Aviation Week and Space Technology

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A McGraw-Hill Publication

August 15, 1960

Pilot Report On Boeing 720

•

USAF Expands Power Search



Polaris Fired From Submarine

KAYLOCK® NUT SEALS VITAL AEROSPACE ACCESS AREAS



Photos of 880 Jet wing access area courtesy CONVAIR, Division of General Dynamics Corp.

ALL commercial jet airliners of the free world, including the new Convair 880, use a Kaylock® self-sealing nut to hermetically seal access areas where re-entry may be required for service and for maintenance. Kaynar was the first to actually mold the seal into the finished nut assembly. Since its introduction, the Kaylock F1968 nut has been specified and used throughout the aerospace industry for sealing fuel tanks, air pressure chambers in space vehicles and other vital areas where an accessible hermetic seal is required. A special flange design at the base of the nut insures a positive hold-down of the seal. The flange does not deform when normal bolt pressure is applied.

Kaynar originated the lightweight, all-metal self-locking nut and is best equipped to serve all your needs for standard parts, as well as for specialized fastener problems. A Kaynar sales engineer is as near as your phone—call him today.

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kansas; New York, N. Y.; Atlanta, Ga.; Renton, Wash.; Montreal; Paris; London; The Hague

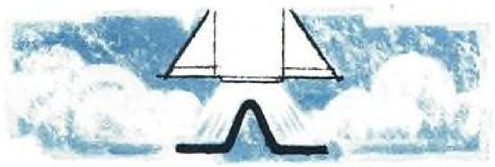
Kaylock®
first in lightweight locknuts



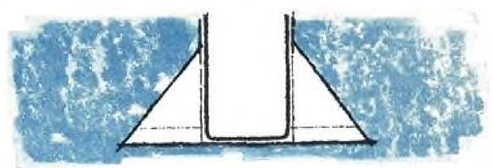
Kaylock F1968 self-sealing locknut

Need a **NONCRITICAL** *material to solve a* **CRITICAL** *heat problem?*

Consider these Goodyear Aircraft capabilities in the field of high-temperature laminates—



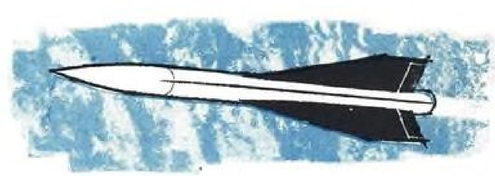
HERE'S AN INEXPENSIVE BLAST DEFLECTOR—made of reinforced plastic—which can withstand the direct blast of a rocket engine. Goodyear Aircraft stands ready to design and fabricate economical, reusable blast deflectors to your specific requirement.



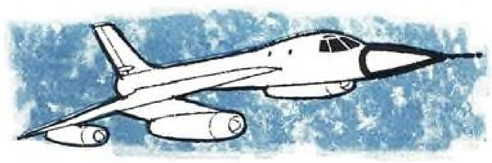
CRYOGENIC FUEL TANK INSULATION by Goodyear Aircraft is less than ¼-inch thick, yet has proved its ability to prevent "boil off" of liquid gaseous rocket fuels, such as liquid nitrogen and liquid hydrogen. Use of a plastic laminate for this purpose can mean substantial weight, space and cost savings.



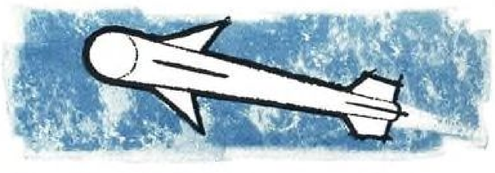
NOSE CONES FOR GLIDE RE-ENTRY VEHICLES can be produced at Goodyear Aircraft to a wide range of specifications. The reason: extensive experience with ablative and thermal-resistant techniques. Do you need a lightweight nose cone material that can withstand 2000° to 2500° for an hour or more? Whatever your re-entry requirement, a specially compounded high-temperature laminate may well be the answer.



LEADING EDGES OF MISSILES or aircraft can be protected against prolonged high-temperature exposure by plastic laminate coverings which conform to the metal structure. Reinforced plastic laminates by Goodyear Aircraft can also be used for jet vanes, rocket nozzles, fins and other miscellaneous missile components.



RADOMES FOR AIRCRAFT which operate at Mach III and above have been produced at Goodyear Aircraft. Goodyear Aircraft has a vast background in radome engineering and manufacturing for both the solid and honeycombed layered constructions.



"PLASTIC" MISSILES—built by Goodyear Aircraft—could utilize a variety of plastic laminates and fabrication techniques. Advantages of such all-plastic components: no use of critical material, high strength-to-weight ratio, low cost in mass production, rust- and corrosion-resistant.

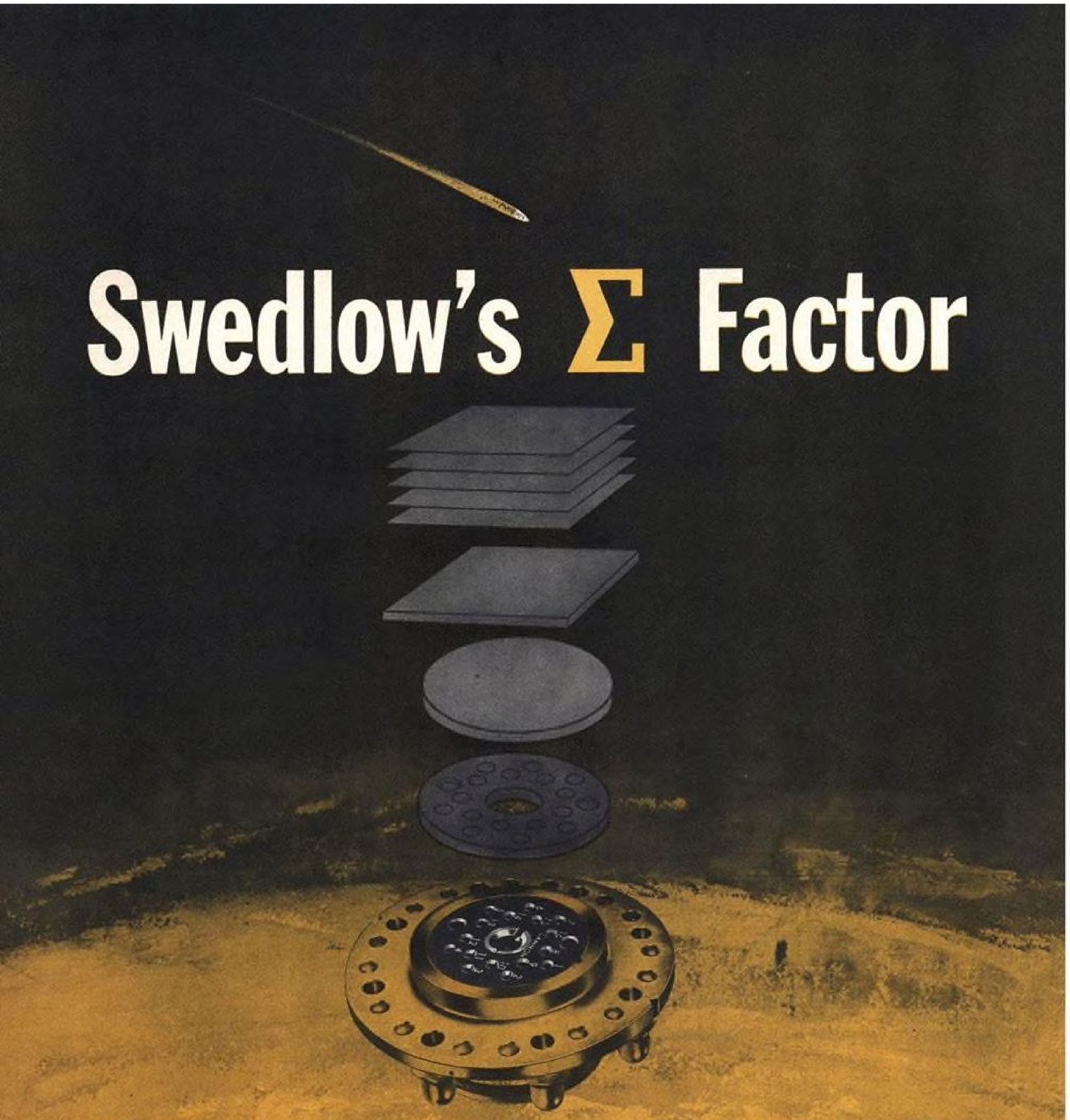
Your inquiry is invited *regarding these specific capabilities—or any requirement calling for a noncritical, high-strength material which must retain its properties under the most demanding heat and stress conditions. WRITE: Goodyear Aircraft Corporation, Dept. 916AN, Akron 15, Ohio.*

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"Sigma": the "sum" of the skill and insight needed to solve challenging problems in reinforced plastics. Swedlow phenolic insulative laminates must combine diverse properties for many of Cannon Electric Company's reliable high temperature connectors—now found on most missiles.

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AVIATION CALENDAR

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado.

Aug. 23-26—Western Electronic Show & Convention, Los Angeles Memorial Sports Arena, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 1—Symposium on Rocket and Satellite Instrumentation, Society of Instrument Technology and British Interplanetary Society, London, England.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland.

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

Sept. 7-9—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Instrument Society of America; American Society of Mechanical Engineers; American Institute of Electrical Engineers; Institute of Radio Engineers; American Institute of Chemical Engineers.

Sept. 8-9—1960 Engine and Operations Symposium, Airwork Corp., Millville, N. J.

Sept. 8-10—1960 National Convention, OX-5 Club of America, Tower Hotel Courts, Dallas, Tex.

Sept. 12-13—Sixth Annual Titanium Metallurgy Conference, New York University's College of Engineering, Bronx, N. Y.

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

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 12-16—First Annual USAF Safety Congress, Mission Inn, Riverside, Calif. Sponsor: Office of the Deputy Inspector General for Safety, USAF, Norton AFB.

(Continued on page 6)

AVIATION WEEK and Space Technology

August 15, 1960

Vol. 73, No. 7

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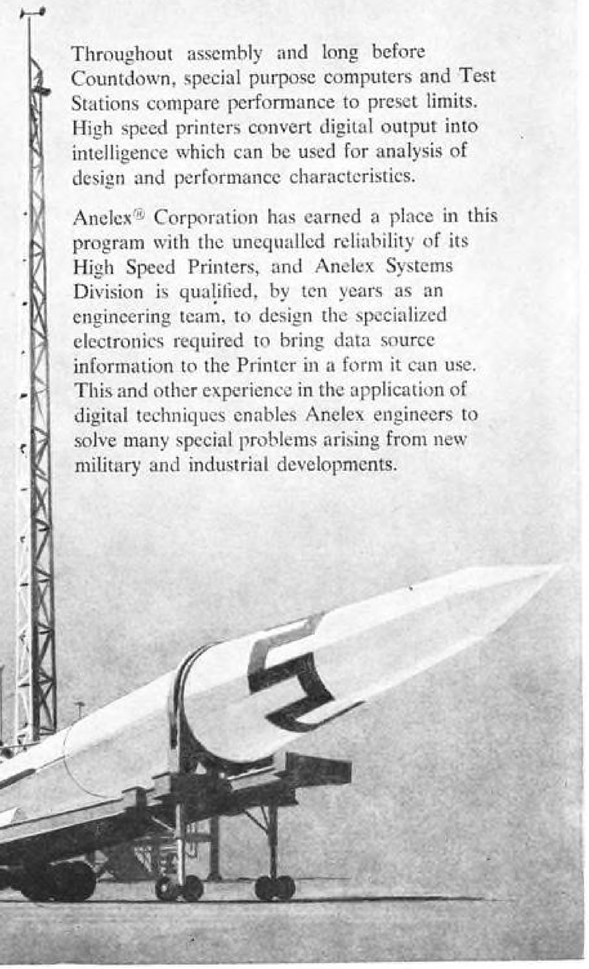
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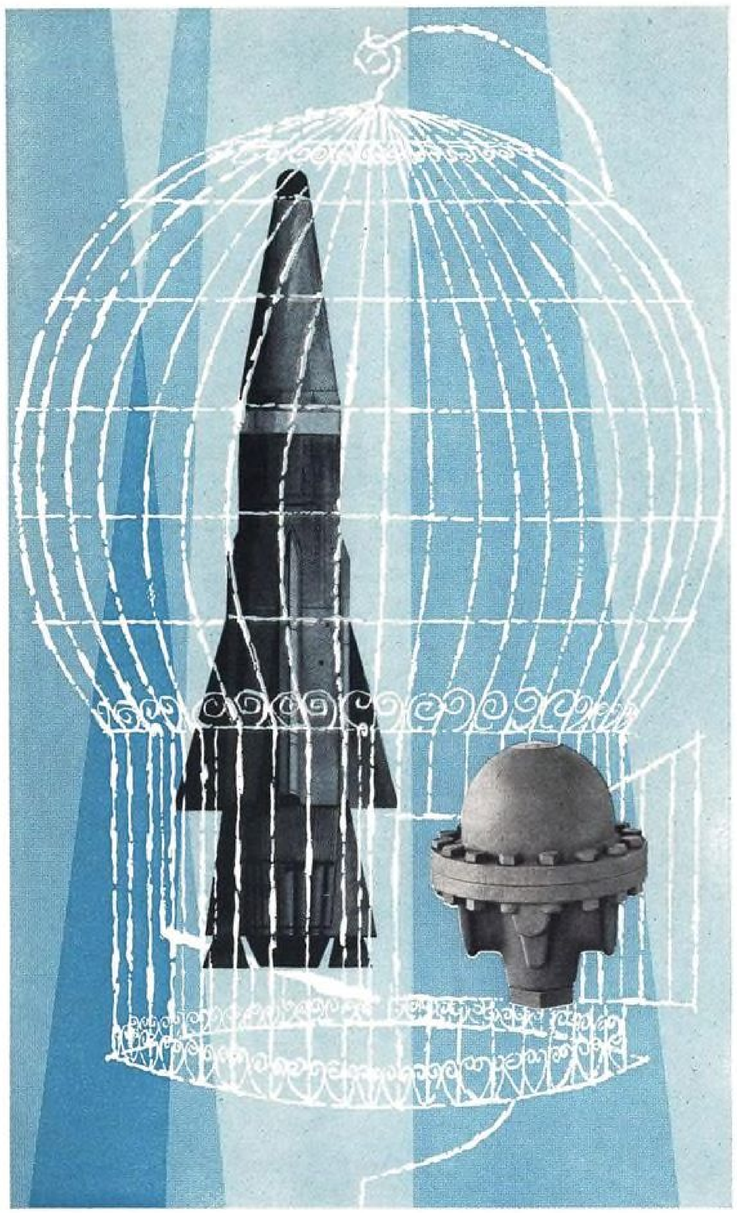
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AVIATION CALENDAR

(*Continued from page 5*)

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 15-16—Eighth Annual Engineering Management Conference, Morrison Hotel, Chicago, Ill.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 20-22—13th Annual Meeting & Forum, National Business Aircraft Assn., Ambassador Hotel, Los Angeles, Calif.

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

Sept. 24—Reunion, 1st Air Commando Group, concurrent with AFA Convention. Contact: Lt. Col. R. E. Moist, USAF, 7025 Hayvenhurst Ave., Van Nuys, Calif.

Sept. 25-27—24th Annual Convention, International Northwest Aviation Council, Harrison Hot Springs, British Columbia.

Sept. 27-30—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica. Cosponsors: USAF; U. S. Army; U. S. Navy; NASA; AEC.

Oct. 2-10—Federation Aeronautique Internationale Annual Meeting, Barcelona.

Oct. 3-5—Sixth National Communications Symposium, Institute of Radio Engineers, Utica, N. Y.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton-Palace Hotel, San Francisco.

Oct. 5-7—Briefing Session on Opportunities in Space-Age Technology, American Management Assn., Hotel Astor, New York, N. Y.

Oct. 6-8—Annual Convention, Airmail Pioneers, El Cortez Hotel, San Diego, Calif.

Oct. 6-8—Society of Experimental Test Pilots Symposium on "Omni-sonic Flight," Ambassador Hotel, Los Angeles, Calif. Fourth Annual Awards Banquet, Oct. 8.

Oct. 6-9—Annual Meeting, National Pilots Assn., Western Hills Lodge, Wagoner, Okla.

Oct. 8—Third Annual National Aero Club Football Fly-in, Michigan vs. Duke, Ann Arbor, Mich.

Oct. 10-14—Society of Automotive Engineers National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Calif.

Oct. 14-15—Symposium on High-Speed Processing, Society of Photographic Scientists & Engineers, Washington, D. C.

Oct. 17-18—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Canada.



Eighteen-foot diameter radome of WSR-57 Stormfinder radar. System operates at S band, has 250-mile range.

Dr. F. W. Reichelderfer, chief of the Weather Bureau, calls this "the best weather radar in the world."*

Raytheon STORMFINDER shows a composite picture of the entire weather front over a 200,000 square mile area. The "weather eye" pinpoints and tracks storms 250 miles away, distinguishes hail, rain, and snow, probes the heart of a hurricane. It is ground-based . . . and designed, developed and produced specifically for weather detection and analysis.

EQUIPMENT CHARACTERISTICS

Iso-echo feature. Sensitivity Time Control of 20 db between 10-100 miles. Triple display indicator unit: (1) 7″ RHI (range height indicator), (2) 12″ PPI (plan-position indicator), (3) 7″ A/R Scope for storm intensity measurement.

Power output	500 KW	
Frequency	2.7 — 2.9 kmc	
Beamwidth	2.2°	
Elevation	−10° to +45°	@ 6 scans/min
Azimuth	360°	@ 1-4 scans/min

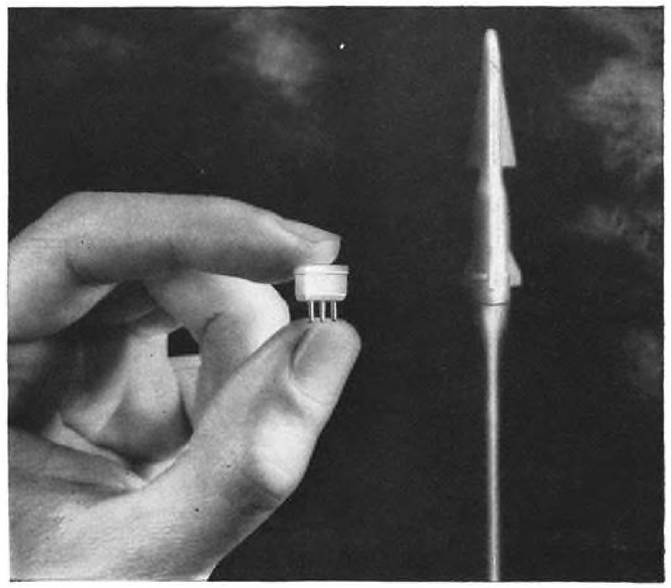
*from testimony before a House Appropriations subcommittee, January 18, 1960.

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For Raytheon Weather Radar Brochure,
Write: Director of Marketing, Equipment Division, Dept. C2, Raytheon Company, West Newton, Mass.

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Now—New developments in TEFLON FEP electronic components by Garlock. With the commercial availability of Teflon FEP, Garlock can now process electronic components never before possible with Teflon TFE. The reason is this—whereas TFE must be processed like powdered metals, the new FEP has the advantage of being melt-processed in conventional extrusion and injection molding equipment.

Think of what this means to you as a designer. You can now specify Teflon for the most delicate and complex components you may design. Teflon FEP opens whole new avenues of design possibilities . . . it can be injection molded into close-tolerance feed-throughs, stand-offs, insulators, tube sockets and connectors . . . it can be heat-bonded to itself and other materials, making possible improved printed circuit design. Also available in rod form, sizes ¼″ to 3″ dia.

Another important point. Developed as a supplement to Teflon TFE, the new FEP resin exhibits the same fine physical properties of chemical inertness, top thermal stability, excellent dielectric strength, and outstanding anti-stick characteristics. FEP is rated at a continuous service ceiling of +400°F, will resist extreme cold down to −395°F.

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Turn to Garlock for more information on components of new Teflon FEP. Your Garlock Electronic Products representative will be glad to give you complete details. Call him, or write for Catalog AD-169, Garlock Electronic Products, Garlock Inc., Camden 1, New Jersey.

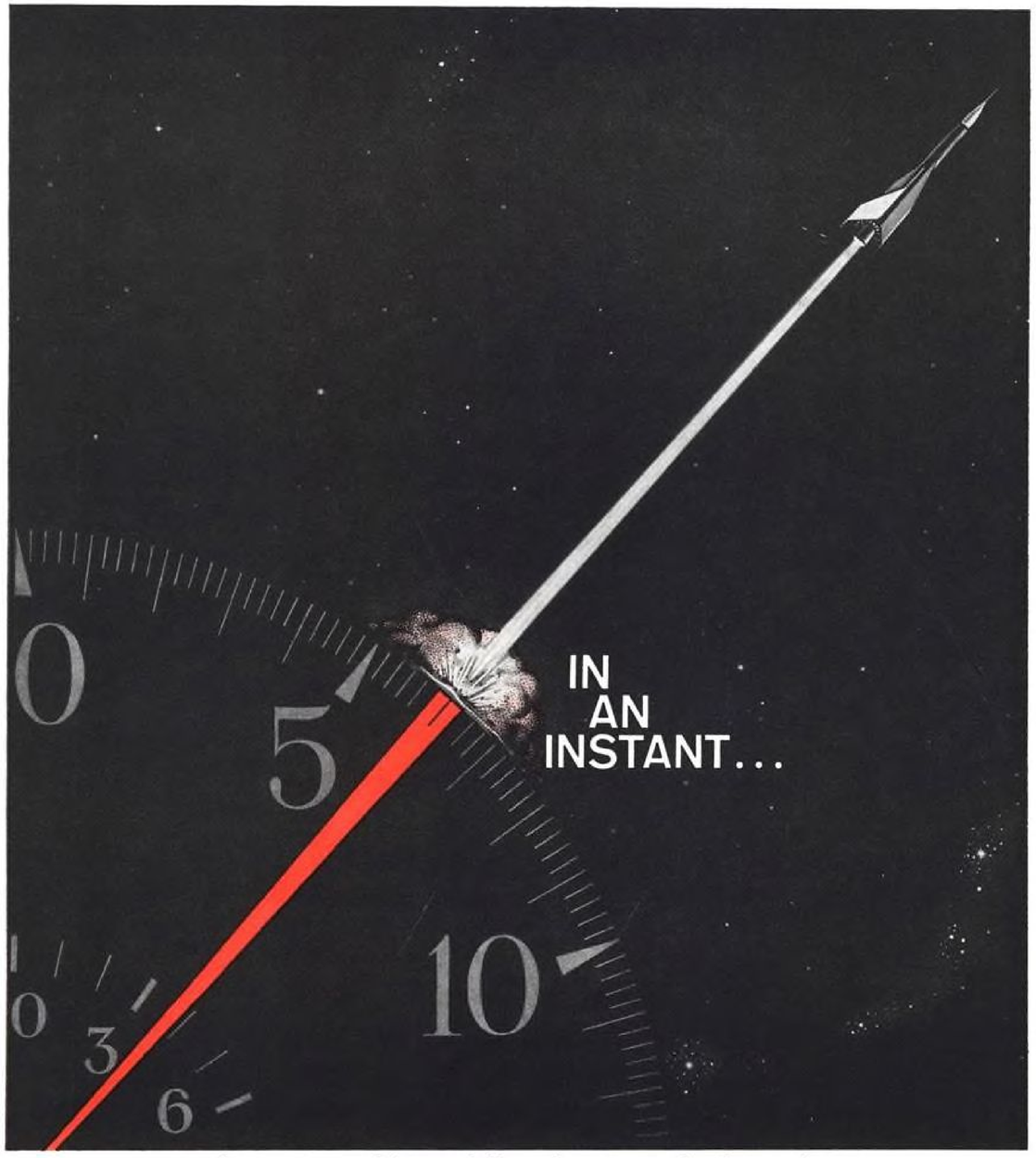
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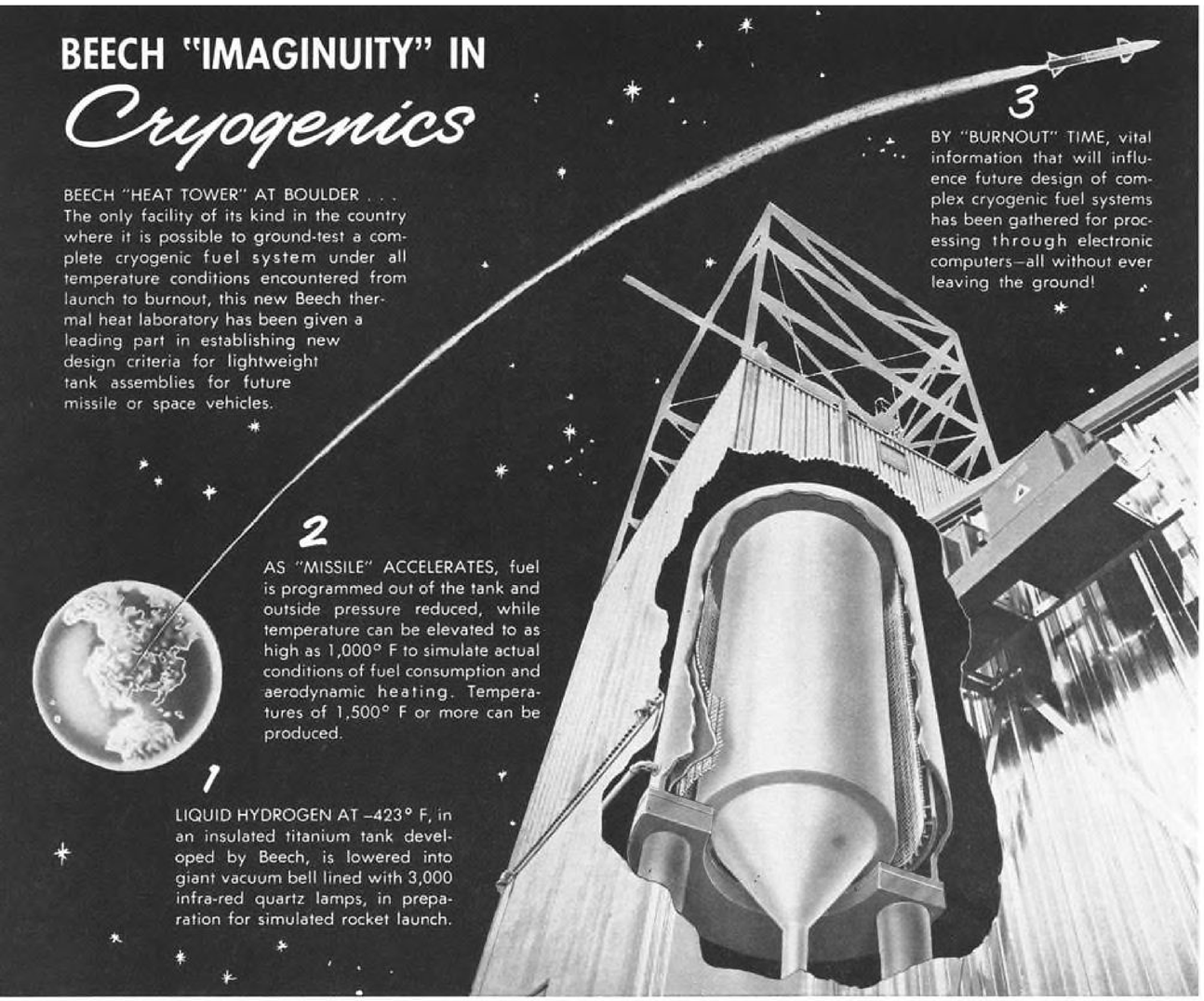
For specifications and local offices, see our insert in Chemical Materials Catalog, pages 475-482 and in Chemical Week Buyers Guide, pages 37-44.

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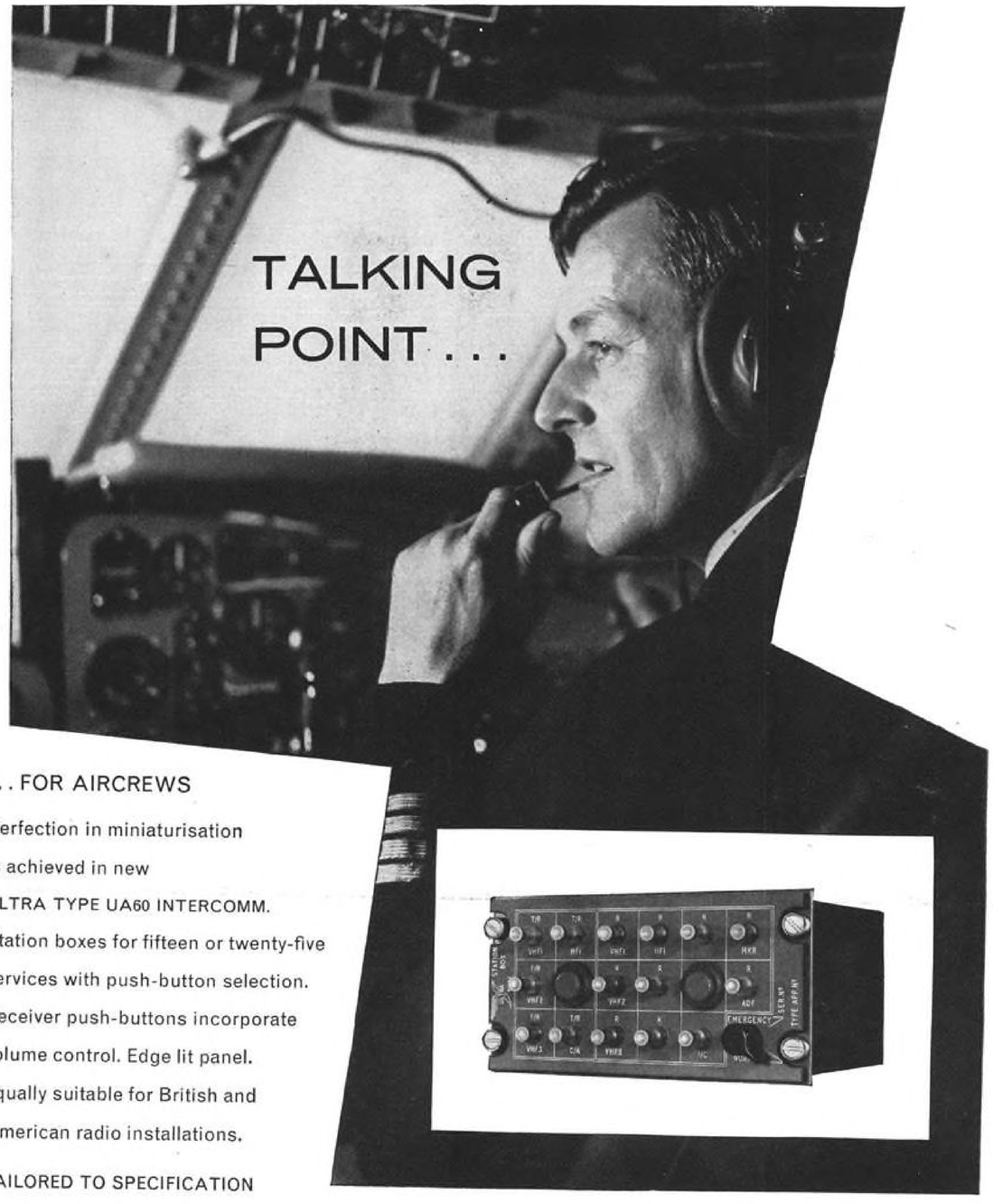
BRUNSWICK OFFERS COMPLETE CAPABILITY FOR AEROSPACE PROJECTS

"Complete capability" sums up Brunswick's ability to produce results at any stage of missile development. From in-house design and production to thorough testing, Brunswick brings to each new job a vast background in successful development of components and primary structures. **1. In nose cones and radomes,** Brunswick designs and materials can be tailored to meet rigorous new requirements for high temperature electrical and ablative purposes. **2. In wings and fins,** Brunswick engineering allows new plastic structures and antennas utilized in combination for more design freedom with maximum efficiency. **3. Missile bodies** constructed by the Strickland "B" fiber glass filament-winding process offer exceptional values in weight-strength ratios while meeting design requirements for unusual shapes and sizes. **4. Brunswick rocket motor cases** constructed by the Strickland "B" fiber glass filament-winding process consistently demonstrate superior properties, whether large or small. *Pressure vessels* designed by Brunswick can deliver an S/D ratio as high as 2,000,000. **5. Reflectors** of metal honeycomb or plastic construction are designed and manufactured to meet close tolerance and conform to the highest standards of quality and performance. **6. Ground radomes** are readily available for ground support applications. Constructed of solid laminate, honeycomb core, or foam, they are standard production design at Brunswick. From the starting line, or at any stage of the development race, Brunswick's complete capability is ready to make your ideas work faster and better. Call on Brunswick's ability to produce results. Brunswick Corporation, Defense Products Division, 1700 Messler Street, Muskegon, Michigan.

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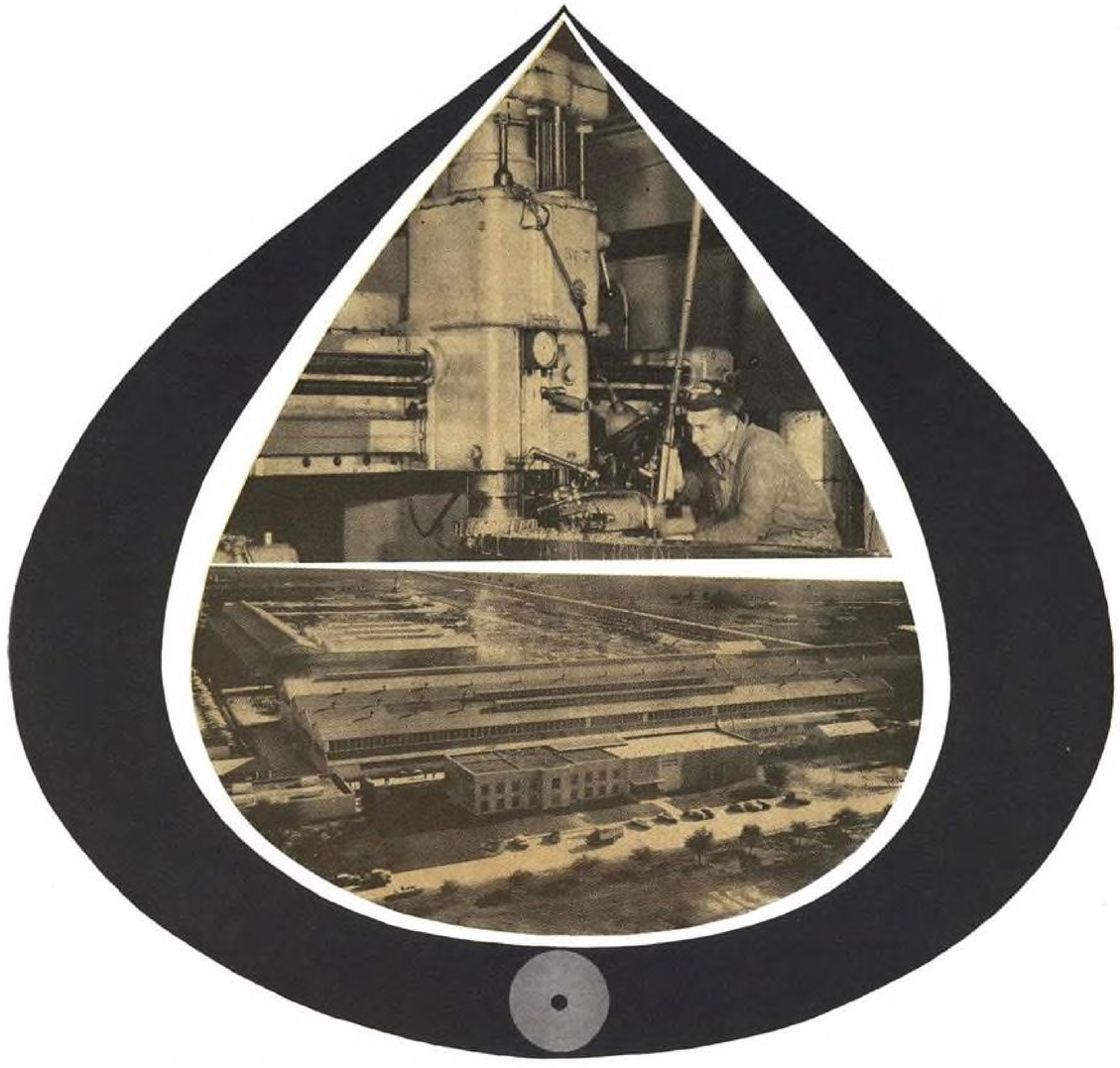
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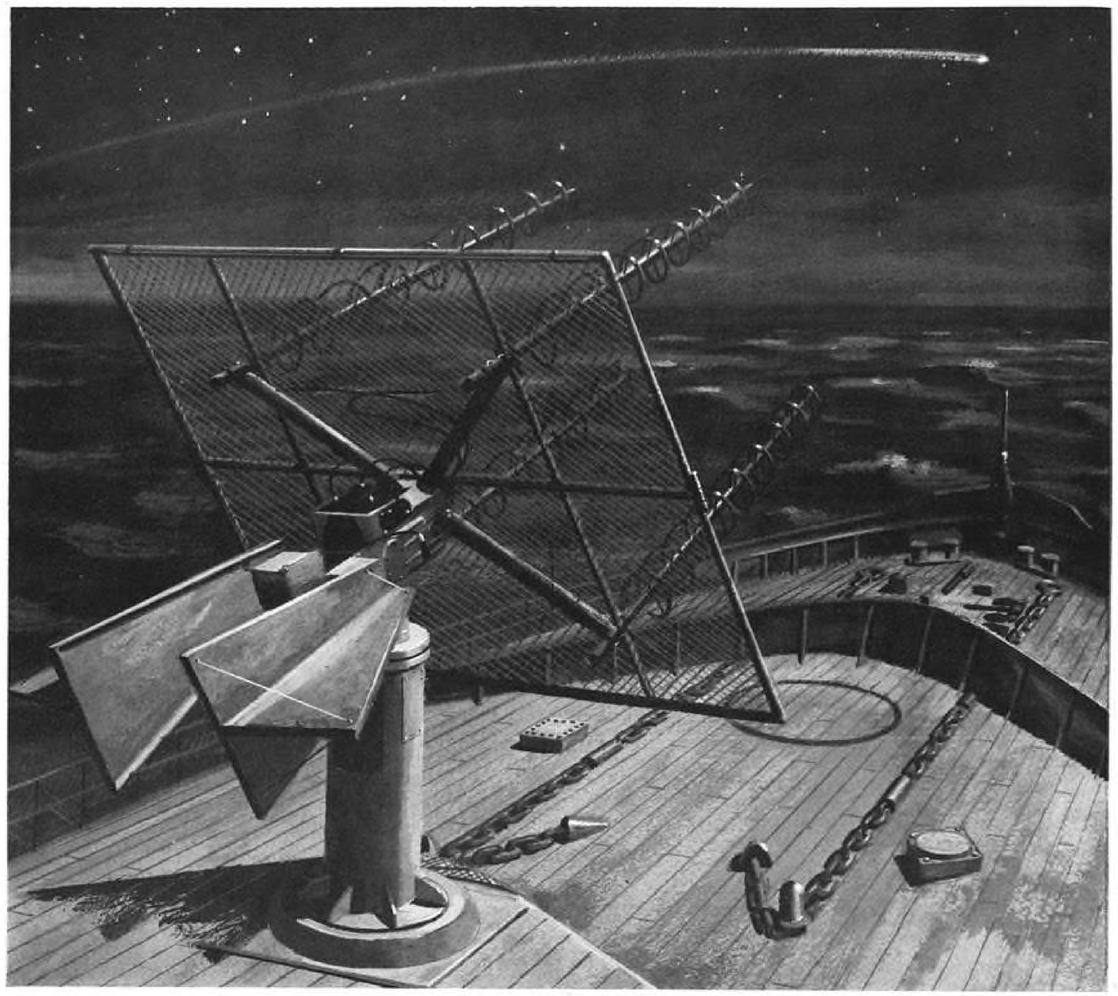
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2-week delivery of Cubic AGAVE for shipboard use steps up Atlantic Missile Range tracking

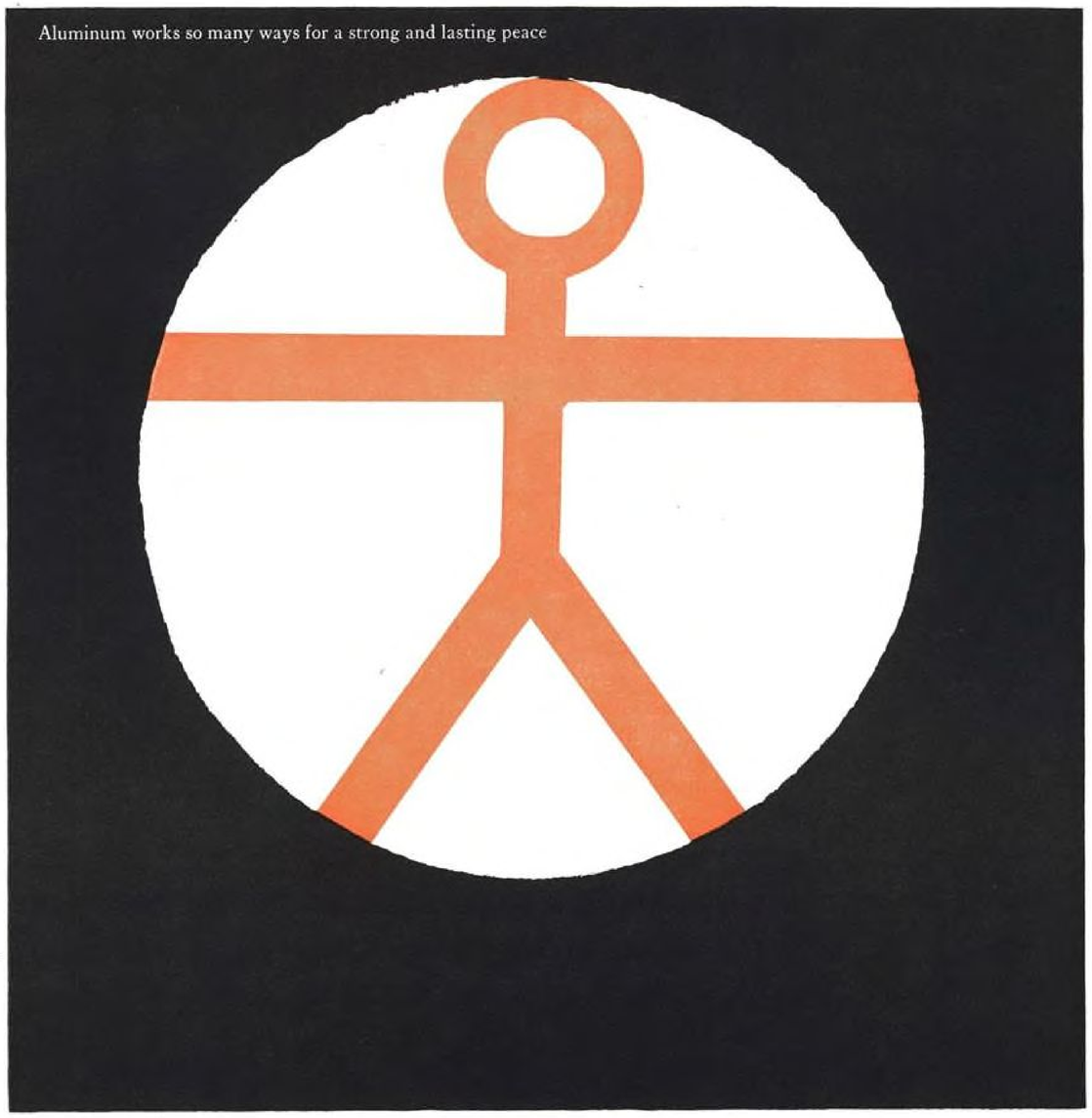
Faster, more accurate location of ICBM nosecones as they re-enter the earth's atmosphere and rush toward impact areas in the South Atlantic will now be possible with a new Cubic AGAVE installation. The system was ready for shipment only two weeks after the initial order was placed. Speed like this typifies Cubic's versatility and flexibility to meet fast changing missile range instrumentation requirements.

This new AGAVE is already installed aboard the American Mariner, a range instrumentation ship operated by RCA. AGAVE (Automatic Gimballed-Antenna Vectoring Equipment) is an automatic tracking antenna system that operates in the 225-mc to 300-mc band. Continuous-wave correlation detection, and the 18-db gain of the antenna array, permit reliable tracking over long ranges.

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Write for a free booklet on AGAVE, to Dept. AW-1, Cubic Corporation, San Diego 11, California.

CUBIC CORPORATION



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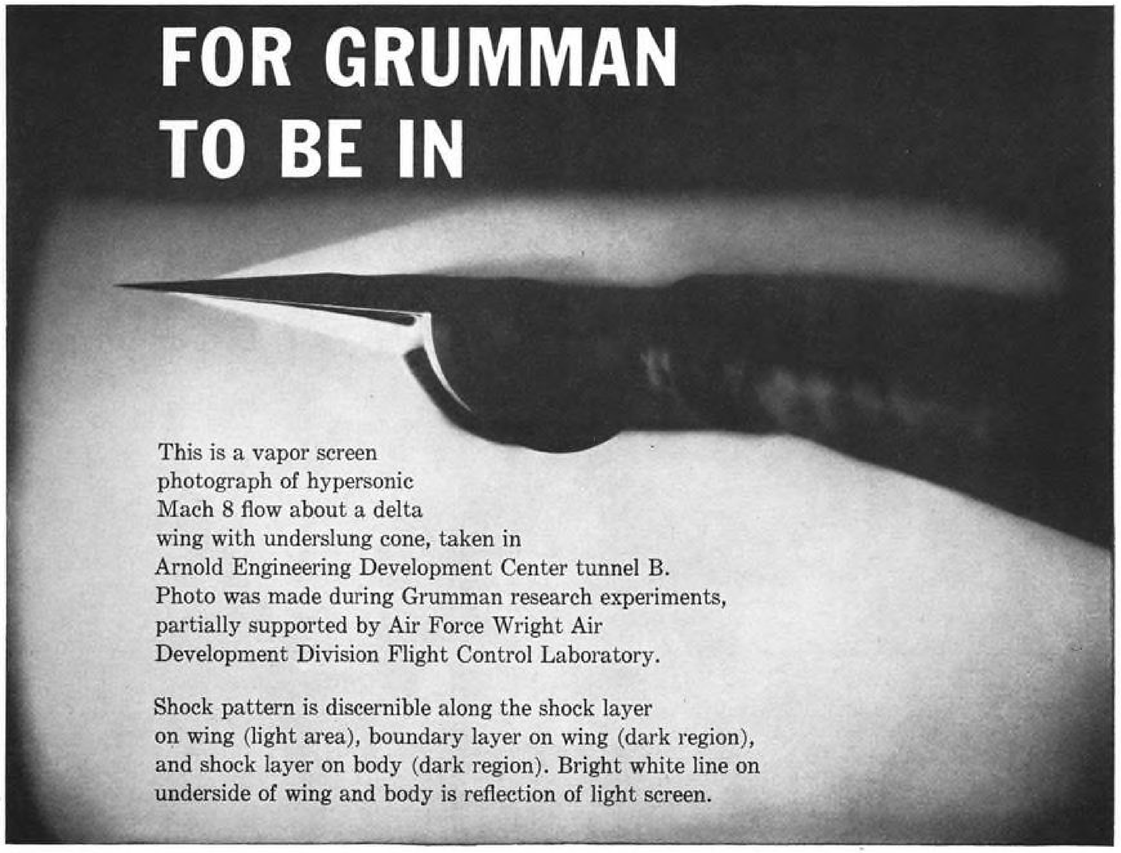
Alcoa goes to work immediately on defense projects

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ALCOA ALUMINUM

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NOTHING IS TOO FAR OUT.... FOR GRUMMAN TO BE IN



This is a vapor screen photograph of hypersonic Mach 8 flow about a delta wing with underslung cone, taken in Arnold Engineering Development Center tunnel B. Photo was made during Grumman research experiments, partially supported by Air Force Wright Air Development Division Flight Control Laboratory.

Shock pattern is discernible along the shock layer on wing (light area), boundary layer on wing (dark region), and shock layer on body (dark region). Bright white line on underside of wing and body is reflection of light screen.

This photo characterizes the work Grumman is doing in hypersonic aerodynamics. Other efforts at Grumman include continuing design and development work on orbiting observatories, interplanetary communication systems, re-entry vehicles and reconnaissance satellites, to name a few.

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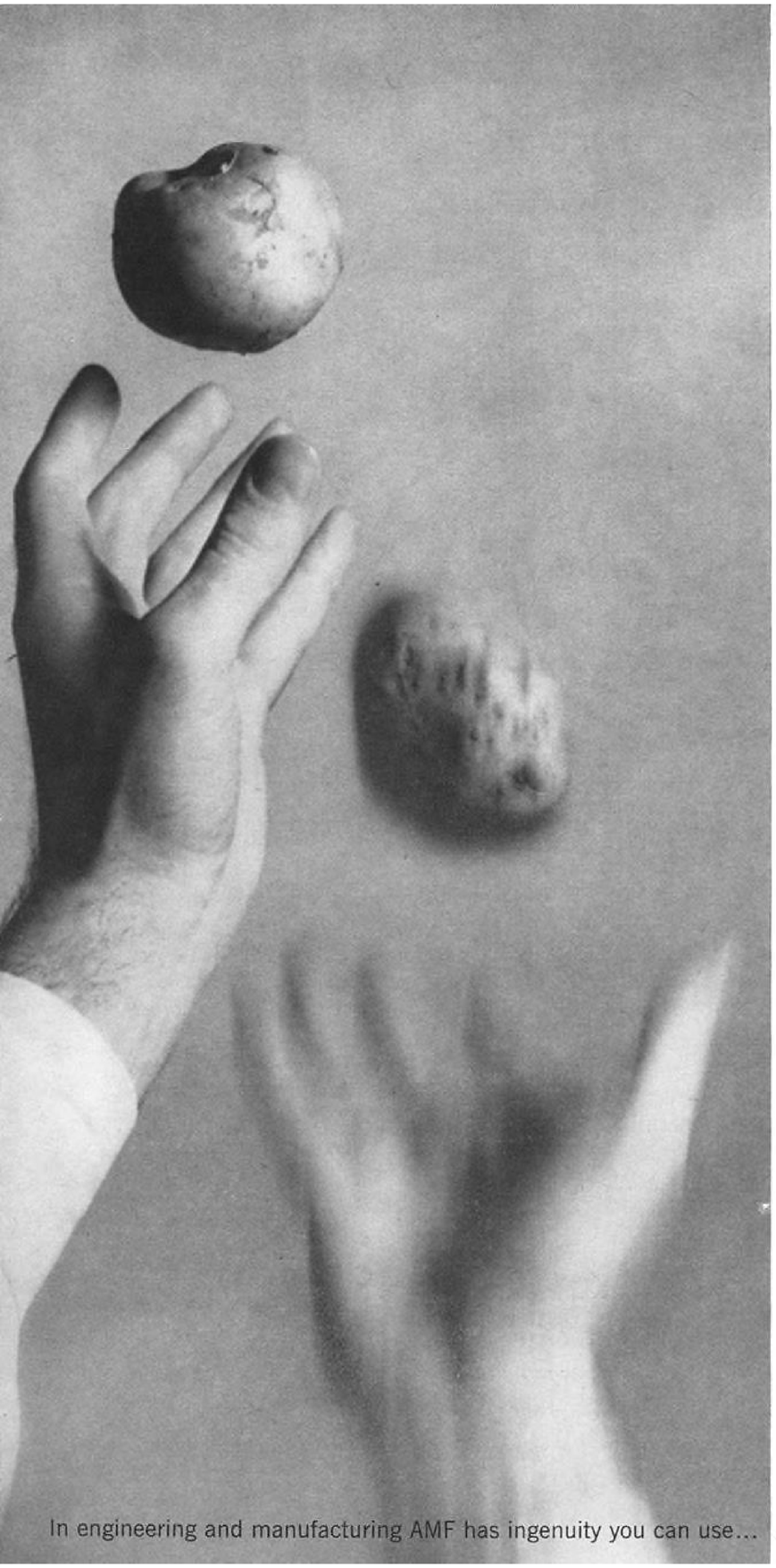
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COVER: Navy-Lockheed Polaris ignites after second successful submarine launch last month from submerged USS George Washington. Instrumented nose cone traveled 1,000 naut. mi. in its 14 min. flight. Early this month, a pad-launched Polaris flew 1,130 naut. mi. for longest Polaris flight to date. President Eisenhower has ordered development of the 2,500-mi. version of the missile. Navy will now push detailed studies to put the solid fuel missile on NATO surface ships as an alternative to land-based Polaris sites. For other pictures, see p. 81.

PICTURE CREDITS

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EDITORIAL

Defense Battle Raging

The executive and legislative branches of the government are locked in a bitter battle over U. S. defense policies as the 86th Congress struggles through its final session. The outcome of this battle has an enormous portent for the future of this nation, not only because of its influence on the presidential election in the fall but also because of its effect on our fortunes in the long-term struggle against the Soviet Union. There has been some pretty bitter debate within the executive branch of the government over the need for a major acceleration of the defense program (AW Aug. 1, pp. 21 and 28), and President Eisenhower, returning to Washington from Newport, has called for some increases in key military programs.

In light of the President's bitter castigation of critics of his defense program with his "Job's boils" reference at the Republican convention in Chicago, it is interesting to note that he is now recommending most of the things these critics have been pressing for and has, in fact, thoroughly reversed his own stand of last January on such key issues as the B-70, strategic jet airlift, reconnaissance satellites and the airborne alert. If the "Job's boils" have stirred the President into sufficient study of these grave matters to convince him that changes in his decisions were required, then their efforts were indeed worth any personal discomfort they may have caused him.

We hope that the generals so bitterly assailed last spring by the President for their "parochial views," expressed in honest testimony given in response to congressional summons, will also take some satisfaction from the President's recent inclination toward their recommendations.

The President's new defense program was greeted with newspaper headlines proclaiming "Ike Orders Big Defense Boost," which is no doubt what Presidential Press Secretary James Hagerty was aiming for. However, on closer examination of the details involved in the President's message and the related action taken by the Defense Department (see story on p. 26), it becomes evident that there is no boost at all, one serious retrogression and a general vagueness as to the degree to which any of the programs cited by the President will really be accelerated.

Out of the Fog

What emerges out of the fog of White House press agentry and Pentagon gobbledygook appears to be the following:

• **The President has merely authorized** spending of a fraction ($476 million out of $1.1 billion) of the funds he had earlier impounded. Total of $621 million is still being frozen in the Pentagon according to documents submitted by the Defense Department comptroller, while another $978 million in the original budget is "apportioned but undergoing further review," which is another Pentagonese phrase for frozen. The $621 million still frozen just about equals the $661 million net boost added by Congress to its Fiscal 1961 defense appropriation.

• **The President now recommends** a course of action on key programs, such as the B-70, Samos, strategic airlift, Army modernization, and airborne alert, advocated by the "Job's boils" critics of his original Fiscal 1961 defense budget when it was submitted to Congress last January. However, as accurately as can be determined at this time, none of the recommendations on the projects is sufficient in scope to achieve the full objectives of each program within a time scale to achieve maximum military effectiveness. To use an old Army phrase, the defense program recommended last week to Congress appears to be "a day late and a dollar short."

• **The President presents as a military asset** in his defense program a decision to retain a portion of Strategic Air Command's B-47 fleet originally scheduled for retirement because of obsolescence. We fail to see the military virtue in retaining a larger quantity of obsolescent aircraft still further into their period of declining military usefulness. The lack of difficulty experienced by Soviet all-weather interceptors recently in catching and destroying an RB-47 in a 200 mi. stern chase does not inspire confidence in retention of this weapon even longer than originally planned. Not a word is mentioned in the President's defense message about expanding or accelerating the supersonic B-58 bomber program to provide a major increase in military effectiveness over the B-47 fleet. This program remains fixed at the relatively insignificant quantity of three wings of 45 aircraft each. Nor is there a word about accelerating KC-135 jet tanker production where a critical bottleneck in SAC's efficiency has been artificially created by a budget decision.

Soviet Truculence

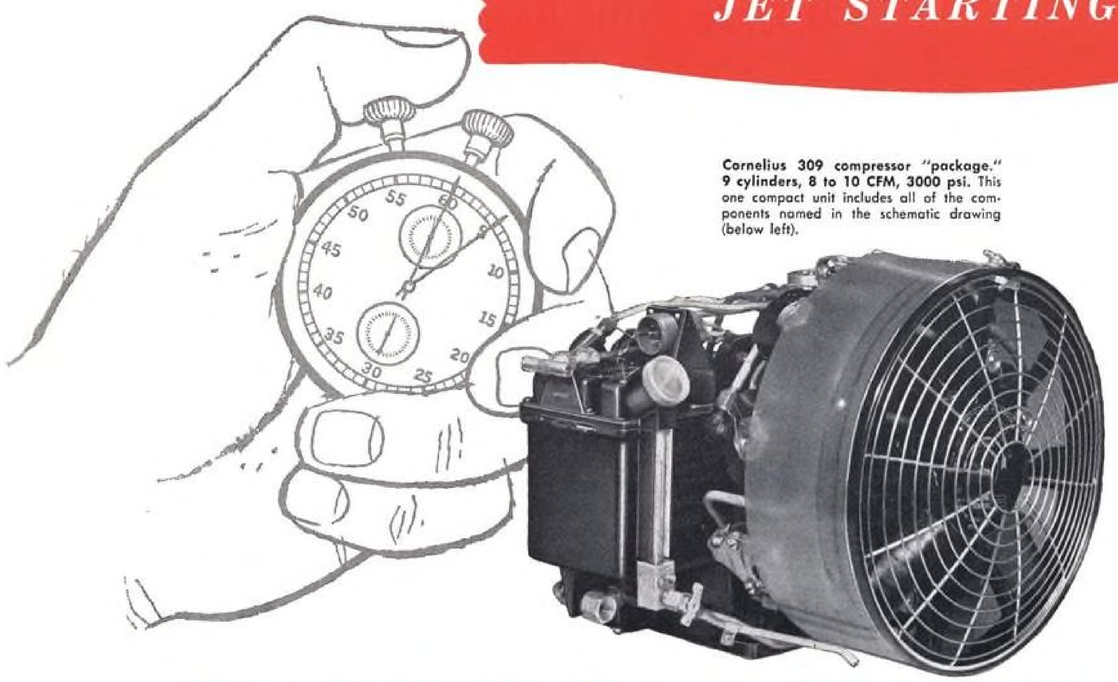
The increased Communist truculence in the past few months has been a predictable reaction to the budget-strictured U.S. defense policies of the past few years. Rightly or wrongly, it is evident that the Soviet leaders feel a shifting balance of military power enables them to abandon their so-called peace offensive and brandish their naked force at us in the crudest threats. We may have won the UN Security Council debate on the RB-47 case, but four U. S. airmen are dead from Soviet cannon fire and two are still held incommunicado in Soviet jails in defiance of every precedent of international law.

The state of the world has deteriorated too far and the state of our defense as the only solid bulwark against the spread of Communist imperialism is too important to be handled for short term political effects. Both parties recognized this in their recent conventions by adopting defense platforms that denied a price ceiling on the security of this nation and called for increased, accelerated and courageous approaches to the defense problem.

The recent presidential defense message to Congress is too transparent to carry much assurance for the American people whose future is at stake or deterrence to the Soviet leaders who are gaging our strength and determination as a basis for their own aggressive policies. To borrow a phrase from the President's Chicago speech, it "does such violence to my sense of what is right that I have difficulty in restraining my feelings of indignation."

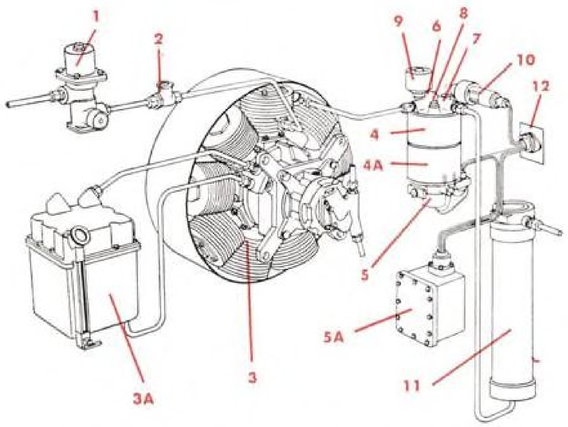
—Robert Hotz

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WHO'S WHERE

In the Front Office

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T. J. Harris, a director of Aero Design & Engineering Co., Bethany, Okla. Mr. Harris is vice president and general manager.

Herman Sondov, board chairman, Specialty Electronics Development Corp., Syosset, N. Y. Mr. Sondov continues as executive vice president.

Brig. Gen. Harley S. Jones (USAF, ret.), a director, Republic Aviation Corp., Farmingdale, N. Y. Gen. Jones is executive vice president of Republic.

Tore N. Anderson, a director, FXR, Inc., Woodside, N. Y. Mr. Anderson is the company's executive vice president and general manager.

George McClellan Joyce, president, Dyna-Therm Chemical Corp., Culver City, Calif., succeeding **Herbert H. Clarke, Jr.,** resigned.

Joseph A. Frabutt, president and a director of The W. L. Maxson Corp., New York, N. Y., succeeding **W. H. Beal,** now board chairman, who continues as chief executive officer.

James R. Kerr, executive vice president of Avco Corp., New York, N. Y., in charge of a newly formed Defense and Industrial Products Group.

Robert F. Moore, deputy vice president-maintenance and maintenance engineering Eastern Air Lines, Inc., and **Capt. Robert C. Springer,** deputy vice president-operations.

Ralph V. Barnett, vice president and Eastern branch manager (Elmsford, N. Y.), Librascope Division of General Precision, Inc., Glendale, Calif.

Richard D. Hanson, vice president, Donner Scientific Co., a subsidiary of Systron-Donner Corp., Concord, Calif.

Fred M. Farwell, vice president-marketing, Defense Electronic Products, Radio Corporation of America, Camden, N. J. Mr. Farwell continues as RCA's vice president-marketing.

Bret N. Reed, financial vice president, Missile Systems Corp., North Hollywood.

William H. Hall, assistant vice president-service engineering, American Airlines, Inc., with offices at the Jet Maintenance and Engineering Center, Tulsa, Okla.

Hayne Constant, scientific adviser to the British Air Ministry, succeeding **Morien B. Morgan,** now deputy controller of research and development.

Josiah Macy, Jr., secretary of Pan American World Airways, Inc., succeeding **H. Preston Morris,** retiring.

Francis D. Tappaan, assistant to the vice president and assistant to the president, North American Aviation, Inc., Los Angeles, Calif.

Dr. S. J. Gerathewohl, head of operational development, and **Dr. Richard S. Young,** chief of flight biology, Office of Life Science Programs, National Aeronautics and Space Administration, Washington, D. C.

James R. Gorson, administrative assistant of the Air Traffic Conference's Military Bureau, Air Transport Assn., Washington.

(*Continued on page 155*)

INDUSTRY OBSERVER

► NASA hopes to explore operating envelope of the North American X-15 rocket research aircraft to a speed of at least Mach 6 and altitudes of around 250,000 ft. by late this year or early next year after Reaction Motors XLR-99 engine is installed and operational, even though recent explosion in the fuel tank system delayed the program by 3-6 months (AW June 27, p. 57).

► **Arma plans to solicit USAF and Navy funding soon for development of a coherent optical generator for use in frequency modulated, optical space communication systems. Device would use thin ferroelectric films to obtain continuous wave outputs at wavelengths near 5,000 angstroms.**

► McDonnell Mercury capsule for second attempt to test structural integrity has been delivered to Atlantic Missile Range. First attempt failed when Atlas launch vehicle exploded (AW Aug. 8, p. 26). Capsule apparently withstood explosion but burst when it hit the ocean.

► **Plasmadyne Corp. has won a negotiated NASA contract to build an experimental one-kilowatt arc jet engine for spacecraft attitude control. Eleven companies bid out of 27 invited to submit proposals.**

► India has ordered two Sikorsky S-62 turbine-powered helicopters as a possible forerunner to a larger military order for aircraft to be built under license there. British, Russians and other U. S. firms are competing for the larger order.

► **Electric space propulsion system responsibility will be shifted gradually from NASA's Goddard Space Flight Center to Marshall Space Flight Center in a long-term realignment of NASA responsibilities. Marshall's payload work eventually will shift to Goddard and to Jet Propulsion Laboratory, but each laboratory is to retain some competence in the other's specialty.**

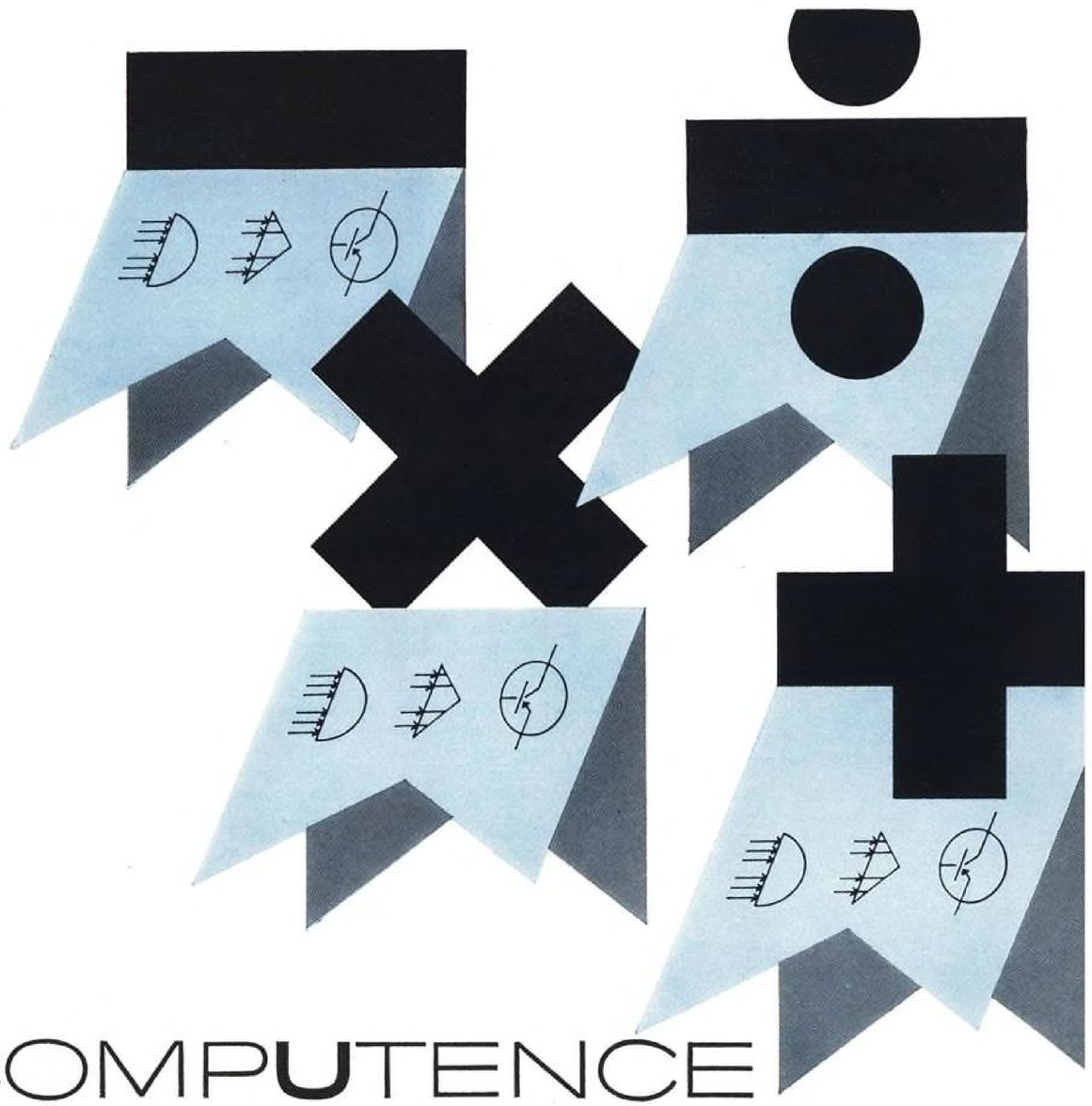
► Range increase in recent firing of Navy-Lockheed Polaris was made possible by a new Aerojet second-stage motor weighing 100 lb. less than those used in earlier shots. Missile reached 1,130 naut. mi., was essentially the same as the 1,200 naut. mi. interim operational missile. Difference of 70 mi. was due to extra weight of instrumentation. Motor uses a new rolled and welded case of a steel alloy containing chromium, nickel, molybdenum and vanadium. Main production problem was prevention of distortion during welding and heat treating.

► **Aerojet-General Corp. and NASA have signed an $8.2 million contract for development of power conversion machinery for a SNAP 8 nuclear auxiliary power and propulsion system. Aerojet won the SNAP competition last March.**

► Mercury Phase II has not been abandoned as a manned space flight concept even though NASA has tentative plans to develop the two—or three—man Apollo modular spacecraft. Phase II once contemplated use of Vega, now canceled, and later Centaur to boost a two-man capsule into earth orbit. NASA now plans no manned launches using Centaur, expects to jump from Atlas to Saturn booster for manned flights. Phase II capsule would be either a high-drag shape similar to current Mercury, or a lift-drag blunt shape with tabs. Progress of Mercury and the NASA-USAF Dyna-Soar program will determine whether a Mercury follow-on precedes the more ambitious Apollo.

► **Bell X-14 is being fitted with a variable-stability control system at Ames Research Center as part of NASA's program to assess characteristic flying qualities of VTOL-STOL aircraft and to try to understand what constitutes desirable flying qualities for this type of aircraft.**

► Research by Russia's Central Aerohydrological Observatory has resulted in a directive from the Main Administration of Civil Aviation to all Soviet airports on freeing fields from winter fog and low clouds by seeding with dry ice. Method has been tested successfully at Alma Ata Airport, which often was closed by winter fog.



COMPUTENCE

total competence in computation and data processing—the breadth, the brains and the background

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Burroughs Corporation Burroughs *"NEW DIMENSIONS / in computation for military systems"*

Washington Roundup

Man-in-Space Group

Space Science Board of the National Academy of Sciences-National Research Council has at last decided to create a man-in-space committee. The board has made important contributions to National Aeronautics and Space Administration's over-all planning, but many board members have remained skeptical about the usefulness of sending man into space.

Now, almost two years after its creation, the board has been convinced by proponents of manned space flight that it should have a committee to deal with this aspect of space technology. Paradoxically, those within the board who first became convinced and later convinced others have concluded that the only real role man will have in space will be of a military nature. Dr. Chris Lambertson of the University of Pennsylvania will head the man-in-space committee.

Another attempt to make the International Academy of Astronautics a truly international body will be made this week at the eleventh annual Congress of the International Astronautical Federation in Stockholm. Key is participation by Soviet Union, which so far has not given official sanction for its space scientists to participate.

Soviet Prof. Leonid I. Sedov, IAF president, will be presented with a new proposal for composition of the academy that may overcome some Russian objections. As in all international groups, they want assurance that their role will be at least as important as that of the U.S., although creation of the academy has been primarily a U.S. effort. Academy would have three main divisions for the basic, applied and life sciences.

Restricted View

Federal Aviation Agency fears its delegation to the Soviet Union will get a restricted view of air navigation and traffic control developments during its visit next month. Apprehension stems from State Department restrictions on the Soviet civil aviation group now touring U.S. facilities.

State Department refused to let the Soviet delegation visit the FAA National Aviation Facilities Experimental Center at Atlantic City. Soviets originally asked to visit Indianapolis, apparently because they thought the center was still there. FAA suggested that State substitute Atlantic City, but the suggestion was vetoed "because the Russians did not ask to visit Atlantic City."

FAA expects the Russians to react with their traditional reciprocal attitude and bar the FAA delegation from any significant view of latest Soviet developments in civil navigation and traffic control systems.

Dr. Marvin Stern becomes assistant defense director of research and engineering for strategic weapons this week. Stern was staff executive for research and development for General Dynamics Corp. He also has been serving on an advisory committee to the board of the Institute for Defense Analyses, the corporation formed by a group of universities to handle defense research problems.

Stern, a mathematician, was a consultant to the Air Force Scientific Advisory Board for two years. He was instrumental in initiating Air Force Office of Scientific Research's astronautics symposiums, current USAF studies on the Midgetman intercontinental ballistic missile (AW July 18, p. 26) and Project Sunrise, a program to expose leading young physicists to scientific problem areas related to defense.

Ferret Jitters

The U-2 incident may have caused more Soviet concern over electromagnetic ferreting than over the widely-publicized photographic aspects of the flight. Some observers here feel there may be a link between Russia's interest in what they call the U-2's "radio-technical reconnaissance apparatus," their shooting down an RB-47 heavily loaded with ferret gear and capturing of survivors, and the apparent defection of two employes of the National Security Agency. NSA deals with monitoring of other nations' communications and with security of U.S. communications.

State Department is informing foreign governments of U.S. plans to put a cloud of thousands of tiny, frangible needles into orbit as a passive communications satellite. This move is intended to reassure other nations and their scientists that the cloud of reflecting needles won't interfere with radio communications or astronomy. State hopes to forestall objections before the cloud goes into orbit during the coming year.

Soviet Union claims it holds a majority of all world aircraft and helicopter records as the result of the large number of marks set and confirmed by Federation Aeronautique Internationale during the first half of 1960. Russians now claim 86 records, and they point out that most were formerly held by the U.S. Three of these records have been won back by the Army with its Bell HU-1 helicopter, see page 31.

—Washington Staff

President Approves Defense Increases

Democratic leaders criticize modest funds released; Budget Bureau keeps $621 million in "deepfreeze."

By Katherine Johnsen

Washington—President Eisenhower loosened the budget purse strings last week to finance acceleration of top priority defense programs—but not enough to placate top Democrats, led by presidential candidate Sen. John F. Kennedy (D.-Mass.), calling for a $2 to $3 billion a year increase.

In a message to the Senate on the opening day of its short pre-election session, the President reported increased funding for airlift modernization, airborne alert, the B-70 program and the Samos reconnaissance satellite program. Funds being released total $476 million. The biggest slice—$164 million—is for fully financing five fleet ballistic missile submarines instead of three, an increase previously disclosed by the Navy.

Expenditures, which reflect actual payments to contractors—rather than new contracts—and are indicative of the production tempo, will be increased an estimated $150 million.

Democrats quickly noted that the money being released on the approach of the presidential campaign was appropriated by the Democratic-controlled Congress over earlier Administration opposition, and is being released only after prodding of Defense Department by Sen. Lyndon Johnson (D.-Tex.), chairman of the Senate Preparedness Subcommittee as well as Democratic vice presidential candidate (AW Aug. 8, p. 30).

Democrats stressed that the Administration is still keeping $621 million in defense funds in a "deepfreeze," plus an additional $978 million in a "partial freeze" for "further review." They also complained that an explanatory letter from Secretary of Defense Thomas S. Gates to Sen. Johnson gave much of the Administration action a tentative tone.

President's Comments

On the $621 million "freeze" charge, the President commented at his press conference: "I know of no reason for anyone to say that I have decided not to spend this money. . . . And to say that this money has been frozen is—the proposition hasn't even been put before me in those terms at all, whatsoever."

Pointing out that Assistant Secretary of Defense-Comptroller Franklin B. Lincoln, had confirmed the $621 million "freeze," Sen. Johnson commented in the next volley: "It would appear from the President's statement, and I take it at face value, no one ever explained this to him. . . . The President tells us that he was not informed that these funds would be impounded. Since the President did not authorize this to be done, then who did?"

Defense financial plans and apportionment charts submitted to Sen. Johnson, along with the Gates letter, disclosed these details:

• **Frozen funds.** The $621 million impounded by the Administration under its Aug. 9 financial plan includes: $181 million for Air Force procurement of aircraft, $50 million for Air Force procurement of missiles and $36.9 million for Navy procurement of aircraft and missiles. Under the previous July 7 financial plan, almost $1.1 billion was impounded, reduced by last week's action releasing $476 million.

• **Partially frozen funds.** These are funds, totaling $978 million, which have been apportioned to the services by the Bureau of the Budget and the Department of Defense, but which cannot be used without final approval. Defense Department refers to this category as "items apportioned but undergoing further review." The $978 million includes $48.5 million for Navy procurement of aircraft and missiles and $275 million for Air Force procurement of aircraft. It also includes these research, development, test, and evaluation funds: Army, $62 million; Navy, $76 million; Air Force, $119 million; and Advanced Research Projects Agency, $149 million.

Projects being financed with the $476 million released last week are the following:

• **Airlift modernization,** $48.5 million. Congress appropriated $194 million for interim modernization of Military Air Transport Service with modified C-130, KC-135, or similar aircraft. Defense Department earlier agreed to use approximately $150 million of this, and last week's action called for use of the remainder. In his letter to Sen. Johnson, however, Gates qualified that the $194 million "will be utilized, in whole or in part, depending upon the specific programs to be determined shortly."

• **Airborne alert, $82 million.** This almost doubles the $85 million requested by the Administration for Fiscal 1961 to develop an air alert capability for one-eighth of Strategic Air Command's B-52 heavy bomber force. In addition to the $82 million, Congress also gave the President blanket authority to use whatever funds he might consider necessary for an airborne alert.

• **B-70 program, $100 million.** Gates explained in his letter to Sen. Johnson that the "technical details" of this Mach 3 aircraft program "are still under study and the exact amount which can be properly applied to it during Fiscal Year 1961 cannot yet be determined. However, it is presently estimated that about $100 million of the congressional add-ons will be used . . ." Congress approved $290 million in addition to the $75 million recommended by the Administration.

• **Samos, $50 million.** Gates' letter qualified that "while this program, too, is under technical study, it now appears that another $50 million will be utilized" in addition to $200 million provided in the Administration budget.

• **Polaris, $164 million.** This will still leave frozen $69.8 million in additional funds appropriated by Congress for the Fleet Ballistic Missile Program: $36.8 million for Polaris missile procurement and $33 million for long lead time items for two submarines. Congress provided for partial financing of seven submarines. The Administration is moving forward with only five.

Congress made reductions in the $39.2 billion Fiscal 1961 budget submitted in January totaling approximately $1.1 billion, and additions totaling approximately $1.8 billion. The net increase in defense funds voted by Congress was over $661 million.

Sen. Johnson protested Gates' failure to include in his reply the specific "shopping lists" of the military services together with changes made by the Department of Defense and the Budget Bureau, so that Congress might have a clear picture of the specific projects for which funds had been withheld. The net $621 million impounded, he noted, approaches the $661 million net added by Congress.

The President and other Administration spokesmen emphasized the fluid, changing nature of the defense program.

The President told his press conference he did not interpret the Republican platform pledging an "intensified and courageous" defense program as implicit criticism of his Administration (AW Aug. 1, p. 28). On the defense platform drafted by Republican presidential candidate Richard M. Nixon and New York Governor Nelson Rockefeller, the President observed: "I say one era or one period or one atmosphere might justify one type of action; another era, another atmosphere, might justify something else . . ."

Volunteering denials of any element of politics in the move toward greater defense spending, Defense Department noted that in May, following the Paris summit failure, Deputy Secretary of Defense James H. Douglas testified befor the Senate Appropriations Committee that the defense program "will have to be seriously reviewed and evaluated" (AW May 23, p. 26). Defense said last week's action was an outgrowth of this re-evaluation.

In his Senate message, the President attributed the acceleration of key defense projects—as well as the recent deployment of additional aircraft carriers to the Sixth and Seventh Fleets, a halt on phasing out B-47 bombers from Strategic Air Command, and expansion of the number and scope of field and airborne exercises of ground troops—to "continuous appraisal of changing Communist tactics and attitudes . . ." He observed that over the past month, "We have seen an intensification of Communist truculence.

"Indeed, the Soviet dictator has talked loosely and irresponsibly about a possible missile attack on the United States.

"An American aircraft has been attacked over international waters . . .

"The Soviet delegation has walked out of the Geneva disarmament negotiations . . .

"All of us know about Cuba," he said.

FAA Studies Satellites

Washington—Federal Aviation Agency Bureau of Research and Development has established a special task force to look into possible civil aviation use of communication and navigation satellites, following a National Aeronautics and Space Administration proposal for a joint FAA-NASA effort.

Vought Awarded Contract To Track Mercury Capsule

Washington—Chance Vought Range Systems Division will operate the Hawaiian Project Mercury tracking station at Kokee Park, Kauai, under a $900,000 National Aeronautics and Space Administration contract.

The 15-month contract, administered through Pacific Missile Range, is for operation and maintenance of the site, one of eight command control stations in the Mercury net. Kokee is scheduled to go into operation late this year and will be manned by 56 persons. The site is under construction.

Disk-Shaped Vehicles Are Studied For Potential as Orbital Aircraft

Washington—Disk-shaped vehicles are attracting strong interest as potential orbital aircraft, making the disk the first configuration to show promise for applications at opposite ends of the flight spectrum.

Although the general impression has been that the disk was of primary interest as a relatively low-performance aircraft—with some promise for high-performance applications well within the earth's atmosphere—a number of major aircraft companies and the National Aeronautics and Space Administration have been investigating its potential as a re-entry vehicle for quite some time.

The disk is among the half-dozen more promising approaches to solution of the re-entry problem, out of a great number of different configurations that have been explored in theoretical studies and by wind tunnel model tests.

Re-entry vehicle shapes will vary according to mission to an even greater degree than conventional aircraft. The disk is competing with blunt, high-drag capsules, blunt but flatter "motorboat" shapes, and a number of others, including several that have not been revealed publicly.

Army and Air Force have for several years financed study of the disk planform VTOL built by Avro Aircraft, Ltd., of Canada (AW Aug. 8, p. 31). Army's interest has centered on a vehicle that would fly subsonically and at low altitudes for a variety of missions ranging from reconnaissance to the possibility of a troop carrier if the basic aerodynamic approach proved feasible.

USAF's aim in investigating the disk has generally been assumed to be a search for a supersonic aircraft to operate at high altitudes. Aviation Week has learned, however, that USAF's interest in the Avro disk, almost from the beginning of its support of the project some five years ago, has been

USAF Concern Over Skybolt

Dayton—Preliminary development engineering inspection of the GAM-87A Skybolt air-launched ballistic missile and its pylon was held successfully at Douglas Aircraft Co.'s Culver City, Calif., plant early this month but apprehension exists in USAF about the company's ability to meet the projected development schedule for the weapon system. Some of the factors apparently contributing to the situation:

• More engineering manpower is needed on the project. Design requirement specifications and layout drawings may be lagging behind schedule. Feeling is that only about 60% of the number of designers required are now on the program.

• Firm engineering directions to subcontractors also are reported to be delayed because not enough designers are available to generate requirements for fundamentals in some work areas.

• Follow-up engineering tasks still are unassigned because of this design manpower shortage.

First milestone in the GAM-87A program will be the firing of a missile without guidance system but carrying a programmer to check launch characteristics and general compatibility with the Boeing B-52G carrier aircraft. This test normally would be made in the summer of 1961.

Full-sytem firing trials probably would not be scheduled before early 1962.

Lt. Gen. Bernard A. Schriever, commander of Air Research and Development Command, personally is keeping an eye on Skybolt progress. One phase of USAF concern, following meetings with Douglas and Northrop Corp.'s Nortronics Division personnel at ARDC headquarters, and later with Nortronics personnel at the division's Hawthorne, Calif., plant, is progress on development of the guidance system, for which Nortronics is subcontractor to Douglas.

ARDC has requested that a team, composed of Air Force Ballistic Missile Division and Space Technology Laboratories personnel conversant with the Minuteman ICBM program, be formed to study the approach taken at Nortronics on development of the guidance system.

STL has systems engineering and technical direction responsibility for the Minuteman program. The inertial guidance systems in Minuteman and Skybolt would differ fundamentally in alignment of the missile guidance system's platform prior to launch.

In this study, the BMD-STL team probably would analyze the basic approach to Skybolt's guidance development, associated problems, specific hardware applications, and cost estimates.

Under this plan, report of the BMD-STL analysis would be submitted to the Skybolt weapon system project office at ARDC's Wright Air Development Division sometime next month.

Belgians Threaten to Cancel F-104 Orders

Geneva—Possible Belgian cancellation of its 100-plane F-104 order would cause no serious disruption in the NATO Starfighter program. Italy is making a strong bid for Fiat to build 200 Italian F-104s plus 100 each for Turkey and Greece and is capable of assuming the role of third partner in the program replacing Belgium.

These 400 airplanes are in addition to the present NATO program total of 800, and bring the over-all program to 1,200 aircraft. Italy would put up $80 million of its own money; Greek and Turkish aircraft would be financed through U.S. aid funds.

Belgian Defense Ministry said last week the F-104 program is under re-examination and a decision will be made soon. Anger over what Belgians feel is lack of U.S. support on the Congo is responsible.

Sources in Bonn, the Hague and here feel the order will be allowed to stand once the first flush of anger is over. Belgium is to build 189 airframes in the over-all program, and Belgian withdrawal would leave the Belgian industry with little work.

Italy made a strong plea for building the 400 additional aircraft at a meeting in Bonn early this month. Its bargaining position is an offer to order from Germany, Belgium and Holland—the German share the largest—any components it cannot make. Italy feels it can make the major components for 400 airplanes over a five year span and is pressing for such a program. If the other nations refuse, Italy could eliminate them from any components business on its 200 aircraft.

in a hypersonic vehicle that would operate up to and into the orbital velocity range. Second in importance is use of a disk for flight just above Mach 1.0.

In addition to NASA's extensive research on hypersonic disks, most of the major airframe companies have shown considerable interest, and a number of them, including Convair, Boeing and Lockheed, have proposed hypersonic disk-shaped vehicles to USAF.

Convair is studying a rocket-powered, disk-shaped craft and has company approval for a major effort if USAF shows enough interest.

Both Army and USAF, but particularly Army, find the disk-shaped machine attractive because it eliminates the weight and complexities involved in landing gear. For a craft without landing gear, the disk appears to be the best configuration.

Army and NASA are engaged in a GTOL—ground takeoff and landing—research program aimed at vehicles that have the general characteristics of VTOL-STOL aircraft but also eliminate the landing gear, and Army hopes to contract small amounts of money in the near future for more studies and for model testing on vehicles of the Avro type. These vehicles would take off and land on the ground cushion, but fly at high speeds up to the vicinity of Mach 1 at low altitudes. Most of the test work would be done by NASA, as in other Army VTOL-STOL programs.

Interest in the disk shape right now lies in these three segments of the speed range:

- **Up to high subsonic**—around Mach 0.7 or 0.8—for low altitude Army missions.
- **Mach 1.2 to 1.5** for a high-speed, low-level Tactical Air Command attack aircraft.
- **Hypersonic flight**, including orbital speed.

Disk presently is not considered competitive with other shapes over most of the subsonic or low hypersonic range.

NASA's interest, both in vertical and short takeoff vehicles and in vehicles that must leave and re-enter the atmosphere, is in providing an across-the-board technology for designers to draw upon. With this approach in mind, it gives no more emphasis to the disk than to several other re-entry shapes, but one NASA researcher said the disk appears now to offer "very great possibilities for a number of missions."

Disk-shaped vehicle would be light, strong and compact and would have a large area to handle the maximum heating load imposed on a re-entering vehicle. It should have the good drag characteristics necessary to slow its entry into the atmosphere and still have the high lift-to-drag ratio necessary for some maneuverability within the atmosphere. Disks for hypersonic applications probably would have sharp edges, rather than the blunt edges of the Avro vehicle, although blunt edges might be preferable if re-entry heating was a stronger consideration than flight within the atmosphere.

A number of inter-related considerations will determine whether and when the disk configuration is used for hypersonic and orbital vehicles. Most of them are to be explored in the USAF-NASA Dyna-Soar orbital boost glider program. They include:

- **Materials.** This currently is one of the most critical problem areas for both aircraft and spacecraft, and much will depend on metallurgical progress, particularly in the refractory metals.
- **Guidance.** Accuracy of guidance equipment and the amount of it that orbital vehicles will be able to carry within their weight limits governs how they enter the acceptable flight corridor for re-entry. This, in turn, helps determine shape, lift-to-drag ratios, angle of attack, materials necessary to handle the heating, etc.
- **Mission.** If the aircraft is to fly for any length of time in the atmosphere after re-entry, it must have a higher lift-to-drag ratio than if it is for re-entry and immediate landing. It now appears possible to obtain much higher L/D ratios from disks in some desirable speed ranges than once was thought possible, if the heating problem can be handled, opening the possibility of a wider variety of missions and more flexibility for a given mission.
- **Boosters.** Vehicles, disk-shaped or otherwise, that are to go into orbit and re-enter most likely will be rocket-boosted from the ground. Whether payloads will be large enough for the vehicle to carry fuel for maneuvering within the atmosphere after re-entry depends on booster capability. This also will directly affect the amount of guidance and control equipment to be carried.
- **Controllability.** This is one of the most difficult problems at present with disk-shaped vehicles, but it is by no means limited to this type of configuration. It is of great importance in all VTOL and STOL machines investigated so far, and of at least as great importance in re-entry vehicles. If disks can be easily controlled with systems having low enough weight and complexity, they will have gained considerably in their competition with other shapes.

IAM Signs New Pact At Pratt & Whitney

United Aircraft's Pratt & Whitney Division production workers last week accepted a new 2½-year contract, following by two days a similar move by International Assn. of Machinists members at Hamilton Standard Division.

At Pratt & Whitney, the workers will get a seven cent per hour increase on Jan. 2, 1961, instead of the usual wage reopener that has been a contract fixture in the past. A 7½ cent hourly raise went to all employes last January, despite the strike. Life insurance benefits were raised from $4,000 to $5,000.

Pratt & Whitney's bargaining unit accepted the new pact by a vote of 2,319 to 316. United has refused to rehire any employes arrested for illegal acts, such as picket line violence and vandalism. Strikers whose jobs have been filled by others will be placed on a preferred list and their cases will be considered by a panel headed by Connecticut Chief Justice Raymond E. Baldwin, a former governor.

Democrats Study Defense Reorganization

By Ford Eastman

Washington—Democrats are launching a major effort, directed by Sen. Stuart Symington (D.-Mo.), to produce a specific Defense Department reorganization plan for use during the campaigning this fall.

Democrats will attempt to present voters with some concrete proposals on defense reorganization to reinforce promises made last month in the party's platform. Republicans also promised some changes in the Pentagon, but there was no effort evident last week to prepare any specific proposals.

Democratic presidential nominee Sen. John F. Kennedy (D.-Mass.) chose Sen. Symington to head a committee to study the issue and produce a plan. This confirms Sen. Symington's role as a major Democratic military adviser for the campaign. A former Air Force secretary and a member of the Senate Armed Services Committee, he is generally considered a likely choice as defense secretary if Sen. Kennedy wins the election.

Sen. Symington will head a committee composed of no more than six defense experts from industry and the universities. Members had not been named late last week, but Symington is expected to select a group with Sen. Kennedy's approval and get the study under way shortly.

The study program will give Democrats a lead over Republicans in outlining specifically what would be done about platform promises on defense. Democratic platform pledges a more thorough reorganization, but the Republican platform noted the need for "further reorganization" for the Defense Department to achieve "the most effective unification of defense planning and command."

Republican Position

Republicans said that a military establishment organized in accord with a national strategy which enables the unified commands in Europe, the Pacific and the continent to "continue to respond promptly to any kind of aggression" is required to maintain the "strategic imperatives" of the national defense policy.

The Democratic platform adopted earlier in Los Angeles (AW July 18, p. 32) had this to say: "A first order of business of a Democratic Administration will be a complete re-examination of the organization of our armed forces.

"A military organization structure, conceived before the revolution in weapons technology, cannot be suitable for the strategic deterrent, continental defense, limited war, and military alliance requirements of the 1960s. We believe that our armed forces should be organized more nearly on the basis of function, not only to produce greater military strength, but also to eliminate duplication and save substantial sums."

Sen. Symington has long advocated reorganization of the Defense Department along the lines called for in the Democratic platform. In February, he introduced a bill in the Senate which would make mandatory a single over-all war plan for the armed services and require the establishment of integrated or unified commands without abolishing the individual services (AW Feb. 8, p. 25).

Symington Plan

He cautioned, however, that his earlier reorganization proposals will not necessarily become the final plan which his committee will develop.

The Symington reorganization bill, which has not been acted upon by the Senate Armed Services Committee, was to provide:

- "**A comprehensive program** for the future security of the United States through the establishment of means for the integration of policies and procedures of the departments, agencies, and functions of the government relating to the national security.
- "**A Department of Defense**, including the three military departments of the Army, the Navy (including the U.S. Marine Corps) and the Air Force under the supervision and control of the Secretary of Defense, and to provide for their administration by under secretaries of defense acting under the direction, authority and control of the Secretary of Defense.
- "**For the elimination** of unnecessary duplication and for more effective, efficient and economical administration within the Department of Defense through increased centralization of control exercised by the Secretary over activities of the Department in the fields of research, engineering and procurement.
- "**For the establishment** of unified defense, strategic, combatant, logistic and other unified commands composed of elements of two or more of the armed forces.
- "**For the unified direction** and control of all of the armed forces through the adoption of a single over-all war plan and the appointment of a single chief of staff for the Department of Defense who shall be the controlling member of the Joint Chiefs of Staff."

The Chief of Staff of Defense would have the power of decision in all matters arising for determination by the Joint Chiefs of Staff and would be the principal military adviser to the President, the National Security Council and the Defense Secretary.

Over-all War Plan

It would be his responsibility to prepare the single over-all war plan, assign responsibilities to the armed forces and review their material and personnel requirements, and formulate policies for joint training and for coordinating the military education of members of the armed forces.

Unified commands established would be responsible to the President and Secretary of Defense for the military missions assigned to them by the Secretary with prior advice of the Chief of Staff. Units, elements, and personnel of the armed forces assigned to unified commands would be under the full operational command of the designated commander.

All other units, elements, and personnel not assigned to unified commands would "remain for all purposes within and subject to control by their respective departments."

Douglas to Build 10 Saturn Stages

Douglas Aircraft Co. will build 10 S-IV Saturn stages at its Santa Monica Division under a contract from National Aeronautics and Space Administration which covers design, research and development and manufacturing phases of the project. Cost of the program is about $65 million.

The S-IV will be the second stage in the C-1 configuration of Saturn. First stage will be propelled by a cluster of eight H-1 engines with a total thrust of 1.5 million lb. Third stage will be powered by two of the S-IV class engines.

Each stage will be 18 ft. in diameter, 50 ft. in length and will be powered by four liquid oxygen-liquid hydrogen engines developing a total thrust of 70,000 lb.

These vehicles will undergo acceptance static firings at Douglas' Sacramento facility prior to shipment to NASA's Huntsville, Ala., facility, then be shipped to Cape Canaveral, Fla. Douglas also will have responsibility for systems checkout and integration activities at Huntsville and at the Saturn launch facilities at Cape Canaveral.

The S-IV will be the third stage in a future and more powerful configuration of Saturn, designated the C-2.

Army Stresses Need for Aircraft To Increase Mobility of Troops

By Larry Booda

Washington—Plans for increasing the mobility of the foot soldier and for moving him principally by air were outlined here last week at the annual meeting of the Association of the U. S. Army.

Short range objective is to increase aircraft strength of each division from an average 50 aircraft to 110. Long-range objective is to have a variety of unsophisticated air vehicles which can move in the "nap of the earth," increasing the effectiveness of the individual soldier.

Emphasis was placed on tactical air mobility as the task of the Army, while improvement in strategic airlift by the Air Force to meet Army needs received strong backing. While there was support for placing all airlift under ground commanders, these views were not reflected in the resolutions passed at the meeting.

Secretary of the Army Wilber M. Brucker stated the broad requirement as the ability to "move one or two battle groups, with essential equipment, to any trouble spot, departing within two hours of the time of alert; to increase this force to one division within a matter of days, then to augment it with the air-transportable elements of a two-division force within four weeks."

Sizable portions of strategic and tactical airlift must be specifically allocated for Army use, he said.

Among the resolutions passed by the convention were pleas to remove the weight limitations of Army aircraft and limitations on the range and employment of missile systems, and for placing the Nike Zeus anti-missile program on a national crash basis.

Pershing Range

Little was said during the meeting about the capabilities of the Army in the ballistic missile field. It was hinted that the maximum range of the Pershing solid propellant ballistic missile could be substantially increased by a small increase in thrust. As the potential replacement for Redstone at European NATO bases, such a versatile missile, it was claimed, could not only fulfill the short range mission, but could be a backup in the strategic missile area.

Any Army attempt to stir interest in the Pershing for the NATO IRBM role would put the missile in competition with a land-based version of Polaris, which the U. S. has offered to NATO countries.

Russia complained last month that NATO discussion of Polaris threatened peace and constituted rearming of West Germany. In a reply, the State Department said it would not be deterred by Soviet threats from giving Polaris missiles to NATO nations.

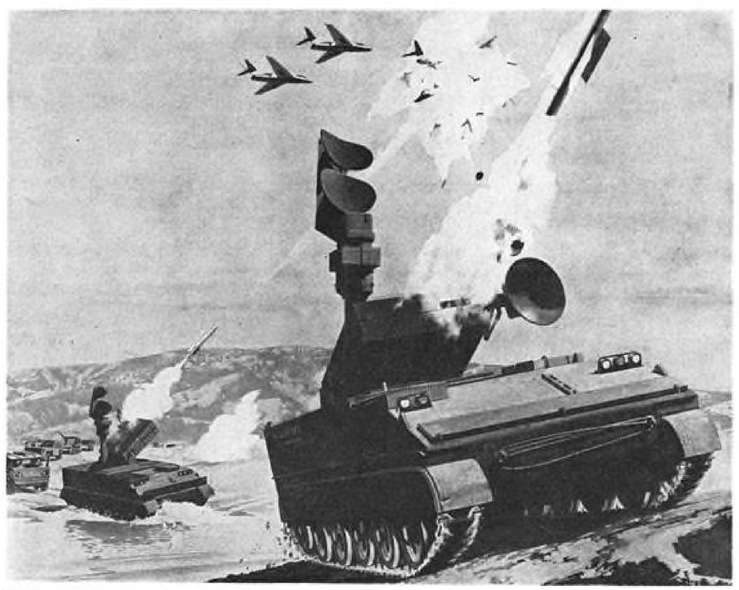
Lt. Gen. Arthur G. Trudeau, Army chief of research and development, hinted that a wide range of nuclear warheads are now available for missiles and rockets, esp ecially in low yield, lightweight weapons for use in close support work.

Gen. Trudeau discussed advances in fuel cell work in discussing Army's R&D program. Fuel cell, an electrochemical device that produces electrical energy by direct chemical reaction, powered a tractor for four months with no fall-off in power. Military interest in the system centers around potential efficiency—60-80 %, compared with the gasoline engine's 25-30%.

Trudeau emphasized that the Army's interest in aircraft which combine the takeoff and landing characteristics of the helicopter with the advantages of fixed wing aircraft in forward flight would increase. Disks and platforms powered by unusual powerplants that fly low and quietly over battlefields are the answer to the Army's mobility problems, he said, but these will not be the sophisticated high performance aircraft of the other services.

Army revealed that 11 L-23D twin engine Seminole aircraft will be modified for installation of newly developed side-looking radar battlefield surveillance equipment. The equipment is designed to take radar photographs in all weather conditions while flying parallel to the battlefield. Beech Aircraft Co. will do the modification.

Requirements for relatively small fixed wing, rotary wing, ground effect and combination machines were reflected in the large number of small turboshaft engines on display at the convention.



U. S. ARMY artist's conception of the Convair Mauler solid propellant surface to air anti-aircraft missile shows chassis designed for high mobility, operable by one man. Radar-guided missile is being developed under $5.5 million Army contract (AW Apr. 11, p. 75).

Davy Crockett

Washington—Davy Crockett tactical nuclear weapon system can fire nuclear warheads, with yields up to the size of the atomic bomb dropped on Hiroshima, over a range of 2.5 mi. The system is built in 200 and 400 lb. versions, and it can be carried disassembled and assembled in the field.

Designed for use by an Infantry Battle Group, the system consists of a four foot recoilless launcher resembling a five inch mortar with an expanded base and blow-back nozzle. Projectile has a larger diameter than the launch tube, and it is propelled by a piston in the tube which is driven by a powder charge in the chamber. Firing is by remote control, and the "spigot" projectiles can be launched from tactical vehicles or ground tripod installations. High explosive warheads can also be used.

These powerplants, in the 250-2,200 shaft horsepower class, are both in the production and development stages. Industry received encouragement in this field as a result of the findings of the Rogers Board—the Army Aircraft Requirements Review Board, headed by Lt. Gen. Gordon Rogers.

As a result, the Army said it has taken the lead in development of the smaller turbine engines. In shifting to this type of propulsion exclusively, engine failure rates were taken into consideration. Reciprocating engines in airline service failed on an average of once each 3,500-4,000 hr., while turbine engines in similar service fail an average of once every 12,000-15,000 hr. This coupled with their compactness and light weight makes, the Army believe turbines will completely replace reciprocating engines.

Largest of the engines is the Lycoming T55-L5, rated at 2,200 shp, which has passed its 150 hr. production test. It will power the Vertol HC-1B Chinook.

On the other end of the scale is the Allison T63, rated at 250 shp. This engine is scheduled to pass its 50 hr. qualification test by September, and the 150 hr. test by September, 1961.

The Lycoming T53-L-1, producing 860 shp., already in production, powered the Bell HU-1 which recently set seven world records (see box). The L-3 version of this engine powers the Grumman twin engine AO-1 observation airplane. Its output is 960 shp. The 50 hr. flight mark was passed in 1958, and the 150 hr. qualification is scheduled to be passed soon. L-5 version, which will power the HU-1B, passed the 150 hr. test in December, 1959, and is in production for the HU-1B. Power is the same as the L-3.

Other engines displayed were the Pratt & Whitney T74, a free turbine engine developing 500 shp. A turbojet engine, the J60, a 436 lb. engine developing 3,000 lb. of thrust, was also on display. Company designation for the T74 is PT6.

Solar Aircraft presented the Titan single-shaft helicopter turbine engine rated at 65 hp. at 4,045 rpm. It operates on a variety of fuels. Boeing showed the 502-10V rated at 270 shp and the 502-10WA rated at 285 shp., both designed for helicopter installations, and the 502-10W rated at 325 shp. for turboprop installations. Boeing also displayed the VT50 at 330 shp. and the free turbine T60 at 430 shp.

Continental 217-6A turboprop and 217-5A turboshaft, both free turbines incorporating a concentric shaft arrangement, permit taking power from the front of the engine. Power is 500 shp.

General Electric displayed the CT58, rated at 1,050 shp., now powering a variety of helicopters.

Army Bell HU-1 Sets Helicopter Records

Washington—Army's Bell HU-1 utility helicopter broke seven world records during an eight day period ending July 26.

Aircraft was a combination version, carrying rotor blades of the HU-1B and the engine of the HU-1A, the Lycoming T53-L1 producing 870 shp. The HU-1B version later will have the T53-L5 producing 920 shp. Helicopter was flown by Army pilots during the record runs. Temperatures ranged between 94F maximum and 72.5F minimum.

Records are:

- Nonstop distance flight in a closed circuit, takeoff gross weight between 3,860 lb. and 6,615 lb.: 441.74 mi. Old record held by Russian Mil-1 was 345.1 mi. Record exceeded by 28%.
- Five hundred kilometer speed record within the same weight ranges: 145.45 mph. Old record held by Mi-1 was 122.2 mph. Exceeded by 21.5%.
- One hundred kilometer speed record within same weight ranges: 142.2 mph. Old record by Mi-1, 130.8 mph. Exceeded by 8.7%.
- Time-to-climb to 3,000 meters: 3 min. 22.4 sec. Old record by French Alouette, 5 min. 30.6 sec. Exceeded by 38.8%.
- Time-to-climb to 6,000 meters: 8 min. 10.2 sec. Old record by Alouette, 11 min. 0.1 sec. Record exceeded by 25.7%.
- Five hundred kilometer speed record, no weight limitations: 148.45 mph. Old record, 136.02 mph., was held by Army Sikorsky H-34. Exceeded by 9.1%.
- Three kilometer speed record, weight between 3,860 lb. and 6,615 lb.: 158.05 mph. This is a new category of competition, making it an automatic record.

Records are subject to final certification by the Federation Aeronautique Internationale in Paris. Speed records must be exceeded by 1% and altitude records by 3% to be official.

Waivers for record attempts by military aircraft that have not been in operational service for six months must be requested from the Department of Defense. Next block of 90 days has been requested by Sikorsky Aircraft for the HSS-2, which crashed on a calibration run during a previous authorized period. Bell will request another period next winter when lower temperatures will permit higher engine efficiencies. Vertol has not yet decided on dates for a try with YHC-1 (Vertol 107) because of necessity of proceeding further with the test program.

ARDC Orders Lab Test Space Capsule

Los Angeles, Calif.—Garrett Corp's AiResearch Mfg. Co. here has been awarded a prime contract for the development of a laboratory test space capsule by the Air Research and Development Command's Wright Air Development Division.

Purpose of the capsule will be to study simultaneously space flight stresses of high altitude, acceleration, heat and isolation to test man's physiological limitations under environmental conditions. The cabin also will serve as a means for evaluating the operation and performance of space life support systems and components.

Cabin environments expected to be found in space flight, such as various mixtures of oxygen, nitrogen and carbon dioxide will be duplicated in the sealed capsule. Heating elements in the liner will permit radiation to the occupant, from the wall, of 200F temperatures to simulate the heat of re-entry.

The test subject will be able to choose the "shirt-sleeve" concept of space flight or use a pressure suit. A closed-circuit system will recondition his exhaled breath, removing the carbon dioxide and water vapor and replacing the oxygen used in the process.

The capsule will be usable in an altitude chamber, thus duplicating all the oxygen and pressure conditions of space. It also can be used on a centrifuge or in heat or cold chambers.

The cabin structure will be cylindrical shell, 6 ft. in diameter and 8 ft. long, fabricated from aluminum alloy, with welded construction. It will be capable of sustaining a limit load factor of 20g along the cabin longitudinal axis, combined with a 3g limit load along the other two axes. These limit load factors are combined with an external pressure differential or 13.3 psi. at 250F.

For test flights of long duration and for other special purposes, a removable air lock will be attached to the main cabin for entry or exit through a door, without excessive loss of cabin pressure. A safety observer may occupy the air lock for periods up to four hours, but the capsule itself is designed for long term, as well as short term, experiments lasting up to a week. The size of the door and air lock is sufficient to accommodate a man in a pressure suit with a small environmental control system on his back.

The environmental life support systems include gas partial pressure controls, relative humidity controls, and cooling systems.



MOROCCAN troops at Sidi Slimane Air Base, Morocco, converge on an **Air Force C-124**, one of the 48 MATS Globemasters that participated in the UN Congo airlift.



JEEPS seen above were brought to Leopoldville from the U. S., then painted with the UN insignia. Below a USAF C-124 taxis up to the terminal at Leopoldville Airport.



Congo Airlift

Provides Tough Support Test for USAF

By Cecil Brownlow

Evreux, France—Urgent United Nations call for immediate and sustained U. S. Air Force support of its mission to restore calm within the Congo Republic presented a severe test of USAF's emergency airlift capabilities as well as its flexibility in coping with the unknown.

Approaching on a limited scale a wartime intensity of effort, aircrews and operational commanders were faced with a myriad of problems, ranging in scope from a crippling lack of maintenance facilities within Africa to the fact that often only the flight crews had more than a general idea of just where their particular aircraft happened to be.

When the airlift alert was first received here at headquarters of the 322nd Air Division, which subsequently commanded the operation and also threw its force of 45 Lockheed C-130 turboprop transports into the breach, almost all Air Force support facilities, including communications, came to an abrupt end along the northern fringes of the African continent, the limit of USAF's normal operation within the area.

There were no weather stations, no navigation kits or airport landing patterns for flights into Central Africa. The airports, except to fading World War II memories, were largely unknown and their names were as unfamiliar as their runway lengths. Where, how and when fuel could be obtained and in what types and quantities were equally unknown.

Availability of crews, both for C-130s and the aging Douglas C-124s of the Military Air Transport Service that were rushed in to join them, was marginal when compared with the effort required.

To complete the cycle, Evreux's 7,800 ft. concrete runway was under routine repair when the initial alert was sounded and, throughout the maximum airlift effort, the aircraft of the 322nd had to operate from a taxiway which, although equally long, was without variable intensity lights or other landing aids and has a width of only 75 ft.

Despite these obstacles and the fact that the major force was composed of obsolescing MATS C-124s, which ranged in numbers between a minimum of 60 and a maximum of 70, the Air Force pushed into the Congo a total of 9,093 troops and 4,531,001 lb. of equipment and supplies during slightly more than two weeks of intense push between July 15 and early August. During the peak of the airlift, slightly more than 100 aircraft were funneling through the Congo system on any particular day. The troops, roughly two-thirds of the United Nations force that had been ferried into the Congo by late last week, represented nine nations, and they were picked up by USAF aircraft from nine airfields scattered across the face of Africa plus one field far to the north in Dublin, Ireland. Cargo airlifted by USAF aircraft to the Congo included 2,419,167 lb. of equipment for UN troops and Air Force support teams, 1,309,779 lb. of C-rations and 802,055 lb. of flour.

While it geared to fly in more troops if and when asked by the UN, the Air Force last week cleaned out its initial backlog of requests when 16 C-124s completed the airlift of 564 Mali troops to the fog shrouded airport of Kindu, deep within the Congo. Following is a list of the major USAF troop and cargo airlifts made to the Congo from outside points:

- **Tunis to Leopoldville,** 2,103 Tunisian troops and 418,436 lb. of equipment in four separate lifts involving total of 25 C-124s, 17 C-130s.
- **Rabat, Morocco,** and nearby Sidi Slimane Air Base of Strategic Air Command to Leopoldville, 2,400 Moroccan troops and 553,962 lb. of equipment in three separate lifts using a total of 38 C-124s and nine C-130s.
- **Cairo to Leopoldville,** 613 Swedish troops who had previously been stationed at UN-manned Gaza Strip between Egypt and Israel, and 365,100 lb. of equipment with 12 C-124s, nine C-130s.
- **Accra, Ghana, to Leopoldville,** 575 Ghana troops and 120,000 lb. of equipment in two lifts with 10 C-124s, three C-130s.
- **Conakry, Guinea, to Leopoldville,** 750 Guinea troops and 132,000 lb. of equipment with one C-124, 13 C-130s.
- **Roberts Air Base, Liberia,** to Leopoldville, 250 Liberian troops and 20,000 lb. of equipment with four C-130s.
- **Addis Ababa to Stanleyville,** 1,168 Ethiopian troops and 202,642 lb. of equipment with one C-124, 22 C-130s.
- **Dublin to Goma and Kindu** in the Congo, 670 Irish troops and 226,000 lb. of equipment with 18 C-130s.
- **Dakar to Kindu,** 564 Mali troops and 180,000 lb. of equipment with 16 C-124s.
- **Chateauroux Air Base, France,** to Leopoldville, 602,055 lb. of flour with five C-124s, 17 C-130s.
- **Lome, Togo, to Leopoldville,** 200,000 lb. of flour in seven C-130s.
- **Bordeaux, France, to Leopoldville,** 461,400 lb. of C-rations in seven C-124s, 11 C-130s.
- **Frankfurt, Germany, to Leopoldville,** communications equipment weighing 100,832 lb. in four C-124s, one C-130.
- **Chateauroux to Leopoldville,** U. S. Army equipment to support UN forces, weighing 30,000 lb. in one C-124.
- **Frankfurt to Leopoldville,** six Bell H-13 helicopters weighing 21,565 lb. in two C-124s.
- **Ramstein Air Base, Germany,** to Leopoldville, 8,400 lb. of helmets painted UN blue in two C-124s.
- **Frankfurt to Leopoldville,** four generators weighing 17,300 lb. in one C-124.
- **Malmo, Sweden, and Gardermoen,** Norway, to Leopoldville, six Piper Super Cubs and two de Havilland Otters weighing 20,000 lb. in three C-124s.
- **Frankfurt to Leopoldville,** 848,379 lb. of C-rations in 21 C-124s, four C-130s.

On their return missions, the aircraft were often clogged with refugees, particularly during the early days when the European rush to leave the Congo was at its climax. Initially, the refugees were flown directly to Brussels, home base for Sabena Belgian World Airlines' mass evacuation effort (AW Aug. 8, p. 49), with the C-130s overflying Evreux, the C-124s their home base of Chateauroux. But, as the demand for military airlift within Africa increased and turnaround point for the C-130s was shifted from Evreux to Wheelus Air Base, Libya, in an effort to save time, the evacuees were off-loaded at four UN-designated "Safe Haven" ports on the continent—Wheelus, Accra, Ghana; Kano, Nigeria and Dakar, Senegal.

At "Safe Haven" ports, refugees were turned over to Red Cross representatives and officials of their respective embassies who arranged other transport for the final leg home.

Exact tallies of just how many refugees left the Congo aboard USAF aircraft are not available, and may never be, but approximately 2,300 were flown into Europe alone, most of them before the "Safe Haven" ports were designated. Refugees were predominately Belgian but included citizens of the U.S., Sweden, Italy, Holland, Greece, Portugal, France, Germany, Great Britain and Canada.

All in all, as the UN requests for troop movements were channeled into Evreux through Wiesbaden, Germany, headquarters of U.S. Air Force in Europe, the airlift route mile structure spread to almost 11,000 naut. mi. (AW Aug. 1, p. 33).

C-130s of the 322nd normally fly an average of 2,200 hr. per month on regularly scheduled cargo runs throughout Europe and into the Near and Middle East, on medical evacuation flights, training operations with the Army and on special missions, including transport of diplomatic personnel to points behind the Iron Curtain.

On July 15, when the airlift began to crank to full force, the Division's 45 C-130s had amassed a total of 900 hr. They ended the month with 4,100 hr.

Rotational MATS C-124 squadron at Rhine-Main Air Base near Frankfurt, Germany, which is attached to the 322nd during its six-month stay in Europe, is geared to fly about 900 hr. per month with its 12 aircraft. Starting with 360 hr. on July 15, the squadron ended the month with 1,525 hr.

The C-124s of MATS' provisional wing at Chateauroux—pulled together from aircraft and crews hurriedly trundled to Europe from Donaldson and Charleston AFBs, S. C.; Dover AFB, Del., and McChord and Travis AFBs in Washington—flew a total of approximately 7,000 hr. in less than three weeks, with total number of planes on hand fluctuating between 60 and 70, depending upon the rate of replacement flown from the U.S. and overlap with aircraft preparing to return to home bases for major maintenance. Another 12 aircraft were supplied by the 52nd Squadron of the 63rd Air Transport Wing, on rotation duty at Rhine-Main when the airlift began.

Of this total, approximately 5,000 hr. were directed into the airlift pipeline. Remaining 2,000 hr. were eaten up on flights from the U.S. to Chateauroux.

Three Fairchild C-119 squadrons of the 322nd, thrown into the breach to fill European route schedules abandoned by the C-130s, boosted their normal monthly flight hour total by about 200 hr.—from 2,400 to 2,630.

Over-all July total recorded within the theater of operations—including that of the C-119 squadrons and flight of five 322nd C-119s to Leopoldville where they were turned over to the UN for support operations within the Congo—was 13,645 hr.

During the two weeks plus of maximum effort, MATS C-124s flew a total of 181 airlift missions into Africa with troops, supplies and equipment. C-130s of the 322nd added another 141.

By shaking loose every rated pilot he could spare from normally assigned desk jobs, 322nd Commander Col. Tarleton H. Watkins managed to scrape together an additional 10 flight crews to augment the 42 crews within the Division.

At Chateauroux, Provisional Wing Commander Col. William Schwartz took the basic C-124 crews as they arrived from the U.S. and melded them into a total of 54 augmented crews of eight men each—three pilots, two navigators, two flight engineers and a load master. With augmented crew aboard,

Col. Schwartz could keep one of his aircraft going for 27 hr. without crew rest.

Time and distances flown were long and grueling. The C-130 following the 3,600 naut. mi. Central African route from Evreux to Leopoldville via Wheelus Air Base and Kano, Nigeria, needed approximately 33 flying hours for the round trip. A C-124 required 44 hr. for the round trip from Chateauroux; 55 hr. if it followed the 4,500 naut. mi. swing around the horn of Africa via Sidi Slimane, Dakar and Accra.

In all, most C-124 flight crews were away from Chateauroux between four and five days at a time. C-130 crews, shuffling between points in Africa, often measured their time away from Evreux in weeks, and some of the headquarters personnel whose assignments normally keep them behind a desk for most of the work month found themselves ringing up 80 and 90 flight hours within a two-week period.

Typical Schedule

As an example of what aircraft and crew were sometimes called upon to do, here's the schedule for C-130 56-0536 of the 322nd Air Division, piloted by Capt. I. E. Jernigan between the airlift's beginning on July 15 and return to Evreux on July 25:

- **July 15**—Depart Evreux empty at 1600 hr. for 937 naut. mi. flight to Tunis, 3 hr. 25 min. away. Depart Tunis at 2200 hr. with 65 Tunisian troops and 8,500 lb. of equipment for a 1,500 naut. mi. flight to Kano, Nigeria, 5 hr. 45 min.
- **July 16**—Depart Kano at 0900 after refueling for a 1,107 mi. flight to Leopoldville, 4 hr. 10 min. Offload troops and equipment.
- **July 17**—Depart Leopoldville at 0915 on an emergency flight to pick up refugees in strife-torn Stanleyville 663 naut. mi. away, 2 hr. 50 min. Offload two passengers. Depart Wheelus at 1600 for Cairo, 928 naut. mi., 3 hr. 30 min.
- **July 20**—Depart Cairo at 1200 with 68 Swedish troops and 11,500 lb. equipment for Wheelus, 3 hr. 55 min. Depart Wheelus at 1745 with troops and equipment for Kano, 4 hr. 45 min.
- **July 21**—Depart Kano at midnight for Leopoldville, 4 hr. 20 min. Offload troops and equipment. Depart Leopoldville at 1630 with 70 troops and 13,400 lb. equipment for Stanleyville, 2 hr. 55 min. Offload troops and equipment.
- **July 22**—Depart Stanleyville at 1045 with 11 passengers, 300 lb. cargo to pick up refugees at Bunia, Congo, 304 naut. mi., 1 hr. 25 min. Offload 11 passengers and cargo. Depart Bunia at 1315 with 70 passengers and 8,000 lb. cargo for Usumbura, Ruanda-Urundi, 317 naut. mi., 1 hr. 15 min. Offload passengers and cargo. Depart Usumbura at 1445 for Bunia, 1 hr. 10 min. Depart Bunia at 1700 with 83 passengers, 8,000 lb. cargo for Usumbura, 1 hr. 15 min. Offload passengers and cargo.
- **July 23**—Depart Usumbura at 0800 for Bunia, 1 hr. 15 min. Depart Bunia at 0945 with 13 passengers for Stanleyville, 1 hr. 15 min. Offload passengers. Depart Stanleyville at 1230 with 51 passengers, 4,000 lb. equipment for Leopoldville, 2 hr. 20 min. Offload passengers and equipment.
- **July 24**—Depart Leopoldville at 0700 for Pointe Noire, French Equatorial Africa, 215 naut. mi., 1 hr. Depart Pointe Noire at 0915 for Leopoldville. Depart Leopoldville at 1445 with 21 passengers and 4,000 lb. cargo for Wheelus, 2,212 naut. mi., 8 hr. and 30 min.
- **July 25**—Depart Wheelus at 0045 for return to Evreux, 1,150 naut. mi., 5 hr. flying time.
- **Total for tour**—20,280 naut. mi. and 80 hr. 35 min. flying time, carrying a total of 580 passengers and 58,900 lb. of cargo.

Sixteen C-124s of the MATS Provisional Squadron at Chateauroux which completed the final troop lift of 564 Mali soldiers into the Congo first flew to Rhine-Main for cargoes of C-rations before channeling down the center route to Leopoldville, with refueling stops at Wheelus and Kano. After offloading the cargo at Leopoldville, the aircraft flew to Accra on the coast of Ghana for a crew rest and to await a call to pick up Mali troops and equipment in Dakar, where housing facilities are limited.

After the 6 hr. 45 min. flight along the 1,284 naut. mi. between Accra and Dakar, C-124s with their troops aboard then moved on to Kano for a crew change and to await a clearance into Kinda in Central Congo. Weather, including a rolling ground fog until at least 8 a.m. each morning which precludes scheduling any flights in before 9 a.m., absence of landing lights and fuel plus a single ramp that can handle only one aircraft at a time, combined to limit the flights into Kinda to an average of four per day.

Once there and after offloading troops and equipment—the aircraft then flew on to either Accra or Kano, depending upon which airport had the least traffic, and from there back to Wheelus and on home to Chateauroux.

No Major Accidents

There was not one major accident—the largest, collapse of a C-124's gear after landing at Dakar, where damage was negligible—although lack of communications in early days helped the spread of erroneous aircraft-missing rumors which piled new worries upon command and operational personnel.

After word arrived at 9 p.m. on July 14 that airlift of flour and Tunisian troops into the Congo was to begin at the earliest possible moment, the first aircraft carrying an advance party of 44 persons commanded by Lt. Col. Francis E. Merritt took off for Leopoldville at 1005 p.m.

Merritt's party arrived in Leopoldville at 4:30 p.m. the next day, setting up a command post in an abandoned hangar at Ndjili Airport, and by midnight the first of the flour and troop supply C-130s had begun to arrive. When Merritt left Evreux, he expected to be away for two, possibly three days. He was relieved on July 30.

When he first arrived, reliable communications from and into Leopoldville were practically nonexistent. Wheelus lost contact with an airlift aircraft after it had flown approximately 500 mi. to the south, and that was the last the 322nd command heard of it until it reappeared on its homeward leg, possibly after flying a mission or two within the Congo or to bordering refugee outlet points.

On the other end, Col. Merritt had little idea when the aircraft would arrive or what their cargo would be, depending primarily on information from incoming flight crews.

Within four-to-five days, however, MATS crews had established single sideband communications sites at Leopoldville, Dakar, Accra and Kano and, as the bugs in the system were worked out, reports on aircraft departures began coming into 322nd headquarters at Evreux within two or three hours as opposed to the two or three days of the early operations.

U.S. Attache Expelled

Moscow—Soviet Union last week expelled Col. Edwin M. Kirton, air attache at the U. S. Embassy, on allegations of improper intelligence activities and "offensive manner" toward Soviet citizens.

Foreign Ministry also accused Capt. I. T. McDonald, assistant air attache, of similar activities and conduct and warned that appropriate measures will be taken if he doesn't halt his "impermissible and unallowable activities and behavior."

Moscow Radio said the so-called improper intelligence activities occurred during visits to Kazakhstan and Odessa. Kirton, according to this account, tried to take photographs and notes of industrial and military objects.

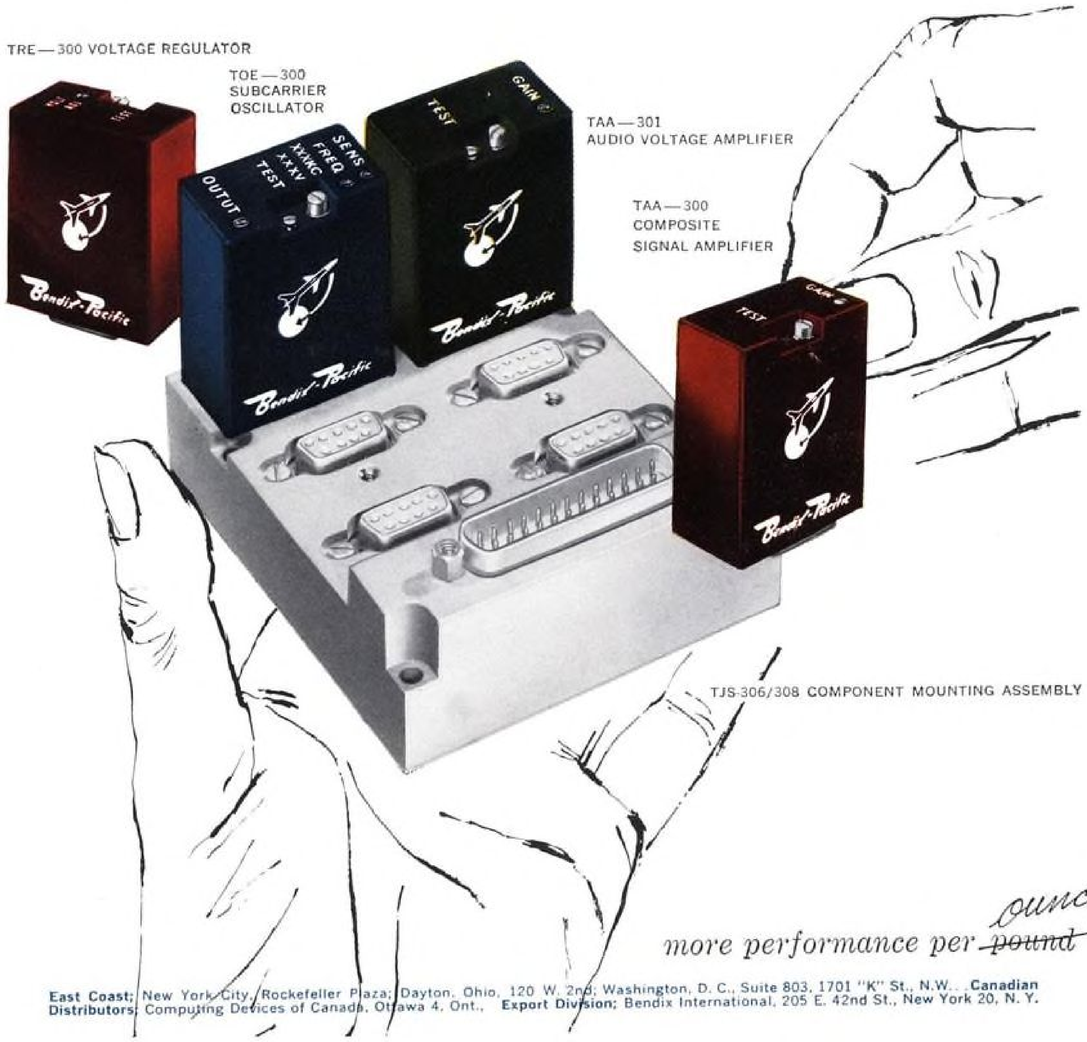
Kirton, a 50-year-old non-flying officer, has been in the Soviet Union almost two years. He was scheduled for transfer Oct. 1 and his successor was to be Col. Melvin Nielsen.

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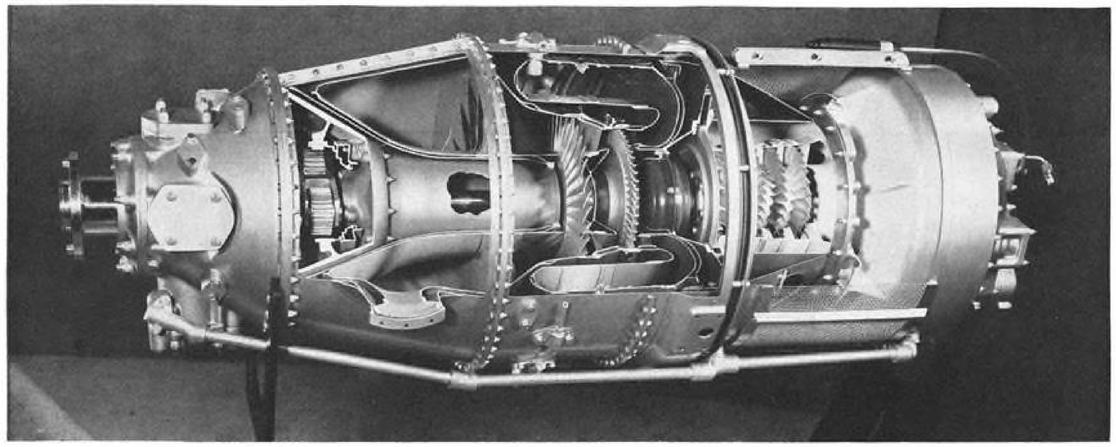
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Mockup Shows T74 Engine Layout

Cutaway mockup of the Canadian Pratt & Whitney PT6 500 shp. turbine engine, now carrying the military designation of T74, shows the directly geared free turbine layout. Air intake plenum chamber and three stage axial compressor is at right. Gas flow through driving turbine (center) drives free turbine, which is linked through planetary gearing (left) to the propeller shaft (AW Sept. 21, p. 31).

News Digest

Gen. Nathan F. Twining plans to retire before his second term as chairman of the Joint Chiefs of Staff expires next August. White House said Gen. Twining has been discussing his retirement with President Eisenhower for some time, but no date has been set.

Thomas G. Lanphier, Jr., has been appointed vice president-planning for Fairbanks Whitney Corp. He will be responsible for advanced planning for the products of several subsidiaries of Fairbanks Whitney, a company whose business is split 5% military and 95% commercial. Lanphier resigned as vice president and assistant to the president of Convair Division of General Dynamics Corp. in March to challenge Administration defense policies as a private citizen.

Kiwi-A3 rocket propulsion reactor test has been rescheduled for late September to allow time for modifications to be made as a result of the Kiwi-A prime test last month.

Atlas High Flight

Cape Canaveral, Fla.—USAF-Convair Atlas D missile was fired 7,000 mi. last week in a flight that lofted its General Electric Mark 3 nose cone to an altitude of approximately 1,000 mi. to gain new data on re-entry heading, loading and ablation. Normal apogee for the usual 6,000 mi. range Atlas flight is 500 to 600 mi.

Allen F. Donovan has been appointed senior vice president-technical, of Acrospace Corp. He formerly was vice president and director of Advanced Systems Planning Division of Space Technology Laboratories. Jack Irving has been appointed vice president, Advanced Systems Planning of Aerospace Corp. He was associate director of STL's Advanced Systems Planning Division.

Complete Air Force Minuteman launch complex will be constructed next to Boeing's Developmental Center in Seattle for testing the Minuteman weapon system. No missiles will be fired from the site. Included will be an underground launch silo, launch control center, trackage for the mobile railroad missile car and support buildings.

Douglas will deliver 21 Thor missiles to Air Force for continuing satellite and space problem programs under terms of a recent contract. The missiles will be modified to accommodate Agena B second stage vehicles. Seven of the missiles, previously ordered as tactical missiles, will be modified, and 14 of the 21 will be new vehicles. The missiles will be powered by a 165,000 lb. thrust engine, 15,000 lb. greater thrust than provided by current Thor engines. Eleven of the missiles are to be assigned to USAF's Discoverer program and will have radio guidance system; the remaining 10 will be assigned to NASA for its space programs.

Reduction of instrument data from the North American X-15 speed run at Edwards AFB on Aug. 4 (AW Aug. 8, p. 39) reveals that plane attained record speed of Mach 3.31 (2,196 mph.) at 66,000 ft. Preliminary figure of Mach 3 (2,094 mph.) was based on pilot Joe Walker's report and radar tracking. Previous speed record of Mach 3.195 (2,094 mph.) was established by the late Capt. Milburn Apt in the Bell X-2.

Hawker P. 1127 strike fighter that will have STOL capability will make its first flight next month at Dunsfold, Surrey, England. Powerplant will be the Bristol Siddeley BE. 53 twin spool fan engine (AW Dec. 28, p. 67).

Air Force Ballistic Missile Division turned over to Strategic Air Command the first exclusively operational Atlas ICBM complex at Warren AFB, Cheyenne, Wyo. Complex includes three launchers, a control center, a guidance station and associated ground support equipment. Additional launch positions for the 564th Strategic Missile Squadron are undergoing final installation and checkout.

Zeus Test Facilities

Washington—Facilities for launching tactical type Nike Zeus missiles from Navy Missile Test Center, Pt. Mugu, Calif., including two surface launchers, a weight and balance tower, three missile assembly buildings and guidance structures, are under construction.

Test firings at maximum range with command guidance will start over the Pacific Missile Range early next year. Later, firings will shift to Kwajalein Atol where the missiles will be fired against Atlas ICBMs launched from Vandenberg AFB, Calif.

Trunklines Lose $5.1 Million in First Half

Loss blamed on load factor decline, cost increases; lower yield from growing coach business also cited.

Washington—Domestic trunklines, currently in the grip of a decline in the rate of traffic growth, will report a net loss after taxes of an estimated $5.1 million for the first six months of 1960.

According to preliminary figures filed with the Civil Aeronautics Board, five of the 12 trunklines will report losses totaling approximately $13.8 million, a figure that wipes off the industry record the $8.7 million net profit the remaining seven carriers will report. Carriers reporting losses to the CAB are Capital, Eastern, Northeast, Northwest and TWA. Capital's loss has been estimated, since, as of late last week, the carrier's filing covered only the first five months.

The poor industry showing has been largely expected by most observers following the first disclosure of traffic growth during the first six months of 1960 (AW July 18, p. 39). The 7.6% gain in passenger revenue miles registered during the first half of the year fell far short of the 14% increase that originally had been almost unanimously forecast as the year's growth rate.

Declines in the load factor level during the period compared with the levels reached during the six months of 1959 plus a continuing rise in expenses are attributed as chief reasons behind the losses. During June, only four of the 12 trunklines reported an increase in their system load factors.

Expenses for the industry during the first six months reached an estimated $941 million, compared with $801 million reported for the same period last year. Gross revenues for the period climbed only slightly—approximately 8%, according to CAB figures.

Eastern Air Lines and National Airlines' operating revenues for the first six months of this year fell short of the six month revenue figures reached in the same period last year. United Air Lines' operating revenues climbed only $916,000, a total of $167 million during the first six month period, compared with the same period last year. All three carriers showed a substantial increase in expenses, a trend none of the 12 escaped.

Despite the recent increase in passenger fares authorized by the Civil Aeronautics Board (AW June 27, p. 41), a number of observers are pointing to a lower yield as another possible reason back of the losses. For the first time in history, coach traffic is beginning to overtake first-class traffic, and the difference in yield per passenger mile is depressing revenues.

The trend toward coach travel appears to be making strong headway, particularly as the number of turbojet transports increases. Shorter travel times with the jets apparently are no longer justifying the additional benefits passengers get from paying higher fares for first-class travel, and a number of passengers are now finding that financial savings, especially on the jets, more than offset minor reductions in the quality of service provided on coach flights. In addition, a number of large industrial and business firms are encouraging their employes to use coach on business travel rather than first-class since the savings on a large volume of travel can be substantial over a long period of time.

A number of leading airline officials have been urging for several years that the differential between coach and first-class be narrowed so that each rate will conform more closely to the slight differences in services now offered. Generally, it is felt that unless such a move is taken soon, first-class travel domestically will suffer the setbacks it is experiencing on international flights. The growing popularity of the low-fare class on North Atlantic services is illustrated by the fact that last year, two thirds of all transatlantic travel was economy class. Tourists services have been superseded completely by economy class.

Among the domestic trunklines, coach load factor was 62% on 10.6 billion available seat miles during the first half of 1960, and first-class load factor was 57.3% on 13.5 billion available seat miles.

Another reason given as the cause of the tight profit squeeze during the first half of this year is the high cost of making the transition from piston-engine transports to turbine-powered aircraft.

United Air Lines was able to overcome a first quarter loss by an operating profit and a gain on the sale of aircraft during the second quarter. United's President W. A. Patterson noted: "the winter of 1959-1960 represented United's transition period to jet operations and now we are beginning to experience the anticipated benefits."

United earned a net profit of $4.4 million in the second quarter, compared with a $2.7 million net loss in the first quarter. Net profit for the six months was $1.7 million. Gains on the sale of aircraft, after tax, amounting to $2.8 million, converted a $1.1 million operating loss to the net profit.

According to the preliminary CAB figures, TWA also showed a substantial profit in the second quarter to help offset the $5.2 million net loss shown for the first quarter on CAB records. Net loss for the six months can be estimated at approximately $2.8 million.

Braniff Airways reported a first quarter loss of $486,968. Preliminary CAB figures indicate that the airline will show a profit of about $443,000 in the second quarter, not quite sufficient to give the airline a six-month profit. The slight deficit undoubtedly will be wiped out during the first weeks of July, as summer traffic moves to its normal peak.

Eastern Air Lines reported a net loss of $3.9 million for the first six months, compared with a profit of $3.6 million for the same period last year. The airline estimated an $8 million loss in revenue during the 12-day labor strike in this period.

The airline cut seat miles by 5.8%, which brought about a 4.3 point increase in system load factors despite a 1.6% decrease in revenue passenger miles during the period. Eastern's expense level climbed 10.5%, while revenues fell 0.8%.

Continental Air Lines continued to show sharp gains in its operation. Total revenues of $28.7 million in the first half were 65% above revenues during the first half of 1959. The airline showed a net profit of $515,000 without benefit of capital gains, compared with a net of $859,000 for the same period last year after capital gains of $1 million on the sale of surplus aircraft.

Western Air Lines, according to the unadjusted CAB figures, will show both a first and second quarter profit and will end the first six months with an estimated $1.2 million net profit. Delta Air Lines, with a highly successful second quarter and a relatively modest profit in the first quarter, will report an estimated net profit of about $1.9 million, according to the Board's preliminary figures.

American Airlines emphasized that its 24% passenger traffic increase during the first half of 1960 was concentrated in coach-fare travel. During the period, coach traffic on American climbed 46%, while first-class traffic showed only a 12% gain. In July, coach travel surpassed first-class travel for the first time, and more than half the airline's revenue passenger miles were generated by Boeing 707 jet transports.

American showed a net profit of $2.6 million for the period, compared with $3.3 million in the same period last year.

Gain on the sale of property during the 1960 and 1959 periods increased the net figure to $3.4 million and $8.8 million respectively.

U. S. Philippine Bilateral Deadlocked

Washington—Philippines and the U. S. remained in deadlock on reaching any accord on a bilateral air transport pact, but Mexico and the U. S. had settled their differences and were slated to sign an agreement late last week.

Initial talks with the Philippines were suspended June 2 (AW June 13, p. 38) when the U. S. refused to bow to Philippine demands for capacity restrictions on U. S. scheduled operations. Late last month, the Philippines again indicated their willingness to resume negotiations, but the renewed talks were broken off early last week when differences on the capacity issue again threw the negotiations into stalemate.

Following the talks, the Philippines placed a ban on the operation of turbojets into Manila. This was lifted two days later, but the Philippine government then forced Pan American to reduce its five weekly turbojet flights into Manila to two turbojet and two piston-engine flights a week. The Philippines are insisting that the issues at stake are political and not of an aviation character.

Reopened talks in Mexico City were slated to end late last week, with Civil Aeronautics Board Member Alan Boyd and State Dept. Director of Transportation Edward Bolster representing the U. S. This is how the terms of the bilateral agreement with Mexico are expected to be written:

- Aeronaves de Mexico will win rights to operate a Mexico City-New York route with beyond rights to Europe. The airline probably will not exercise the transatlantic operating privileges at the present time because of the heavy expenses involved in conducting such a service.
- U. S. will be granted a Miami-Mexico City route to parallel the present exclusive route now operated by Guest Aerovias Mexico.
- Braniff will win its long-sought San Antonio-Mexico City route. Aeronaves de Mexico will get a route Mazatlan-Torron-San Antonio and Compania Mexicana de Aviacion will win nonstop rights Mexico City-Dallas/Ft. Worth and Mexico City-Chicago.
- Aeronaves de Mexico will be granted a route from Hermosillo to Tucson-Phoenix.

CHA Traffic Falls After S-58C Crash

Chicago, Ill.—Chicago Helicopter Airways traffic has fallen about 20% below normal since July 27 when 13 persons were killed in the crash of a Sikorsky S-58C helicopter operated by the carrier (AW Aug. 8, p. 39).

On the day of the accident, CHA carried 1,082 passengers. The day after, it carried 885. Although traffic forecasts for the first part of August indicated an average daily passenger count of about 1,000, CHA's fleet averaged only 709 passengers daily during the first nine days of the month.

The mid-summer vacation period that depressed airline traffic throughout the Midwest contributed to CHA's slump which, as of last week, was showing signs of improvement.



First Flight Photo of Soviet An-24 Turboprop Feederliner

First flight photo of the Soviet An-24 twin turboprop feederliner (AW July 25, p. 45) points up sharp upsweep in aft undersection and high tail fin. Plane was designed for flights in 800-1,100 mi. stage lengths and will carry 40 passengers in a high density seating configuration. Powerplants develop about 2,000 eshp. each, and plane will operate at 20,000 ft. altitudes.

Competition Cuts U.S. Share of Traffic

By L. L. Doty

Washington—Dwindling share of U. S. flag carriers in international air travel business is now being attributed to the steady increase in the number of flag carriers throughout the world rather than to the competitive impact of long-established foreign flag carriers.

While U. S. flag carriers have suffered declines in their share in virtually all world markets in the face of a 9.7% average annual increase in all international traffic during the past five years, other major carriers are expected to encounter similar reverses as the flood of competition mounts. And there are no signs that the growth in the number of international carriers is about to stop.

Nationalistic Surge

The surge of nationalism now sweeping younger nations throughout the world is and will continue to be accompanied by the establishment of flag carriers as prestige devices. How this growth in carriers has cut into the share of U. S. airlines in global markets is illustrated by these statistics: in 1951, U. S. airlines were handling 36% of all international revenue passenger miles generated by the airlines of 51 countries. By 1958, 73 nations were participating in scheduled airline operations, and the U. S. share of international air transportation had declined to 32%. Despite this decline in their percentage of total market, U. S. airlines generally have been able to increase their volume of business because of substantial growth in international traffic.

Biggest loss to the U. S. airlines has been in the North Atlantic market, where the U. S. share of passengers carried has dropped from 57.4% in 1951 to 40% in 1959. However, the decline has been paralleled by a similar percentage drop in the number of scheduled flights in the same period—from 59% to 33%—and in the number of available seats—from 61% to 36%.

Hardest Impact

It is in the transatlantic and Latin American markets that the impact of new airlines competing against U. S. carriers has hit the hardest. It is difficult to gage the number of Latin American airlines offering scheduled service because a number of them are not members of the International Air Transport Assn., but the figure has been unofficially estimated at 70.

From 1955 to 1958, the 30 foreign flag carriers operating out of the Miami gateway to the Caribbean and Latin America increased their market participation from 38% to 44%. There are eight U. S. airlines authorized to operate in this area through the Miami gateway. Pan American World Airways has attributed a drop of $3.3 million in 1958 revenue from the previous year to this intensified competition.

Number of carriers operating in the North Atlantic market has increased from eight in 1950 to 15 at the present time. Lufthansa German Airlines, which began transatlantic service in 1955, has made the biggest gains in recent years of any of the North Atlantic competitors.

During this period of carrier growth, the number of U. S. foreign flag carriers serving the North Atlantic has remained constant at two—TWA and Pan American. Drop in U. S. share of the North Atlantic market has been due to a sharp decline in TWA's share of traffic. Pan American currently is at about the same level it reached in 1953, although it surged upward in 1955 and 1956 to give the U.S. more than 50% of the total market.

TWA, which has undergone a series of top management shakeups in the past two years, has reported steady declines in its share of traffic, although thus far this year, it is again making deep inroads against its competition, due, undoubtedly, to its Boeing 707-320 turbojet equipment.

British Overseas Airways Corp. made notable gains in 1959 following the introduction of de Havilland Comet 4s in October, 1958. The airline now appears to be losing its recently won position in the market as competition stiffens. KLM and SAS ended last year with a smaller share than they had in 1953, and this trend for these carriers appears to be continuing into 1960.

Swissair showed a marginal increase in 1959 over 1953, but the airline lost ground during the first five months of 1960. Sabena was down in 1959 over 1953 and is about matching its 1953 position at the present time. Air France has remained relatively consistent in its position during the past seven years, although it is making a more impressive showing this year.

Both El Al and Alitalia have shown improvement since 1953, but the share of each is still relatively minor.

Significantly, the share of traffic taken by the seven carriers which have entered the market since 1950 is almost double the share lost by Pan American and TWA. The seven new carriers are Lufthansa, Iberia, Aerlinte, Alitalia, El Al, Qantas and Air India.

Substantial Increases

Scheduled airlines continued to show substantial increases in the number of passengers carried on North Atlantic routes last year to reach a total of 1.5 million, an 11% gain. Total of 89% of these passengers were carried on scheduled flights, with the balance moving on special and charter flights. The growing threat of this type of business to scheduled operators is indicated by growth figures in this category during the past two years: a 95% gain in 1958 and 75% in 1959.

In the Pacific area, the U. S. has a strong foothold in the market with only Japan Air Lines, which now serves two U. S. West Coast gateways, providing any serious competition to the two U. S. flag carriers—Northwest Airlines and Pan American. Canadian Pacific Airlines operates through the Vancouver gateway and is not directly competitive with U.S. airlines, although there is some traffic diversion as a result of the Canadian carrier's polar route.

In the South Pacific, Qantas has been an effective competitor, and the new route of Transportes Aeriens Intercontinenteaux (TAI) linking southeast Asia with the U.S. through the Los Angeles gateway for connections with Air France may prove a serious competitive threat to U. S. airlines (AW Nov. 9, p. 50). British Overseas Airways has been operating a transpacific route through Tokyo since May of last year (AW June 1, 1959, p. 41), but its participation is limited to the capacity provisions of the Bermuda Agreement (AW Aug. 1, p. 47). Nevertheless, it is unrestricted in the volume of traffic it may carry out of Hong Kong.

Pacific Airline Growth

As in the North Atlantic, the real threat to U. S. carriers in the Pacific lies in the growth of new airlines in the area. Already, Philippine Air Lines and Korean National Airlines have indicated their intentions of launching transpacific scheduled service. And both airlines can be expected to demand traffic capacity restrictions on U. S. carriers before they agree to a reciprocal exchange of routes.

Civil Air Transport, Nationalist Chinese flag carrier, is currently confined to the Far East area by its own choice. However, the Nationalist Chinese government is known to be putting pressure on the carrier to exercise its rights under the bilateral agreement with the U. S. and to inaugurate transpacific services.

Air India International, which is already taking a traffic bite in the North Atlantic after less than a year's identity in the market, has plans to expand its routes from Tokyo east to the U. S. Venezuela and Chile are also showing interest in extending routes of their flag carriers through the Pacific to the Orient. The two latter carriers, however, would be curtailed in their operation by Fifth Freedom restrictions.

On a world-wide scale, U. S. airlines reversed a two year trend by showing a larger increase in traffic during 1959 than that of all other airlines combined. The U. S. rate of increase last year was 15%, compared with 8% for the carriers of other nations. During the two previous years, U. S. carriers reported 13% and 1% gains in 1957 and 1958, compared with 16% and 12% for all other airlines.

U. S. airlines accounted for 60% of all traffic—domestic and international—carried by the world's scheduled airlines in 1959. In the past decade, this percentage figure has ranged from a low of 58.7% to a high of 63.5%. It was 58.9% in 1958.

During the year, however, airlines of several other countries also registered traffic increases of 15% or more. These include: New Zealand, 15%; United Kingdom, 17%; Canada, 18%; Germany, 23%; Japan, 27%; and Italy, 39%. Soviet Union claims Aeroflot showed a 48% traffic increase during 1959 (AW Aug. 8, p. 47). Nations which showed flag carrier traffic decreases in 1959 compared with the previous year are Brazil, Belgium, Columbia and Switzerland.

U. S. airlines' share of domestic revenue passenger miles flown by the scheduled airlines of the world—excluding carriers of the Soviet Union and People's Republic of China—has declined from a high of 77% in 1952 to 73% in 1958.

Traffic Growth

During the years between 1951 and 1958, international revenue passenger miles increased from 2.7 billion to 6.1 billion, a 130% jump. However, the gain registered by foreign flag carriers during the same period far outstripped that of U. S. carriers—from 4.6 billion revenue passenger miles to 12.7 billion for an expressive 175% gain.

Passenger load factors during 1959 rose to 60.5% from 58.6% in 1958 for all airlines operating international services. On U. S.-Europe routes, Pan American and TWA showed load factors of 78.5% and 64.5% respectively for a combined U. S. load factor of 73.7%, compared with 61.8% for foreign flag carriers.

Pan American and TWA have reversed positions on load factors since 1953. In that year, Pan American was operating with a 62.9% load factor, compared with TWA's 71.7%. During the five year period, foreign flag carriers reached a high of 65.8%, a low of

Transatlantic Passenger Traffic Distribution
International Air Transport Assn. Carriers

	1953	1954	1955	1956	1957	1958	1959	1960*
Pan American	27.5%	28.2%	32.0%	32.0%	30.5%	26.4%	27.9%	26.8%
TWA	24.0	24.2	21.8	20.5	18.1	15.2	12.1	17.3
BOAC	11.4	9.5	8.8	8.5	9.4	11.4	13.7	11.8
KLM	8.6	8.6	8.0	8.1	8.5	7.4	7.7	6.8
SAS	9.8	9.1	7.9	7.2	8.6	9.8	8.5	6.7
Air France	7.6	8.4	7.8	8.5	8.9	8.6	8.2	9.0
Swissair	3.4	4.1	3.8	3.5	4.0	4.0	3.8	3.1
Sabena	4.3	3.7	3.9	3.5	4.5	5.5	4.0	4.4
Lufthansa	.....	.....	1.2	4.2	4.3	5.2	5.5	6.1
Alitalia	1.5	2.3	2.3	1.8	1.3	2.5	3.3	2.9
El Al Israel	1.9	1.6	1.3	1.1	.9	1.8	2.1	2.1
Iberia	.....	.3	1.3	1.1	.9	.9	.9	.6
Qantas	.....	.....	.....	.....	.....	.5	.5	.9
Aerlinte	.....	.....	.....	.....	.....	.8	1.8	1.3
Air India	.....	.....	.....	.....	.....	.....	.....	.2

* — Jan. 1-June 11



South African Airways Receives First Boeing 707

South African Airways' first Boeing 707 is seen at Jan Smuts Airport, Johannesburg, after a 21¼-hr., 11,450 mi. flight from Renton, Wash State-owned South African Airways has ordered three 707s to enable it to overfly troubled areas on the African continent. Main runway at Jan Smuts Airport is being lengthened from 10,500 ft. to an eventual 14,500 ft. to accommodate maximum weight takeoffs for all operational jets. Second of the three Boeings on order is expected this month, the third in early 1960.

CARAVELLE

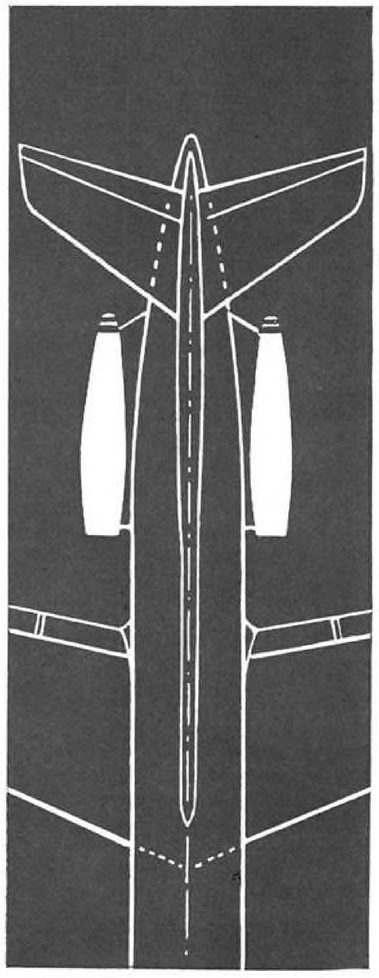
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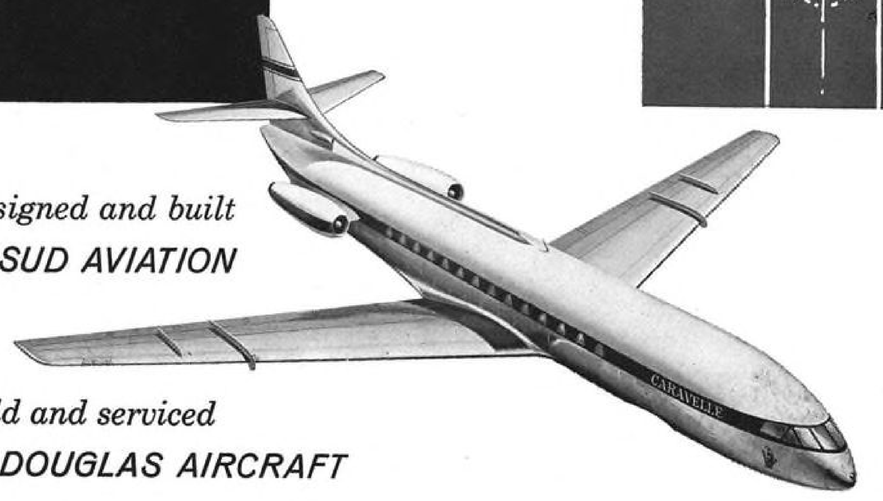
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Misrair Starts London-Cairo Comet Service

Misrair, airline of the United Arab Republic, has started Comet 4C service between London and Cairo. The carrier will operate a fleet of three Comet 4C aircraft powered by Rolls-Royce turbojet engines.

58.7%. One of the major issues now at stake in U. S. foreign policy in the air transportation field is the declining favorable balance of trade between the U. S. and foreign nations. On the basis of revenues alone, U. S. foreign carriers have earned more abroad than foreign carriers have earned here. But the margin is narrowing, and taking airport expenditures into account, the U. S. now has an unfavorable balance of trade with other nations served by U. S. carriers.

In 1952, the net favorable balance of trade for the U. S. was some $67 million. By 1958, this amount had been chopped to about $6 million. However, it is estimated that about $55 million more was spent abroad by U. S. carriers in 1958 than foreign carriers paid out in airport costs here to give the U. S. an approximate $49 million unfavorable balance of trade.

On this point, foreign flag carriers are quick to argue that such a calculation of balance of trade does not show a complete picture of the fiscal relationship between the U. S. and other countries. They say that the estimated $1 billion which foreign flag carriers will pay for new aircraft plus spares and parts automatically restores the balance of trade on the favorable side for the U. S.

Fleet Expansion

It is possible that the high cost of operating turbine equipment may discourage expansion of fleet power to compete against major flag carriers. However, experience thus far suggests that most nations will willingly underwrite operating deficits in order to be represented in blue ribbon markets with modern and competitive equipment.

At the present time, a total of 401 turbojet transports have been bought by the world's scheduled airlines. Most major airlines have completed the first round of their equipment programs, a number of which have been partially financed by the Export-Import Bank of Washington, sometimes with assistance from either the airframe or engine manufacturer or both.

Carriers of a few small nations have already placed orders for turbojet equipment—Ethiopian Airlines, for example—and others can be expected to follow the trend as the only means of keeping their countries' flags flying on international routes.

At the present time, the U. S. has bilateral air transport agreements with 53 nations, but only 27 have airlines actually operating into the U. S. On the other hand, the U. S. operates airline service to all but two of these 53 nations: Czechoslovakia and Yugoslavia. U. S. also serves several nations with which it has no bilateral agreement: Liberia and Vietnam, for example.

With the new equipment and the bilateral rights to serve U. S. markets, some of these smaller nations can be expected to request foreign air carrier permits which would multiply competition against the U. S. Meanwhile, a reverse trend toward consolidation is taking place among larger foreign carriers which, ironically, could strengthen competition against the U. S. even more than the addition of new airlines: alliances of major carriers, the most significant of such arrangements being the organization of Air Union (AW May 2, p. 55).



First Photo of Max Holste Super Broussard

First photo of Max Holste Super Broussard was taken during first flight on July 29. Super Broussard is equipped with Turbomeca Bastan turbine engines, developing 1,000 hp. on takeoff (AW Jan. 25, p. 87). Super Broussard will be produced by Max Holste and Nord Aviation.



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Trans-Canada Vanguard Starts Certification Tests

First of 23 Vickers Vanguard 952 turboprop transports ordered by Trans-Canada Air Lines has started flight tests leading to a certificate of airworthiness at Weybridge, England. Powerplants will be four Rolls-Royce Tyne 11s, rated at 5,545 eshp. each. Vickers-Armstrongs expects to deliver two or three Vanguards to Trans-Canada and British European Airways, its major buyers, before the end of the year. However, no production Tynes have been received as yet from Rolls-Royce.

Allegheny Sees Expansion Of Nonstop Short Haul Services

New York—Pending mergers provide an opportunity for the Civil Aeronautics Board to overhaul what have become increasingly out-of-balance air transport route patterns, Leslie O. Barnes, Allegheny Airlines president, told the New York Society of Security Analysts.

Short haul services have steadily and consistently deteriorated as trunk carriers put new equipment into service needing stages of 300 mi.—or longer—to make money, Barnes said.

In its efforts to strengthen the regional trunk carriers, Barnes said, CAB, abetted by the airlines themselves tacked new routes onto route systems without regard as to whether they fit. The result: "Too many routes left over and not being handled."

Barnes broke the short haul market dilemma into two parts:

• **Terminal cities**—Cleveland and Detroit for example—that are no longer being served as markets in themselves but as stops on long haul trunk routes.

• **Smaller cities** that cannot now and probably never can be served without subsidization.

Not even all local carriers agree with him, Barnes noted, but he sees possible solutions in:

• **Permitting local carriers** to compete in short haul terminal markets against trunk carriers without restriction.

• **Ending competition** in marginally economic points between trunk and local service airlines. It makes no sense, he believes, for Allegheny to operate alongside a trunk carrier between a city of 45,000 population and a terminal point. Someone must have the courage to say, "suspend the trunk," or "suspend the local."

• **Facing the permanent need** for subsidy in many smaller cities and, rather than repealing the federal transportation tax, using it in a form so that people in such cities would pay for being provided service.

Allegheny's future lies in the concept that it will always be a short haul carrier—that an airline can't be both a short and long haul carrier—and that new ideas like Allegheny's commuter shuttle service will be the means of shaping this future.

The original Allegheny commuter service between Pittsburgh and Philadelphia is making money, Barnes said, and Allegheny is providing 28% of the capacity of four airlines serving this market and is getting 39% of the business.

Commuter service in June alone provided 10% of total commercial revenues, or approximately $100,000, Barnes said. Load factors have been running over 60%, the minimum on which the commuter fare of $13 for the Pittsburgh service was derived.

Allegheny has found no rush hour pattern in this service. In the morning reserved seat tickets predominate. Com-

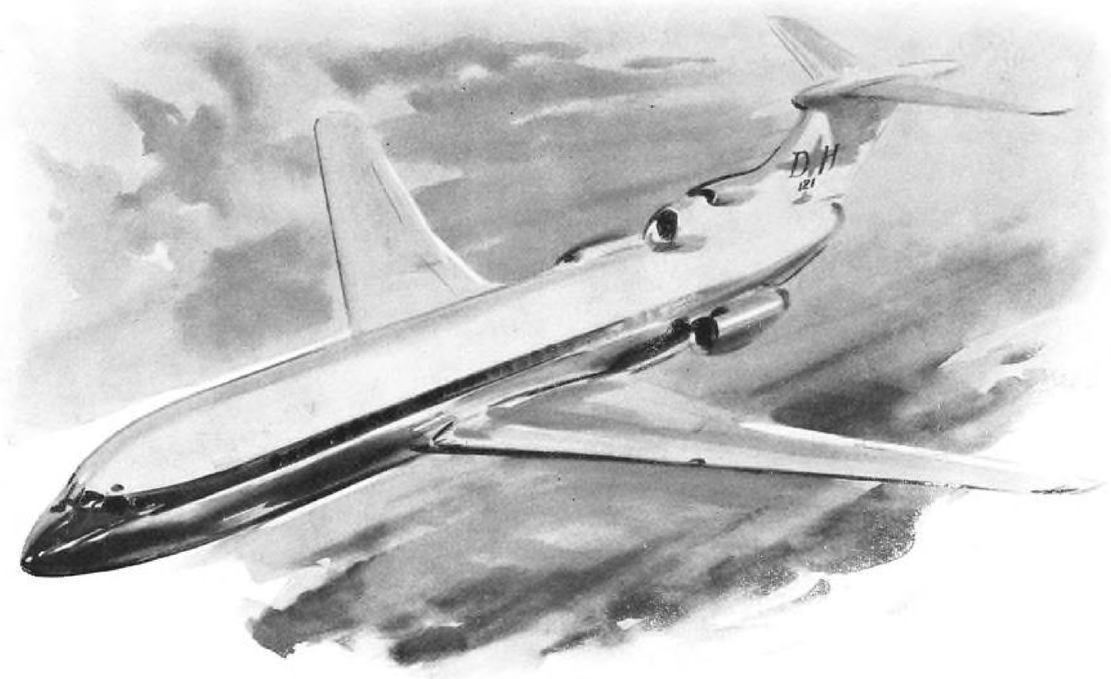
Future Equipment For Local Carriers

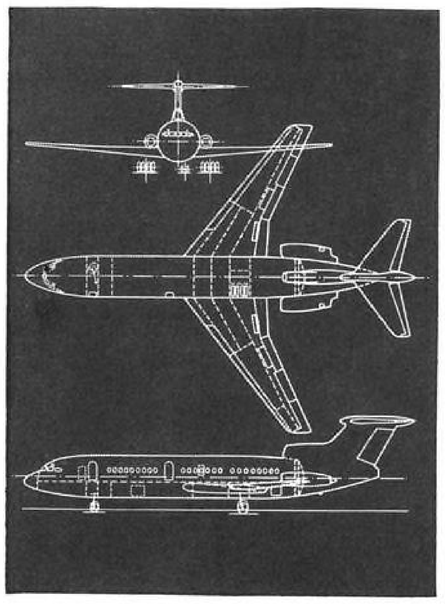
Short haul carriers might have to consider turbojet equipment seriously in three to five years if technological advance continues, but Allegheny Airlines currently is studying more intensely the potential of VTOL aircraft.

Allegheny is looking at the Fairey Rotodyne as a type of VTOL aircraft that would fit its route pattern and economic requirements. It has one major drawback in its high noise level, Allegheny President Leslie O. Barnes said.

Current rotary wing aircraft are handicapped by high cost of operation, he said, but a breakthrough in the next three to five years could alter this situation. Barnes felt the progress made in the last two years in reducing the stage length requirement for pure jet operation indicates short haul potential also.

E X P E R I E N C E





D H 121

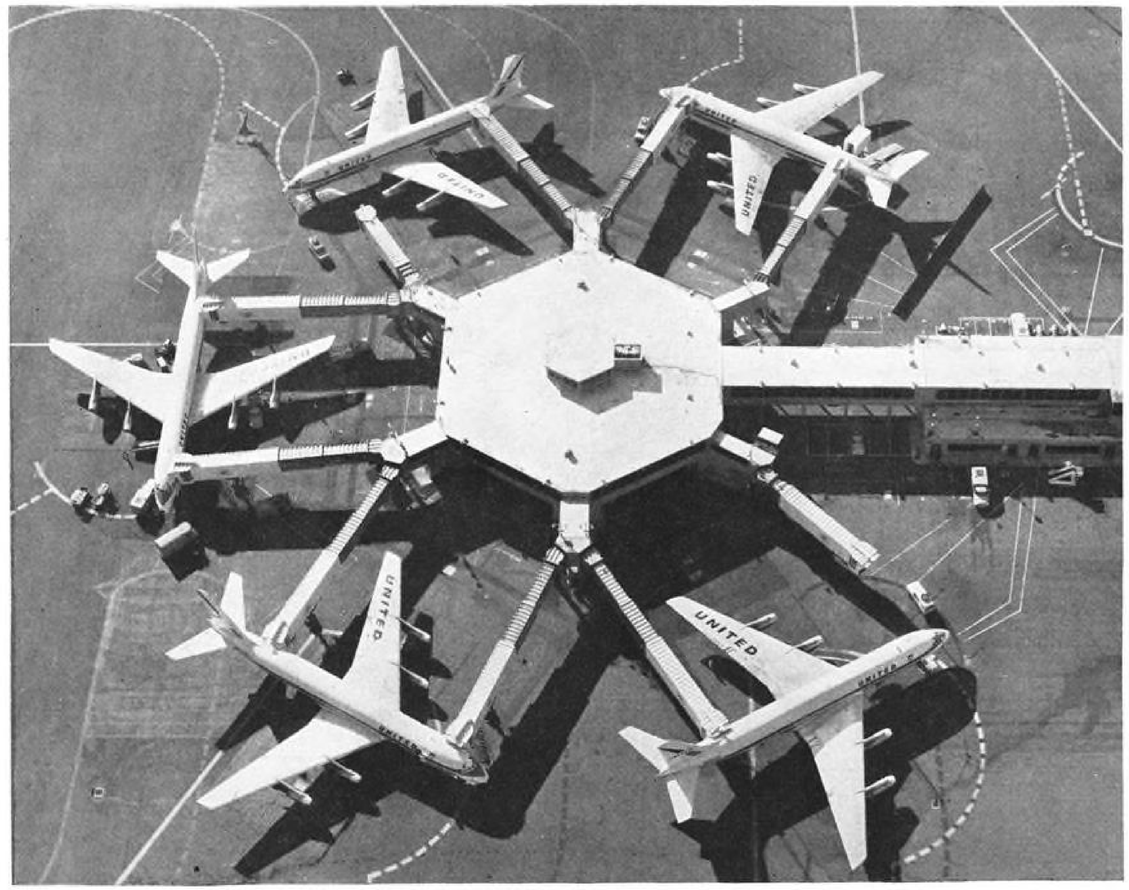
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D E H A V I L L A N D



United DC-8s at San Francisco Terminal

Five United Air Lines Douglas DC-8 jet transports are shown around United's passenger terminal concourse at San Francisco International Airport. The airplanes are connected to the concourse by telescopic all-weather corridors which automatically extend and retract. United has similar Jetways in operation at Idlewild Airport. Besides weather protection, the units also eliminate passenger traffic on the ramp.

muter tickets rise in the afternoon and evening, but do not concentrate at any particular hour. This follows a logical pattern, Barnes said, for a traveler on his way to an appointment in the morning wants a definite flight and arrival time; coming back is a more flexible situation in which he would rather not be committed to a specific departure time.

Load factors vary considerably as is typical of commuter runs—some flights are 90%, some 25%. Over-all, the breakdown so far has been approximately 60% full fare and the balance commuter on the Pittsburgh service.

Allegheny has begun a Boston-Philadelphia and Providence-Philadelphia commuter service. Initial response has been encouraging, with the Providence service showing more strength.

Barnes is eager to expand short haul nonstop service. Allegheny is seeking to take over Pittsburgh-Buffalo, Pittsburgh-Washington, Buffalo-Washington, Buffalo-Philadelphia and Buffalo-Baltimore routes from Capital in event of the Capital-United merger, but nonstop authority is an essential part of the package. Allegheny also is seeking a Detroit-Cleveland shuttle service in the Great Lakes Service Investigation, which would be operated with Allegheny's surplus Martin 2-0-2 aircraft.

Revenues for Allegheny are 35% ahead of last year now and by year-end should be running 50% ahead, Barnes said. He forecast revenues of $17-19 million in the period July 1, 1960, to June 30, 1961.

Los Angeles Studies Terminal Transport

Los Angeles—Three proposals for overhead transportation systems to convey passengers within the new 265-acre airline terminal at International Airport here are being studied by the Board of Airport Commissioners.

Lockheed Aircraft Corp. has proposed a "horizontal elevator" system of cars suspended from overhead and automatically controlled by the rider so that the passenger may select his station and go directly to it, bypassing others. Each car can carry four passengers and baggage.

Stephens-Adamson Mfg. Co. and Goodyear Tire & Rubber Co. have proposed the Air-Flyt Carveyor which consists of cars riding on a conveyor system with a unique arrangement of accelerating and decelerating rollers leading the cars from a main overhead track into the stations. Each of these cars can carry up to eight persons with baggage.

American Crane and Hoist Co. has proposed the American Rapid Transit System, a two-directional suspended monorail system with cars suspended from a stable overhead monorail structure. Cars will be lowered to ground level to pick up passengers and rise to rail for travel. Each car will contain an operator and 24 passengers.



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SHORTLINES

► **Aerovias Sud Americana** has received a two year extension of its temporary suspension of service to Havana due to a "rapidly and substantially decreased" air cargo market at the Cuban capital. Aerovias said it could not economically re-enter the Havana market "until a radical change for the better has taken place . . ."

► **Alaska Airlines** has received a $600,000 contract from Federal Electric Co. to provide an average of six weekly resupply flights from the contractor's depot at Fairbanks to Distant Early Warning Line stations in the Arctic.

► **American Airlines** will begin Boeing 720 turbojet service from Chicago and New York to Tucson and Phoenix, Ariz. on Sept. 18. Daily service will provide both first class and Royal Coachman seats. American says it now has carried more than 1.5 million passengers with its turbojet fleet.

► **Capital Airlines** reports its schedule performance and on-time record for departure was 85.2% during July. That percentage of Capital's flights left within 15 min. of scheduled departure.

► **Civil Aeronautics Board** has issued a Handbook of Airline Statistics covering traffic and financial material for the period 1949-1956. The handbook, which has 276 pages, may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

► **Delta Air Lines** has signed an agreement with Railway Express Agency which will enable companies to ship cargo via Railway Express to the nearest airport served by Delta, then have it flown as air freight by the airline. One shipping receipt is issued.

► **Eastern Air Lines** has extended its family fare plan to include Monday and Saturday as well as the mid-week period from Tuesday to Thursday noon.

► **New York Airways** using five 15-passenger Vertol 44B helicopters, carried 68,908 passengers in the first six months of this year, an increase of 15,130 over the same period a year ago.

► **United Air Lines** has received CAB permission to temporarily suspend service to Cheyenne, Wyo., until the Board issues a decision on United's request to drop Cheyenne from its system. The city also is served by Frontier Airlines and Western Airlines.

AIRLINE OBSERVER

► Airline merger talks continue, but discussions are on a very informal level with interested companies now only cautiously surveying prospects or proposals. Wall Street is speculating that American-National is the next logical alliance. Feeling is mixed on timing. Some observers believe a third proposed merger in the hopper would be of major assistance to the Civil Aeronautics Board in plotting an adjusted over-all domestic route structure. Others feel that no firm agreements will be reached until outcome of proposed Capital-United and Northeast-TWA mergers is known.

► **Chances are now strong that Britain will propose a joint U. S.-U. K. program to develop a supersonic jet transport (AW Aug. 8, p. 47).**

► Eastern Air Lines decision to lease 10 Boeing 720s reflects in part the reluctance of institutional lenders to commit any more funds at this time to airline equipment financing. With equity financing unpalatable because stock prices are below book value in most cases, airlines are more willing now to turn to leasing to acquire aircraft even though they still may not favor leasing as a primary means of acquiring a fleet of airplanes.

► **Feasibility of a network of ship-based omnirange (VOR) and Tacan distance measuring equipment (DME) stations installed on Coast Guard weather ships across the North Atlantic will be evaluated by Federal Aviation Agency starting in October and using a trial installation operating off the East Coast. Using existing weather ships, FAA believes it can provide Vortac navigation coverage over more than half of the North Atlantic air routes. Gaps in coverage could be partially filled by installing VOR-DME stations on air defense picket ships and Texas towers. The VOR antenna will be gyro-stabilized in azimuth, but unstabilized in pitch and roll.**

► Civil Aeronautics Board will investigate "overbooking" practices of the 12 domestic trunklines. Both "intentional" and "unintentional" overbooking will be studied for the purpose of setting a regulatory policy on reservations. Unintentional overbooking is caused by substitution of smaller equipment on scheduled flights, lag in communications, human error and the "free sale" of seats by one airline on another without prior clearance. Intentional overbooking is over-selling in anticipation of no-shows.

► **International Assn. of Machinists will watch the Civil Aeronautics Board closely to make sure labor protection provisions are included in approval of any of the pending airline mergers.**

► Italy has formally agreed to exchange traffic statistics with the U.S., but other major European countries are expected to rebuff current U.S. drive for free exchange of such information (AW Aug. 1, p. 47). At the same time, Italy and the U.S. signed amendments to the bilateral agreement between the two countries giving the Italians the right to extend its transatlantic route from New York to Chicago as a coterminal and to extend the route to points in other countries which will be determined in the future. U.S. received the right to serve Turin in addition to Rome, Naples and Milan, which were previously authorized.

► **Federal Aviation Agency plans to put portions of a newly developed semiautomatic traffic control data processing system into operational use several years ahead of original schedule, without waiting for availability of the complete system being developed by General Precision Corp. FAA will shortly procure traffic control computer, developed by General Precision's Librascope Division, and automatic flight progress strip posting console, with delivery in about 12 months and operational use in roughly two years. This equipment will provide a traffic controller with automatic preparation and revision of flight strips, automatic conflict search and transfer of data.**

► Nation-wide drive to generate more airmail, parcel post and perishables business through lower rates instituted last January appears to have paid off for Aeroflot, Soviet-owned airline. During the first six months of 1960, the carrier's airmail tonnage increased 46% and cargo volume 26%, compared with the same 1959 period.



The 88 windows of the new Convair 880 jet airliner are triple-glazed with PLEXIGLAS *acrylic plastic. Two of the three panels in each window are stretched* PLEXIGLAS 55, *permanently bonded together to form the outer section; the third, inner, panel is transparent grey* PLEXIGLAS II.

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"WHERE THERE'S PROGRESS, THERE'S PLEXIGLAS"

Lockheed Will Take Electra Loss Now

New York—Lockheed Aircraft Corp. chose a forum in the heart of the financial community last week to reveal that it had decided to take the whole monetary bath now on the Electra transport project—and some others as well—which will mean a first half net loss of $55,409,000.

The entire package calls for write-offs, write-downs and adjustments totaling $67,569,000 after taxes, all to be charged against earnings for the first half.

Chairman Robert E. Gross told the New York Society of Security Analysts that this cleaning of the board now will mean a profitable second half. Second half earnings of $9-10 million, he said, will cut the net loss for the year to about $45 million.

Breakdown of the write-off package on an after taxes basis:

- **Modification costs** expected for the Electra—$11,441,000.
- **Electra investigation** costs—$1,241,000.
- **Production losses** on 21 Electras delivered in the first half and on 27 Electras on order—$11,774,000.
- **JetStar development** costs and inventory write-downs on 26 airplanes on order—$31,153,000.
- **Supersonic transport** development costs—$1,214,000.
- **Super Hercules** development costs—$788,000.
- **Write-down** to resale value of 21 used airplanes on hand or committed to be acquired—$3,091,000.
- **Provision for cost disallowances** on government contracts, renegotiation refunds and income tax deficiency for prior years—$6,867,000.

Lockheed has reached agreement with operators of 110 out of a total of 138 Electras to pick up virtually all the modification costs, Gross said. In return, Gross said, the airlines waive any claim for consequential damage arising out of the two Electra in-flight accidents or the speed-restricted operation that resulted.

Tax carrybacks will soften some of the sting, Gross said, estimating that $30 million or more in cash would be generated in this fashion. Lockheed's six-month income statement, released at the meeting, showed $57,820,000 in tax credits for the first half, based on a pre-tax loss of $113,229,000.

One question asked by the analysts was whether Lockheed had any assurance that Internal Revenue would accept its accounting for tax purposes.

"This, of course, is a great hazard," Gross replied. "We relied on the advice of our tax counsel, who has been with us for 20 years, and on our external auditors. We have an opinion from each—strangely enough in conformity—that they feel it will be accepted."

Gross pointed out that there would be differences in timing between losses as recorded on Lockheed's books and those recorded for tax purposes. Some of the Electra modification costs, for example, will not actually be incurred until next year, when they would be recorded for tax purposes even though these losses are being charged off on Lockheed's books this year.

Breaking bad financial news in a way calculated to gain maximum attention from financial interests set something of a precedent, but at the same time frankness about such problems generally is applauded by investment men.

The size of the total write-off seemed to startle a few in the audience, but the step did not surprise analysts who had been following Lockheed's affairs. There was little price movement in Lockheed stock, but volume increased some. The Electra modification costs already had been estimated at $25 million prior to taxes (AW Aug. 1, p. 37).

Development costs for the JetStar, supersonic transport and Super Hercules had been shown in Lockheed's 1959 annual report as a deferred asset on the balance sheet (AW Apr. 4, p. 39) on the assumption that, as military projects, contracts would be forthcoming against which these costs could be charged. But, Gross explained:

- **Mission for the JetStar** deteriorated because of the Administration's constant demand for reduction of expenditures on manned aircraft to find money for missile and satellite projects. Air Force's original estimate of a military market for 300 airplanes has been translated so far into actual USAF orders for only five. Lockheed is going ahead with production, foreseeing still an excellent civil and military market for the JetStar, but any future airplanes will be sold on a book profit basis with the write-down out of the way.
- **Supersonic transport** does not exist today as a project, and if there is to be one it must be given sufficient military, government or industry-wide support. Since there appears to be no such immediate prospect, Lockheed wrote off the costs.
- **Super Hercules** prospects, which seemed strong to Lockheed a year ago, declined with the constant erosion of the military transport development market. Thus Lockheed wrote out this program, though it is continuing to propose a turbofan power version in a current military competition.

Lockheed no longer will do commercial business on the basis of assumptions, Gross said. In the past, calculations were based on projections of how many airplanes would be sold, but this policy is now formally abandoned. In the future, product development costs will be written off as incurred.

Both the Electra and JetStar are built on a lot basis, creating the problem of gaining enough orders in the time allotted to release the next lot to production. Orders in the right quantity for building the airplane at a profit undoubtedly will figure in any future sales, following a general industry trend away from a commercial-sales-at-any-price atmosphere.

Gross felt that, with the write-offs behind, Lockheed could look forward to a profitable 1961. He noted:

- **Missiles and Space Division,** with its Polaris program in which the Navy has indicated an ultimate requirement of 1,000 missiles, and its Samos reconnaissance satellite program which is being fully funded, will do more than $600 million worth of business this year and $600 million next year. Earnings for this division alone are running at a rate of $13 million annually.
- **Foreign F-104** orders aggregating $2¼ billion, will produce $680 million of in-plant sales for Lockheed.
- **Navy P3V production program** is now under way with $100 million funding and the airplane may be a successor to the P2V, which recorded sales of $1 billion over a 15 year period.
- **Grand Central Rocket Co.** in which Lockheed has a 50% interest, has a backup contract in the USAF Big Boost program in which Aerojet-General Corp. is developing a 1 million lb. thrust solid propellant rocket.

Lockheed, which omitted its third quarter dividend, will have the cash from tax credits to pay a cash dividend at the end of the year, but Gross said it would undoubtedly not be prudent to do so while the company shows a loss. The next year is expected to be a different story.

Though the Lockheed write-off, coming at one time, may seem large, its Electra program charges do not appear out of line when compared with other commercial jet manufacturers.

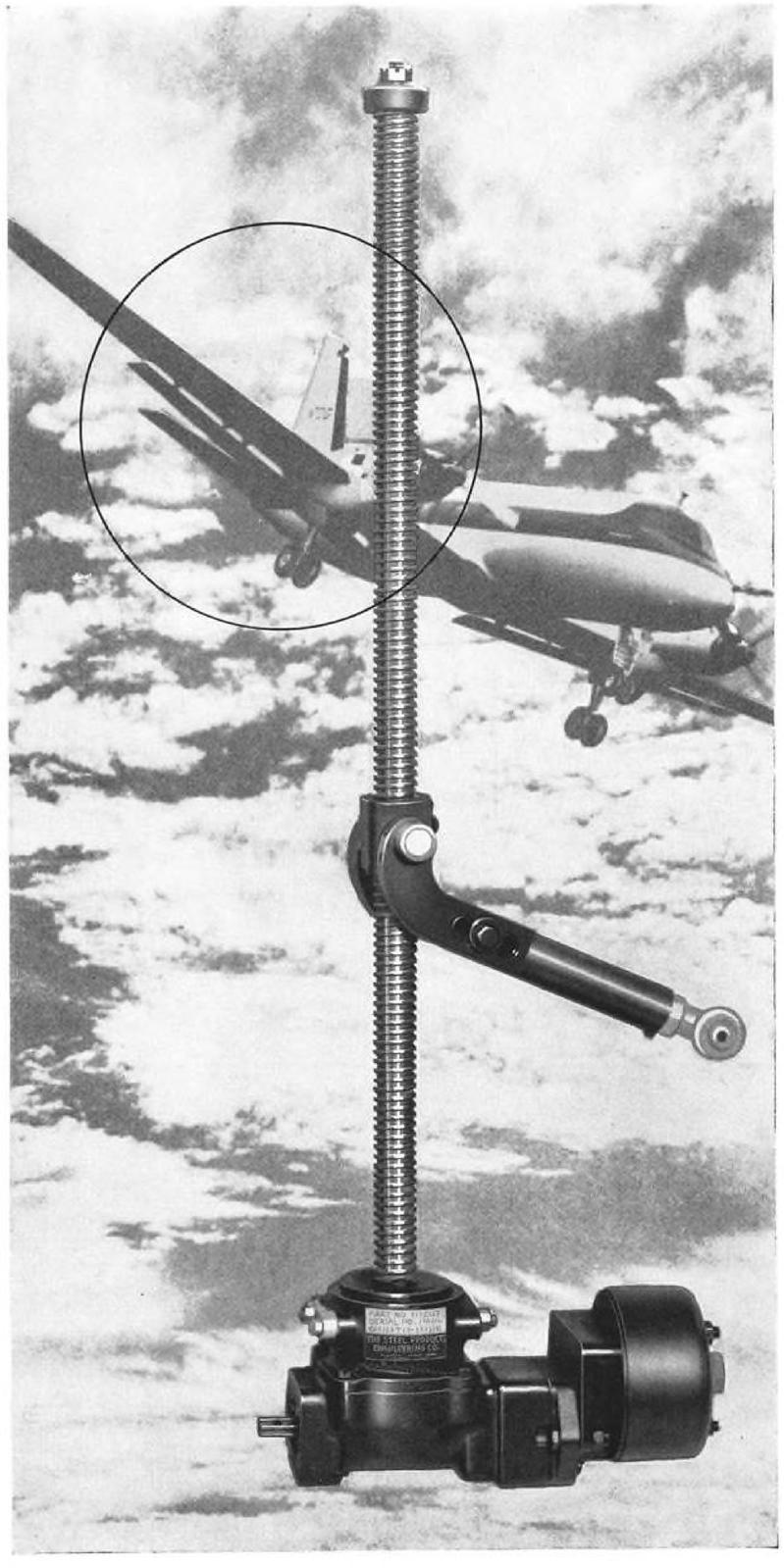
Lockheed's pre-tax charges, including modification, amount to approximately $150 million, based on previous company reports (AW May 2, p. 177). Douglas had written off $236 million on the DC-8 at the end of 1959 and Boeing $152 million.

General Dynamics Corp., reporting on its first half results last week, said its total Convair 880/600 write-offs to June 30 were about $100 million.

Airline Traffic—June, 1960

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNK								
American	785,366	612,847	72.0	1,823,612	976,362	8,969,075	70,512,132	61.1
Braniff	206,066	103,373	64.0	459,767	190,100	723,324	11,280,716	52.3
Capital	359,219	153,398	60.6	612,416	300,101	503,201	16,127,332	55.3
Continental	123,881	86,965	53.7	188,372	109,676	495,126	9,120,802	43.2
Delta	312,321	170,820	68.7	492,484	338,479	1,488,857	18,720,094	57.7
Eastern	485,369	244,577	54.23	860,956	406,127	1,223,395	26,007,862	42.75
National	159,525	100,260	63.6	355,595	74,388	778,744	10,877,792	50.1
Northeast	148,775	56,894	62.1	121,078	39,999	273,711	5,878,952	53.8
Northwest	182,495	137,504	63.4	657,714	306,572	1,393,875	15,535,148	54.8
Trans World	479,232	443,649	72.8	1,464,818	679,749	3,547,398	48,194,543	57.7
United	708,308	523,398	72.1	3,006,930	976,190	6,234,084	60,419,182	61.5
Western	150,454	89,727	58.5	314,728	94,864	372,648	9,367,891	51.3
INTERNATIONAL								
American	8,966	8,871	57.5	10,627	572	216,906	1,146,883	61.1
Braniff	6,112	13,382	64.2	28,020	.....	165,943	1,623,085	56.5
Caribbean Atlantic	29,601	2,006	66.1	1,987	.....	8,237	226,730	69.4
Delta	2,987	4,514	52.8	6,603	.....	32,208	531,739	49.8
Eastern	38,417	55,766	65.81	66,425	.....	118,862	5,865,201	61.19
Mackey	16,272	1,947	44.7	.....	259	3,612	213,885	48.1
National	2,401	1,929	48.1	1,732	1,400	12,976	222,919	44.0
Northwest	19,180	34,372	59.0	1,248,032	21,147	968,710	5,884,541	58.8
Pan American								
Alaska	8,513	9,039	68.7	37,688	.....	218,678	1,201,677	64.3
Atlantic	149,379	217,559	70.3	1,324,702	.....	4,278,374	28,193,158	60.3
Latin America	106,062	131,439	71.9	470,661	.....	3,875,401	17,065,561	64.9
Pacific	39,312	135,050	72.2	1,778,264	.....	2,303,610	18,103,810	61.8
Panagra	9,620	15,437	53.0	84,162	.....	657,053	2,418,592	56.8
Resort	.....	.....	.....	.....	.....	3,607,769	3,607,769	81.2
Trans Caribbean	15,256	23,797	89.8	.....	.....	305,195	2,322,536	75.0
Trans World	46,461	144,195	69.3	1,192,568	.....	1,464,879	17,570,844	63.7
United	17,014	42,252	80.5	188,354	9,614	175,923	4,661,416	67.6
Western	4,484	6,972	65.2	8,837	.....	22,779	762,386	67.7
LOCAL SERVICE								
Allegheny	68,776	13,741	47.7	17,756	31,780	49,478	1,415,546	48.4
Bonanza	21,214	5,388	38.2	6,935	3,046	10,655	535,441	39.1
Central	15,940	3,097	42.6	9,063	3,877	9,886	319,581	38.4
Frontier *	.....	.....	.....	.....	.....	.....	.....	.....
Lake Central	22,494	3,556	46.7	5,055	16,757	.....	362,082	47.2
Mohawk	59,945	12,165	50.7	17,722	21,159	18,942	1,217,880	47.2
North Central	91,968	16,403	47.84	39,267	41,910	41,198	1,721,311	48.86
Ozark	53,099	9,384	42.2	16,283	26,073	32,432	972,539	45.8
Pacific	46,232	10,458	52.7	17,850	4,592	8,047	1,027,954	46.7
Piedmont	41,842	10,127	53.6	15,070	16,924	22,269	1,025,980	54.9
Southern	7,654	1,365	40.3	3,971	3,148	5,079	143,134	42.1
Trans-Texas	30,791	7,176	43.8	22,856	12,723	42,449	763,493	44.7
West Coast*	.....	.....	.....	.....	.....	.....	.....	.....
HAWAIIAN LINES								
Aloha	34,683	5,195	59.9	2,908	.....	9,297	429,162	63.8
Hawaiian	47,890	11,125	64.6	67,570	.....	437,355	1,505,929	61.5
CARGO LINES								
AAXICO	.....	.....	.....	.....	.....	6,690,365	6,690,365	69.20
Aerovias Sud Americana	.....	.....	.....	.....	.....	508,602	508,602	76.0
Flying Tiger	5,181	8,836	73.3	35,756	54,563	6,663,193	7,637,058	67.8
Riddle								
Domestic	.....	.....	.....	39,336	36,884	1,085,391	1,161,611	75.6
Overseas	279	1,062	94.6	7,931	.....	662,841	776,996	61.6
Seaboard & Western	2,220	8,966	100.0	474,851	.....	3,518,722	4,911,462	72.2
Slick	2,517	11,494	100.0	.....	.....	6,490,608	7,638,850	100.0
HELICOPTER LINES								
Chicago Helicopter	31,962	534	54.1	1,219	.....	.....	52,183	45.1
Los Angles Airways	3,950	133.1	61.6	4,594	2,216	.....	19,536	70.5
New York Airways	14,594	289	58.4	1,983	1,291	625	31,531	58.2
ALASKA LINES								
Alaska Airlines	11,261	9,931	64.7	77,274	3,947	351,938	1,414,737	67.2
Alaska Coastal	7,060	704	55.7	4,303	.....	5,620	81,437	58.8
Cordova	1,862	294	40.1	4,351	.....	70,578	105,722	47.4
Ellis	6,780	403	51.2	2,960	.....	1,968	45,854	58.2
Northern Consolidated	3,723	1,149	42.8	34,781	.....	94,718	252,970	60.6
Pacific Northern	13,270	13,884	63.9	116,934	7,690	361,380	1,980,603	74.1
Reeve Aleutian	1,575	1,381	36.5	50,897	.....	64,959	266,707	59.8
Western Alaska *	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	5,756	1,784	64.2	53,575	.....	150,866	386,236	57.5

* Not available.
Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.



Grumman Gulfstream

newest business aircraft equipped with Kelsey-Hayes wing-flap actuators

This new twin turbo-prop business airplane carries up to 12 passengers in pressurized comfort well above 30,000 ft. and at airspeeds exceeding 350 mph.

Capable of operating from short runway airports, Gulfstream gets its wing flap action from a hydro-mechanical actuation system designed and produced by our SPECO Division in Springfield, Ohio.

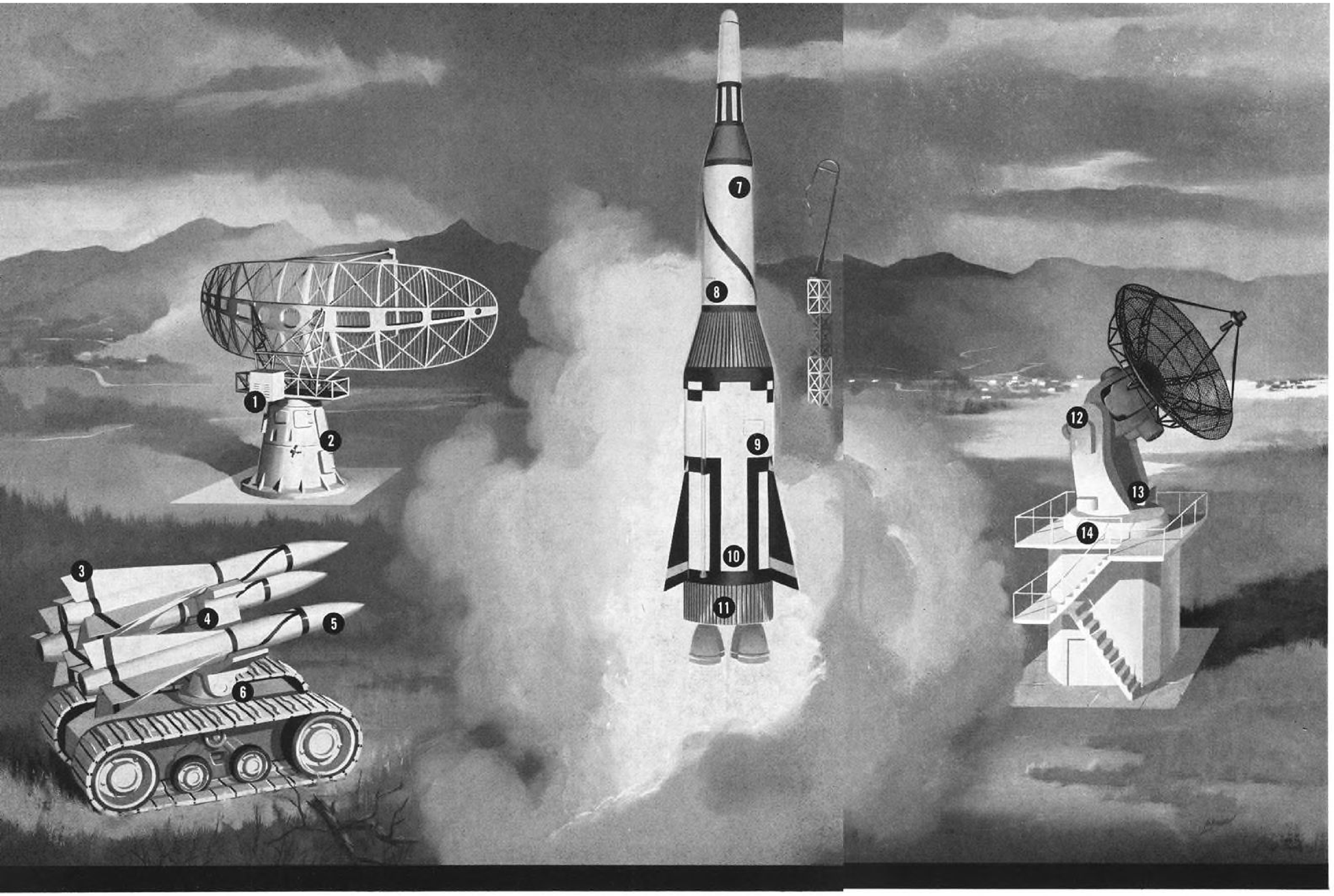
SPECO, supplier to the aircraft industry for over 40 years, also produces helicopter transmissions, lightweight special hoists, precision radar antenna mounts, precision gears and gear assemblies for the aerospace industries. Kelsey-Hayes Company, Detroit 32, Michigan.

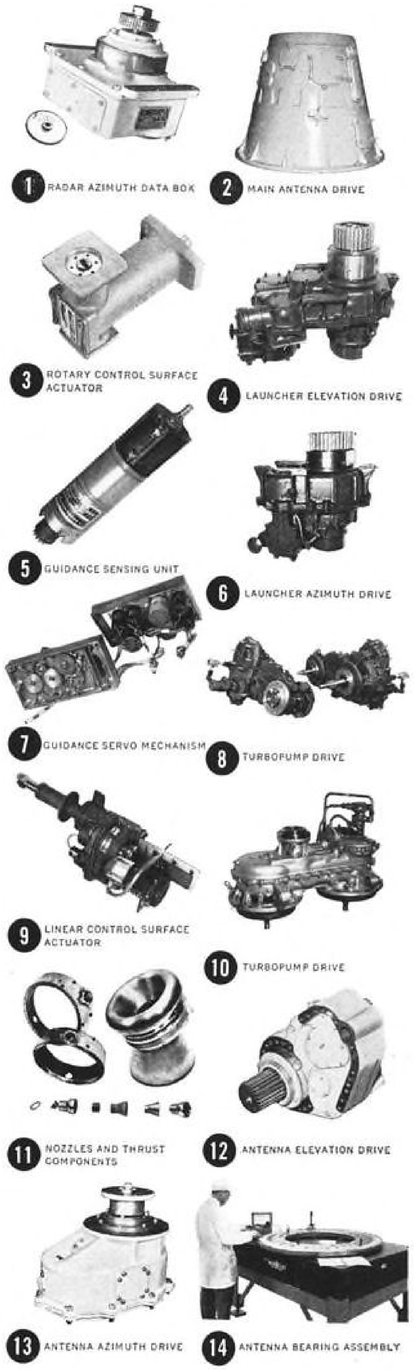
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K H





IN THE AIR...ON THE GROUND...HERE'S HOW

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BOEING 720 intermediate range jet transport has slower approach speed than previous aircraft in the 707 family.

Aviation Week Pilot Report:

Performance, Response Improved on 720

By William S. Reed

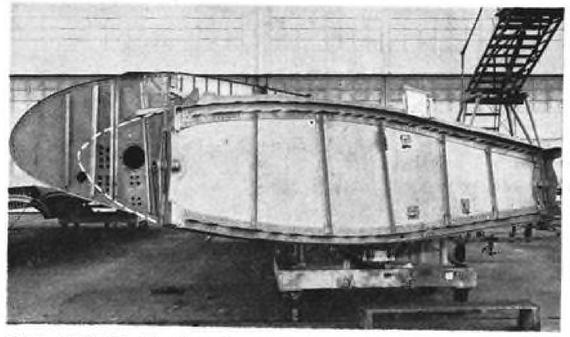
Seattle, Wash.—Improved handling qualities plus increases in performance over earlier 707s, resulting from extensive weight reduction and higher-thrust engines, make the recently certificated Boeing 720 highly adaptable to its medium-range transport role.

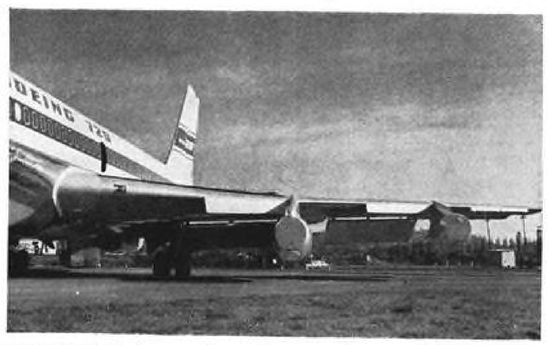
Flight evaluation by this AVIATION WEEK pilot reveals that the 720 is a true medium-field aircraft, capable of cruising at 600 mph. with control forces and response at a level better than might be expected from a large transport. Aircraft flown was N7528A, the 12th 720 off the Boeing Airplane Co. production line and the second of 25 ordered by American Airlines (AW July 18, p. 47). The evaluation was performed during a three-hour shakedown flight prior to delivery, with Boeing production test pilot F. J. Salisbury as aircraft commander.

Gross weight of the aircraft for this flight was 167,000 lb., a relatively light loading since the model 720 can gross up to 213,000 lb. A check of the airplane flight manual showed that optimum V_1 speed was 120 kt., V_2 speed 133 kt.; V_1 is the speed at which, if an engine failure occurs, the horizontal distance to continue the takeoff to a height of 35 ft., is equal to the distance to stop, and V_2 being the climb speed attained when reaching a height of 35 ft. Rotation speed, V_R, in this case coincided with V_1.

With the outside air temperature reading 30C (85F), altimeter setting of 30.08, the aircraft rolled down Boeing Field Runway 31 and reached V_1 speed of 120 kt. in considerably less than 5,000 ft. Under similar ambient conditions at its maximum gross weight of 213,000 lb., the handbook shows that the 720 would have required a balanced field length of about 9,000 ft. The FAA defines balanced field length, which is not necessarily runway length, as the horizontal distance required from takeoff roll to reach an altitude of 35 ft., assuming an engine failure at V_1 speed.

Speed of 133 kt. was held during gear retraction and throughout the second and third segments of the climb. Airspeed then was allowed to build up to about 160 kt., or 1.25 V_s (stall), at which point flaps were retracted. Power was reduced after climb speed of 260 kt. was reached, the exhaust pressure ratios read 2.3 with V_1 (first compressor) showing 98% rpm. Even at this reduced





FULL EXTENT of leading edge glove is shown by comparison of dotted line (left) which shows contour of former wing root. Glove fairs into the former leading edge where inboard pylons are fitted. Leading edge slots are shown in full deflection position (right).





ADDITION of 40 in. to the vertical fin was made to obtain better directional control during engine-out operations. At right, dark portion on wing, near fuselage, outlines the leading edge glove. Note forward sweep and reverse camber at aft portion. Leading edge devices on this wing serve as full span flaps; effect of engine pylons reduces need for them outboard of the pylons.

power setting, the aircraft was climbing at a stabilized 3,000-plus fpm. when passing through 5,000 ft.

The test mission required that the aircraft be flown at various airspeeds at 10,000, 20,000 and 35,000 ft. mean sea level. Functional tests were given to the aircraft systems and checks were made of trim setting at a variety of airspeeds. Throughout all speed ranges, the 720 exhibited good handling qualities and demanded only a nominal amount of trim change as the airspeed varied. Amount of trim change necessary, however, is somewhat greater than that in the 707, possibly due to the higher thrust Pratt & Whitney JT3C engines and the shortening of the tail moment arm resulting from an over-all 80-in. reduction in fuselage length.

Of particular note is the improvement in handling about the vertical and longitudinal axes which results from installation of a full-boosted rudder and major rework in the aileron system. Not only does the boosted rudder effect a considerable reduction in pedal forces, but a 40 in. cap on the vertical fin provides better directional control during critical engine-out operations at low speed. The ventral fin, however, is of shallower depth than on the 707-120 or -320 models owing to the necessity for increased ground clearance at high angle of attack landings. The 720's ventral fin is approximately 19 in. in depth compared with 39 in. for the earlier models.

Improved lateral control results from modifications to the aileron control system which eliminate driving the aerodynamic tabs through the trim system. Not only was the linkage redesigned but the mechanical design of the aileron control tab system was refined. Lateral control at high speed is obtained by a pair of inboard ailerons, while low speed control is effected by an additional pair of ailerons brought into play when flaps are lowered.

Four pairs of hydraulically-actuated spoilers, positioned by a follow-up valve, augment the ailerons.

Spoilers can be uniformly deployed by a pedestal-operated lever to act as speed brakes for deceleration or as lift destroying devices to shorten the landing roll. In addition to producing a very marked deceleration similar to that experienced in extending speed brakes in a jet fighter, the spoilers produce a slight nose-up pitching moment which can be utilized to effect longitudinal control in the event of a jammed stabilizer.

Maximum cruise speed of the 720 has been boosted by Mach 0.02 by the incorporation of a leading edge glove. Speed increase, which amounts to about 12 kt., is achieved at no increase in cruise thrust so that effectively, the specific fuel consumption of the aircraft is improved and the speed increment occurs as a bonus with no additional cost in fuel consumption.

The leading edge glove reduces drag, thereby allowing an increase in cruise speed, by effectively:

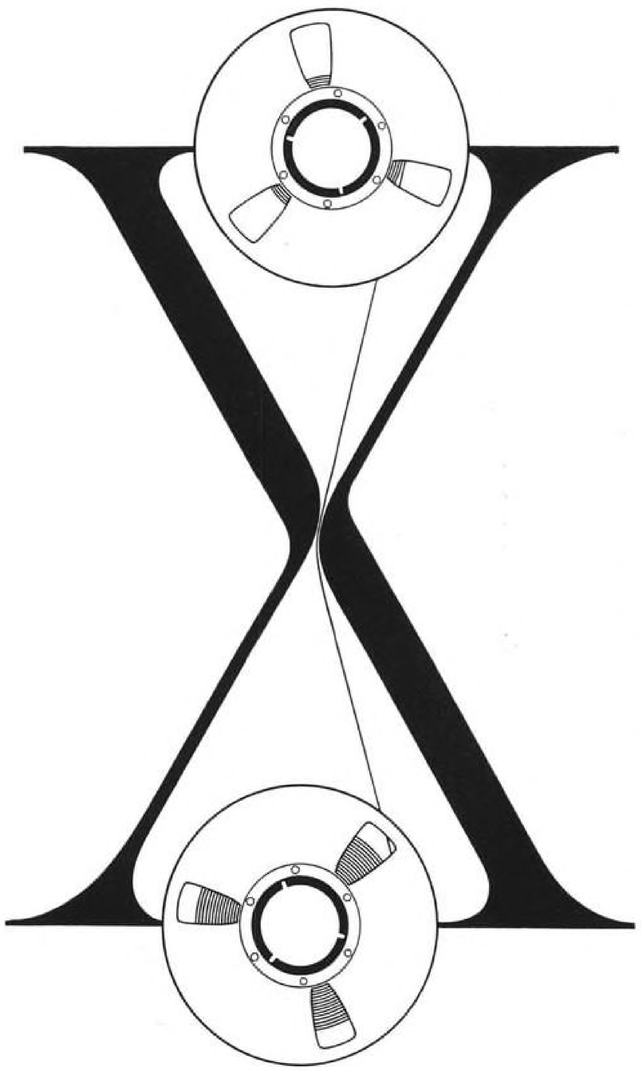
- **Increasing** the angle of wing sweep.
- **Decreasing** the thickness of the wing near the root.
- **Bringing forward** the point on the wing chord at which flow separation takes place by sweeping the maximum thickness point forward.

The glove, or leading edge extension, is not a structural part of the wing, but more in the nature of a fairing. Had the wing structure been redesigned to make the fairing a part of the basic structure, the wing would have had to be lowered on the fuselage, or a "hump" incorporated in the cabin floor. Boeing engineers worked it out so that the original wing skin and structure is retained for strength and the glove section is constructed so as not to pick up bending or twisting loads between the wing and fuselage. Leading edge sections of the glove are made of metal to withstand the effects of wind, rain and hail erosion, but the upper portion is fabricated of glass fiber for lightness and rigidity.

Boeing also conducted theoretical and wind tunnel investigations on other types of drag reduction devices such as wing "anti-shock" bodies, but discarded these in favor of the glove. Data showed that while the wing bodies delayed the drag rise above Mach 0.88, they caused more drag than the glove arrangement if cruise speed was lower. Final decision was that hot day thrust of the JT3C-7 would not be sufficient to allow the aircraft to economically maintain a high enough cruise speed to

NO DOUBT ABOUT IT—

"SCOTCH" BRAND Sandwich Tapes wear 10 times as long without errors



IN THAT NARROW LITTLE LIFELINE OF DATA known as magnetic tape, a miss is magnified into a mile. A missed bit, or one picked up by error is confusing, frustrating and time-consuming. If you're in doubt about the kind of performance you're getting, perhaps "SCOTCH" BRAND Sandwich Tapes can solve some of your tape and equipment problems.

The exclusive construction of the Sandwich Tapes combats the causes of error because it eliminates the source—oxide rub-off and head build-up. Tests prove it wears a minimum of 10 times as long as ordinary tapes before it errs. As a by-product, you can rely on it to drastically reduce maintenance and replacement costs on equipment.

The Sandwich is constructed as shown in the diagram at the right. The famous "SCOTCH" BRAND high potency oxide coating is sandwiched between a tough polyester base and a 50 micro-inch layer of plastic. Since the oxide is never in contact with the head, tape movement is smooth and low in friction—easy on both tape and equipment. Oxide can't rub off and distort valuable data.



Yet, the real meat of this remarkable Sandwich is the "SCOTCH" BRAND high potency oxide coating. Even under the protective plastic, the oxide's potency is quite sufficient to pick up 500 pulses per inch—and give desirable high-frequency response in many AM, FM and PDM applications. Sandwich Tape is but one of the developments to come out of 3M research—the same research responsible for "SCOTCH" BRAND Video Tape—the first video tape in commercial use.

Whatever your application—you'll find the right tape for reliable, error-free performance in the "SCOTCH" BRAND line-up. Check them all. *High Resolution Tapes 158 and 159* pack more bits per inch, offer either standard or extra-play time. *New Heavy Duty Tapes 198 and 199* offer good resolution and exceptional life even in poor environments. *High Output Tape 128* gives top output in low frequencies, even in temperature extremes. And *Standard Tapes 108 and 109* remain the standard of instrumentation.

Your 3M Representative is close at hand in all major cities—a convenient source of supply and information. For details, consult him or write Magnetic Products Division, 3M Co., St. Paul 6, Minnesota.

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SCOTCH BRAND MAGNETIC TAPE
FOR INSTRUMENTATION

MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW

avoid the low speed penalty of the anti-shock bodies.

Cruise speed attained at 35,000 ft. MSL was slightly over 300 kt. IAS. At this speed, the 720 was indicating Mach 0.88 which works out to 514 kt. The free air temperature was —35C, about 20 deg. warmer than standard. The true airspeed came out to 593 mph., which compares favorably with Boeing's claim of 600 mph. cruise. Had the temperature been at standard, or if these raw data were reduced to standard, the true airspeed would work out to considerably more than 600 mph.

At the above cruise speed the 720 handled very well. Aileron forces are particularly pleasant and the thumb operated elevator trim is convenient for maintaining stabilized flight even with a number of engineers running back and forth in the cabin. As with most large aircraft though, the autopilot, in this case a Bendix PB-20, does a far better job of flying the aircraft and will no doubt be so utilized.

Stall Warning Reduced

Addition of the leading edge glove has caused a lessening in the amount of stall warning buffet in the 720, but at the same time permits a more usable margin of airspeed between takeoff speed and the onset of buffet. Boeing has deemed it advisable to install a "stick shaker" on the aircraft to replace the small increment of buffet warning lost by the modification. Stall characteristics, however, remain identical to those of the original 707 series, with the aircraft falling through straight ahead and recovery accomplished in a straight forward manner.

The addition of leading edge flaps results in an approximate 20% increase in lift coefficient at takeoff and an approximate 15% increase at landing $C_{L_{max}}$. There are four flaps on each wing leading edge which deploy to the full open position when the flap handle reaches 30 deg. Leading edge flaps on the 720 resemble flat plates and serve to increase the effective camber of the wing at low speed. They retract flush with the lower wing surface when the main flaps retract beyond 30 deg.

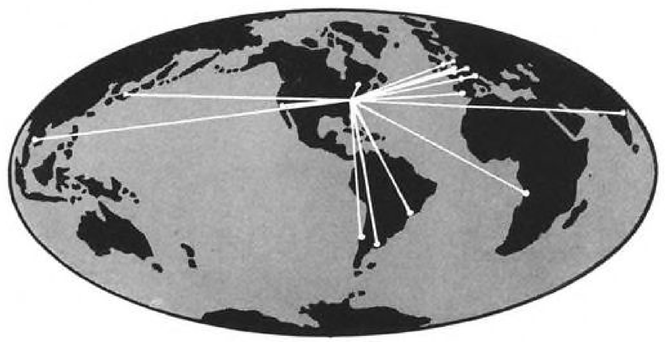
Boeing engineers say that these leading edge flaps serve effectively as full span flaps although they extend over only about half of each wing semi-span. The engine pylons, they explain, serve as flow fences, preventing the spanwise flow of air and eliminating the need for flaps on the leading edge immediately outboard of each nacelle. Full span leading edge flaps, and in fact many combinations of leading edge devices, were tried on the "dash Eighty" prototype 707 before this configuration was accepted. Tests in flight determined that leading edge flaps outboard of the pylons contributed little and so were not incorporated in the improvement program.

As N7528A was brought back to the vicinity of Seattle and the descent for landing was made, it was determined that the landing gross weight would be 130,000 lb. At this weight, the stall speed with full 50 deg. flaps is 90 kt., and the book showed the landing reference speed to be 115 kt. (The FAA defines landing reference speed as the speed at the 50 ft. height in a normal landing. This speed must be equal to 1.3 times the stall speed in the landing configuration.)

After the landing gear was lowered and the flaps extended to 30 deg., the aircraft was flown at 140 kt. in the landing pattern. Control about all three axes seemed good and no particularly great physical effort was needed to make the aircraft do exactly what was required. As roll-out onto final was completed, flaps were extended fully to 50 deg. and the airspeed slowed to 125 kt. Again, even at this low airspeed, control was good. Of particular note was the very good aileron response which coming down the final approach.

Touchdown occurred in a nose-high attitude with the airspeed passing through 100 kt., and the nose was held off with no difficulty. Reverse thrust was applied after the nose wheel

A LINK WITH THE WORLD MARKETS

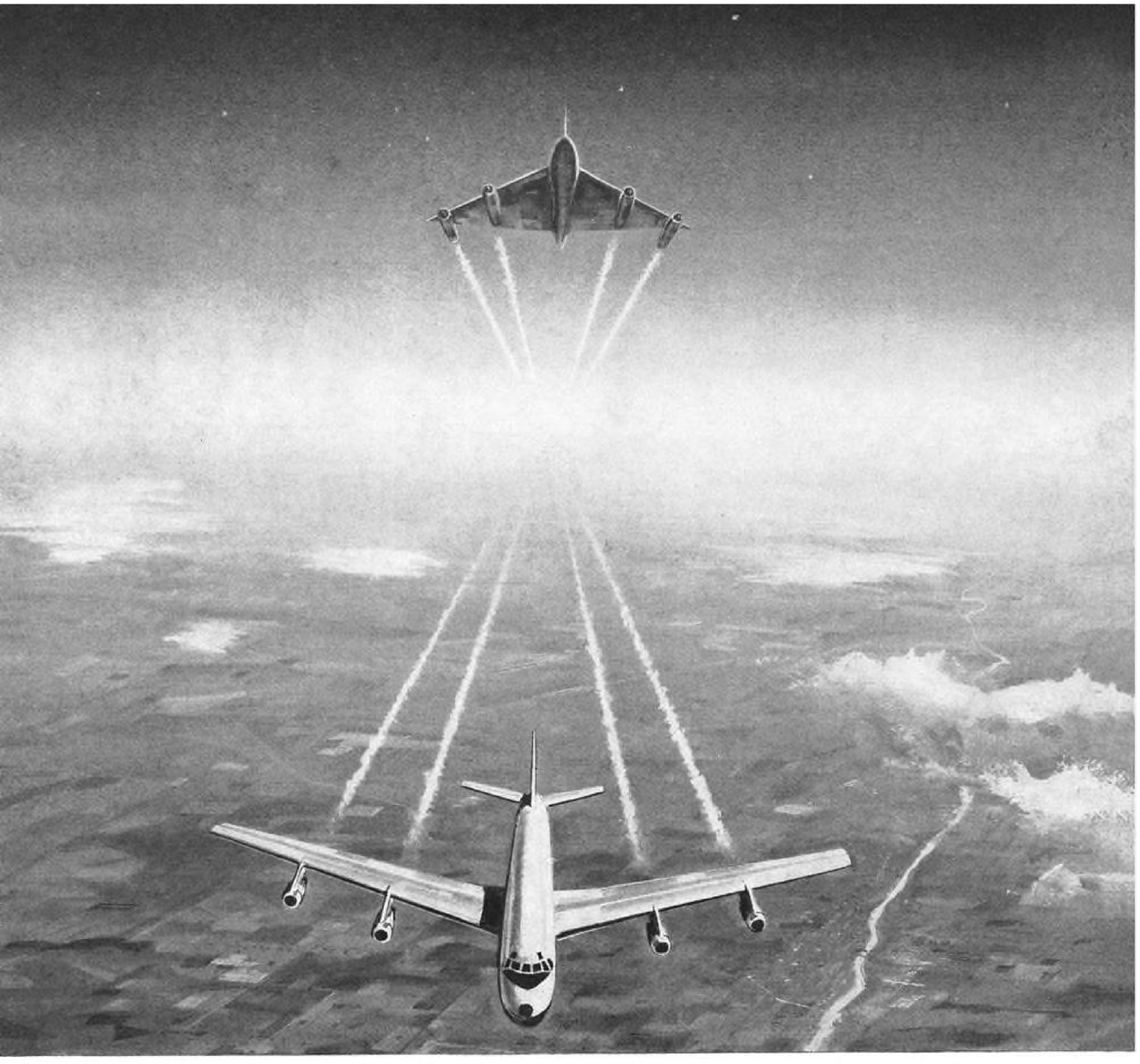


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touched the ground and turnoff was accomplished at mid-field with a minimum of braking. Had a "panic" stop been required, spoilers could have been fully deployed and maximum braking used for a turnoff in a much shorter distance. The technique used on most jet aircraft for minimum distance landing also could have been employed, involving a nearly three-point touchdown to get the nose wheel on the ground after which spoilers would have been deployed, reverse thrust used to the maximum and full braking action applied for the shortest possible role. Under these conditions, the 720 could have been brought to a stop in about one-third the length of Boeing Field's 10,000 ft. runway.

Boeing describes the 720 as the first member of the second generation of a family of jet transports. Firm orders are on the books for 215 aircraft plus 23 as yet unannounced orders. Of these 238 aircraft, 79 are for either the 720 or 720B models. (720B aircraft will be fitted with the P&W turbofan engine.) Delivery of the 215th aircraft will occur in May, 1961 with the unannounced orders following.

Potential Market

Boeing sales department is very optimistic about the potential market for the aircraft and expects to be delivering derivations of the original 707 family until at least 1970. This may or may not be a realistic estimate.

All models of the 707 series aircraft are being produced simultaneously on the Boeing production line. Models include the 707-120, -120B, -220, -320, -420, and the 720 and 720B. Some controversy still exists in the airline industry over what to call the 720, with some customers calling it the 707-720 and some referring to it simply as the 707.

Ability to produce the various size airframes on the same assembly line is a result of what Boeing calls "rubber tooling." This permits the use of most of the same jigs and fixtures in producing the various models and results from planning for the manufacture of a family of aircraft from the beginning. In the 720, approximately 70% of the parts are common with the earlier, parent 707.

One example given by Boeing of the "rubber tooling" concept is the production of spar caps designed so they can be produced in a variety of sizes and weights by keeping the working surfaces constant and varying the amount of material removed. In many cases, extrusions of the same size are used and the cuts varied to lighten the structure instead of leaving the wing stressed for higher gross weights than needed.

Another major change is in the dual-tandem main landing gear truck which has been lightened. Since the maximum takeoff gross weight is nearly five tons less than that of a -320, considerable weight has been saved by reducing the diameter of the oleo strut from 10 in. to 8 in. and by using smaller tires; 40 x 14 instead of the 46 x 16 sizes on the larger aircraft.

The shorter cabin length, 96 ft. 6 in. compared with 104 ft. 10 in. in the 120, plus increased unit reliability also has eliminated the need for one of the three turbo-compressors used for cabin pressurization. Two units are used in the 720, housed in the leading edge of the inboard engine pylons. As a back-up measure, bleed air from the first stage compressors of all four engines is available to supplement the output of the cabin superchargers.

Certification Completed

Certification on the 720 was completed on June 30 and the aircraft put into service on July 5. A complete certification program was run on the aircraft as if it were an entirely new design. Only exception was the functional and reliability phase of testing, which was cut from 150 hr. to 12 hr. because of the similarity with the 707 family.

The 720 is a Chicago-West Coast airplane, Boeing salesmen say, but only a marginal coast to coast transport unless added fuel tankage in the center section is installed (as is planned by Irish International Airlines). With the added tanks installed, the payload must be reduced, cutting down on the original medium haul route economics which are the basis for the aircraft concept.

Additional Refinement

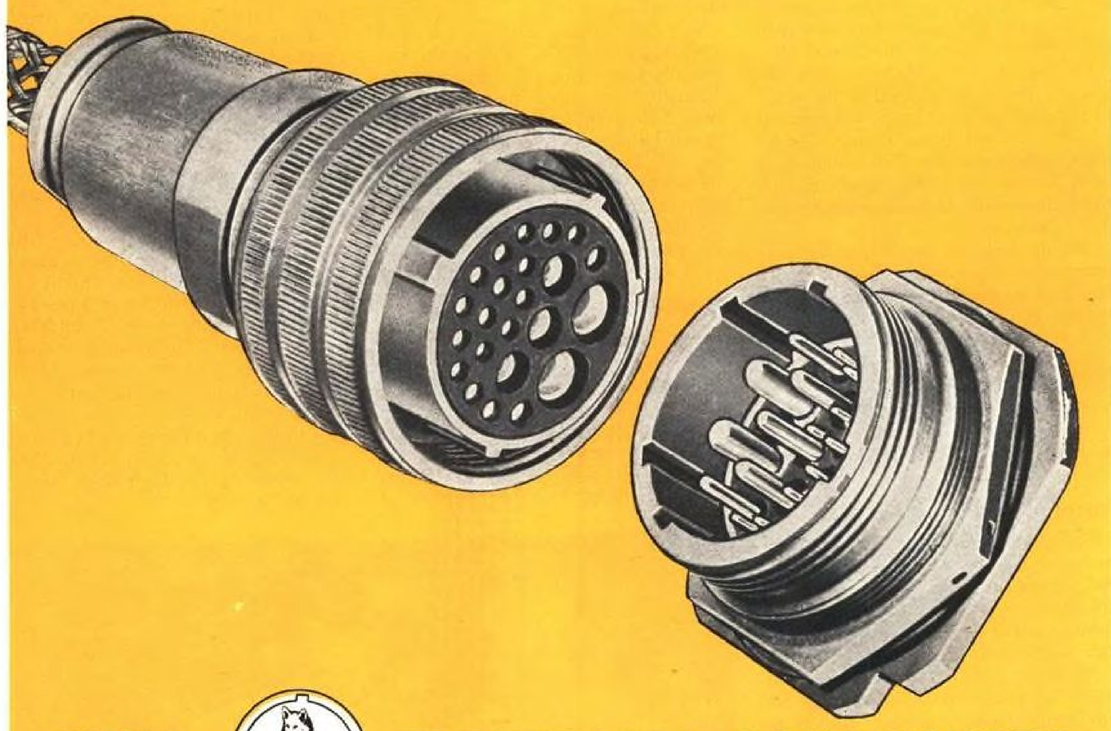
Further refinements are incorporated in the 720 as a result of the reliability program Boeing conducted on all its jet transports in service. The rearrangement of accessory drives, easing of inspection methods and the elimination of trouble spots which arose as aircraft utilization increased are among the benefits 720 customers will find. Data on 720 utilization are not available in sufficient quantity to form any valuable trend this early in the transport's service, but judging from 707 statistics, it should be high. Boeing now says that daily utilization on all aircraft in service averages 8.5 hr., with Continental Airlines achieving the high fleet time of 11.5 hr. per day.



Titanium Blanking Dies Save Time

Steel-rule dies, introduced this year at Chance Vought Aircraft, Inc., for blanking and piercing Crusader fighter parts of titanium, steel and aluminum, are credited with providing man-hour savings totaling more than $50,000. On an average titanium part, a saving of 20.47 man-minutes per part is being realized. The punch is flat steel-rule stock, shaped to the form of the part to be made and placed in a wooden form for support. Die is tempered steel. Photo shows part (left) formed using steel-rule die supported on the table.

NEW FROM BENDIX



QWLD ELECTRICAL CONNECTORS

FOR MISSILE GROUND SUPPORT EQUIPMENT



WITH SUCH OUTSTANDING ADVANTAGES AS:

FIVE INTEGRAL KEYS AND KEYWAYS that provide for positive polarization and positive mating—even in blind locations. ***No possible contact damage.*** QWLD connectors can be fully mated and unmated by hand.

HEAVY-DUTY CONSTRUCTION through use of extra-heavy machined or forged aluminum shell components, resilient inserts, silver-plated copper alloy contacts, and rugged cable accessories with new superior gasket design.

TWO NEW SERIES AVAILABLE with the QWLD having standard solder or solderless contacts and the QWLG having provisions for grounding one contact to the shell.

PLUS . . . IMPROVED WATERPROOFING • CLOSED ENTRY SOCKET CONTACTS • SELF-EJECTING COUPLING ACTION • DESIGNED TO MEET MILITARY SPECIFICATIONS • WIDEST RANGE OF CABLE ACCESSORIES.

QWLD is the latest development in Scintilla's long line of multiple conductor cable connectors—and is specially designed to meet the rugged environmental conditions of missile launching equipment, ground radar, or power and control circuits—and heavy-duty industrial applications such as are found in oil fields or mining. Be sure to investigate the new QWLD HUS-KEY* Connectors from Scintilla.

*TRADEMARK

Scintilla Division
SIDNEY, NEW YORK

THE Bendix CORPORATION

Inertia Platform To Test Flight Motions

Los Angeles—An inertia-measuring platform will be constructed for Air Research and Development Command's Wright Air Development Division at Edwards AFB, Calif., for testing controlled yaw, pitch and roll motions on full-sized flying vehicles weighing up to 300,000 lb. U.S. Steel's Consolidated Western Division will design, fabricate and erect the cruciform test platform. Construction will begin this month and work is to be completed by December.

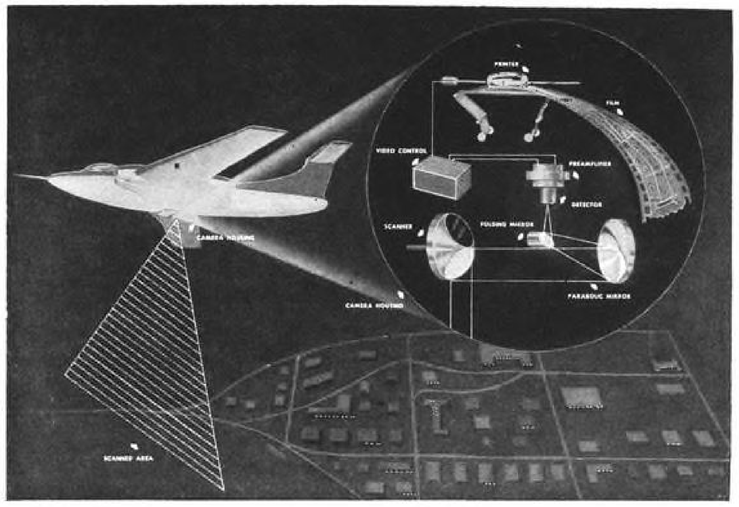
Force measurements from the tests will be fed through computers and resulting data will be used in determining the inertia of the plane or missile and the location of its center of gravity for studying flight characteristics and solving control problems.

The cross-shaped platform will be supported on a hydrostatic bearing set within a 16-ft.-deep pit which will be excavated inside a hangar with its top at hangar floor level. Structure's moving or oscillating section will be 110 ft. long by 80 ft. wide and will weigh approximately 600,000 lb. Aircraft or missiles being tested will be jacked in place on the platform and will be oscillated on four segments of a large spherical hydrostatic bearing.

The platform will be subassembled at the company's Maywood, Calif., facility with field installation to be done under simulated live loads, using optical measuring techniques to ensure that the completed product will be a precise measuring instrument. Preliminary concept for the system was established by Cornell Aeronautical Laboratory, Inc., under study contracts with WADD. Cornell is also developing the measuring and actuating instrumentation.

Joint Recruitment Program Set for Los Angeles Area

A cooperative recruitment program to match the requirements of some 80 employer companies with the available talents of engineers and scientists in the Los Angeles area will be conducted by Careers, Inc., August 23-26. Reception and interview center will be established in the Shrine Auditorium during the Western Electronics Show and Convention. Similar Career, Inc., operation was held in New York last March and resulted in more than 10,000 interviews between prospective employers and scientists and engineers. Organizations reported to be participating are: Curtiss-Wright, Martin-Orlando, Thiokol (Utah), Collins Radio, Ampex, Burroughs, National Aeronautics and Space Administration, Jet Propulsion Laboratory and Minneapolis-Honeywell.



Infrared System that gives Outstanding Thermal Mapping Results

a major advance in infrared by HRB-SINGER

HRB is now permitted to discuss, outside military circles, some of the company's achievements in the field of infrared reconnaissance.

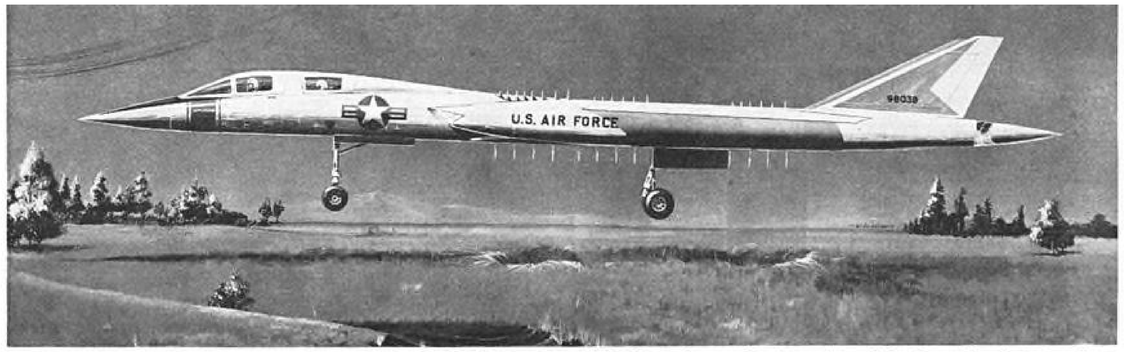
Pictured above is a schematic of the RECONOFAX® infrared system at work. Outstanding results from this system include the recently released "Manhattan Island" in which detail is accurate enough to reveal undeveloped areas in Central Park, and residential, commercial and industrial areas throughout New York City.

Data may also be collected and relayed to earth for instant viewing—a technique which will prove useful in the area of combat surveillance. Hundreds of targets can now be closely scrutinized back at field headquarters without fear of losing the observation aircraft's recorded information.

Write HRB-SINGER, INC., Dept. I, for a complete series of data sheets on HRB's RECONOFAX® systems.

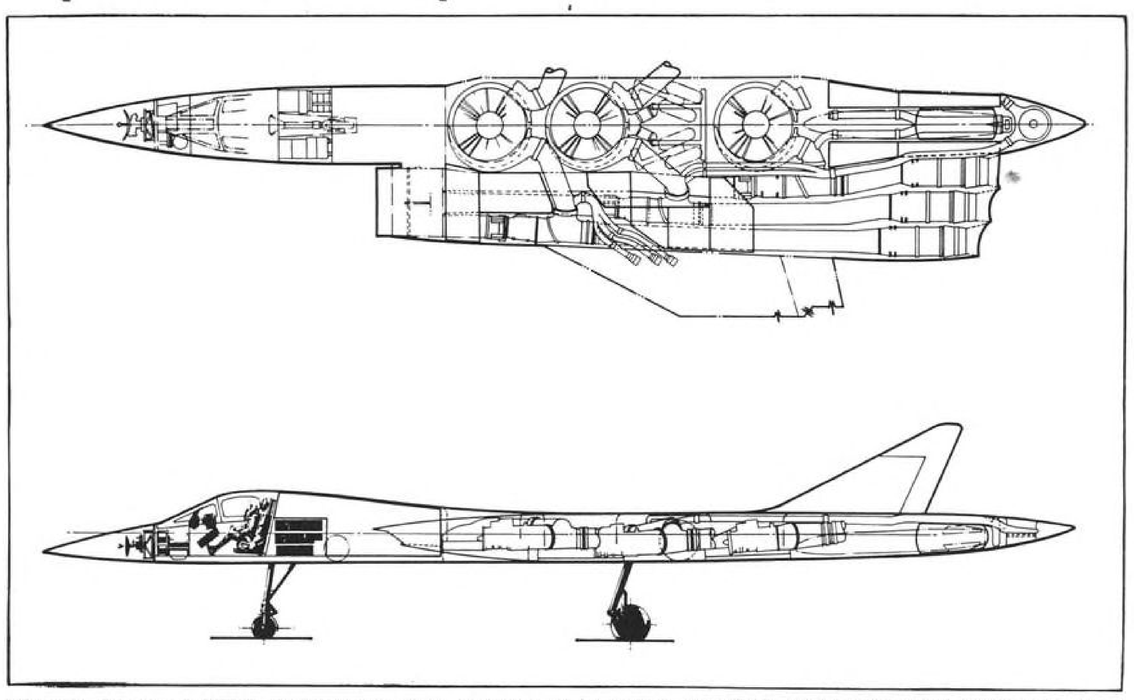
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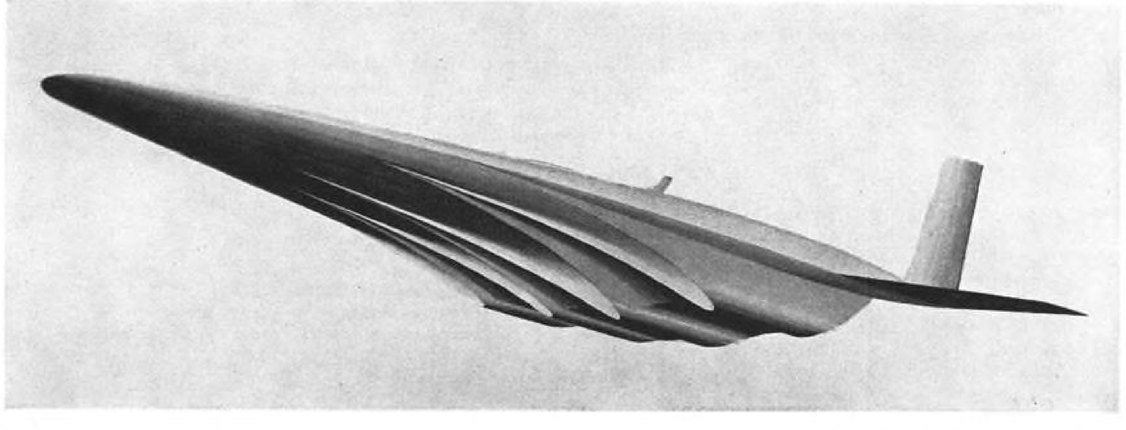


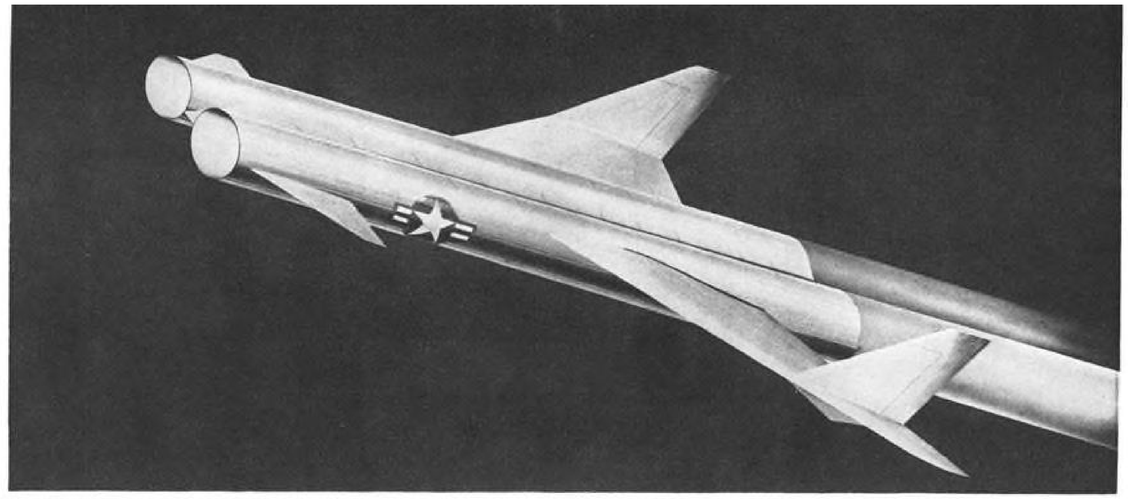
Vertical takeoff manned fighter-bomber, designated AP-100, capable of 1,500 mph. speeds, is envisioned by Republic Aviation Co.

Republic Studies Supersonic VTOLs, Bombers

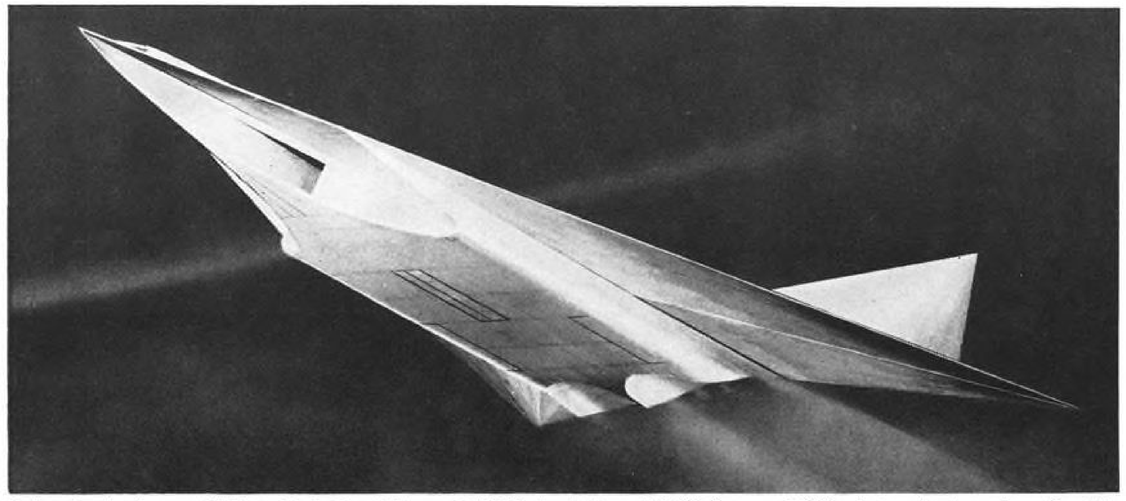


Schematic drawing of VTOL fighter-bomber shows placement of jet engines; after liftoff, special valves would divert engine thrust backward for level flight regimes. Republic says supersonic plane could operate at 75,000 ft. Below is another Republic concept, a 15,700-mph. vehicle which could reach 200,000 ft. carrying a small fighter piggyback. It would be powered by eight engines, four of which would be J58 types burning hydrogen, according to Alexander Kartveli, Republic vice president-research and development.

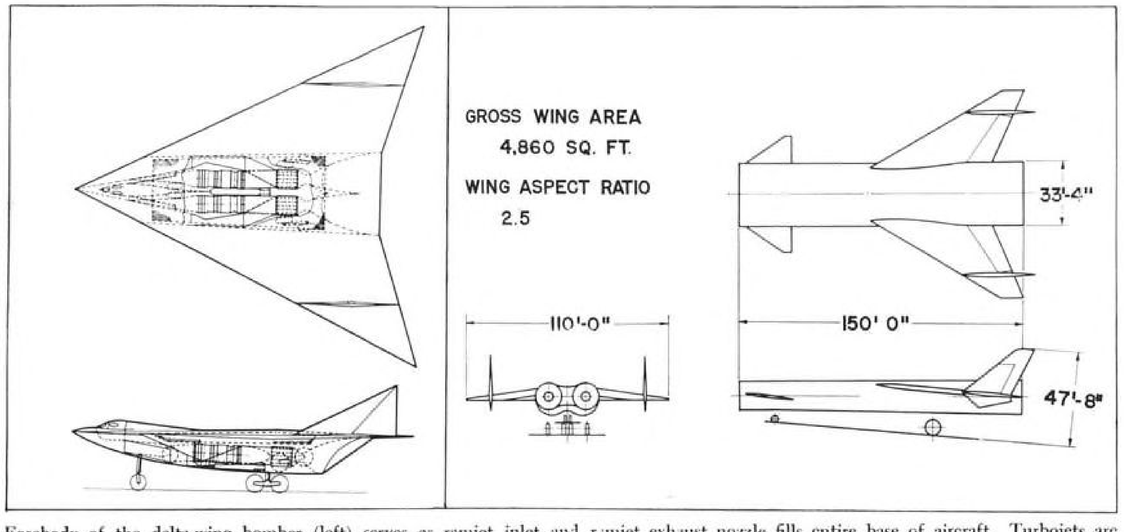




Republic's nuclear ramjet-powered bomber would have 2,800 mph. speed, 8,500 mi. range and could fly by 1970-75.



Delta wing bomber would fly at Mach 7 to deliver a 2,000 lb. bomb from 120,000 ft., some 5,000 mi. from its home base, Republic says. Powerplants would be two ramjet and two turbojet engines; company envisions a wide capability for stratospheric reconnaissance.



Forebody of the delta-wing bomber (left) serves as ramjet inlet and ramjet exhaust nozzle fills entire base of aircraft. Turbojets are shut down at Mach 3. At right is three-view of the nuclear bomber; two ramjets are based on General Electric AC-210-1 nuclear engine.



LOW-SHOCK TRACKED MOBILITY FOR SENSITIVE ELECTRONIC EQUIPMENT

The tactical advantages of full off-road *tracked* mobility in military support vehicles have been well proved in many years of field operation. But the idea of transporting intricate radar and communications equipment and fully-assembled missiles over rugged terrain raises the question, "What about vibration and shock input to sensitive components?"

The answer – favorable. Carrying a simulated missile and sensitive oscillograph recording equipment, an FMC tracked vehicle ran a 2,000-mile shock test over our proving ground – on 60° slopes, over rough cross country terrain, and on high speed roads. Data returns showed that the vehicle's torsion suspension system effectively cradled the missile, with a low shock input factor.

For full details on these tests and other questions of adapting tracked mobility for your purposes, contact FMC, America's leading producer of military-standardized tracked vehicles.

For further information, write, wire or phone Preliminary Design Engineering Dept., FMC Ordnance Division, P.O. Box 367, San Jose, California. Phone: CYpress 4-8124.

Putting Ideas to Work

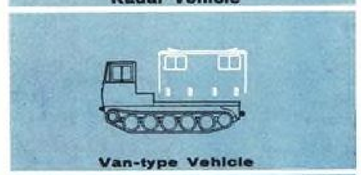
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Ordnance Division
1105 COLEMAN AVENUE, SAN JOSE, CALIF.

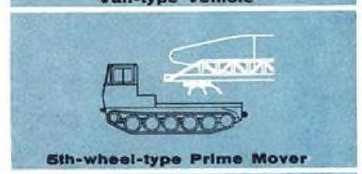
fmc

Illustrated below are the M-113 and five vehicle adaptations of this basic tracked vehicle. All of the vehicles use the same military standard equipment, including engines, power train, and suspension components; thus reducing the military logistic burden and R&D costs in weapons systems.













FMC's Aluminum Alloy Welding Techniques Open New Horizons for Structural Applications



Machine welding heavy aluminum armor plate in FMC's Ordnance Division's shops.

Food Machinery and Chemical Corporation's recently developed welding techniques make economical heavy aluminum weldments possible. High strength, low weight, gas and liquid tight construction are a few of the characteristics available through modern welded aluminum fabrication. These techniques are ideally suited to the construction of vehicles – landing craft, barges, containers – on an economically sound basis.

FMC's aluminum welding capabilities are the result of extensive research and development work performed in cooperation with military agencies to develop reliable, economical welding techniques for the production of the aluminum M113 Armored Personnel Carrier. Thousands of pounds of various aluminum alloys were formed, welded, machined and tested to select the best alloys and fabrication methods. Over a score of prototype M113's were then constructed and subsequently tested by military agencies to substantiate the vehicle's design and construction.

The economy realized through FMC's development of welding and fabrication techniques is an important factor... making the cost of the aluminum M113 competitive with the M59, its steel predecessor. Welding costs for this all aluminum vehicle were reduced through the use of –

Optimum joint geometry
Maximum use of welding fixtures
Maximum use of automatic plate preparation equipment
Maximum use of machine welding equipment
Maximum use of extruded shapes

These modern methods and facilities may provide the answer to your problems in procuring high performance equipment.

The new aluminum welding techniques developed for the M113 program and vehicle production, illustrates FMC's fully integrated capabilities and facilities.

Got Critical Applications?

Check These Advantages of

A-L Vacuum Melted Steels and Alloys

✓ Greater cleanliness

✓ Improved soundness

✓ Decreased gas content

✓ Enhanced mechanical properties

✓ Superior hot and cold workability

✓ Greater homogeneity (Less anisotropy)

✓Better quality in the finished part, properties to withstand severe manufacturing processes, fewer rejections—these are some of the cost savings of vacuum melted materials from Allegheny Ludlum.

A-L vacuum melted steels and alloys are specified for really critical applications—places where their improved metallurgical and mechanical properties get a chance to go to work. Aircraft and missile designers find vacuum melted alloys especially useful in solid fuel rockets, and in the missile and jet engine fields. Other important uses are critical parts for machinery and chemical processing equipment.

Low alloy steels, bearing steels, stainless steels, and high temperature alloys all take on new value when vacuum melted at Allegheny Ludlum. These steels and alloys are available in all commercial mill forms—plates, sheets, strip, billet, bar, wire, tubes, and even extrusions.

Three different vacuum melting processes are used at A-L to provide you with the exact properties you need at the lowest possible cost. For more information on A-L's vacuum melting processes and their advantages, write for your copy of the new booklet, "Modern Melting at Allegheny Ludlum." It contains technical data on new melting techniques and the quality improvement in alloys. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. AW-8.*

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FINANCIAL

Some Profits Reverse Downtrend

Signs that the generally downward trend of earnings in the aerospace industry may be slackening are carried in first half results of Boeing Airplane Co. and Grumman Aircraft Engineering Corp.

Though Grumman and Boeing showed improvement, this has not become an industry-wide pattern. United Aircraft Corp. reported first half earnings well below last year's.

No technological or product pattern influenced the first half results, except that improved earnings generally reflect the final phases of write-offs and write-downs for commercial projects.

Martin Co., for example, continued to show sales and earning improvement from its predominantly missile programs (AW Aug. 8, p. 117), but Thiokol Chemical Corp., which has ridden the crest of the rapidly growing solid propellant rocket wave, reported a 39% decline in net earnings for the period.

Major reason for the Thiokol decline is that sales from Thiokol Chemical to Thiokol rocket operations are down because of the type of propellant in the Minuteman first stage Thiokol is developing. This stage uses a polybutadiene acrylic acid polymer that Thiokol Chemical doesn't make—unlike materials used for other Thiokol projects—and Thiokol must buy this from other vendors. Stocks have reflected the more optimistic outlook for defense companies. Boeing's stock has risen approximately $8 a share in the last month. Other major aerospace companies have had stock prices rises of various degrees.

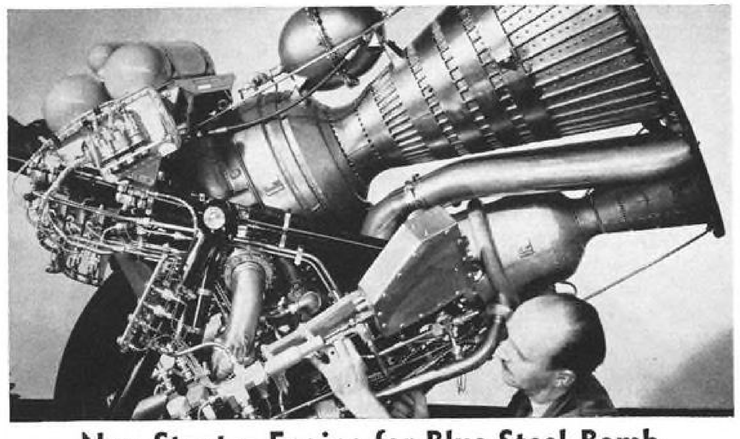
The company results:

• **Boeing**—Sales of $817,463,295 and earnings of $10,260,056 or $1.29 a share compared with sales of $681,432,522 and earnings of $3,778,984 or 48 cents a share for the same period a year ago. Book profits were recorded for the first time on the commercial jet program, though these were more than offset by research and development, administrative and other general expenses which are written off as incurred. Sales this year are expected to reach $1.6 billion and the commercial programs may make an over-all contribution to earnings.

• **Grumman**—Sales totaled $154,071,814 and earnings $4,125,365 or $1.88 a share compared with first half 1959 figures of $131,463,446; $1,841,601 and 84 cents a share respectively. Backlog stood at $315 million as against $342 million a year ago.

• **Thiokol**—Net sales were $83,361,675 and net profits were $1,736,648 or 38 cents a share compared with sales of $80,735,952, earnings of $2,868,568 or 64 cents a share for same 1959 period.

• **United Aircraft Corp.**—Sales of $543,227,294 for the first half of 1960 closely approximated the $545,512,546 total for the same period last year, but earnings fell from $15,758,616 or $2.35 a share last year to $10,040,759 or $1.46 a share this year. Company sponsored research and development spending rose from $12 million for the first six months of 1959 to $21 million this year and this resulted in a $4.5 million after-tax reduction in earnings. Such expenditures will total $40 million for the year.



New Stentor Engine for Blue Steel Bomb

Avro Blue Steel stand-off bomb (AW June 6, p. 109) will be powered by this Bristol-Siddeley Stentor A.S.S.T-1-1 rocket motor which burns kerosene with hydrogen peroxide in two high pressure combustion chambers. Engine is a development of the Gamma motor.

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Aerospace Officers List Salaries, Stocks

Washington—Following is a list of aerospace officers' and directors' salaries and stock holdings for 1959, as reported to the Securities and Exchange Commission:

Piasecki Aircraft Corp.—No officers or directors received more than $30,000 for the year 1959.

F. N. Piasecki, president and director, 195,332 shares of common stock; **D. N. Meyers**, vice president and director, 43,207 shares of common stock; **R. Deetjen**, director, 1,404 shares of common stock; **G. J. Higgins**, 450 shares of common stock; **E. Deland**, director, 34,888 shares of common stock; **J. J. Davis**, director, 575 shares of common stock.

Piper Aircraft Corp.—**W. T. Piper**, chairman of the board, president and director, $41,362.12 salary and 133,144 shares of common stock*; **W. T. Piper, Jr.**, executive vice president and director, salary not listed and 21,678 shares of common stock*; **T. F. Piper**, vice president-operations and director, salary not listed, and 21,534 shares of common stock * and †; **H. Piper**, vice president-research and development and director, salary not listed and 23,333 shares of common stock * and †; **W. C. Jamouneau**, secretary, chief engineer and director, 315 shares of common stock; **C. W. Pool**, treasurer and director, 577 shares of common stock.

Following directors were not paid a salary: **N. J. Greene**, 5750 shares of common stock; **R. K. Griffin**, 586 shares of common stock; **E. N. Hunting**, 1,102 shares of common stock†.

* W. T. Piper also holds 147,000 shares of common stock as trustee under a voting trust agreement which includes 18,900 shares beneficially owned by each son, H. Piper, T. F. Piper and W. T. Piper, Jr. (each son's holding in the trust is shown in the above stock listings), 14,070 common shares beneficially owned by minor children of H. Piper and 10,710 common shares owned beneficially by minor children of T. F. Piper. In addition, Mrs. W. T. Piper owns 6,958 common shares, Mrs. H. Piper owns 1,870 common shares, Mrs. W. T. Piper, Jr., owns 652 common shares, minor children of H. Piper own 1,446 common shares and minor children of T. F. Piper own 964 common shares.

†Includes shares of common stock jointly held with wife.

Republic Aviation Corp.—**M. I. Peale**, president and director, $141,066 salary and 1,939 shares of common stock; **H. S. Jones**, executive vice president, $94,355 salary and stock not listed; **A. Kartveli**, vice president-research and development and director, $83,724 salary and 2,928 shares of common stock.

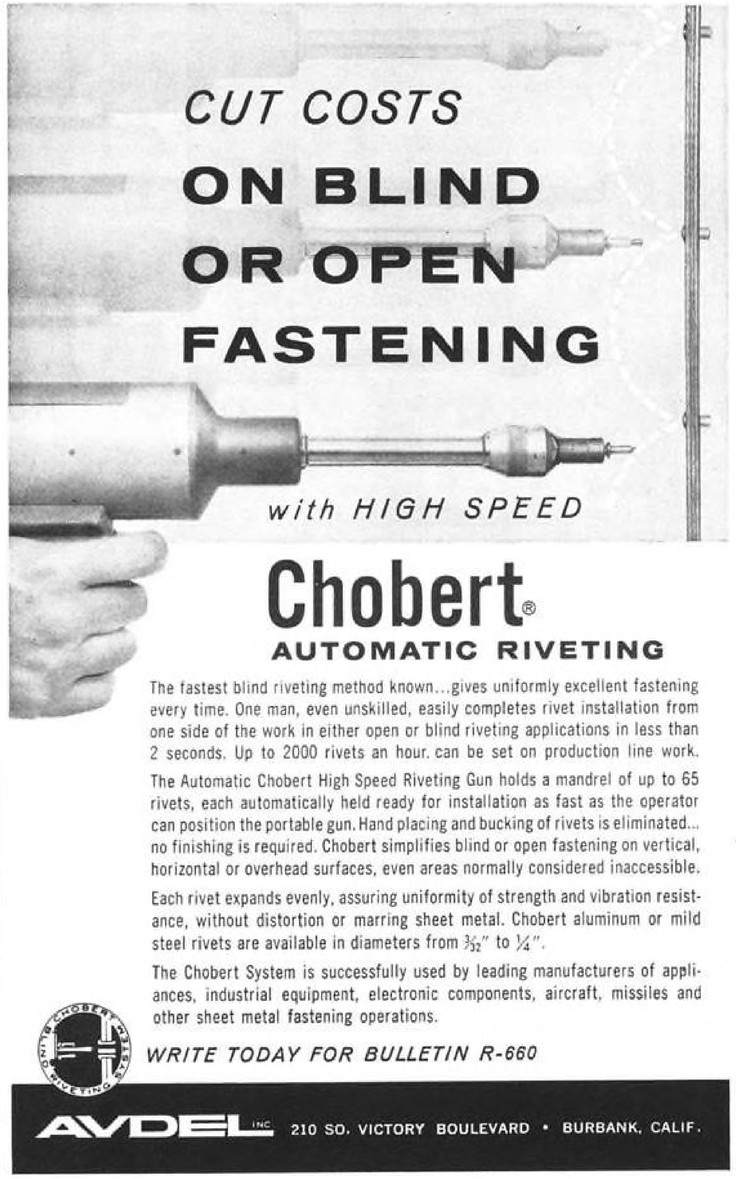
Following directors were not paid a salary: **R. L. Clarkson**, 146 shares of common stock; **F. C. Coburn**, 300 shares of common stock; **W. H. Moore**, 605 shares of common stock; **L. Platt**, 292 shares of common stock; **H. N. Taylor**, 200 shares of common stock; **W. V. Platt**, 100 shares of common stock; **R. C. Taylor**, 511 shares of common stock.

Radio Corporation of America—**J. L. Burns**, president Radio Corp. of America and director RCA, National Broadcasting Co. and RCA Communications Co., $172,917 salary and fee and 20,992 shares of common stock; **J. T. Cahill**, director, RCA, NBC and RCA Communications, (firm of **Cahill, Gordon, Reindell & Ohl** received $425,000 for legal services rendered during 1959), 3,550 salary and fee, 510 shares of common stock and $3,500 in 3½% convertible subordinated debentures.

E. W. Engstrom, senior executive vice president RCA, director RCA, NBC and RCA Communications, $132,917 salary and fee, 3,385 shares of common stock and $4,300 in convertible subordinated debentures; **F. M. Folsum**, chairman of the executive committee of the board of directors and director of RCA Communications, $83,333 salary and fee 10,426 shares of common stock; **H. C. Hagerty** chairman of the finance, incentive and stock option committees and director RCA and NBC, $16,850 salary and fee, and 102 shares of common stock; **J. H. Hammond, Jr.**, director RCA (**Hammond Research Corp.** received $60,000 for service rendered during 1959), $800 salary and fee, 100 shares of preferred stock; **Mrs. D. Horton**, consultant to RCA and subsidiaries and director RCA and NBC, $6,350 salary and fee and 408 shares of common stock.

H. C. Ingles, consultant to RCA Communications and director RCA, NBC and RCA Communications, $13,250 salary and fee and 102 shares of common stock; **C. B. Jolliffe**, vice president and technical director of RCA and director RCA Communications, $68,458 salary and fee and 1,652 shares of common stock; **P. M. Mazur**, chairman of the salaries committee and director RCA and NBC, $2,650 salary and fee and 714 shares of common stock; **E. F. McGrady**, consultant to RCA and director RCA, NBC and RCA Communications, $14,911 salary and fee, no stock listed.

A. Meyer, chairman of the contributions committee and director RCA and NBC, $1,200 salary and fee and 10,200 shares of common stock; **C. M. Odorizzi**, group executive vice president RCA, chairman of the board of RCA Institutes and director RCA, RCA communications and RCA Victor Distributing, $122,917 salary and fee and 10,892 shares of common stock; **D.**



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Sarnoff, chairman of the board RCA and RCA communications and director NBC, $200,000 salary and fee and 25,100 shares of common stock; **R. W. Sarnoff**, chairman NBC and director RCA, $150,000 salary and fee and 10,280 shares of common stock; **W. B. Smith**, chairman of the retirement benefits committee and director RCA and NBC, $15,750 salary and fee and 102 shares of common stock; **L. L. Strauss**, director RCA, no salary or fee, 500 shares of common stock.

Raytheon Co.—**C. F. Adams**, president and director, $131,400, salary and 32,135 shares of common stock; **R. E. Krafve**, executive vice president and director, $50,192 salary and 1,000 shares of common stock; **P. L. Spencer**, senior vice president and director, $77,900 salary and 7,798 shares of common stock; **D. D. Coffin**, group vice president, $58,667 salary, no stock listed.

Following directors were not paid a salary: **R. C. Damon**, 100 shares of common stock; **D. S. Edmonds**, co-trustee of a trust which owns 9,080 shares of preferred stock and 54,115 units of interim certificates; **W. Gammell, Jr.**, 9,928 shares of common stock.

C. J. Gilbert, 500 shares of common stock; **G. L. Langreth**, 348 shares of common stock; **S. P. Lovell**, 625 shares of common stock; **R. W. Stoddard**, 220 shares of common stock.

Philco Corp.—**H. F. Argento**, vice president, $45,000 salary, stock not listed; **H. E. Bowes**, vice president, $48,000 salary, stock not listed; **H. W. Butler**, vice president and director, $30,000 salary and 9,193 shares of common stock; **J. H. Gillies**, vice president and director, $45,000 salary and 6,202 shares of common stock; **L. F. Hardy**, vice president and director, $45,000 salary and 6,322 shares of common stock; **R. F. Herr**, vice president and director, $30,000 salary and 24,953 shares of common stock; **J. M. Skinner**, president and director, $75,000 salary and 10,360 shares of common stock; **W. R. Wilson**, vice president-finance, treasurer and director, $45,000 salary and 15,000 shares of common stock; **L. J. Woods**, vice president and director, $45,000 salary and 6,377 shares of common stock.

Following directors were not paid a salary: **R. C. Bond**, 106 shares of common stock; **W. L. Day**, 190 shares of common stock; **G. P. Harnwell**, 714 shares of common stock; **W. F. Kurtz**, 831 shares of common stock; **Adm. A. W. Radford**, (USN ret.) 155 shares of common stock.

Ryan Aeronautical Co.—**T. C. Ryan**, president and director, $68,333.32 salary and 111,107 shares of common stock*; **R. C. Jackson**, executive vice president and director, $36,758.95 salary and no stock*; **G. C. Woodward**, vice president and director, $54,166.66 salary and 1,610 shares of common stock; **C. A. Stillwagen**, vice president-finance, treasurer and controller, $44,100 salary, stock not listed; **C. A. Smith**, director, no salary and 3,600 shares of common stock; **A. J. Hair**, director, no salary and 241 shares of common stock*.

*T. C. Ryan is a director of Emtor, Inc., a holding company, and owns 400 shares in that concern. R. C. Jackson is a vice president and director of Emtor, owns 4,000 shares of that concern and is sole owner of Jackson Investment Co. which owns 1,272 shares of Ryan Aeronautical. A. J. Hair owns 2,500 shares of Emtor. Emtor, Inc., owns 329,100 shares of Ryan Aeronautical Co.

Sperry Rand Corp.—**N. B. Frost**, General counsel and director, $35,000 salary and 7,507 shares of common stock; **K. R. Herman**, executive vice president, president-Remington Rand Division and director, $124,060 salary and 27,300 shares of common stock; **C. G. Holschuh**, executive vice president and director, $111,620 salary and 8,706 shares of common stock.

H. Landsiedel, vice president-Remington Rand Division and director, $76,320 salary and 8,000 shares of common stock; **Gen. D. MacArthur**, (USA ret.), chairman of the board and director, $68,600 salary and 1,760 shares of common stock; **J. Sanderson**, executive vice president, $34,320 salary, stock not listed; **H. F. Vickers**, president, chief executive officer and director, $229,140 salary, 154,216 shares of common stock and 2,500 shares of common stock in reversionary trust; **D. L. Bibby**, executive vice president-Remington Rand Division and director, salary not listed, no stock; **I. J. Harvey, Jr.**, director, no salary, 2,000 shares of common stock; **B. F. Pope**, director, no salary, 276 shares of common stock.

Thiokol Chemical Corp.—**J. W. Crosby**, president and director, $70,000 salary and 26,316 shares of common stock; **H. R. Ferguson**, executive vice president and director, $51,500 salary and 29,436 shares of common stock; **J. S. Jorczak**, vice president and director, $32,000 salary and 6,324 shares of common stock; **S. M. Martin, Jr.**, vice president and director, $38,000 salary and 28,801 shares of common stock; **H. W. Ritchey**, vice president and director, $45,000 salary and 6,977 shares of common stock.

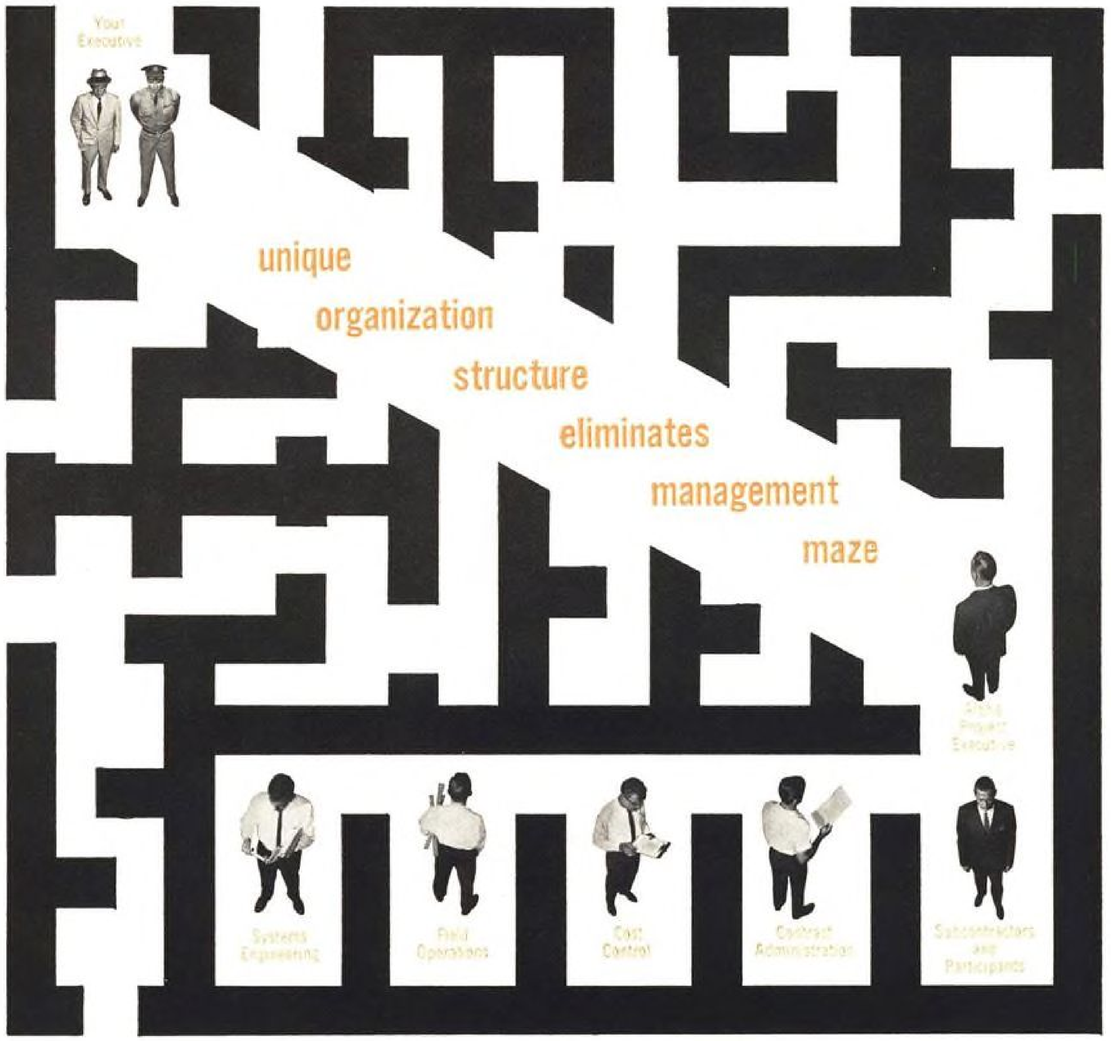
Following directors were not paid a salary: **J. E. Hughes**, 102 shares of common stock; **R. Lang**, 336,912 shares of common stock; **C. S. Lutkins**, 2,250 shares of common stock; **C. S. Proctor**, 2,690 shares of common stock; **O. L. Schweng**, no stock; **D. N. Sosland**, 128,808 shares of common stock owned in three partnerships; **W. M. Spencer**, 3,088 shares of common stock; **C. B. Vose**, 42,947 shares of common stock; **T. F. Walkowicz**, no stock.

United Aircraft Corp.—**W. P. Gwinn** president and director, $155,900.08 salary and 3,133 shares of common stock; **H. M. Horner**, chairman of the board and director, $191,360 salary and 10,180 shares of common stock; **E. Martin**, vice president and director, $102,020 salary and 1,000 shares of common stock; **W. A. Parkins**, vice president-engineering, general manager-Missiles & Space Division and director, $121,020 salary and 2,032 shares of common stock; **W. R. Robbins**, vice president, controller and director, $110,920 salary and 5,000 shares of common stock.

Following directors were not paid a salary: **H. S. Beers**, 200 shares of common stock; **J. D. DeWitt**, 120 shares of common stock; **O. Enders**, 589 shares of common stock; **P. M. Fraser**, 500 shares of common stock; **L. S. Hobbs**, 400 shares of common stock; **G. S. Moore**, 400 shares of common stock; **J. P. Ripley**, 4,200 shares of common stock; **H. G. Stoddard**, 1,644 shares of common stock.

Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Resultant Holdings for the period May 11 to June 10, 1960, reported the following transactions by nine executives of Collins Radio Co.: disposition of 2,900 common shares by Lester E. Bessemer, officer and director, leaving a holding of 2,989 (indirect holding in trust remains 352); disposition of 3,120 common shares by Max W. Burrell, officer and director, leaving a holding of 3,176; disposition as trustee of 200 common shares by Arthur A. Collins, officer, director and beneficial owner, leaving a holding of 82,423 (direct holdings remain 131,288 and other indirect holdings remain 276,996); disposition of 2,042 common shares by Robert T. Cox, officer and director, and acquisition of 2,000 common shares through exercise of option, leaving a holding of 2,000; disposition of 200 common shares by H. V. Gaskill, officer, and acquisition of 435 common shares through exercise of option, leaving a holding of 1,368; disposition of 500 common shares by Frederick F. Robinson, director, leaving a holding



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of 500; disposition of 260 common shares by L. M. Schoon, officer, leaving a holding of 260; acquisition of 100 common shares through exercise of option by Sveinn J. Storm, officer, and disposition of 100 common shares, leaving a holding of 1,442; acquisition of 520 common shares through exercise of option by John B. Tuthill, officer, and disposition of 500 common shares, leaving a holding of 540; acquisition of $25,000 of 4¼% convertible debentures by Frederick F. Robinson, director, making a holding of $25,000.

Other transactions for the period May 11 to June 10 include:

American Bosch Arma. Disposition of 650 common shares, his total holding, by Raymond C. Farrell, officer; disposition of 1,340 common shares, his total holding, by Sidney E. Miller, officer; disposition of 400 common shares by Harold R. Sennstrom, officer, leaving a holding of 5.

Ampex Corp. Acquisition of 5,250 common shares through exercise of option by Robert Sackman, officer, making a holding of 6,660.

Belock Instrument Corp. Disposition of 500 common shares by Harry D. Belock, officer and director, leaving a holding of 232,946; acquisition of 4,502 common shares through exercise of rights by Stanley R. Grant, director, making a direct holding of 5,593 and an indirect holding in trust of 2,250; disposition of 400 common shares by Donld C. Walton, officer and director, leaving a holding of 19,171 (indirect holding remains 1,743).

Capital Airlines, Inc. Disposition of 200 common shares, his total holding, by William V. Couchman, director; disposition of 1,000 common shares by Hayes Dever, officer, leaving a holding of 900.

Cessna Aircraft Co. Disposition of 8,000 common shares by Delbert L. Roskam, officer and director, leaving a holding of 19,117.

Continental Air Lines. Disposition of 1,500 common shares by Lawrence C. Ames, director, leaving a holding of 10,500; disposition of 3,800 common shares by Louis H. Mueller, director, leaving a holding of 27,595; acquisition of $10,000 of convertible debentures by Lawrence C. Ames, director, making a holding of $10,000; acquisition of $16,000 of convertible debentures by Louis H. Mueller, director, making a holding of $16,000.

Curtiss-Wright Corp. Acquisition of 200 common shares by Roger W. Mullin, Jr., officer, making a holding of 1,000.

Electronics Specialty. Disposition of 1,500 capital shares by C. Ray Harmon, director, leaving a holding of 6,500.

Fairchild Camera & Instrument Co. Disposition of 100 common shares by F. Eugene Newbold, Jr., director, leaving a holding of 100.

General Dynamics Corp. Disposition of 407 common shares by Frederic de Hoffmann, officer, leaving a holding of 2,023; disposition of 7,530 common shares, his total holding, by Andrew I. McKee, officer; acquisition of 500 common shares by Frank Pace, Jr., director, making a holding of 30,500; disposition of 200 common shares by Kenneth Stiles, officer, leaving a holding of 500; disposition of 1,800 common shares by Vernon M. Welsh, officer, leaving a holding of 5,200.

General Electric Co. Disposition of 2,600 common shares by F. J. Borch, officer, leaving a holding of 10,719; disposition of 2,400 common shares by Ralph J. Cordiner, director, leaving a holding of 12,090; disposition of 1,200 common shares by Robert L. Gibson, officer, leaving a holding of 6,319; disposition of 200 common shares by George F. Metcalf, officer, leaving a holding of 2,937 (indirect holdings remain 242); disposition of 1,000 common shares by Charles K. Rieger, officer, leaving a holding of 4,825; disposition of 1,570 common shares by Willard H. Sahloff, officer, leaving a holding of 5,109.

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MULTI-POLARIZED ANTENNA. A new antenna system, recently developed by Vought Electronics, provides linear, dual linear, right or left circular polarization. No need to change elements to have the polarization mode best suited to a missile or space vehicle. The Pacific Missile Range's first tracking vessel is being equipped with the multi-polarized antenna — one of more than 165 different antenna systems conceived by Chance Vought's Electronics Division.

THERMOMETER FOR PLASMA. Tremendous heat that accompanies the break-up of hydrogen molecules is being accurately measured at Chance Vought Research Center. Scientists are using a spectrograph and a scanning device to determine temperature in any part of the flame inside the Center's plasmatron. Experiments in measuring intense heat are part of the Center's broad studies into energy sources.

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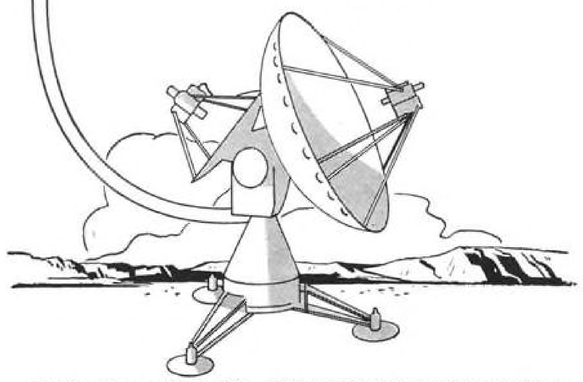
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- weight—2¾ lbs.
- temperature range —55° C. to +85° C.
- accuracy—¼ of 1% of full scale (360°)



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Hercules Powder Co. Disposition of 2,000 common shares by J. J. B. Fulenwider, officer and director, leaving a holding of 4,525; disposition of 100 common shares by John E. Goodman, officer, leaving a holding of 333; acquisition of 100 common shares through exercise of option by Edward C. Hastings, officer, making a holding of 675; disposition of 1,000 common shares, his total holding, by G. F. Hogg, director.

Lockheed Aircraft Corp. Acquisition of 100 capital shares by Harry L. Dunn, director, making a holding of 610; disposition of 646 capital shares, his total holding, by J. R. Janssen, officer; acquisition of 400 capital shares by Vernon A. Johnson, officer, making a holding of 408; disposition of 1,796 capital shares by Burt C. Monesmith, officer, leaving a holding of 35; acquisition of 1,000 capital shares by Leonard E. Root, officer, making a holding of 3,374; disposition of 200 capital shares by Donald M. Wilder, officer, leaving a holding of 128.

Loral Electronic Corp. Disposition of 5,500 common shares by William Lorenz, officer, leaving a holding of 107,000.

The Martin Co. Disposition of 400 common shares by Howard W. Merrill, officer, leaving a holding of 547.

McDonnell Aircraft Corp. Disposition of 3,700 common shares by C. Warren Drake, officer and director, leaving a holding of 14,150 (indirect holding remains 1,892).

Microwave Associates. Disposition of 2,000 common shares by Joseph C. Bothwell, Jr., officer, leaving a holding of 6,020; disposition of 2,000 common shares by Vessarios Chigas, officer and director, leaving a holding of 15,000; disposition of 400 common shares by Lawrence Gould, officer, leaving a holding of 850; disposition of 300 common shares, his total holding, by Julian Z. Millar, director; disposition of 800 common shares by Julian Pathe, officer, leaving a holding of 2,000; disposition of 2,408 common shares by Richard M. Walker, officer, leaving a holding of 37,860.

National Airlines, Inc. Acquisition of 100 common shares by Anne L. Stanley, officer, making a holding of 100.

North American Aviation. Disposition of 700 capital shares by Joseph G. Beerer, officer, leaving a holding of 100; disposition of 100 capital shares by S. K. Hoffman, officer, leaving a holding of 400; acquisition of 100 capital shares by W. H. Yahn, officer, making a holding of 100.

Northrop Corp. Acquisition of 400 common shares through exercise of option by Charles C. Cilley, officer, making a holding of 1,224; acquisition of 100 common shares through exercise of option by Patrick W. Timberlake, officer, making holding 300.

Pan American World Airways. Acquisition of 100 capital shares by Alfred M. Gruenther, director, making a holding of 100; acquisition of 1,000 capital shares by David S. Ingalls, director, making a holding of 4,244; disposition of $2,600 of 4½% convertible debentures, his total holding, by Robert B. Murray, Jr., officer.

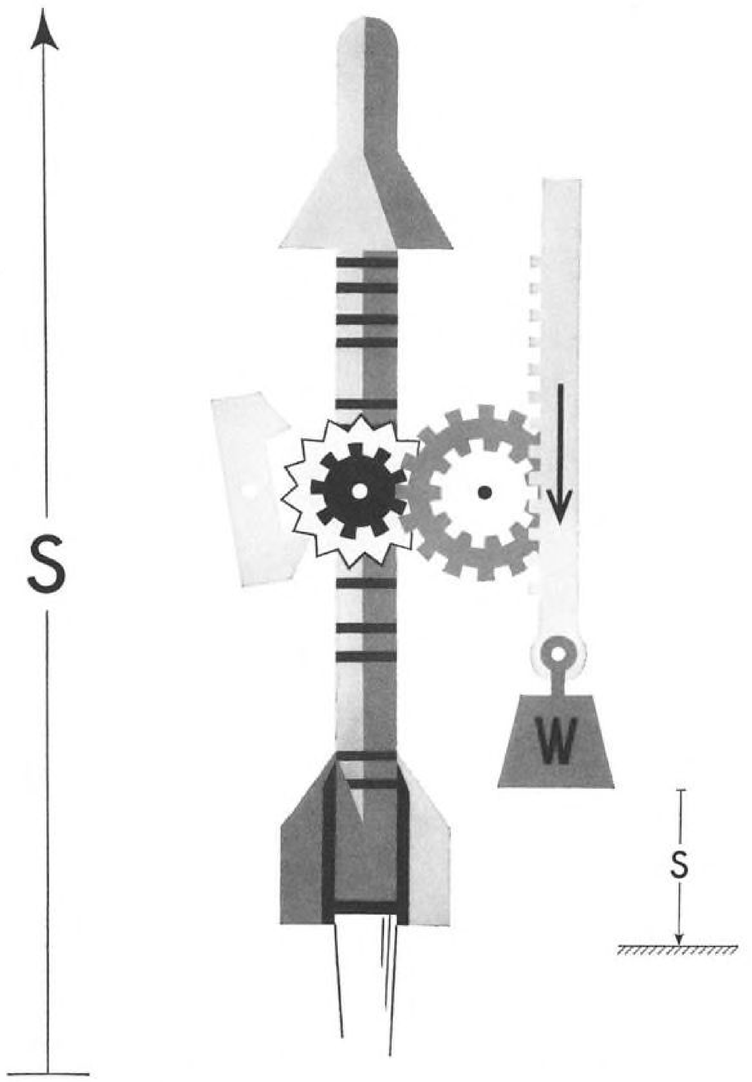
Raytheon Co. Acquisition of 100 common shares by Stuart D. Cowan, officer, making a holding of 100; acquisition of 39,059 common shares in exchange for interim certificates by Dean S. Edmonds, director, making a holding of 38,500.

Seaboard & Western Airlines, Inc. Disposition of 2,800 common shares by Raymond A. Norden, officer and director, leaving a holding of 28,513.

Sundstrand Corp. Disposition of 200 common shares by Bruce F. Olson, officer, leaving a holding of 14,011 (indirect holding remains 6,977); disposition of 300 common shares by L. H. Schuette, officer, leaving a holding of 5,343; disposition of 1,000 common shares by Arthur H. Swenson, officer, leaving a holding of 5,504.

Texas Instruments, Inc. Disposition of 610 common shares by E. O. Vetter, officer, leaving a holding of 6,777.

Thiokol Chemical Corp. Disposition of 10,000 common shares by Robert Lang, director, leaving a holding of 315,912; disposition of 1,200 common shares by S. M. Martin, Jr., officer and director, leaving a holding of 22,901; acquisition of 100 common shares by Carlton S. Proctor, director, making a holding of 2,790; disposition of 600 common shares by Charles B. Vose, director, leaving a holding of 42,347.



Bulova escapement used as an integrating accelerometer

Bulova's unusually creative teams of scientists and engineers play an ever increasing role in the vanguard of precision design and development. Consider the nature of a Bulova escapement; it's generally employed as a second-order integrating accelerometer. However, the basic mechanism lends itself equally well to rotational motion of unbalanced rotors in an accelerating field.

The drawing above shows an inertial element, or weight, coupled to a runaway escapement by a rack. A safe-arm latch locks the system until missile launch. Under acceleration the escapement will delay the weight from moving through its stroke, s, according to the following:

(1.) $$t = \sqrt{\frac{K}{ag}}$$

Where t is the time for the weight, W, to traverse its stroke, s, under an acceleration a, K is the mechanism constant which takes into account the gear ratio; the moment of inertia of the system as reflected at the pallet wheel; and the number of pallet cycles involved during stroke s.

If the acceleration is constant, the change in distance of the missile during t is

$$S = \frac{1}{2} agt^2$$

or

(2.) $$t = \sqrt{\frac{2S}{ag}}$$

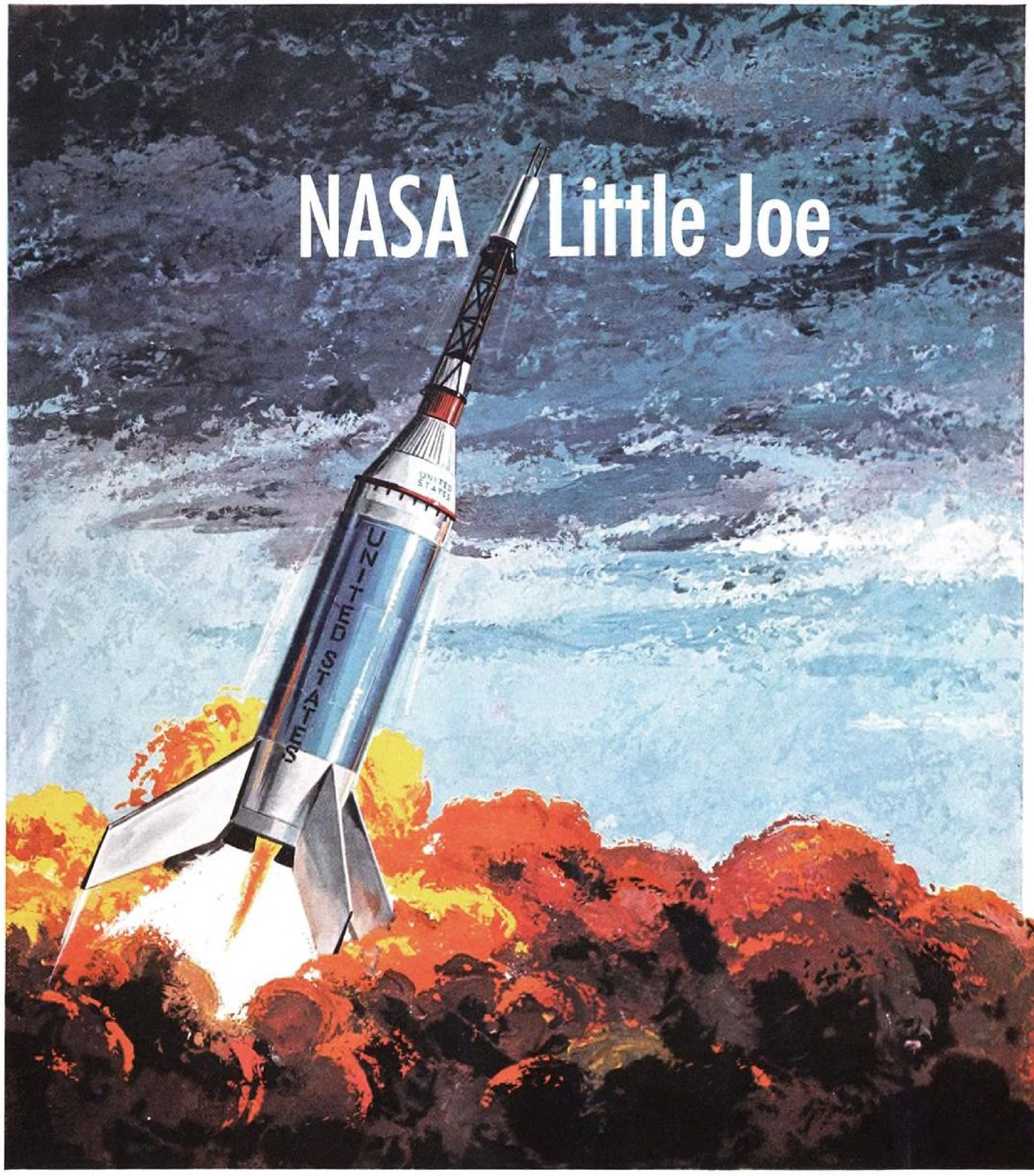
Equating (1) and (2)

$$\sqrt{\frac{2S}{ag}} = \sqrt{\frac{K}{ag}} \qquad S = 2K$$

It is thus evident that, for a given escapement with a given stroke, the distance integrated is constant, and is independent of acceleration.

Bulova developments in the field of time measurement are particularly significant because they advance the state-of-the-art with existing systems and elements . . . with existing components of proven reliability and accuracy. But, continuing study of new concepts keeps Bulova systems years ahead—ready to meet the future needs of both the military and industry.

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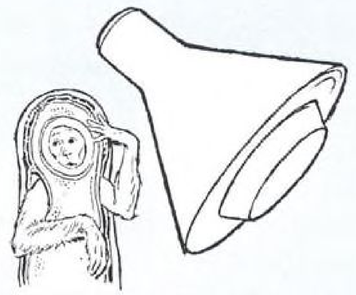
Consistently successful flight performance in Project Mercury confirms unsurpassed reliability of THIOKOL solid rocket motors.

Time after time, NASA's workhorse, Little Joe, has soared into space, checking out the workability of materials, propulsion and escape systems, and reaction of research animals to the environment of space flight.

Pollux, Recruit, Castor—solid rocket motors from THIOKOL's Elkton and Redstone Divisions—have unfailingly provided the thrust and power for Little Joe in its developmental flights.

THIOKOL's record of propulsion reliability in the spatial program is long and brilliant, reaching back to the X-17 which flew successfully in 96% of its launches, and to earlier research vehicles.

In NASA's Little Joe series, THIOKOL booster motors in various configurations have developed up to 250,000 lbs. thrust, today's ICBM class. Smaller THIOKOL rockets have been used to free escape capsule from booster.



Little Joe has carried this research and development capsule and research animals to varying altitudes to obtain engineering and medical data prior to launching man into orbit with subsequent safe recovery. The reliable THIOKOL solid rocket motors used in these missions are virtually off-the-shelf items and are available to other research groups.

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Electronic Solutions

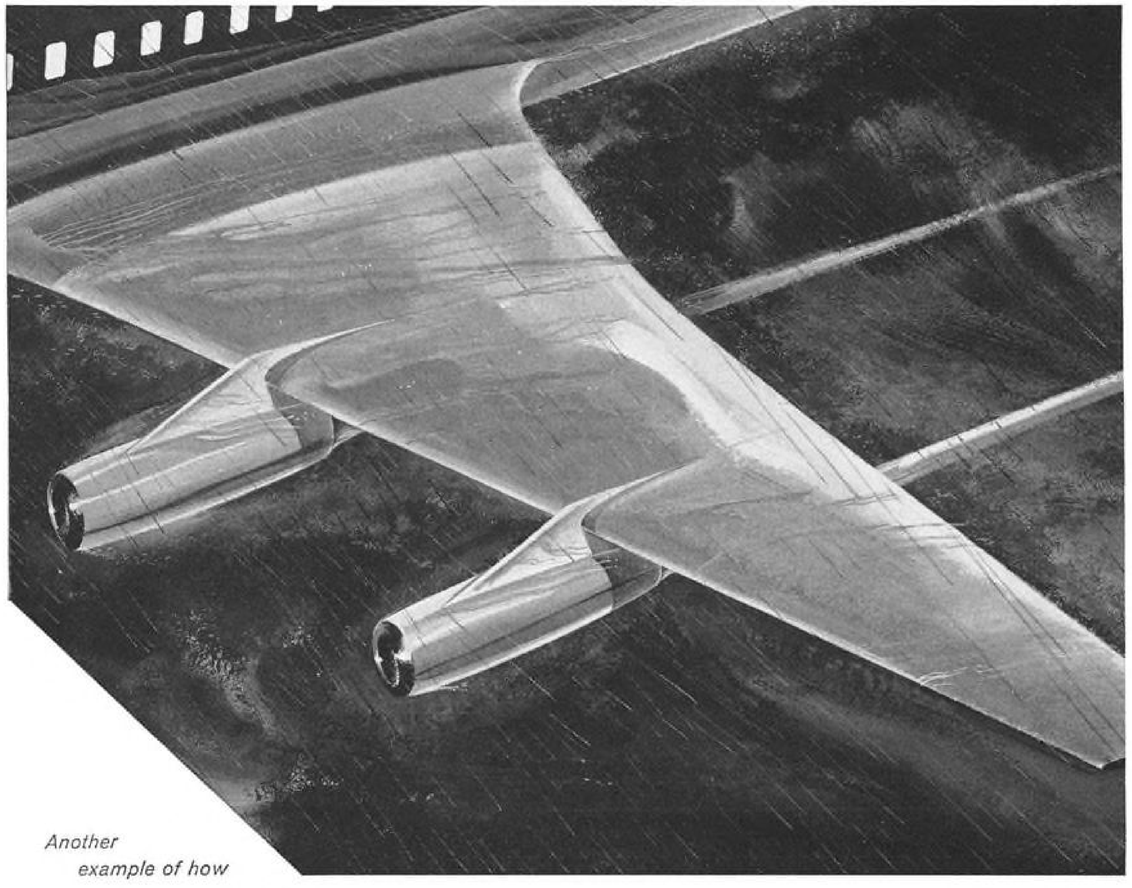
to in-flight temperature problems

Detection and control of temperature and overheat conditions in aircraft and missiles demand highly specialized electronic equipment. Producing such equipment is the business of the Monitor and Controls Division of Fenwal Incorporated.

In this new, integrated facility, Fenwal is currently developing advanced electronic systems for a broad range of applications such as the following:

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A Fenwal System can be designed and built precisely to *your* in-flight temperature requirements. Write Fenwal Incorporated, 128 Pleasant Street, Ashland, Massachusetts.



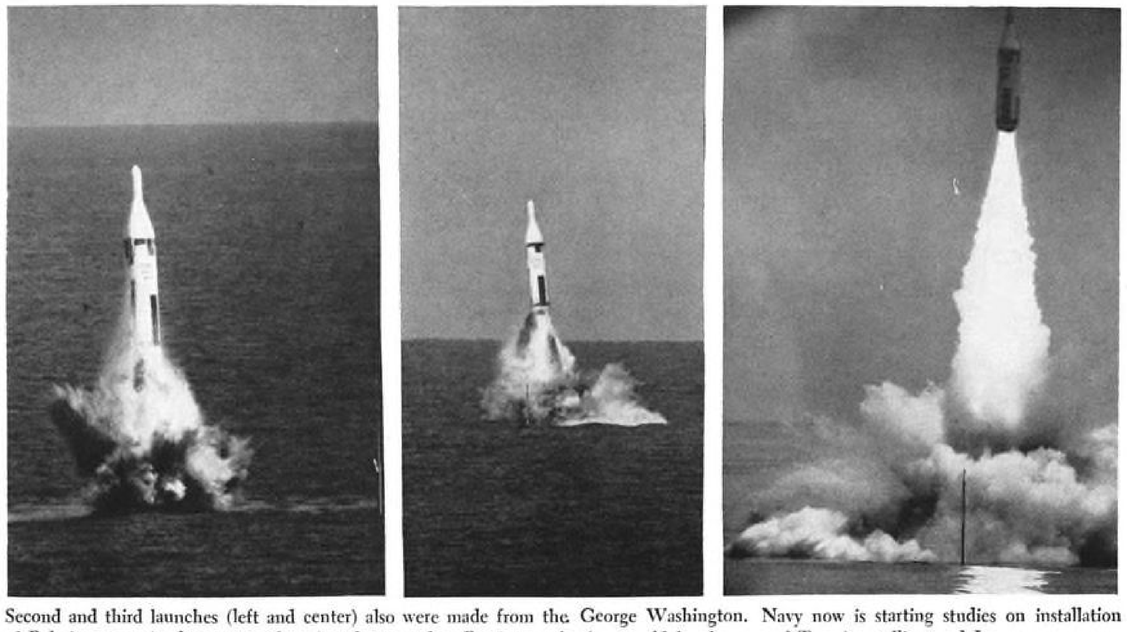
Another example of how

Fenwal CONTROLS TEMPERATURE . . . PRECISELY

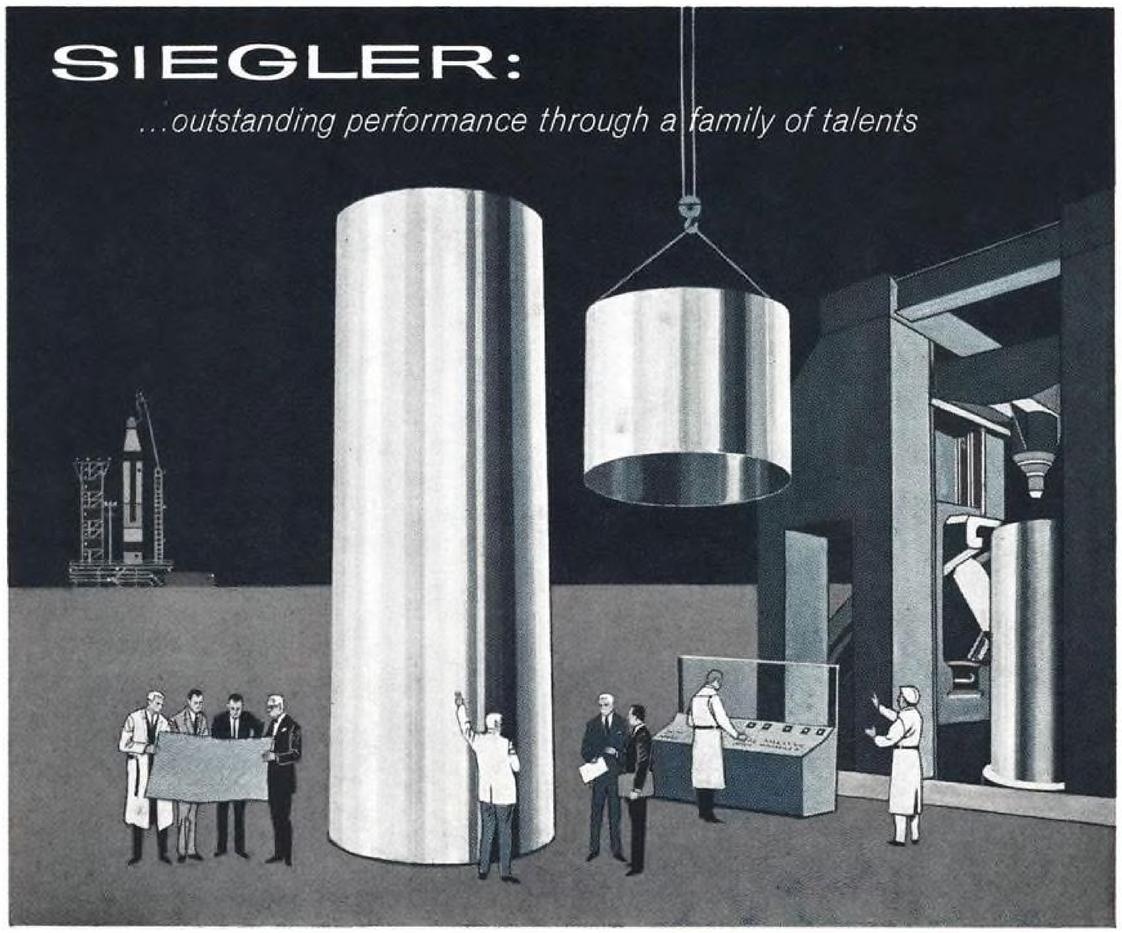


First Polaris IRBM launch from submarine USS George Washington was successful and included installation of instrumented nose cone. Because of test success, Navy expects to push for more submarine construction money during the special congressional session.

Navy Fires Polaris IRBM From Submarine



Second and third launches (left and center) also were made from the George Washington. Navy now is starting studies on installation of Polaris system in destroyer and cruiser-class vessels. Precise navigation would involve use of Transit satellites and Loran.



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Siegler's Hufford Division, long a leader in metal forming techniques, announces the installation of its 120" Spin Forge Machine, entirely paid for from corporate funds at a cost of $1,250,000. This giant machine, augmented by the existing 72" Spin Forge, comprises the largest and most complete Spin Forging facility in the world. It enables aerospace scientists to design well beyond previous limitations.

The Hufford Division Spin Forge facility is capable of producing precision surface-of-revolution parts from 4 inches to 120 inches in diameter, to 25 feet long, and with wall thicknesses from forty thousandths of an inch to one inch – out of all metals, including space age exotic materials. The giant Spin Forges can exert a pressure exceeding a million pounds per square inch – to flow metal to the desired shape quickly, with great accuracy, and with little or no metal lost to machining. Hufford Division also produces Spin Forges for the aerospace industry.

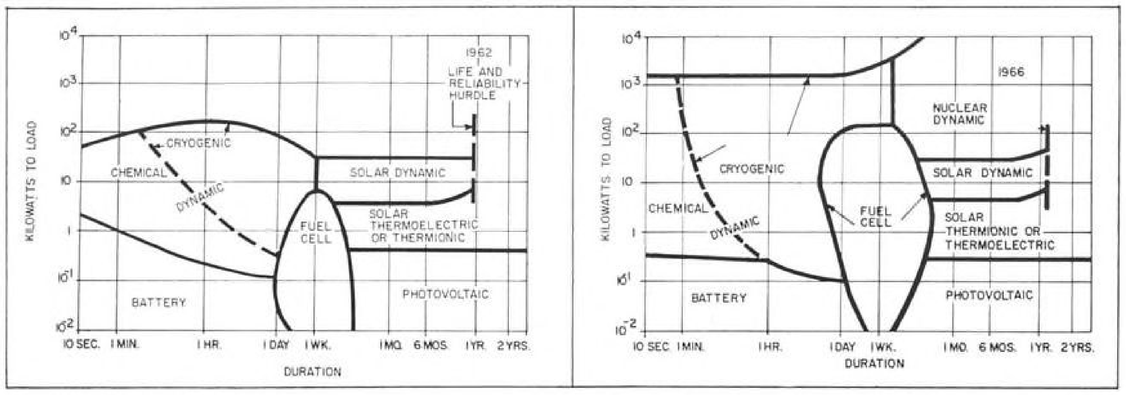
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OPTIMUM choice of energy conversion technique for space vehicle power as a function of required power level and duration of use is shown in forecast for 1962 (left) and for 1966 (right). Lines of demarcation are not sharply defined.

Air Force Space Vehicle Power Program: Part I

USAF Expands Energy Conversion Effort

By Philip J. Klass

Washington—Air Force is expanding its efforts in energy conversion technology, already the most far-ranging program of basic and applied research ever attempted in this field, to meet the electric power needs of military space vehicles and ultimately of lunar bases.

Nearly every possible approach is being explored to meet the variety of needs of space technology, which range in size from a few watts to tens of megawatts, with lifetimes ranging from a few hours to several years.

Projects range from studies of the basic mechanism of photosynthesis, nature's own successful methods for converting solar energy, to new higher-efficiency solar cell materials; from magnetodynamic plasma studies to techniques for improving the characteristics of batteries.

Power Conversion

Although space technology is providing the impetus for the Air Force effort, and those of the Army and Navy which are more limited in scope, the technologies coming out of these basic programs in energy conversion could have a significant impact on power conversion for industrial and consumer use. Except for nuclear powerplants, in which the heat is supplied by nuclear fission instead of burning coal or oil, there has been little change in the basic technology of electric power generation in 50 years.

The Air Force program in basic and applied research on energy conversion technology, excluding systems being developed for use on specific space vehicles or weapon systems, totaled about $10 million in Fiscal 1960, roughly four times the previous year's figure. (This included about $1 million in funding from Advanced Research Projects Agency.) Fiscal 1961 funds are expected to be slightly more than $10 million, permitting continuation of existing programs and the launching of new ones. These expenditures are not large as military programs go, but $10 million will buy considerable research when there is relatively little hardware fabrication involved.

Two Agencies

The Air Force energy conversion research program is being carried out by two agencies:

• **Flight Vehicle Power Branch,** Flight Accessories Laboratory, Wright Air Development Division, Dayton, is responsible for programs which are of an applied research nature, with some hardware fabrication to establish feasibility. Majority of contracts are with industry.

• **Energy Conversion Branch,** Geophysics Research Directorate, AF Research Division, Bedford, Mass., carries on projects which lean more heavily toward basic research. Bulk of these contracts are with universities.

The Ballistic Missile Division, as the ultimate user of techniques coming out of the program, is the office of management responsibility for the WADD portion of the effort.

WADD's Flight Vehicle Power Branch has about 75 active contracts covering about 50 major tasks, according to George W. Sherman, branch chief. During the coming year the branch hopes to place about 25 new contracts in addition to supporting ones now in existence. The GRD Energy Conversion Branch at Bedford now has slightly over 20 contracts, a number expected to increase by about 25% during the coming year, according to Dr. Norman Rosenberg, branch chief.

The WADD program already encompasses projects with a wide range of power sizes and timetables. Representative of the relatively low-power, short-term payoff projects are several in solar cell technology, intended to boost conversion efficiencies. Near the other end of the power-level spectrum is the program for the design of a 300 kw. nuclear reactor-powered turbine generator system, whose first complete system tests are scheduled for 1966. Even farther along the time axis are studies of plasma generators and other unconventional power generation techniques.

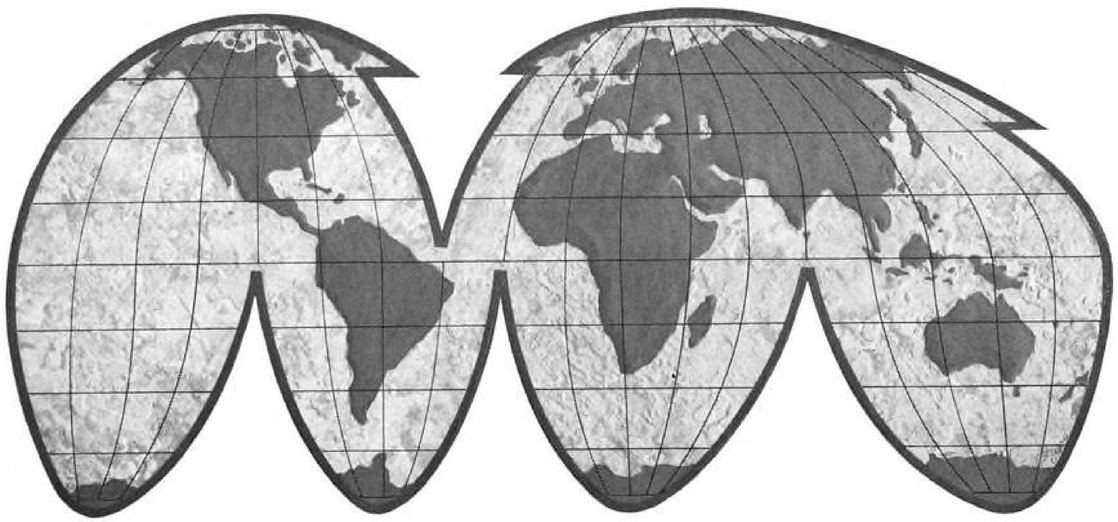
Current Program

Current WADD programs in photovoltaic (solar) cell technology include the following:

• **Improved silicon cell efficiency** is the goal of a contract with Westinghouse Electric. Theory indicates that maximum conversion efficiency of silicon solar cells is about 23%, but until recently the maximum that could be obtained in production was only around 10%. Program objective is a conversion

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efficiency of 15%, or 50% better than previously available. Progress to date indicates the objective will be met.

• **Gallium arsenide cell** should, in theory, provide higher conversion efficiency than silicon and be able to operate at higher temperature. Radio Corporation of America holds a contract to investigate gallium arsenide solar cells with a program objective of fabricating cells with a conversion efficiency of 15%, a figure which presumably could be raised with subsequent effort. Program results to date are encouraging, according to WADD representatives. Feasibility investigation of solar cells made of cadmium sulfide, and study of basic physics of the material, is also being carried out under WADD contract by Harshaw Chemical Co.

• **New cell materials,** with more nearly ideal photovoltaic characteristics than silicon or gallium arsenide, particularly compound and ternary materials, will be investigated by Electro-Optical Systems, Inc., Pasadena, Calif., under a recently awarded contract.

• **Novel cell structures** and configurations, other than the widely used small rectangular "shingles," which would permit use of a wider portion of the energy in the solar radiation spectrum and therefore greater electrical output, are being investigated by General Electric.

• **Photovoltaic cell parameter study,** to be carried out by Shockley Transistor Corp., Palo Alto, Calif., will seek a more basic understanding of the physics involved in solar cell operation and construction, including such factors as cell configuration, desired material characteristics and heating effects.

• **Photoelectric emission,** in which solar radiation photons striking a suitably coated surface release electrons to a nearby anode, has been a relatively unexplored technology. Theory indicates that photoelectric emission should have a conversion efficiency comparable to that of photovoltaic (solar) cells, and such cells should be easier, less expensive to fabricate. Air Force therefore has given a contract to Radio Corporation of America for basic study of photoelectric emission for energy conversion.

• **Solar energy concentrator,** which will collect solar radiation over a wide area and focus it into a small area to reduce the number of cells required, is the object of a contract with Electro-Optical Systems, Inc. The experimental feasibility model which the company will fabricate will provide a concentration factor of about 8:1, use reflecting surfaces which are coated so as to reflect primarily that portion of the spectrum to which the solar cell is sensitive and not the infrared portions which serve only to the heat the cell without producing significant output. Concentrator is expected to be considerably lighter and less costly than previous designs, according to WADD's George Sherman.

• **Cell array configuration** for optimum utilization of solar energy is the objective of a study by Radio Corporation of America.

• **100 watt/500 watt power system,** using silicon cells and collector, which in combination with nickel cadmium batteries can provide 100 watts power continuously and 500 watts for 20 min. intervals, is the object of a design study by Hoffman Electronics Corp. Company is fabricating a one-quarter scale breadboard model of the system.

Program, sponsored by Geophysics Research Directorate with Technical Operations, Inc., is investigating new techniques for improving solar cell efficiency. One which shows promise is a thin film coating on cell surface

Space Power Fundamentals

Fundamentally, the energy which is used to provide electric power for a space vehicle must come from either an external source or be carried aboard the vehicle. The sun provides the most obvious source of external power in the form of solar radiation. This can be converted into heat, which in turn can be converted into electricity by a variety of means, or its photon energy can be converted directly into electricity. Solar radiation has the advantage of being "free," available everywhere in the solar system except in the shadow of a planet or the moon. Its disadvantage is the relatively low intensity of power available (about 130 watts per square foot in the vicinity of the earth) which, coupled with the relatively low efficiency of present energy converters, sets a practical upper limit on the amount of solar power which can be obtained by a space vehicle.

There are two basic type of energy sources which can be carried aboard a space vehicle: chemical and nuclear. Chemical energy can take the form of batteries, combustible fuels, or non-combustible fuels which produce electricity by electrolysis, as in the fuel cell. Chemical energy sources usually are easily controlled and packaged, but their bulk generally limits them to short-term use because of payload limitations. Nuclear energy sources are fundamentally long-lived, but require moderately elaborate control systems and heavy shielding to protect other equipments in the payload from damage.

There are a variety of techniques that can be used to convert the source of energy into electricity. These include:

• Photovoltaic cells, or solar cells as they are commonly called, employ a semiconductor material such as silicon which releases electrons within the material when bombarded by photons from solar radiation.

• Photoelectric emission, in which solar radiation photons striking a material cause its surface to release electrons which are collected by a nearby metal surface, much as electrons emitted by a vacuum tube cathode are collected by the plate, except that emission is produced by photons instead of heat.

• Thermoelectric, in which voltage is developed across junction of two dissimilar materials by the application of heat to one of the materials. Principle, called Seebeck Effect (discovered in 1821), has long been used in thermocouples to measure temperature by signal voltage it produces.

• Thermionic, in which heat applied to a specially coated surface causes it to emit electrons which are collected at nearby anode. Device operates in somewhat similar manner to a vacuum tube except that cathode is heated directly by solar, chemical or nuclear energy instead of by electricity.

• Dynamic heat engine, in which heat from solar energy, fuel combustion or nuclear reactor, transferred to suitable working medium, drives rotating turbine or reciprocating engine that is coupled to electric generator. This approach requires more complex system and rotating machinery which makes it potentially less reliable than static conversion devices, but there is no upper limit to its power capability.

• Fuel cells, in which gases or other chemicals are combined to produce electricity through process of electrolysis. Some types of fuel cells are reversible, enabling them to serve as storage devices when used with other power sources. If solar energy is primary source, for example, it can be used to decompose product of electrolysis when vehicle is exposed to sunlight. When vehicle is shaded, the decomposed chemicals can be run through fuel cell in reverse direction to produce electricity.

• Batteries, long used for converting chemical energy to electricity, also have important capability of providing storage facilities for solar-shaded conditions or to handle peak load conditions. Batteries are relatively heavy for their power output and have comparatively short lifetimes.

• Plasma generator, which uses interaction of hot gases and electric fields to produce electricity, has advantage of no moving parts. However, technology is only in the early stages and considerable time and effort will be required to advance techniques to operational stage.



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which would convert ultraviolet solar radiation, to which the cell is not normally responsive, into visible light which will produce electrical output. Also under investigation are means of sensitizing a cell to solar radiation of longer wavelengths which now produce only undesired heating.

Both thermionic and thermoelectric converters are heat engines whose efficiency is a function of the difference in temperature between their "cold" and "hot" elements, i.e. the greater the temperature differential, the greater the conversion efficiency.

In space, the only means of obtaining long-term cooling is to radiate heat into space. The effectiveness of the radiator is proportional to the fourth-power of its temperature. Thus the higher the temperature at which the cold-element of the converter and radiator operate, the less radiator surface is required for cooling—an important item for payload-limited space vehicles. For space vehicles, the highest possible operating temperature is therefore a major objective.

Lower Temperatures

Because present and anticipated future thermoelectric materials operate at lower temperatures, below approximately 1,000C, while thermionic converters inherently operate best at temperatures above 1,000C, the thermionic converter appears more attractive for space vehicle use than does the thermoelectric converter. (For submarine or shipboard use, where sea water provides an excellent cooling medium, thermoelectric converters are more attractive. This explains why Navy currently has an extensive thermoelectric program under way.)

However, the combination of thermoelectric and thermionic converters shows attractive possibilities. Westinghouse Electric recently demonstrated a combination unit in which a thermionic converter was built into the fuel element of a nuclear reactor, where it is exposed to extremely high temperatures of several thousand degrees, while the thermoelectric material enclosing the thermionic converter anode is exposed to lower temperatures, where it operates best.

Current WADD programs in thermoelectric conversion include:

• **Thermoelectric generator,** capable of producing 5 watts output, is being developed by General Electric, with early delivery to WADD for evaluation tests. Company also is under contract to provide design specification for a solar-powered unit capable of delivering 100 watts.

• **Solar thermoelectric generator,** in 100-watt output size, complete with solar collector and radiator, will be designed and fabricated by Hamilton Standard Division of United Aircraft Corp. Initial testing is scheduled to begin this fall. Company also will design a 1,500 watt version suitable for satellite use. The 100-watt system will employ hundreds of small aluminum reflectors, assembled in groups of 28 on lightweight aluminum tubing, to collect and focus solar radiation on the hot end of the thermoelectric generator.

• **Parallel operation problems** when using two thermoelectric generators to jointly supply electric power will be investigated by Westinghouse Electric, using two 100-watt models. Company carries on an active thermoelectric power program under Navy sponsorship.

Geophysics Research Directorate has several programs under contract in the field of thermoelectricity:

• **Thermo-magnetic-electric effects**—the effect of magnetic fields on thermoelectric characteristics of semiconductor compounds—is under study by Laboratoire Centrale of France. Laboratory is investigating such semiconductor materials as magnesium stannide, telluride and plumbide. Work to date indicates that magnetic field sometimes enhances thermoelectric effect, sometimes reduces it, but the basic physics of the effect is not well understood. New York University also is working in this field under GRD contract.

• **New materials investigation** is under way at New York University. Work includes investigation of large photovoltaic voltages reported for crystals and evaporated layers of compounds made from zinc and Group VI elements. University also is investigating thermoelectric properties of organic crystals, alloys and semiconductors.

The simplest type of thermionic converter, called the close-spaced diode because its two electrodes are separated by only a fraction of a thousandth of an inch, operates somewhat like a two-element vacuum tube rectifier. Important difference is that electron emission results from direct application of heat, and the anode must be maintained at a cooler temperature, whereas in a diode-rectifier, cathode is heated by electricity. The close-spaced diode has relatively low efficiency (6%-10%), but its operation is fairly well understood and working devices can be fabricated with present knowledge.

More efficient, but less advanced in state of understanding, are the vapor-filled diodes and even newer cross-field converters. These more sophisticated designs are intended to overcome low efficiency of the close-spaced converter which results from space charge build-up that limits the flow of electrons to anode and heating of anode by cathode radiation.

Vapor-filled diode contains material such as cesium which vaporizes and releases electrons when bombarded by electrons emitted from the cathode. The crossed-field converter employs electromagnetic fields to minimize space charge build-up. Because the field can be used to accelerate electrons, the two electrodes can be separated by greater distance, minimizing radiation heat loss from cathode to anode.

Projects in thermionic conversion now under way at WADD, or programed, include the following:

• **Closed-space diode,** capable of developing 500 watts output, is being developed by General Electric. Contract originally was awarded by Advanced Research Projects Agency, subsequently transferred to Air Force for monitoring.

• **High temperature gas-filled diode,** designed to operate at temperatures of 1,700 to 2,500C, which are obtained in a nuclear reactor, and to deliver 75 watts output, will be developed by General Atomics Division of General Dynamics. Program objectives call for minimum conversion efficiency of 15%, cathode current densities equivalent to 15 watts per square centimeter and an operating lifetime of one year.

• **Solar powered diodes,** one closed-spaced type and one gas-filled type, each capable of delivering 250 watts, will be fabricated by Thompson Ramo Wooldridge Corp. under a contract which calls for a study to determine optimum design for a solar thermionic power system with outputs in the 1-10 kw range.

Present WADD plans call for a program in the relatively new cross-field converters during the coming year.

Research programs in thermionic conversion being sponsored by the Geophysics Research Directorate include:

• **Fundamental investigation** of thermionic conversion process, with emphasis on both vacuum and vapor-filled converters, is under contract with General Electric. During the coming year the emphasis will shift to vapor-filled diodes, both low and high pressure types, according to Dr. Norman Rosenberg.

• **Ion sources** for use in low-temperature converters and plasma stability are subjects of studies and investigations by Radio Corporation of America. RCA already has been able to achieve conversion efficiencies of 14% at temperatures of 1,100C, several hundred degrees below those formerly required (AW June 20, p. 71.)

Fuel cells employing hydrogen and oxygen as fuels have been constructed which exhibit conversion efficiencies of more than 60% compared with a figure of about 40% for steam turbines which generate most of the electricity produced in the world. Maximum theoretical conversion efficiency for fuel cells is about 80%.

If cells can be developed to operate

CONDEC

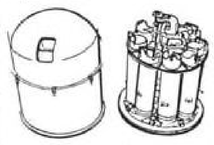
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Instrumentation and Controls

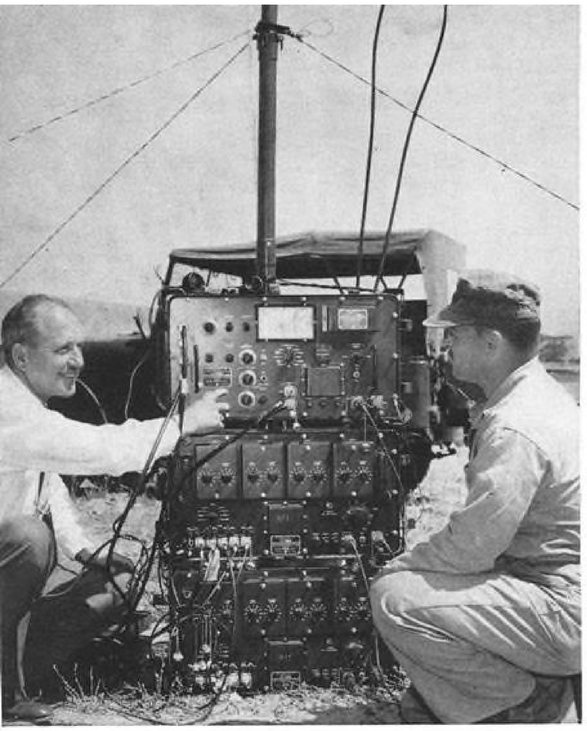


Consolidated Controls produces instrumentation and control devices and systems for liquid level, temperature, pressure, speed and flow applications. Typical is this gas-filled thermometer which measures temperatures of jet engine air intakes. It provides one-second response and needs no electrical connection.

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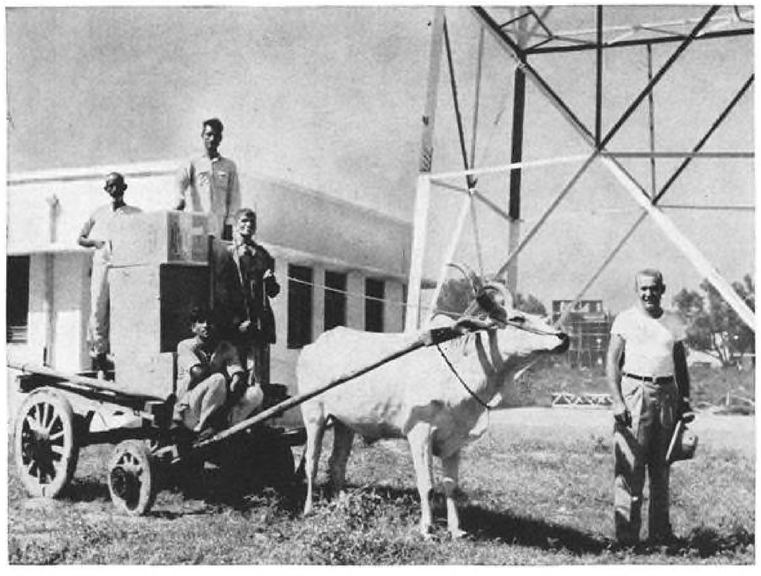
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The Lima Electric Motor Co., Inc., Lima, Ohio
Ultradyne, Inc., Albuquerque, New Mexico
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Instructing Marine Corps personnel in portable microwave communications equipment, AN/TRC-27.

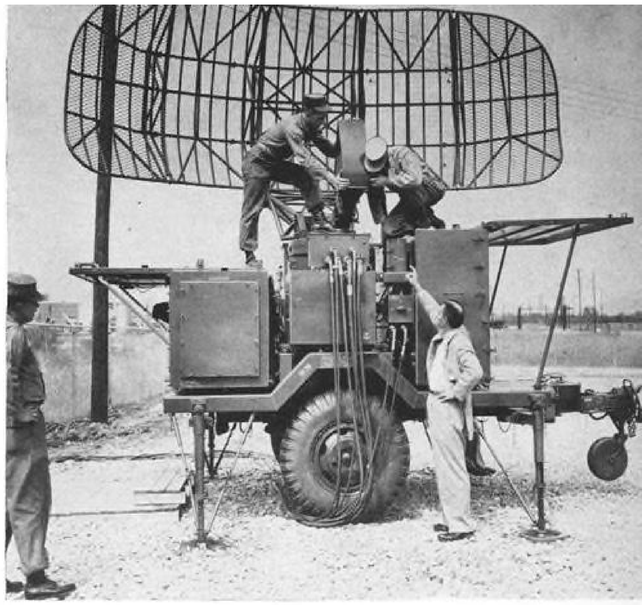
In Germany, checking a proposed radar site for masking objects, preparatory to installation.





Delivering AN/CPS-9 weather radar parts for the Department of Meteorology, New Delhi, India.

On-the-spot training in the field on part of the Hawk missile system,



(U.S. Navy photo)

About to board a B-47, this Raytheon field engineer provides technical assistance on electronic countermeasures equipment.





On Midway, Navy technicians receive instructions on adjustment of airborne navigational equipment.

Now in their 18th year of technical assistance to the Armed Services and government agencies, Raytheon field engineers, in over 100 locations in the United States and overseas, work on installation, instruction and maintenance of electronic equipment.

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RAYTHEON

EXCELLENCE IN ELECTRONICS

efficiently from fuels which can be regenerated by solar energy and thus reused, greatly reducing the amount of fuel which must be carried for long missions, the fuel cell can be expected to find increasing use in space because of its simplicity, relatively high conversion efficiency, and moderate weight.

Wright Air Development Division's program includes both regenerative and unregenerative fuel cell projects:

• **Hydrox fuel cell,** using hydrogen-oxygen gases, developed by Patterson-Moos Division of Universal Winding Co., has been under test for about a year. Tests on the 12-cell model revealed need for additional work, now under way, to prevent electrode flooding and provide better quality control of electrode sintering.

• **Carbon electrode fuel cell,** which employs carbon electrodes and potassium hydroxide as an electrolyte and operates at near-room temperature and pressure, is being developed by National Carbon Co.

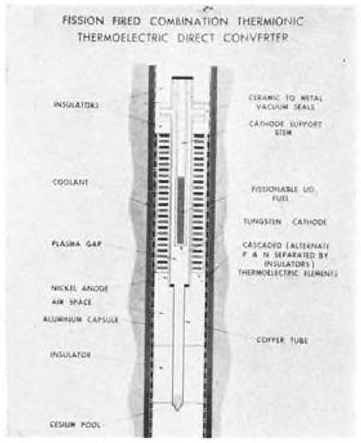
• **Solar regenerative fuel cell,** using nitrous oxide and chlorine as fuels, is being developed by Sundstrand Corp. In this fuel cell, the two fuel gases are converted to nitrosyl chloride as the electricity is produced. Subsequently, the nitrosyl chloride is converted back to nitrous oxide and chlorine when it is exposed to sunlight. Company is investigating methods of increasing quantum yield and improving separation of the decomposed products.

• **Nuclear regenerative fuel cell,** using lithium and hydrogen, produces lithium hydride in the processes of generating electricity, which can be decomposed back to original fuels using heat from a nuclear reactor. Thompson Ramo Wooldridge recently received a contract to investigate such a fuel cell.

• **Organic fuel cell,** which uses organic materials rather than inorganic chemicals, is under investigation by Resin Research Laboratories.

• **Fuel cell** used as an energy storage medium in combination with a thermionic converter powered by solar radiation is under investigation by General Electric. When vehicle is in shade, fuel gasses passing through cell would generate electricity. When vehicle is in sunlight, excess power generated by thermionic converter would be used to decompose cell's electrolysis product back into fuels for subsequent use.

The Geophysics Research Directorate's energy conversion program leans primarily toward basic investigations of the chemistry of materials rather than being oriented toward specific converter technology, according to GRD's Dr. Rosenberg. During the coming year, GRD hopes to have about $2.2 million in contract funds, compared with around $1.3 million in Fiscal 1960, with which to continue promising programs and launch new ones.



COMBINATION thermionic-thermoelectric converter, powered by nuclear fuel, has thermionic element built into fuel element to operate at extremely high temperature while thermoelectric converter surrounds element and operates at lower temperature. Device, first of its kind, was built by Westinghouse Electric.



Many of GRD's research programs are in the fields of photochemistry, photocatalysis and photobiology. Knowledge coming out of these programs could find application in solar regenerative fuel cells, storage of solar energy, or even new techniques for converting solar energy directly into electricity.

In the area of photochemistry, there are a number of chemical systems which, when exposed to solar energy in the visible and ultraviolet portions of the spectrum, undergo reactions that produce stable compounds which store the solar energy that produced the reaction, according to Dr. Rosenberg.

General objective of GRD's efforts in this area is to improve the efficiency of these reactions and extend them into portions of the solar spectrum which contain maximum energy.

There are other chemical systems which in their natural state do not absorb solar energy but which can be "sensitized" through the addition of a suitable catalyst. Programs in this area of photocatalysis include the study of catalysts capable of inducing or promoting this absorption of solar energy.

Because nature's photosynthesis is the only known successful photochemical mechanism for converting solar energy, GRD also is seeking a basic insight into this process.

Representative of the GRD energy conversion studies are the following:

• **University of Southampton** (England) is investigating photocatalysts which can make materials photosensitive to the high-intensity energy portion of the solar spectrum. University also is synthesizing unusual types of photochemical materials.

• **Massachusetts Institute of Technology** is investigating the basic mechanism of using a photo-sensitive catalytic agent (photocatalyst) to decompose water into hydrogen and oxygen using solar radiation. MIT also is investigating the mechanism of intermolecular and intramolecular electron transfer in simple organic materials.

• **St. Joseph College** is studying the basic mechanism by which a photocatalyst absorbs solar energy and transfers it to the working medium, with emphasis on the use of semiconductor materials as photocatalysts.

• **Ohio State University** is studying photosynthesis of hydrogen peroxide from water and oxygen which occurs at cadmium sulfide, selenide and telluride surfaces exposed to sunlight.

• **University of Sheffield** (England) is investigating the effect of paramagnetic ion additions and the general field of energy transfer within a molecule.

• **Stanford Research Institute** is experimenting with use of concentrated sunlight to convert water and nitrosyl chloride into nitrous oxide and chlorine for use in a solar regenerative fuel cell.

• **University of California** at Los Angeles is investigating important parameters of system in which an inert iron electrode is immersed in photo-active thionine solution that absorbs solar energy and transfers electrons to the iron electrode.

• **Brooklyn Polytechnic Institute** is investigating different types of dyes as photocatalysts to enable solution to absorb solar energy and convert it into electrical energy. Studies include energy storage, photo-reversible systems. *(Ed. Note: Concluding article in this two-part series on the Air Force's extensive energy conversion program for space use, describing dynamic type power conversion systems using turbine or reciprocating engines powered by solar, chemical or nuclear energy, will appear in a subsequent issue of* AVIATION WEEK.)

FILTER CENTER

▶ **Transistor Sales Continue to Slip**—Figures on transistor sales for May, just released by Electronic Industries Assn., reveal the smallest gain over the same month of the previous year that industry has experienced for many years, confirming first signs of a market saturation reported by AVIATION WEEK (Aug. 1, p. 75). Unit sales for May were 9.0 million, an increase of only 42% over May 1959, while the May 1959 unit sales were up 110% over May 1958. Dollar sales for May, 1960 were $24.1 million, an increase of only 26% over same month in 1959, which was up 160% over May 1958.

▶ **Semiconductors Deliver One Watt at 1,000 mc.**—An all solid-state UHF generator, capable of delivering one watt at 1,000 mc., many times the power levels previously available at this frequency from semiconductors, will be unveiled at Wescon by Pacific Semiconductors, Inc. The development may ease vacuum tubes out of one of their last strongholds in space vehicle transmitters. New UHF power generator uses transistors and silicon high-Q voltage-variable capacitors. Circuit details will be described in Wescon report by George Luettgenau, Peter H. Dirnbach and Murray V. Duffin.

▶ **Radiation-Resistant TV Camera Developed**—International Telephone & Telegraph Corp. has developed a television camera capable of operating in a radiation environment, which will be used to monitor Atomic Energy Commission's Project Pluto nuclear ramjet operation. Previous TV camera designs have been susceptible to radiation damage. New Model CM-40, developed by ITT's Industrial Products Division, San Fernando, Calif., uses ceramic radiation resistant components.

▶ **Digital Transducer Contract Awarded**—In an effort to eliminate complexity of analog-to-digital conversion equipment now required for airborne digital computers, Wright Air Development Division has awarded study contract for digital transducers to Servomechanisms, Inc. Work will be carried out at company's Research Division in Goleta, Calif.

▶ **Promising New Dielectric**—New film-forming and moldable dielectric which has the highest dielectric constant—12½—of all known organic film-forming materials has been developed by American Cyanamid. New material, known as Cyanocel, should permit reducing size of capacitors by a factor of 2:1 to 6:1, the company says. Company reports it has cast transparent dielectric films which are as thin as 0.1 mil and as thick as 5 mils. At frequency of 60 cps., the 2-mil thick films have dielectric constant of 10-15 and a dissipation factor of 0.010 to 0.025.

▶ **Infrared Detector Range Extended**—Technique for sealing germanium windows to infrared detectors, which can pass IR energy at wavelengths beyond 25 microns compared with transmission only out to nine microns obtainable with silicon windows, has been developed by Philco's Lansdale Division. Philco says its sealing technique enables device to remain leak-free at vacuums of 10^{-6} mm. mercury. Seal will withstand thermal shocks from ambient temperature to that of liquid nitrogen and back to room temperature.

▶ **Miniature Flip Flops Delivered**—Philco Corp. recently delivered high-speed (20 to 30 megapulses/sec.), low-power (2.5 mw.) all solid-state circuits to the Computer and Mathematical Sciences Laboratory of the Electronics Research Directorate, Air Force Cambridge Research Center. Individual units are completely contained on a ¾ in. x ¾ in. thin silicon wafer onto which passive and active components are etched or diffused. The flip flops are fabricated by photolithographic techniques and Philco hopes to incorporate as many as four or more of them on the area now occupied by one. This work was done under a $198,000 contract. Other organizations under contract to the laboratory for microminiature component development include IBM, Stanford Research Institute, Texas Instruments, RCA, GE and Motorola.

▶ **Signed On the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Zenith Radio Corp.,** Chicago, will study feasibility of developing an extremely rapid solid-state optical shutter capable of reacting quickly enough to nuclear explosions to prevent flash blindness. Contract is with Army Ordnance Department. Company also has received a contract from USAF's Command and Control Development Division for development of a parametric amplifier system using Zenith's electron beam par-amp.

• **Micromega Corp.,** Venice, Calif., will design and fabricate low-noise parametric amplifiers, operating at S-band and covering a 100 mc. frequency range, for use by Philco Corp. in a satellite tracking radar.

• **Cubic Corp.,** San Diego, will modernize data processing and missile tracking system equipment at Naval Ordnance Test Station, China Lake, Calif. Contract includes installation of data digitalization system to operate with Cubic's Missile Intercept Data Acquisition System (Midas).

• **Telechrome Manufacturing Corp.,** Amityville, N. Y., $1.6 million Navy contract for telemetering systems for exercise heads of Terrier and Tartar anti-aircraft missiles.



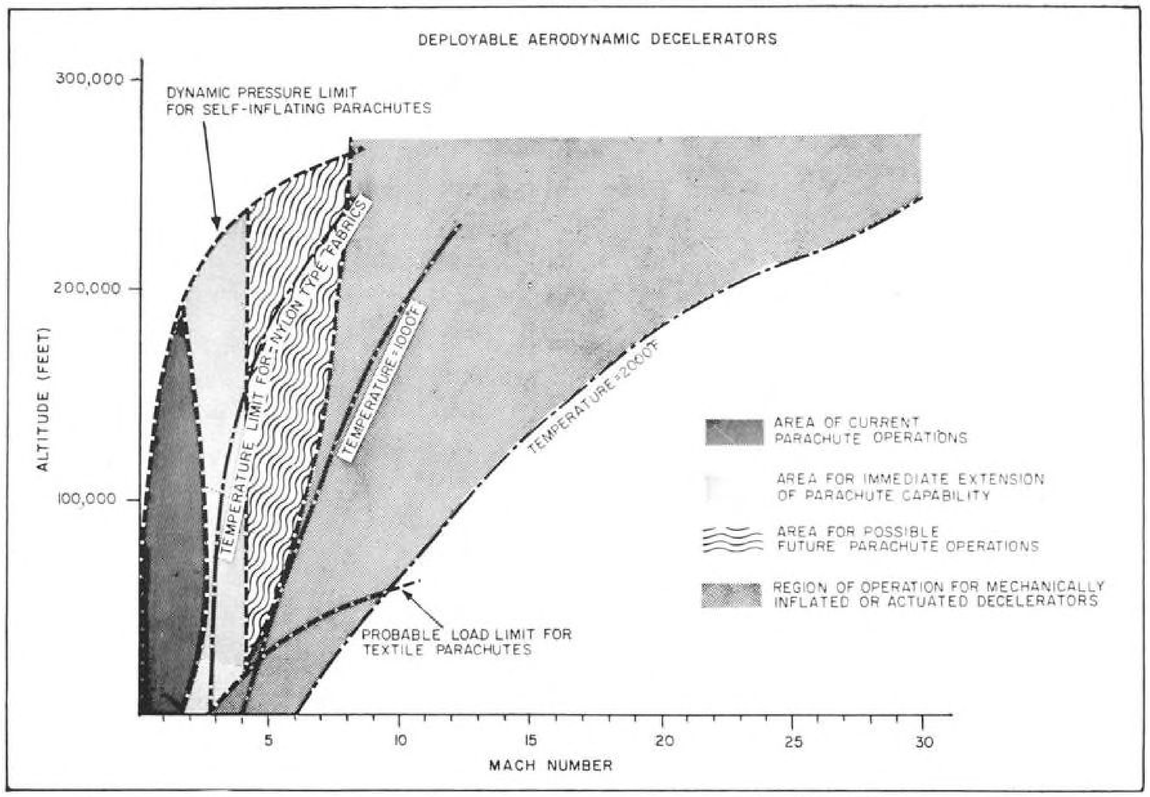


CHART drawn by Aerodynamic Decelerator Branch scientists shows areas of current and anticipated drag-producing devices.

Drag Devices Studied for Recovery Units

By Michael Yaffee

Dayton, Ohio—Inflatable toboggans, magnetized umbrellas and wire mesh parachutes are some drag devices now under consideration for possible use in future Air Force high speed, high altitude recovery systems for drones, boosters, re-entry vehicles and ejection capsules.

Possibly the greatest current need in this area is for an aerodynamic decelerator that can brake a vehicle from hypersonic to zero velocity and at the same time provide precise landing point control, all ideally at a cost in bulk and weight comparable to that of a parachute.

A system such as this will probably employ lift as well as drag and, scientists believe, will take a long time to develop. Meanwhile, they say, there is still much to be learned about the operation of the ordinary parachute and other devices that are expected to precede the deployable lift-drag decelerators.

Currently, the Aerodynamic Decelerator Branch of the Wright Air Development Division here is studying a variety of devices in an effort to compile the data needed to narrow the gap between vehicle performance and recovery capability. All these devices have one thing in common: their operation depends upon their interaction with the molecules or ions available in the environment to create drag, as opposed to the operation of devices such as retrorockets.

Work under the Aerodynamic Decelerator Branch falls into three broad categories: constant area drag devices, variable area drag devices and devices in which drag is supplemented by a small amount of lift. Still the most important type of constant area drag device is the parachute, which provides more drag for a given amount of bulk and weight than any other unit. The parachute still possesses a significant potential for improvements, ADB scientists say.

Currently, self-inflating parachutes will function reliably up to approximately Mach 2.5. ADB believes it can extend the operational capability of parachutes to Mach 4 in the immediate future. There is no requirement at the present time for parachutes beyond Mach 4, but ADB scientists George Solt and Rudi Berndt believe that eventually it may be possible to develop parachutes which will function at velocities up to Mach 8.

The magnetic parachute is still in the early stages; if ever it reaches the hardware level, odds are that it won't look like a parachute or even fall into the category of constant area drag devices. At the moment, ADB researchers are simply pondering how magnetohydrodynamics might fit into the picture.

One thought, for example, is on the potentialities of a magnetized, slotted metal device similar to a fabric, ribbon parachute that might be deployed in the ionosphere and slowed down by interaction with the ions that flow through it. Another thought concerns a magnetized, variable area drag brake type device that might interact with the ions formed in the wake of a re-entry vehicle.

To push the operational capability of parachutes to Mach 4, scientists must overcome a number of problems. One is the phenomenon of pulsating shock waves, a problem also encountered in the development of ramjet inlet diffusers. Air Force scientists first came into contact with this problem with the basic, fabric, ribbon parachute at Mach 1.5. They solved this problem, or more accurately delayed it, until Mach 2.5, by altering the geometry of the inflated shape, adding a skirt among other things, and by increasing the porosity to balance air in-flow and out-flow.

This time, ADB is taking a broader approach to the problem and, working with University of Minnesota and Cook Research Laboratory, is obtaining data on opening shock, opening hesitation or squidding, pressure distribution on canopy, strength distribution, materials and designs. In addition to solving the shock problem, ADB—with an eye to decreasing bulk and weight—wants to see if parachutes are being overdesigned, also what high temperature materials will serve best in high speed recovery.

For speeds above Mach 3, ADB believes metal textile (woven) parachutes will be required.

ADB researchers first started thinking of the deceleration requirements of space flight in terms of large parachutes with inflatable rings that could be built into the skirts to force the parachutes open at high altitudes. But exploratory wind tunnel tests in 1956 gave them their first view of the pulsating shock problem they were to encounter above Mach 1.5, and another look at the temperature regime showed them they could expect trouble from melted suspension lines. Also, the weight penalty of using available high temperature metals or coatings for each suspension line appeared prohibitive.

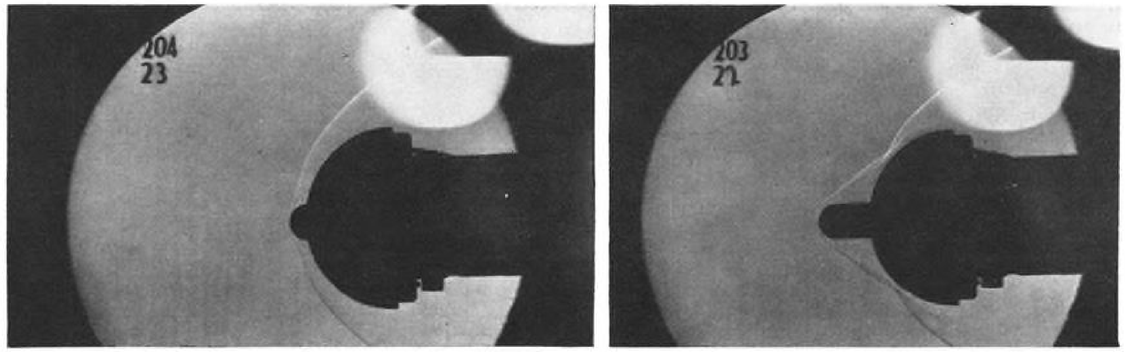
It was primarily for these reasons that ADB researchers started thinking in terms of balloon decelerator devices. So far, they have tested pressure-inflated balloons in wind tunnels up to speeds of Mach 3.5; and they now are starting free flight tests of balloon decelerator devices, using Cree missiles which will carry the devices to speeds of Mach 4 and altitudes of 150,000 ft. The first device will be Goodyear Aircraft Corp.'s Ballute system in which balloon deceleration is supplemented by a parachute ejected at lower altitudes (AW July 11, p. 67).

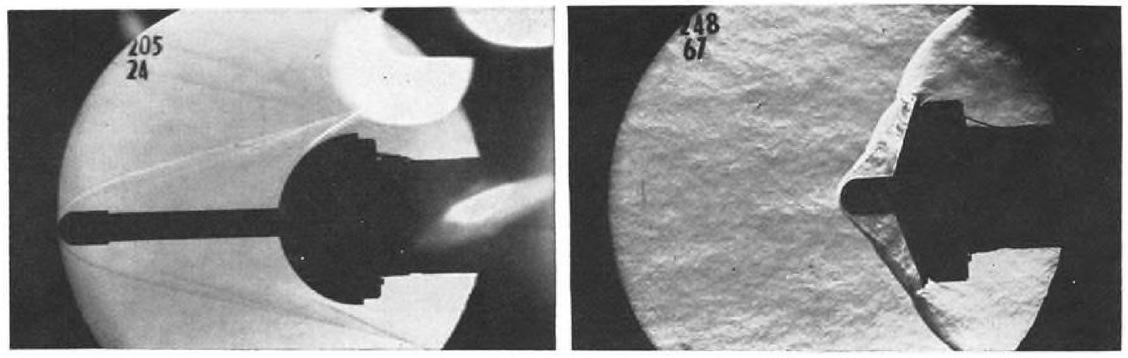
At present, balloon-supplemented decelerators look promising for the Mach 2-10 range. For the time being, they are still in the constant area drag category. Their drag efficiency (weight/drag area) is not as good as that of the parachute—if a Mach 4 parachute is developed, use of balloons would probably be restricted to the Mach 4-10 range. Principal advantages of the balloon are that it can be easily inflated, that it avoids the pulsating shock problem encountered by parachutes at relatively low Mach numbers, and that it has only one main suspension line which, if necessary, can be made out of metal and given a refractory coating with a comparatively mild weight penalty.

Variable area drag devices came into the picture with the requirement for decelerating manned re-entry vehicles. Studies showed that changing the size of constant area drag devices didn't alter the maximum deceleration g-load a re-entry vehicle would generate, only the altitude at which it was generated.

On the other hand, ADB researchers found that this maximum g-load could be reduced significantly by varying the drag area—starting at high altitudes, for example, with a maximum drag area, gradually reducing the area and then increasing it again for the final landing phase. The Air Force awarded Cornell Aeronautical Laboratory, Inc., a contract for the investigation and study of hypersonic zero-lift devices which could be used in the recovery of a space vehicle re-entering the earth's atmosphere. (Hypersonic is generally used in referring to velocities above Mach 5.)

The laboratory finished Phase I of this program early last year. This was mostly an analytical study in which it





SCHLIEREN photographs of drag devices in Mach 8 flow were taken in Cornell Aeronautical Laboratory shock tunnel as part of Air Force study of hypersonic zero-lift devices. First three show hemispherical drag devices at varying distances behind a capsule, while the last photograph shows a conical drag model.

postulated a number of re-entry vehicles, drag devices and flight paths and then calculated various re-entry parameters. Among the conclusions reached by Cornell scientists are the following:

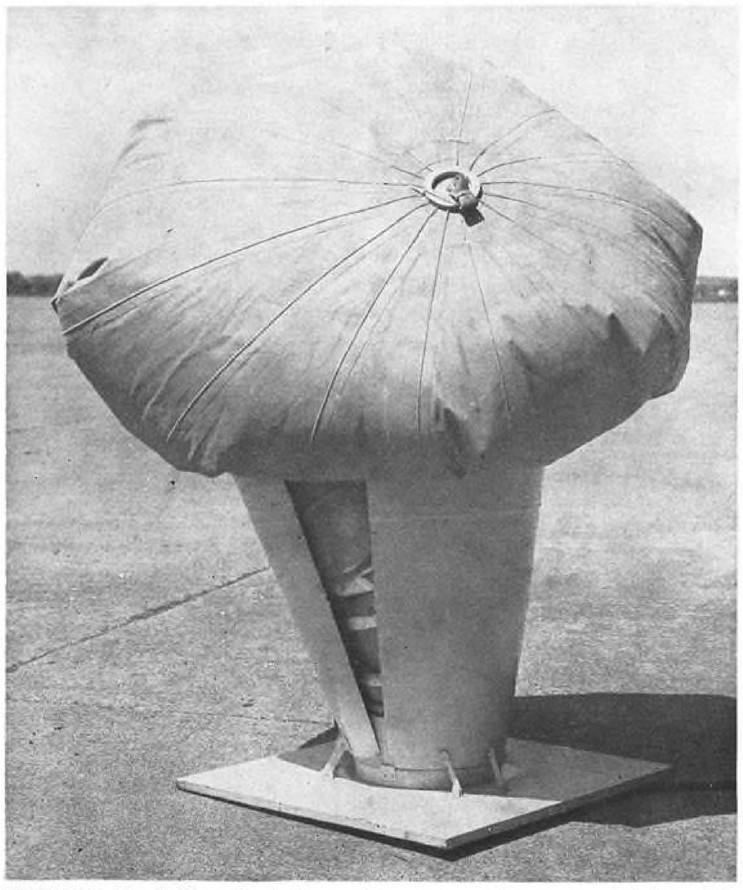
- **In the case of fixed area drag** devices, minimum peak deceleration is achieved with a drag/weight co-efficient of 0.1 for the entire vehicle.
- **Variable area drag device** which maintains constant deceleration will produce lower deceleration and heating during re-entry than a fixed area drag device.
- **Optimum re-entry paths** for variable area drag devices are obtained with an initial drag/weight value of 0.5 and entry angles to −1 deg. or a drag/weight value of 1.0 and entry angles to −2 deg.
- **Change in re-entry altitude** from 400,000 ft. to 300,000 ft. has little effect on re-entry parameters, but changes at lower altitudes do have a significant effect.
- **Use of a device** with a large drag-to-weight coefficient to initiate return from orbit appears feasible, if increased ranges and flight time can be tolerated.

Now in Phase II of this program, CAL is testing models of several different drag device shapes in its hypersonic shock tunnel (AW Jan. 25, p. 64). Among other things, the scientists are measuring drag, lift, pitching moment, heat rates and pressures at various points. This phase is now drawing to a close and a final report is expected before the end of the year.

Avco Drag Brake

Some time ago Avco Corp. sent Air Force an unsolicited proposal for a variable area drag device that would have the additional advantage of being able to initiate re-entry from orbit without the need of a retrorocket (AW June 22, 1959, p. 81). The Avco drag brake also was said to provide landing point control to within plus or minus 150 naut. mi. Early this year, Avco received a WADD contract covering both study and demonstration of the feasibility of its particular variable area drag concept.

The problem of landing point control has become more and more pressing, according to ADB. Simply locating



GOODYEAR Aircraft Corp. drag balloon pushes a test container apart as it inflates. The balloon is capable of being inflated to a diameter of 9 ft. within a time span of only 0.1 sec.

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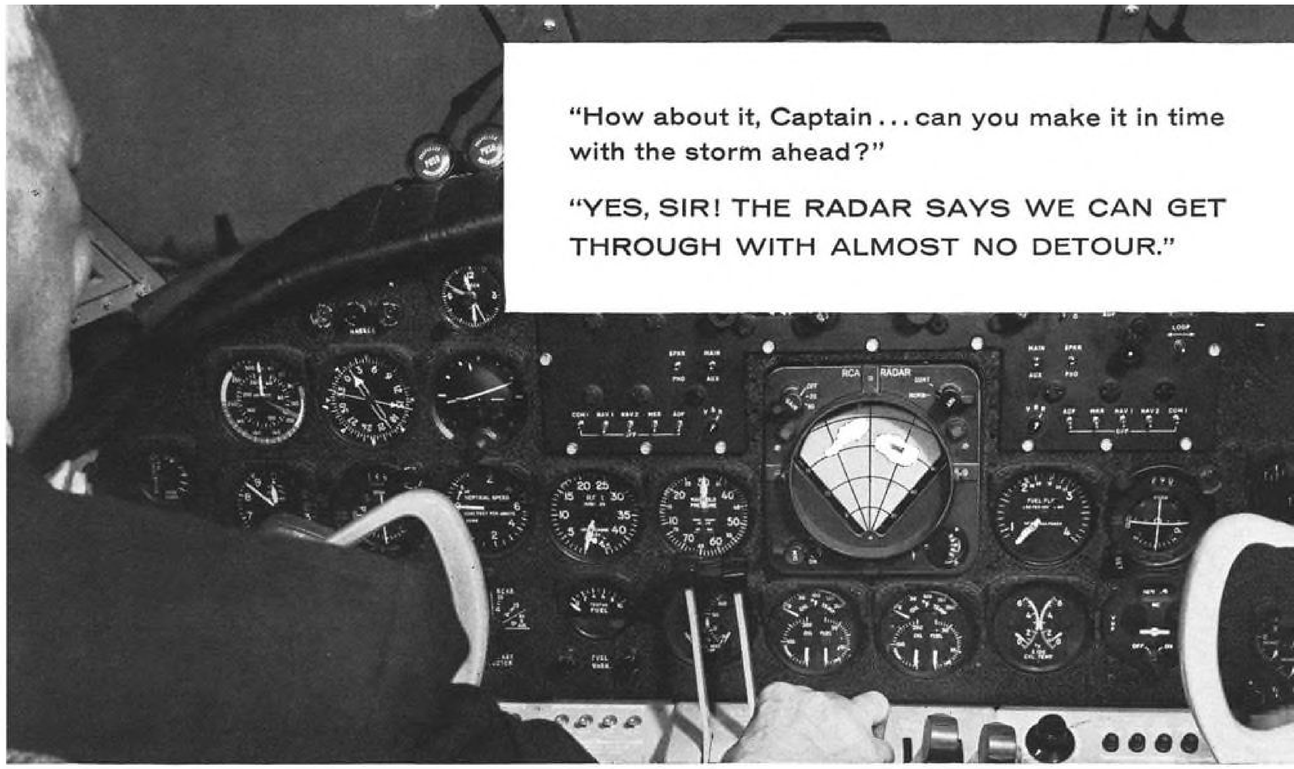
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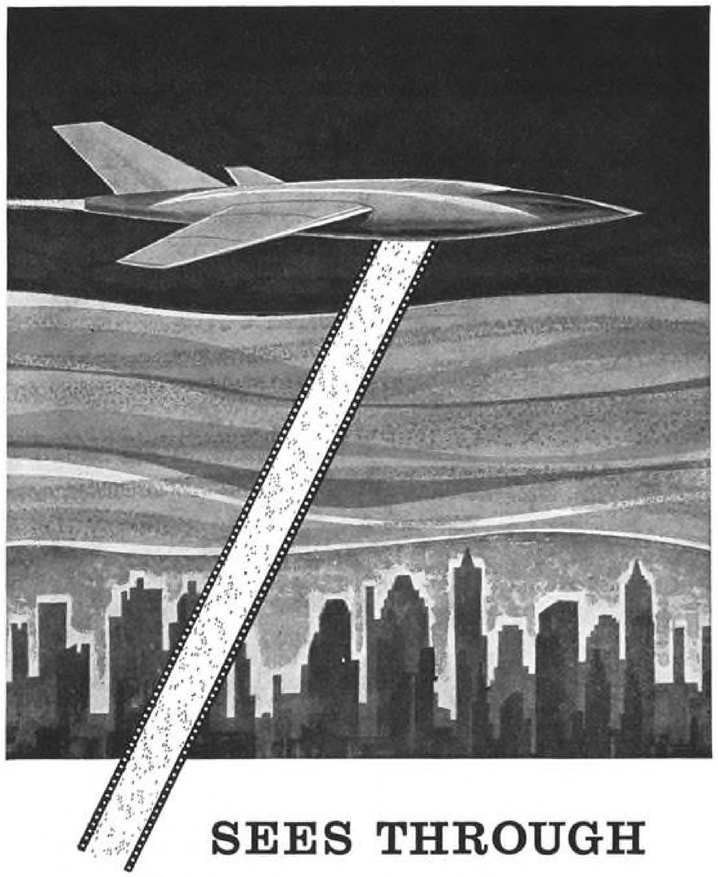
RCA also offers the AVQ-10, a Weather Radar system designed for larger craft and the AVQ-60B ATC Transponder, a device which automatically and independently of the pilot, sends coded data on the plane's identity and location to ground control centers.

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downed nose cones is still a problem. In the projected use of large, recoverable boosters, the amount of time they spend in the water will determine to a large extent their useful life. The problem is even more critical in the case of manned re-entry vehicles and satellites and even ejection capsules.

MIT Study

To achieve precise landing point control, ADB scientists decided they would have to introduce a small amount of lift on the drag device. Massachusetts Institue of Technology was awarded a WADD contract to obtain data on different shapes of deployable, hypersonic lift/drag devices. Included in this study, reportedly, were inflatable toboggan-shaped structures and U-shaped tubes with a skin stretched across the top or bottom, the latter looking somewhat like an aircraft life raft with one end cut off. The final report on this two-year study now is being sent to WADD.

Earlier this year Kaman Aircraft Corp. was given an Air Force contract for the study of a different approach to this problem of precise landing point control. The Kaman work will be on the use of deployable rotor systems to provide controlled deceleration and bring boosters and re-entry vehicles to preselected landing sites at almost zero vertical and horizontal velocities (AW July 11, p. 119). In Phase I of this contract, Kaman will attempt to demonstrate the feasibility of this system at subsonic speeds; in Phase II, at hypersonic speeds.

Feasibility Reports

Purpose of the Aerodynamic Decelerator Branch, which comes under WADD's Directorate of Advanced System Technology, is to demonstrate the feasibility of new aerodynamic decelerator systems. Its end product is technical reports, not hardware. Design criteria and performance data compiled by ADB from the work carried out in-house and by the contractors is generally turned over to the Parachute Section of WADD's Directorate of Systems Engineering. (The data is also available to their services and to NASA.)

In the Parachute Section, the data may be combined with similar data from other groups on such things as retrorockets and crushable structures and used in the development of a recovery system for which the Air Force has established a requirement. The final responsibility for turning the system into operational hardware as part of a weapon system falls either to WADD's Directorate of Systems Management or to the Ballistic Missile Division.



3M Materials Memo

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



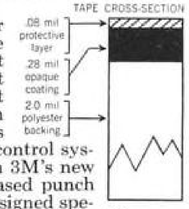
■ All Shook Up?

In a lather over vibration problems in your bird? Settle down, then, while we tell you the absorbing story of 3M's new vibration damping tape. Y-9052, as it's called, is an easily applied construction of self-adhering flexible foam. It stems from an entirely new basic theory on vibration control. The actual key to all this is the high internal shear action of its specially compounded foam and pressure sensitive adhesive coating. A top layer of reinforced vinyl film intensifies this damping effect. Thus, you get a structure engineered to give maximum energy absorption at minimum weight—Y-9052 weighs only ¼ lb./sq. ft.

Y-9052 is particularly effective in controlling vibration or noise due to resonance. And there's no need to emphasize how important this can be in reducing fatigue of structural materials. For maximum effectiveness, the foam should be considerably thicker than the base metal. For example, one layer of Y-9052 is at its best on sheet metal up to approximately 0.060". Of course, with an additional layer of tape, you can boost the metal thickness up to 0.125". Y-9052 brings you the added advantages of thermal insulation (0.038 Btu's/hour/°F/sq.ft./ft.), flame retardance, and excellent moisture resistance. Its high conformability to irregular surfaces and ease of cutting make application a real breeze.

If vibration problems have you jumping (and they needn't be restricted to airframes), let our INDUSTRIAL TRADES TAPE DIVISION help you.

■ More Brawn for Your "Brain"



Plain old paper tapes may be fine for Wall Street stock tickers—but they just won't take the beating in many of today's punch tape data control systems. Not so with 3M's new #360 polyester based punch tape stock. It's designed specifically for critical and repetitive applications of machine tool control, automatic checkout systems, guidance systems, computers, and high speed readers—to name just a few.

The high tensile strength (56 lb./inch) and the high tear strength (40 grams) do not interfere with the sharp clean perforations that are obtained with a minimum of die wear. Also appealing is the absence of annoying static so often found in plastic films. Reliable performance from Maine to the Mojave is assured with the excellent dimensional stability. Then there's the high opacity to visible light and other radiation. With an optical density greater than 4, it's a natural for use with photocell readers.

All these outstanding properties add up to literally thousands of passes through your equipment, even under unfavorable conditions. If you'd like to try your hand at punching holes in our product, call your local MAGNETIC PRODUCTS DIVISION representative, or check the box below.

■ It's rough all over

But 3M's new "SCOTCH-BRITE" BRAND Cleaning and Finishing Material can provide a smooth solution for your metal cleaning and finishing problems. Made of a nylon web impregnated with microscopic abrasive mineral particles, it's already cut a niche in production processes for steel, stainless steel, aluminum, zinc, brass, copper and titanium.

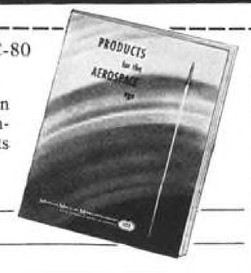
It does a cleaner, faster job of preparing primary metals for pickling . . . helps deliver a superior finish with better adhesion in metal plating . . . does a beautiful job of blending abrasive scratch patterns in metal fabrication—and, in fact, can provide a unique satin-like finish of its own.

The open-textured structure of "SCOTCH-BRITE" gives you not only lightness, but also conformability to varying work geometries. To learn how it can fit into your operations, see your local COATED ABRASIVES DIVISION representative, or check the box below.



3M Company, Missile Industry Liaison—Dept. VAC-80
St. Paul 6, Minn.

Please send more information on ☐ Y-9052 Vibration Damping Tape ☐ "Scotch-Brite" Cleaning and Finishing Material ☐ #360 Punch Tape Stock ☐ 3M Products for the Aerospace Age.

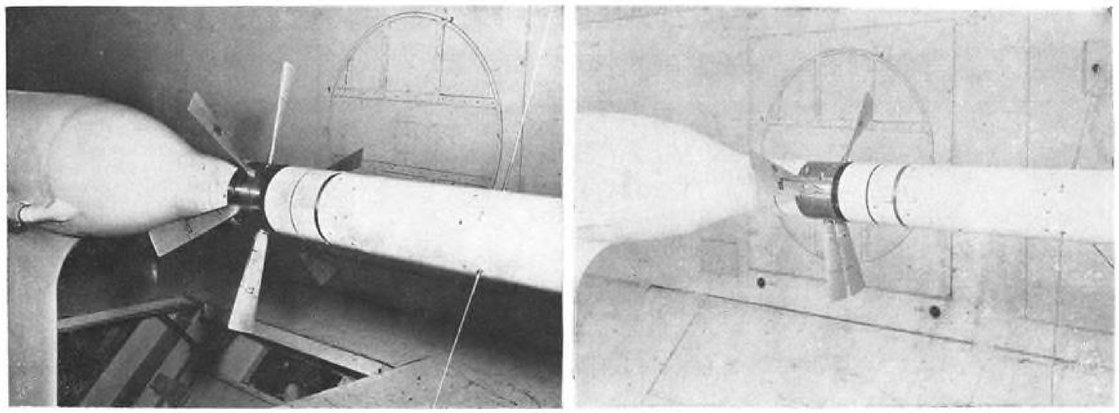


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3M COMPANY

MISSILE INDUSTRY LIAISON



WIND TUNNEL model propeller was adjusted to represent a conventional six-bladed prop to measure any performance losses when the prop was in low camber cruise configuration. Hamilton-Standard reports that the performance penalty of the paired blades is negligible. The company's intuitively designed wind tunnel model did not perform well above Mach .5 due to relatively thick blades.

Variable Camber Prop Studied for VTOL

By Barry Tully

Windson Locks, Conn.—Variable camber propeller, capable of changing effective blade camber in flight to provide most desirable lift/drag in takeoff and cruise flight regimes, will be developed for the U. S. Navy.

The propeller, designed by Hamilton-Standard Division of United Aircraft Corp., will be developed with a Marine Corps VTOL project in mind. Primary applications for the new propeller design will be for tilt wing or tilt engine VTOL designs; however, Hamilton-Standard says that substantial benefits may be gained with the propeller on high speed (Mach .6 to .8) conventional turboprop transports.

Design Goals

The variable camber propeller is an attempt to solve the conflicting lift/drag requirements of takeoff and cruise, which, along with weight, place the most stringent restrictions on propeller design. Unable to resort to flaps, slats and other wing devices, propeller designers must compromise, usually sacrificing prop efficiency to meet either takeoff or cruise performance goals. This design stretch becomes critical with conventional propeller aircraft cruising above Mach .6 and with VTOL vehicles with lower cruise requirements.

The new prop design is called a tandem variable camber propeller. The company's test model consists of six inversely tapered blades mounted in tandem pairs about the prop hub in the configuration of a three-bladed propeller. For takeoff or high camber configuration the blades are rotated to form, in effect, three highly cambered blades. For maximum cruise efficiency, blade angles are adjusted to provide six low camber blades mounted in tandem pairs. The inverse taper (maximum chord at blade tips) permits a near constant spacing between paired blades.

On-Station Time

In addition to VTOL applications, the Navy is considering use of the variable camber prop to increase the on-station time of airborne early warning aircraft. Here the variable camber prop would be used, not to gain static thrust on takeoff, but to minimize fuel consumption at cruise. An aircraft such as the Grumman W2F early warning plane, with engines at low power settings and props of low camber, would be capable of "loitering" at low speeds with minimum fuel consumption, thus increasing on-station time.

The present Navy contract for the development of the variable camber propeller totals $350,000. This calls for development from the present wind tunnel model to the point where a prop may be designed for flight testing.

Hamilton-Standard's initial contract to develop the tandem variable camber propeller is in three stages:

- **Wind tunnel investigation** of two-dimensional air foil sections will provide basic data necessary to design a variable camber prop of maximum efficiency. All work thus far has involved an intuitively designed wind tunnel model intended only to prove the feasibility of the tandem variable camber concept. This first stage of development should settle such basic questions as individual blade camber, relative blade size and blade spacing.
- **Model propeller,** designed on the basis of stage one research, will be built and subjected to wind tunnel tests. The efficiency of this model will be measured at high and low camber and at varying air speeds. Any interference effects while operating at low camber also will be studied.
- **Full scale blades** will be constructed for wind tunnel investigation of structural stress and vibration. Third stage will be conducted concurrently with the first two.

Full Scale Prop

Construction of a full scale propeller for flight testing will not take place until completion of the initial contract, scheduled to run 14 months. The variable camber propeller has been under study at Hamilton-Standard since 1958.

George Rosen, Hamilton-Standard's chief of analysis and the inventor of the company's variable camber propeller design, estimates that 2- 2½ years will be required before the propeller is flight tested. Rosen says he hit upon the tandem variable camber prop concept after considerable thought on a hinged propeller blade. Propeller designers have always been interested in wing flaps, which solve neatly the conflicting high lift/high speed requirements of aircraft wings. The high rotational forces acting on propellers, however, have always hampered efforts to design structurally sound, controllable blade flaps.

Rosen next considered splitting his blade and providing a separate movable flap section to vary blade camber. This appeared impractical but it served to bridge the gap between the hinged blade idea and the paired tandem blades of the variable camber propeller.

After making with small models to convince himself and Hamilton-Standard that the tandem blade geometry was feasible, Rosen and his staff designed a wind tunnel test model. This 2.5 ft. diameter test propeller was tested in the United Aircraft Research Laboratories wind tunnel at East Hartford, Conn.

The purpose of the company-sponsored wind tunnel program was to confirm the capability of the tandem variable camber propeller to provide substantial effective camber for takeoff without penalizing cruise performance. The test model consisted of six adjustable blades mounted in a 7 in. diameter hub to match the test rig. Airspeeds in the program covered a Mach range from zero to 0.2 in the 18 ft. throat section of the wind tunnel and from 0.3 to 0.6 in the 8 ft. throat section. The model was tested in tandem, variable camber and, for purposes of comparison, as a conventional six-bladed propeller.

Thrust Increase

The wind tunnel feasibility tests demonstrated a magnitude of static thrust increase to be equivalent to that achieved by an increase in integrated design lift coefficient from .122 to .7 on a conventional propeller. Cruise performance on the model was shown to be equivalent with either the conventional or tandem blade configuration. This eased any apprehensions that interference effects between the closely spaced tandem blades might penalize propeller efficiency during cruise.

Hamilton-Standard points out that the design of the test model in advance of the availability of adequate aerodynamic criteria is unlikely to demonstrate the maximum performance potential of the tandem variable camber propeller. However, on the basis of the encouraging test results, the company submitted a proposal to the military which resulted in the Navy development contract. Air Force, although not funding the project, has expressed interest and is watching the project.

Hamilton-Standard has made technical presentations to various aviation companies to stimulate interest in the variable camber propeller. The propeller company says that reception to the propeller concept has been favorable, particularly by companies, engaged in VTOL design studies.

The VTOL vehicle, with its high static thrust requirement at zero velocity, places severe demands on conventional propellers if an efficient cruise is to be realized. Hamilton-Standard, to demonstrate the advantages of its variable camber prop, has envisioned a typical VTOL vehicle. This tilt wing aircraft would have a 36,000 lb. gross weight and carry 8,000 lb. of fuel and a 4,000 lb. payload. The aircraft would fly 1,000 mi. at 300 kt. Static thrust sufficient to provide vertical liftoff would be 40,000 lb. This means that if four engines delivering 2,500 shp. each were employed, a static thrust level of 4 lb./shp. would be required.

According to Hamilton-Standard figures, use of the variable camber propeller on this hypothetical VTOL aircraft would provide one of the following potential benefits:

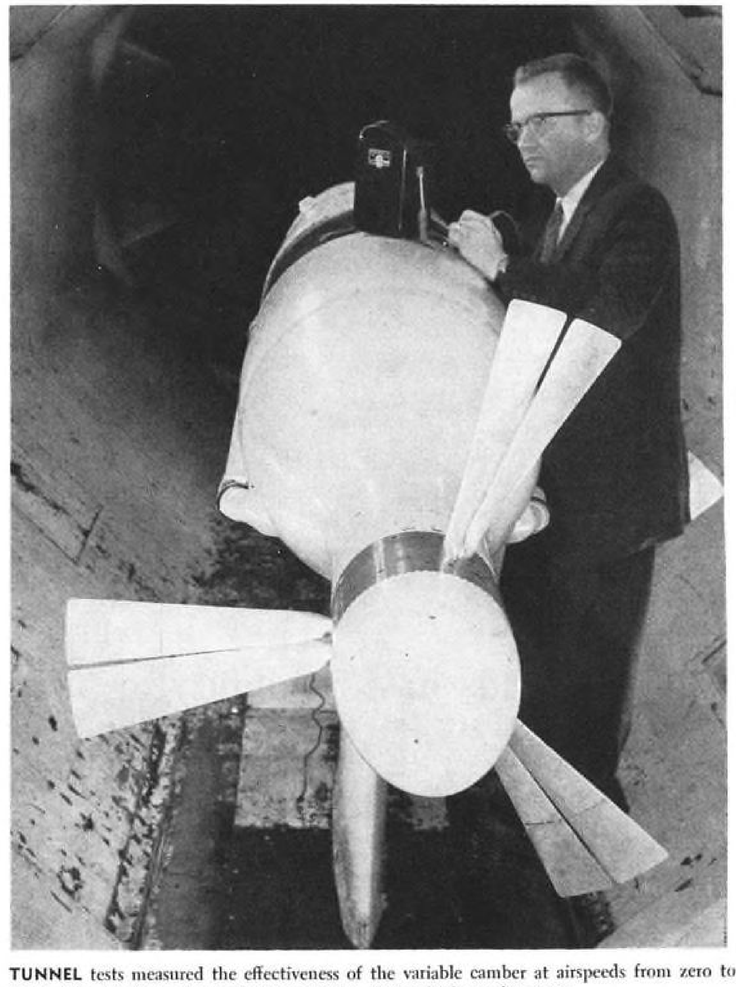
- **A 40% payload increase** from 4,000 to 5,600 lb.
- **A 30% range increase** from 1,000 to 1,300 lb.
- **Alternative benefits** of the variable camber prop might be a 20% reduction in propeller diameter or a decrease in engine power.

Hamilton-Standard feels that a turboprop transport aircraft equipped with the variable camber props will enjoy economic advantages over the turbofan in the Mach .6 to .8 speed range. Below this speed range, conventional propellers are adequate; above this speed, propellers lose out to pure jets and turbofans.

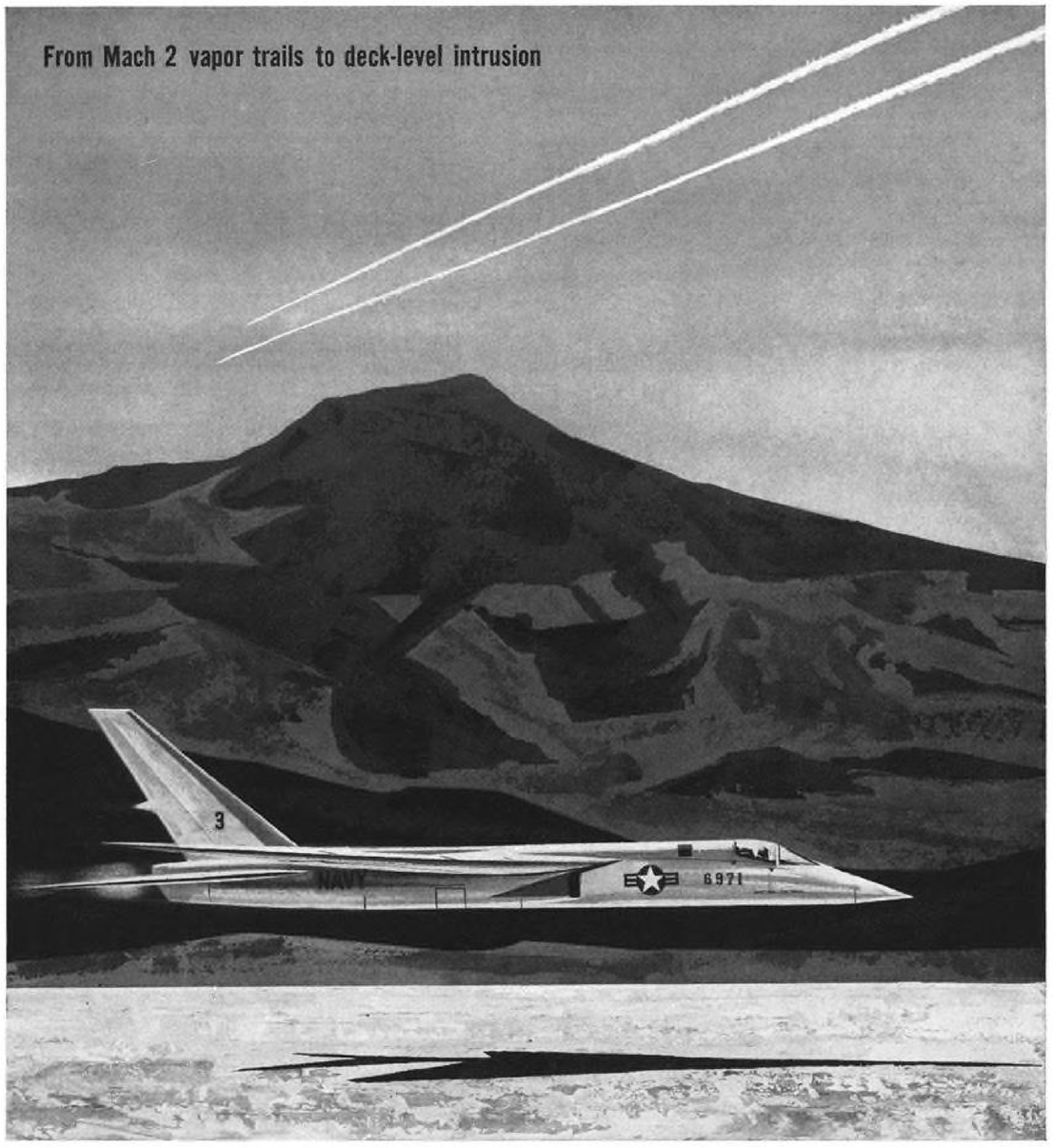
Design Potential

In attempting to demonstrate the design potential of the variable camber propeller on a high speed (Mach .6 to .8) cruise transport, Hamilton-Standard cites the following alternative performance benefits:

- **Decrease of 15%** in takeoff roll might be gained. The company's hypothetical transport shortened its takeoff over obstacles from 5,000 to 4,250 ft.
- **Payload increase of 30%,** from 20,000



TUNNEL tests measured the effectiveness of the variable camber at airspeeds from zero to Mach 0.6. Engineer checks instrumentation during high camber tests.



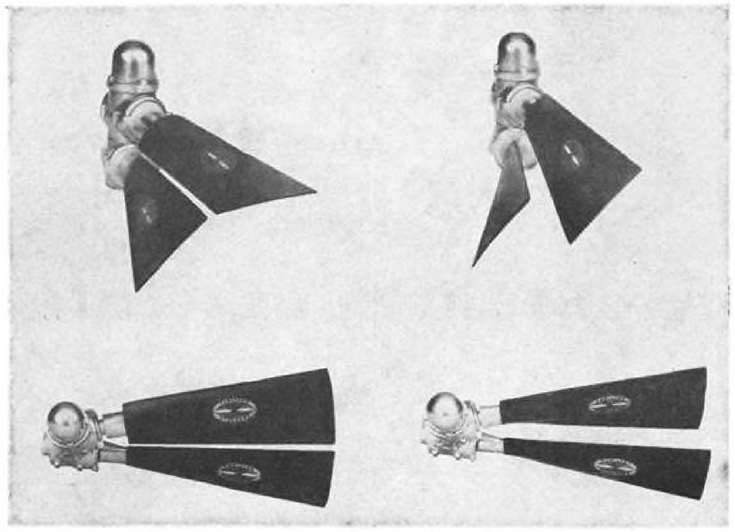
The A3J adds new flexibility to America's sea-air power

Small enough to land on a carrier deck, yet potent enough to pack a heavyweight punch, the Navy's A3J Vigilante is the world's most versatile Mach 2 airplane.

It is capable of long-range interception, low-level attack, or high-performance strike missions. Its short-field landing capability makes it an ideal major support weapon for limited warfare. And advanced control systems equip it to deliver weapons from any attitude, at any altitude, and in any weather.

The A3J—a compact, businesslike, hard working airplane with unlimited talents—was designed and built by the Columbus Division of North American Aviation.

THE COLUMBUS DIVISION OF **NORTH AMERICAN AVIATION, INC.**
Columbus, Ohio



MODEL propeller blades demonstrate the change in effective camber of the variable camber propeller. During takeoff the blades form, effectively, three high camber airfoils; cruise performance is gained through six paired low camber blades.

to 26,000 lb., would be achieved over a 2,500 mi. stage length.

• **Range increase of 20%**, from 2,500 to 3,000 mi., with the 20,000 lb. payload could be achieved.

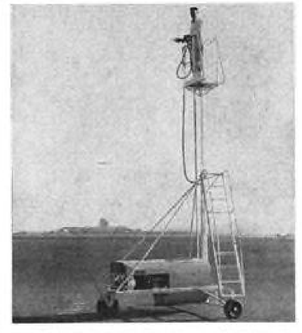
One holdback to the application of the variable camber propeller to high subsonic speed transports is development of high power turboprop engines which have taken a back seat to the turbofan. Despite design advantages, acceptance of a high speed turboprop will require a reversal in the thinking of engine designers, many of whom are convinced that the greatest benefit of the turbojet was its elimination of the propeller.

Hamilton-Standard, along with other prop manufacturers, is acutely aware of the trend away from propellers. The company, therefore, is enthused that an immediate demand for its propeller exists in the VTOL vehicle. As far as transport aircraft go, it can only hope that the inherent advantages of its propeller will stimulate efforts in the turboprop powerplant field.

The variable camber propeller will be conventional in its hydramatic controls. Although the original wind tunnel model employed six blades, eight-blade models will be investigated. One problem may be in fitting the blade roots into the propeller hub. This has limited most metal propeller designs to four blades, but the tandem blade arrangement may surmount this obstacle.

Camber change of the propeller will be programed along with pitch change. The pilot will have the usual prop governor control of any constant speed propeller. As the prop speed is brought back to cruise rpm., the effective high camber airfoils will be rotated to form six low camber blades.

On takeoff, the front blade only will maintain constant speed. The propeller will be capable of full feathering and reverse pitch may be provided.



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Mitchell glycol sprayer speeds de-icing job!

Mitchell's Glycol Sprayer, used successfully on several airlines for two full seasons, is now available for jets. Working platform extends on hydraulic lift to 16 feet. Tank capacity has been doubled. Booster heater gives 30°F temperature rise at maximum flow. Write for details.

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The cases are splash proof and dust tight, of close fitting bakelite. Husky black-finished aluminum indexing knobs are used to turn the stainless steel shaft supporting the rotating brushes.

RESISTANCE BULB SWITCHES

A companion line of the same construction except that they are fitted with a common-terminal ring for three-wire bulb connections.

THE 9S SERIES
THE SPACE SAVERS

FOR AIRCRAFT RESISTANCE THERMOMETERS



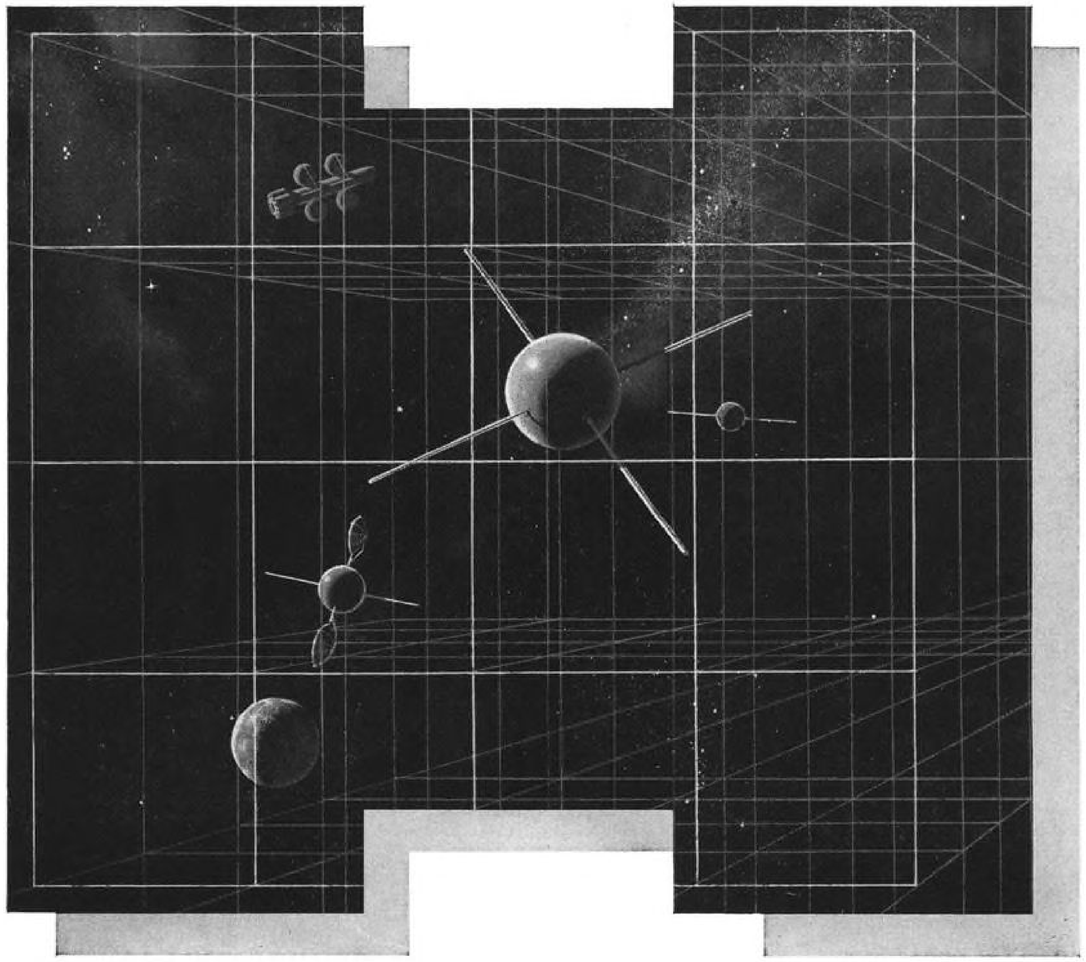
1¼" dia.

Small, sturdy, steel-cased switches 1¼ inches in diameter, 2-9/32 inches total shaft length, one hole mounting with ½-32 NS-2A threaded bushing. Designed especially for connecting two or more resistance temperature detectors to one instrument, now flying in the modern jets.

Write for our descriptive bulletin on Selector Switches

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How to take a satellite census



At present rates, man will soon have space cluttered with numerous orbiting objects. These objects are creating a major space-age problem.

This extra-atmospheric clutter can be resolved, sorted and classified at great range by a new systems concept of satellite intelligence now being developed by Hughes.

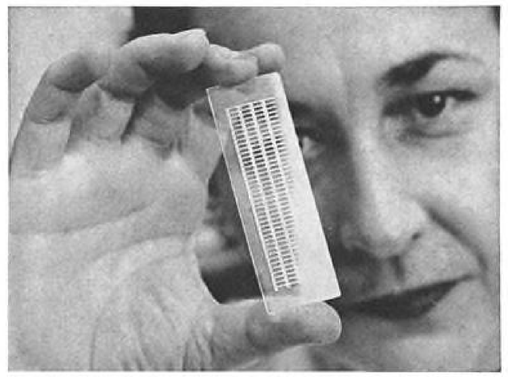
The prime sensor is a highly flexible, computer-programmed radar which can chop space into billions of small information cells on thousands of simultaneous beams.

This enormous multiple-beam capacity permits search, track and examination of huge numbers of targets. It also provides the capability for transmitting control information to defense systems or satellite platforms.



These alpha-numeric displays, *developed by Hughes Fullerton engineers, can simultaneously plot hundreds of fast-moving aircraft.*

Starting with an etching *made from an original drawing, this extremely small electrode structure is created by vacuum deposition. The unusual matrix of memory cells is used in Hughes data processing equipment.*



These capabilities require a new beam-scanning technique, a major step beyond frequency or phase control of arrays. This kind of advance is typical of the work done by Hughes in radar.

For Hughes was the first to develop three-dimensional radar, the most important advance in the state of the art since radar itself was invented.

This work draws on Hughes' unique experience in virtually every area of advanced electronics, including: space ferries, microwave communications systems, airborne control systems, air-to-air guided missiles, signal recovery techniques, radar and IR detection systems, and many others.

The reliability and operational capabilities of these systems have earned them the confidence of users throughout all the free world.

Creating a new world with ELECTRONICS

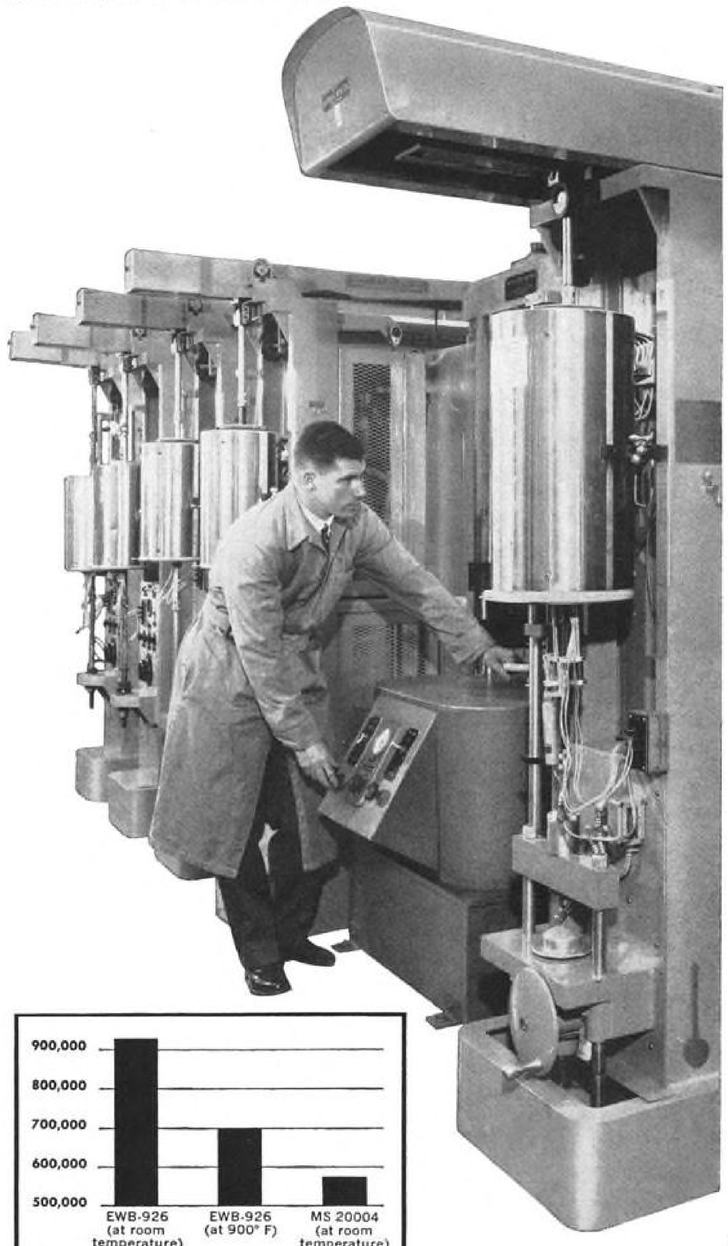
HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo, Fullerton, Newport Beach, Malibu, Oceanside, Santa Barbara and Los Angeles, California; Tucson, Arizona.

New from SPS . . .

260,000 psi aircraft bolt with high strength-to-weight ratio at temperatures to 900°F

High temperature testing of new EWB 926 bolt at SPS Laboratories for Advanced Research



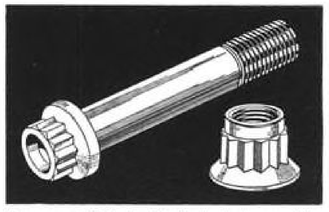
SPS's new EWB 926—a 12-point external wrenching bolt—has what it takes when the going gets hot! Its performance at 900°F actually tops that of a standard MS 20004 series bolt at *room* temperature. The EWB 926 delivers a tensile strength of 200,000 psi at 900°F. And a designer using this bolt can build in 160% more strength than with use of 160,000 psi room temperature bolts.

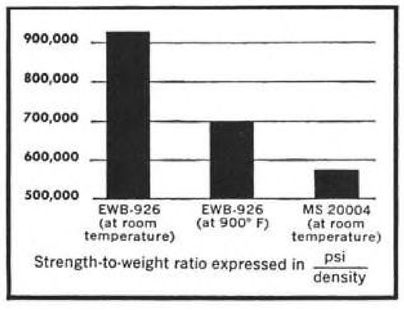
What's more, the EWB 926 affords you significant weight savings. Since it provides the same holding power as bolts two to three times as large but of less strength, smaller diameters can be used. Also, because of the reduced bolt hole required, smaller flanges and other structural savings are possible.

Behind this combination of high strength-to-weight ratio and superb performance at elevated temperatures lie careful selection of material (5% chrome, ultra-high-strength steel alloy), thread rolling *after* heat treatment, Hi R thread form with increased root radius, cold working of head-to-shank fillets.

Additional characteristics of the EWB 926 include:

- Fatigue strength and tensile strength proportionately high
- High minimum shear strength—156,000 psi
- Performance-proved diffused nickel-cadmium finish for oxidation and corrosion resistance at high temperatures
- High stress-rupture life
- Available with lightweight companion locknuts—FN 926 series—in sizes from #10 through 7/8 in.





For complete technical data on the EWB 926 and the FN 926, write for new Bulletins 2578 and 2651. Standard Pressed Steel Co. AIRCRAFT/MISSILE Division, SPS, Jenkintown 3, Pennsylvania • Santa Ana, California.

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POD LOADING positioning trailer under Convair B-58A Hustler shows the small amount of working space available, which made it necessary to design considerable automation into loading procedure. Trailer maneuvers pod for exact mating to bomber.

Units Speed B-58 Pod Ground Handling

By Erwin J. Bulban

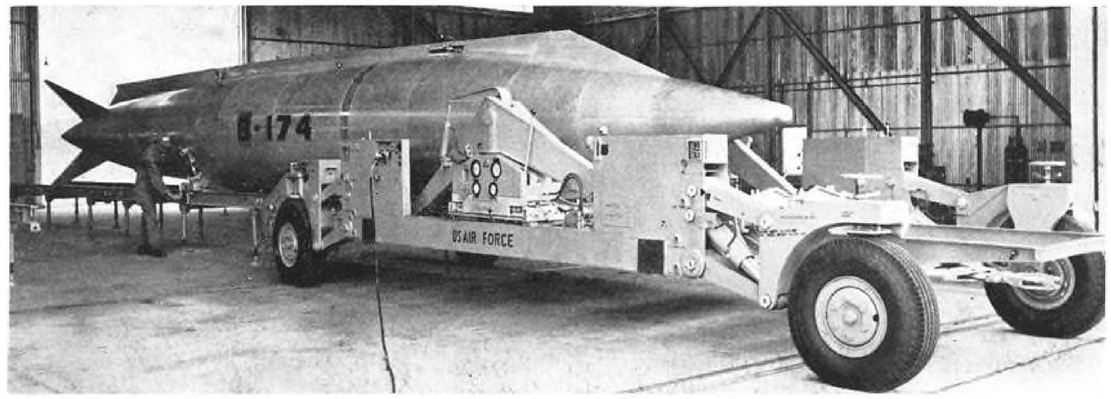
Ft. Worth, Tex.—Versatile ground support system for storing, transporting and quickly loading the large fuel-weapons pod that provides the Convair-Ft. Worth B-58A Hustler bomber with its nuclear strike capability has passed U.S. Air Force evaluation at Carswell AFB here and is now in production.

The B-58A's strike and restrike capability hinges to a large extent upon the speed and ease with which ground crews can handle and load the 57-ft. long, 5-ft.-dia. streamlined pod, particularly in the last stage where they are operating under the bomber, where space is at a premium. Convair-Ft. Worth's ground support equipment section was faced not only with the need to consider ease of handling and speed, which was solved by turning to as near push-button control as possible, but also the problem of keeping costs down.

The system they evolved in cooperation with engineers of Space Corp., Garland, Tex., which is producing it for USAF, consists of a series of three basic components:

- **A storage and work-stand** unit mounted on 12 adjustable legs, which will be located at a weapons site, probably some distance from the flight line.
- **A transport trailer,** to which the pod is transferred and then trucked to the loading site, at or near the flight line.
- **A positioning trailer,** to which the pod is transferred from the transport unit, which has the capability of maneuvering the pod under the B-58A for exact mating to the bomber.

The three units are provided with exactly spaced rail systems, so that each can be connected to the others in the proper sequence and the pod transferred via movable cradles rolling on these rails. Rails on the transport trailer can be adjusted vertically or laterally to mate with those on the



HUSTLER POD is transferred from storage-work-stand unit to positioning trailer, showing how rail system can be matched up between any of the pod handling system units. Normally, pod would be loaded similarly onto transport trailer.

example...

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Compression molded high temperature insulation materials at work...

red eye missile



for Nose Cones, Blast Tubes, Exit Cones and Aft Closures

Minimum erosion, ablation combined with dimensional stability and shock resistance over 5000°F.

Fiberite compression molded high temperature insulation materials designed for MIL-M-19536 applications; chopped fiber impregnated phenolic with special reinforcement materials as fiberglass, graphite cloth, ceramic, and quartz. Fiberite insulation is specified in the LAR, Bull-Pup, Polaris, Minuteman, Nike Zeus and many others.

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Winona, Minnesota



SAC AIRMAN, wearing loading control console, climbs atop positioning trailer to make final fine adjustments for exacting mating. In final 1½-in., positioning trailer provides freedom of movement so that pod will not overstress aircraft in event of asymmetrical contact. In center of trailer's right side is standby wobble pump system that can be used for pod loading.

storage and positioning units. The cost was the basic reason for developing the three-component system. The complex positioning trailer inventory can be kept to a minimum using the transport trailers to shuttle to and from the weapons storage site and the positioning trailers meeting them after completing a loading to pick up another pod and returning to the airplane. Each 36-aircraft wing of B-58s will have an inventory of 103 storage and work stand units, nine transport trailers and nine positioning trailers. Transport trailers cost approximately one-third that of a positioning trailer, so the savings in the system envisaged here are obvious.

Designed for Mobility

All units are designed for maximum surface or air transportability. Legs on the storage and work-stand unit, for example, are easily removable and the unit can be tied down to a flat-bed trailer or in an airplane while providing enough adequate clearance for the pod fins.

The positioning trailer is the heart of the system. With a 15,000-lb. load capability, it is a four-wheel steerable unit with two-wheel hydraulic drive that permits movement at some 2 mph.

A four-man crew steers the vehicle under the bomber.

Bed of the positioning trailer is operated by an air-oleo system that doubles as a shock system while the unit is moving and restricts bouncing loads to 2g. Once in position under the bomber, the trailer is locked in position by four jacks that extend to the ground.

From here on, a crew chief raises the pod, using an electrically driven hydraulic system. Guided by three strategically placed ground crewmen equipped with earphones, he can exactly position the pod by actuating controls on a small cubic-foot console suspended from his neck. Controls permit him to move the pod six inches forward, backward or to either side, minus pitch and 1½-degrees plus-or-minus pitch and 1½-degrees plus-or-minus yaw. Since the B-58A has a critical center of gravity, complete freedom of motion is designed into the pod loading device in the last 1½-in. of movement possible so that, should it contact the underside of the airplane unsymmetrically, it will not impose a loading that would overstress the pod or the aircraft.

Lock-on is accomplished by two hooks at the rear of the pod pylon and one at the front; large Allen-type wrenches are used to provide final tightening up.

Although the loading procedure sounds complicated, the recent USAF six-weeks evaluation at Carswell AFB to check its "go-to-war" capability, showed that "green hands" could load the airplane and remove the positioning trailer in 20 min., including time used in positioning the trailer under the airplane.

Low Cost Barrier Developed for FAF

Paris—French air force is adopting an inexpensive runway arresting barrier based on mechanical braking and remote control operation.

FAF system, developed in France, reportedly meets standards higher than those demanded by NATO. System costs roughly $30,000, plus $5,000 for installation and is being installed at 25 FAF bases.

FAF has been using earlier USAF chain-drag braking units as well as a Swedish pneumatic braking system. The new FAF system, the French claim, is considerably more flexible to use and cheaper to install and to operate than these U.S. and Swedish systems.

French barrier system is designed to arrest aircraft either taking off or landing.

Braking force can be set at any of three values. At the lowest value the equipment stops a 10 metric ton aircraft traveling at 107 kt. within 650 ft. after hitting the barrier. At its highest value the equipment stops the same aircraft hitting the barrier at 185 kt. For heavier aircraft, up to 30 metric tons, top impact speeds are lower.

For example, maximum braking equipment handles 30 metric ton aircraft at 107 kt.

Braking effect is progressive and deceleration felt by the pilot is always less than 2g. During the recent NATO demonstration at Istres, FAF test center, a Dassault Mystere IV, weighing seven tons, went through the barrier at 120 kt. Aircraft, which itself had activated the system, came to a stop within 460 ft. System was ready to operate again within 30 min.

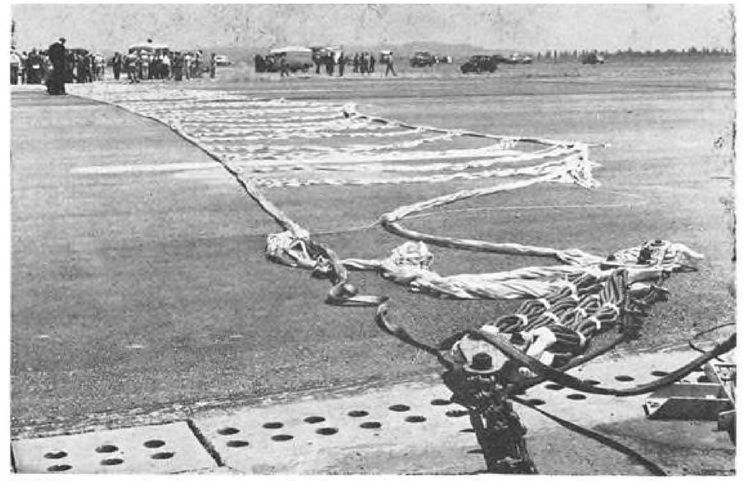
Weighing seven tons, FAF system consists of three main elements:

- **Two dry-friction brake drums** located on each side of the overrun area.
- **Nylon barrier** made up of 28 nets of flat nylon straps which form a barrier 45 meters wide (137 ft.) and four meters high (13 ft.).
- **"Electric eye" remote control** posts which straddle the runway some 400 meters (1,320 ft.) from the nylon barrier.

Behind each brake drum is a cable storage unit. The cable is wound 11 times around the brake system, made up of steel and bronze disks, and then runs out to the nylon barrier. The cable is attached to the barrier via a nylon shock absorber to handle shock at the rebound.

The system works in the following manner:

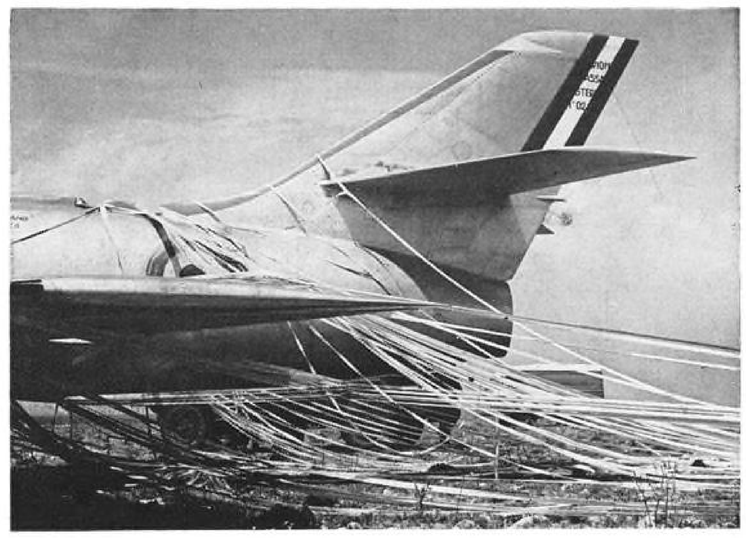
An aircraft passing between two photoelectric posts located one behind the other on each side of the runway



NYLON runway barrier developed for French air force is shown in inactive position; barrier is activated when aircraft trips remote control posts. Forces are less than 2g.



BARRIER is shown in activated position (above) after plane trips remote posts. Below is Dassault Mystere IV after arresting. Note damage to forward tail fairing.



determines whether the barrier is activated. The barrier is raised if the aircraft's speed is calculated as too fast to stop the plane with its own brakes, or too slow for normal takeoff. These speed values can be varied, but the aircraft speed activates the barrier. The latter, however, also can be commanded from the control tower or from a control board situated near the arresting equipment.

When the aircraft hits the barrier, the brake drums start operating progressively. Blocking of a brake is impossible, French say. Moreover, if one brake is working more than the other, there is automatic compensation. Thus the aircraft is held roughly on a straight line no matter where it hits the barrier or its angle of impact.

French engineers say that even in case of high stress, brake heating is negligible.

Brake disks show little wear or fatigue effects even after repeated use.

Tower Control

Another feature of the system is that the three values of braking force can be selected from the control tower. Thus if a heavier aircraft, not typical of an airfield's normal traffic, has to be handled, control tower operators merely increase the braking power by push-button command. The barrier is ready for the heavier load within 5 sec. after the command signal.

Once used, the nylon net is refitted and a new cable from the storage unit is threaded through the brake unit. Rolled-off cable can be fitted again on the cable reserve if it isn't defective. Designers recommend the ¾ in. cable not be used more than twice, except when only 120 to 150 ft. have been rolled off. Used cable in this case is merely cut off.

Barrier is ready for use again within 30 min. from emergency operation. This time is shortened to 10 min. if a standby nylon net is kept ready. Brake drum requires no regulation after use.

Barrier was designed to FAF specifications by three French companies headed up by La Societe des Ateliers Rolba, Grenoble. French companies hope to market their barrier design throughout the NATO region.



PRODUCTION BRIEFING

Weather sounding rocket, capable of taking a 6-lb. payload to 230,000 ft. and designed to be fired from a 5-in. gun for shipboard use or from its plastic shipping container, has been designed by Solid Propellant Operations, Rocketdyne Division, North American Aviation, McGregor, Tex. Ammonium nitrate propellant, extruded into a single star-shaped grain, provides 660 lb. of thrust for approximately 13 sec. to the 105-in.-long, 4-in.-dia. vehicle.

Collins Radio will investigate problems involved in communicating with unmanned soft-landing lunar probe vehicle both during flight and after landing under contract awarded by McDonnell Aircraft Co. McDonnell is one of four companies conducting five-month study of an instrumented lunar probe under contract with National Aeronautics and Space Administration's Jet Propulsion Laboratory (AW July 18, p. 33).

Northrop Corp. has a $950,000 Air Force contract for research in low drag boundary layer control.

General Electric Co. has delivered the first production model Polaris fire control trainer to the Navy. Trainers will be installed in Polaris submarines to help crews maintain proficiency.

Chance Vought Aircraft has a $3.5 million contract to install a new electronic guidance system in Regulus I to supplement the missile's radio command guidance system.

Convair B-58 entered Category 3 of its operational and evaluation program

see Giannini's newest products, Booths 758 — 759 WESCON, Los Angeles Sports Arena August 23 — 26

Giannini Controls Corporation
A NAME TO PLAN WITH

HETEROGISTICS

It's a non-Aristotelian world; few of us can take our syllogistics straight. Most of us chase them with a swig each of empirical data and educated hunch. Let's call it **Heterogistics!** Example: 1 Premise: Giannini's systems capability is based on unsurpassed depth of component experience in **Air Data Instruments, Inertial Instruments, Servo Components.** 2 Premise: From that depth comes a standard of performance best appreciated by those who already depend on Giannini for better measurement and control, everywhere on earth and above it. 3 Add: Long experience in anticipating and solving complex systems problems; continuing research into changing requirements for component performance. ● Conclusion: Giannini is a Name to Plan With.



THESE AND DOZENS OF OTHER MEASUREMENT AND CONTROL SUBSYSTEMS IN DAILY OPERATION HAVE BUILT THE GIANNINI REPUTATION FOR FAST, KNOWLEDGEABLE DEVELOPMENT OF **SYSTEMS**

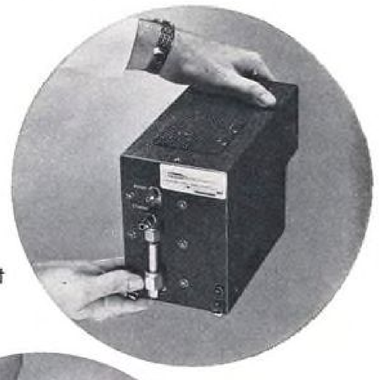


A "GUN BARREL" HALF-A-MILE LONG

The need was for a new inertial platform. Small and light enough for tactical missiles. Yet able to keep the boost trajectory gun-barrel-straight and the impact dispersion small. • First to answer the need was Giannini with a revolutionary new inertial system you can hold in your hand . . . and which costs one tenth as much as full guidance. • This startling development is made possible by Giannini's diversified capabilities and is based on two exclusive Giannini components. A miniature free gyro. And an ultra-miniaturized accelerometer which senses very small lateral accelerations, yet ignores the high g's of boost thrust.

PITCH TRIM COMPENSATOR FOR DC-8 JETLINER

Problem . . . As aircraft proceed into the transonic speed range, aerodynamic trim characteristics change. An adjustable Mach computer and power package were needed to deliver corrective force at the pilot's control column. • Solution . . . Giannini delivered a small, highly accurate servocomputer-controller with a pulse-modulated output. • Douglas now specifies the Giannini Trim Compensator system as standard equipment on every DC-8 delivered.



THREE-AXIS RATE GYRO SYSTEM FOR TITAN

Flight stabilization of the Martin Titan required a package gyro system—to provide the highest degree of performance stability, accuracy and reliability under severe environmental conditions. • Giannini met the requirement by designing a three-axis gyro system for flight control and for telemetering pitch, roll, and yaw rates. Two of these subsystems are used in every Titan.



THIS MAKES GOOD SENSE: HE WHO KNOWS MOST ABOUT ALL THE PARTS CAN BEST PUT THEM TOGETHER INTO A WHOLE THAT WORKS. ONLY GIANNINI HAS PROVEN EXPERIENCE IN SUPPLYING ALL OF THESE **COMPONENTS**



AIR DATA INSTRUMENTS

Giannini Air Data Instruments offer you the widest choice in the industry. For years they have set avionic standards and served as building blocks for control and flight test subsystems. The Air Data line includes: **Absolute, Differential and Gage Pressure Transducers — Servoed Pressure and Pressure Ratio Instruments — Probe and Vane Sensors.** All give evidence of a progressive engineering philosophy that emphasizes originality, simplicity, flexibility.

SERVO COMPONENTS

The Giannini line of precision potentiometers and special electromechanical devices meet standard and special needs for all types of high-performance servo systems. Included are: **Precision Potentiometers.** Linear and non-linear. Single-turn and multi-turn rotary. Low-torque models. Rectilinear units with or without spring loading. Unique Spiralpot® with infinite resolution from a wire-wound element. **Stepping Motors — Segmented Torquers — Milliwatt Motors.** More reasons why Giannini serves aerospace engineering/management fast and well . . . in design, liaison, production, field service.

INERTIAL INSTRUMENTS

Success in the design and production of inertial instruments puts a premium on the maker's experience. For more than a decade, Giannini has been developing outstanding inertial components for the nation's missiles and spacecraft. The line includes: **Gyros, Rate and Free.** High-level AC or DC output. AC and DC electrically powered rotor. Pyrotechnic rotor. High reliability in presence of unfriendly environments. **Accelerometers, Linear and Statistical.** Environments: normal, high-temperature, intense nuclear radiation. **Integrating Acceleration Switches.** Used by virtually all major prime contractors in scores of world-wide projects.







FACILITIES . . . A PLANNED FLEXIBILITY

Every Giannini product is designed to solve a specific problem. Often, a problem never before solved. This calls for utmost flexibility. In design. In manufacture.

At Giannini, flexibility is management-planned and management-guided with emphasis on these basics: Qualified personnel. Continuous training. A core of proved principles and procedures. Awareness of schedules. Control of critical processes. Responsibility with authority.

These basics guide the work of all Giannini departments and echelons. You benefit from them when you choose Giannini as your contractor for advanced subsystems management and creative development programs.

SALES ENGINEERING OFFICES

Ask a Giannini representative to call for a friendly, informative talk about your system and component needs. You'll find he has been selected for high technical competence and for his attitude of helpful service.

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WASHINGTON
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AXminster 9-7383

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CApital 6-7777

TECHNICAL LITERATURE

Like a parabolic antenna to the space pilot, case studies and other Giannini technical literature focus valuable information and guidance for those with advanced design and project responsibilities. Please order by title or number.

System Case Studies

1. Trim Compensator for Jet Liner
2. Stall Warning System for Douglas Cargomaster
3. Compact True Airspeed Computer for Rugged Environment
4. Voltage Monitor for Telemetry System
5. Engine Pressure Ratio System for Jet Aircraft
6. Variable Inlet Controller for Supersonic Fighter

Component Data

7. Air Data Instruments
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10. Giannini Technical Notes

Giannini Controls Corporation 1600 South Mountain, Duarte, California
A NAME TO PLAN WITH

Explore new career openings. Write to Giannini's Director of Technical Personnel.

when 12 of the bombers were turned over to the Strategic Air Command last week at Carswell AFB, Ft. Worth. The 43rd Bomb Wing will conduct combat crew training and evaluation missions. Second wing will be 305th at Bunker Hill AFB, Indiana.

Army has awarded $30 million contract to Martin Co. Orlando Division for continued work on Pershing system, including engineering services and hardware procurement.

Pratt & Whitney Division of United Aircraft, E. Hartford, Conn., will continue development of the J52 engine under $11.2 Navy contract. The 8,500 lb. thrust engine powers the Grumman A2F, the forthcoming Douglas A4D-5 and the North American Hound Dog air-to-surface missile.

Northrop Corp.'s Radioplane Division, Van Nuys, Calif., will build an additional 300 RP-76 target missiles under Army contract. The total contract, including spares, ground support, control and checkout equipment, is $4,147,748.

The Garrett Corp.'s AiResearch Mfg. Division, Phoenix, Ariz., will produce 232 small gas turbine engines for the Navy and 30 for Convair. The Navy contract will be for various ground power applications both on shore and on board aircraft carriers. The Convair turbines will support the B-58 bomber. Contracts for the 262 turbines total approximately $10 million.

Twin Coach Co., Buffalo, N. Y., will continue production of Boeing 707 fin and rudder assemblies under a $1.5 million follow-on contract from Boeing. Deliveries of the assemblies will begin in March, 1961, and continue through the following November.

General Electric's Large Jet Engine Dept., Cincinnati, Ohio, will refine the J79 jet engine used on the Convair B-58 under $2 million Air Force contract.

Western Electric Co. has a $11,341,510 Army contract for development of high volume manufacturing and inspection techniques, special tooling, test equipment and facilities required for Nike Zeus components, plus contracts totaling $6,658,490 for development of advanced production techniques for Zeus electronic components.

Contract exceeding $1 million for depot-level maintenance of USAF Douglas C-133A Cargomaster turboprop transports has been awarded

TIME TEAM

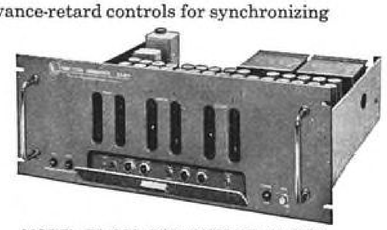
EECO'S ALL-STAR LINEUP OF TIME CODE GENERATORS COVERS ALL THESE BASES

From missile base to basic research, in launching-area heat or Dew-Line cold, Electronic Engineering Company answers your project's time code needs with these outstanding time code generators . . . for binary or BCD readouts, coded for Atlantic Missile Range, Eglin Test Range or the new Inter-Range Instrumentation Group (IRIG) format proposed for world-wide use in satellite tracking.

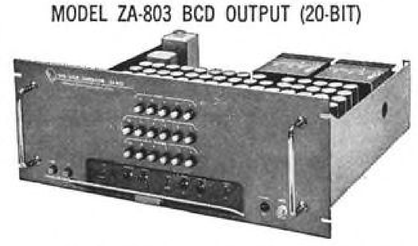
All EECo time code generators can be used with oscillographs, strip chart recorders, magnetic tape or for driving neon flash lamp amplifiers . . . for time-correlation of data recorded by different instruments at one or more sites. All have advance-retard controls for synchronizing internal 1 pps to WWV.

MORE ACCURACY PER DOLLAR
Both time-of-day code output (24-hour recycling) and any 2 of 8 pulse rates. Time-correlate data to within ±1 millisecond at a cost of only $7,650 for the ZA-801, $7,050 for the ZA-802. Frequency Stability: 3 parts in 10^8 per day.

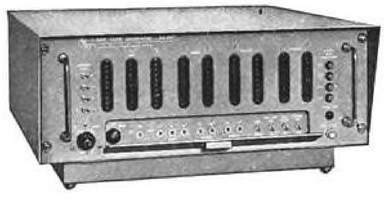
Compact ... solid-state plug-in circuits ... sized for standard rack mounting. Complete unit, including power supply, 7" x 19" x 17".



MODEL ZA-801 BCD OUTPUT (24-BIT)
MODEL ZA-803 BCD OUTPUT (20-BIT)



MODEL ZA-802 BINARY OUTPUT (17-BIT)



MODEL ZA-810 36-BIT 100 PPS CODE
ALSO MODEL ZA-810-M1
23-BIT 2 PPS CODE (IRIG TYPE C)

GENERATES NEW IRIG FORMAT
These new solid-state time code generators use proposed Inter-Range Instrumentation Group formats. ZA-801, currently being used for National Bureau of Standard broadcasts over WWV.

Both generators have same high accuracy as ZA-801 and 802. Packaged plug-in circuits. Complete unit 7" x 19" x 18". Weight only 35 pounds. Price of either model: $11,180.

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CLOSER THAN YOU THINK

Yes . . . The world has shrunk and now the Universe is shrinking, due to man's restless thirst for knowledge. California General . . . fabricators of assemblies for missiles and rockets . . . is playing a significant role in helping to bring the bodies of outer space closer to us.

One of California General's products . . . exhaust nozzles for rocket engines . . . is an essential part of the vehicle which will eventually carry man into space . . . making us closer neighbors to the moon and planets.

CALIFORNIA GENERAL, INC.

Foot of F Street, Chula Vista, Calif.

Temco Overhaul & Aerosystems, Greenville, Tex., by San Bernadino Air Materiel Area. First C-133 will arrive at Greenville this month and deliveries will continue through July, 1961.

Vitro Corp. of America's Vitro Laboratories Division received a $7 million USAF contract for operation and maintenance of the Eglin Gulf Test Ranges through June, 1961. Vitro designed and laid out the range system nine years ago.

Sikorsky Aircraft Division of United Aircraft Corp. will modify 30 H-37 helicopters, including installation of automatic stabilization equipment, under a $3,438,094 contract from Army Transportation Materiel Command.

American Machine and Foundry Co. will study methods of simplifying, standardizing and reducing number of Defense technical manuals, the volume of which has increased four times since 1950.

Ryan Electronics Division of Ryan Aeronautical Co. will build AN/APN-122(V) doppler navigation sets for installation in Lockheed P3V-1, ASW aircraft under orders exceeding $250,000.

Navy has awarded contracts for $28 million to Northrop Corp. for design, development and production of electronic components for Polaris fleet ballistic missile. Contracts include automatic checkout systems (AW July 25, p. 86), gyroscopes, Type 11 periscopes and radiometric sextants.

American Bridge Division of U.S. Steel has started erection of steelwork for construction of a new United Air Lines hangar for jet transports at Chicago's O'Hare International Airport. Hangar will be single leaf, cantilever-type building with a 320-ft. door.

Space Power Operation to design and build systems to power equipment in space vehicles has been formed by General Electric's Flight Propulsion Laboratory Department at Cincinnati, Ohio. M. A. Zipkin heads the new unit, which now is working on nuclear turbogenerator systems using high temperature liquid metal as the working fluid.

Kellett Aircraft Corp., Willow Grove, Pa., has been awarded a new contract by the U.S. Navy Purchasing Office for the manufacture of hydraulic hand trucks. The four-wheeled, portable stands are cantilever-lift type, with a 4,000-lb. capacity, and are designated Model NHS-1. The trucks will be used in maintenance support activities and for handling parts, supplies, weapons and other items in operational service.

Army Schedules 29 Test Flights For Fairchild Surveillance Drone

Washington—Army has scheduled a test program of 29 flights for the Fairchild long-range surveillance drone during Fiscal 1961 in a development plan aimed at issuing the drone to overseas troops by mid-1964.

Fairchild Engine and Aircraft Corp. AN/USD-5 will be first of three drone types designed specifically to support tactical field missile operations. Army has ordered 15 drones for the test program under a $48.6 million four-year development contract awarded in June 1957.

Rheem Manufacturing Co.'s short-range AN/USD-2 is scheduled for use by divisions and battle groups soon after the Fairchild drone becomes available. Republic Aviation Corp.'s medium range AN/USDA-4, to go to corps-strength units, is in the early development phase.

Long-endurance SD-5, to be issued to armies and army groups, has a range of approximately 1,000 mi. and flies at high subsonic speed. It will carry 150 lb. of instrumentation, which initially will be photo, infrared and radar sensors. Army Signal Corps is studying television, electromagnetic and radiation sensors for future installation.

The 8,500 lb. vehicle is built principally of plastics reinforced with glass fiber. Method of forming plastic structure under high pressure was pioneered by Fairchild in the canceled Goose decoy missile program. The USD-5 is 36 ft. long and 8 ft. high. Delta wing has a span of 24 ft.

The drone is launched from a zero-length rail. Solid fuel Picatinny Arsenal boost rocket burns three seconds, then drops off. Sustainer engine is a Pratt & Whitney J60 turbojet. Booster has a thrust of 40,000 lb., and the drone is controlled in the boost phase with a jetavator.

Inertial Navigation

Each mission is preprogramed, using an inertial navigation system for guidance. An autopilot is used for stabilization. As the drone approaches the recovery area, excess fuel is jettisoned and the engine flames out.

Twin recovery parachutes then deploy, and the landing shock is attenuated by air bags, one under the nose and one under each wing.

During flight, sensors transmit real-time data to a command post acquisition hut. System also contains on-board data tape which can be stored and removed after recovery.

First powered drone flight was made May 14, and second June 24, both at Yuma Drone Test Station. Initial flight lasted 70 min., and the second lasted more than two hours. Powered runs were preceded by three dynamic dummy launches to test the boost system and by two Boeing B-52 drops from 1,500 ft. to exercise the parachute system.

Pratt & Whitney J60 powerplant is the military version of the JT12, which earlier this month received its Federal Aviation Agency airworthiness certificate (AW Aug. 8, p. 39). The 436 lb. J60, rated at 3,000 lb. takeoff thrust, also will power the Republic SD-4 drone.

Army says manned reconnaissance aircraft will continue in combat surveillance use, but the fluid tactical situation envisioned in missile warfare makes unmanned drones necessary.

All Weather Capability

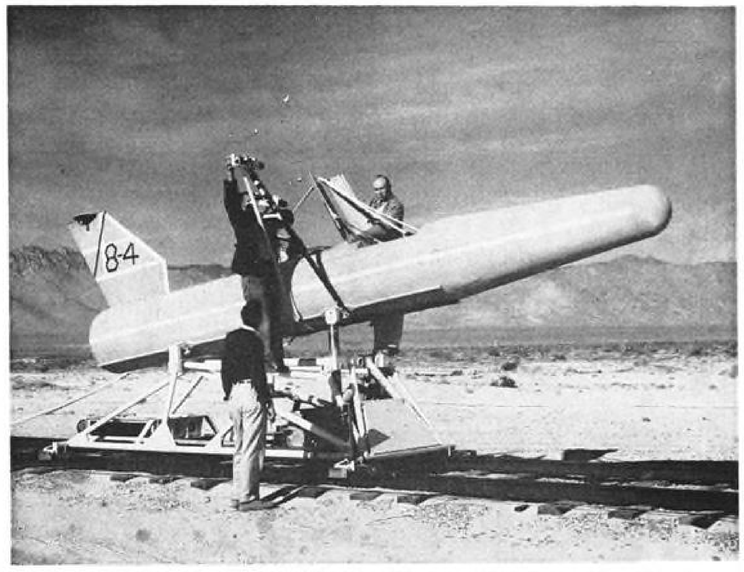
Col. George M. Wertz, deputy commander of the Army Combat Surveillance Agency, points out that reconnaissance vehicles must penetrate deep into enemy territory without regard to weather minimums. He said drones can be developed with range and performance characteristics giving reasonable chance of survival without requirement for airfields.

Fairchild is building vehicles and assembling ground support equipment at its Hagerstown, Md., plant. Systems manager for electronics, guidance and control is Fairchild's Astrionics Division.

Major subcontractors in addition to Pratt & Whitney are Space Recovery Systems, Inc., for landing systems; Texas Instruments, Inc., radar; Fairchild Camera and Instrument Corp. and Chicago Aerial Industries, Inc., cameras; National Electric Products Co. booster cases; Minneapolis Honeywell Regulator Co., inertial navigation; Eclipse Pioneer Division of Bendix Corp., autopilot; CBS Laboratories Division of Columbia Broadcasting Systems, Inc., data display; Philco Corp., computers, and International Telephone and Telegraph Laboratories, guidance.

The 29-flight test program scheduled for the remainder of this fiscal year will make use of 15 test vehicles. Fairchild estimates each production drone will cost $350,000-$400,000, and each data acquisition-ground handling system will cost about $2 million.

Ground support equipment will be used for more than one drone, and Fairchild will fabricate the vehicles so that parts most damage-prone can be replaced quickly by the launch crew.



Republic Tests Swallow Chute System on Sled

Republic Aviation missile engineers make final adjustments to this sled testbed prior to running tests on the main parachute system of Republic's Army SD-4 Swallow reconnaissance drone for the Signal Corps. Sled pushes the system down rails at from 200-300 mph. to check out mechanism which makes the Swallow recoverable. Swallow, a delta-wing configuration, is powered by a Pratt & Whitney JT12 turbojet engine (AW July 6, 1959, p. 85) and will use infrared detection and radar to report enemy activities.

IN PRODUCTION AND IN USE

BELL AVIONICS

MINIATURE ACCELEROMETER

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆



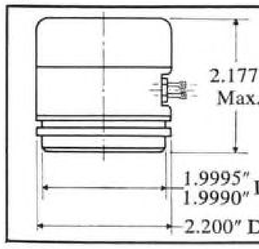
It's the LIGHTEST and SMALLEST with HIGHEST PERFORMANCE of any Accelerometer available in quantity today.

The BELL Model III B Accelerometer* is an electrically constrained, linear, inverted pendulum type with a D-C forcer and spring suspension. This precision instrument has been thoroughly tested and evaluated by government laboratories.

The superiority of Bell Accelerometers has been proved in many competitions. They have already been selected for such programs as:

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MODEL IIIB IS AVAILABLE WITH ANALOGUE OR DIGITAL CIRCUITRY

Range: ±45 g

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OTHER BELL AVIONICS PRODUCTS also designed and developed by Bell's Inertial Systems Laboratory under the direction of Dr. Helmut Schlitt include:

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NEW AVIATION PRODUCTS

Helicopter Power Unit

Electrical power unit provides d.c. current to start helicopters aboard Navy ships.

Model BS41-400K4 power supply is rated 26 to 38 v.d.c., 300 amp. with permissible overloads to 900 amp. The power supply unit contains magnetic amplifiers and silicon diode rectifying elements.

Christie Electric Corp., 3410 W. 67th St., Los Angeles 43, Calif.

Radar Safety Plate

Cathode ray tube safety plate, designed for FAA radar control centers, reduces eye fatigue without creating target distortion.

The plate incorporates a transparent conductive coating which is grounded to eliminate hand capacitance effect. A neutral density filter absorbs ultraviolet and increases the contrast ratio, permitting the scopes to be monitored in lighted control rooms. The safety plate may be supplied with or without the conductive coating, and with any desired color characteristic.

Marks Polarized Corp., 153-16 10th Ave., Whitestone 57, N. Y.

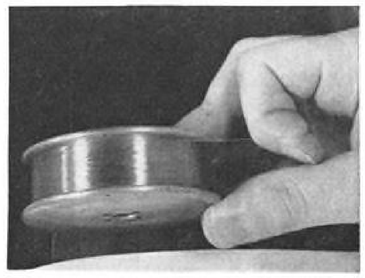


Maintenance Trailers Support Republic F-105

Air transportable trailers will permit squadron level maintenance on Republic F-105 aircraft at forward air strips. The trailers are designed for one of five operations: metalwork, electrical repair, painting, welding and pneumatic-hydraulic work. Self-contained power units provide 120 v., 60 cps. a.c. and two of the trailers supply air at 200 psi. Republic Aviation designed the F-105 ground support units.

Solid Rocket Wire

Steel wire is designed to form casings for solid fueled rockets. The wire,



which is combined with plastics to form the high pressure containers, has a tensile strength of 575,000 psi.

National-Standard Co., Niles, Mich.

Polaris Power Unit

Power unit drives the main hydraulic system of the first and second stages of the Polaris missile. The package has a guaranteed storability of five years.

The APU operates on 28 v.d.c batteries at 11,000 to 20,000 rpm. The pump section operates on MIL 5606 fluid with a maximum operating temperature of 275F. Pump operating range is designed to meet varying load requirements of first and second stages. An unaged silicone coating ages during heat of rocket firing to serve as a heat sink, thus protecting the APU from high temperature.

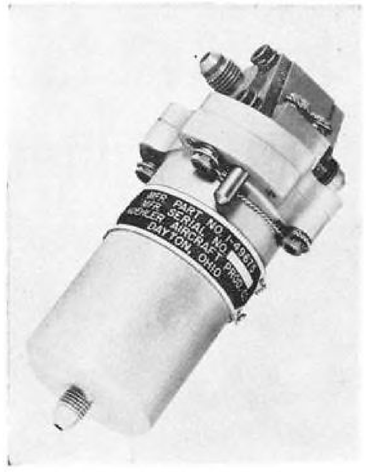


Vickers, Inc., division of Sperry Rand Corp., Detroit 32, Mich.

Rocket Igniter Shut-off

Pneumatic actuator controls the flow of SF-1 fuel to rocket motor igniter.

Helium gas is used to actuate a ¼ in. line ball valve which opens at speeds of 0.010 to 0.15 sec. and closes in 0.060 to 0.100 sec. Operating pressure of the cryogenic valve is 750 psig.; ambient temperature range is from −320 to +165F; pressure drop across valve



is approximately 14 in. of water at 400 pph. flow.

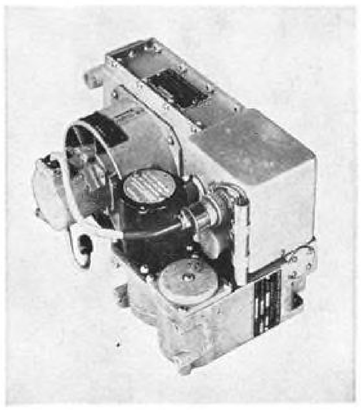
Koehler Aircraft Products Co., 409 Leo St., Dayton, Ohio.

ECM Cooling System

Liquid cooling system for airborne electronic countermeasures system consists of a hydraulic coolant pack with

a constant-mass blower-radiator assembly.

The cooling system components may



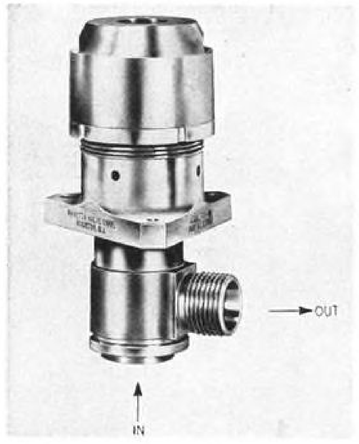
be mounted together (as shown) or separately. The cooling pack, weighing 17 lb. and measuring 8¼ x 7 x 13¾ in., has a capacity of 2,000 watts. Coolanol 45 is provided as coolant at a maximum temperature of 185F delivered at 1 gpm. and 55 psig. discharge pressure. Power requirements: 115/208 v., 400 cps., 3 phase, and 28 v.d.c. for control purposes.

Eastern Industries, Inc., 100 Skiff St., Hamden, Conn.

Hot Gas Valve

Pressure relief valve relieves excess pressure in solid-propellant gas generators. Original application was for an altitude control system for a re-entry vehicle.

The valve, model PRV-29, can be set at any cracking pressure between 1,250 and 1,650 psig. with operating line tem-



peratures to 2,000F. The unit is qualified to MIL-E-52720.

Marotta Valve Corp., Boonton, N. J.

High Temperature Locknut

Self-locking nut is rated at 145,000 psi. axial tensile strength with a temperature ceiling of 1,000F. The lightweight nut is intended for high performance aircraft and missile requirements.

The FN 1014 nut exceeds minimum NAS 1291C requirements and has a reduced-height hexagonal wrenching area for minumum mass. The nut is rated for locking torque on the basis of 15 separate seated applications at an induced bolt stress of 75,000 psi., rather than on basis of 15 unseated applications.

Standard Pressed Steel Co., Jenkintown, Pa.

High Speed Switch

Lightweight, high speed Size 8 rotary switch for use in aircraft or missiles has been developed to sequence or switch circuitry as a function of time or of shaft position.

High current loads can be handled when the switch is used in conjunction with sensitive relays or solid state switching techniques, according to the manufacturer.

Kearfott Division of General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

Unit Provides Night Landing Simulation

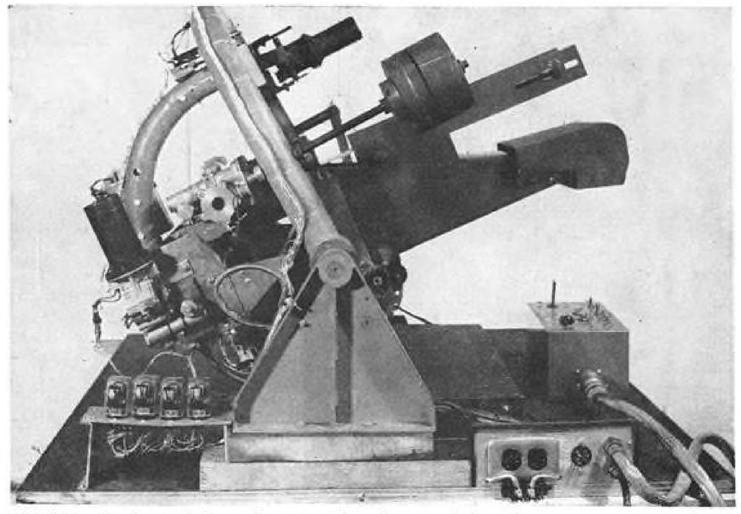
Washington—Flight simulator attachment, expected to reduce the costs of training pilots to shift from instrument to visual flight conditions in the landing approach area, has been developed by Burton-Rogers, Inc.

Simulator Landing Attachment for Night Training (SLANT) provides a realistic visual simulation of night landing conditions from the point of breakout through touchdown to the end of landing roll. SLANT has been demonstrated to the Navy and Air Force.

Simplicity and easy maintenance are claimed for SLANT by the company, which also claims that rear projection techniques used in SLANT, plus its compact size, will offer significant purchase and maintenance savings when compared with the costs of more complex systems using closed circuit television systems with simulators.

Heart of the system is a self-contained rear projection unit which is fitted to the front of the cockpit of a flight simulator so that a viewing screen, which forms one side of the projection box, is visible to the student pilot through the simulator windshield.

Different approach and runway light-



SLANT projection unit is cradle-mounted and counterbalanced to present varying degrees of runway approach angles. Special film feeds through boom arm, at the right of unit, for screen projection three feet forward. Disk weights above are counterbalanced. Servo drive motor at the top of the cradle governs aircraft yaw angle, while vertical-mounted servo on the rear presents sideslip action. Switchbox positioned on base mounting of prototype model is manually operated to pick up inputs from simulator trainer. Later production models will accomplish this task automatically.

New GV-1 tanker delivers jet fuel for the United States Marines

Now Marine Corps jets can refuel at 300 knots—over 25,000 feet high. The new GV-1 Lockheed Hercules tanker pumps jet fuel probe-and-drogue style at 300 GPM. There's a hose-pod mounted outboard of the engines on each wing, so the big tanker can handle customers two at a time. The GV-1 can rendezvous with jet fighters at 1000 miles from its home base to off load 28,000 pounds of fuel.
The first of the GV-1s will go on active duty this year.

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Men who read more ...earn more!

Most of us recall at least one classmate who "never cracked a book", but somehow got by. But today, in business and industry, "just getting by" isn't good enough.

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Recently, research in another field showed that men who invested five hours a week in reading business magazines earned an average of 75 percent more than those men who spent only an hour in reading. It makes sense in your business, too . . . doesn't it?

Men who read more...earn more!

ing configurations are presented by means of an opaque film strip within the projection unit. This film, which Burton-Rogers says will not stretch, is passed between a fixed light and a viewing screen so that a projected image is produced on the screen. Correct perspective of the image is controlled by maintaining an exact scale relationship between the film and the light source so that the scale reflects a true analogy of the relationship between the simulated aircraft and the runway.

Use of separate servo systems to sense each of the degrees of aircraft movement result in the accurate positioning of the film regardless of aircraft altitude, the company said.

Complete System

A complete SLANT system, all of which can be contained within the simulator training room, consists of the projection unit, the computer control housed in a separate cabinet to synchronize the visual display with the simulator, and a trainer modification kit to integrate the aircraft position signals.

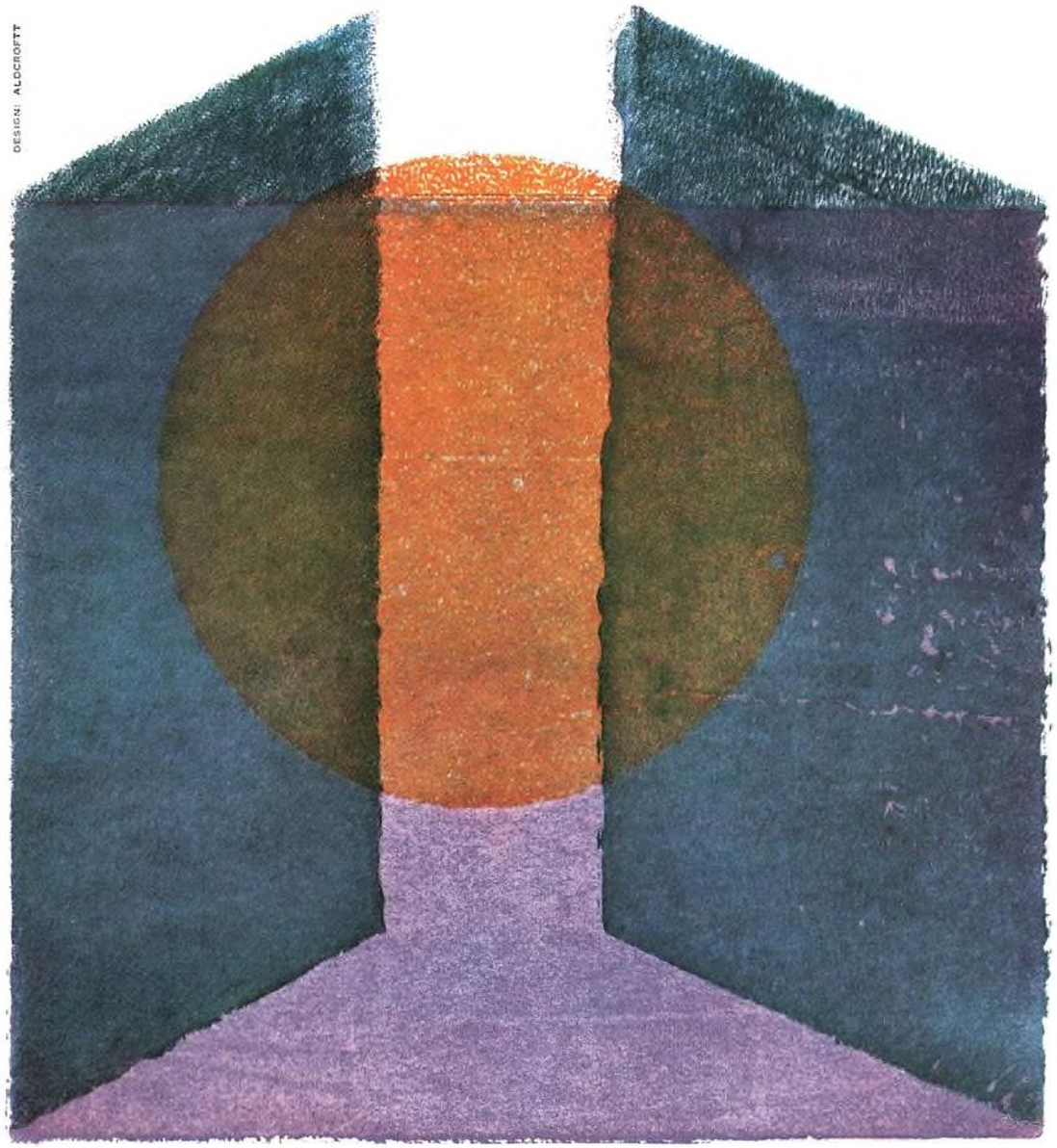
To provide further realism, variations in ceiling, visibility and broken cloud effects are produced within the projection unit by means of separately controlled, variable density light filters.

Burton-Rogers says that the use of rear projection techniques eliminates the image distortion and errors in perspective usually found in front projection systems because of the displacement between the projector and the eyes of the viewer. Company points out that the light source for the picture and the student are the same distance from the screen in SLANT, eliminating distortion.

In addition, company said the SLANT system with direct projection also eliminates two major problems encountered in systems which transmit pictures through a closed television circuit. These are the size limitations of existing television receivers and the loss of picture clarity through the resolution capability of the particular television system used.

Over-all Costs

While Burton-Rogers has not announced any firm price for SLANT systems, the company said that next to meeting basic training needs, its major design consideration was the over-all cost to the user. Advantages claimed are relatively low purchase, installation and maintenance costs. Company said considerable savings can be expected from the system because of its compact size which reduces the demand on floor space, the elimination of television equipment, the small degree of simulator modification and the versatility of changing airport layout patterns for the cost of an inexpensive film belt.



THERE IS NO ROOM FOR SMALL MINDS where men fathom the laws and create the vehicles of space. Nor is there any limit to what these minds can accomplish in a total celestial climate like Martin-Denver. If you seek the stimulation of projects, associates, tools, accomplishments far beyond the ordinary, write: N. M. Pagan, Director of Technical and Scientific Staffing, Martin-Denver, P.O. Box 179H, Denver, Colorado.

MARTIN
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KNOW YOUR ALLOY STEELS . . .

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

Annealing: Its Uses with Alloy Steels

Broadly speaking, the primary purpose of annealing is to soften steel and make it more workable. Annealing, as applied to alloy steels, may be defined as a process that heats above, and furnace-cools through, the critical range at a controlled, specified rate of speed; or that heats to a point within, and furnace-cools to a point below, the critical range. In either case, the choice depends upon the structure and maximum hardness desired.

The first method produces a lamellar pearlitic structure, while the second creates a spheroidized condition. These will be discussed separately in the following paragraphs:

(1) *Lamellar pearlitic structure.* It should be mentioned at once that this structure can be obtained both as described above and by a modified method known as isothermal annealing. In the isothermal process, the steel is heated above the critical temperature (austenitized), then transformed at a predetermined temperature, which depends upon the analysis. This operation requires two furnaces or salt baths —one for austenitizing, one for transformation.

Lamellar pearlitic structures are generally associated with machinability in carbon ranges from 0.20 to 0.60 pct, provided the hardness does not exceed the optimum maximum Brinell numeral. This is especially true where critical tooling is involved. It is a very versatile structure, as it gives best results in such operations as broaching, tapping, threading, deep drilling, boring, milling, and tooling as applied on single- and multiple-spindle bar automatic machines.

(2) *Spheroidized structure.* There are two general fields of use for this type of structure when alloy steels are employed. In the low and medium carbon ranges, spheroidization is necessary for cold-shaping operations, such as heading, extruding, drawing. In the higher carbon ranges (over 0.60 pct), it is mandatory where machining is involved, because it tends to lower the hardness of the steel.

If you want more details about these and other uses of annealing, and the results to be expected, by all means consult with our technical staff. And when you need alloy steels, Bethlehem can offer the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

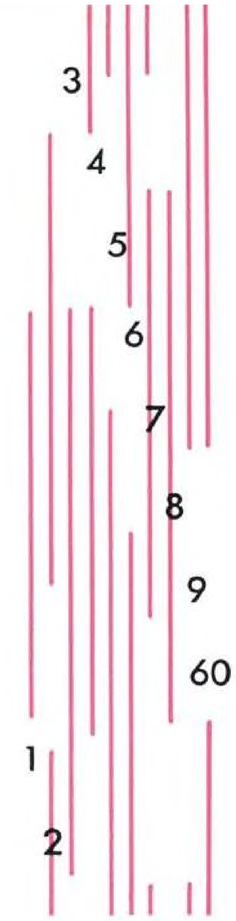
This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
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BETHLEHEM STEEL

BETHLEHEM STEEL

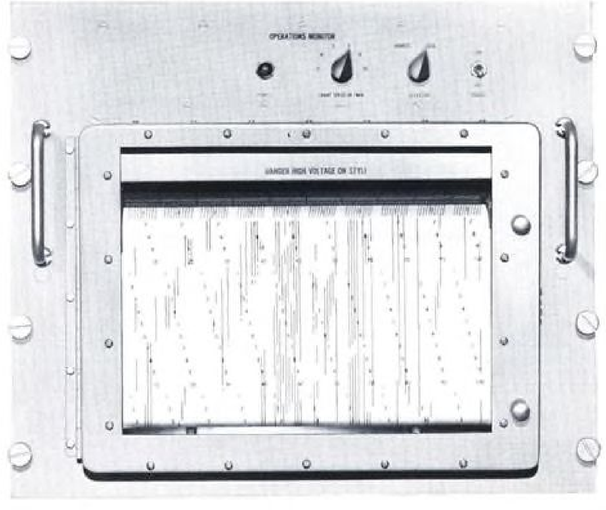
verity events permanently in milliseconds



Brush Operations Monitors' response to signals is virtually instantaneous—less than 4 milliseconds. Multiple high-speed events are clearly defined from start to stop, on a common time base—and at rates up to 500 per second. Portable 30 channel or rack-mounting 100 channel models record sharp reproducible traces with fixed-stylus electric writing that provides the utmost in reliability. "Built-in" transistor switching to eliminate relays is optional. No direct writing recording system can match the capabilities of Brush Operations Monitors for industrial and military analysis and control. Write for complete specifications and application data.

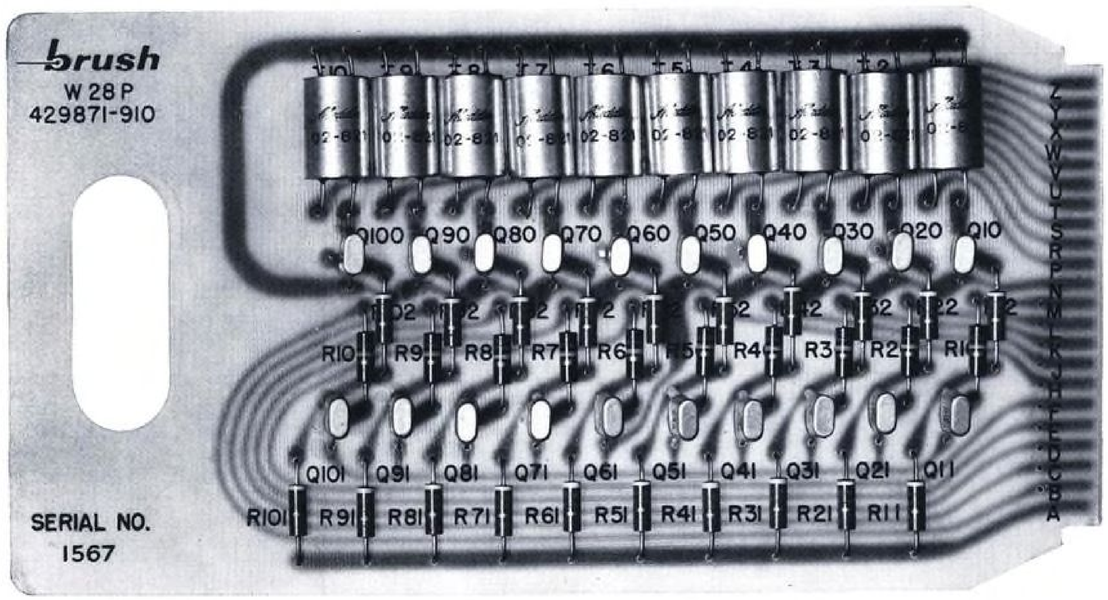
brush INSTRUMENTS
DIVISION OF CLEVITE CORPORATION
37TH AND PERKINS CLEVELAND 14, OHIO





compact
transistor switching
for
millisecond
monitoring

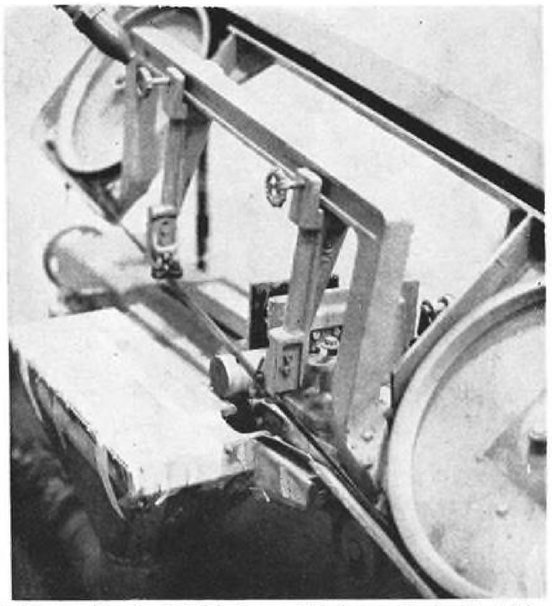




The new Brush Trans-Switcher eliminates relays—greatly simplifies your problems of operations monitoring. Designed to take full advantage of the fast response and high resolution of Brush Operations Monitors, this compact, solid-state switching unit accepts up to 100 different "on-off" signals in a broad range of pulse shapes and amplitudes. Interchangeable, plug-in decade boards are designed to accept different voltage ranges and modes of operation. Avoid the "black box" approach—specify the *standard* Brush Trans-Switcher for the ultimate in precise, reliable monitoring. Write for complete details.

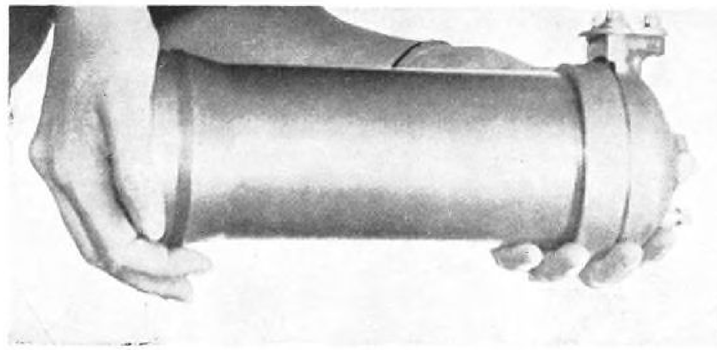
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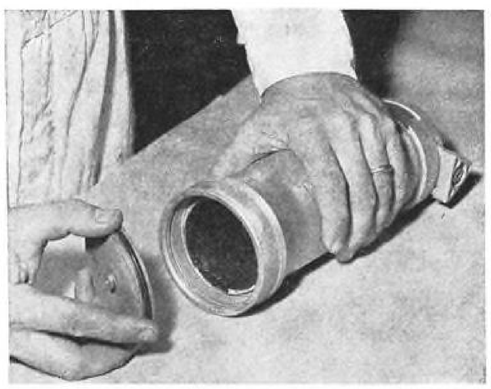
Generator propellant grain is wrapped with 0.007-in. glass tape, each turn overlapping half the tape width to provide double thickness. Saw-trimming to final size (right) is done to grain at burning end to provide smooth finish and good adhesion of inhibitor.

Rocketdyne Builds Tartar, Terrier Gas Generators

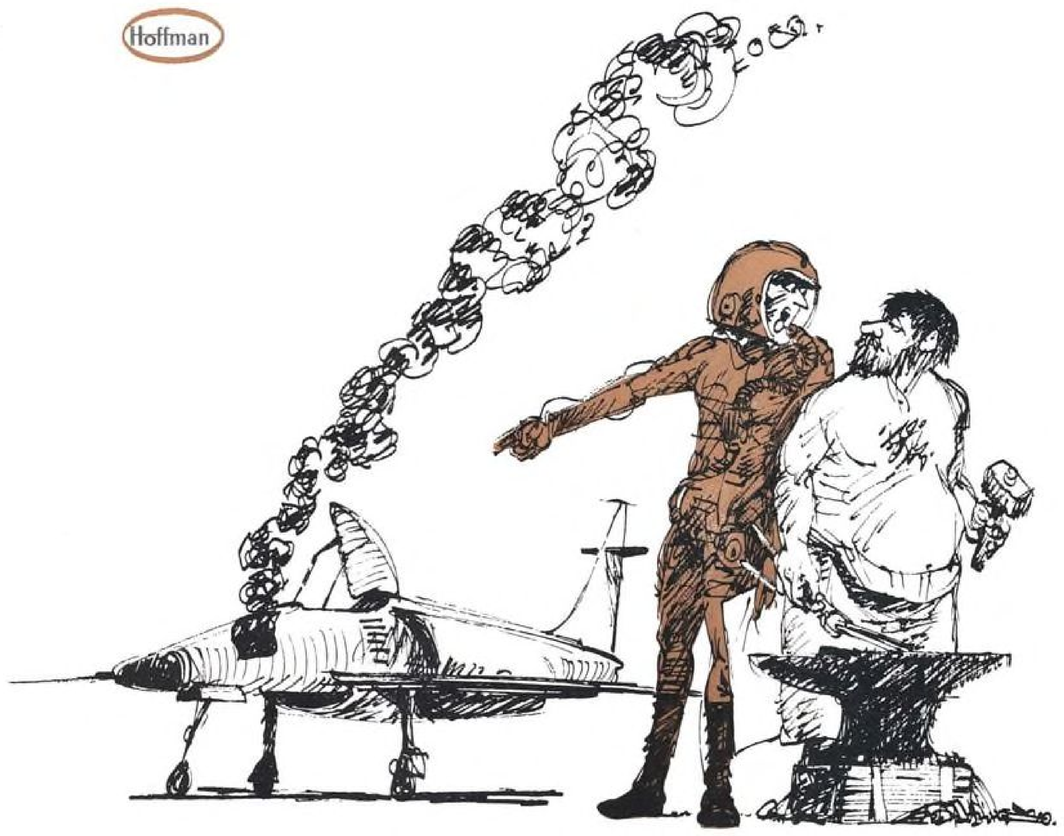


Production of solid propellant gas generators to provide rapid activation of Tartar and Terrier missile electrical and hydraulic systems will be carried out at McGregor, Tex., by North American Aviation's Rocketdyne Solid Propellant Operations under a Navy contract. Compact gas generators (completed unit is at left) use a clean-burning RDS-176 propellant that leaves no detrimental deposit on component parts of the gas generator system. These gas generators incorporate a novel boost phase of fast burning nitrate-perchlorate oxidizer that overcomes the initial inertia of the missile system turbines and a cool burning main stage propellant adaptation of ammonium nitrate propellant used in the M15A1 JATO.





Full-sleeve insulation, Formica FF-34 fibrous glass-impregnated cloth protects gas generator case from heat of burning propellant, in combination with glass tape, holding case outside temperature to maximum of 200F although the RDS-176 propellant burns at approximately 2,100F. End plate (right) is ready to be locked into place with grain already inserted in case.



Hoffman

field service problems?



Maintenance of electronic equipment in the field is of prime importance in the defense of the Free World. To keep this equipment in perfect operating condition and to train the men who must install and maintain it is the work of expert field engineers. Hoffman's Field Service Department offers to military and industrial customers a complete package of services including field engineering, overhaul and repair, as well as on-the-job and in-plant training programs. Expert personnel, with a background gained through experience, provide Hoffman with the capability for solving your field service problems.



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

WHAT'S NEW

Publications Received:

Small Gas Turbines—Arthur W. Judge—Macmillan Co., 60 Fifth Avenue, N. Y. $10.00; 328 pp. Emphasis is placed on the medium output engines, but also covers models of 30 to 40 bhp. and 1,000 to 1,500 bhp.

Missile Aerodynamics—Jack N. Nielsen—McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. $12.50; 450 pp. Various methods of determining the air flow about missiles, wing-body and wing-body-tail interference, vortex effects in missiles and stability derivatives are presented.

Rocket Propellant Handbook—Boris Kit & Douglas S. Evered—The Macmillan Co., 60 Fifth Avenue, N. Y., N. Y. $12.50; 349 pp. Description of chemicals, including fuels, oxidizers and monopropellants having possible use as rocket propellants.

Theory of Inertial Guidance—Connie L. McClure—Prentice Hall, Inc., Englewood Cliffs, N. J. $12.00; 340 pp. Approaches the basic fundamentals and theories of Inertial Guidance in the Space Aeronautical Engineering program. Includes appendices, charts, graphs and a bibliography.

High Productivity in Heavy Engineering—A. G. Thompson—Iliffe & Sons, Ltd., Dorset House, Stamford Street, London S.E.1. 66s. 3d. (approximately $9.29); 339 pp. Technology which has been built up around welded fabrication, accurate dimensioning, coding, methods of transferring dimensions, etc. Assembly and handling and quality control and inspection are dealt with also.

Systems Preliminary Design—Joseph J. Jerger—D. Van Nostrand Co., Inc., Princeton, N. J. $14.75; 625 pp. References to complete works is provided, although theoretical background material is used. Includes chapters on reliability theory, heat transfer, static and dynamic stability of aerodynamic and space vehicles.

Artificial Earth Satellites—Vol. I. & II.—Translated from Russian—Edited by L. V. Kurnosova—Plenum Press, Inc., 227 W. 17 Street, New York 17, N. Y. $9.50; total of 227 pp. Exploration of the data obtained from Russian satellites and the results of the scientific investigations. This is the revised work from the reports presented at the Fifth Assembly of Special IGY Committee in August, 1958.

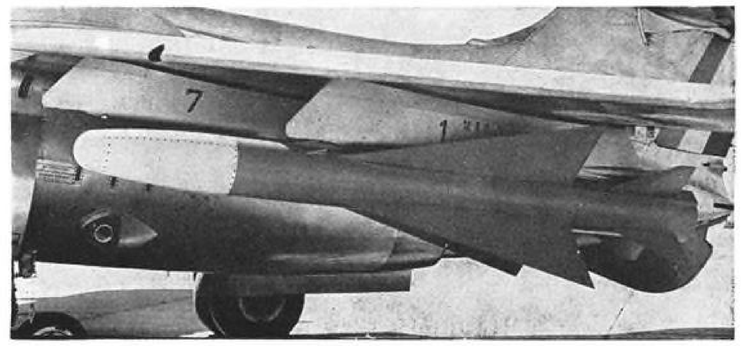
Dynamics of Conducting Gases—Northwestern University Press, Evanston, Ill. Papers and lectures which were presented at the 1959 Proceedings of the Third Biennial Gas Dynamics Symposium. (212 pp.)

The Restless Atom—by Alfred Romer—Doubleday & Co., 575 Madison Avenue, New York, N. Y. $.95; 198 pp. paperbound. A history of the scientific progress made by Henri Becquerel, Ernest Rutherford, Wilhelm Röntgen, Albert Einstein and others.

Rocketship X-15—by Myron B. Gubitz—Julian Messner, Inc., 8 West 40th Street, New York 18, N. Y. $4.95; 288 pp. A study and account of the X-15 project.

Statistical Handbook of Science Education—National Science Foundation, Wash. 25, D. C. $.55; 94 pp. Statistical material on the education and training of scientists and engineers in the U. S.

Plasma Dynamics—F. H. Clauser—Addison-Wesley Publishing Co., Inc., Reading, Mass. $12.50; 369 pp. Based on an international symposium on plasma dynamics held at Woods Hole, Mass., June 9-13, 1958, under the sponsorship of the National Academy of Sciences and the Office of Scientific Research, ARDC.



French Matra R-530 Missile on Vautour

New French Matra air-to-air solid propellant missile, the R-530, is a derivation of the Matra 511 which was produced in limited quantities. Missile is mounted on wing of a Sud Vautour twinjet bomber. Missile apparently will be manufactured in a limited quantity; weight is 430 lb., span is 3.6 ft. and length is 11 ft.



The Exploration of Space—Robert Jastrow—the Macmillan Co., 60 Fifth Ave., N. Y. 11, N. Y. $5.50; 160 pp. Discusses the Van Allen radiation belts, the Argus experiment, plasma and magnetic fields in the solar system, rocket astronomy and other categories.

Advances in Cryogenic Engineering—K. D. Timmerhaus—Plenum Press, Inc., 227 W. 17 Street, N. Y. 17, N. Y. $13.50; 584 pp. Proceedings of the Fifth National Conference, held at the University of California in Berkeley, Sept. 2-4, 1959. Volume V.

Infrared Radiation—Henry L. Hackforth—McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $10.00; 272 pp. A minimum of mathematics, practical examples, and clear illustrations are given in explaining the versatility and inherent possibilities of infrared.

Handbook of Geophysics—U. S. Air Force—The Macmillan Co., 60 Fifth Ave., New York, N. Y. $15.00; 8½ x 11½ Revised Edition. Topics presented are the earth's atmosphere, geomagnetism, cosmic radiation, meteors and weather and others. Sixty civilian scientists employed by the U. S. Air Force prepared the book.

Advances in the Astronautical Sciences—Plenum Press, Inc., 227 W. 17 St., New York 17, N. Y. $8.00; 356 pp. The Proceedings of the 2nd Western National Meeting of the American Astronautical Society.

Revolution in Transportation—by Karl M. Ruppenthal—Graduate School of Business, Stanford University, Stanford, Calif. $4.75; 153 pp. Based on speeches given at the 1959 Transportation Management Program at Stanford University, and the 14th annual convention of the National Defense Transportation Assn.

Theory of Wing Sections—by Ira H. Abbott & Albert E. Von Doenhos—Dover Publications, Inc., 180 Varick Street, New York 14, N. Y. $2.95; 693 pp. paperbound. Concise presentation of the most important and useful results of research on the aerodynamics of wing sections at subcritical speeds.

A Treatise on Gyrostatics and Rotational Motion—by Andrew Gray—Dover Publications, Inc., 180 Varick St., N. Y. 14, N. Y. $2.75; 530 pp. paperbound. A systematic discussion of gyrostatic action and rotational motion.

Theory of Flight—by Richard von Mises—Dover Publications, Inc., 180 Varick Street, N. Y. 14, N. Y. $2.85; 629 pp. paperbound. Account of fundamental fluid dynamics.

Basics of Gyroscopes—by Carl Machover—John F. Rider Publications, Inc., 116 W. 14 St., New York, N. Y. Vol. 1, 112 pp., Vol. 2—120 pp. $3.30 ea. paperbound. Basic explanation of the principles of science of gyroscopics.

Theory of Thermal Stresses—Bruno A. Boley and Jerome H. Weiner—John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., $15.50; 586 pp. Account of theoretical techniques for determination of stresses produced in a solid object when it is subjected to specified heating conditions.

Fundamentals of Rocket Propulsion—Raymond E. Wiech, Jr. and Robert F. Strauss—Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y., $5.50; 135 pp. Illustrations and explanations of the rocket engine.

Aviation in the Modern World—James V. Bernardo—E. P. Dutton & Co., Inc., 300 Fourth Avenue, New York 10, N. Y., $5.95; 352 pp. History of aviation plus missiles and space vehicles. Photos and line drawings are provided.

Nuclear Flight—Lt. Col. Kenneth F. Gantz, USAF—Duell, Sloan & Pearce, Inc., 124 E. 30th St., New York 16, N. Y., $4.00; 216 pp. A report of progress being made by the USAF toward nuclear flight. Including a glossary of terms, guide to symbols, and notes on the contributors.

Dynamics of Conducting Gases—Ali Bulent Cambel & John B. Fenn—Northwestern University Press, Evanston, Ill.—The proceedings of the Third Biennial Gas Dynamics Symposium presented by the American Rocket Society and Northwestern University.

Digital Computer and Control Engineering—Robert Steven Ledley—McGraw-Hill Book Co., 330 W. 42nd Street, New York 36, N. Y., $14.50; 83 pp. This book, which is divided into five parts, covers the field from a detailed engineering viewpoint.

Wind on My Wings—Percy Knauth—Doubleday & Co., 575 Madison Ave., New York, N. Y., $3.95; 237 pp. An account of the author's experience on his mastery of flight from his first solo to a 25 hr. trip across the Atlantic in a light plane.

Ghost Ship of the Pole—Wilbur Cross—William Sloane Associates, Inc., 425 Park Ave. South, New York 16, N. Y., $5.00; 304 pp. Story of the Italia, the dirigible that crashed into the Arctic Ocean on May 25, 1928, her captain, Umberto Nobile, and her crew.

The Years of the War Birds—Arch Whitehouse—Doubleday & Co., Inc., 575 Madison Ave., New York, N. Y., $4.95; 384 pp. Account of the pilots and planes of World War II.

Civil Air Regulations for Mechanics—Aero Publishers, Inc., 2162 Sunset Blvd., Los Angeles 26, Calif., $4.50; 152 pp. Applicable to mechanics working on either the structural or engine sections of aircraft.

Flights of Fancy—Frank K. Smith—Random House, Inc., 457 Madison Ave., New York 22, N. Y., $3.95; 247 pp. The author relates his and his family's adventures on "Fancy," a Piper Comanche.

Tu-114 Records Certified

Moscow—Federation Aeronautique Internationale has certified 24 world speed records set by a Russian four-turboprop Tu-114 during three flights last March and April (AW Apr. 25, p. 41).

The marks involve 1,000, 2,000 and 5,000 km. closed course flights, each of which set eight records for speed with loads of 0, 1, 2, 5, 10, 15, 20 and 25 metric tons. As confirmed by FAI, the Tu-114's speed for 1,000 km. was 871.38 kph. (541.13 mph.), for 2,000 km. it was 857.277 kph. (532.369 mph.) and for 5,000 km. it was 877.212 kph. (544.749 mph.).

Six of the records were formerly held by the United States.

PROBLEMATICAL RECREATIONS 27



A man started for a walk when the hands of his watch were coincident between three and four o'clock. When he finished, the hands were again coincident between five and six o'clock. What was the time when he started, and how long did he walk?

—*School Science and Mathematics*

We counted up the other day and found that Triad Transformer Corporation, a Division of Litton Industries, makes 982 different transformers. RIQAP, the Signal Corps quality control plan, determines the environment in which the transformers are made.

ANSWER TO LAST WEEK'S PROBLEM: He didn't end up with two equal squares; their sides are 31″ and 49″.

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the NEW Buckeye aviation refueling equipment catalog

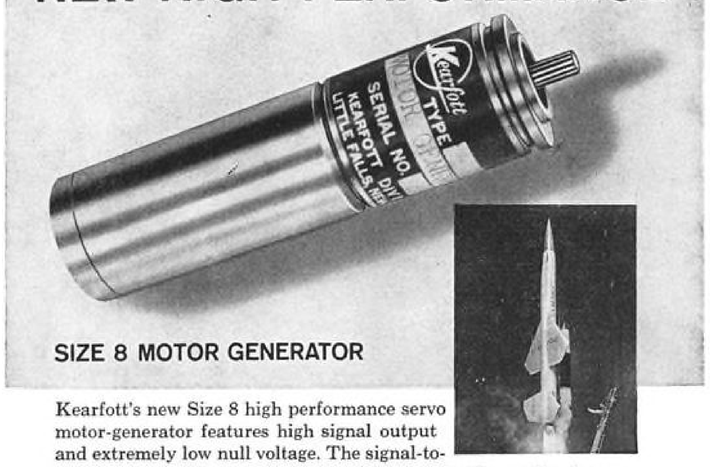
Contains Facts and Figures on Buckeye's complete line of new aviation refueling equipment.

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- UNDERWING REFUELING NOZZLES
- OIL NOZZLES
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NEW HIGH PERFORMANCE



SIZE 8 MOTOR GENERATOR

Kearfott's new Size 8 high performance servo motor-generator features high signal output and extremely low null voltage. The signal-to-noise ratio of 100:1 and linearity of 0.2% make the application of this motor generator to lightweight integrator packages most desirable. Stainless steel construction and thermal stability assure its reliability and long life in the most severe environments.

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Another of a series of files on precision products by **ALINCO**

LOAD CELLS



Model 344
Tension
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Accuracy, Linearity, Low Hysteresis—ALINCO

- ACCURACIES OF ±0.1%
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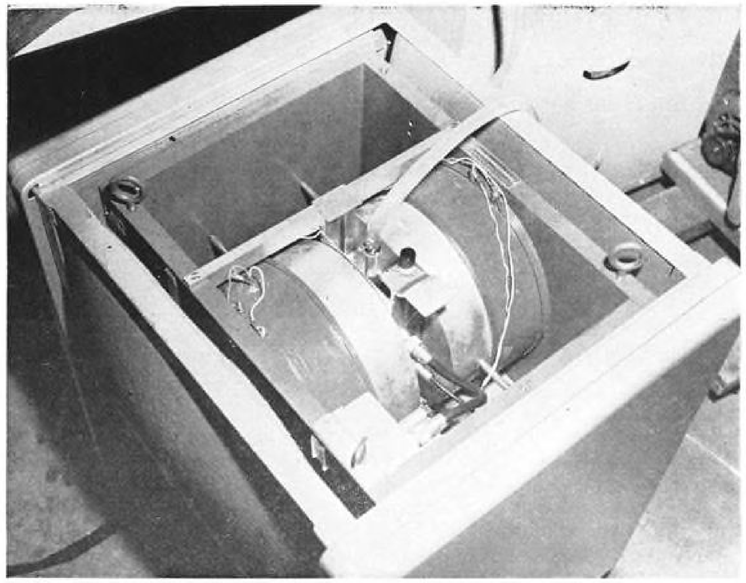
ALINCO is now producing a new tension compression load cell, thoroughly tested and use-proven for reliability and accuracy.

Designed by ALINCO to meet the latest and most stringent requirements in rocket and missile testing, Model 344 and 344LS (Linear Standard Series) tension compression load cells are reliable, rugged and accurate force transducers. Reliability is assured by using two and more bridges. In ranges of 10,000 lbs. and above, termination boxes are recessed to prevent accidental damage to the connectors due to rough usage. For greater accuracy, a standard bridge resistance of 350 ohms is used with split modules and factor resistors. ALINCO unique electrical circuitry and mechanical layout minimize the effects of non-axial loads. Ranges to 3,000,000 lbs. are available, permitting use of a single load cell for obtaining measurements where previously several parallel units were necessary.

For additional information on the Model 344 Load Cells or for the answer to a specific load cell requirement, write:

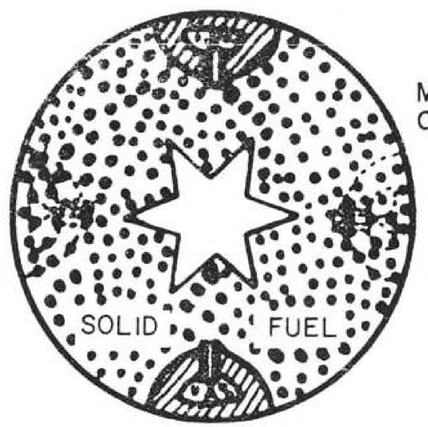
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Detector Analyzes Solid Propellants

Nuclear magnetic resonance is being studied by Schlumberger, Ltd.'s Ridgefield (Conn.) Instrument Group as a means for non-destructive analysis of the quality of solid propellants. Nuclear magnetic resonance detector above is test version of unit proposed for on-stream installation of U. S. Army's Longhorn Ordnance Works, Marshall, Tex. (AW Oct. 12, p. 64). Unit is designed to continuously analyze composition of solid propellant produced by continuous-mix process and would electronically control mixing of oxidizer and fuel. The Longhorn facility is being operated under contract by Thiokol Chemical Corp. Schlumberger's Ridgefield Instrument Group also is investigating methods for non-destructive detection of aging in solid propellants. Proposals include insertion of a nuclear magnetic resonance detector probe into an aperture made in a solid propellant grain, or actually casting small detection heads throughout the solid propellant grain (below).



MISSILE
CROSS SECTION

LOCATION OF NMR HEADS
IN FUEL SECTION OF A MISSILE

WHO'S WHERE

(Continued from page 23)

Changes

S. N. Bean, manufacturing manager-Polaris missile system program, Lockheed's Missiles and Space Division, Sunnyvale, Calif.

Robert G. Wilson, manager of the lunar soft landing study program, North American Aviation's Missile Division, Downey, Calif.

Kent Doolittle, general manager of the Western Operation, Santa Ana, Calif., of CTL Division of Studebaker-Packard Corp.

George J. Grabowski, manager-standard products, Fenwal, Inc., Ashland, Mass.

Donald F. White, chief engineer, Rutherford Electronics Co., Culver City, Calif.

Dr. Tai Nien Feng, associate director of research, Cedar Engineering Division of Control Data Corp., Minneapolis, Minn.

Lawrence H. Stanley, manager of marketing services, ACF Industries, Inc., New York, N. Y.

Thomas LeSueur Hardy, senior systems engineer in charge of Arnoux Corp.'s new Huntsville, Ala., office.

John H. McLachlin, general purchasing agent, Solid Rocket Plant, Aerojet-General Corp.'s Sacramento (Calif.) plants.

Robert H. Lusk, general manager, Don-Lan Electronics Division of Regan Industries, Inc., Santa Monica, Calif.

Grant L. Hansen, assistant chief engineer for design, Convair (Astronautics) Division of General Dynamics Corp., San Diego, Calif.

Frank A. Parker, assistant director for Naval Weapons, Department of Defense, Washington, D. C.

Russel J. Keller, general manager, American Machine & Foundry Co.'s Buffalo Division, Buffalo, N. Y.

Harold T. Ashworth, director of manufacturing, Raytheon Co., Waltham, Mass.

Dr. Joseph R. Feldmeier, associate director of research, Research Division, Philco Corp., Philadelphia, Pa.

Dr. W. Wai Chao, director of research and development, Vickers, Inc., division of Sperry Rand Corp., Detroit, Mich.

Robert J. Baumann, manager, Systems Division, Beckman Instruments, Inc., Anaheim, Calif.

Burton D. Hatch, consultant and manager of a newly established Design and Standards Engineering Operation, General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa.

Carl L. Cahill, general sales manager, Aircraft Radio Corp., Boonton, N. J.

M. J. Gordon, manager-commercial engineering, Beech Aircraft Corp., Wichita, Kan. Also, the following were named senior project engineers: **D. E. Burleigh** for heavy twin aircraft; **R. P. Aylward** for light twin aircraft.

Richard J. Hanschen, manager of marketing, Semiconductor-Components Division, Texas Instruments, Inc., Dallas, Tex.

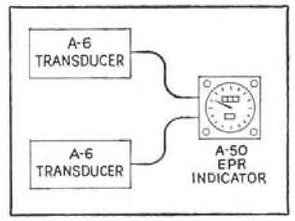
Malcolm A. Pelton, assistant chief engineer, Filtors, Inc., Port Washington, N. Y.

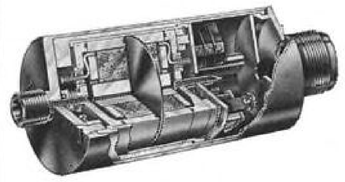
John W. Corcoran, chief scientist, Research & Development Division of Beckman & Whitley, Inc., San Carlos, Calif.

Dr. Yusuf A. Yoler, Dyna-Soar staff engineer, Boeing Airplane Co., Seattle, Wash.

Engine Pressure Ratio System Is

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A-6 Transducer

Highest reliability and accuracy of the Astromics Engine Pressure Ratio System are assured because of two distinct advantages: 1. Only the transducers are mounted on the engine, subject to high shock and vibration. All ratioing is done within the Indicator on the instrument panel. Transmission is electrical—no linkages or potentiometers. 2. The Pressure Transducers are of advanced design featuring stretched flat diaphragms and completely sealed inductive pick-off coils. Accuracy of system is % of reading in the critical ratio range.

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DUAL CHANNEL
BUFFER AMPLIFIER

This small, light-weight unit, a completely transistorized dual channel buffer amplifier, is designed to drive Kearfott's size 11 R980 winding compensated synchro resolvers. The amplifier-resolver combination has stable gain characteristics and negligible phase shift through an ambient temperature range of —55°C to +85°C. This unit meets the environmental requirements of MIL-E-5272.

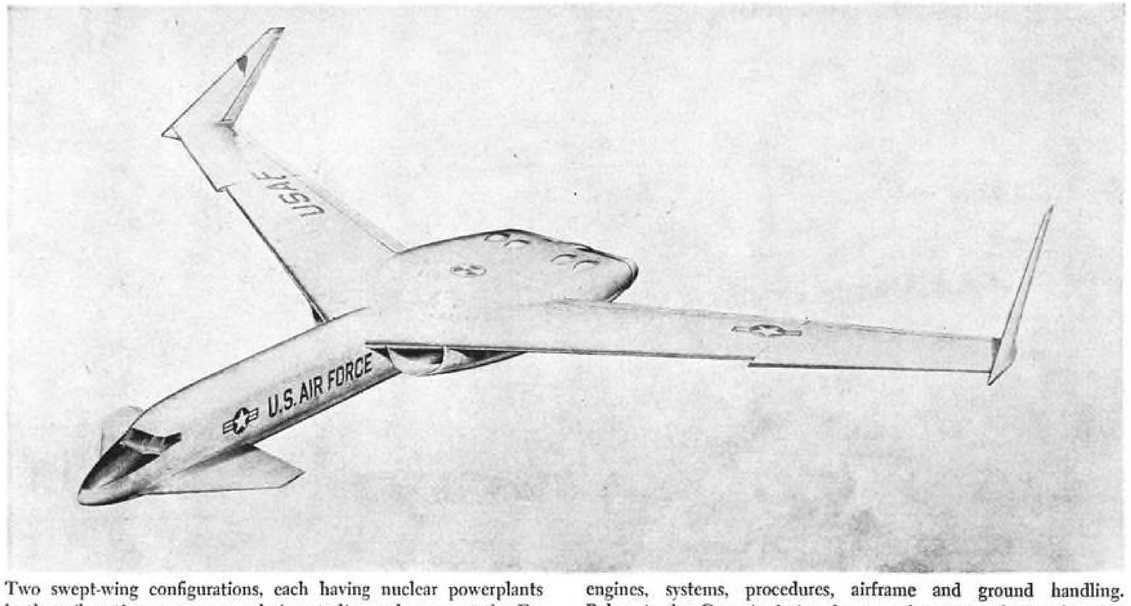
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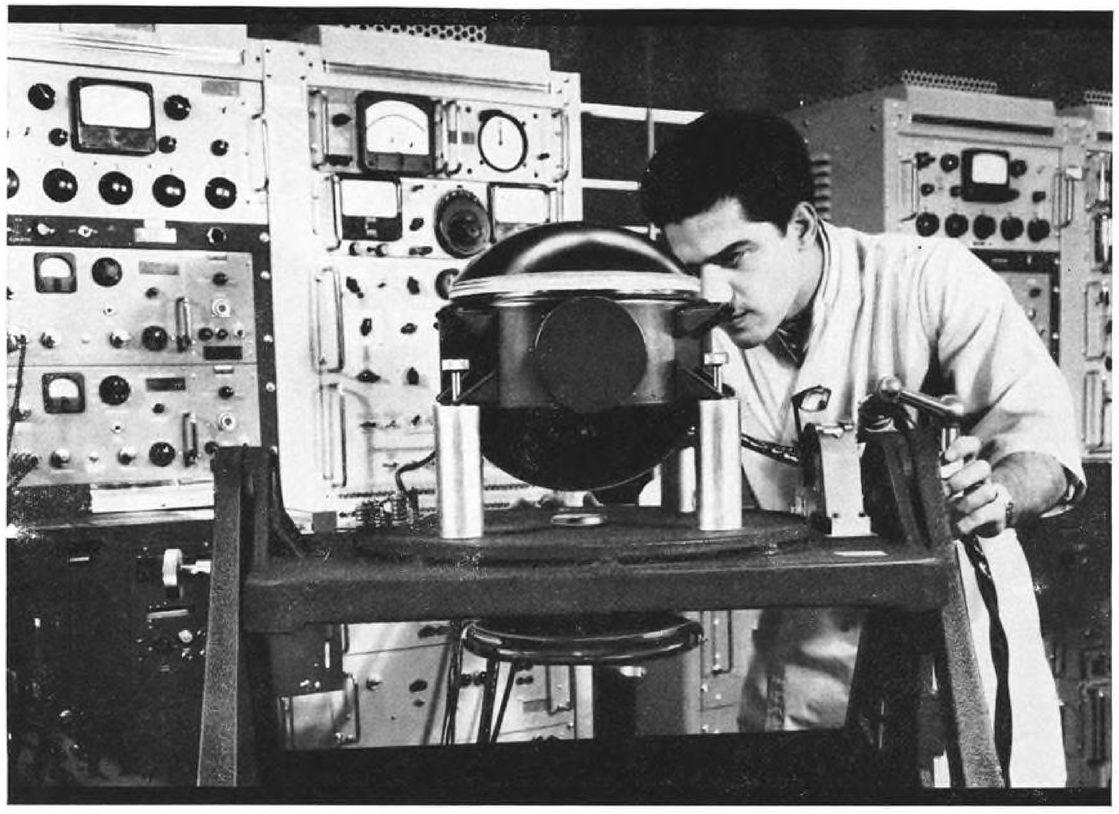
Convair design utilizing direct cycle nuclear engines has horizontal stabilizer-elevator surfaces forward on nose section.

Convair Designs Swept Wing Nuclear-Powered Planes



Two swept-wing configurations, each having nuclear powerplants in the tail sections, are among design studies under way at the Ft. Worth, Tex., plant of Convair Division of General Dynamics. Plane studied for USAF (above) would be powered by three General Electric direct cycle nuclear engines installed in the fuselage; conventional turbojets using hydrocarbon fuel are suspended from the wings in pods to augment thrust on takeoff and at high speeds. Convair testbed will be subsonic and is intended primarily to test engines, systems, procedures, airframe and ground handling. Below is the Convair design for a nuclear-powered aircraft using Pratt & Whitney indirect cycle engines. This system has one reactor to supply heat to four turbojet engines by pumping hot liquid metal into the heat exchanger that takes the place of the combustion chamber. Direct cycle nuclear turbojets each have a reactor integrated with the heat exchanger to heat air passing through the engine.

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3 GYRO PLATFORM

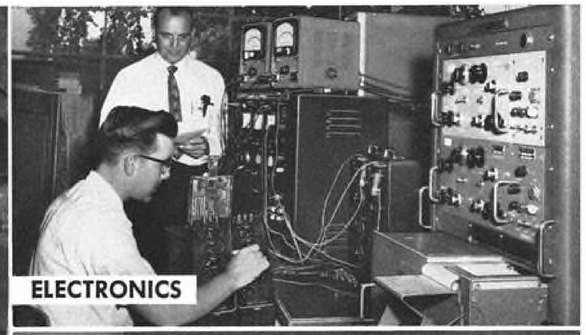
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STRUCTURES, MATERIALS DEVELOPMENT



CRYOGENICS, FUEL HANDLING





INTEGRATED TEST AND MANUFACTURING FACILITIES

Hamilton Standard's systems-engineering experience and technologies provide GSE resources of tremendous scope

Today Hamilton Standard can supply the widest range of aircraft and missile ground support equipment—from tiny precision components and safety devices to complete architectural structures and weapon sub-systems. This capacity stems from Hamilton Standard's 40 years' experience in systems-engineering its own laboratories and broadening product line.

IN SYSTEMS-ENGINEERING its facilities and products, Hamilton Standard has carried out new concepts in precision gaging, electrical and electronic control, automatic interlocks, and other safety devices that are essential to many of today's sophisticated GSE systems. These programs have also produced an unusual knowledge of structures, materials development, and such critical technologies as:

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Cryogenics and Fuel Handling— Hamilton Standard is constantly working with low-temperature gases and fuels. This experience, plus extensive work with freon air conditioning systems and fuel controls for liquid oxygen and liquid hydrogen, is a natural foundation for solving complex fuel handling or storage problems.

UNMATCHED RESEARCH AND DEVELOPMENT FACILITIES. As a division of United Aircraft Corporation, Hamilton Standard shares in one of the largest privately owned research installations in the aerospace industry.

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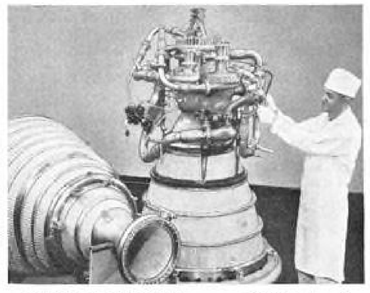
DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

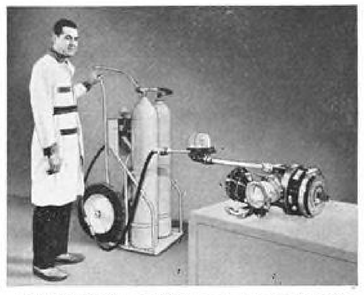
SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD



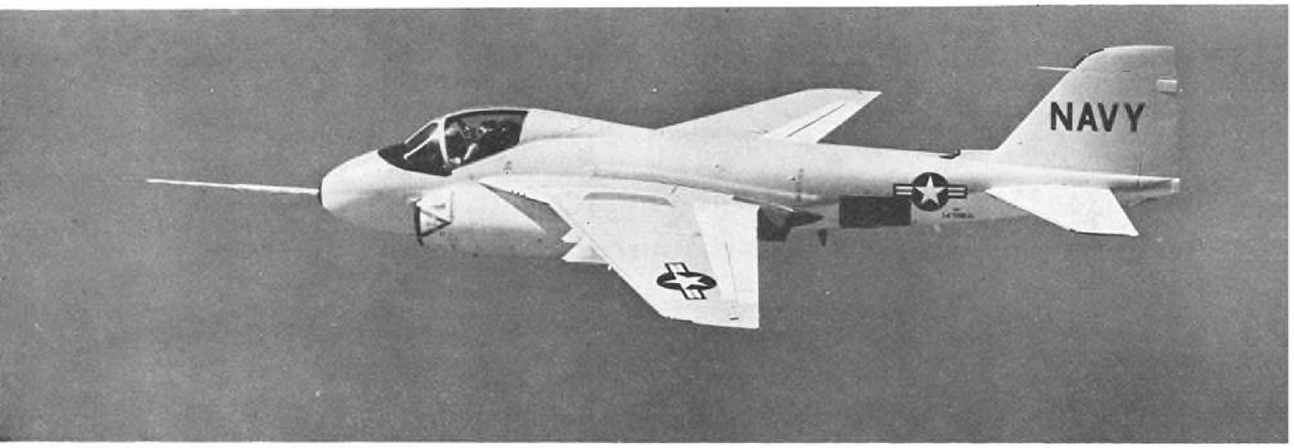
ENVIRONMENTAL CONDITIONING SYSTEMS for space vehicles and such advanced aircraft as the B-58, 880, B-70 are important aspects of Hamilton Standard diversification.



ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work involves advanced rocket engines.



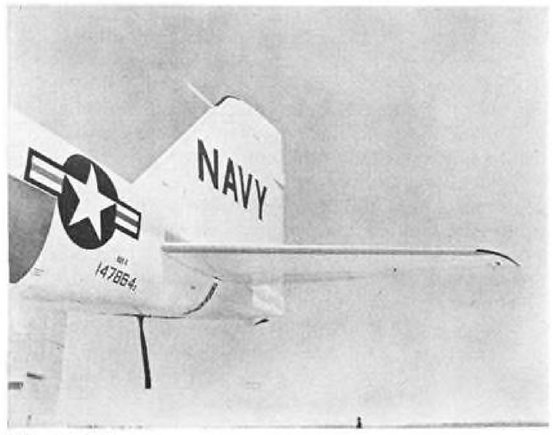
STARTERS. Over 15,000 pneumatic and fuel-air starters are in service on many of the nation's front-line aircraft. The new Hi-Lo system, above, permits drastic weight, cost savings.



Side-by-side seating in the Navy-Grumman A2F-1 Intruder low level attack bomber (AW May 9, p. 94) can be seen in this flight view.

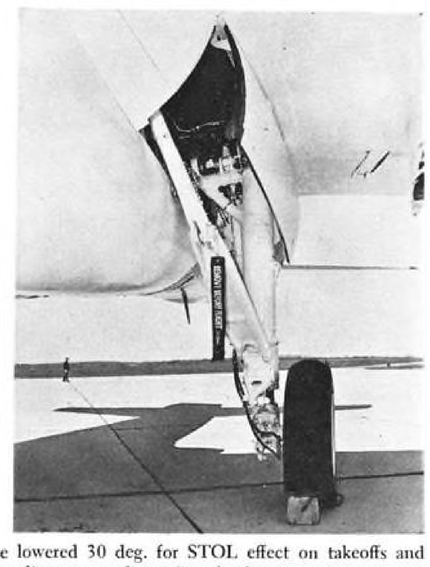
Grumman Tests Twin Jet A2F-1 Intruder for Navy



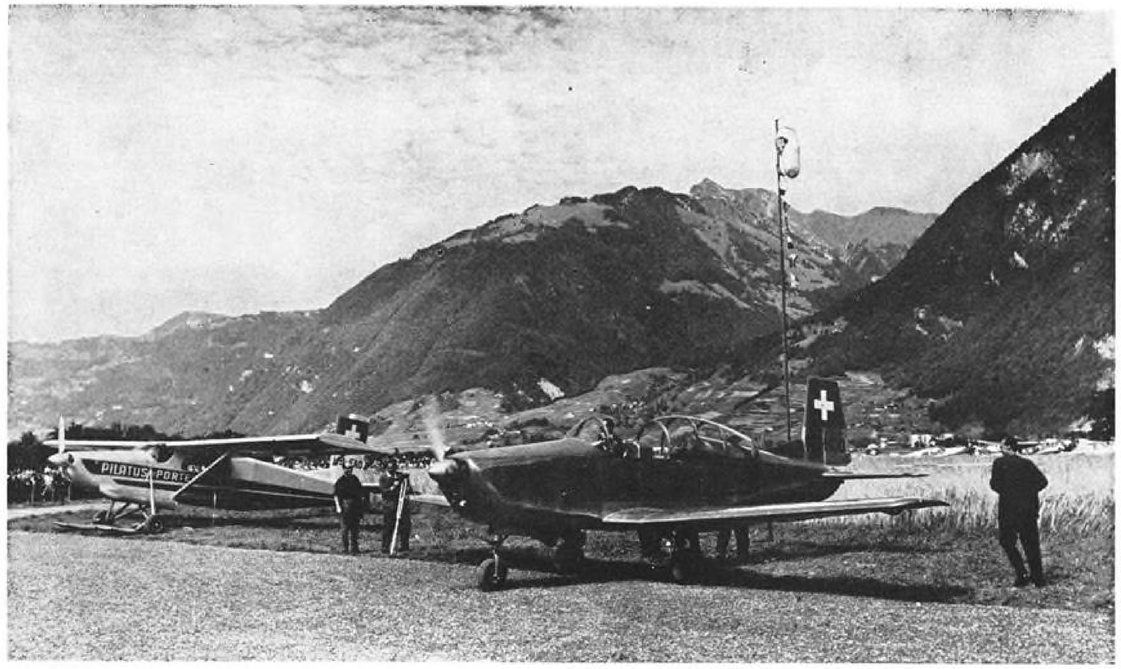


Martin Bullpup missile is slung under A2F-1 wing (left) outboard of Mk. 84 GP bombs on wing and belly; tail detail at right.





Tailpipes for two Pratt & Whitney J52-P6 turbojets are adjustable (left) and can be lowered 30 deg. for STOL effect on takeoffs and landings. Each engine delivers 8,500 lb. thrust; maximum gross weight is 54,000 lb. Landing gear tucks up into fuselage.



RYAN Navion four-seat aircraft, seen here alongside the Pilatus Porter, may soon be added to the fleet at Rennaz to meet rapidly increasing demand for the airlift. Newly inaugurated service offers access to major European vacation areas including Swiss Alps.

Swiss Charter Serves European Resorts

Montreux, Switzerland—New tie-in charter air service recently started here offers lightplane transport to the major resort areas of Europe, including the rims of 10 glaciers located in the Swiss Alps.

Operated by the Montreux town council and designated the Aerodrome Regional de Montreux S. A., the company is now flying one Swiss six-to-seven seat Pilatus Porter, one Czech Brigadier four-seater and a Piper Cub, which is used for training purposes only. Spokesmen for the firm say, however, they may soon purchase additional aircraft if the present demand for glacier flights continues.

Serves Swiss Alps

Catering largely to tourists, the firm began operations last month upon the opening of Montreux's new Rennaz Airport, making its first flight to the glacier on the top of the Matterhorn in the Swiss Alps.

On request, passengers arriving at any of the main cities or airports in Switzerland are met and flown to their destinations. Under present plans, two full-time and two part-time pilots will operate year-round flights on a regular basis from Rennaz to Basle, Zurich and Geneva, ferrying tourists from this vacation center to Switzerland's major commercial airport complexes.

Savings in time spent en route can compensate passengers for the higher cost of the airlift, compared with surface transport. For example, it takes deplaning tourists in Geneva approximately 8 hr. to reach St. Moritz by train, against 2 hr. by plane.

Flying Time

Flying time from Zurich to Montreux is 45 min., compared with 3½ hr. by rail. The Geneva-Montreux hop takes 18 min., at least 1½ hr. by train and a flight to Nice on the French Riviera from Geneva or Rennaz only 2 hr. as compared with 8-9 hr. by rail.

Jean Baer, chief pilot of Aerodrome Regional, says the firm expects to conclude negotiations within the near future for the purchase of a Ryan Navion four-seat aircraft from its present owner in Geneva. It will then be fitted with a 260 hp. Lycoming engine and a Lear autopilot. With a cruising speed of 149 mph., the aircraft will go into service between Rennaz-Basle, Zurich, Geneva, Milan and Nice.

Estimated cost per flying hour of the Navion is about $50. By comparison, the six-to-seven-seat Pilatus Porter averages $90; the four-seat Brigadier $50; a two-seat Super Piper fitted with a 150 hp. Continental powerplant, also about to be added to the fleet at Rennaz, $38; and the Piper Cub $16.25 per flying hour for students, $17.50 when used for normal tourist or sightseeing flights.

Baer also is instructor at the pilot training school which presently has 21 students including two 17-year-old girls. Courses in gliding are scheduled to be added to the school's program later on.

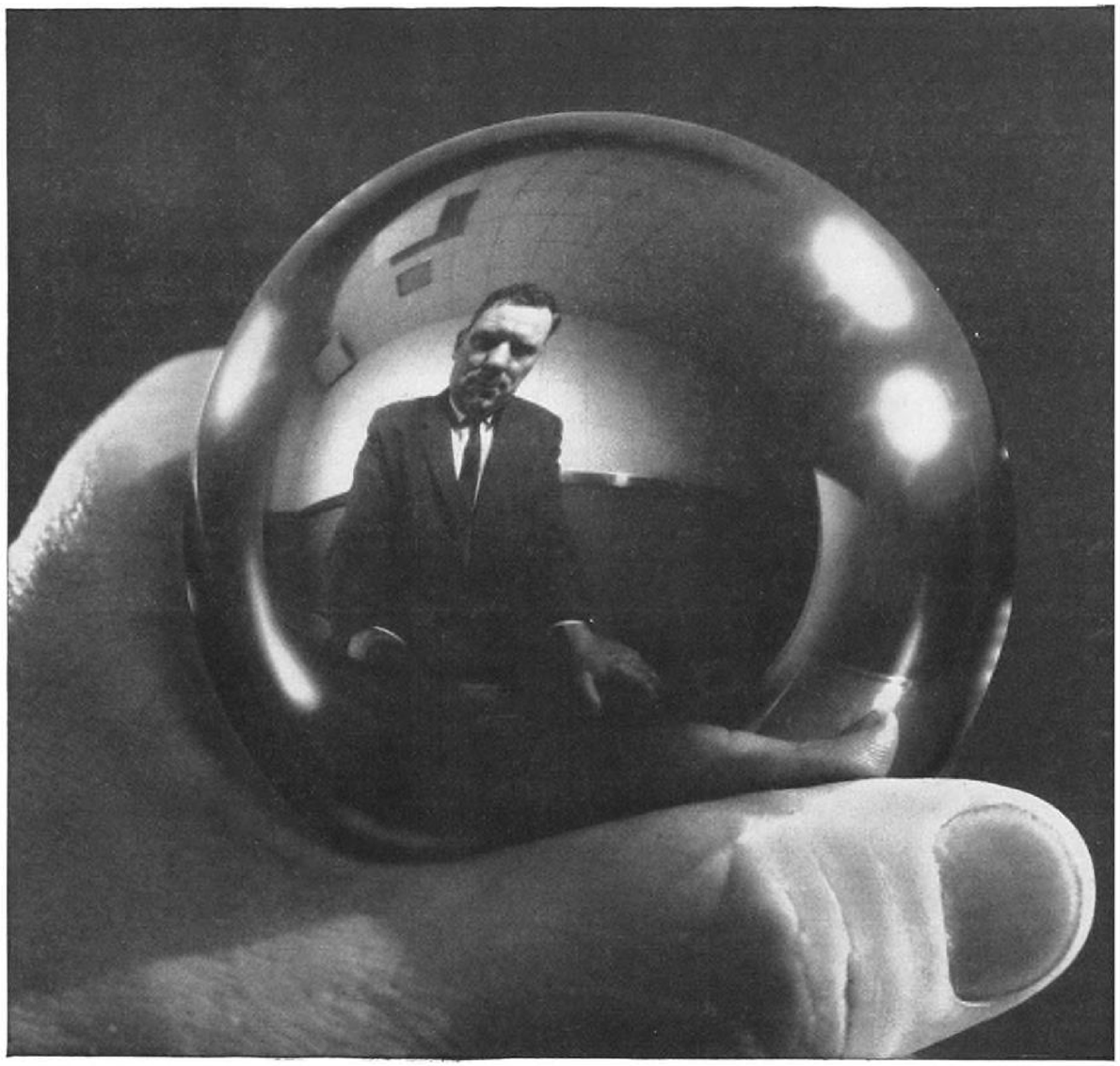
Rescue Pilot

Baer, trained by pioneer Alpine rescue pilot Fredy Wissel of St. Moritz in the glacier landing technique, also conducts mountain rescue missions. To aid pilots engaged in this work, the Collins radio-equipped control tower now being built at Rennaz soon will be connected to a radio tower high up in the Swiss Alps above Montreux.

M. Mueller-Veillard, a Montreux businessman, first conceived the idea of establishing a Montreux charter airlift to serve the increasing number of

Theoretical Concept
is Turned into Hardware

Honeywell Develops a Practical Electrically Suspended Gyro!



Mr. Robert Maze, Chief Engineer of Honeywell's Marine System Group, is reflected in the highly polished beryllium spherical rotor of Honeywell's new Electrically Suspended Gyro. The Marine System Group is a special Honeywell "task force" assigned to guide the ESG program through its rapid development.

Advanced new gyro concept using friction-free spherical rotor will bring greater accuracies to marine and airborne inertial systems, and northfinder systems.

Honeywell's leadership in the field of inertial systems and sensors is further demonstrated with advances on its Electrically Suspended Gyro. Here the company has taken a theoretically superior gyro concept, conceived by Dr. Arnold Nordsieck of the Univ. of Illinois, and turned it into practical development hardware. This new ESG concept is being developed under funding from the Navy Special Projects Office and Wright Air Development Division. Recognizing the unique capabilities of this new device, Honeywell has assigned a special task force group to continue to press the development of the gyro and the inertial system designed to take fullest advantage of the gyro's capabilities. In the near future, the Honeywell inertial system incorporating the ESG will be put into its test phase.

This new gyro has only one moving part, a spherical rotor, electrically suspended in a self-contained, hard vacuum to completely isolate the sensing element. The spherical rotor is made of beryllium, machined and polished to tolerances of a few millionths of an inch! The gyro is brought up to speed by electronic means, then coasts throughout long periods of operation. Reference information is picked off optically.

Honeywell, because of its experience in gyro components and systems, has already solved many problems related to this new gyro concept.

1. **Precision Machining of Problem Metals:**
   In order to take advantage of beryllium's high material stability, Honeywell has developed manufacturing techniques that overcome beryllium's brittleness and toxicity problems.
2. **Precision Ceramics:**
   Honeywell has perfected the techniques for firing and machining the precision ceramic envelope, and for overcoming the difficulties in fabricating the ceramic-to-metal seals.
3. **System Integration:**
   Honeywell, with its advanced system experience, has created a new inertial system to take fullest advantage of the capabilities of this new Electrically Suspended Gyro.

For more information on Honeywell's new products, write to Minneapolis-Honeywell, Dept. AW-8-111, Minneapolis 8, Minn.



Precision ceramic envelope receives a final machining after being fired at a temperature of 1300° C. Diamond grinding and ultrasonic drilling are utilized in finishing the envelope.



Beryllium rotor, after being machined, ground and polished, is checked for sphericity to tolerances of a few millionths of an inch!

Honeywell

H Military Products Group

NOW OPERATIONAL: Weather-sounding rockets carrying R/M Pyrotex® motor-tube liners



Motor-tube liners for new weather-sounding rockets are R/M Pyrotex asbestos-phenolic tubes. These liners withstand a direct rocket blast for periods up to 90 seconds.

High ablation-resistance, good thermal insulation, high strength-to-weight ratio—all resulting from the unique R/M blend of phenolic resins and extra-long spinning-grade asbestos fibers – make choice of R/M Pyrotex materials clear for this and many other high-temperature applications.

Test R/M materials without tooling costs. We can supply your testing program with molded billets or tubes from which you can machine your prototype parts at the cost of the materials alone – *no charge for tooling*. What better way to learn the merits of an exciting new material for nozzles, exit cones, fins, nose cones, etc.? Phone, wire or write your requirements.

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Reinforced Plastics Department, Manheim, Pa.
SPECIALISTS IN ASBESTOS,
RUBBER, ENGINEERED PLASTICS, SINTERED METAL



INAUGURATING the new Swiss airlift service, the six to seven-seat Swiss Pilatus Porter aircraft lands on the Matterhorn in the Swiss Alps.

visitors to this popular resort area. It has taken him 10 years to achieve his objective.

During that period, he bought and constantly added to any land that became available in the vicinity of Montreux, often later exchanging it again for plots that would expand the area required for the envisioned Rennaz Airport.

In 1957, he produced some $300,000 capital and formed a private company, the Societe Domaine des Tille, to develop and operate the project. Early this year the Montreux town authorities acquired the Rennaz premises and Aerodrome Regional de Montreux S. A. was formed to take charge of operations.

The capital of the new company, amounting to $100,000, was invested in small-scale airport buildings and a 2,296-ft. runway. The success of the plan already has enabled the company to increase its capital to $162,500. This sum will be used to extend the runway to about twice the size of its present length.

Recognizing the increasing popularity of the jet transports using the major airports in Switzerland, Baer told AVIATION WEEK that the planned runway extension is aimed at enabling larger piston-engine aircraft such as the Douglas DC-3, Douglas DC-4 and the Convair 440 Metropolitan to land at Rennaz.

B.F.Goodrich



Omega-design bellows for precision instrumentation

B.F.Goodrich now manufactures bellows and bellows assemblies to customer requirements. Convolutions shaped like the Greek letter Omega (Ω) equalize stress, result in extended service life. The design also improves accuracy, provides a more linear deflection output. Write for new brochure, "Seamless Bellows and Bellows Assemblies".

B.F.Goodrich
aviation products
Dept. AW-8C, Akron, Ohio

PRIVATE LINES

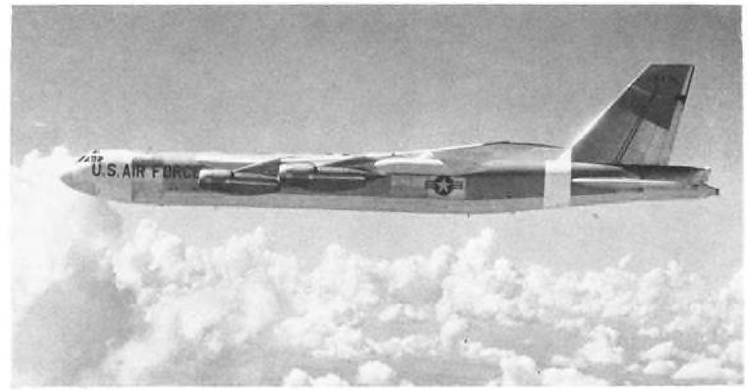
Substantial increase in Pacific Airmotive Corp. Engine Division's volume is expected over the next year as a result of five contracts received. All are with airlines, four being piston engine overhauls for new customers. The fifth succeeds PAC's former agreement with Continental Air Lines, and will increase Pratt & Whitney JT3 engines for Continental's Boeing 707s to seven monthly. Five or six R-2000 engines will be overhauled monthly for World Airways. PAC will do Frontier Airlines Pratt & Whitney R-2800-CB-16s, three R-2000s will be overhauled per month for Brazilla Export Corp. and Transcontinental S. A. is sending two to three R-2800-101Hs each month.

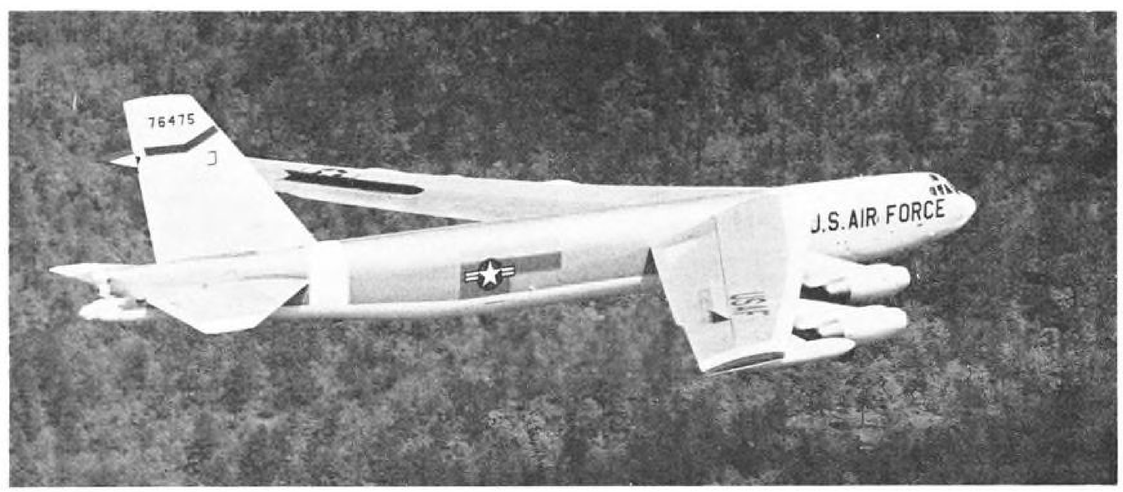


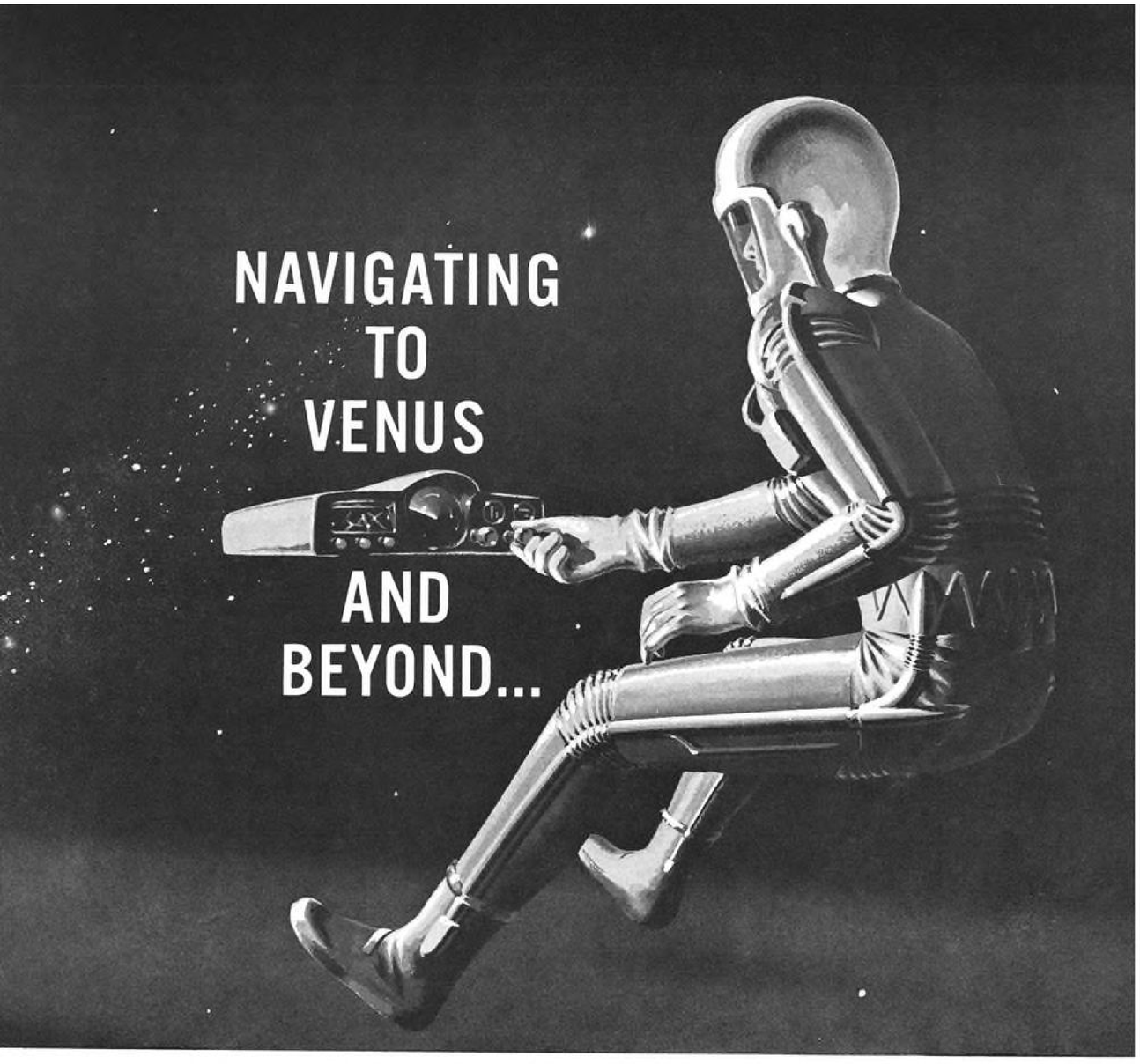
Light prototype YTF-33-P-1 turbofan engines demonstrate increased efficiency in B-52G test flights.

B-52G Tests Turbofans, Simulates Combat Flights

Boeing B-52G aircraft shown above and right are equipped with prototype turbofan Pratt & Whitney YTF-33-P-1 engines with the following specifications: takeoff thrust—16,000 lb.; military thrust—15,000 lb.; normal thrust—12,500 lb.; 75% of normal—9,375 lb.; specific fuel consumption (75% of normal)—.58; weight—4,350 lb. (compared with the J57 of 3,870 lb.). Below, the B-52G is flown on low-level tests to ascertain effects on the crew and aircraft of flights at altitudes under 1,000 ft. Daily simulated combat missions are performed by Strategic Air Command to test feasibility of penetrating enemy defenses by flying under their radar screens. Areas tested range from human factors to insect removal from windshields.







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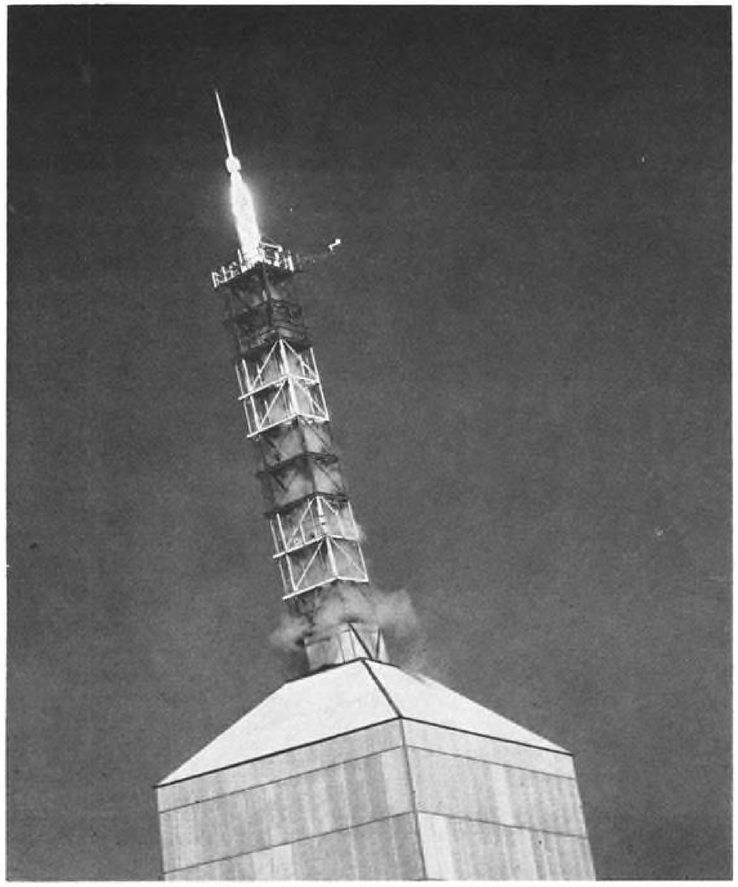
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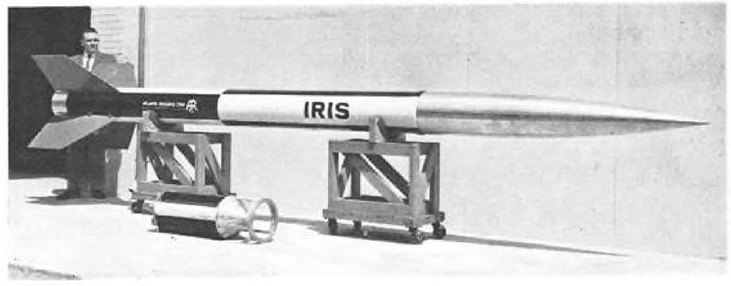
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First Iris Sounding Rocket Fired

Atlantic Research Corp.'s Iris sounding rocket, developed for National Acronautics and Space Administration, made the first of three qualification flights from NASA's Wallops Island, Va., station July 22, carrying a 150-lb. instrumentation payload to 140 mi. altitude. Initiated by Navy, Iris is 20 ft. long, 12¾ in. in diameter, has a 46½ in. fin span and weighs 1,216 lb. without payload. Thrust is 3,800 lb. and burning time 62 sec. Burnout velocity is about 6,774 fps. Slow burning solid propellant eases takeoff shock to instruments, gives higher accelerations at upper altitudes where drag is lower. Iris uses a 40-in., seven-cluster booster with 18,000 lb. thrust and 1 sec. burning time. It will take loads of 100 lb. to about 200 mi. Early development problems of chamber insulation erosion and nozzle component deterioration have been overcome, and NASA called firing "highly successful." Iris is the largest of a family of three Atlantic Research Corp.-developed sounding rockets. Arcas, the smallest of the trio, carries a 12 lb. payload to 40 mi. altitudes, and Arcon is capable of pushing 40 lb. payload to 60 mi. heights. In photo below, the object in the foreground is the seven-rocket-cluster booster section.



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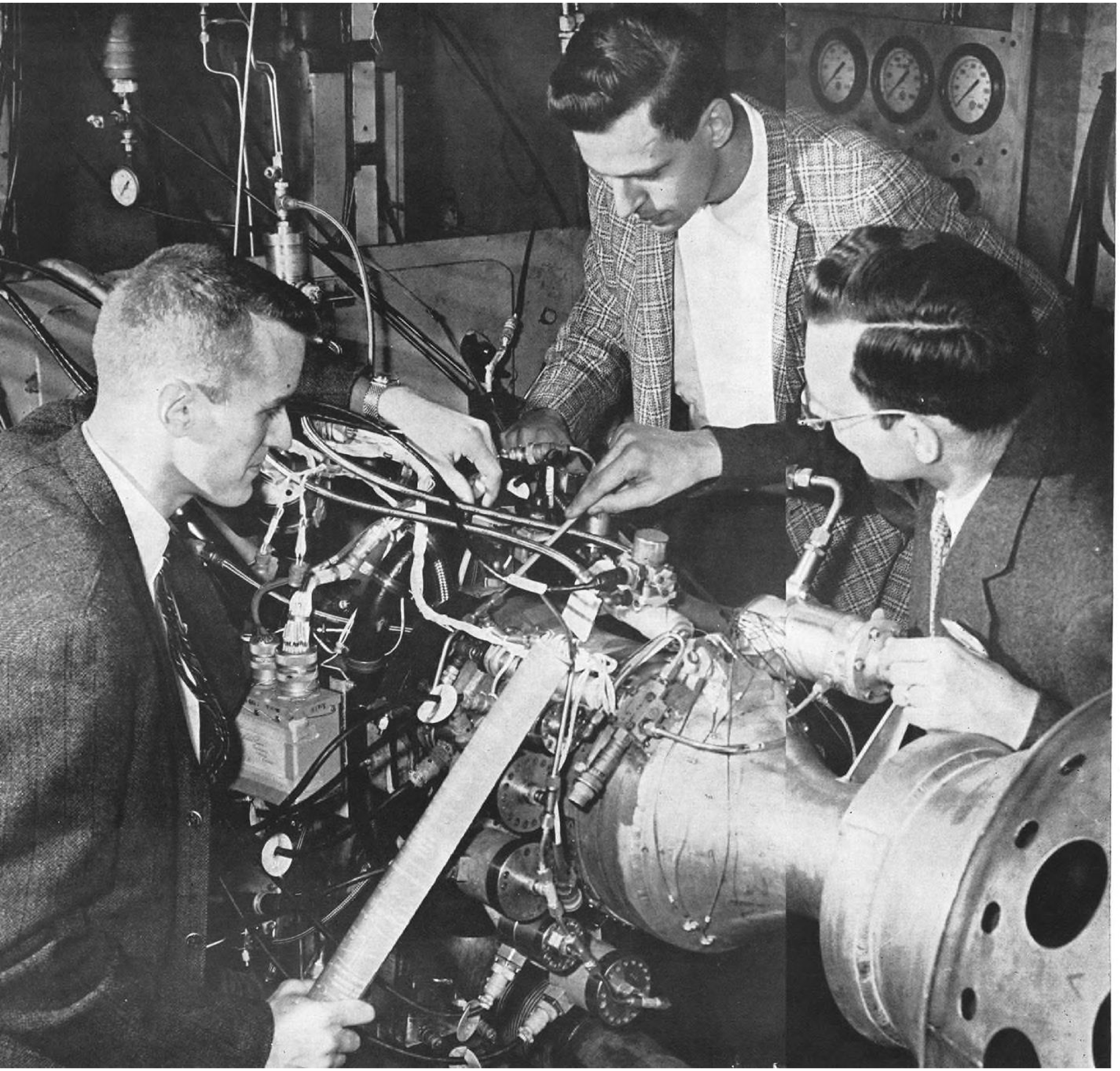
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SAFETY

British Accident Investigation Report:

'Inexperienced' Dove Pilot Lost Control In Engine Restart Attempt

(Following is a report to Minister of Aviation Duncan Sandys by J. W. Duggan, chief inspector of accidents, on an investigation of the crash of the de Havilland Dove 104 G-ALEC at 1:39 p.m. May 6, 1959, near Cardiff, Wales. The pilot, R. P. Chambers, and three passengers were killed. The Dove was owned by Lec Refrigeration, Ltd.).

The aircraft took off at 1320 hr.[1] on a private flight to fly over the opening ceremony of the Welsh Ideal Homes Exhibition being held in Sophia Gardens near the center of Cardiff.

The aircraft passed over the exhibition at least three times. On the last occasion it was at an extremely low altitude with the starboard propeller feathered. After continuing some distance beyond the exhibition the starboard propeller commenced rotating and a few seconds later the aircraft dived steeply to the ground. All on board were killed instantly. Fire broke out following the impact.

The aircraft was manufactured in 1952 by the de Havilland Aircraft Co., Ltd., and had been sold to a Mexican bank early in 1953, registered as XB-SUU. In September, 1958, the aircraft returned to the United Kingdom on being bought by Flight Servicing Co., Ltd., of Croydon. After overhaul and modification, its Certificate of Airworthiness was renewed on Jan. 7, 1959. The aircraft was then sold to Lec Refrigeration, Ltd., on Jan. 21, 1959, after having been granted, on Nov. 25, 1958, the registration G-ALEC following special application by the company.

At the time of the accident the aircraft had flown a total of 2,434 hr., of which 33 hr. were since the renewal of the Certificate of Airworthiness. It was fiitted with two de Havilland three-bladed hydromatic fully feathering propellers. Records shows that the aircraft had been properly maintained.

A load sheet was not required for the flight but it has since been estimated that at the time of the accident the gross weight of the aircraft was about 750 lb. below the maximum permissible weight of 8,800 lb. It has not been possible to calculate the position of the center of gravity but it is probable that it was within the prescribed limits.

Mr. Chambers was 24 years of age. He learned to fly with the Christchurch Aero Club in 1957. In 1958 he became a "trainee" with British Overseas Airways Corp. and underwent a course with Air Service Training, Ltd., Hamble, to obtain a commercial pilot's license and instrument rating. He succeeded in obtaining the license and rating but did not remain in the employ of BOAC. His commercial pilot's license was endorsed in Group 1 for Auster aircraft and was valid at the time of the accident.

There were no endorsements in Group 2 of the license.

Mr. Chambers joined Lec Refrigeration, Ltd., on Mar. 16, 1959, and on Apr. 26 he underwent a flying test with a qualified examiner in the subject aircraft in order to obtain a Group 1 type rating endorsement of his license. He failed to pass the test on the grounds that he was not competent to fly the aircraft under conditions of asymmetric flight, i.e., with one engine stopped. On the day before the accident he had made arrangements with the examiner to receive two hours dual instruction in asymmetric flying after returning from his visit to Cardiff.

He had completed a total of 256 flying hours chiefly on single-engine aircraft. His flying log book shows that of this total 28 hr. were in Dove aircraft, and as far as can be ascertained only 3 hr. 45 min. were as pilot-in-sole-command.

The weather was fine; wind was east at 10 kt. and visibility was 4 naut. mi.; cloud cover was ⅛ at 3,000 ft.

The Cardiff trade agent of Lec Refrigeration, Ltd., was one of the exhibitors at the exhibition. Arrangements had been made by the agent with the company, and agreed by the organizer of the exhibition, for the aircraft to fly over the exhibition at 1330 hr.—the time of the official opening ceremony. Correspondence between the company and the agent, who was chiefly responsible for the arrangements, although he was not an employe of the company and who was killed in the accident, made reference to this particular flight as a "fly past." In this respect the organizer of the exhibition has stated that it was arranged that the flight would include a "dip in salute" at the time of the opening. Two days before the exhibition opened the agent telephoned the Cardiff City Police and requested permission for the aircraft to fly low over the city. He was informed that the flight must be conducted in accordance with the Air Navigation Order (see below).

The senior pilot of the company has stated that while he may not have given the pilot any specific instructions in respect of height to fly he had reminded him that the flight was not a "beat-up" and was to be carried out at a safe height.

The operating company made no request to the minister for a dispensation of the minimum safe altitude regulations.

The aircraft took off at 1320 hr. with three passengers from Pengam Moors, an airfield on the eastern outskirts of the city, and flew over the exhibition at least three times at a very low altitude. The length of each run extended for some three to four miles and its altitude during the first two of these was estimated to have varied between 200 and 1,000 ft. The engines were running normally and there was no outward sign of any malfunctioning of the aircraft.

On the final run toward the exhibition the aircraft was seen approaching from the southeast at a range of about 1½ mi. and at an altitude of about 100 ft. The starboard propeller was then stationary and was later identified as being feathered.

It passed over the exhibiton with the propeller feathered at an extremely low altitude and after continuing for about half a mile rotation of the starboard propeller indicated that the pilot was attempting to restart the engine. A few seconds later the aircraft yawed from side to side and climbed slightly to clear some high trees. It then went into a steep right-hand climbing attitude from which it dived almost vertically to the ground.

In the close vicinity of the place where the aircraft crashed was a school, a number of houses, business premises and Maindy

[1] All times in this report are Greenwich Mean Time.

Note: Rule 11, Section III, Schedule II of the Air Navigation Order, 1954, is as follows:

"An aircraft shall not be operated in a negligent manner or in a reckless manner so as to endanger life or property".

Rule 15 (1)(a), Section III, Schedule II of the Air Navigation Order, 1954, is as follows:

"An aircraft other than a helicopter shall not fly over any congested area of a city, town or settlement below—

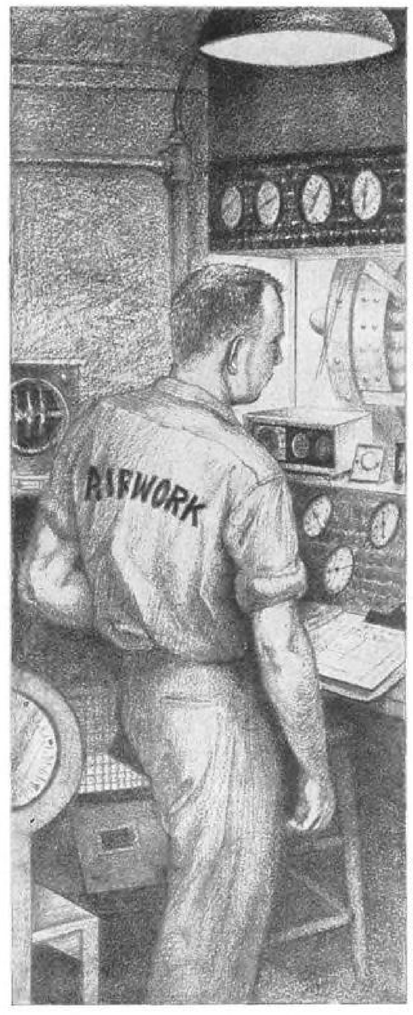
(i) Such height as would enable the aircraft to alight clear of the area and without danger to persons or property on the surface, in the event of failure of a power unit; or

(ii) a height of 1,500 ft. above the highest fixed object within 2,000 ft. of the aircraft, whichever is the higher."



Bartow Accepts FSF-Aviation Week Award

Flight Safety Foundation-Aviation Week Award is presented to Jack Bartow (second from left) by Jerome F. Lederer, FSF managing director, for Bartow's work on high intensity approach and runway light systems. With them are Robert Knight, safety officer, National Aviation Facilities Experimental Center, FAA, left, and C. Townsend Ludington, founder of Ludington Air Lines



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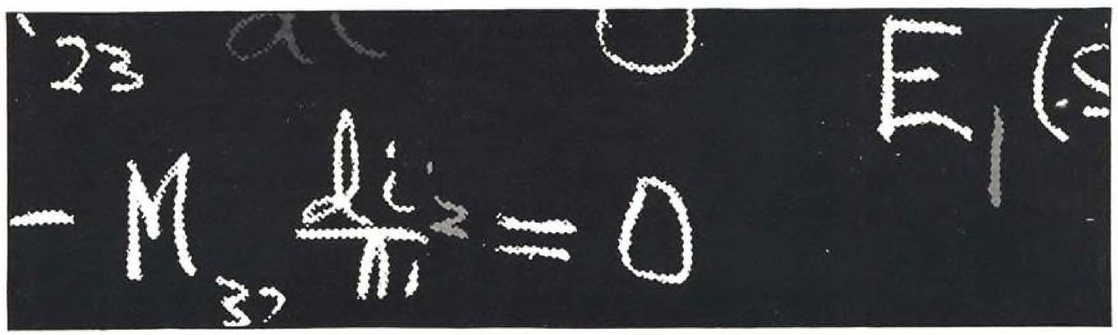
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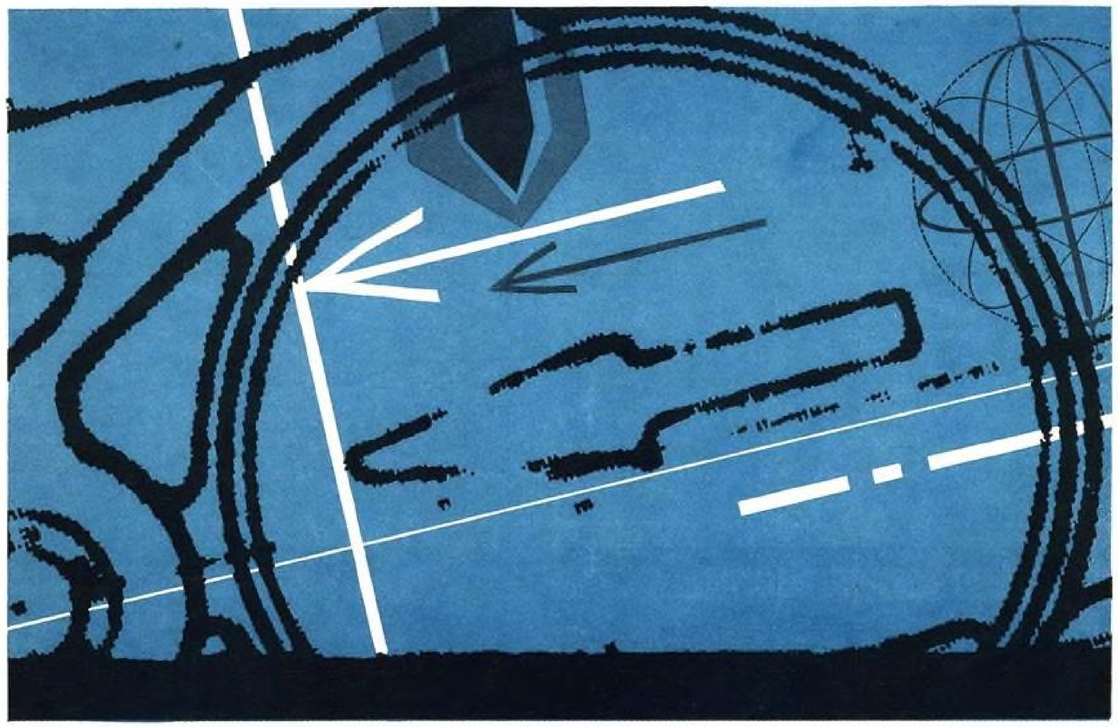
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sports stadium which was in use at the time by a large number of school children. It was entirely fortuitous that no one on the ground was either killed or injured. A lorry driver who courageously attempted to extricate the pilot from the wreckage received severe burns when the aircraft burst into flames.

Wreckage Examined

Inspection at the scene of the accident confirmed that the aircraft had dived into the ground in a near vertical attitude. With the exception of the outer sections of the mainplane the aircraft was almost entirely burned out.

The flaps and landing gear were retracted. There was no evidence that the aircraft had been on fire in the air.

The starboard fuel cock was in the OFF position. There was no evidence that the starboard engine was running under power at the moment of impact. The port engine was under power.

Damage sustained by the pilot's pitch control mechanism of the starboard propeller indicated that the control lever was in the feathering position at the time of impact. Both propellers were in the constant speed pitch range but the starboard was at a pitch angle nearer to the feathered position. There was no evidence of any pre-crash defect.

Observation

It is probable that during the unfeathering action of the starboard propeller the pilot omitted to turn on the fuel. Consequently, the engine did not develop power and the aircraft lost airspeed due to drag from the wind-milling propeller. Under the prevailing conditions the performance of the aircraft, with a propeller windmilling and with maximum power from the other engine, would permit only a very small rate of climb. The fact that the starboard propeller was not feathered and that the cockpit pitch control lever was in the feathered position indicates that the pilot had initiated refeathering action at the last moment.

Conclusions

(1) The aircraft had a valid Certificate of Airworthiness.

(2) The aircraft was correctly loaded.

(3) There was no pre-crash failure of the airframe, its engines or propellers.

(4) The pilot's license was valid for the flight.

(5) The pilot was inexperienced in Dove aircraft and was not proficient in asymmetric flying.

(6) The starboard engine fuel cock was found in the OFF position.

(7) The drag of the windmilling propeller resulted in loss of airspeed.

(8) The flight over Cardiff was made below the regulatory minimum safe altitude.

Opinion

The accident was the result of loss of control by an inexperienced pilot during an attempt to restart an engine following asymmetric flight at a very low altitude.

J. W. Duggan
Deputy Chief Inspector of Accidents

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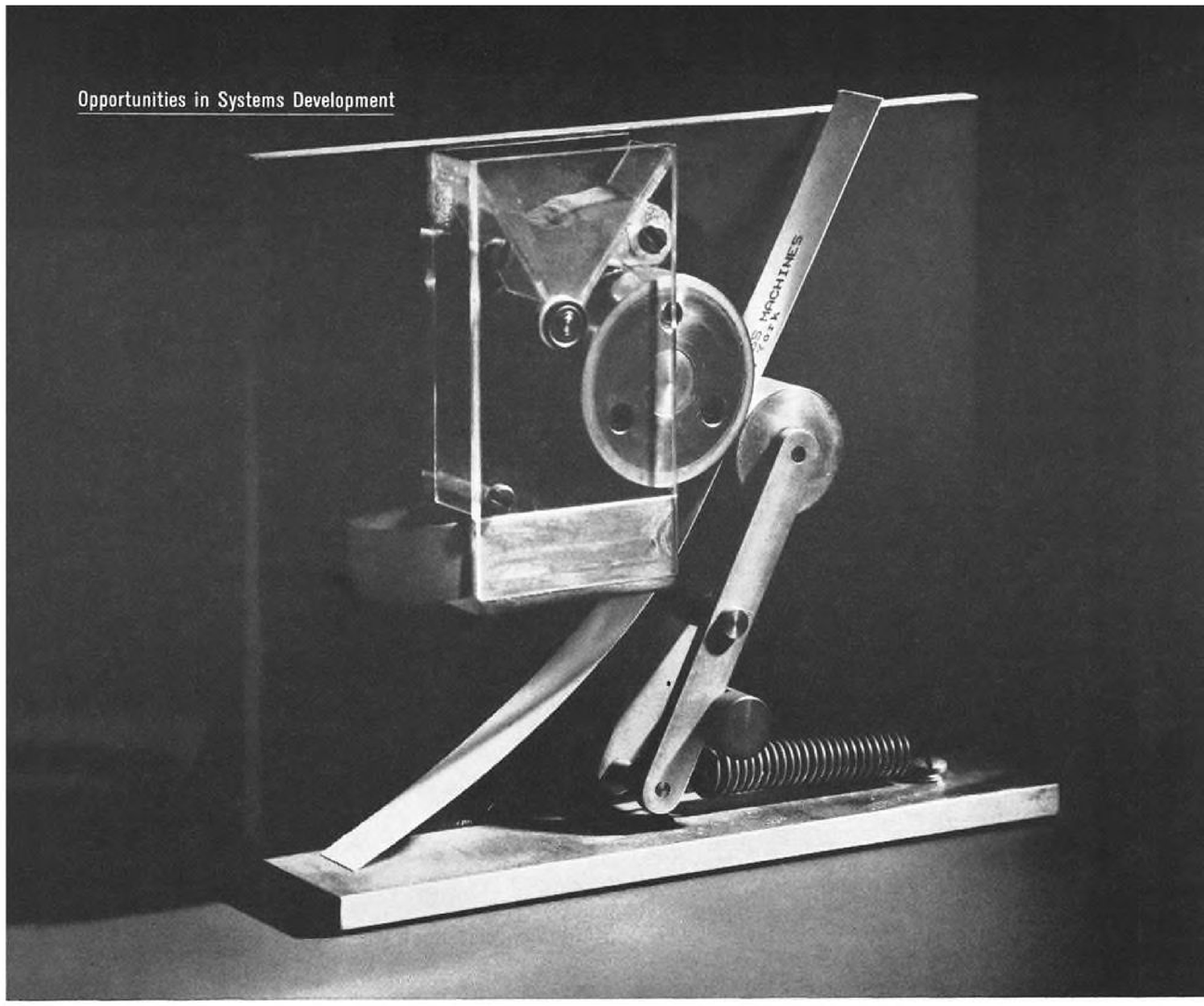
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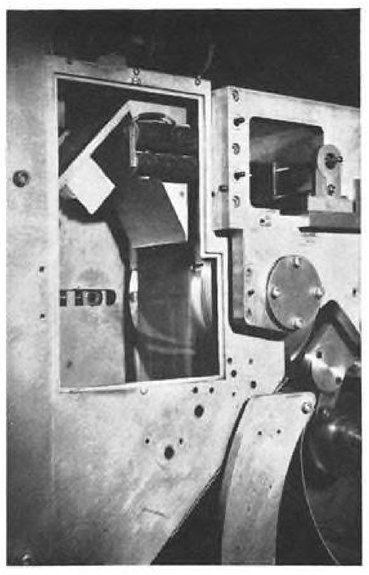
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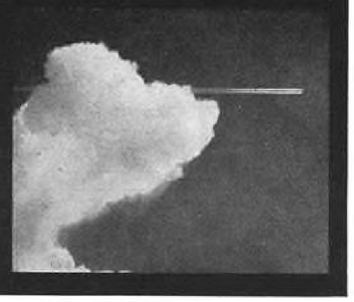
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LETTERS

Photo-Recon Camera

Mr. James Dunn's derogatory comments (AW July 4, p. 102) concerning the Fairchild camera used in this year's winning Royal Flush contest (AW June 13, p. 54) cannot go unchallenged.

We are at a loss to understand why he chose to recommend a camera (KA-30) for this operation which is more limited in performance than the one he is criticizing. Actually, the camera used was a standard KA-2 which is used by both the USAF and NATO defense forces throughout the world.

The KA-30, by no means a standard model, produces a photograph only one-quarter the size and yet has a shutter speed only approximately half that of the KA-2.

The image motion stopping capability of a camera is a function of its shutter speed, particularly in high oblique photography where image motion compensation is of little value.

Thus, all else being equal, the camera with the fastest shutter permits operation at the greatest speed and lowest altitude. Actually the KA-2 camera imposes no serious limitation for "on-the-deck" missions with the RF-101, provided sufficient light is available to use the top shutter speed. Even at Mach 1 and 500 ft., satisfactory high oblique photos can be obtained. The KA-30 would be considerably inferior in this respect because of its slow shutter.

Please publish this in an early issue so that the false impression created will be rectified.

A. Gordon Nash, Chief Engineer
Fairchild Camera and Instrument Corp.
Syosset, N. Y.

Airline Economics

Let us face facts about airline economics. Is not the matter of load factor of more importance than many people have been giving it? Is it not true that as the price per mile for air fare goes up the load factor goes down? If an airline hurts the consumer does it reduce airline business?

We should also look into the matter of increasing the yearly total of passenger miles while we are studying load factors. It seems that in recent years load factors have been going down. Yet the number of people traveling by airplane has been increasing each year. This means that the number of planes available for travel use has been increasing. Load factors for trunklines during the police action of the first part of the 1950s reached about 75%. Recently I have found that trunkline load factors amount to about 55%.

It seems that it takes a strike or a war to bring about reasonably high load factors. How about making use of good selling and advertising to bring about effective load factors instead of having bad things to happen to improve business?

The airlines have been failing to solve the problems of competition for a large number of years. We have seen monopoly make inroads into the passenger travel motives. In many cases, where travel could take place, it would not take place because of high rates. Not only does the air traffic system have a high base per rate (in proportion to technological advances) but very little of the promotion schemes which could take place have taken place. The airlines do not give return trip discounts as the railroads do, and in many ways inducements for travel in a great way are not made.

The thing for the airlines to do is to reduce costs. The airlines can make use of better technology as well as any other group. What the airlines have been doing is to the effect of letting the aircraft manufacturers pull the wool over their eyes. When the aircraft manufacturers wake up also to the fact that they can have production on a mass basis, things will be better for the air traveler. Things also will be better for business in general. The airlines and the aircraft manufacturers and the consumer need to be lined up for better business. More planes flying at good load factors should be the aim.

Charles W. Shepard
Atlanta, Ga.

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.

Discoverer Recovery

I have read with interest the recent letter by Mr. Frederick Pilcher (AW June 27, p. 102) concerning capsule recovery. I feel that he has brought forth a very good point which should certainly be further pursued.

The facts of the matter seem to unequivocally call for over-land recovery. For example, take the case of a polar orbiting vehicle launched from Vandenberg into a 96-min. orbit. These are the average characteristics of the Discoverer satellites. On the fifteenth orbit this vehicle would pass over Vandenberg on about the 122nd meridian. Actuation of the recovery mechanism from a station in Canada or Greenland on this orbit would bring the capsule down into the California-Oregon-Nevada area. Civilian residents of the area could be requested to watch for the capsule and report any sightings to Air Force personnel close by. Airborne snag lines could continue to be primary means for recovery, but rendezvous directions could be issued from ground-based tracking stations rather than radar picket aircraft, thus providing more precise information. If airborne recovery was not accomplished, then a long-term ground search could be instituted based on all the trajectory data acquired. Let us keep in mind that the two capsules known to have successfully re-entered over water were never reported recovered or even sighted. On the other hand, the capsule from Discoverer II which came down in Norway was found by the Russians sometime later. This fact in itself seems to be a tremendous point in favor of dry land recovery.

I feel that Aviation Week should investigate and publish the reasons for the Air Force's decision not to use over-land recovery techniques. I further feel that if dry land recovery appears to be definitely more satisfactory that Aviation Week should align its editorial policy in this direction in the interest of the success of Discoverer and subsequent programs.

Roger D. Bourke
Aerojet-General Nucleonics
San Ramon, Calif.

Aerial Firefighting

The following subject has been bothering me since I moved to the dry Southern California area four years ago; it concerns forest fires and improved methods for extinguishing same.

At this writing we have a violent fire going in San Gabriel Canyon, Los Angeles forest, uncontrolled.

Why is it not possible to utilize Air Force bombers and cargo A/C to help extinguish these fires when they are small, instead of allowing them to spread, then appeal to the services to furnish manpower but no A/C.

The few TBMs and PBYs, etc., stationed throughout the potential fire areas do a fine job when called on, but usually they are called after the fire has a good start. I realize that this suggested idea is not new and presents many problems.

The responsibility for extinguishing these fires and the prevention of loss of life and property should be jointly shared by the military, especially the Air Force and the Area Fire Warden.

The Air Force has the A/C that can be converted to part time water bombers, and the personnel to do an excellent job quickly.

I would like to read the opinions of others on this subject; possibly something can be done through our congressmen.

Roy R. Russell, Engineer
Convair, Plant No. 42
Palmdale, Calif.

Boeing 720 Range

I was interested to read about the Boeing 720, since it recently finished its flight testing at this base.

However, when I noticed the 707 emblazoned on the fuselage my curiosity led me to consult the cover story on p. 19 of the July 18 issue. I then consulted the story on p. 47, and there found a suitable explanation of the errant 707.

But, with all regards to Boeing and Aviation Week, I became more confused when I learned the 720 "is tailored primarily for use over American's nonstop routes ranging up to 2,000 mph."

Has Aviation Week made another scoop, or do I detect a slightly crimson-faced staff? 2,000 mph.? Ye gads!

Henry D. Steele, 1st Lt., USAF
Air Force Flight Test Center, ARDC
Edwards AFB, Calif.

(The explanation Lt. Steele found on p. 47 is that 707-023 is American's designation for the Boeing 720. What he found on p. 19 is an error; the sentence should read ". . . nonstop routes ranging up to 2,000 mi."—Ed.)



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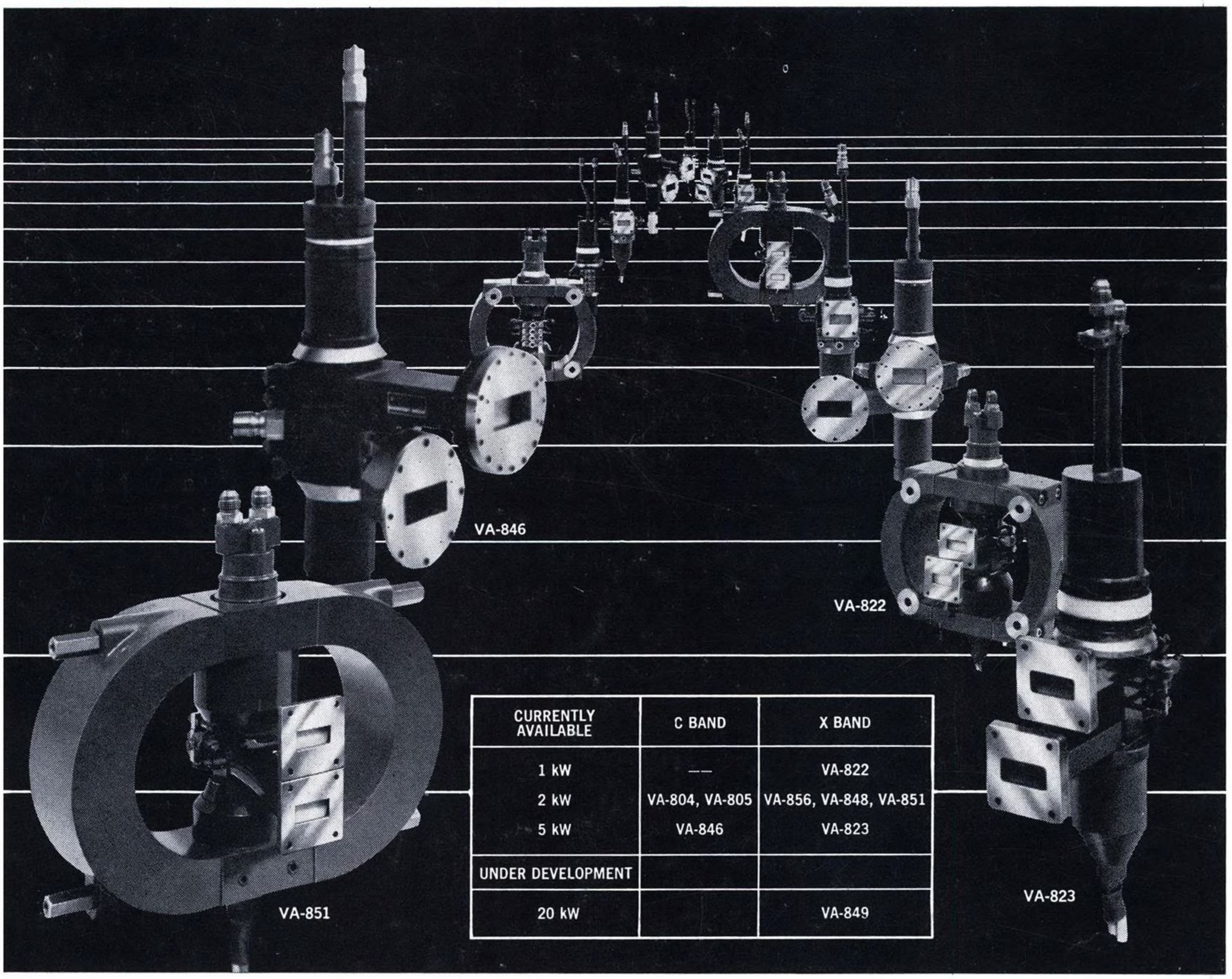
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