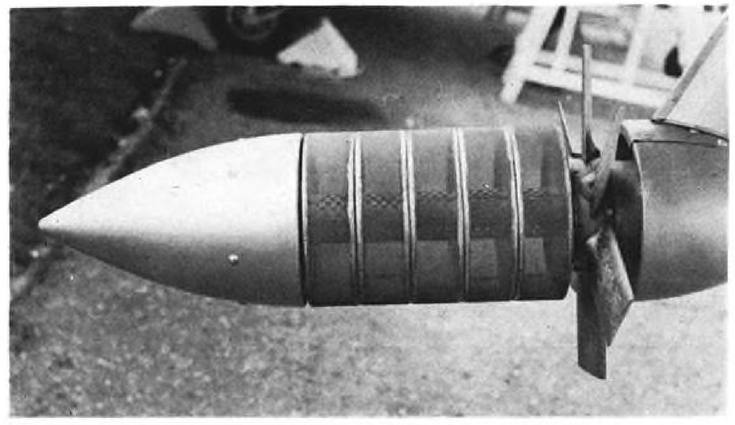
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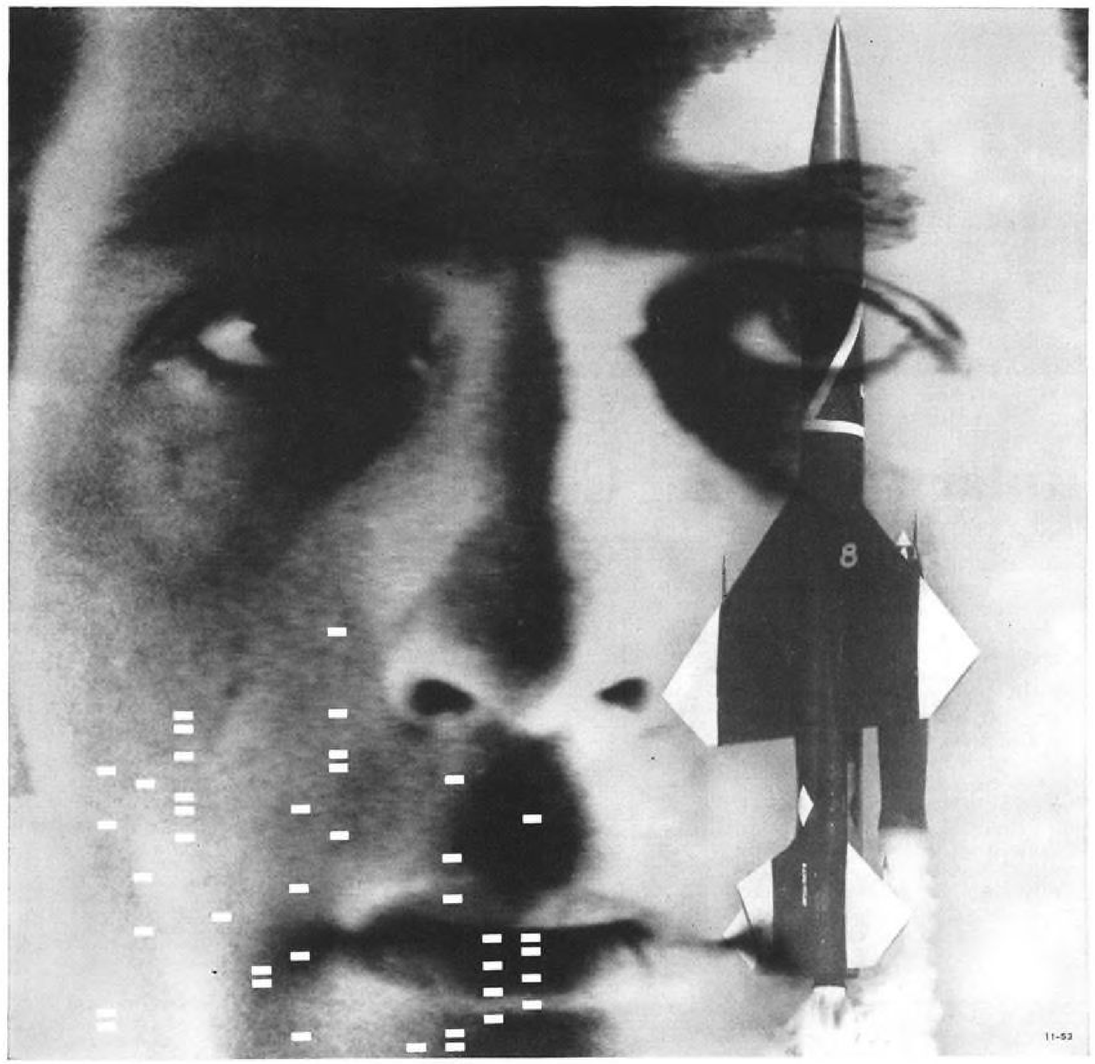
ULTRA-FINE chemical spray is produced by atomizers under wings of Auster Alpha agricultural plane flying at typical altitude.

Rotary Atomizer Controls Spray Droplets

British-developed system of rotating atomizers for dispensing chemicals from agricultural planes obviates installation of conventional spray booms attached to wings, instead contains units in streamlined canisters. Rotary atomizers, designed and built by Britten-Norman, Ltd., have individual drive systems comprising multi-blade fans, pitch of which can be adjusted to provide any desired rotating speed for atomizer. By adjusting atomizer rotation, size of droplets dispensed can be regulated to extremely fine dimensions, a distinct aid when dense coverage is desired for potent chemicals. Installation shown on Auster J1N Alpha includes a 45-gal. chemical tank in cockpit which may be loaded through a filler nozzle atop the fuselage.







Man-Machine Relationships: A New Field for Scientists and Engineers

A new field for Operations Research Specialists, Engineers, Computer Programmers and Behavioral Scientists has arisen from System Development Corporation's work on relationship of men and machine systems.

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Both activities also have these elements in common: they are constantly changing • they are long-range in nature • they are essential to the welfare of the United States.

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The expanding scope of SDC's work has created a number of positions in these fields. Inquiries are invited. Address: R. W. Frost, 2404 Colorado Ave., Santa Monica, California, or phone collect at EXbrook 3-9411 in Santa Monica.

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SAFETY

Handley Page Accident Investigation Report:

Turboprop Gearbox Shaft Failure Cited as Dart Herald Crash Cause

(This is an official Handley Page report on the loss of the prototype Dart Herald Aug. 30, while the transport was en route to the Farnborough air show.)

On Aug. 30, while flying at 6,000 ft. and being photographed en route to the Farnborough air show, chief test pilot Squadron Leader H. G. Hazelden heard a loud bang from the starboard engine which immediately caught fire.

Squadron Leader Hazelden noticed the rpm. decreasing rapidly on this engine and immediately took the necessary action to close the high and low pressure fuel cocks and feather the propeller. The fire extinguisher had no apparent effect, so he throttled the port engine and descended at 150-160 kt. with the intention of crashing in the first available open space.

In a very short time, the aircraft began pitching and although the pilot felt that a major break-up was imminent, he was still able to control it with the elevator. Some gentle rolling from side to side also occurred and as the ailerons were beginning to jam, he had to use considerable force to overcome it.

At about 1,500 ft. there was a much more violent roll which required full port aileron to correct. This was the point at which the starboard engine and nacelle dropped away from the aircraft, but within a few seconds the machine righted itself although the pitching was somewhat worse.

As Squadron Leader Hazelden approached the field he had chosen, he noticed that it had high tension cables running across it. There was insufficient space beyond the cables before the trees at the far end, so he forced the aircraft on to the ground, touching down at about 130 kt., and slid under the cables, one of which struck the tip of the fin.

The initial deceleration was very mild but as the aircraft crossed a ditch into the next field, it struck a large tree stump which tore a hole in the starboard side of the fuselage just behind the cockpit. All nine occupants of the aircraft escaped unhurt through this hole. Only 4-5 min. had elapsed from the time that the fire began, to the final touchdown. Owing to the inaccessible location of the crash, it was some time before the fire brigade arrived on the scene and by that time the fuselage and starboard inner wing were burnt out.

Result of Investigation

Rolls-Royce has inspected the Dart engine concerned and reached the following conclusions:

1. The initial failure was of the auxiliary gearbox, breather layshaft which fractured in the undercut between the splines and the threaded portion.
2. Failure of this shaft interrupted the flow of oil to the turbine bearings.
3. The bearings failed and allowed the high pressure turbine disk to move rearward and foul the interstage seals circumferentially.
4. The resultant grooving and overheating of the turbine disk caused it to fail in tension.

Portions of the turbine disk rim severed the fuel pipe and an engine mounting strut and in the few seconds which elapsed before the fuel cock switches were operated by the pilot, several gallons of fuel flooded the engine bay. Such a quantity of fuel is considered by the experts to be sufficient to cause an uncontrollable fire. The fire extinguisher has been found to have operated.

Fuel Flows Back

The accumulation of fuel poured out of the holes made in the nacelle by the turbine disk and flowed back along the outside of the nacelle before entering the undercarriage door gaps where the fire continued to burn inside the wheel well.

Although the fire wall was intact, the skin panels behind it were burnt through as well as all the nacelle frames and the whole of the rear of the nacelle. The undercarriage doors fell away and the starboard landing gear may have been partly lowered. When the nacelle attachment points finally burned away, the engine and the remainder of the nacelle fell away and were found 1¼ mi. before the point of touchdown.

In falling away, the nacelle pulled away the fuel pipes from the wing tanks and allowed a free flow of fuel to maintain the fire under the wing which reached back to the starboard tailplane, half of which was burned off and fell away 200 yd. before touchdown.

We attribute the fact that the wing strength was maintained, in spite of what must have been considerable damage caused to the structure by the intense fire, to the fail-safe construction and corrugated sandwich skin employed in the manufacture of the wing. In addition, the fact that the wing panels and trailing edge structure are continuous across the nacelle, the latter being hung as a separate item, no doubt prevented the wing from being burned off in flight.

Although the aircraft touched down at about 130 kt., the fuselage was practically undamaged. This says much for the strength of the underfloor structure of the Dart Herald; there was no displacement of the passenger seats.

There have been two auxiliary gearbox, breather layshaft failures on the Dart 520 series, three-stage turbine engines. Both failures were identical and were associated with a certain manufacturing batch. Action has been taken to replace these with strengthened layshafts.

In addition, the low oil pressure warning

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light switch has been repositioned to sense the oil pressure to the turbine bearings so that, in the event of a cessation of the oil supply, an immediate indication would be given by a red warning light and feathering action taken before a major failure occurs.

As this is the first instance of debris from an engine severing a fuel pipe, Handley Page, apart from the action being taken by Rolls-Royce, is investigating the desirability of introducing an automatic cutoff in the fuel line which will operate should the pipe be fractured. Means of protecting the fuel line, forward of the fireproof bulkhead, are also being studied.

The aircraft which crashed, had finished its flying trials—200 hr. in the air—since it made its first flight earlier this year. Only one or two tests remained to be completed to enable a certificate of airworthiness to be granted to it. The second prototype Dart Herald is already near completion.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command.

Arma Division, American Bosch Arma Corp., Garden City, N. Y., bomber fire control systems, bomber, flexible, tail defense, type AN/ASG-15 fire control system for B-52 aircraft, (PR PE-7-11E-4648, -1 and PR-8-11E-3211), $3,240,000.

Collins Radio Co., Cedar Rapids, Iowa, ARN-58 radio receivers units for T-38A aircraft, (PR PE-8-16A-3550), $30,091.

Small Aircraft Engine Department, General Electric Co., West Lynn, Mass., T58 turboshaft engine preproduction implementation, (MIPR-R57-1169-146-NOas), $669,235.

AiResearch Manufacturing Co. Division, The Garrett Corp., Los Angeles, Calif., actuators (supply), (PR SA-8-03C3-4811), $127,837.

B. F. Goodrich Aviation Products Division, B. F. Goodrich Co., Dayton, Ohio, wheel assemblies, landing gear for C-124 aircraft, (PR 00-8-03B-1101 and 00-03B-1552), $635,916.

Arma Division, American Bosch Arma Corp., Garden City, N. Y., fabrication and installation of ECP kits in MD-9 fire control systems (used in B-52 aircraft), (PR WR-8-MAINT-682-1 and WR-58-1270-505), $60,000.

Lycoming Division, The Avco Corp., Williamsport, Penna., 0-480-1 reciprocating aircraft engines for installation and support of L-23D aircraft for the U. S. Army, (PR PE-7-02A-4885 "Q" and PE-8-02A-3608 "Q"), $1,242,078.

AC Spark Plug Division, General Motors Corp., Flint, Mich., product improvement of the 107 inertial floated gyroscope to increase its reliability and performance: end use is TM-76 and weapon system 315A. (PR PE-8-11A-3175), $1,162,658.

Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J., product improvement engineering services of J65 engine projects during CY 58, (MIPR R57-1078-56-AER and amendment no. 3), $1,000,000.

Aeronautical Experiment Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., computer set, bombing system, low altitdue, type AN/AJB-5B for F-100F aircraft, (PR PE-8-11A-3333), $310,000.

Small Aircraft Engines Department, General Electric Co., West Lynn, Mass., J85 engine product improvement for CY 58(AF supported program), (PR PE-8-02A-3363), $10,998,332.

Fairchild Engine Division, Fairchild Engine and Airplane Corp., Deer Park, L. I., N. Y., CY 58 product improvement program for J83 series engines, partially funded. (PR PE-8-02A-3393 and PE-8-02A-3668), $6,700,440.

WHO'S WHERE

(Continued from page 23)

Changes

Capt. Robert F. Titus has been named Air Force Project Pilot for zero length launch (ZEL) tests on the F-100D at the Air Force Flight Test Center, Edwards AFB, Calif.

Gilbert L. Bates, senior associate, Planning Research Corp., Los Angeles, Calif.

Frederick B. Lee, director-Washington, D. C., Offce, Olin Mathieson Chemical Corp., New York, N. Y.

Dr. Arthur Uhlir, Jr., director of semiconductor research and development, Microwave Associates, Inc., Burlington, Mass.

Maj. Gen. Alvin L. Pachynski (USAF, ret.), director of program planning, Lenkurt Electric Co., San Carlos, Calif.

William H. Herrman, director of advertising and public relations, Hoffman Laboratories Division, Hoffman Electronics Corp., Los Angeles, Calif.

John M. Sayre, manager-advertising and ublic relations, Resistoflex Corp., Roseland, N. J.

Francis P. Rice, director of operations, International Resistance Co., Philadelphia, Pa.

Robert L. Rhodes, head, newly established Maintenance Division, Northwest Orient Airlines.

Leslie Hyland, sales manager-Western routes, British Overseas Airways Corp., succeeding George Boughton, now chief executive of Kuwait Airways, BOAC associate.

George Masurat, general superintendent-production, Philco Corp's Government and Industrial Division, Philadelphia, Pa. Also: **Sol Zechter,** manager-transistorized devices laboratory; **Edwin A. Fink,** section manager-missile fuse engineering.

Francis T. Greenup, manager-engineering services and Alectra Department, Central Engineering Division, Consolidated Electrodynamics Corp., Pasadena, Calif. Also: **George M. Slocomb,** assistant chief development engineer; **E. James Penrose,** administrative manager.

Donald F. Wentzler, director-planning and organization, and **Edward J. Felesina,** director-public relations and advertising, ITT Laboratories, division of International Telephone and Telegraph Corp., Nutley, N. J.

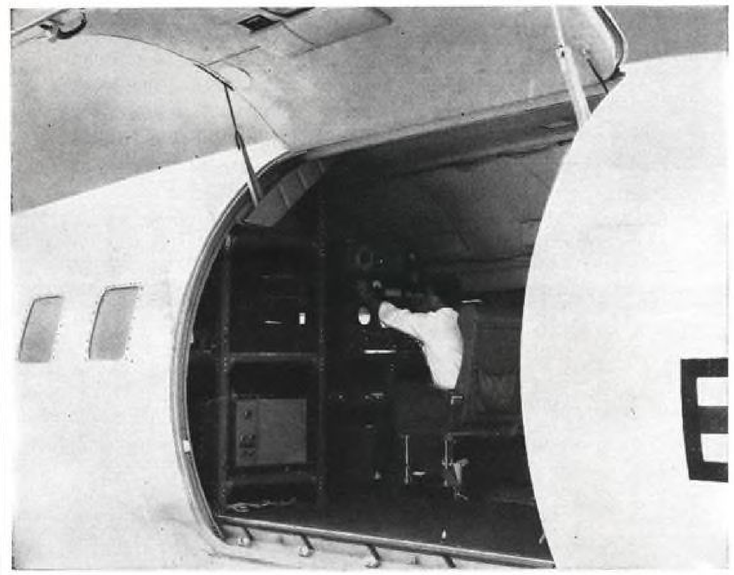
Douglas Aircraft Co., Inc., Santa Monica, Calif., has appointed the following assistant chief engineers in the Missiles and Space Systems Engineering Department: **M. W. Hunter**—space systems; **C. S. Perry**—missile systems; **E. B. Sporleder**—administration. **A. J. Carah** succeeds Mr. Hunter as missile chief design engineer. Also: **H. W. Adams,** assistant chief engineer-design in the Aircraft Engineering Department.

Edward R. Arnold, technical service representative, Defense Products Department, Callery Chemical Co., Pittsburgh, Pa.

Dr. William O. Wetmore, special assistant to the vice president—Azusa Operations, Aerojet-General Corp., Azusa, Calif.

John B. Rieker, division manager, lighter-than-air, Goodyear Aircraft Corp., Akron, Ohio. Also: **William L. Leek,** head, newly created metal products department, and **James P. Banks,** manager of public relations.

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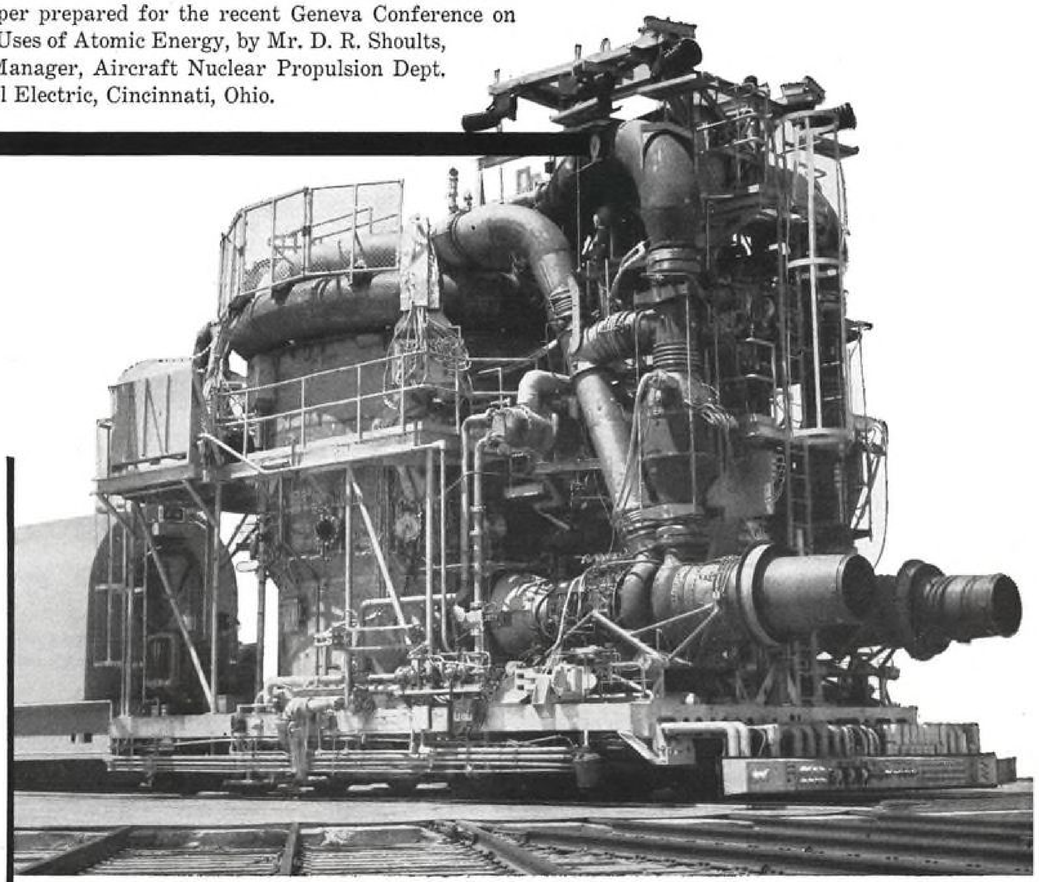
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ENGINEERS, SCIENTISTS: Specific Experimental Data have now been declassified from which you can gauge the breadth of the opportunities for original work open to you in the pioneering field of nuclear power for aircraft. This information is made available from a paper prepared for the recent Geneva Conference on Peaceful Uses of Atomic Energy, by Mr. D. R. Shoults, General Manager, Aircraft Nuclear Propulsion Dept. of General Electric, Cincinnati, Ohio.



Test Assembly for HTRE No. 1 to the right is on its way to test area on a flat car, drawn by a shielded locomotive. Test area control center itself is underground for safety considerations. During test period, the *Direct Cycle Nuclear Turbojet System* was shut down between operating phases and the Test Assembly returned to the "*Hot Shop*" (a chamber with 7 ft. thick concrete walls and 6 ft. thick windows) where remote handling equipment, designed for this program, disassembled components for the inspection or replacement of parts.

FIRST PHOTOGRAPHS, DIAGRAMS AND TECHNICAL DATA RELEASED ON HISTORIC TESTS PROVING FEASIBILITY OF DIRECT CYCLE NUCLEAR TURBOJET SYSTEM FOR AIRCRAFT

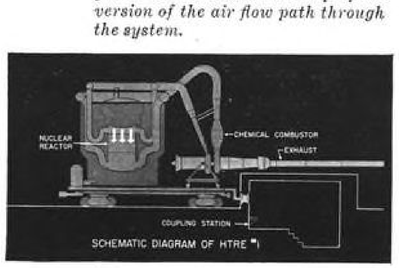
Successful Heat Transfer Reactor Experiment No. 1 Basis of Present Advanced Development Stage of Aircraft Nuclear Power Plant

HTRE No. 1 marked *the first time* that all the components of a combined reactor and jet engine power plant were assembled and operated.

The system was developed and produced by General Electric engineers and scientists at the Aircraft Nuclear Propulsion Department, Cincinnati, Ohio, under dual contract with the U.S. Air Force and the U.S. Atomic Energy Commission. The tests were conducted at the National Reactor Test Station in Idaho Falls, Idaho, during the period January 1956-January 1957.

"These tests," Mr. Shoults writes, "were of great significance in meeting the objective of developing a useful aircraft nuclear propulsion system. HTRE No. 1 proved conclusively the operability of the system and the predictability of its performance."

The Test Assembly for the experiment consisted of an air-cooled, metallic-fuel-element, water-moderated reactor operating a modified J47 turbojet engine designated X39. *A photograph of this assembly is reproduced at the left; schematic diagram below shows a simplified version of the air flow path through the system.*

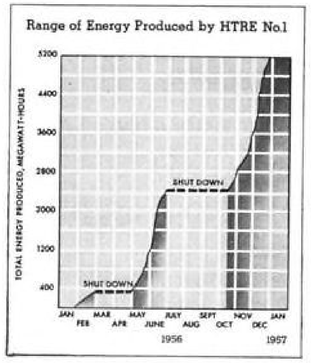


Test Assembly utilizes the direct air cycle to which propulsive thrust is provided by sending atmospheric air from the compressor (compressed to 5 times the intake pressure) directly through reactor, into the turbine, and out exhaust nozzle.

The reactor core structure consists of a cylindrical water vessel penetrated by air tubes. The shield plug structure and the heavy gamma ray shielding are of stainless steel. Moderator water is used for neutron shielding in shield plug.

The power plant is started on chemical fuel alone, with compressor air passing through the cold reactor. As the reactor power increases, the chemical fuel flow is decreased. When nuclear power is sufficient for self-sustaining operation, chemical fuel is cut off.

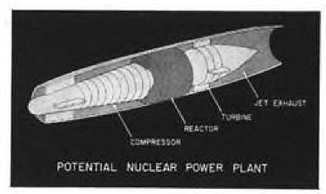
Throughout the tests, operation was stable during the transition from chemical to nuclear power and the reactor was responsive to both manual and automatic control. Combined operating time during test period totalled 258 hours. *A chart showing total energy produced in test period is reproduced below.*



Confirmation of Design Concept of Direct Cycle Nuclear Turbojet System Obtained

Extensive operation at full nuclear power was recorded without failure or significant leakage of radioactive material to the airstream. Proof was obtained that overheating portions of the reactor would not lead to local flow starvation and progressive overheating.

Much of the apparatus illustrated was provided for developmental convenience and would not be used in an actual system for aircraft. The shield, for example, is extra-heavy to allow external contact maintenance during shut-down. In an aircraft installation the shield would be much lighter and the engine would be coupled more closely to the reactor-shield assembly. *A diagram of a potential configuration for a Direct Cycle Nuclear Turbojet System for airframe application is shown below.*



2nd and 3rd Generation Nuclear Power Plants for Aircraft Now Under Development

Research and development has proceeded at an accelerated pace at General Electric, since the epochal results of HTRE No. 1 in early '57.

The great challenge of the aircraft nuclear propulsion project is that this type of system requires generation of large amounts of heat from a nuclear reactor of very small volume. Also, all items comprising the power plant must be provided within very stringent weight limitations.

Intensive work has been — and is — under way in areas of reactor design, shield design, and the development of new materials to withstand extreme temperatures and neutron bombardment, as well as new methods of fabricating these materials.

While much progress has been made, many problems must still be solved before the first high performance aircraft flies on nuclear power.

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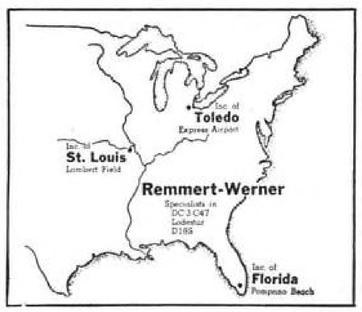
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LETTERS

Reply on Lighting

Mr. Robson, in his column in your Sept. 29 issue (p. 31), has seized upon a statement that appears on the cover of every document that is printed and distributed by the Office of Technical Services, regardless of origin, to discredit the status of CAA Technical Development Report No. 338.

This report was prepared by two members of the staff of the CAA Technical Development Center, and one official, Bob Gates, of the CAA Office of Flight Operations and Airworthiness. As director of the Technical Development Center, I am responsible for the technical accuracy of the report and for the competence, integrity and objectivity of the authors. These three men have these qualities to a marked degree, and the report is an accurate account of work done and observations made.

In the evaluation of airport lighting it is not possible, in the absence of statistical information derived from a great number of observations, to express the results with anything like mathematical precision. Therefore, there is always room for honest differences of opinion as to conclusions drawn from this type of study. Mr. Robson is certainly entitled to disagree with our findings. He has not, however, any basis upon which to question the honesty or objectivity of the people who did the work and authored the report. This kind of abuse of experienced, capable government people is damaging to aviation generally and is irresponsible journalism.

I often enjoy reading "Cockpit Viewpoint" and don't mind the good captain "sounding off." I suggest, however, that a little restraint in dealing out abuse to others who also have the cockpit viewpoint would enhance the value of his column.

D. M. Stuart, Director
Technical Development Center
Civil Aeronautics Administration
Washington, D. C.

Risk and Security

I take vigorous exception to Mr. Tipton's implications (AW Sept. 29, p. 28) to the Boston Rotary Club, to wit: pilot pay is staggering the airlines and lining the pockets of pilots with ill-gotten wealth. It is impossible to justify one's existence in a few paragraphs, but an answer of sorts must be made to Mr. Tipton's charges.

I am a copilot on the North Atlantic operation of a major scheduled carrier, with sufficient experience to submit two fundamental reasons why airline pilots and their jobs cannot be compared—as Mr. Tipton attempts to do—with house painters, or for that matter, with most other kinds of work. These I define as risk and career security.

With respect to the risk attendant to a lifetime of airline flying, consider the following incidents which I experienced in the past two months:

1. Engine failure with subsequent three-engine operation commencing at the exact midpoint of a Shannon-Goose Bay flight. In that the other engine on the same side was losing oil, we turned to Keflavik, Iceland—weather zero, zero, and forecast to remain so for the succeeding six hours.
2. Engine fire warning on takeoff at V_1 speed at maximum gross weight on a runway of minimum legal length.
3. Routine engine failure while we were high and light—no problem but still startling.

In these cases, as in numerous others, flight crew performance turned potential emergencies into a continuation of the fine safety record enjoyed by our airline. Mr. Tipton uses this record as an excuse to limit pilot pay, i.e., our good work is being used against us. Furthermore, is it possible to get the same performance out of crews attracted by some lesser pay? Perhaps, but I doubt it. The hours of boredom and the moments of terror would not be worth it.

With respect to career security, I have the following point to make. Unfortunately, techniques and training acquired while piloting do not carry over into other career fields. An ex-airline pilot would find his ILS technique worthless when applying for a sales position, his weather judgment worthless to an engineering firm. In short, everything learned while piloting is worthless to a potential employer on the "outside world." With this background, what happens to the pilot who is furloughed (143 on our airline in the past eight months), fails a physical, or is found wanting when being upgraded from copilot to captain? Truly, when you take up airline flying, you are crawling out on a limb. If the limb is sawed off, you go in but one direction. There are no compatible occupations to turn to. This career risk should be compensated for while with the airline. I submit, therefore, that the differences between the job of an airline pilot and other professions should be acknowledged and compensated for, and that risk and tenuous career security are the big differences to the pilot and his family.

Jeremiah S. Burns
First Officer, TWA
Salem, Mass.

Airline Vigilance

Without jumping into the raging VFR-IFR issue, I just want to make one thing clear. Many of the fellows I fly with are tired of being accused of "sleeping," reading, and otherwise not looking out for other aircraft. Strangely enough, we have not been accused of this neglect by the CAA, CAB, or any duly authorized flight safety group concerned with such matters. The "laymen" who have fired these verbal bullets apparently fail to realize that we pilots are in the airplane, also, and are just as concerned for our own safety, as well as the passengers. Since I am on "reserve," most every trip is with a different crew, and I have yet to see anyone who does not exercise a continuous vigilance, especially climbing or descending in terminal areas. In fact, company regulations require that not even essential writing be performed during climb or descent, that both pilot seats be occupied at all times, that, of course, no reading not necessary to the trip be done in the cockpit, and other regulations which demand our increased vigilance in these days of overcrowded air lanes.

In closing, I have found that the control column is a very handy holder for a folded Jepco Avigation Chart. From ". . . about one-third of the way aft . . ." looking through the cockpit door, this could very easily be mistaken for ". . . the morning newspaper . . . spread . . . on the yoke." (AW Sept. 29, p. 90).

J. P. Houck
United Air Lines
San Francisco, Calif.

Helicopter Expenses

On p. 34 of the Sept. 29 issue of Aviation Week you report New York Airways total operating expenses for the month of July, 1958, as $733,713, whereas the correct figure is $233,713. I would appreciate your publishing a correction of this error.

William W. Hogan, Treasurer
New York Airways, Inc.
Flushing, N. Y.

Two Nikes

You print a very fine magazine and have a lot of good stories. But in your Sept. 15 issue of Aviation Week you have a rather misleading description. On p. 71, in the photo titled "Nike Hercules Site," you say "Douglas Nike Hercules surface-to-air missiles are poised on Army launch ramp." The fact is, both of the missiles in the picture aren't Nike Hercules. The one in the front of the picture is really a Nike Hercules, but the other missile isn't. It is a Nike Ajax. I think you have a very good magazine and I'm glad my father subscribes to it. I am very interested in aviation. A lot of my friends are too. Thank you.

Glenn Scammel, Age 10
Dallas, Tex.

Helicopter Piloting

Mr. John Tunstall in his article "Transmission Design Cuts 192's Weight" (AW Aug. 18, p. 64) reports claims that the Bristol 192 is the "first to maintain cruising flight on one engine."

I respectfully take exception to this claim as I flew the U.S. Navy XHJD-1 side-by-side twin rotor helicopter many times on one engine as early as 1947. Moreover, at about the same time I flew the USAF XH-20 ramjet helicopter on one jet in cruise flight unintentionally and perhaps with some loss of altitude.

C. R. Wood, Jr.
U.S. Army Transportation Supply and Maintenance Command
St. Louis, Mo.

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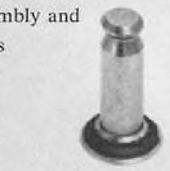
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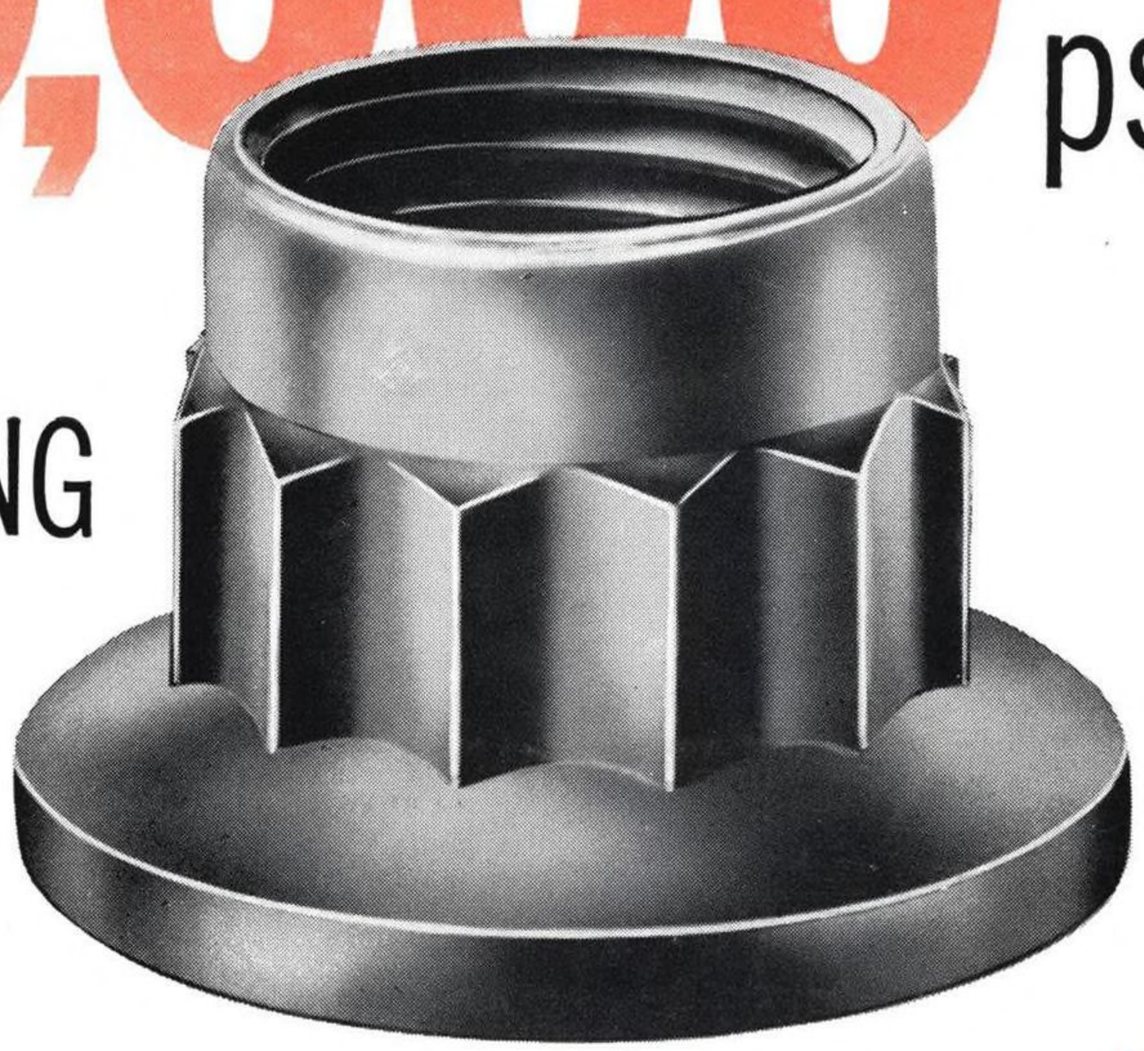
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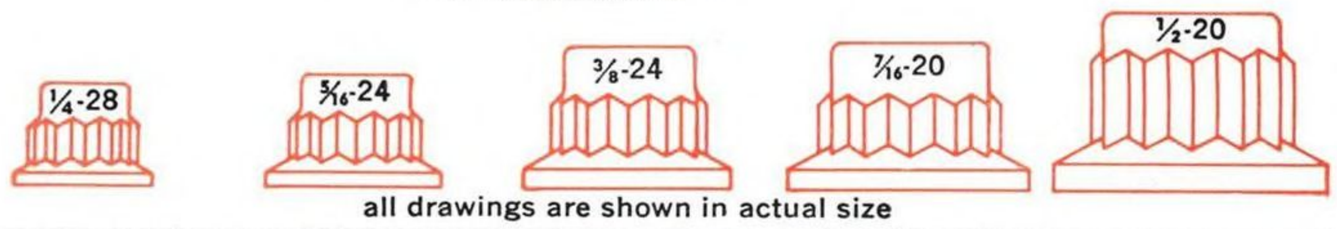
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