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Including Space Technology

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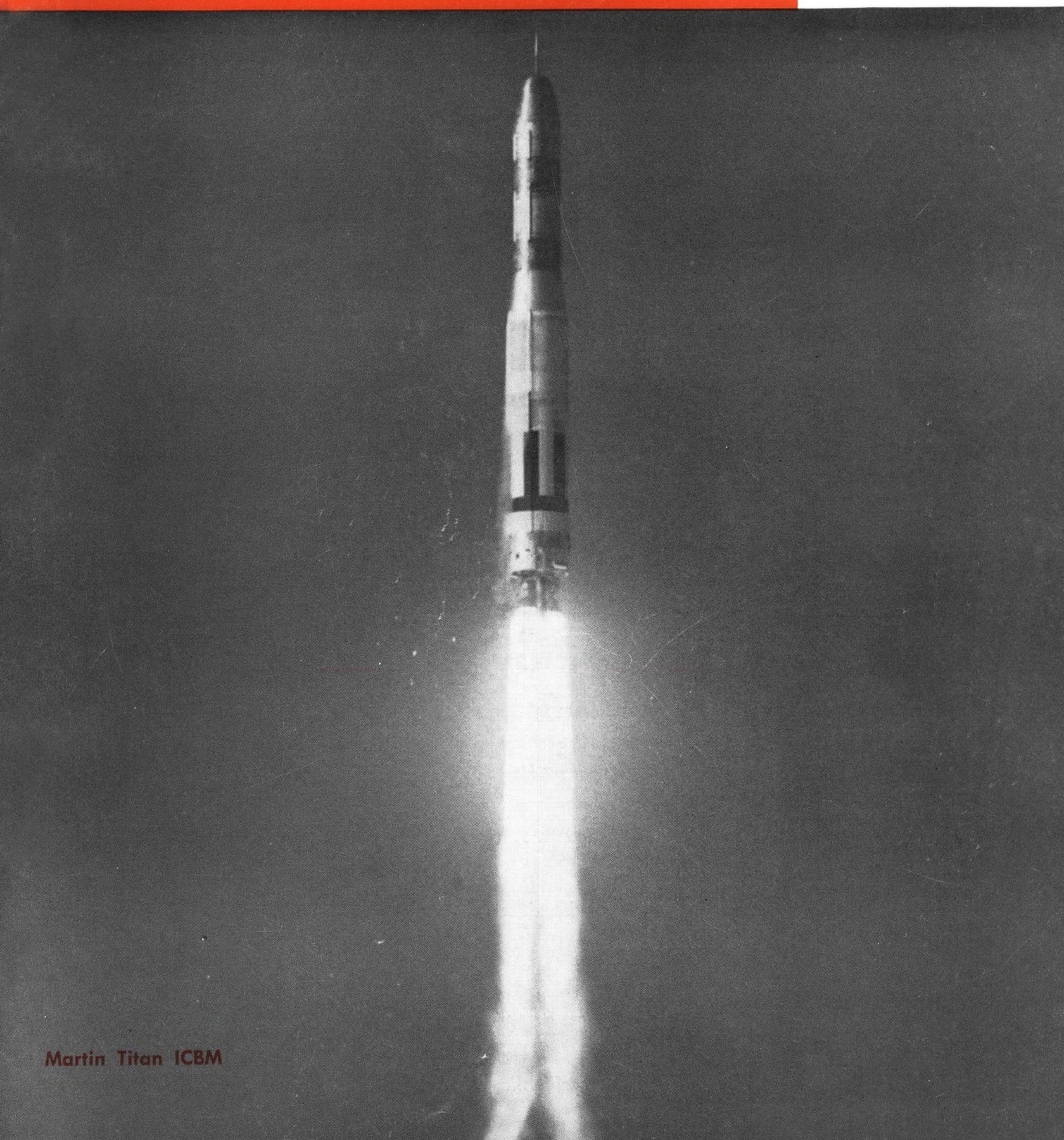
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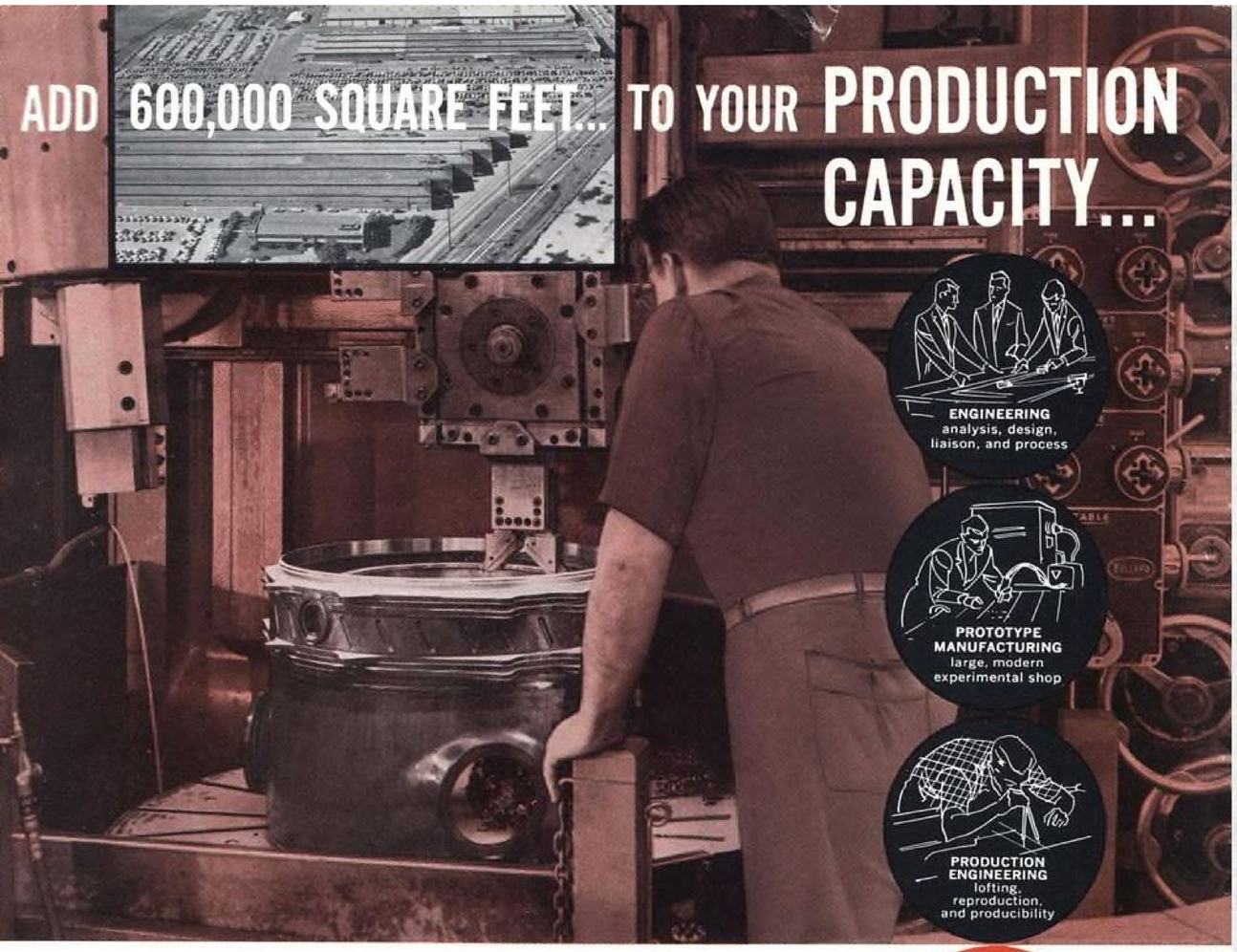
Rocket Cluster Designs Studied

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Kaman H-43A Pilot Report



Martin Titan ICBM



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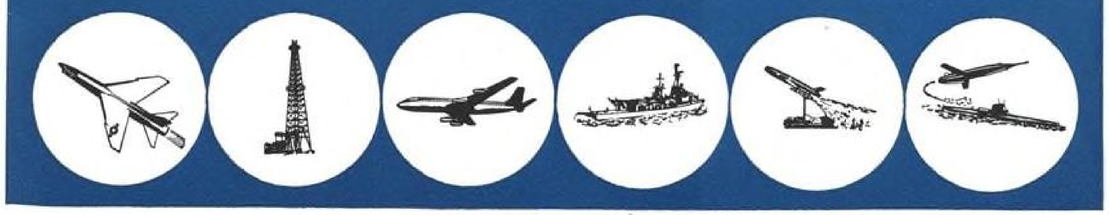
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AVIATION CALENDAR

March 3-5—1959 Western Joint Computer Conference, sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and Assn. for Computing Machinery, Fairmont Hotel, San Francisco, Calif.

March 5—Mid-America Missile Briefing, Conrad Hilton Hotel, Chicago, Ill. Sponsors: Aviation Committee/Chicago Assn. of Commerce and Industry; Illinois Wing/Air Force Assn.

March 5-6—Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Hotel Carter, Cleveland, Ohio.

March 5-7—Western Space Age Conference and Exhibit. For information: Domestic Trade Dept., Los Angeles Chamber of Commerce, 404 South Bixel St., Los Angeles 54, Calif.

March 6—Air Transport Command Reunion, World War II Officers, Waldorf Astoria, New York, N. Y.

March 8-11—Gas Turbine Power Conference and Exhibit, Netherlands-Hilton Hotel, Cincinnati, Ohio. Sponsor: American Society of Mechanical Engineers.

March 9-12—Aviation Division Conference, American Society of Mechanical Engineers, Statler-Hilton Hotel, Los Angeles.

March 10-11—Third Annual Shock Tube Symposium, Old Point Comfort, Ft. Monroe, Va. For details: Armed Forces Special Weapons Center, Kirtland AFB, Albuquerque, N. M. Attn.: SWRS R. R. Birnkoff.

March 12—Symposium on Microwave Techniques for Computing Systems, Department of Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

March 16-17—Conference on the Nuclear Optical Model, Florida State University, Tallahassee, Fla. Sponsors: National Science Foundation, Office of Naval Re-

(Continued on page 6)

AVIATION WEEK Including Space Technology

February 23, 1959

Vol. 70, No. 8

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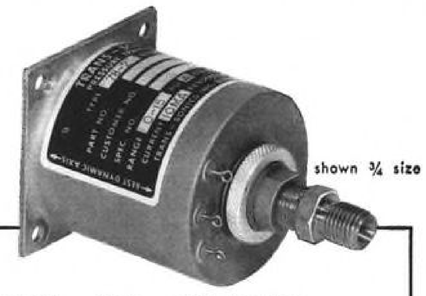
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Hermetic sealing protects entire mechanism against sand and dust, humidity, salt spray, fungus, and the fluid being measured. Unit has welded stainless-steel case, is 1⅞" diameter by 1⅞" long, weighs only 6 ounces. Standard ranges are 0-15, 0-25, and 0-50 psia; other ranges available.

Write to Trans-Sonics, Inc., Dept. 7, Burlington, Mass., for further information on Type 78 Pressure Potentiometers.

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HYPOXIA is oxygen starvation of the blood and body tissues. It is perhaps the most serious of environmental stresses affecting the pilot in outer space.

An insidious menace at low altitudes, hypoxia can kill within a minute at ambient pressures above 50,000 feet.

Countermeasures thus far involve pressure breathing, pressure suits and sealed pilot compartments. But also needed, for flight safety as well as for record, is a means of continuously monitoring pilot respiration status.

That's why the first man to cleave the atmosphere in a manned capsule will most likely wear a face mask with a built-in transducer to measure respiration rate. Data thus obtained will be continuously telemetered to earth and control action taken if necessary.

Respiration rate is only one of many physiological parameters capable of measurement in space with Gulton electronic devices. Others include blood pressure, heart rate, E.K.G.—even psychological behavior of the pilot.

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AVIATION CALENDAR

(*Continued from page 5*)

search, Air Force Office of Scientific Research/Nuclear Physics Division. (Publication of proceedings is anticipated.)

March 16-20—11th Western Metal Exposition and Congress, American Society for Metals, Pan Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

March 23-25—Flight Testing Conference, American Rocket Society, Daytona Plaza Hotel, Daytona Beach, Fla.

March 23-26—National Convention, Institute of Radio Engineers, Coliseum and Waldorf-Astoria Hotel, New York, N. Y.

March 25-27—16th Annual Conference, Pacific Coast Section of the Society of the Plastics Industry, Hotel del Coronado, San Diego, Calif.

March 30-Apr. 3—Short course in Strain Gage Techniques, San Antonio, Tex. Sponsors: Society for Experimental Stress Analysis; Southwest Research Institute. For information: Dr. M. M. Lemcoe, Southwest Research Institute, Box 2296, San Antonio 6, Tex.

March 31-Apr. 3—National Aeronautic Meeting, Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 2-3—Conference on Electrically Exploded Wires, sponsored by the Thermal Radiation Laboratory of the Geophysics Research Directorate of the Air Force, Cambridge Research Center, Somerset Hotel, Boston, Mass.

Apr. 5-10—1959 Nuclear Congress, Municipal Auditorium, Cleveland, Ohio. For information: Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

Apr. 8—Aviators' Post No. 743 Gen. William Mitchell Award Dinner, Waldorf-Astoria, New York, N. Y.

Apr. 12-16—International Conference on Fracture, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Air Force Office of Scientific Research/Solid State Sciences Division, Office of Naval Research, National Science Foundation, National Academy of Sciences/NRC. (Contact: Dr. David K. Felback, National Academy of Sciences, Washington, D. C.)

Apr. 12-19—Air Force Assn.'s World Congress of Flight, Las Vegas, Nev.

Apr. 16-17—17th Annual Meeting, Aeronautical Training Society, Desert Inn, Las Vegas, Nev.

Apr. 21-22—Spring Technical Conference on Electronic Data Processing, Cincinnati Section of the Institute of Radio Engineers, Engineering Society Bldg., Cincinnati, Ohio.

Apr. 30-May 1—Controllable Satellites Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

May 4-6—National Aeronautical Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 4-7—Fifth Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle Section, Olympic Hotel, Seattle, Wash.

May 6-8—Seventh Regional Conference and Trade Show, Institute of Radio Engineers, University of New Mexico, Albuquerque.

June 12-21—23rd French International Air Show, Le Bourget, Paris, France.



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At B.F. Goodrich the space age started in 1934

That was the year B.F.Goodrich developed the first rubber stratosphere flying suit for attempts at setting altitude records. Through the years this suit has been constantly improved to meet the needs of higher-flying pilots. And when the first man sets foot on the moon he will probably be wearing a modification of today's B.F.Goodrich Full Pressure Suit.

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GPL data handling

equipment for the Federal Aviation Agency

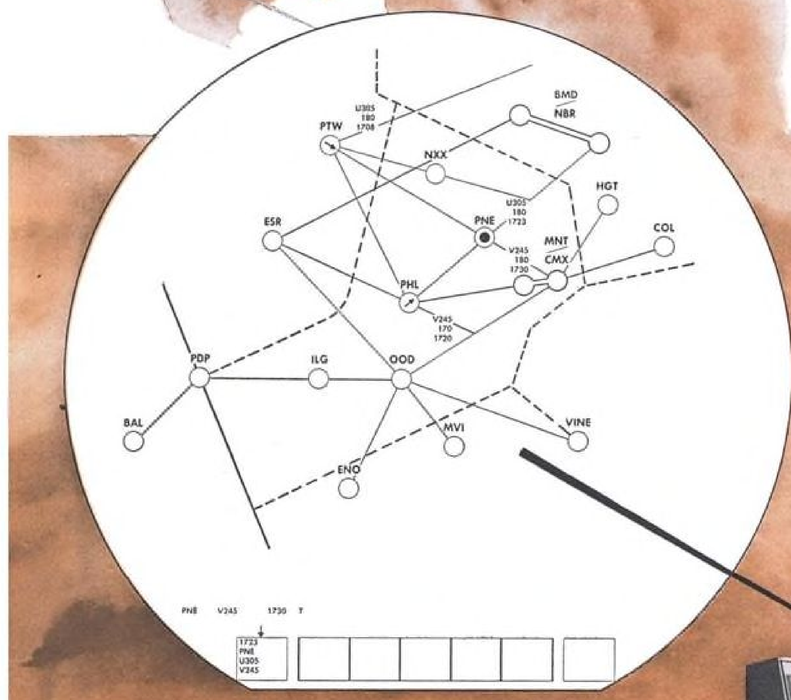


GPL's experience and ingenuity are at work assisting the FAA Bureau of Research and Development in the creation of a modern data processing central, the heart of tomorrow's air traffic control system. The central will receive up to 400 aircraft flight plans hourly, "remember" 1,000 such plans simultaneously and transmit 200 plans and 800 updates hourly to adjacent centers. Automatic processing and unique displays of such data will make significant contributions to the efficient control of aircraft in en-route, transition and terminal areas.

The FAA data processing central is just one of a number of airborne and ground-based programs reflecting GPL's capabilities in the data handling field. These programs are supported by GPL's proven ability to understand the customer's problem and capacity to anticipate future requirements. The GPL organization is "systems oriented," offers complete capabilities ranging from research, engineering and manufacturing to customer service.

Why not put these broad capabilities to work on your problem?

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KEARFOTT PRECISION RESOLVERS FOR EVERY SYSTEM APPLICATION

Kearfott has available a complete line of precision resolvers for every system application. Computing resolvers range in functional accuracy from .05% to .005%, in bridge accuracy from 3 minutes to 20 seconds of arc and in size from 11 to 25. Non-compensated resolvers range from 5 minutes to 20 seconds of arc in accuracy, from 8 to 25 in size. All Kearfott resolvers feature stainless housing, shafts and bearings and corrosion-resistant lamination materials for maximum environmental resistance. Optional designs available for operation at 200°C and in environment of 2000 cps vibration at 30 g's.

Computing Resolvers

Available with integral compensating windings. Can be provided with trimming networks to match existing isolation amplifiers or Kearfott-designed transistorized amplifiers.

Size 11

For applications where size and good functional accuracy are of paramount importance. Functional accuracy as good as .05% and bridge errors of 3 minutes of arc are in production.

Size 15

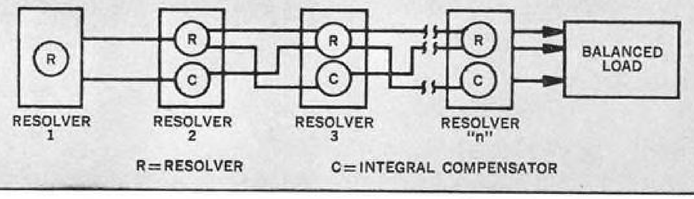
A 2:1 improvement in functional accuracy and bridge error obtained in this configuration. Unit tabulated is the direct equivalent of standard Navy BuOrd Mark 4 Mod 3 and contains necessary trimming net- work for standard buffer amplifiers. Transformation ratio is 1.000 ± .0001, phase shift 0° ± 1 minute. Functional accuracy of .025% and bridge error of 1.5 minutes of arc are standard.

Size 25

For applications demanding the highest order of accuracy. Close attention has been paid to design parameters.

Size 18

A special resolver which permits a unique cascading of these units without the necessity for buffer amplifiers. Typical application is illustrated in following cascade:



COMPENSATED RESOLVERS FOR PRECISE COMPUTER APPLICATIONS

SIZE	11		15	18	25
PART NUMBER	R980-01	R980-41	T980-51	V980-004	425506-1
Excitation Volts–(Max.)	60	60	26	26	25
Frequency–(cps)	400	400	400	400	400
Primary Impedance	629 + j2510	450 + j2200	220 + j1000	3000 + j (0 ± 40)	1630 /78.5°
Secondary Impedance	695 + j2750	500 + j2300	240 + j1100	3000 + j (0 ± 40)	1620 /80°
Transformation Ratio (Primary to Secondary)	.980	.980	.980	.775	.980
Transformation Ratio (Compensator to Rotor)	.985	.985	.950	.775	.985
Phase Shift (Lead)	8.5°	7.5°	8.5°	0° ± 10'	1°
Fundamental Null (MV)	15	15	8	15	15
Bridge Error From E.Z. (Max.) Primary	7 mins. Stator	5 mins. Stator	3 mins. Stator	3 mins. Stator	20 Seconds Stator

Non-Compensated Resolvers

Basically for application in precise data transmission systems. These synchro resolvers permit system designer to achieve system errors of better than 1 minute of arc without using 2-speed servos and elaborate electronics. By proper impedance matches up to 64 resolver control transformers can also operate from one resolver transmitter.

Size 11

Where size is important. These units have a maximum unit error of 3 minutes of arc.

Size 25

Where highest accuracy is required. These units have a maximum error as low as 20 seconds of arc.

NON-COMPENSATED RESOLVERS FOR PRECISE DATA TRANSMISSION

	SIZE 11			SIZE 25		
Type Resolver	Transmitter	Differential	Control Transformer	Transmitter	Differential	Control Transformer
Part Number	R982-004	R982-011	R982-012	Z5161-001	Z5191-001	Z5151-003
Excitation Volts (Max.)	26	11.8	11.8	115	90	90
Frequency (cps)	400	400	400	400	400	400
Primary Impedance	170/77°	850/80°	2000/80°	400/80°	800/80°	8500/80°
Secondary Impedance	42/80.5°	1000/79°	8000/76°	260/80°	900/80°	14000/80°
Transformation Ratio	.454	1.000	1.906	.7826	1.000	1.278
Max. Error from E.Z. Primary	3 mins. Rotor	3 mins. Stator	3 mins. Stator	20 seconds Rotor	20 seconds Stator	20 seconds Stator

Write for complete data.

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WITH SOLDERLESS SNAP-IN CONTACTS

Cuts Wiring Assembly Time as much as 80%

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THE PROBLEM—To design a miniature environmental-resistant connector, suitable for use on present and future aircraft, missiles and equipment, in accordance with military requirements. Dependability with simplicity to facilitate assembly, installation and field service were vitally important.

THE SOLUTION—Crimp-type solderless contacts, with wire insulation support, are used in the new KM. They can be easily snapped into place, or removed as necessary. Individual contacts can be serviced one at a time, without removing others. A specially designed moisture-sealing grommet replaces potting. Closed entry, machined socket contacts are probe-proof. All materials are of finest obtainable quality. Shells and related parts are of aluminum alloy, cadmium plated. Contacts are plated with gold over a heavy silver undercoat.

These features combine to provide a plug of optimum reliability that can be assembled and installed with utmost speed and be easily serviced in the field.

The new KM mates with the Cannon KO Plug Series, and is available in a wide variety of shell sizes, styles and insert layouts. Hermetically sealed receptacles also available. *For complete information write for Catalog KM-1.*

Come to Cannon for all plug needs —27,000 kinds to choose from. If we do not have what you want we'll make it for you. The largest facilities in the world for plug research, development and manufacturing are at your service. Write us today about your problem. Refer to Dept. 110

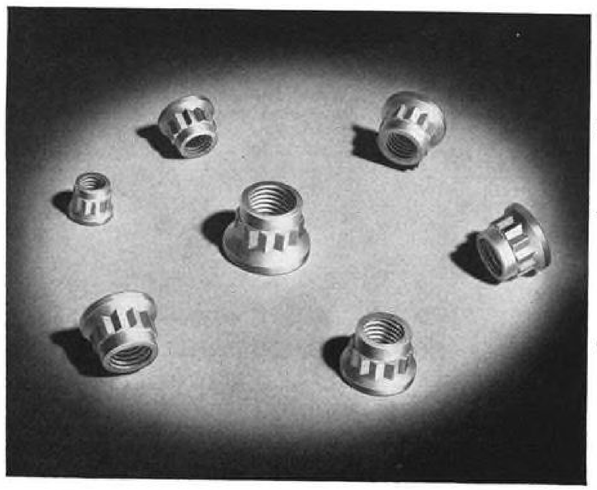
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New SPS 1200° F Featherweight Locknuts save you up to 57% in locknut weight



WEIGHTS OF FN-1216 AND COMPARABLE LOCKNUTS

(all weights expressed as pounds per 1000 pieces)

Size	SPS FN-1216	Competitive Locknut A	Competitive Locknut B	SPS 119 FW
#10-32	2.4	5.0	2.5	6.1
¼-28	4.0	8.0	4.1	8.6
5/16-24	6.3	13.0	6.5	12.2
⅜-24	9.4	17.0	—	16.4

New SPS FN-1216 Featherweight Locknuts provide over 150,000 psi tensile at 1200°F, weigh up to 57% less than any comparable nut. Thread pitch diameter is square with the bearing face of the nut within .003 in. when measured according to MIL-N-25027.

New SPS FN-1216 Featherweight Locknuts are designed for high-temperature structural applications on airframes, jet engines and missiles. They provide 200,000 psi minimum tensile strength at room temperature and over 150,000 psi at 1200°F. They are the lightest nuts available for their type of service, weighing up to 57% less than conventional counterparts. And because of their controlled dimensions they can be used with shorter bolts and installed closer to vertical bulkheads. This miniaturization permits additional weight savings.

The FN-1216 is the first lightweight locknut of its class to be fully documented for reliability by extensive service-simulating tests. These show that under conditions of cycling through 1200°F for 100 hours in the stressed condition with reapplication, the FN-1216 retains its locking action at least twice as long as any comparable nut. They also show a stress rupture life exceeding 23 hours at 1200°F under 100,000 psi loading.

FN-1216 locknuts are forged from AMS 5735 material and silver plated per AMS 2410. Thread pitch diameter is square with the bearing face of the nut within .003 in. when measured according to MIL-N-25027. The FN-1216 is the only standard high-temperature locknut held to this tolerance. Locking action is achieved by closing in the threaded collar at three points during manufacture. Standard sizes range from #10-32 through ⅜-24. For new Bulletin 2468, write SPS—manufacturer of precision threaded fasteners, including titanium. Aircraft/Missiles Division, STANDARD PRESSED STEEL CO., Jenkintown 3, Pa.

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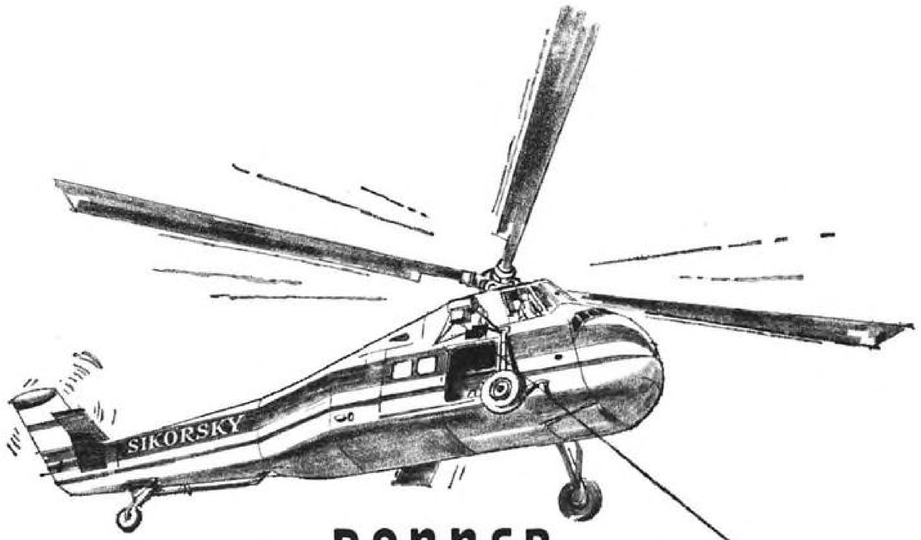
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AIRCRAFT, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

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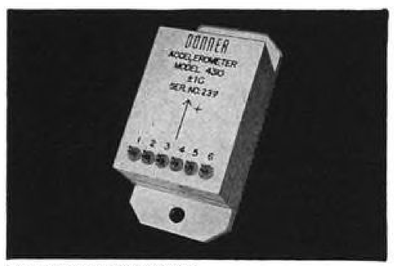


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Using only a few ounces of force, anybody can walk a helicopter fitted with automatic stabilization equipment using a Donner designed stabilizing coupler. In a more useful vein, the big birds perform vital tasks where the ability to hover precisely and maintain stability is critical. Currently, Donner equipped Sikorskys are used extensively for submarine detection, surveilance, rescue, lifting, and a host of other activities.





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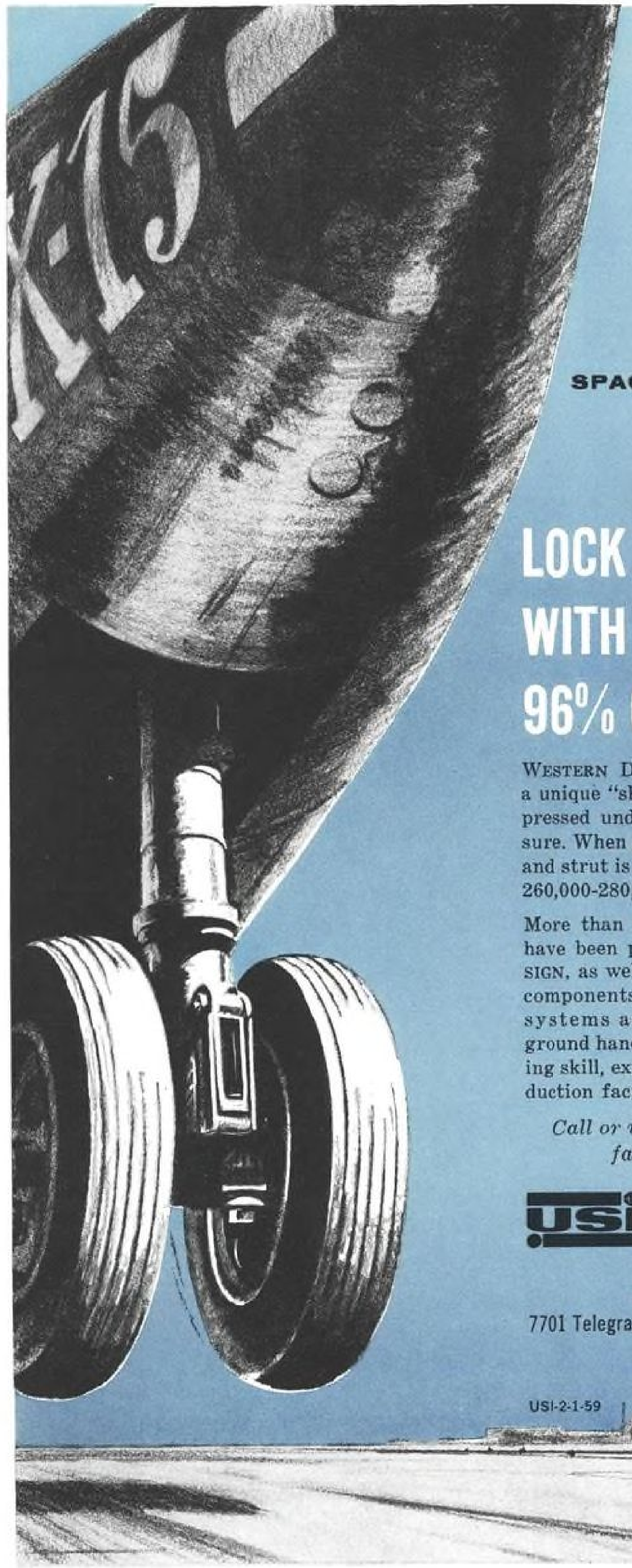
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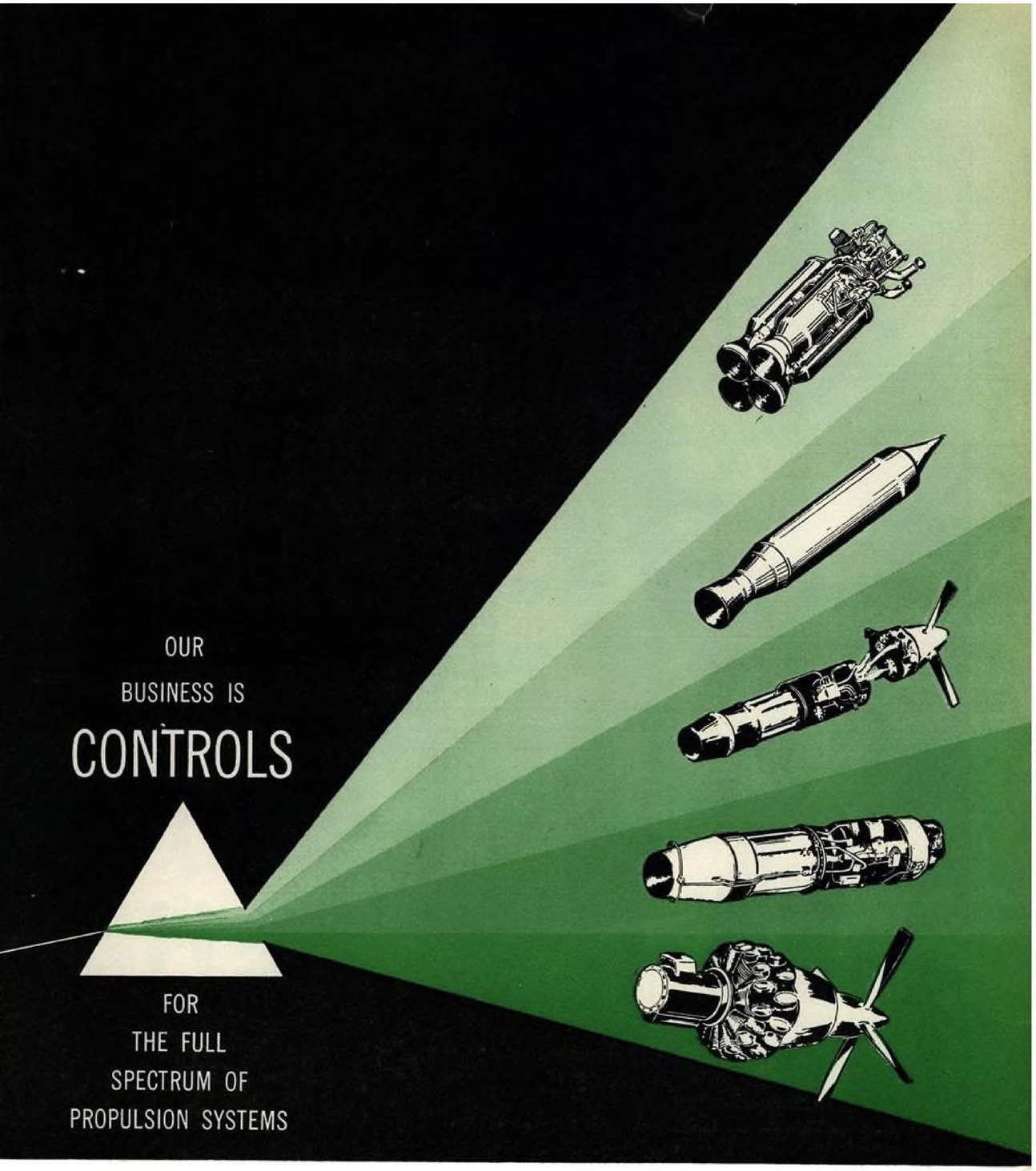
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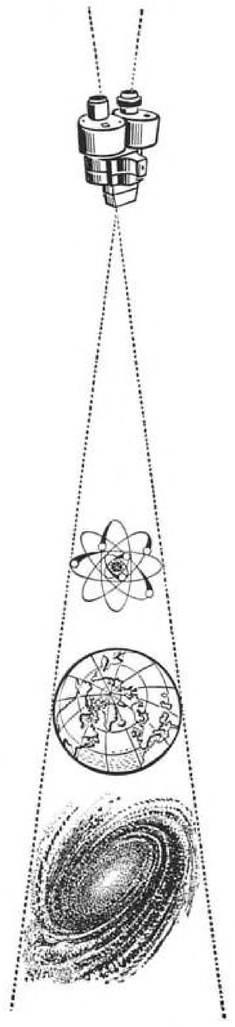
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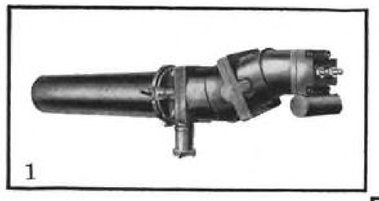
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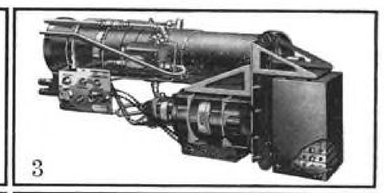

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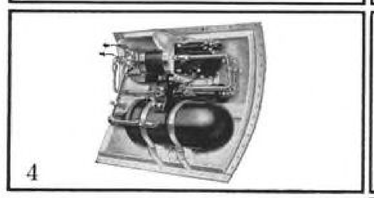
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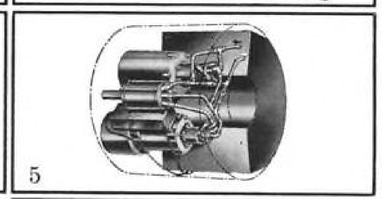
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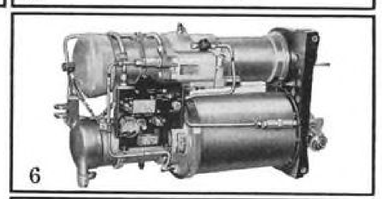
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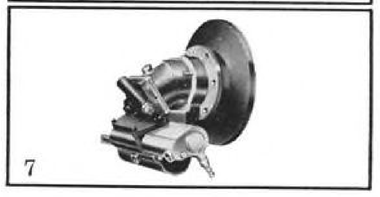

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PICTURE CREDITS

COVER—USAF; 28, 29—North American; 31, 115—U. S. Army; 33—USAF; 39, 41—Delta Air Lines; 38—McDonnell; 49—Aviation Week; 59—U. S. Navy; 60—Sperry Gyroscope Co.; 61—Hughes Aircraft Co.; 69, 99—James A. Fusca; 70—Goodyear Aircraft Corp.; 82, 83, 84, 87, 89—Kaman; 91—Lockheed; 93, 95—Convair; 103—Dept. of Agriculture; 114—de Havilland.

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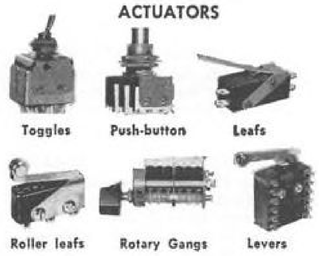
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EDITORIAL

Will We Close the Missile Gap?

The recent congressional hearings on the current United States defense posture and the program planned for its future development in an era of revolutionary technical change in weapons development have thrown a glaring spotlight on three facts vital to the future survival of this nation. They are:

1. The Soviet Union will have a numerical superiority of three to one in intercontinental ballistic missiles for at least the next three years. This is the most conservative estimate of our national intelligence agency and has been reduced from earlier estimates without much explanation of why such reductions were rather hastily made. Other sources with access to the same intelligence data dispensed in secret briefings, such as Sen. Stuart Symington, unequivocally state the admitted Soviet superiority is actually four to one. Based on our own sources, we are inclined to regard even Sen. Symington's estimate as being unduly conservative.

2. The United States has no present plans for attempting to close this ICBM gap before 1962 at the earliest. This was made abundantly clear by Defense Secretary McElroy in his testimony on Capitol Hill. Mr. McElroy also made it clear that plans for closing the gap by 1963 were based largely on the hoped for operational use of new missiles that are still in the early research and development stage and which, in fact, may not meet what many observers consider to be unrealistic operational timetables.

3. During this period between now and 1963, the United States strategic deterrent will depend upon a mixed bag of weapons consisting primarily of Strategic Air Command's manned B-47 and B-52 bombers. New weapons scheduled to phase into some operational capability to augment SAC's bombers beginning in 1960 include the USAF Atlas ICBM and the Navy's submarine-launched Polaris IRBM, with the USAF Titan and Minuteman ICBMs scheduled to appear later. This position again was made clear in Mr. McElroy's testimony before Congress, although some of his earlier optimistic statements on operational capability dates of new weapons were admitted to be erroneous and were corrected to later dates for the official record.

Spearhead Changes

Now, it is a hard technical fact that must be faced that the sharp spearhead of our strategic deterrent based on the doctrine of instantaneous, massive retaliation has passed from the 600 mph. manned bomber to the 18,000 mph. ICBM. And, although other elements will still play a supporting role, it is the quantity, operational deployment and reliability of this megaton-tipped ICBM spearhead that is the most significant factor in the immediate future balance of military power.

With the present planned and publicly announced Defense Department policy, we are deliberately allowing the Soviet Union to take a significant and commanding superiority in the most significant weapon for the next three to five years. Our announced ICBM program for the next three years will see nine squadrons of Atlas and 11 squadrons of Titan ICBMs emplaced and operational by 1963—a total of only 200 missiles. From the officially confirmed intelligence estimates, this justifies the conclusion that the Soviets will have an operational ICBM capability expanding from the present to at least 600 ICBMs by the end of 1962. It did not take Nikita Khrushchev's public announcements that the Soviets are in "series production" on their ICBM to relay this fact to U.S. sources. And the great ICBM production complex in the Dniepropetrovsk area hardly lends itself to concealment even in a police state such as the USSR.

Atlas Capacity

In the face of these officially admitted and well-documented facts, it is difficult to comprehend why the only ICBM production line now operating in this country is operating at hardly more than 40% of its current tooling and plant capacity. We have listened to all of the arguments against increasing Atlas production to its current capability to make the only attempt now feasible to cut the Soviet missile superiority to a less dangerous margin in the next three to five years. None of them really hold water in the face of facts.

The Atlas is the only ICBM that has demonstrated reasonable systems reliability and mission performance over intercontinental ranges. Its initial operational version, the Atlas D, has a range of more than 7,500 naut. mi. capable of reaching any target in the Soviet Union from any spot in the United States. It has a development growth stretch in its propulsion system to accommodate even larger warheads for the future. It is already programed for inertial guidance and its internally pressurized structure can be deployed in concrete silos or any other type of hardened base utilizing maximum dispersal potential.

The total cost of an immediate maximum acceleration of the Atlas production program, plus the accelerated base construction and crew training operations required, is less than the $3.5 billion we taxpayers have already spent to store surplus corn in the past few years. Its immediate effect on the Fiscal 1960 budget would probably not exceed $500 million.

It is high time that Congress, the Defense Department and the White House faced up to the grim facts they have publicly spread on the record. They must immediately tackle a concrete plan to narrow the ICBM gap with the Soviet Union in the quickest and only feasible method left within the critical time period we face. The alternative is to allow the Soviets to build an ICBM force capable of smashing both our own small ICBM capability and the grounded bombers of SAC in one swift 30-min. blow.

—Robert Hotz



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WHO'S WHERE

In the Front Office

George F. Hannaum, director, Industry Planning Service, Aircraft Industries Assn., Washington, D. C., named assistant general manager of the association.

Robert P. (Pat) Boyle, senior associate general counsel, Federal Aviation Agency, Washington, D. C. Also: **Brig. Gen. Marcus F. Cooper,** assistant administrator, FAA Office of Plans and Requirements.

Leon Robbin, president, and **Hans G. Boehm,** vice president, P. R. Mallory International Inc., newly formed subsidiary of P. R. Mallory & Co. Inc., Indianapolis, Ind.

Ward D. Davis, president, and **Herbert Chernin,** vice president, The Dalto Corp., International Airport, N. Y.

Howard Irvin and **Joseph Showalter,** vice presidents, Marbon Chemical Division, Borg-Warner Corp., Washington, West Va.

Raymond Stuart-Williams, a vice president, Telemeter Magnetics, Inc., Los Angeles, Calif. Mr. Stuart-Williams will continue to direct the engineering department.

E. H. Lockhart, vice president-engineering coordination, Radiatronics, Inc., Van Nuys, Calif.

Moe Berlin, executive vice president, and **Arnold Lowell,** treasurer, Arkwin Industries, Inc., Westbury, N. Y.

Albert J. W. Novak, vice president and general manager, Hoover Electronics Co., a subsidiary of The Hoover Co., Timonium, Md.

Tom G. Conway, vice president-manufacturing, Pesco Products Division, Borg-Warner Corp., Bedford, Ohio.

Honors and Elections

Honorary Companionship of the Royal Aeronautical Society has been conferred on **Gustavus Green** for his work on the design and development of the early Green engines. Green engines were used for many successful early British flights.

Merritt L. Kastens, of Stanford Research Institute, has been named to the Science Information Council of the National Science Foundation, Washington, D. C.

Changes

Convair Division of General Dynamics Corp., Fort Worth, Tex., is expanding customer service operations, and the following appointments have been announced by J. T. Cosby, B-58 program director and manager of customer service department: **G. S. Green,** assistant manager-base operations; **E. D. Mathis,** assistant manager-technical services; **R. S. Reade,** chief-service planning.

Arthur P. Adamson, manager of the newly organized Vertical Takeoff and Landing Engine Development Project, Flight Propulsion Laboratory Department, Aircraft Gas Turbine Division, General Electric Co., Cincinnati, Ohio.

Carlos C. Wood, director of advanced engineering planning, Douglas Aircraft Co., Inc., Santa Monica, Calif. **Charles S. Glasgow** succeeds Mr. Wood as chief engineer, Long Beach Division.

(*Continued on page 131*)

INDUSTRY OBSERVER

► Boeing has developed the T60 gas turbine engine designed for helicopter and marine use under a Navy Bureau of Aeronautics contract. T60 is rated at 425 shaft horsepower and has a specific fuel consumption of .7 lb. per hour per hp. T60 is based on Boeing's earlier Model 502 gas turbine and has a company designation of Model 520.

► **Convair Atlas D now in production at the San Diego Atsronautics Division is the initial operational configuration of this ICBM and has a range of more than 7,500 naut. mi. with full military load. Maximum range required to hit any part of the Soviet Union from any point in U. S. with an ICBM is 6,900 naut. mi.**

► Pratt & Whitney Aircraft Division of United Aircraft Corp. has an Air Force contract to study possible design and operational use of recoverable air-breathing boosters for launching orbital vehicles.

► **Test vehicle of Navy's Subroc long-range anti-submarine missile being developed by Goodyear Aircraft Corp. and designed for use by killer submarines has been successfully fired through its planned trajectory. Launched from beneath the water, the vehicle successfully emerged, traveled a short distance through the air and then re-entered the water on its programed course.**

► Army will proceed with development of its own world-wide communication system, known as UniCom (AW Dec. 15, p. 32), following a Defense Department decision not to combine program with Air Force AirCom system (see p. 33). Briefing session for prospective Army bidders was scheduled for late last week.

► **Afterbody of the Air Force Martin Titan intercontinental missile is being heat tested in a specially designed quartz-lamp furnace gold plated for reflectivity at Chrysler Corp.'s Simulated Atmosphere Re-entry Testing Facility. Facility was established in 1956 to test Redstone tactical re-entry bodies. Chrysler is working with Avco Manufacturing Corp., which is nose cone subcontractor on the Titan.**

► Three concrete and steel control centers included in the hardened launching installation for each squadron of Martin-Air Force Titan intercontinental ballistic missiles (AW Feb. 16, p. 27) will not be completely buried. A small portion of these spherical chambers, which have a radius of 51 ft., will protrude above the ground.

► **Modification of vertical test tower at Army Ballistic Missile Agency to ready it for tests of the 1.5-million lb. thrust Project Saturn engine cluster, formerly called Juno V, is under way and will include construction of concrete caissons, erection of 470 tons of structural steel, installation of a bridge crane, construction of an observation bunker and support facilities. Contract for $364,377.50 went to Dunn Construction Co., Inc., Birmingham, Ala., one of four companies asked to bid.**

► Pratt & Whitney Aircraft also is studying the feasibility of using J57 and J75 turbojet engines for auxiliary power sources during peak load periods by natural gas lines, electrical, powerplants and similar systems.

► **Construction of satellite launching pads and gantries is about to begin at Navy's Pt. Arguello, Calif. facility, a part of the Pacific Missile Range complex. They will begin to be handed over to users in July.**

► Possibility of using ultrasonics to protect an area or aircraft carrier from nuclear fallout is being investigated by Gulton Industries scientists.

► **Filtron Co., Inc., Culver City, Calif., is negotiating a contract in excess of $2 million for an electromagnetic interference study and reduction program for the Air Force-Convair Atlas missile system. This involves responsibility for radio interference compatibility, susceptibility and frequency environment test studies including airborne, manufacturing, ground systems and all test sites.**



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Washington Roundup

Canadian Bomarc

Watch for an announcement shortly that Canadair Ltd. of Montreal will build Bomarc missile wings and control surfaces under subcontract to Boeing Airplane Co. Meanwhile, more than 100 Canadian firms have been invited to participate in competitive bidding for other Bomarc subcontracts in an effort to broaden Canadian economic participation in the joint USAF-RCAF Bomarc air defense program. Total of 180 Canadair engineers already are working on loan in Seattle on Boeing's missile program. Canadian subcontractors on Bomarc will participate in complete production program, not just on those missiles earmarked for the RCAF. Canadians will purchase and deploy the B model Bomarc, which has an effective intercept range of about 400 mi., on semi-hardened bases.

'Proficiency' Flying Hours

Also look for flight pay for "proficiency" flying hours for rated officers assigned to desk jobs in both USAF and Naval aviation to appear again as a target for defense economy advocates in both Congress and the executive branch of the government. White House already has ordered the Pentagon to make a study aimed at reducing the costs of this activity to meet congressional criticism. With advent of missiles into operational commands, "proficiency" flight pay for personnel in non-flying assignments will become increasingly difficult to defend. Legislators also question just how much useful "proficiency" is maintained by officers logging four hours a month in such obsolete equipment as the C-47 and B-25.

York's Authority Defined

Responsibilities and authority of Dr. Herbert F. York, director of Defense Research and Engineering—after being questioned earlier by Congress (AW Feb. 16, p. 29)—were defined in a directive issued last week by Defense Secretary Neil H. McElroy. Basic concept of the office as outlined by McElroy:

- **Director will rank immediately** after the service secretaries and will be principal adviser and staff assistant to the Defense Secretary in scientific and technical matters; basic and applied research; research, development, test and evaluation of weapons, weapon systems and defense materiel, and design and engineering for suitability, producibility, reliability, maintainability and materials conservation.
- **He will supervise all research** and engineering activities in Defense Department, including those of the Advanced Research Projects Agency and office of Director of Guided Missiles.
- **Direct research and engineering** activities that require centralized management.

Air Defense Research

In a related move, Dr. Hector R. Skifter has been named Assistant Director of Defense Research and Engineering (Air Defense) with particular responsibility for technical evaluation and integration of defensive weapon systems, planning and supervision of development of improved systems and related control environment, including anti-aircraft and anti-missile missiles and interceptor aircraft. Appointment is first step in move to shift all air defense research and development out of Air Force, Navy and Army and place them directly under Dr. York as predicted by AVIATION WEEK (Feb. 16, p. 25). Dr. Skifter is on leave of absence as president of Airborne Instruments Laboratory, Mineola, N. Y.

Anderson to AMC

Lt. Gen. Samuel E. Anderson will receive a fourth star and take command of USAF's Air Materiel Command at Wright-Patterson AFB, Ohio, on Mar. 1. Gen. Anderson has been chief of Air Research and Development Command for the past two years. He replaces Gen. Edwin W. Rawlings, commander of AMC for the past eight years, who is retiring. No replacement for Gen. Anderson has been named.

Renegotiation Claim

Justice Department plans to file a motion in the U.S. Tax Court at Seattle increasing the government's claim of excessive profits against Boeing Airplane Co. from $10 million to $20 million by a Mar. 2 deadline. Boeing said "such a motion has been a routine government move in a great majority of renegotiation actions." The company already has appealed the $10 million claim determined by the Renegotiations Board (AW Nov. 17, p. 31). The case has been recessed to June 15.

In Congress

Meanwhile developments in Congress include:

- **Missile funds.** Democratic congressional leaders are discussing a $500 million to $700 million increase in the Administration's $40.8 billion Fiscal 1960 defense budget to accelerate Atlas and Titan ICBM production. This, they say, would significantly "narrow" the gap of Russian intercontinental ballistic missile superiority—assuming the Soviet Union uses its full existing production capacity—during the three-year 1961-63 period. Rep. George Mahon (D.-Tex.), chairman of the House Appropriations Subcommittee on the Armed Services which will make the first congressional decision on the coming-year defense budget, favors an increase of approximately this order. House Armed Services Committee has requested Defense Secretary Neil McElroy to submit an estimate of the cost of "closing" the gap and matching the Russians ICBM for ICBM.
- **Missile management.** House Military Operations Subcommittee headed by Rep. Chet Holifield (D.-Calif.) has an investigation of the Institute of Defense Analysis under way. IDA is the non-profit organization formed by Massachusetts Institute of Technology to give technical direction to Defense Department's missile and other advanced weapons programs and furnish scientific staffs. Public hearings are scheduled Mar. 5 and 6. The subcommittee will hold hearings on Army and Navy management of their missile programs Mar. 2, 3 and 4.
- **Airport Aid.** Legislation authorizing funds for an expanded airport construction program is likely to have difficulty clearing Rules Committee, headed by economy-minded Rep. Howard Smith (D.-Va.). The measure passed by the Senate provided $465 million over a four year period. House Commerce Committee is scheduled to take final action Feb. 24.

—Washington staff

NASA Programs Venus, Lunar Probes

Space agency plans accelerated effort to advance U. S. technology well beyond Soviet achievements.

Washington—Series of exacting excursions into space indicating an accelerated program to advance U. S. technology well beyond Soviet achievements is scheduled to begin this spring under the sponsorship of the National Aeronautics and Space Administration. Projects will include:

- **High-altitude earth satellite** traversing an elliptical orbit with a peak height of approximately 30,000 mi. Vehicle is scheduled to be launched April 15.
- **Interplanetary probe,** which will be aimed to achieve the vicinity of Venus. Scheduled date of launching is June 3.
- **Venus satellite** orbiting that planet is an elliptical path. Launching is planned for June 4, one day after the attempt to probe the region of the planet.
- **Lunar probe,** which may involve orbiting, scheduled for August.

Firings From Canaveral

All of the space vehicles are to be fired from the Air Force Missile Test Center, Cape Canaveral, Fla.

Under NASA's cognizance, these projects will be implemented in a large measure by Space Technology Laboratories working through Air Force's Ballistic Missile Division. With a sizable technical force assigned to the projects. STL is designing and building the payload package with its special instrumentation and equipment. University of Minnesota and the University of Chicago are collaborating with STL in certain phases of the payload instrumentation.

STL is performing calculations for trajectories and establishing operational techniques and will operate the tracking network in conjunction with Air Force personnel. In a sense, its role in these projects will be an extension of its job with the Pioneer lunar probe projects.

Able III

High altitude earth satellite will be known as Able III. It will be a proving vehicle for follow-up shots to Venus and be fitted with extensive instrumentation similar to that contained in Air Force's Pioneer lunar probe but will stress measurement of radiation levels and earth's magnetic field over the long swath of its orbit.

Highlights of the project are:

- **Low point of orbit** will be 500 mi. above earth, sweeping out to a maximum altitude of about 30,000 mi.
- **Vehicle configuration** will be similar to Pioneer—Douglas Thor booster, Aerojet-General modified liquid-propellant second stage Vanguard engine and Allegany Ballistic Laboratory solid-propellant third stage rocket.
- **Payload will be similar** to the biconical configuration of Pioneer, but it will have a hexagonal center section instead of circular band.
- **Weight of payload** will be about 325 lb. Reason for large increase over the 83-lb. payload stage of the Pioneer I is that the earth satellite will not have to achieve escape velocity, hence the speed potential can be translated into payload.
- **Spin rate of the payload** for stabilization will be approximately two revolutions per second.
- **Vernier rockets on payload** will be used to adjust payload orbiting speed.
- **An injection rocket also** will be carried on payload. It will be fired when orbiting payload has rounded its 30,000-mi. apogee and is traveling toward perigee. Purpose apparently will be to increase perigee to vary the configuration of the elliptical orbit, but this probably will not be attempted until initial orbit has been established for a number of passes.
- **Infrared scanner will** be installed in payload for actual viewing from orbit.
- **Four solar panels will** be retained retracted in the payload and be popped out by signal when payload is in orbit. These panels, an electrical power source, will be arranged in cruciform pattern and will be oriented by position of payload to minimize shadowing of one panel by another to ensure absorption of a maximum amount of solar energy with a minimum number of panels, thus minimizing weight and complexity.

Able IV Thor

First of the Venus shots will be designated Able IV Thor because it will use the same rocket components as the Able III earth satellite—Thor booster, modified Vanguard second stage and Allegany Ballistic Laboratory's solid-propellant unit for the third stage.

Highlights of Able IV Thor Venus probe include:

- **Vehicle will be first of a** new series of probes planned for interplanetary exploration.
- **Payload** will be approximately 78 lb.
- **No terminal rocket will** be attached to payload, since no attempt will be made to orbit the payload around Venus.
- **Advanced guidance system** developed by Burroughs Corp. will be used during launch phase and for about 18 min. thereafter.
- **Time required to reach vicinity** of Venus will be approximately 150 days when the planet will be about 56 million miles from earth.
- **Vernier rockets on Able III** Thor may be programed to fire for speed adjustment about 60 days after launch.
- **Same tracking network will** be used for Venus probe as was used for lunar probe, but from the 60th to 150th day only the Manchester, England, station with its huge dish will be used to track the probe.
- **Vehicle will be erected** on the launch pad at Cape Canaveral during the early part of May for payload installation, hookups, adjustments and general preparational checkouts necessary before missile is launched.
- **Variety of instrumentation** necessarily will be limited because of the decreased payload but should be similar to that used for Pioneer lunar probe, which weighed about 75 lb. after vernier rocket separation.
- **Pop-out solar panels** also will be carried.

If probe is successful, it will return information of extreme interest to space planners and researchers. Planet's surface is not visible because of the dense cloud layer which surrounds it. It receives about twice the solar radiation as does the earth. Carbon dioxide has been identified in its atmosphere. Surface gravity of the planet relative to the earth is 0.86, and maximum surface temperature is estimated to be 120F. Mean distance of Venus from the sun is about 67 million miles and inclination of orbit of Venus to ecliptic (plane of the earth's orbit) is approximately 3.4 deg.

Able IV Atlas

Second shot to Venus, intended to orbit the planet, will be boosted into space by Convair Atlas intercontinental ballistic missile and, for this reason, will bear designation Able IV Atlas. Features are:

- **Over-all configuration,** except for substitution of Atlas for Thor booster, will be similar to Able IV Thor.
- **Payload** will be about 325 lb.
- **Retrorocket will be fitted** to payload and will function much the same as the retrorocket used with the Pioneer lunar probe for added push to put the payload into orbit around the planet.
- **Detailed instrumentation** is likely to be same as that carried in Able III earth satellite since payloads of the two vehicles will be about the same.
- **Pop-out cruciform-pattern** solar panels also will be used on payload package.
- **Trajectory, guidance and** operational conditions associated with Able IV Atlas will be similar to Able IV Thor.
- **Vehicle also will be erected** on pad at Cape Canaveral in May.

Sometime in August another attempt is tentatively projected to launch a lunar probe, duplicating, in effect, the Air Force Pioneer probe's makeup and trajectory.

Experience gathered with the earth satellite projected for launch in April, and the follow-up shots to Venus on June 3 and 4, undoubtedly will be a valuable technical input for this moon orbiting attempt in August.

NASA Space Group

Washington—Top personnel for the Space Task Group which will manage Project Mercury man-in-space project have been named by the National Aeronautics and Space Administration.

Robert R. Gilruth has been named director of the Space Task Group which will be located at the NASA's Langley Research Center. Gilruth formerly served as assistant director of the center. Assistant director is Charles J. Donlan; special assistant to the director is Paul E. Purser.

The Task Group is divided into three divisions: Operations, headed by Charles W. Mathews; Flight Systems directed by Maxime A. Faget, and Engineering and Contract Administration headed by Charles H. Zimmerman.

All of these men held high posts at the NASA's Langley Aeronautical Laboratory.

GE Official Urges Nuclear Plane Acceleration, Cites Soviet Effort

Washington—Forty-two page critique urging acceleration of the U. S. nuclear aircraft program and sent to President Eisenhower by a key project official who believes the White House staff has not kept the President properly informed was made public in Congress last week.

Rep. Melvin Price (D.-Ill.) said he was releasing the document because "the comments of this man are so important to a better understanding by Congress and the public of the issues involved . . . issues which are vital to the national security." Price is chairman of the Joint Atomic Energy Committee's research and development subcommittee.

John W. Darley, Jr., author of the critique and manager of the operational analysis section of General Electric Co.'s Aircraft Nuclear Propulsion Department, sent the document to Price after waiting for a month without receiving even an acknowledgement from the White House. He said he wrote it as "a conscientious voting citizen who is sorely troubled" and not as an official of General Electric.

Darley's critique included a history of the project, strategic and technical arguments for a nuclear plane and those most frequently used against it, relative U.S. and Soviet progress and criticisms of the government's administration and funding of the program.

Darley's critique was prompted by three answers the President gave at a press conference last Dec 10 concerning AVIATION WEEK's exclusive report on Dec. 1 (p. 26) that the Soviet Union had begun initial test flights of a nuclear-powered bomber.

Quoting these answers in a covering letter to the President, Darley said he believes the President has "been on the receiving end of some sloppy staff work, which may be setting some sort of historical records in this direction."

Taking issue with the President in his critique, Darley said:

"The third comment which you are reported to have made went to the effect that 'there is absolutely no intelligence to back up a report that Russia is flight testing an atomic-powered airplane.' The question which prompted your reply was undoubtedly triggered by the article in the Dec. 1 issue of AVIATION WEEK which reported on the estimated status of the Soviet ANP program.

"I would like to say, however, that the staff man who provided your text, was a hair-splitter of the first order:

- **"Intelligence is available.** In the first place, I am positive that there is intelligence on the relative state of the Soviet ANP program . . . Maj. Gen. D. J. Keirn, in charge of the U. S. program, made a public statement to this effect a few weeks ago—adding that it would not surprise him if the Soviets flew on nuclear power within a year.
- **"Characteristics of Soviet** aircraft are significant. To a second point, I understand that there is significant evidence that a Soviet aircraft of the size and configuration described in the AVIATION WEEK article has been sighted. Using the article's over-all dimensions—and unless the Soviets have suddenly retrogressed in their ability to competently design chemically-powered aircraft—there is little doubt but that this particular airframe is intended for use with nuclear powerplants. As a purely chemical airplane even with advanced chemical turbojets—it is not a very good aircraft or weapon system.

"As a side note this is the first very large Soviet aircraft with pylon-mounted powerplants—it being the usual Russian design approach in such cases to bury their powerplants within the wing structure. This difference is particularly significant, however, because this is the direction you would take for easier later replacement of chemical with nuclear machinery and subsequent easier maintainability of the nuclear powerplants . . .

"I agree with your advisors, however, that the AVIATION WEEK article presented no concrete evidence that this Soviet aircraft currently has nuclear powerplants installed. To the contrary, it is difficult to believe that any nuclear engine is currently installed within the comparatively small engine nacelles indicated on their drawings.

"Whether or not this aircraft has actually flown on nuclear power—as questioned by your advisors and provided in their text for your use—is not really the point.

"It does not take any classified information to realize that if the U. S. started today on its prototype-aircraft program for ANP purposes, it would be approximately three years before any substantial chemically-powered flight test program on the aircraft would take place. As far as the relative airframe programs are concerned, therefore, we now have a pretty good fix on relative progress.

"Sightings of this Soviet aircraft, of course, do not necessarily testify as to the state of progress in the Soviet nuclear powerplant program. Some criticism of the news article takes this direction—with the additional inference that the Soviet nuclear powerplant program is probably only to follow with an installed powerplant at a much later date.

"Even if this opinion is partially true, as it would be for any such program where the approach must be to take logical sequenced steps, it is a defensive comment and underestimates Russian technological competence in those areas where they really apply their effort. Certainly it does so if you believe, as I do, their Jan. 1 announcement (that they are going to fly a nuclear-powered 'civil' aircraft during the next year)."



PROJECT PILOTS, practicing landing pattern for X-15 research aircraft, use a North American F-100 in dirty configuration. Lowering landing gear, speed brake and deploying a small drag chute provides a sink rate estimated for the X-15.

Ground Bases Prepare for X-15's Flight

By William S. Reed

Los Angeles—High Range, area designated for the forthcoming North American Aviation X-15 out-of-atmosphere flights, will extend from Wendover AFB, Utah, to Edwards AFB, Calif. Range, which is 485 mi. long, 50 mi. wide, and away from airways and known traffic, was selected because of the many dry lakes along its route, usable as emergency landing sites.

High Range will be monitored by three instrumented stations located at Ely, Nev., Beatty, Nev., and Edwards AFB, Calif., with interstation radio at Wendover AFB.

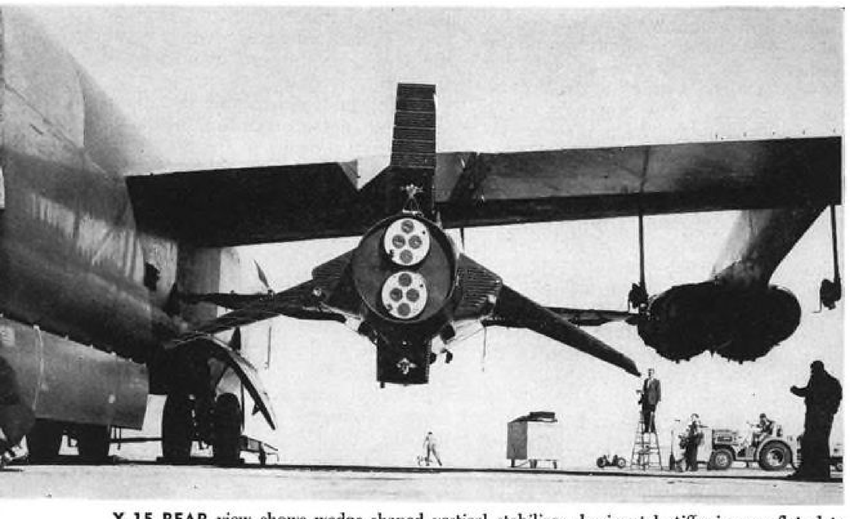
All three stations contain radio, telephone and telemetry communications in addition to radar, "main bang" of which will pick up an aircraft 400 mi. distant.

Electronics Engineering Co. of California is prime contractor for the range, calibration of which was completed in December. Manning of High Range during calibrations, as well as forthcoming flights of the X-15, will be a joint effort of USAF, North American Aviation, National Aeronautics and Space Administration and Army Signal Corps.

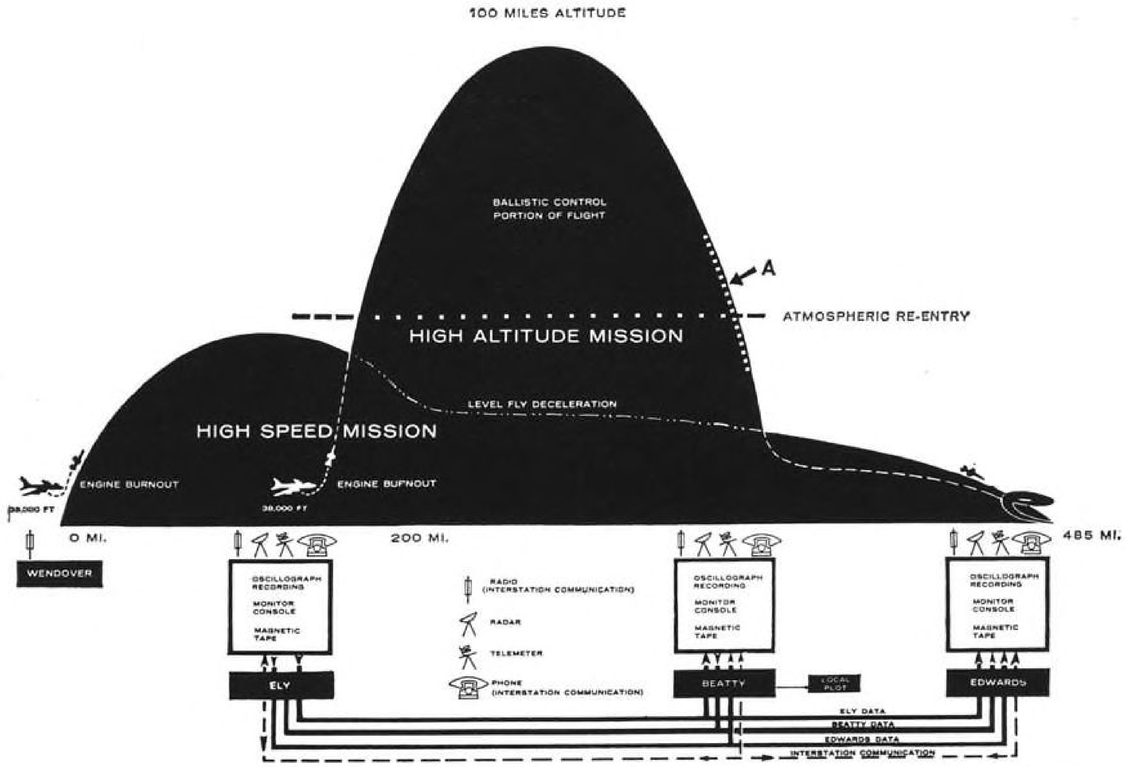
Instrumentation planned for the X-15 necessitated the extensive range requirements. Approximately 1,000 different channels of information will be recorded on each flight, some retained aboard the X-15; the most critical being telemetered to the ground. Data from these 1,000 channels will be recorded at intervals of 1 to 15 times per second. Instrumentation which the X-15 will carry aloft includes:

- **Pickups,** both inside the airframe and on the skin, to record temperatures at 656 different locations. Temperatures during the critical re-entry phase of the flight and at peak altitude will be of extreme interest.
- **Strain pickups** which will measure aerodynamic loads at 104 points.
- **Pressure pickups** at 140 different places on the airframe.
- **Position** of 15 different cockpit controls will be continuously recorded.
- **Engine and fuel bay** pressures and temperatures. This data will be among that telemetered to the ground for observer monitoring. Should malfunctions occur, the pilot can be informed should he fail to detect the discrepancy on his own instruments.
- **Physiological information** also transmitted by telemetry to flight surgeons for constant checking of the pilot's reaction during all phases of flight. Pickups worn by pilots of the X-15 will provide an electrocardiograph of heart action as well as various body temperatures.

Data taken at any of the three stations will be recorded locally, and also transmitted simultaneously to the other two stations. Local plots will be kept at each station and a master plot recorded at Edwards.



X-15 REAR view shows wedge shaped vertical stabilizer, horizontal stiffening on flat-plate area at rear of rudder. Research aircraft is mated to Boeing B-52 jet bomber in preparation for first flight from Edwards AFB, Calif. (AW Feb. 16, p. 67).

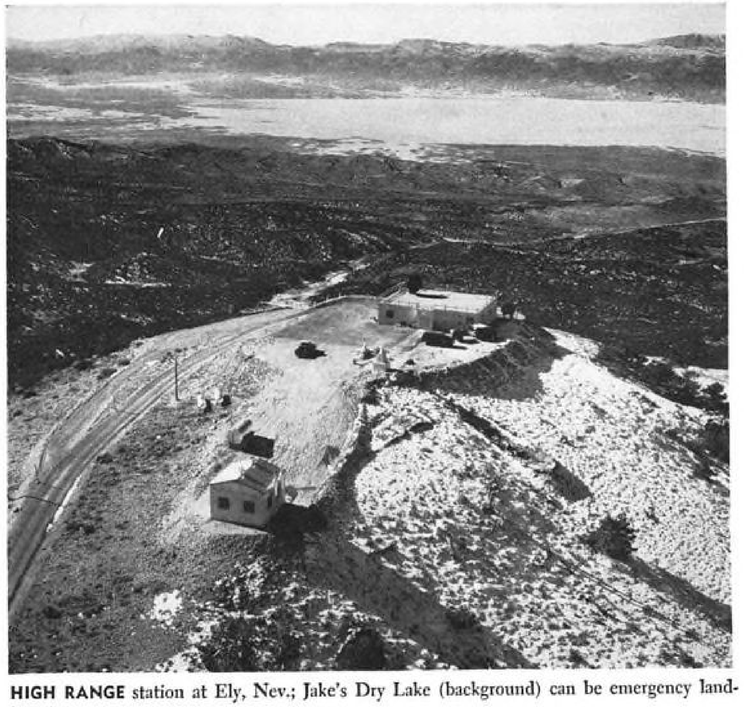


HIGH SPEED and high altitude X-15 missions are shown in this drawing; area denoted at "A" indicates high temperature portion of X-15 flight path on re-entry into earth's atmosphere. Triple-based communications net is portrayed at bottom.

Test Flights

North American Aviation has been allowed 20 flights to demonstrate controllability and airworthiness to USAF and NASA. First flight will be to test the mated X-15/B-52 combination and for crew familiarization. Particular emphasis will be placed on checking out the closed circuit TV system aboard the mother ship which monitors the X-15 while it is suspended from the B-52's right inboard pylon.

Second and third flights will be confined to the Edwards area, since these will not be powered flights. Second flight will be a "dry" drop during which low-speed stability and aerodynamic control will be tested. Third drop will be a "heavy" drop. Complete fueling operation will be checked out prior to heavy drop since continuous topping off of the X-15 fuel tank is necessary. Handling characteristics with full load



HIGH RANGE station at Ely, Nev.; Jake's Dry Lake (background) can be emergency landing site.

will be investigated; fuel will be jettisoned and a routine power-off landing will be made.

If no trouble occurs during the first three flights, the fourth flight will see the first engine "light-up." North American then has 16 more flights to demonstrate contractual fulfillment. Of particular interest during the latter flights will be proving the unusual upper-atmosphere control system, consisting of 100-lb.-thrust jet vanes in the nose arranged cruciform fashion for pitch and yaw control, and 40 lb.-thrust units in each wing for roll control. Jet-vane control system derives its power from hydrogen peroxide fuel.

None of North American's flights are planned to explore the full potential of the rocket-powered craft, and will stay within what has been described as known flight regimes (AW Oct. 20, p. 26). Exploration of the aircraft's complete flight envelope will begin with USAF's acceptance of the first of three identical X-15s. Full capability of the craft is reportedly in excess of 100 mi. altitude and speed beyond 3,600 mph. Scale models of the X-15 have been tested to Mach 6.9 at NASA's Langley facility's 11-in. hypersonic wind tunnel (AW Oct. 27, p. 88).

Of special interest is the X-15's unusual black coating, a distinct departure from finishes on previous research aircraft. The special formula silicone-type paint is designed to withstand temperatures of 1,000F for short periods of time, is one-half to one-fourth as thick as a standard automobile finish. For additional protection, the oxide formed on the nickel alloy surface during heat treating was left on under paint.

Continuous training is still being conducted by all X-15 project pilots and their alternates. This includes familiarization with High Range and simulating X-15 landings on the dry lake at Edwards AFB. Lockheed F-104 has a flame-out sink rate and airspeed similar to that projected for the X-15. F-100, with the addition of a small drag chute, also has similar characteristics. Pilots have used these two aircraft to determine the optimum altitude and position for making glide approaches required at the termination of each flight.

Human factors have also been given careful consideration during the program. In addition to heat and cold tests on the aluminized-coated suit, anthropomorphic dummies have been used during high-speed ejection seat runs and parachute drops.

ARDC, MATS Conduct Debate On Jet vs. Turboprop Transport

Phoenix, Ariz.—Future of the Douglas C-133 Cargomaster designed as a logistics-type aircraft from its inception, hangs in doubt pending outcome of a controversy between Air Research and Development Command and Military Air Transport Service.

Concern was expressed by ARDC that the C-133 series would be allowed to die after completion of the last aircraft in the 50-plane contract. Douglas already has delivered 29 C-133s to the Air Force and unless additional aircraft are ordered, logistics-type aircraft, conceived and designed as such, will have seen their day.

ARDC and MATS representatives met here with officials of Douglas Aircraft Co. and C-133 contractors in a Weapon Systems Phasing Group Conference. Coincident with the conference, Air Force Assn., Arizona Chapter, put on a static display of cargo aircraft ranging from the veteran Douglas C-47 to the C-133.

Although the purpose of the conference was to resolve difficulties inherent in introducing any new weapon systems into the Air Force inventory, AVIATION WEEK learned that MATS, unwilling to be left out of the jet race, is holding out for swing-tail versions of Douglas DC-8, Boeing 707 or Convair 880 turbojets, rather than additional C-133s as advocated by ARDC.

MATS favors immediate transition to turbojet cargo aircraft even though ARDC argues that the speed advantage of turbojets over turboprops does not outweigh the attendant disadvantages of complicated ground-handling and greater runway requirements.

One of the biggest selling points of the C-133 is ease of loading resulting from a low cargo deck which is about equal to truck bed level, permitting transfer of cargo directly from truck to aircraft. For roll-on type cargoes, a 7-deg. inclined ramp is used, affording drive-on loading for vehicles or missiles. MATS computations show that loading costs for the C-133 were $.36 per ton compared with $2.80 per ton for piston engine type transports (AW May 12, p. 70).

Swing-tail version of the jet transports probably would have no such ease of loading capability. Douglas, Boeing and Convair have all proposed a "kneeling" main landing gear to bring deck to a reasonable height for cargo loading. In addition, extra weight and complexity of special landing gear, plus added weight of the swing-tail provisions, would compromise performance of a military version of the jet transports, according to ARDC spokesmen.

Further support for the C-133, as against a swing-tail military version of a jet transport, is gained when runway requirements are viewed. Many airports served by logistics aircraft will be unable to accommodate large jets, especially in times of emergency where major airports may be blocked, according to ARDC spokesmen, who feel that MATS could not adequately serve its mission were it to restrict logistics support to those airfields which were adequate for jet transports.

Further impetus was given arguments when Douglas flew in the DC-8. Briefing on the aircraft, with emphasis on a swing-tail counterpart, was followed by a flight demonstration for 25 representatives from MATS and ARDC.

The C-133 can carry up to 100,000 lb. and is capable of hauling Martin Titan and Douglas Thor missiles. The C-133B, which will have enlarged rear cargo doors, will carry a complete Convair Atlas missile from San Diego to Cape Canaveral in seven hours.

Vertiplane Crash

San Francisco—Crash of Ryan's experimental Vertiplane at Moffett Field, Calif., last week will cause great delay in the Navy's VTOL program. A spokesman for Ames Laboratory, National Aeronautics and Space Administration, said the damage would be "expensive" and that in his opinion a new Vertiplane would have to be built if this phase of the VTOL program is to be continued. Cause of the crash is still undetermined.

Peter F. Girard, Ryan chief engineering test pilot who has made several conventional flights in the Vertiplane, suffered broken bones in his foot, but otherwise escaped injury.

The Ames spokesman said there is a possibility that this phase of the VTOL program would be discontinued as a result of the crash but that final word would come from the military.

Navy Electra Contract

Burbank, Calif.—Lockheed Aircraft Corp. last week announced receipt of an $8 million Navy contract covering purchase of an Electra turboprop transport and its modification, development and testing as a tactical testbed for anti-submarine warfare systems.

Designated the YP3V-1, the modified aircraft is scheduled to make its first flight with a full complement on electronic equipment sometime this fall. No production-type Electras have yet been ordered by Navy. Two earlier contracts provided approximately $12 million for additional research, development and preproduction activities on the modified Electra.

Space Technology

Vanguard II Maps Earth's Cloud Cover

By J. S. Butz, Jr.

Washington—First weather reconnaissance satellite, the Vanguard II, designed to provide a picture of the cloud cover over the earth, was launched successfully last week by a Vanguard.

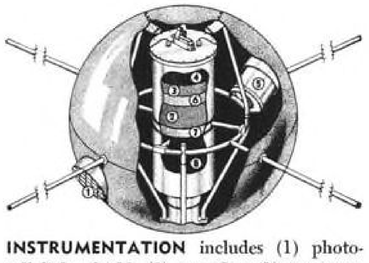
Project Vanguard, formerly a Navy program contributing to the International Geophysical Year, was absorbed on Oct. 1 by the National Aeronautics and Space Administration. Vanguard II is a forerunner of military missile warning satellites and more sophisticated weather reconnaissance systems.

The firing marked the first Vanguard launching since the transfer of authority and followed four consecutive unsuccessful attempts by the Vanguard to launch a satellite. Information gained through this vehicle will be distributed under the IGY program to all of the nations which participated in the geophysical year.

Orbit of the weather satellite is the second highest of the satellites now in orbit, exceeded only by the smaller Vanguard I. Its perigee is about 335 mi. and apogee approximately 2,050 mi. with a predicted lifetime ranging up to 100 years or more. Angle of the orbit with the equator is 34 deg.

Instrumentation in the 20-in., 20.5-lb. weather satellite was designed by the Army's Signal Research and Development Laboratory at Fort Monmouth, N. J., and has functioned perfectly to date. It consists of two photocells which measure the sunlight reflected from the earth primarily in the infrared range, a recording unit to collect the information gathered by the photocells and a Minitrack transmitter that will relay 50 min. of data within 60 sec. when interrogated from ground (AW Aug. 18, p. 82).

The equipment is described by the Army and NASA as the forerunner of much more sophisticated instrumentation now in the planning stage and principal benefit of Vanguard II will be to develop the basic art and procedures for using satellites for weather reconnaissance and forecasting. Resolution of the present photocells is such that they will record the average reflected light from a circle 7 mi. in diameter when they are pointed directly at the earth. Two photocells are mounted on opposite sides of the spherical satellite at 45 deg. to the rotational axis so that, as Vanguard II rotates, they cover a path about 7 mi. wide and 600 mi. long.



INSTRUMENTATION includes (1) photocell light shield; (2) recorder; (3) interrogation radio receiver; (4) weather data transmitter; (5) photocell; (6) data electronics; (7) tracking transmitter, and (8) mercury cell batteries.

Clouds can be picked out from this photocell data because they reflect about 80% of the sunlight that falls on them, while the land reflects only 15 to 20% and the sea only about 5%. The photocell readings made as the instruments trace across the earth's surface can be pieced together to form a mosaic showing the planet's cloud formations.

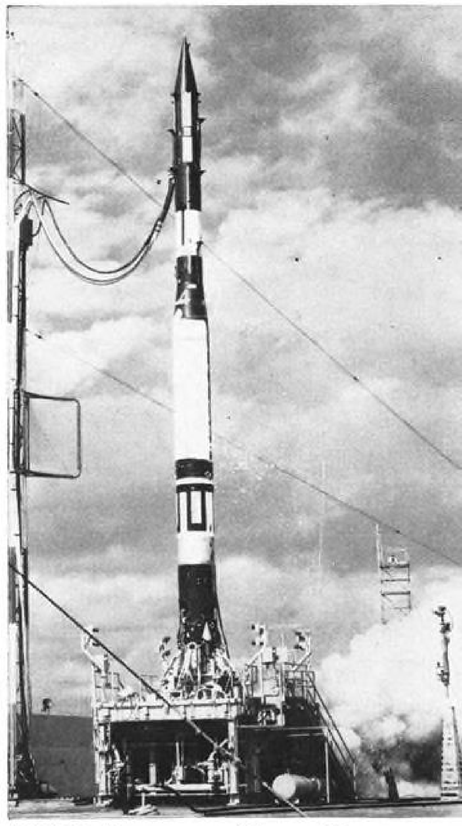
The almost rudimentary nature of Vanguard II, which was frozen in design about a year and a half ago, is clear when it is compared with current satellite plans. It lacked any stabilization system to ensure that its photocells would be pointed in the proper direction. Instead, it was meticulously balanced dynamically so that it would rotate precisely about the longitudinal axis of its cylindrical Minitrack package during its short useful lifetime.

The photocells were precisely arranged so that they would never point directly at the sun as the satellite rotated through space at about 50 rpm. If this happened, the photocells would be burned out.

While the predicted life of the satellite runs as high as 100 years or better, the mercury batteries carried in it will allow the cloud cover instrumentation to function about two weeks; the Minitrack transmitter another two weeks when it is putting out only a steady signal for tracking purposes. Solar or atomic batteries, which have progressed considerably since the cloud cover satellite design was made final, would allow this weather information to be gathered for an almost indefinite period.

Launching of the Vanguard II occurred essentially at the desired time with no major hitches during the countdown. There was a deviation in allowable firing time of about four to four and one-half hours so that the satellite could be injected into its perigee approximately at local noon over the equator. This was required so that the perigee would occur during daylight over the entire two-week life of the cloud cover instrumentation. After two weeks, the precession of the satellite's orbit, the constant tilting of the earth's axis and the shift of the perigee position around the orbit would alter the original conditions so that Vanguard II would not be at its lowest altitude when passing over the sunlit portion of the earth. This would reduce the resolution of the photocells, and at apogee they would be recording the average light intensity from a circle 50 mi. in diameter instead of the seven miles as at perigee.

A number of changes in the Vanguard rocket have been made since the project was taken into the NASA. The changes were not concentrated in any one stage or area and were pretty



STATIC testing nears completion on Vanguard satellite launching vehicle No. 4 at Cape Canaveral, Fla.; note liquid oxygen trail near figure 4. Third stage of the Vanguard booster carries the 21¼-lb., 20-in. diameter weather reconnaissance sphere.

well distributed over the vehicle, according to Dr. Abe Silverstein, NASA's director of space flight development. A lengthy review of the complete Vanguard design was made by a committee formed of original Vanguard personnel, which transferred to NASA, and by NASA engineers not previously connected with the project. All firings were halted while this review and modification were in progress and the original IGY schedule of completing the program before last Jan. 1 was not met, but plans are to launch the remaining three Vanguard satellites as soon as possible.

Exact nature of the changes made in the rocket were not reported, but Silverstein indicated that many of the changes were made possible by recent advances in rocket technology that were not available when the Vanguard was designed. New methods of preventing foreign object contamination of the propellants were among the changes made.

Technical improvements in solid propellant engines will be incorporated in the third stage of the final Vanguard satellite launching rocket so that the orbital payload will be raised to about 50 lb., or more than doubled. This payload will include instrumentation to measure solar radiation, ultraviolet and X-rays, plus a proton precessional magnitometer to measure the precession as well as the magnitude of the earth's magnetic field.

The two other Vanguard satellites on the remainder of the schedule will each have the normal weight of about 21 lb. The first will carry only magnitometer instrumentation; the second only radiation measuring equipment.

Soviet Subs Pose Major Threat

By James A. Fusca

Rochester, N. Y.—Soviet Union's fleet of 450 submarines pose the most urgent threat to the nation's defenses—more immediate and less recognized than the threat of intercontinental ballistic missiles—according to naval authorities attending a top level conference of naval and civilian anti-submarine warfare specialists here last week.

Rear Adm. John S. Thach, commander of Task Group ALFA, AW July 21, p. 73), told a news conference that if the Soviet claim of having submarines capable of firing Polaris-type missiles was true it would require only about a dozen such submarines penetrating U. S. defenses to wipe out 70% of the U. S. economy in one surprise blow.

He stated that he believed the reduction in intelligence estimates of the Soviet submarine fleet from 464 last June to 450 today indicates that the force is going through a transition period, retraining crews and building new submarines toward the eventual goal of a nuclear-powered, missile-equipped fleet.

The conference was held in conjunction with the dedication of the country's largest and most modern indoor sonar test tank by Stromberg-Carlson Division of General Dynamics Corp.

Adm. Thach defined for the conference the two major problems of anti-submarine warfare as being detection and classification. Present detection systems are totally inadequate for reliable detection at extended ranges, he said. Instant assurance that the object detected is a submarine, not a whale, school of fish, or submerged pinnacle, must be attained. This cannot be done with present equipments.

To meet the threat of the deep-running, quiet submarine made possible with nuclear power, he considers the most urgent requirements to be:

- **Burglar alarms.** Warning systems that will indicate the presence and locations of submarines in deep ocean areas, in the areas around convoys and task forces, and in special areas where other systems cannot operate.
- **Identification systems.** Systems that will ensure that when the warning system flashes it has been triggered by a submarine and not a stray whale.
- **Prediction system.** A system similar to weather prediction systems for forecasting sound propagation conditions below the surface over wide ocean areas.
- **Mobile ASW forces.** Anti-submarine forces to be capable of apprehending a submarine must be made highly mobile.

Other requirements are for systems that can assure certain detection of a submarine exposing a periscope or snorkel above the surface, and for providing in each ASW vehicle capability of finding, identifying, destroying submarines.

He referred to the nuclear depth charge as, "just an expensive excuse for inaccuracy." "What is more to the point," he said, "you can't even scare him with an atomic bomb if you can't find him."

(The two air-dropped nuclear depth charges in existence are named Betty and Lulu. Betty, now with the fleet, is an earlier and bulkier version that can be dropped only from the Grumman S2F-2 of which only 45 were ever built. Lulu, just getting into use, is smaller and lighter, and can be dropped by the S2F-1, of which several hundred are in operational use.)

The sonar test tank is 48 ft. in diameter and 30 ft. deep, the large size being required to accommodate the longer acoustic wavelengths that have come into use since World War II.

Pershing Launch Complex

Details of the Army-Martin Pershing ballistic missile system's launch complex at Cape Canaveral, Fla., first revealed by Aviation Week (Dec. 22, p. 26), have been confirmed by the Army. Complex (above) includes two launch pads; a blockhouse with a partial second floor to accommodate 50 non-operational personnel; a nose cone installation building with missile processing bays and control, power and terminal rooms and a shop; and a self-powered, three-level mobile service tower serving both pads. Clearing of the site, near Army's Jupiter and Navy's Polaris complexes, has begun. R. E. Clarson, Inc., of St. Petersburg, Fla., has a $2,062,152 construction contract under supervision of the Jacksonville District, Army Corps of Engineers. Martin-Orlando will build the service structure to Army Ballistic Missile Agency design. Launch team will be composed of ABMA and Martin personnel, with ABMA training Martin in checkout and firing procedures. Later, Army experts will withdraw and ABMA will retain technical supervision over all firings, which will then be by troops. ABMA's Missile Firing Laboratory will be responsible for telemetry and data coordination in the research and development tests. Pershing is a 500-750 mi. range solid-fueled replacement for the 200-mi. liquid-fueled Redstone.

USAF Plans Communications Expansion

Washington—Team headed by International Telephone & Telegraph Corp. (ITT) has been selected by Air Force for an all-out systems approach to modernization and expansion of USAF's global communication system (AIRCOM) to meet expanding needs in the 1959 to 1970 period and beyond.

Objective of the program, identified as Electronic Supporting System 480-L (formerly 456-L), is to improve and expand Air Force's communications network in five basic areas:

- **Capacity:** Number of available voice channels must be increased by at least a factor of four, with a 10-fold increase in data handling circuit capacity for use by computers and data processing machines.
- **Security:** Speedy and direct on-line cryptographic machines for coding and decoding voice, teletype and data must be provided on all circuits instead of only a handful as at present.
- **Reliability:** New techniques, including scatter communications and possibly communication relay satellites, will be required to assure at least 99.9% reliability in all circuits. High frequency radio now used extensively, particularly in the Pacific area, is highly vulnerable to atmospheric outages and jamming.
- **Video-Graphics:** System's capability must be expanded to provide for transmission of TV and photographs.
- **Compatibility:** System must be able to operate with systems of other military services, commercial communications facilities and those of other nations.



DISTANCES are approximate in this map of USAF's global communications system.

Initial Award

Initial contract award to ITT is expected to be around $3 million, but additional funds will be allocated as the program gets under way, Air Force spokesmen indicate. Radio Corporation of America is a senior associate on the ITT team, with Hoffman Electronics and Hughes Aircraft as major subcontractors.

Unsuccessful bidders for the 480-L program included Western Electric and two teams, one headed by Philco, and the other by Westinghouse.

Air Force plans for major systems approach to modernizing and expanding its global communications network were first reported by AVIATION WEEK more than two years ago (AW Aug. 6, 1956, p. 253). The system, which has expanded on piecemeal basis, now represents an investment of $491 million, 14 times the investment of RCA Communications Co. facilities which provides world-wide radio services. Air Force employs 12,000 people in the operation of its AIRCOM, handles a total of eight billion words per year, nearly 20 times the traffic of RCA Communications Co., according to Col. Earl Humphries, chief of plans and requirements in USAF's Telecommunication System's Division. Network serves over 650 facilities.

Advent of the ballistic missile threat has greatly increased the Air Force need for rapid, reliable global communications, while the prospect of space vehicle communications has greatly increased scope of system capabilities required since program was conceived.

Under the terms of the contract being negotiated with ITT, the company and its associates will assist Air Force in the following:

- **Establish total system** future requirements.
- **Prepare system master plan.**
- **Design and fabricate models** for system studies.
- **Develop necessary components.**
- **Prepare final system equipment** specifications.
- **Conduct over-all system** engineering.

To assure that the 480-L prime contractor does not use its position to dominate the subsequent avionic equipment procurement or unfairly compete with other manufacturers, Air Force called the four bidders together prior to selecting a winner and obtained "agreement in principal" from all to the following limitations on contractor:

- **System will not be designed** and engineered so as to give system contractor (ITT, RCA, Hughes and Hoffman) an advantage over other equipment suppliers in hardware procurement.
- **System contractor** can compete for subsequent hardware procurement with other suppliers when feasible.
- **However, system prime contractor** will be limited to "a level of business for development and production of commercial equipment that is reasonably related to that obtained in former years," unless it is determined to be prejudicial to government interests.

Air Force insistence on the inclusion of such provisions is believed to result in part from fears expressed by some smaller companies that now produce commercial radio and communications equipment that the system prime contractor might propose a design which only his own products could meet. The restrictions are somewhat similar to those in USAF's contract with Space Technology Laboratories and Thompson Ramo Wooldridge but appear more lenient.

ARPA Plans Maneuverable Satellite Unit

By Ford Eastman

Washington—Plans to develop a satellite vehicle that can be controlled and maneuvered on an extended basis throughout outer space were reported last week by Roy W. Johnson, director of Defense Department's Advanced Research Projects Agency. Some versions probably would be manned.

Johnson told the House Science and Astronautics Committee that the project designated "Mrs. V" (Maneuverable, Recoverable Space Vehicle) is being actively pushed by the Defense Department as a vital requirement. He said:

"We see an urgent requirement to move from the area of controlled orbits to the area in which space vehicles maneuver in and out of orbit and develop space flight performance similar to that currently enjoyed by manned aircraft in atmosphere."

During the coming year, Johnson said, ARPA will sponsor work leading to advanced maneuverable vehicles. He predicted that preliminary objectives will be achieved in this field within the next five to 10 years.

Johnson assured the committee that ARPA is implementing a program designed to achieve and maintain space leadership over the Soviets. He predicted that, at the present rate of the U. S. program, the Soviet Union should be overtaken within three to four years.

ARPA Program

Johnson told the committee that programs currently under way or in the planning stage include:

• **Use of the Convair Atlas** intercontinental ballistic missile to increase booster capability from about 150,000 lb. thrust to 350,000 lb. thrust.

• **Next jump in propulsion** will be the 1.5 million lb. thrust booster to be obtained by clustering eight North American Rocketdyne engines. Cluster, when mated with the Centaur, a high-energy upper stage under development by Convair and Pratt & Whitney Aircraft Division of United Aircraft Corp., will permit the placing of a 35,000 lb. useful payload into a 300 naut. mi. orbit.

• **Next step in the propulsion** program is the million lb. thrust single chamber engine, also being developed by North American. This is expected to be available in five years.

• **By clustering the million lb.** thrust engines within two years after it is available, boosters of six to 12 million lb. thrust can be obtained. This, Johnson said, will permit placing between 200,000 and 400,000 lb. in 300 naut. mi. orbit.

• **Space satellite launches** under the Discoverer program to return satellite from orbit are in final preparation. Initial launching will be primarily to test the vehicle itself, particularly propulsion and guidance. Later, the satellite will contain biomedical experiments to seek data on environmental conditions. Recovery of these experiments will be undertaken.

• **With information obtained from** Discoverer, National Aeronautics and Space Administration's Man-in-Space program and the Dyna-Soar orbital bomber project, next step will be "Mrs. V."

• **Communication satellite program** now under development. Project was initiated by Project Score on Dec. 18 when an Atlas launch vehicle placed a simple delayed repeater system into orbit. Research and development program for this satellite will continue for five to six years.

• **Navigational system satellite** tests will begin in mid-1959 and are expected to be operational in a few years.

• **Tactical cloud cover program.** Schedule calls for first launching by mid-1959. This will be similar to the Vanguard II, launched by NASA last week (see p. 31).

• **Project MIDAS** to develop an early warning system based on use of satellites.

• **Sentry satellite program to** provide timely military information vital to Defense planning.

• **Tracking stations.** Agreements signed between NASA and Defense Department to provide for four additional tracking and data acquisition stations for deep space probes and broad-band data readout to be located at separate overseas installations.

• **ARPA is pursuing several** programs for basic and exploratory military research involving auxiliary power systems and solid propellant technology.

Johnson told the House Space Committee that tests of the communication satellite system will begin with launches within a year or so. Satellite will be launched by intermediate range ballistic missile-type boosters into orbits of 300 to 500 mi. The system, a more highly sophisticated version of Project Score, will have a communications capacity equivalent to 20 continuously available 100-wpm. teletype channels.

The courier delayed repeated phase of the satellite program, Johnson said, will help relieve intercontinental electric communications systems by handling large amounts of routine traffic.

Later phase of the communications satellite program will be the orbit repeater system, Johnson said. This phase will provide satellites capable of receiving and retransmitting messages on an instantaneous basis from 3,000 to 22,300 mi. orbits.

Instantaneous repeater will involve communications equipment of greater sophistication and capacity than that to be used in the courier delayed repeater system, Johnson said. Most important, he stated, the instantaneous repeater system will provide intercontinental point-to-point communications, ground-to-air and ship-to-shore communications and broadcast-type communications to ground and mobile units on an instantaneous basis.

Optimum performance will be obtained by using three or four satellites equally spaced around the equator in stationary orbit at 22,300 mi.

Defense interests, Johnson said, dictate that navigational systems employing satellites also be developed since large areas of the world and oceans are still inadequately plotted. A more accurate all-weather space-based navigational system will be an essential component of world-wide military movements and operations, he said.

Saturn Timetable

Washington—Four 1.5 million lb. thrust Rocketdyne engine clusters have been ordered, a need for eight is seen and a proposal for a total of 16 is now being evaluated, Roy W. Johnson, director of the Advanced Research Projects Agency, said last week. Development of the cluster is known as Project Saturn (AW Feb. 16, p. 23).

Johnson also said he has asked Defense Department to increase funding for Saturn launch facilities at Cape Canaveral, Fla., from a total of $63 million in Fiscal 1959 and 1960 to a total of $80 million for the two years. Breakdown now is $23 million for 1959, $40 million for 1960. Johnson wants $34 million and $46 million.

Saturn cluster is to be flight tested in the fall of 1960 and may make use of the Centaur high-energy upper stage, Johnson told the House Science and Astronautics Committee. Johnson had said earlier (AW Nov. 24, p. 26) that the cluster will form the basis for a "space truck" that might use Atlas, Titan or the Minuteman as upper stages. He said then that static tests might come this summer.

Timetable for Saturn development already has been accelerated since the program began last August and could be stepped up again with more funding, Johnson said. Saturn uses eight 150,000 lb. thrust North American Rocketdyne engines of the type used in Jupiter, Thor and Atlas. Development is directed by Army Ballistic Missile Agency.

The high-energy Centaur upper stage being developed by Convair Division of General Dynamics Corp. and Pratt & Whitney Aircraft Division of United Aircraft Corp. is to be ready in time to be mated with the cluster, Johnson said.

These will provide "the new building blocks necessary to place 35,000 lb. of useful payload into a nominal 300 naut. mi. orbit," Johnson said. Last November, Johnson said the "space truck" would provide the power capability to put a 25,000 lb. satellite into a very high orbit, send a manned vehicle around the moon and possibly land a vehicle there that could return to earth.

Study of techniques for recovering Saturn boosters is under way at ABMA under ARPA contract, Johnson said, and recovery looks feasible. He said that by clustering engines, the U. S. will gain more than three years over any other method for achieving 1.5 million lb. of thrust, and at about half the cost of other methods (see p. 49).

ABMA also is understood to be developing capsules for use with the Saturn vehicle.

Contract Awards Detailed by NASA

Washington—National Aeronautics and Space Administration last week announced a total of 44 contracts for over $50,000 each awarded by the agency between the time it officially began operation last Oct. 1 and through Jan. 1.

Over $105 million have been obligated on these contracts for expenditure during Fiscal 1959. Total amount of the 44 contracts will be more than $206 million over a period of years.

Largest single contract listed by NASA is with Rocketdyne Division of North American Aviation for development of a single chamber liquid propellant rocket engine of 1.5 million lb. thrust. A total of $10 million dollars has been obligated for this work during Fiscal 1959. Total funds for program are about $102 million.

Other work covered are lunar and space probes by the Air Force, lunar probes by the Army, Convair Atlas D boosters for NASA's Project Mercury Man-in-Space program and storable liquid propellant systems for rocket engines to be developed by Jet Propulsion Laboratory of Cal Tech.

Collins Radio Sextant Used to Track Moon

Cedar Rapids, Iowa—Moon has been successfully tracked for the first time by means of its own extremely weak microwave radiation using AN/SRN-4 radio sextant developed by Collins Radio Co.

Feat opens the way to using the moon as well as the sun for precise all-weather navigation of Polaris-type submarines and other naval vessels. It will enable submarines and ships to rendezvous with complete radio and radar silence under foul weather conditions.

The SRN-4 radio sextant used here by Collins to track the moon is identical to the one currently installed aboard the Navy's USS Compass Island and originally was developed to track the sun by means of its microwave radiation during daylight hours (AW Nov. 8, 1954, p. 43).

Radio sextant employs a 5-ft. diameter parabolic antenna and an extremely sensitive receiver operating in the 1.8 cm. band. Sextant must operate from lunar energy which is only 1/500,000,000,000,000 as strong as power consumed by a small Christmas tree bulb.

The sextant scans a circle around the sun or moon's rim to establish effective body center location. Unless the antenna is aimed directly at the sun or moon, a scanning modulation results which is converted into error signals to drive the antenna into proper position in order to continuously track the moving body.

Sabreliner Gets JT-12s

Los Angeles—North American T-39 Sabreliner twin-jet utility transport production models will be powered by Pratt & Whitney JT-12 turbojet engines, as predicted by Aviation Week last Dec. 29 (p. 27). Engine has been redesignated J60 and is rated at 2,900 lb. thrust. Sabreliner prototype is powered by General Electric J85 (2,500 lb. thrust). U. S. Air Force has ordered seven Sabreliners; company said use of the J60s will boost maximum speed to about 600 mph. Production models also will have provisions for wing tanks, each carrying about 125 gal.

News Digest

Competition for an airborne ballistic missile early warning system for the Air Force has centered around a large aircraft that will be capable of destroying as well as detecting ballistic missiles at considerable distances from the U.S. mainland (AW Feb. 16, p. 23). Aircraft would carry anti-ICBM missiles as well as the avionic systems necessary to detect and intercept enemy missiles. Canadair is participating in this project rather than in a competition for a U.S. Navy anti-submarine aircraft as reported by AVIATION WEEK (AW Feb. 16, p. 32).

International Air Transport Assn. Paris session moved toward closer agreement last week on the jet surcharge problem with both sides giving ground.

International Air Transport Assn. last week opposed, at a special meeting on short distance navigation aids of the International Civil Aviation Organization, any compromise that would result in dual navaid standards. IATA, which favors the U. S. VOR/DME-T system, said that not finally adopting one standard system at this meeting would have consequences as grave as choice of a dual standard.

Last Convair B-36 was recently retired from Air Force service at ceremonies in Fort Worth, giving the Strategic Air Command an all-jet bombing force. This final B-36, which will be placed on permanent display at Amon Carter Field in Fort Worth, is the last of 383 built by Convair Division of General Dynamics Corp.

General Electric Co.'s Heavy Military Electronics Department has established two new marketing units—Defense Industries Sales and Defense Industries Contract Administration. Both will serve the defense prime contractor market. Defense Industries unit will be headed by George D. Prestwich, and Fred Glickman will be manager of the contract administration unit.

Honeycomb panels for the North American F-108 long range interceptor will be constructed by Aeronca Manufacturing Corp., Middletown, Ohio. Contract calls for use of welded high-strength steel, titanium and large amounts of brazed steel honeycomb.

Kaman Aircraft Corp. sales will reach $30 million this year, an increase of more than 50% over 1958, according to Charles H. Kaman, president. He told company supervisors that contracts totaling more than $14 million are "imminent."

Economy Fares Boost Transatlantic Runs

Foreign-flag lines gain most of increase through use of bigger piston fleets in advance of heavy jet service.

By Glenn Garrison

New York—Most of the 23% increase in scheduled North Atlantic airline traffic last year went to foreign-flag carriers making the most of expanded piston fleets during the last year before jets will be out in force.

An AVIATION WEEK survey shows that Pan American World Airways gained 8% in traffic on the route and Trans World Airlines' increase was a modest 4.5% over 1957. Over-all total of International Air Transport Assn. members' scheduled traffic was about 1,193,000, up from 968,000 in 1957. Charter business by the IATA carriers was up 95% to almost 100,000 passengers.

Continued sharp increase in transatlantic traffic—in contrast to recession-hit domestic traffic, which scarcely more than held its own—was partly due to the new economy class fare, which went into effect last April and accounted for more than half of the total. As predicted, the tourist class was fading fast and several additional airlines will join Scandinavian Airlines System and eliminate it from their summer schedules. SAS took the leap last year when the new fare went in.

The North Atlantic airlines stepped up seating capacity by about 33%, offering 1,925,186 scheduled seats and suffering a loss in load factor over the previous year, from about 67% to 62% in both directions. Eastbound, the 59% load factor was the same as 1957's, but westbound it dropped from 74% to 65%. Decrease in low-fare immigrant traffic was partly responsible for the westbound results.

Economy class passengers totaled 662,634 for the year. Tourist traffic was down 63% to 274,896, but first class (including de luxe) business showed a comfortable gain of 12% to a 255,620-passenger total.

Traffic Pattern

Pattern of passenger traffic over the year followed that of 1957, with a relatively slow start, heavy peak season traffic, and a good volume holding up through the fall. During the first four months of 1958, eastbound scheduled traffic totaled about 117,700 passengers; from May through August, the figure was 298,000; and for the last four months in the year, about 143,500 eastbound passengers. However, in April, when the economy fare went into effect, the eastbound total jumped almost 13,000 over the same month of 1957.

Results of the top five North Atlantic carriers in terms of 1958 traffic volume and including the West Coast-to-Europe polar route are as follows:

• **Pan American** carried 251,340 scheduled passengers, up from 233,319 in 1957. Airline increased its transatlantic seats only 12% to 439,915, achieved an over-all load factor of 57%. Polar route traffic totaled 19,818 passengers during PanAm's first full year of the service. The 1957 total was 3,124. Transatlantic charter business increased from 21,309 passengers to 23,554. Economy passengers accounted for 127,317 of Pan American's total. Tourist total was down from 162,853 in 1957 to 57,042; first class dropped from 70,466 to 66,999. PanAm's share of the total North Atlantic market dropped from 28.6% eastbound and 30.1% westbound to 23.9% and 25.3% respectively. Major event for the airline in 1958, of course, was introduction of Boeing 707-120 jet schedules to London, Paris and Rome. During the period Oct. 26 through Jan. 10, PanAm carried 23,089 de luxe and economy passengers in its jets. PanAm will eliminate both tourist class seats and all-first-class airplanes from its 1959 summer accommodations. Its Douglas DC-7Cs will carry first class and economy or de luxe and economy passengers. Last year Boeing Stratocruisers handled the all-first-class schedules.

• **TWA's transatlantic total** last year was 160,484 passengers, up 4.5% from 1957. Split was 127,396 tourist and economy, up 1.1% from the tourist total in 1957, and 33,088 first class passengers, up 19.6% from 1957. Load factor for first class was 58.7%; for tourist and economy, 58.1%. TWA has not finally decided to eliminate tourist class this year, but such a move is now under consideration.

• **British Overseas Airways Corp.** carried 149,287 passengers, up from 114,871 in 1957. First class business increased from 34,782 passengers to 41,085; tourist dropped from 80,089 to 39,007; and the new economy class attracted 69,195 BOAC passengers. Airline's share of the total traffic was 27%, same as the year before. BOAC began the first transatlantic jet service last fall with Comet 4s and has experienced a load factor of about 82% in the first class and de luxe service. Bristol Britannia turboprops also plied the Atlantic for BOAC last year, although Britannia service actually began in December, 1957. BOAC will go along with the tourist class this year, on the assumption that a lot of passengers still use it even if the economy class has far outstripped it. Combinations of tourist, economy and first class will be offered in Britannias, while Comets will continue in first and de luxe service and DC-7Cs will handle single or mixed class economy-tourist flights.

• **SAS's** total, including polar route, was 118,088 passengers, up from about 87,000. Airline offered 195,084 seats and achieved load factors of 60.1% eastbound and 63.1% westbound. SAS carried 8,381 tourist passengers before the April switch, then rolled up a total of 88,168 economy passengers during the rest of the year. First class total was 21,539.

• **KLM Royal Dutch Airlines** carried 162,716 North Atlantic passengers, up from 99,748 in 1957. Seats offered totaled 169,153 up from 131,595.

• **Air France** was a close sixth in traffic volume with 90,569 North Atlantic passengers, up from 75,241. Capacity was up from 105,800 to 142,127 seats. The 1958 split was 38,000 economy, 28,000 tourist, and 23,000 first class and de luxe.

Among other developments during 1958 on the route:

• **Sabena Belgian World Airlines,** with last year's Brussels Fair at its doorstep, increased its share of the North Atlantic market from 3.8% to 6.9%. It carried 58,650 passengers, up from 39,976 in 1957. Apparently because of the fair, Sabena's eastbound traffic last year exceeded its westbound traffic, with totals of 30,374 and 28,276 respectively. Economy class customers accounted for 37,696 passengers in the 1958 total.

• **Lufthansa German Airlines,** with new equipment including Lockheed 1649 Constellations, increased its seat capacity from 55,550 to 85,105, carried 17,003 more passengers than in 1957 for a total last year of 54,413.

• **Irish Airlines,** newcomer on the Atlantic, began service in May with Super Constellations leased from Seaboard and Western Airlines. Airline carried about 11,000 passengers with an over-all load factor of 38%. Irish Airlines service is all-economy.

• **Alitalia,** in its first full year of transatlantic operation after merging with LAI and taking over the Italian flag service on the route, carried 26,425 passengers. The 1957 Italian flag transatlantic total was 12,161 passengers. Italy's share of the total traffic increased from 1.4% to 2.5%. Alitalia operated new DC-7Cs on the route during 1958.

• **Swissair's traffic** increased from 33,702 passengers to 41,914.

• **El Al Israel Airlines,** during the first full year of its all-Britannia transatlantic service, offered 31,920 seats, up from 13,611 seats in 1957. It carried 19,022 passengers, up from 8,000. Pre-Britannia equipment flown on the Atlantic by El Al was the Lockheed 049 Constellation.

• **Iberia Spanish Airlines** carried 7,950 passengers, up from 10,950 in 1957. Equipment consists of Super G Constellations.

Success of the charter business and the economy fare seem to reinforce the view that low cost transatlantic transportation appeals to a wide market untapped at previous fare levels.

Cut in Electra Speeds Proposed Pending Propeller Vibration Study

Washington—Possibility of excessive vibration of the outboard engines on the Lockheed Electra turboprop transport has caused the manufacturer to recommend a reduction in cruise speeds pending completion of a current vibratory study of the aircraft.

Lockheed has recommended that both American and Eastern airlines reduce the original high speed cruise and maximum design speed to 288 kt. and 320 kt. respectively. Operating specifications call for a high speed cruise of 324 kt. and maximum design speed of 364 kt., with the latter figured for an 8,000 ft. altitude.

Changes were recommended as a "purely precautionary move," according to Lockheed, and should have "virtually nil effect" on airline operating performance. Basis of the trouble was traced to a propeller stress condition with the manufacturer officially declining to identify the propeller type other than specifying that it does not involve the Aeroproducts propeller used on most of its Electras. A spokesman for Hamilton Standard Division of United Aircraft Corp. conceded that the propeller involved is a Hamilton Standard product but declined any further comment.

Other Lockheed spokesmen said the company originally made vibration tests on the airlines' Electras using Aeroproducts propellers on the inboard engines only since any attendant noise of vibration would be closer to the cabin. At present, the manufacturer is conducting further tests with Aeroproducts propellers mounted on the outboard engines to settle the question of possible difference in performance between this type of propeller and others. Study also is exploring such areas as shaft and bearing loading and wing stress.

Test results, thus far, are proving satisfactory, according to Lockheed.

Allison engine company officials said the Lockheed study has no relation to the Allison 501 engines which power the Electra. They said that, to date, the powerplant has experienced no more mechanical difficulties than normally expected in the phasing in of new equipment, and the company has no design changes planned for either the engines or propellers.

Some problems of a minor nature have arisen but already have been solved, Allison said. Early loss of turbine compressor blades was caused by a loose fit of retaining pins in the rim of the compressor disk. Addition of a special ring at the base of these pins catches and holds the blade that has worked loose, preventing further damage to other compressor stages.

Maintenance reports show that extensive damage was done to the No. 2 engine of an Eastern Air Lines Electra last month by the loss of a turbine blade. A blade was thrown from the third-stage compressor, damaging the next stage, cracking the No. 5 burner can and shearing off 24 bolts linking the turbine intake to the turbine casing. Escaping exhaust from the breech caused fire warning lights and signals to respond, but the engine was feathered with no difficulty.

The engine manufacturer also said there had been a problem of insecure bolt retention in the propeller gear box. Changing to bolt retainers with stronger tabs also settled this issue, according to Allison.

American Airlines last week disclaimed trouble with vibration of any kind and said its Electras have no major mechanical faults. Engineers for the company say there has been trouble with runaway starters leading to a few engine shutdowns, but that in most cases it happened on the ground prior to takeoff. The problem has been solved by rewiring the starters, they say.

While both American and Eastern are operating Electras under the lower speed recommendations, they agree with Lockheed's contention that this has had little effect on their operation of the aircraft.

Federal Aviation Agency officials who have been receiving daily mechanical reports on the Electra from both airlines say mechanical failures reported thus far have not been serious. The few that have been reported, they say, are "nuisance" types common to new equipment and are not considered a hazard to flight safety.

Addition of Flasher Lights Aids LaGuardia Runway Identification

By Robert I. Stanfield

New York—Runway identification at LaGuardia Field has been considerably improved with the addition of condenser discharge flasher lights to threshold lighting, a flight check by AVIATION WEEK indicated.

Sylvania Strobeacons—white stroboscopic lights that can develop 3,000,000 candlepower, with a two-per-second flash frequency—are operating off the corners of Runways 22 and 31, and shortly will be in use on Runway 13.

Need Cited

Need for increased visual aids at LaGuardia was stressed following the Feb. 3 crash of an American Airlines Electra during a back-course combined range-ILS localizer approach to Runway 22 (AW Feb. 9, p. 38). Reason for the crash is still unknown.

Runway 4, which utilizes the complete ILS approach—including the glide path—is equipped with Configuration "A" approach lights extending 3,000 ft. This configuration includes 2,500 ft. of Strobeacons, the last of which is 500 ft. from the approach end of the runway. These are expected to be operative in several weeks.

Work on the new lights, which are installed and maintained by the Port of New York Authority, initially began in April, 1958. First NOTAM (Notice to Airmen) to pilots, on Feb. 7, stated that the lights were available on request.

Second NOTAM, on Feb. 11, indicated that the Strobeacons would be operating during visibility of three miles or less and would be turned off should the pilot so request (this is because of their flash, which might prove distracting during the final phase of an approach).

Check of the system is being made by the Federal Aviation Agency and the Port Authority. Effectiveness reports also will be obtained from pilots



McDonnell Model 119 UCX Starts Flight Testing

Flight tests of McDonnell Model 119 UCX utility jet transport-trainer are under way at St. Louis, Mo.; first flight lasted 45 min. (AW Feb. 16, p. 35). Airplane is a candidate in U. S. Air Force UCX competition; prototype powerplants are four Westinghouse J34 turbojet engines. Interior can be varied for either personnel transport or radar training mission.

using the lights during varied approach conditions.

Aviation Week pilot-editor accompanied FAA flight operations specialist Richard Skully and Port Authority airport navigation standards engineer Albert Odell during a flight-check of the system. Takeoff was made shortly before official sunset—1740 EST. Ceiling at LaGuardia was 14,000 ft. Visibility was about 5 mi. in smoke and haze. Aircraft flown was a twin Beech.

Stroboscopic lights were quite effective during right-angle convergence courses to runway approaches from 3 mi. out. Several low approaches at 110 kt., to Runways 22 and 31, were made from initial altitude of 800 ft. to go-arounds at 100 ft. Two of these followed converging courses to the range station at Clason's Point, where the lights were clearly visible, following which standard back course letdowns were made to Runway 22, 2.8 naut. mi. southwest.

Runway identification was positive in all instances. One or the other of the two lights could be seen as aircraft was angled to approach centerline. Coming around on final approach, both could be observed, though here the clearness was not as sharply defined, possibly because of the toe-out angle. The intensity of the flashes was not quite as acute on the centerline.

The Stroboscopic lights are installed 40 ft. outboard of each side of the runway and about 50 ft. forward from the approach end (threshhold lights, by comparison, are set 25 ft. out from the approach end). They are being evaluated at a 20-deg. toe-out, and angle up at 7.5 deg.

Optimum effectiveness of lights during extremes of rain, haze, low scud, etc., is still to be determined. Approach minimums for LaGuardia are 400 ft. and 1 mi. visibility for the back course; 400 ft. and ¾ mi. visibility for the front course.

Resort Plans to Restore Service

Washington—Resort Airlines, certificated cruise carrier which suspended regular passenger service four years ago, has told the Civil Aeronautics Board that it intends to resume service by the first of July.

Filing of its intentions by the carrier was in answer to a CAB decision in the Resort Renewal Case in September, 1957, directing the airline to resume operations under its certificate by September of last year. Board members later gave Resort a time extension to July of this year with a proviso that the carrier submit plans for a resumption of service by Mar. 1. Failure to actively resume passenger service probably would mean a loss of Resort's certificate to conduct package tours, according to CAB spokesmen.

Resort told the Board that "Skycruise" tours will be reinaugurated on or before the July deadline with plans for a summer cruise operation between June 27 and Sept. 12 with a once-a-week Douglas DC-4 round trip flight from New York to Haiti and Jamaica at an all expense price of $389.

Two winter season tours, between Dec. 12 and Mar. 26, 1960, also are planned. One would connect the same Caribbean points, while the other would be a round trip from New York to Nassau and Havana.

Resort estimates that the 15-day summer season tour would bring Resort $124,100 in operating revenues, on a basic air fare of $185, but would result in a net loss of $4,273 because of heavy developmental expenses.

However, the airline says it would realize a $74,227 operating profit from the planned winter tours which are expected to earn $310,760 in operating revenues on base fares of $155 and $160.

Resort said it plans to ask CAB permission to suspend all operations between Sept. 27 and Dec. 12 because of the customary seasonal drop in the Caribbean tourist market and hazardous hurricane conditions.

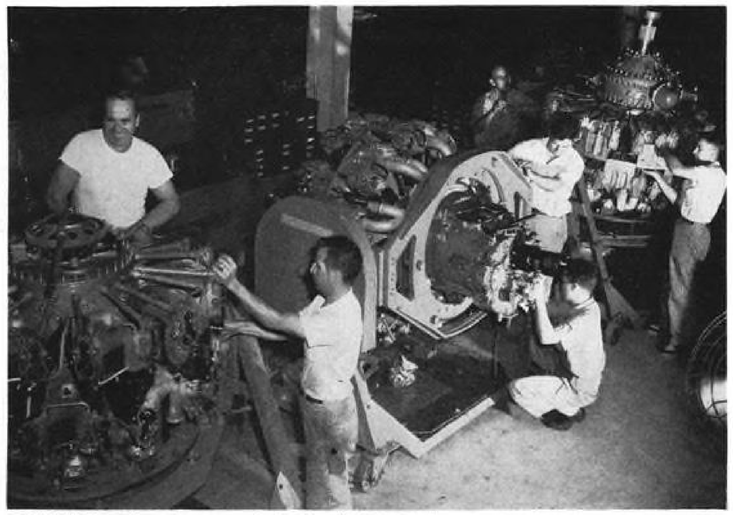
Only major drawback reported at this time in the Resort plan is a question of what landing rights the carrier still has in its certificated area since it has been inactive as a regular passenger carrier for many years. Attorneys for the airline say they have contacted the U. S. State Department requesting that the needed rights be brought up to date in time for the June service.

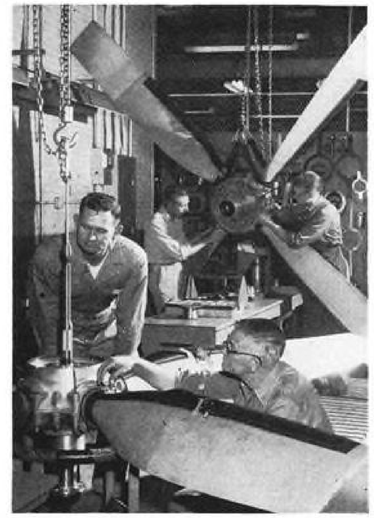
Resort told the Board it intends to concentrate on Miami convention groups with the thought of getting large groups for Caribbean tours. In preparation for the planned summer service, the airline said its salesmen will contact large industries for package tours, with a tie-in to any current incentive plan in the company.

The airline has also started negotiations with Northwest and Trans World airlines on interline agreements to sell Resort's Miami, Havana, Nassau package which the airline says would allow the two major trunks to compete with National and Eastern for beyond Miami traffic.

Resort Request

Washington—Resort Airlines has asked Civil Aeronautics Board approval of planned corporate changes to permit formation of a new company under the presidency and directorship of Morris M. Townsend, who also is president and director of the Townsend Investment Co., which currently owns 83% of the airline. Resort said it will change its state of incorporation from North Carolina to Delaware under the name of Resort Airlines, Inc.





OVERHAUL and maintenance for Delta Air Lines' piston engine fleet is completed at Atlanta, Ga.; each aircraft is sent to the maintenance facility after 2,000 hr. At left, mechanics work on engines. Propeller shop is shown at right.

Delta Details Plans for Jet Maintenance

By L. L. Doty

Atlanta—Maintenance system that permits major overhaul of aircraft on a two-shift, five-day-week basis is being projected to cover jet operations by Delta Air Lines. The system, known as the block or cycle maintenance system, has been in operation at Delta's overhaul base here for the past two years.

Because the program provides management with a continuing analysis of operating standards of Delta's entire piston engine fleet, the company feels it will be particularly effective during the initial shakedown period of Douglas DC-8 and Convair 880 jet transport operations. The system provides for an eight-way breakdown of the normal full major overhaul cycle of aircraft. For example, the 16,000 hr. major overhaul period of the Convair 340 is divided into eight separate 2,000 hr. periods or blocks.

Major Overhaul

Each aircraft is thus brought into the Atlanta base headquarters every 2,000 hr. for major overhaul on one of eight designated sections of the plane. In this way, no airplane is held in company hangars for more than five days at one time, a significant advantage when compared with the 20 to 30 days aircraft would be tied up for major overhaul under the old system of complete maintenance every 16,000 hr.

Here are a few of the specific advantages gained by the staggered maintenance system:

• **Delta's hangars are open** for full-scale overhaul work Monday through Friday only so that all but a few mechanics have a free two-day weekend, barring serious non-routine problems which may crop up periodically. Midnight shift also has been eliminated.

• **Plan evens the workload,** eliminates peaks and valleys.

• **System releases aircraft** for heavy weekend traffic and has permitted Delta to specialize in specific type charter work.

• **Provides management and supervisory** personnel with continuing knowledge of standards of aircraft.

Delta prefers the block system to the so-called progressive system of maintenance since it feels the latter, with its tight two-to-three day periods of overhaul, can too easily become bogged down by non-routine malfunctions. Delta considers its open weekend and extra night shift as buffers which can, through overtime, pick up any slack resulting from serious non-routine problems.

In addition, Delta operations and maintenance heads feel that the block system enables supervisors to predict the



ENGINE is removed from Delta DC-7 at Atlanta, with aid of hydraulic-powered mobile crane. Delta utilizes a staggered maintenance system based on a five-day work week.



ENGLISH CHANNEL CONQUERED BY AIR!

FLIGHT INAUGURATES FIRST SCHEDULED AIR SERVICE BETWEEN PARIS AND LONDON

Lucien Bossoutrot

London, Eng., Feb. 8, 1919—The first international passenger flight became aviation history today when Lucien Bossoutrot successfully landed his Farman "Goliath" aeroplane at Kenley Aerodrome after a 2½-hour flight from Paris with 13 persons aboard. Captain Bossoutrot and his co-pilot reported that the bimotor biplane performed perfectly throughout the 178-mile trip. The flight fulfilled the dream of Louis Blériot, who ten years ago made the first channel

FIRST IN INTERNATIONAL AIR TRAVEL! It's as true of Air France today as it was 40 years ago when Lucien Bossoutrot made the first international passenger flight from Paris to London. Air France still follows this great tradition of French leadership in aviation. Today Air France offers the most non-stop flights between New York and Paris. This spring Air France will fly the fastest jet service in Europe and the Middle East. And next year Air France will cover the world's largest route network with one of the largest jet fleets in the world.

40TH ANNIVERSARY OF INTERNATIONAL FLIGHT

AIR FRANCE

WORLD'S LARGEST AIRLINE/WORLD'S FIRST INTERNATIONAL AIR SERVICE

workload to a more exact degree than other systems allow. Actually, Delta projects its complete maintenance program for one year in advance so that it can schedule overhaul of all aircraft to meet the demands of personnel vacations and heavy seasonal traffic periods.

At present, the carrier is establishing maintenance standards for jet transports under the block system so that a realistic program will be functional when the first of its DC-8s arrive this summer.

Under the block system, aircraft are pulled into hangars on Sunday night where they are immediately turned over to ground crews for a thorough cleaning. Mechanics take over Monday with routine jobs for which standards and work sequences have been established under the program. During the day, inspectors follow through on complaints received from flight crews and base ground crews and submit their findings and recommendations to lead mechanics.

These non-routine matters are included with routine work, and the workload is then rescheduled to encompass both routine and non-routine work so that overhaul covering any one of the eight block periods can be completed by Friday. Often, non-routine problems are uncovered by X-ray processes to which the aircraft is subjected one week prior to scheduled block maintenance. Non-routine problems are under constant review and analysis to determine whether recurring troubles should be reclassified as routine.

Workload during the week is spread out so that the work sequence follows an orderly pattern and so that no area of the aircraft is overcrowded at any one time by mechanic crews. Work during the week is analyzed by a "earned hours report" which rates the "effectiveness" of crews and foreman. In effect, the report is a time measure study and is used, not as measure of efficiency, but rather as a "scoreboard" which aids supervisors in running down problems that may be creating delays in overhaul functions.



AIRBORNE radar equipment is checked in Atlanta hangar by Delta's John Mitas.

Although employes are traditionally bitterly opposed to time and work studies, Delta mechanics generally have accepted the earned hours report as a necessary factor in the over-all maintenance program of the company. Mechanics' willingness to abide by the program is best testified by the fact that Delta mechanics represent the only mechanic group in the trunkline industry which has not been organized by a labor union. Delta's management attributes the five-day week as a major reason for this unusual employe-management relationship.

The earned hours report is compiled from information entered on International Business Machines cards, each of which contains the details of individual work items.

Before the earned report is printed and circulated to department heads and management, foremen are given the opportunity to suggest any changes or corrections they feel warranted. Base maintenance programs continue throughout a seven-day week. All DC-6 and DC-7 base maintenance is performed at the company's base in Miami and all Convair 340 and C-46 base maintenance is done in Dallas.

Swing-Tail Convair 600 Proposed

New York—Swing-tail features, to facilitate loading and still retain the tube-configuration of the Convair 600 turbojet and Canadair CL-44 turboprop cargo transports, were described here last week by Earl D. Johnson, executive vice president, General Dynamics Corp.

Speaking at the Wings Club, Johnson said the swing-tail feature will become standard on the CL-44, now in production for Royal Canadian Air Force, and has been proposed to the military and airlines for the Convair 600. Both aircraft are now being built with conventional side-loading features.

CL-44, a derivative of the Bristol Britannia turboprop, will be able to carry maximum payload of 60,000 lb. or 167 passengers; interior cabin is about 100 ft. long and has a cubic volume of 7,375 ft.

Swing-tail Convair 600 would have a cargo-cabin area of about 80 ft. long, 10 ft. 8 in. wide and 7 ft. 1 in. high. Plane would have a range of 5,750 mi. with a 20,000 lb. payload, or 2,935 mi. with a 70,000 lb. payload.

Johnson said one change, to facilitate high-speed loading and unloading, will be to design the 600 landing gear for "kneel-down" characteristic, bringing the plane's floor level even with a standard truck bed.

Operating Costs

He added that corporation analysts have predicted that the CL-44 can be operated for "as little as three and a half cents a ton mile for freight, and less than one cent a mile for passengers in direct costs." The Convair 600 swing-tail version, Johnson continued, can compete with surface transportation in direct cost-per-ton-mile.

Turning to development costs, Johnson emphasized that the "astronomical costs" of complex weapon systems "virtually precludes the government from pioneering new transport-type aircraft." This leaves, he said, one major customer—the airlines—and a possible other customer, the non-scheduled carriers.

But these customers, the executive declared, may lack the necessary purchasing power, largely due to sluggish action on fare relief. A past president of the Air Transportation Assn., Johnson, in 1954, made presentations to the Civil Aeronautics Board requesting such fare relief, since it was "obvious that it was necessary to enable the airlines to finance the needs of the coming jet and cargo age."

Slight Relief

He noted that "some slight relief" has been granted, but stressed:

"It verges on the ridiculous that here in the spring of 1959, with at least three of the 12 scheduled airlines in the country in severe credit difficulties and with three of the remaining nine in a financial bind, after months and months the General Fare Investigation still seems but little closer to a conclusion.

"It is almost impossible to reconcile the slow, cumbersome working of the CAB and its policies with the fact that it was established under the terms of the 1938 act to foster and promote aviation," Johnson said, and added:

"Instead, it is crippling the very industry it was designed to aid."

Referring to everyday air transport of goods, Johnson noted that expansion of air cargo business is an inevitability but that the key to making air cargo a conventional means of transport is in expanding the market from low-density, high-value goods into the lower-premium freight items.

"I know that some of the nation's largest airlines are proceeding under the assumption that during the late 1960s they may be carrying more cargo than passengers," Johnson said.



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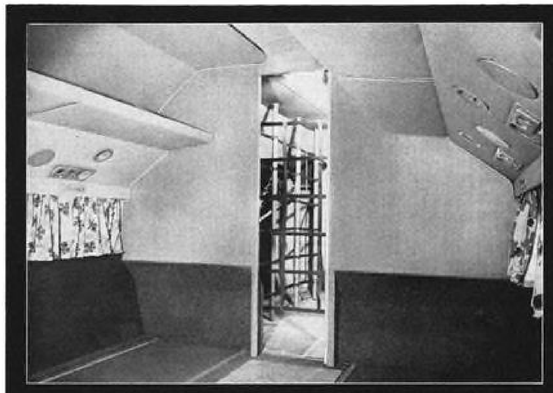
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SINCLAIR REFINING COMPANY, Aviation Sales
600 Fifth Ave., New York 20, N. Y.

Airline Traffic—December, 1958

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	408,209	273,154	68.0	1,811,361	818,285	6,444,129	35,300,561	62.0
Braniff	187,974	91,840	67.5	556,678	302,031	833,351	10,503,640	58.3
Capital	350,579	152,005	67.8	602,763	293,607	383,790	15,857,643	56.1
Continental	76,029	43,203	59.4	146,688	63,193	192,081	4,548,102	52.5
Delta	283,041	159,061	73.0	840,545	436,812	1,306,221	17,901,890	67.0
Eastern†	.....	.....	....	130	25	.....	155	....
National	203,537	142,779	71.6	739,172	146,687	779,222	15,496,171	59.0
Northeast	120,255	61,092	70.3	250,179	58,157	108,454	6,275,116	57.8
Northwest	136,088	109,037	56.9	904,096	321,635	1,338,725	13,025,208	51.3
Trans World	307,498	268,556	66.0	1,664,046	732,198	1,917,236	30,036,697	61.0
United	561,704	427,381	68.4	3,933,290	1,319,726	7,099,193	53,396,676	63.8
Western	116,637	64,589	58.3	396,561	102,738	382,041	7,070,949	50.9
INTERNATIONAL								
American	6,991	5,916	50.0	12,660	347	123,602	785,470	52.0
Braniff	3,619	7,055	46.3	17,961	.....	90,723	886,915	42.9
Caribbean-Atlantic	21,775	1,550	60.1	3,043	.....	4,785	171,314	66.8
Delta	4,763	5,527	57.2	9,156	.....	53,329	681,951	47.6
Eastern†	.....	.....	....	.....	.....	.....	.....	....
Mackey	7,284	1,566	39.3	.....	204	3,100	172,400	39.3
National	9,346	7,275	57.5	9,760	6,264	29,950	826,131	49.0
Northwest	10,165	21,678	44.3	2,314,565	19,633	806,683	5,527,713	68.1
Pan American								
Alaska	2,657	3,038	37.2	57,664	.....	145,655	531,439	48.9
Atlantic	79,019	107,828	63.1	2,691,271	.....	2,530,431	16,741,368	60.9
Latin America	117,083	130,708	66.7	724,802	.....	4,728,239	18,119,741	65.7
Pacific	22,821	87,857	71.0	2,226,563	.....	2,032,343	13,574,641	70.0
Panagra	9,859	13,013	51.2	95,312	.....	499,410	2,042,207	58.2
Resort	.....	.....	....	.....	.....	3,781,290	3,781,290	81.3
Trans-Caribbean*	.....	.....	....	.....	.....	.....	.....	....
Trans World	16,464	52,947	65.8	1,224,079	.....	1,366,071	8,138,815	71.1
UMCA	198	65	51.6	.....	.....	1,382	7,976	58.6
United	7,163	17,857	55.0	241,369	.....	87,296	2,153,987	52.6
Western	3,997	6,262	56.0	10,132	.....	8,326	702,438	59.5
LOCAL SERVICE								
Allegheny	36,792	6,718	46.2	22,253	23,824	22,759	710,088	47.7
Bonanza	13,918	3,412	43.4	9,664	3,900	6,117	346,384	42.3
Central	11,673	2,544	36.5	10,351	5,428	12,530	272,030	34.2
Frontier	18,135	5,106	45.3	30,965	10,135	61,227	592,928	55.3
Lake Central	18,145	3,058	44.6	7,294	16,066	.....	315,964	48.6
Mohawk	42,352	8,558	58.9	14,541	15,968	14,252	860,210	59.2
North Central	56,820	9,626	43.1	38,120	43,071	.....	1,003,885	45.0
Ozark	34,484	6,477	46.9	14,829	22,271	21,105	676,101	49.7
Pacific	29,245	6,773	47.0	22,512	5,047	6,975	680,289	46.1
Piedmont	35,098	9,013	61.2	20,683	17,277	16,710	918,395	61.5
Southern	25,371	5,510	55.7	22,040	16,112	9,220	576,354	55.7
Trans-Texas	22,725	5,441	45.4	26,220	12,570	35,452	595,555	47.6
West Coast	20,324	3,865	44.69	6,985	2,189	7,937	386,145	43.76
HAWAIIAN								
Hawaiian	34,358	5,395	56.7	10,526	.....	133,925	586,554	58.7
Trans-Pacific	14,218	1,784	50.0	1,992	.....	11,315	156,905	51.8
CARGO LINES								
AAXICO	.....	.....	....	50,882	77,996	3,485,625	3,614,503	73.0
Aerovias Sud Americana	.....	.....	....	.....	.....	745,094	745,094	83.0
Flying Tiger	1,954	9,414	100.0	73,183	98,119	11,609,308	12,722,063	87.9
Riddle								
Domestic	.....	.....	....	100,345	101,885	4,914,968	5,117,198	88.2
Overseas	.....	.....	....	.....	.....	929,035	929,035	79.6
Seaboard & Western	630	2,417	100.0	768,367	.....	1,666,975	2,688,677	59.35
Slick	3,004	18,987	91.87	.....	.....	51,848	1,890,580	88.2
HELICOPTER LINES								
Chicago Helicopter	7,905	148	30.2	1,314	.....	.....	15,417	23.2
Los Angeles Airways	1,842	69.7	44.5	3,557	1,785	.....	11,986	52.2
New York Airways	8,808	179	47.4	1,779	1,436	587	20,937	48.5
ALASKA LINES								
Alaska Airlines	5,093	2,979	36.8	128,449	3,143	241,684	681,986	42.1
Alaska Coastal	2,208	206	57.7	5,345	.....	3,223	29,722	67.0
Cordova	607	93	31.2	5,469	.....	41,094	56,062	46.5
Ellis	3,084	164	53.1	2,983	.....	2,120	21,744	70.4
Northern Consolidated	1,179	386	31.3	33,873	.....	43,375	119,935	55.8
Pacific Northern	7,812	7,420	44.9	190,381	7,011	293,616	1,296,700	63.6
Reeve Aleutian	845	907	35.4	46,831	.....	88,246	234,064	59.4
Wien Alaska	1,914	547	10.6	38,639	.....	206,094	301,150	54.4

* Not available. † Eastern strike during December.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.



Movable bulkhead permits versatility in ratio of passenger-cargo space.



DC-6A cargo airliner converted to tourist seating arrangement.



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SHORTLINES

► **Aloha Airlines Inc.,** formerly Trans-Pacific Airlines Ltd. of Hawaii, has been reissued a certificate of public convenience and necessity by the Civil Aeronautics Board to reflect the carrier's formal change of name. The reissue became effective Feb. 11. Aloha announced the airline's $1 million issue of four million shares of preferred stock has been completely sold to residents of the Territory of Hawaii at 25 cents per share. The airline also has signed a loan agreement with U. S. Life Insurance Co. and Continental Assurance Co. for $2,290,000.

► **American Airlines** is rescheduling inauguration of its New York-Chicago-San Francisco Boeing 707-120 turbojet service for Mar. 22. Delay from original date of Mar. 1 was attributed to flight training delays brought about by bad weather conditions.

► **Civil Aeronautics Board** has denied Rutas Aereas Nacionales, S. A.'s petition for reconsideration of the carrier's application for a foreign civil aircraft permit to operate six flights per week for 12 weeks from Port-au-Prince, Haiti, to Miami. RANSA wanted to use the permit to transport bananas from Haiti to Miami.

► **Pan American World Airways,** which has had a team of company experts training Pakistanis in all phases of airline operation since June, 1955, plans to train 34 Pakistan International Airlines employes in the U.S. this year under the auspices of the International Cooperation Administration.

► **Riddle Airlines** carried 6,453,779 lb. of air freight during December, a new company record.

► **Southern Airways** will offer a fare discount of 33⅓% to college students beginning Mar. 20, subject to Civil Aeronautics Board approval. Reduced-rate traveler must present a certificate from an official of his school and must purchase a round trip ticket, the return portion of which must be used within 10 days after the going portion.

► **Air France,** which celebrated its 40th anniversary on Feb. 8, will increase its transatlantic flights to 28 weekly, with 23 on the New York-Paris nonstop route, during 1959. Three flights each week will serve the Chicago-Montreal-Paris route and two weekly flights will be inaugurated between Montreal and Paris. Air France also will have four nonstop flights between New York City and Mexico.

AIRLINE OBSERVER

► Watch for a new flareup of the crew complement battle between the Flight Engineers International Assn. and the Air Line Pilots Assn. Executive board of the engineers' union meets in New York at the end of this month with drastic action indicated over the use of the fourth crew member. Action of the board will center around the question of safety and probably will be brought before the Federal Aviation Agency as a technical discussion.

► **Trans World Airlines is operating its first Boeing 707-120 transport for crew training and route checks from its Kansas City base. Although Howard Hughes has clamped a personal publicity lid on all TWA jet transport deliveries, there are seven 707s in brilliant red TWA markings on ramps outside Boeing's Renton and Seattle plants with numbers 9, 10 and 11 well along on the Renton final assembly line. Hughes has publicly admitted buying only eight 707s while actual order calls for 32 of which 15 will be the 707-120 for domestic use and 18 model 707-320s for international operation.**

► Pan American World Airways has been averaging 10 hr. a day utilization with its fleet of six Boeing 707-120 jet transports on transatlantic operations, training flights and its interchange with National Airlines between New York and Miami. Utilization rate for Douglas DC-6B at similar point in Pan American's fleet introduction averaged about three hours a day.

► **American Airlines realized a load factor of 99.5% on its Boeing 707-120 flights during the first 18 days of transcontinental operation. Between Jan. 25 and Feb. 11 the daily nonstop flights between New York and Los Angeles carried some 3,270 passengers over the route out of a total of 3,751 seats available on the scheduled jet flights.**

► Sikorsky Aircraft Division of United Aircraft Corp. plans to formally unveil its S-61 commercial jet helicopter this spring. S-61, which will carry 25 passengers, is powered by two General Electric T58 gas turbines.

► **Russia has started delivery of four turboprop An-10 and Il-18 transports to its Polar Aviation Administration. Soviets say the aircraft will be used for regular passenger and cargo service to mainland and offshore island points north of the Arctic Circle and for supplying scientific expeditions on the polar ice.**

► Federal Aviation Agency has published a new Airplane Flight Instructor Examination Guide. Developed by the Examinations Branch of the former Civil Aeronautics Administration, the guide features a list of 20 sample questions to familiarize the applicant with testing techniques employed in the written examination, plus studies of weight and balance, radio-telephone procedures, aerodynamics and determination of attitude.

► **First of three identical VC-137 military transport versions of the Boeing 707 will be delivered to the USAF Special Mission Squadron in April with the other two following in May and June. Interiors of the aircraft are designed as flying offices for President Eisenhower and other top government officials but are less elaborate than the present Columbine presidential transport. Special communications area is contained behind the crew compartment and includes both upper and lower cabin decks. Eight seats in two-abreast configuration occupy the next compartment followed by the office fitted with couches which convert into beds. Remainder of cabin upper deck is fitted with two abreast seats with a small table between, similar to American Airlines first class configuration.**

► Turboprop and turbojet transports are expected to account for 95% of all ton miles flown by Aeroflot in 1965. Officials of the Soviet airline regard this as a major goal under the new Russian Seven Year Plan and claim it is feasible because of the high productivity of such planes as the twin jet Tu-104 and the four turboprop Il-18. Aeroflot lists the Tupelov as "seven times" more productive than piston powered aircraft; the Il-14 as "eight times" more productive, and the Tu-114 as "20 times" more productive.



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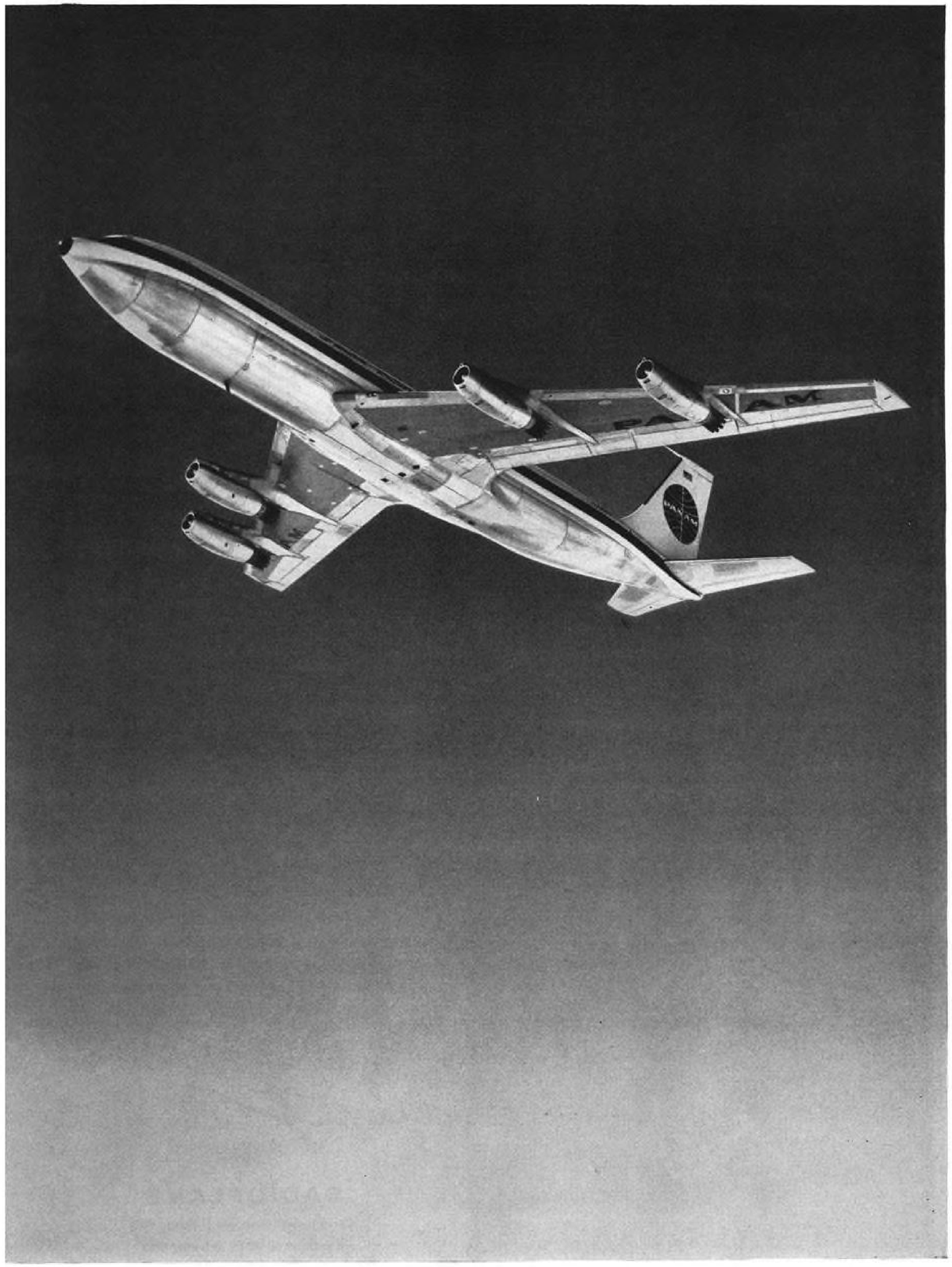
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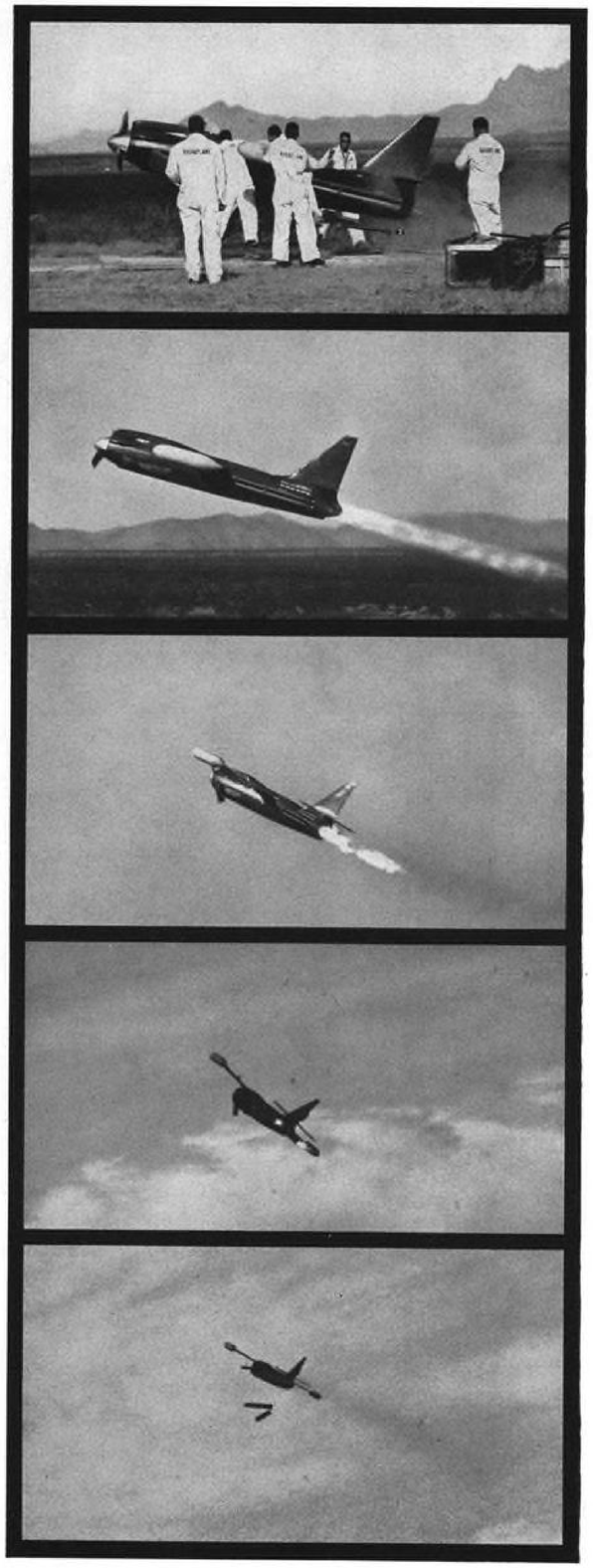
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...NEWS IS HAPPENING AT NORTHROP

RADIOPLANE RP-77D SETS NEW DRONE ALTITUDE MARK!

New holder of an unofficial world altitude record for propeller-driven drone aircraft – Radioplane's RP-77D aerial target. This record-breaking bird climbed to more than 46,000 feet during Army evaluation at Dona Ana Range, Fort Bliss, Texas.

Sidelight on the flight: the record-setting drone had six previous flights to its credit – is ready for further action after its seventh recovery by two-stage parachute.

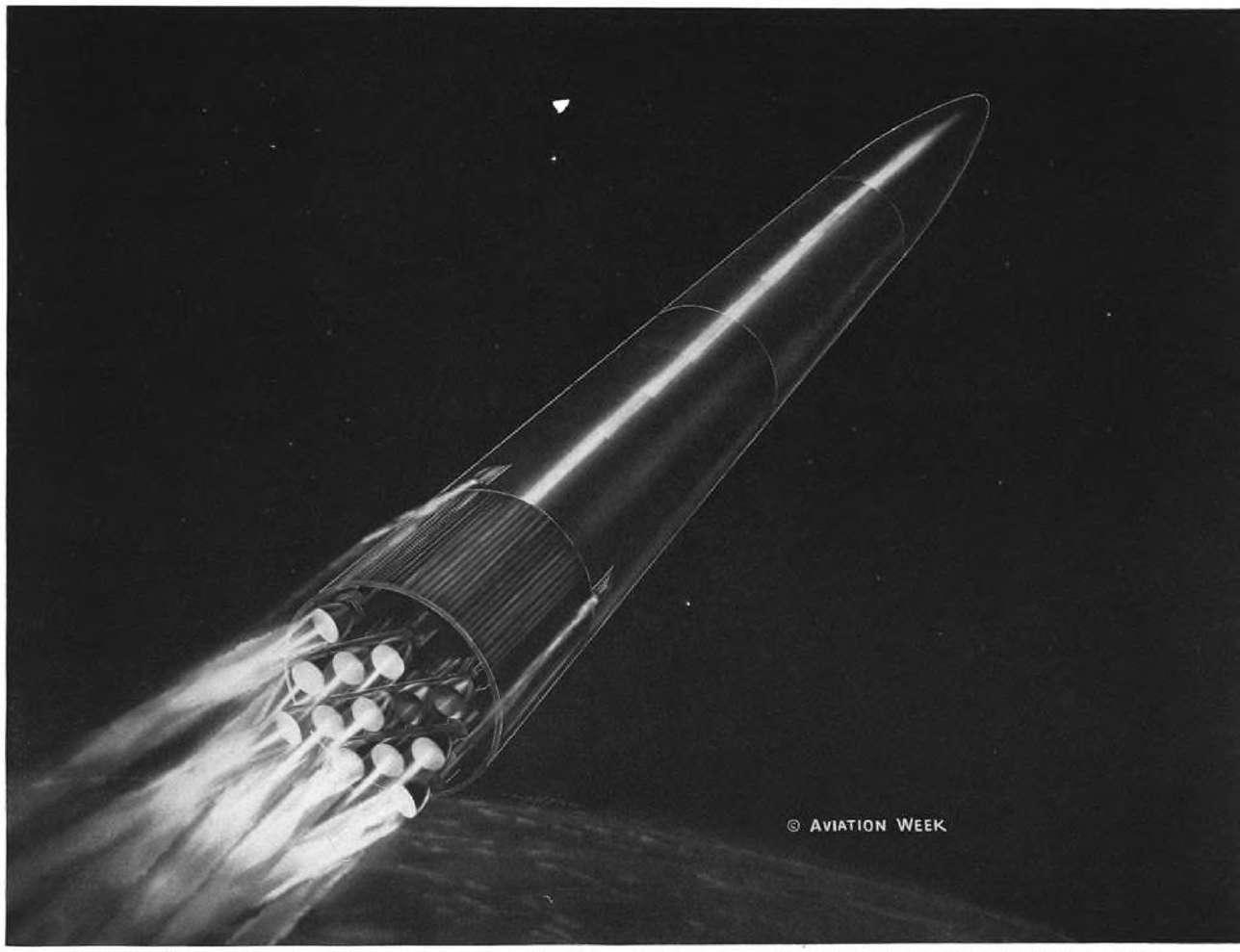
Rocket launched, Radioplane's RP-77D is turboprop powered to speeds in excess of 400 miles per hour at above 40,000 feet – and is capable of flight duration exceeding one hour at this altitude. Relative to performance, it is a low-cost target. Constructed almost entirely of fiberglass laminate, the RP-77D has an additional capability for photo and television combat surveillance missions.

Other current Radioplane drones in development are the supersonic USAF XQ-4A weapon evaluation target and the XKD4R-1 rocket target for the U.S. Navy – two more members of the world's only complete drone family.

RADIOPLANE

Van Nuys, California, and El Paso, Texas

A Division of Northrop Corporation



RELIABILITY of rocket-engine clusters can be raised considerably by designing them with engine-out capability. Hypothetical vehicle can have successful first-stage boost with two engines shut down on one side of the cluster even though one is a gimbaled control engine. Other three control engines are canted left to counteract asymmetric thrust. To allow a mission to be completed with a 2/13 reduction in thrust, payload would have to be reduced by about the same percentage. With this design it is theoretically possible to make reliability of cluster higher than that of any single engine in the cluster.

Clustered Rockets May Boost Reliability

By J. S. Butz, Jr.

Washington—Clusters of rocket engines that will be capable of completing a mission after one or more engines have failed may become the most reliable and economic boosters for large space vehicles. Using the engine-out safety concept employed for years on multi-engined aircraft, the aggregate reliability of clustered space propulsion systems may be theoretically raised well above the reliability of any single rocket engine.

This philosophy of redundant engines for million pound thrust plus boosters is receiving consideration among industry and government agencies for financial as much as reliability reasons. Even though the payload of vehicles powered by such clusters of existing powerplants would be considerably smaller than that of a similar vehicle powered by a large single chamber engine, the possible increase in reliability could more than offset the weight penalty.

Apparently the time is not many years away when the U.S. will be launching space vehicles which weigh over one million pounds and cost in the neighborhood of $100 million each. The thought of losing several of these budgetary as well as physical giants during a development program is not resting easily at many management levels.

Reliability of the various systems in these vehicles then is of great concern and must approach 100% if the overall reliability of the vehicle is to be acceptable.

Two primary methods of achieving high reliability are being debated at the technical level as planning for the first large space vehicles progresses in U.S. military and civilian agencies and in industry. The two general methods are:

• **Dual systems**—Use of redundant guidance packages, instrumentation,



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Cluster Reliability

Reliability of Each Engine in Cluster	Probability All Engines Will Operate Properly	Probability Nine or More Engines Will Operate Properly	Probability Eight or More Engines Will Operate Properly
95%	60%	91%	98%
90%	35%	74%	91%
85%	20%	54%	78%

Estimates of theoretical reliability of clusters with 10 engines are shown. Figures are only intended to show trends and were obtained using simple probability and assumed reliability for each engine. Main benefit of clusters is to greatly increase available thrust using existing engines but engines must have high reliability for the cluster to have good reliability even if it is designed to function with one or two engines out.

control units and other systems as well as clustered engines which can back each other up in case of failure.

• **Single systems**—Develop components with high enough reliability to allow single systems to be used thus allowing a significant increase in payload.

It is generally considered that reliability data on present systems and that projected for future equipment is not conclusive enough to show that either of these design philosophies has a clear superiority over the other. The debate probably will continue at least through the next generation of space and ballistic missile systems.



Radiation Sleuth

Mass spectrometer, similar to this unit (arrow) developed by Carl McIlwain of State University of Iowa, may be used to determine composition of van Allen radiation by establishing whether it consists predominantly of electrons, protons or other charged particles. One type spectrometer employs focusing coil which allows only electrons to pass through to scintillation counter. By varying voltage on coil, scientists can establish electron energy level. Another type of spectrometer uses permanent magnet to sweep out electrons and pass only positively charged particles. Third type gives an output pulse whose height indicates whether positive charged particle is a proton or an alpha particle. Spectrometer shown is type used in earlier rocket probes aboard a Nike Cajun fired from Fort Churchill, Canada.

Contracts already have been let for some of this equipment which includes two 1- to 1.5-million lb. thrust rocket engines. One is a cluster of eight of the widely-used Rocketdyne engines basically developing about 150,000 lb. thrust which has reached a reliability of around 90% or better in most of its installations. This cluster will be engineered by the Army Ballistic Missile Agency for Defense Department's Advanced Research Projects Agency. The other is a single chamber engine to be developed by the Rocketdyne Division of North American Aviation for the National Aeronautics and Space Administration. If past experience may be used as criteria, this engine will not have a reliability near 90% until it has been flight tested 20 or 30 times.

According to the schedule being presented to Congress, these two boosters will carry U.S. hopes for large space vehicles during the next 10 years. Both engines are best suited as regards efficiency to power vehicles with takeoff weights around 1 million lb. or more but the cluster with engine-out capability could materially raise the chances of successfully launching lighter vehicles.

There are a number of major considerations in the design of clusters that have satisfactory engine-out performance. One is to keep each engine in the cluster completely separate from the others with individual fuel pumps and turbines. The propellant tankage would be the only system common to all the engines. In this way any engine may be eliminated from the cluster without impairing the operation of any other.

Another design point is to provide instrumentation to detect the beginning of trouble in each engine and an automatic control to cut the engine off.

Experience has proven that most malfunctions in a rocket engine are not immediately catastrophic and that a great percentage of failures give advance warning. Instrumentation that might be used to report an impending failure could include a vibration gage to show unsteady or rough burning of the en-

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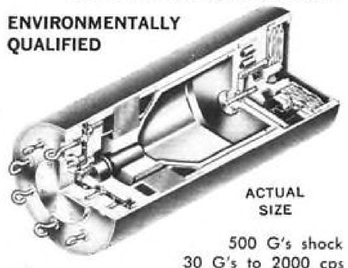
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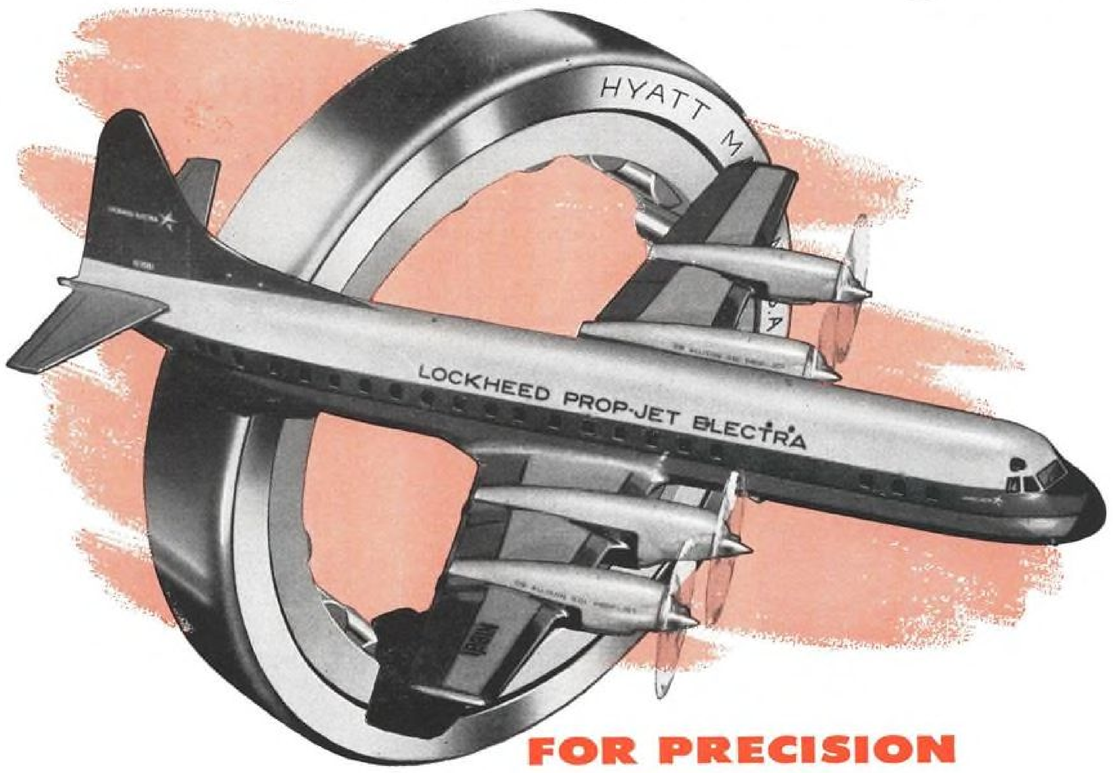
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gine, pressure gage to monitor combustion chamber pressure and temperature gages to indicate the development of hot spots. Even though sophisticated systems could be developed to cut off an engine having any of wide variety of troubles, the systems would add to the general complication of the vehicle.

From the control standpoint, a cluster that had only four gimbaled engines would be able to operate with any one of the four shut down. Pitch and yaw control can be maintained so long as one engine on each axis is running but roll control requires two engines on any one axis. A switching arrangement would be required in the autopilot to phase one control axis completely out when roll signals were sent from the guidance system and one gimbaled engine was not functioning.

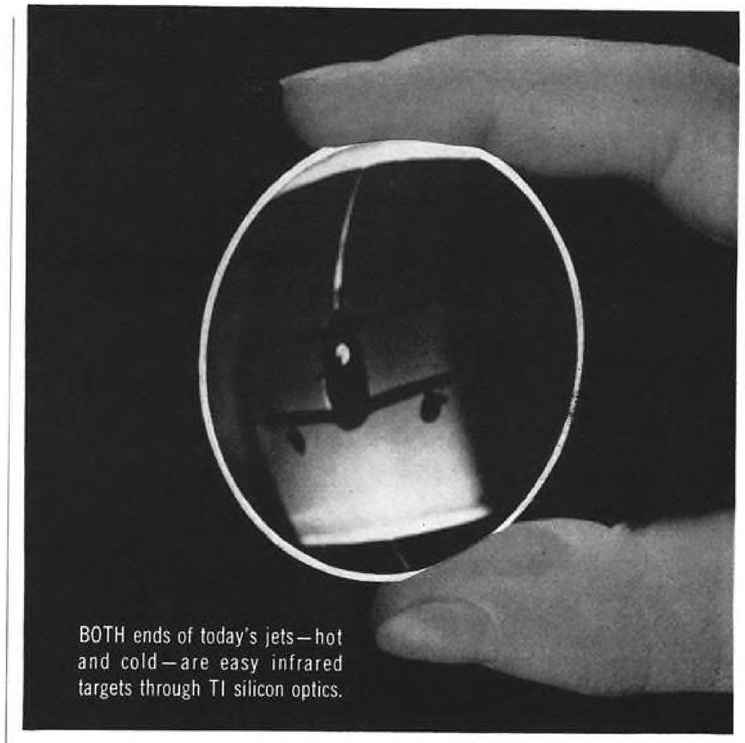
Other major points in the debate concerning clusters and very large single chamber engines include:

- **Clusters lend themselves** to reduced manufacturing and maintenance costs because assembly line techniques can be used to produce the larger numbers of smaller engines required. Defective systems on clustered engines would be easier and less costly to replace.
- **Development costs of clusters** of proven engines would be much lower than those for developing single chamber engines over 1 million lb. thrust.
- **Reliable single chamber engines** of this size, however, are considered vital for the very large space probes planned for the 1970s. These 1 million lb. thrust plus single chambers would be clustered to send payloads of up to 100,000 lb. on long space journeys.
- **Ground checkout** of the clustered engines prior to launching, while it probably would be more of a routine job, especially if today's engine were used, also probably would require more personnel and considerably more time. Cutdown schedules would be more difficult to maintain.
- **Clustered engines might** be less susceptible to damage during recovery after boosting a space vehicle. Recovery of both types of 1 million lb. thrust plus boosters is planned to cut down costs of the large space probes.

British Continuing Blue Streak Missile

London—Continued development of the Blue Streak, liquid fueled, medium range ballistic missile, and a "significant increase" in the production rate of nuclear warheads are the main points of a defense White Paper published here. Defense expenditure will reach $4,239,564,000 during 1959-60, the report says, which is 4% over the original estimate.

The White Paper also disclosed that



BIRD'S IR VIEW...
of a Hot Stove Pipe

THE WEDDING OF OPTICS to electronics may well be the marriage of the century . . . a TI-fostered union producing infrared guidance systems capable of finding, evaluating, rejecting false targets, and directing its "bird" to point-of-impact. Texas Instruments — leading producer of silicon optics for infrared applications — has achieved an intimate understanding of this and other unusual materials for specific portions of the spectrum.

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MODEL 131S
6-INCH line, 150 PSI rated pressure. Pressure operated, full travel RESPONSE as fast as 30 MILLISECONDS. Includes externally adjustable valve position switch.
TYPICAL APPLICATIONS: Ground support LOX topping on ICBM and LOX fueling trailers for IRBM.

MODEL 125F
1-INCH line, 3,000 PSI rated pressure. DC MOTOR operated, with automatic current shut-off and positive Geneva-Lock mechanism. Weight 3.5 LBS.
TYPICAL APPLICATION: Airborne ICBM propellant pressurization control valve.

MODEL 133LD
Pressure operated linked PROPELLANT VALVE. 2½-INCH LOX & 3-INCH AMMONIA lines. 1,200 PSI rated pressure. Includes integral by-pass for pre-cooling and gas bleeding.
TYPICAL APPLICATION: Airborne rocket engine main propellant valve for manned space vehicle.

MODEL 133C
1/2-INCH line, 1,000 PSI rated pressure. Pressure operated, full travel RESPONSE 25 MILLISECONDS. Weight 1.9 LBS. Includes externally adjustable valve position switch.
TYPICAL APPLICATION: Airborne LOX bleed control on ICBM.

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a unified command embracing all the armed services is to be set up soon in the Mediterranean and possibly later in the Far East.

The White Paper had nothing to say on the present uncertain status of a number of aeronautical research and development contracts. Neither did it comment on the current priority of Blue Streak development—an omission from previous years.

The decision to proceed with Blue Streak scotches persistent rumors that this missile was to be abandoned in favor of the Lockheed Polaris fleet ballistic missile system. According to the White Paper, the V bomber series will be phased out as Blue Streak becomes operational.

Among the reasons currently being quoted for this decision is the fact that Blue Streak could be used in a future British space program—as noted in the White Paper—but the Polaris could not.

Progress Report

Most of the White Paper amounted to a progress report on the five year defense program that was announced in 1957.

It confirms that (1) the English Electric P.1B Lightning jet fighter will go into service next year equipped with the Firestreak infrared missile and will later be armed with a higher performance guided weapon; (2) later version of the Army's Thunderbird and the RAF's Bloodhound ground-to-air missiles are under development; and (3) development of the Avro stand-off bomb is progressing satisfactorily.

No further details of the TSR-2 project to replace the Canberra bomber (AW Feb. 2, p. 37) were noted in the White Paper. But the government confirms its intention to order a small number of strategic fighters capable of carrying guided missiles and their associated radar vehicles.

Commenting on Royal Navy equipment, the White Paper states that preliminary work on the County-Class guided missile ships has begun. These will have propulsion equipment of very low specific weight combining steam and gas turbine units and will be armed with the Seaslug missile and the short ranged Seacat. The Sea Vixen, which comes into service this year, will have the Firestreak missile. The Westland Wessex will become the Navy's main anti-submarine aircraft—an all-weather helicopter.

Greater production rate of nuclear warheads, according to the White Paper, has been made possible by a "valuable" exchange of technical information with the U.S., together with the results of the government's latest tests.

Some observers believe that this collaboration has led to a partial substitution of lithium for tritium in the warhead.

The report adds nothing new to the dreadnought nuclear submarine development situation which is stated to be proceeding at an advanced rate.

Space Avionics Study Contract Given ITT

New York—Terminal guidance methods for space vehicles will be studied by International Telephone & Telegraph Corp. under a new contract awarded by Air Research & Development Command.

Program objective is to define guidance system requirements and suitable techniques and designs. This will include sensors to measure the vehicle's velocity vector relative to space objects, altitude of vehicle above the planet surface and attitude of vehicle with respect to its velocity vector as well as its position in space.

Guidance system is to process measured data, determine the acceleration forces to be requested of the control system, transmit these requests to earth or space stations for referenced signals. The program will be carried out at ITT's Astrionics Laboratory, Ft. Wayne, Ind.



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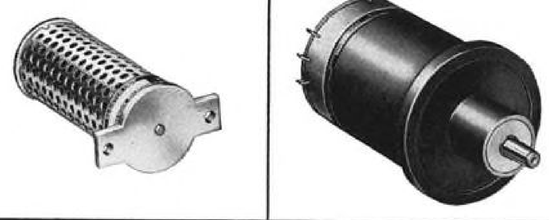
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Army Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Army contracting offices:

U. S. ARMY ENGINEER DISTRICT, Jacksonville Corps of Engineers, 575 Riverside Ave., Jacksonville, Fla.

Jefferson Construction Co., Miami, Fla., construction of Eglin Gulf Test Range, Marco Island Site, Naples, Fla., (EBG-08-123-59-30), $1,247,403.

James H. Craggs Construction Co., Gainsville, Fla., construction of apron, operational, utilities and hazard removal, McCoy AFB, Pinecastle, Fla., (ENG-08-123-59-18), $1,998,669.

Diversified Builders, Inc., Patrick AFB, Fla., construction of telephone exchange addition and auto maintenance facilities, AFMTC, Patrick AFB, Fla., (ENG-08-123-59-33), $275,119.

U. S. ARMY ENGINEER DISTRICT, Sacramento Corps of Engineers, Wright Bldg., 1209 - 8th Street, Sacramento, Calif.

Earl & Wright, San Francisco, preliminary and final design of ammunition storage multi-cubicle magazine and hangar, maintenance operational at Beale AFB, Calif., contract no. DA-04-167-eng-2014, $58,000.

H. J. Brunnier, San Francisco, design of shop, aircraft maintenance, field, Travis AFB, Calif., contract no. DA-04-167-eng-2015, $32,500.

W. J. Kubon Co., San Rafael, Calif., standard automatic portion addition to operations building, Mather AFS, Mather, AFB, Calif., contract no. DA-04-167-eng-2018, $82,295.

Gordon H. Ball, Inc., Danville, Calif., runway primary strengthening and facilities, McClellan AFB, Sacramento County, Calif., contract no. DA-04-167-eng-2020, $1,782,590.

U. S. ARMY ENGINEER DIVISION, New England Corps of Engineers, Providence Area, 187 Westminster St., Providence 3, R. I.

Theodore Loranger & Sons, New Bedford, Mass., construction of airmen dormitories, Otis AFB, Mass., (IFB ENG-19-016-59-55), (contract no. DA-19-016-ENG-6209), $1,350,500.

U. S. ARMY CORPS OF ENGINEERS DISTRICT, Huntington Corps of Engineers, 237 - 4th Ave., Huntington, W. Va.

W. Harley Miller, Inc., Martinsburg, W. Va., construction of Air National Guard control tower and installation of runway barriers at Martinsburg Municipal Airport, Martinsburg, W. Va., contract no. DA-46-022-ENG-2503, (IFB ENG-46-022-59-14), $154,379.

George W. Timmons, Columbus, Ohio, modifications to existing dining hall at Clinton County AFB, contract no. DA-46-022-ENG-2513, (IFB ENG-46-022-59-20), $124,898.

George W. Timmons, Columbus, Ohio, grading, roads and utilities at Clinton County AFB, Ohio, contract no. DA-46-022-ENG-2514, (IFB ENG-46-022-59-21), $596,569.

SAVANNAH DISTRICT CORPS OF ENGINEERS, Savannah, Ga.

Ballenger Paving Co., Inc., Greenville, S. C., construction of apron, operation, alert, Turner AFB, Albany, Ga., (IFB ENG-09-133-59-17), $1,155,640.

R. H. Wright, Jr., & Associates, Columbus, Ga., construction of readiness crew building, Robins AFB, Ga., (IFB ENG-09-133-59-24), $326,981.

U. S. ENGINEER DISTRICT, New York, Corps of Engineers, 111 East 16 Street, New York 3, N. Y.

Ames and Denning, Inc., Rome, N. Y., construction of alert hangar protection, Griffiss AFB, N. Y., (IFB ENG-30-075-59-13), $32,095.

Anderson Construction Co., Inc., Huntington Station, N. Y., construction of AN/FPS-35/24 radar tower, Montauk AC&W Station, (IFB ENG-30-075-59-101) contract DA-30-075-ENG-8584, $792,023.

Guldi Electric Construction Co., Inc., Westhampton Beach, N. Y., ADC ramp and hangar electrification, Suffolk County AFB, Westhampton, L. I., N. Y., (negotiated) contract DA-30-075-ENG-8685, $31,500.

U. S. ARMY ENGINEER DISTRICT, Mobile, Corps of Engineers, 2301 Grant Street, Mobile, Ala.

Mechanical & Chemical Equipment Co., Inc., Tampa, Fla., construction of demineralized water supply facility at Eglin AFB, Fla., contract DA-01-076-ENG-4450 (IFB ENG-01-076-59-43), $34,351.

Greenhut Construction Co., Inc., Pensacola, Fla., construction of blast deflector fences at Eglin AFB, Fla., contract DA-01-076-ENG-4451 (IFB ENG-01-076-59-41), $37,337.

Valley Construction Co., Columbus, Miss., construction of field maintenance hangar at Tyndall AFB, Fla., contract DA-01-076-59-38, $611,504.

Pearce and Gresham Co., Decatur, Ala., construction of propellant development facilities (Thiokol) at Redstone Arsenal, Ala., (first increment), contract DA-01-076-ENG-4444 (IFB ENG-01-076-59-39), $1,042,253; construction of preflight evaluation laboratory at Redstone Arsenal, Ala., contract DA-01-075-ENG-4445 (IFB ENG-01-076-59-34), $1,060,948.

U. S. ARMY ORDNANCE DISTRICT, Philadelphia.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-ORD-2228, $48,896.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-ORD-2228, $118,516.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-ORD-2228, $568,097.

Trustees of Princeton University, Princeton, N. J., study of aerodynamics of flame stabilization, DA-36-034-ORD-2183, $17,800.

U. S. ARMY ENGINEER DISTRICT, Los Angeles Corps of Engineers, 751 S. Figueroa St., Los Angeles 17, Calif.

Matich Bros., Colton, Calif., alert facilities at March AFB, Calif., (ENG-04-353-59-38), $1,513,562.

Montgomery Ross Fisher, Inc., Los Angeles, control building, firing control room and connecting passageway at Edwards AFB, Edwards, Calif., (ENG-04-353-59-53), $65,000.

DISTRICT ENGINEER, U. S. Army Engineer District, Galveston District, Galveston, Texas.

Archie C. Fitzgerald, Austin, Texas, readiness crew bldg., Bergstrom AFB, Texas, contract no. DA-41-243-eng-3920, (Inventory no. ENG-41-243-59-33), $349,065.

BOSTON ORDNANCE DISTRICT ARMY BASE, Boston, Mass.

Raytheon Manufacturing Co., Andover, Mass., electronic components, Hawk missile, DA-19-020-ORD-4777, 11 line items, $866,880.

Raytheon Manufacturing Co., Waltham, Mass., engineering services, Hawk missile, DA-19-020-ORD-4041, $5 million.

Yale University, New Haven, Conn., research study of theoretical nuclear physics, DA-19-020-ORD-4763, $42,054.

Barnes Engineering Co., Stamford, Conn., research in measurement of re-entry bodies of missiles, DA-19-059-ORD-2656, $92,672.

U. S. ARMY ORDNANCE DISTRICT, Los Angeles 55 South Grand Ave., Pasadena, Calif.

Sperry Utah Engineering Laboratory Division, Sperry Rand Corp., Salt Lake City, Utah, work on the Sergeant missile and its ground handling equipment, $22 million.

Rocketdyne Division, North American Aviation, Inc., classified contract work, $4,380,730.

California Institute of Technology, Pasadena, Calif., research and development work to be performed at the Jet Propulsion Laboratory, Pasadena, $947,640.

The Firestone Tire & Rubber Co., Los Angeles, Corporal missile repair parts, $442,172.

General Electric Co., Phoenix, Ariz., digital computation facility operation at the U. S. Army Ballistic Missile Agency, Redstone Arsenal, and supplementary work at Tempo, Ariz., $286,435.

Dale Products, Inc., Albuquerque, N. M., supply contract for test equipment, $143,033.

Interstate Electronic Corp., Anaheim, Calif., research and development contract for airborne transponders, $127,580.

Douglas Aircraft Co., Inc., Santa Monica, Calif., Nike missile repair parts, $120,818.

Solar Aircraft Co., San Diego, Calif., classified research and development contract, $98,850.

Gilfillan Brothers, Inc., Los Angeles, Corporal missile repair parts, $69,633.

Houston-Fearless Corp., Los Angeles, operation of photographic laboratory, $52,732.

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Army contracting offices:

AVIATION SUPPLY OFFICE, 700 Robbins Avenue, Philadelphia, Pa.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., services and materials: to overhaul, repair and modify gyro horizon indicators, N383-57026A (383/216355/59), $45,826.

Servo Corp. of America, New Hyde Park, N. Y., computer assemblies: for various aircraft, N383-56948A (383/216179/59), $481,400.

Airaterra, Glendale, Calif., valves: oxygen for various aircraft, N383-57334A (JD-383/217087/59), $33,076.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., services and materials; to repair, overhaul and place in operating condition, indicators, N383-57012A (383/216113/59 and 383/216114/59), $46,470.

Scintilla Division, Bendix Aviation Corp., Sidney, N. Y., coils and cable assemblies: for various aircraft engines, N383-57436A (383/213159/59), $47,528.

A. M. Byers Co., Pittsburgh, Pa., steel bars; chrome-molybdenum, N383-57627A (IFB-383-366-59), $43,669.

Aeronautical Division, Minneapolis-Honeywell Regulator Co., Minneapolis, bearing and stage assemblies: used on indicators for F11F-1 aircraft, N383-56940A (383/216315/59), $26,078.

Co-operative Industries, Inc., Chester N. J., waveguide assemblies: for airborne radar equipment, N383-57510A (383/232091/59), $27,092.

Henry Spen & Co., Inc., Brooklyn, N. Y., disks and valves: to support oxygen trailers, aircraft support equipment, N383-56802A (383/261107/59), $95,695.

Lear, Inc., Grand Rapids, Mich., controls: altitude for various aircraft, N383-56917A (383/7144-29969/57), $89,015.

Dynamic Air Engineering, Inc., Los Angeles, fans: axial for use on WV-2 and 3 aircraft, N383-57228A (383/234445/59), $60,437.

AiResearch Manufacturing Co., Los Angeles, services and material: to overhaul, repair and restore to operating condition, compressors, N383-56099A (383/212090/59 and 383/212091/59), $292,819.

Avien, Inc., Woodside, N. Y., indicators; fuel quantity, for various aircraft, N383-57403A (383/216376/59), $31,561.

Flight Refueling, Inc., Baltimore, gear and sprocket assemblies: for use on aerial refueling reel assemblies for A3D-2 aircraft, N383-56693A (383/214150/59), $58,332.

B. F. Goodrich Aviation Products Division, B. F. Goodrich Rubber Co., Akron, Ohio, boots: de-icer for various aircraft, N383-564-0A (383/217067/59), $823,955.

Rubber Fabricator, Inc., Grantsville, W. Va., vests: life preserver, pneumatic, N383-56410A (383/217067/59), $823,955.

David Clark Co., Worcester, Mass., sound attenuating devices; for use on flight deck helmets, N383-57488A (IFB-383-307-59), $89,119.

R. A. Hawks Division, Sierra Engineering Co., Sierra Madre, Calif., N383-57468A (IFB-383-349-59), $54,020.

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Bendix Proposes Supersonic Targets

By David A. Anderton

Paris—First details of a pair of target systems—Penny and Hilo—designed for more realistic training of interceptor pilots and missile operators were presented at the Bendix Engineering Conference and Display here Feb. 9-11.

• **Project Penny** is an air-launched, supersonic expendable target, powered by a dual-chamber liquid rocket engine.

• **Project Hilo** is a ground-launched target powered by a ramjet engine and capable of high performance at all altitudes from a few feet off the deck to above current bomber cruise heights.

Both projects have been submitted by Bendix Aviation Corp. in current USAF and Army competitions. Competing designs are now being evaluated and decisions are expected by May.

Presumably such target systems would be procured to supplement the high speed but subsonic Ryan Firebee, recently used with success in the USAF's William Tell gunnery meet (AW Nov. 3, p. 28).

Basic mission of Penny is to simulate a supersonic bomber or fighter flying at high altitudes. As a radar target, augmentation of the reflected echo in the X-band region comes from a plastic spherical lens (Luneberg lens). With S- and L-band radar systems, any lens is too large and radar beacons are used for augmentation.

Two types of infrared flares can be used for working with infrared systems. Both the amount of radiation and the spectrum of the radiation can be varied. Penny can simulate a target of the Boeing B-52 size.

Bendix is systems manager on the Penny proposal, and Bell Aircraft Corp. is major subcontractor responsible for the airframe production and the rocket motor package.

Basic layout of Penny is a canard airframe with fixed delta surfaces. Pitch control comes from the gimbaled rocket motor and roll is controlled by small reaction jets in the wingtips.

Over-all length is about 20 ft., diameter is about one foot and wingspan is five feet three inches. Gross weight is about 4,600 lb. and empty weight of the target is about 2,200 lb.

Construction of Penny has been kept simple to make the cost as low as possible. All lifting and stabilizing surfaces are cast magnesium. Forward nose section is plastic, transparent to radar in the working frequency bands. Fuel tanks in the center section are integral construction, of unspecified material. Aft fuselage section is of conventional aluminum alloy construction.

Bell rocket motor has two chambers, one fired during the boost phase only and the other used as a sustainer. The engine is gimbal-mounted for pitch control. Fuel and oxidizer are fed by a nitrogen pressurizing system which also supplies the working fluid for the wingtip roll jets.

Guidance system is a two-axis autopilot type, with tape programing.

Penny development was handled by Bendix Systems Division. Development time cycle was about two years from concept to completion of prototype testing. All development work was paid for by Bendix.

Hilo mission is indicated by its name. It is intended to, simulate aircraft at either high altitudes or ground-gripping levels, and presumably is wanted by the Army to train Nike and Hawk missile batteries.

Basic configuration of Hilo shows a long cylindrical body with movable lifting surfaces and a small fixed dorsal fin. Slung underneath the fuselage on a pylon is a single 14-in. diameter Marquardt ramjet engine burning triethylene boron.

For low-altitude missions, the target is launched with a single solid propellant Hawk booster. Roll and pitch control comes from the movable lifting surfaces which can deflect either together or differentially.

For high-altitude missions, more wing area is required, and so a pair of fixed, highly swept, triangular surfaces is plugged in the sides of the Hilo, just ahead of the movable lifting surfaces. The lifting surface then becomes partially a fixed unit with a movable trailing edge section. Additional boost is supplied by replacing the Hawk booster with a Viper solid-propellant rocket.

Airframe construction, to be handled by Republic Aviation Corp., is similar to that of Penny. Plastics, cast magnesium surfaces and aluminum alloy construction are used.

Hilo is intended to be a recoverable target in contrast to the expendable Penny. Recovery system combines a tail-mounted parachute and a nose-mounted spike.

Radar altimeter is used on the low-level mission and a standard barometric altimeter is used for the high altitude runs.

Over-all length of Hilo is about 23 ft., wingspan is three feet, three inches. Gross weight is about 3,750 lb. and empty weight is about 2,200 lb.

Bendix-designed ground support system for Hilo features a transport van, which carries four of the targets, and a separate launcher trailer.

Both Penny and Hilo carry Bendix-developed miss-distance indicators of one of two types:

• **FM-CW radar miss-distance** indicator which records a projectile passing within a fixed-diameter area surrounding the target.

• **Pulse miss-distance** indicator which works in the UHF range, is more accurate and has a longer range than the FM-CW type.

Both Penny and Hilo have growth potential, Bendix engineers say. They can be flown with extended cruise performance to give longer mission flight times and more realistic attack simulation. They can be made available with alternate subsystems in infrared, in photo-reconnaissance and in television surveillance for battlefield work. They can serve as decoy vehicles or they can take on a countermeasures job.



F3H-2 Armed With Sparrow III

Raytheon Sparrow III air-to-air guided missile is operational with Navy's Seventh Fleet in western Pacific. McDonnell F3H-2 carrier interceptor can carry four Sparrow IIIs.

Industry Awaits 'Tough' Wage Act Ruling

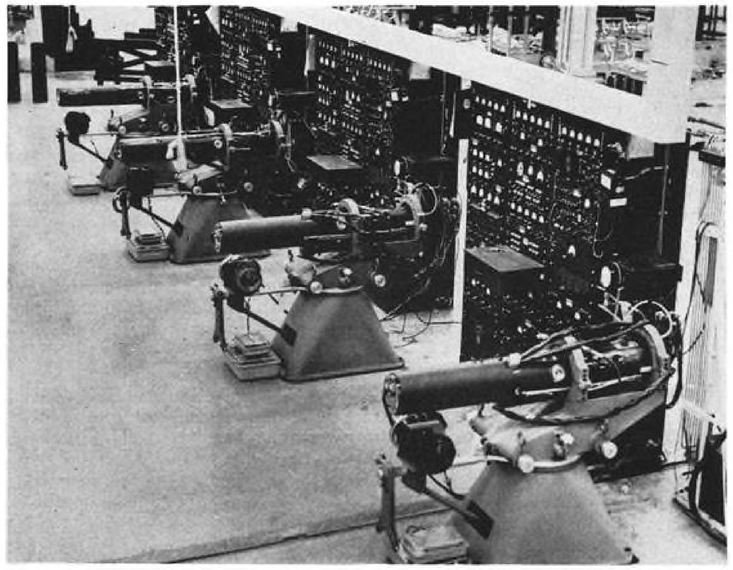
By Philip J. Klass

Washington—Question of whether producers of missiles and manufacturers of avionic equipment must pay the same Walsh-Healey Act minimum wage as aircraft manufacturers, now up for Department of Labor decision, could have a major impact on all three groups, regardless of the outcome. Labor Department spokesmen concede it is the toughest "industry definition" task they've ever encountered.

If the Labor Department should decide that both missile and avionics manufacturers must pay the aircraft minimum wage, it could cause a sharp wage structure upheaval throughout the electronics industry, whose average is about 46 cents per hour below that in aircraft manufacturing, according to Electronic Industries Assn. (EIA). Such a decision would add $500 million to $1 billion annually to defense program costs, EIA contends.

If, however, the Labor Department decides that missile manufacturers are not subject to the aircraft industry minimum, Aircraft Industries Assn. (AIA) says this wage differential will handicap aircraft companies in bidding against avionics manufacturers for missile prime contracts.

One of the objectives of the Walsh-Healey Act, passed in 1936, was to prevent wage differentials between different manufacturers from giving one a decided competitive edge in bidding for government business. The act was passed during the depression, prior to the Fair Labor Standards Act which set a minimum wage for all companies engaged in interstate commerce.



MINIMUM WAGE controversy centers on electronics companies operating missile facilities, such as Sperry Farragut Co. test facility above, used for checkout of Sparrow missiles.

Competition Factor

If the Labor Department decides that manufacturers of avionic equipment need not pay the same minimum as aircraft manufacturers, AIA says this will work a competitive hardship on companies such as North American, Bell Aircraft, Lockheed and Martin which are engaged in avionics manufacturing. Although these aircraft company-owned groups would not be legally subject to the Walsh-Healey aircraft minimum, in effect they are because the same unions bargain for employes in both types of operations.

United Auto Workers (UAW) and the International Assn. of Machinists (IAM), which are dominant in aircraft manufacturing, strongly support the Aircraft Industries Assn. position. But the International Brotherhood of Electrical Workers (IBEW) is on record as favoring a compromise that groups aircraft and missile manufacturing in one category, electronics manufacturing in another, each with its own Walsh-Healey minimums.

It is interesting to note that inclusion of a portion of electronics manufacturing in new aircraft industry minimum wage determination would result in a lower minimum. Four companies which are members of both AIA and EIA are actively supporting the Electronic Industries Assn. position. These are General Electric, Radio Corporation of America, Sperry Rand and Westinghouse Electric.

Prevailing Minimum

The Walsh-Healey minimum of $1.05 per hour established for the aircraft industry in 1950, prior to the Korean War, is considerably below the minimum wages paid in aircraft manufacturing and probably in most of the electronics companies, but will soon go up. The important question is: How much?

The "prevailing minimum" wage for Walsh-Healey Act purposes is determined from a survey of the minimum wages paid by all members of a defined industry. The figure, established by the Secretary of Labor, is determined on the basis of the approximate "center-of-gravity" of industry minimums, rather than as a simple average or median.

The electronics industry has never had a Walsh-Healey minimum wage standard established or applied. Labor Department planned a wage determination in 1950 but postponed it when the Korean War broke out. Until recent years, this was not a problem because the Walsh-Healey Act normally applies only to prime contractors on government contracts in excess of $10,000.

Nearly two years ago, the Labor Department announced plans for making a Walsh-Healey wage determination for tube and semiconductor manufacturers which it and Electronic Industries Assn. agreed was a homogeneous group. A year ago, similar plans were announced for manufacturers of other electronic components, and last summer plans were disclosed to complete the electronics industry definition with a wage determination for producers of electronic equipments.

Hornet's Nest

At about the same time, the Labor Department announced plans for a new aircraft industry wage determination in recognition of the fact that the 1950 figure of $1.05 per hour no longer was realistic. But before such a determination could be made, it was necessary to define just what constituted the aircraft industry.

In announcing plans for an informal conference of interested industry and union representatives for such purposes, the Labor Department indicated it would consider possible inclusion of manufacturers of guided missiles and certain avionic equipment in the aircraft industry definition. When the conference convened on July 24, Labor Department found itself with a hornet's nest of conflicting views.

Proposed Definition

After further study, the Labor Department on Sept. 5 issued a proposed definition for an "Aircraft and Guided Missile Manufacturing Industry." This included the manufacturing and assembly of "airplanes, lighter-than-aircraft, gliders, drones, guided missiles, aircraft-type engines, guided missile propulsion systems, aircraft and guided missile airframes, aircraft propellers and parts and accessories especially designed for use with or on the above-mentioned products, such as fuselage parts . . . armament equipment (except guns), and specialized aircraft and guided missile servicing equipment . . . for repair of aircraft and guided missiles and parts and accessories therefor."

However, this proposed definition specifically excluded the manufacture of "electrical and electronic systems and equipment and parts therefor, such as ignition and lighting systems, communication equipment, guidance systems, data recording systems, telemetering systems, intelligence systems, navigation systems and ground support equipment." A number of other products also excluded ranged from engine, flight and navigation instruments to photographic equipment and de-icing equipment.

Issue Taken

In briefs filed shortly afterward, both EIA and AIA took issue with the proposed Labor Department definition:

- **EIA approved the exclusion** of aircraft-missile avionics equipment, but asked that guided missiles also be excluded from the industry definition.
- **AIA approved the inclusion** of missiles, but called the expanded definition which also included helicopters, space vehicles and satellites. Further, Aircraft Industries Assn. called for inclusion of manufacturers of the following: "electronic, hydraulic, electrical, pneumatic, and mechanical systems for purposes such as flight control, guidance, airborne intelligence, telemetering and navigation; and/or major assemblies for use in such systems for such vehicles, which are especially designed for and perform specific functions in such vehicles; and specialized ground support servicing equipment which is especially designed for and performs specific functions in such vehicles, engine and systems . . ."

The inclusion of both missiles and avionics, Electronic Industries Assn. says, "would change the determination from one encompassing a single, clearly identifiable industry—aircraft manufacturing—to a determination which would have repercussions upon a number of entirely different industries, including electronic manufacturing."

"If the wages in the lowest labor grade must be increased to conform to a minimum wage determination," the association says, "it is inevitable that corresponding increases will have to be made in the plants affected in all the higher labor grades in order to maintain differentials based on skills and incentives."

Wage Structure

Nor would such wage structure upheaval be limited to the avionics manufacturing portion of the industry, EIA says. It would spread to consumer and industrial electronics, EIA suggests. For example, a company cannot pay one wage to the floor sweeper who cleans part of a factory producing avionics equipment while paying a lower wage to a sweeper who cleans an adjoining part of the factory used to produce television sets or defense electronic equipment destined for other than aircraft-missile use.

The proposed Aircraft Industries Assn. definition, EIA says, would create an artificial and unreasonable line of demarcation between defense electronic equipment produced for aircraft-missile use and similar or identical equipment produced for other defense use.

Electronic Industries Assn. says that inclusion of avionic equipment in an aircraft industry classification is inconsistent with the statutory objective of the Walsh-Healey Act, as stated by the Labor Department: ". . . the prevention of unfair competition for government business by firms who might obtain that business solely because they pay lower wages than generally paid by their competitors."

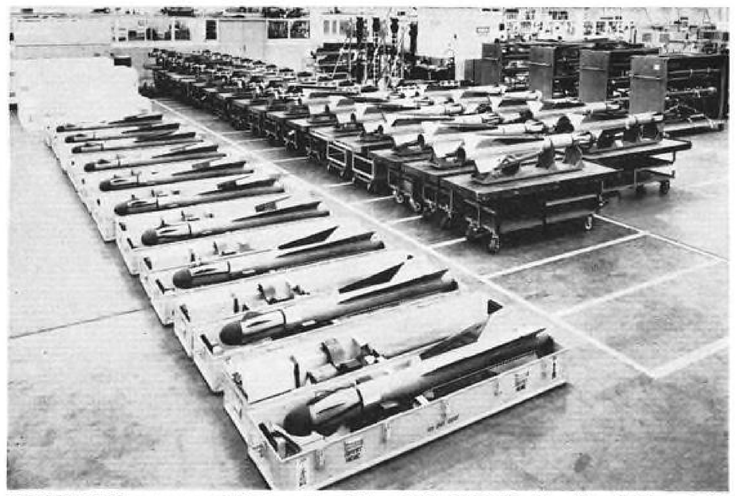
Members Compete

The association's position is that its members who produce avionic equipment "are not basically in competition with aircraft plants (but) . . . compete primarily with other electronic establishments."

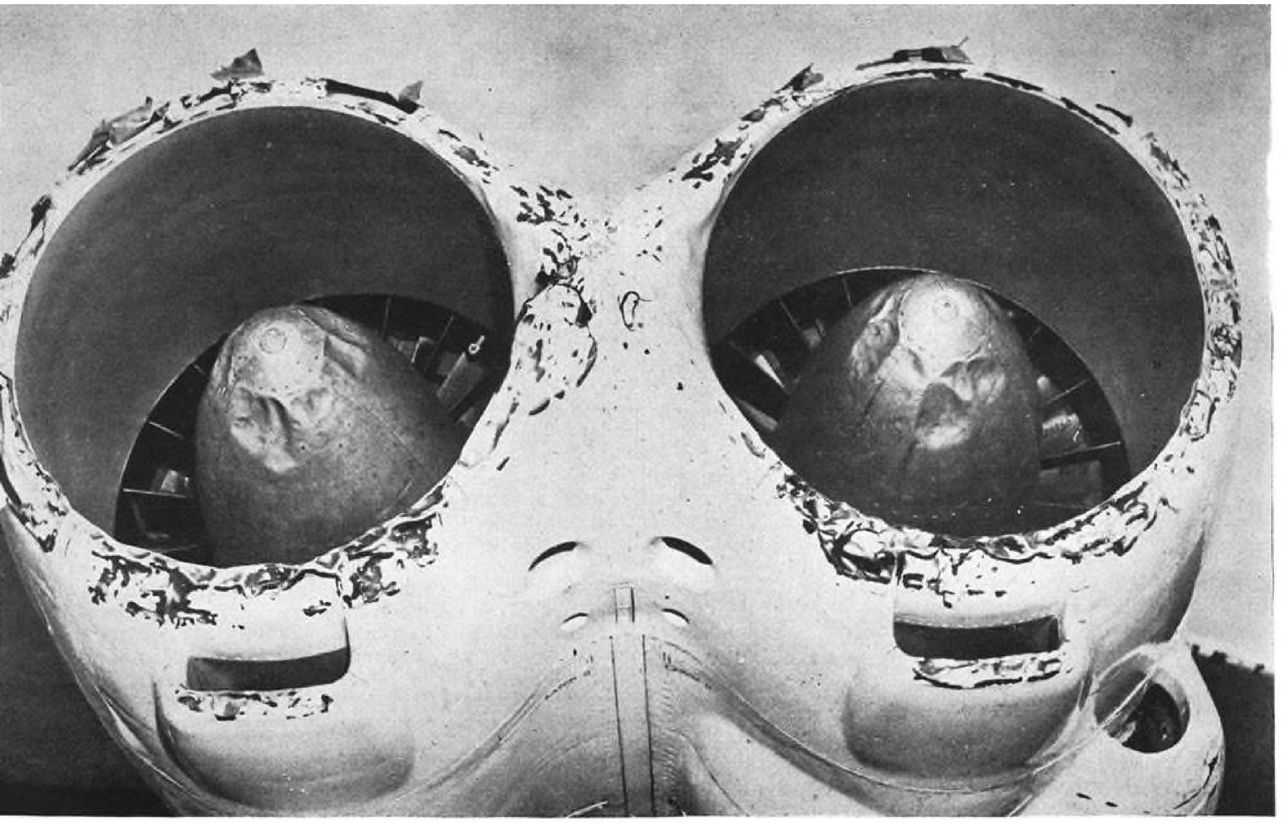
"It is true," EIA says, "that to the extent that aircraft manufacturers may have acquired or built electronic equipment plants, they may also be in competition with general electronic manufacturers in seeking government contracts for guidance and communication equipment. But this is beside the point. The real test of industry classification is whether the establishments, not the over-all corporations, compete.

"It would be absurd to state that the electronic plants whose wages are in the upper half of the electronics industry are paying substandard wages because of the existence of higher wage levels in the aircraft industry," EIA says. "The competitive position of the latter is not impaired by the fact that the wages which prevail in aircraft manufacture are considerably higher than those paid to electronic workers."

Aircraft Industries Assn. brief filed with the Labor Department says that "many" aircraft companies now develop and assemble avionic systems. It cites the products of North American's Auto-



ELECTRONICS company which has entered the missile field is Hughes Aircraft Co.; missiles above are Falcon air-to-air type, awaiting shipment at Hughes' Tuscon, Ariz., plant.



J-57 Titanium engines save nine-man crew in their $8-million B-52

At 8,000 feet, the B-52 ran into a small and very violent frontal area. Suddenly the airplane was pelted with hailstones the size of baseballs. Flying at 400 miles an hour the damage to the B-52 was terrific.

The windshield smashed. The radome was torn away. The radar antenna was demolished. Wing edges were hammered flat. Holes were punched in the wings and engine nacelles. Flying metal was sucked into the engines and disappeared. Some of the electrical system failed and most of the instruments were out. The aircraft went momentarily out of control.

Major W. F. Zerdecki, the air commander, struggled with the controls. Captain Charles L. Borgeson, Jr., the instructor pilot, sent out the distress call. The crew prepared to bail out.

By this time, the shuddering aircraft had already bucked through the storm. The eight Pratt and Whitney titanium version J-57 engines were still giving full power. Major Zerdecki climbed the B-52 to 23,000 feet where he rendezvoused with a KC-135 tanker. The B-52 crew tested their controls by instrument readings relayed by the tanker crew. The light and powerful titanium engines kept the shattered aircraft aloft for almost two hours after it hit the storm.

The performance of the J-57's in bringing safely home the nine-man crew in their $8-million ship, was described by Brigadier General Nils H. Ohman, 19th Air Division Commander:

"The engines put out all the power required. They performed perfectly. If they hadn't, Major Zerdecki would never have been able to fly the ship back."

Carl Cooper, Pratt & Whitney technical representative, reported: "All eight engines had ingested metal. Magnesium cowling pieces shattered as they went through the engine. Six of the engines were found to have bits of cowling metal one-eighth of an inch long at the end of the high compressor assembly and pieces of magnesium approximately the same length were found stuck to the first stage turbine blades. The J-57 engines, though slightly damaged, were still serviceable and satisfactory for continued, limited, safe operation. The damage was repairable with a minimum of time and effort."

Since 1954, some 5000 titanium engines have been put into service containing material supplied by Titanium Metals Corporation of America. More than 500,000 hours service time have been accumulated with no reports of failure of the titanium parts.

GREAT STRENGTHS...The strengths of titanium, coupled with its light weight (density 0.16 pounds per cubic inch), have meant valuable fuel economies and increased payloads. At the same time, the excellent corrosion resistance of titanium has reduced costly maintenance and parts replacement.

Steadily declining prices; advances in machining, welding and heat-treating techniques; and development of new alloys have combined to maintain titanium's role as an important engineering metal in the new engines now in design or advanced development.

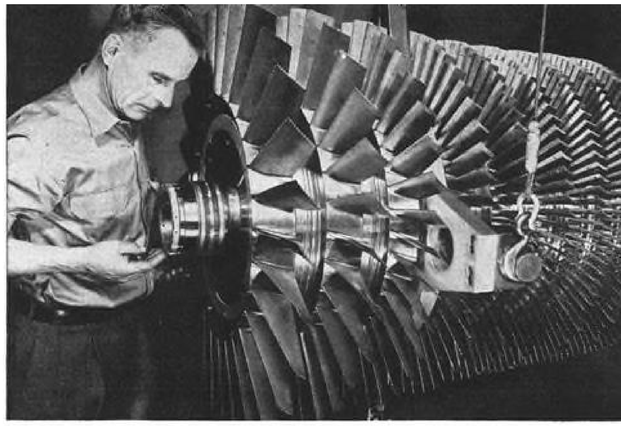
These same advantages also make titanium metal an economical material of construction for the dead-weight area known as airframe. For example, heat-treated titanium forgings can cut structural weights almost in half.

Titanium Metals Corporation of America has dedicated its full resources to development and production of high-strength aircraft quality material and the technical assistance required to make design potentialities of the metal production realities.

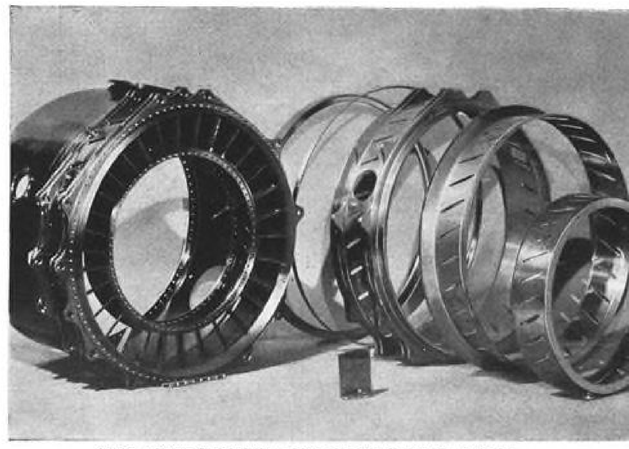
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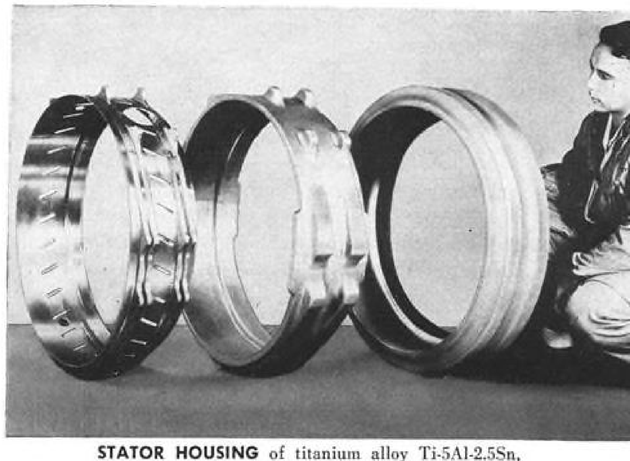
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J-57 ROTOR ASSEMBLY, with wheels, blades and spacers forged and machined from TMCA titanium alloy Ti-6Al-4V. Now *new* alloys, such as Ti-7Al-4Mo—already in commercial production—extend useful temperature range and meet higher creep strengths required for engines in design or advanced development stage.



THIS INTERMEDIATE COMPRESSOR CASE ASSEMBLY is used in fighter versions of J-57 engine. Fabrication techniques include ring-rolling, welding, machining, stretch-forming, and piercing. Use of titanium saves 443 pounds per compressor.



STATOR HOUSING of titanium alloy Ti-5Al-2.5Sn, shown here in various stages of fabrication from rolled and welded ring to finish-machined part, provides important weight savings to J-57 engine.



DESIGN

As missile programs passed from early development to production, servovalves of increased sophistication became necessary. Keeping pace with this development, Moog has been responsible for all major servovalve improvements.

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- double-nozzle servovalves*
- dry motor servovalves*
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*Patented †Patent Pending

MOOG: *continued progress from*

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Today reliability is the key requirement for missiles. Anticipating this need, Moog has had under intensive development and test for the past year the simplest, lightest, most compact and reliable of all production servovalves. Its performance in all important respects exceeds that of any other available unit. Moog is pleased to announce immediate availability of the new Model 31 and 32 Series valves in quantity to your specifications. ▶

WRITE FOR CATALOG No. 310

MOOG VALVE CO. INC. PRONER AIRPORT, EAST AURORA, NEW YORK

netics Division, Martin, Lockheed Missile Division and Bell Aircraft's Avionics Division, and says "many other examples could be presented."

These groups, the association contends, would be faced with a major competitive inequity unless the AIA proposal is adopted, because "as a practical matter, they would have to pay the prevailing minimum wage for the aircraft industry."

The role of the aircraft-missile prime contractor in establishing over-all specifications for individual avionic subsystems, and in integrating such systems, in the vehicle, is emphasized in the AIA brief. However, this function does not appear to raise any question of basic competition with producers of such subsystems insofar as the intent of the Walsh-Healey Act is concerned.

Competition for Missiles

Aircraft Industries Assn.'s argument for inclusion of missile manufacturing in the aircraft industry classification, in line with draft definition issued by the Labor Department in September, points out that airframe companies dominate as missile prime contractors in terms of their percentage of total missile dollars.

Electronic Industries Assn., however, says its members actually turn out greater number of missiles. (Production of high-quantity, low-cost air-to-air missiles in the past has gone to electronic companies while airframe companies have been responsible generally for the large strategic and tactical missiles.)

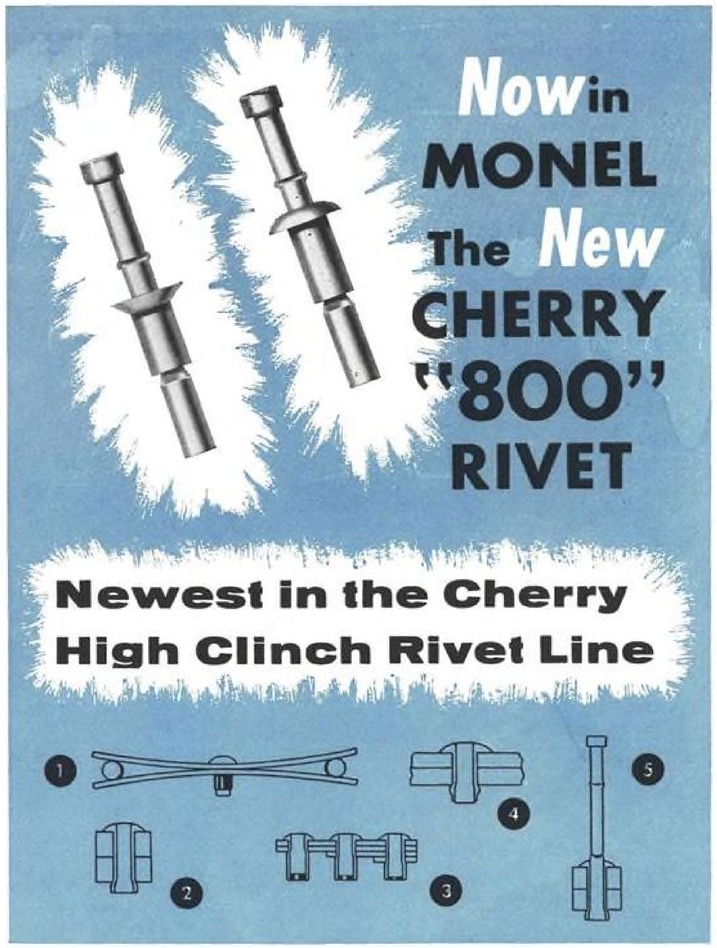
EIA claims there is no definable missile industry at present time, pointing out that missile primes now are held by airframe, electronic, automotive companies and a rubber company. Association therefore not only opposes inclusion of missiles as part of the aircraft industry, but also opposes a separate Walsh-Healey determination for missile manufacturing as such.

There is some question whether the Labor Department could accept both exclusions and leave so large a portion of defense procurement completely uncovered by the Walsh-Healey Act.

Act's Significance

If the stated objective of the Walsh-Healey Act is the deciding criterion, the most significant question would appear to be: Will airframe companies be competing against avionics companies for missile prime contracts to any significant degree in the future? This would appear to be more pertinent than arguing over who dominates current production missiles whose original development contracts were won five to 10 years ago. Opinion of qualified observers is as follows:

• **Long-range ballistic missiles:** Aircraft companies appear likely to dominate this field, with relatively little competi-



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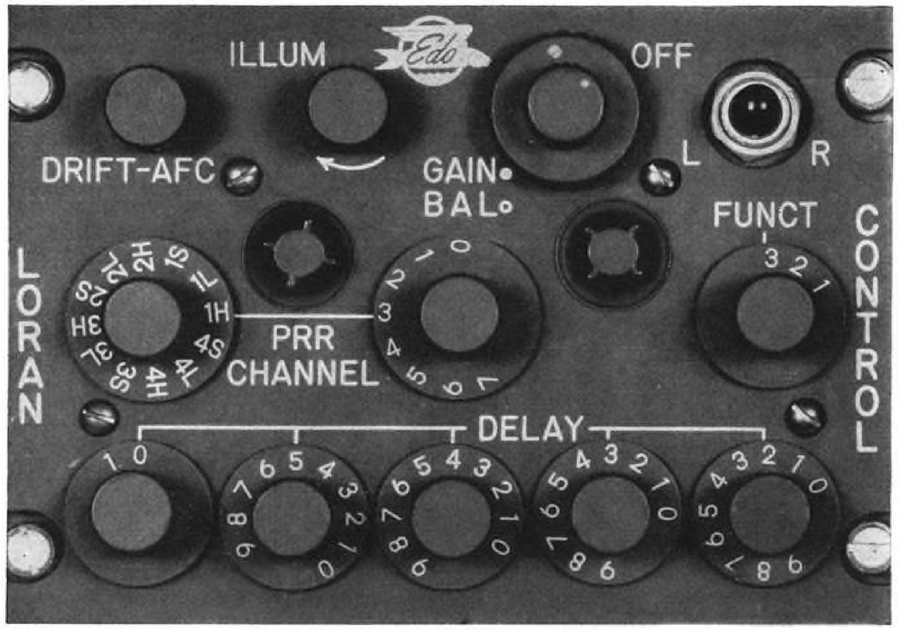
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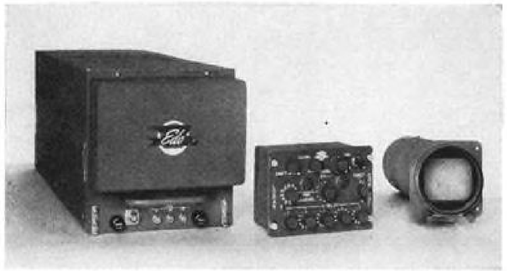


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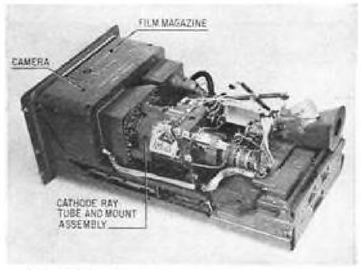
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B-58 Radar Recorder

Convair B-58 bomb-navigation radar scope picture is recorded on 35 mm. film strip by means of new photo-recorder which simultaneously records time in binary form. Recorder contains its own cathode ray tube which displays the same picture appearing on the main radar scope, permitting the entire recorder to be remotely located and operated. Upon command, the unit makes three photos, each at a different gain setting of the radar receiver. Recorder, developed by Raytheon for Sperry Gyroscope, which makes the B-58 bomb-nav system, weighs 41 lb. and measures 22 x 8 x 12 in., including camera and a 100 ft. film magazine.

tion from electronic manufacturers.

• **Air-to-air missiles:** Strong competition from both airframe and electronics companies, with the latter possibly retaining a slight edge. In Navy's recent Eagle air-to-air missile competition, five of the nine bidders were electronics companies, three were aircraft and one was United Aircraft, which can be considered a member of aircraft industry, giving a 5:4 split.

• **Air defense missiles:** These medium-size missiles, with moderately sophisticated airframe and propulsion and complex avionic guidance may be an area of heavy competition between airframe and electronic companies. In current Air Force anti-ICBM defense system studies, three of the companies are airframe manufacturers, four are electronic (AW Feb. 2, p. 23).

Satellite Competition

Another competitive area may develop in satellites. Electronic companies will probably go after the unmanned reconnaissance, navigation and communications satellites while aircraft builders dominate the manned satellite, space vehicle field.

Labor Department clearly faces a difficult decision, requiring the wisdom of a Solomon, in establishing a line of demarcation between the aircraft industry and its contributing industries which reach far into the nation's industrial complex.

It appears difficult if not impossible to split missile manufacturing down the middle, "giving" half to the aircraft industry and half to electronics, except possibly on the basis of the

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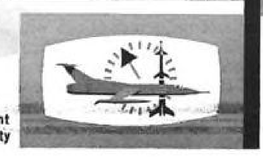


Highly Accurate ... Series 4202
Unique torsion-bar suspension gives very low hysteresis with exceptionally rugged, long life. Single or dual pot and/or switch pick-off provides versatility. Automatic caging mechanism.



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Shipping container mountings made with LORD's remarkable new BTR (Broad Temperature Range) elastomer meet military packaging specifications from —65° to +165° F. In addition to positive protection, you will benefit from all the advantages of elastomeric systems—compactness, light weight, ease of installation and excellent shock absorption characteristics.

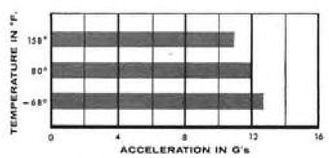
BTR Mountings are now furnishing dependable all-climate protection for high-reliability missiles, missile components and other equipment.

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BTR Mountings are the only elastomeric mountings which meet the rigid requirements of military packaging specifications over the entire operational temperature range. For more information on the advantages of these new mountings, contact your nearest LORD Field Engineer or the Home Office, Erie, Pa.

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missile's function, i.e. strategic bombardment versus air-to-air. But there would be problems in deciding the classification for a small air-to-surface bombardment missile, or a ground-launched air defense missile.

Little wonder that Labor Department officials told AVIATION WEEK that this is the most difficult industry definition problem they have encountered since the Walsh-Healey Act was passed. These officials emphasize that they have definitely not yet formed a firm opinion and are awaiting data from the Defense Department to assist them in making their decision.

Compromise More

Labor Department officials say they still hope that they can work out a satisfactory compromise with Aircraft Industries Assn., Electronic Industries Assn. and the unions. If not, the Labor Department will make its survey of wage levels in aircraft, missile and related avionics industry this spring so as to have all the facts needed regardless of the final decision.

After an analysis of the wage level data, the department will hold a public hearing on its proposed aircraft industry definition and its estimate of the prevailing minimum wage for the companies included in this definition. At that time, all interested parties will be able to express their views.

Labor Department will then weigh these views, come up with its "a proposed finding of fact." Industry and unions again will be able to submit briefs taking issue with any of these findings. After weighing these views, the Department of Labor will then make a final determination. The latter is not expected in less than six months, and it might require a year or more.

All-Weather Device Enters Production

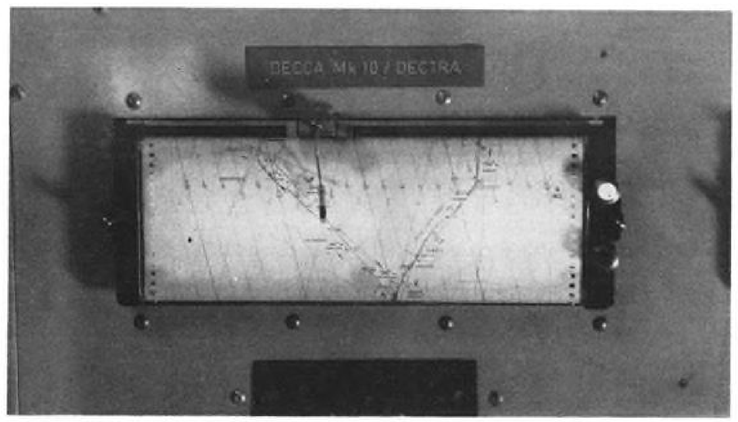
Windsor Locks, Conn.—Avionic device designed to permit helicopter all-weather operation and hands-off flight has been put into production by Hamilton Standard Division of United Aircraft Corp.

Device, which will be utilized on automatic stabilization equipment (ASE) for Sikorsky S-61 helicopter, consists of a stabilization amplifier and coupler package. The unit also will allow the helicopter to hover completely automatically during sonar dunks in anti-submarine warfare operations.

Avionic components for each stabilization channel are on plug-in printed panels; transistorized circuitry is used throughout the system. Design features redundant components to ensure that no single failure will disable more than one stabilization channel.







British Demonstrate Decca-Dectra Systems

British Decca-Dectra short and long range navigation systems were demonstrated early this month in New York as part of the United Kingdom's preparation for the International Civil Aviation Organization meeting on short range navigation aids that began three weeks ago in Montreal (AW Feb. 2, p. 34). Equipment is installed in a Ministry of Supply de Havilland Comet 2E. Demonstration console (top photo) includes both Decca Mark 7 and 10 systems. Decometers (middle photo) show position with reference to Decca zones and lanes by dial readout, while flight log (bottom photo) continuously indicates track of aircraft on a specially prepared chart.

FAA Plans Traffic Control Integration

By Russell Hawkes

San Bernardino, Calif.—Federal Aviation Agency research and development program was outlined here in a joint military-civil Air Navigation Conference, sponsored by Gilfillan Bros., Inc.

Planned program was described by a panel of 14 FAA Bureau of Research and Development officials in six hours of presentations before approximately 200 military, civilian and foreign delegates. Much discussion was devoted to the traffic control organization and policies concerning use of new equipment.

Least understood point was the FAA plan to take over virtually all military traffic control organizations and facilities including navigation aids, airport control towers and supporting units. Move will be an integration, rather than a replacement, of the military organizations and will include foreign as well as domestic activities.

Job Assignments

FAA spokesmen said assignment of U.S. civil servants to ATC jobs overseas would be discussed with foreign governments when necessary. Seaborne and mobile battlefield-type equipment will undoubtedly be left in the hands of the services. Delegates from the military services said that retention of enough controllers for purely military operations might be made even more difficult than it is by joint staffing of ATC facilities because of differences in pay and privileges.

Lt. Col. Carl Fisher of the Bureau of Research and Development said that authority for the take-over exists in the Federal Aviation Act of 1958 but that he personally would not expect it for two or three years. Where logistic support for navaids is now provided by USAF, he said there would probably be no take-over for another three or four years.

Air traffic control philosophy of FAA is based upon "control by exception" under which all airspace users are offered the greatest possible freedom of movement with positive monitoring of position and collision hazard and no interference by the traffic control system except when required for safety. Frequency of necessary exceptions is hard to predict. Steps toward this end will be simplified procedures and minimum fix reporting.

If pilots could always hold to their flight plans precisely or if aircraft location could be determined from the ground, the necessity of position reporting could be eliminated, bringing the ideal of control by exception closer to realization. Automatic navigation and radar-beaconry may make it possible.

FAA is aware that the ideal of maximum freedom could lead to the stumbling block of separate aids to meet the requirements of separate users, conferees were told. A British delegate reported that in the United Kingdom, uncoordinated growth of the air traffic control system is approaching the point of special navaids for every category of aircraft.

FAA will carry out research and development in a three phase program:

- **Phase 1 is continuous** in-service improvement of existing equipment and procedures.
- **Phase 2 is a five-year** plan to apply existing technology to the problem of designing equipment capable of making a large improvement in system performance.
- **Phase 3 is continuing program** of long range research and development aimed at expanding the technology.

The five-year plan is divided into seven elements dealing with data processing, integration of air defense and air traffic control, communication, radar and beaconry, navigation, weather and airports.

FAA considers the heart of the five year plan to be the development of a data processing central which will automate routine chores now done manually by controllers to free them for essential decision-making roles. The semiautomatic data processing and display system has been given highest priority and is expected to replace the present manual system in high density traffic areas by 1963.

System Criticized

The plan has been criticized by persons who feel the program should produce a totally new method rather than a mere automation of the existing one but the FAA bureau argues that new equipment must be phased in as it becomes available without disrupting operation of the rest of the system and controller training program, calling for "some combination of old and new."

With or without good radar coverage, the heart of the air traffic control system is the flight progress strip board on which the controller posts in tabular form the actual and estimated times at which every controlled aircraft arrives over certain geographic fixes along with altitude and other data. Presently, strips are made out, posted and corrected by hand and copied by other controllers monitoring the flight.

Data processing central of phase 2



Goodyear Aircraft Builds 68-ft. Radome

Goodyear Aircraft Corp. has built a 68-ft. diameter glass fiber radome at Akron, Ohio, for the Missile Detection Systems Section of General Electric Co.'s Heavy Military Electronics Department, under U. S. Air Force contract. Laminated plastic structure is made up of panels; six-man crew can assemble it in about 80 hr. Each panel is made of resin reinforced with glass cloth. Finished structure is said to be able to withstand 150 mph. winds.

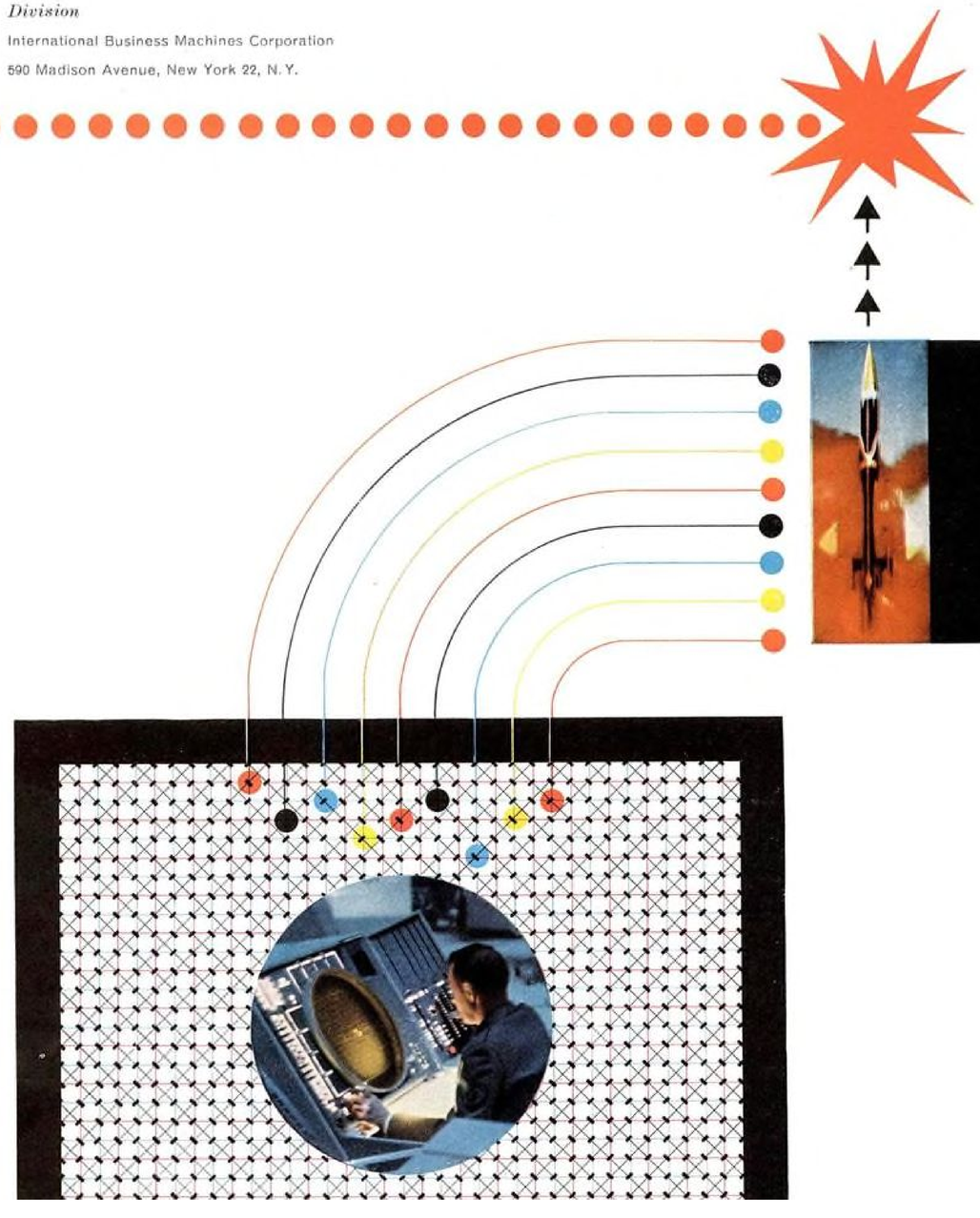
HOW a computer system directs a missile to an oncoming target with unfailing accuracy—The oncoming weapon is picked up by the warning radar system. The information is flashed to elements of the SAGE computer system. The SAGE system supplies the military with information needed to fire the BOMARC missile, then to guide it to the oncoming target. This latest achievement is only one example of the increasing role the IBM Military Products Division is playing in national defense. As a leader in computer science, advanced weapons systems, and systems management, IBM is a primary source for the research and development of electronic data systems for the military. All its resources are immediately available for national security. Complete facilities for: **Research • Development • Manufacturing • Testing • Product Support • Systems Management.**

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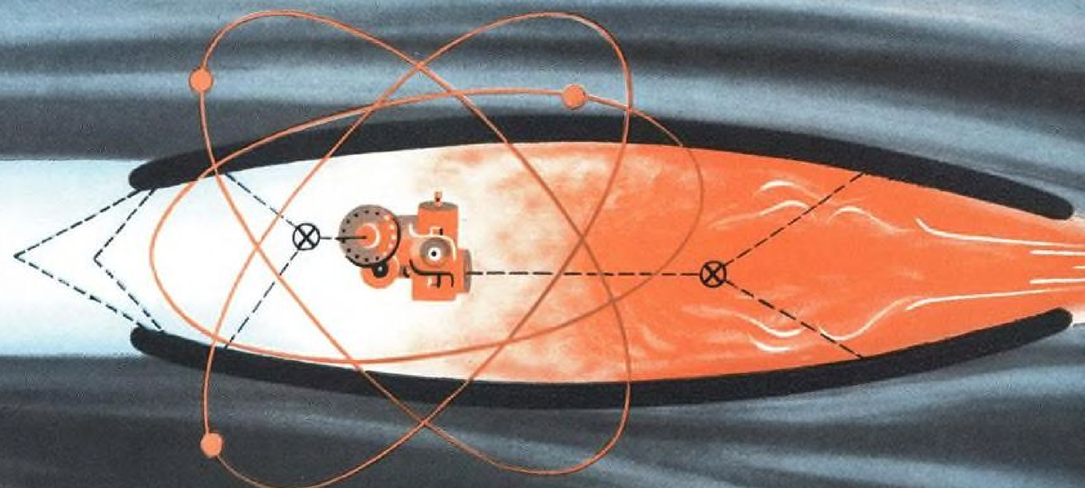
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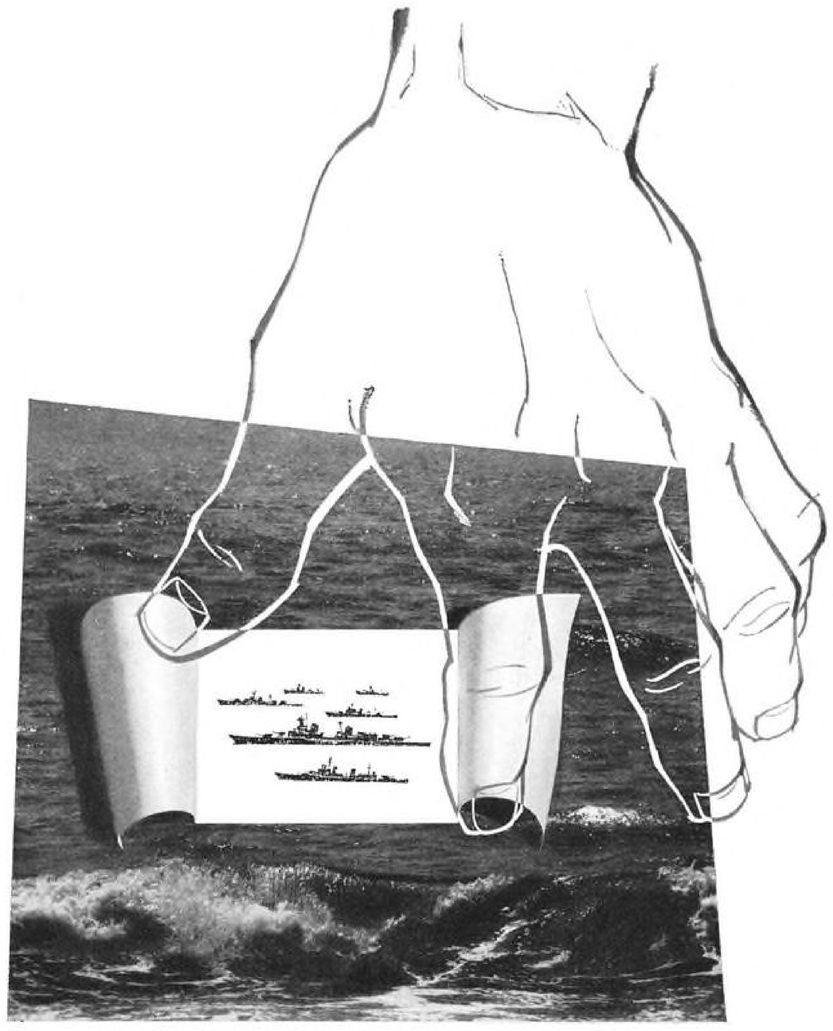
Roy E. Marquardt, *President*



◀ C & A Division engineers made many contributions to the "state of the art" when they developed the fuel control system for the supersonic ramjet engine.

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will mechanize the strip posting process. It is based upon a multiple electronic digital computer integrating computation with a large capacity magnetic drum storage system in a way which permits simultaneous operation of the data processing computer, drum file system and flexible input-output buffer system.

Contract for the computer is held by Librascope of Glendale, Calif.

Flight Plans

Before data processing can begin, flight plans must be entered in the system by punch and printer units near each console. Flight plan entry position is connected to en route data processer which breaks down all flight plans and probes for potential violations of separation criteria which might occur in the next 30 min. Punch and printer prepares original posting strips.

Print head for the automatic flight progress strip comes up on a pneumatic lift to correct each posted strip at every control position. Command to make a change comes from a local drum which is scanned to establish fix and aircraft identity data, etc. The tabular posting bays appear at most of the consoles in the system along with a pictorial conflict display and a data entry keyboard. Controllers can resort to a completely manual use of the flight progress strip board if the electronics fail.

Pictorial display shows the point of conflict along with identity, altitude and estimated time of arrival of the aircraft involved. At the same time, a conflict warning appears beside the appropriate flight strip. Experiments show that giving the controller both pictorial and tabular displays just about doubles his handling capacity. Unresolved conflicts are tabulated and displayed in chronological order.

Conflict Action

When a controller sees a conflict indication he can push a button and be shown the corresponding conflicts on the pictorial display or he may elect to see all the aircraft within a given altitude envelope which are to arrive at a fix during the next 30 min. Controller can use a key punch to locally reroute an aircraft and can cancel his flight plan on landing, when he goes VFR or when he leaves the area. Data on that aircraft then is erased from the computer and the progress strip can be removed from the board.

Data processing central will permit each facility to:

- Accept 400 flight plans per hour by teletype.
- Break down and store 44 flight plans per hour.
- Store a total of 1,000 flight plans.
- Print 1,600 posting strips per hour.
- Process 6,000 updatings per hour for

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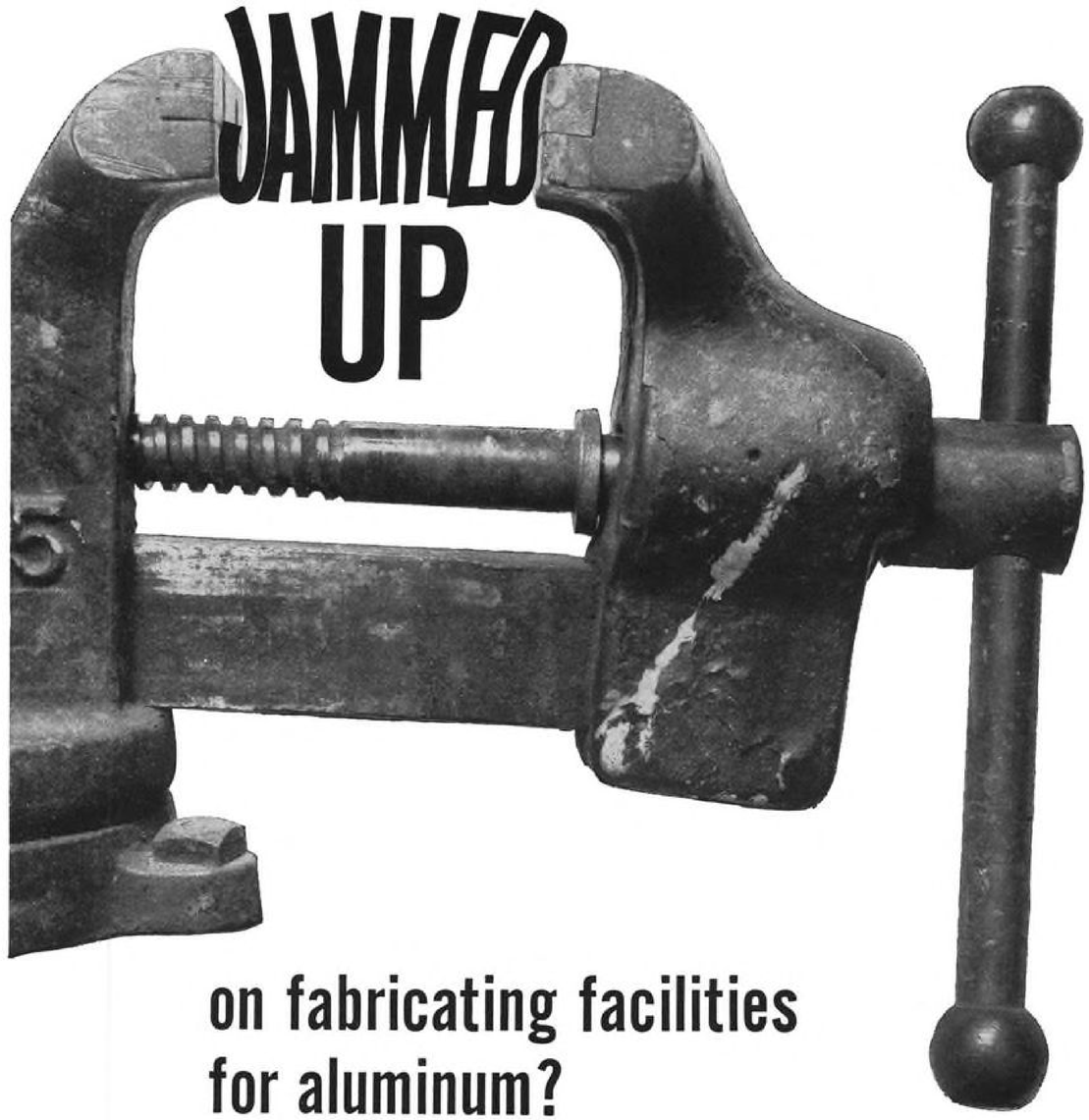
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the 1,600 strips based on 2,600 keyboard entries per hour.

- **Process 1,700 complete** conflict searches per hour.
- **Transmit to SAGE** all necessary flight plans and updates.
- **Transmit to nearby ARTCC's** 220 flight plans and 1,300 updates per hour.
- **Track, identify, schedule,** and transfer control of all aircraft under radar surveillance or close control.

Separate Jurisdiction

An aircraft will pass through the hands of three types of air traffic control centers with separate jurisdiction over traffic enroute, at the terminal and in a transition area between the other two. Radar and radar beaconry will play a large part in close control of aircraft in the transition-terminal area. Sector radar console is to be one of the most important transition area positions. It will exercise radar control of arriving, departing and overflying aircraft.

The station is arranged to permit two teams of controllers to work simultaneously with minimum explicit coordination. Each console is to be equipped with duplicate track-while-scan tracker controls, dual two-bay flight progress boards, keyboards and communication equipment.

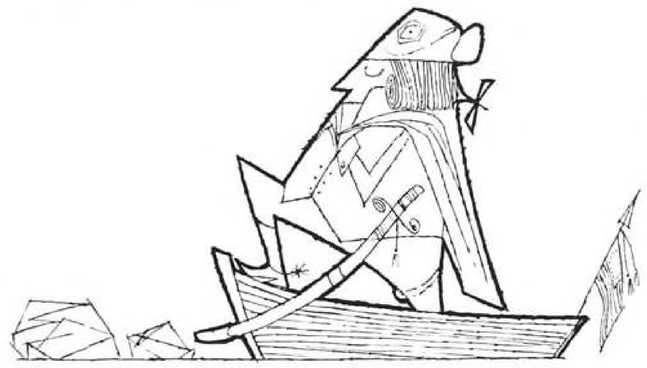
Conflict warnings are not entered in the transition area because formal separations have less meaning in a high density area under radar control. Each aircraft in the transition area will be assigned an individual three-dimensional track-while-scan channel. They are automatically slewed to the expected arrival gate two minutes prior to entry. When locked on a target, the tracker automatically updates flight progress strip, moves character format across pictorial display and provides early-late scheduling information to the terminal sequence controller. Control becomes progressively tighter as an aircraft approaches the terminal and landing sequence can be varied as the situation develops. Sequence controller gets new information from the computer at one minute intervals.

Radar Responsibility

Responsibility of radar sector controller is spatial separation of aircraft in the area over which he has jurisdiction and that of the sequence controller is time separation at the end of the runway. Computer feeds the sequence controller the earliest time at which an incoming airplane could touch down. He assigns the earliest landing slot the airplane can make good and the computer figures the best descent speed or path stretch maneuver to bring the airplane into the approach gate at the correct time.

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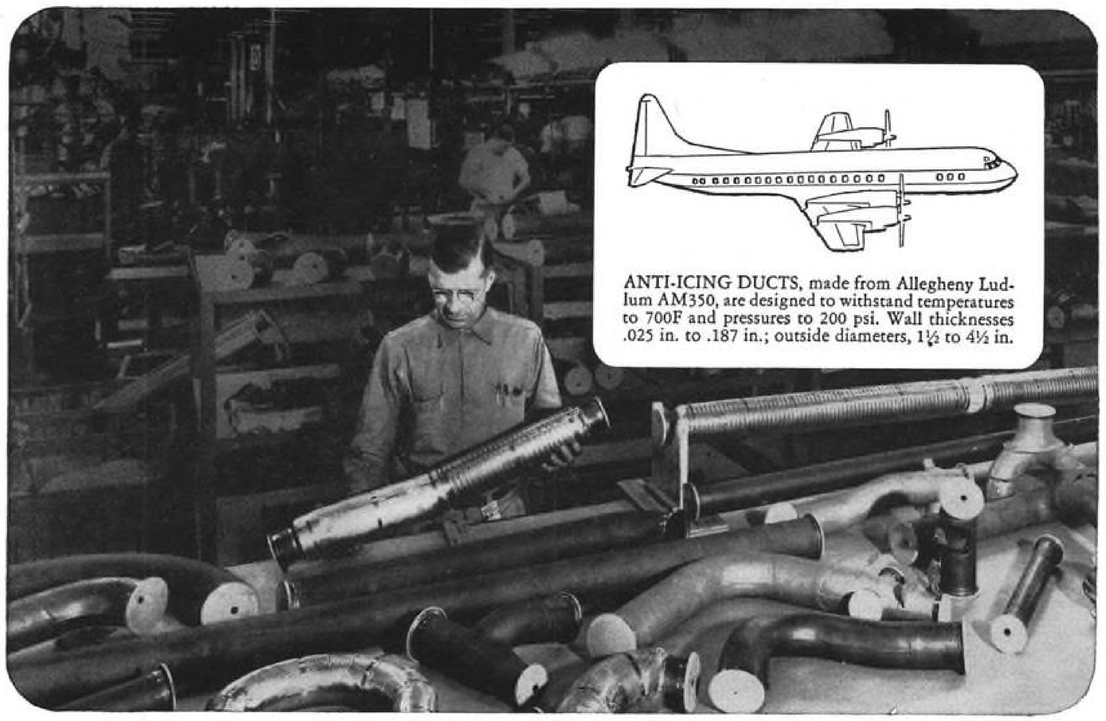
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availability: AM350, introduced several years ago, is available commercially in sheet, strip, foil, small bars and wire. AM355, best suited for heavier sections, is available commercially in forgings, forging billets, plates, bars and wire.

corrosion resistance: Compared to the more familiar stainless grades, AM350 and AM355 resist corrosion and oxidation better than the hardenable grades (chromium martensitic) and only slightly less than the 18 and 8's. They resist stress corrosion at much higher strength levels than do martensitic stainless grades.

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have an electromechanical display showing data on the last five aircraft in the landing sequence. Tabular display is a duplicate of that at the precision approach console and, supplemented by a hotline telephone, will improve cooperation between the two stations.

In a high density area, the supervisor's console will display the flow of traffic to the different terminals in the area. This will include the number of aircraft en route to each, acceptance rate of each, and will forecast arrival rates as much as four hours in the future and traffic from adjacent centers in the same period. If the arrival rate is too high, some sort of flow control will be used to eliminate excessive holding times. An effort will be made to spread any delays equitably. The supervisor can use his keyboard to send instructions to adjacent centers.

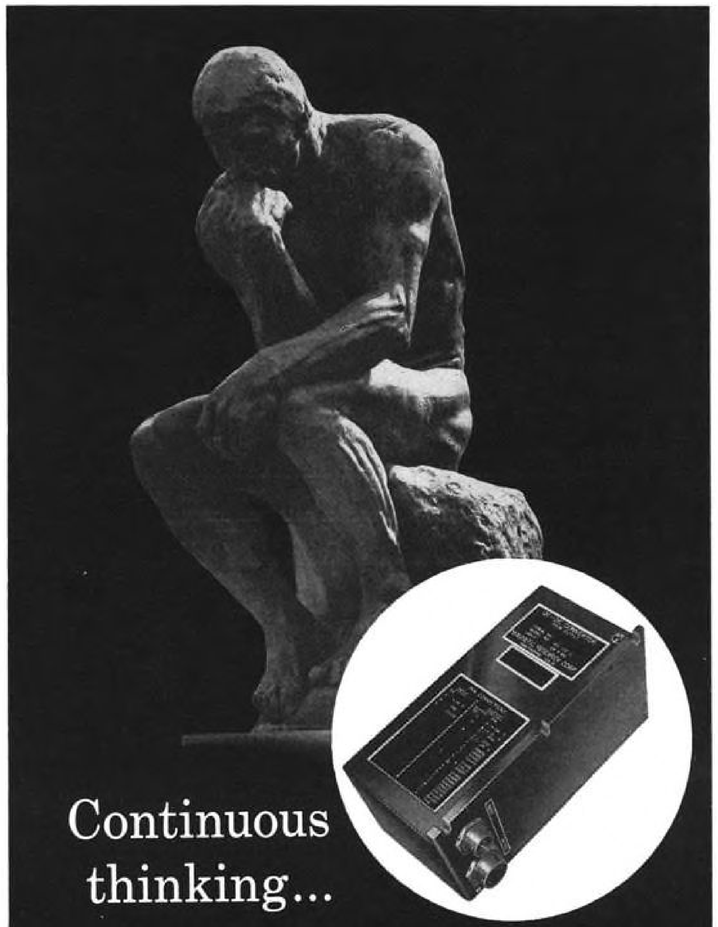
Data link automatic ground-air-ground communication system, called AGACS, (AW July 28, p. 58) greatly increases the usefulness of data processing central. Interrogation rate of AGACS is high enough to permit the system to handle 500 aircraft in two minutes. Range of operation will be 200 mi. or line-of-sight for one in a million bit probability. FAA's bureau calculates system dependability at 99.983% error-free communications per aircraft per year. Altitude will be reported automatically in 500 ft. increments.

Weather Reports

FAA and the U. S. Weather Bureau are working out ways to use AGACS for automatic weather reporting for pilots and dispatchers. They are considering use of automatic voice transmission until AGACS is ready. USAF Project 433L has already developed some of the hardware needed to make automatic weather reporting a reality. A test net soon will be set up between Boston and Washington, D. C., plus picking up a few intermediate points to check problems of high speed weather data transmission.

Integration of air defense and air traffic control is considered a "must" requirement by FAA. The plan now being worked out is the result of an agreement reached in January, 1958, by Departments of Defense and Commerce. It is based on the premise that while Air Defense Command and the Air Traffic Control net must normally retain their separate identities to meet their individual responsibilities, there are basic similarities in equipment and technique which can be shared with a great cash saving and an improvement in the capability of each.

The main areas of similarity are operator qualifications and equipment for surveillance, data processing, situation display, communications and



Continuous thinking...

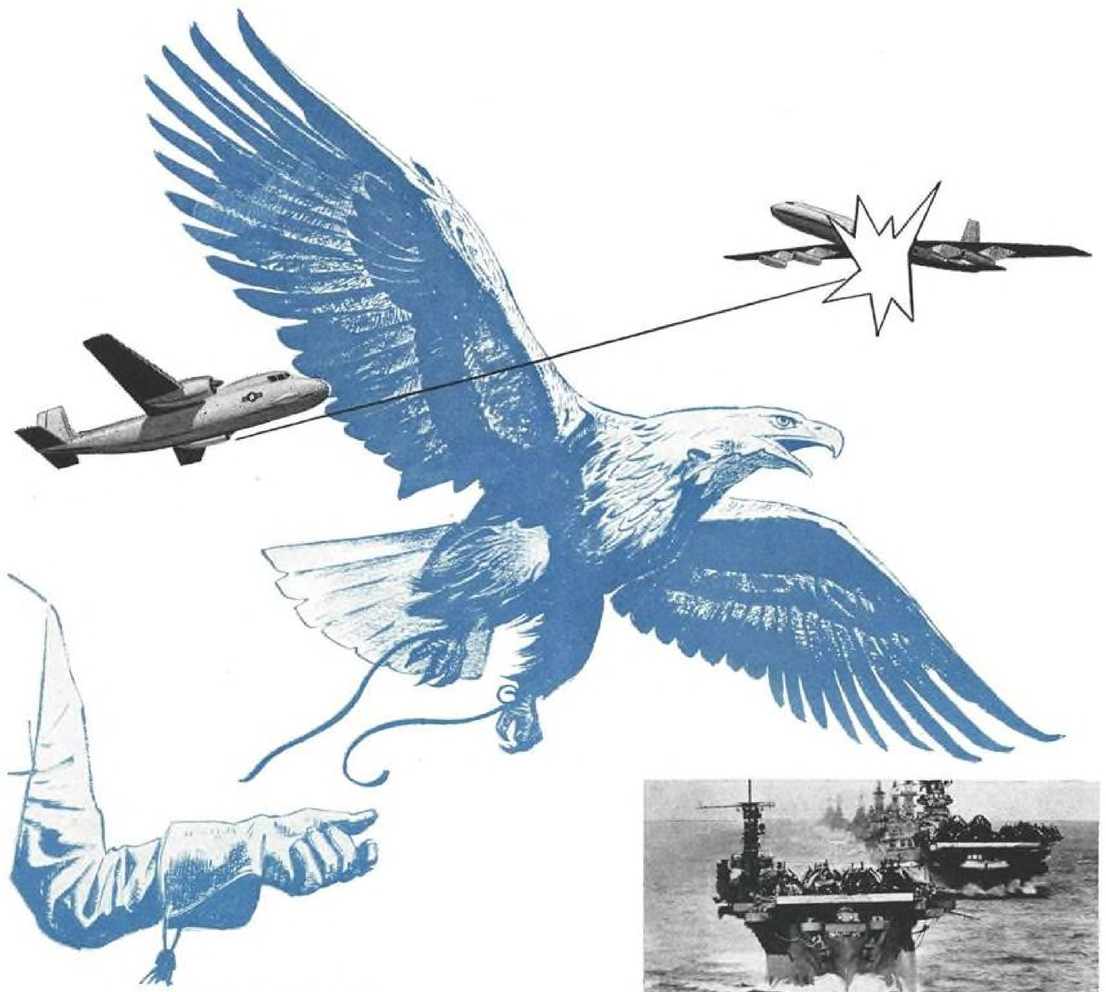
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The high performance EAGLE missile will be employed in Naval fleet defense or intercept missions. It will be fired from aircraft at long ranges against attacking enemy aircraft and guided missiles under all tactical conditions.

The EAGLE team includes three key divisions of the Bendix Aviation Corporation—the Systems Division, the Pacific Division and the Research Laboratories Division—as well as the Grumman Aircraft Engineering Corporation, and other members of the electronic and aviation industry.

The Bendix Systems Division has prime responsibility for EAGLE systems management and engineering. This, and other programs in such fields as global weather reconnaissance, air defense, infrared surveillance and underwater acoustics, exemplify Bendix leadership in "the systems of tomorrow."

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identification. A committee to administer the integration has been set up under the cochairmanship of the FAA bureau and USAF's Air Defense Systems Integration Division. Other members are representatives from NORAD ADC, ARDC, Lincoln Laboratory, Systems Development Corp. and International Business Machines Corp.

Integration will be evolutionary. Radar and radar beacons already are being used jointly. FAA and the Systems Integration Division group expects an early improvement exchange of flight plan and air surveillance information. A standard message format to ease automation is now being developed.

Initial Tests

ADC-ATC cooperation will be tried out in the first section of the phase 2 net which will be installed and tested in the New York area. ADC base there is Suffolk County AFB. An experimental operational plan for scramble and return of Suffolk-based interceptors thorough New York air route structure is intended to permit more flexibility in employment of interceptors by SAGE than is possible with present ATC-ADC coordination.

An interagency group now is trying to work out a realignment of SAGE and ARTCC boundaries to simplify joint data processing and information exchange. Possibility is seen of using SAGE radar and radar beacons for high altitude air traffic control. By 1962 SAGE will have virtually complete radar coverage of the continental United States and will be most useful with high altitude targets. FAA looks forward to common air surveillance centers with break-outs for control and defense functions.

FILTER CENTER

► **USAF to Buy Par-Amps**—Wright Air Development Center plans to sponsor development of a family of low-noise parametric amplifiers for airborne applications, covering a wide portion of the radio frequency spectrum. Interested companies can obtain details from WADC's Electronic Components Laboratory.

► **Coherent Radar for Recon**—Wright Air Development Center is sponsoring development of high resolution, coherent-type airborne radar for aerial reconnaissance. Set is identified as AN/APS-73.

► **Super-Power Transistor**—Pacific Semiconductors, Inc., has developed a new switching transistor which can handle current up to 100 amp. at megacycle switching rates. New transistor, developed under Wright Air Development Center sponsorship, opens the way to using semiconductor modulators for radar sets.

► **New Type Antenna Tuner Sought**—New techniques which will permit extremely rapid tuning of aircraft high frequency (HF) antennas are being sought by Wright Air Development Center's Communication & Navigation Laboratory. Behind the requirement is the idea of determining optimum HF frequency at any instant by having ground station transmit test signals whose frequency sweeps from low to high end of the bond with aircraft receiver-transmitter repeating back the transmission. Frequency at which the strongest test signal is received establishes the frequency used for subsequent communications. Olympic Radio has conducted a feasibility study of the basic technique.

► **New Instruments for F-105, F-106**—First Air Force aircraft to be equipped with new "whole-panel presentation" instruments (AW July 23, 1956, p. 62), including new vertical display altitude, airspeed and rate-of-climb indicators, will be the Republic F-105D and Convair F-106, starting this summer. Similar instrumentation may be used in the new North American F-108 and B-70. Vertical altitude, airspeed indicators are produced by Eclipse-Pioneer, the new horizontal situation indicator is made by Collins Radio, while the attitude indicator and associated two-gyro stabilized platform is produced by Lear. New instruments were developed under sponsorship of Wright Air Development Center's Flight Control Laboratory.

► **Wescon Paper Deadline Set**—Authors who wish to present technical papers at the 1959 Western Electronic Show & Convention, to be held Aug. 18-21 in San Francisco, must submit 100-200 word abstracts together with complete texts or additional detailed summaries by May 1. Material should be sent to Dr. Karl R. Spangenberg, Wescon, 60 West 41st Ave., San Mateo, Calif.

► **Defense Electronics Sales Up, But Down**—Defense Department electronic procurement for first quarter of Fiscal 1959 (July through September, 1958) is estimated at $958 million, up $32 million over same quarter of previous year, but down from the $1,187 million estimated for final quarter of Fiscal 1958, according to figures released by Electronic Industries Assn. The EIA figures are estimated and from rule-of-thumb percentages applied to procurement of missiles, aircraft, plus categories specifically devoted to electronics.

► **Polaris Computer Never Rests**—Fire control computer to be used aboard Polaris launching submarines must continuously recalculate new trajectory required to hit assigned targets as sub changes position, inserting new equations into memory circuit of missile's airborne digital computer. Computers are being developed by Massachusetts Institute of Technology, will be designed and produced by General Electric.

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

• **Hazeltine Corp.** reports substantial initial contracts from Air Material Command for AN/APS-95, a new airborne early warning radar system. The new radar is outgrowth of AN/APS-70 and will be successor to AN/APS-20 produced by company for use on AEW aircraft.

• **Bendix Radio,** $1.4 million contract from Rome Air Materiel Area, for long-range search radar for air defense application.

• **Daystrom Inc.,** Archbald, Pa., $1.7 million for production of AN/SPS-10 search radar for Navy Bureau of Ships.

• **Hoffman Electronics Corp.,** $276,000 contract from Navy for development and production of a digital gyroscope for use in torpedos. Also, $150,000 order from General Electric for gimbal assemblies for use in Sidewinder missile.

• **Applied Science Corp. of Princeton,** $500,000 contract for three telemetry ground stations to be used for Air Force's Eglin Gulf Test Range in Florida. Each system will include FM/FM, pulse amplitude modulation (PAM) and pulse width modulation (PWM) equipment, will be able to simultaneously handle data signals from three aircraft, or missiles, and from three target drones. Each aircraft or missile will be able to transmit four continuous data channels and up to 90 channels of time-division commutated data.

• **Kearfott Co.,** Clifton, N. J., $1.2 million Air Force contract for AN/AJA-1 computer group used with Boeing B-52 weapon guidance system.

• **Wilcox Electric Co.,** Kansas City, reports that Delta Air Lines has selected its Model 714B air traffic control transponder for use on its Douglas DC-8 jet transports. Company says Pan American World Airways also will buy a substantial quantity of Wilcox transponders.

• **Sanders Associates, Inc.,** Nashua, N. H., $1.4 million from Navy for production of sonobuoys.

• **The Deutsch Co.,** Los Angeles, research and development contract for miniature connectors for use on North American B-70. Connectors will use crimp-type snap-in contacts.



KAMAN'S H-43A is 24 ft. 10.8 in. long. Height over rotor hubs is 12 ft. 5 in. Intermeshing rotors are two-bladed "teetering" type.

Aviation Week Pilot Report:

H-43A Possesses 'Stick and Rudder' Qualities

By Robert I. Stanfield

Bloomfield, Conn.—Kaman Aircraft's piston-powered H-43A is a "stick and rudder" helicopter embracing an intermeshing rotor system and servo-flap control. It has no tail rotor. Its adaptability to its search and crash-rescue and firefighting role can be keyed to its maneuverability, slow-flight characteristics and flight-safety features.

The small helicopter is basically similar to the HOK, first delivered to the Marines in 1955, and the Navy's HUK. Air Force has ordered 18 H-43As, all earmarked for the Tactical Air Command, and has followed up this order with contracts for 74 turbine-powered H-43Bs through Fiscal 1959 (AW Dec. 22, p. 72).

Mission role of the H-43A with USAF will include standby air operation during mass airplane landings and takeoffs, to locate and pinpoint any emergencies and accidents and bring back disabled crew members. Thousand-pound firefighting and rescue kit, including fire extinguishing agent, axes, bars, metal cutters, etc., can be suspended beneath the helicopter. Normal crew for this operation would include pilot, medical attendant and two firefighters.

The H-43A is powered by a Pratt & Whitney R1340-48 nine-cylinder air-cooled engine generating 600 hp. at takeoff; 550 hp. normal. The blower ratio is 12 to 1. Engine is basically the same that had been used with Air Force and Navy fixed-wing T-6 and SNJ advanced trainers, respectively. It is mounted to the helicopter with four bolts and can be "rocked back" for maintenance in 15-20 min.

Empty weight of the helicopter is 4,280 lb. Normal mission gross weight is 5,572 lb. Alternate mission weight—with firefighting equipment—is 6,772 lb. Maximum range is specified as 190 naut. mi.





ABSENCE of a tail rotor, plus its "bear paw" gear configuration, give H-43A access to bushy, swampy areas, snow or sand.

Evaluation Data

Features evidenced during flight evaluation by AVIATION WEEK included:

• **Maneuverability.** Vertical and horizontal tails provide stability augmentation. With application of rudder, helicopter will turn as well in one direction as the other. No force gradient is tied in to rudder pedals, though response is not as quick as that encountered with tail rotor. Helicopter was landed in a small area of about 250 sq. ft., surrounded by trees 40 to 50 ft. in height. Climbout followed acceleration to only 20 kt., half the usual speed.

• **Safety factors.** Blade stall is eliminated in the H-43A, allowing for fast acceleration during crash-rescue emergencies. Autorotation capabilities are excellent. Landings following simulated engine failures were made from altitudes of 50 ft. (during climb at 20 kt.); from 1,000 ft., preceded by two 360 deg. turns (left and right) with descent



ROTOR downwash cuts path through fire during simulated crash rescue. Firefighting rig is carried to scene beneath helicopter.

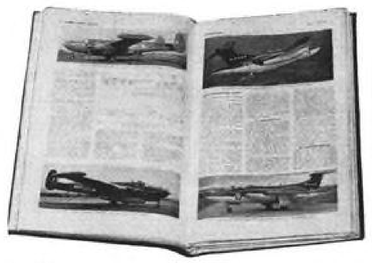


H-43A hoist, above, is electrically operated and equipped with 100 ft. of cable, which feeds over pulley on tripod. Below, production at the Bloomfield plant.



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FLIGHT instruments are centered above caution panel in H-43A, flanked by engine instruments, tachometer, manifold pressure.

in turns 1,600 fpm.; and from 1,000 ft., zero airspeed, preceded by 2,000 fpm. rate of descent.

• **Rough-area landings.** Helicopter's "bear paw" gear configuration, plus absence of a tail rotor, give it accessibility to areas that normally would be restrictive. H-43A was set down into "boondocks," resting lightly on swampy grass-water amidst bushes up to 15 ft. high. Rotor blades were visibly checked for clearance before landing.

• **Crash-fire rescue.** About 15 sec. after helicopter began fanning the fire, the dummy was "rescued" from a burning fuselage which had been drenched with 400 gal. of high-octane gas. The helicopter was brought in upwind of fire, about 15 ft. high, hovering 50 ft. back from flames. Downwash of rotors washed a path through the fire to the cockpit. Three-man fire crew helped keep the path open and needed but 20 gal. of aerated foam-water to affect the "rescue."

• **External cargo.** Evaluation at Bloomfield included external pickup of a 1,100 lb. blade box. High-drag dimensions were 28 ft. by 4 ft. by 2.5 ft. The box was suspended at one point, via a 5-ft. cable. The helicopter didn't fight back. Nose-down pitch occurred; airspeed was 40 kt. Also picked up, via an 8-ft. cable, was a 564-lb. cement weight; flight was made at 60 kt. The helicopter can carry a 2,500 lb. jeep externally.

Airframe Construction

Airframe of the H-43A is of semi-monocoque construction. The engine is mounted in the rear and the transmission is located in the lower pylon. Upper pylons support the rotor shafts. Vertical stabilizers are located at the aft ends of the tail booms.

Clutch housing is mounted directly on the engine output shaft and rotates with the shaft. Engine cooling fan is bolted to the clutch housing. Quick-disconnect coupling between the clutch and transmission facilitates engine removal.

Intermeshing rotors are two-bladed "teetering" type with a drag hinge and inter-blade friction dampers. With rotor hubs paralleled and blades moved around the drag hinge, rotors can be positioned "fore and aft" over the fuselage for hangar stowage.

Kaman engineers chose the intermeshing rotor system because it lends itself to the use of larger rotor blades which result in a larger rotor disk area. Company also desired a configuration which would be inherently balanced by the use of two counter-rotating rotors.

The servo-flap control system, which imparts a stabilizing factor to the rotor blade, was aimed at reducing pilot-fatiguing aerodynamic and centrifugal forces and inertia movements. There are no pitch-change bearings involved. Pilot's controls are connected to the servo-flap by push-pull rods and bell-cranks.

Each blade is flown independently. Relationship of the servo-flap to the rotor blade is similar to that existing between the elevators and the main wing of an airplane.

Reduction gearing embraces common transmission (one gearbox) for both rotors, with overhaul interval of 480 hr. Single clutch serves for both engaging rotors and as an overrunning clutch. Kaman feels the clutch is good for two service tours. Intermeshing rotors eliminate the need for anti-torque provisions.

There are no special hydraulic or electric servo mechanisms.

Evaluation Flights

Helicopter flown by AVIATION WEEK was Air Force No. 58-5524. Accompanying this pilot was W. A. "Al" Newton, chief test pilot for Kaman. Evaluation flights totaled about 6 hr.

H-43A does not take up much ramp space; parking is no problem. Cabin doors on both sides slide aft for normal entrance. One-half of the nose bubble opens wide to admit litter patients or internal cargo.

Rotorcraft flown was equipped with dual controls, though minimum crew complement of the H-43A is one pilot. Aft cabin area contains three removable seat cushions and canvas back rests, with lap-type safety belts and shoulder harnesses. Should casualty equipment be installed, the passenger seat directly behind the pilot's seat is used by medical attendant. The other two passenger seats, copilot's seat and controls must be removed.

Flight instruments are centered on the single panel, flanked to the left by engine instruments and to the right by



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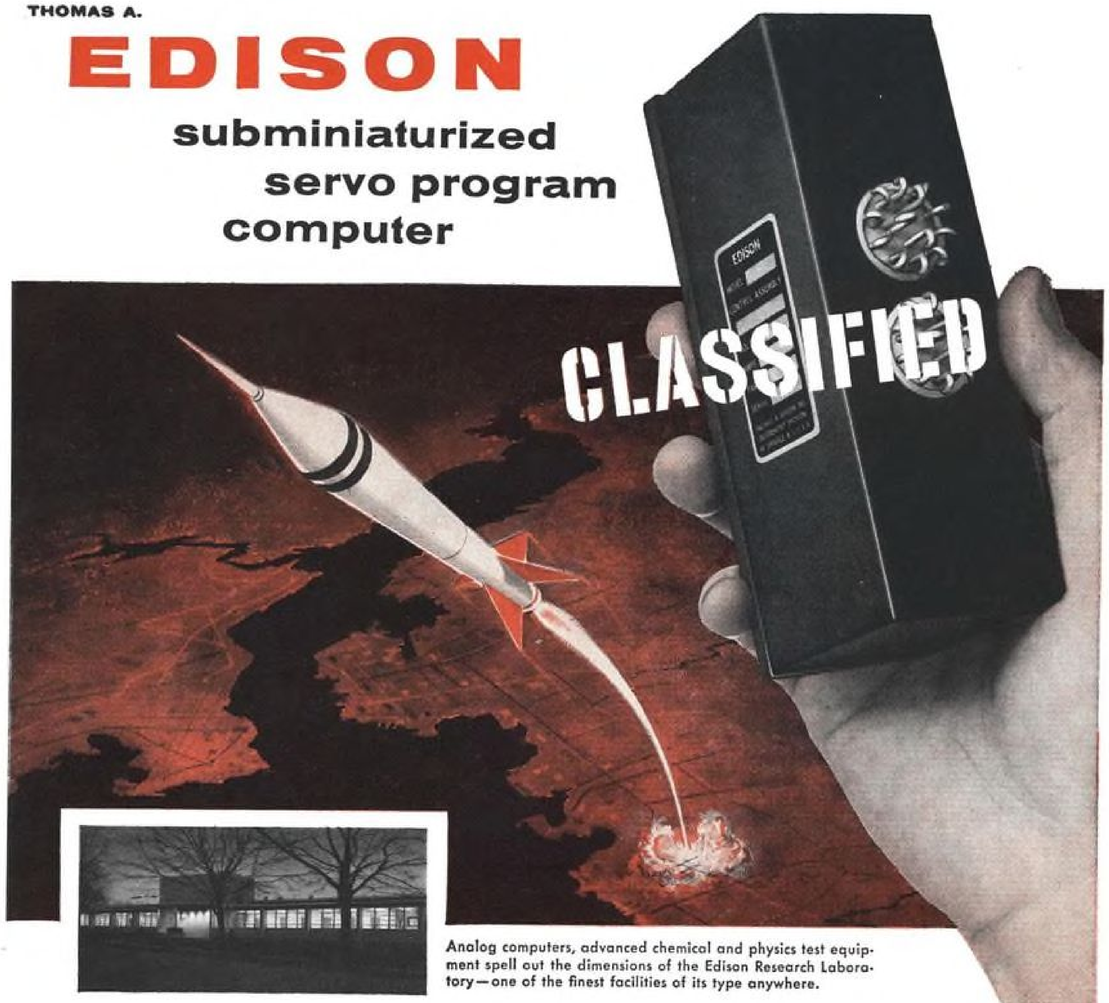
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Kaman H-43A Specifications

Gross weight (normal mission)	5,572 lb.
Alternate mission weight (firefighter)	6,772 lb.
Empty weight	4,380 lb.
Useful load (normal mission)	1,192 lb.
Length	24 ft. 10.8 in.
Over-all width (outer fins)	9 ft.
Cabin width	5 ft. 2.3 in.
Height, over rotor hubs	12 ft. 5 in.
Height, over rotor tips in 45 deg. position (with blade blocks installed)	16 ft. 5 in.
Rotor diameter	47 ft.
Rotors, operating	50 ft. 6 in.
Gear tread:	
Main	7 ft. 6 in.
Auxiliary	5 ft. 1 in.
Ground clearance:	
Cargo hook	3 in.
Tail fins	2 ft. 6 in.
Rotor tip ground clearance-minimum (at rest)	6 ft. 4 in.

Powerplant: Pratt & Whitney R1340-48 nine-cylinder aircooled engine generating 600 hp. at takeoff; 550 hp. normal.

tachometer and manifold pressure indicators. Caution panel is seated below flight instruments.

Console panel includes avionic, light, ignition, fuel boost switches. Circuit breakers are located both on console and overhead panel. Fuses also are overhead.

H-43A Controls

Pilot's collective stick controls the throttle with a motorcycle-type grip. Starter switch and landing and floodlight switches are at top of collective lever. Stick also contains a friction lock for the throttle and lever itself. Cyclic stick contains switches for stick trim and microphones.

Communications and avionic equipment are remotely controlled from radio and interphone control panels on the console and the left cabin wall in addition to switches on the pilot's cyclic stick and the hoist operator's grip.

Rotor brake control is located on center of cabin ceiling and is used to stop rotors from free-wheeling during ground operation. Brake is a single-disk mechanical friction unit that acts on the input shaft of the transmission. A flexible cable from the control actuates a hydraulic master cylinder in the right pylon.

The R1340 engine can be started quickly. There is no external power source requirement. Simple procedures call for closed throttle and rich mixture before hitting the starter switch. Throttle was adjusted at 1,000 rpm. and clutch engaged. With needle marriage, rpm. was increased to 1,200. During starting and run-up it is not necessary to monitor controls.

Engine warmed up at 1,700 rpm. Magnetoes were checked at 2,000 rpm. and 21 in. manifold pressure, and helicopter was ready for takeoff.

With two of us aboard, plus 600 lb. of fuel, the H-43A grossed about 5,325 lb. Wind was calm. Outside air temperature was 46F. Sea level pressure was 30.15 in.

The small helicopter initially was taxied about, with little difficulty, at 1,900 rpm. and 21 in. manifold pressure. Rudder control during taxi was quite positive. Rotorcraft takes limited operating space on ramp.

Initial climb was made at 35 in. and 2,200 rpm., preceded by acceleration to 45 kt. Climb was made at 50 kt.; rate of climb was 1,200 fpm. Pilot visibility in the H-43A is excellent to the point that rotor blades can be observed, particularly for clearance in tight areas. Vibration was apparent, but not to an abnormal degree.

Helicopter later was climbed at 33 in. manifold pressure and 2,200 rpm. at 40 kt. Rate of climb was 500 fpm.

During one phase of evaluation, the H-43A was pulled off the ramp, flown about and climbed at constant power of 26 in. and 2,200 rpm. Airspeed initially was about 15 kt., then built up past 20 kt. Climbout was made at 30 kt. at 50 fpm. Helicopter was leveled off at 200 ft., where it cruised at same power setting at 50 kt.

During cruise at 500 ft., pulling 30 in. and 2,200 rpm., true airspeed was 77 kt. Increasing power to 35.5 in., holding 2,200 rpm., airspeed trued out at 91 kt.

Rotor Stall

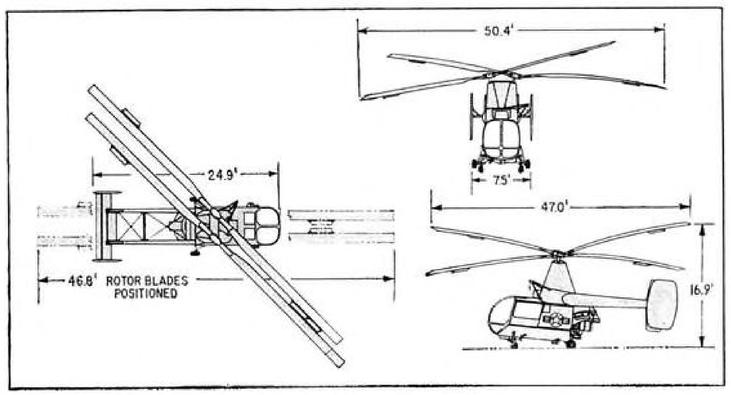
Counter-rotating rotors and relatively light rotor disk loading negate rotor stall within operating limitations. During flights at high airspeed and altitude, with low rotor rpm., minor roughness may occur. This can be reduced by decreasing airspeed and increasing rotor rpm., or descending to a lower altitude. Kaman has had the H-43A to 18,800 ft. at normal gross weight.

Helicopter's airspeed indicator is redlined at 115 kt. Maximum power manifold pressure is 36.5 in.—for five minutes after takeoff—at 2,250 rpm. The H-43A, Kaman told AVIATION WEEK, is capable of operating in high winds and turbulent conditions—up to 50 kt. —for starting and stopping rotors.

Stability of the H-43A is pronounced both in climb and local flight. In each instance helicopter was flown "hands off." Collective stick is spring loaded to compensate for centrifugal loading of control rods and blades; pilot can leave it where he wants it. Helicopter can be trimmed fore and aft. No force gradient is tied in to rudder pedals and trim system here is not necessary.

The rudder is the most complicated part of the H-43A control system because it ties in with both cyclic and differential collective control, producing both yaw and roll.

During one phase of "hands off" flight, stick was displaced laterally, helicopter banking some 10 to 15 deg. H-43A recovered deadbeat in one cycle. Flying in the pattern at 60 kt.,



THREE-VIEW of H-43A shows how rotor blades can be positioned for stowage.



CECO NEWS

CHANDLER-EVANS SYSTEMS • CONTROLS WEST HARTFORD, CONNECTICUT

New Center Has Unique Features

The Control Console in CECO's newest test facility incorporates latest state-of-the-art instrumentation and provides for push-button ease of operation. Any malfunction in any part of the system activates both audible and visual alarms. Electrical interlocks automatically shut down the system and indicate the specific area of malfunction.

If the operator does not or cannot take the necessary corrective steps within a predetermined amount of time, required corrections are made automatically and the test is resumed.

Engineered for Safety

While the Test Platform with its Ambient Chambers can easily be seen through a maximum safety window in the forward wall of the Control House, all tests are 100% remotely controlled. Operators set and control temperatures and pressures, and assemble all necessary data at the Control and Instrumentation Console.

The entire CECO Thermo-Research Center has been painstakingly engineered to provide optimum safety, both for operating personnel and for the valuable mechanisms being tested.

So thorough are the safety precautions that despite the hazards inherent in handling fuels at elevated temperature, lowest premium cost fire insurance premiums on this facility are in the category ("Sprinkler Rating").

Described as "Operator-Proof"

A highly complex operator-overriding system, developed especially for this facility, assures proper operation at all times. Operator errors, if and when they occur, are corrected automatically.

Fuel Density Indicator

A meter in the Control House gives continuous indication of fuel density. It gets its signal from the intensity of radiation through a section of the fuel conduit. Isotope Cesium 137 is used in this radiation process.

Chandler-Evans Announces New High-Temperature Test Center

CECO Facility Tests Fuel Devices In Environments To 1000°F.

LATEST CECO DEVELOPMENT TOOL: Two structures make up the Chandler-Evans Thermo-Research Center. One (shown above in foreground) is a concrete and steel, insulated and soundproofed Control House.

The second structure (background above) is an "open air" Test Platform, sheltered from the elements by a sheet metal roof containing plastic blow-out sections. Test Chambers and all associated equipment are installed on this platform.

West Hartford, Conn. (CECO)—Completion of a new and vastly capable Thermo-Research Center has been announced by Sidney A. Stewart, General Manager of Chandler-Evans. The 100% company-owned facility is considered to be unique in the modern aircraft industry. It is designed to subject sensitive fuel mechanisms and other hydraulic devices to elevated temperatures similar to those developed in ultra high-speed flight.

As a development tool, the Center is expected to provide answers to many questions that have perplexed engineers since advanced air speeds first began to create critical high-temperature problems.

Chandler-Evans has been "hot-testing" aircraft engine accessory products for a number of years. Initially, relatively simple facilities were equal to the task. But, as aircraft and missile speeds advanced into Mach ranges, it became apparent that temperature problems would [illegible] (to accommodate 300-hour fuel system tests, for example) can be carried out twenty-four hours a day, seven days a week.

Others to Use Lab

CECO's new Thermo-Research Center has been made available to others, according to Ercole J. Vitali, Manager of the Company's Engineering Test and Experimental Departments.

On a limited basis, the laboratory and its staff will be put at the disposal of manufacturers who are similarly concerned with the functional performance of liquid fuels, fuel system components, and other hydraulic equipment when subjected to the stresses of elevated temperature. Ambient and fuel temperature capabilities currently specified are 1000°F. and 500°F. respectively.

Vitali went on to say that subcontract customers can gain valuable time and save money as well by calling on CECO's

S. A. Stewart Lauds CECO's New Test Lab

"This unique engineering tool will enable CECO to continue developing superior products empirically," said Sidney A. Stewart, General Manager of Chandler-Evans, when the company's new Thermo-Research Center was unveiled for the aircraft industry.

He went on to point out that high-temperature problems have become increasingly critical with advancing speeds of air and space vehicles. "We expect to find in this new laboratory definitive answers to a variety of questions relative to the precise metering of liquid fuels at high temperatures," he said.

Further underscoring the importance of *temperature extremes* in the modern aircraft and missile industry, Stewart mentioned concurrent activities in the cryogenics field. He said CECO is designing and producing devices for use in liquid nitrogen systems, for example, where temperatures of −330° F. are encountered.

Part Numbering

To simplify trouble-shooting and minimize time losses when repairs or replacements are required, each of the [illegible]

throttle only was used, with no need to play collective lever. Overspeeding of rotor would pull collective up; underspeeding would pull it down. Aircraft is quite responsive to rudder during all phases of flight.

Approaches for landings were made at 60 kt. indicated, best approach speed. Maneuverability and stability again were evidenced during hovering. The helicopter was docile, and turned easily to left or right. Opposite rudder was used to break turns. Power during the hover was 32 in. and 2,150 rpm.

Autorotation Descent

Several autorotations were made from 1,000 ft. to zero-roll touchdown. Airspeed in the descent was usually 60 kt. (45 kt. is best for minimum rate of descent). Rate of descent varied between 1,200-1,300 fpm. Collective stick is held down; there is no need to jockey it.

At one point the helicopter was drifted downwind (backwards) to get zero airspeed. Rate of descent during autorotation was about 2,400 fpm. (needle was off the indicator) prior to flare and touchdown.

In one instance, from cruise speed of 60 kt. at 1,000 ft., autorotation embraced two 360 deg. turns, left and right, at 40 kt. indicated during descent. With power at "idle" and collective full down, the engine ran at 1,200 rpm.; rotor stabilized at 220 rpm. Rate of descent, in turns, was 1,600 fpm. Recovery to full landing was made at 50 kt.

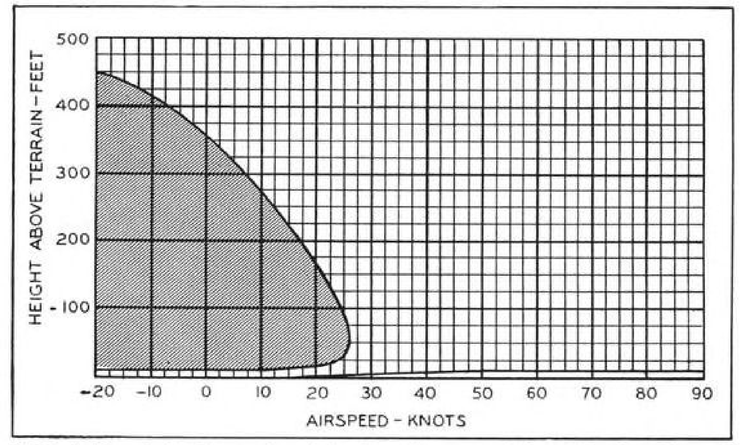
H-43A tail improves stability and directional control, during autorotation, over that of the HOK and HUK. By comparison to the latter, the USAF helicopter has a 2-ft. wider tail, with elevator surface correspondingly increased (one foot added to span on either side). H-43A servo tab was increased in area, and two dorsal and ventral fins added to ends of the tail booms. Elevator is isolated on springs to eliminate fatigue factor. Stabilizer is fixed.

Simulated Failure

Engine failure also was simulated at 50 ft., climbing—with climb power of 35.5 in. and 2,200 rpm. Speed was but 20 kt. when engine was chopped and helicopter autorotated to touchdown.

The helicopter will not stall at slow speed. In downwind flares it will go through condition of zero airspeed accompanied by settling inertia, which may make it difficult to avoid ground contact. Counter-rotating rotors permit a greater angle of rearward flare due to relatively short tail structure.

Provisions are made for carrying two litters, either Stokes or pole type, one above the other. Supports are secured to fuselage structure. Cargo tie-down



H-43A height-velocity diagram for safe landing after engine failure. "Dead man's curve" allows good margin of tolerance for operational pilots.

floor paneling may also be installed on left side of cabin. Four tie-down fittings are provided in forward section; two aft.

During a litter demonstration, two "patients" were loaded through the nose and strapped in, and helicopter was airborne, within one minute following start of this operation. Takeoff was made at normal power—35 in. manifold pressure and 2,200 rpm. Following landing both "patients" (with feet forward) were removed in 25 sec. Either the pilot or a crewman can operate the litter.

In-flight tracking, made possible with the servo-flap, is standard on all H-43As. It enables the pilot to adjust tracking of the tip paths of the rotor blade during flight, which would be necessary following rotor changes or major maintenance, and during normal flight operations. Pilot can visually observe blade tip paths; movements are made via spring actuated track switches on upper forward cabin ceiling.

Simulated "rescue" of three men by hoist was made from a hover of about 20 ft. Within a few minutes all three were pulled up to open left-hand cabin door and swung in.

H-43A Performance

Cruising speed:	
At 70% power, sea level	80 kt.
For maximum range	70 kt.
Maximum speed	99 kt.
Hovering ceiling (NRP) (OGE)	11,250 ft.
Service ceiling (NRP)	21,300 ft.
Vertical rate of climb	1,120 fpm.
Best rate of climb	1,475 fpm.
Fuel capacity	102.5 gal.
Fuel consumption (max.range)	190 lb./hr.
Range	190 naut. mi.
Endurance	3.4 hr.

Hoist is electrically operated and is equipped with 100 ft. of cable. The cable drum and hoist motor are mounted between the lower pylons. The cable feeds off the drum over a pulley mounted to a rigid tripod. When the cable is fully up or down, limit switches automatically stop the hoist. Automatic brake will hold the cable in any position. Pilot-controlled guillotine-type cutter is available for emergency severence.

Firefighting Use

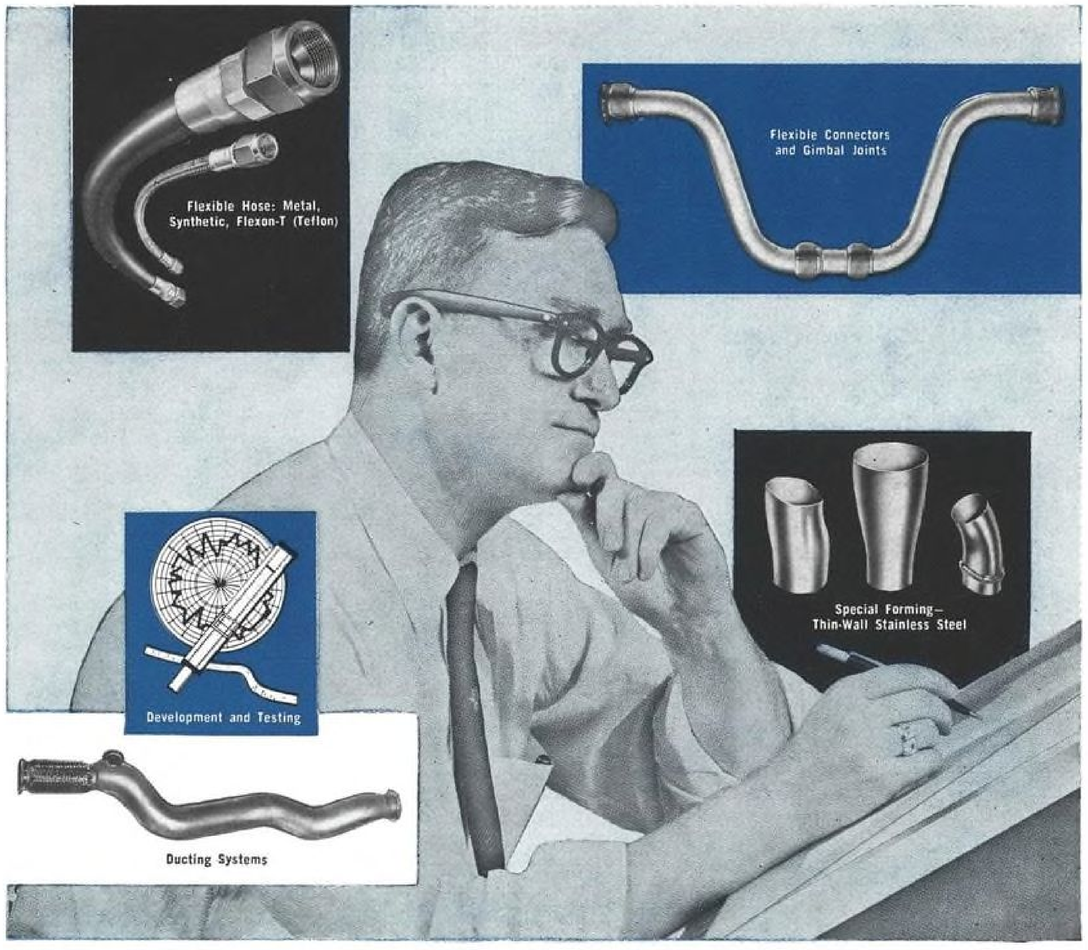
With 1,000 lb. of firefighting equipment hooked underneath, the H-43A pointed up its capabilities of sparking rescue efforts involving an aircraft fire. For this demonstration Kaman spilled 400 gal. of gas-plus-thinner over fuselage with a dummy "pilot" in the cockpit.

Firefighting rig included extinguisher container plus 150 ft. of 1½ in. hose on a reel. Helicopter normally would fly upwind of the fire, drop the rig and crash-rescue crew and, with rotors, wash a path through the fire to the cockpit.

For this operation the H-43A dropped the rig, but a standby truck was used for source of aerated foam. A gun-type 13-lb. Rockwood combination water-foam nozzle was used, which had been specifically developed for the Air Force.

Fire was at a peak when the helicopter moved in, about 15 ft. high and roughly 50 ft. back from the flames. At hover, pulling 33 in. manifold pressure and 2,200 rpm., strong rotor downwash quickly opened a path through the fire and we moved up a bit.

The three-man crew sprayed foam at the rate of 800 to 900 gal. per min. Pressure at truck was 150 lb.; at nozzle, because of friction loss, 110 lb. Crew had the dummy out of the cockpit in about 15 sec. Only 20 gal. of foam were used. Helicopter continued "knocking



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down" the fire throughout the rescue.

Power of the rotor downwash was further evidenced when helicopter was moved to the other side of the fire, and rotor blast accidentally caught some eight empty fuel drums that were stacked to the side. The blast sent drums barreling through some very active flames. Everybody ran; we backed away in a hurry.

Rubber Fuel Cell

H-43A's rubber fuel cell is located in the lower aft fuselage, under the engine compartment and passenger area of cabin. Cell is not self-sealing. Fuel is discharged through a system of dual sumps and automatic flow control valves. The forward sump is located at lowest level of the cell and contains a submerged electrically operated boost pump which discharges fuel at 4 to 6 psi. Fuel is drawn from aft sump by engine-driven fuel pump when nose-up maneuvers cause fuel to flow away from the forward sump.

Electric power supply system provides 28 v. direct current and 115 v., 400-cycle, 3-phase alternating current. The 200 amp. generator, driven by transmission, operates only when the engine is running and the clutch is engaged. External power receptacle is located on the left side of the fuselage exterior. A 36-amp-hr.-battery is installed at the forward center area of the cabin and is accessible through the nose bubble door.

Landing gear consists of four nonretractable wheels, with individual shock struts. Rear wheels are fixed; nose wheels swivel, but can be locked in alignment with rear wheels. Nose wheels are equipped with shimmy dampers. All wheels have skid assemblies. Aft wheels have disk-type hydraulic brakes.

Ventilation air is supplied from the engine fan. Air flows through jacket surrounding the combustion chamber of a gasoline heater. Heater is located at lower right side of the engine compartment.

Production Data

The first two H-43As are temporarily at Kaman, where USAF pilots and mechanics are being checked out on the aircraft and rescue work. Air Force took delivery of one helicopter in November; one in December. Deliveries of the balance—16—will be completed by mid-1959. Kaman has the capacity to produce 33 rotorcraft per month.

Kaman stresses that two men can "rock" the R1340-48 engine out in 40 min. Installation takes about 1 hr. 30 min. Rotors can be removed in 1 hr. and installed in 2 hr. Blade changes can be made in slightly over 2 hr.

Some Marine bases, according to the company, have achieved 3 hr. maintenance to 1 hr. of flying for the basically similar HOK (81 have been produced). During the eight-day Atlantic Fleet Exercise Phibex, in March, 1958, the Navy's HUK (24 were produced) was operational 98% of the time.

Company also feels rotorcraft's clutch —overhaul interval is 480 hr.—is good for two service tours. Total time on returned service components—clutches, drive shafts and transmissions—averaged 1,000 hr. in tests at takeoff power.

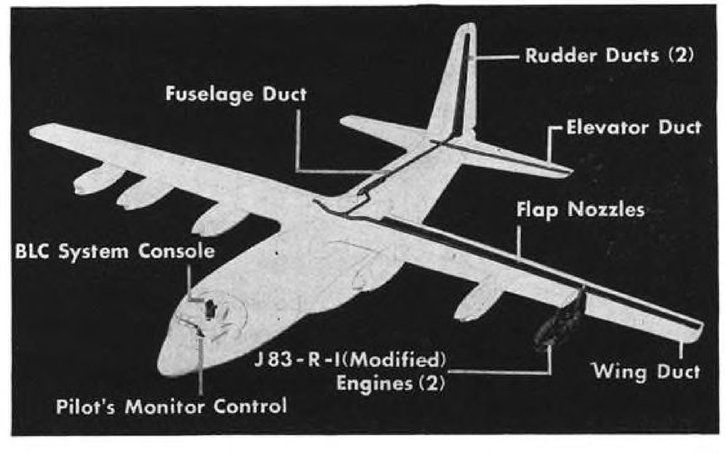
One complete H-43A plus additional spares can be transported in a Fairchild C-119. One and one-half will fit into a Lockheed C-130. Two complete H-43As can be hauled by a Douglas C-124.

In comparison with the piston-driven H-43A, the commercial version of the turbine-powered H-43B could be available in 12 to 18 months. Cost would be in the neighborhood of $200,000. The B model has the capability for an eight-place general utility and passenger helicopter. Free turbine power plant eliminates the need for a clutch in this model.



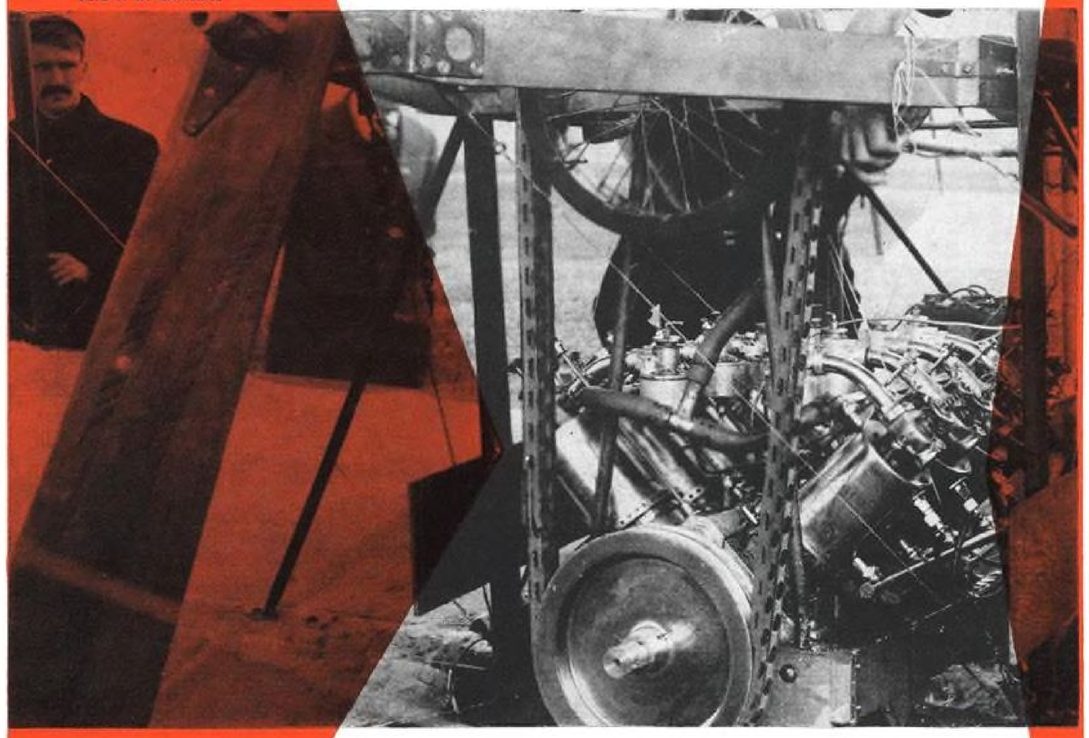
Lockheed to Design C-130 STOL Transport

Lockheed Aircraft Corp. will build a C-130 turbojet transport flying testbed which will include two Fairchild J83-R-1 turbojet engines to provide a constant flow of air over control surfaces, in development of a boundary layer control system. Top photo shows turbojet engine placement, as drawn by a Lockheed artist on a C-130 photograph. Job is undertaken on the basis of a USAF contract to design a short takeoff and land assault transport; work will be done by Lockheed's Marietta, Ga., division. Jet engines will blow air over ailerons, flaps, rudder and elevators through system of wing, fuselage and tail assembly ducts (see drawing below). Jets will operate in addition to the four Allison T56 turbojet engines. Company said the pods will not seriously reduce speed or range. Boundary layer control (BLC) system will operate from flight engineer's post, with monitor provided for pilot.



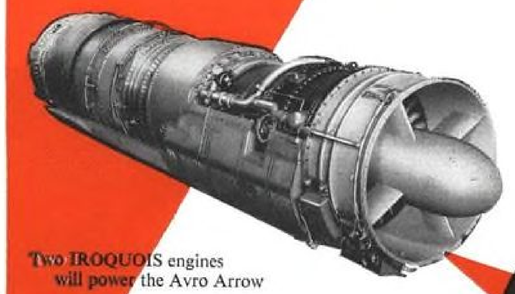
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On Feb. 23, 1909, a 35-horsepower, eight cylinder piston engine powered McCurdy's 'Silver Dart' on the first official flight in the British Commonwealth.

Today, less than a lifetime later, over 60,000 horsepower in Orenda's IROQUOIS turbojet—an engine six times the combined weight of the 'Silver Dart', its engine, pilot and fuel.



Two IROQUOIS engines will power the Avro Arrow

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Convair Tests Electric Flight Controls

By Richard Sweeney

San Diego—Exploitation of electric primary flight controls, considered to have several advantages over hydromechanical units for high performance aircraft, has made a substantial advance with development of an appropriate emergency backup system.

Termed a "minimal manual" system by Convair Division of General Dynamics Corp., which developed it under contract with Flight Control Laboratory at Wright Air Development Center, the system now is completing a two-month flight evaluation in a non-instrumented F-102A at Edwards Air Force Base.

In high performance aircraft, control forces are so high that hydraulic power has long been used as the muscle force for moving control surfaces. Current control systems have a hydraulic connection between the pilot's stick and the control valves which govern the hydraulic actuators which move the surfaces.

Automatic flight, stability augmentation, and fire control systems replace this hydraulic connection between pilot inputs (stick) and the control valves with electric signals.

Electric primary flight controls also replace the hydraulic connection between stick and control valves with electric signals.

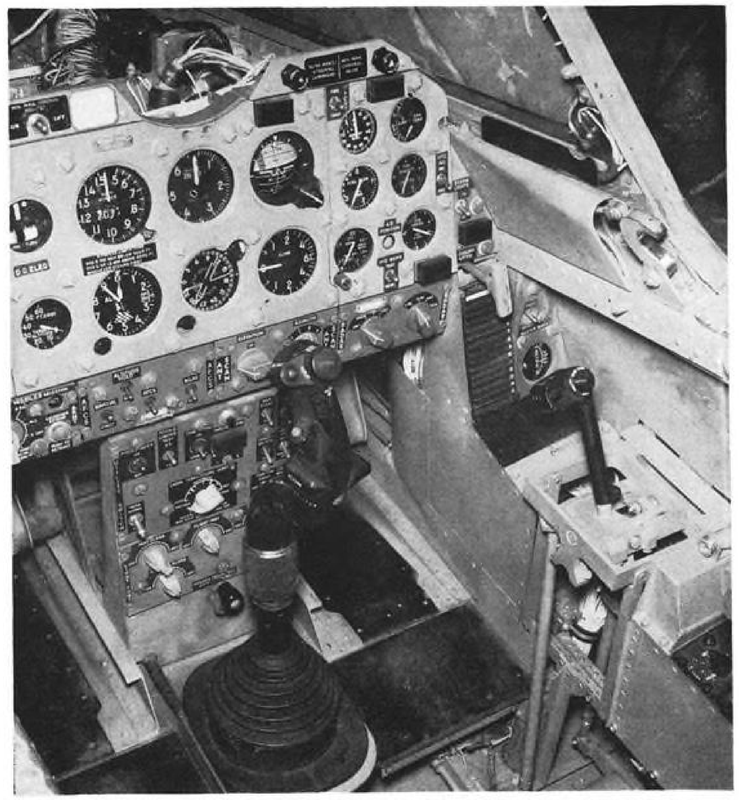
Prime Advantage

A prime advantage of electric control systems, proponents say, is that better pilot control of the aircraft can be maintained throughout the entire performance envelope, from takeoff and landing through high supersonic speeds, utilizing electronic techniques, that can be obtained with mechanical units.

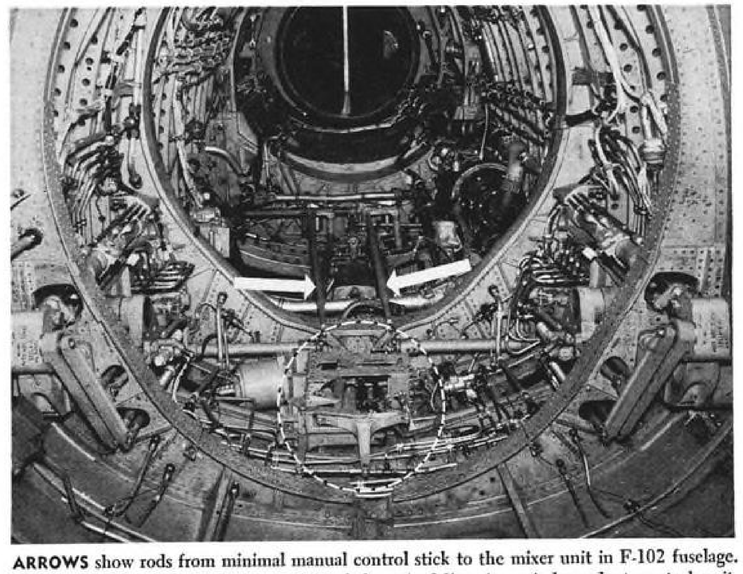
Another advantage of electric primary flight controls is ease of integration with the stability augmentation, automatic flight and fire control systems which are standard on today's high performance aircraft. Signals generated by stick movements can be routed through components common to stability augmentation, automatic flight and/or fire control systems, items such as amplifiers, for example.

Convair first proposed the electric primary flight control system for production aircraft in 1956 and was awarded a study contract in 1957 by Flight Control Laboratory.

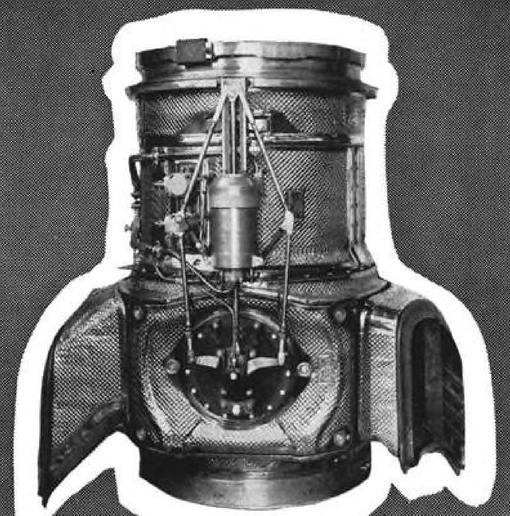
Currently, Convair holds a two-phase contract in which development and flight evaluation of the emergency backup minimal manual system is Phase I. After Convair completes its evaluation in February, the equipment will be



CONVAIR F-102 jet interceptor cockpit has been modified for installation of electric primary flight controls (minimal manual stick is at pilot's right) for Wright Air Development Center tests.



ARROWS show rods from minimal manual control stick to the mixer unit in F-102 fuselage. System mixer is in lower foreground (circled area). Mixer is an independent control unit.



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further flight evaluated by WADC pilots until June.

Phase II of the contract, which got under way last November, calls for a one year program which will culminate in a flight test program of both equipments, electric primary flight controls and the minimal manual system, installed in the F-102A.

In the second phase, electric controls will utilize as many of the already installed components in the F-102A as is possible, including parts of the Hughes MG-10 fire control system, plus parts of plane's regular operational control system. Using this philosophy, Convair is able to "get more for the money" both by using existing hardware per se, also will save time and cost of developing and testing and integrating new hardware.

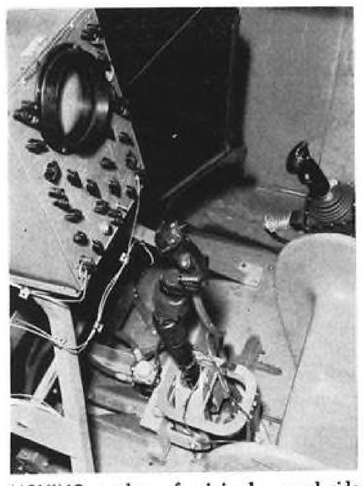
Control Malfunction

The minimal manual system is somewhat better than a "just get home" equipment, yet is not enough to complete a mission should electric primary controls malfunction en route to target. According to Convair however, future minimal manual systems may be able to complete missions.

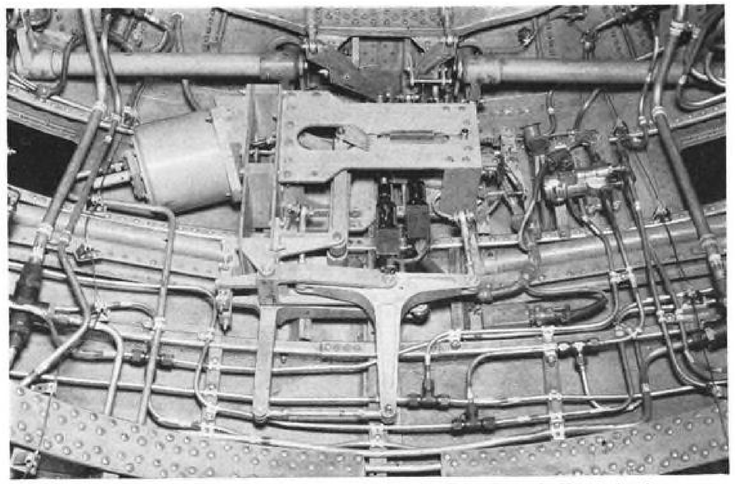
In the minimal manual system, a small formation type stick is used, mounted on right hand cockpit console, with an arm rest behind it. The unit has a modified grip and a 4-in. throw from top of the stick to pivot point is provided.

Direct rod connection is provided between minimal manual stick and the mechanical elevator-aileron mixer unit for F-102's elevons which was developed especially for the minimal manual system.

This mixer is an independent unit in minimal manual system and is not related to plane's regular control system mixer, which is heavier duty since it operates through the entire flight regime of F-102A.



MOVING mockup of minimal manual side stick was used in control development work.



CLOSEUP view of minimal manual mix unit installed in Convair F-102 jet interceptor. Direct rod connection is provided between minimal manual stick and the mixer unit.

The minimal manual mixer is the unit operating the control valves which port fluid to the actuators which move the aircraft's control surfaces.

In the direct rod connections, important factors are system friction and breakout force, key parameters in view of small leverage obtainable with the short stick.

Special Bearings

Special bearings and mounting techniques were developed for minimal manual system with development work accomplished by Fafnir Bearing Co. Development program resulted in a technique whereby bearings are mounted loosely at first, aligned exactly, then solidly locked into place by a potting compound. In this manner, friction increases usually induced by slight misalignment resulting from conventional bearing mounting practices were reduced throughout the system.

Although individual friction increases were never great with the old mounting method, the cumulative contributions became a potent factor in strictly manual system.

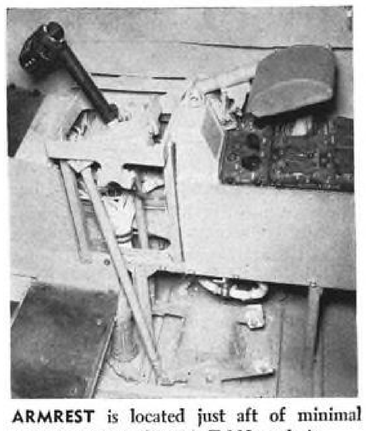
Using a potting technique, cumulative friction levels in minimal manual system are 8 to 9 oz. in pitch, 7 oz., in roll, a considerably significant reduction from levels of previous emergency manual systems.

Force feedback to minimal manual system is through conventional, unsophisticated dynamic-static pressure comparing (q) unit which is not programed the same as force feedback system in F-102A's regular controls.

Minimal manual q unit uses a pot with maximum force differential level of 500 psf. Subsonic maneuvering stick forces were intended to be between 1½ and 2 lb. per g, wound up being about 1 lb. per g. Pilot reports from evaluation flights indicated levels were too low, so a cam is being reshaped to boost values to originally intended levels.

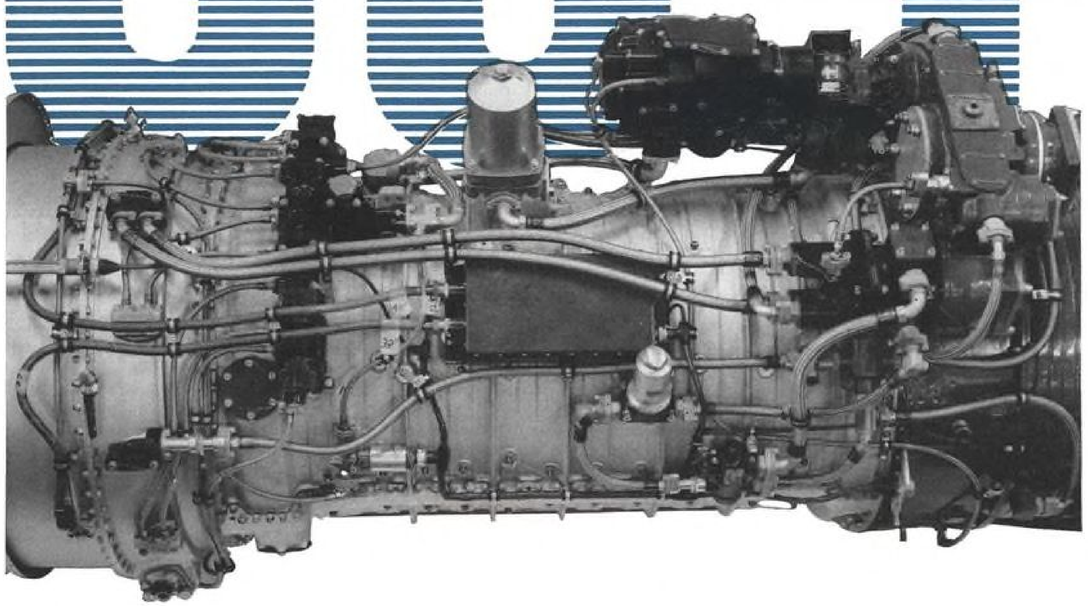
Above the transonic speed region, maneuvering stick forces are allowed to rise to approach values of 12 to 15 lb. per g. Operational concept for minimal manual-electric system envisions, when electric primary flight controls fail in supersonic flight, immediate speed reduction to subsonic flight condition.

Early in the electric stick program, Convair built a moving mockup of a cockpit with sidestick, to evaluate certain ideas. In the mockup, which had pitch and roll movements produced by stick forces fed through analog computer, it appeared possible that the q



ARMREST is located just aft of minimal manual stick in Convair F-102 cockpit.

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unit might be eliminated from minimal manual.

In flight test aircraft, provisions were made for a pilot operated switch to turn the pressure sensing portion of q unit off, leaving the pilot flying against forces generated by a spring which is integral part of the q unit. Spring in test airplane was not the best, but changing it required engine removal, so it was left installed, with allowances to be made after evaluating flight test pilot opinions for a better spring.

However, in preflight program, mock-up indications were proved invalid—the entire force feedback system was rated as an essential part of minimal manual by evaluation pilots.

A ratio changer is incorporated into the minimal manual system in pitch axis, in the form of a torsion bar in elevator linkage, to guard against an over-sensitivity problem. This too can be shut off during flight evaluation to see if it is absolutely required in minimal manual flight control system.

Sidestick mounting is such that neutral position for the control is with 10 deg. inboard and 20 deg. forward slants, this derived as best position from which to apply control movements with arm on the adjustable arm rest. Minimum manual stick does not move with trim.

Full control surface deflections are obtained with minimal manual, with 15 deg. forward and 45 deg. aft stick movement producing full pitch range, 35 deg. stick travel giving full lateral surface displacement.

Orifice Technique

In minimal manual installation, with direct mechanical connection between cockpit stick and rear unpressurized part of the aircraft, a controlled leakage orifice technique is used to pass moving components through pressure bulkheads.

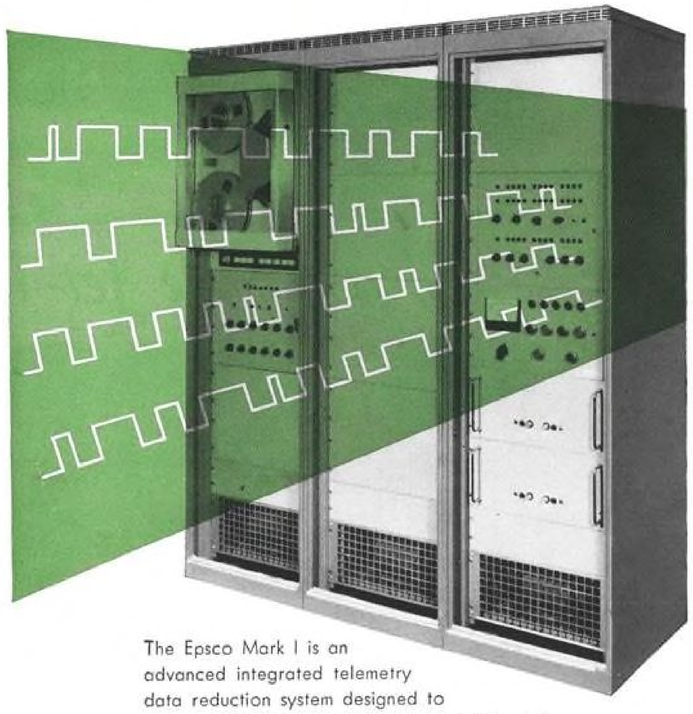
In the F-102A test bed, the air plane's normal hydraulic control system is installed and operative, will remain intact in Phase II flights also. This gives the aircraft two control systems now—minimal manual and normal operational, while second phase will see three systems installed and working—normal, minimal and electrical.

Minimal manual installation provides for a button on the sidestick to engage the minimal manual system, while disengagement (actually reengagement of operational control system) is done by a push button on the main control stick.

In the Hughes MG-10 fire control system used by operational F-102A airplanes, some of the functions of a conventional autopilot are incorporated as subsystems, since the airplane does not carry a separate autopilot itself. Such functions will include Mach and head-

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During Phase II, following study, analysis and simulation work, a report will be made by Convair to Flight Control Laboratory which will spell out requirements for what parts (functions) of off-the-shelf MG-10 can be used in the electric primary flight control system.

Parts of the MG-10 relating to weapon aiming and discharge will not be in the electric stick test airplane, but altitude and heading hold components will be used. The airplane's stability augmentation system also will be used.

In interests of simplification in the original F-102A design, Convair developed what is called the Convair Damper Amplifier Package, which is a single set of amplification units accepting inputs from the MG-10 and stability augmentation equipments, sending on one electrical signal to the plane's control surface actuator control valves. This same amplifier package will also be used in the electric stick installation.

Essentially, the electric stick development will put the aircraft into the full autopilot force authority control, with voltages replacing human-hydraulic commands to control surface actuator control valves.

Force transducers will be used off the main stick, with shaping networks immediately behind the transducers. In this, the amount of stick movement (by which the pilot usually judges how much surface displacement he wants to obtain a desired airplane attitude) is related to the amount of force he applies to the stick to put the aircraft where he wants it, hence the use of force transducers.

In addition, airplane will be equipped so that the amount of stick travels to produce a given amount of surface displacement and airplane attitude change can be varied, in effect changing the aircraft's handling characteristics.

Present Convair thinking envisions simplification of such factors as gain in the system according to flight condition. Maneuvering capability will be provided by use of HIG (hermetically sealed integrating gyro) gyros, with no lockout on rudder. Uncoordinated maneuvers such as slip, can be affected simply by rudder pedal pressure.

Data will be gathered in flight tests on stick force per g, friction (and breakout from trim) forces, and on use of rate or g command in the pitch axis. Rate will govern roll control.

Flight test by Convair will be a system shakedown and safety of flight program, after which WADC will conduct the evaluation with Convair furnishing technical support.

One of the prime objectives of the flight program will be to evaluate the system with a possible aim of modifying Mil Spec F 8785 for electric control systems.



Silencer Installed on Comet 2E

Silencers in tailpipes of de Havilland Comet 2E outboard engines are the first, experimental versions of suppressor used with Rolls-Royce RA.29 engines in Comet 4. The Comet 2E, above, photographed at Idlewild Airport, is fitted with Avon 524 outboard engines and Avon 504s, civil version of a military model, in inboard positions.

Germans Coordinate Research Activities

Essen-Muelheim—Led by Germany's major aeronautical research establishment, Deutsche Versuchsanstalt fuer Luftfahrt (DVL), all other research institutes and establishments of any importance in Germany have decided to streamline and coordinate their future activities.

Aim is to avoid any duplication and therefore waste in research and development work.

To this end a new company called Gesellschaft zur Foerderung der Flugwissenschaft E. V. (Establishment for the Advancement of Aeronautical Research), located in the West German capital of Bonn, will be formed April 1.

The new company will represent the interests of the following research establishments:

- **Deutsche** Versuchsanstalt fuer Luftfahrt E. V., DVL, Essen-Muelheim.
- **Aerodynamische** Versuchsanstalt E. V., Goettingen.
- **Deutsche Forschungsanstalt** fuer Luftfahrt E. V., Braunschweig.
- **Deutsche Forschungsanstalt** fuer Segelflug E. V., Muenchen-Riem.
- **Deutsche Studiengemeinschaft** Hubschrauber E. V., Stuttgart-Echterdingen.
- **Forschungsinstitute** fuer Physik der Strahlantriebe E. V., Stuttgart-Flughafen.
- **Max-Plank-Institute** fuer Stroemungsforschung, Goettingen.
- **Graf-Zeppelin Arbeits** und Forschungsgemeinschaft E. V., Stuttgart.
- **Wissenschaftliche** Gesellschaft fuer Luftfahrt E. V., (WGL), Braunschweig.

Final details have not yet been worked out, but it is expected that the new company will be headed in turn by leading persons of the member research establishments. The latter will put up in the limited amount of capital required which is not yet determined.

12 U.S. Companies To Enter Paris Show

Paris—Record number of U.S. companies will participate in the Paris Air Show to be held at Le Bourget June 12-21.

For the first time, U.S. companies will be represented in force. Strong participation is slated from other countries as well. To date 12 countries have signed up for the show. Soviet Union has been invited but as yet hasn't answered. French expect Russians to show up with some of their later commercial aircraft.

Countries so far lined up are Austria, Belgium, Canada, Germany, Czechoslovakia, Great Britain, Holland, Italy, Spain, Sweden, Switzerland and the U.S. To house the large number of exhibitors, the French are building an extension to the regular exhibition building at Le Bourget. At request of several U.S. companies, who want to demonstrate amphibious helicopters. The French government also is building a special water tank.

U.S. companies signed up so far include United Aircraft, Douglas, Boeing, Convair, Lockheed, Northrop, Chance Vought, Curtiss-Wright, Martin, Republic, International General Electric and Bendix.

Business Planes Gain Despite Recession

By Erwin J. Bulban

A substantial increase in number of units and dollar value marked deliveries by U. S. business aircraft manufacturers in 1958 compared with 1957, despite last year's much-publicized industrial recession.

Business plane airframe manufacturers delivered 6,416 units last year having a total net billing value of $101,527,000, compared with 6,118 aircraft valued at some $99.6 million in 1957. By applying average distributor-dealer markups to the net billing value, retail dollar value of 1958 shipments totals some $135 million, approximately $10 million higher than in 1957.

Upswing of business plane deliveries in face of the declining over-all industrial curve last year pointed strongly to continued growing acceptance of the airplane as a vital tool of industry and provides an optimistic indication for the outlook in 1959. With industry generally experiencing an upturn, indications are that U. S. business aircraft manufacturers should be able to do even better this year.

Sales Estimates

Optimistic outlook is further borne out by recent estimates by leading business aircraft manufacturers to Federal Aviation Agency Administrator Elwood R. Quesada that they expect to achieve retail sales totaling some $1 billion in the five-year period 1958-1962. They also reported that in this period they expected to spend some $100 million in research, development, facilities and equipment.

Business aircraft sales and service operations, which are now operating at a level of some $500 million annually, are expected to grow to total business dollar volume annually of some $1 billion in five years. Current capital investment in these fixed base facilities, now estimated at approximately $200 million, could triple in this five-year period, industry leaders estimate.

Part of this latter estimate is attributed to the belief that business flying annual hours will show a large rate of increase in the future over the scheduled airlines. It is estimated that business planes flew some 5.7 million hours last year, compared with some 5.4 million hours in 1957. Scheduled airlines flew approximately 3.7 million hours in 1957, according to FAA records.

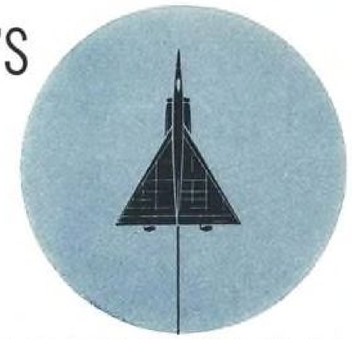
All segments of general aviation

Make & Model	January	February	March	April	May	June	July	August	September	October	November	December	Totals
Aero Design 500	0	0	0	0	0	0	2	9	4	4	7	5	31
560E	1	2	2	3	3	1	2	2	0	0	1	1	18
680, 680E	2	0	5	5	6	6	5	5	2	4	4	2	46
720	0	0	0	0	0	0	0	0	1	1	0	0	2
	$227	$128	$466	$636	$690	$567	$683	$997	$509	$696	$788	$515	$6,902
Beech E18S	4	6	6	5	6	5	6	5	5	3	5	4	60
M5760	0	0	0	0	0	0	0	0	1	0	0	0	1
Bonanza	39	36	40	40	34	29	29	20	16	29	29	35	376
Twin-Bonanza	5	7	9	6	6	4	1	6	4	4	5	3	60
Mentor [1]	0	0	0	15	0	10	0	0	0	0	0	0	25
Travel Air	29	20	24	22	21	16	7	5	6	6	9	7	172
	$2,581	$2,802	$3,154	$3,112	$2,693	$2,291	$1,570	$1,640	$1,673	$1,436	$1,978	$1,730	$26,660
Call Air A4	0	2	4	5	6	4	5	0	0	0	0	0	26
A5	0	0	0	0	0	0	0	6	3	2	1	1	13
A6	0	0	0	0	0	0	0	1	1	1	0	1	4
	$0	$17	$23	$34	$38	$28	$44	$31	$29	$21	$6	$15	$286
Cessna 150	0	0	0	0	0	0	0	0	0	17	37	68	122
172	65	77	55	72	57	48	41	16	4	214	84	57	790
175	0	0	146	126	87	85	73	60	60	37	19	9	702
180	24	26	23	26	27	21	16	10	12	7	29	41	262
182, Skylane	132	80	63	90	73	70	70	48	47	32	26	143	874
310B	21	25	23	16	12	11	11	13	10	7	1	26	176
	$3,605	$3,223	$4,044	$3,993	$3,036	$2,885	$2,595	$2,076	$1,809	$3,022	$1,834	$4,775	$36,897
Champion 7EC	2	2	6	8	7	3	7	1	8	2	3	1	50
7FC	23	21	19	16	22	23	16	11	9	16	7	17	200
7GC	0	0	0	0	0	0	0	10	9	7	12	8	46
	$128	$113	$127	$123	$146	$131	$116	$114	$134	$128	$118	$138	$1,516
Colonial Skimmer	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	6
	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	$138
Fairchild F. 27	0	0	0	0	0	0	0	0	0	0	1	1	2
	0	0	0	0	0	0	0	0	0	0	....	....	$1,500
Helio H-391B Courier	4	4	1	3	1	2	0	1	1	2	1	1	21
	$112	$114	$27	$89	$24	$59	$0	$33	$33	$67	$26	$29	$613
Mooney Mk. 20	10	6	13	13	13	12	12	9	16	13 [2]	34	9	160
	$106	$66	$167	$140	$147	$137	$137	$103	$182	$147	$433	$103	$1,868
Piper PA-18	10	22	13	21	24	13	13	19	14	7	13	13	182
PA-18-A	26	24	41	42	38	45	35	38	14	8	17	14	342
PA-22 Tri-Pacer	92	62	88	57	60	58	38	62	37	76	54	36	720
PA-23 Apache	25	24	40	39	29	29	21	21	15	15	27	19	304
PA-24 Comanche	26	16	34	24	47	62	43	61	78	75	81	67	614
	$1,979	$1,637	$2,573	$2,261	$2,348	$2,536	$1,840	$2,347	$2,103	$2,268	$2,611	$2,054	$26,548
Taylorcraft 20	1	1	1	1	1	1	1	1	1	N.R.	N.R.	N.R.	9
	$11	$11	$11	$11	$11	$11	$11	$11	$11	N.R.	N.R.	N.R.	$99
Totals (Aircraft)	541	463	656	655	580	558	454	440	378	589	507	589	6,416
Totals (Net Billing Prices)	$8,749	$8,111	$10,592	$10,389	$9,133	$8,645	$6,996	$7,352	$6,483	$7,785	$7,794	$9,350	$103,027

[1] Military primary trainer export sales, considered commercial transactions.
[2] Estimate.

SHIPMENTS of U. S. business and utility aircraft during 1958 are outlined in this table. Net billings are in thousands of dollars.

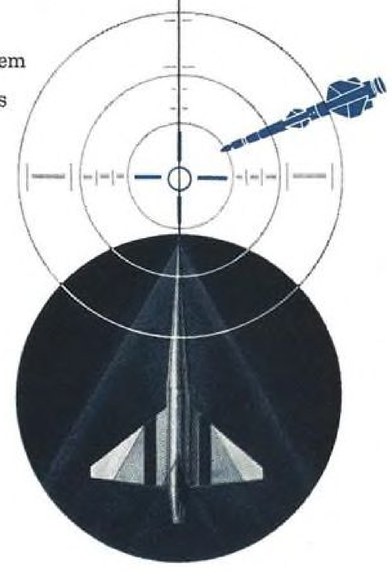
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The mission:

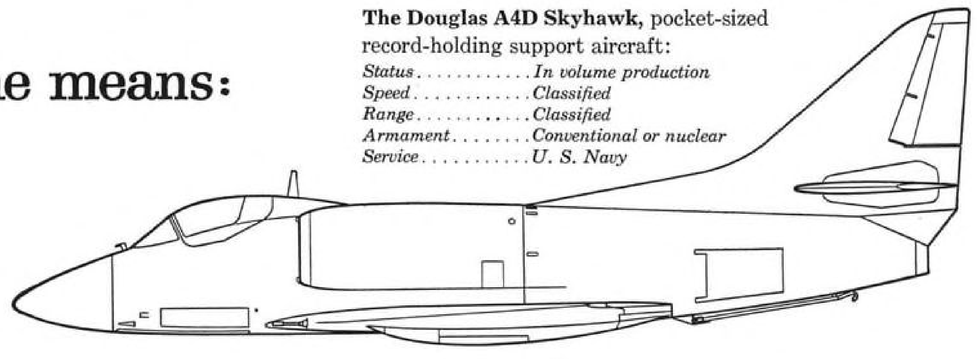
Providing support for our fast-moving military groups assigned to containment of Red threats. Here we see a phase of the brushfire operations at Quemoy.



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Service . . . . . *U. S. Navy*



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The Nation's Partner in Defense

which includes all flying other than military or scheduled airlines increased flying hours from 8.9 million in 1954 to 10.9 million in 1957 and it's expected that total of hours will increase to some 11.5 million for 1958. Approximately half of hours flown in the general aviation industry are flown by business aircraft. Instructional flying hours have also shown significant increases in recent years—from 1.3 million hours annually in 1954 to 1.9 million hours in 1957.

Total delivery picture for 1958 upon closer examination showed that not all manufacturers fared as well as in 1957. Actually of the "Big Three"—Beech, Cessna and Piper—only Cessna forged ahead, compared with calendar year 1957. Beech delivered 694 airplanes in calendar year 1958, a decrease of 94 units from calendar year 1957, records of the Utility Airplane Council of Aircraft Industries Assn. reveal. The firm's net billings were down some $5.4 million over calendar year 1957. Piper units declined 138 in calendar year 1958 compared to calendar year 1957 and net billings were off approximately $3.2 million compared to calendar year 1957.

Cessna, as a result of a noticeably aggressive sales campaign and aided by introduction of further models to its line, showed a gain of 431 units delivered in calendar year 1958, compared with calendar year 1957 and an increase in net billings to more than $36.8 million, compared with some $30.9 million in calendar year 1957.

There was some drop in export sales in calendar year 1958 by some manufacturers: last year, Aero Design, Beech, Cessna and Piper shipped 865 aircraft abroad (of which 87 were delivered to U. S. territories) having a net billing value at the factory of $12,044,800, compared with 1957 exports of 1,131 aircraft (of which 84 went to U. S. territories) having a net billing of $17,372,539.

Last year's exports represented 14.7% of the total output by these four manufacturers, compared with 19.8% of their total deliveries in 1957.

A major reason for the decrease in exports last year is increasing shortage of U. S. dollars available abroad. Because of the dollar shortage, many markets, including South American, have been turning to soft-currency nations—such as England, France and Italy, for light aircraft, and industry observers feel that Germany will play an important role in the lightplane export market when it has available equipment in sufficient quantities.

Spray Plane Used in Soil Program

Experimental aerial soil top-dressing experiment at a hilly, remote farming community in North Carolina demonstrated to farmers there recently for the first time how the airplane can provide a needed solution to utilization of resources that cannot be tapped economically using conventional agricultural methods.

Watauga County is a typical area in which U.S. Department of Agriculture's Rural Development Program is trying to help people improve their farm incomes by expanding their agricultural opportunities—primarily by making better use of the properties they now have.

The program could provide significant business for agricultural aircraft operators who could participate in demonstrations and in follow-up contracts that might develop in course of these



MODIFIED Stearman PT-17 is loaded by mechanical loader at Watauga demonstration.

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Product Improvement Program

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Product Improvement Program

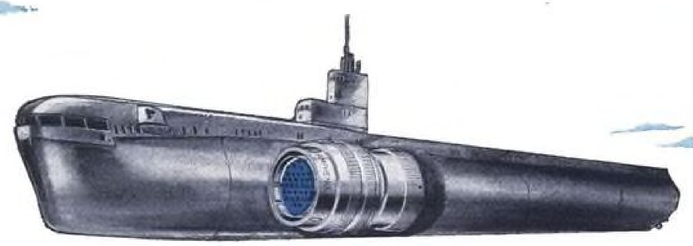
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THE FLYING SUBMARINE

"Flying Submarine" describes AMPHENOL's new *MINNIE* 67 series connector; it may seem a large and unlikely name to fasten on such a small connector, but it's quite accurate. Here's why: The performance conditions under which these miniature "E" connectors will operate reliably are exactly like those encountered by a submerged submarine—flying at 80,000 feet altitude.

"Flying Submarine" also means *altitude-moisture resistant.* Under a test recently devised by industry and the armed services, wired *MINNIE's* are completely submerged in salt water, altitude cycled to 80,000 feet for one minute, 65,000 feet for one half hour and then returned to ambient pressure for another half hour. Following this test, the minimum insulation resistance of *MINNIE* connectors is 1000 megohms, well in excess of the 100 megohms required by MIL-C-5015 after moisture exposure.

What can a "Flying Submarine" do for you? If you use electrical connectors in aircraft, missile or naval applications (including non-flying submarines), *MINNIE* connectors provide *assured environmental resistance to moisture* at sea level and at high altitudes. Write for complete information on AMPHENOL'S *MINNIE* connectors!

AMPHENOL's Authorized Industrial Distributors stock MinniE's and other standard AMPHENOL components—and provide on-the-spot delivery.

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local education programs. Federal Extension Service and Soil Conservation Service alone are providing some $1,350,000 in funds for Rural Development Programs this year. A total of 102 countries in 30 states currently are involved in these programs, according to USDA.

A prime problem in many low-income farm communities—some 56% of American farm families produce less than 10% of marketed farm products, according to USDA—is their lack of ability to diversify production because in many cases bad topography makes it uneconomical to use considerable amount of lands.

USDA points out that some 4 million acres of stony or steep land in humid sections of this country could be used for pasture, enabling soil farmers to improve their incomes by taking on sheep, beef and dairy cattle raising if the land could be economically fertilized.

Watauga County was selected for the Rural Development Program experiment in this category since of its approximately 55,000 acres of mountain pasture land only some 16,000 can be classed as improved pasture, according to county farm agent L. E. Tuckwiller. Slopes of more than 30 deg. prevent using surface farm machinery from improving the available, unused land.

To demonstrate to local farmers how their problem could be licked using airplanes, an aerial soil top dressing demonstration was organized with nine farmers under the leadership of the county agricultural agent, other county agricultural workers and American Potash Institute.

By harvesting a corn crop on a few acres of bottom land in the community, a landing strip was prepared, and the field was smoothed down by driving farm trucks over the strip. Yadkin Valley, Inc., an aerial agricultural operator, based at Winston-Salem, flew in a modified Stearman and a Piper Super Cub.

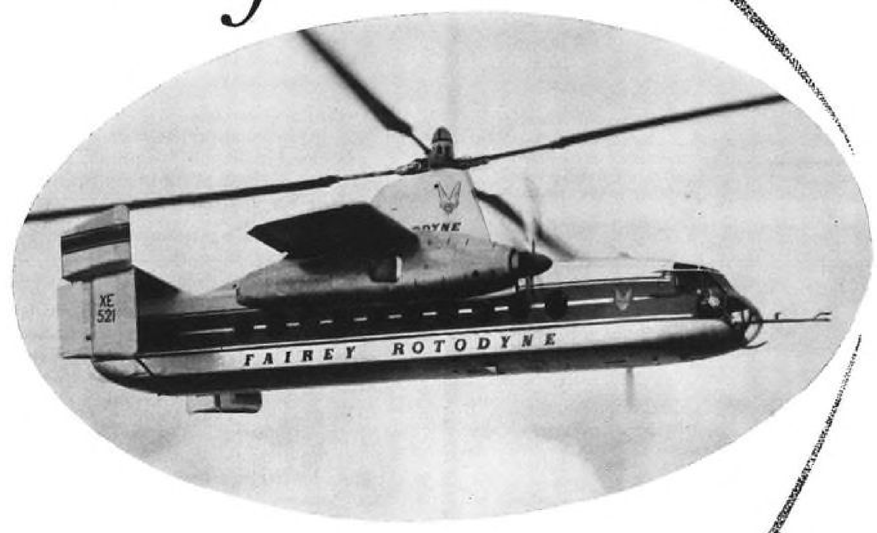
Planes distributed approximately 300 lb. of mixed fertilizers per acre plus some lime, top-dressing some 166 acres total. Cost of application: 1.25 cents per acre.

Third Gulfstream Enters Flight Status

Third Grumman Gulfstream turboprop-powered executive transport was expected to enter flight status last week at the company's Bethpage, N. Y. plant, company sources report. Number four Gulfstream currently is in preflight.

First prototype is undergoing tests at Stuart Field, Fla. and number two recently completed a two-weeks icing test program in the Dayton, Ohio area. Company expects FAA certification of Gulfstream in early April.

The World's fastest Rotorcraft



ROTODYNE sets new world record at 191 m.p.h.

(Subject to F.I.A. Confirmation)

Fairey's Rotodyne vertical take-off airliner has established itself as the fastest rotorcraft in the world. On 5th January, 1959, it flew round a 62 mile closed-circuit record course at an officially observed average speed of 191 m.p.h. for a new world convertiplane speed record—at *cruising* power and *operational* weight.

This record, almost 50 m.p.h. faster than the corresponding helicopter record and 30 m.p.h. faster than the absolute speed record for helicopters, confirms Fairey's claim that the true V.T.O. airliner is here, now, for city-centre to city-centre journeys, needing no expensive airfields, wasting no valuable time.

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HAWK—the Army's defense against low-altitude attackers—carries out its destruction in the blind zone of conventional radars. Hawk development and production is under Raytheon prime contract.



TARTAR—A substantial contract for vital electronic controls for this Navy destroyer-launched missile is held by Raytheon. This equipment—a tracking radar and associated units—enables it to "lock on", cling to target's path, despite evasive tactics.



ADVANCED PROJECTS in aeronautical structures as well as missile guidance and control are now underway in Raytheon laboratories. New facilities are continually being added for this work.



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Dynamic Raytheon growth—the fruit of this management's progressive policies—is best illustrated by the fact that Raytheon is already the only electronics company with two prime missile contracts—Navy Sparrow III and Army Hawk.

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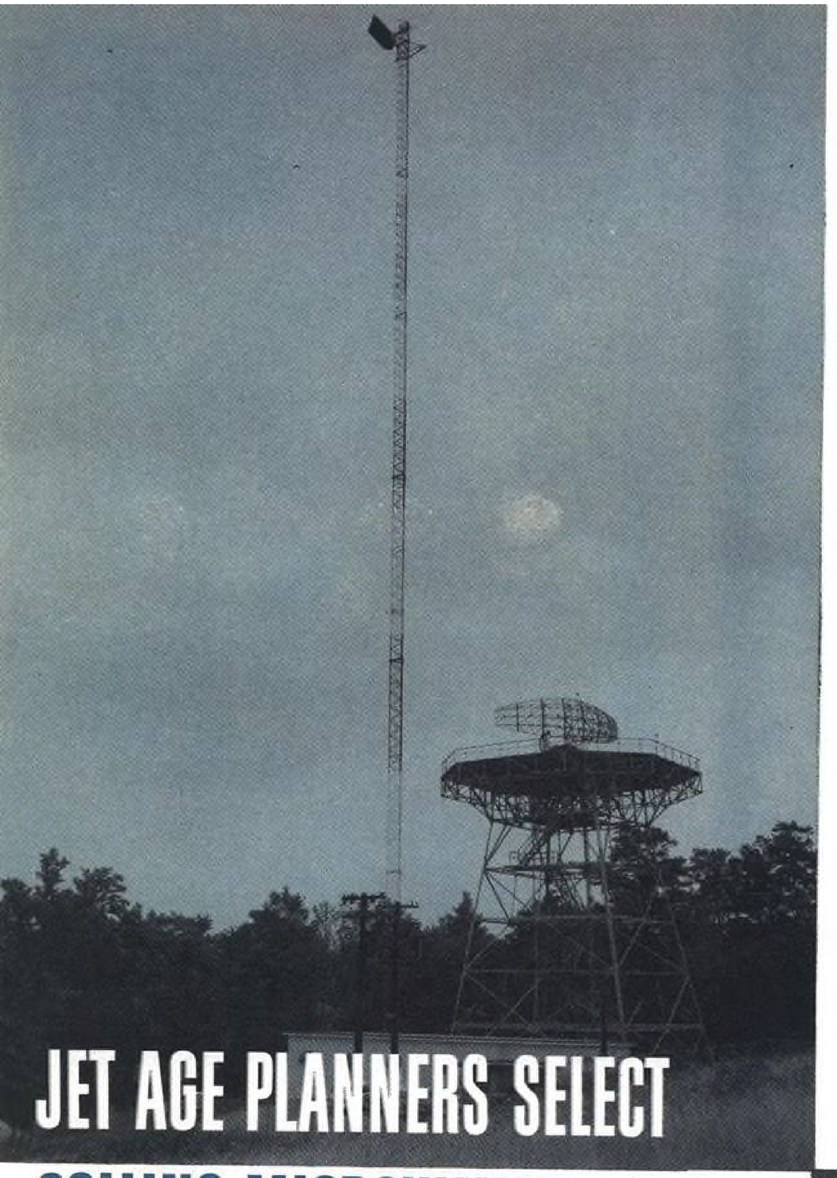
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Complete Collins Microwave Systems have been designed and are being installed for the Federal Aviation Agency (which includes the former CAA) in its current expansion program to increase air traffic capacity and safety.

The microwave systems are used to relay radar and remote control information and voice communication between long range radar sites and Air Route Traffic Control Centers. Collins is providing systems encompassing equipment for 104 terminals and 181 repeater stations located throughout the United States.

Collins was selected over several companies because it could do the job economically with excellent equipment, providing capable engineering assistance for all project phases.

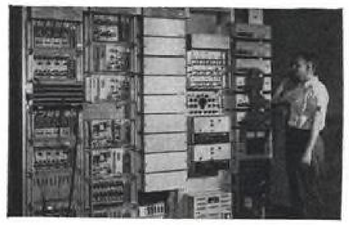
If you have a microwave requirement, large or small, let Collins assist you in evaluating, planning and installing your system. Write or phone Collins Radio Company, Texas Division Sales, 1930 Hi-Line Drive, Dallas 7, Texas.

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Typical radar/microwave station (left) detects all aircraft in a 200 mile (320 km) radius; radar signal is processed and relayed to Air Route Traffic Control Center through Collins Microwave link (tower at left).

FAA technician (below) talks over the service channel at the radar/microwave installation. Both Collins carrier and RF equipment are used at such sites.

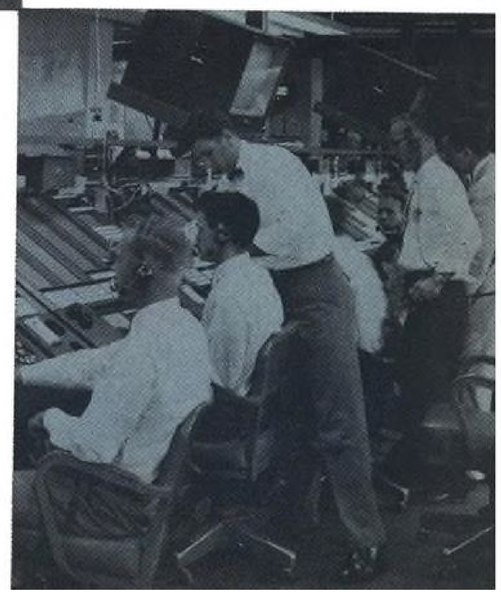


FAA and Collins engineers (below) check out a typical Collins microwave repeater station used to link radar/microwave sites to Air Route Traffic Control Centers.



Collins RF and carrier installation (below) at this Air Route Traffic Control Center utilizes two bays to control equipment at two different radar sites.

The nerve center (below) of all FAA Air Route Traffic Control Centers utilizes Air Traffic Controllers who keep track of all aircraft in the center's area.



NEW AVIATION PRODUCTS



Missile Ball Valves

Ball valves are intended for use with standard and high energy fuels, oils, oxidizers, coolants and cryogenics. Valves are designed for both ground support and in-flight missile applications.

When functioning as drain, selector, fill and flushing valves, ball type valve can be actuated by manual, mechanical or electrical means.

Kochler Aircraft Products Co., 409 Leo St., Dayton, Ohio

Nitrile Silicone Rubber

Nitrile silicone rubber compound now available in evaluation quantities is suitable for airframe seals, boots, diaphragms and shock mounts. Material is intended for uses involving intermittent contact with high swell fluids or continuous immersion in milder fluids.

NSR-X5602, now available, is a 60 durometer, relatively low modulus stock. A rubber of higher oil assistance intended for 0-rings, gaskets and oil seals, NSR-X8701, is rated at 70 durometer and will be available for evaluation in March.

General Electric Co., Silicone Products Department, Waterford, N. Y.

Liquid Fluorine Pump

Liquid fluorine transfer pump is designed to permit the safe handling of the fluid without gas pressurization.

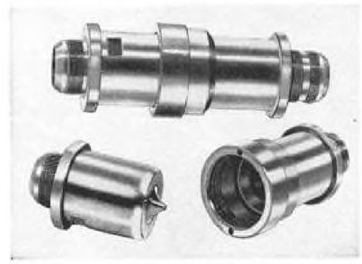
System utilizes a commercially available throttle valve and a pump supported by commercially available tankage pressurization and shutoff valve. Pump is designed to deliver 1,000 gpm. at a pressure rise of 150 psi. Pump's efficiency of 55% is slightly lower than conventional pumps operating at similar speeds due to large internal clearances which prevent components from rubbing together. Fluorine pump is driven by a 160 hp. induction motor at 3,250 rpm.

Aerojet-General Corp., Turbo-Machinery Division, Azusa, Calif.

Liquid Oxygen Coupler

Liquid oxygen and liquid nitrogen disconnect couplers are intended for use on missile fueling and pressurization ground support equipment.

Coupler, made of 300-series stainless steel and chrome plated in wear areas, is a slip joint type that disconnects



with little break-away force. Operating pressure is from 0 to 500 psi; with proof pressure of 1,000 psi. Leakage at zero to 160 psi, both connected and disconnected, is nil, the maker states. Operating temperature range is from −325F to +500F. Coupler comes in tube size ¼, ¾, 1 and 1½ in.

The Bruning Co., Lincoln, Neb.

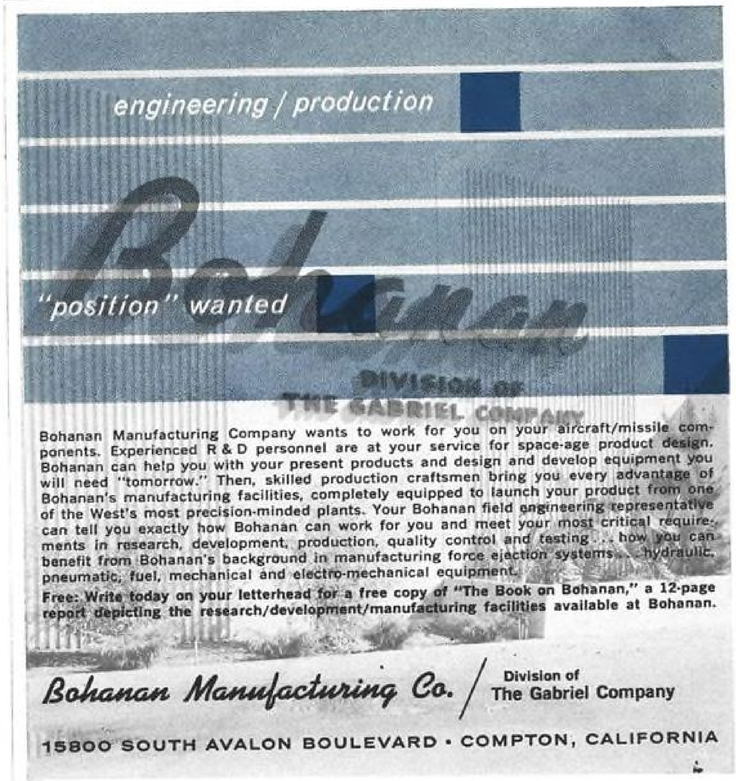
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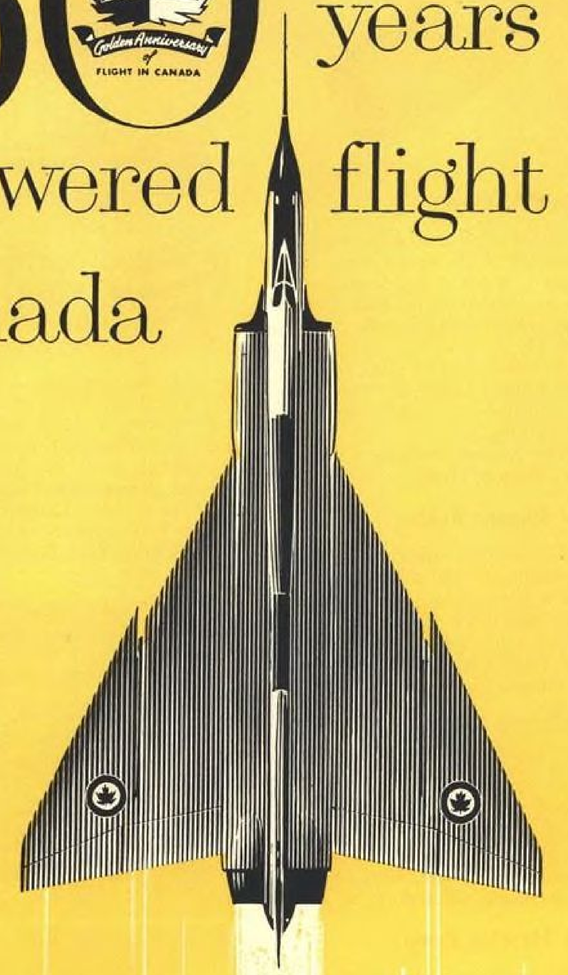
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WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.:

The Effect of Temperature on the Magnetic Properties of Nickel-Iron Alloys—by J. J. Clark and J. F. Fritz, Westinghouse Electric Corp., for Wright Air Development Center, U. S. Air Force. Dec. 1957. $1.00; 36pp. (PB 131799).

Study of Physical Characteristics on Thin Film Resistance Elements—by D. W. Moore, Servomechanisms, Inc., for Wright Air Development Center, U. S. Air Force. Dec. 1957. $1.25; 48pp. (PB 131703).

Investigation of Germanium-Silicon Alloys: Final Report—by C. C. Wang, Sylvania Electric Products, Inc. for Bureau of Ships, U. S. Navy. Feb. 1955. $1.25; 48pp. (PB 131422).

Gas-Recoil Fast Neutron Spectrometer—by R. E. Benenson, Wright Air Development Center, U. S. Air Force. June 1958. $1.00; 36 pp. (PB 151187).

An Electron Beam Density Probe for Measurements in Rarified Gas Flows—by F. C. Hurlbut, University of California for Wright Air Development Center, U. S. Air Force. Jan. 1958. $.75; 28pp. (PB 151204).

A Portable Adiabatic Calorimeter—by B. L. Hansen and H. H. G. Jellinek, Corps of Engineers, U. S. Army. July 1957. $.50; 8 pp. (PB 131636).

Rolling Pullout Study: Part 1—Development of a Large Disturbance Theory for Calculating Airplane Motions and Tail Loads in a Rolling Pullout Maneuver—by D. W. Rhoads and J. C. O'Hara, Cornell Aeronautical Laboratory for Wright Air Development Center, U. S. Air Force. July 1957. $2.50; 99pp. (PB 151018).

Research to Investigate the Feasibility of Electron Mirror Microscopy in the Study of Magnetic Domains—by L. J. Mayer, General Mills, Inc., for the Wright Air Development Center. Sept. 1957. $1.00; 32pp. (PB 131624).

Fundamentals in Noise Source Calibration at Microwave Frequencies—by J. E. Sees, Naval Research Laboratory. Jan. 1958. $.75; 24 pp. (PB 131367).

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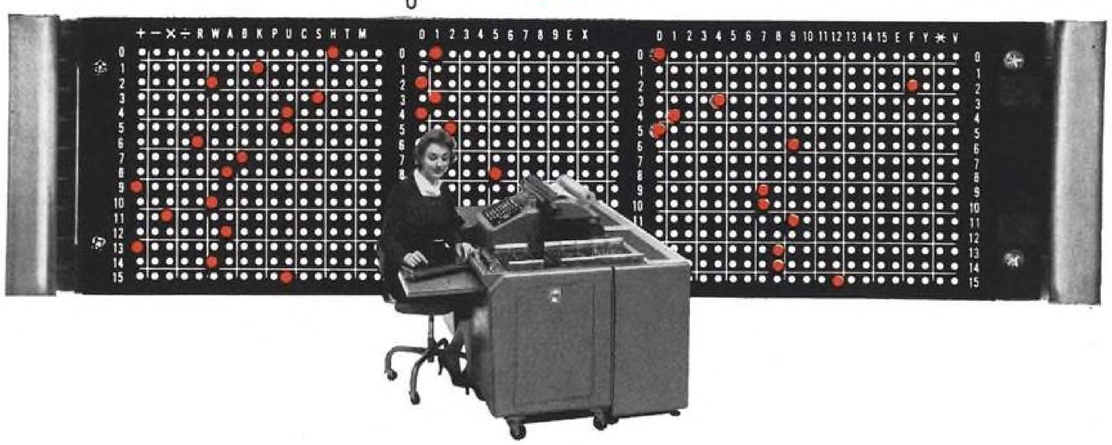


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fire Antenna—by J. O. Pullman, Naval Research Laboratory. Jan. 1958. $.75; 22pp. (PB 131473).

Physical Action of Intense High Frequency Sound on Vertebrate Tissue: Part 2—by W. J. Fry and others, University of Illinois for Wright Air Development Center, U. S. Air Force. Mar. 1958. $1.25; 44pp. (PB 151219).

Effects of Severe Whole Body Vibration on Mice and Methods of Protection From Vibration Injury—by J. Roman, Wright Air Development Center, U. S. Air Force. Apr. 1958. $1.00; 37pp. (PB 151212).

Transient Response Studies of the Blood Volume Receptor System in Dogs—by K. M. Chapman, Wright Air Development Center, U. S. Air Force. May 1958. $.50; 15 pp. (PB 151146).

Publications Received:

Gas Turbines For Aircraft—by Arthur W. Judge—Pub. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. $12.00; 439pp.

History of the gas turbine from its manufacture to the combustion, starting and control systems. Guide for students undertaking internal combustion engineering courses.

The Atom and the Energy Revolution—by Norman Lansdell—Pub. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. $6.00; 200pp.

Subjects covered include: the atom, its energy and methods of releasing it; material sources of atomic energy; exploitation by separate countries, and its impact on the world.

The Years of the Sky Kings—by Arch Whitehouse—Pub. Doubleday & Company, Inc., 575 Madison Avenue, New York 22, N. Y. $4.95; 336pp.

The history of the airplanes in World War I, and of the men who flew them.

The Story of Aviation—by David C. Cooke—Pub. Herman & Stephens Inc., 200 East 37th Street, New York 16, N. Y. $4.95; 264pp.

One of America's foremost writers on aviation tells the story of man's conquest of the air up to the latest rockets and jets.

Guided Missile Engineering—by Allen E. Puckett and Simon Ramo—Pub. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 36, N. Y. $10.00; 497pp.

This book gives important principles and engineering techniques of the various sciences that make up the guided missile engineering field and their interrelations.

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U.S. Urged to Increase Study Of Oceanography as Defense Aid

Washington—Committee of the National Academy of Sciences last week urged an increase in ocean exploration—which it viewed as militarily more urgent than space exploration.

Noting that "we know less about many regions of the oceans today than we know about the lunar surface," the committee headed by Dr. Harrison Brown, professor of geochemistry at the California Institute of Technology, stated:

"From the point of view of military operations, there is no comparison between the urgencies of the problems of the oceans and those of outer space. The submarine armed with long-range missiles is probably the most potent weapon system threatening our security today. It seems clear that the pressures of establishing effective bases, and of protecting ourselves from attack, are relentlessly driving us into the oceans. . . .

"We will not be able to navigate under the oceans with adequate precision until our knowledge is greatly expanded. Nor will we be able to detect submerged submarines efficiently. . . . We will not be in a position to negotiate an adequate international submarine control and monitoring system until we have the ability to make the oceans transparent so that we can track all submarines in the oceans. . . ."

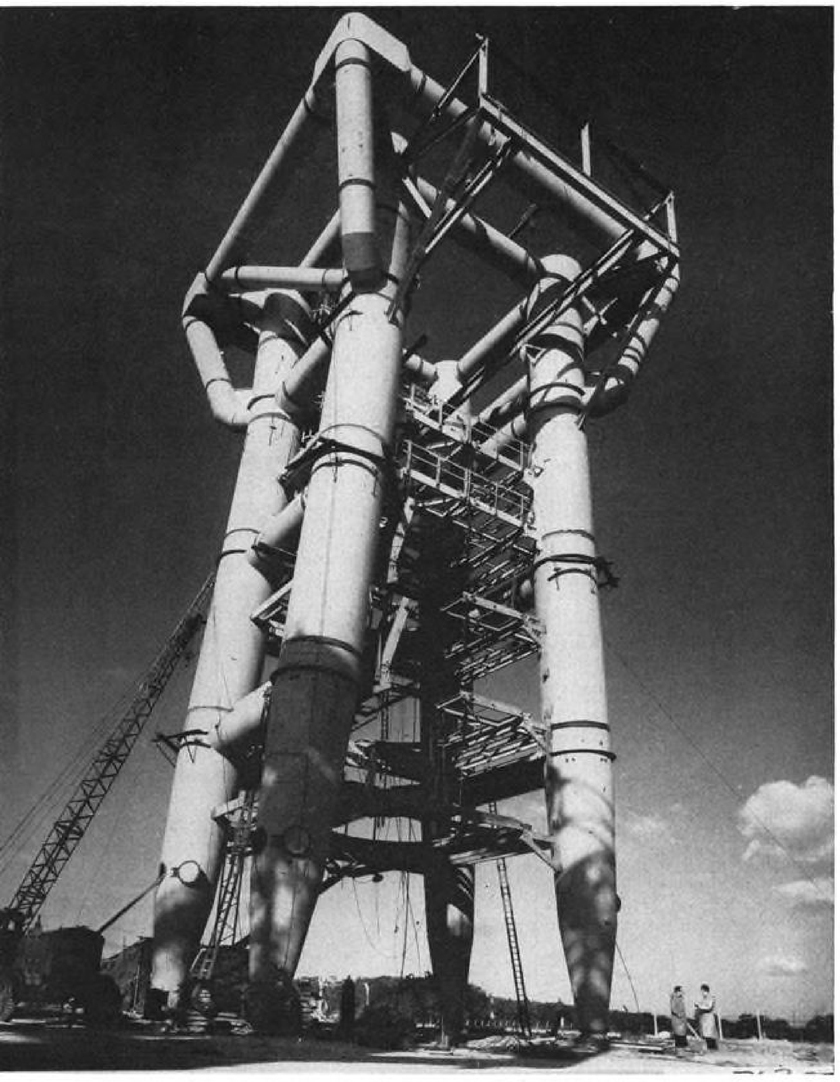
The present level of ocean research is approximately $23 million a year. The 10 year program blueprinted by the committee "as an essential first step" would total $881 million, an average $88.1 million each year. Navy would sponsor all the military research and development operations, the National Science Foundation and the Office of Education the program for increasing scientific and technical manpower in marine sciences.

Hardware requirements for the explorations planned by the Academy committee include:

- **Manned submersibles that** can operate down to and on the bottom of most of the ocean.
- **Open-ocean manned research** platforms which are stable and which can remain in place so that time studies can be made.
- **Aircraft for open-ocean** research and surveys, involving both problems of oceanography and meteorology.
- **Submarine capable of breaking** into and out of ice. "Surface icebreakers are of limited value to Arctic oceanographic research. . . ."
- **Survey instruments "which are more** accurate, effective and trouble-free than those now in use. The techniques needed to use them more effectively should be developed. Specialized devices such as Loran C, inertial navigation equipment, gravity meters and stable platforms should be made available for research as well as surveys as soon as possible."

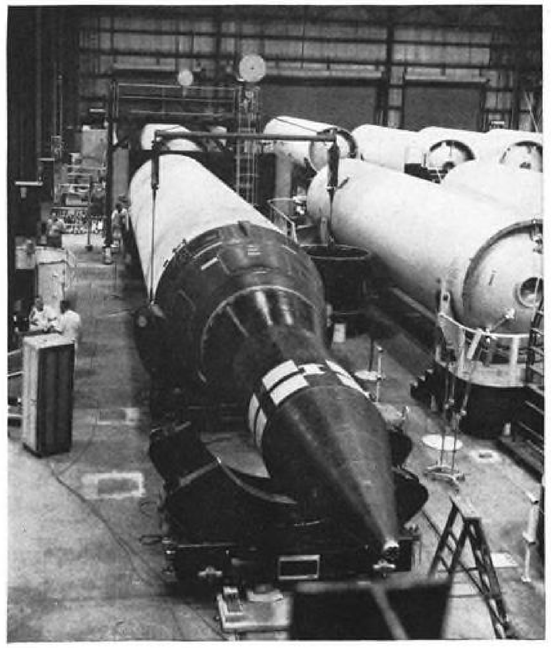
The committee's report was based on a two-year study sponsored by Atomic Energy Commission, Office of Naval Research, National Science Foundation, and Bureau of Commercial Fisheries.

In addition to Dr. Brown, the committee included Maurice Ewing, Lamont Geological Observatory of Columbia University; Columbis Iselin, Woods Hole Oceanographic Institution; Fritz Koczy, Marine Laboratory of the University of Miami; Sumner Pike, former Atomic Energy Commissioner; Colin Pittendrigh, Biology Department of Princeton University; Roger Revelle, Scripps Institution of Oceanography; Gordon Riley, Bingham Oceanographic Laboratory of Yale University; Milner Schaefer, Inter-American Tropical Tuna Commission; Athelstan Spilhaus, Institute of Technology, University of Minnesota.



British Build Blue Streak Tower

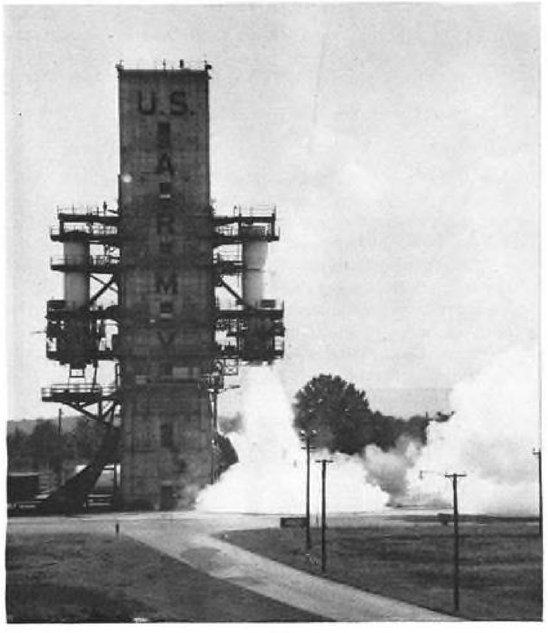
Test tower for British Blue Streak ballistic missile (AW Sept. 15, p. 30) is being constructed at Hatfield, England, test center by de Havilland Propellers, Ltd. For details on British government emphasis on Blue Streak development, see p. 53.

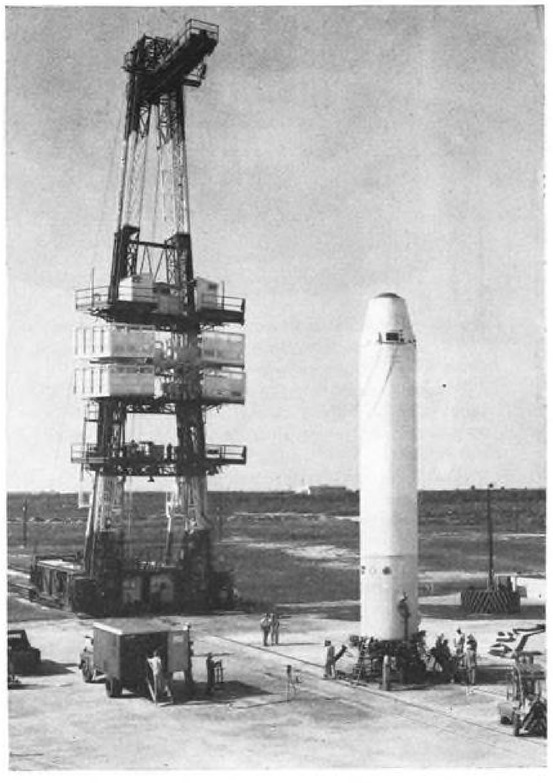


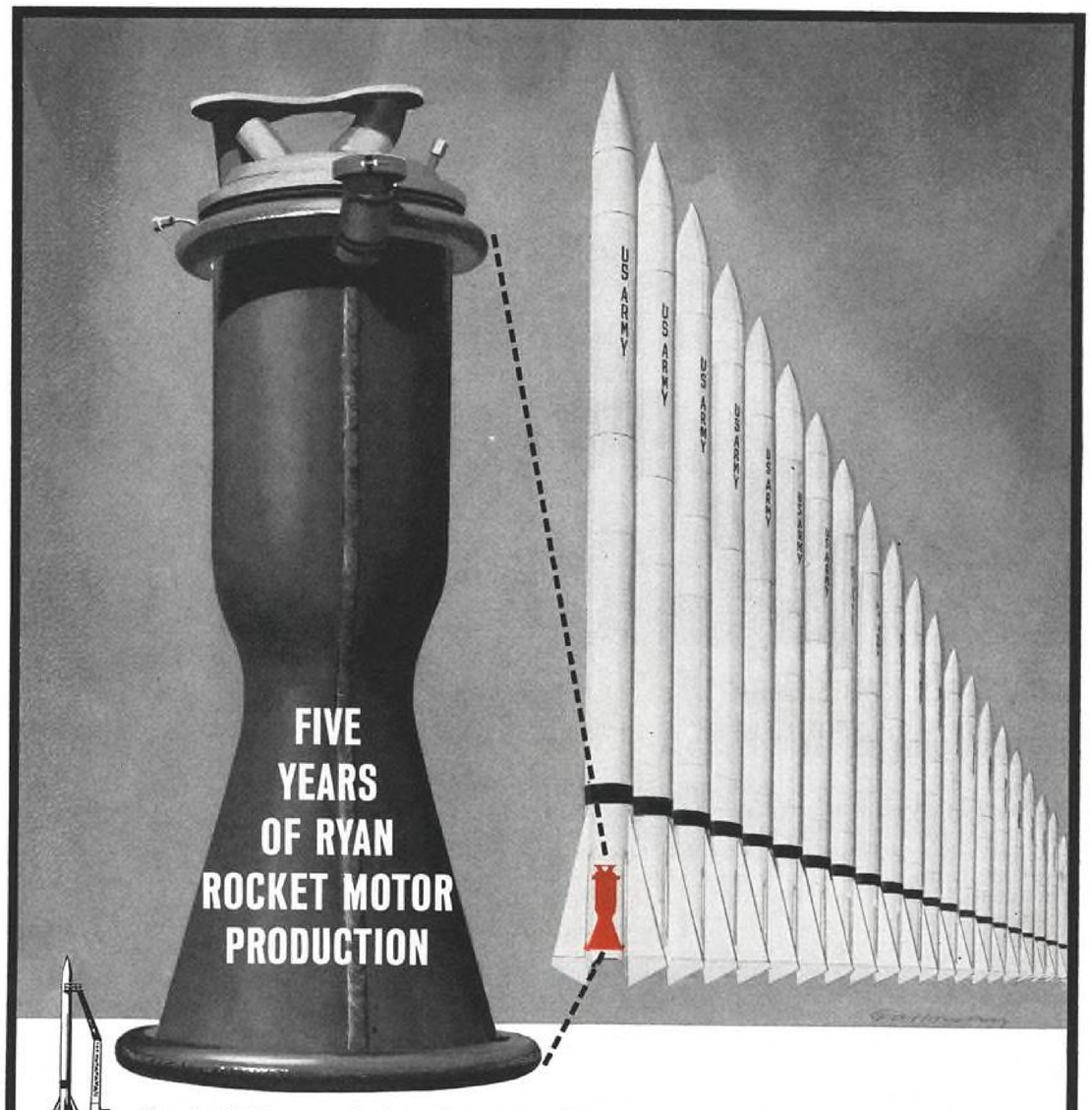


Army Fabricates Juno II Space Vehicles for NASA

Juno II space vehicle's upper portion (above) is at Army Ballistic Missile Agency's fabrication laboratory, Redstone Arsenal, Ala. Vents at base of shroud (above, right) allow second stage gases to exhaust before instrument compartment separates. Juno II's Rocketdyne 150,000 lb. thrust booster engine is static-tested (below) at ABMA. Juno II main stage (below, right) is on launching ring at Cape Canaveral, Fla.







Ryan has built every production rocket motor for America's first operational guided missile—the Army's Corporal—for over five years.

It takes tremendous power to boost the 10-ton Corporal to Mach 3 flight speeds... to drop its atomic blast on a target 100 miles away. And this power must be controlled with pinpoint precision.

Ryan achieves this fine precision by forming, welding, and machining Corporal rocket motors to laboratory-like tolerances. Ryan has over twenty years' experience in this exacting type of work, which merges high-temperature metallurgy with manufacturing skills.

Designed by the Cal-Tech Jet Propulsion Laboratories, the Corporal motor is built by Ryan for the Firestone Tire and Rubber Company, prime contractors for the Corporal missile.

The Army relies on the Corporal's rocket motors for unerring performance—shot after shot. America's aircraft, engine, and missile manufacturers can rely on Ryan, too—for building complete propulsion systems ...for building single components for rocket motors, ramjets, or turbojet engines.

RYAN BUILDS BETTER

AIRCRAFT • POWER PLANTS • ELECTRONICS

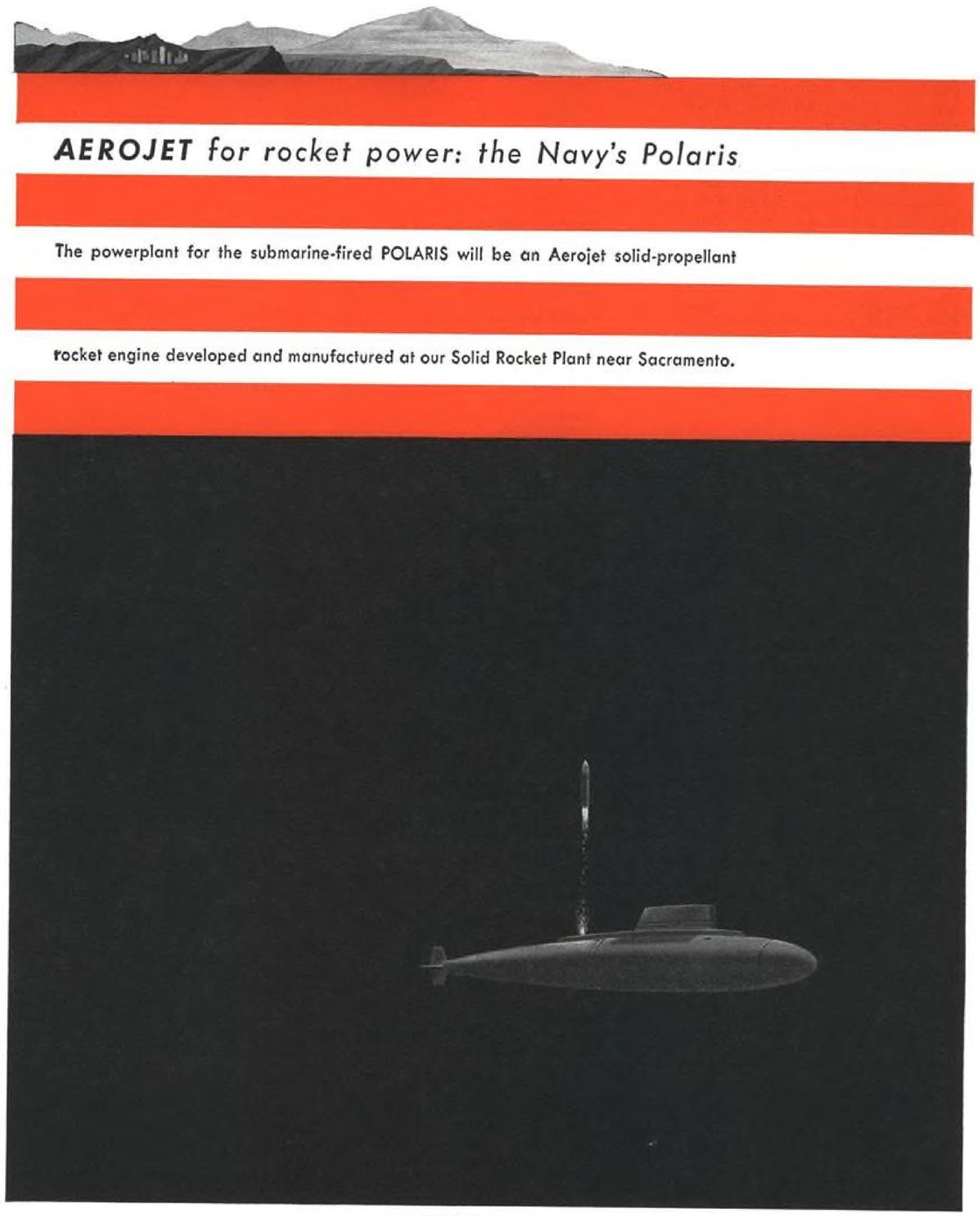
Ryan Aeronautical Company, San Diego, Calif.

Defense Lists 100 Prime Contractors

Washington—Department of Defense has tabulated net awards to the 100 companies and their 130 affiliates that received the largest volume of military prime contracts in Fiscal 1958.

Procurement of aircraft and missiles accounted for 50% of all military prime contract awards of $10,000 or more, an increase of 11% over the previous year. Following is a breakdown by companies and affiliates.

RANK	COMPANIES	MILLIONS OF DOLLARS
	U. S. TOTAL[a]	$21,794.8
	TOTAL, 100 COMPANIES AND THEIR SUBSIDIARIES[b]	16,164.3
1.	**Boeing Airplane Co.**	2,131.0
2.	**General Dynamics Corp.**	1,382.6
	Electronic Control Systems, Inc.	0.6
	Total	1,383.2
3.	**General Electric Co.**	783.4
4.	**Lockheed Aircraft Corp.**	700.8
	Lockheed Aircraft Service, Inc.	22.6
	Lockheed Aircraft Service International, Inc.	7.1
	Lockheed Aircraft Service Overseas, Inc.	24.1
	Lockheed Air Terminal, Inc.	0.5
	Total	755.1
5.	**United Aircraft Corp.**	661.1
6.	**American Telephone & Telegraph Co.**	0.3
	Teletype Corp.	2.3
	Western Electric Co.	657.2
	Westrex Corp.	[c]
	Total	659.8
7.	**North American Aviation, Inc.**	646.5
	Astrodyne, Inc.	1.2
	Total	647.7
8.	**Douglas Aircraft Co.**	513.4
9.	**Hughes Aircraft Co.**	472.6
10.	**Martin Co. (The)**	400.0
	Rias, Inc.	0.2
	Total	400.2
11.	**Sperry-Rand Corp.**	$361.9
	Vickers, Inc.	8.2
	Wright Machinery Co.	[c]
	Total	370.1
12.	**Chance Vought Aircraft, Inc.**	360.4
13.	**McDonnell Aircraft Corp.**	352.0
14.	**International Business Machines Corp.**	316.4
	Service Bureau Corp.	0.1
	Total	316.5
15.	**Radio Corp. of America**	288.1
	National Broadcasting Co.	0.1
	RCA Communications, Inc.	[c]
	RCA Victor Distributing Corp.	0.1
	Total	288.3
16.	**Northrop Aircraft, Inc.**	283.5
17.	**General Motors Corp.**	280.2
	Ethyl Corp.[d]	0.1
	Frigidaire Sales Corp.	0.6
	Total	280.9
18.	**Westinghouse Electric Corp.**	268.9
	Westinghouse Electric International, Inc.	0.1
	Westinghouse Electric Supply Co.	0.3
	Westinghouse Electric Appliances Sales Corp.	[c]
	Total	269.3
19.	**Republic Aviation Corp.**	264.7
20.	**Chrysler Corp.**	253.1
	Chrysler Airtemp Sales Corp.	5.5
	Mira Corp.	[c]
	Total	258.6
21.	**Grumman Aircraft Engineering Corp.**	245.1
	Dynamic Developments, Inc.	0.1
	Total	245.2
22.	**Raytheon Manufacturing Co.**	237.0
23.	**Curtiss-Wright Corp.**	204.0
	Aerophysics Development Co.	6.3
	Propulsion Research Corp.	0.4
	Total	210.7
24.	**Bendix Aviation Corp.**	$207.4
	Bendix-Westinghouse Automotive Air Brake Co.	0.1
	Sheffield Corp.	[c]
	Total	207.5
25.	**Standard Oil Co. (N. J.)**	0.0
	Carter Oil Co.	7.9
	Enjay Co., Inc.	0.1
	Esso Export Corp.	155.7
	Esso Research & Engineering Co.	0.1
	Esso Standard Oil Co.	17.9
	Ethyl Corp.[e]	0.1
	Gilbert & Barker Mfg. Co.	0.1
	Humble Oil & Refining Co.	2.6
	Penola Oil Co.	0.1
	Standard Vacuum Oil Co.[e]	2.2
	Total	186.8
26.	**General Tire & Rubber Co.**	11.6
	Aerojet-General Corp.	147.2
	Byers (A. M.) Co.	1.0
	Total	159.8
27.	**Ford Motor Co.**	146.3
	Aeronutronic Systems, Inc.	10.3
	Total	156.6
28.	**Standard Oil Co. of California**	68.9
	American Bitumuls & Asphalt Co.	[c]
	California Oil Co.	3.2
	California Research Corp.	0.1
	California Tanker Co.	0.1
	Caltex Oil Products Co.[f]	37.6
	International Bitumen Emulsions Corp.	[c]
	Lincoln Oil Co.	[c]
	Pacific Oil Co.	0.1
	Standard Oil Co. of Texas	7.3
	Total	117.3
29.	**Fairchild Engine & Airplane Corp.**	103.2
30.	**International Telephone & Telegraph Co.**	51.9
	Federal Electric Corp.	43.3
	Intelex Systems, Inc.	[c]
	Kuthe Laboratories, Inc.	1.5
	Royal Electric Corp.	[c]
	Total	96.7
31.	**AVCO Manufacturing Corp.**	$86.5
32.	**Bell Aircraft Corp.**	41.7
	Bell Helicopter Corp.	40.3
	Hydraulic Research Mfg. Co.	0.1
	Wheelabrator Corp.	0.1
	Total	82.2
33.	**Texas Co. (The)**	37.2
	Caltex Oil Products Co.[f]	37.6
	Texaco Brazil, Inc.	[c]
	Texas Co. (Caribbean), Ltd.	[c]
	Texas Co. (Puerto Rico), Inc.	0.1
	Texas Petroleum Co.	0.3
	Texas Pipeline Co.	[c]
	Total	75.2
34.	**Continental Motors Corp.**	32.8
	Continental Aviation & Engineering Corp.	40.5
	Gray Marine Motor Co.	[c]
	Wisconsin Motor Corp.	0.1
	Total	73.4
35.	**Burroughs Corp.**	70.0
	Control Instrument Co.	1.4
	Haydu Electronic Products, Inc.	0.2
	Total	71.6
36.	**American Bosch Arma Corp.**	70.9
37.	**Socony Mobil Oil Co.**	11.3
	Basin Oil Co.	[c]
	General Petroleum Corp.	8.7
	Magnolia Petroleum Co.	6.9
	Mobil Overseas Oil Co., Inc.	38.1
	Standard Vacuum Oil Co.[e]	2.2
	Total	67.2
38.	**Philco Corp.**	65.7
	Lansdale Tube Co.	0.2
	Sierra Electronics Co.	0.3
	Total	66.2
39.	**Kiewit (Peter) Sons' Co.**	65.1
40.	**Brown-Raymond-Walsh[g]**	64.1
41.	**Thompson Products, Inc.**	$18.8
	Ramo-Wooldridge Corp.	45.0
	Ramsey Co.	[c]
	Total	63.8
42.	**Greenland Contractors[h]**	63.2
43.	**Cities Service Co.**	0.0
	Arkansas Fuel Oil Corp.	1.7
	Cities Service Gas Co.	0.3
	Cities Service Oil Co.	57.8
	Orange State Oil Co.	2.2
	Total	62.0
44.	**Collins Radio Co.**	61.3
45.	**Pan American World Airways, Inc.**	60.6
46.	**Marquardt Aircraft Co.**	60.2
47.	**Hayes Aircraft Corp.**	60.1
48.	**Olin Mathieson Chemical Corp.**	50.5
	Liberty Powder Co.	7.0
	Liberty Powder Defense Corp.	0.9
	Total	58.4
49.	**Food Machinery & Chemical Corp.**	57.8
50.	**Goodyear Tire & Rubber Co.**	22.9
	Goodyear Aircraft Corp.	41.0
	Goodyear Engineering Corp.	(—)6.4
	Kelly-Springfield Tire Co.	0.1
	Total	57.6
51.	**Thiokol Chemical Corp.**	56.8
	National Electronics Laboratories, Inc.	[c]
	Hunter-Bristol Corp.	[c]
	Total	56.8
52.	**Massachusetts Institute of Technology**	56.1
53.	**Newport News Shipbuilding & Dry Dock Co.**	54.1
54.	**General Precision Equipment Corp.**	0.1
	Askania Regulator Co.	0.1
	General Precision Laboratory, Inc.	7.4
	Graflex, Inc.	1.0
	Griscom-Russell Co.	0.1
	Kearfott Co., Inc.	9.6
	Librascope, Inc.	21.3
	Link Aviation, Inc.	12.8
	National Theater Supply Co.	[c]
	Precision Technology, Inc.	0.1
	Strong Electric Corp.	0.4
	Total	52.9
55.	**Minneapolis-Honeywell**	



AEROJET *for rocket power: the Navy's Polaris*

The powerplant for the submarine-fired POLARIS will be an Aerojet solid-propellant

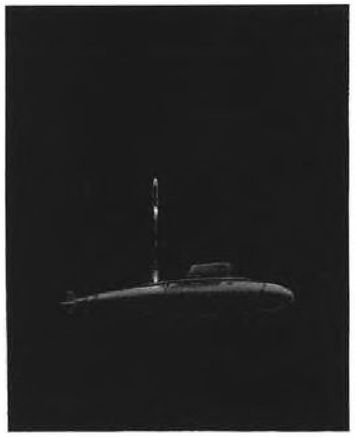
rocket engine developed and manufactured at our Solid Rocket Plant near Sacramento.

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STRESS ANALYSTS

1. Experience and/or training in *analytical* stress computations, with emphasis on structural and pressure vessel applications. B.S. required; graduate work desirable.

2. Experience and/or training in *experimental* stress analysis. Familiarity with advanced experimental techniques and expedient methods of stress analysis. B.S. required; graduate work desirable.

GAS DYNAMICIST

M.S. or Ph.D. in engineering, physics or applied mechanics. Five to ten years' experience in analytical and experimental work in the fields of boundary layer studies, supersonic and hypersonic flows, or application of non-ideal-gas theories.

AERODYNAMICIST

M.S. or Ph.D. in aeronautical or mechanical engineering or applied mechanics. Five to ten years' experience in the field of advanced aerothermodynamics, missile aerodynamics, heat transfer in rockets, missiles, etc.

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B.S., M.S. or Ph.D. in engineering, physics or applied mechanics. Five to ten years' experience in analysis and evaluation of interactions between propellant systems and other missile components. Capable of developing optimum vehicle configurations from the standpoint of the propulsion system.

U.S. Citizenship Required

Resumes cordially invited. Write:

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RANK	COMPANIES	MILLIONS OF DOLLARS
	Regulator Co.	47.0
56.	**Garrett Corp.**	46.7
57.	**California Institute of Technology**	45.4
58.	**Tidewater Oil Co.**	44.3
	Seaside Oil Co.	0.9
	Total	45.2
59.	**Mathiasen's Tanker Industries, Inc.**	42.9
60.	**Bethlehem Steel Corp.**	0.0
	Bethlehem Pacific Coast Steel Corp.	4.8
	Bethlehem Sparrows Point Shipyard, Inc.	0.1
	Bethlehem Steel Co.	36.7
	Bethlehem Steel Export Co.	0.1
	Total	41.7
61.	**Lear, Inc.**	38.4
62.	**Sylvania Electric Products, Inc.**	37.0
63.	**Hendy (Joshua) Corp.**	37.0
64.	**Firestone Tire & Rubber Co.**	31.9
	Firestone Industrial Products Co.	0.1
	Ravenna Arsenal, Inc.	4.6
	Total	36.6
65.	**Rand Corp.**	31.7
	Systems Development, Inc.	4.9
	Total	36.6
66.	**Marine Transport Lines, Inc.**	36.4
67.	**Bath Iron Works Corp.**	36.3
68.	**DuPont (E. I.) de Nemours & Co.**	6.6
	Mall Tool Co.	[c]
	Remington Arms Co.	28.5
	Total	35.1
69.	**Oman-Farnsworth-Wright[i]**	33.7
70.	**DeFoe Shipbuilding Co.**	33.1
71.	**States Marine Corp.**	23.3
	States Marine Corp. (Del.)	5.3
	Isthmian Lines, Inc.	4.5
	Total	33.1
72.	**Oman-Farnsworth-Wright-Kaiser-Morrison-Knudsen[i]**	32.7
73.	**Kaman Aircraft Corp.**	31.6
74.	**Westinghouse Airbrake Co.**	11.4
	Le Tourneau-Westinghouse Co.	0.9
	Melpar, Inc.	19.2
	Union Switch & Signal Construction Co.	[c]
	Total	31.5
75.	**Todd Shipyards Corp.**	31.3
76.	**Union Oil Co. of California**	30.0
77.	**Motorola, Inc.**	29.7
	Motorola Communications & Electronics, Inc.	0.1
	Total	29.8
78.	**Sinclair Oil Corp.**	0.0
	Fletcher Oil Co.	1.2
	Sinclair Refining Co.	28.5
	Total	29.7
79.	**Temco Aircraft Corp.**	29.6
	Fenske Fedrick & Miller Inc.	0.1
	Total	29.7
80.	**Goodrich (B. F.) Co.**	28.8
81.	**White Motor Co.**	(—) 9.5
	Diamond T Motor Truck Co.	38.1
	Total	28.6
82.	**Sundstrand Machine Tool Co.**	28.0
	Sundstrand Aircraft Service Corp.	0.3
	Total	28.3
83.	**Shell Oil Co.**	25.6
	International Lubricant Corp.	0.8
	Shell Chemical Corp.	1.2
	Shell Development Co.	0.4
	Total	28.0
84.	**Tishman (Paul) General Contractors, Inc.**	27.5
85.	**Blue Cross Association, Inc.**	27.1
86.	**Penn-Texas Corp.**	0.0
	Colt's Manufacturing Co.	0.1
	Pratt & Whitney Co.	11.9
	Quickway Truck Shovel Co.	15.0
	Total	27.0
87.	**Continental Oil Co.**	26.9
88.	**Hercules Powder Co.**	26.8
89.	**Eastman Kodak Co.**	24.8
	Eastman Chemical Products, Inc.	[c]
	Eastman Kodak Stores, Inc.	0.2
	Recordak Corp.	1.1
	Total	26.1
90.	**Richfield Oil Corp.**	25.7
	American Mineral Spirits Co.	0.2
	Total	25.9
91.	**Cessna Aircraft Co.**	25.0
92.	**Standard Oil Co. (Indiana)**	11.7
	American Oil Co.	7.0
	Tuloma Gas Products Co.	[c]
	Utah Oil Refining Co.	6.3
	Total	25.0
93.	**Beech Aircraft Corp.**	24.0
	Beechcraft Research & Development, Inc.	[c]
	Total	24.0
94.	**Sunray Midcontinent Oil Co.**	0.3
	DX Sunray Oil Co.	23.1
	Suntide Refining Co.	0.5
	Total	23.9
95.	**Gilfillan Brothers, Inc.**	23.7
96.	**Johns Hopkins University**	23.2
97.	**U. S. Lines, Inc.**	22.9
98.	**Asiatic Petroleum Corp.**	22.8
99.	**Ryan Aeronautical Co.**	22.2
100.	**Union Carbide Corp.**	22.2

FOOTNOTES:

[a] Figures are net, reflecting total value of new procurement minus cancellations, terminations or other credit transactions. Data does not include purchase commitments or pending cancellations that have not yet become mutually binding.

[b] Assignment of subsidiaries is based on stock ownership of 50% or more by the parent company. Only contracts awarded directly by Department of Defense are included in totals.

[c] Less than $50,000.

[d] Stock ownership is equally divided between General Motors Corp. and Standard Oil Co. of New Jersey; half of the total military awards is shown under each of the parent companies.

[e] Stock ownership is equally divided between Standard Oil Co. of New Jersey and Socony Mobil Oil Co.; half of the total of military awards is shown under each of the parent companies.

[f] Stock ownership is equally divided between Standard Oil Co. of California and Texas Co.; half of the total of military awards is shown under each of the parent companies.

[g] A joint venture of Brown & Root, Inc., Raymond Concrete Pile Co., and Walsh Construction Co.

[h] A joint venture of Kiewit (Peter) Sons, Inc., Groves (S. J.) Sons Co., Johnson (Al) Construction Co., and Condon-Cunningham, Inc.

[i] A joint venture of Oman Construction Co., Farnsworth (R. P.) Co. and Wright Contracting Co. (itself a joint venture, see No. 69), Kaiser (Henry J.) Construction Co., and Morrison-Knudsen Co., Inc. (see No. 72).

Office of the Secretary of Defense.

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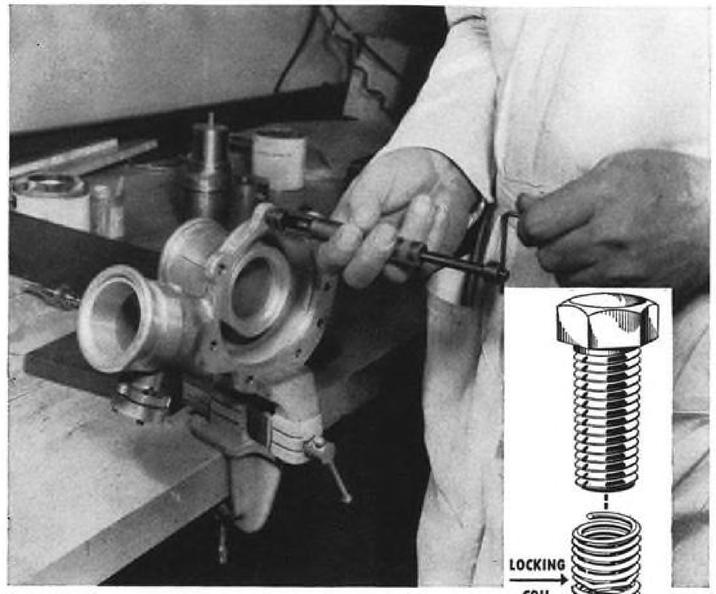
Consult OUR Engineering Department on YOUR bearing problems

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MARLIN-ROCKWELL CORPORATION
Executive Offices: Jamestown, N. Y.

Following is a tabulation of the 100 top company rankings for Fiscal 1957:

RANK	COMPANIES	MILLIONS OF DOLLARS
	U. S. TOTAL[a]	$18,954.4
	TOTAL, 100 COMPANIES AND THEIR SUBSIDIARIES[b]	12,962.4
1.	**General Dynamics Corp.**	1,018.8
	Electronic Control Systems, Inc.	0.1
	Total	1,018.9
2.	**Boeing Airplane Co.**	907.4
3.	**General Electric Co.**	876.8
4.	**United Aircraft Corp.**	705.8
5.	**American Telephone & Telegraph Co.**	0.1
	Teletype Corp.	9.9
	Western Electric Co.	581.8
	Westrex Corp.	[c]
	Total	591.8
6.	**Lockheed Aircraft Corp.**	503.6
	Lockheed Air Terminal, Inc.	[c]
	Lockheed Aircraft Service International, Inc.	30.4
	Lockheed Aircraft Service Overseas, Inc.	1.7
	Total	535.7
7.	**North American Aviation, Inc.**	499.9
8.	**Hughes Aircraft Co.**	389.9
9.	**Martin Co. (The)**	366.0
10.	**International Business Machines Corp.**	362.0
	Service Bureau Corp.	0.3
	Total	362.3
11.	**McDonnell Aircraft Corp.**	293.8
12.	**General Motors Corp.**	258.4
	Ethyl Corp.[d]	[c]
	Frigidaire Sales Corp.	0.6
	Total	259.0
13.	**Bendix Aviation Corp.**	250.4
	Bendix-Westinghouse Automotive Air Brake Co.	0.1
	Sheffield Corp.	0.1
	Total	250.6
14.	**Douglas Aircraft Co., Inc.**	249.2
15.	**Chance Vought Aircraft, Inc.**	234.9
16.	**Raytheon Mfg. Co.**	217.5
17.	**Sperry-Rand Corp.**	210.3
	Vickers, Inc.	4.2
	Wright Machinery Co.	[c]
	Total	214.5
18.	**Northrop Aircraft, Inc.**	159.1
	Radioplane Co.	48.2
	Total	207.3
19.	**Curtiss Wright Corp.**	114.8
	Aerophysics Development Co.	7.1
	Propulsion Research Corp.	0.6
	Utica-Bend Corp.	72.7
	Total	195.2
20.	**Standard Oil Co. (N. J.)**	0.0
	Carter Oil Co.	3.4
	Enjay Co., Inc.	0.1
	Esso Export Corp.	142.1
	Esso Research & Engineering Co.	0.1
	Esso Standard Oil Co.	31.9
	Ethyl Corp.[d]	[c]
	Gilbert & Barker Mfg. Co.	0.1
	Humble Oil Co.	9.0
	Penola Oil Co.	0.5
	Standard Vacuum Oil Co.[e]	5.1
	Total	192.3
21.	**Republic Aviation Corp.**	189.6
22.	**Westinghouse Electric Corp.**	181.8
	Westinghouse Electric International Co.	[c]



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...with *HELI-COIL*® SCREW-LOCK INSERTS*

Use of aluminum makes Carrier installation lighter in Douglas DC-8 Jetliner

To reduce weight in the refrigeration system designed for air conditioning the giant Douglas DC-8 Jetliner, Carrier engineers used aluminum alloy compressor castings. To obtain maximum performance and reliability of threaded connections exposed to heat and vibration encountered at 600 mph, they selected the *Heli-Coil* stainless steel wire thread, *internal locking* Screw-LOCK Insert.

The results: design simplified, boss areas minimized, weight reduced as much as 40%, lock nuts and lock wiring eliminated. Now one man assembles the entire unit in 30% less time than before ... and danger of thread failure and screw loosening has ended!

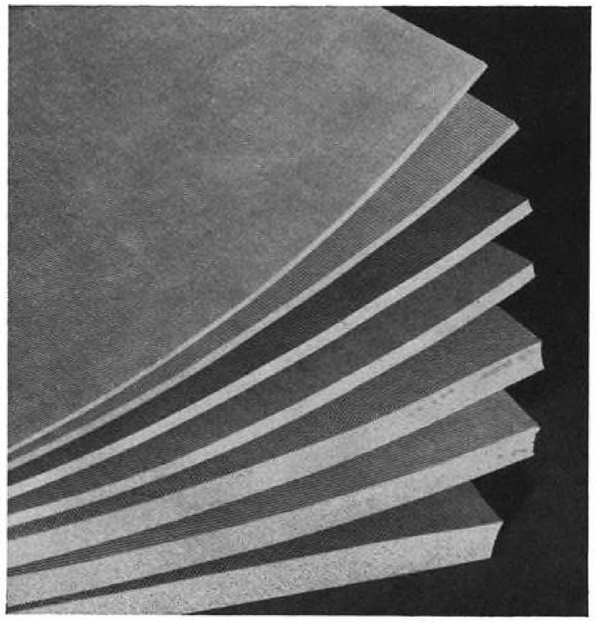
Manufacturers in every field are relying on one-piece, stainless steel *Heli-Coil* Screw-LOCK Inserts to meet torque and vibration specs... protect threads against wear, stripping, galling and corrosion... save costs, space and weight. *Patented

HELI-COIL CORPORATION
DANBURY, CONNECTICUT

HELI-COIL CORPORATION, 202 Shelter Rock Lane, Danbury, Connecticut
I'd like more information on *Heli-Coil* Screw-LOCK Inserts

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IN CANADA: W. R. WATKINS CO., Ltd., 41 Kipling Ave., S., Toronto 18, Ont.



Silicone Sponge Rubber

remains flexible at extreme temperatures
—100° F to 500° F

COHRlastic R-10470 silicone sponge rubber has a dense, uniform, non-absorbing closed cell structure, highly suitable for soft gasketing, vibration dampening, fairing strips, seals, pads, bumpers, dynamic cushions and other applications where resiliency at extreme temperatures is required. It has superior compression set resistance, excellent dielectric properties, immunity to aging, ozone and weather hardening and good chemical resistance — non-sticking, odorless, non-corrosive.

COHRlastic R-10470 can be bonded to metals, plastics, fabrics or silicone rubber. Sheets 24″ x 24″ and in thicknesses 1/16″ through 1/2″ are available from stock. Larger sizes up to 30″ x 30″ and special molded and extruded shapes are made to order. CHR silicone sponge rubber is sold nationally through distributors.

FREE SAMPLES and folder — write, phone or use inquiry service.

CHR

COHRlastic R-10470
Silicone Sponge Rubber

SPECIFICATIONS:
COHRlastic R-10470 meets many specifications. Some are listed below:
AMS 3195
AMS 3196
MIL-R-6130A type 2
Boeing BMS 1-23
Martin MC1 4546
Martin MB 6130
Bendix ES 0709
Douglas DMS 1597
Lockheed LAC 1-924

PROPERTIES	Range of typical properties COHRlastic R-10470	Typical accepted standards
Tensile	50-130 psi	40 psi, min.
Elongation	175-225%	125% min.
Water absorption (Immersion 24 hrs. @ 75°F.)	3-6%	10% max.
Density, lbs./cu. in.	.020-.030 (firm)	.030 max.
	.013-.018 (medium)	.020 max.
Low temperature brittleness (5 hrs. @ −100°F., bend flat)	No cracking	No cracking
Compression deflection (compressed to 75% of original thickness)		
Room temperature		
Type firm	12-18 psi range[1]	12 min.-20 max. psi
Type medium	8-14 psi range[1]	6 min.-14 max. psi
−65°F. pct. difference	−10% to +15%[1]	
212°F. pct. difference	+5% to +10%[1]	
Compression set (compressed to 50% of original thickness)		
22 hrs. @ 70°F	0-5% (firm)[1]	10% max.
	5-30% (medium)[1]	40% max.
22 hrs. @ −65°F	0-5% (firm)[1]	10% max.
	5-30% (medium)[1]	40% max.
22 hrs. @ 212°F	10-25% (firm)[1]	30% max.
	20-50% (medium)[1]	60% max.

1 ASTM D 1056-56T

CHR products include:
COHRlastic Aircraft Products — *Airframe and engine seals, firewall seals, coated fabrics and ducts*
COHRlastic Silicone Rubber Products — *Silicone rubber moldings and extrusions, silicone rubber sheets, silicone sponge rubber*
Temp-R-Tapes — *Pressure sensitive, thermal curing Teflon and silicone tapes*
Allied Products — *COHRlastic silicone cements and conductive gasketing*

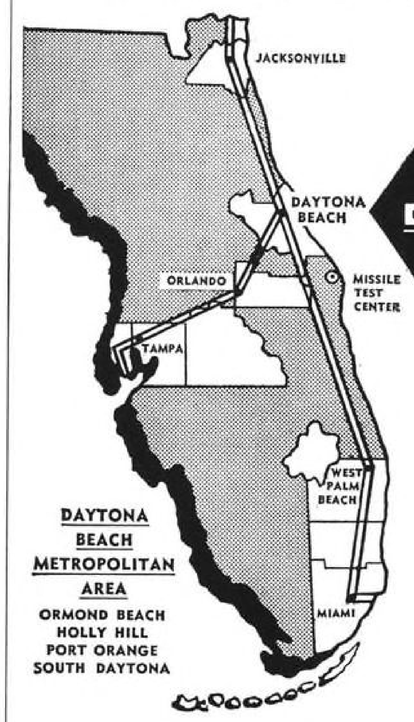
CHR Leader In Fabrication of Silicone Rubber

CONNECTICUT HARD RUBBER COMPANY

Main Office: New Haven 9, Connecticut

RANK	COMPANIES	MILLIONS OF DOLLARS
	Westinghouse Electric Supply Co.	0.3
	Total	182.1
23.	**AVCO Manufacturing Corp.**	178.1
24.	**Radio Corp. of America**	116.3
	RCA Communications, Inc.	0.1
	RCA Service Co., Inc.	16.9
	Radiomarine Corp. of America	0.1
	Total	133.4
25.	**American Bosch Arma Corp.**	128.3
26.	**Bell Aircraft Corp.**	107.7
	Bell Helicopter Corp.	10.7
	Hydraulic Research & Mfg. Co.	0.1
	Wheelabrator Corp.	0.1
	Total	118.6
27.	**Standard Oil Co. of California**	61.3
	American Bitumuls & Asphalt Co.	0.3
	American Gilsonite Co.	e
	California Oil Co.	4.3
	California Research Corp.	0.2
	California Spray-Chemical Co.	0.1
	Caltex Oil Products Co.[f]	41.0
	Lincoln Oil Co.	e
	Oronite Chemical Co.	0.3
	Standard Oil Co. of Texas	7.8
	Total	115.3
28.	**Bethlehem Steel Corp.**	0.0
	Bethlehem Pacific Coast Steel Co.	22.0
	Bethlehem Sparrows Point Shipyard, Inc.	41.2
	Bethlehem Steel Export Corp.	0.1
	Bethlehem Steel Co.	45.9
	Total	109.2
29.	**Chrysler Corp.**	92.0
	Chrysler Motors Corp.	7.2
	Total	99.2
30.	**International Telephone & Telephone Co.**	60.9
	Airmatic Systems, Inc.	e
	Federal Electric Corp.	35.4
	International Standard Electric Co.	0.1
	International Standard Trading Co.	0.1
	Kuthe Laboratories, Inc.	0.6
	Mackay Radio & Telegraph Co.	0.1
	Royal Electric Corp.	e
	Total	97.2
31.	**General Tire & Rubber Co.**	15.1
	Aerojet-General Corp.	79.9
	RKO Teleradio Pictures, Inc.	0.2
	Byers (A. M.) Co.	0.6
	Total	95.8
32.	**Merritt-Chapman & Scott Corp.**	1.7
	Devoe & Raynolds Co., Inc.	0.1
	Highway Trailer Co.	e
	New York Shipbuilding Corp.	90.9
	Tennessee Products & Chemical Co.	e
	Total	92.7
33.	**Goodyear Tire & Rubber Co.**	22.3
	Goodyear Aircraft Corp.	62.9
	Goodyear Engineering Corp.	4.6
	Goodyear Tire & Rubber Export Co.	e
	Kelly-Springfield Tire Co.	0.1
	Total	89.9
34.	**Bath Iron Works Corp.**	88.6
35.	**Continental Motors Corp.**	40.9
	Continental Aviation & Engineering Corp.	46.2
	Gray Marine Motor Co.	0.1
	Wisconsin Motor Co.	0.1
	Total	87.3
36.	**Socony Mobil Oil Co., Inc.**	44.3
	General Petroleum Corp.	13.0
	Magnolia Petroleum Co.	8.8

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Metropolitan Area Industrial Sites

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R. H. MILES, MGR.
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Please write for literature. **Autonetics**
A Division of North American Aviation, Inc., Downey, California

You're in for a Hot Time

but Fenwal's New Miniature

Hermetically Sealed THERMOSWITCH® Unit will control it—precisely!

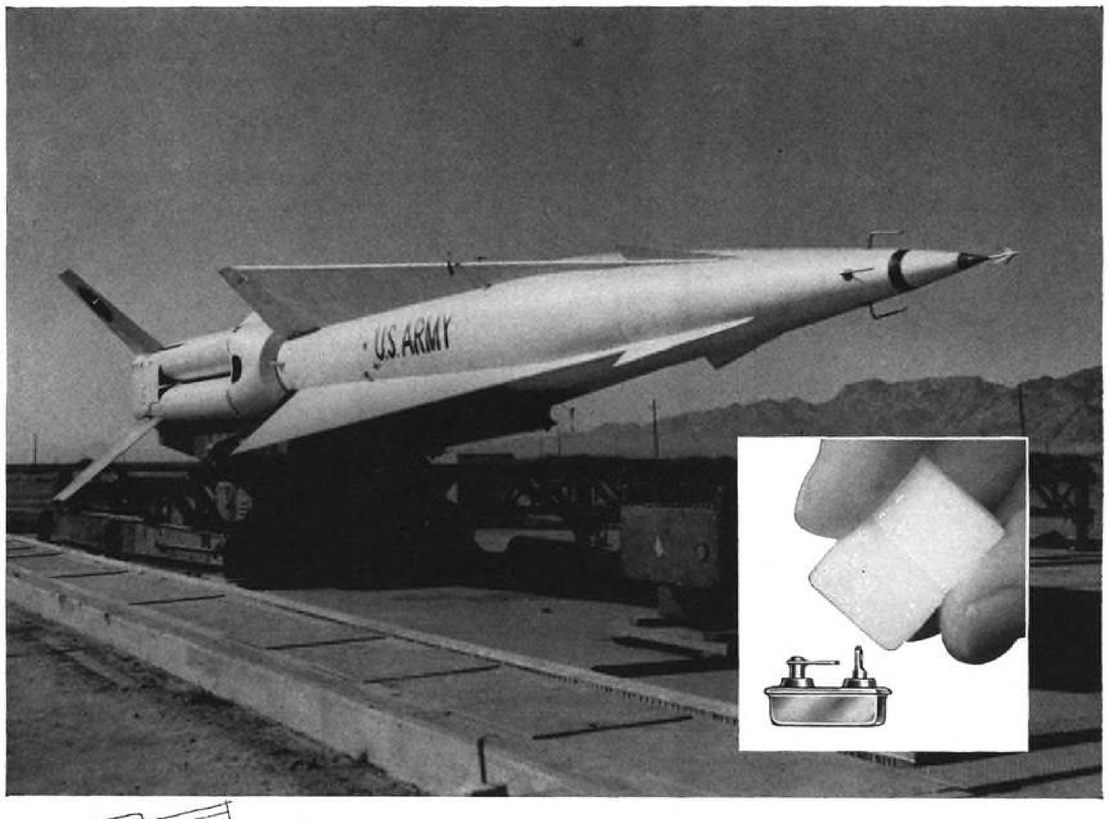
There'll be a hot time in the old ionosphere tonight. But with Fenwal's new Miniature Hermetically Sealed THERMOSWITCH Unit aboard everything will be under control. This tiny Fenwal unit responds quickly and accurately to temperature changes — *it's reliable!*

It's hermetically sealed, yet field adjustable. Even extreme vibration and shock won't upset its control characteristics — *it's built to take it!*

But most of all, this corrosion-resistant Fenwal unit does it all with exacting control of within 1° — in temperatures of −20°F to +200°F (−65°F to +220°F exposure limits). And it's the only unit that has all three features — *small size, ruggedness and precision control!*

If missiles are your business you'll want all the information on this tiny, tough, sensitive and reliable control. For more information on this unit or complete Fenwal temperature control systems, write for our catalog. If you want, we'll send our sales engineer, too. Fenwal Incorporated, 122 Pleasant Street, Ashland, Massachusetts.

The new Fenwal Miniature THERMOSWITCH Unit (compared here with a lump of sugar) weighs less than ½ oz. Its current capacity is 2.5 amps, 115 VAC, 2.0 amps, 28 VDC. Widely used for crystal ovens, tuning forks, gyro assemblies, missile blankets and missile batteries.



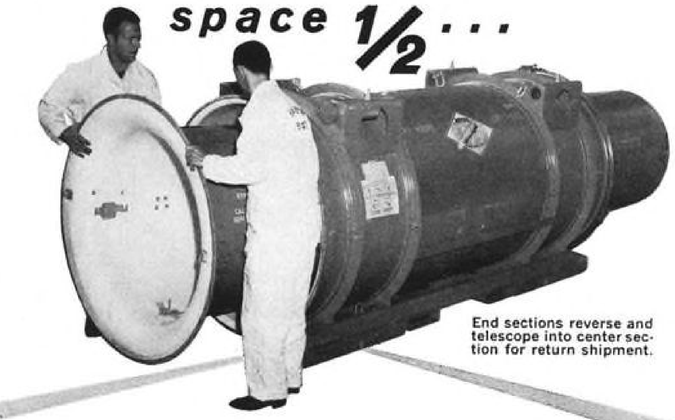
ANOTHER EXAMPLE OF HOW **Fenwal** CONTROLS TEMPERATURE . . . PRECISELY

RANK	COMPANIES	MILLIONS OF DOLLARS
	Mobil Overseas Oil Co.	10.6
	Standard Vacuum Oil Co.[a]	5.1
	Total	81.8
37.	**Texas Co.**	33.0
	Caltex Oil Products Co.[f]	41.0
	Texas Co. (Caribbean) Ltd.	e
	Texas Co. (Puerto Rico) Inc.	e
	Texas Petroleum Co.	1.9
	Total	75.9
38.	**Minneapolis Honeywell Regulator Co.**	73.4
	Datamatic Corp.	0.1
	Total	73.5
39.	**Ford Motor Co.**	68.4
	Aeronutronic Systems, Inc.	0.9
	Total	69.3
40.	**Burroughs Corp.**	65.1
	Control Instrument Co.	1.0
	Haydu Electronics Products	0.1
	Total	66.2
41.	**Fairchild Engine & Airplane Co.**	64.8
42.	**Collins Radio Co.**	63.3
43.	**Olin Mathieson Chemical Co.**	39.7
	Liberty Powder Co.	3.7
	Reaction Motors, Inc.	18.1
	Total	61.5
44.	**Garrett Corp.**	59.1
45.	**Hayes Aircraft Corp.**	58.5
46.	**Philco Corp.**	57.0
	Dexter Co.	e
	Lansdale Tube Co.	0.3
	Philco International Corp.	0.1
	Sierra Electronic Corp.	0.3
	Total	57.7
47.	**Brown-Raymond-Walsh**	56.7
48.	**Cities Service Co.**	0.0
	Arkansas Fuel Oil Corp.	0.5
	Cities Service Gas Co.	0.2
	Cities Service Oil Co.	54.3
	Orange State Oil Corp.	0.4
	Total	55.4
49.	**Tide Water Oil Co.**	52.1
	Seaside Oil Co.	1.2
	Total	53.3
50.	**Morrison-Knudsen Co., Inc.**	52.5
	Alaskan Plumbing & Heating Co., Inc.	0.5
	Total	53.0
51.	**Ingalls Iron Works Co.**	0.0
	Ingalls Shipbuilding Corp.	52.2
	Total	52.2
52.	**Massachusetts Institute of Technology**	49.9
53.	**General Precision Equipment Corp.**	1.8
	Ampro Corp.	0.2
	Askania Regulator Co.	0.4
	General Precision Laboratories, Inc.	24.4
	Graflex, Inc.	0.5
	Griscom-Russell Co.	0.5
	Hertner Electric Co.	e
	Kearfott, Inc.	5.4
	Librascope, Inc.	1.5
	Link Aviation, Co.	12.8
	Precision Technology, Inc.	0.2
	Strong Electric Co.	0.6
	Total	48.3
54.	**Temco Aircraft Corp.**	46.5
55.	**Pan American World Airways, Inc.**	46.4
56.	**Northern Pump Co.**	0.0
	Northern Ordnance, Inc.	45.9
	Total	45.9

fiberglass

HARCO CONTAINERS

cut return shipment space ½ . . .



End sections reverse and telescope into center section for return shipment.

for transport, storage and ground handling of

in-flight refueling stores, missiles, rockets, jet engines and accessories



Harco Containers with integral Harco stores trailer can be return-shipped in ⅓ the space required for conventional containers.



Three steps of loading in-flight refueling stores into Harco Container; after unloading, Harco trailers are returned to container for re-use.

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by BuAer, cuts 60% of weight, speeds loading and unloading of stores through unique Vee-band fastening of end sections to center section.



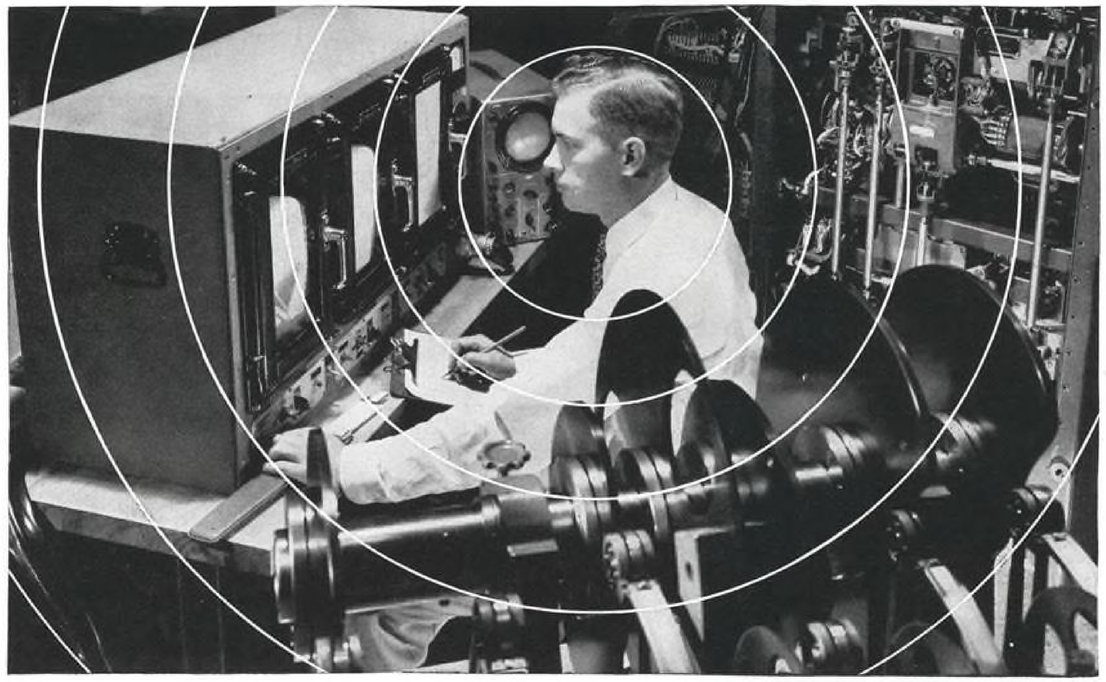
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AC SPARK PLUG ❀ THE ELECTRONICS DIVISION OF GENERAL MOTORS

RANK	COMPANIES	MILLIONS OF DOLLARS
57.	**Sinclair Oil Corp.**	0.0
	Sinclair Refining Co.	43.9
	Hughes Oil Co.	0.6
	Total	44.5
58.	**Marquardt Aircraft Co.**	43.9
59.	**Todd Shipyards Corp.**	43.6
60.	**Jones (J. A.) Construction Co.**	39.1
61.	**Union Oil Co. of California**	38.8
62.	**Shell Oil Co.**	34.4
	International Lubricant Corp.	1.4
	Shell Chemical Corp.	1.9
	Shell Development Co.	0.6
	Total	38.3
63.	**Kiewit (Peter) & Sons Co.**	38.1
64.	**Phillips Petroleum Co.**	37.3
65.	**Greenland Contractors**	36.7
66.	**Hawaiian Dredging Co., Ltd.**	36.5
67.	**Thiokol Chemical Corp.**	36.0
	National Electronics Laboratories, Inc.	0.2
	Total	36.2
68.	**Ramo-Wooldridge Corp.**	35.6
	Pacific Semiconductors, Inc.	0.3
	Total	35.9
69.	**Newport News Shipbuilding & Dry Dock Co.**	35.8
70.	**Westinghouse Airbrake Co.**	4.4
	Corvey Engineering Co.	0.4
	LeTourneau-Westinghouse Co.	3.0
	Melpar, Inc.	24.4
	Union Switch & Signal Co.	2.3
	Total	34.5
71.	**Richfield Oil Corp.**	33.7
	American Mineral Spirits Co.	0.7
	Total	34.4
72.	**Defoe Shipbuilding Co.**	34.4
73.	**States Marine Corp.**	25.3
	States Marine Corp. (Delaware)	5.4
	Isthmian Lines, Inc.	3.6
	Total	34.3
74.	**Standard Oil Co. (Indiana)**	19.7
	American Oil Co.	9.4
	Utah Oil Refining Co.	4.9
	Total	34.0
75.	**Standard Coil Products Co.**	1.7
	Kollsman Instrument Corp.	30.8
	Total	32.5
76.	**Sunray Midcontinent Oil Co.**	0.0
	D-X Sunray Oil Co.	23.8
	Suntide Refining Co.	8.0
	Total	31.8
77.	**California Institute of Technology**	30.7
78.	**Firestone Tire & Rubber Co.**	21.9
	Firestone Industrial Products Co.	*
	Firestone Steel Products Co.	*
	Ravenna Arsenal	7.3
	Total	29.2
79.	**Motorola, Inc.**	28.0
	Motorola Communications & Electronics, Inc.	0.8
	Motorola Philadelphia Co.	*
	Total	28.8
80.	**Ryan Aeronautical Co.**	28.4
81.	**Hercules Powder Co.**	27.8
82.	**Air Products, Inc.**	26.1
	Gas Industries, Inc.	1.7
	Total	27.8



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RANK	COMPANIES	MILLIONS OF DOLLARS
83.	**Diamond T Motor Car Co.**	27.6
84.	**Eastman Kodak Co.**	18.9
	Eastman Chemical Products, Inc.	c
	Eastman Kodak Stores, Inc.	0.1
	Holston Defense Corp.	7.5
	Recordak Corp.	1.0
	Total	27.5
85.	**Continental Oil Co.**	27.4
86.	**Dupont (E. I.) de Nemours & Co.**	10.6
	Mall Tool Co.	c
	Remington Arms Co., Inc.	16.5
	Total	27.1
87.	**Cessna Aircraft Co.**	26.0
88.	**Rand Corp.**	25.0
89.	**Hoffman Electronics Corp.**	0.3
	Hoffman Laboratories, Inc.	24.7
	Total	25.0
90.	**Farnsworth & Chambers Co., Inc.**	24.4
91.	**Gulf Oil Corp.**	20.1
	Gulf Refining Co.	0.3
	Gulf Research & Development Co.	c
	Mene Grande Oil Co.	3.6
	Warren Petroleum Corp.	c
	Total	24.0
92.	**Sundstrand Machine Tool Co.**	23.3
	Sundstrand Aircraft Service Corp.	0.3
	Total	23.6
93.	**White Motor Co.**	23.0
94.	**Blount Bros. Construction Co.**	22.7
95.	**Pomeroy-Hawaiian-Bechtel**	22.4
96.	**California Eastern Aviation, Inc.**	9.7
	Land-Air, Inc.	12.7
	Total	22.4
97.	**American Machine & Foundry Co.**	21.7
	AMF Pinspotters, Inc.	c
	Associated Missile Products Corp.	0.2
	Beaird (J. B.) & Co.	c
	DeWalt, Inc.	0.1
	Potter & Brumfield, Inc.	0.1
	Voit (W. J.) Rubber Co.	c
	Total	22.1
98.	**Gilfillan Bros., Inc.**	22.0
99.	**Eastern States Petroleum Co., Inc.**	21.6
	Eastern States Chemical Corp.	0.3
	Total	21.9
100.	**ACF Industries, Inc.**	21.7

FOOTNOTES:
[a] Figures are net, reflecting total value of new procurement minus cancellations, terminations or other credit transactions. Data does not include purchase commitments or pending cancellations that have not yet become mutually binding.
[b] Assignment of subsidiaries is based on stock ownership of 50% or more by the parent company. Only contracts awarded directly by Department of Defense are included in totals.
[c] Less than $50,000.
[d] Stock ownership is equally divided between General Motors Corp. and Standard Oil Co. (N. J.); half of the total military awards is shown under each of the parent companies.
[e] Stock ownership is equally divided between Standard Oil Co. (N. J.) and Socony Mobil Oil Co.; half of the total military awards is shown under each of the parent companies.
[f] Stock ownership is equally divided between Standard Oil Co. of California and Texas Co.; half of the total military awards is shown under each of the parent companies.

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Division of SPERRY RAND CORPORATION
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FROM DESIGN
TO PRODUCTION

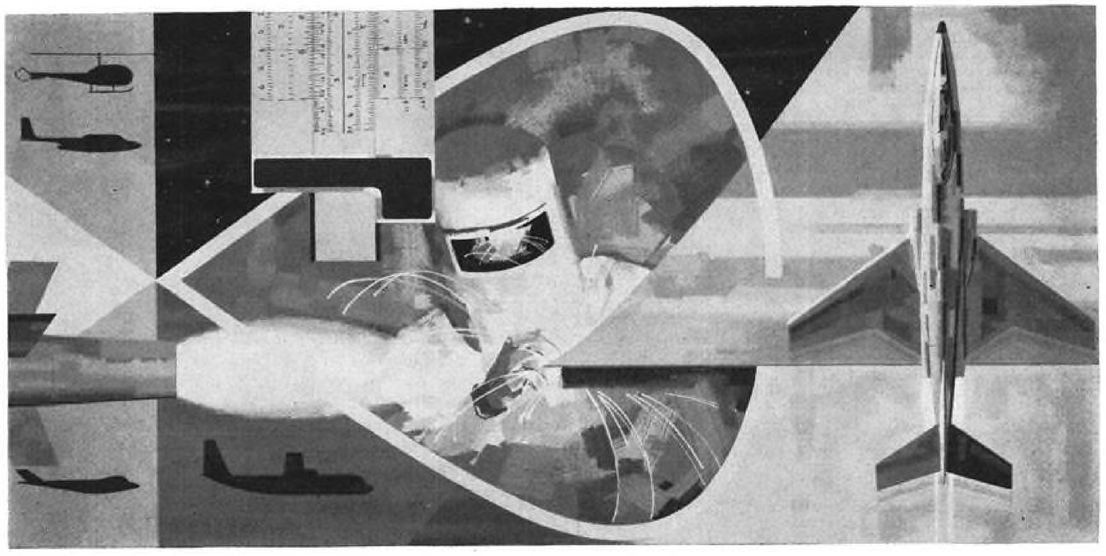
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DEVELOPMENT
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WHO'S WHERE

(*Continued from page 23*)

Changes

Ralph W. Waniek, director of research of the recently organized Magnetohydrodynamics Laboratory, Giannini Plasmadyne Corp., Santa Ana, Calif.

John W. Lazur, manager of military planning-technical planning office, Hughes Aircraft Co., Culver City, Calif.

George R. Harris, manager-marketing operations, Armament & Control Section, Light Military Electronics Department, General Electric Co., Johnson City, N. Y.

W. A. (Dick) Pulver, assistant general manager, Lockheed Aircraft Corp.'s Georgia Division, Marietta, Ga. **Arthur E. Flock** succeeds Mr. Pulver as chief engineer of the Georgia Division.

Dr. Clare P. Standford succeeds **Dr. J. A. Hunter** as chief-engineering department, Nuclear Division, The Martin Co., Baltimore, Md. Dr. Hunter is now assigned to the office of the vice president-engineering.

Alexander F. Giacco, manager-plans and programs, Chemical Propulsion Division, Hercules Powder Co., Wilmington, Dela.

Leonard F. Glancy, operations manager, Vernistat Division, The Perkin-Elmer Corp., Norwalk, Conn.

Col. Richard B. Robbins (USAF, ret.), executive adviser-Defense and Technical Products Division, Rheem Manufacturing Co., Downey, Calif. Col. Robbins will have headquarters in Washington, D. C.

S. O. Perry, general manager of the newly formed Range Systems Division, Chance Vought Aircraft, Inc., Dallas, Tex. **Dr. J. F. Reagan,** Vought's chief engineer-electronics, named consultant.

Harrison F. Edwards, chief engineer-product engineering, Simmonds Aerocessories' Manufacturing Division, Vergennes, Vt.

C. Dudley Fitz, head of the newly formed Physics and Space Sciences Department, Vitro Laboratories, division of Vitro Corporation of America, West Orange, N. J.

Rear Adm. Eddie R. Sanders (USN, ret.), executive adviser on military relations to the director of engineering and customer relations, Ryan Aeronautical Co., San Diego, Calif.

Donald Kirk, senior staff engineer-communications engineering, Government and Industrial Division, Philco Corp., Philadelphia, Pa. Also: **Phillip H. Goodwin,** manager, military control systems; **Charles L. Murphy,** manager, radar systems; **George M. Rouzee,** manager, advanced military systems.

John L. Herre, government and special accounts sales manager, Semiconductor Division, Raytheon Manufacturing Co., Waltham, Mass.

B. P. DuMars, assistant to the marketing director, Autonetics, a division of North American Aviation, Inc., Downey, Calif. The division also appointed the following sales managers: **A. J. Grant** for inertial navigation; **W. G. Fort** for armament controls; **C. H. Sword** for computers and controls.

B. R. Alsobrook, manager-brazed stainless steel products, Rohr Aircraft Corp., Chula Vista, Calif.

Carl E. Johnson, executive assistant to the assistant general manager, Lockheed Missiles and Space Division, Sunnyvale, Calif.

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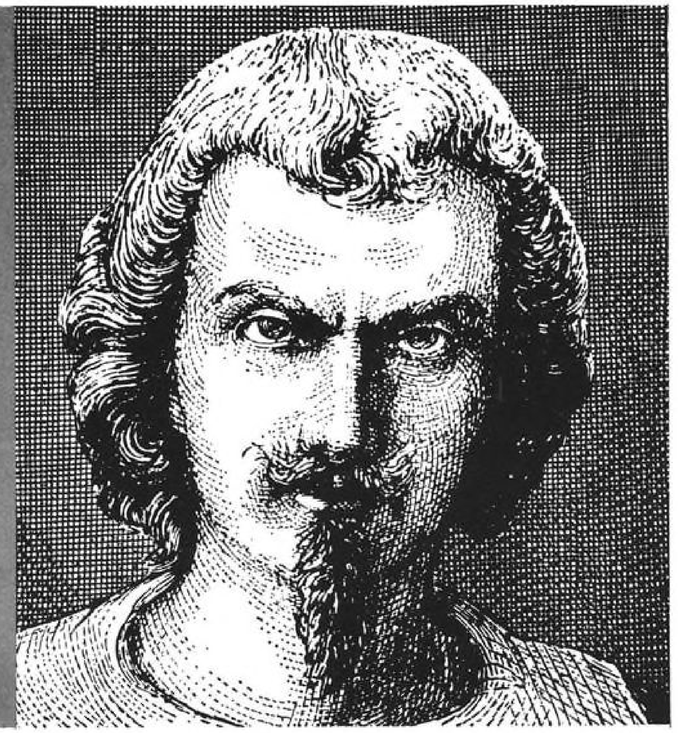
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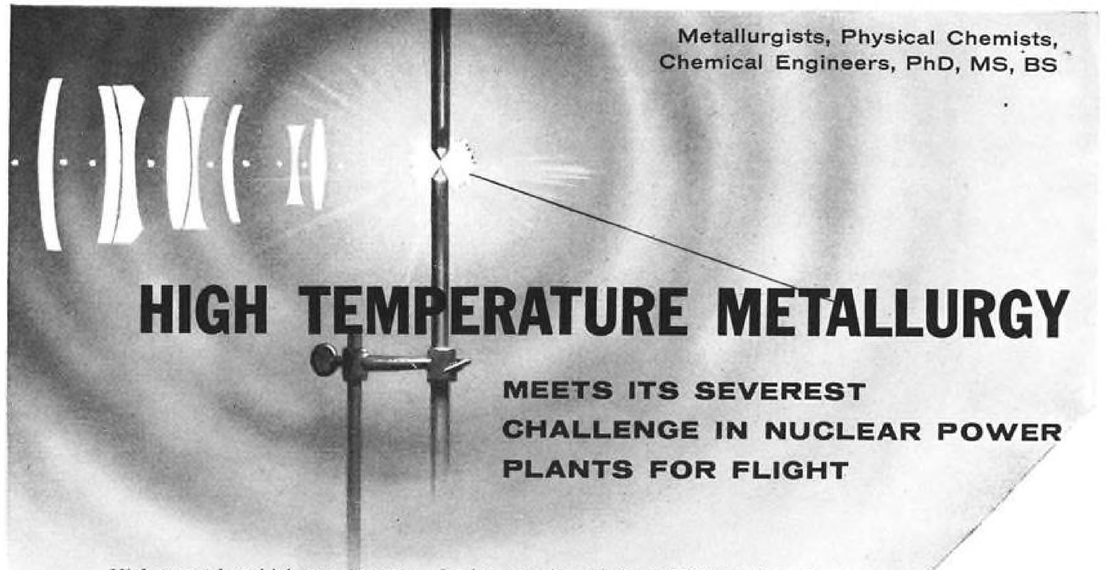
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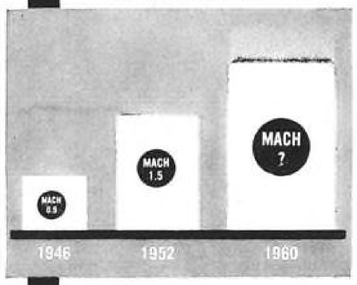
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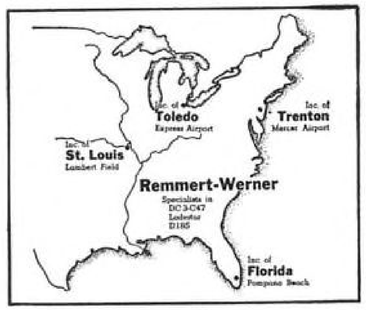
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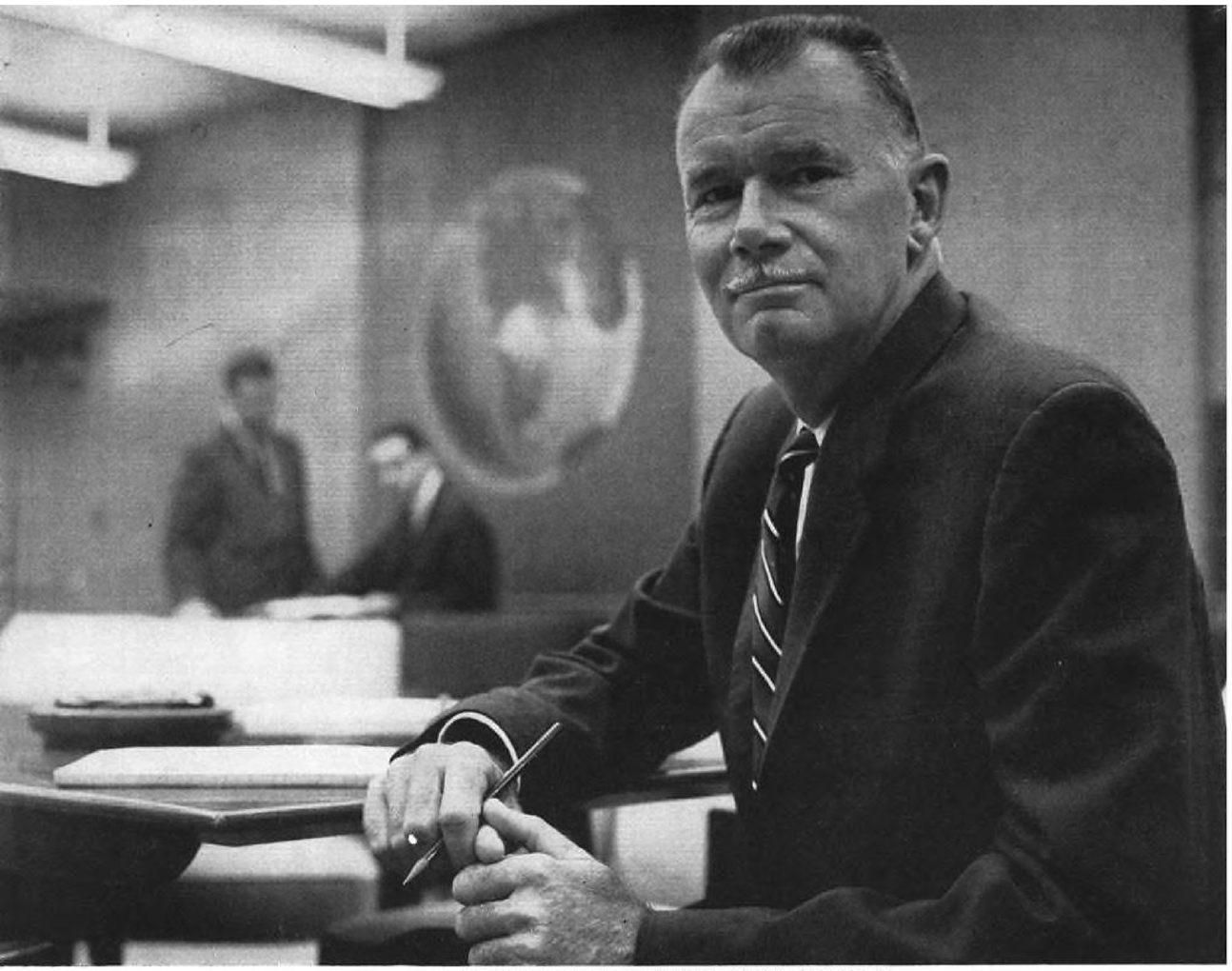
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LETTERS

Pilot Age

I have read every issue of AVIATION WEEK for the past 10 years. As an amateur businessman-pilot and American citizen advocate for the very best and most for our country's defense, you have my respect and future encouragement for the job you are doing. Your views are extreme at times, but so are those of the conservative opposition. It's a good balance. I'm sure the men burning the midnight oil in the Kremlin will never pass as any of your ghost writers. Keep up the good work!

My letter comes as a result of a qualm that popped into my mind after reading the Feb. 9 issue of AVIATION WEEK.

Your editorial "The Cost of False Economy" mentioned that the fatal American Airlines "Electra" crash, which was encountered on an ILS back course approach to LaGuardia, was possibly caused by the lack of glide path facility. I concede that this is very desirable, particularly over a path covered by obstacles, where headwinds would affect the time element of the approach, etc., but what is more sweat-free flying than an over-the-water letdown, with no obstructions, on a fresh altimeter setting?

The captain of this "Electra" flight was reported to be 59 years old. In the same issue of your periodical, the CAB accident report (p. 103) concerning a Braniff DC-7 crash at Miami, Fla., involved a captain who was 50 years old. I was left aghast to read in bold print that the captain of this ill-fated flight had experienced on previous check flights (to quote) ". . . it was necessary for him to be rechecked . . . because of his initial failure to receive passing grades. Some instrument flight checks reflected inability to maintain altitude during turns; however, he did pass rechecks and remained on flying status."

The particular captain here was only 50 years old. It is evident that he had his good and bad days, judging from the report. The findings of the Board simply indicate that he failed to maintain sufficient altitude during the attempted go-around, due very probably to his ". . . preoccupation with an engine fire. . . ."

My question is, "How much deterioration and retardation accompanies age, when measuring the human senses, reflexes and, in the case of pilots, general flying technique?" I fully realize that there will be a different answer with every case. The general advances recently made in aero medicine and flight simulator evaluation tests, etc., must offer additional evidence that there are other physical and psychological factors to consider in addition to the general existing tolerances of physical examinations and routine flight tests, often conducted by friends.

I am thinking about the actual measurement of the preceptions, reflexes, etc. of a person at the age of say 35, and the same test findings of that identical person 25 years later, taking the same test. I strongly feel that there will exist a great difference in the results.

Age alone should never be a determining factor with the retirement or assignment of an airline pilot. It may well be proven in the near future to be a factor about which we'll be hearing much more.

God bless all of our senior pilots. May they be permitted to continue in their chosen and respected profession as long as they are capable. I seriously pray that the airline operational people and the unions do not compel the oldest senior man to check out on the latest and fastest jets. The diesel was a little too fast for the granddaddies of the railroads.

Naperville and other serious accidents proved this true.

With no degrees, no proof, but just a pilot's feeling for the picture, I'd take any pilot with five years of continuous captain's duty on a line flying the heaviest four-engine equipment operating, and bet that he and his fellow constituents would do a fine job of checking out in the super jets that are coming up. He may be only 38, not too gray around the temples, but I'd bet, in confidential conversation with those of the local arena, he would carry the vote.

With the pattern of such a procedure where age did not carry the big priority for the advancement to more current type aireraft, I'd venture there wouldn't be too much smoke coming from the senior pilots approaching the high age limit for line pilots, should they not be the natural expected candidates to check out in the new and more demanding equipment. These men in most cases would be more comfortable and safer in the equipment in which they have logged thousands of safe schedules.

This letter was written in the most constructive attitude. It is not an invitation for any sour grape correspondence. I can't prove a thing. It is only my hope that it may stimulate some thought, research, and expression by professional people who are dedicated to the furtherance, safety and progress for American aviation.

I realize that there are many individuals in government, military and airline operations who could not express these thoughts over their signature, but quite possibly share my beliefs.

J. S. KIMMEL, JR.
Republic Heating Wholesalers
Davenport, Iowa

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

'Nuff' Said?

Reading your Feb. 9 issue brought to mind discussions triggered by Capt. Robson many months ago on the comparison of the merits of airline vs. military transport pilots. I do not wish to further this discussion, but three items of subject issue were considerably enlightening.

1. The American Electra crash, which appears to be the result of an experienced pilot flying into the water on a minimum back course ILS approach. At this stage of the investigation—strictly pilot error!

2. The PanAm 707 that lost 29,000 ft. due to an autopilot malfunction. "Capt. Lynch said the plane experienced some buffeting (compressibility effects?) and may have reached Mach .94 . . ."; ". . . wings were leveled after Capt. Lynch reduced power on all engines." Why didn't Capt. Peters (the copilot) immediately reduce power when the dive was entered? Is not Capt. Peters, the flight engineer?

3. The Braniff DC-7C crash at Miami. This is a gem! "First Officer Winthrop stated . . . he could not remember performing any of the emergency procedures involved in feathering." "Mr. Fink further said that after No. 3 was feathered they did not increase power on the remaining engines," and, ". . . he did not have his headset on . . ."!!! The headset bit is common practice on the airlines but a rather dangerous practice near the ground. Capt. George had ". . . to be rechecked by company check pilots because of his initial failure to receive passing grades. Some instrument flight checks reflected inability to maintain altitude during turns . . ." A rather deplorable situation for a 20,000 hr. pilot! The crew, although informed by the tower that smoke was observed trailing from the No. 3 engine, did not enter this information on the flight log. "Nuff" said?

J. G. CARL
Florissant, Mo.

Hail Damage

Reference p. 57, AVIATION WEEK, Dec. 29, photo of B-52 hail damage:

As a taxpayer and industry associate my first reaction, as well as my colleagues, was—where the hell was the radar man?

JACK WARD
Wheaton, Ill.

(The original news release accompanying the pictures stated that the hail pocket was not detectable on radar.—Ed.)

Second Chances

The Northeast Airlines' captain who crashed on Rikers Island Feb. 1, 1957, reportedly had landed a Convair in Flushing Bay some four years previously. Both crashes were blamed on pilot error. The second one cost many lives.

Now comes Capt. (Thomas D.) George (AW Feb. 9, p. 115), who on several occasions had to be ". . . rechecked by company check pilots because of his initial failure to receive passing grades." More lives were lost.

How many second chances to these poor scholars are we, the traveling public, required to risk our lives for? In the progressive business world, of which I am a part, they would have long since passed into oblivion.

VERNON DALE
Marietta, Ga.

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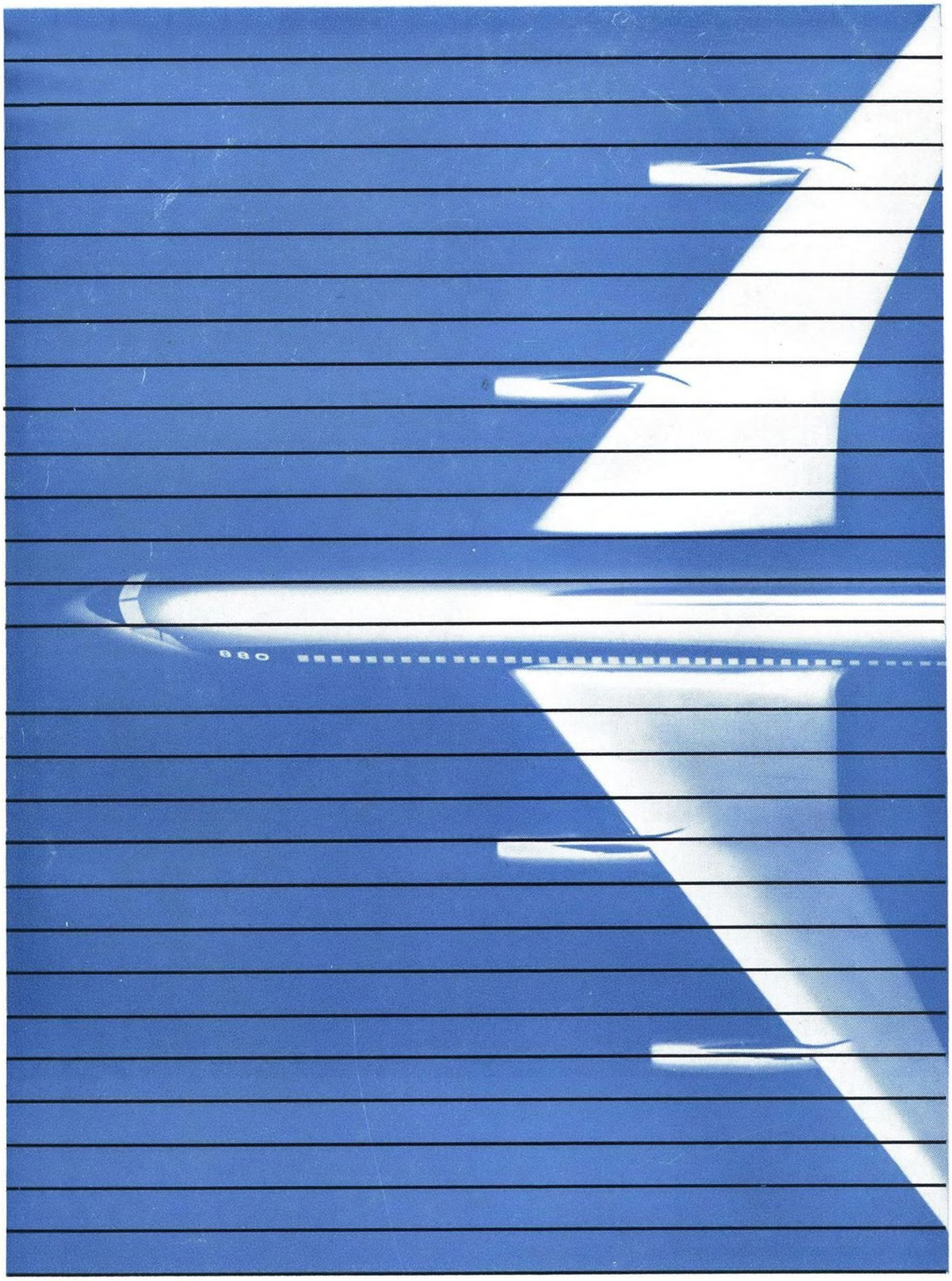
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