March 25, 1957 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

NACA Models Test High Speed Spins

•

Pilot Describes Pacific Ditching



Vertol H-21 Tows LST

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AVIATION CALENDAR

Mar. 25-29—Tenth Western Metal Congress, Ambassador Hotel, Los Angeles.

Mar. 26-28—Sixth Weather Radar Conference, American Meteorological Society, Cambridge, Mass.

Mar. 27-29—Educational Colloquium on Radiation Effects on Materials, sponsored by Office of Naval Research and Glenn L. Martin Co., Johns-Hopkins University, Baltimore, Md.

Apr. 2-5—National Aeronautic Meeting, Aeronautic Production Forum and Aircraft Engineering Display, sponsored by Society of Automotive Engineers, Hotel Commodore, New York.

Apr. 3-6—Spring Meeting, American Rocket Society, Sheraton Park Hotel, Washington, D. C.

Apr. 7-10—Spring Meeting, American Society of Mechanical Engineers (includes trips to Hayes Aircraft Corp., Redstone Arsenal), Dinkler Tutwiler Hotel, Birmingham, Ala.

Apr. 10-12—National Nuclear Instrumentation Conference and Third Southeastern Industrial Instrumentation Exhibit. Atlanta Biltmore Hotel, Atlanta, Ga.

Apr. 12—Latest Developments in Capsule Escape Systems, Douglas Aircraft Co. and Society of the Experimental Test Pilots, Lancaster, Calif.

Apr. 14-16—1957 National Symposium on Telemetering, sponsored by the Institute of Radio Engineers' Professional Group on Telemetry and Remote Control, Sheraton Hotel, Philadelphia, Pa.

Apr. 15-17—Symposium on Systems for Information Retrieval, sponsored by Western Reserve University, Masonic Auditorium, Cleveland, Ohio.

Apr. 16-17—Aircraft Ball Bearing Conference, sponsored by New Departure Division, General Motors Corp., Statler Hotel, Hartford, Conn.

Apr. 22-24—Second Annual Jet Engine Hydraulics Symposium, Hotel Statler, Detroit, Mich.

Apr. 23-25—Annual Convention, International Airline Navigators Council, Piccadilly Hotel, N. Y.

(Continued on page 6)

AVIATION WEEK • MARCH 25, 1957

Vol. 66, No. 12

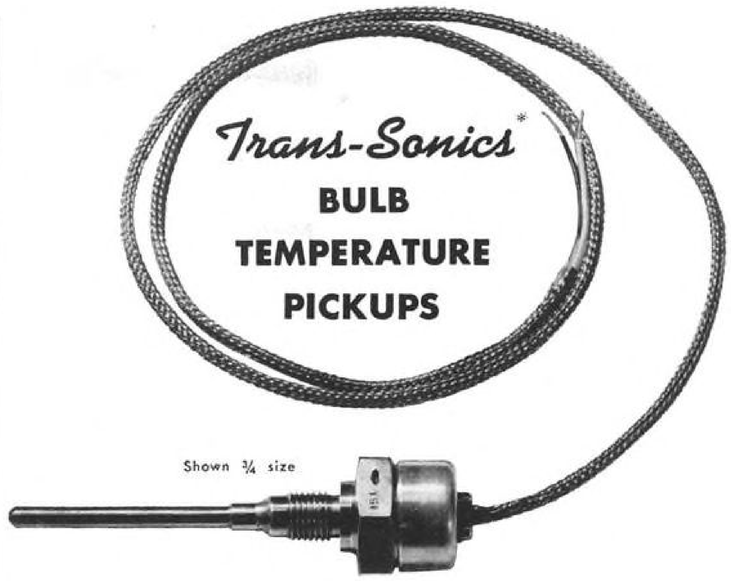
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AVIATION CALENDAR

(Continued from page 5)

Apr. 29—Third Flight Test Instrumentation Symposium, Statler Hotel, Los Angeles.

Apr. 29-May 2—16th Annual National Conference, Society of Aeronautical Weight Engineers, Broadview Hotel, Wichita, Kans.

Apr. 30—Atlantic Rate Commodity Rate Board Meeting, International Air Transport Assn., Torquay, Devonshire, England.

May 1-3—Spring Meeting and Exhibit Society for Experimental Stress Analysis, Hotel Statler, Boston, Mass.

May 5-8—30th Annual Convention, American Assn. of Airport Executives, Shamrock Hilton Hotel, Houston, Tex.

May 5-8—1957 Convention, American Association of Airport Executives, Shamrock Hilton Hotel, Houston, Tex.

May 6-8—28th Annual Meeting, Aero Medical Assn., Shirley Savoy Hotel, Denver.

May 8-11—13th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 13-15—National Conference on Aeronautical Electronics, sponsored by Institute of Radio Engineers, Dayton, Ohio.

May 15-17—Jet Age Airport Conference, Air Transport Division, American Society of Civil Engineers, Park-Sheraton Hotel, New York.

May 24-June 2—22nd Paris Air Show, Society of French Aircraft Constructors, Le Bourget Airport, Paris.

June 1—8th Annual Maintenance and Operations Meeting for Business Aircraft Owners, sponsored by Reading Aviation Service, Reading Municipal Airport, Pa.

June 1-9—First Annual National Aviation Trade Show, Monmouth County (N. J.) Airport.

June 7-8—30th Annual Homecoming and Reunion, Parks College, East St. Louis, Ill.

June 17-20—National Summer Meeting, Institute of the Aeronautical Sciences, Biltmore Hotel, Los Angeles, Calif.

June 23-25—29th Annual Meeting, Aviation Distributors & Manufacturers Assn., The Broadmoor, Colorado Springs, Colo.

July 2-11—24th National Soaring Contest, Elmira, N. Y.

July 12-13—British Lockheed International Aerobatic Competition, the National Air Races (third round) and the King's Cup Air Race, Coventry Civil Aerodrome, Bagington, England.

Aug. 20-23—Western Electronic Show & Convention Board of Directors, Cow Palace, San Francisco, Calif.

Sept. 1-6—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

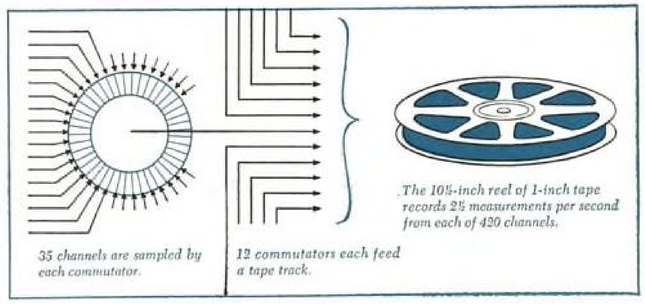
Nov. 7-8—Weapons System Management Meeting, Statler-Hilton Hotel, Dallas Tex.

Dec. 17—Wright Brothers Lecture, Department of Commerce Auditorium, Washington, D. C.

How to record 420 channels of simultaneous data

Boeing Airplane Company's flight tests demonstrate an easy way

Have you ever seen an oscillograph record that was eight and a half feet wide? At fifty channels per foot this is what it would take . . . which shows the decided advantages in the way the Boeing Airplane Company solves the problem. They put 420 channels of data onto a one-inch magnetic tape. Two hours of flight test can be recorded on one 10½-inch reel.



In a published article, Mr. Arthur T. Snyder of Boeing describes their system as a low level, low-speed, pulse-width-modulation technique. It time-multiplexes 35 channels of data onto each of 12 tracks (of 14) on an Ampex 814 Airborne Magnetic Recorder; (35 × 12 = 420). The system inputs are variable resistances, thermocouples, strain-gage bridges and other bridge-type transducers. Each is fed to a segment on one of twelve rotating commutators that sample every channel 2½ times per second. The Ampex 814 recorder running at 3¾ in/sec. records over 8-million measurements in two hours.

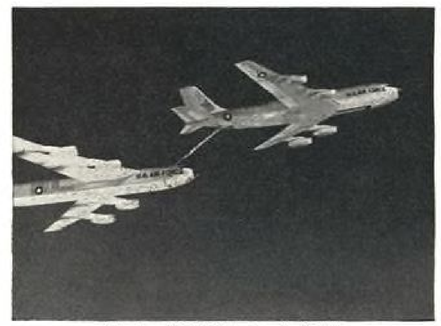
This recording system used by Boeing is limited *by choice* to data that changes at a slow rate. This is by no means a fixed limitation. Certain Ampex recorders (Series 800, FR-100 and FR-1100) have interchangeable amplifiers. Each track can thus be used with any one of three types of recording according to frequency requirements:

With PWM recording (like the Boeing example) as many as 88 channels of low-frequency data can be put onto one track.

With direct recording up to 18 channels of RDB subcarrier data of varying frequency requirements can go onto one track — or very high-frequency data uses one track per channel.

With FM carrier recording one channel of data occupies one track and provides high instantaneous amplitude accuracy. FM is particularly suitable for shock and vibration records.

When a recording containing a large number of channels of data is reproduced, another of magnetic tape's advantages becomes apparent. The data can be reproduced in electrical form. Consequently it is a relatively simple matter to unscramble the channels by automatic or semi-automatic means. Any combination of channels can be scanned, correlated and fed to computing devices. These fortunate faculties of magnetic tape help reduce the handling of vast amounts of data down to a task of wieldy size. For example in the Boeing flight tests already mentioned, all data is published within two or three days after the test instead of from several weeks to several months later as by previous methods.



Boeing KC-135 tanker in flight.

If you have a specific problem involving large amounts of data or unusual combinations, Ampex's application engineers will be pleased to furnish further information. More of the capabilities of magnetic tape will be discussed in this continuing series of bulletins. Would you like to have copies mailed direct? If so, write Dept. UU-3.

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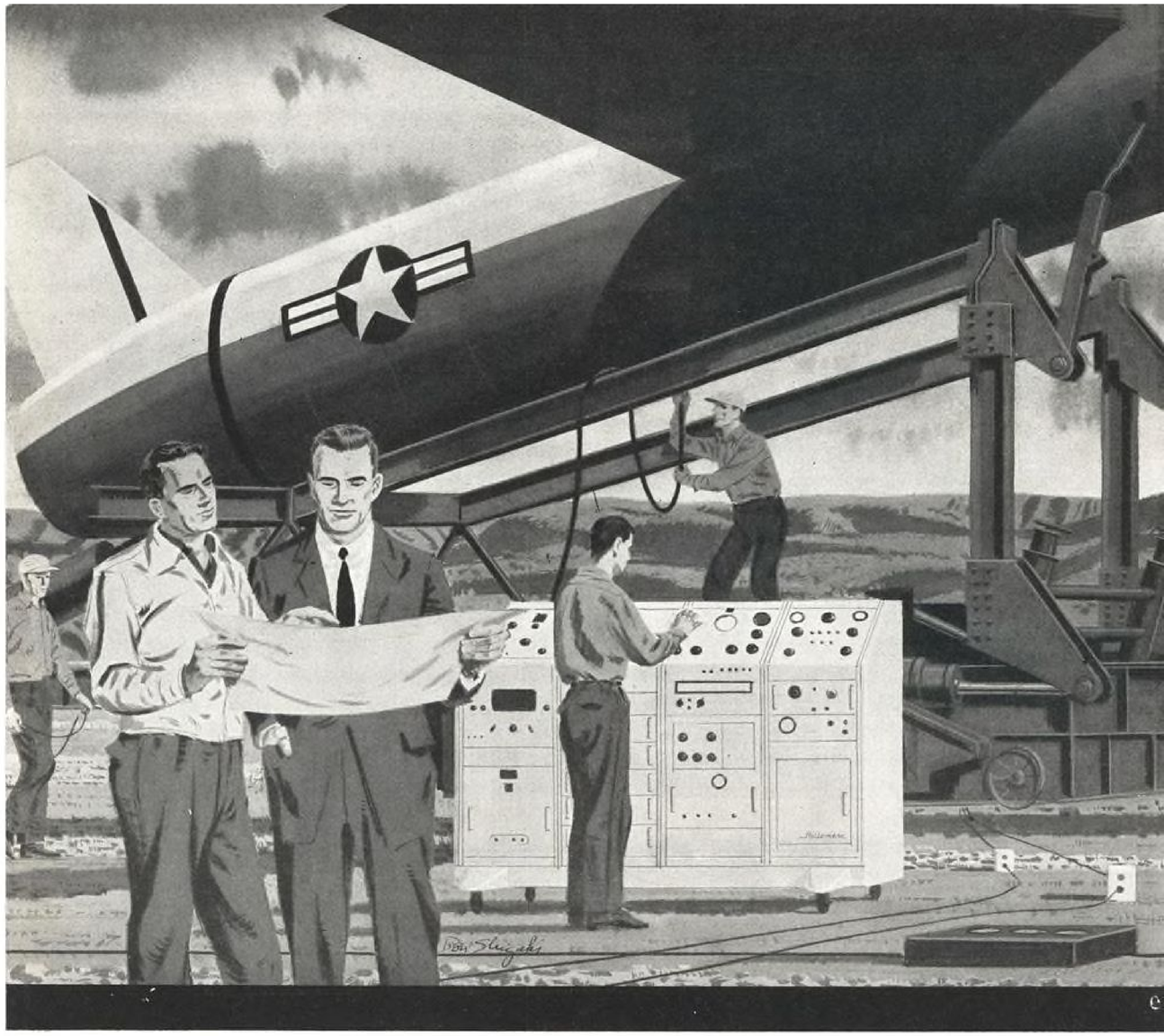
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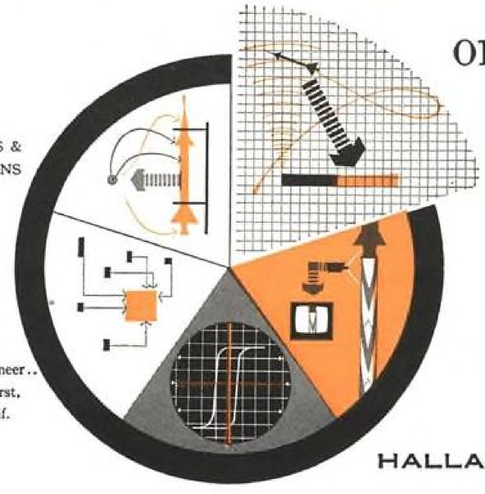
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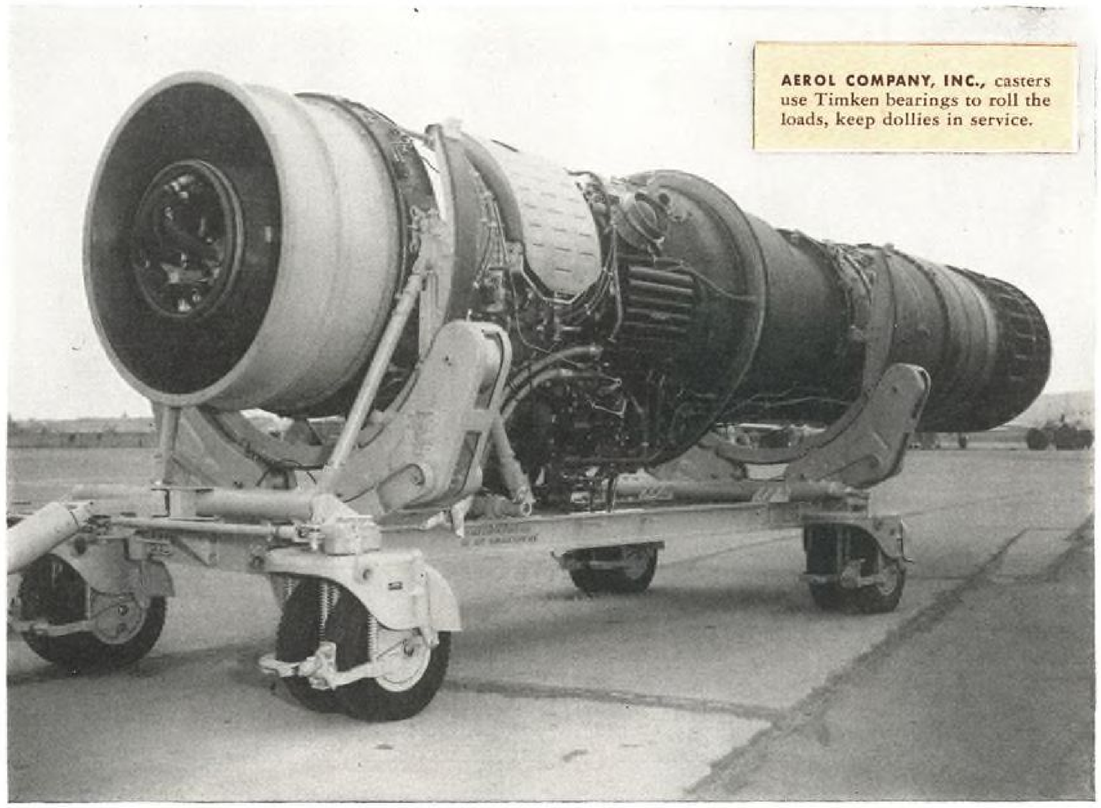
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78-57



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Timken bearings virtually eliminate friction. They're geometrically designed to give true rolling motion and they are precision manufactured to live up to their design. Lower friction means the dollies roll easier, have less starting resistance. There are fewer jolts to the engine. If shock loads are encountered, Timken bearings shrug them off. They're case-carburized to give wear-resistant surfaces over tough, shock-resistant cores.

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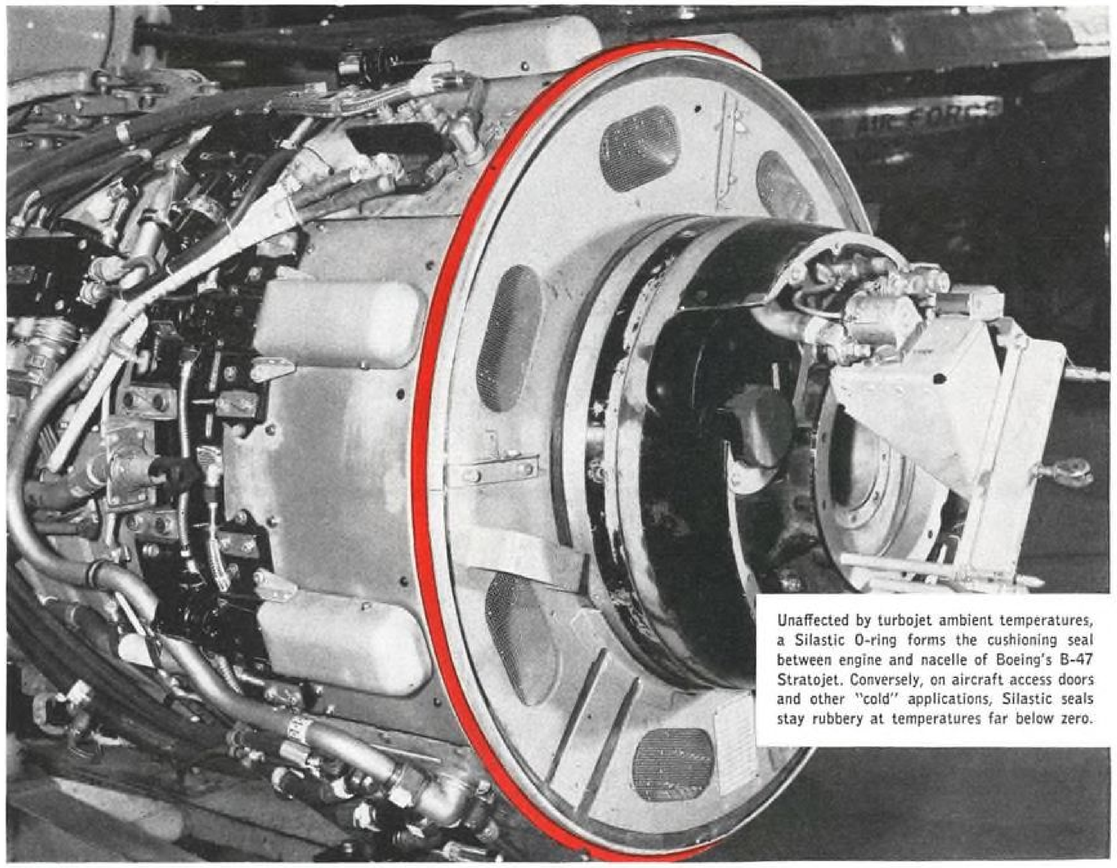
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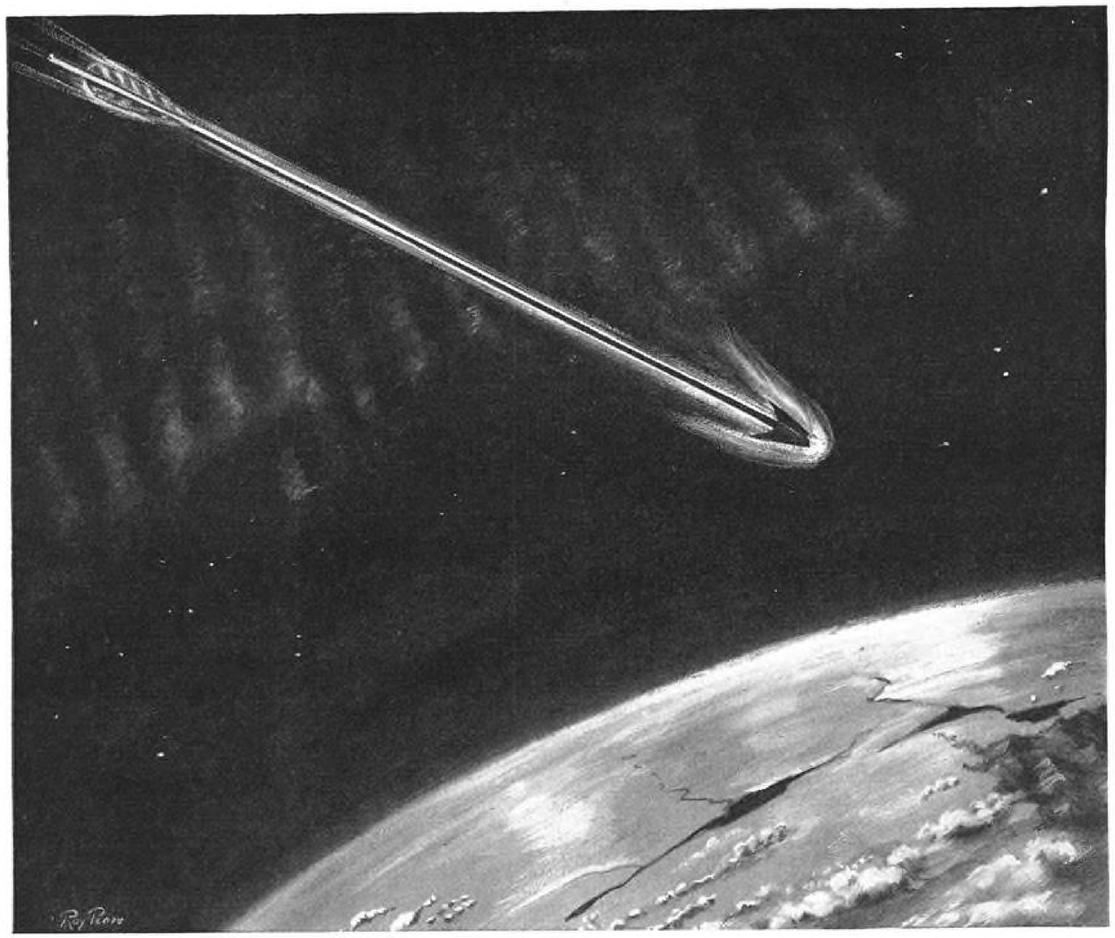
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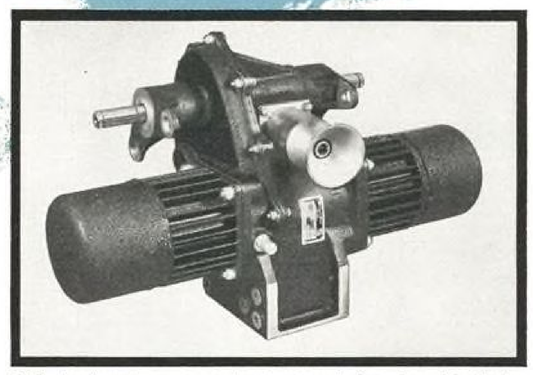
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RESEARCH AND MARKETING

Mary Whitney Fenton, Joan Read, Judith P. Wheeler

Navy Reports Mach 200 Shock Waves **26**
▶ Ionized gas pushed to 300,000 mph., temperatures to several hundred thousand degrees Kelvin mark.

Douglas Proposes Replacement for DC-3 ..... **38**
▶ High-wing, four-turboprop transport proposed for local carriers; production hinges on reception.

NACA Models Seek Critical Spin Answers **50**
▶ High performance, large fuselage-to-wing ratio aircraft demand new recovery techniques.

Pilot Describes Stratocruiser Ditching **133**
▶ Detailed account written by Capt. Richard Ogg of Pan American includes his conclusions.

MISSILE ENGINEERING

Army Partisans Attack Wilson 27
Plasma Jet Melts Test Shape 30
Sparrow III Revealed 33

AERONAUTICAL ENGINEERING

First Republic F-105 Photo 27
Some NACA Funds Will be Restored .. 28
F8U Leaves Shock Diamonds 29
French Fly Griffon II, Alize 37
Russians Build Turboprop Airliner ... 41
Vertol H-21B Tows Ships 64
Low Costs Forecast for AW 650 67

AVIONICS

Traffic Control Radar-TV Display 34
Collins' New Management Plan 77
Changes in Avionics Industry 78
New Avionics Products 83

PRODUCTION

Producting Briefing 113

EQUIPMENT

USAF Tests New Approach Lights ... 89
Timer Warns of Engine Failure 93
Turbine Powered Fuel Tank 97
Detector Shows Water in Fuel 98
New Aviation Products 101

BUSINESS FLYING

F-51 Gathers Tornado Data 117

AIR TRANSPORT

Riddle C-46 Certification 29
British Show Off Their Jetliner 32
J57, J75 Certificated 32
Turbo-Liner Begins Test Program 43
Carriers Win Mexico Rights 43
Convair 880 Details 43
Fare Increase Proposals Suspended .. 44
Viscounts Inspected 45
Dutch-U. S. Talks Resume 45
PanAm Rate Case Reopened 45
Shortlines 47
Airline Observer 47

FINANCIAL

Financial Reports 69
Stock Transactions 124
AMC Contracts 129
USAF Contracts 129
Navy Contracts 131

MANAGEMENT

Marines Simulate Brush-Fire War 33
News Digest 34
Who's Where 23
Industry Observer 23
Washington Roundup 25

Calendar 5, 6
Letters 158

EDITORIAL

Navy's Blimps Perform 21
Fiscal Facts 21

COVER: Vertol H-21B succeeded in towing a Navy LST of 3,000 tons displacement at a speed of 4.5 kt. in tests conducted by Navy at Coronado, Calif. Vertol is proposing use of the tandem helicopter in towing and salvage operations. H-21 also pulled an LCU of 330 tons displacement at 8-9 kt. and hauled a 2½ ton DUKW off a sandy beach into water (for further details, see page 64).

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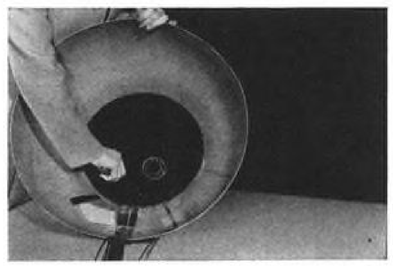
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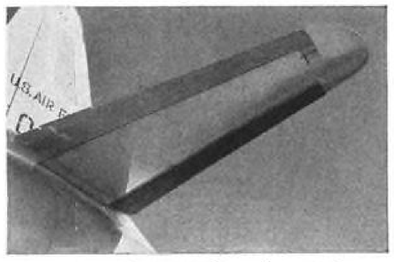
All the heat you want –served in thin slices



BFG electrically heated rubber gives ice protection to air scoops, inlets and other exterior parts.



Diffuser cowls for jet engines are kept ice free by B. F. Goodrich heated rubber applied inside.

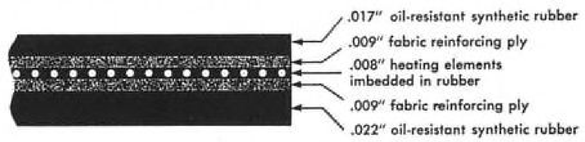


Empennage and wing leading edges are ice protected by abrasion resistant BFG heated rubber.

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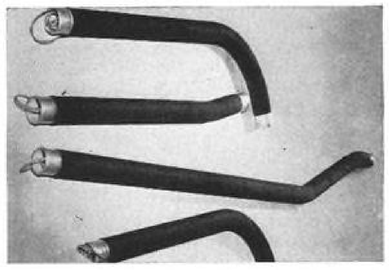
Cross section of typical BFG heated rubber construction. Precision spaced heating elements are sandwiched between rubber and fabric plies and vulcanized into a flexible unit.

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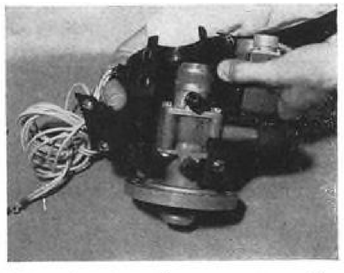
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EDITORIAL

Navy's Blimps Perform

It may be news to many readers that the non rigid, lighter than air ship is doing anything more exciting than carrying electric advertisements and lofting tourists over the greater Miami area. But during the past few months Navy blimps have been performing in a manner that highlights their increasing importance in the Navy's primary job of anti-submarine warfare.

Perhaps the most spectacular performance was the nonstop distance and endurance record set by a Goodyear ZPG-2 which remained aloft 264 hours and traveled over 7,000 miles without refueling. The course of this blimp during more than 11 days of continuous flight took it from the Atlantic coast to Portugal, North Africa and the Caribbean before it landed at Key West, Fla.

Anti-Submarine Watch

Even more significant was the feat of a trio of ZPG-2 blimps in maintaining a 10-day continuous anti-submarine and early warning radar picket watch 200 miles at sea off the New England coast during the worst weather experienced in 35 years. These Navy blimps relieved each other on station at intervals during a period that included freezing rain, heavy snow, winds up to 60 mph. and severe turbulence—conditions that grounded fixed wing aircraft of both the military and commercial airlines. One blimp flew through 32 hours of continuous icing conditions during a 40-hour patrol; another was airborne for 56 hours continuously in this wide variety of bad weather.

These feats by modern blimps, continuing the long tradition of Goodyear development of lighter than air ships, emphasize the growing role of this type of aerial vehicle in a modern defense system. The modern blimp has a number of inherent advantages for a modern naval role. Its large carrying capacity available for weapons, electronic gear, fuel and large crews of technicians makes it attractive for radar picket duty and anti-submarine warfare.

Nuclear Armament

The blimp can carry the largest antenna of the most modern airborne search radar. It is equipped with a variety of sonar devices and magnetic airborne detection equipment and can carry a heavy armament of homing torpedoes and air to underwater missiles, including the nuclear depth charge Lulu.

It can carry sufficient fuel for dogged hunting and relentless pursuit of submarines even without refueling and replenishment. But new techniques in refueling and resupplying while aloft from tankers, supply ships or aircraft carriers now make it feasible for the blimps to range over any ocean distances and accompany convoys or naval task forces over indefinite ranges.

The growth of an enemy submarine threat and the need for long-range warning of approaching aircraft over the vulnerable northeast and northwest approaches to the U. S. have enhanced the value of the abilities of the blimp in modern naval operations. True, the blimp is an extremely expensive piece of equipment, and it is extremely vulnerable to aggressive enemy action.

But the Navy appears to be convinced that the modern advantages of the blimp for anti-submarine warfare and radar picket duty far outweigh its vulnerability. The blimp will be an essential part of the Navy's airpower for some time to come.

Fiscal Facts

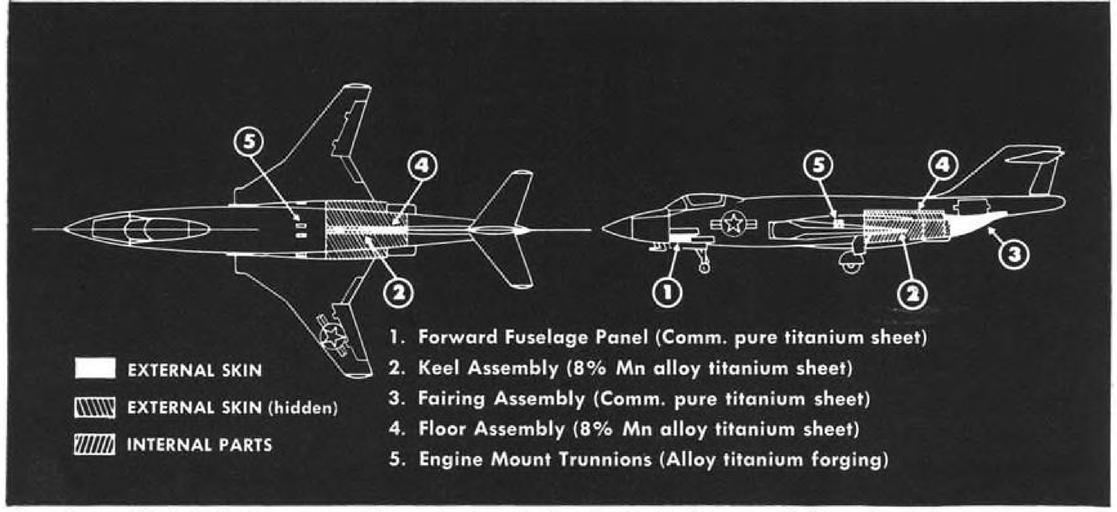
There are few places in the concrete cobweb on the Potomac known as the Pentagon where a reporter, taxpayer or any old U. S. citizen can get a straight answer to a straight question. Seldom in the history of this Republic have a group of military men and top civilian officials gone to such lengths as the current Pentagon incumbents to censor, distort and conceal legitimate information on how $35 billion of the taxpayers dollars are being spent annually on the defense of this country.

One bright exception to this general Pentagon policy is the shop run by Wilfred J. McNeill, Assistant Secretary of Defense for Fiscal Matters. Mr. McNeill was the first comptroller of the unified Defense Department and has served as the top Pentagon fiscal officer under both Democrats and Republicans since 1948. During these years, he has done the best job of any Pentagon official in informing the public on what is happening to its tax dollar. His annual briefings on the Defense Department budget—ably assisted by Max Lehrer—are a compact bundle of fiscal facts backed by a lucid and unusually candid description of the current Pentagon fiscal policy.

During the year, his office makes an intelligent effort to compile and release a running account of how expenditures and obligations are being made. There is seldom a time that a straight question put to Mr. McNeill or his office will not produce a straight answer in a reasonably short period of time. His example should serve as a guide to other top Pentagon officials on how to discharge their responsibility to the public, press and industries contributing to the defense program.

—Robert Hotz





Five major assemblies in the Voodoo are commercially pure titanium or titanium alloy. For the fairing assembly alone—where high strength is required—McDonnell effects a 33% weight saving by using titanium.

TITANIUM boosts the Voodoo's performance

The McDonnell F-101A Voodoo, Strategic Air Command's long-range supersonic fighter, owes much of its high performance to generous use of strong, light-weight titanium.

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WHO'S WHERE

In the Front Office

A. A. Garthwaite, board chairman, Republic Rubber Division, Lee Rubber & Tire Corp., Youngstown, Ohio. **A. A. Garthwaite, Jr.** succeeds the senior Mr. Garthwaite as president.

E. A. Link, vice chairman of the board, General Precision Equipment Corp., New York, N. Y.

Carl B. Wooten, executive vice president, Trecker Aircraft Corp., Milwaukee, Wis.

Bernard Levine, vice president, Norden-Ketay Corp., Stamford, Conn.

Orville M. Dunning, vice president, Airborne Instruments Laboratory, Mineola, N. Y.

Honors and Elections

Mrs. Rebecca Hall Sparling, design specialist for Convair Division of General Dynamics Corp., has received the 1957 Award of the Society of Women Engineers for significant contributions to engineering.

Dr. Walter R. Dornberger, technical consultant for Bell Aircraft's Research Division, has been named chairman of the Spacecraft Systems Subcommittee of the Space Flight Technical Committee of the American Rocket Society.

William C. Foster, executive vice president of Olin Mathieson Chemical Corp., has received an honorary doctor of laws degree from Syracuse University.

Changes

James R. Lewis, director-public relations, the Ramo-Wooldridge Corp., Los Angeles, Calif.

F. P. Caruthers, project engineer, Specialties, Inc., Syosset, N. Y.

Frank H. Sheldon, director-contract sales, Slick Airways, Inc.

Maynard D. Shumaker, superintendent-B-47 Modification Division, Lockheed Aircraft Corp., Marietta, Ga. Also: **Vic E. Alexander,** superintendent-Production Flight Line Division.

K. J. Bossart, technical director, Convair-Astronautics Division, Convair Division of General Dynamics Corp., San Diego, Calif. **Mortimer Rosenbaum** succeeds Mr. Bossart as chief engineer. Also: **H. R. Friedrich,** assistant chief engineer (development), and **Krafft A. Ehricke,** assistant to the technical director.

Ernest Lagelbauer, chief engineer Flettner Aircraft Co., Kew Gardens, N. Y.

Capt. Marshall B. Gurney (USN, ret.), manager-Government Relations Dept., Raytheon Manufacturing Company's Santa Barbara Laboratory, Santa Barbara, Calif.

Capt. Ormand Gove, director-flight operations (Atlantic), Trans World Airlines, Inc.

John C. Waugh, manager-public relations, Vertol Aircraft Corp., Morton, Pa.

Jack F. May, manager-cargo sales, Eastern Air Lines, Inc. Mr. May succeeds **Richard W. Gilbert,** resigned.

Charles A. Neubling, manager-engineering Electronics Division, Fairchild Controls Corp., Syosset, N. Y.

O. A. Wright, engineering manager, Actuation Research Corp., Glendale, Calif.

INDUSTRY OBSERVER

► Army plans to test launch a second production prototype model of its Jupiter intermediate range ballistic missile from the USAF Missile Test Center, Cape Canaveral, Fla., sometime this week. In the first launching (AW March 11, p. 25), Jupiter production prototype reportedly reached an altitude of 60,000 ft. before aborting.

► **Lockheed's Military Operations Research Division is pushing a new defense concept centered around a large aircraft carrying both warning radar and batteries of interceptor missiles of the Boeing Bomarc class.**

► Temco Aircraft Corp. is developing an air-to-surface missile for the Navy. Designation is Corvus. The Dallas firm recently received a $16 million Navy contract for work on the missile.

► **Convair ejection system developed for the F-106A incorporates a seat that rotates the pilot so that he emerges from the cockpit feet first and on his back. Purpose is to cut decelerative forces and protect the pilot's body from supersonic air blasts. New system will be tested by USAF at Hurricane Mesa, Utah, within the near future. Air Research and Development Command already has conducted extensive sled-track tests on the best position for a pilot to assume during high-speed bailout (AW Dec. 10, p. 81).**

► Chance Vought will add two small ventral fins to future production models of Navy's F8U Crusader to offset inertial coupling problems on present models. The fins, to be located near the tail, will slant down 45 degrees at low speeds, move to 90 degrees downward at high Mach numbers.

► **Hughes Tool Co.'s Aircraft Division, Culver City, Calif., is redesigning its Model 269 two-place helicopter. Present performance and handling characteristics are good, but the handbuilt prototype design was found unsuitable for high volume production at a low price. Hughes hopes to hold the cost down in order to sell the helicopter to commercial operators as well as the military.**

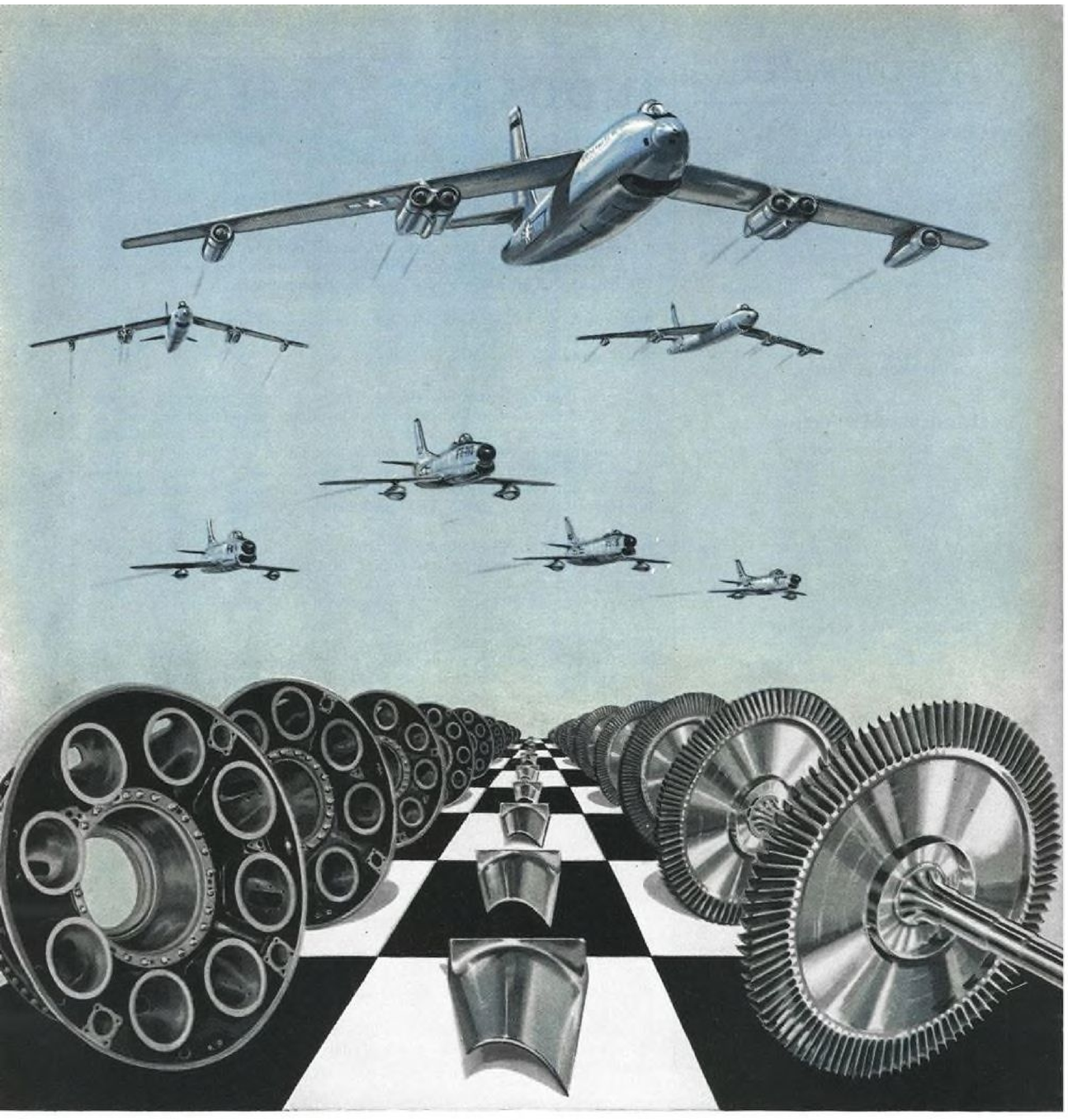
► Russia Type K turboprop engines, believed to be current powerplants for four-engined Bear bomber, were designed to give 8,000 shp. plus residual thrust at operational altitude of 36,100 ft. and 8,250 engine rpm. Single-spool engine has a 14-stage compressor, a five-stage turbine, measures approximately 45 inches in diameter and is 20 feet long. Dry weight without propeller is about 5,100 lb. Specific fuel consumption at design altitude is 0.352 pounds per horsepower per hour. Sea level ratings of the engine: 12,000 shp. plus about 2,650 lb. residual thrust. Specific fuel consumption is 0.573 lb. per horsepower per hour. Engine was designed by a team of about 800 German engineers and technicians from Junkers and BMW Flugmotorenbau G. m. b. H. deported to Russia in 1946.

► **Russia's plans for a moon circling rocket project call for a unit with a payload of between 45 and 50 kilograms. Present plans call for the rocket to circle the Moon at a distance of approximately 30,000 kilometers from the surface. Director of the project is Dr. I. Chebolaryev of the Astronautics Institute of Moscow.**

► Thrust reverser developed by Marquardt Aircraft Co., Van Nuys, Calif., has been ordered by Douglas Aircraft Co.'s El Segundo Division for its A3D Skywarrior Navy attack plane.

► **Air Force planning calls for production of the present crop of Century Series fighters beyond the Fiscal 1958 buying program.**

► Bethlehem Steel has received Navy contracts for the conversion of two more ships as weapon carriers for Convair's Terrier suface-to-air missiles. Contracts are worth $13 million each. Name of one of the vessels will be the U.S.S. Springfield, CL66. Navy now has two cruisers, the Canberra and Boston, equipped with the Terrier.



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...WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS!

Washington Roundup

New Profit Review

General Accounting Office, watchdog agency over federal finances which reports directly to the Congress, plans a major investigation into defense contract costs and profits.

Exploratory work, according to Comptroller General Joseph Campbell, indicates "a serious need for corrective action." Campbell is particularly critical of the cost data on military price redeterminable contracts. Many contracts, he says, do not provide for proper cost data "as an enforcible right" and that the failure of the services to obtain proper data, either in negotiating revised prices or in fully exercising options to demand price redeterminations, "has, in many cases, resulted in contractors receiving profits which greatly exceeded those contemplated."

Procurement Hearing

Outlook now is that the House Armed Services Investigating Subcommittee headed by Rep. Edward Hebert (D.-La.) won't begin hearings on the profits and procurement policies of military aircraft manufacturers before May 1. These will be followed by hearings on electronics and other aircraft equipment manufacturers.

Shakeup in SAGE?

Change in top level direction of the Lincoln Laboratory indicates the SAGE system is moving into a new phase with heavier emphasis upon management in contrast to the earlier primary concentration upon scientific development. George Valley, associate director of Lincoln and prominently identified with development of SAGE has left on a year's leave of absence.

Marshall G. Holloway, director of Lincoln laboratory, also left his post to head the Nuclear Energy Products Division of ACF industries. Carl J. Overhage, formerly head of Lincoln's Aircraft Control and Warning Division, is the new Lincoln Laboratory director, with William Radford taking Valley's post as associate director. Radford was head of the Communications and Components Division at Lincoln.

Army Seaplanes

Newest manifestation of U. S. Army's determination that it will not rest with 5,000-lb. and 100-mi. limitations on its aircraft lies buried in a Defense Department study on large seaplanes. Army's interest is in a nuclear-powered and water-based aircraft to supply small, mobile nuclear armies fighting in distant countries as reported in AVIATION WEEK last Dec. 10 (p. 25). The Pentagon report says the Army has expressed a firm requirement for aircraft of this type for use after 1960. The paper also criticizes the Navy for alleged failure to push studies in this field and recommends consideration for bomber weapon systems of the future.

Brown Potatoes: Pro and Con

Defense Secretary Charles E. Wilson's oft stated view that basic research into such matters as why potatoes turn brown or why the grass is green should not be supported by Defense funds is not universally shared in the top levels of the Pentagon.

Garrison Norton, Assistant Navy Secretary for Air, had this to say to representatives of Navy laboratories at an Office of Naval Research symposium:

"In 1946 the Navy found it stood almost alone in the support of scientific research, particularly in the field of basic research, which was receiving support from practically no other source . . .

"Perhaps this is a good place to discuss just what research is. First and most important, there is basic research, which is the cornerstone of all scientific development. The man engaged in basic research is not a visionary. . . .

"Just like the inquiring child, he wants to know why the sky is blue, but the mature researcher is aware of how complex the answer is and that it requires the patient assembling of all sorts of bits and pieces of information.

"His only product is a scientific paper. . . . Yet this paper may provide the key that an applied scientist or an engineer has been avidly seeking in developing a new means of communication or a revolutionary type of engine or a life-saving vaccine.

". . . As workers in our naval laboratories, all of you are aware of the importance of basic research. . . . If you sat back and waited until the Chief of Naval Operations requested a new type of radar or guided missile, it would be many years before he got it.

"If the Navy is to get what it wants when it wants it, at least some of the basic research must already have been accomplished . . . either in your own laboratories or in conjunction with university, private and industrial laboratories."

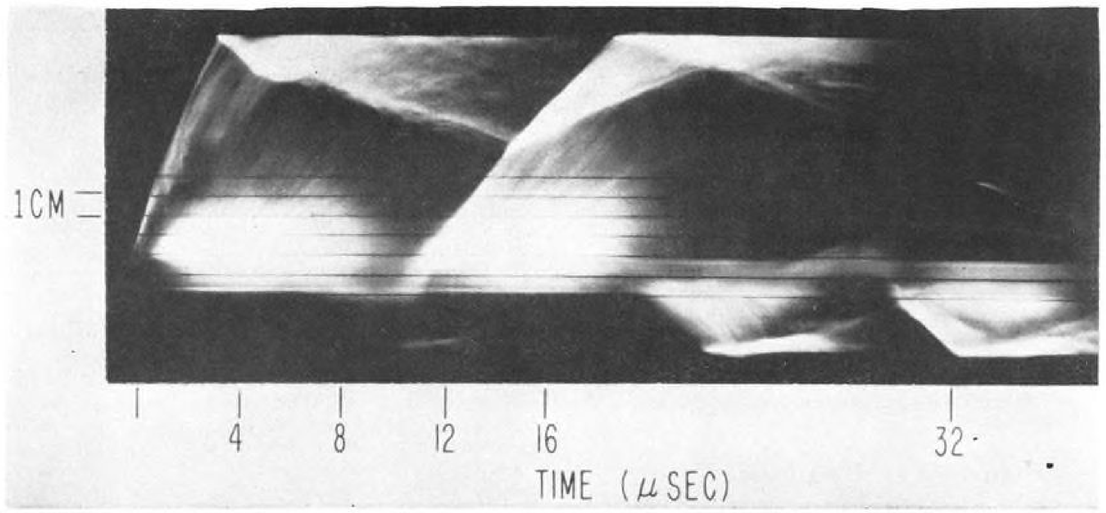
Approval for Hector

Senate Commerce Committee is scheduled to give its approval of Louis Hector to fill the Democratic vacancy on the Civil Aeronautics Board on Wednesday. Confirmation by the full Senate is expected before the week's end. Hector, a 41-year-old Florida attorney, was nominated for the post after President Eisenhower failed to re-appoint former Democratic Member Joseph Adams at the expiration of the latter's term.

ACC Pushes SWG 13

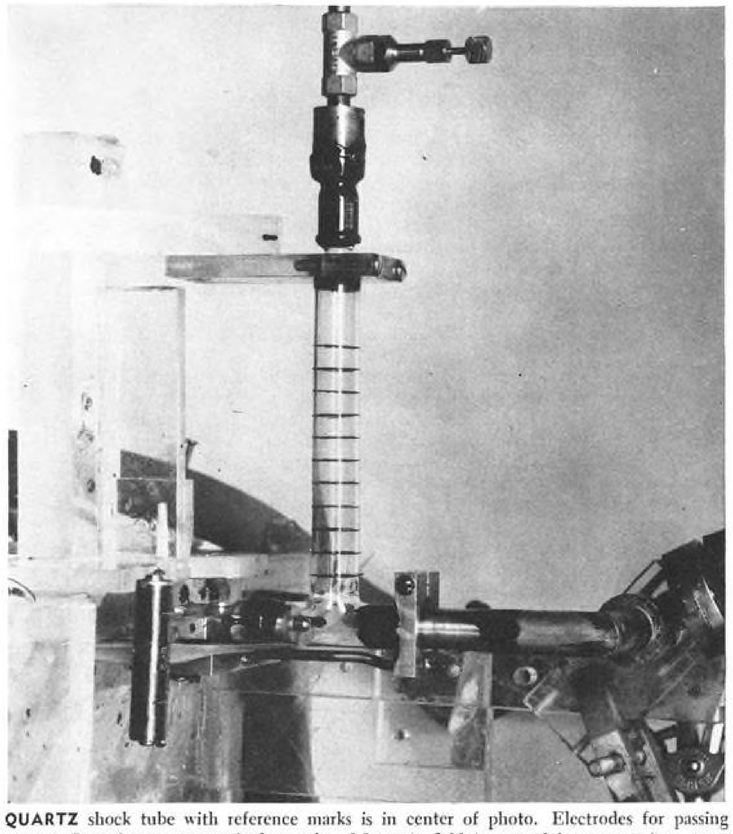
Air Coordinating Committee is apparently attempting to publish the report of Special Working Group 13 before the May 1 deadline set for the final report by the Aviation Facilities Planning Group headed by Presidential Aide Edward Curtis. Some observers say the Commerce Department is resorting to sales pressure in order to get an early endorsement of the "watered down" SWG 13 report to offset any criticism that may result after issuance of the Curtis report. ACC wants to show it has kept pace with air traffic control and navigational developments by publicizing the report of its recommendations.

Complete draft of SWG 13 was distributed to airways users on Feb. 25 with the announcement that the Navigational Panel would meet two days later to obtain approval of the report. The users protested that at least 30 days would be required to study the report's contents before any decision could be made. At a NavPanel session last week, some user groups refused to endorse the lengthy document on grounds that the large number of late revisions left them "unclear as to what they were being asked to approve." —Washington staff



NAVY SHOCK wave apparatus during operation. Successive shocks are due to the current oscillation. Gas temperatures are quenched rapidly by heat conduction to the tube walls. This is indicated by reduced luminosity of the gas in right of the photo.

Navy Reports Mach 200 Shock Waves



QUARTZ shock tube with reference marks is in center of photo. Electrodes for passing current through gas are attached to tube. Magnetic field is created by current in a strap near the tube or by solenoids.

By J. S. Butz, Jr.

Washington—Shock waves traveling Mach 200 at velocities approaching 300,000 mph. and with temperatures of several hundred thousand degrees Kelvin are being achieved for tenths of a microsecond by a research group at the Naval Research Laboratory. The speeds and temperatures are accomplished by accelerating an ionized gas with an electro-magnetic force.

The project, directed by Dr. Allen C. Kolb, represents a significant advance in laboratory capability for study of highly ionized gas flows at great temperatures and velocities.

Highest previously publicized shock wave Mach numbers were around 40, with associated temperatures of 15,000 to 20,000K.

The NRL apparatus could conceivably provide basic information of great importance to the development of controlled thermonuclear reactions and ionized-gas propulsion systems. It could also lead to more quantitative information of high temperature gas phenomenon.

The Kolb device is extremely simple.

A quartz tube of a few centimeters diameter and containing a gas—deuterium, hydrogen, and helium have been used—is located perpendicular to a magnetic field. A current, whose path is also perpendicular to the field, is applied through the gas. This directs a tremendous upward force in the tube and creates a shock wave.

The shock front is luminous and can be photographed to provide a time history of its movement. From this history, the velocity can be graphically determined. A check on the velocity is made by measuring the Doppler shift of a 9mm. microwave reflected off the shock front.

These are standard techniques of proven accuracy.

Temperatures are then estimated using precise velocity values, and gas temperatures of several hundred thousand degrees have been indicated. Temperature measurements are also being made with spectra, but the degree of correlation with the estimates has not been reported.

Details of the work by the Kolb group were reported last week at a symposium marking the tenth anniversary of the Office of Naval Research.

Indications are that considerably more has been accomplished than was presented.

The apparatus for producing the shock waves is relatively inexpensive, since it consists of a quartz tube and several banks of condensers. Up to 125,000 volts and 300,000-400,000 amperes have been used, but the peak current lasts only from .3 to 1.0 microsecond.

Greatest portion of the research cost is in the instrumentation required to investigate a condition which exists for less than a microsecond. Several hundred thousand dollars are needed to provide the necessary cameras, spectrascopes, etc. used in the investigation.

Army Partisans Challenge Wilson; Denounce IRBM, Aviation Edicts

Washington—U. S. Army partisans last week opened an all-out attack on Defense Secretary Charles E. Wilson's competency to make military decisions, centering their fire on his recent order giving operational jurisdiction of the intermediate range ballistic missile to the Air Force.

Detailed criticism of policies set down by the Pentagon chief was contained in an 18-page statement issued by the Assn. of the United States Army, an organization composed of 60,000 Army alumni.

The study implies that budgetary and political considerations have played an important part in determining Secretary Wilson's attitude toward strategic concepts, roles and missions, airlift, Army aviation and the entire field of guided missiles.

The statement was issued at almost the same time Wilson was denying an AVIATION WEEK report that USAF evaluation experts had been refused admission to Redstone Arsenal to evaluate the work being done there on the Jupiter IRBM (AW March 18, p. 26).

The report that USAF has been unsuccessful in attempts to have a team study the Jupiter project on the scene where it was developed was labeled by Wilson as "not true in that sense." He declared that "properly authorized representatives of the Air Force" never have been denied access to information.

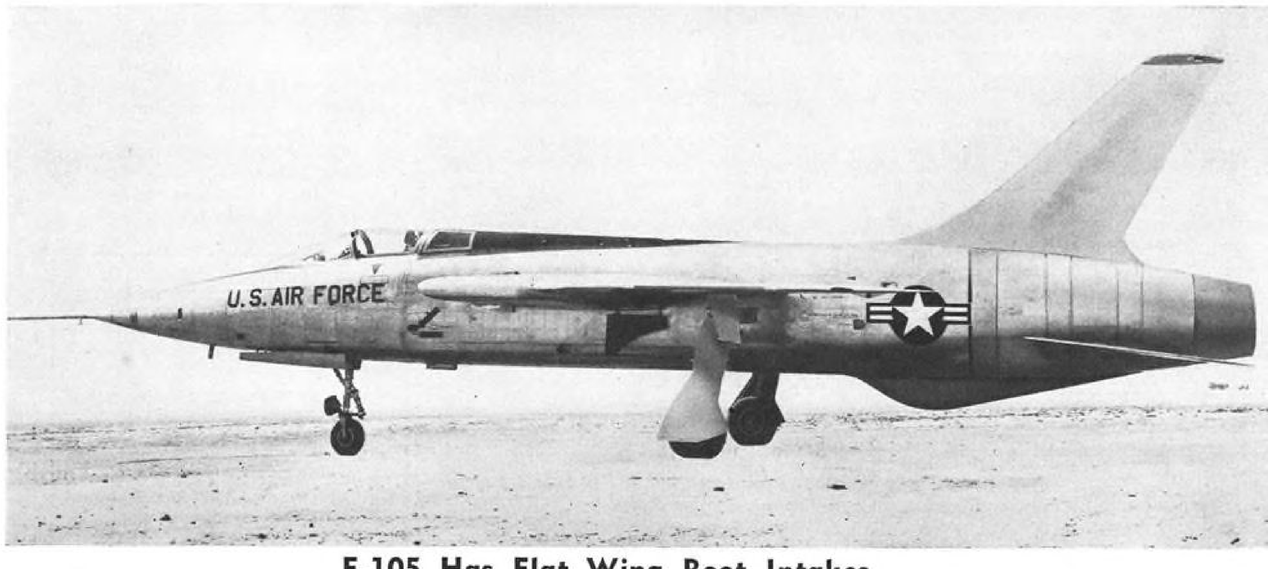
His remarks were limited to the "interchange of information," and he made no reference to proposed USAF visits to the Army Ballistic Missile Agency at Redstone.

Wilson's statement was delayed for approximately 36 hours after some members of the Pentagon press corps had asked for comment on the AVIATION WEEK report.

The Army had been struggling for more than a day to break loose a vehement denial of the AVIATION WEEK story, but was restrained as a result of top level consultations involving both Army Secretary Wilber Brucker and USAF Secretary Donald A. Quarles.

It is common knowledge in USAF, particularly among missile development experts, that Army has impeded efforts to evaluate the Jupiter project. It has been pointed out that Army has met no parallel problems in its program to take over development, procurement and use of the Talos ramjet anti-aircraft missile.

The Defense Department did confirm that, on Jan. 7, about two and a half months after Wilson ordered USAF



F-105 Has Flat Wing Root Intakes

First photo of Republic F-105 Thunderchief supersonic fighter-bomber indicates it has flat wing root intakes. Unusual boundary layer separators extend above and below intakes and apparently dump at exposed trailing edges. Nuclear armed F-105 is powered by Pratt & Whitney J75, has flown over 250 times and exceeded Mach 1 on first flight. Wings are short, thin and swept. Ventral fin improves directional stability at high angles of attack when Mach wave interference limits effectiveness of dorsal fin and rudder. The F-105 assembly line is already operating. Except for intakes, F-105 configuration drawn by Japanese artist (AW Jan. 7, p. 31) compares closely with photo.

Infrared Camouflage

Washington—Navy has developed a camouflage paint that is effective against infrared photograph, it was reported last week at a symposium marking the Office of Naval Research's 10th anniversary.

Theoretical work was done at the Aeronautical Materials Laboratory of the Naval Air Material Center at Philadelphia. Field testing was done by the Marine Corps Equipment Board at Quantico, Va. Development took approximately three years.

to take over the Jupiter project, an effort was made to launch an evaluation of the rival Jupiter and USAF's Thor.

Eger V. Murphree, Wilson's special assistant for guided missiles, sent a memorandum to Army Secretary Brucker suggesting that it would be helpful if he and a group of USAF experts could visit Redstone on an evaluation mission.

The Defense Department said the Army agreed to this, but that the plan never materialized because, as reported in AVIATION WEEK, Wilson, on Feb. 27—another month and a half later—said the Army would be permitted to finish Jupiter's early test firing program now under way at the USAF Missile Test Center, Patrick AFB, Fla.

Last week, Wilson reiterated his insistence on this approach and declared, "We are going to finish our testing of the hardware already ordered" and "use the best data we can develop from . . . both missiles." With USAF already ordered to take over operational and financial cognizance of the intermediate range ballistic missile, he did not deny that its experts still lack intimate contact with the Redstone Arsenal's work.

Medaris Statement

Maj. Gen. John B. Medaris, commander of the Army Ballistic Missile Agency at Huntsville, Ala., said in a statement issued at the arsenal that a civilian contracting agency, employed by USAF, was denied permission to visit his facilities "for good reasons."

Secretary Wilson said he had not heard of this action by Gen. Medaris and could not confirm or deny that the contractor involved was the Ramo-Wooldridge Corp. Ramo-Wooldridge provides management and technical advisory services for USAF's ballistic missile program.

The Defense Secretary professed to be perplexed "about all this argument" and labeled it as "sort of ridiculous." He said, "I don't see what it is all about unless the Army expects to fight the Air Force some day."

The answer to Wilson's question clearly was offered by the bitter criticism contained in the statement of policy by the Assn. of the U.S. Army. While it did not suggest war on USAF, it launched an openly organized attack on Wilson himself.

The association makes no reference to the pending court martial of Col. John Nickerson, Jr., a senior officer at Redstone accused of violating security in his effort to promote the Army's case and force modification or withdrawal of Wilson's order on the IRBM.

There is no doubt, however, that the association is marshaling forces to make the Nickerson case the biggest Pentagon controversy since the "Revolt of the Admirals" in 1949.

Report Highlights

Excerpts from the association report, entitled "The Security of the Nation, A Study of Current Problems of National Defense," include:

- **Wilson, who must make military** decisions, is forced to rely upon civilian assistants who are competent in the managerial but not the military field.
- **Army will not have the mobility** it needs to carry out its missions.
- **Army forces are** at an "irreducible minimum," and it is essential that they have funds for modernization.
- **Limitations on range,** size, speed, location or lethality of weapons denies any service the benefit of scientific and technological advances.
- **Army-developed Jupiter** has been "assigned arbitrarily to the Air Force in order to provide the Air Force with a capability, perhaps to offset the diminishing importance of manned aircraft weapons systems."
- **Weight limitation of Army aircraft** denies the Army the "full fruits of technological progress."
- **Ability to airlift** two Army airborne divisions to any area is essential to national security.
- **Army's basic requirement** for longer range missiles is tactical, not strategic. Distance is not a factor in determining a tactical target. The Army also has a capability for using the IRBM against strategic targets.
- **Arbitrary limit on range** for Army missiles—Wilson has set the figure at 200 miles—is "unrealistic and illogical."

The statement reiterates the Army argument that the Wilson memorandum of last November "hits right at the heart of our ability to maintain technological superiority over the enemy in the missile field." It declares:

"It appears to disregard the fact that the Army has been by far the most successful service in missile development. It ignores the experience, training and organization which the Army has developed in the missile field."

Senate May Ease NACA Budget Cut

Washington—At least part of the $13.2 million cut from the National Advisory Committee for Aeronautics' Fiscal 1958 budget by the House probably will be restored by the Senate.

The $105 million approved by the House was $28.3 million over NACA's current fiscal year allocation. Most of the new money is scheduled to provide for newer facilities and additional employes.

The House allowed:

- **Salaries and administration,** $70 million. Although there was a cut of $6.8 million in NACA's request, this amount will still give NACA additional $7.3 million for hiring personnel during the next fiscal year. Allocation for Fiscal 1957 is $62.7 million.
- **Construction and equipment,** $35 million, $21 million more than the current appropriation but $6.5 million below NACA's request.

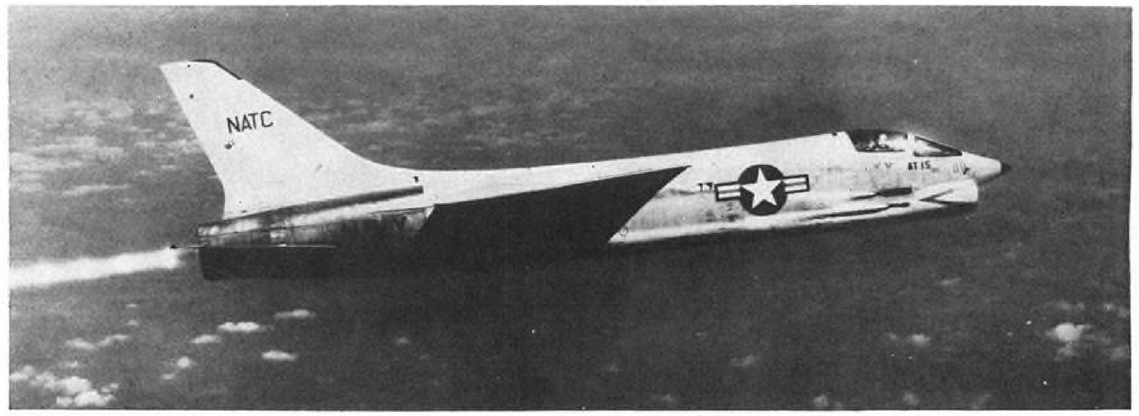
These are the major projects in NACA's planned construction program:

- **Langley Aeronautical Laboratory,** Langley, Va., a $1.9 million hypersonic physics test area and a $3 million data reduction center.
- **Ames Aeronautical Laboratory,** Moffett Field, Calif., an $11.7 million hypersonic tunnel and a $4.4 million boundary layer removal in the 14 ft. transonic tunnel to increase the Mach capability from 1.2 to 1.4 and to allow a doubling of the model size.
- **Lewis Flight Propulsion Laboratory,** Cleveland, Ohio, a $5.7 million rocket systems research facility; a $5.8 million expansion of the propulsion systems laboratory, and $5.6 million modifications to the component research facility.
- **Wallops Island, Va.,** $2.5 million for modernization of obsolescent instrumentation equipment.

USAF Procurement

Washington—Dudley C. Sharp, Assistant Air Force Secretary for Materiel, reported last week that USAF's proposed $2,746.9 million aircraft procurement program for Fiscal 1958 breaks down like this:

- Bombers, $999.4 million. Representing 36.4% of the total funds, the money will buy 8% of the total aircraft planned under the program.
- Fighters, $1,167 million, 42.5% of the total funds, will provide 46% of the aircraft planned for Fiscal 1958.
- Transports, $462.1 million—16.8% in funds, 14% in quantity.
- Trainers, $118.4 million—4.3% in funds, 32% in quantity.



Crusader Completes Fleet Introduction

Chance Vought F8U-1 Crusader, with shock diamonds in jet exhaust during flight over Atlantic Coast, has completed Navy Fleet Introduction Program at Naval Air Test Center, Patuxent River, Md. Deliveries have begun to fleet squadrons for operational duty. FIP program required 53 days, included 412 flights for a total of 603 flight hours. VF-32 based at Cecil Field, Fla., is first squadron to receive 1,000 mph. Crusader.

Firm Program Asked For Nuclear Plane

Washington—Construction of a flying prototype of a nuclear propelled aircraft "with a realistic target date for completion" is being demanded by the chairman of the Joint Congressional Atomic Energy Commission.

Rep. Carl T. Durham (D.-N. C.) has protested that, "despite steady progress since a cut-back in 1953, the Defense Department is again using the meat axe instead of the scalpel on the aircraft nuclear propulsion program." In a speech at the National Industrial Conference Board Conference on Atomic Energy in Industry, Durham said:

"Here is a program where the sound principles of management have constantly been violated. Management has been indecisive with authority spread out among several different offices and branches. In the current cut-back, no objectives, schedules or target dates have been set to provide guidance in the program."

C-46 Conversion Receives Certification

New York—C-46 conversion under development for two years by Riddle Airlines has received its Civil Aeronautics Administration certification.

Riddle's transport category C-46R (AW Nov. 26, p. 41) was developed at Miami by Chief Engineer Norman Golden. According to the airline's figures, the converted Curtiss plane can make 235 mph. true air speed at 9,000 ft., an increase of 40 mph. A ton of payload has been added, and the airplane now can carry 50 passengers and take off at 49,900 lb. gross weight. Rate of climb is 1,140 fpm. at sea level with both engines, 330 fpm with one engine out.

New maximum range of the airplane is 1,600 mi. Other improvements include a new Janitrol heating system, new Goodrich wheel and brake assemblies, new Edison continuous wire fire detection equipment, stainless steel tubing for fuel and oil line fireproofing, fireproofed emergency wiring in fire zones, ignition analyzer systems, additional fuel and emergency hydraulic pumps, redesigned instrument panels, and better radio and navigation equipment.

Conversions will be handled at Riddle's Miami base. The aircraft is designed for airlines with short-medium haul needs.

Avionic Firms List Record Profit

New York—Texas Instruments, Inc., and Minneapolis-Honeywell Regulator Co. each reported record sales and net income for their Fiscal 1956. Texas instruments reported sales of $45,699,358, an increase of 59% over the previous year.

The Dallas, Tex., manufacturer of transistors reported its military sales, principally in the apparatus division, increased 45% to $12,850,247. This was 28% of total sales.

Texas Instruments net income was $2,349,103 in 1956 compared with $1,581,790 in 1955. President J. E. Jonsson said 1957 overall sales may reach $65 million, and that military backlog was $25 million with several contracts extending into 1958.

Minneapolis-Honeywell increased its sales 18% to a record total of $287,944,462 in 1956 compared with $244,842,068 in 1955. Net income was $22,463,657 against $19,278,648.

Consolidated net sales of Olin Mathieson Chemical Corp. in the U. S. and Canada increased by 6.5% in 1956 to a record $596,673,005. Sales in 1955 were $560,480,335.

Net income for 1956 increased from $44,558,102 in 1955 to $44,791,071.

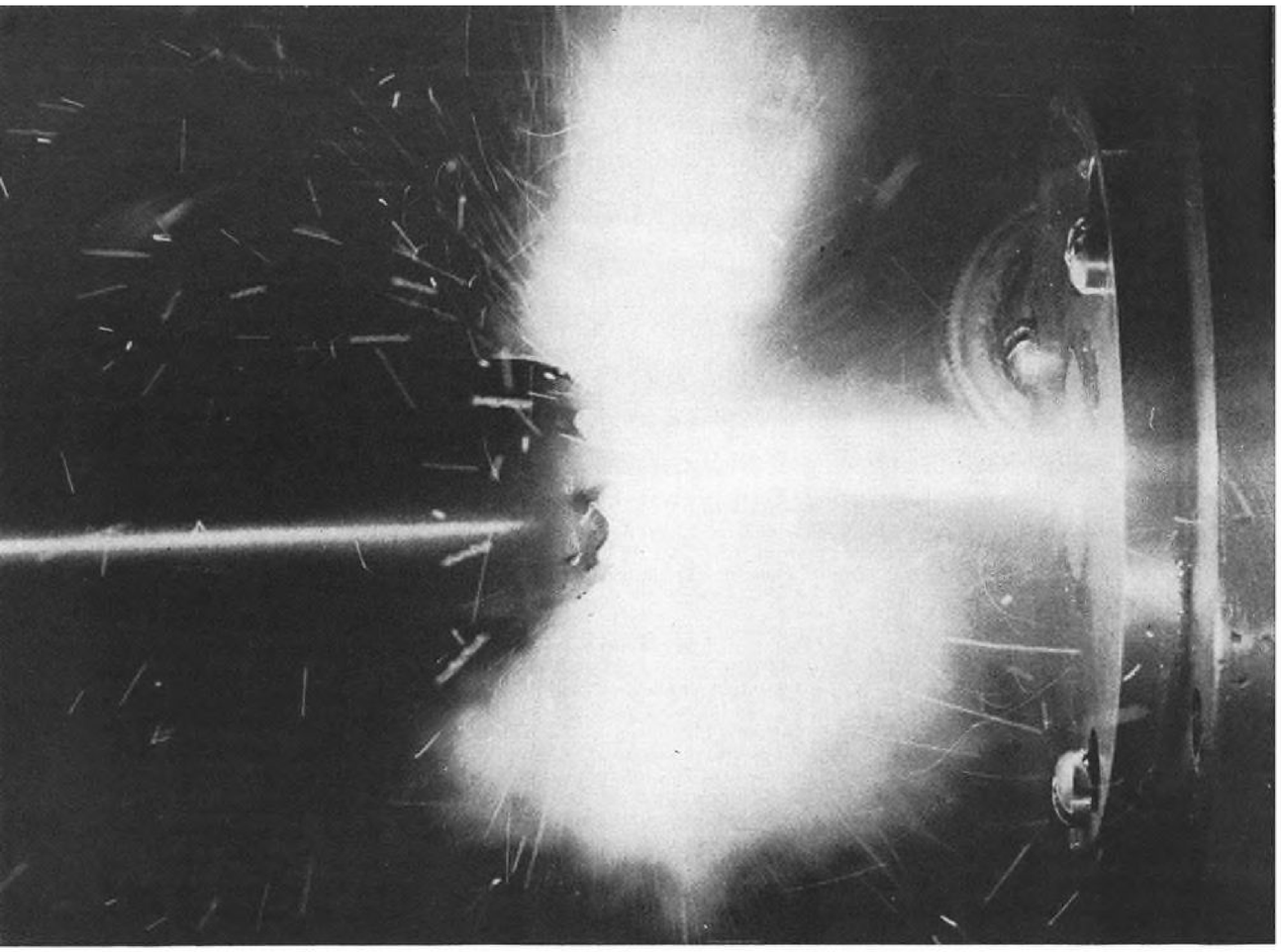
The company in 1956 spent $49 million on new plant and equipment, including new explosives facilities near Marion, Ill.; new aluminum facilities at Omal, Ohio, and new pilot plants and expanded research facilities for nuclear and high energy fuel operations.

Other financial news:

- **Rohr Aircraft Corp.** reported new orders of $36,891,400 received in February boosted its backlog to a new all time high of $242,583,800. Rohr is building power packages and major components for military airplanes and airliners.

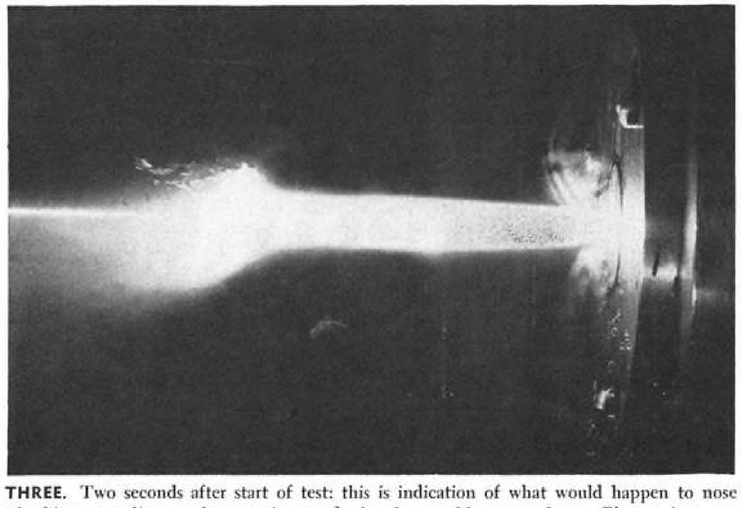
J. E. Rheim, president, said sales are expected to hit $116 million by the end of the fiscal year July 31, compared with last year's $90 million.

- **De Havilland Holdings, Ltd.,** reported a net income of $4,635,598 for the fiscal year ended Sept. 30 compared with $2,776,628 in the previous year. The company said the increase in profits "has, to a considerable extent, been due to the excellent results of our Canadian subsidiary, the de Havilland Aircraft Company of Canada, Ltd. The company declared a 7½% dividend, an increase over 1955's 5%.



ONE. Half-second after Giannini plasma jet starts pouring a 10,000K stream on solid steel "aerodynamic body" blunt nose begins to melt.

Plasma Jet Heats, Melts Missile Test Shapes



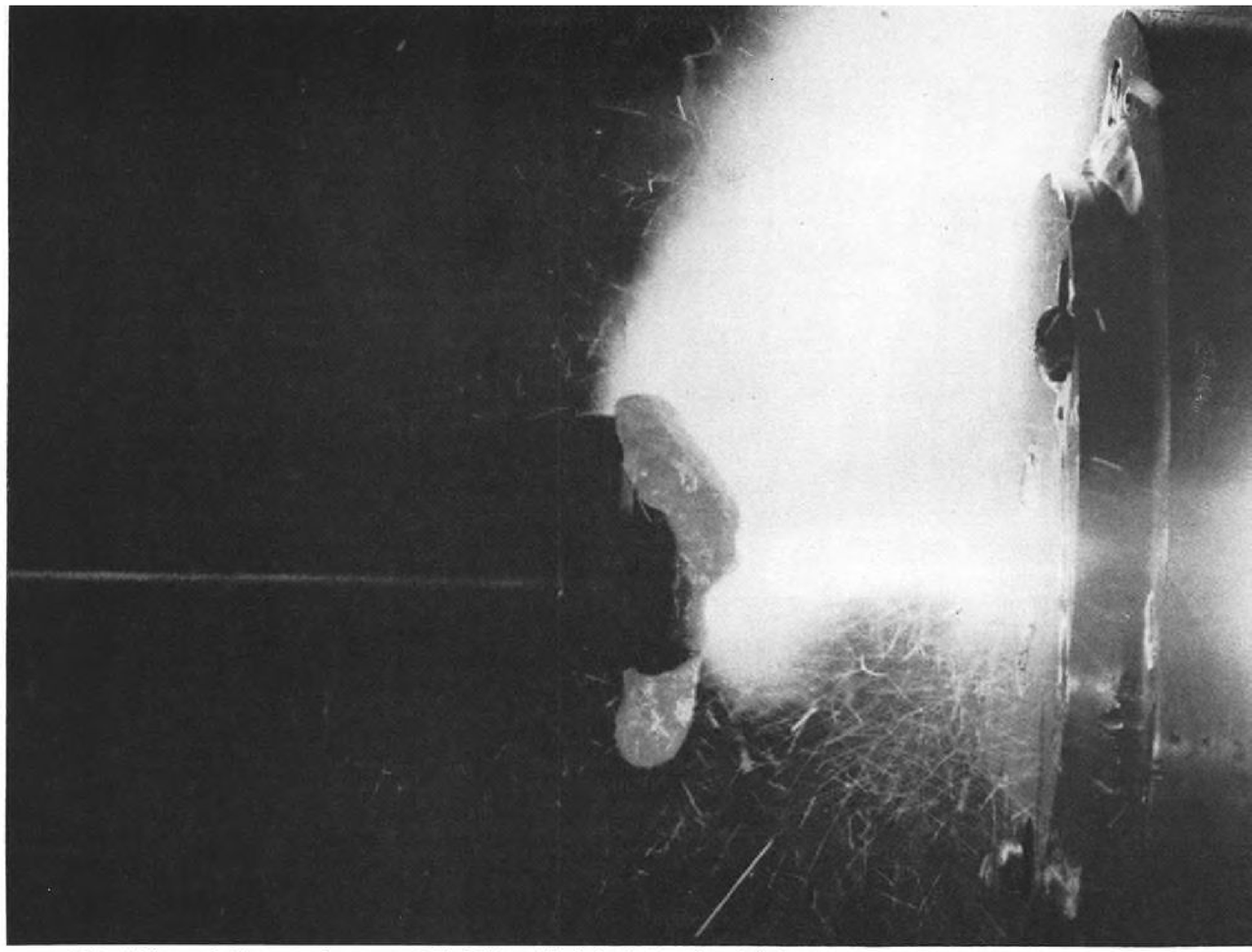
THREE. Two seconds after start of test: this is indication of what would happen to nose of object traveling at hypersonic speeds in the earth's atmosphere. Plasma jets can produce temperatures twice those on the surface of the sun.

Two companies are operating plasma jet facilities.

General Electric Missile and Ordnance Dept., Philadelphia, Pa., plasma jet (lower right) consists of an electric arc in a water cooled pressure vessel. The dissociated water vapor resulting from the powerful electric arc is directed out a nozzle in the pressure vessel at the test specimen.

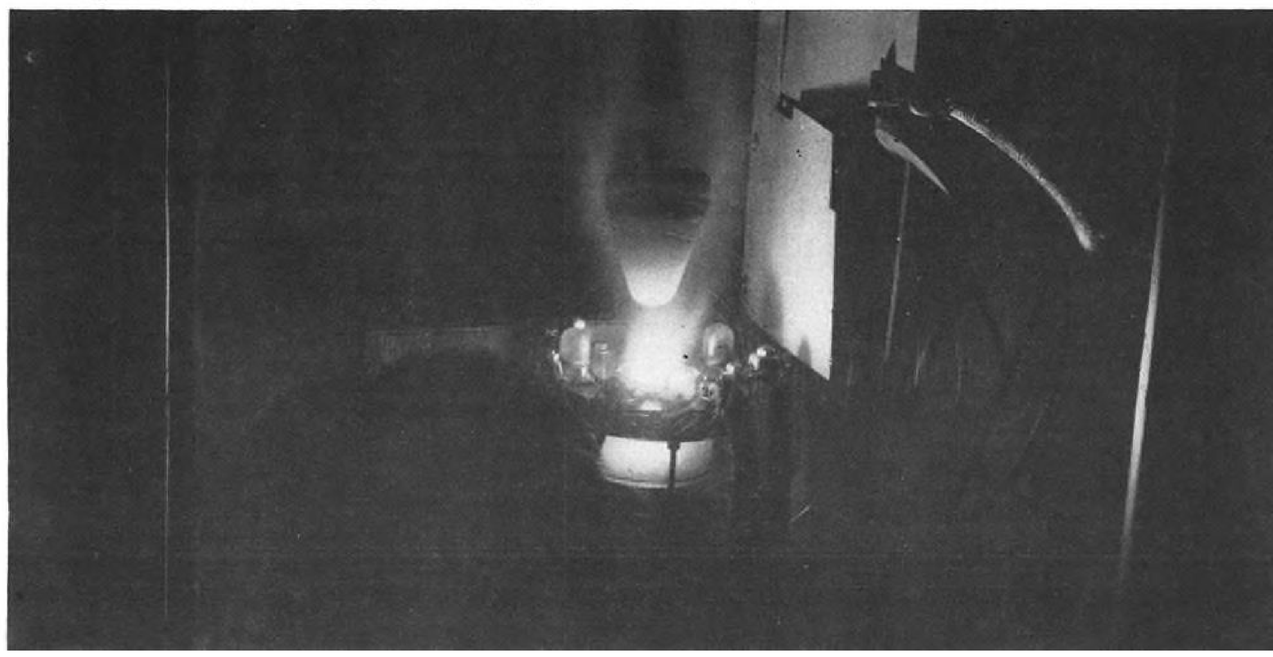
The Giannini Research Laboratory, Santa Ana, Calif., plasma jet is similar. Plasma or ionized jets are expected to be a significant addition to missile test devices, for they are able to simulate continuously hypersonic flight temperatures in the laboratory. Shock tubes can only simulate these temperatures fleetingly as the shock wave passes.

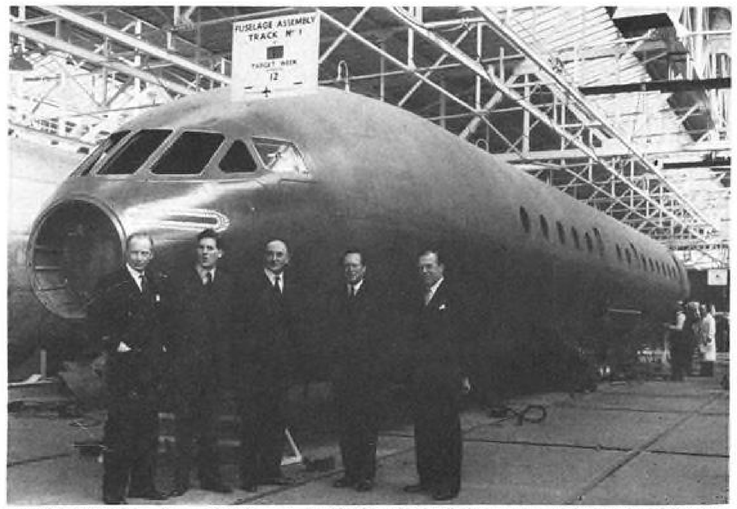
GE unit is 70 kw but GE plans to build a 10,000 kw size which will have a supersonic nozzle. Present unit has a ¼ in. diameter electrode for its anode, but larger unit will have a 3 in. electrode. Both use a hollow cathode.



TWO. Full second after start of test nose of "body" is rapidly losing its "aerodynamic" shape.

GENERAL ELECTRIC bathes a nose cone in a 2,000F, 4,000 ft. per sec. plasma jet. The nose cone, which is located about four jet diameters away from the nozzle, is experiencing a heat flux density of over 2,000 Btu/sec.-sq. ft.





COMET 4 fuselage in production at de Havilland Hatfield factory, is inspected by British government officials. Capital Airlines has ordered Comet 4 and 4A for U. S. service.

British Show Off Their Jetliner; RAF Comet Flies Press to Malta

London—To show off the swift "airline" efficiency of its new de Havilland Comet II jet transports, Royal Air Force flew 41 newsmen from England to Malta for lunch—a roundtrip of 2,782 mi. in 6:43 flying hours, an average of 440 mph.

Ground speed on the flight went as high as 530 mph.

Comet's flight, a week later, was higher but considerably slower than Boeing 707 flight (AW March 18, p. 38).

The Comet II demonstration was put on by RAF's first military jet transport squadron, which now has eight Comet II's and is due to take delivery next month of the two remaining on order.

No. 216 Squadron received its first Comet II in June of last year. Since then it has logged more than 2,300 Comet hours. Most of that time has been devoted to aircrew training but the squadron will begin a regular service to Australia this summer, through Karachi and Singapore, designed to provide high-speed support to the Woomera missile test range.

Flight to Malta and back in less than seven hours provided an effective sample of the squadron efficiency. After takeoff from Lyneham at 8:23 a.m. GMT, Squadron Leader W. I. Harris climbed the Comet XK699 at 230 kt., crossing the French coast 27 min. later. Altitude was 36,000 ft. and ground speed 450 mph.

At 39,000 ft. the jet transport was cut back to cruising power at Mach .73 and went into cruise climb. Fuel consumption of the four Rolls-Royce Avon Mk. 117 engines in cruising is 5,500 lb. per hour. To keep the true airspeed constant, the aircraft is allowed to climb gradually as fuel consumption reduces gross weight. An hour and seven minutes after takeoff, the Comet reached the top of its long curving flight at 42,000 ft. 80 miles north of the Mediterranean coast of France. Ground speed was 530 mph. at this point.

After crossing Sardinia, Squadron Leader Harris began his descent 190 mi. from Malta at 10:49 a.m., throttling back the two inboard engines and letting down at 230 kt. to Luqa Airfield on Malta.

Landing was made at 11:27 a.m. after a 3 hr. 4 min. flight at an average of 464 mph. After slightly more than two hours on the ground for lunch, the return to England was made in 3 hr. 39 min. at a 416 mph. average against headwinds.

Poor weather in Britain provided a compulsory demonstration of a jet GCA letdown. Squadron Leader Harris made an approach letdown to 20,000 ft. directly over the airfield, dropped into the overcast in a tight altitude-losing spiral, leveled out into a conventional letdown and broke clear at 2,500 ft.

RAF crews report they are pleased with Comet II performance. Experience has shown that on a normal day's flying, with two legs of 1,600-2,000 mi. taking four to five hours each and an intermediate refueling stop of two hours, crews are less liable to fatigue than when operating piston-engined aircraft.

RAF crews are not qualified to carry passengers in the Comet until they have logged 75 hours on the aircraft. After that, six month examinations and flying tests are carried out to ensure that they maintain proficiency. The Mk. II carries an operational flight crew of five with cabin seating for up to 48 passengers.

The fully loaded Comet II weighs 120,000 lb. and flies over 2,000 nautical miles at an average speed of 450 kt. It is fully pressurized to 8,000 ft. cabin altitude.

RAF Comets are limited to an operating ceiling of 45,000 ft.

J57 Passes Test

Wright-Patterson AFB, Ohio—A Pratt & Whitney J57 jet engine last week completed 1,000 flying hours without overhaul. The engine is installed in a Boeing B-52 bomber at the Air Research and Development Command's Wright Air Development Center here.

WADC's Powerplant Laboratory began a program in January, 1954, to determine wear on J57 engine parts under service conditions. Overhaul at that time was required every 100 hours. Normal overhaul time before the 1,000 hour mark was reached had increased to 600 hours.

CAB Certificates P&W J75, J57

Washington—Certification of the Pratt & Whitney J57 and J75 turbojet engines was announced last week by the Civil Aeronautics Board.

Full-scale production of the commercial version of the J75, which has the commercial designation of JT-4, is scheduled to begin this summer. More than 8,000 of the smaller J57s, which will be designated the JT-3 for commercial use, have been delivered to the military.

A total of 1,300 JT-4s and 400 JT-3s has been ordered by 14 U. S. and foreign airlines. The JT-3 will power early production models of the Douglas DC-8 and one of the three Boeing 707 models designed for medium-stage hauls.

The JT-4 will power the two long-range models of the 707 and later production models of the DC-8. By the time the two jet transports are placed into service, the JT-3 will have accumulated 4.5 million operational hours. The JT-4 is expected to reach 350,000 hours by 1959.



Fleet Squadrons Will Use Sparrow III

First picture of Sparrow III air-to-air missile mounted on McDonnell F3H Demon shows blunter nose than predecessor Sparrow I. Developed by the prime contractor, Raytheon Manufacturing Co., Sparrow III will go into operational use with Navy fleet squadrons. Sparrow III is a radar guided missile with an internal guidance system. Sparrow I, a supersonic 12 ft. long, 300 lb. missile, is a beam rider. Experimental Sparrow II, developed by Douglas, is not expected to be used by fleet. Tail surfaces of Sparrow I and III appear similar, but forward surfaces of Sparrow III, while retaining wedge shape, display smaller degree of sweep than that of Sparrow I's delta planform.

Marines Simulate Brush-Fire War

Mojave, Calif.—Using aircraft, avionics and ordnance under conditions which would obtain in the event of a brush-fire war outbreak, U. S. Marine Corps Third Air Wing deployed recently for its Second Annual Fighter and Attack Weapons Meet.

Six squadrons from Marine Air Station, El Toro, Calif., were represented by teams composed of pilots, mechanics and avionics and armament specialists. Aircraft used were: Grumman F9F-5 Panther, four squadrons; North American FJ-4 Fury, one squadron, and Douglas F3D Skyknight, one squadron.

The FJ-4 and F3D participated only in air-to-air gunnery phases, neither being equipped to handle air-to-ground stores. Sidewinder air-to-air missile is now considered the standard ordnance item for F3D. Later versions of the FJ-4 will be equipped to handle external stores, with retrofit on current types expected.

Spares Eliminated

To better simulate realism of combat field conditions, the teams estimated requirements in spares for all aircraft prior to the meet, and airlifted them to Mojave where line maintenance in aircraft and ordnance were standard. Avionics work consisted primarily of replacing black boxes which went out. These were readjusted, calibrated, bench tested and replaced in the aircraft. In all cases, spares estimates were reported as holding valid, although it was permissible to change engines if necessary.

FJ-4 aircraft used Aero 10-C-1 fire control systems, composed of the Mk. 16 gunsighting and computing units, coupled with APG-30A radar units. For a new system, the units performed well. It was the first such gunnery deployment of an FJ-4 unit, first planes having been delivered to the using squadrons only in January, with a short time since for gunnery practice for pilots. These also had routine transition and qualification flight work to accomplish.

The FJ-4 mounts four 20 mm. cannon, with a rate of fire of around 1,000 rounds per minute under ordinary circumstances, plus Mk. 9 feeders and a windup system. It was the first competition use of both the gun and feeder, as well as the fire control system.

As a gun platform, according to reports, the FJ-4 leaves something to be desired. Stability is such that malfunction of one gun is enough to produce heavy yawing. Plane carries air recharging system in which firing the guns also recharges air bottles. Five recharges can be accomplished from air bottles before exhaustion if guns fail to fire and recharge bottles. FJ-4 equipped squadron had a rounds-fired-out average of more than 93%.

In the FJ-4, the Wright J65 powerplant, rated at 7,700 lb. thrust, proved out well at the meet, with very few aborts due to engine malfunction.

F3D position in the meet was more for representation than anything. Plane's fire control system, other operational characteristics call for different techniques than those used in the meet.

In the straight-winged Panthers, pilots and crewmen were dealing with aircraft and fire control systems of a proven type. Plane utilizes Aero 5-A system, composed of Mk. 6 fire control coupled with APG-30 radar. Guns are Mk. 2 cannon, with electrical feed system. Main problems in the weapon system included proper gun lubrication, and fire control system operation at altitudes greater than 15,000 ft.

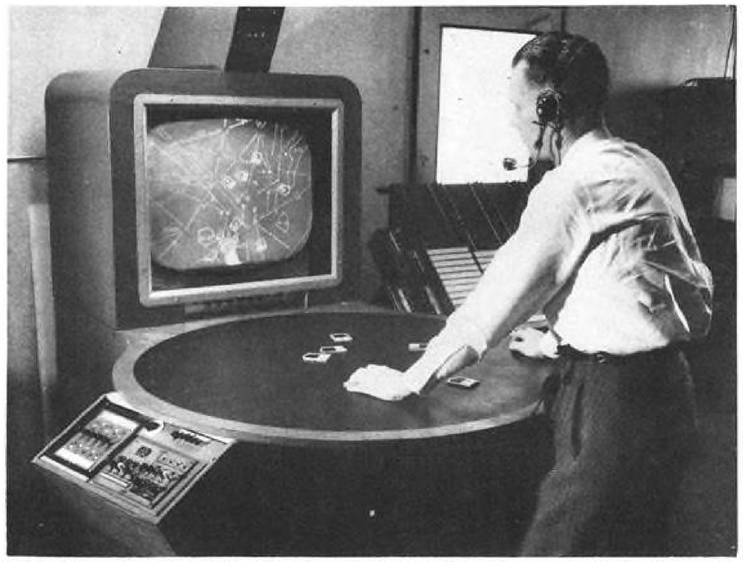
The fire control system is unpressurized in the F9F-5. Also, pilots reported both radar and fire control touchy in that extra hard landings, rough handling, could throw out delicate adjustments and ruin sighting.

Drop in Hits

In all cases, pilots said that malfunction of radar caused a two thirds drop in hits scored, both in air and ground gunnery. While fire control can be operated as a fixed sight, techniques differ so widely in firing that today's pilots are greatly dependent on avionic fire control and sighting, ranging, tracking by radar.

Air-to-air missions were fired on standard 6x30 ft. nylon targets with radar reflectors attached to forward portion of targets. On all missions, four planes participating carried 100 rounds for each of the four guns. All units reported better than 90% of ammunition was fired on each mission, air and ground. Passes were high side, as used in World War II practice.

Strafing was accomplished on square nylon panels, while skip bombing was done against rectangular targets with Mk. 76 (25 lb.) practice bombs, four loaded per plane per mission. In rocketry, four 2.75 in. FFAR's were loaded per plane per mission.



COMBINED radar, aircraft identification and airways information can be displayed in well-lighted area on TV-type monitor using new French-developed system tested by CAA.

Bright TV-Type Radar Display Shows Traffic Control Promise

French-developed radar display system which can superimpose aircraft identification and airways on a radar presentation and can be viewed in high ambient light has been successfully tested by the Civil Aeronautics Administration.

Donald Stuart, CAA Technical Development Center director, says that "initial evaluation indicates the equipment is far superior to existing display systems in monitoring air traffic." Stuart predicts that units of this type will find wide application and the CAA is considering the system for use in its new nationwide radar network.

Loaned to CAA

The new Picture Transformer System, as it is called, was loaned to the CAA for evaluation by Intercontinental Electronics Corp., Mineola, N. Y. The company is 50% French owned, 50% U.S., with most of the latter share by Airborne Instruments Laboratory.

Previous experimental system tried at TDC utilized an overhead projector to display radar information on a plotting board around which were grouped traffic controllers who positioned small aircraft identification markers ("shrimp boats") over the radar blips.

Because of the low-level illumination available from the radar projector, traffic controllers were forced to operate in a darkened room. Conventional radar scopes used in approach control and control towers also require viewing in low-level ambient light.

The new system's ability to provide a display which can be viewed in daylight results from using television techniques. Radar information is converted to a TV-type signal, then combined with signals from a TV camera mounted overlooking a plotting board. The combined picture can then be displayed on a conventional TV receiver or studio monitor, much like closed-circuit TV.

Excellent Resolution

Traffic controllers view the combined presentation to see location of radar blips and determine when and where to move their identification markers. (See photo.)

Although there have been previous attempts at bright-tube displays by conversion to TV-type signals, the new system reportedly provides far greater resolution and involves less complexity.

Heart of the new system is a storage-type cathode ray tube with two separate electron guns. One of these is used to paint the radar picture on a storage surface within the tube while the other, employing a TV-type scan, "reads" the radar picture and converts it to a TV-type signal. The tube has controllable persistence which enables it to display the past track of an aircraft as well as its present position, if so desired.

The new system can remote the combined radar display to any number of monitors using microwave links, or ordinary telephone lines if band-compression techniques are used.

Intercontinental Electronics Corp. will build the system in the U. S. if it receives CAA orders, according to company President Harry E. Pinkerton. The system was developed by Compagnie Generale de Telegraphie Sans Fil (CSF).

News Digest

North American Aviation will continue study of WS 110 chemical bomber under a $3,520,000 Air Force contract.

Lockheed F-104 Starfighter completed cold weather tests in Alaska. Tests included flights after overnight cold soaks at −42F and at −49F; low speed taxi runs over 18 in. of snow, high speed runs over hard packed runways, with and without drag chute.

Nord Gerfaut II delta wing interceptor, in climb clocked by supervisors under FAI rules, established these times, claimed by French as records: 12,600 ft. in 1 min. 22 sec.; 20,500 ft. in 1 min. 41 sec.; 39,369 ft. in 2 min. 18 sec. and 49,200 ft. in 3 min. 35 sec. Gerfaut, powered by Snecma Atar G with afterburner rated at 10,000 lb. thrust, made climb at 620 mph. speed.

Mrs. Faye Milburn Apt, widow of Capt. Milburn Apt, received posthumous Distinguished Flying Cross for her husband. His flight in Bell X-2 research craft, in which he was killed, carried him to new unofficial speed record of above 2,160 mph.

Two Royal Canadian Navy Banshees and two Trackers flew across the Atlantic to join Canada's new aircraft carrier Bonaventure, which is beginning sea trials operating from south coast of England.

Convair Division awarded initial contract to General Electric for more than $20 million worth of CJ805 engines to power the Convair 880 transport. Engines will be fitted with reversers, suppressors and self-starters.

General Electric will open second European office at Geneva to handle technical service of commercial jet engines and accessories. William O. Meckley will be manager.

Firth Sterling Inc. will study titanium carbide cermets and undertake research or intermetallic compounds under two contracts from USAF.



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Forty-one leading airlines on all six continents now offer you the unexcelled convenience, comfort and dependability of the Convairliner. Built-in steps, ample racks for carry-on luggage, and many other comforts that are only now being planned for airliners of the future, are yours to enjoy *today* on a Convair!

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CONVAIR

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RESEARCH AND DEVELOPMENT



PILOT LINE PRODUCTION



FINAL ASSEMBLY



TESTING IN SCREEN ROOM

COMMUNICATIONS at Ramo-Wooldridge

Communications activities at The Ramo-Wooldridge Corporation include research, development, and manufacture of advanced types of radio communication systems, ground-reference navigation systems, and electronic countermeasure systems. Major programs are in progress in each of these fields.

New and unusual techniques have been employed to provide systems having a high order of security in the transmission of information, broad flexibility in combating unfavorable signal propagation conditions, and substantially greater information capacity per operating channel.

Some of the techniques used have made possible an increased range for given levels of transmitter power and reliability of communications. Others have provided specific advantages in very long distance communications or in operational situations requiring unique signaling capabilities. Developments in navigation systems have resulted in new equipment that is suitable for the guidance of aircraft at long ranges from their bases.

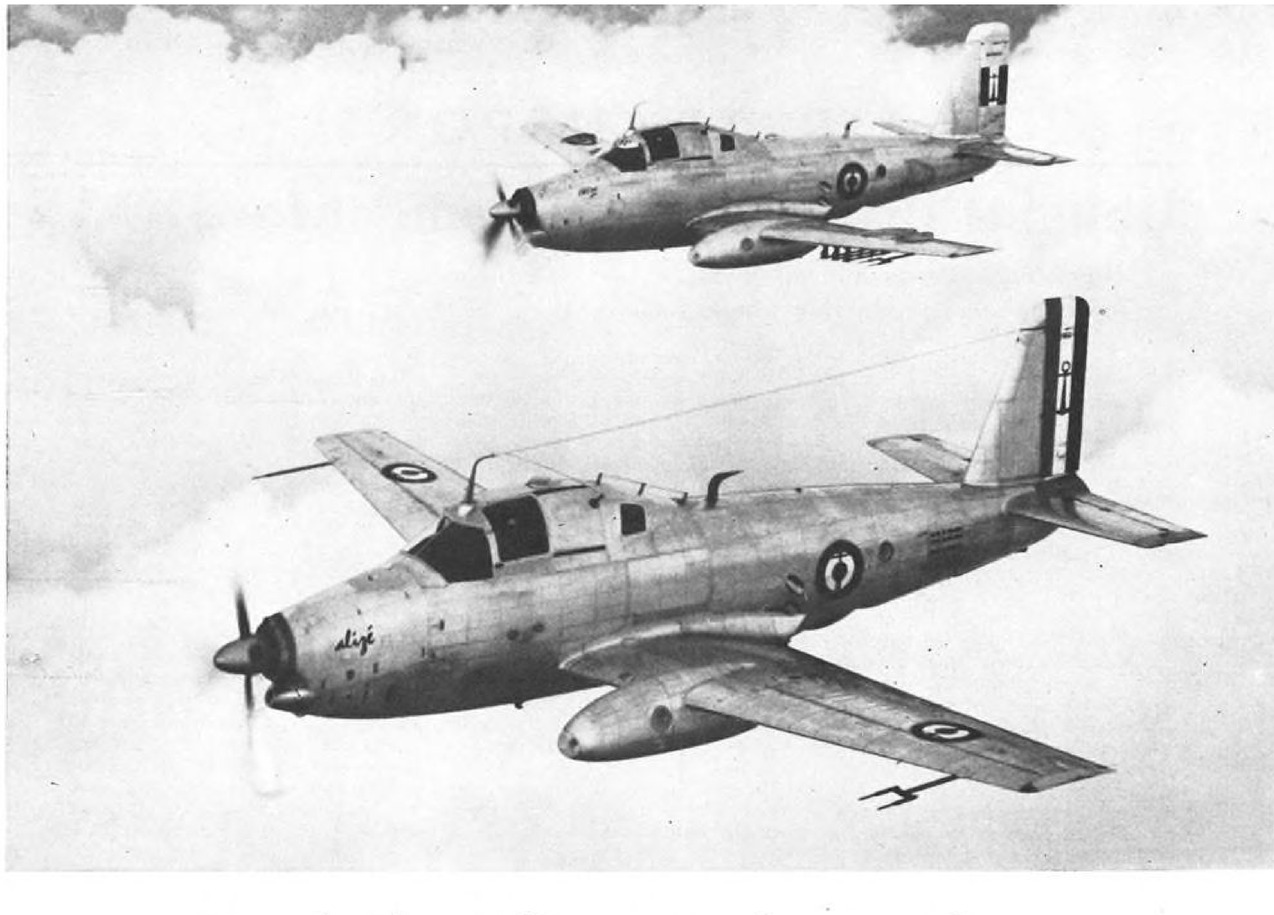
In the work currently under way, some systems are in the laboratory development stage, some in the flight test stage, some are in production. Several types of systems developed and manufactured by Ramo-Wooldridge are in extensive operational use.

Openings exist for engineers and scientists in these fields of communications activities:

- Systems study and analysis
- Airborne transmitters
- Transistorized video and pulse circuitry
- Airborne receivers
- Reconnaisance systems
- Digital communications systems

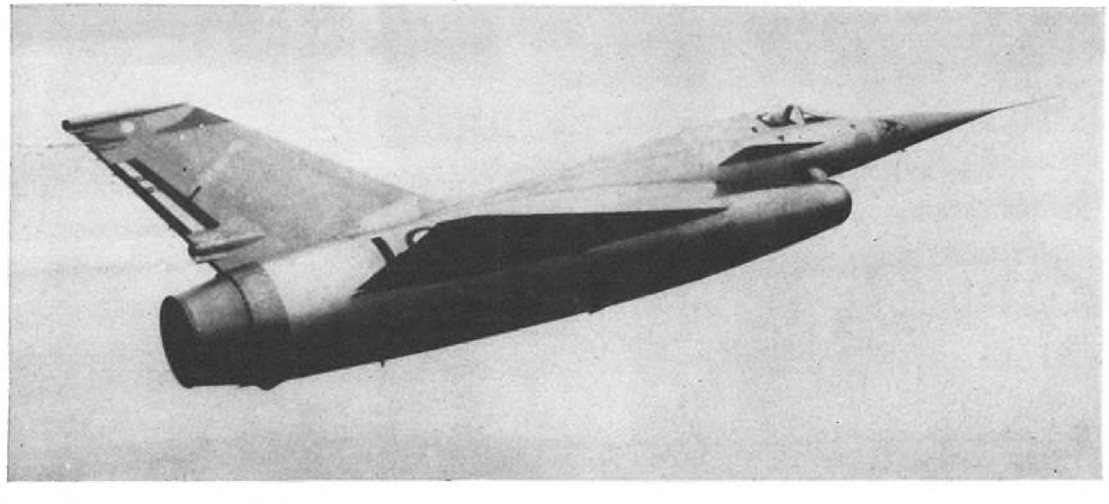
The Ramo-Wooldridge Corporation

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French Fly Griffon II, Turboprop Alize

First in-flight photo of Nord Griffon II ramjet-turbojet interceptor (below) shows delta planform of supersonic experimental airplane. Griffon II, successor to the Snecma Atar powered Griffon I, has turbojet-inside-ramjet powerplant similar to Leduc 022 (AW Feb. 18, p. 27). Note canard surfaces, fairing above intake. Breguet 1050 Alize (above) is an anti-submarine aircraft ordered by French navy. Powered by a Rolls-Royce Dart 7 developing 2,105 eshp., Alize carries a crew of three. French have ordered 100. Prototypes are undergoing field carrier landing tests at French air force testing base at Istres; Alize is designed for carrier operation.



Douglas Proposes Replacement for DC-3

High-wing, four-turboprop transport proposed for local carriers; production hinges on reception.

By L. L. Doty

Washington—Douglas Aircraft Co. is making a tentative bid to tap the local service airline market with plans for a high-wing, four-engine turboprop transport that will be marketed as a "DC-3 replacement."

The aircraft, which bears the company designation 1940, has gone through the first design stages in both passenger and cargo versions and is now ready for wind tunnel testing. Although neither a price tag nor availability date has been set, promotional material is now being distributed to airlines and other potential customers.

Douglas hopes the response to the prospectus it is mailing to local-service carriers will furnish some indication as to the demand for such an aircraft. If it is high enough, Douglas will order the plane into production.

The proposed transport's operating characteristics and specifications:

• **Lycoming** T55s or Rolls-Royce Dart 510 turboprops will power the aircraft.

• **Configuration** calls for 60 seats located six abreast, although the passenger version can be quickly converted to a combination passenger-cargo plane.

• **High lift** system for short runway operations includes full-span, double-slotted 40% chord trailing edge wing flaps and full-span, 15% chord leading edge flaps.

• **Wing span** is 102.5 ft.; wing area 1,300 sq. ft., and overall length, 92.5 ft. Outside diameter of the fuselage is 152 in., height at tail is 36.8 ft. and wheel base is 29.8 ft. Propeller diameter is 13 ft.; propeller-to-ground clearance is 78 in.

• **Thermal deicing** from combustion chambers is used in outerwing panels and tail surfaces. Air intake scoops, propeller blades and spinners will be equipped with electric cyclic de-icing.

• **Nose wheel** of the tricycle landing gear will swivel 360 degrees, enabling the pilot to pivot aircraft on either main wheel for fast taxiing and ground maneuvering.

The designations 1940 and 1940A (cargo version) are specification numbers next in line for Douglas models. Assignment of a DC identity probably will follow a decision as to whether the DC-9 medium turbojet transport will move into production. Some Douglas officials feel that the latter project has been all but shelved.

Ground Handling

The 1940 is designed to provide economic service under hard use involving quick turn-arounds over multiple route segments from small airports. Low cabin floor, single point refueling at the rate of 400 gal. per minute and three main doors permitting simultaneous loading of cargo and passengers will help cut ground-handling time.

A Douglas official told AVIATION WEEK that his company has been considering such an airplane for some time to relieve the economic penalties imposed on local service airlines by the DC-3. Earlier action was deferred because of lack of a suitable powerplant.

Jack Frye's project to build the Safari, another four-engine DC-3 replacement, has been deferred because of failure to obtain full-scale financial backing. Frye is now negotiating with Grumman Aircraft Corp. to produce 101 models.

Other Replacements

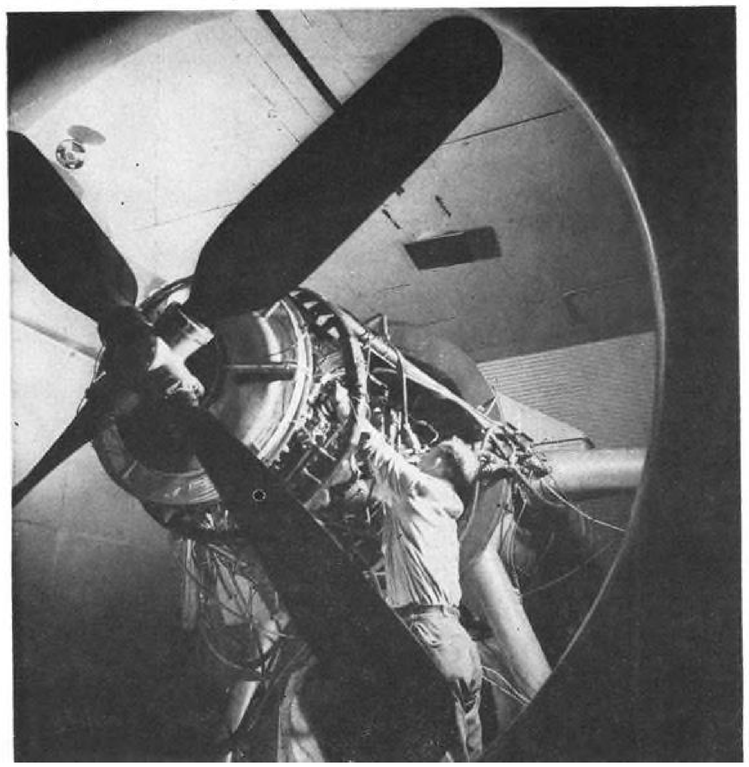
The DC-3 average break-even load factor for local service carriers is now 98.3%. One airline has break-even load factor of 154%. Low speed of the DC-3 (175 mph.), slow rate of climb (257 ft. per minute at maximum gross weight) and low lift capacity (average of 24 seats) combine to prevent the local carriers from attaining a state of economic self-sufficiency.

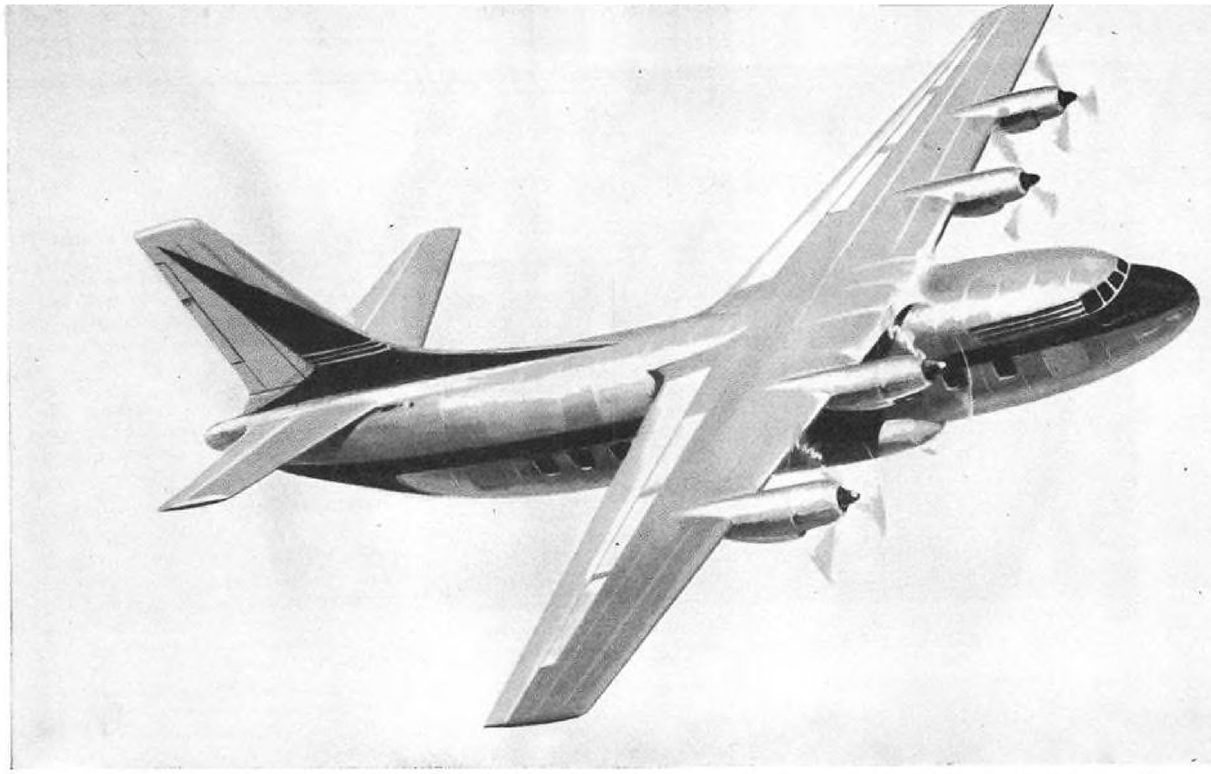
Southwest Airways and Allegheny Airlines are operating fleets of Martin 202s and several airlines have placed orders for the Fairchild F-27 turboprop transport as means of re-equipping with a profitable replacement of the DC-3.

In designing the 1940 as a solution to the local service airlines' operational and economic problems, Douglas considered these factors:

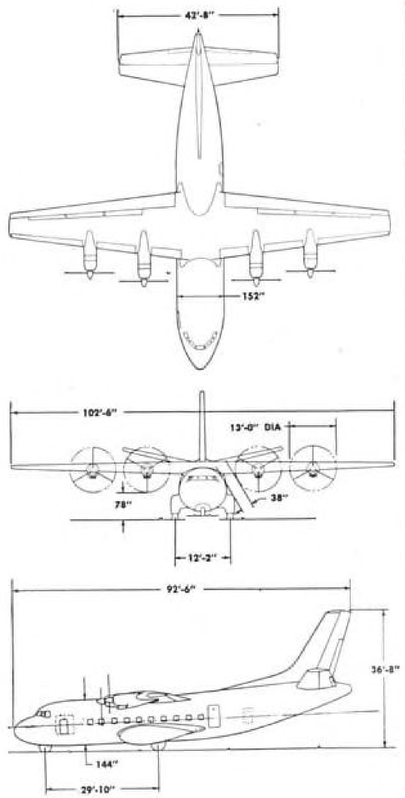
• **Douglas feels** traveling public is now

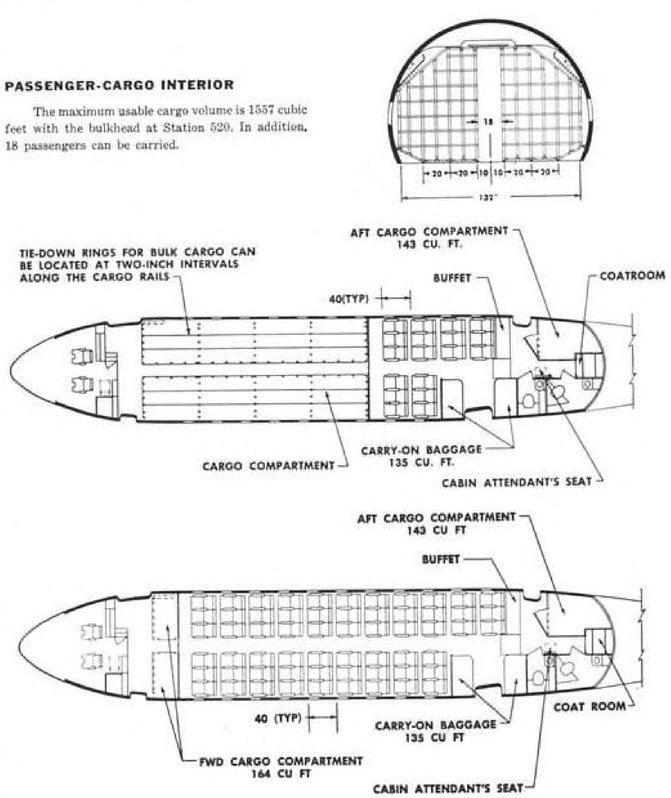
LYCOMING T55 is checked by technician in test cell. Turboprop engine, rated at 1,651 eshp., weighs 695 lb. Free power turbine, plus automatic fuel control, allows simple straightforward manual engine-propeller coordination. Other powerplant possibility for new airplane is Rolls-Royce Dart 510.





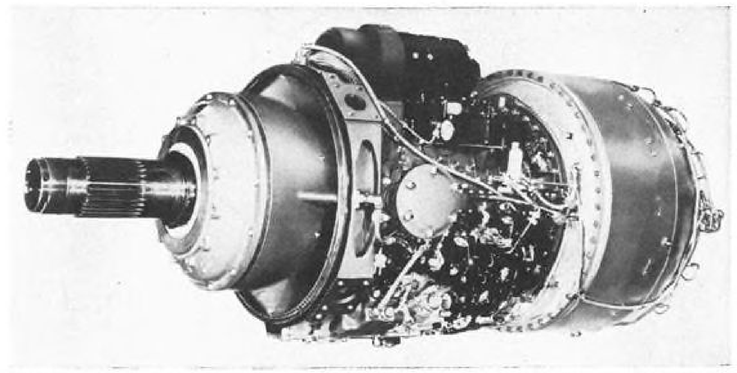
DOUGLAS DC-3 replacement, designated 1940, has high wing, high lift design, with full-span, double-slotted 40% chord trailing edge wing flaps and full-span 15% chord leading edge flaps for short runway operations. Seating calls for 60 passengers located six abreast.







FUEL system has many features of DC-6, DC-7 and DC-8. Single point refueling is provided on right side of aircraft. Two hoses can be attached to increase refueling rate.



T55 is designed for low fuel consumption using automotive and aviation gasolines or JP-4 fuel. It consists of combination axial-centrifugal compressor and external annular vaporizing combustor, a single stage compressor-driving turbine and two stage free power-turbine.

"turbine conscious" and will show a continuing preference for turbine powered aircraft over piston engine aircraft.

The company also believes passengers favor four-engine aircraft—a belief that also influenced Capital Airlines in its decision to buy the Vickers Viscount. According to one Douglas spokesman, the Rolls-Royce Dart has proved itself through its operating record with the Viscount as both a popular and efficient engine. The company is confident the T55 will demonstrate equal capabilities although the engine has not yet been type tested.

• **Narrow spread** between gross takeoff weight and allowable landing weight is essential to short-stage operation and is incorporated in the performance factor of the 1940. For example, on an 80 nautical mile flight, if gross takeoff weight of the aircraft is 62,840 lb. and runway takeoff distance 2,100 ft., landing weight at the end of the flight will be 61,571 lb. Runway distance will be 2,850 ft.

• **Fast climbs and descents** are essential to short-haul operations. Douglas feels that VTOL has not yet been developed sufficiently to be of practical use for airlines at this time (AW March 18, p. 25). The company has studied STOL possibilities, including tilt wing or tilt engines, but has abandoned these innovations on the grounds that heavy, costly maintenance work would be involved.

T55 Favored

Douglas leans toward the Lycoming T55 as the best powerplant for the 1940 because of the weight element. The Dart weighs 1,100 lb. and generates 1,600 shp., while the T55 weighs 695 lb. and generates 1,500 shp. Final engine choice is not likely to result in any drastic revisions of present specifications for the 1940.

Douglas wants an engine that contains a self-sufficient starting system. Nacelles will be of semi-monocoque construction. The aircraft is designed to permit removal of each demountable powerplant package at the firewall, and each engine may be removed through a large door at the bottom of the nacelle.

Propeller reverse-thrust is specified as a requisite to short-haul operations. The Dart engine uses ground-fine pitch to brake landing speed and reduce ground roll.

Passenger-Cargo Configuration

Cabin of the 1940 can quickly be converted from a 60-passenger configuration to a passenger-cargo combination accommodating 18-passengers and 15,000-lb. of cargo. Section of the cabin between the flight compartment and station 520 located approximately midships is equipped with a standard cargo floor and removable folding seats.

The compartment bulkhead can be positioned at 40 in. intervals within this section to increase or decrease the size of the cargo section according to traffic needs.

Maximum cargo volume is 1,557 cu. ft. when the bulkhead is moved to station 520 position.

The floor will support 200 lb. of cargo per sq. ft. and 100 lb. per in. of cabin length.

Cargo is secured by longitudinal and transverse web gates and stanchions.

The passenger door is located on the port side of the trailing edge of the wing. The cargo door is located to the rear of the flight deck on the starboard side.

Cargo door is 48x60 in. with an alternate size of 75x60 in. available. A service door is located on the starboard side of the fuselage at the rear of the passenger cabin.

When fitted to handle 60-passengers, the aircraft is equipped with a forward cargo compartment 164 cu. ft. in size, an aft compartment 143 cu. ft. in size and a carry-on baggage compartment 135 cu. ft. in capacity.

Cabin heat is obtained from cabin compressors that are augmented by electric heaters when cold weather prevails. Cooled air is furnished by a heat exchanger which can be reinforced by a freon evaporator for another flight or ground service. Cabin is pressurized to a maximum operating differential pressure of 4.16 lb.

Directional and longitudinal control systems are operated by cable, and the movable surfaces are driven by spring control tabs. Lateral control is provided by slot-lip segments actuated by hydraulic power cylinders.

The 1940 will require a takeoff distance of 2,300 ft. at sea level with maximum structural takeoff weight of 65,500 lb. on a standard day using 20 degree flaps. With maximum structural landing weight of 65,000 lb., the airplane calls for a 3,000 ft. landing strip with flaps full down 50 degrees.

Operating Costs

Block-to-block speed is 200 kt. on a 200 nautical mile flight leg and 225 kt. over a 400 nautical mile run, increasing to 250 kt. at ranges of 900 nautical miles and beyond.

Direct operating costs amount to 1.9 cents per passenger nautical mile for a 200 nautical mile flight and decrease to 1.6 cents on flights 830 nautical miles in length. On flights less than 50 miles, direct operating costs are 3.1 cents per mile, declining to 2.5 cents at 100 nautical mile flights.

Direct operating costs per nautical plane mile are $2.10 on flights less than 50 miles, $1.15 on ranges of 200 miles and $1.00 on runs of 600 nautical miles.

Capacity payload of 15,000 lb. is attainable on flights up to 550 nautical miles with maximum takeoff weight of 65,500 lb.

Payload decreases progressively to 10,000 lb. as flight range is increased to 1,075 nautical miles.

This is how the 1940 will perform on an 80 nautical mile flight:

Cruise altitude will be 10,000 ft., cabin altitude 800 ft., average cruising speed 262 kt., block-to-block speed 153 kt. with a payload of 15,000 lb. at a direct operating cost of 2.0 cents per 200 lb. per nautical mile. Fuel consumed will total 1,269 lb. leaving a reserve of 5,710 lb. and time taken would amount to 31.32 minutes including a 10-minute allowance for taxiing and takeoff and landing.

Loading Doors

The 1940A cargo version is equipped with rear loading doors 100 in. wide and 98 in. high. Ramp angle on the aircraft is 12 degrees. Upsweep design of the fuselage provides a clearance sufficient to allow movement of a truck bed 50-inches high directly to the ramp sill.

Clear width of the cabin floor is 116 inches; height is 98 inches; length 220 inches. The floor is designed to handle a unit loading of 300 lb. per sq. ft.

Landing gear of the 1940A is equipped with universal skis that can be installed on all three wheels with attachable fittings. Wheels extend below the ski surfaces so that the aircraft can taxi from an unprepared area to a hard surface.

Payload of the all-cargo plane is 16,000 lb., cruise speed is 243 kt. and range is 1,590 nautical miles. Maximum takeoff weight is 65,500 lb.; maximum structural landing weight is 59,100 lb., and fuel capacity is 26,600 lb. or 4,000 gallons.

Lycoming T55 Specifications

Lycoming's T55, rated at 1,651 eshp., is a scaled up version of the 825 eshp. Lycoming T53. The T55 model LTC4A-1 for turboprop use has an automatic fuel control system for simple, straightforward manual engine propeller coordination.

Specifications for the turboprop and helicopter models:

TURBOPROP ENGINE

Horsepower (Takeoff)	1,651 eshp.
Horsepower (Maximum Continuous)	1,383 eshp.
Specific Fuel Consumption (Takeoff)	657 lb./eshp./hr.
Specific Fuel Consumption (Maximum Continuous)	688 lb./eshp./hr.
Weight	665 lb.
Diameter	24.25 in.
Length	58.8 in.
Nominal Output Shaft Speed	1,200 rpm.

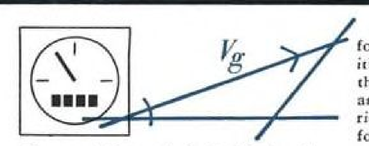
HELICOPTER ENGINE

Shaft Horsepower (Takeoff)	1,676 eshp.
Shaft Horsepower (Maximum Continuous)	1,392 eshp.
Specific Fuel Consumption (Takeoff)	.648 lb./eshp./hr.
Specific Fuel Consumption (Maximum Continuous)	.685 lb./eshp./hr.
Weight	600 lb.
Diameter	24.25 in.
Length	44 in.
Nominal Output Shaft Speed	Approx. 6,000 rpm.



Russians Build Turboprop Airliner

Turboprop airliner designed by O. K. Antonov is designated Ukraina by Russians. Specifications given by the Russians call for cruising speed of 360 mph. at 24,000-30,000 ft. altitudes, and a combination payload of 85 passengers and 3½ tons of cargo. Russians describe it as 30-50% cheaper to operate than piston engine transport. Nose resembles Il-28 jet bomber; chin bulge appears to be weather radome. Note ventral fin. Landing gear consists of two four-wheel bogies. Passenger doors are visible in each side of rear fuselage. Russians say there is a large door "in back of the plane through which a truck can drive," enabling Ukraina to be used as cargo plane.

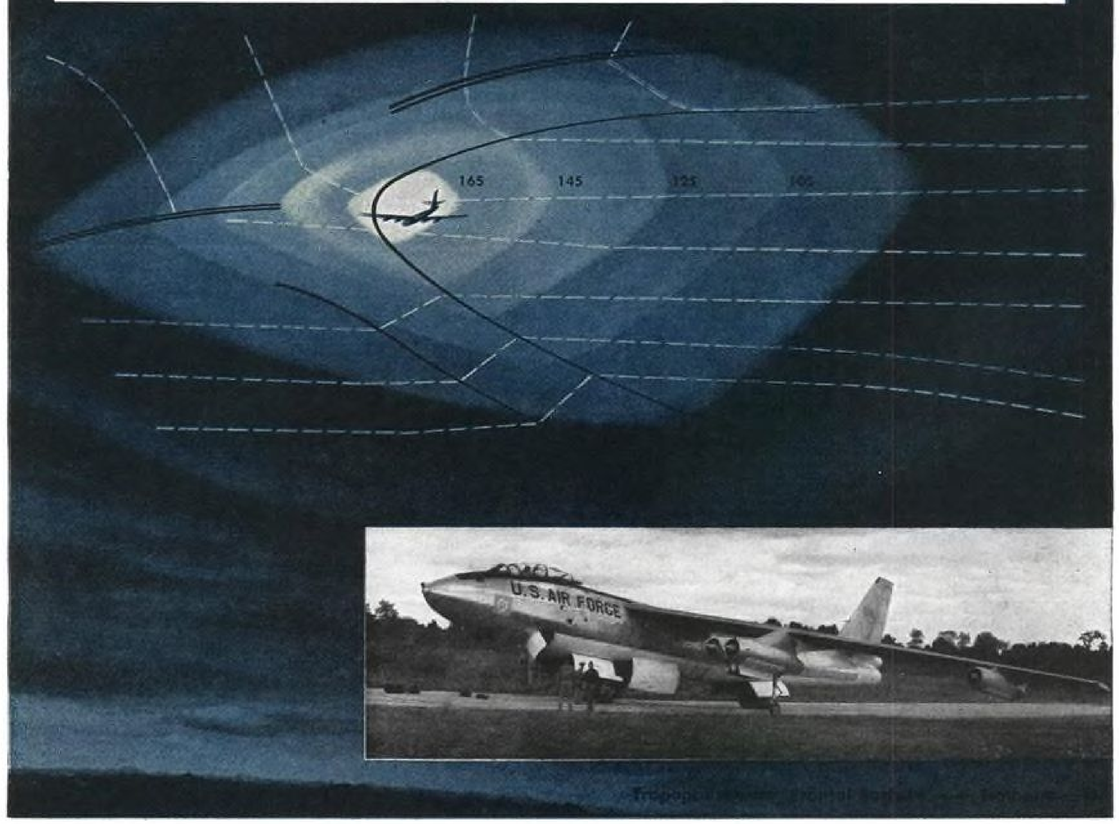


Ground Speed & Drift Angle
Any Time, Anywhere, Any Weather

Jet streams were cross-sectioned for the first time using the capabilities of GPL auto-navigators. Now these same ground speed and drift angle measuring equipments make riding aerial "express-ways" S.O.P. for military fliers.

A leading news magazine's story on the record-setting B-47 flight defined jet stream flying this way:

"To find the jet stream the pilot flies in its general direction . . . When the '66' tells him that his drift angle is increasing, he knows that he is getting into the jet stream . . . When the drift angle reaches a maximum, he turns downstream until the drift angle falls to zero . . . When the '66' is hooked to the autopilot, the airplane will follow the stream automatically, getting maximum benefit."



Cross-section of a headline

On January 25, 1957, in the early hours of a California morning, a USAF B-47 climbed skyward into the jet stream. With the aid of one of GPL's self-contained, airborne navigation systems, AN/APN-66, the crew put the plane into a 165 mph-plus jet stream core and held it there all the way across the country. 3 hours, 47 minutes later, the same "47" touched down within sight of the Atlantic Ocean.

The story made headlines and so did the part played by the GPL equipment.

GPL auto-navigators' demonstrated usefulness in locating and flying jet streams is just one application of their basic function – *precise point-to-point navigation, any time, anywhere, any weather.* The systems have flown millions of miles in transport, bombing, fighter, patrol and weather planes.

GPL, who harnessed Doppler shift to air navigation and developed self-contained auto-navigators, is the nation's leading manufacturer of these systems.

GPL A SUBSIDIARY OF GPE

GENERAL PRECISION LABORATORY INCORPORATED, Pleasantville, N. Y.

ENGINEERS – GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.



Turbo-Liner Begins Engine Test Program

Allison Turbo-Liner, a turboprop powered Convair, takes off from Weir Cook Municipal Airport, Indianapolis, for test program on Allison 501-D13 turboprop engines and Aeroproducts four-bladed propellers. Combination will be used on Lockheed Electra transport. Using same engine but a three-blade Aeroproducts propeller, Allison pilots have run propeller icing tests with Turbo-Liner. They report only 4% loss in propeller efficiency because of icing, not 14% loss previously accepted.

Three U. S. Carriers Win Rights To Serve Five Routes to Mexico

Washington—Three American carriers were designated last week to serve five of the seven routes established by the first Air Transport Agreement between the U.S. and Mexico (AW Mar. 18, p. 45).

Dates have been set for hearings to determine the selection of carriers to serve the remaining two routes.

Airlines designated by the U.S. government last week were:

- **Western Airlines** to begin service between Los Angeles and Mexico City via intermediate points in the U.S.
- **Eastern Airlines** to inaugurate service between New Orleans and Mexico City.
- **Pan American World Airways,** already serving three U.S.-Mexico routes under a temporary permission from Mexico to begin service from New Orleans to Merida, Mexico, and to Guatemala and beyond; from Houston and Brownsville to Tampico, Mexico City and Tapachula and to Guatemala and beyond, and from Miami to Merida to Guatemala and beyond.

New York-Mexico City

Still pending is the question of which of three airlines that have applied shall receive authority to operate nonstop service between New York, Washington and Mexico City. Applicants are Pan American, American and Eastern. Action in this case was suspended in 1954 pending negotiation of the bilateral agreement and will be resumed tomorrow.

A seventh route provided under the agreement permits service between Chicago and Mexico City, either nonstop or via Dallas or San Antonio. It also provides a more complicated picture.

American Airlines now flies between Dallas and Mexico City, both nonstop and via San Antonio under temporary permission from Mexico. It also operates between Chicago and Dallas under its domestic authority and can offer one-plane through service from Chicago to Mexico City, but not nonstop.

Braniff vs. Pan American

Braniff International Airways also operates a domestic route between Chicago, Dallas and San Antonio and is certificated to fly between San Antonio or Laredo and Monterey and Mexico City. Braniff, however, does not have Dallas- Mexico City or Chicago-Mexico City nonstop rights.

Since the agreement permits not more than one carrier to a route, further proceedings are necessary. The CAB said it would take steps to determine whether additional authorization should be issued to permit full utilization of the Chicago-Mexico City rights.

However, the notice and hearing required in such a case will not permit a decision by June 5, the effective date of the agreement. The Board, therefore, has ordered an oral argument between American and Braniff on April 18 to determine which airline should be designated on the Dallas or San Antonio-Mexico City portion pending its Chicago-Mexico City decision.

Convair 880 to Use Flying Tab Controls

Convair's Model 880 jet transport will use flying tab controls in elevator, rudder and ailerons to provide manual pilot control during flight. In addition, hydraulically actuated spoilers will be used in lateral control system, with a mechanical mixer providing proper coordination between aileron and spoiler displacement.

Hydraulically operated screw jack will provide horizontal stabilizer trim, with manual override available to both pilot and copilot. Stability augmentation in the form of a yaw damper will be incorporated into the rudder.

Double slotted Fowler type flaps are to be used on the aircraft.

CAB Delays Decision on Fare Increase

By Ford Eastman

Washington—Airline proposals for a 6% boost in passenger fares on April 1 to offset increased expenses were suspended by the Civil Aeronautics Board last week pending a hearing on April 4.

In issuing the order, the CAB said the reported declines in net operating income during 1956 appeared moderate and do not indicate any emergency situation that would support permitting the proposed increases to become effective without an investigation and hearing.

Thus far, seven airlines have petitioned for the increase—Braniff Airways, Capital Airlines, Delta Air Lines, Eastern Air Lines, Northwest Airlines, United Air Lines and Trans World Airlines.

The CAB order made American Airlines, Continental Air Lines, National Airlines, Southwest Airways Co., Western Air Lines, Los Angeles Airways and New York Airways parties to the proceedings.

The Board said it was important, from both the carriers' and public's standpoint, that its planned investigation be completed promptly.

Investigation Limited

To limit issues in the proceeding, the CAB excluded consideration of the $1 per ticket increase proposed by Eastern and Capital in addition to the 6% fare boost. The Board said the proposal involved both a change in the fare level and the fare structure.

The CAB also limited the issue of determining the earnings element in the fares to the single question of the rate of return to be allowed on an original cost less depreciation rate base.

For the airline industry as a whole, the Board said the proposed fare boost would amount to an additional $67 million a year. If the $1 per ticket additional increase was added on, the total increase for the trunkline industry could be as much as $95 million.

Gurney Objects

Vice Chairman Chan Gurney took exception to the Board's action. He said the material the carriers have filed in support of an interim fare increase convinced him the Board should have explored the matter more thoroughly before suspending the proposed tariffs.

"Some of the carriers," he said "allege that current and impending increases in fuel costs, wages and equipment will reduce their net income to less than the 8% considered by the Board as the reasonable rate even for the subsidy carriers.

He added: "One airline pleads that its 1956 domestic net operating income before taxes will not be sufficient to absorb these increases. The carriers further point out that the industry can no longer absorb these increases as operating efficiencies have reached their peak and the phenomenal rate of traffic growth is slowing down."

Gurney said that, in view of these contentions, he would have favored affording all carriers involved an immediate opportunity to meet with the Board to state their problems.

Airlines claim the net earnings reflected in financial reports present a misleading picture as to the need for relief. Eastern, for example, said its 1956 earnings set a record that was largely accounted for by low depreciation costs.

During 1957, the airline said, depreciation costs will be much greater, and earnings are expected to take a dip as a result. Other financial reports, including United's, reflect considerable income from the sale of equipment.

The Air Transport Assn. says gross revenues increased 11% in 1956, but that the net income for the whole industry decreased by 10%. During the last five years, according to ATA, airline net income dropped from 6.3% to only 4.7% of gross revenues.

The big problem facing airlines today, industry spokesmen say, is the retention of sufficient earnings to attract the financing necessary to acquire $4.6 billion worth of new equipment needed over the next 10 years. More than $2.6 billion already is committed for the jet fleets on order.

Increase in fares, while it would help to alleviate the situation, is not the complete solution, the industry claims. The government's method of determining a fair rate of return—based on original cost less book depreciation—has been criticized as allowing insufficient earnings.

Fair Return

The ATA says that, in an industry with a large capital investment and a low rate of capital turnover, profits based upon a fair return on investment will ordinarily represent a substantial proportion of gross revenues. If a company such as private utility company has a capital investment of $100 million, for example, and annual revenues of $40 million, a return of 6% on investment will bring in profits amounting to 15% of operating revenues. Because the investment base is large in relation to operating revenues, profits determined on that base will provide a substantial margin over operating expenses.

A reversal of the relationship between investment and revenues—such as the airlines have—will produce a reverse on the margin. If investment is $40 million and annual revenues are $100 million, a return of 6% on investment amounts to only 2.4% of revenues. With such a small margin, ATA points out, a small change in either revenues or expenses can turn the profit into a loss.



LAI Viscount Flight Tested

First of ten Viscount 785s ordered by Linee Aeree Italiane is ready for flight testing at Vickers Hurn plant. Six will be delivered to LAI this year, four next spring.

U. S., Dutch Resume Bilateral Negotiations

Washington—Bilateral talks between the Netherlands and the U. S. were resumed last week in a new move to reach a compromise settlement on KLM requests for route extensions within the U. S.

Negotiations between the two countries were cut short last year because of the failure to reach an agreement on KLM's request for the routes without granting the U. S. anything in return.

The State Department was originally hopeful that a compromise could be reached by granting one of the three routes KLM wants, but, by the end of last week, most observers were pessimistic over the eventual outcome of the present sessions.

The Dutch seek three routes—Amsterdam-New York-Los Angeles; Amsterdam - Montreal - Houston - Mexico City and Amsterdam - New York - Curacao. KLM readily admits it has no similarly attractive operating rights to exchange in reciprocity.

The Dutch have had high hopes on the latest negotiations and named E. H. Van der Beugal, a top-level official in the Netherlands Foreign Ministry, to head their delegation.

Earlier, Dutch Prime Minister Dr. Willem Drees sent a personal letter to President Eisenhower stressing the importance of the route extensions to the Dutch economy.

U. S. delegates, however, worried that the granting of the routes to the Dutch may create an unfair competitive balance between KLM and the U. S. flag carriers.

Meanwhile, Pan American World Airways filed an application with the Civil Aeronautics Board for permission to operate through service from Houston to the European gateways of Oslo, Paris and Lisbon. Pan American now flies from Houston to Mexico City and beyond to Central and South America. The new route would in effect establish through one-carrier service from Latin American cities to Europe.

Viscount Flap Bolts Tested After Crash

London—All 21 British European Airways Viscounts were scheduled to be back in service last weekend following their grounding for replacement of wing flap attachment bolts. BEA's action, and precautionary measures by other operators, followed the Viscount crash fatal to 22 persons during a landing approach at Manchester, England.

Vickers has advised all Viscount operators to make checks of the bolts on aircraft which have reached a certain operational life as "an ultra safety precaution," though cause of the crash has not been officially revealed. Witnesses reported plane dropped a wing suddenly before it touched down.

Capital Airlines last week grounded and checked its entire 60-aircraft Viscount fleet during a 72-hour period beginning at 7 p.m. March 18. Ten flights scheduled to leave New York during this period were canceled, and 45 other flights departing New York went out with substitute equipment. Capital's Viscounts are Model 744; BEA's are Model 701. Designations within the 700 series, however, have little relationship to aircraft time. Capital found nothing in its check.

Trans-Canada Air Lines first checked bolts on 14 of its 25 Viscount 724s and 757s then pulled 20 of the planes off schedules for replacement of flap bolts as an "ultra ultra safety measure." Latest five TCA Viscounts to go into service were not affected. Airline expected full resumption of service by end of last week.

Air France, with 12 Viscount 708s and 701s in service, grounded the 708s for checking and decided to replace the bolts.

British Overseas Airways Corp., with four Viscount 702s in New York-Bermuda service, ran precautionary checks without interrupting service. In Australia, Trans-Australian Airlines grounded seven 720s, one of Butler Air Transport's two 747s was grounded. Aer Lingus withdrew its 701s from service. Viscount 800s were not involved.

BEA's Viscounts were first withdrawn on Sunday, placed into operation again on Monday, then withdrawn once more on Tuesday.

Delta Wants Stock On N. Y. Exchange

Atlanta—Delta Air Lines has filed an application with the New York Stock Exchange asking the exchange to list its $3 par value common stock on the New York board. The stock is now sold over the counter.

Similar applications have been filed with the Securities and Exchange Commission, and the effective date of trading on the exchange will depend upon the action of the two agencies. Outstanding common stock now totals 1,122,525, and the number of Delta's stockholders number about 6,000.

Pan American Case Reopened

Washington — Civil Aeronautics Board last week ordered Pan American World Airways' transatlantic mail rate case reopened as a result of an uncompleted audit of the airline's systemwide operations for 1954.

In its examination, the CAB will determine if changes or modifications should be made in the mail pay Pan American has received since 1946.

From an analysis of the audit, the CAB said, it appears that Pan American's subsidy needs may have been overstated by as much as $6,500,000 between 1946 and 1953. The Board says completion of the audit may disclose additional information that would require further exploration.

The information contained in the audit relates to the practices of Pan American in respect to the charging for service to affiliates and to the carrier's accounting practices.

The Board said many practices of Pan American require examination. In addition, it said that much of the newly developed information throws doubt onto the reasonableness of the mail rates established for the carrier for the 1946-1953 period.

The CAB said the information now available may be "subject to substantial qualification" but added that it now appears that:

- **Pan American has failed to charge** Uraba, Medellin and Central Airways, a certificated U. S. carrier entirely owned by Pan American and operating in Central America, proper costs for aircraft leased to it. This, the CAB says, has resulted in apparent undercharges of $270,000 between 1946 and 1953.
- **Pan American has absorbed** ground service costs of Central Airways at Tocumen Airport, Panama, amounting to about $246,000 from 1950 to 1953 and $99,000 in 1954.
- **Pan American has failed** to bill outside companies, including affiliates, with proper charges and rates for airport service it renders at a number of airports in Central and South America and has absorbed $4.1 million of the costs from 1946 through 1953 that should have been charged to these companies.
- **Pan American should** have allocated $595,000 overhead costs of its Latin American Division to Central Airways.
- **Pan American** overstated its operating expenses by improperly charging $280,000 of depreciation expenses from 1950 through 1954 on $548,000 of flight equipment spare parts it acquired from American Overseas Airlines but which were not given any value by the latter airline on its books at the time the transfer was made.
- **Pan American failed** to allocate to its Miami and Brownsville overhaul bases, which performed maintenance services for other companies, a portion of that part of the Pan American system's general and administrative expenses charged against its Latin American Division. The allocation, CAB estimated, totals $1,145,000 from 1946 through 1953.
- **Pan American** deviates in numerous instances from the Board's uniform system of accounts or failed to observe accepted accounting principles in keeping its books and records and in reporting the results of its operations.

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★ San Francisco to Salt Lake City, Denver and Minneapolis-St. Paul.
★ Los Angeles to San Francisco.
★ Los Angeles to San Francisco, Portland and Seattle/Tacoma.
★ Los Angeles to Salt Lake City and Minneapolis-St. Paul.
★ Minneapolis-St. Paul to Denver, Salt Lake City and San Francisco.

SHORTLINES

► **Pan American** will cut New York-Nassau first-class round-trip fares by 20% with a new 30-day excursion rate effective April 15. The daily DC-7B flights will be offered at $146.50 round-trip.

► **Travel agents** produced 17.1% of Capital Airlines' passenger revenues in 1956. Increase in revenues from agents was 45% over 1955.

► **Trans Canada Air Lines** Viscount fleet now totals 22. Carrier has received four more of 31 it has on order. Deliveries will be completed by mid-1958.

► **Lufthansa** gave 100 construction workers a free 1½-hr. Super Constellation ride after opening of new airport buildings at Hamburg. Workers got aerial view of their job, also free drinks from hostesses.

► **Lockheed Aircraft Service-International** is expanding Idlewild facility, plans to add 211,500 sq. ft. of hangar, ramp, storage and parking space. Additional space will accommodate 12-15 two-engined, or as an alternate eight four-engined planes.

► **Convair 440** orders have increased by 21 to a total of 146 in past 18 months, with 70 deliveries of the twin-engined transports already made. Most recently announced orders are Cruzeiro do Sul of Brazil, 4; Eastern Air Lines, 5; Ansett Airways, 3; Jugoslovenski Aero Transport, 1; Lufthansa, 3; an unnamed Japanese airline, 1; REAL S/A, 2; Aero O/Y in Finland, 1; Union Oil Co. of California, 1.

► **United Air Lines** will inaugurate DC-7 non-stop coach service between New York and San Francisco on April 1. Fare will be $102 one way at present fare levels, $108 if fare increases are approved.

► **Airline** real estate department has been established in New York by Julien J. Studley, Inc. Special department of real estate firm will handle office space and ticket counter locations for its carrier customers.

► **Los Angeles International Airport** handled 3,944,967 passengers in 1956, a 16.3% increase over previous year. Mail, freight and express total rose 7% to 127.5 million lb. Last fiscal report of the Los Angeles Department of Airports showed $1,451,170 net profit for year, including Los Angeles and San Fernando Valley airports.

AIRLINE OBSERVER

► Airlines will get no decision on a new goal for transport aircraft eligible for the government's fast tax writeoff program until late this year. Office of Defense Mobilization previously had planned to close the goal at 900 commercial aircraft, but the Air Transport Assn. objected on the grounds that applications for accelerated tax amortizations on almost 400 aircraft would be denied. ODM now says that a "final decision on the establishment of new goal in this area should be postponed until the new requirements are transmitted to the ODM by the Department of Defense."

► **Northwest Airlines is shooting for an April 28 target date to begin DC-7C service over the Great Circle Route to the Orient. First of 14 DC-7Cs was delivered March 1; two more are scheduled for delivery before the April 28 target date. Plans call for four weekly round trips between Seattle-Tacoma and Manila via Tokyo and Okinawa. Combination tourist/first-class configuration will be used over the route.**

► Viscount 812 ordered by Continental Air Lines will fly with derated engines. The Viscount's Rolls-Royce RDA. 7/1 engines deliver 2,100 shp. but are limited to 1,800 shp. at takeoff because of the aircraft's lack of directional control if an engine suddenly fails at takeoff and causes asymmetrical thrust. Pilot, however, can avail himself of the higher power during climb and cruise.

► **Aeroflot, Russia's state-owned airline, admits it fell short of its 1956 passenger-mile quota although new highs in traffic were reached during the year. Aeroflot said poorest results were shown in Far Eastern and Eastern Siberian administrations. "Failure to meet goals in these areas indicates there are serious shortcomings in economic management by several of our subdivisions," the airline said. It also added: "Errors are still being tolerated in economic planning, formulation of flight schedules and flight crew training."**

► Civil Aeronautics Administration is investigating the Iatron projection system of radar display as a means of producing a picture 16 inches in diameter of sufficient brightness to be seen under all daylight conditions in control towers. CAA's eventual goal is radar display 48 inches in diameter with targets bright enough to stand up against daylight conditions. CAA also is testing a French-developed system at Indianapolis Technical Development Center.

► **Boeing Airplane Co. has commissioned Stanley H. Brewer, professor of transportation at the University of Washington, to study the feasibility of producing an all-cargo turbojet aircraft.**

► Douglas Aircraft will have nine DC-8s in both domestic and intercontinental versions with three different engine configurations ready for flight during testing and CAA certification of the jet transport. By the time CAA certification testing program is completed, the company expects to have 39 DC-8s ready for delivery.

► **If the French government decides to begin a local-service type operation, the feeder airline will be jointly owned by Air France, the state-owned railways, private airlines and banks and insurance companies.**

► Convair has completed full-scale mockup of its 880 jet transport except for cabin interior. Mockup consists of complete fuselage, one wing with nacelles, one horizontal stabilizer and all but the upper tip of the vertical stabilizer which was cut short to allow for ceiling clearance. Basic elements of all systems are contained in the fuselage including air conditioning, fire detection and radio.

► **Air traffic controllers are renewing their protests against recent reclassification of standards by the Civil Service Commission that resulted in the downgrading of some personnel (AW Oct. 1, p. 41). Civil Aeronautics Administration is handling the problem as a "priority project" and has assigned its Chief of Operations Division to review the classification standards in conjunction with the CAA Classification Division.**



AN EXAMPLE OF DESIGN

FOLLOW-THROUGH AT CHANCE VOUGHT

Integral Tanks in a *Razor-Thin* Wing

How to make a fuel container out of a supersonic wing . . . Crusader designers who were given this problem saw in it the earmarks of a typical Chance Vought assignment. First, the job had never been done before. Second, the whole problem was theirs to solve and control — from design through test to the factory floor.

They began with a philosophy that proved sound all the way: design a fuel container first, then make it behave like a wing. Next, they focused on the major problem — adequate sealing — and selected a sealing method to solve it.

To determine best configurations and leakproof bolt and screw attachments, designers put several trial tanks through a stiff test spectrum. Then they moved to the shop to oversee the production and assembly of parts for their wing.

Looking ahead to the assembly line, they prepared a manual for shopmen and held classes explaining methods for assembling and sealing the two-purpose wing. To complete their job, they also wrote a maintenance bible on wing tank repair — a book which, significantly, hasn't been needed to date.

Technically, the fuel cell project was one of a kind. So was our pioneering work in electromechanical stabilization systems. Likewise, our discoveries in antenna weight, cost and performance improvement resulted from specialized effort.

In engineering challenge, however, these efforts were related. Each allowed the designer to take a new route . . . to follow through . . . and to see his idea make good.

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Support Equipment Designer. To design shipboard handling equipment and loading devices for missiles and fighter aircraft. Requires flair for mechanical design, engineering degree, or equivalent experience.

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ANTI-SPIN roll rocket on right wing tip of 1/25 scale model of F-104A is tested as an emergency spin recovery device at NACA Langley Free Spinning Tunnel. Technician has just tossed model into tunnel using a spinning motion. Arrow (right) indicates wing tip rocket.

NACA Models Seek Critical Spin Answers

By Evert Clark

Langley Field, Va.—Increasingly critical problems of spin in high performance aircraft may lead to automatic controls designed to keep incipient spin from becoming a violent maneuver.

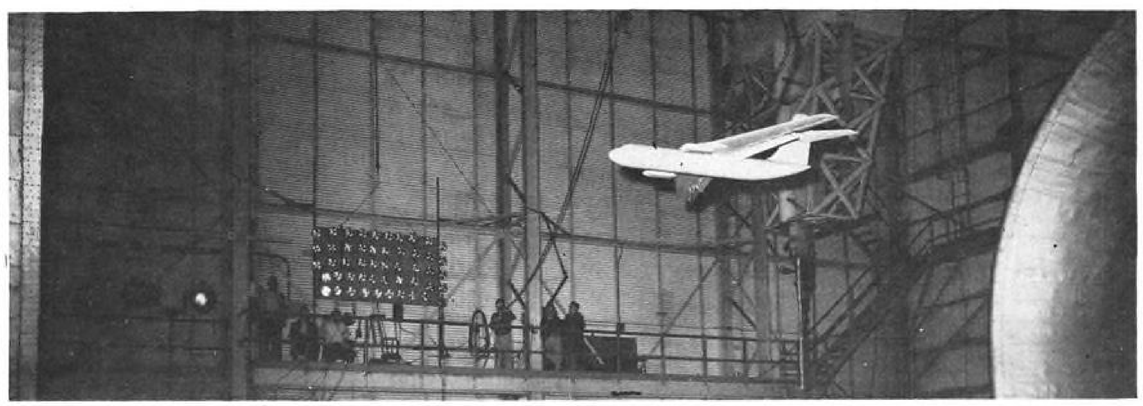
Although free-flight models have been used in a variety of ways for more than 20 years by researchers at the National Advisory Committee for Aeronautics' Langley Aeronautical Laboratory, their importance in the exploration of incipient spin has forced development of new techniques for their use outside spin tunnels.

New techniques also are being found for the use of free-flight dynamic models in investigating vertical and short takeoff and landing configurations, even after 10 years of experience with VTOL and STOL models here.

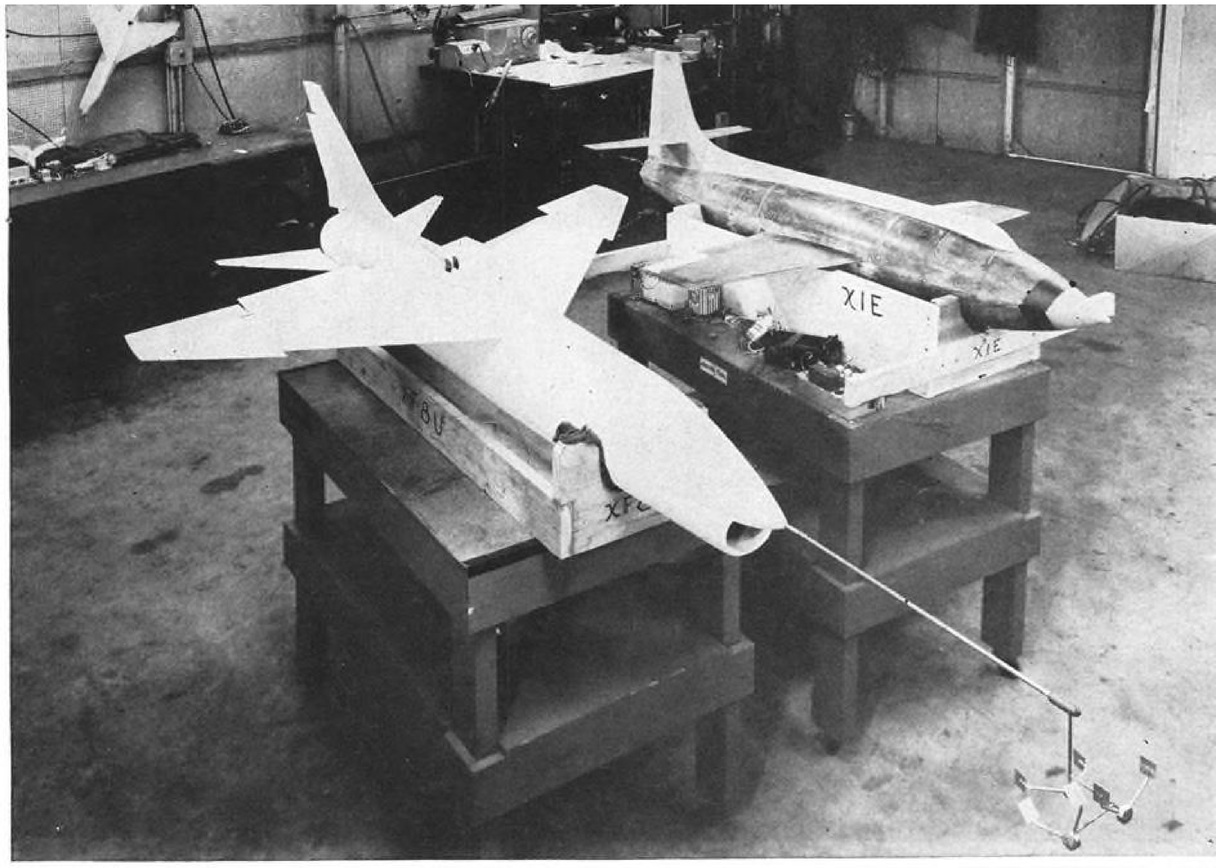
Spins in high-speed research and fighter aircraft happen so rapidly and so violently and are so difficult to recover from, that spin research has been broadened to put greater emphasis on prevention.

Spin recovery problems changed "appreciably and suddenly" with the advent of swept-wing rocket and jet designs and "the associated extreme mass characteristics," according to A. I. Neihouse, head of the Spin Tunnel Section of Langley's Stability Research Division.

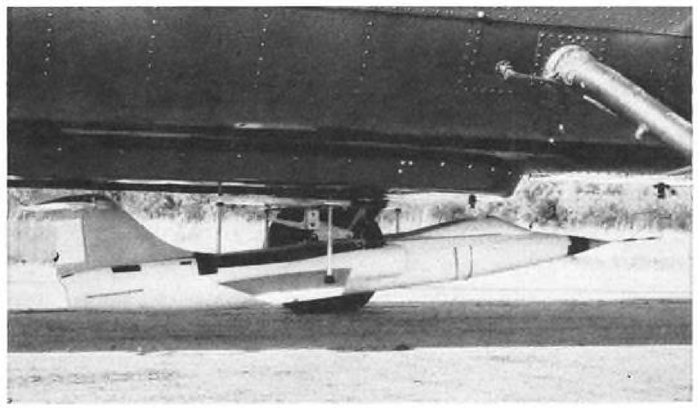
Nature of the spin also changed from a fairly steady motion to an ex-



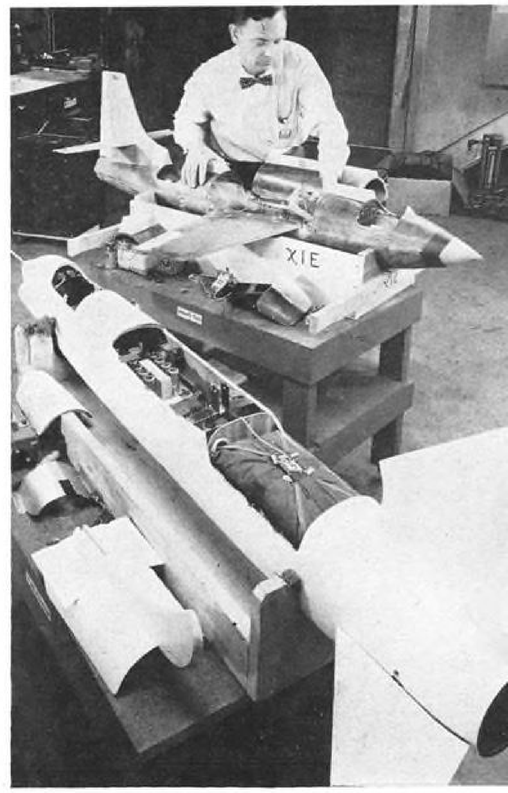
FOUR ENGINE transport model with jet augmented flap is tested in Full-Scale Wind Tunnel at Langley. Compressed air power line for model's cold jet engines and control lines for wing and tail surfaces are taped to slack safety cable, visible above model.



RADIO controlled models of XF8U in 1/9 scale and X1E in 1/6 scale (above and right) are launched from helicopters to carry out incipient spin tests. Instrumentation of the models include vanes on boom of XF8U (above) which obtain the approximate angles of attack and sideslip during flight. Air Force gun in model photographs vanes through engine air intake. Radio receivers, parachute installation and camera hatch near nose of XF8U model are visible at right. Both models are in the Dynamic Tunnels Operation Shop at NACA's Langley Aeronautical Laboratory.



HELICOPTER launching attachment holds 1/7 scale model of F-104A. Scene is West Point Airport, West Point, Va., where drop tests are made.



TMI TUBING

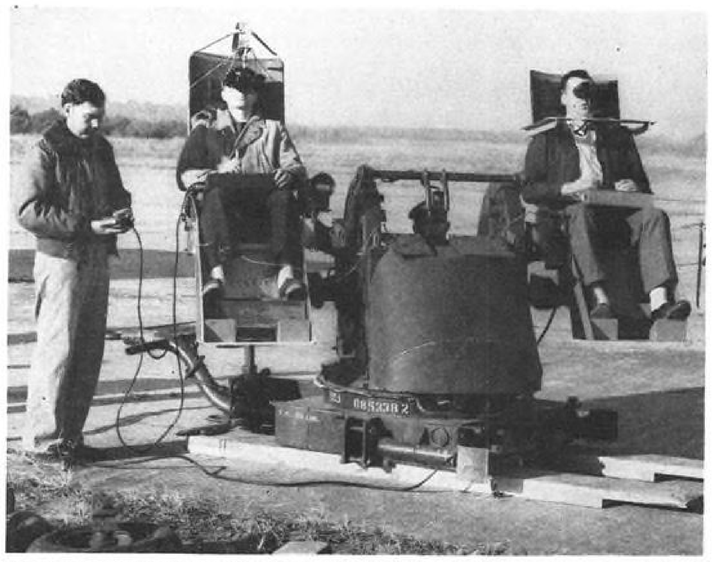
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MODIFIED M-55 gun tracker is used in radio controlling helicopter-dropped models. One man controls pitch, second roll and yaw, third tracks. NACA has second tracker ordered.

tremely oscillatory one, and aircraft displayed a tendency to go into spins not only near landing speeds but at very high speeds as well.

Reasons for these changes—some of them still being discovered—are all interrelated. They include:

• **Extreme changes in mass** distribution. From piston-engine designs, in which mass was more evenly distributed over a relatively stubby fuselage and relatively high performance large wings, aircraft have gone to designs in which mass is concentrated almost entirely in elongated fuselages.

• **Loss of effectiveness of control** surfaces. As aircraft come to resemble missiles more, with longer bodies and a greater percentage of mass in the body, control surfaces are shrinking—even though they have ever-increasing moments of inertia to combat in trying to recover from a spin.

• **Gyroscopic effects of jet engine** torque. Rotation of masses within a jet engine create a gyroscopic effect that can contribute considerably to a spin. This further unbalances the struggle between control surfaces and spin moments and forces.

• **"Flying" effect of fuselages.** Long, thin noses of high performance aircraft tend to act as thick airfoils and "fly" the aircraft into the spin. This phenomenon is one of the reasons why new techniques, using larger-scale models, have become necessary. Reynolds number effects, which plays a large part in flow over a body of revolution such as the fuselage, becomes a problem in trying to obtain useful data with small (usually 1/25th) scale models in the spin tunnel.

• **Speed.** In the inadvertent high speed spins experienced in newer military and research aircraft of the X series, forward speed not only makes gyrations more violent but helps to decrease relative effectiveness of control surfaces, adds to pilot confusion at the beginning of the spin, cuts down the time in which he can react to prevent it and contributes to his disorientation during the spin, lessening his chances of recovery.

Change in Technique

Already, research has led to a change in techniques for spin recovery in advanced aircraft. The old rule was to use full opposite rudder and full down elevator.

The rudder acted almost as a brake, and the elevator threw the aircraft into a dive attitude.

Now, tail control surfaces are ineffective, and the aileron has become the useful surface. It is applied with the direction of the spin—not against it. In a right spin, for example, right full stick drops the right wing and starts a roll to the right, which becomes a dive and makes recovery possible.

With 15 years of spin tunnel research behind it, the NACA reached a point after World War II at which aircraft designers could, through consideration of mass and dimensional data, anticipate whether their planes would meet spin recovery requirements, often without testing.

But with the high-speed jet and rocket designs that followed, Neihouse says, "Criterions established after years of testing were no longer adequate."

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Now in quantity production at Canadair's Montreal plants, the CL-28 becomes a major component of the NATO defenses of the Western world.

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CECO SYSTEMS / CONTROLS

were used by the Spin Tunnel Section for spin studies:

- **A 20-ft. atmospheric free-spinning** tunnel. This has been in operation since 1941. A 15-ft. tunnel also was used from 1935 to 1946. The 20-ft. tunnel is instrumented with a motion picture camera with timer and airspeed indicator (manometer). Stop-watches and a tachometer also are used.
- **Six-component resistance strain gage** which measures normal force, longitudinal force, lateral force, and moments of roll, pitch and yaw.
- **Sling-shot arrangement** for catapulting dynamic models into still air. They are caught in a retrieving net. Synchronous motion picture cameras provide a record from which time histories can be obtained.
- **Spin-rig** fitted with rudder pedals, stick, aileron and turn indicators. The rig is most useful for studying pilot orientation in inverted spins. Research has shown that a rudder may be almost entirely ineffective in an upright spin but still have some effect in an inverted spin because it is in the free air stream, not shielded by elevators and fuselage.
- **Reeves analog and IBM 704** computers. Project priority is sometimes a limiting factor here.

New Study Method

Newest technique is to drop large, radio-controlled dynamic scale models from a helicopter and actuate their control surfaces in flight to produce incipient spin and to attempt recoveries. Models are recovered by radio-actuated parachutes.

The possibility of using large radio-controlled models powered by liquid-fuel rocket motors and flown from the ground to altitude to study stall, spin and roll divergence also is planned.

Surplus fabric-covered OQ-3 target drones equipped with landing gear are being flown to gain experience and to learn techniques needed for drone flight.

Helicopter drops are made from an old Air Force training field—West Point Airport at West Point, Va. When the helicopter reaches the desired altitude, the model—slung just below the fuselage—is lowered on a 10-ft. pole to move it as far as possible from the rotor down-wash. The model is released from a hook at the end of the pole by the pulling of a wire.

Later drops will be from as high as 3,000 ft. Weighting models to get a high specific density simulates flight at higher altitudes.

Models once were built of spruce spars, reinforced with metal and built up with balsa. Now most are made by the Dynamic Tunnels Operations shop from quarter-inch Fiberglas or other plastics.

Typical equipment for the drop

ROCKET POWER PROGRESS REPORT

Taming Rocket Powerplants

by Walter O. Borcherdt



In charge of the Engineering Development Laboratory as well as the Valves and Controls Section at RMI, Mr. Borcherdt has over a decade of rocket experience. Before coming to RMI in 1951, he was senior project engineer on controls in the rocket department of Curtiss-Wright Corporation. Mr. Borcherdt received his degree in mechanical engineering from Stevens Institute of Technology in 1938.

Reliability of a rocket powerplant is the direct result of the simultaneously correct operation of all of its elements. Generally, this is assured by overcoming each element's own peculiar development problems. Among these elements is one type which has the interesting property of being composed of specific components, yet whose operational characteristics are significant only in the performance of the entire powerplant system. This element is the control system.

Present powerplant controls requirements are based on these straightforward, simple considerations:

1. **Prepare the powerplant for firing**
2. **Sequence and control the system to rated thrust**
3. **Vary thrust rapidly and safely as required**
4. **Shut down smoothly**

Step one may require the use of gas pressure regulators and relief valves to push the propellants safely from tankage to pumps. There must be switches and relays to indicate or control the valves which admit propellants to the gas generators and combustion chambers, and time delay cutouts to insure against unsafe accumulation of propellants.

In step two, ignition and combustion may be monitored to insure correct use of the high energy release rates. Turbines may be safely brought up to speed by throttling the propellants. Safety devices may be added to limit over-speed and avoid the danger of structural failure.

In step three, a controller (it may be hydraulic, electric, pneumatic, or a combination) is used to vary thrust. Here multiple loop servo systems are sometimes used to insure that thrust change rates, turbine speeds, vehicle acceleration or terminal velocity, and other parameters vary in a coordinated manner.

Finally, in multiple stage powerplants or piloted vehicles, the rocket engine must be shut down safely and the system automatically purged of propellant accumulations.

The successful implementation of these four steps involves the application of many devices of unique characteristics whose individual selection is intimately tied to the following question:

"What is the actual control system problem to be solved?"

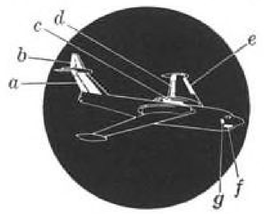
Once this question is clearly and consistently defined, a tight performance envelope results. This makes the few possible solutions fairly obvious. The final stage is to apply the knowledge of a team of control specialists and proceed through the usual component development stages. At RMI, this team of specialists in controls engineering is made up of highly qualified mechanical, electrical and chemical engineers. These professional men have wide experience in the creation of control units and systems for rocket powerplants as well as other types of propulsion systems. However, there is a continuing need for qualified graduate engineers, able to participate in working closely with other groups of specialists, integrating the control system into the overall engine performance envelope.

The systems approach is of extreme importance to successful rocket powerplant control efforts. It is a standard approach of the RMI Controls Section. Sequence system design, switching circuit analysis, human engineering, feedback control methods, statistical procedures, information theory and latest research data on fluid flow control are among the techniques used. They are applied along with practical design concepts which result in the development of simple but effective controls systems.

If you desire one or more reprints of Mr. Borcherdt's article, or would like to receive further information about employment at RMI, write to our Information Services Coordinator, Reaction Motors, Inc., 14 Ford Road, Denville, New Jersey.

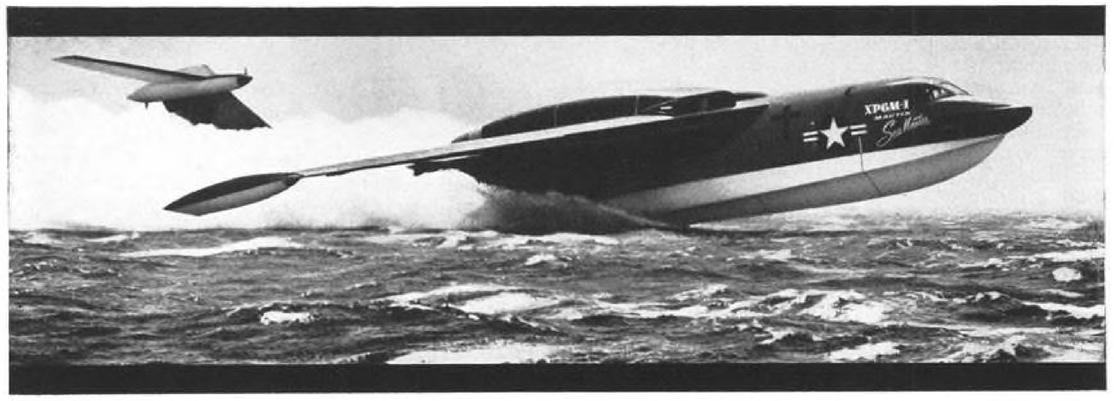
Power for Progress
RMI

CELL STRUCTURE OF A SEA MONSTER



Key to Some of the SeaMaster's HEXCEL Honeycomb Structures

(a) fin, rudder; (b) stabilizer, elevator; (c) engine work platform; (d) wing trailing edge, outboard, inboard; (e) wing leading edge, slat innerpanel, accesses; (f) interior floor; (g) interior door.



One hundred million square miles of landing field await the new Martin SeaMaster. The waters of the earth have become one global air base for the Seaplane Striking Force — the new concept of defense, in which this Martin P6M is the pioneer.

A plane in the more than 600 mile per hour class that can lift a 30,000 pound payload off six foot waves demands the utmost in structural materials. To build the greatest strength with the least weight, Martin engineers turned largely to Hexcel honeycomb. In fact, the SeaMaster employs the widest range of structural honeycomb applications ever used in one airplane. New shapes and new ideas in light and strong honeycomb construction . . . the result of engineering and research cooperation between Hexcel Products Inc. and the Martin Company . . . contributed to the success of the SeaMaster.

Hexcel's laboratories and sales-engineers are at the aircraft industry's immediate service. Write, wire or telephone Hexcel Products Inc., the Home Plant, at 951-61st Street, Oakland 8, California, the Eastern Plant, P.O. Box 177, Havre de Grace, Maryland. Branch offices: 1025 W. Arbor Vitae Street, Inglewood 1, California; 3309 Winthrop Avenue, Fort Worth, Texas.

HEXCEL PRODUCTS INC.

America's leading producers of honeycomb core materials

ALUMINUM, GLASS FABRIC—PLASTIC, COTTON, STAINLESS STEEL

models, which usually run around 1/7th to 1/9th scale, might include a four or five channel Aerolab radio receiver for aileron control, a two or three channel Babcock receiver for elevator control, two spare channels to actuate the parachute, a rate gyro developed by Langley's Instrument Research Division and an Air Force gun camera which would shoot through the engine air intake at angle of attack and angle of sideslip vanes on a nose probe.

A modified M-55 gun tracker is used by the ground controllers. One man tracks while another concentrates on controlling pitch and a third controls roll and yaw. A second tracker has been ordered.

Spin tunnel researchers have investigated various emergency recovery devices, including wingtip and tail parachutes, anti-spin roll rockets mounted at the wingtip and the possibility of using deflection plates to divert engine thrust and produce a moment that would work against gyration forces.

A three ounce, two second step rocket mounted on the wingtip of a scale model of the Lockheed F-104A has been tried in the spin tunnel, and North American Aviation, Inc., has experimented with a wingtip rocket on a full-scale aircraft.

Greatest objection to the use of tip rockets or jet tip controls is the same as the objection to most anti-spin characteristics that might be built into high performance aircraft. For almost every desirable characteristic gained, another must be sacrificed.

The standard reaction when a designer is told that his model may have undesirable spin characteristics tends to be: "O.K., fix it but don't change anything."

Manpower Limiting Factor

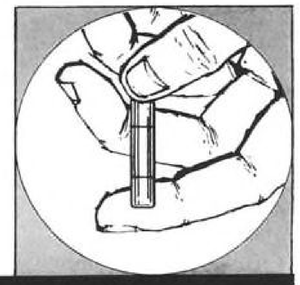
One limitation on spin research at the moment is lack of manpower. NACA has encouraged manufacturers to permit their representatives to assist in spin tunnel work to the obvious benefit of both parties.

Spin work, like most of the research done at Langley, is complemented by high-speed rocket-model flight at the Pilotless Aircraft Research Division's Pilotless Aircraft Research Station at Wallop's Island, Va. (AW Mar. 11, p. 51).

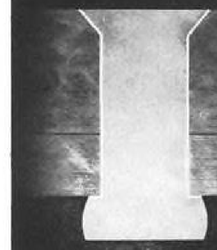
What general solutions spin research might produce for high performance aircraft is not yet clear, but automatic controls are considered a good possibility.

Charles H. Zimmerman, chief of Langley's Stability Research Division, says past spin research has brought an "inestimable saving in time, dollars, planes and lives." Almost every fighter in the Air Force and Navy inventories has been tested here. Models of the

Pastushin

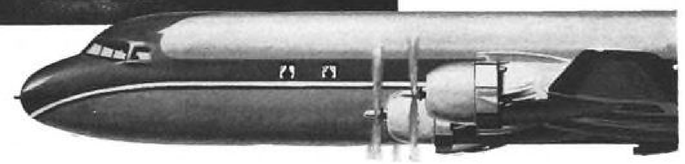


FLUID-TIGHT JACKETED RIVETS



This photomachrograph of a sectioned specimen illustrates the sealing principle of the Pastushin Slug Rivet. Standard sizes 5/32"—3/16"—1/4"... other sizes available.

...flight tested millions of miles



Flight tested by millions of rugged air miles flown by the finest commercial and military aircraft. Pastushin Fluid-Tight Rivets automatically seal themselves when they are driven, without the use of conventional sealants.

Sealing is accomplished by the use of a soft aluminum sleeve which extrudes into any wall cavity as the rivet is being driven.

Pastushin Rivets are available for immediate delivery—Here is just a partial list of users:

AMERICAN AIRLINES, INC.	NORTHEAST AIRLINES, INC.
BRANIFF AIRWAYS, INC.	PAN AM WORLD AIRWAYS, INC.
CALIFORNIA EASTERN AVIATION, INC.	SABENA BELGIAN WORLD AIRLINES
CANADIAN PACIFIC AIRLINES, LTD.	SCANDINAVIAN AIRLINES SYSTEM
CAPITAL AIRLINES, INC.	SLICK AIRWAYS, INC.
DELTA AIR LINES	TRANS-CANADA AIR LINES
EASTERN AIR LINES, INC.	TRANSOCEAN AIRLINES
PACIFIC SOUTHWEST AIRLINES	UNITED AIR LINES, INC.
JAPAN AIR LINES	WESTERN AIR LINES, INC.
KLM ROYAL DUTCH AIRLINES	USAF INSTALLATIONS
NATIONAL AIRLINES, INC.	USNAS INSTALLATIONS



Pastushin Fluid-Tight Jacketed Rivets are available for use with automatic machines and for installation where hand-driven equipment is required. Both types give absolute Fluid-Tight construction. The Pastushin Repair Kit is available for field applications. Ask for Bulletin PA-3, which gives full instructions for its use.

Write for Slug Rivet catalog PI-5 and No. PA-3 for details on the Pastushin Repair Kit.

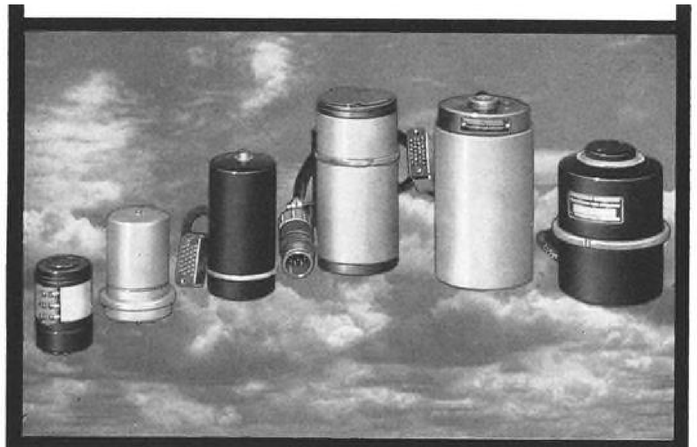
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DEVELOPERS AND MANUFACTURERS OF AIRCRAFT FASTENERS



HIGS, HEART OF INERTIAL GUIDANCE. New and advanced development of Honeywell's famous family of floated gyros—the world's most accurate—will be carried on at the new Florida plant. Honeywell now makes 6 models of hermetic integrating gyros in the main Aero plant in Minneapolis.



TESTING, THE ESSENCE OF PERFECTION. To assure absolute accuracy, all Honeywell gyros are assembled and tested in a scientific, dust-free atmosphere. Technicians must wear lint-free nylon uniforms as they put each gyro through hours of checking the balance, calibration and other crucial performance factors.

ADVANCED DESIGNS DEMAND SPECIAL FACILITIES. The latest type analog and digital computers will be standard equipment in the new Florida plant. Honeywell pioneered the use of these in developing extensive analytical techniques now employed in designing systems and components.

Announcing:

Honeywell's new Florida plant...

devoted exclusively to inertial guidance!

WITH INERTIAL GUIDANCE, aviation stands at a new threshold of development. And Honeywell Aero is up front with a new Florida plant to be opened in May.

This new multi-million dollar, 90,000 square-foot structure is one of the first constructed solely for the purpose of designing and developing inertial guidance systems.

Inertial guidance is the new system that permits an airborne vehicle to guide itself—independent of radio, radar, or stellar tracking—to a destination many miles away. It is an electronic "brain" that knows where it is, because it knows where it was and where it wants to go. Gyros, integrating accelerometers and other precise instruments enable the system to "memorize" and "think" along a course in space.

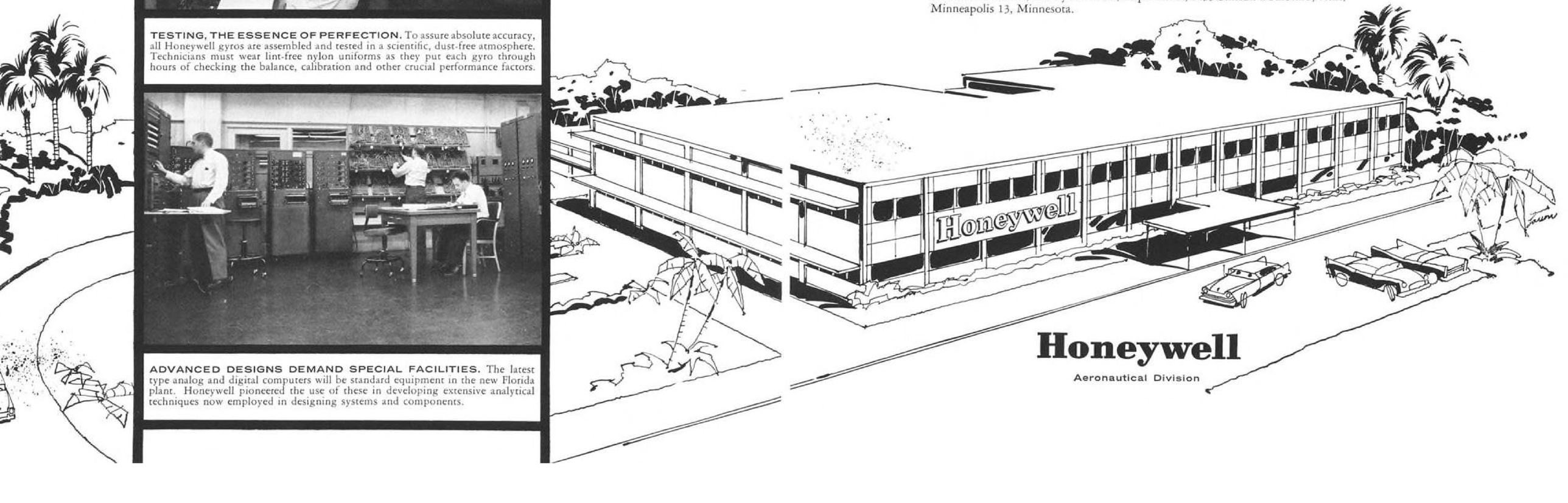
The new plant is being built in the triangle formed by St. Petersburg, Clearwater and Tampa—all within a 15-minute drive. Air conditioned and ultra-modern, the plant will house some of the world's most advanced scientific equipment—much of which is Honeywell designed and built.

Some of the country's best qualified and experienced engineers will be directing operations at the new Florida site. Total employment will be about 600 by late this year with 150 key engineering and administrative heads being transferred from Minneapolis shortly.

A few administrative and personnel officials from Minneapolis are already manning Honeywell Aero's temporary offices in the Fencon Building at Clearwater.

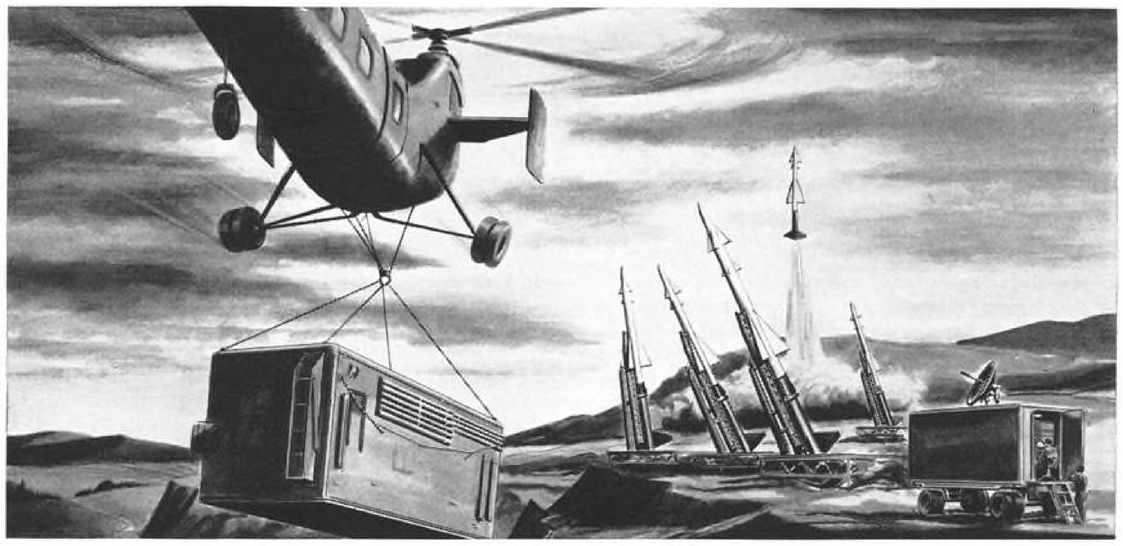
It is through engineering skill, modern plants and highly specialized facilities, that Honeywell Aero is able to maintain its leadership in the field of automatic flight control systems and components for aircraft, rockets and missiles.

Opportunity for Engineers—Honeywell's new engineering facilities offer outstanding opportunities to engineers qualified to head up design and development teams. Salaries are first-rate, benefits liberal, and early recognition assured. If you have a degree in physics, mechanical or electrical engineering and experience in inertial guidance or related equipment, write: Bruce D. Wood, Technical Director, Honeywell Aero, Dept. TF1A, 1433 Stinson Boulevard, N.E., Minneapolis 13, Minnesota.



Honeywell

Aeronautical Division



A "CLEARING HOUSE" OF KNOWLEDGE ABOUT MOBILE HOUSING STRUCTURES



AIRBORNE HOUSING SPECIALISTS . . . Structures for radar and communications equipment.



SEAGOING DEFENSE STRUCTURES . . . Design and production experience with housings of all types.



MOBILE GROUND CONTAINERS . . . Units for missile guidance, "listening," and generating equipment.

Consult Fruehauf's Experienced Research and Engineering Staff With Any Problem Concerning Mobile Housings

Since the need for airborne, seagoing, and ground-propelled radar control equipment arose when the guided missile became important as a weapon, Fruehauf has built thousands of highly specialized housings for such equipment. These Fruehauf-designed or Fruehauf-built shelters have run the structural gamut. They include insulated, air conditioned, heated, and refrigerated units to function from the Arctic to the desert. And they include compact, retractable-wall units for rapid delivery by air, land, or sea to the firing line wherever it may be.

Fruehauf's vast store of design, engineering, and production experience — with all types of metals, structures, insulations, heating and cooling systems, and transportation methods — makes this 42-year-old firm a veritable "clearing house" of knowledge for you to draw upon. As the world's largest commercial Trailer builder, Fruehauf is perfectly geared to meet problems and schedules in the mobile housing category.

Whether your contract concerns housing for missile guidance equipment, radar units, communications equipment, generating machinery, or any other mechanisms requiring both protection and mobility, consult Fruehauf freely for design or production assistance — to be sure.

FRUEHAUF TRAILER COMPANY

MISSILE PRODUCTS DIVISION

10986 Harper Avenue, Detroit 32, Michigan
5137 S. Boyle, Los Angeles 58, California

McDonnell F-101B and F4H have been tested in recent weeks.

VTOL and STOL configurations also will be investigated with free-flying, radio-controlled dynamic models. They will be powered by hydrogen peroxide decomposition motors. Jet-augmented flap, a method of shortening takeoff and landing (AW Oct. 22, p. 34), also will be explored this way.

The Free-Flight Tunnel Section, headed by John P. Campbell, has worked with the Spin Tunnel Section on development of techniques.

Three years of work has gone into development of radio control systems that meet accuracy, economy and weight requirements.

VTOL/STOL Study

Radio models will permit the use of larger-scale models and study of the entire flight range. Hovering, conversion and a form of free flight have been studied in the return tube of the full scale wind tunnel, out of doors on a revolving crane facility (AW Oct. 15, p. 29) and in the full scale tunnel.

Equipment now being installed on a truck will allow study of lateral and longitudinal characteristics of powered VTOL/STOL models during rapid transitions to forward flight and in approaches and landings.

Models hung from a boom by a safety cable will take off vertically with the truck stationary. As they go through the transition into forward flight, the truck will follow so that the cable remains slack. Roll, pitch and yaw pilots will be housed in a cab at the rear of the truck, with a full view of the models at all times.

The general feeling at this point is that the deflected slip-stream technique is better suited to STOL aircraft and tilt wings better suited to VTOL types.

NACA is now testing a tilt-wing model on which the wing is mounted high and hinged near the back, and employs a sliding flap for low speed forward flight. This model also has jets at the tail to aid control.

Grand Central Rocket Builds New Test Site

Los Angeles—New static test center is being developed by Grand Central Rocket Co. in Riverside County, Calif.

The new test site is centered in more than 8,000 acres, surrounded by mountains. Development to date includes roads, firebreaks and construction of the first test cell.

The facility will accommodate the largest solid propellant rockets now on the drawing boards.

Grand Central is developing the third stage, 18,000-mph. solid propellant motor for the Vanguard project.

In air-foil sections, strength, accuracy and smoothness are of primary importance. These characteristics, plus a minimum of machining, are offered by this Antioch Process missile fin casting. The alloy: A-356. Tolerances of ±.010" in thickness and .020" T.I.R. on flatness are held in production. Surface finish, as cast, is better than 125RMS. Test bars machined from heavy hub section have minimum ultimate strength of 36,000 psi and elongation of 11%.

Morris Bean & Company specializes in casting parts for wave guide, fluid flow, and aircraft application to demanding standards and in volume production.

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a cast rocket fin?



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KLIXON
KX4
Sine Switch

Gives You
Precision Switching Unaffected by Environmental Conditions

Here's a precision switch especially designed for use in:

AIRCRAFT
GUIDED MISSILES
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INSTRUMENTS

Protected by a strong steel case, the KX4 has a class "A" hermetic seal. Operation is accomplished through the use of a metal "wave-type" diaphragm at the actuating lever.

The KX4 is designed with maximum electrical insulation and clearances, and has unusually high current capacity for its small size. It can be ganged for multiple pole operation, and it is available with a variety of auxiliary actuators.

Get full details on the new KLIXON Precision Sine Switch line — write now for Bulletins PRSW-1, 2, 3, 4 and 5.

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Cost Rise for Swifts Criticized in Britain

London—Purchase of Supermarine Swift fighters, already criticized as a failure by a parliamentary committee, has drawn further fire from Britain's comptroller and auditor general.

He charged that there was a large disparity between initial estimates and final costs of the Swifts. The report says that Britain got only 129 operational aircraft for an outlay of $112 million. Of these, says the report, 28 were subject to operational limitations.

The report says the original production contract for 100 Swift airframes was placed in November, 1950, at an estimated cost of $80,000 each. When the first Swift flew in August, 1952, the cost of those on order had gone up to $120,000 each. Orders for a total of 492 aircraft had been placed up to August, 1953.

By February, 1955, 39 aircraft had been delivered. Estimated cost per airframe then had climbed to $182,000. It was decided at that time that the first three marks of Swift were not up to required standards for squadron service and that the Mk. 4 could not be relied on for high altitude operation.

Orders then were reduced to 170 aircraft, excluding prototypes.

The comptroller general charged that by initially accepting unsatisfactory aircraft, the Ministry of Supply made it impossible to collect any breach of contract damages.

German Group Founded For Rocket Industry

Bonn—German technical committee for the rocket industry will be founded by the German Study Group for Rocket Technique, Bremen, and the Association of Aircraft-Standard Parts Producers, Frankfurt.

The new technical committee plans to secure prominent experts as cooperators. It will coordinate the work of the two industrial groups and give advice to German officials.

Army Awards Research Contract to Caltech

Pasadena, Calif.—Army has awarded a $21 million contract for engineering research and development in the fields of guided missiles, free rockets, wind tunnel operations, and materials research in support of ordnance projects to Caltech Jet Propulsion Laboratory, Pasadena, Calif.

Laboratory has received nearly $115 million in Ordnance contracts for its research. An additional $6 million will be awarded to supplement the present contract.

THIS IS FOR YOU ... IF YOU HAVE AN AC GENERATOR COOLING PROBLEM!



SPECIFICATIONS
208/120 Volts, 0.75 Power Factor, 3 Phase, 400 CPS

Type No.	Rating KVA	Rated Cooling Air Pressure in "H_2O"	Rated Cooling Air lb./min.	Diam. in.	Speed RPM	Approx. Weight lbs.	Flange and Drive Spline
*28E16-1	20	4	11	8.25	5700-6300	60	AND 10266 XVI-A
*28B23-1	20	4	11	8.25	4800-7200	65	AND 10262 XII-A
*28E17-1	30	8	14	8.25	5700-6300	69	AND 10266 XVI-A
*28E14-1	40	5	14.5	9.25	5700-6300	83	AND 10266 XVI-A
*28E15-1	60	6	16	9.25	5700-6300	103	AND 10266 XVI-A
28E19-1	10	4	7	6.5	7600-8400	30	AND 10262 XII-A
28E19-3	10	4	7	6.5	7600-8400	31	New 9" Flange
28E20-1	20	6	8.5	6.5	7600-8400	45	AND 10262 XII-A
28E20-3	20	6	8.5	6.5	7600-8400	46	New 9" Flange
28E21-1	30	10	12.4	6.5	7600-8400	60	AND 10262 XII-A
28E21-3	30	10	12.4	6.5	7600-8400	61	New 9" Flange
**28E10-1	9	6	8.6	6.5	7600-8400	39	AND 10262 XII-A

*These generators include integral fan permitting full load continuously up to 80°C at sea level with no additional cooling.
**This generator incorporates a DC output of 30 volts, 50 amps capacity in addition to the AC output.
All generators have been designed to MIL-G-6099 and MS-33542, which specifies cooling air of 120°C at sea level, 40°C at 50,000 ft., and −12°C at 65,000 ft., and will deliver full-rated load under these conditions.

Bendix Red Bank

HIGH-TEMPERATURE AC GENERATORS

meet military class C air-cooled specifications ... offer maximum performance at minimum size and weight ... range from 9 KVA to 60 KVA

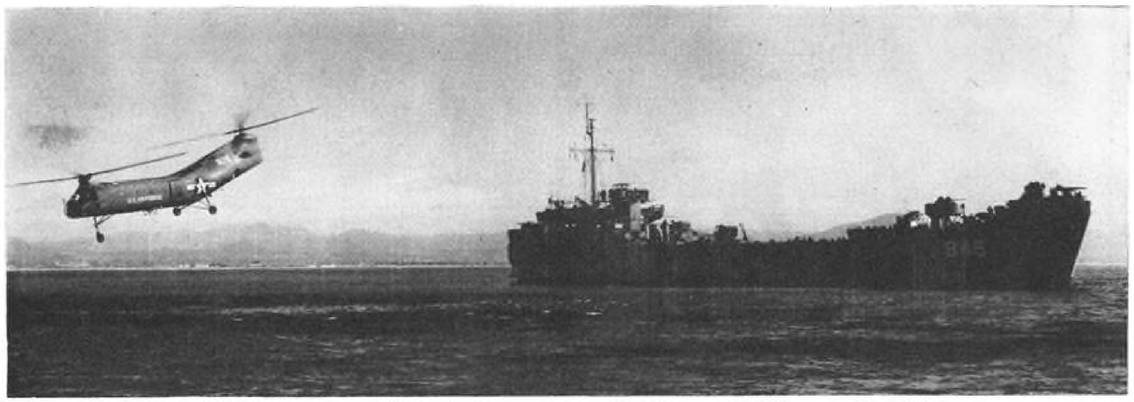
These generators are designed as part of complete Red Bank high-temperature AC generating systems that also include magnetic amplifier voltage regulators and system protection components. For full details, write Red Bank Division, Bendix Aviation Corporation, Eatontown, New Jersey.

West Coast Sales and Service: 117 E. Providencia Ave., Burbank, Calif.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P.Q.
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Red Bank DIVISION | Bendix AVIATION CORPORATION

ENGINEERS WANTED: Opportunities now available for experienced design engineers to work on aircraft type AC and DC rotary power supplies and associated control equipment and distribution systems. Write today: Attention of Personnel Department K.

Navy Tries Vertol H-21B as Vehicle for Towing Ships



LST which has 3,000 ton displacement, is turned 180 deg. in six minutes. H-21B can pull LST at speeds of 4.5 kt.



LCU (Landing Craft Utility) of 330 tons displacement is pulled toward beach. H-21B can move it at 8-9 kt.



"DUCK" or DUKW, a 2½ ton amphibious truck, is pulled off shore by H-21B in test at Coronado, Calif.

Morton, Pa.—Use of the tandem helicopter as a towing vehicle in land and sea salvage operations is being proposed to the U. S. Navy by Vertol Aircraft Corp.

In a series of tests at the Naval Amphibious Base, Coronado, Calif., the Vertol H-21B Work Horse was used to move surface vessels and land vehicles.

Several types of landing craft and an amphibious truck (DUKW) were towed successfully with the H-21B as a tug.

The demonstration was an outgrowth of earlier Vertol work in the field of minesweeping.

The company at one time had a Navy contract for the development of equipment and techniques for towing and experimental work was begun in 1952 at Panama City, Fla. (AW March 21, 1955, p. 19).

In the more recent West Coast tests, held last December, loads as large as an LST (Landing Ship Tank), which has 3,000 tons displacement and is 382 ft. long, were moved and maneuvered. The LST, with rudder amidships, was turned in a radius of 550 yd. and towed at speeds of 4.5 kt. Its normal cruising speed is about 9 kt.

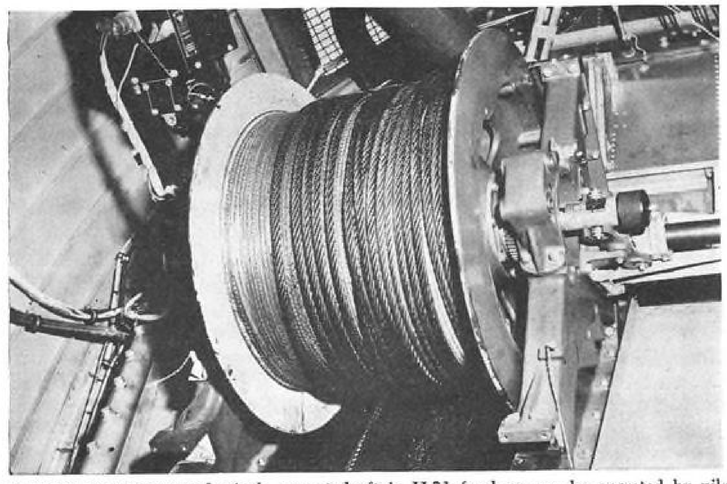
Other landing craft, lighter in weight, were towed at faster speeds—up to 25 kt. for one displacing five tons.

According to Vertol, the tests showed these various advantages for helicopter towing:

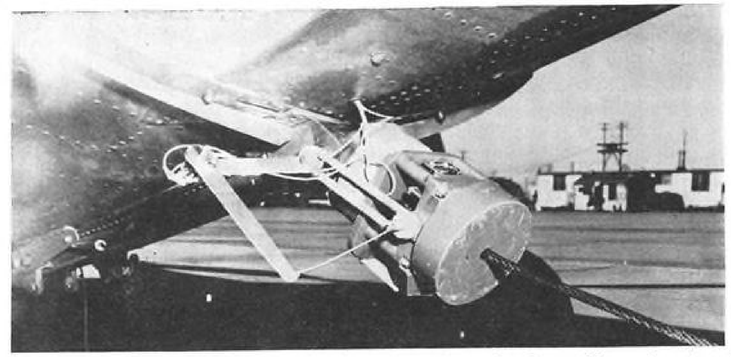
- **Salvage operations can be initiated** quickly because the helicopter is highly mobile and maneuverable, independent of terrain difficulties.
- **Salvage operations can be carried out** in spite of rough surf or sea conditions that would preclude use of surface tugs.
- **Beachheads can be kept clear** during amphibious landing operations and surface craft pulled out of traffic channels in case of mine damage.
- **Helicopter salvage can reduce** the number of craft and vehicles normally abandoned during amphibious landings.

The experiments, carried out with an Army H-21B flown by USAF and Navy pilots, utilized a Vertol-designed electric winch installed in the aft section of the helicopter. The cable is controlled by the pilot from a button on the stick. In addition, he can release the load instantly or operate an emergency cable cutter that will snap the load loose by chopping the line about at the point where it leaves the helicopter.

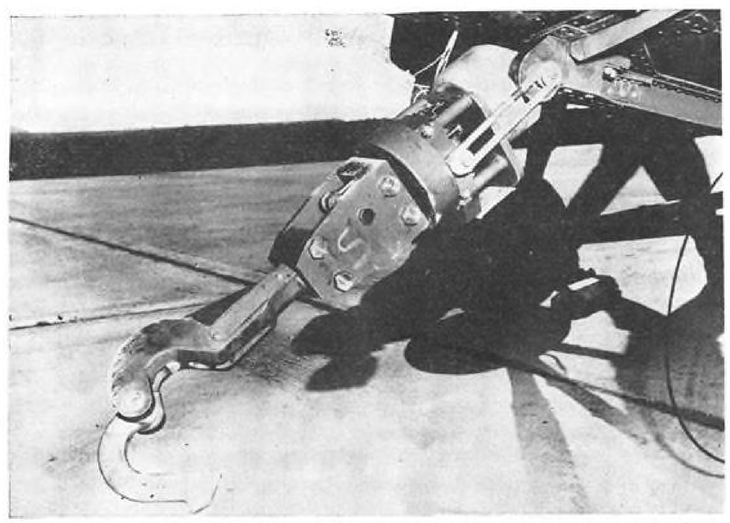
Additional tests showed that the H-21B can tow causeway sections into position on a beach to set up a pier for supply and personnel ships to unload.



ELECTRICALLY powered winch, mounted aft in H-21 fuselage, can be operated by pilot from cabin. A button on the control stick actuates the cable mechanism.



TOW attachment on H-21 shows traveler for remote release. Load on cable can be released instantly by pilot, or he can operate a cable cutter to snap load loose.



TOW attachment with cable and hook in retracted position. Besides ships and vehicles, H-21B can tow causeway sections into position to set up beach unloading pier.

PROVEN PERFORMANCE

in a hermetically sealed

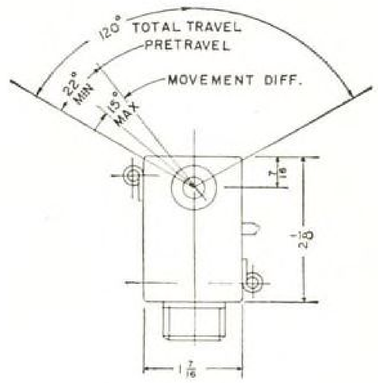
ROTARY MOTION SWITCH

10 AMPS @ 125/250 V a-c
10 AMPS @ 28 V d-c IND.
15 AMPS @ 28 V d-c RES.
Simultaneous DPDT without adjustment.

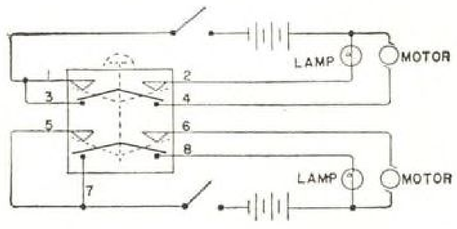


H10-7 SWITCH (ACTUAL SIZE)

- A seal — not a packing — bonds shaft to case.
- Leakage rate LESS than 1 micron per cu. ft. per hour! Full rating up to 75,000 ft. altitude.
- No-slip splined shaft — adjustable or fixed actuating arm.
- Permits 120° rotary travel — a minimum of 50,000 cycles!
- Long overtravel eliminates need for fine adjustment; permits greater flexibility in linkage action.
- Tough, drawn-steel case. Rigid two-bolt mounting.



TYPICAL CIRCUIT



1-2—Remote Lamp indicates when arm is fully returned.
3-4—Motor driving linkage counter clockwise 120°.
5-6—Switch stopped motor at predetermined position.
7-8—Remote lamp indicates arm at full travel position.

The many switching jobs done *best* by rotary-motion limit switches can now be done even better! Electro-Snap's new shaft seal gives you *positive* hermetic sealing, simplifies mounting, saves weight and space, and provides a full 50,000 cycle minimum life.

Elimination of external cranks, cams, links, and other gear to translate rotary to linear motion (as is often done to permit use of hermetically-sealed, lever type switches) reduces weight, space congestion, and the need for tedious adjustment. This simplicity gives you greater freedom in locating interlock and indicating switches on rotary mechanisms; allows positive linkage attachment.

Ice, altitude, rain, or corrosive atmospheres cannot effect this Electro-Snap switch sealed in a dry, inert gas. The steel case protects against shocks; prevents loss of the hermetic seal—also permits tight draw-up on mounting bolts without "springing" the case.

GET FULL ELECTRICAL AND MECHANICAL DATA IMMEDIATELY — WRITE FOR DATA SHEET H10 M-3

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Low Ton-Mile Costs Forecast for AW 650

London—Ton-mile operating cost of 8.75 cents on optimum length stages for Armstrong-Whitworth 650 turboprop transport (AW Jan. 21, p. 41) will be half that of DC-3 according to the manufacturer. The twin boom cargo carrier is the first British design using fail-safe fuselage structure.

Development history revealed recently to AVIATION WEEK indicated that the project was first proposed by the British government as a military freighter. The company was expected to pay a large part of the development cost because of the design's civil applications.

Armstrong-Whitworth later decided to accept full financial responsibility because market research indicated that the airplane's commercial future depended on giving primary emphasis to civil requirements. The government continued support for a military version.

Market research also led to the abandonment of the standard fuselage mounted tail. Operator preference for specialized versions of freight aircraft made it desirable to offer a design able to incorporate fuselages of different diameters and lengths with minimum structural modifications.

The two boom layout also enables the builder to offer the airplane in two and four engined versions with the best structural economy. The twin-engined version will use the Rolls-Royce Tyne. The four-engined one will be powered by the Rolls-Royce Dart.

Fail-safe fuselage structure has its frames spaced at 22 in. and taken out flush to the skin. The stringers are six inches apart and pass through cutouts in the frame webs with litle joggling. Each joint is double strapped. The 22 in. x 6 in. matrix is expected to confine skin cracks to a single panel preventing catastrophic failures and explosive decompression of pressurized versions.

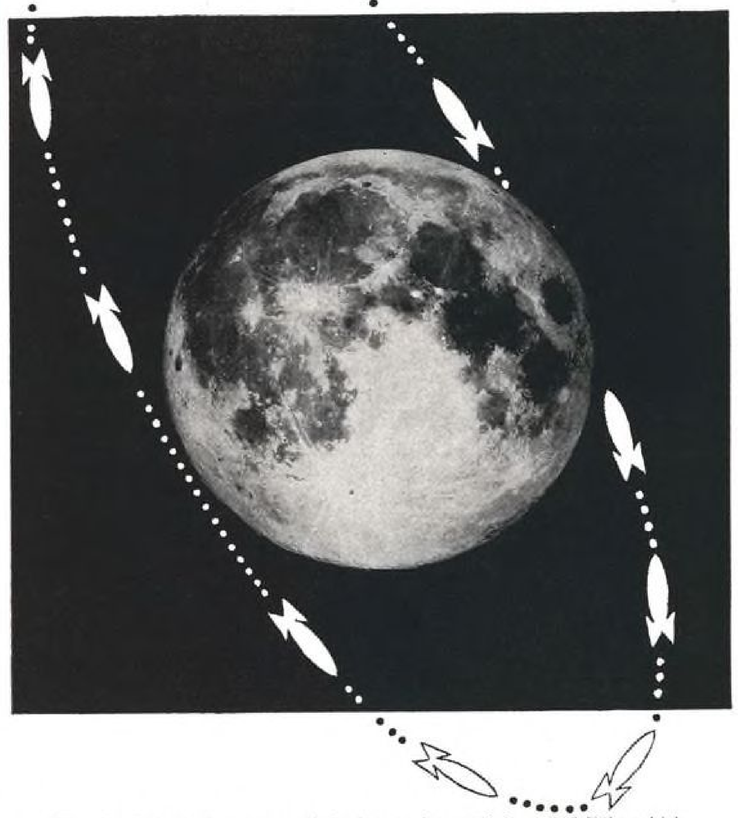
Important testing and production advantages follow from the use of a slightly modified Avro Shackleton Mk. 3 wing of conventional two spar construction. Use of accumulated wing fatigue and flight data and employment of existing jigs, tools and techniques will cut development time by 30% and enable the company to meet the tight production schedule announced.

Use of redux bonding is confined to the regions of the window frames. More extensive use would prolong development and exceed plant bonding facilities.

The aircraft is extensively subcontracted both within and outside the Hawker Siddeley Group. All the out-

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Scientists a generation ago saw little chance of an earth-launched flight vehicle ever traversing outer space. Today . . . as a future accomplishment . . . the aim seems "feasible".

A just announced, gratifying step in this direction is the development of D.R. Critical Temperature Cable . . . already helping to fulfill the task of high atmospheric rockets. D.R. Critical Temperature Cable, reliably functioning between -85° F and + 410° F, lifts the ceiling on cabling limitations and helps the engineer or scientist move into "outer space" in his cable specifications.

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The Automax 35 mm Ciné-Interval data recording camera is standard equipment in 9 out of 10 airborne research and flight test installations... Seven years of intensive use have proved the reliability of the Automax design... Orders and re-orders from a single customer have totaled as many as 250 units.

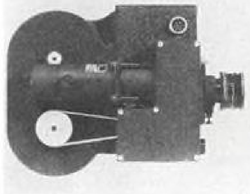
In its ten years, TRAID has designed many specialized cameras, and has had the opportunity to represent many others, such as the Automax. Only the best of these—the Staple Items—have been added to the TRAID line.

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side companes have agreed to offer extended credit facilities until the first sales.

Following discussions with Fairchild and French companies on the rumored proneness of boom construction to fatigue failure, the company channeled an intensive research program through its digital and analog computers before committing itself to the design.

Switch to double bubble construction was favored in spite of a 5% drag penalty because of greatly increased loading and unloading accessibility. For the same reason, toilets swing out with the single hinged front and rear loading doors.

Chance Vought Report Confirms New Plane

Dallas—Confirmation that Chance Vought Aircraft, Inc., is developing a new carrier-based fighter for the Navy (AW Feb. 25 p. 84) was made last week in the company's annual report.

AVIATION WEEK first disclosed that this airplane, designated the F8U-3, is an improved version of the F8U-1 Crusader aimed at speed of about Mach 2. It is about three years away.

The company also said the F8U-1P, photo-reconnaissance version of the F8U-1, made its first flight late in 1956.

Chance Vought's total business last year was $118,186,055, a sharp drop from the 1955 level of $147,095,440. The report attributes the drop in sales to the fact that 1956 was a year of transition from production of the F7U Cutlass to production of the Crusader.

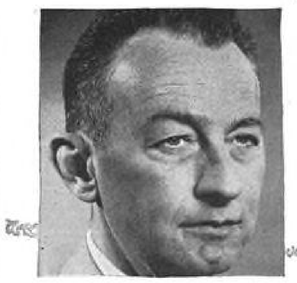
During 1956, Chance Vought concentrated primarily on development of the Crusader and the new Regulus II surface-to-surface missile. The report said "preparations for increased production of these products were well along at year end."

Net income after taxes for 1956 was $4,135,181, compared with a $4,759,544 profit in the previous year. The company shifted to a new system of accounting in 1956 designed to spread general and administrative expenses more evenly over all deliveries under contracts. This move increased net income in 1956 by $1.2 million.

At the end of last year, Chance Vought had $508 million backlog, compared with $214 million at the end of 1955. The company paid dividends of $1.60 a share in 1956, the same rate that has prevailed since Chance Vought became an independent company in 1954.

Reporting on the Regulus I program, the company said that the recoverable version of the missile has averaged six flights per missile, and that one Regulus I flew 16 times. According to the report, the successful recoveries of the

(Advertisement)



Valve Talk

FOR WM. R. WHITTAKER CO., LTD.

BY MARVIN MILES

Back before 1938, Lockheed's engineering flight test organization consisted of one man, Clarence (Kelly) Johnson, who supervised flight testing in addition to his duties as chief aerodynamicist and design engineer.

Today Kelly is vice-president, engineering and research, and flight test numbers more than 1000 people, headed by R. L. (Rudy) Thoren.

Rudy was the first specialist hired by Kelly (in 1938) as a flight test engineer, and during nearly two decades he has built the organization into a vital and integral phase of Lockheed production, working closely with design groups from the early phases of development on every new aircraft.

It's the responsibility of Rudy and his crews, flight test-wise, not only to ensure that Lockheed planes meet all the requirements of flight engineering-wise, but also to see that the various designs benefit from the operational experience of veteran flight test personnel.

Take the case of the F-104 Starfighter, for example. Flight test entered the development program as soon as the airplane left preliminary design and entered the active project design phase—a year before the Starfighter's first flight in 1954.

Seven top men were assigned as a flight test team to work directly with Bill Ralston, XF-104 project engineer, and his two assistants, Don Palmer and Dick Boehme.

They included Thoren, A. W. (Tony) LeVier, then chief engineering test pilot and now director of Lockheed's flying operations; Herman (Fish) Salmon, then LeVier's assistant and now chief engineering test pilot; W. L. Howland, flight test division engineer; J. E. (Elly) Hawkes, manager of the F-104 flight test department; Firman C. Gray, superintendent of the flight test shop, and Dorsey Kammerer, Gray's No. One man on jets.

LeVier, Salmon and Thoren worked closely with the project office in coordinating the entire cockpit layout—to provide a pit designed specifically for fighter pilots—and Hawkes and A. C. Murphy, another flight test engineer, planned and arranged the prototype's instrument design and fabrication while construction of the XF-104 was underway in the engineering department's experimental shop under direction of A. M. Viereck.

During later stages of the prototype construction, the flight test organization worked with the experimental shop on the installation of all test equipment and checked the plane's systems. Simultaneously, detailed plans were being prepared for the actual flight test program to be conducted at Edwards Air Force Base.

As a result of this close cooperation between project design, experimental shop and flight test, the prototype Starfighter reached complete assembly with all flight test instrumentation checked out and installed and all its various systems—hydraulic, electrical, electronic, controls, etc.—completed and signed off by inspection.

The airplane was trucked to Edwards on Feb. 22 and initial engine runs were made the next day. LeVier made the first flight, a lift off, on Feb. 28 and logged the first official flight just four days later on March 4, 1954.

Thereafter, Thoren and Howland became virtually daily commuters between their headquarters in Burbank and the desert base in supervising the flight test program, with LeVier and Salmon sharing all the prototype flying on the stub-winged, missile-like fighter. On-base direction of the XF-104 flight test program was Hawkes' responsibility.

By last fall the prototype had made 375 flights and production model Starfighters—F-104As—were flying, but extensive test work with the prototype has continued, nevertheless, on "debugging" missions that are necessary in the perfection of any new and advanced type.

Difficulties were corrected as fast as they were found and the changes incorporated into both the F-104A and the F-104B tandem trainer. The program also was speeded up by the assignment of seven initial production airplanes to specific test phase operations such as armament tests, stability and control, radio and electronics performance, air conditioning, etc.

Lockheed has a lot of airplane in the Starfighter—the only ship I've heard a B-52 pilot praise somberly as "real rough opposition." And the company has a wealth of talent in the combination of such men as Johnson, Thoren, LeVier, Salmon, et al.

missiles saved the Navy about $70 million in test flight and training programs.

In other financial reports, Robert E. Gross, Lockheed Aircraft board chairman, has disclosed that the company's missile division was recently named system manager of another major program, details of which have not been revealed.

Lockheed already has been designated system manager for the Navy's intermediate range ballistic missile Polaris. In all, Gross said, the division is handling about a dozen major missile projects of which only a few have been revealed—among them USAF's X-7 and X-17.

The division now is carrying on missile business at an annual sales rate of $70 million.

Bell Aircraft reported sales of $216,033,290 for 1956 compared with $205,033,871 for 1955. Net income was $5,761,104, compared with $5,914,482 in the previous year.

Bell's slight decline in earnings was attributed to increased costs of labor, materials, the unusually high starting load costs of new products under fixed price contracts, and growing engineering and development expenses. Commercial helicopter sales of $8 million were 49% above 1955.

Hiller Helicopters showed a net income of $98,299 for 1956 against a loss of $36,698 in 1955. Sales for the year hit $9,857,743, an increase of 26% over the previous year. Hiller's backlog was $13,065,926 at year's end.

Other reports from aircraft and related companies included:

• **American Bosch Arma Corp.** defense backlog was $300 million. Increase is



Models Show Nuclear Aircraft Test Reactors

Two General Electric nuclear test reactors used in the Air Force development program were exhibited in model form at the recent International Atomic Exposition in Philadelphia. One model (right) is of a shielding development reactor which will be suspended 200 ft. above the ground on cables (AW Dec. 24, p. 57). The other is a radiation effects reactor which tests effects on materials that will be used in the program (left).

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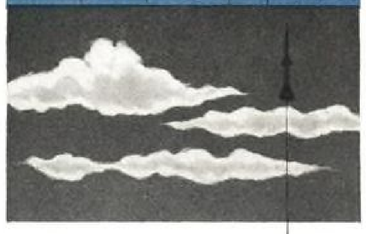
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MR-1	AM/FM	2	8	0-250
MR-2	AM/FM	2	7	0-250
MR-3	AM/FM	1	7	0-500
MR-11	AM/FM	2	16	0-250
MR-50	FM	4	7	0-1500
MR-51	FM	4	7	0-1500
MR-52	FM	4	7	0-1000



NOTE:
All recorders contain micro-miniature carrier oscillators for timing. Weight MR-1, 2, 3 is 4.5 lbs. MR-11 (illustrated) is 5.5 lbs. MR-50, 51, 52 —11, 10, 10 lbs. respectively.

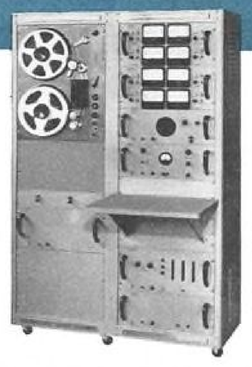
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Proved by use in hypersonic test vehicles and other missiles, NORTHAM'S amazing 7-16 track miniature tape recorders have been found virtually indestructible in test after test and have been re-used as often as ten times. No larger than a man's hand, their small size and weight help solve space problems yet don't detract from reliability and durability. Advanced recording technique, employing the erasure of pre-recorded carrier, requires only 20 microwatt input and eliminates effects of wow and flutter.

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due partly to company's participation in production of defense systems for B-52 guidance systems for ICBM. Sales were $122,237,735 compared with $73,805,023 in 1955; earnings $4,626,357 against $3,383,568 in 1955.

• **Aluminum Co. of America** net income in 1956 was $89,621,033 compared with $87,600,808 in the previous year. Gross revenues were $869,785,315 in 1956 compared with $848,745,207 in 1955.

• **Kawneer Aluminum Co.** reported net earnings of $1,215,722 against $2,083,057 in 1955. The company said losses in the Aircraft Division were the major cause of lower earnings.

• **Fairchild Camera and Instrument Corp.** net profit was $910,324 in 1956 compared with $791,743 in 1955. Net sales were $42,969,000 against $33,070,000 in the year previous.

Avro Presents Toronto University With $50,000

Avro Aircraft Ltd. and Orenda Engines Ltd., Toronto, have presented $50,000 to help finance part of an expansion program of University of Toronto's Institute of Aerophysics. Program is to meet the increasing demand for aeronautical engineers by the Canadian aviation industry. Other firms in the industry are expected to contribute.

The University has allotted 24 acres near its Connaught Laboratories for new quarters for the Institute of Aerophysics. In 1955 the institute began its first courses in training graduate engineers as aeronautical engineers, and had so many applications it had to turn away students because of lack of accommodation.

The institute played an important part in the development of the modern hypersonic wind tunnel capable of temperatures of hundreds of thousands of degrees and speeds corresponding to satellite Mach numbers.

De Havilland DHC-4 Will Gross 24,000 lb.

Further performance details of the de Havilland DHC-4 Caribou call for a cruising speed of 185 mph.

It will have a gross weight of 24,000 lb. empty weight of 14,500 lb. Payload will vary from 7,320 lb. for 200 mi. to 6,000 lb. for 600 mi. The aircraft will be able to carry 28 combat troops, be loaded with cargo or jeeps from the rear, and carry 22 standard Army litters as an ambulance plane.

The Caribou will have a touchdown landing speed of 60 mph., a rate of climb at sea level with two engines of 1,580 fpm. and fly at a service ceiling of 26,000 ft. Its wing span is 95 ft. and length is 63 ft. 8 in.



"An infinite capacity for taking pains"

The above familiar phrase is usually given as a definition of genius. We borrow it as a job description.

The lengths to which our Quality Control people go, to insure the reliability of our complex products, are truly painstaking, and are applied equally to components we make ourselves and those we purchase from outside suppliers.

For example, consider vacuum tubes, the heart of hundreds of projects in our Electronics Division. No spot check satisfies here (even if that's all our customer specifies)—but a whole series of critical tests, including such precise evaluations as these:

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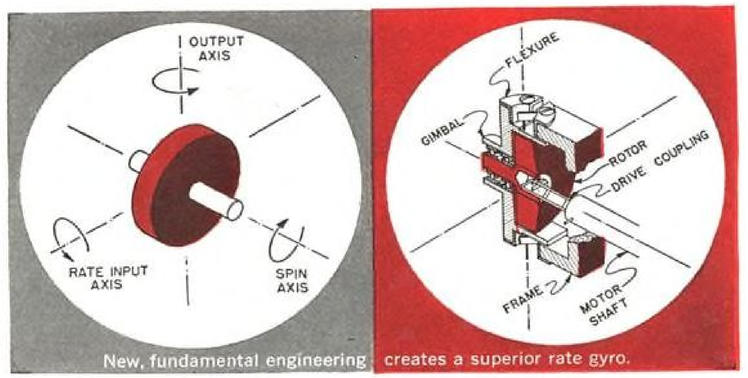
Inspection by X-ray, looking for deeply hidden potential faults which could cause malfunction at any time after first use.

Inspection by microscope, seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. *All* components must pass similarly rigid tests, to assure operating performance, ruggedness and reliability in the completed equipment.

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Fundamental engineering and precision manufacturing team up to enable new Humphrey *SW* Rate Gyros to deliver superior performance. More rugged ... more dependable ... greater precision for the most demanding applications in advanced missile and aircraft systems.

Simplicity of design eliminates unnecessary parts. Heart of the *SW* Rate Gyro is the solid rotor inertial element mounted on precision radial thrust bearings in the exclusive bridge-like gimbal. Two unitized steel flexures give pivot and spring-restraint functions attaching gimbal to frame.

Using compatible materials and high-G centrifuge balancing adds to superior performance qualities. No deterioration of the *SW's* performance even under the most severe environmental conditions. Operates in temperatures from −65° F to ±185° F; vibration at 10G from 20 to 2,000 cps; and shock to 100G.

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Minimum number precision parts: solid rotor; exclusive coupling, flexures.



Simple sub-assembly: one compact unit; motor separate from sensing element.



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General Electric's T58 engine, featuring free power turbine controlled through new constant-speed control, undergoes system tests.

Tests Show How T58 Simplifies Control, Promotes Operating Efficiency of Helicopters

Designed to take full advantage of the General Electric T58 turboshaft engine's free power turbine, the new G-E constant-speed control permits operation of a helicopter rotor at maximum levels of efficiency and eliminates the need for speed adjustment by the pilot during normal operation. A new concept, this hydro-mechanical control is designed to maintain essentially constant rotor speed by automatically regulating engine power. The new control will permit helicopters to more effectively use the turboshaft engine's 3:1 power-to-weight ratio and 0.69 normal SFC to more than double their present ton mile capacity, fly at much faster speed, and reach a new level of operating economy.

Specific advantages of the new control are being demonstrated at General Electric's Flight Test Center, Schenectady, N. Y. In these tests a complete T58 power system including reduction gear, constant-speed control, and transmission and rotor for the Sikorsky S-58 helicopter are being operated over a wide range of rotor speeds and power settings. These five distinct advances in helicopter operation are provided by T58's advanced design constant-speed control:

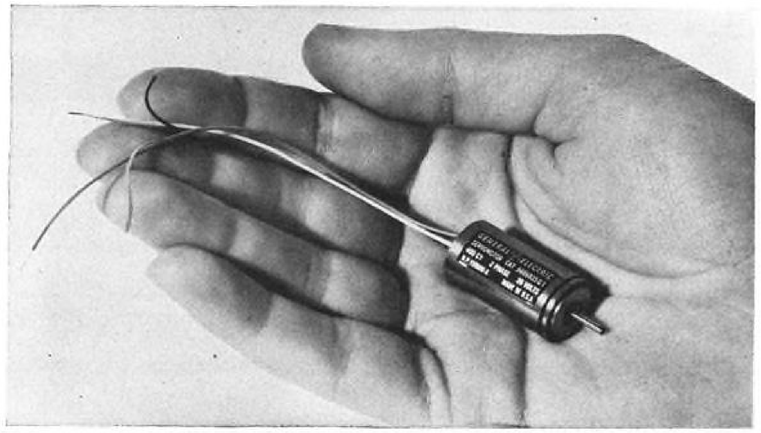
1. AUTOMATIC CONTROL to replace the standard manual rotor speed control.
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4. ROTOR SPEED RESETTING as required for major changes in flight attitude can be easily made.
5. FULL POWER UTILIZATION of both engines without danger of engine or rotor overspeeding.

For more information on the constant-speed control and the many other advanced features of the General Electric T58 engine, contact your G-E Apparatus Sales Office. Check block A on the coupon at right for your free copy of the T58 descriptive brochure.

New, Thumb-size 400-Cycle Servo Motor to Help Increase Accuracy of Measurement and Control

The new General Electric, 400-cycle servo motor weighs only 1.2 ounces yet provides the high accuracy needed in null-method measurements and power to initiate control. This exceptionally small motor (5/8 inches in diameter by 1.2 inches in length) has the high torque-to-inertia ratio to qualify for many applications. The two-phase principle fits it for use in a wide variety of circuits used to convert error signals from a synchro-control transformer into control action. Other uses include power-failure indicating and power-brake applications.

To achieve accurate operation the motor is designed around a two-phase stator. The first phase is excited by a fixed potential, the other, the variable phase, is excited only when torque or rotation is desired. Motor torque or speed is controlled by varying the input to the variable phase and the direction of rotation is controlled by the relative phase angle (lead or lag 90 degrees) between the inputs to the fixed and variable phases. In this way the motor can be controlled so as to operate under continuously stalled conditions through to a no-load speed minimum of 19,250 RPM.



New General Electric servo motor has high torque-to-inertia ratio and can operate under continuously stalled conditions through to a no-load speed minimum of 19,250 RPM.

Watts per phase at stall is 3.4, at no load 2.00.

Sturdy construction gives the new servo motor capabilities to withstand extremes of environment. It will operate satisfactorily at altitudes up to 60,000 feet and at temperatures from −55 to +90 C. The motor is rated at 26 volts and has exceptionally high acceleration, stall torque, and efficiency for a motor of its size and type.

For more information on this new 400-cycle servo motor check block B on the coupon below or contact your nearest G-E Apparatus Sales Office.

New Molded PVZ* Tubular Capacitors Meet 125 C Requirements at Half the Cost of Metal-Clads

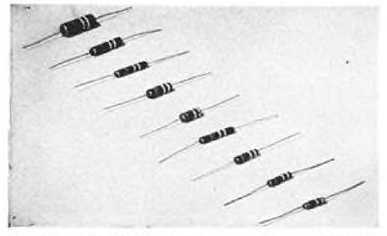
Priced at less than one-half the cost of a comparable metal-clad tubular, the new G-E Molded PVZ Tubular Capacitor meets requirements for a quality capacitor at a moderate price. Designed for advanced electronic equipment, the new capacitor line has characteristics similar to "K" of MIL-C-25A and will operate at temperatures from −55 C to +125 C. Life is a minimum of one year at rated voltage and 125 C.

Excellent humidity characteristics are assured through the use of high-grade case material and carefully controlled molding techniques. Though small, to aid equipment miniaturization, the insulated bodies are easy to locate in the chassis and provide protection from other parts or ground. Lead pull and bend resistance is high.

Microfarad ratings range from .00047 uf (100 to 400 volts) through .15 uf (100 volts), .1 uf (200 volts), .068 uf (300 volts) and .022 uf (400 volts). Capacitance ratings are available with ±20%, ±10%, and ±5% tolerances. Smaller than equivalent metal-clad tubulars, the PVZ capacitors range in size from .175″ diameter by 5/8″ long to .375″ diameter x 1 1/16″ long. Nine different sizes are offered to accommodate the various ratings.

For complete details on the new molded PVZ tubular capacitors, contact your local G-E Apparatus Sales Office or check block C and mail the coupon below.

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Small to aid miniaturization, new General Electric, Molded PVZ Tubular Capacitors have excellent humidity characteristics.

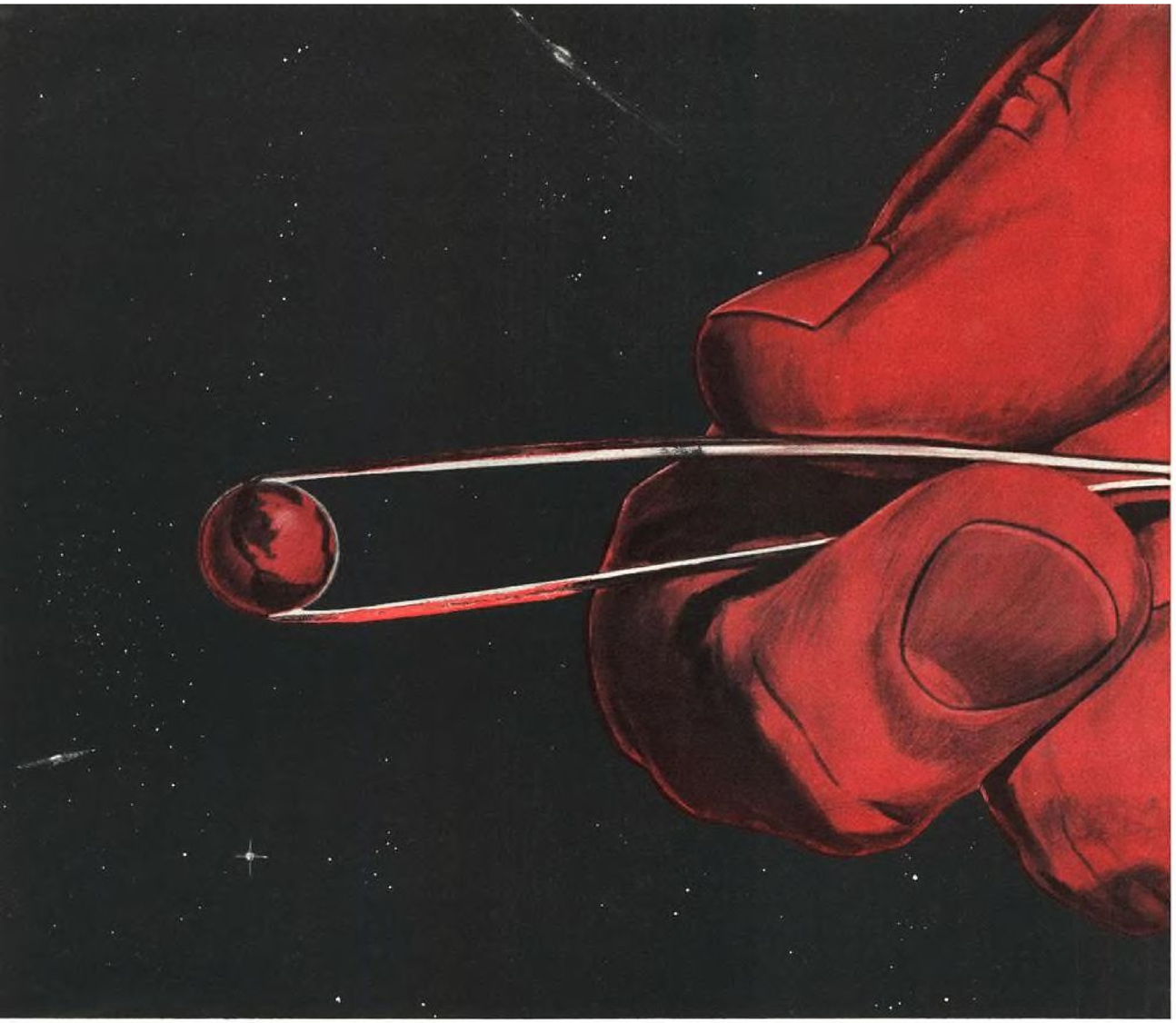
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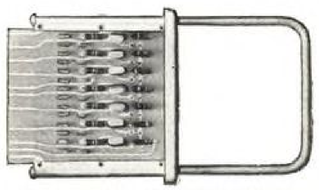
- ☐ A. T58 Turboshaft Engine GED-3098
- ☐ B. 400 Cycle Servo Motor GEC-1359A
- ☐ C. Molded PVZ Tubular Capacitors GET-2671
- ☐ For immediate project
- ☐ For reference

Name.....
Position.....
Company.....
Street.....
City..... Zone..... State.....



SMALL WORLD—The world of the diode... the transistor... the printed circuit... the new magnetic and dielectric components—this world expands in significance as it shrinks in physical proportions. Popularly symbolized by the tinier-than-ever hearing aid and the pocket radio, the new, small world of solid state circuitry is omnipresent. It safeguards our skies. It simplifies our living. It opens new doors to learning.

Stewart-Warner Electronics has pioneered in the development of solid state circuitry. Out of a manufacturing environment second to none, Stewart-Warner Electronics is mass-producing equipment containing solid state devices by the thousands of units.



One of 160 plug-in modules for the desk-size Stewart-Warner Data Processing Unit. Modules employ solid state circuitry to save space and eliminate many vacuum tubes.

Your problem of solid state circuit design and production techniques will be handled at Stewart-Warner Electronics with equal efficiency. If you are an engineer interested in advanced circuit development, write: Stewart-Warner Electronics, Dept. 14, 1300 North Kostner Avenue, Chicago 51, Illinois.

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Collins Pioneers New Management Plan

By Philip J. Klass

Cedar Rapids, Iowa—A novel approach to engineering management is being pioneered by Collins Radio Co. and its success to date confirms the old adage that two heads are better than one.

The unusual organization set-up is intended to provide both improved technical direction and better business management of Collins' engineering activities and officials say it is achieving both.

Under the plan, each of seven departments in the Collins Engineering Division here operates under the direction of two chiefs:

• **Department Heads:** This is the top man in the department. An engineer or scientist, he devotes his attention primarily to technical direction of the department's activities.

• **Department Manager:** Also an engineer, the manager is responsible for administering the operation and for carrying out the broad policies of the department head.

The Collins set-up should not be confused with the growing practice of providing an engineering department chief with an administrative assistant, although both concepts are intended to free the engineering executive of administrative chores.

At Collins the two engineering department executives share management responsibilities on a partnership basis. When the department head is out of town, the manager is fully authorized and qualified to act and speak for him on practically all phases of the department's activities.

Useful in Avionics Industry

This is what makes the Collins set-up so useful to an avionics manufacturer whose engineering executives spend much of their time on the road, determining future technical needs from direct first-hand conversations with far-flung customers.

With the new dual-chief organizational set-up, Collins department heads are free to travel as needed. Yet when a project officer or other customer visits the Collins plant he is assured of finding an authoritative spokesman—the department manager—who is qualified to discuss the status of any job in his department and to make engineering commitments.

Possibly the most important objective of the new organization arrangement is to free the department head of administration responsibilities so he can concentrate on immediate and long-range direction of his group's technical activities.

After roughly a year of operation at the main Collins plant here in Cedar Rapids, the plan has been so successful that the company's Burbank (Calif.) plant is now preparing to adopt it, according to D. C. Arnold, Director of research and development here.

Manager's Responsibilities

Broadly speaking the department manager's responsibilities include:

• **Supervision of draftsmen,** technicians, secretarial and clerical help.

• **Monitoring cost progress** of department programs.

• **Salary and personnel admininstration.**

• **Preparation of proposals.** If proposal is for brand new piece of equipment, it may be written by head of one of several engineering groups in the department which would carry on the program.

However, department manager will examine proposal, look over "technical boiler plate," and be sure it gets out on time.

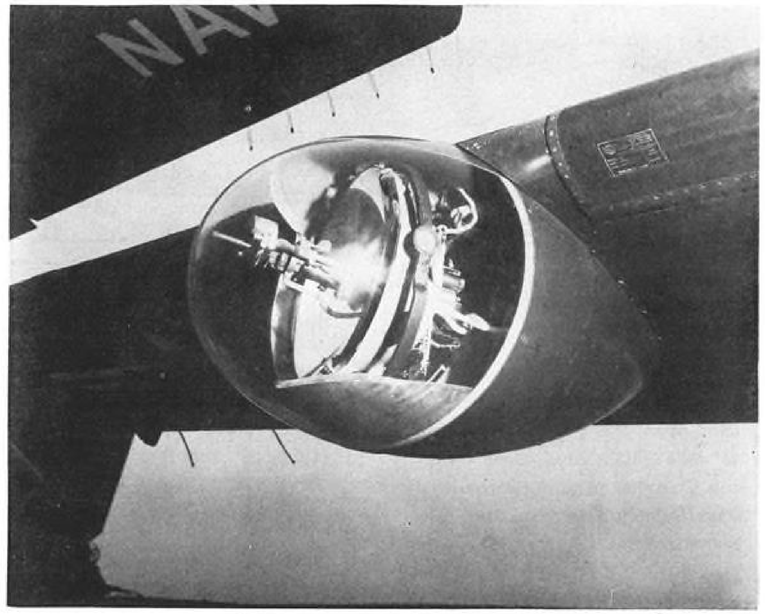
The department manager has a non-engineer administrative assistant who in turn relieves him of some non-technical chores.

The department manager normally does not travel, nor perform technical liaison with the customer except when the latter visits Collins and the department head is out of town. Decisions on whether to bid on a new customer requirement and how it should be approached technically is usually up to the department head.

No Struggle for Power

When Collins decided to try the new organization arrangement, it recognized the potential danger of having two chiefs in a single teepee. For this reason each department head was allowed to select the man who would work under him as department manager.

In every instance, the managers were



Airborne Searchlight

New airborne searchlight, AN/AVQ-3, for anti-sub and sea-rescue use, develops 130 million candlepower and can be aimed either manually or by airborne radar. Developed by Arma Division of American Bosch Arma Corp. under Navy sponsorship, new searchlight can be operated continuously whereas its predecessor had to be shut down for 4½ minutes after 30 seconds of use. The AVQ-3 also has automatic magazine and feed mechanism for replenishing carbon supply.

selected from one of the engineering group heads within the department. As a result each manager has a strong engineering background, familiarity with the problems of his department, and he speaks the language of the group heads with whom he deals.

Another Approach

So far there have been no basic problems between department heads and managers over their relative areas of responsibility and authority, Arnold told AVIATION WEEK.

This is despite the fact that there is no knife-edge delineation of each man's responsibilities.

The Ramo-Wooldridge Corp. is one of several companies that uses a different approach to the same problem. At R-W each of the technical division heads has an admininstrative director to relieve him of all possible non-technical matters. The individual administrative directors and their staffs coordinated their activities through a central company administration and finance division.

This arrangement "removes from the shoulders of the division head the vast bulk of administrative detail that would otherwise occupy a major portion of his time and attention," according to Dr. Dean E. Wooldridge.

See how
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Oakite brings into the field almost 50 years of work in engineered maintenance cleaning. This new Bulletin F-10059 tells about time-proved materials and methods that overcome problems specific to aviation maintenance cleaning. It presents up-to-the-minute data to help you save time, improve results, cut costs.

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Expansions, Changes In Avionics Industry

Raytheon Manufacturing Co. will begin construction immediately on a 42,000 sq. ft. laboratory at Santa Barbara, Calif. to be devoted to development of communications, countermeasures, infrared and radar equipment. New facility will employ about 200.

Other recently announced expansions and changes within the avionics industry include:

• **Aerojet-General Corp.** will build new



50,000 sq. ft., $880,000 facility for its Avionics Division at Azusa, Calif.

• **Graphik Circuits** has opened new 26,000 sq. ft. facility at La Puente, Calif. Company, which manufactures etched circuits, is a division of Cinch Manufacturing Corp.

• **California Technical Industries** is new name of the former **Color Television Inc.**, 1421 Old County Road, Belmont, Calif.

• **Bendix Computer Division** has opened new digital computation laboratory for use by outside organizations at 5630 Arbor Vitae St., Los Angeles. Facilities include two Bendix G-15 general purpose digital computers, a DA-1 digital differential analyzer accessory, and associated input-output equipment.

• **Geisler Laboratories** is new name of the former **Stanford Laboratories Co.**, Menlo Park, Calif. Company develops and produces microwave tubes.

• **Stromberg-Carlson** has established a developmental cathode ray tube facility in San Diego, called the first such facility on the West Coast.

• **Eclipse-Pioneer Division** of Bendix Aviation has opened sales-service office in San Francisco Bay Area, at San Carlos, to serve Northern California and parts of Nevada and Utah.

• **Transitron** has opened engineering sales office in Camden-Philadelphia area at 227 South Sixth St., Camden 3, N. J. Philip Astra is in charge.

• **John Oster Manufacturing Co.**, Avionic Division has opened East and West Coast offices at 237 N. Main St., Hempstead, L. I., N. Y. headed by Irving G. Epstein and at 5333 Sepulveda Blvd., Culver City, Calif., under Ward S. Carlson.



Painting by Chesley Bonestell from the book *The Conquest of Space*, by Willy Ley and Chesley Bonestell, published by the Viking Press ($4.95). © C.B.

How many Fenwal Controls aboard?

You might make a reservation for the first passenger trip to the moon now. But there are still some things to be determined.

We don't give you a list here of all the Fenwal temperature and control devices that may be found on board. But we do know that our past performance in solving the temperature problems on such a high proportion of modern aircraft will stand us in good stead on solving new problems. And, give manufacturers a good sense of security in adopting Fenwal devices.

For instance, in the field of fire and over-heat detection, Fenwal products are well advanced and proven in both unit and continuous types. Fenwal has the men, the equipment and the knowledge to insure fruitful exploration and practical, trustworthy products for today and tomorrow.

It will be encouraging to find, too, that your engineers will get along fine with Fenwal engineers. Our aircraft catalog on request. It's interesting. Fenwal Incorporated, Aviation Products Division, Ashland, Mass.

Fenwal Controls Temperature . . . Precisely

This Year's biggest Air Race will be held Here

The Place is the Drafting Room—and The Race is for Global Air Supremacy. Here's what Goodyear is doing to advance the completion dates of tomorrow's planes and missiles.

Never has time been so much of the essence.

In secret drafting rooms across the land, the nation's foremost aeronautical engineers and designers are pitted in a world-wide race for leadership in air commerce and air defense.

Radical new concepts are on the drafting boards. And, as is so often the case, each progressive step echoes new and searching problems.

It is in tackling these problems that Goodyear engineers and Goodyear Aviation Research have scored notable successes —and in the doing they have aided considerably in keeping America's air power "timetable" intact.

FOR MISSILES OF INTERCONTINENTAL RANGE — Goodyear has designed, developed and produced special fuel systems and cells for handling such formidable propellants as fuming nitric acid and others equally awesome.

FOR ARCTIC DEFENSE—Goodyear has given fighter aircraft the first completely automatic system of ice detection and protection for all-weather operation — built electromagnetically transparent enclosures for housing huge polar radar antennas against the elements without hampering the transmission of their signals.

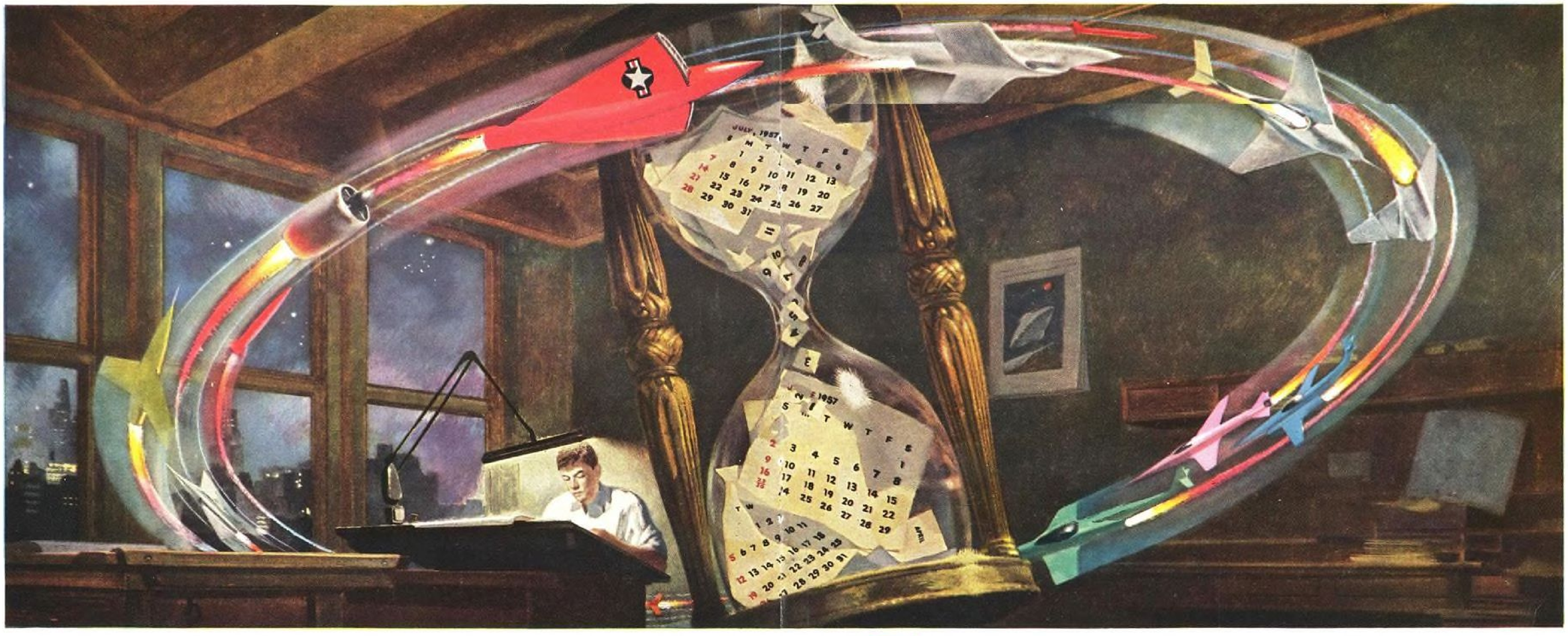
FOR LONG-RANGE BOMBERS — Goodyear has pioneered airplane wheels, brakes and tires of special design which accomplish great weight-savings — and which allot those savings to bonus fuel and extended striking range.

FOR INTERCEPTORS AND MISSILES destined to fly at speeds which can fuse conventional metals and materials into molten masses—Goodyear's extensive high-temperature research facilities have found new "synthetic elements" which offer hope for 2,000-mile-per-hour flight and promise for safe, high-speed landings.

Behind an essential shroud of secrecy, the work continues.

Each day, these Goodyear engineers and extensive Goodyear facilities are uncovering more answers, more knowledge, more advancements in a race vital to the Free World.

If you're in the Secret Drafting Room, seek the help of these Goodyear men. Write or call: Goodyear, Aviation Products Div., Dept. C-1715, Akron 16, Ohio, or Los Angeles 54, Calif.



GOODYEAR AVIATION PRODUCTS

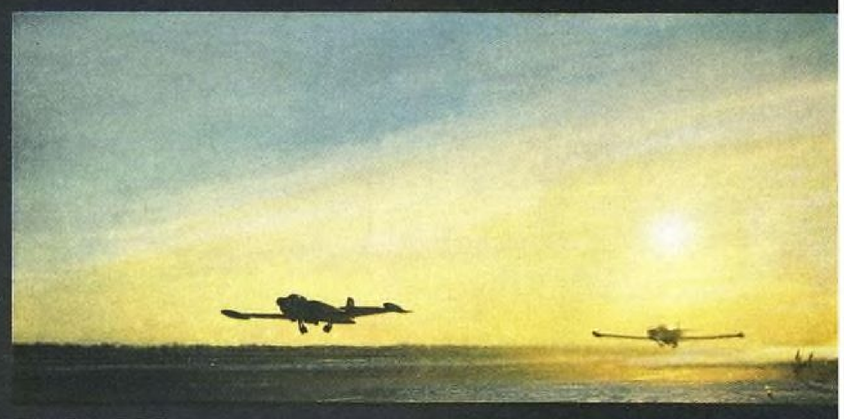
AVRO CF-100 NIGHTFIGHTERS AT WORK



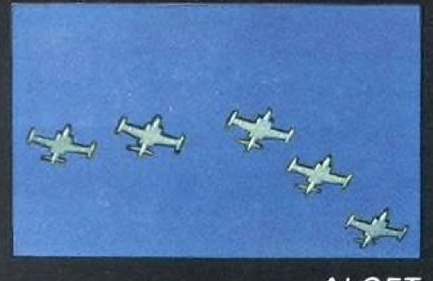
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The Royal Canadian Air Force nightfighter crews who fly these powerful CF-100's know that they guide one of freedom's most efficient weapons in the defence of North America and Western Europe.

•

Four RCAF squadrons of CF-100's have been assigned to NATO to meet its specific nightfighter requirements.

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NEW AVIONIC PRODUCTS

Components & Devices

• **Subminiature relay,** less than 1 x ¾ x ¼ in. and weighing only 0.44 oz., operates up to temperature of 125C, comes in DPDT model with contacts rated 2



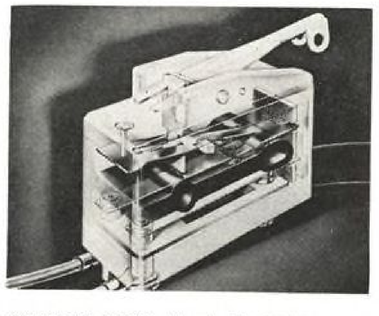
amps resistive at 28 v.d.c. or 115 v.a.c. Unit will withstand 0.06 in. vibration over 10 to 80 cps. and 20G acceleration from 80 to 2,000 cps. Elgin National Watch Co., Electronics Division, Elgin, Ill.

• **Right-angle octal socket** mounted on printed-circuit laminate base with conductor current capacity of 15 amps is suitable for use on printed circuit



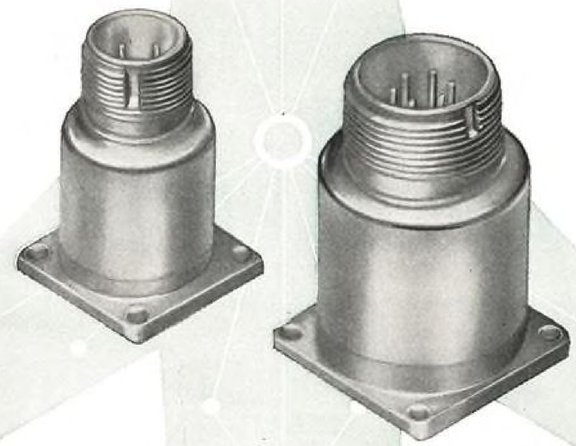
boards. Detailed application data is available from Cleveland Metal Specialties Co., 1783 E. 21st St., Cleveland 14, Ohio.

• **Miniature DPST switch,** lever actuated, with mechanical parts completely isolated from electric current carrying



NEW BRIDGEPORT CAPSWITCH POSITION INDICATOR

for Aircraft and Missiles Systems



This highly sensitive device signals control board apparatus when a valve completes its opening and/or closing cycle. Thus malfunction of one or more valves in a fuel propellant system, for example, is instantly detected.

The new Capswitch position indicator is mechanically actuated by a sealed plunger that closes or opens control circuits when depressed or released by a complete cyclic movement of the valve stem.

Two small, lightweight models with the mechanism sealed in epoxy resins and encased in a steel shell. Model 65M41—SPDT type—weighs .095 lb.; model 65M83—DPDT type—weighs .19 lb. Both are made to close-tolerance specifications and are adaptable to any type of control where repeatability within ± .001″ is wanted.

Bridgeport's new Capswitch Position Indicator can prevent costly errors and add appreciably to the safety factor in handling high-speed aircraft, missiles and rocket engines. Write for engineering bulletin No. EA-250.

Bridgeport Thermostat Division also manufactures seamless metal bellows and bellows assemblies for aircraft control mechanisms. Literature available.

Mr. Controls

Robertshaw-Fulton CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION

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Yes, around the world in 80 hours flying time is possible with the Howard Super Ventura. No other executive airplane in the Super Ventura field can cover as much territory in as little time.

The Super Ventura, with the most amazing single engine operation in the executive field, cruises at more than 300 miles per hour — more than 2,000 miles non-stop — with up to 14 passengers and 1,500 pounds of baggage.

The Super Ventura is the executive airplane which in the past year has out-sold all others in its field. This is the world's most outstanding executive airplane.

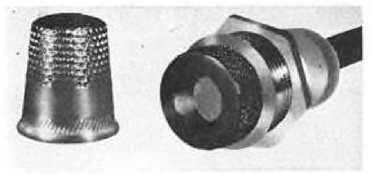
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Howard Aero INCORPORATED MANUFACTURING DIVISION

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parts. Switch measures 1⅞ x 1½ x ¾ in., comes in normally closed model. The Tait Mfg. Co., 500 Webster St., Dayton 1, Ohio.

• **Miniature photo-electric detector,** Model 6350, develops 300 mv. output for 100 foot-candle input when con-



nected to 1 megohm load, or 20 microamps into a 100 ohm load. Autron Engineering, Inc., 1254 West Sixth St., Los Angeles 17, Calif.

• **Magnetic amplifier,** Type MA-61, for 60 cps, 115 v. operation, offers power gain up to 3 million, zero drift of less than 0.2% full scale over temperature range of 0 to 170F, and zero error of less than 1% full scale output for 10%

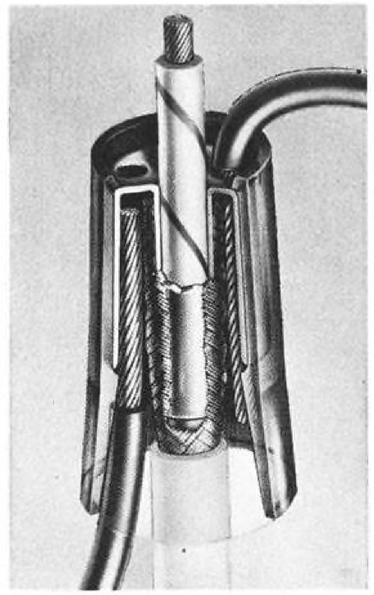


variation in supply voltage and frequency. Amplifier has maximum power rating of 25 milliwatts, measures 2⅜ x 2¾ x 3¾ in. Dynamics Research Associates, P. O. Box 5841, Ferguson 21, Mo.

• **Ruggedized miniature cold cathode rectifier,** Type CK6763, has electrical characteristics similar to Type CK5517 but can withstand 35Gs at 320 cycles for 96 hours without change in characteristics. Tube can handle 2,800 v. peak inverse at a rectified current of 12 ma. and requires no heater power. Application data is available from Raytheon Manufacturing Co., Technical Information Service, 55 Chapel St., Newton 58, Mass.

• **Thin wire-wound resistor** Type 1288, measures ⅛ in. dia. x 1 in. long, comes in resistances up to 100,000 ohms, dissipates 0.15 watt, with standard tolerances of 1% but in some sizes can be obtained as close as 0.1%. Type 1289, measures ⅛ in. dia. x 2 in. long, comes in resistances up to 200,000 ohms and is rated 0.2 watt. Both units reportedly meet environmental requirements of MIL-R-93A. The Daven Co., 530 West Mt. Pleasant Ave., Livingston, N. J.

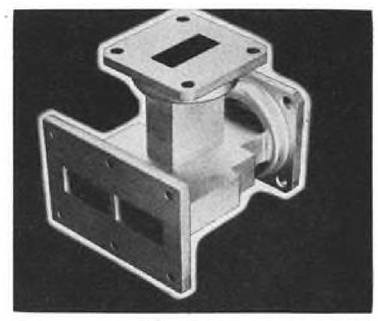
• **Tap connector for shielded or coaxial cable,** called Uniring, permits speedy installation of connections to braided conductor. Single or multiple



taps, from either front or back of connector are possible. Samples are available from Omaton Division, Burndy Corp., Norwalk, Conn.

Microwave Equipment

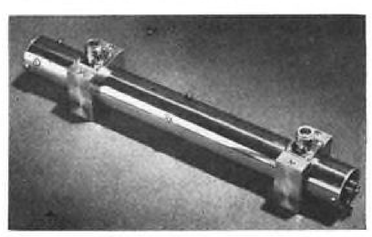
• **Folded hybrid Tee,** H-plane, available for wide range of frequencies from 2.7 to 36 kmc., is cast in either aluminum or beryllium copper, provides high iso-



lation, low SWR. Units were developed by Hughes Aircraft Co., are manufactured by Microwave Development Laboratories, Inc., 92 Broad St., Wellesley 57, Mass.



• **Variable polarization antenna,** high-gain, broadband for use at K_u-band consists of 6 ft. diameter aluminum reflector and a "question-mark" rectangular waveguide feed with conical horn. Remotely controlled ferrite transducer in the feed is used to rotate plane of polarization. Gain is more than 45 db., beamwidth is 0.7 deg., front side lobe level is down more than 24 db. and all other side lobes are down more than 30 db. System insertion loss is less than 1 db. at any rotation. Variation of signal strength with polarization rotation does not exceed 0.5 db. peak-to-peak at distance of 2,000 ft. from antenna along axis of beam, according to manufacturer. Diamond Antenna & Microwave Corp., 7 North Ave., Wakefield, Mass.



• **Traveling-wave tubes,** available in eight types covering range of 2 to 12 kmc., weigh 5 to 7 lb. including solenoid. Four tubes, covering 2 to 4 kmc. band, have power outputs of 10-30 dbm. and small-signal gains of 28-34. Two tubes cover band of 4 to 8 kmc. with 10-30 dbm. outputs and small-signal gains of 30 and 32. Two more cover range of 8.2 to 12.4 kmc. with outputs of 20, 30 dbm., gains of 25-30 db. Geisler Laboratories, Menlo Park, Calif.

• **K_u-band ferrite isolator,** operates over band of 16 to 17 kmc., provides minimum isolation of 15 db., maximum insertion loss of 0.4 db., can handle 100 kw. peak power and 100 watts average power into a 2:1 mismatch load. When terminated with matched load, presents VSWR of 1.10 to magnetron. Unit operates over temperature range of −55C to 100C. Airtron, Inc., 1103 West Elizabeth Ave., Linden, N. J.



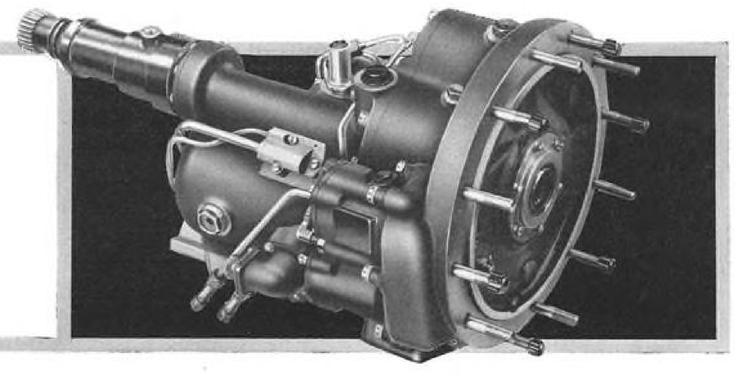
SUNDSTRAND DRIVES

are going on more B-47's because of their record for reliability

Sundstrand Drives have now logged over 400,000 flight hours in the Air Force's Boeing B-47E aircraft. Look at the record and you'll find: (1) A dramatic increase in trouble-free flights compared with aircraft equipped with earlier electrical systems. (2) A drastic reduction in number of flight aborts. This results from the dual benefits of improved system reliability and improved reliability of electrically powered *components*. This record for reliability is such that active consideration is being given to the retrofit of many earlier model B-47's with Sundstrand-driven electrical systems and the addition of a third drive generator unit to E-model aircraft to provide for additional electrical load. The record attained with the B-47E installation, first automatically paralleled, constant-frequency electrical system in a production aircraft—typifies the combination of reliability and performance that make Sundstrand *first* in constant speed drives.

WIDE RANGE OF MODELS

The "Package-Type" unit at right is designed to fit into the nose cone of the jet engines. Close control of frequency and voltage permits automatic navigation, identification, and bombing systems to operate at optimum levels. Other Sundstrand drives are also custom-engineered to fit your space, weight, mounting, and kva requirements.

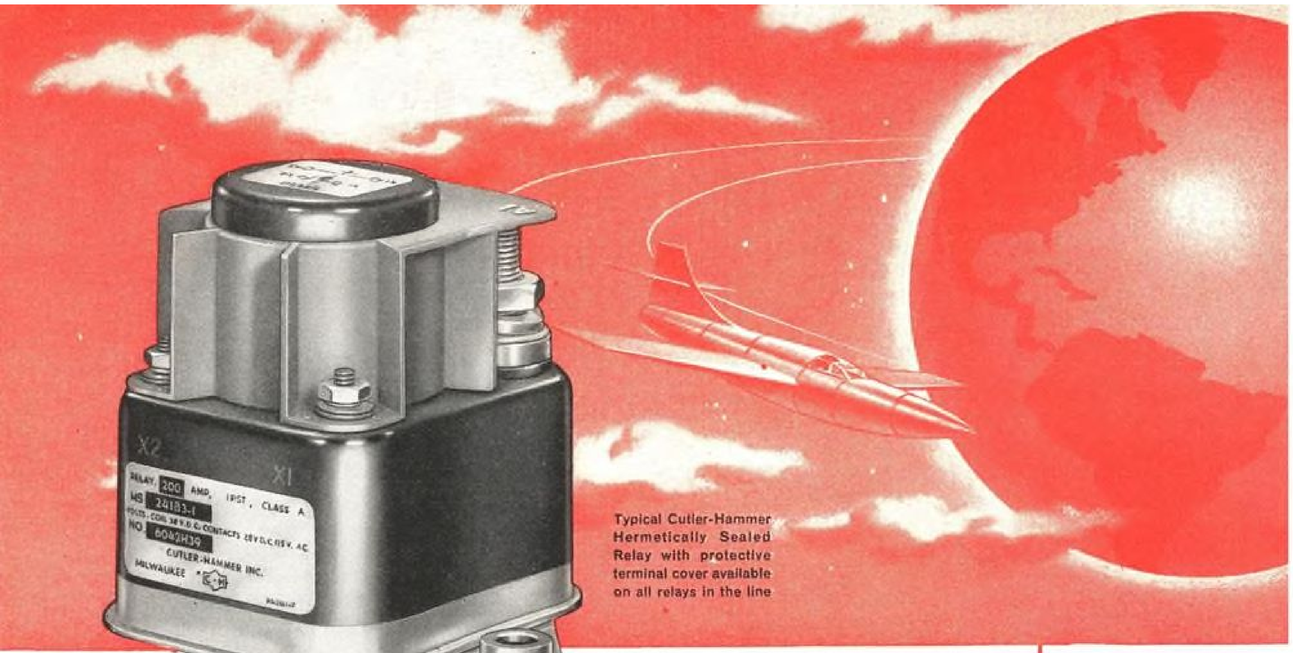


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CONSTANT SPEED DRIVES • AIRCRAFT ACCESSORIES



Typical Cutler-Hammer Hermetically Sealed Relay with protective terminal cover available on all relays in the line

Cutler-Hammer Hermetically Sealed Relay Family is Growing Steadily

The line of Cutler-Hammer Hermetically Sealed Aircraft Power Relays is constantly being extended with new types and capacities. They reflect the years of intensive development and research by Cutler-Hammer engineers in close cooperation with leading aircraft builders. Designed for use in higher ambient temperatures and better able to withstand shock and vibration, they meet both present and future needs for environment-free dependability. They offer longer life and contribute directly to increased safety.

Only permanent non-aging materials are used. All metal parts (except those carrying current or those in the magnetic structure) are stainless steel. The stainless steel case is covered *both outside and inside* with a special blue glass fused thereto at extremely high temperatures. This special glass is chip-proof and has great dielectric strength with maximum recovery should a flashover occur.

These new relays are standardized to be generally interchangeable with presently-used unsealed relays. As this advanced line is being extended continuously as to types and capacities, be sure you have the latest data. Write on your company letterhead for Pub. EE-140, "Cutler-Hammer Aircraft Electrical Control." CUTLER-HAMMER, Inc., 1471 St. Paul Ave., Milwaukee 1, Wisconsin.



50 amp. single pole, single throw Class A power relay.



200 amp. single pole, single throw Class B power relay with N.O. and N.C. auxiliary contacts.



25 amp. three pole, single throw Class B power relay with N.O. and N.C. auxiliary contacts.



100 amp. three pole, single throw Class B power relay.



50/25 amp. single pole, double throw Class B power relay.



25 amp. three pole, double throw reversing duty Class B power relay.

Cutler-Hammer Power Relays—Finest in Flight

Cutler-Hammer Hermetically Sealed Relays are designed to meet Spec. Mil. R. 6106B (A.S.G.). Operate at 80,000 feet. Class A can operate in ambient temperatures to 71°C; Class B in ambient temperatures to 120°. Class B are available with or without auxiliary contacts.

CUTLER-HAMMER
AIRCRAFT CONTROL
C-H

Cutler-Hammer Leadership in Aircraft Control

Cutler-Hammer has long held the respect of the aircraft industry because this company has been *part* of the aircraft industry for 35 years. It has never been an opportunist supplier. It has *pioneered* the designs others have followed. It has sought to serve, not merely sell. It has been in the forefront of all co-operative activity in standardization and long-range planning. It has supplied complete lines of equipment, not merely the items of widest use and most profitable manufacture. Today, as for the decades past, Cutler-Hammer engineers are working closely with the aircraft industry's leaders . . . thinking ahead, planning, designing and building for the future.

Here is the record:

1920 Cutler-Hammer designed and manufactured the first line of switches ever created specifically for use in aircraft.

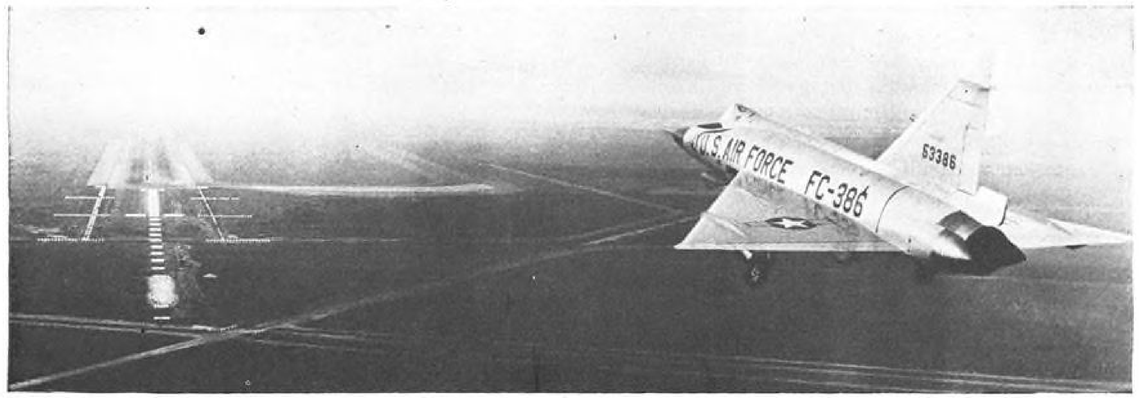
1938 Cutler-Hammer designed and manufactured the first d-c power relays ever created specifically for use in aircraft.

1943 Cutler-Hammer designed and manufactured the first a-c power relays ever created specifically for use in aircraft.

1949 Cutler-Hammer started development of the first environment-free power relays for use in aircraft.

1953 Cutler-Hammer submitted samples and certified test reports on the first hermetically sealed power relay to WADC and Bu. Aer. Cutler-Hammer configuration was adopted as industry standard by ASG.

1955 Cutler-Hammer designed and manufactured the first one hole mounting Lever Lock aircraft switches.



CONVAIR F-102 fighter-interceptor uses Electronic Flash Approach System at March AFB. Note light bursts at approach start.

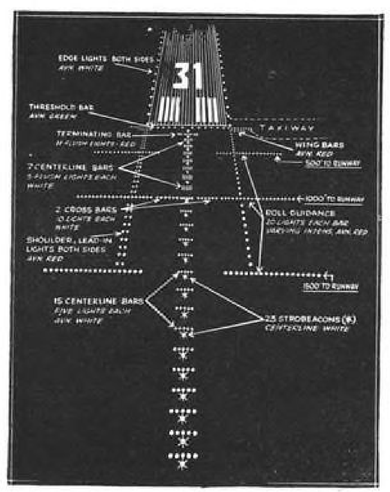
USAF Tests Flashing Approach Lights

By Irving Stone

March Air Force Base, Calif.—Enthusiasm appears high for the new Electronic Flash Approach System now under evaluation at March Air Force Base. Initial construction has begun on another EFAS system at Dow Air Force Base, Me., which is expected to be completed in early summer.

The March EFAS is a considerable improvement over one recently installed at Idlewild (AW Jan. 23, p. 95), including the installation of flush fixtures in the first 1,000 ft. closest to the runway.

EFAS, whose flashing lights were developed by the Sylvania Electric Products, Inc., is a series of brilliant, fog-piercing, high-intensity centerline lights which flash swiftly in sequence toward the runway from 3,000 ft. out. Beams of 30 million candlepower are emitted





BOEING B-52 in landing configuration is well into EFAS approach. Line of 23 Strobeacons emit fog-penetrating light bursts of 30 million candlepower in sequence twice per second, giving effect of tracer shells down runway center.

in sequence twice a second by each of the system's 23 evenly spaced lights on the approach.

To the pilot, the effect is that of tracer shells traveling at 3,600 mph. toward the target, which is the center of the runway.

Guidance Bars

Each of the 23 Strobeacon condenser-discharge lights is mounted on a center-line bar flanked on each side by two white incandescent lamps. The beam is non-blinding since it lasts just 1/5,000th of a second. The center line guidance bars give the pilot a horizon reference after the Strobeacons have guided him to where the incandescent lamps are visible.

Additional roll guidance is provided for high performance aircraft at points 1,500 ft., 1,000 ft. and 500 ft. from the end of the runway by wider horizontal bars extending out from each side of the center line. On each of these bars are 20 red incandescent lamps.

At March, the Strobeacon center line bars have been extended to within 200 ft. of the runway; previously Air Force had barred obstructions for the last 1,000 ft. to allow for possible emergency landing or takeoff situations. This was solved by housing the last eight light bars below ground in concrete grill-covered Elfaka units supplied by Structural Concrete Products Corp. which are capable of withstanding the impact of a 200-ton bomber. Seven of these flush bars and a red flush terminating bar are included in the March system.

Complete System

The complete center line approach system includes:

- **Hundred foot incandescent** lamp bar 1,000 ft. from the runway threshold.
- **Sixty foot terminating bar** of red incandescent lamps 200 ft. from runway.
- **Two wing bars** of red incandescent lamps 100 ft. from runway.
- **Row of green** incandescent lamps at the runway threshold.

Each EFAS unit consists of a xenon-filled lamp designed to last 500 hr. when operated at 2,000 volts. Xenon, a rare inert gas, emits a white light when high electrical discharges are made through it.

Lamps are placed across a 30-microfarad condenser, and application of high voltage trigger pulse causes condenser to discharge through lamp. Two rectifiers provide a 2,000-volt DC potential used to charge the condenser. A relay connected with a central timing device discharges a small condenser through an ignition-type transformer. This provides instantaneous high-voltage pulse required to flash lamp.

All parts of Strobeacon are non-corrosive, and are housed in a waterproof aluminum cabinet. Tempered glass is used in front lens to resist breakage. Rear cover is easily removed with a screwdriver for replacement of inside chassis.

Device inside the unit allows for leveling the reflector even though unit may be mounted on a platform which is not level.

All components are tested from −55F to 140F.

Significance of the March installation is highlighted by the fact that since January, 1953, 15 aircraft within SAC have been totally destroyed in accidents in which lack of adequate approach lighting could have been a contributing cause factor. These accidents have resulted in 50 fatalities and about $35 million replacement cost for the aircraft involved.

Object of Tests

System installed at March is a pilot model for determining the suitability for Air Force acceptance as a standard. Object of tests performed at March is to obtain a final evaluation of an approach lighting system which will facilitate landings of high performance aircraft under restricted visibility conditions.

Within the past two weeks, pilot reaction to the system installed at March has been very good. Pilots have been able to line up with the center line of the system 4 to 5 mi. from the runway when visibility has been down to 1 to 2 min. because of haze.

The Dow installation will be Air Forces' first integrated system, including approach lighting system before the runway coupled with continuation of guidance on the runway. It will duplicate the system at March and, additionally, will continue for 3,000 ft. down the runway the flush lighting fixtures used in the area immediately in front of runway threshold. This additional feature planned for the actual runway at Dow will be known as a narrow-gauge landing mat to permit the pilot to safely complete extremely low visibility landings.

Fundamental Differences

Fundamental differences between the March installation and the one at Idlewild:

- **Roll guidance bars** added by military at 500, 1,000 and 1,500 ft. from the threshold.
- **Elfaka flush fixtures** in the first 1,000 ft. closest to the runway. Use of Elfaka flush units within this 1,000 ft. clear zone required at military fields removes the USAF objection of having electrical fixtures protruding upward where anchor chains used at fighter bases for barriers would cause light fixture damage, and where aircraft inadvertently landing short of the threshold would be damaged.
- **Strobeacons** are installed to within 200 ft. of the runway threshold instead of to within 700 ft. as at Idlewild.
- **March installation** has added red edge lights on both sides of the approach area.

Approximate cost of the March installation is about $180,000. About 20% of this cost is for actual hardware.



Kaman Develops External Control

External control system, called halter, enables ground personnel to "walk" helicopter to desired location. Kaman Aircraft Corp. developed system for its remotely controlled HOK helicopter. Use of halter to cause HOK to take off, hover, land or move forward, backward or sidewise, can be learned in two or three minutes.



... In the infinity of the future that begins in the next instant, people like yourselves ... scientists, engineers and intelligent businessmen ... will be dreaming of things for a better world. And these dreams ... the formulas and the blueprints ... will be rushed into realities because other men who believe in the future are now working to provide you with the methods and materials that will give wings to your imagination.

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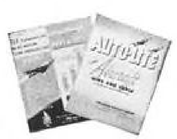
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Wide scale, high speed jet travel will be a reality with the new Lockheed propjet Electra. The Electra will be powered by thrifty and quiet Allison engines. These engines reduce frontal area and engine weight by one-half over piston engines of equal horsepower. The Electra is capable of reaching an altitude of 30,000 feet faster than any propeller-driven airliner in service, and is specified to use Auto-Lite 350 Wire in many critical applications. Like many other airframe manufacturers, Lockheed finds the extra temperature range performance of Auto-Lite 350 Wire ideally suited to jet aircraft demands. In addition to its high resistance to abrasion, flame, solvents, fuels, and lubricants, many manufacturers find that Auto-Lite 350 Wire reduces production costs compared with other high-temperature wires.

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Timer System Warns of Engine Failure

By Robert H. Cushman

New York—Sudden gas turbine engine failures due to accumulated overtemperatures melting the hot parts of an engine can be forestalled by a maintenance device developed by Avien Inc., Woodside, L. I.

The new system uses a series of stop clock timers which add up the intervals that the engine has been subjected to various levels of overtemperature.

The Time-Temperature-Recorder, or TTR as it is called, is being retrofitted on 2,000 Air Defense Command F-86D interceptors.

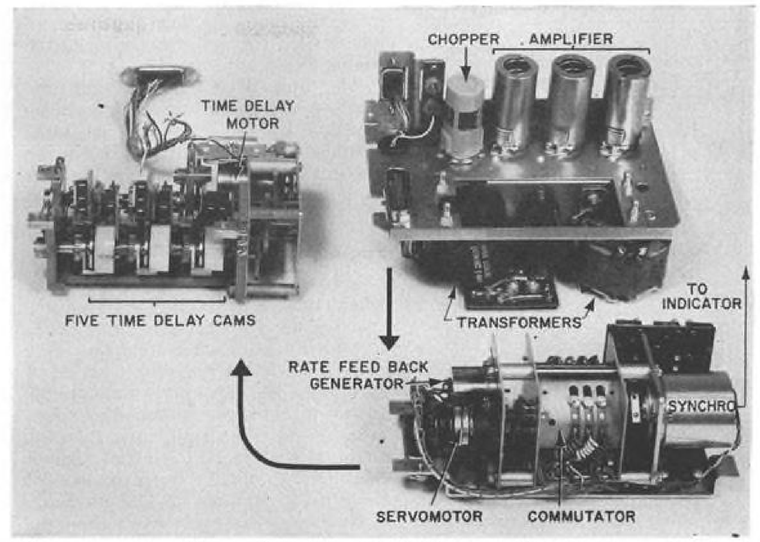
Addition to Indicator

Essentially the TTR is Avien's standard jet engine exhaust gas temperature indicator with the addition of mechanisms which separate six levels of overtemperature and start the timing clocks whenever these occur.

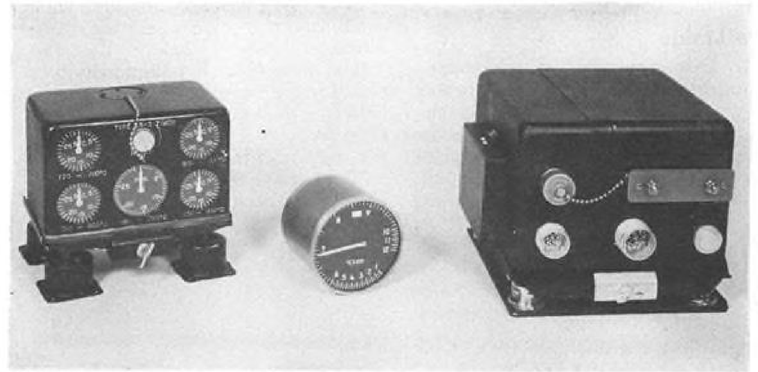
Instead of relying on the pilot's "clerical ability" for noting and logging the overtemperatures, the TTR automatically chalks up the engine's overtemperature history. This is expected to give the maintenance crewmen a more reliable gauge on whether the engine should be pulled for inspection or complete overhaul, or whether the engine still has a safe margin of service left in it.

The overtemperature problem has been with gas turbine engines since their inception and it is said to be especially critical with the electronically controlled General Electric J47-GE-17 and -33 engines which power the North American F-86D interceptor.

Engine turbine failures due to accumulated overtemperatures have been one of the biggest headaches to Maj. Walter Berry, chief of maintenance engineering, Air Development Command, Colorado Springs, Colo.



TTR components are (left to right) timer with clocks to record five overtemperature levels, pilot's indicator with warning flag, amplifier. Total weight is 13 lb.



TTR amplifier box contains amplifier (upper right) which powers servomotor (lower right) which drives commutator which cuts in time delays (left) which start clocks.

Peak Temperatures

"While other versions of the J47 engine have proved themselves very reliable in cruise-type mission as in the B-47 bomber, our missions require the engine to fly on afterburner at its very peak temperatures all the way," Berry said.

"The interceptor pilot scrambles off at 100% throttle (full afterburning) and holds it there during climb, intercept and recovery. The GE electronic control is supposed to accelerate the engine automatically to full power and hold it but there is the continual possibility of transient overtemperature. The pilot with his head in the radarscope on intercept cannot be expected to monitor the indicator needle and jot down each time it goes over the 685C limit. Meanwhile, he is flying an engine which can only afford to accumulate 13 total seconds at 1,000C.

"You can see that it only takes a few intercept missions before the turbine is likely to fly out the tailpipe without warning.

Unreported Overtemperatures

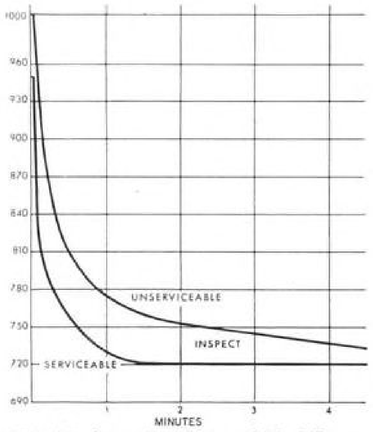
"When we first started to cope with the problem, investigation showed that over-eager operational supervisors in their zeal to have their units score high ready rates weren't reporting all the overtemperatures.

"We believe we have corrected this with an educational program but it still isn't enough. We are looking to the TTR to fill us in on where we stand."

The graph sets forth the information which the TTR must keep track of. It shows, using present information, the allowable durations which a J47 engine can accumulate in its exhaust gases without being prone to failures in the turbine area.

It shows that the higher the overtemperature, the shorter the allowable duration.

The Avien temperature sensing and indicating system was described in Aviation Week two years ago (AW May 16, 1955, p. 35). It uses a back-to-back diode voltage standard to simulate the sensing thermocouple's cold-junction and a position servomechanism to drive the indicator pointer until the



CURVES show time limits which J47 can operate at various overtemperatures.

pointer wipes out a nulling voltage on the feed-back resistor.

In the TTR, Avien has added two electro-mechanical units, a commutator and five time delay cams, to program the five recording clocks. The commutator is driven by the regular temperature indicator's shaft position output and the delay cams are driven by their own timing motor.

Five Levels

To present the engine's overtemperature history in a form directly useable to the maintenance personnel, the Avien TTR first breaks up the incoming temperature signal in the form of shaft position into five levels, 690, 720, 760, 800 and 950C (1270-1740F), by using the commutator to successively cut in the respective timer circuits. The commutator contacts cause magnetic clutches to close on the delay shaft and rotate the time delay cams until second microswitch contacts are made and the timing clocks are started.

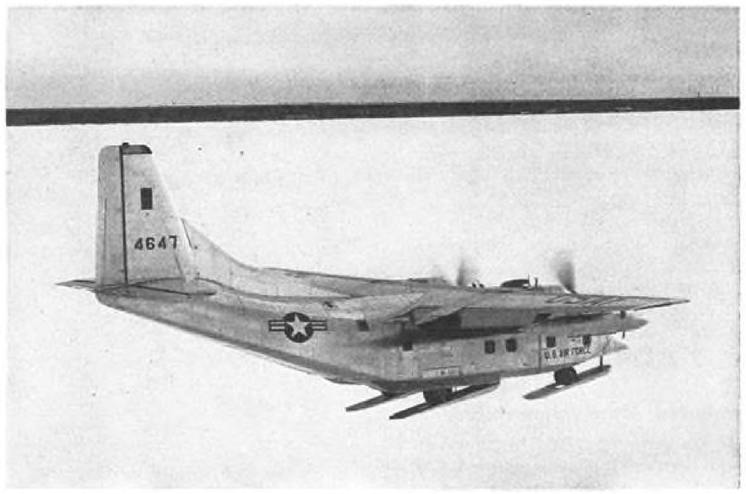
The time delay cams prevent momentary overtemperatures from being recorded by the clocks. The initial transient overtemperatures, shown on the graph as the area under the left hand curve, have been found not to affect engine life.

Engine Record

What the maintenance men see, when they remove the access panel covering the TTR timer in the F-86D's forward fuselage, is the total time (less delays) which the engine has stayed at each of the five temperatures monitored. If any of these are beyond the values given by the right hand curve, then the engine is sent back to overhaul without question. If only a small amount of dwell time is clocked up, and the times fall between the two curves, then the engine is inspected and if sound sent back into service. If no times are recorded it is presumed that the engine has not been abused either by its pilots, faulty control system, or unavoidable combinations of engine and flight conditions.

The timer box has purposely been placed out of the pilot's sight and reach. Only the crew chief can get at it. All the pilot sees is a red warning flag at the top of his indicator dial.

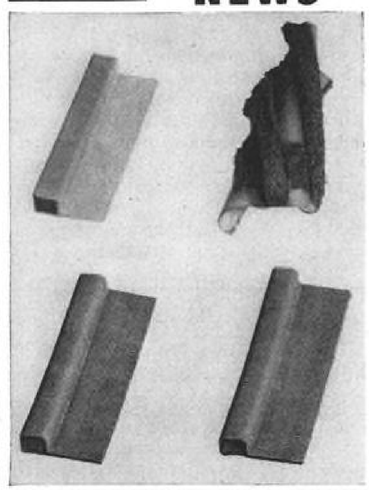
The warning flag serves two purposes. During starts it takes over to the exclu-



C-123 Tests Wheel-Ski Gear

Fairchild C-123 assault transport, testing new wheel-ski gear system on a lake at Bemidji, Minn., took off and landed at gross weights approximating 56,000 lb. Load exceeded 55,165 lb. lifted by an experimental YC-123E a year ago. Testing program on frozen lake is being conducted by the Wright Air Development Center.

CHR Silicone Rubber NEWS



At left, control samples; at right, seals soaked 16 hours in AN-F-48 (100/130 octane) fuel. Seal made with ordinary silicone rubber (top right) is destroyed. Seal made with new Dow-Corning LS-53 (bottom right) is virtually unaffected and is tough, resilient and operable.

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Resist jet fuels, hydraulic and synthetic oils, and abrasion in temperatures —85°F to 400°F.

The new Dow-Corning LS-53 is the first rubber to combine fuel resistance with extreme high and low temperature flexibility. This *fluoro-silicone* rubber can be sponged, molded, extruded. It is readily adaptable to seal constructions which provide the most practical and economical use of the rubber.

LS-53 is available *now* and CHR is already designing it into fabric reinforced seal constructions. The outstanding resistance of these seals to one aircraft fuel is illustrated *above*. *Write or phone* for a CHR data sheet giving full test data. If your need for LS-53 seals is immediate, CHR will expedite seal design coordination and production. Phone or write us. CHR field representatives are available for direct contact.

ALSO AVAILABLE, LS-53 custom molded sheets, extrusions, sponge sheets, sponge extrusions, COATED FABRICS.

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Boeing 707 Intercontinental—drawing courtesy Boeing Airplane Co.

CHR's high tear strength silicone rubber picked for 707's major door and window seals

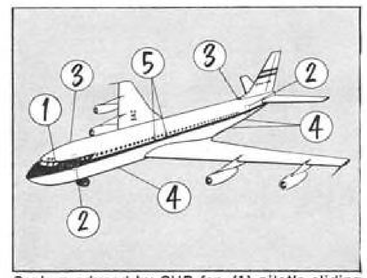
These seals, produced by CHR, will resist tear, abrasion, compression set, weathering, sticking, —100°F. to 400°F.

All present versions of the Boeing 707 will have silicone rubber door, window and hatch seals in the important traffic areas. The speeds, altitudes and temperatures to be encountered by the 707s would soon render organic rubber seals useless in working areas such as the pilot's sliding window, the passenger, cargo and galley doors where silicone rubber is to be used.

It is significant that the seals for these areas will be produced by CHR with compounds meeting Boeing's BMS 1-22 specification. This specification and AMS 3345 and 3346 were written around CHR's COHRlastic HT* high tear strength silicone rubber compounds. These CHR compounds, at the present, are the *only* stocks which will meet these specifications.

In the single year that these compounds have been available, a trend to designing with high tear strength silicone rubber has been established. Other airframe and engine companies are writing specs around CHR's compounds or specifying AMS 3345 and 3346 on new and revised prints.

CHR representatives calling on all major airframe and engine manufacturers are available for consultation on use of these compounds. Write or phone for specifications and samples of COHRlastic HT silicone rubber.



Seals produced by CHR for: (1) pilot's sliding window (2) passenger door (3) galley door (4) cargo hatch and (5) escape hatch are made with CHR's COHRlastic HT 666 silicone rubber meeting Boeing's BMS 1-22 specification. Other CHR silicone rubber seals are used throughout all 707 models.

*COHRlastic HT 665 and HT 666 are produced from high molecular weight gums reinforced with du Pont's Valron® estersil.

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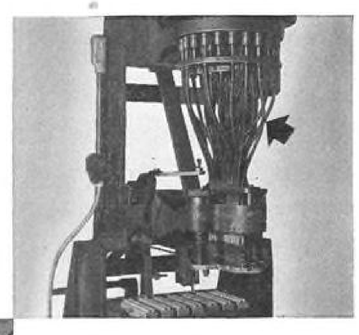
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sion of the five recording circuits. On the theory that a start either is or isn't a hot start, the flag is set to pop up at 950C (1,740F) after a two second delay. During normal flight the flag is set to go up at 850C (1,560F) with no time delay.

The timers can be reset after overhauls and engine changes and the time delay relays can be biased to take into account better service experience, future improvements in turbine materials, and even different makes of engines.

Accurate Data

Actually, USAF feels that since a recorder of this type has not been available the exact location of the curves on the graph, especially the right hand curves, are not really known. One result of having the TTR in service is expected to be a more accurate set of service data which will permit new curves to be roughed in. The time delays on the TTR will be biased to suit the better statistics.

Engine manufacturers are expected to benefit also. For the first time the user will be able to feed-back quantitized information through the manufacturer's "tech reps."

Future for TTR

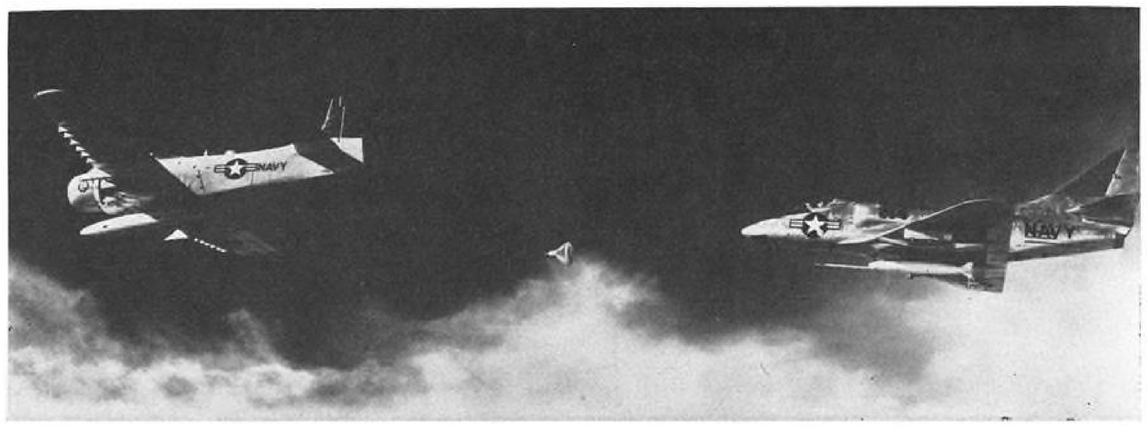
This information has not always been available, even in the manufacturer's test cells.

The need for operational recorders like the TTR will become even more pronounced in the future, Avien engineers say. They will be mandatory for high performance fighters and bombers which will be forced to run at engine temperatures way above today's levels, and whose inlet and control systems may be so complicated that occasional overtemperatures will be virtually unavoidable. One could perhaps extend the principle to encompass monitoring the structural parts of supersonic aircraft which might penetrate too far into the thermal thicket if they by accident flew too fast and too low.

In time of national emergency this type of recorder could prove a valuable tactical aid by rapidly pinpointing the probability of an overtaxed aircraft fulfilling "one-more-mission."

On the other hand commercial jets and turboprops are likely to become more interested in a device built around this principle when their times between engine overhauls become longer. The TTR could be used actually to extend the overhaul life of an engine known to be vulnerable to turbine overtemperature failure by permitting the engine to be used until the TTR dictated that its "time was up."

Both engine manufacturers and com-



Turbine Powers New Quick Conversion Fuel Tank Unit

Self-contained refueling unit has been developed by Douglas Aircraft Co., Inc., for quick conversion of Navy fighters and attack bombers into aerial tankers. The refueling device has been flight tested, is now in production for use on the piston-powered AD Skyraider and A4D Skyhawk midget jet bomber (top).

One contemplated usage for the refueling store is the "buddy" mission in which two aircraft of the same type deploy together, with one refueling the other at mid-point and then returning to base. Aircraft not required for tanker use can be restored to normal combat function with removal of the externally carried refueling unit.

Powered by a ram-air turbine driven by a short four-bladed propeller (left), the refueling store in addition to its fuel accommodates fuel pump, hydraulic motors, reel of flexible hose and collapsible drogue. The store can be jettisoned in an emergency.



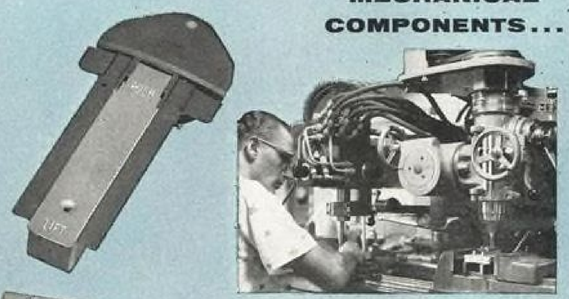
mercial operators have been interested in the TTR, Avien said. Allison, GE, Pratt & Whitney and Pan American and American Airlines have considered the TTR as a feature or maintenance tool for the coming jet airliners.

The price for this model probably will remain at the present $2,000-2,500 level, said Avien. It seems unlikely, the company says, that commercial or other military orders will ever top the present 2,000 unit (exclusive of spares) volume of the $5 million F-86 order. It is possible the same principle could be repackaged in cheaper versions by cutting corners.

The system could also be redesigned to monitor other inputs as well. For example, recorders could be built to monitor stress levels in both engine and airframe, airspeed in dives, gust loads, pressures, or in fact anything which has a cumulative operational limit.

The retrofitting of the ADC F-86Ds will take place at Sacramento AFB and the Fresno and Los Angeles North American Aviation facilities. The first delivery is for around April 1 and the delivery rate will go up to 200 units per month. Meanwhile, to expedite matters the USAF will send its WADC inspection team to Avien's factory to witness the qualification tests.

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Detector Shows Water Undissolved In Fuel

London—Devised at the Thornton Research Center and developed by the Shell Petroleum Company, a new detector for checking the percentage of undissolved water in aviation turbine fuel is being put into service at London Airport and on all airports throughout the world where Shell's aviation turbine fuel is supplied.

In the interest of aviation safety, it is being made available without patent royalty to all those who wish to use the detector.

The Shell detector is capable of detecting the presence of as little as 0.003% undisolved water. Under the worst conditions, in which turbine fuel supplied to aircraft at 40C, is cooled during flight to below zero centigrade without the usual loss of water to the atmosphere, 0.014% wt. water could be precipitated from a fuel which contained no undissolved water when it was put into the aircraft.

Therefore, assuming that aircraft fuel must contain not more than a total of 0.02% water, this fuel must contain less than 0.006% undissolved water when supplied.

As the Viscount 700 fuel system incorporating MOD D693 will function satisfactorily with fuel containing up to 0.02% wt. dissolved water plus 0.02% wt. free dispersed water, the Shell detector provides a substantial safety margin, the company said in describing the device.

It has been given extensive field trials and has proved reliable, quick and easy to operate.

Technical details:

A small element filter paper sensitized with chemicals is mounted in a plastic molding or detector head, which is made to fit the "record" taper of a standard hypodermic syringe. In this way a 5 ml. sample of fuel is drawn through the detector head in the center of which is an exposed area of paper through which the fuel can flow.

The outer edges of the paper are sealed in order to prevent the passage of fuel there.

If suspended water is present in the sample, the water droplets coalesce on the fibers of the exposed portion of the paper and react with the chemicals. The resultant color change gives a marked contract in the center, or target area, in relation to the unchanged part of the paper. The sensitivity of the method depends directly upon the ratio of the volume of the fuel sample to the area of filter paper through which it passes.

A ratio which gives a detectable indication at water concentration of 0.003% wt. has been chosen.



MICHAEL SCALZO

Graduated from Purdue, B. S. in Aeronautical Engineering 1948 and joined Bell in 1952 as a Preliminary Design Engineer. He later became Project Engineer for Weapon System Requirement and Analysis and today, at 33, he is Chief of the Installation Design Department, Aircraft Division.

Engineers Advance at Bell

The variety of Aircraft being worked on in Bell's recently formed Aircraft Division offers the engineer rare opportunities for fast personal advancement and professional achievement. From research airplanes to supersonic military fighters, he deals with new concepts that offer exceptional rewards for creative thinking. Probing deeper than ever before into the world of supersonic flight, he writes tomorrow's textbooks on airplane design.

If you're looking for a profitable move with a challenging, unlimited future, investigate what Bell Aircraft has to offer. Top pay and benefits. Congenial associates and excellent living conditions.

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- Telemetering Engineers
- Turbine Pump Designers
- Vibration & Flutter Analysts
- Weapons Systems Engineers
- Wave Guide Development Engineers
- Weights Engineers

THE ERA OF THE ELAND IS BEGINNING···

Every medium-haul airline in the world is faced with an urgent decision: how, and how soon, to convert to turbo-props in the 3,000-4,000 e.h.p. range.

It becomes clearer every month that ELANDS are the simple and immediate answer. Because of its single-spool design the ELAND is inherently safe and fundamentally economical to run and service. Because of its extreme flexibility in performance it is adaptable to any and every operating condition. And because of its simplicity and its excellent power-weight ratio it is a good engine for conversion projects. The case of the Napier Eland Convair—bought from the makers and converted to ELANDS—is a convincing illustration.

Few structural alterations. Installation of ELANDS in the Convair 340 has meant remarkably few modifications—and these have taken place ahead of the main engine bulkhead frame, which has otherwise been retained unaltered from the original installation. Other alterations have been confined to the instrument panel, the control quadrant, and the aircraft electrical system (adapted to include a circuit for Napier 'Spraymat' electrical de-icing of engine intake, propellers and spinners).



Three examples of successful Napier Eland conversions: the Convair 340, the Elizabethan, the Varsity.

The profit of ELAND operation—From studies made of the published direct operating costs (including depreciation) of a number of typical airlines, it is proved that in the light of our guarantees a converted aircraft will be cheaper to operate—whether the costs are calculated on the basis of aircraft miles, ton miles or passenger miles. Such calculations, of course, take no account of the increased revenue which will be earned by this, as by all other turbine-engined aircraft thanks to greater passenger appeal.

Eland conversion means increased profits to the progressive airline

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Representatives: J. C. K. SHIPP & A. GUALTIERI, Suite 909, Dupont Circle Building, 1346 Connecticut Avenue, N.W., Washington, 6 D.C. Tel: Dupont 7-2123

J. J. WAITE, 6035 Cote-de-Liesse Road, Montreal 9, Quebec

CBC B26

NEW AVIATION PRODUCTS

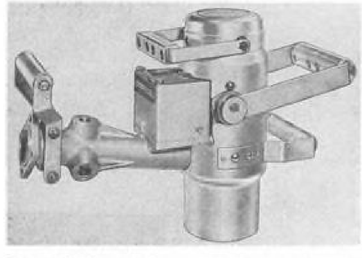
Compass Shield

Fernetic shield around weather radar magnetron eliminates need to recompensate magnetic compass whenever radar is pulled for check or replacement. Result is lower maintenance cost and time. Shielding is not affected by shock or vibration because fernetic material does not retain residual magnetism or require periodic annealing. Radar chassis can be mounted or turned in any direction without influencing compass deviation. Shield is comparatively light and acts as dust cover.

Magnetic Shield Division, Perfection Mica Co., 20 N. Wacker Dr., Chicago 6, Ill.

Rocket Fueling Nozzle

Liquid propellant rocket fueling nozzle is designed especially for transferring fuming nitric acid with minimum danger to operator. One is used for filling and another for venting the tank. Only pure alumina and special stainless steel alloys are used to resist corrosion. Vent and fill hoses are attached to teflon gasket flanges. An interlock prevents inadvertent opening of the flow control valve before the nozzle is attached and locked to the adapter on

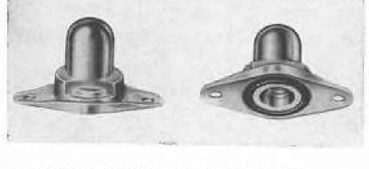


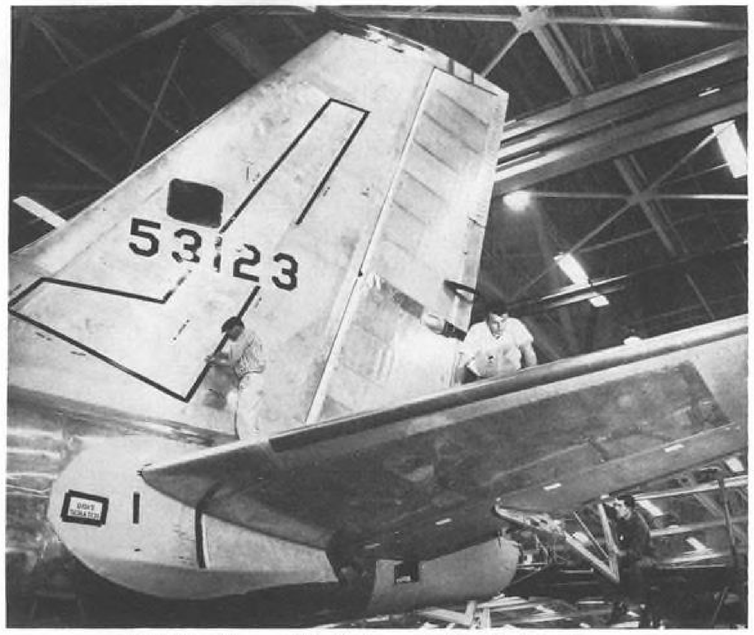
the missile tank. Another prevents unlocking of the nozzle from the adapter while the flow control valve is open. The nozzle operates at −65F to +140F. It is designed to MIL-N-25556.

Lear-Romec Division, Lear, Inc., Elyria, Ohio.

Self-Sealing Anchor Nut

Fuel resistant, self-sealing floating anchor nut contains integrally molded rubber seal to provide tolerance-free sealing. Rigid construction resists deflec-



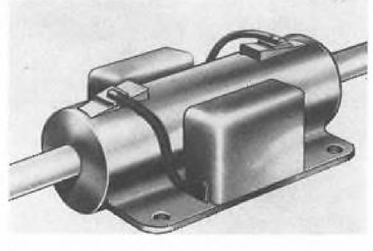


B-52 Has Stainless Steel De-Icer

Lightweight stainless steel de-icer for B-52 horizontal stabilizer was developed by B. F. Goodrich Aviation Products, division of B. F. Goodrich Co. Electrical heating element sandwiched between layers of resin impregnated glass fabric is covered by stainless skin. Steel is bonded to leading edge. Unit, which is hail and erosion resistant, was chosen over bleed air system with heavy ducting or a tail blower system.

tion under push-out conditions and assures tight continuous seal against normally encountered pressures. Net element floats independently of seal to accommodate misalignment.

Kaylock Division, Kaynar Co., Los Angeles, Calif.



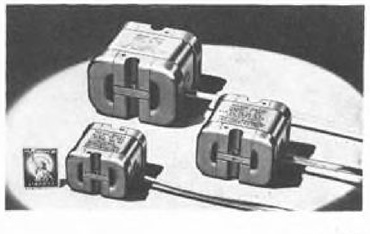
Ultrasonic Flowmeter

Straight-through flowmeter accurately measures rate without causing pressure drop across sensing element by using modification of ultrasonic beam as indication of flow rate. Absence of obstruction to flow simplifies maintenance and permits greater accuracy without influencing flow parameters. It is especially adapted for use with kerosene, liquid oxygen, water and other low viscosity liquids. Designated model UF-100, it will measure flow rates in the range from 1,000 to 4,000 gpm. with accuracy of better than 1%. It provides 5 volts full scale output to feed standard telemetering and recording systems.

Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.

Miniature Torque Motors

Miniature torque motors designed for missile and aircraft servo systems are said to have highly efficient magnetic circuits, very high natural frequencies, and low phase lag. No pins, screws, safety wires or lock washers are used as fastenings. Motors meet military specifications and are available in three sizes producing forces of 13½ lb., 8 lb. and



Motor - Gear - Trains

3:1 to 150,000:1 Ratio Range • Up to 18 Foot Pounds Torque

- Motors available: DC, 60 or 400 cycle, PM, split series, series, shunt, single phase and 2-phase. All are reversible.
- Available with either governor or brake.
- 1000 hour life minimum.
- Designed to meet MIL-E-5272A.
- Precision gearing throughout.
- Can be furnished up to 125°C.
- Designed for continuous duty or intermittent duty applications.



MOTOR GEAR TRAIN									Size	Overall Length Inches-Max.	Motor Type	Mounting	Oster Type
Gear Ratio	No-Load Speed	Nominal Voltage D.C.	Voltage Range D.C.	No-Load Current	Normal Speed	Normal Load OZ.IN.	Normal Current	Operating Temp. Range					
5.68:1	1800	28	24-32	0.4	1800	5.0	1.0	−55° To +85°C	13	3.777	P.M. GOVERNOR	FACE	13R-9102-08
17.9:1	600	28	24-32	0.4	600	12.0	1.0	−55° To +85°C	13	3.930	P.M. GOVERNOR	FACE	13R-9102-06
32.3:1	300	28	24-32	0.4	300	12.0	1.0	−55° To +85°C	13	3.935	P.M. GOVERNOR	FACE	13R-9102-02
67:1	150	28	24-32	0.4	150	12.0	0.6	−55° To +85°C	13	4.092	P.M. GOVERNOR	FACE	13R-9102-05
85:1	150	27.5	—	.25	130	50.0	0.7	−55° To +85°C	13	4.095	P.M.	FACE	13R-9101-11
109:1	100	28	24-32	0.4	100	32	0.6	−55° To +85°C	13	4.094	P.M. GOVERNOR	SYNCHRO	13R-9102-12
109:1	180	27.5	—	0.4	175	30	0.5	−55° To +100°C	13	2.843	P.M.	FLANGE	13R-9104-01
125:1	75-90	28	—	.25	70-85	20	0.3	−55° To +71°C	13	3.920	P.M.	FACE	13R-9101-13
157:1	60	28	24-32	0.4	60	12.0	0.6	−55° To +85°C	13	4.095	P.M. GOVERNOR	FACE	13R-9102-03
285:1	48	35	—	.25	40	160	0.6	−55° To +71°C	13	4.038	P.M.	FACE	13R-9103-01
333:1	30	28	24-32	0.4	30	12.0	0.6	−55° To +85°C	13	4.317	P.M. GOVERNOR	FACE	13R-9102-04
410:1	15	27	25-29	0.3	15	8.0	0.3	−55° To +85°C	13	4.400	P.M. GOVERNOR	FACE	13R-9102-11
1043.8:1	5-10	27	24-30	0.15	7	30	0.2	−55° To +71°C	13	4.450	P.M. BRAKE	FACE	13R-9105-01
1044:1	5-10	27	24-30	0.15	7	30	0.2	−55° To +71°C	13	3.910	P.M.	FACE	13R-9101-12
2214:1	3-4	6	—	1.2	3.4	30	1.2	−55° To +71°C	13	4.454	P.M.	FACE	13R-9101-04
3241:1	5.5	35	—	.35	5.5	18	0.4	−55° To +71°C	13	4.454	P.M.	FACE	13R-9101-03
5933:1	1.3	30	—	.13	1.3	30	0.15	−55° To +71°C	13	4.816	P.M.	FACE	13R-9101-10
21,707:1	2-3	120	—	.25	2-3	12	0.25	−55° To +71°C	13	3.475	P.M.	FLANGE	13R-9101-16
322:1	80	110	—	0.2	30	240	0.3	−55° To +71°C	15	3.815	SPLIT SERIES	FLANGE	15R-9201-01
407:1	22	27	—	0.2	20	8	0.2	−20° To +50°C	15	3.989	SPLIT SERIES	SYNCHRO	15R-9201-03
433:1	30	26	—	0.6	25	260	1.2	−50° To +80°C	15	3.110	SHUNT	FACE	15R-9201-02
955:1	33	27	—	0.6	12-18	420	1.0	−55° To +50° C	15	4.419	SPLIT SERIES	FLANGE	15R-9201-08
26:1	240	27.5	24-29	0.65	240	40	1.3	−18° To +71°C	17	5.315	SHUNT GOVERNOR	SYNCHRO	17R-9251-01
4.26:1	1800	28	—	0.6	1800	12	1.85	−30° To +55°C	24	4.640	SHUNT GOVERNOR	FACE	24R-9451-01

Speed tolerance on governed motors is ±2% over voltage and an ambient temperature range. Closer speed tolerance units can be designed to fit the particular application.

Many other variations available. There is an Oster motor-gear-train to fit your exact specification. Consult Oster specialists today, sending your detailed requirements.

Other products include servos, synchros, AC drive motors, DC motors, servo mechanism assemblies, synchro indicators, servo torque units, reference and tachometer generators, actuators, motor driven blower and fan assemblies and fast response resolvers.

John Oster MANUFACTURING COMPANY
Your Rotating Equipment Specialist
AVIONIC DIVISION
Racine, Wisconsin

Engineers For Advanced Projects:
Interesting, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Zelazo, Director of Research, in confidence.

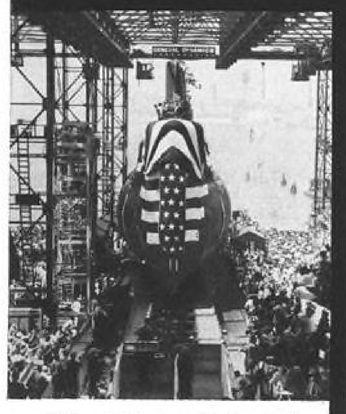
BURTON BROWNE ADVERTISING



FICo engineers and produces the guidance for the Redstone Missile. *U.S. Army Photo*



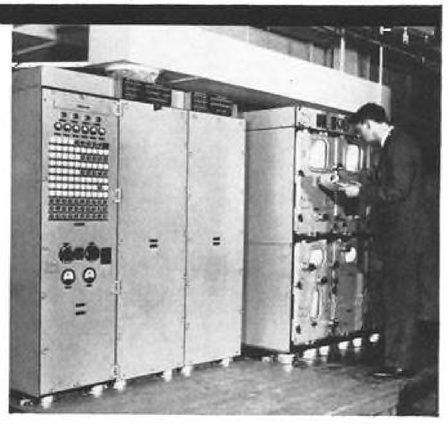
FICo navigational equipment goes into a wide range of aircraft. *U.S. Air Force Photo*



FICo controls are used in the atomic submarine program. FICo is also working toward development of the closed-cycle gas-cooled reactor. *U.S. Navy Photo*



FICo research and design led to improved safety and arming device for Army atomic cannon. *U.S. Army Photo*



FICo analog and digital computers can be readily developed and produced—using modular techniques—for special purpose applications.



FICo launching and control order computers are used for Navy A-A missiles.—*U.S. Navy Photo*

FICo COMPUTER AND CONTROL SYSTEMS

- For Weapons Control
- For Processing of Data
- For Special Purpose Computer and Control Applications

Ford Instrument Company develops and produces the most modern of special purpose computer and control systems—for missile, airborne, shipborne, land-based, and nuclear applications—for *government and industry.*

FICo is one of the foremost organizations in the United States working in the field of automatic control. Hundreds of engineers and extended precision mass production facilities enable FICo to handle complete systems contracts from start to finish.

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TECHNIQUES and DEVELOPMENTS in oscillographic recording



FROM **SANBORN**

PHASE SENSITIVE DEMODULATOR PREAMPLIFIER PROVIDES A DC VOLTAGE PROPORTIONAL TO AN INPHASE COMPONENT OF AN AC VOLTAGE WITH RESPECT TO A REFERENCE.

THE measurement of the amplitude of an AC voltage component is often necessary in performance studies of servo systems or of suppressed carrier signals over the carrier frequency range from 60 to 10,000 cps. In such cases the demodulator responds to inphase signals and rejects quadrature signals.



A circuit with these characteristics for use in an oscillographic recording system can be seen in the Model 150-1200 Servo Monitor (Demodulator) Preamplifier. It was developed by Sanborn as one of twelve interchangeable, plug-in front ends for "150" Series equipment, to be used with the appropriate Driver Amplifier-Power unit in any channel of a "150" system. Elements comprising the circuit from input to output, include: compensated stepped attenuator and cathode follower input circuit, phase inverter, push-pull mixer and demodulator stages, differential DC output amplifier and low pass filter. In addition, the chassis contains a VTVM to facilitate accurate adjustment of the reference voltage, and an overload indicator which lights a warning lamp when excessive quadrature voltages exist.

Adaptability to a fairly wide variety of applications is accomplished through broad input voltage, reference voltage and frequency ranges. In order, these are 50 mv to 50 v (for full scale 5 cm deflection), 10 v to 125 v; 60 cps to 10kc. Rise time with low frequency plug-in demodulation filter is 0.1 seconds; with high frequency filter, 0.01 seconds. Quadrature rejection is better than 100.1; for carrier frequencies up to 5000 cycles.

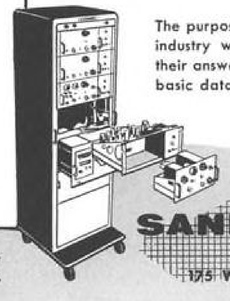
Two representative uses of the Servo Monitor Preamplifier are in the design and adjustment of servo systems, and with instruments used in the design, development or adjustment of other apparatus. The first is illustrated by use of the Preamplifier and associated equipment in the recording of the output shaft amplitude and driving frequency of an AC positional servo; the second by recordings made with a similar setup of the difference between output signals from a gyroscopically-controlled stabilizing device and the "pitch" and "roll" signals generated by a "Scorsby Table" used for testing the device under dynamic conditions.

For a detailed discussion of the principles and design considerations involved in the Servo Monitor Preamplifier, refer to the February, 1955 issue of the Sanborn RIGHT ANGLE, for Dr. Arthur Miller's article on "Measurements with the Servo Monitor Preamplifier."

Technical literature and engineering assistance on specific problems are always available from our engineering department.

BASIC FACTORS IN SELECTING OSCILLOGRAPHIC RECORDING EQUIPMENT

WHEN considering any oscillographic system or equipment for your application, three useful "yardsticks" to apply are (1) the recording method, (2) equipment adaptability, and (3) variety of equipment available. Here are the answers to the three, as they apply to Sanborn systems. In the record, rectangular coordinates accurately correlate multiple traces, simplify interpretation and eliminate errors. Permanent traces, produced by a hot ribbon stylus without ink, provide sharp peaks and notches, and clearly reveal all signal changes. One percent linearity results from current feedback driver amplifiers and high torque galvanometers of new design; maximum error is ¼ mm in middle 4 cm of chart, ½ mm across entire chart. From the standpoints of "adaptability" and "variety", Sanborn "150" equipment offers the versatility of 13 different plug-in front ends for any basic system . . . the choice of one- to eight-channel systems . . . the variety of nine chart speeds, timing and coding controls, console or individual unit packaging . . . availability of equipment as either complete systems or individual amplifier or recorder units.

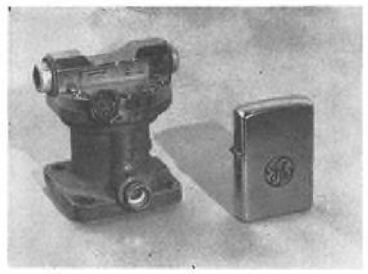


The purpose of the foregoing information is to better acquaint industry with typical oscillographic recording problems and their answers, design considerations in Sanborn equipment, and basic data on what Sanborn makes and how it is being used.

SANBORN COMPANY
INDUSTRIAL DIVISION
175 WYMAN STREET, WALTHAM 54, MASS.

5 lb. There are high temperature models for continuous operation up to 400F. Wide variety of coils is offered to match impedances of electronic, magnetic or transistor amplifiers.

Raymond Atchley, Inc., 2340 Sawtelle Blvd., Los Angeles, Calif.



Missile Fuel Pump

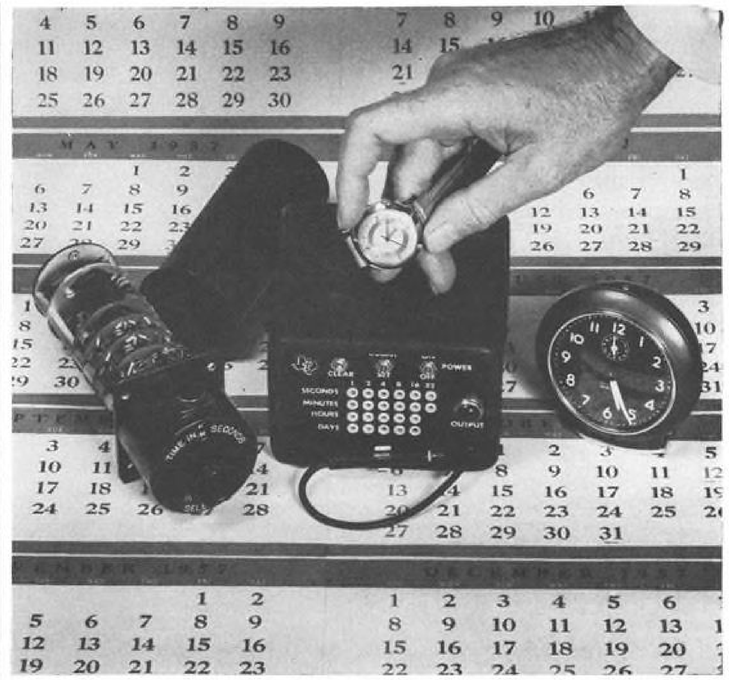
Fuel pump for low viscosity, low lubricity, highly corrosive propellants such as normal propyl nitrate is designed to operate in missiles at high temperatures. Low pump weight to discharge flow ratio is achieved by high speed operation of balanced symmetrical parts. Ball piston concept is used for reliability.

Aircraft Products Dept., General Electric Co., Schenectady 5, N. Y.

Ratio Plotter

Automatic and continuous ratio plotter saves 50%-75% of vibration laboratory testing time and eliminates data reduction. It plots complete vibration transmissibility curve on strip chart during test for immediate evaluation. Basic unit offers same advantages for dynamic testing that is a function of any ratio which can be indicated by two a.c. voltages. One unskilled technician can program and run a complete test. Frequency response is ±2% from 5 to





Texas Instruments transistorized timing devices offer new highs in timing / reliability / application

- No moving operational parts
- Accuracies up to one part in 50 million
- Intervals from microseconds to months
- Instant response without warmup
- With ¼ the space; ½ the weight; a small fraction of the power needed for timers based on other methods
- Qualified under all applicable MIL specifications

Already in production, TI transistorized timers are blazing new trails in applications and in performance . . . with extraordinary accuracies and with interval variations to infinity . . . improvements never before practical because of size, weight, power drain, and maintenance limitations.

Designed for repetitive or continuous sequential timing or programming, these lightweight, dependable timers are now in production at Texas Instruments for use in camera timing, flare dropping, bomb release, mine laying, and sonobuoy placement. These are just a few of many potential uses. And, since modification engineering only is required, these remarkable TI timers can be built to *your* specifications within reasonable lead-time. Contact Apparatus division . . .

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INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

UNEQUALED PERFORMANCE IN

- TELEMETERING
- GUIDED-MISSILE MONITORING
- RADIOSONDE RECEPTION

TYPE 1501 SPECIAL PURPOSE RECEIVER



This Special Purpose Receiver is an improved version of the NEMS-CLARKE 167-J1 and 167-J2. This new Receiver incorporates the best qualities of both of the former types plus many new features including a BFO. A video bandwidth control is provided to greatly improve signal-to-noise ratio when full bandwidth is not needed. It is especially useful as a high quality general purpose laboratory receiver.

SPECIFICATIONS

Type of reception	AM, FM, or CW
Tuning range	55-260 mc
IF bandwidth	300 kc
Sensitivity (measured without band-restricting filters)	8 uv produces at least 23 db S/N ratio with 100-kc deviation, 400-cycle modulation.
Noise figure	11 db, maximum
IF rejection	Not less than 70 db
Image rejection	Not less than 40 db below 130 mc; 30 db minimum at any frequency.
FM output	0.15 volt per kc deviation (Approx.)
AM output	12 volts for 10 uv input modulated 30% at 1000 c.p.s. (Approx.)
Squelch	Operates on monitor circuit

NEMS-CLARKE
INCORPORATED
919 JESUP-BLAIR DRIVE
SILVER SPRING, MARYLAND

For further information write Dept. H-6



INSTANT PRESSURE REGULATION

0 TO 3000 PSI

WITH THE Futurecraft HI/LO HAND LOADER
Proven Superior in Comparative Tests

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GENERAL SPECIFICATIONS

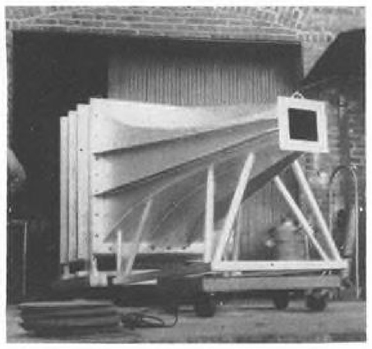
Port Size	¼" tube per AND 10056
Pressures	Operating—100-3000 psi Proof—6000 psi Burst—7500 psi Minimum
Flow	Exceeds any other loader available
Operating Temperatures	— 65° to + 250°F
Weight	2⅓ pounds

2,000 cps. and ±2½% from 2,000 to 4,000 cps. Chart speed is variable from 6 to 960 in. per hour. Unit is called T/Plotter.

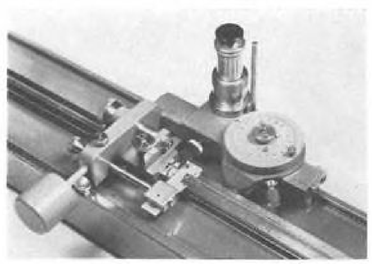
Dept. T, Barry Controls Inc., 815 Pleasant St., Watertown 72, Mass.

Jet Noise Simulator

Jet engine noise simulator makes possible realistic environmental testing of components in which vibration effects may be critical. It is also useful for testing noise suppressors and acoustic insulation. Simulator is offered in complete package test installations which are engineered to specification and include soundproof enclosures. Typical installation uses James B. Lansing loudspeakers, generates 151 db. of noise in the range between 50 and 10,000 cps. through 8 in. x 8 in. opening into free field. Sound source may be single sine wave, white noise or variation between the two extremes.

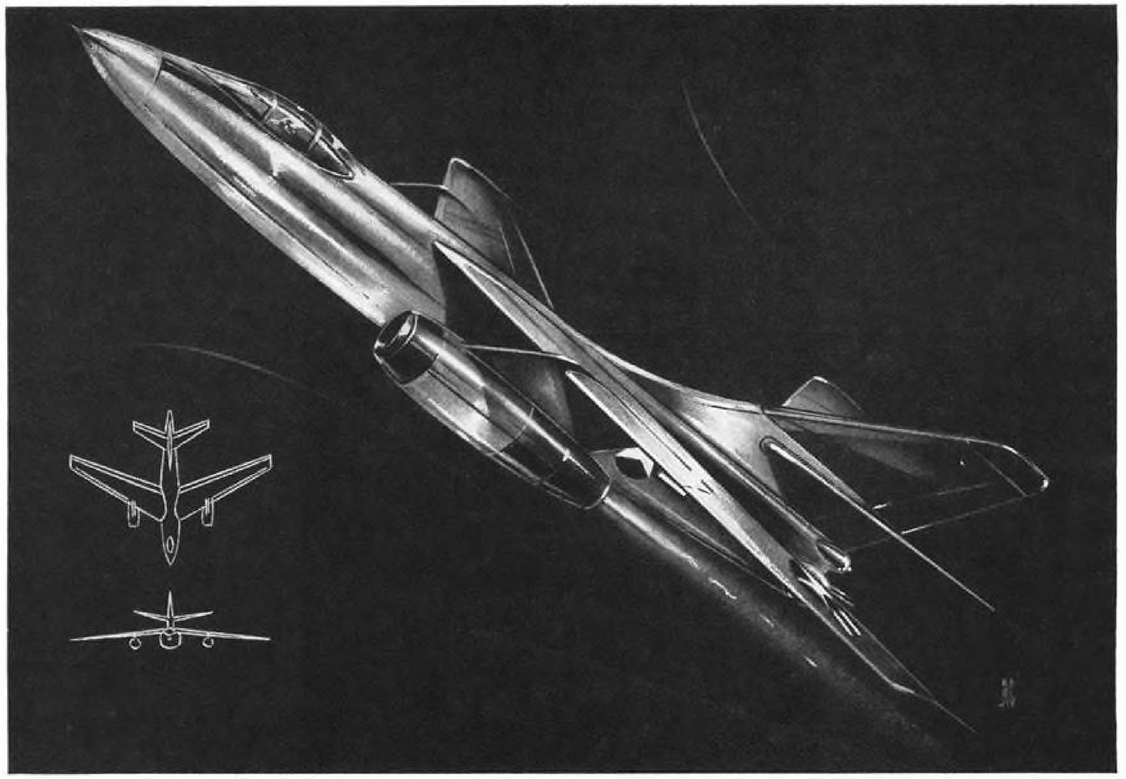


Kittell-Lacy, Inc., 10816 E. Fawcett Ave., El Monte, Calif.



Plotting Instrument

New precise plotting instrument called Coordinatograph plots points along X and Y coordinates within .001 in. It is used for aircraft lofting, gage charts, laying out small parts, plotting blades in a stack, plotting flow patterns for turbine blades, establishing coordinate positions precisely for chart and map makers and plotting reticules or targets for instrument makers. Working area is 47½ in. x 47½ in. table made of vertically laminated wood strips. Radii



Biggest carrier-based plane — The A3D Skywarrior was developed by Douglas, El Segundo, Calif., for bombing, mine-laying, and photo reconnaissance. She's capable of close-to-sonic speed — and can fly above 40,000 feet.

So powerful it could take off straight up!

That's right! The U. S. Navy's A3D Skywarrior *could rise vertically* from a carrier deck.

Of course, this long-range attack bomber is not designed for such take-offs . . . but with JATO units mounted on her fuselage, with the enormous thrust of two J-57 turbojet engines, she packs all the power she'd need.

Power like this means searing heat and other destructive conditions in engine and air-frame parts.

That's why the Skywarrior — like many modern jets — has Inco Nickel and Inco Nickel Alloys at critical locations. These metals provide heat resistance, corrosion resistance, strength, and ductility in just the combinations required for top performance of today's powerful aircraft.

Investigate the Inco Nickel Alloys when *you* want a metal for severe service. Just write Inco's Mechanical Engineering Section, giving details of your problem.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO Nickel Alloys

are marketed under the following trademarks:
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Where Inco Nickel Alloys are used in jet aircraft

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Fine fuel line tubing

Inconel "X"
Rotor discs
Afterburner bellows
High-temperature bolts
Rocket engine rotors

Nimonic Alloys
Combustion liners
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Turbine blades
Rotor discs

Inconel "W"
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Afterburners

Inconel "700"
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Incoloy "901"
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Fine fuel line tubing
Rivets

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Pure Nickel for electrical and electronic gear. Primary Nickel as alloying element in other materials. Inco Precision Castings in many different alloys.

NEW

THE JET M-84 ROBINSON WIRE TWISTERS



Robinson Quality for $15.50

Here is the answer to your demand for a mass produced wire-twister. It's the all new JET M84 Robinson Wire Twister. The JET is a worthy partner to the standard Robinson model that has cut engine wiring time 66⅔ for virtually every major aircraft company in the free world.

Robinson quality? Certainly. You'll find it in the specially rehardened jaws and cutters, in the optional Grip-Lok or Sleeve lock, in the swift, smooth (and patented) action, in the heat treated, drop forged, alloy steel pliers with black finish.

Outstanding price? Yes, indeed. Your $15.50 now buys a **Robinson** . . . the three way labor saver — plier, cutter, twister. The tool that can pay for itself the very first day you use it.

Get the full details today. Write for the beautifully illustrated JET brochure. It describes a precision tool you will be proud to own, and happy to use in the shop . . . and in your home workshop.

Write today, your brochure will be sent by return mail. Write to Ralph C. Robinson Company, Dept. WJ, 2516 Crosby Way, North Sacramento 15, California. Ask for the JET brochure.

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FIRST NAME IN WIRE TWISTERS

THE WIRE TWISTER WITH THE EXCLUSIVE DIAGONAL JAWS

from 12 in. to 40 in. may be plotted. Pricker point has 7 power microscope so that the point can be observed and plotted in a single set-up.

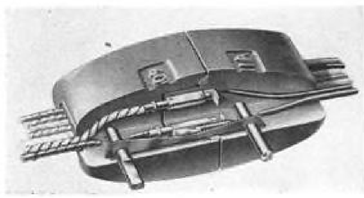
Aero Service Corp., 210 E. Courtland St., Philadelphia 20, Pa.



Wide Angle Lens

Compact 3.45 mm. wide angle camera lens is equipped with an iris ring adjustment from f/1.5 to f/8. Lens covers a field 165 deg. wide and is available in gun camera (GSAP) or "C" mount. With gun camera mount, lens protrudes 4½ in. from camera front plate and is 4 in. dia. at widest point. It is called Traid 720.

Traid Corporation, 17136 Ventura Blvd., Encino, Calif.



Missile Connector

Connector with insulation molded directly onto contacts is finding use as missile umbilical disconnect. Single-shot molding of insulation around leads and contacts in connector body which is integral with cable eliminates costly assembly operations. Connectors are tamper-proof and promise trouble-free field operation. Positive moisture seal is provided and leads and contacts are protected from shock and vibration.

Dept. AUC-8, Alden Products Co., 117 N. Main St., Brockton, Mass.

Countermeasures Contract Goes to General Electric

General Electric received $20 million contract for production of airborne electronic countermeasures equipment (radar jammers) from Air Force. Award is initial contract which permits production before final contract is negotiated. No estimate was made of final value of contract.

PhotoStress Technique Licensed by Tatnall

PhotoStress, a stress analysis technique which puts the stress pattern directly on the part, has been licensed for this country and Canada by the Budd Co.'s new subsidiary, Tatnall Measuring Systems, Phoenixville, Pa. Developed in France by Dr. Felix Zandman, PhotoStress was promoted in this country by Marc Wood, 30 Rockefeller Plaza, New York (AW, May 21, p. 23). It is an extension of the well known polaroid visual analysis method. However, instead of examining a two-dimensional model of the part, a thin film of transparent epoxy resin is applied directly on the part and the patterns in this film are observed as loads are applied to the part. By spraying the catalyzed plastic on in liquid form and curing it by moderate heat the stress patterns in complex shaped parts can be examined quantitatively as well as qualitatively, Zandman claims. It may be used under stroboscopic light to observe the progressive stress patterns leading to a fatigue failure. A somewhat severe limitation for tomorrow's aircraft and missiles is that it is limited to temperatures below 284F. Professor D. C. Drucker, Brown Univ., Providence, R. I., has been working on the approach in this country.

The Men Who Are Air France

No. 5 OF A SERIES



CAPTAIN LUCIEN GAMBADE

A Senior Air France Captain

MORE THAN 858 DAYS AND NIGHTS ALOFT!

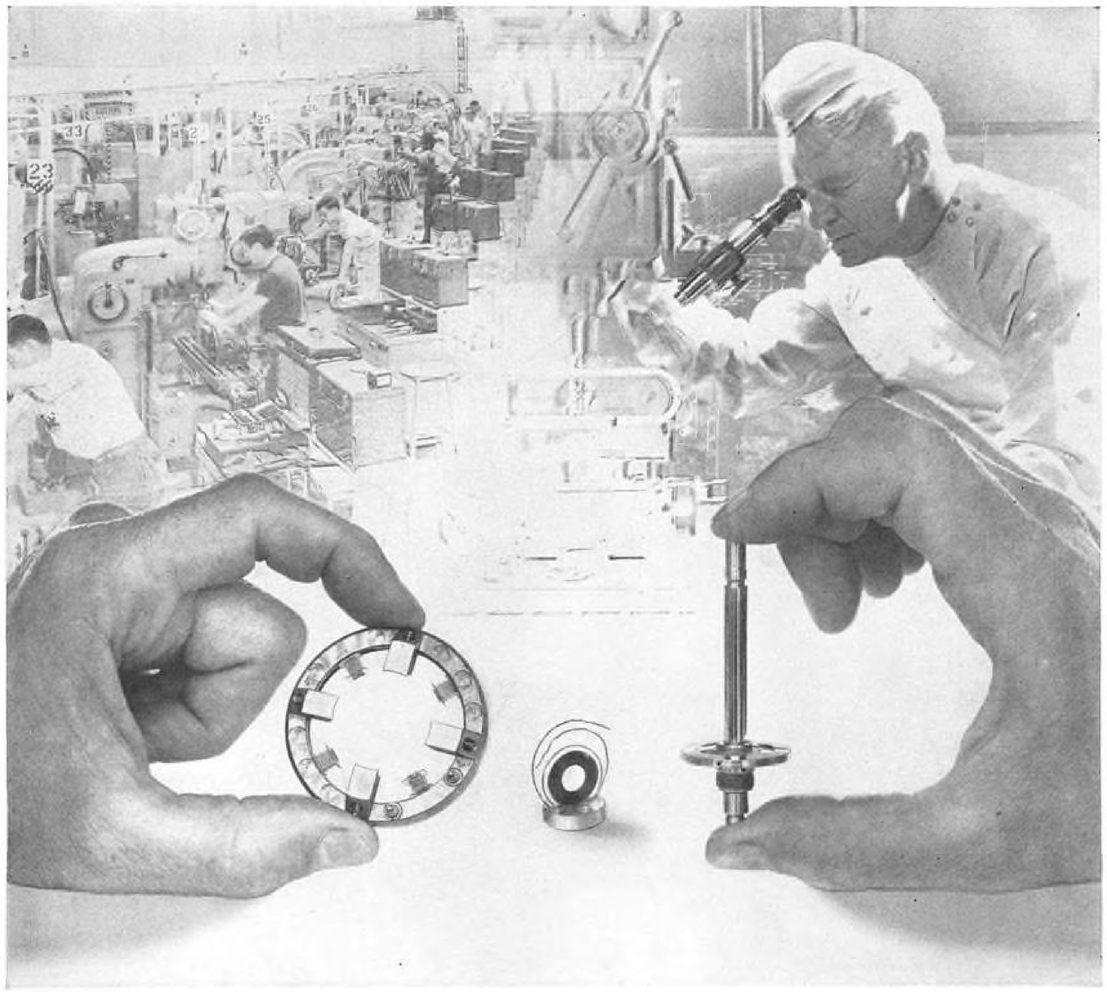
Almost two and a half years is a sizable segment of a lifetime. This is the time Captain Gambade has spent aloft for Air France, flying the rugged routes of Africa, the Near and Far East. Decorated repeatedly by France and other countries for his services to aviation, Captain Gambade is in active service on the Air France network under the Regional Representation of Madagascar. He is typical of the type of man who has helped build Air France's 38-year record of dependable service to people of 73 countries.

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...with quantity production of electro-mechanical brains, nerves and muscles

Automatic flight control or guidance systems must operate as dependably as the human faculties they supplement. Compact enough for the sleek confines of a jet or missile... yet rugged enough for environmental phenomena that defy description . . . they must be machined and assembled with a precision as exact as diamond-cutting. To make just *one* is a technological triumph—but the need is for *thousands*.

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In a business where even a thumbprint could cause intolerable inaccuracies, mechanisms are assembled in special dust-free rooms... by technicians as immaculate as surgeons, and with the same scalpel sureness. Production tolerances have been reduced to millionths of an inch.

Finally, these systems—on whose accuracy human lives and purposes will one day depend—must be tested by equipment more sensitive, and to standards more exacting, than the products themselves.

Today AUTONETICS is one of the few companies in the world that can produce in quantity the electro-mechanical products it designs: autopilots, autonavigators, armament controls, computers, and other complete systems for the military and industry.

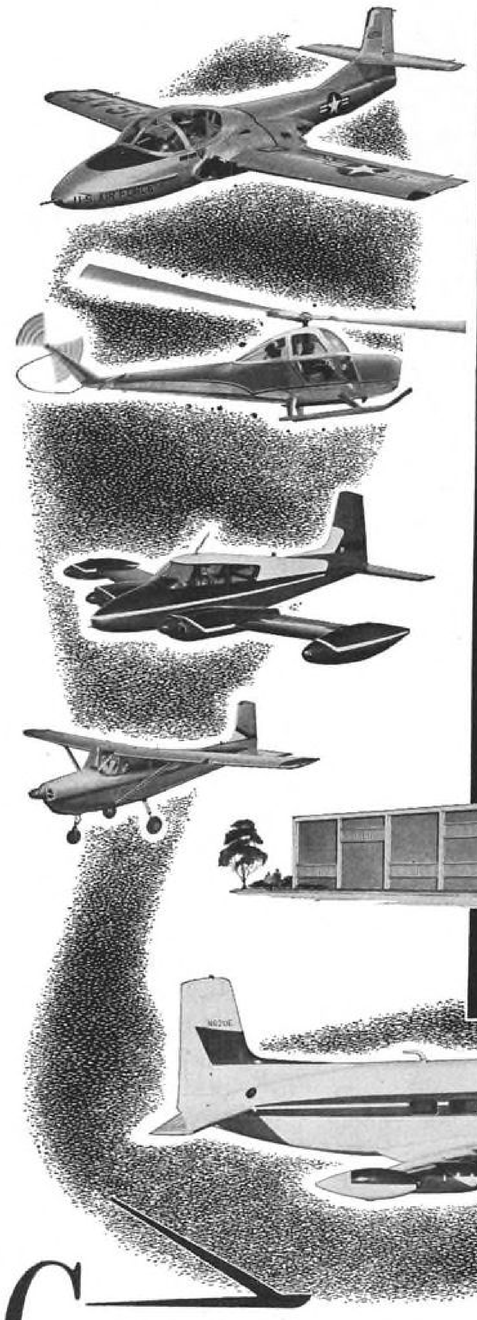
For detailed information—or for employment in this dynamic field—write: AUTONETICS, Dept. W-72, 12214 Lakewood Blvd., Downey, California.

Autonetics

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AUTOMATIC CONTROLS MAN HAS NEVER BUILT BEFORE

engineers:



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Hayes Aircraft Corporation has a competent staff of infrared scientists and engineers which is conducting research and development programs calculated to advance the frontiers of infrared physics. Much of this work of course is classified, and Hayes respects the needs of national security.

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Hayes is a fully competitive company, employing more than 8,000 people. Without a doubt, it is the fastest growing aircraft company in the United States.

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Infrared physics is but one of the sciences presently being explored by the Hayes scientific staff. There are many challenging positions open here to personnel qualified in the fields of infrared physics, spectroscopic analysis, physical chemistry, kinetic molecular theory, semi-conductor research and development, thermodynamics, fluid dynamics, and kinematics, to name a few. Mail a resume of your training and experience to Director of Personnel.

Hayes
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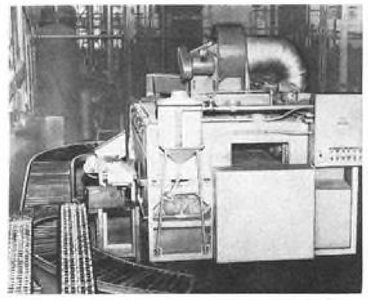
ENGINEERS • DESIGNERS • MANUFACTURERS

PRODUCTION BRIEFING

Alloy Tube Division, Carpenter Steel Co., Union, N. J., anounces it is producing tubular forms of Armco 17-7PH precipitation hardened stainless steel. Because it combines high strength per weight at high temperatures with corrosion resistance, this material has been growing in popularity in aircraft, guided missile and rocket applications.

Anadite Inc., South Gate, Calif., will open a new half-million dollar plant in Hurst, Tex., to serve the southwestern area for chemical milling and most forms of metal finishing on aluminum, magnesium and steel. Plant will also use the Hardas Process, which is another method of hard anodizing.

Ransohoff, Inc., Hamilton, O., says its combination continuous drum and belt conveyor type cleaner will do the work of two machines. Small parts are washed, rinsed and dried in the



drum section and larger work or tote pans are processed at the same time in the conveyor section. Design is flexible enough so that pickling, neutralizing, phosphate coating and similar processes can be accomplished.

U. S. Safety Service Co., Kansas City, Mo., says its new S-7 square frame



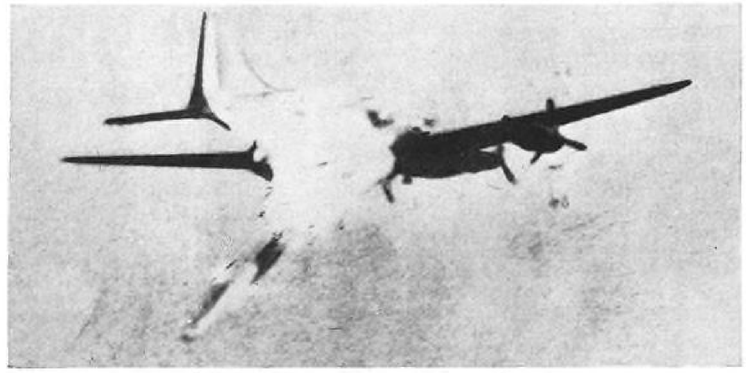
safety glasses are good looking, comfortable and satisfy government specifications.

Flex-O-Tube Division, Flexonics Corp., Chicago, reports its new line of extruded Teflon hose with stainless steel wire braid will withstand 3,000 psi pressure at usual temperatures or 1,000 psi. pressures at 500F. Teflon is able to resist the corrosive action of many chemicals including certain jet fuels.

Aero-engines accounted for 27% of the $290 million 1956 export business of the British Aircraft Industry, according to the Society of British Aircraft Constructors, London.

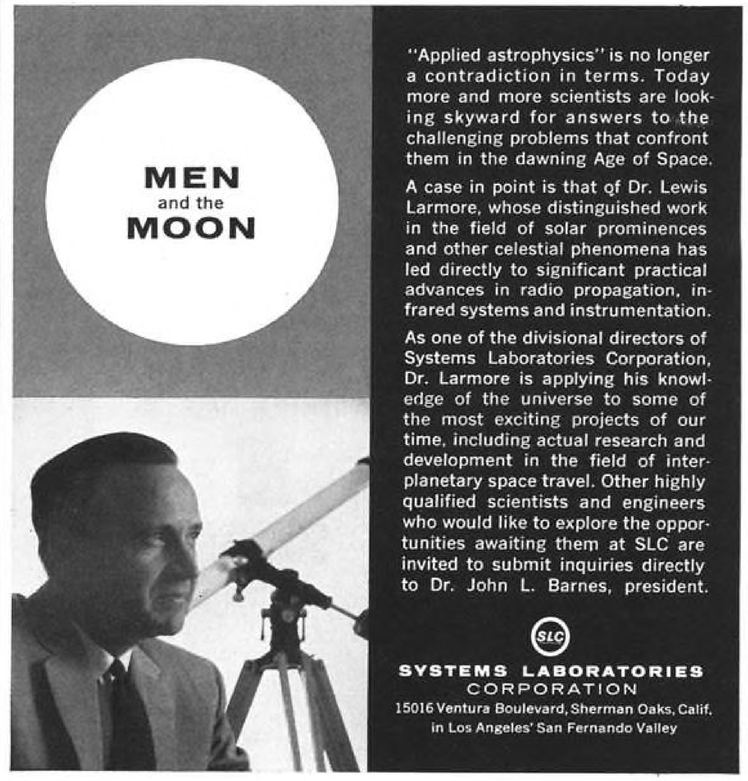
North American Aviation, Inc., announced it will open a European office in Geneva, Switzerland, with Robert J. Clark as director. Clark will develop commercial and military overseas markets as well as maintain liaison with USAF.

Martin Co.'s Nuclear Div., Baltimore, Md., ordered two Stanat TAH-400 machines which roll metal powders directly into strips. Made by the Nuclear Division of Stanat Manufacturing, Inc., Westbury, N. Y., the TAH-400



Nike-Hercules Hits B-17

Nike-Hercules missiles scores a hit on B-17 drone in tests over the Tularosa Basin firing area of White Sands Proving Ground, N. M. Nike-Hercules, formerly Nike B, can carry a nuclear warhead (AW Mar. 4, p. 30), but conventional warhead was used here.



"Applied astrophysics" is no longer a contradiction in terms. Today more and more scientists are looking skyward for answers to the challenging problems that confront them in the dawning Age of Space.

A case in point is that of Dr. Lewis Larmore, whose distinguished work in the field of solar prominences and other celestial phenomena has led directly to significant practical advances in radio propagation, infrared systems and instrumentation.

As one of the divisional directors of Systems Laboratories Corporation, Dr. Larmore is applying his knowledge of the universe to some of the most exciting projects of our time, including actual research and development in the field of interplanetary space travel. Other highly qualified scientists and engineers who would like to explore the opportunities awaiting them at SLC are invited to submit inquiries directly to Dr. John L. Barnes, president.

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SYSTEMS LABORATORIES CORPORATION
15016 Ventura Boulevard, Sherman Oaks, Calif.
in Los Angeles' San Fernando Valley

WHEELS ARE IMPORTANT



There have been some improved models made lately by

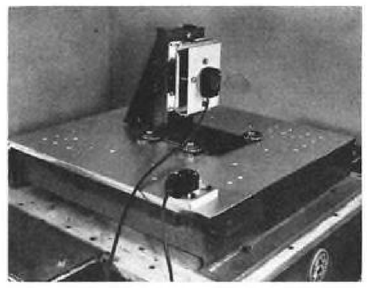
DETROIT CONTROLS CORPORATION
CONTROL ENGINEERING UNIT
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Developers and Manufacturers of Gyros
Gyro Flight Stabilizers
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DIVISION OF American-Standard

unit is designed primarily for processing fuel elements used in nuclear reactors. The $7,500 machines successfuly produce strip from such powders as aluminum, brass, copper, nickel, nickel-iron, molybdenum, tantalum, stainless-steel and other ferrous alloys.

Finn Aeronautical Division, Hawthorne, N. J., which has been producing liners, flameholders, exhaust nozzles, fuel systems for Curtiss-Wright Corp.'s Navaho missile ramjets, announces it is doubling its facilities by adding 10,000



ft. of floor space. Finn also has made C-W thrust reversers. Company specializes in the fabrication of high temperature parts using Inconel, Inconel X, Hastelloy, N-155 and the high temperature stainless steels. Picture shows Finn Co. "all attitude" shake table.

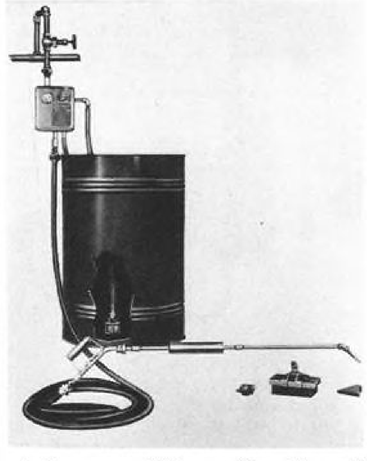
Keuffel & Esser Co., Hoboken, N. J., has opened a factory at Cranford, N. J., for expanding optical tooling production.

Narmco Mfg. Co., La Mesa, Calif., reports three-fold payroll growth during the last year from 150 to 475 employes, with a backlog increase of from $1,350,000 to more than $4,600,000. Narmco produces wing tips, rudders, elevons, wing fences and outboard wing extensions for the Convair F-102A, as well as parts for Boeing, Douglas, Chance Vought, Lockheed and McDonnell. As part of its expansion to meet the demand Narmco has a long term lease on a 20,000 sq. ft. plant addition which is now being built.

Roylyn Inc. products will now be sold through Airaterra Corp., Glendale, Calif.

Townsend Co., New Brighton, Pa., announced the acquisition of G. O. Noville & Associates Inc., a research and development organization in Santa Monica, Calif. Other companies which the 141 year old Townsend Co. has purchased are: Impact Products, Inc., Orangeville, O.; Armament Components, Inc., Los Angeles, Calif.; Cherry Rivet Co., Santa Ana, Calif.; The Dunn Steel Products Co., Plymouth, Mich.; and an interest in Parmenter & Bullock Mfg. Co., Ltd., Canada. Most of these firms have some connection with the parent company's cold forming and fastener interests.

Steamerette cleaner by Turco, Los Angeles, Calif., is described as an inexpensive steam cleaning unit for cleaning aircraft exteriors, paint stripping, phos-



phating or sanitizing. Operating off plant steam lines, the Steamerette converts the dry steam into a useful form by adding water and a suitable detergent before spraying work surfaces.

Like to curl up some wintry evening?

With a good book, I mean. Try these Stillman books. Terrific plot, all about Stillman services, facilities and products. And be sure to read about PERMADIZING, the amazing rubber-to-metal bonding process. Simply fascinating. Drop me a line and I'll have the PERMADIZING Man send you some copies right away.





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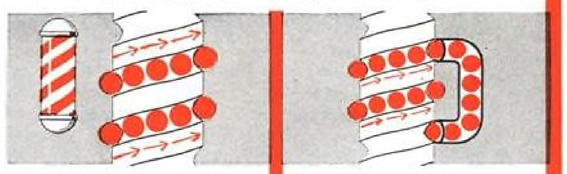
ACTUATION PROBLEM too tough for ordinary devices?

SAGINAW CAN HELP YOU SOLVE IT!

Saginaw b/b Screws guaranteed 90% efficient —offer 6 major advantages for designers



Available in custom machined and commercial rolled thread types—have been built from 1½ inches to 39½ feet long—⅜ to 10 inches diameter.



Nut *glides* on steel balls. Like stripes on a barber pole, the balls travel toward end of nut through spiral "tunnel" formed by concave threads in both screw and mating nut.

At end of trip, one or more tubular guides lead balls diagonally back across outside of nut to starting point, forming closed circuit through which balls recirculate.

1 VITAL POWER SAVINGS. With guaranteed efficiency of 90%, Saginaw b/b Screws are up to 5 times as efficient as Acme screws, require only ⅓ as much torque. This permits much smaller motors with far less drain on the electrical system. Circuitry is greatly simplified.

2 SPACE/WEIGHT REDUCTION. Saginaw b/b Screws permit use of smaller motors and gear boxes; eliminate pumps, accumulators and piping required by hydraulics. In addition, Saginaw b/b Screws themselves are smaller and lighter. Units have been engineered from 1½ in. to 39½ ft. in length.

3 PRECISE POSITIONING. Machine-ground Saginaw b/b Screws offer a great advantage over hydraulics or pneumatics because a component can be positioned at a predetermined point with precision. Tolerances on position are held within .0006 in./ft. of travel.

4 TEMPERATURE TOLERANCE. Normal operating range is from −75° to +275° F., but assemblies have been designed in selected materials which function efficiently as high as +900° F. These units are practical where hydraulic fluids have lost efficiency or reached their flash point.

5 LUBRICATION LATITUDE. Even if lubrication fails or cannot originally be provided because of extreme temperatures or other problems, Saginaw b/b Screws will still operate with remarkable efficiency. Saginaw units have been designed, built and qualified for operation without any lubrication.

6 FAIL-SAFE PERFORMANCE. Far less vulnerable than hydraulics. In addition, Saginaw offers three significant advantages over other makes: (1) Gothic arch grooves eliminate dirt sensitivity, increase ball life; (2) yoke deflectors and (3) multiple circuits provide added assurance against operating failure.

YOUR FREE COPY OF THIS NEW b/b SCREW AND SPLINE "PROBLEM SOLVER" SHOWS HOW

36 pages crammed with time-, work-, and money-saving facts: Principles • Types • Basic Operations • Coupling Methods • Efficiency • Advantages • Selection Factors • Design Data • Sample Problems

SAGINAW b/b SPLINE



● Averages 40 times lower coefficient of friction than ordinary sliding splines!

Utilizing the same basic *gliding ball* principle, Saginaw has developed the *Saginaw b/b Spline* which radically increases the efficiency of transmitting or restraining high torque loads.

It can be fitted with integral gears, clutch dogs, bearing and sprocket seats, etc. Units have been built from 3 inches to 10 feet long—⅜ to 6 inches in diameter.

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FREE TO PILOTS! See your nearby Esso Aviation Dealer for your free copy of "The Esso Co-Pilot"—a complete directory of Esso Aviation Dealers.





Contract F-51 Gathers Tornado Data

New York—Civilian-owned F-51D flown under contract with the Weather Bureau has begun to fill in gaps in understanding of squall line and tornado formation, and promises to pay benefits in lives saved in the Midwest "tornado alley."

Besides soundings made of severe local storm situations where tornadoes were forecast to form, the project has provided observations of general interest to pilots. As described by the pilot-owner, Jim Cook of Jacksboro, Tex., at a recent meeting here of the American Meteorological Society, these include:

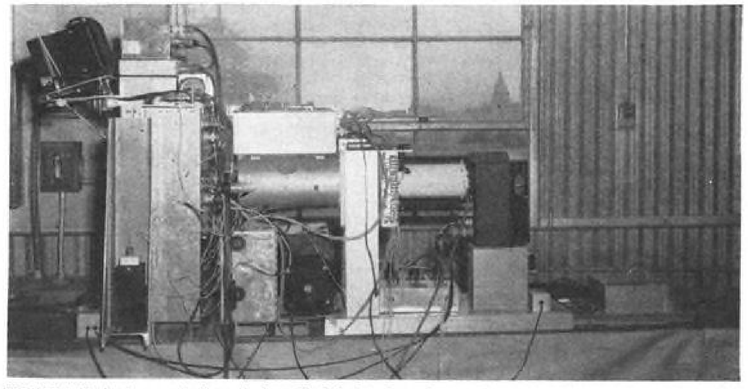
• **Electrical field** measurement instruments carried in the airplane, which have shown capability for signalling approach to turbulence—in weather and in clear air.

• **"Holes"** along the tops of squall lines between storm cells, though not often encountered, can be mistaken for saddlebacks. These cone shaped holes with a Niagara-like waterfall outline appeared to Cook to be intense downdrafts.

The hazards for pilots attempting to slip through saddlebacks in squall lines are obvious.



PILOT Jim Cook in his F-51 has time lapse camera mounted behind his left shoulder.



WEATHER instrumentation is installed behind cockpit. Over-shoulder camera is at left.

Chance Meeting

Beginning of the project goes back to a chance meeting in June, 1955, of Cook and Robert G. Beebe, a research meteorologist with the Weather Bureau's Severe Local Storm Forecast Center at Kansas City, Mo.

Cook, who got interested in using fighter type aircraft in cloud seeding after the war, was flying in Western Nebraska then under contract with a group of farmers near Scotts Bluff to suppress hail by seeding thunderstorm tops with silver iodide. Beebe had gone to Scotts Bluff to collect data on a family of tornadoes that had been extensively photographed there.

When the two men met again that fall at an American Meteorological Society meeting in Oklahoma devoted to severe local storms, the project of using a contract airplane to obtain badly needed soundings in tornado areas was born.

The alternative to using the airplane, which cost $50,000 last year and will cost $40,000 through the end of this fiscal year, was a multi-million dollar network of closely spaced stations in the Mid-Western "tornado alley."

Donald House, supervisor of the SELS unit, said the use of a private airplane under contract has paid off. Skeptics had said that the instrumentation, handled by the Bureau and Dallas Aero Service where Cook bases the plane, would be too do-it-yourself to provide the necessary accuracy. Others felt navigation foul-ups would leave much data useless.

After installation, the airplane instrumentation was tested in a flight following radiosonde balloons released at Topeka, Kan., and the separate observations correlated closely.

Radar Checks

By flying preselected tracks through a storm area, through use of radio and visual checks, and with Air Defense Command radar checks, the navigation has been no problem.

Though not enough data has been gained for flat conclusions, House has been able to develop a promising hypothesis for development of severe squall lines. This does not include tornadoes directly, but House points out that for the practical forecasting the unit does, a severe squall line and tornadoes are kith and kin—tornadoes forming probably in 85% of the cases.

Squall Lines

Squall lines forming as a result of frontal activity have largely been abandoned as a theory by SELS. The ripe situations in which the unit is interested are the confluence of low and high level jets streams producing shear over a tongue of low level moist air. This is a peculiarly Mid-West situation in spring, as are tornadoes.

The project was not designed to test any one hypothesis. Rather, it was designed to measure parameters common to most theories of squall line and tornado development. The airplane soundings have given all meteorologists some new evidence such as:

• **Near-vertical moisture** gradient encountered in an 800 millibar (4,000 ft.) horizontal sounding in Western Ne-

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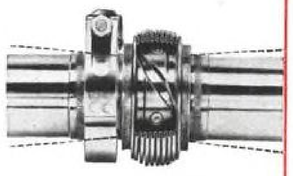
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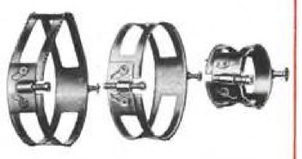
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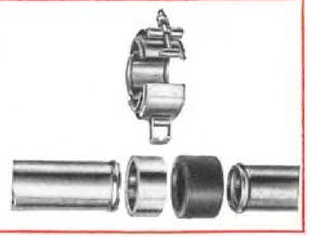
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APRIL 22nd AIR TRANSPORT Facts and Figures

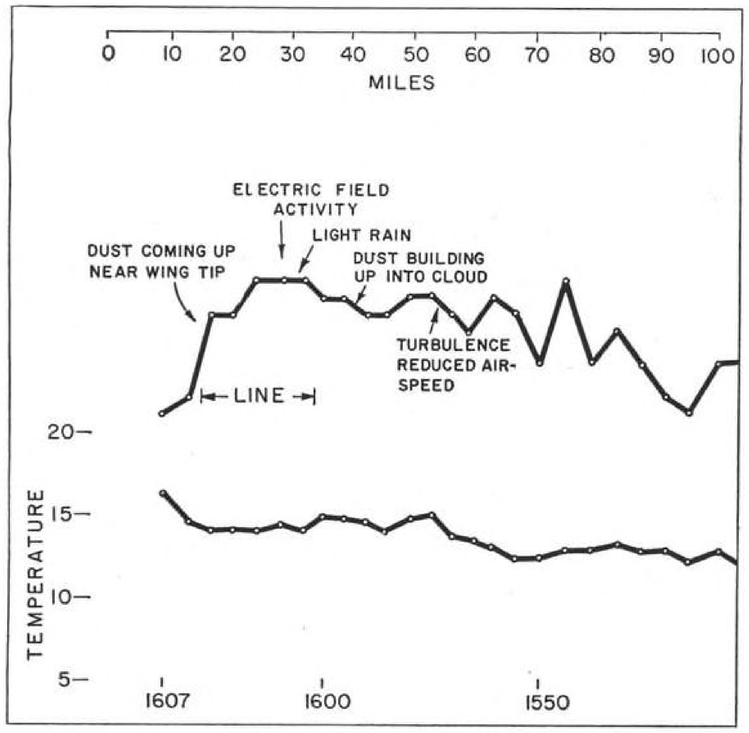
(PUBLISHED BY THE AIR TRANSPORT ASSOCIATION)

AVIATION WEEK has again been officially designated to publish "Air Transport Facts and Figures," compiled by the Air Transport Association. This editorial feature will appear in our April 22nd issue and will provide an impressive picture of the tremendous progress achieved by the carriers during the past year. We are particularly grateful that this vitally important editorial feature is again available to AVIATION WEEK's world-wide audience.

AVIATION WEEK average net paid ABC circulation June-December, 1956: **62,970**. Paid circulation of current issues; **65,726**. Recent readership research by Advertising Research Foundation shows 2.1 potential readers for every subscriber copy of AVIATION WEEK (readership determined by personal interview using strict recognition test). Current print order **69,817** copies.

Your advertising message scheduled for the April 22, 1957 issue will be timed to gain maximum attention from all those interested in the Air Transport industry. Regular advertising rates apply.

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PART of tracing by Weather Bureau shows conditions Cook encountered in traversing squall line near Sydney, Neb. Traverse made earlier did not show such a steep moisture gradient.

braska. This gradient, not marked at higher altitudes the morning of the sounding, developed later in the day, and a squall line subsequently developed just ahead of this gradient—not in the center of the moist layer as might be expected.

• **Temperature** gradient, equally steep, encountered near Gage, Okla., in a frontal situation.

• **Ice cloud** trailing from a thunderstorm cell only 500 ft. above the freezing level near Oklahoma City, a cell from which a tornado later developed.

Significance of these things has not been explained, but SELS forecasters felt the demonstration of convective lifting of the moist layer in Nebraska was worth the entire expense of the project.

Jet Stream Sign

Tornado forecasts are issued by the unit generally for a rectangular shaped area based on the jet stream confluence and its expected movement. Though flying these areas would seem to be hazardous, the Weather Bureau is not interested at this point in any observations within the activity.

Cook will get some rough rides, as the day he flew a pattern from Omaha, Neb., Norfolk, Neb., Sioux Falls, S. D., Omaha and Kansas City—an area in which six tornadoes were later verified. But he has complete discretion to leave the track specified by the Weather Bureau, and he has not yet penetrated any thunderstorms in tornado areas.

That will await more experience and probably radar. From a psychological standpoint, Cook explains that penetrating thunderstorms and penetrating thunderstorms in tornado areas are two different things. Cook has seen too many tornado forecasts verified.

Amount of flying Cook will do varies widely. When tornado activity is imminent—and the forecasters usually have a pretty good idea half a day in advance that it will develop—Cook may fly 6-8 hr. a day. But days may elapse with no activity.

Contracting Advantage

Weather Bureau, which could ask for assignment of a military aircraft to the tornado project, finds the contract with a civilian operator offers more flexibility.

Military airplanes are used in the bureau's hurricane study project.

With the civilian airplane, the tornado group finds it can make changes in airplane and instruments with a minimum of red tape, saving time in the relatively short tornado season.

Cook's first contract from February-June, 1956 called for 300 hr. of flying at a cost of $45,000, based on a sliding scale hourly rate. Actual time was 100 hr. Second contract, for July-August, 1956, was for $5,000 a month, plus $150 an hour. The third contract, to run through June this year takes a more experienced view of the total flying time needed. It calls for 150 hr. at $40,000.

Cook is given a track and general departure time by the Weather Bureau, if possible with a destination where he can obtain 100 octane fuel. Forecasters also give him a direction to fly for clear weather in emergency. Generally the flights are set up for 240 kt. TAS, which divides into six miles a minute for easy calculating. Last year most flights were at 800 or 700 millibars. Cook was able to fly these pressure altitudes using a cockpit instrument calibrated to read in pressure heights.

Project Altitudes

This year most flights will be at the surface or at the 500 millibar level (18,000 ft.), which are areas of greater atmospheric change in severe storm situations. The F-51 has flown to 35,000 ft. in the project.

In the first two contracts, Cook made 107 flights in 110 days with only two aborts. Forty were in areas of tornado activity. Cook believes in precise engine monitoring in flight, and has all sensitive type engine instruments. A flowmeter is his No. 1 engine gage, enabling refined mixture adjustment. Airplane and Weather Bureau instruments are checked every 50 hr., instead of conventional 100 hr. airplane checks, and plug changes are frequent.

Airplane instrumentation is off-the-shelf. It includes a Pioneer flux-gate compass, sensitive airspeed indicator, and a J-8 spill proof artificial horizon. Cook plans to go to a Lear VGI for elimination of turn error.

Weather Bureau instrumentation, weighing about 700 lb., is installed behind the canopy replacing an 85 gal. fuel tank. It includes:

• **Vortex thermometer.**

• **Infrared hygrometer.**

• **Two electric** field measuring systems, with probes on the nose, wingtips and tail.

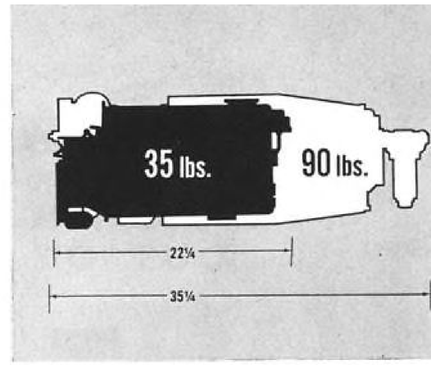
• **Pressure sensing device.**

• **Recording system** for the instruments.

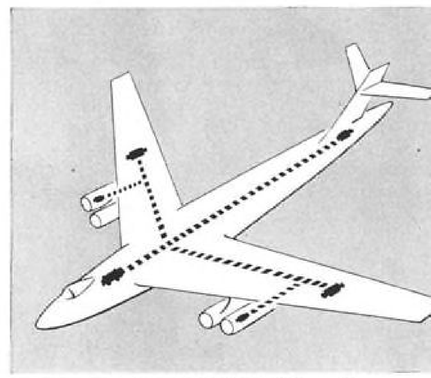
Slaves from the recorders carry the weather instrument readings to a separate panel in the cockpit. A 16 mm. time lapse camera mounted in the canopy behind the pilot is trained out at a 45 deg. angle. Cook also carries a hand-held 16 mm. movie camera.

Weight of the weather instruments affects the airplane's balance, but does not hurt landing performance. Cook





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COMPLETELY SELF-CONTAINED, G-E turbopump systems can be located wherever hydraulic power is needed, permitting effective integration into the basic airframe.

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The turbopump system's finned reservoir casing acts as a heat exchanger, eliminating supplementary cooling devices. Integral reservoir construction helps protect against handling shocks, and minimizes the possibility of leaks.

For additional information, call your G-E Aviation and Defense Industries Sales Office or mail the coupon below. *Aircraft Accessory Turbine Dept., General Electric Company, Lynn, Mass.*

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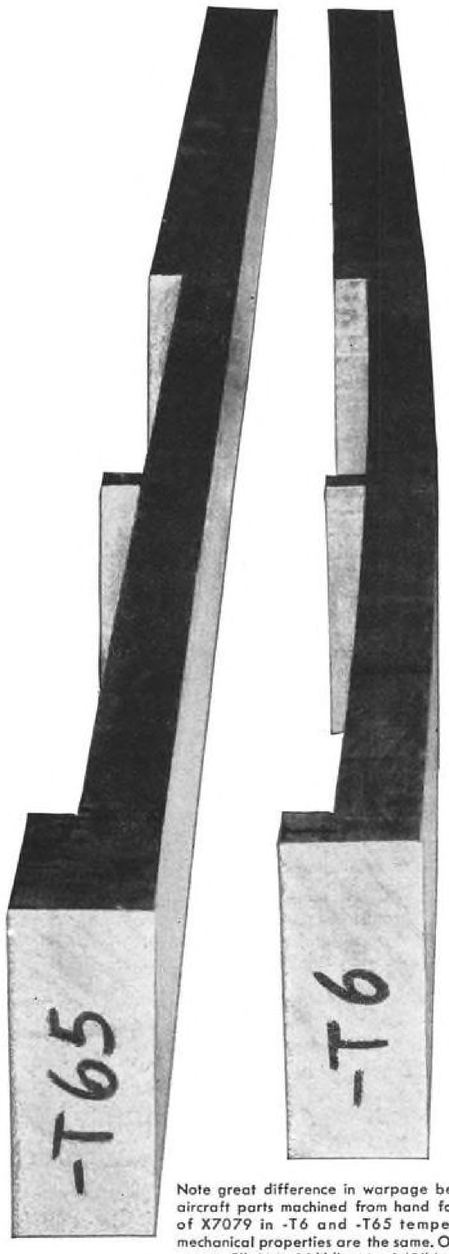
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NEW ALCOA PROCESS TAKES THE WARP OUT OF AIRCRAFT HAND FORGINGS



Note great difference in warpage between aircraft parts machined from hand forgings of X7079 in -T6 and -T65 temper. Yet, mechanical properties are the same. Original part is 5" thick, 11½" wide, 143" long.

Major technical advance saves machining, money, time

Up till now, hand forgings of aluminum in the high-strength heat-treated condition have had the unfortunate tendency to warp during machining, due to the presence of internal stress (see photo). The -T6 temper, now commonly used, gives you optimum mechanical properties but it may also mean extra machining, heat treating and straightening.

Well, a new day has dawned. Alcoa® can now supply hand forgings and rolled rings of X7079 alloy in the stress-relieved -T65 temper. These forgings have the same mechanical properties as found in -T6 temper but the warpage is practically nil—just about what you'd find in stretched plate and extrusions. In rolled rings, ovality caused by machining is reduced to a minimum.

We've supplied over 150,000 lbs of X7079 alloy in -T65 temper to a major aircraft builder and it has been thoroughly proved. So you can buy with assurance. This manufacturer used X7079-T65 to make parts of larger cross sections than have been made with 7075 or X7079-T6. They reported "uncountable savings in production time and machining costs."

So . . . for alloy X7079 in the -T65 temper, Alcoa will guarantee the same standard published properties now available within commercial heat-treat limits. Outside these limits we will negotiate guaranteed properties. The -T65 temper is also being applied to alloys 7075 and 2014 although sufficient data are not yet available to establish guaranteed properties in -T65 temper. (This we hope will come soon. Also, we hope to make die forgings in -T65 temper.)

This is another important "first" for Alcoa's Development Division and Research Laboratories. As we were first to develop stress-relieved sheet, plate, extrusions and rolled parts, now it's hand forgings and rolled rings. We think it is what you would expect from Alcoa. Aluminum Company of America, 1800-L Alcoa Building, Pittsburgh 19, Pa.

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lands the airplane at about 110 kt., 10 kt. faster than normal.

Cook would prefer a B-26 for this type flying, simply to make room for more manpower to handle instruments and cameras. He likes the way the F-51 handles, however, and feels lucky to have found one to buy.

The airplane is 14 years old. He bought it in June, 1955, after he lost another F-51, a wet wing version that he elected to bail out of rather than attempt a landing with one wheel jammed in a retracted position.

He found the new airplane in Kansas City, stripped and tired after it had been used for racing. He put the airplane back to standard condition, removing the tank behind the cockpit and making a wet wing center section to provide for 260 gal. of fuel, the original airplane capacity. The new fuel system saved 150 lb.

Cook had a cloud seeding contract to finish, but decided he could fly the 50 hr. left with the old engine. It lasted 50 hr., but went to pieces at 15,000 ft as Cook was flying home to Texas. As a result Cook had to make an engine change himself in a field at Wray, Col., in 10 deg. temperatures after a forced landing. With the installation of a new Packard-built Merlin engine, Cook had invested $16,000, not including purchase price.



'Gold' Interior

First Horton & Horton installation of its "Gold-Crest" series interiors for business planes is shown in Dactics Corp.'s new Aero Commander. Solid gold engraved plate of the company's emblem is set in Plexiglas extending down the rear bulkhead, continuing the overhead center panel which conceals three large ceiling lights and gives the effect of lengthening the cabin. An oversize leather-lined hatbox is set into the bulkhead and extends behind the rear seat. Individual gold-bronze swivel lights and air vents are on either side of the cabin; the golden tone repeated in the curtain racks and draperies of woven wood. Other decorative materials include imported Scottish leather and heavy napped wool broadcloth. Seats and sidewalls are of mohair. Dactics Corp. manufactures electronic computers.



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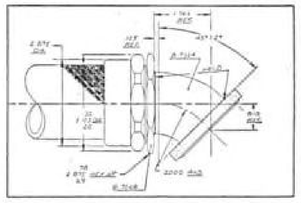
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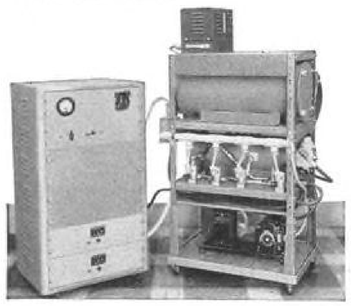


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Stock Transactions

Washington—Acquisition of 35,502 common shares of Slick Airways Inc. Stock by Earl F. Slick, director and beneficial owner, has been reported by Securities and Exchange Commission. Slick's total holding is now 173,283 shares, with Slick Oil Co., a beneficial owner, holding 7,200 shares.

Roy G. Woods, Sr., director, acquired 10,000 common shares for a total holding of 12,293 shares, and Charles F. Urschel, Jr., director and beneficial owner, disposed of 100 common shares leaving a holding of 9,901 shares. Other transactions from Jan. 11 to Feb. 10 include:

A.C.F. Industries Inc. Disposal of 200 common shares by Ernest L. Nye, director, leaving a holding of 600.

Aeroquip Corp. Acquisition of one and disposal of 400 common shares by Charles Hollerity, officer and director, leaving a holding of 17,062; disposal of 5,000 common shares by Stuart M. Sheram, director, leaving a holding of 20,060.

Aero Supply Manufacturing Co., Inc. Disposal of 4,150 common shares by Henman Investing Corp., leaving a holding of 20,335; acquisition of 5,450 common shares by Henry Margolis, director, for an indirect holding of 42,861; acquisition of 12 common shares by Leo Struss, officer, for an indirect holding of 18,585.

Air Reduction Co. Inc. Acquisition of 2,000 common shares through exercise of option by Charles D. Gibson, officer and director, for a holding of 4,000; disposal of 1,000 common shares by George E. Hawkins, officer and director, leaving a holding of 4,150.

American Bosch Arma Corp. Acquisition of 125 capital shares by Maurice L. Sindeband, director, for a holding of 125; disposal of 100 capital shares by Kenneth H. Rockey, director, leaving a holding of 4,310; disposal of 1,955 capital shares by a holding company, William S. Wasserman, director and owner in holding company, leaving a hold of 16,000.

Avco Manufacturing Corp. Acquisition of 500 common shares by Loyd P. Smith, officer and director, his total holding; disposal of 16,000 common shares by Harry Oedekerk, leaving a holding of 5,370.

Beech Aircraft Corp. Acquisition of 150 common shares by Lynn D. Richardson, officer, for a holding of 400.

Boeing Airplane Co. Acquisition of 700 common shares by William G. Reed, for a holding of 1,312; disposal of 263 common shares by William M. Allen, officer and director, leaving a holding of 15,301; disposal of 300 common shares by Evan M. Nelson, officer, leaving a holding of 1,336.

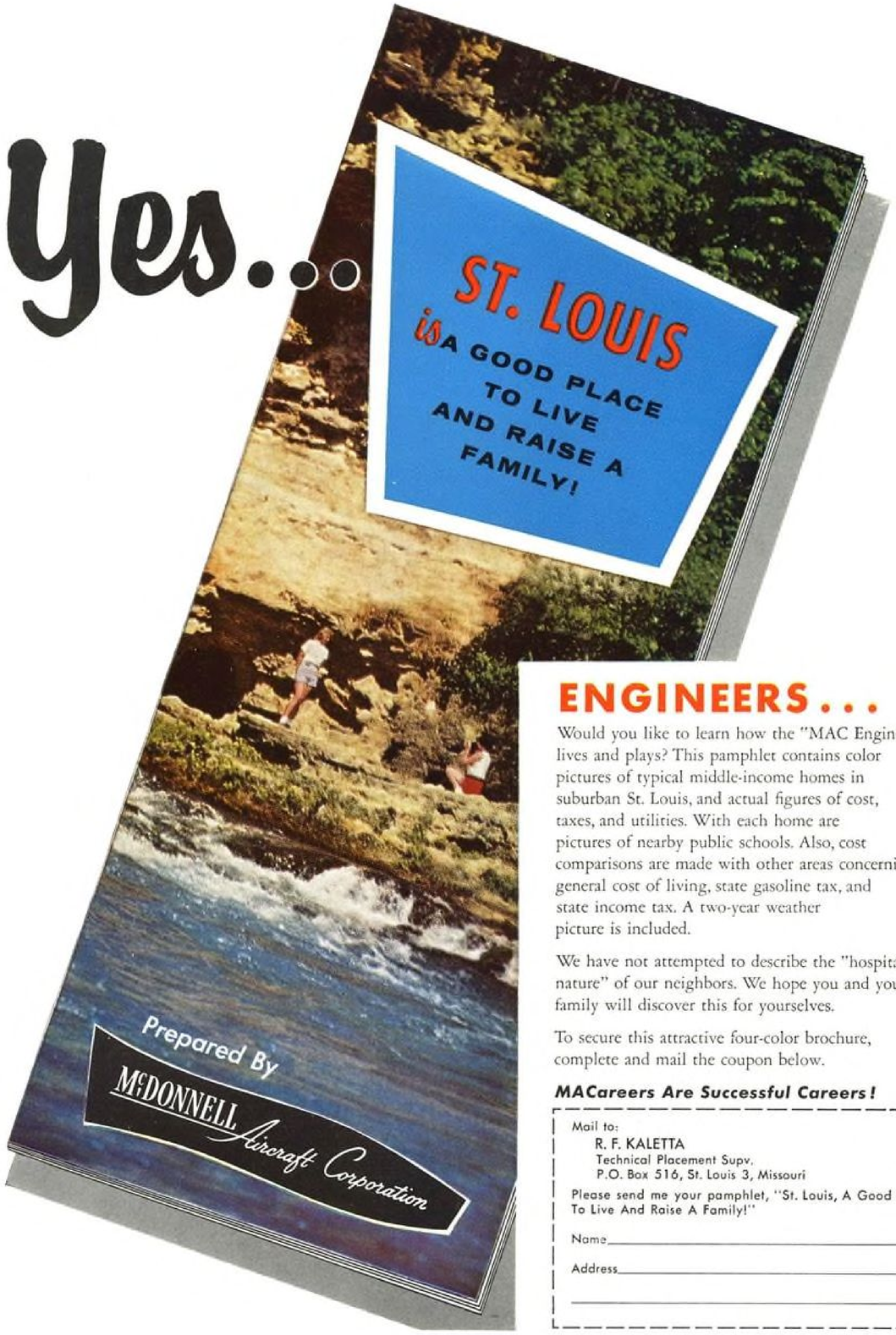
Capital Airlines Inc. Disposal of $25,000 in convertible debentures by James R. Stockton, director, leaving a holding of $6,000; disposal of $6,000 in convertible debentures by Harold B. Smith, director, his total holding; disposal of 200 common shares by Robert P. Wright, officer, leaving a holding of 375.

Chance Vought Aircraft Inc. Acquisition of 300 common shares by James J. Gaffney, officer, for a holding of 400; acquisition of 200 common shares through exercise of option by Charles J. McCarthy, officer, for a holding of 1,000.

Continental Air Lines Inc. Disposal of 2,000 common shares by Lawrence G. Ames, director, leaving a holding of 12,000.

Continental Motors Corp. Acquisition of 2,750 capital shares by Earl C. Ginn, officer,

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New and unusual applications for hydraulics are being scheduled into several of the newer helicopter designs. Among these are hydraulic motor operated fuel transfer pumps and hose reels. Vickers Hydraulic Equipment will also be used for taxiing, rotor fold, starting, rescue hoist systems and auxiliary electrical power generation.

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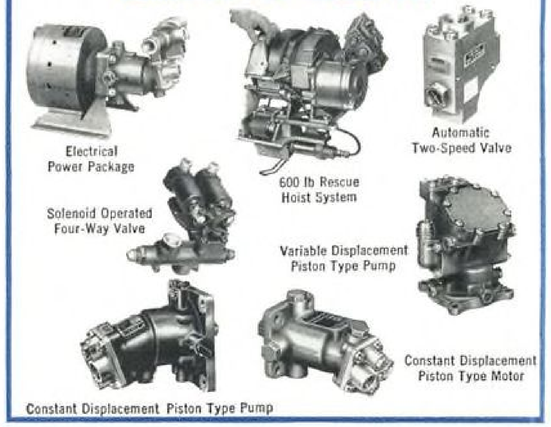
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7637

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

for a holding of 5,000; acquisition of 1,000 capital shares by Clarence J. Reese, officer, for a holding of 17,500.

Curtiss-Wright Corp. Acquisition of 5,000 common shares through exercise of option by James G. Byron, officer and director, for a holding of 7,500; acquisition of 2,500 common shares through exercise of option by Frank H. Hawkins, Jr., officer, for a holding of 5,000; acquisition of 1,500 common shares through exercise of option by Marion E. Jordan, Jr., officer, for a holding of 3,100; acquisition of 1,200 common shares through exercise of option by Joseph V. Miccio officer and director, for a holding of 2,000; acquisition of 800 common shares through exercise of option by Fran W. Mencik, officer, for a holding of 3,100; acquisition of 300 common shares through exercise of option by S. B. Kurzina, Jr., officer and director for a holding of 2,000.

Eastern Airlines Inc. Acquisition of 400 common shares by Leslie P. Arnold, officer, for a holding of 4,200; acquisition of 102 common shares by Branch T. Dykes, officer, for a holding of 461.

Emery Air Freight Corp. Acquisition of 300 common shares by Henry A. Pfaff, officer, for a holding of 3,700; disposal of 100 common shares by Walter G. Corcoran, officer, leaving a holding of 2,369.

Flying Tiger Line Inc. Disposal of $15,000 in 5½% convertible debentures by Frank B. Lynott, officer, his total holding; disposal of $15,000 in 5½% convertible debentures by William E. Bartling, officer, leaving a holding of $25,000.

General Dynamics Corp. Acquisition of 150 common shares by Sylvan C. Coleman, director, for a holding of 300; disposal of $3,000 in 3½% convertible debentures by Frederic de Hoffmann, officer, his total holding.

General Electric Co. Acquisition of 683 common shares through exercise of option by W. R. G. Baker, officer, for a holding of 10,152; acquisition of 1,468 common shares and disposal of 782 common shares by Francis K. McCune officer, for a holding of 5,594; acquisition of 1,725 common shares and disposal of 2,850 common shares by C. K. Rieger, officer, for a holding of 2,332; disposal of 800 common shares by W. V. O'Brien, officer, leaving a holding of 4,010; disposal of 100 common shares by William A. Mann, officer, leaving a holding of 610.

Lear Inc. Acquisition of 736 common shares as compensation under incentive bonus plan and disposal of 2,822 common shares by Richard M. Mock, officer, for a holding of 13,574.

Lockheed Aircraft Corp. Disposal of $10,000 in 3.75% sub convertible debentures by J. R. Jannssen, officer, his total holding.

Glenn L. Martin Co. Disposal of 2,960 capital shares by Jess W. Sweetzer, officer, leaving a holding of 2,605; disposal of 2,100 capital shares by Earl R. Uhlig, officer, leaving a holding of 2,310; disposal of 195 capital shares by W. L. Lucas, officer, leaving a holding of 1,000.

Northeast Airlines Inc. Acquisition of 400 common shares through exercise of rights by Henry E. Foley, officer, for a holding of 900.

Northwest Airlines, Inc. Acquisition of 400 4.6% cumulative preferred shares by Malcolm S. Mackay, officer and director, for a holding of 1,800.

Pan American World Airways Inc. Acquisition of 1,000 common shares through exercise of option by Harold E. Gray, officer, for a holding of 7,064; acquisition of 200 common shares by Merrill Griswold, director, for a holding of 400; acquisition of 1,250 common shares through exercise of option by Clarence M. Young, officer, for a holding of 3,750.

Piasecki Aircraft Corp. Disposal of 200 common shares by Edward G. Vanderlip, officer and director, leaving a holding of 1,050.

Rohr Aircraft Corp. Acquisition of 300 common shares through exercise of option by Guy M. Harrington, officer, for a holding of 2,050; acquisition of $5,000 in 5¼% convertible debentures by F. E. McCreery, officer, his total holding; acquisition of $1,000 in 5¼% convertible debentures by J. E. Rheim, officer, his total holding; acquisition of $10,000 in 5¼% convertible debentures by S. W. Shepard, officer, his total holding.

Seaboard & Western Airlines, Inc. Acquisition of 3,000 common shares through exercise of option by Samuel I. Fondiler, officer, for a holding of 3,220; disposal of 600 common shares by Charles B. Ripley, director, leaving a holding of 26,965.

Skiatron Electronics & Television Corp. Acquisition of 1,500 common shares through exercise of option and disposal of 1,700 common shares by Kurt Widder, director, making a holding of 9,550.

Sperry-Rand Corp. Disposal of 1,000 common shares in a joint tenancy with his wife by Harry Landsidel, officer, leaving a holding of 30,960; disposal of 5,000 common shares by Albert M. Ross, officer and director, who disclaims any beneficial ownership, leaving a holding of 40,903.

Temco Aircraft Corp. Acquisition of 200 common shares by I. Nevin Palley, officer, for a holding of 425.

United Airlines Inc. Acquisition of 800 common shares by Dick R. Petty, officer, for a holding of 1,815; disposal of 250 common shares by A. M. de Voursney, officer, leaving a holding of 150.

United Aircraft Products. Acquisition of 500 common shares by Aron S. Sphier, officer, for a holding of 3,725.

Western Air Lines Inc. Acquisition of 520 capital shares through exercise of option by Terrell C. Drinkwater, officer and director, for a holding of 5,720; acquisition of 260 capital shares through exercise of option by Stanley R. Shatto, officer and director, for a holding of 3,380; disposal of 200 capital shares by G. G. Brooder, officer, leaving a holding of 1,360.

Westinghouse Electric. Acquisition of 1,000 common shares by John M. Schiff, director, for a holding of 12,500.

Royal AMPHIBIAN NEWS

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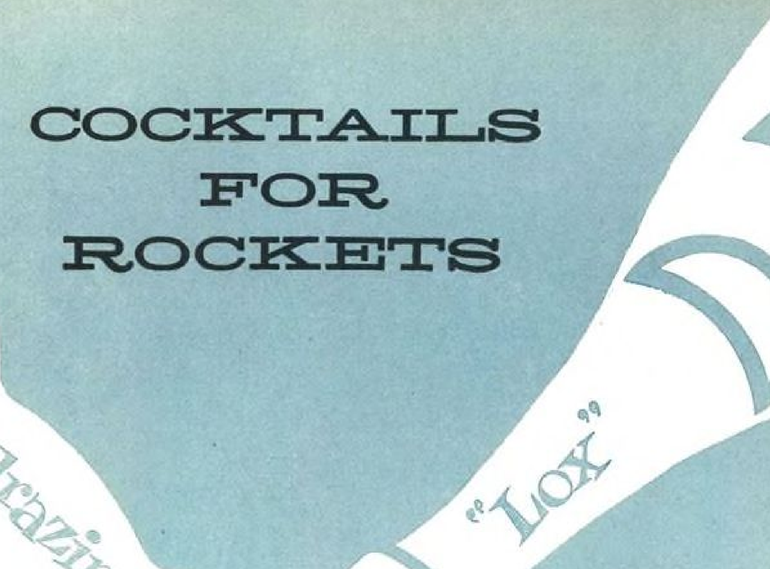
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AMC Contracts

Wright-Paterson AFB, Ohio—Following is a list of unclassified contracts as released by the Air Materiel Command.

General Motors Corp., Allison Division, Indianapolis, Ind., 15,199,315 for T56 turboprop engines for installation in C-130.

Union Carbide & Carbon Corp., Carbide & Carbon Chemicals Co., Division, New York, N. Y., $1,898,821 for menthanol.

E. I. du Pont de Nemours & Co., Wilmington, Del. $1,623,430 for menthanol.

Hughes Aircraft Co., Culver City, Calif., $14,195,373 for aircraft and weapon control systems, fire control systems and support equipment and $1,291,319 for R&D fire control system, making a total of $15,486,692.

Ryan Aeronautical Co., San Diego, Calif. $9,225,849 for aerial target drone and spare parts.

Standard Oil Co. of Indiana, Chicago, Ill., $3,412,593 for starter cartridges for aircraft engine in B-57 aircraft.

Avco Mfg. Corp., Lycoming Div., Stratford, Conn., $2,080,460 for development of the T53 engine.

Cessna Aircraft Co., Wichita, Kan., $1,829,310 for L-19E aircraft for the Department of the Army.

Bendix Aviation Corp., Eclipse-Pioneer Division, Teterboro, N. J. $1,606,562 for indicators, spare parts, tools and data.

United Aircraft Corp., Sikorsky Aircraft Division, Stratford, Conn., $13,752,090 for H-34A helicopters spares.

Lockheed Aircraft Corp., Burbank, Calif. $2,314,000 for final assembly and production flight test site for jet aircraft at Plant 42, Palmdale, Calif.

Aeroil Products Co., Inc., South Hackensack, N. J., $1,916,438 for spray unit for cleaning, de-icing and decontaminating.

Bendix Aviation Corp., South Bend, Ind., $1,645,074 for wheel and brake assemblies for KC-135 tanker aircraft, spare parts and data.

United Aircraft Corp., Windsor Locks, Conn., $1,127,140 for pneumatic aircraft engine starters, type MB-6.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over, as released by Air Force Contracting Offices:

WARNER ROBINS AIR MATERIEL AREA, Robins AFB, Ga.

Topp Industries Inc., 5255 W. 102 St., Los Angeles, Calif., repair and modification of angle of attack detectors and angle of attack compensators, (PR-735034) $64,403.

Heyer Products, Inc., 471 Courtlandt St., Belleville 9, N. J., Rectifier matallic, portable, type B-9, (IFB-449) 500 ea., $362,500.

Curtiss Wright Corp., Propeller Div., Caldwell, N. J., Repair and/or modification, test, C735S-A propeller assemblies and No. 1056 blades (PR-735008) $1,535,000.

Curtiss Wright Corp., Propeller Div., Caldwell, N. J. spare parts for various propeller assemblies, $297,010 (six contracts).

Curtiss Wright Corp., Propeller Div., Caldwell, N. J. Repair and/or modification of propellers (PR-734997), $580,000.

Glenn L. Martin Co., Baltimore, Md. Repair and modification of aircraft components, (PR-735026) $300,000.

General Mills Inc., Mechanical Division, Minneapolis 13, Minn. Spare parts for periscopic bomb sights, (IFB-462) $345,641.

Curtiss Wright Corp., Propeller Div., Caldwell, N. J. Essential repair, testing, packaging and shipping two lots of propeller assemblies (PR-735017 and 735014) $137,000.

Hughes Aircraft Co., Culver City, Calif., spare parts for E series fire control systems (IFB's 56-367, 428 and 395) $264,240.

Radio Corp. of America, Defense Electronic Products Div., Camden, N. J. Spare parts for E series fire control systems, (IFB's 56-367, 428 and 395) $207,577.

Minneapolis-Honeywell Regulator Co.,



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Volts	120	120/208	120/208
Speed (rpm)	12,000	6,000	12,000
Phase	3	3	3
Frequency (cps)	400	400	400
Power Factor (minimum)	.8	.75	.9
Weight (lb)	66	75	29.5
Length (in.)	13	9	10
Diameter (in.)	9	9.75	7

To Meet Your Specific Needs: J&H missile power specialists are available to confer on your specific requirements . . . generators and regulators. You may obtain basic engineering data on other J&H environment-free generators by writing to Jack & Heintz, Inc., 17632 Broadway, Cleveland 1, Ohio. Export Department: 13 East 40th Street, New York 16, New York.

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JACK & HEINTZ AIRCRAFT ELECTRIC EQUIPMENT

Aeronautical Div., 2600 Ridgway Rd., Minneapolis 13, Minn. Repair and/or modification of gyros and other components of LABS, (PR's 735053, 735406) $389,396. Two contracts.

Wayne Pump Co., Fort Wayne, Ind. Air compressor, skid mounted, electric motor driven. Type MB-9, (IFB-528) 1097 ea., $1,491,378.

SACRAMENTO AIR MATERIEL AREA, McClellan AFB, Calif.

Hughes Aircraft Co., Culver City, Calif. Kits, control surface tie-in for CSTI system in F86D Aircraft unit 900 (P/R 6667), $1,284,555.

North American Aviation, Inc., Los Angeles, Calif., Kit, extended leading edge on F86D aircraft, unit 900 (P/R 6667) $3,698,750.

DAYTON AIR FORCE DEPOT, Gentile Air Force Station, Dayton 10, Ohio.

Lavoie Laboratories, Inc., Morganville, N. J., Frequency meters, contractors part No. LA-6 (PR 613409) 512 ea., $486,400.

SHELBY AIR FORCE DEPOT, Wilkins Air Force Station, Shelby, Ohio.

Waco Aircraft Co., Troy, Ohio, Cradle, bomb hoisting and transportation 8,000 lb. cap. type MA-1, 776 ea., $298,674.

HEADQUARTERS, OGDEN AIR MATERIEL AREA, Hill Air force base, Utah.

ERCO Division, ACF Industries, Incorporated, P. O. Box 209, Hyattsville, Md. Contractual maintenance of flight simulators, Class 28A, (PROO-555375) $1098510.

Army Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Army Contracting Offices.

REDSTONE ARSENAL, Huntsville, Ala.

Ralph M. Parsons Co., 617 S. Olive St., Los Angeles 14, Calif., Engineering and procurement services for equipment and instrumentation for the missile assembly, inspection hangar facility (Nr SPS-17-57) $568,169.

CORPS OF ENGINEERS, Mobile District, 2301 Grant St., Mobile, Ala.

Blount Bros. Construction Co., P. O. Box 949, Montgomery, Ala. Missile Assembly and inspection hangar, at Redstone Arsenal, (DA-01-076-Eng.-3525) $2,114,064.

Butler & Cobbs, P. O. Box 1608, Montgomery, Ala., Guided Missile Test Shop at Redstone Arsenal, (DA-01-076-ENG-3225) $1,226,414.

CORPS OF ENGINEERS, New England Division, 150 Causeway St. Boston 15, Mass.

Westinghouse Electric Corporation, 10 High St., Boston Mass., Design and furnish four liquid metal pumps for Connecticut Aircraft Nuclear Energy Laboratory, Middletown, Conn. (DA-19-016-ENG-4434) job, $415897.

Carrier Corporation, 385 Madison Avenue, New York, N. Y. Furnish and deliver two 3000 H. P. condensing steam turbine driven 10,000 SCFM air compressors and accessories for Connecticut Aircraft Nuclear Energy Laboratory, Middletown, Conn. (DA-19-016-ENG-4740) job $407663.

The Lane Construction Corporation, 965 East Main St., Meriden Conn., Construction of air nation guard taxiway and parking apron Otis Air Force Base Fairmouth, Mass., (IFB-ENG-19-016-57-20B) job, $11-68728.

The Griscom-Russell Company, 285 Madison Avenue, New York City, N. Y. Furnish one 265000000 BTU/HR high temperature air cooler and with auxiliaries and accessories for Connecticut Aircraft Nuclear Energy Laboratory, Middletown, Conn. (DA-19-016-ENG-474) Job, $290000.

LOS ANGELES ORDNANCE DISTRICT, 55 S. Grand Ave. Pasadena, Calif.

G. M. Giannini and Co., Inc. 918 East Green Street, Pasadena, Calif. Transmitters Job. $127904.

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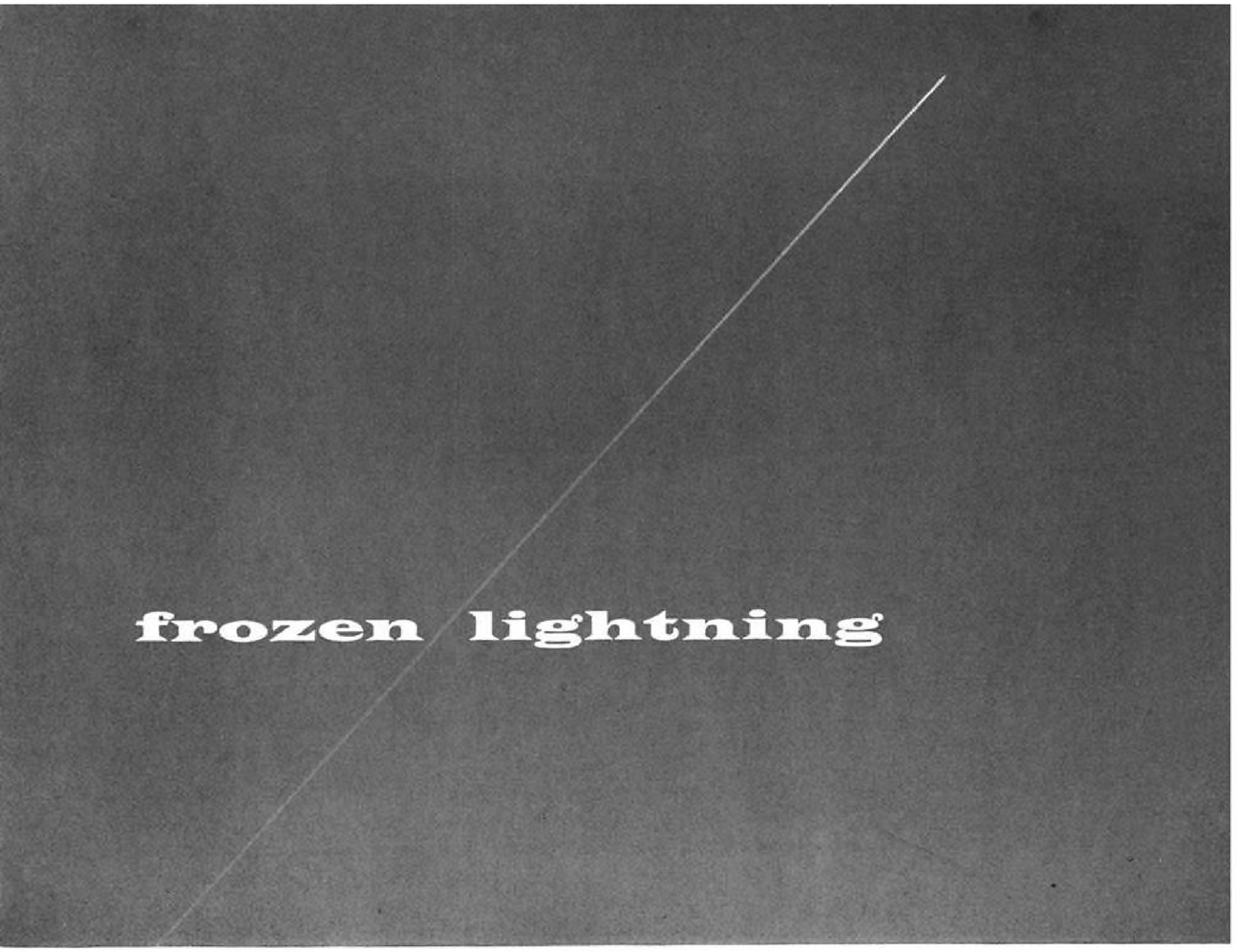
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Pilot Describes Stratocruiser Ditching

(The following detailed account of the successful ditching of a Pan American World Airways Stratocruiser midway between Honolulu and San Francisco last Oct. 16 was prepared by Capt. Richard N. Ogg, the aircraft's pilot. The report was presented at the Air Line Pilots Assn.'s fifth annual Air Safety Forum.)

The emergency landing last Oct. 16 of PAA Stratocruiser N90943 beside the Coast Guard vessel Ponchartrain halfway between Honolulu and San Francisco has aroused much interest throughout the various pilot groups, and it is appropriate to set forth the story from the pilot's standpoint, and to detail what was learned and what might be suggested in the way of changes in our emergency equipment and technique to improve our ability to perform in possible future emergencies.

The aircraft, a Boeing B-377 equipped with P & W R4360-B6 engines with CH-10 superchargers and Hamilton Standard 24260 propellers had come from Tokyo, and my crew acquired it at Honolulu for its last leg to San Francisco.

We had been to Manila and had had 48 hours rest at Honolulu. PAA overseas crews have seven members: Captain, First Officer, Second Officer/Navigator, Flight Engineer, and three cabin attendants. Twenty-four passengers were aboard when the load was completed; three of these were small children.

Flight Plan

Our flight plan specified an initial cruising altitude of 13,000 ft. to approximately the halfway point, then 21,000 to destination. En route weather was good, with a high pressure area centered about the midpoint. Winds were very light at all altitudes.

Takeoff was at about 7:30 p. m., Honolulu time. Flight proceeded uneventfully through serving of dinner, after which most of the passengers went to sleep.

My watch list gave First Officer Haaker, Second Officer Dick Brown and myself all some time at the navigation station. This system of shifting assignments among the pilots prevents boredom, and consequent decrease of attention to duty, and allows the captain and first officer to keep themselves proficient at navigation.

The watch schedule placed me at the navigation table for the two hours across midpoint. As I took over the station, I noticed that we were only slightly to the left of track and would therefore pass the Coast Guard ship at Ocean Station N within about 28 miles.

Our weight and airspeed now indicated it would be appropriate to climb to 21,000, so I told Haaker, who was at the controls, to obtain clearance and climb. During climb, I busied myself with preparation of the routine message for transmission to the ship as we passed. This message gives pertinent data about the aircraft's identity, altitude, track, etc., and may request a radar fix while within range.

Coast Guard vessels as this one at Ocean Station November are stationed at various important en route points on the overseas air lanes of the Atlantic and Pacific. They serve triple purposes. As weather stations, they gather important surface and upper air data to implement mainland weather forecasting, and can furnish upper air reports to passing aircraft.

As navigational aids, they furnish radiobeacon signals and radar fix service to passing traffic. And as lifesaving units, they are capable of diversified and prompt search and rescue activity in time of need to air or surface transports. This particular ocean station, N, is almost exactly halfway between Honolulu and San Francisco, and we had used the navigational and weather data from the ship on duty there on almost every crossing.

Propeller Trouble

When we reached 21,000 and our speed picked up after Haaker's leveling off, it happened: the sudden, rising, deafening scream of a propeller running far past normal speeds.

It was a left hand propeller, and in perhaps four seconds its speed rose from normal to tremendous. As I ran forward, I saw Haaker's hand reach up and press the feather button for Number 1 propeller. There was no change in the sound.

As I squirmed into my seat, Engineer Garcia was pulling the throttles back and Haaker was getting wing flap down. I tried the feather button. Nothing happened. Garcia hit the gang bar with no result. As the airspeed fell off, the speed of the racing propeller diminished, but the noise was still alarmingly loud and high-pitched.

I held the button down for a long period, at 140 kt. IAS. No result. We were losing altitude, and restored climb power to the good engines. Haaker reported our trouble to flight watch and mentioned our emergency descent.

I told Garcia to freeze the engine. He shut off the oil. We were still losing altitude with 20 degrees flap and 140 kt. IAS. After about three minutes with the oil off, the engine seized. There was a thud that shook the frame, and the propeller continued its bawling runaway. Its weight had sheared the shaft, leaving the engine stopped and the propeller free to windmill. A continuing left-turn torque showed the drag was still great from the propeller.

Radios Coast Guard

An uncontrollable runaway prop constitutes a serious hazard for several reasons. I called the Coast Guard ship on 121.5 mc. and advised the officer on watch that we were having mechanical trouble and might need its assistance. He acknowledged and gave me a ditching heading (which is kept posted on the bridge at all times and is revised as necessary) and said he was alerting all hands.

I checked our ADF to be sure it was on the ship's beacon, 335 kcs. While I was thus engaged, the plane yawed a little and Haaker said Number Four engine was failing. Its BMEP gauge ranged erratically up and down the scale, finally settling down at about 100. Engineer Garcia now bent his efforts to diagnosing and remedying this new failure. He tried increasing the temperatures, juggling manifold pressure and rpm. The analyzer showed a number of low resistance shorts on ignition leads. I increased power on engines 2 and 3 to rated. We were losing altitude at 500 to 1,000 ft. per minute at 140 kt. IAS. This speed was critical. Allowing speed to increase to 142 kt. or above caused the disabled propeller to speed up alarmingly, while allowing a decrease to 137 kt. or less caused buffeting stall warning. I had retracted wing flap to zero.

From indications at this point, it now appeared that unless we could restore power to Number 4 or feather Number 1, an immediate landing would be necessary or we would have to dump fuel to a very low level to stay above the surface. So I altered heading to home in on the ship and addressed the cabin on the loudspeaker system.

Passengers Warned

I told the passengers we had an emergency situation that might make an emergency landing necessary. I told them there was a Coast Guard ship nearby ready to assist us, that we had the situation under control, that they were to follow the instructions of the cabin personnel.

Immediately after, I monitored on the interphone the calm voice of Purser Reynolds, reading the emergency instructions as to life vests, ditching position, etc.

I now talked again to the ship's crew telling them we were now homing in, had a real emergency and might have to land within a few minutes. The officer's reply was that all hands were at stations and that a short string of water lights was already out along the ditching track and more were being added. He said the ship's guns were firing flare shells to illuminate the surface, and he gave us swell and wind conditions and an altimeter setting.

I considered dumping fuel at once but decided against it as we still had several thousand feet altitude, and dumping time to stand-pipe level would be only a minute or so.

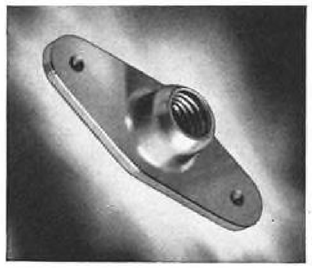
Our efforts to nurse Number 4 back to health were fruitless. So were our continued efforts to feather Number 1 propeller by holding in the circuit breaker while also holding down the feather button.

Since past Stratocruiser ditchings have shown a consistent history of tail separation on landing, I instructed Purser Reynolds to remove all passengers from the last three



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rows of seats. PAA B-377 cabins have the galley and lavatories in the rear part of the cabin area, extending well forward before the seats begin. We also removed passengers from the plane of the Number 1 propeller. We were still losing altitude.

The first we saw of the ship was a glow caused by its searchlight, directed vertically upward, filtering through the cloud deck. After overheading it at about 6,000 ft., we began shuttling back and forth along the ditching track, using a more-or-less race-track ADF holding pattern and trying to arrange our excursions so we could end up at sea level and beside the ship, aligned on the ditching track.

I contemplated dumping fuel when 2,000 ft. was reached. Our rate of descent was decreasing. Haaker was busy on the radio, passing details to Honolulu and San Francisco, while I talked to the ship.

Water Lights Out

Commander Earle, captain of the Ponchartrain, said they now had out a one and one-half mile string of water lights along the ditching track and were in complete readiness for our landing. As soon as we passed through the cloud layer, I addressed the passengers again, pointed out the lights of the ship and reassured them that we had competent help awaiting us.

The three passenger service girls had worked fast—they had distributed life vests, had re-instructed the passengers in their use and had cleared the cabin and galley of all loose articles.

At 2,000 feet our descent stopped. At 140 kt. IAS rated power on engines 2 and 3 and at 100 BMEP on 4, we were holding our own. This development now changed the picture. It re-opened the possibility of reaching land, and it made possible postponing the landing as long as fuel remained.

A few gyrations with a computer showed, however, that, with a fuel consumption of 3,600 lb./hr., a TAS of 147 kt. and the very low wind component that existed, we could not reach either Hilo or San Francisco. We would be 150 to 250 mi. short either way.

Even with the possibility of stretching range by reducing fuel consumption as the load decreased, there existed the necessity to consider the high swells in the Honolulu area, the cold water in the San Francisco region and the good conditions at Ocean Station N. I abandoned ideas of reaching land and notified the ship we were committed to an eventual, but not immediate, ditching.

Waits For Daylight

In considering delay of landing until daylight, it was necessary to take into consideration the condition of the passengers as to the possibility of panic resulting from prolonged tension and the possibility of losing Number 1 propeller, with probable damage to the aircraft, due to its sustained high speed rotation.

However, after talking with the passengers personally and discussing with Garcia the propeller situation, it appeared best to make use of our chance to make a daylight landing. The passengers received this decision with considerable obvious relief.

Number 4 engine, after about an hour's running crippled and at fractional power,



L. K. Edwards (center), head of the Advanced Design and Systems Analysis Department, discusses atmosphere effects on missile guidance with W. F. Wright (right), head of the Analysis, Plans and Reports Section, and A. L. Lowell, Advanced Design Staff Engineer.

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finally failed entirely and was feathered.

The Ponchartrain gave us time of sunrise and first light and constantly revised data on wind, weather and swell conditions.

The long wait for dawn allowed us to improve further our ditching preparations. I had decided to evacuate the plane and launch our rafts just as if no help were near. Accordingly, we each reviewed and mentally rehearsed our individual part in the evacuation. Some helpful passengers who volunteered to aid.

As fuel burned out and weight lessened we were able to climb. So, to check our rudder control in the unbalanced condition at ditching speed and configuration, we climbed to 5,000 ft. and went through a simulated landing. This showed we would have good control.

When dawn came, I postponed the landing again to exhaust fuel to almost-empty tanks. The sight of the Ponchartrain in the morning sunlight was a reassuring sight to us all. Morning conditions brought a change of swells and wind. Commander Earle withdrew the water lights, suggested a new ditching heading of 350 deg. and told me he wanted 10 minutes' notice before landing to lay a trail of foam on the surface to mark the track.

In an informal and "chatting" manner, I passed all developments to the passengers, and I believe this contributed to their calm state of mind throughout the emergency. Haaker, Garcia and Brown visited the cabin at times, talking to the passengers and reassuring them. We never had any panic at any time.

Finally, when our fuel was down to about 30 minutes' supply, I told Commander Earle we would land in 10 minutes. Passengers were re-seated and re-briefed. Garcia packed pillows between himself and the forward part of his desk. The foam track on the water made a helpful runway which gave perspective and directional emphasis.

Dick Brown assumed his ditching station in the cabin on a passenger seat near the main entry door.

After completing the emergency landing check list and squaring away at the "runway" we gave the passenger a "one minute to go" warning and got a final swell and wind condition check.

Touchdown

Swells were four feet, wind calm. With full flap down, gear up, at 90 kt. IAS, I touched down at a likely-looking spot on top of the main swell, about a third of a mile from the ship. I figured that considerable rebound and runout would bring us to a stop quite near the ship.

There was a light impact as we clipped the top of a secondary swell, then a very heavy decelerating impact. We were thrown heavily forward against our belts. A violent water loop to the left took place, probably caused by the Number 1 engine being torn from its nacelle. The nose buried itself in the sea, and the entire cockpit was momentarily submerged.

Then we stopped moving, floated level, and there was no water above the floor. We had come to a stop in a very short distance. None of us were hurt. Garcia,

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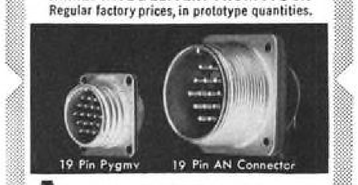
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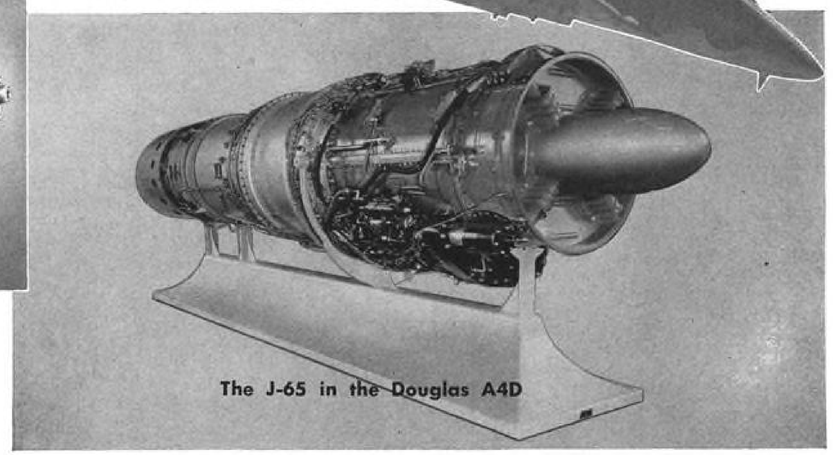
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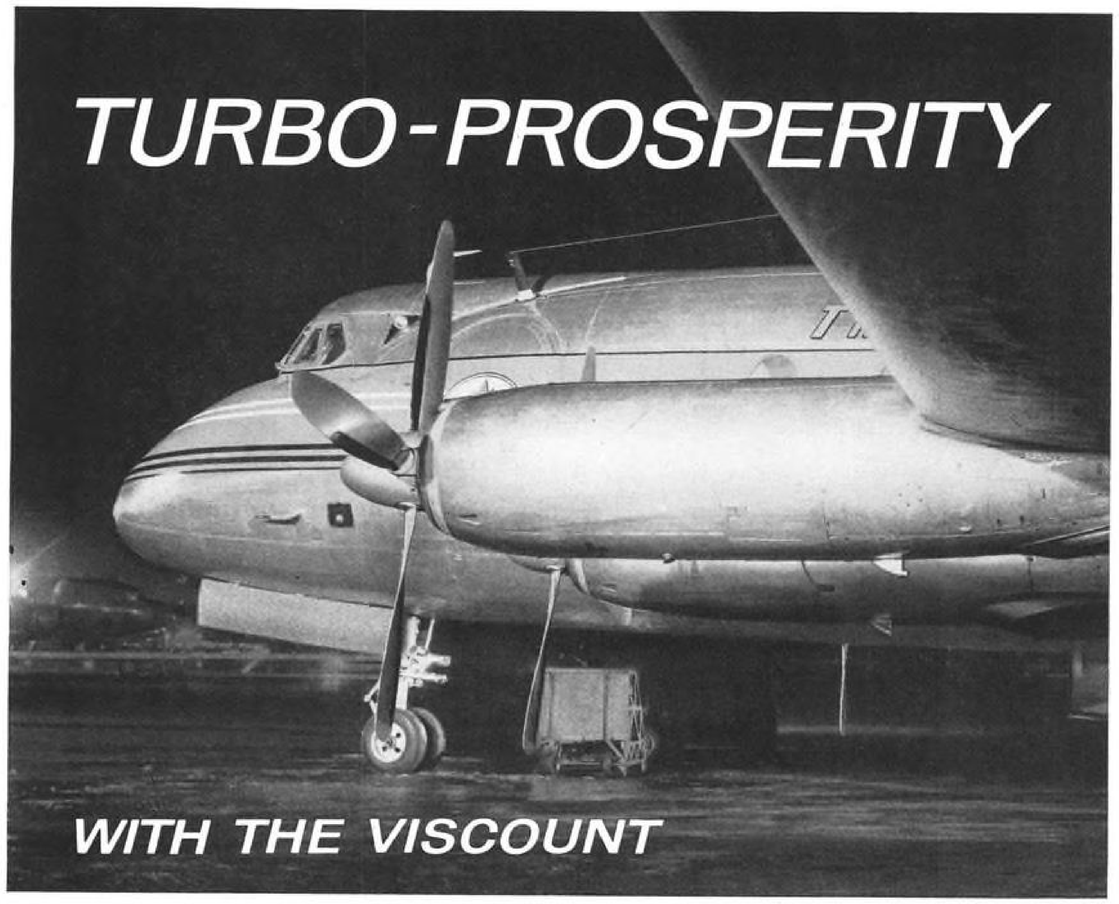
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SAFETY

Haaker and I hurried back to the cabin. The door between the cockpit and the cabin was jammed shut and could not be opened, but we climbed through the inserted or "dutch" door which is a part of the upper main door.

Tail Breaks Off

The tail had broken off and had carried away the two rearmost rows of passenger seats. One occupied seat had torn loose, and one seat belt had broken. Very minor injuries had resulted to three or four passengers. Some trim from the top of the cabin had fallen. Seatbacks on unoccupied seats were folded forward. Otherwise, there was not much destruction to the cabin.

Dick Brown had already launched his raft out the main cabin door; it was inflating slowly, and the hiss of the gas from the bottles was audible. Our helpful passenger was out on the right wing very quickly, inflating a raft. Garcia was right behind him. Haaker took his raft out the right wing, rigging a life line as he went. Passengers were standing patiently by the exits awaiting their turn to board the rafts. I busied myself checking the entire cabin to be sure no one was incapacitated, hidden and in danger of being left behind.

Brown grew impatient with his raft's slow inflation rate; he jumped into it, smoothing it out on the surface and hastening its inflation. Passengers began embarking. On the right wing, our cooperative passenger had not pulled the raft's "D" ring hard enough, and only half of the raft had inflated. Garcia, right behind him, noticed it and pulled the ring again, releasing the second bottle and inflating the other half.

Cabin Cleared

Within four minutes, we were all out of the cabin. I boarded the right wing raft and, using the paddles, we shoved off via the trailing edge. There was no jagged or upward-distorted metal from wing flaps to impede us or threaten the raft.

The main door raft encountered temporary difficulty when the broken tail, still attached to the fuselage by its cables, floated around and barred the way to pulling away from the plane. This trouble disappeared shortly, however, when the tail sank. Much jagged metal was in evidence in the area of the tail breakage.

Coast Guard launches showed up at this point and put a man aboard the plane to check for complete evacuation. The raft on the left wing had not yet pushed off, and one launch crew threw a rope aboard and pulled it free. In this operation the lower half of the raft was punctured, probably by jagged metal from the torn Number 1 nacelle.

The Coast Guardsmen wasted little time transferring us to their launches, then to the ship. Had I anticipated the sudden stop on landing I would have touched down much closer to the ship and the Guardsmen would have been to us even sooner.

Lessons of Accident

From this incident, most impressive things learned were:

- **Quicker inflation of rafts** would be a big step forward toward more effective emergency equipment.
- **An improved seat belt arrangement for**



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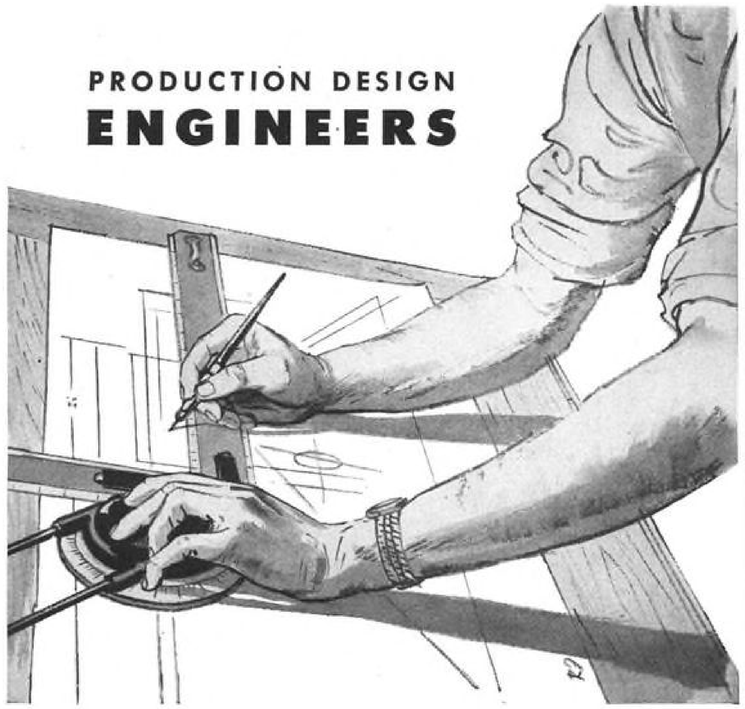
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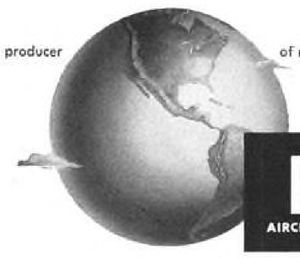
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children-in-arms during emergency landing is necessary. A good solution would seem to be the use of an extra, auxiliary quick-attach belt which could be fastened to the parent's seat and which would encircle the infant, independent of the parent's belt.

• **In handling passengers** under emergency stress, the importance of crew calmness and deliberateness is very great. When crew members and especially the captain, convey the idea of "We aren't scared, we know what we are doing, and we are going to do it right," then passengers will assimilate the same feeling.

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• **Mechanical device** to hold open the door firmly between the crew and the passenger compartment is a must.

All crew members flying over water would do well to familiarize themselves completely with the facilities, services and information provided by the Coast Guard and search and rescue organizations. Publication CG306, Aircraft Emergency Procedures Over Water, available from our Government Printing Office, contains a wealth of information on this very important subject.

Phoenix Case Report Names Three Airlines

Washington—Western, Frontier and Bonanza Air Lines have been recommended for new or improved service between Denver and California.

Reporting on the Phoenix service case, James S. Keith, CAB examiner, recommended:

• **Western Air Lines**—Extend Route 35 from Denver to San Diego via Phoenix and from Salt Lake City to Phoenix, subject to the condition that flights between Denver and San Diego serve Phoenix.

• **Frontier Airlines**—Amend present certificate to permit two-stop service between Phoenix and Denver subject to certain conditions.

• **Bonanza Air Lines**—Palm Springs designated as a joint intermediate point with Indio on Route 105.

Delta Begins Training For Jet Operations

Atlanta—Delta Airlines, expecting delivery in June, 1959, of the first of 18 jet transports, has opened a school here to train pilots, flight engineers, stewardesses, maintenance, and reservation employes.

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AGE:
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EDUCATION:
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EXPERIENCE:
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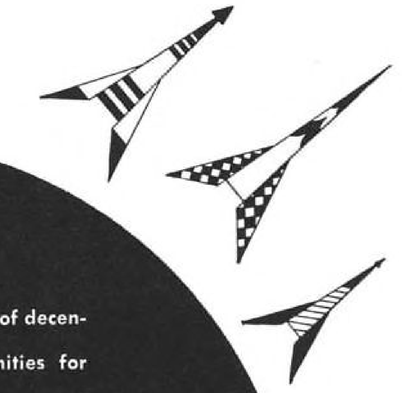
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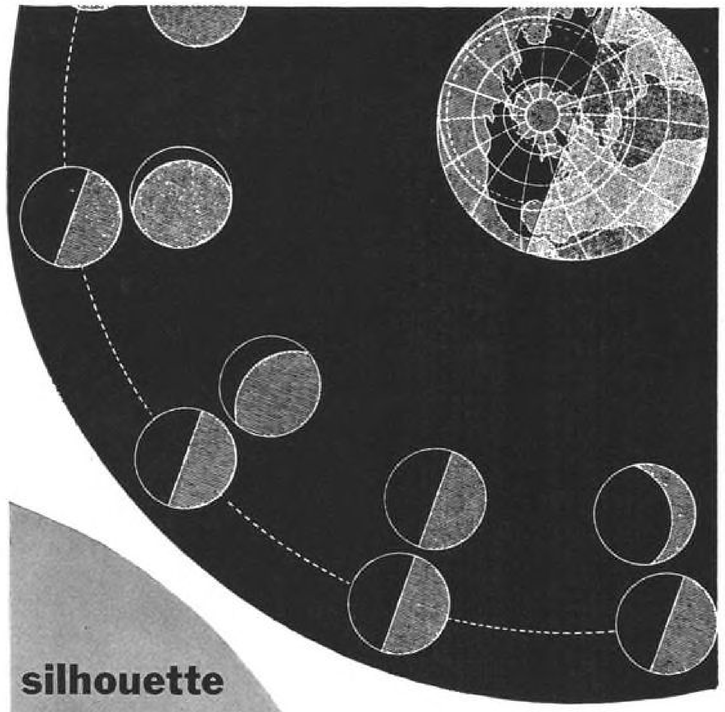
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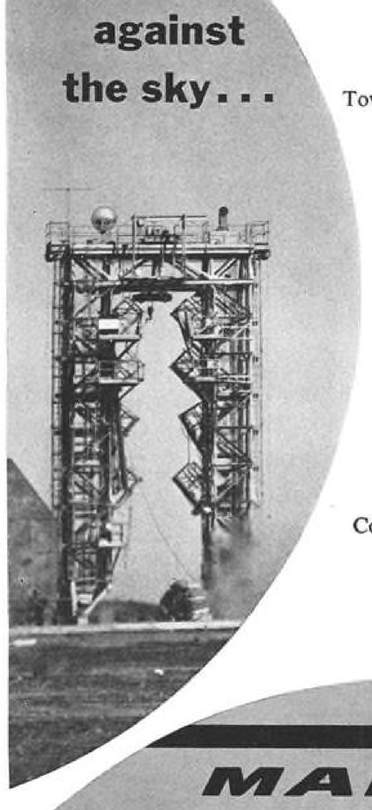
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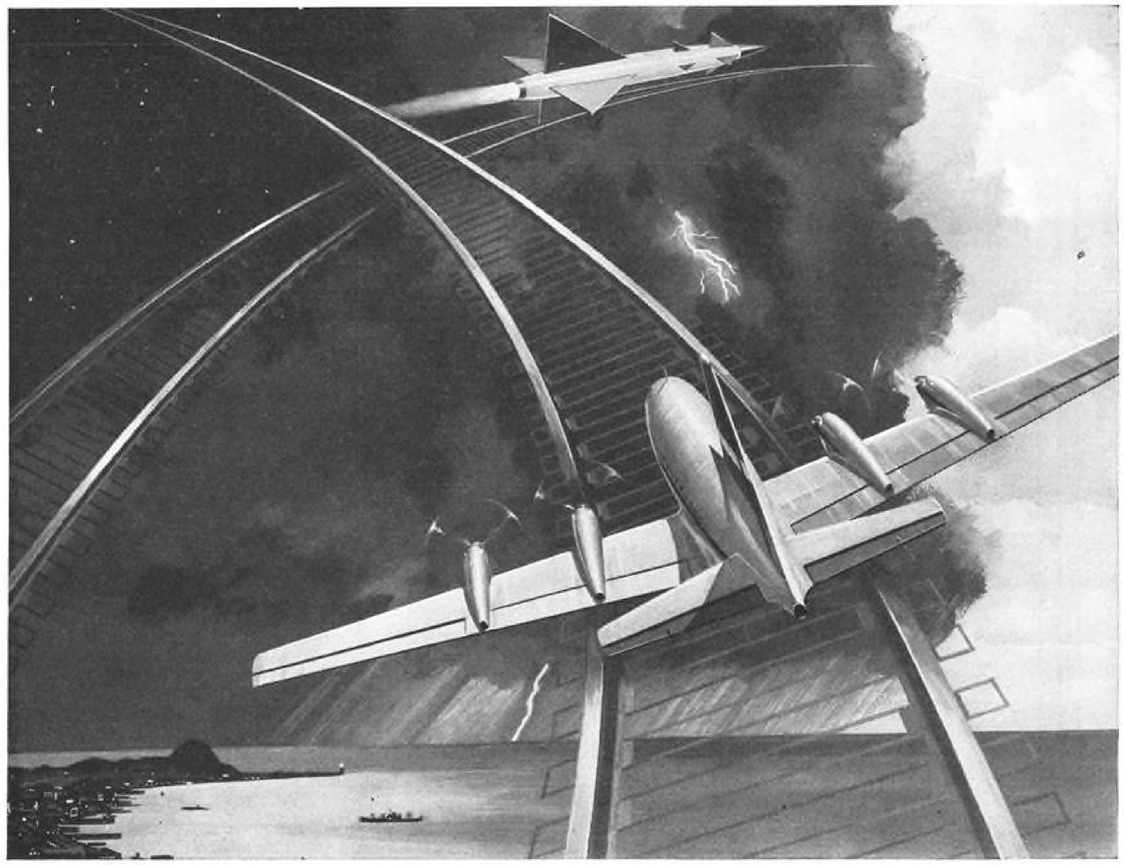
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ATRAN—T. M. Goodyear Aircraft Corporation, Akron 15, Ohio



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P-4641—Aviation Week
Class. Adv. Div.,
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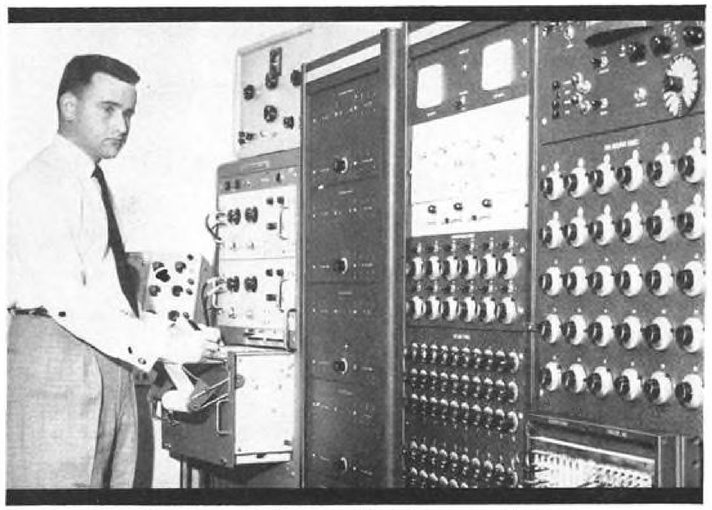
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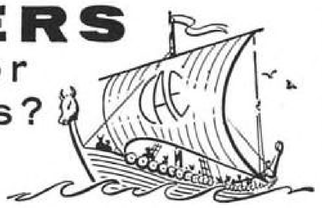
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Classified Advertising Division—Mar. 18, 149

AVIATION WEEK, P. O. Box 12, New York 36, N. Y.

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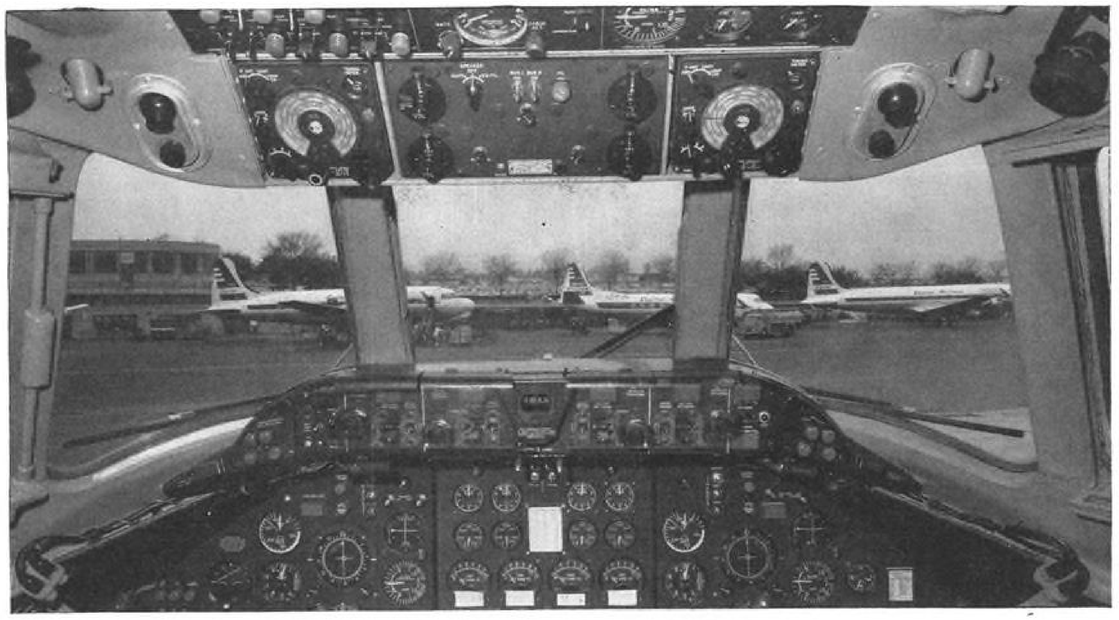
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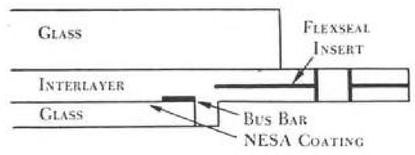


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Agency—Buchanan & Co., Inc.
ALUMINUM CO. OF AMERICA 122
Agency—Fuller & Smith & Ross, Inc.
AMERICAN LATEX PRODUCTS CORP. 91
Agency—Byron H. Brown & Staff, Inc.
AMPEX CORPORATION (INSTRUMENTATION DIV.) 7
Agency—Roland Associates
AUTONETICS A DIV. OF NORTH AMERICAN AVIATION, INC. 110
Agency—Batten, Barton, Durstine & Osborn, Inc.
AVICA CORPORATION 124
Agency—Knight and Gilbert, Inc.
AVRO AIRCRAFT LIMITED 82
Agency—Cockfield, Brown & Co., Ltd.
AVIATION WEEK 119, 140, 141

BELL AIRCRAFT CORP. 99
Agency—Baldwin, Bowers & Strachan, Inc.
BENDIX PRODUCTS DIV., BENDIX AVIATION CORP. ..... 3rd Cover
Agency—MacManus, John & Adams, Inc.
BRIDGEPORT THERMOSTAT DIV., ROBERTSHAW-FULTON CONTROLS CO. 83
Agency—Arndt-Preston-Chapin-Lamb & Keen, Inc.
BYRON H. BROWN & STAFF, INC. 157

CALIFORNIA TECHNICAL INDUSTRIES 124
CANADAIR, LTD. 53
Agency—Walsh Advertising Co., Ltd.
CARPENTER STEEL COMPANY THE 132
Agency—Beaumont, Heller & Sperling, Inc.
CESSNA AIRCRAFT COMPANY 111
Agency—Lago & Whitehead, Inc.
CHANCE VOUGHT AIRCRAFT, INC. 48, 49
Agency—Tracy Locke Adv.
CHANDLER-EVANS 54
Agency—G. F. Sweet & Co., Inc.
COLOR TELEVISION, INC. 124
CONNECTICUT HARD RUBBER COMPANY, THE 94, 95
Agency—Troland, Inc.
CONTROL ENGINEERING UNIT, DETROIT CONTROLS CORP. 114
Agency—S. Gunnar Myrbeck & Co.
CONVAIR A DIV. OF GENERAL DYNAMICS CORP. 35
Agency—Buchanan & Co., Inc.
CUTLER-HAMMER, INC. 88
Agency—Kirkgasser-Drew Advertising

DOUGLAS AIRCRAFT CO., INC. 143
Agency—J. Walter Thompson Co.
DOUGLAS ROESCH CABLE DIV. OF HALL SCOTT, INC. 67
Agency—Byron H. Brown & Staff, Inc.
DOW CORNING CORPORATION 16
Agency—Church & Guisewite Advs., Inc.

ELECTRIC AUTO-LITE CO. THE (WIRE & CABLE DIV.) 92
Agency—Grant Advertising, Inc.
ELECTRO-SNAP SWITCH & MFG. CORP. 66
Agency—Stoetzel & Associates, Inc.
ESSO STANDARD OIL CO. 116
Agency—McCann-Erickson, Inc.
EXECUTIVE AIRCRAFT SERVICE, INC. 123
Agency—Auld Advertising

FAIRCHILD ENGINE & AIRPLANE CORP. 24
Agency—Gaynor, Colman, Prentis & Varley, Inc.
FENWAL, INC., AVIATION PRODUCTS DIV. 79
Agency—James Thomas Chirurg Co.
FOSTER MFG. CO., JOHN J. 124
Agency—Rhea Advertising
FORD INSTRUMENT CO., DIV. OF SPERRY RAND CORP. 103
Agency—G. M. Basford Company
FRUEHAUF TRAILER CO. (MISSILE PRODUCTS DIV.) 60
Agency—The Allman Company, Inc.
FUTURE CRAFT CORPORATION 106
Agency—L. J. Swain Advertising

GENERAL ELECTRIC COMPANY 74, 75, 121, 129
Agency—G. M. Basford Company
GENERAL ELECTRIC CO., (LMEED) 9
Agency—De Garmo, Incorporated
GENERAL MILLS, INC. MECHANICAL DIV. 136
Agency—Knox Reeves Adv.
GENERAL PRECISION LABORATORY, INC. 42
Agency—Geer, Du Bois & Co.
GOODRICH CO., THE B. F. AVIATION PRODUCTS DIV. 20
Agency—Batten, Barton, Durstine & Osborn, Inc.
GOODYEAR TIRE & RUBBER CO., INC. 80, 81
Agency—Kudner Agency, Inc.

HALLAMORE ELECTRONICS COMPANY 13
Agency—Graphics, Inc.
HARRISON RADIATOR DIV., GENERAL MOTORS CORP. 15
Agency—D. P. Brother & Co. Adv.
HARTWELL AVIATION SUPPLY CO. 98
Agency—The McCarty Company
HAYES AIRCRAFT CORPORATION 112
Agency—Silver & Douce Co., Inc.
HEXCEL PRODUCTS, INC. 56
Agency—Peter Hurst Adv., Inc.
HOWARD AERO, INC. (MANUFACTURING DIV.) 84
Agency—Jack Kemp & Associates
HUMPHREY, INC. 73
Agency—The Phillips-Ramsey Co., Adv.
HYDRO-AIRE, INC. 3
Agency—Byron H. Brown & Staff, Inc.

INTERNATIONAL NICKEL CO., INC., THE 107
Agency—Marschalk & Pratt Div. of McCann-Erickson, Inc.

JACK & HEINTZ, INC. 130
Agency—Fuller, Smith & Ross, Inc.

LOCKHEED AIRCRAFT CORP. 135
Agency—Hal Stebbins Adv.

MARLIN-ROCKWELL CORPORATION 137
Agency—Griffith & Rowland Adv.
MARMAN DIV. AEROQUIP CORPORATION 118
Agency—The Fred M. Randall Co.
McDONNELL AIRCRAFT CORPORATION 125
MILLER ELECTRIC MFG. CO., INC. 131
Agency—M & M Advertising, Inc.
MINNEAPOLIS-HONEYWELL REGULATOR CO. 58, 59
Agency—Foote, Cone & Belding
MONADNOCK MILLS-UNITED-CARR FASTENER CORP. 134
Agency—H. B. Humphrey, Alley & Richards, Inc.
MORRIS BEAN & COMPANY 61
Agency—Odiorne Industrial Adv., Inc.

NAPIER & SON LIMITED D. 100
Agency—C. R. Casson Ltd.
NEMS-CLARKE, INC. 106
Agency—John E. Waterfield Admasters Adv., Inc.
NORTH AMERICAN INSTRUMENTS 70, 71
Agency—Heintz & Co., Inc.

OAKITE PRODUCTS, INC. 78
Agency—Marschalk, Richard, Gebhardt & Reed, Inc.
OSTER MFG. CO., John (AVIONICS DIV.) 102
Agency—Burton Browne Advertising

PASTUSHIN INDUSTRIES, INC. 57
Agency—Western Adv. Agency, Inc.
PITTSBURGH PLATE GLASS CO. (SAFETY GLASS) 156
Agency—Batten, Barton, Durstine & Osborn, Inc.
POTTER AERONAUTICAL CO. 128
Agency—Richard & Gunther, Inc.
POWELL COMPANY HAROLD H. 136
Agency—Harriet Tannenholz Adv.

RAMO-WOOLDRIDGE CORP., THE 36
Agency—The McCarty Company
REACTION MOTORS, INC. 55
Agency—Doyle Kitchen & McCormick, Inc.
RED BANK DIV., BENDIX AVIATION CORP. 63
Agency—MacManus, John & Adams, Inc.
REM-CRU TITANIUM, INC. 22
Agency—G. M. Basford Co.
REYNOLDS METALS COMPANY ..... 4th Cover
Agency—Clinton E. Frank, Inc.
ROBINSON CO., RALPH C. 108
Agency—Ellison L. Meier Adv. Agency
ROHR AIRCRAFT CORPORATION 142
Agency—Barnes Chase Co.

SAFEWAY HEAT ELEMENTS, INC. 6
Agency—G. F. Sweet & Co., Inc.
SAGINAW STEERING GEAR DIV., GENERAL MOTORS CORP. 115
Agency—D. P. Brother & Co.
SANBORN COMPANY 104
Agency—Culver Advertising, Inc.
SARGENT ENGINEERING CORP. 4
Agency—Darwin H. Clark Co. Adv.
SEARCHLIGHT SECTION 144-155
SERVICE STEEL DIV., VAN PELT CORP. 131
Agency—Claude E. Whipple Adv.
SIKORSKY AIRCRAFT DIV., UNITED AIRCRAFT CORP. 139
Agencies—G. F. Sweet & Co., Inc.

SINCLAIR REFINING CO. 11
Agency—Morey, Humm & Warwick, Inc.
SOLAR AIRCRAFT COMPANY 8
Agency—The Phillips-Ramsey Co. Adv.
SPENCER THERMOSTAT DIV., METALS & CONTROLS CORP. 82
Agency—Sutherland-Abbott Adv.
SPERRY GYROSCOPE CO., DIV. SPERRY RAND CORP. 134
Agency—Equity Adv. Agency
STEWART WARNER CORP. (ELECTRONICS DIV.) 76
Agency—The Buchen Company
STILLMAN RUBBER CO. 114
Agency—Lann-Wyckoff, Inc.
STROMBERG-CARLSON CO. A DIV. OF GENERAL DYNAMICS CORP. 72
Agency—Charles L. Rumrill & Co., Inc.
SUNDSTRAND MACHINE & TOOL CO., AVIATION DIV. 86, 87
Agency—Howard H. Monk & Associates, Inc.
SYSTEMS LABORATORIES CORP. 113
Agency—David Parry & Associates

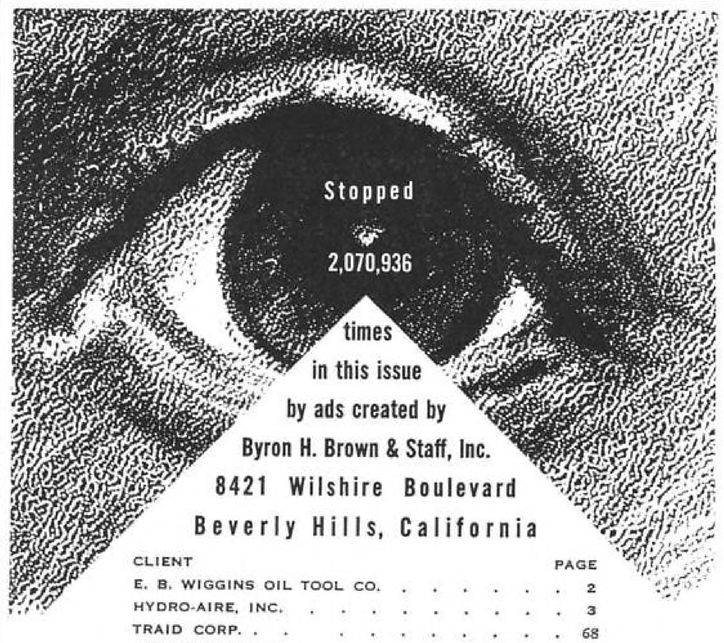
TEXAS INSTRUMENTS INCORPORATED 105
Agency—Don L. Baxter, Inc.
TIMKEN ROLLER BEARING CO. 14
Agency—Batten, Barton, Durstine & Osborn, Inc.
TITANIUM METALS CORPORATION OF AMERICA 17
Agency—W. L. Towne Advertising
TRAID CORPORATION 68
Agency—Byron H. Brown & Staff, Inc.
TRANS-SONICS, INC. 5
Agency—Louis K. Frank Co.
TRECKER AIRCRAFT CORPORATION 127
Agency—Bert S. Gittins Adv., Inc.
TUBE METHODS, INC. 52
Agency—John Miller Adv. Agency

VICKERS-ARMSTRONG CO. 138
Agency—McCann-Erickson, Inc.
VICKERS, INC., DIV. OF SPERRY RAND CORP. 126
Agency—Witte & Burden Adv.

WEBER AIRCRAFT CORP. 12
Agency—Byron H. Brown & Staff, Inc.
WESTERN AIR LINES, INC. 46
Agency—Buchanan & Company, Inc.
WESTERN GEAR CORP. 18
Agency—Ruthrauff & Ryan, Inc.
WHITE DENTAL MFG. CO., THE S. S. 96
Agency—Hazard Adv. Agency, Inc.
WHITTAKER CO., LTD., W. R. 69
Agency—Mogge-Privett, Inc.
WIGGINS OIL TOOL CO., INC., THE E. B. ..... 2nd Cover
Agency—Byron H. Brown & Staff, Inc.

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EQUIPMENT
(Used or Surplus New)
For Rent 154
For Sale 154, 155



CLIENT	PAGE
E. B. WIGGINS OIL TOOL CO.	2
HYDRO-AIRE, INC.	3
TRAID CORP.	68
AMERICAN LATEX	91
SUMMERS GYROSCOPE	10
DOUGLAS ROESCH	67
WEBER AIRCRAFT	12

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LETTERS

Rascal Mount

I have appreciated your magazine for many years. In my opinion, it is the best aviation magazine published in the United States. And, in particular, your cover photo—each one a masterpiece.

However, I would like to bring to your attention the write-up on your Feb. 18 cover. It stated that the Rascal was mounted on an underwing pylon on the B-47. If I am not mistaken, you are only partially correct. It is under the wing, but the pylon is connected directly to the fuselage above the bomb bay.

I was fortunate enough to see this type of rig on a B-47 on the Boeing flight line while on TDY to Wichita, Kan., in mid-December, although, at the time, I didn't recognize it for what it was.

A/1C JOHN W. RAMSAY, USAF
Belleville, Ill.

(Airman Ramsay is right! Rascal pylon is connected directly to the B-47 fuselage.—Ed.)

Sweet Simplicity

I've been flying quite a few years and a remark of Mr. C. D. Perkins in your Feb. 18 issue ("USAF's Perkins Poses Budget Problems," p. 75) brings out a hearty "amen."

I refer to the part of his expression that asks for more ". . . simplicity of concept, development and engineering design and tactical operation and could reduce budget requirements many fold . . . if we paid more attention to reducing problems to their simplest form, we could go a long way toward solving not only our money problems but our technical manpower shortages at the same time." If Mr. Perkins does not mean to include it, I would add: the same attentiton could be paid to *administration*.

It seems to me many responsible people are already overcommitted in their honest and dedicated zeal to administer by complex gadgetry. I have specific reference to the phobia, or if not that, the fad for meticulous work measurements accompanied by associated paper analysis. Seemingly, this is done by about as many people (bird watchers) as people who do productive work. I am aware of my relatively limited viewpoint, but I have seen and experienced the impact of never perfect mechanized thinking and chart engrossed leaders. In their genuine pursuit of administration, some key leaders appear to lose sight of practical and simple aspects that could give a more effective operation. When machines react to human input error, it is quite often the operational activity at the very end of the line that receives the disruptive impact of the error. Corrective action is often slow, awkward, and expensive in dollars, as well as human energy.

Another addition to Mr. Perkins' plea for simplicity—how about a screaming halt to the trend pushed by people who try to make modern flying appear more difficult and complex? It seems as if many people forget the great simplicities of the jet engine and the jet airplane that were extolled a few years ago—and now the opposite seems to be true. For example, I agree with most of Capt. Robson's articles, but I feel he is inclined to make today and tomorrow's flying appear more complicated than it really is. It's still an airplane and the basic fundamentals for a safe effective flight are the same.

Getting back to earth—automobiles; here's an amazing example. Think of the mass of traffic lights, police and stop signs, etc., there are in New York—and how slowly traffic moves and the accidents. Then, go to Buenos Aires and look at its traffic set-up—no lights, no police, no signs—nothing! But traffic seems to move quite reasonably. Maybe they have something. Since the air world is considered complicated, I wonder if a concentrated drive for simplicity would be worthwhile? I have flown passengers and have had the services of copilots, navigators, etc., but I know first-hand the average fighter pilot has and will continue to handle these modern "complications" *alone*. In short, let's emphasize the simplicity of modern flying.

COL. CHARLES W. STARK, USAF
Kelly Air Force Base, Texas

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 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.

Infrared

Congratulations on your interesting article on infrared, March 4 edition. In listing firms active in field you failed to mention Kett Corp., Cincinnati, Ohio. We have been and still are engaged in research and development in this field on classified contracts for the Air Force.

KARL SCHAKEL, president
The Kett Corp.
Cincinnati, Ohio

Enlightenment

Englishman Wilkinson (AW, Feb. 18, p. 126) needs to be enlightened. I'm sure that all the records, if true, that he claims are Britain's would not have been possible had not the United States loaned them to money to make them.

At the time Britain was concentrating on beating the turboprop market, we were busy turning out jet fighters for the Korean conflict.

How far ahead are we, Mr. Wilkinson? Far enough ahead to save your neck in World War II and far enough ahead to feed you in addition to ourselves.

ROBERT E. BROWN
Senior Mechanical Engineer
Melpar, Inc.
Falls Church, Va.

(Reader Brown's letter is typical of a large volume of mail received, taking issue with Mr. Wilkinson's letter.—Ed.)

Traffic Separation

I should be grateful if you would be good enough to correct a statement in Mr. Doty's article in your Jan. 28 issue ("BOAC Proposes New Navigation Plan," p. 39, 40) to the effect that I want to see an end to the vertical separation of traffic on the North Atlantic. What I would like to see ended is reliance on vertical separation alone, by making much more use of lateral separation and reconsidering the basis of longitudinal separation. There is no doubt in my mind that vertical separation properly used will continue to prove one of the desirable means of traffic separation and I should be extremely grateful if you would be good enough to make this clear in a future issue of your magazine.

E. W. PIKE
Control & Navigation Superintendent
British Overseas Airways Corp.
London Airport

Nuclear Fear

It appears that fear of a nuclear attack is the controlling factor in our defense concept. We will have to devote a great deal of effort on research and development on missiles and long range nuclear bombers, but only as a deterrent to attack.

The nuclear weapon reached the same state in the bombing of Japan that poison gas reached in World War I.

The Korean War, the fighting in the Far East, and the Suez Canal should clearly illustrate this.

It then follows, and the above examples emphasize this, that we should be turning our efforts to tactical weapons. A mobile infantry, armored divisions and tactical aircraft to support these. Not nuclear weapons; they won't use them if we don't and vice versa!

DONALD G. WEERSING
Columbus, Ohio.

Il-28's Bombsight

In regard to Feb. 11 issue, p. 63, the picture on the left shows a navigator-bombardier in the nose of a Soviet Il-28—bombsight shown is M-9 Norden American bombsight mounted on Norden stabilizer gyro. Also, lower left corner shows directional panel of American C-1 autopilot. How come?

SUN VALLEY, CALIF.

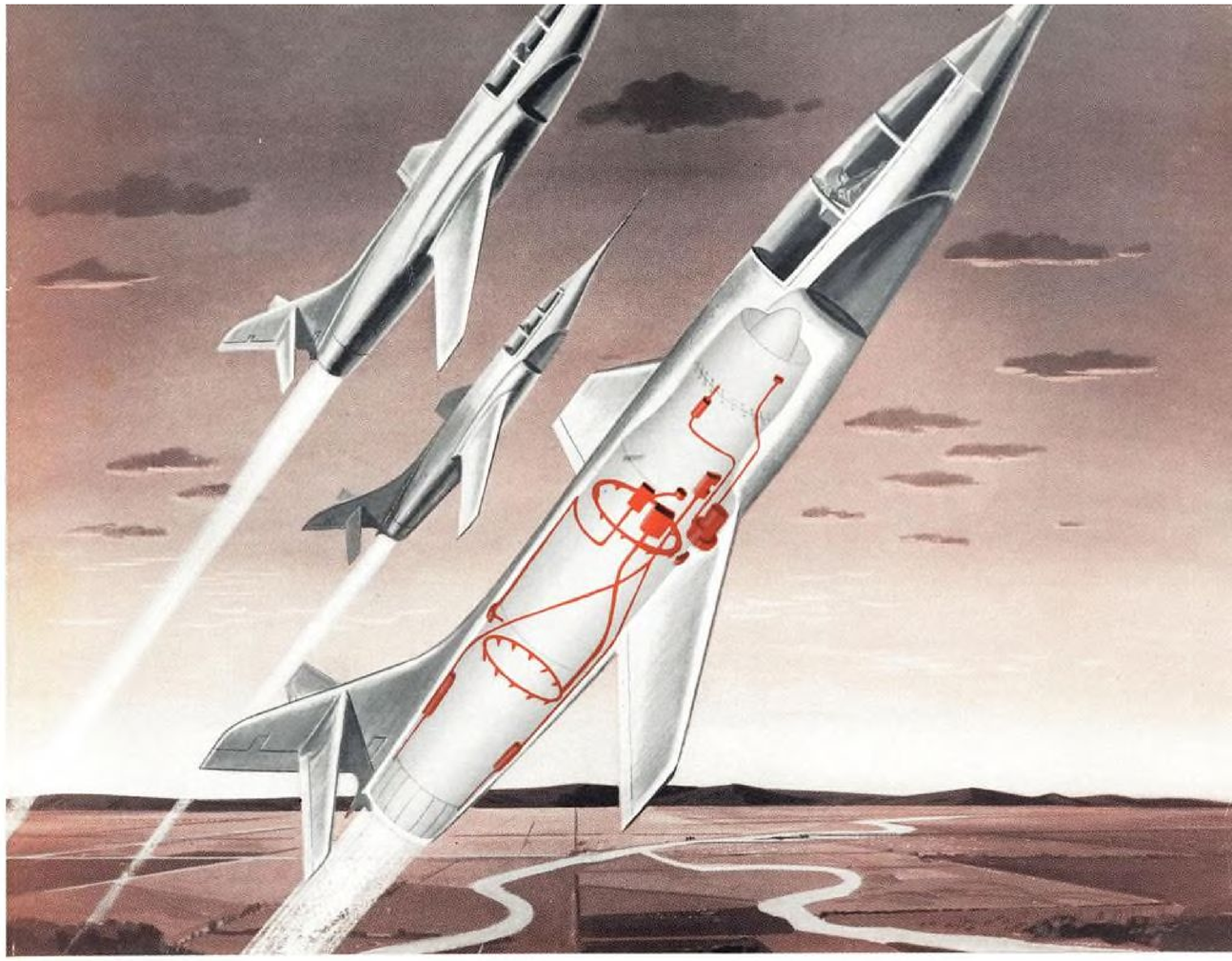
(This type equipment was furnished the Russians in World War II as lease-lend.—Ed.)

Age-Old Incentive

The companies that now spend $1,000 to $5,000 per engineer recruit could have hordes of engineers beating at their gates by eliminating advertising and recruiting expenditures and applying the saving to salaries.

This suggestion will very likely not sit well with personnel or AVIATION WEEK.

NED W. RICHARDSON
Aero Engineer
Air Proving Ground Command
Eglin AFB, Fla.



TOWARD MACH 3

WITH A COMPLETE BENDIX SYSTEM FOR FUEL METERING AND ENGINE CONTROL

When the pilot swings the lever from idle to emergency thrust—or back again—things must happen fast in the big jets.

But not too fast!

For, pouring it on, or cutting back faster than the engine can take it, spells disaster. The penalties are ruinous over-temperatures, compressor stall or flame-out.

When the pilot orders a change in thrust, the Bendix* fuel metering and engine control system takes over. Fuel feed is automatically computed and scheduled. Geometric controls such as exhaust nozzle area and inlet vane angles are set. Automatically and instantly, engine response is crowded to the limit—but not beyond!

Matched sets of Bendix components—pressure and temperature sensors, electronic amplifiers, fuel metering units and engine control actuators—work together as a *system*, spanning the length and girth of the engine.

Bendix components, designed and engineered together, invariably give more efficient performance than any arbitrarily assembled system.

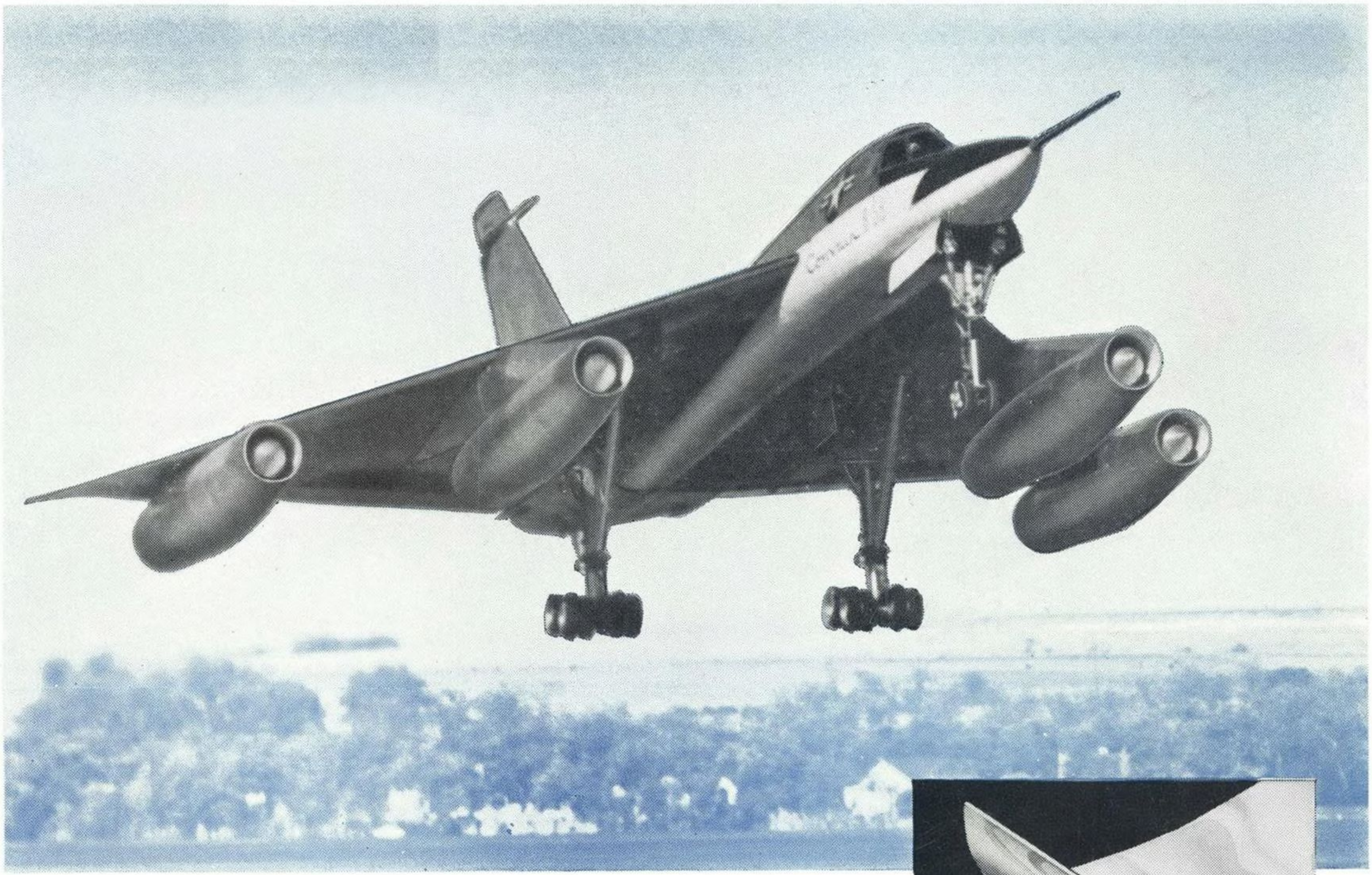
And there is the further important advantage of having one source and having that source completely responsible for over-all dependable operation on the plane.

So, when it comes to fuel metering and engine controls, think of a complete and integrated system. Then we suggest you think of Bendix and the Bendix Products Division.

*REG. U.S. PAT. OFF.

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Bendix AVIATION CORPORATION



New aluminum sheet gives Convair B-58

THINNER, TOUGHER SKIN

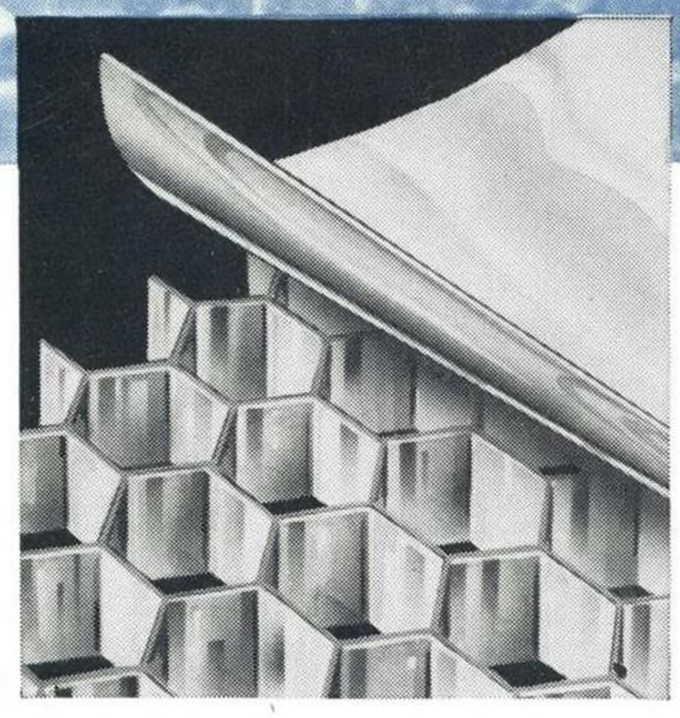
The new muscle in America's air arm, Convair's supersonic B-58 bomber, has a wing-skin that's probably the thinnest, toughest yet—bonded to an aluminum honeycomb section. This new construction method uses a new light-gauge, high strength, heat-treated aluminum alloy skin produced by Reynolds. It has the strength-weight ratio, the superior mechanical properties and the excellent surface qualities demanded of skins on a supersonic ship like the Air Force's B-58 "Hustler".

Whenever aviation advances, Reynolds Aluminum advances with it. And Reynolds goes beyond meeting material specifications. Reynolds technical services contribute to customers' design and engineering staffs—make Reynolds a part of many important industries rather than just a supplier.

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The above illustration shows how Reynolds new light-gauge, heat-treated, strong alloy sheet is bonded to an aluminum honeycomb for B-58 wing sections. This new skin material is available in a range of thin gauges, widths, lengths, and alloys for several airframe applications. A typical size in Alclad 7075-T6 is .010″x36″x120″ in sheets, and in conventional coil lengths. Write for complete information and application assistance.

See "CIRCUS BOY", Reynolds exciting dramatic series, Sundays, NBC-TV

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