AVIATION WEEK

A McGRAW-HILL PUBLICATION

JANUARY 9, 1956

50 Cents

Airlines' High Credit Eases Jet Financing

Earth's Pendulum Key To Inertial Guidance

the
only
miniature floating
nut . . .

. . . in the true sense of the word

KAYLOCK
TRADE MARK

ALL METAL SELF-LOCKING NUTS

for aircraft, guided missiles and electronics

LIGHTEST — STRONGEST — SMALLEST

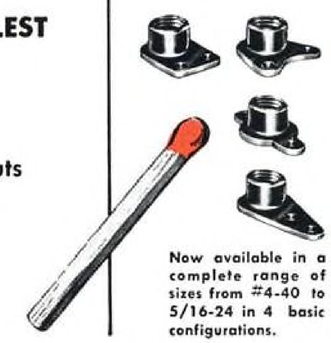
only **FRACTION OF SIZE**
uses less than 1/2 the space of comparable standard anchor nuts

only **FRACTION OF WEIGHT**
1/5 the weight of comparable standard anchor nuts

For MAXIMUM strength with MINIMUM space and weight characteristics specify Kaylock "MF" series miniature nuts.

A positive, simple design principle provides the utmost in locking dependability.

Kaylock nuts are precision products, produced in full conformance with air force-navy specifications AN-N-5 and AN-N-10.



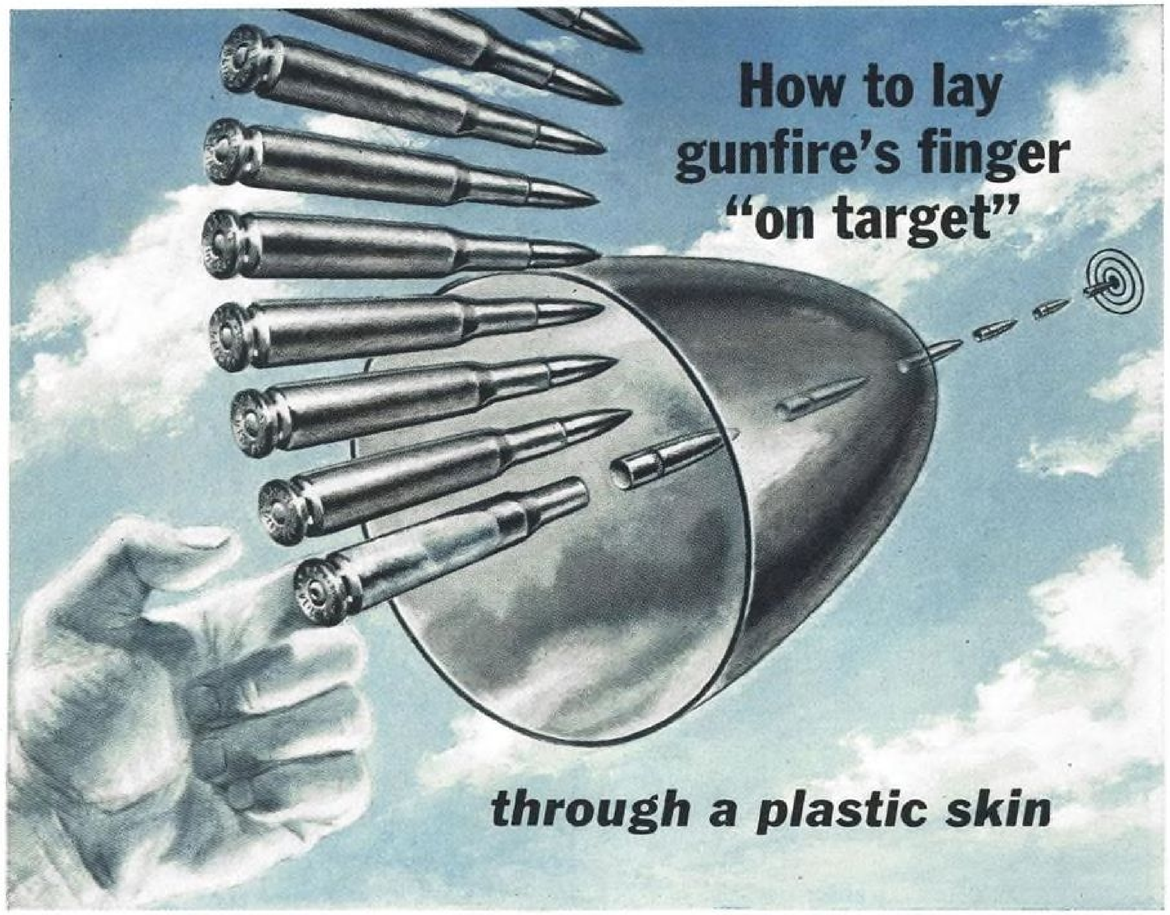
Now available in a complete range of sizes from #4-40 to 5/16-24 in 4 basic configurations.

Check these features:

- Lightest Weight
- Highest Axial Strength
- Lowest Height
- Most Constant Locking Torque
- "Infinite" Reusability
- Impossible to damage by cross-threading
- Only one part required for both 250° F. and 550° F.
- No fungus nutrient
- No low temperature limitations

THE KAYNAR COMPANY · KAYLOCK DIVISION · BOX 2001, TERMINAL ANNEX · LOS ANGELES 54, CALIFORNIA

Canada Distr.: Abercorn Aero Limited, Montreal



PRODUCING radomes—protective plastic housing for gun-laying radar—is one of the many challenging tasks of Goodyear Aircraft as a member of America's aeronautical team.

But we've come up with a way of controlling the accuracy—limiting the deflection caused by interposing the plastic housing in the path of the electronic fingers—which has fire control officers grinning with appreciation.

For you see, only a short while ago, substantial errors in bore-sight radomes were tolerated. Unsatisfactory cross-talk and bore-sight results were accepted in exchange for the benefit of being able to submerge the radar equipment within the sleek aerodynamic contours of the aircraft.

Today, deflection has been cut drastically (we'll be glad to tell properly cleared personnel the details)—thanks to foamed radomes and special bore-sight testing equipment developed by Goodyear Aircraft.

The Goodyear foamed radomes have made it possible to raise the quality of difficult void-free laminates — to exercise greater uniformity of control and thickness.

The bore-sight testing equipment makes it possible for Goodyear Aircraft to *pre-test* every radome before it leaves the plant—ascertain its accuracy while it utilizes simultaneous lobing or conical scanning antennas. And Goodyear's latest bore-sight developments have a special significance for prototype programs.

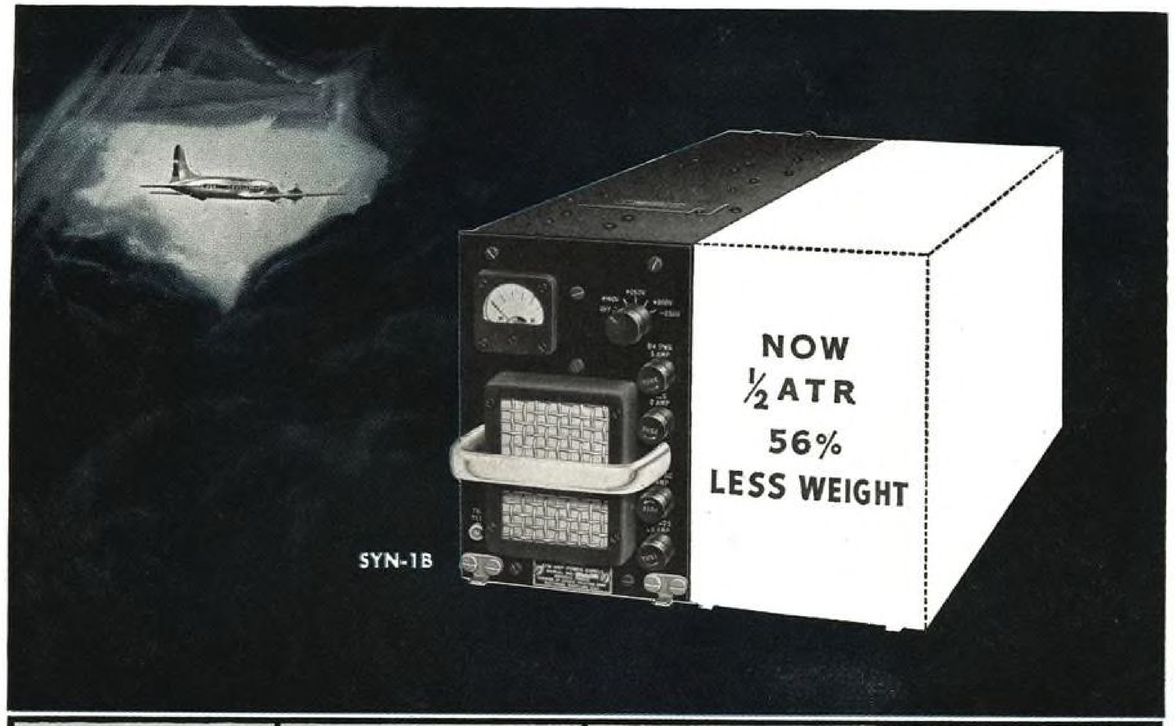
Such assurance of quality is a source of real satisfaction to both the manufacturer of the aircraft for which the radome is produced and for the military air arm which gets final delivery.

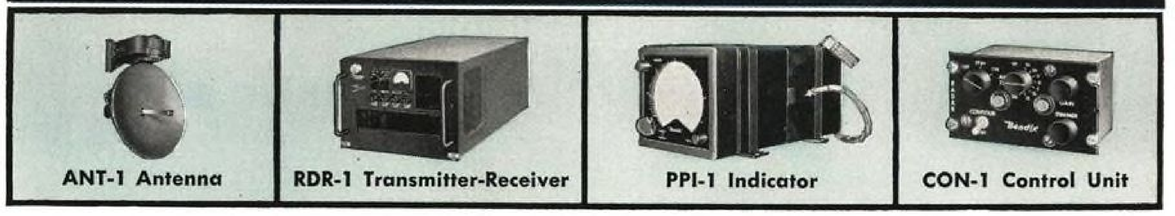
It's typical of the way we go the whole way to better serve our customers.

Goodyear Aircraft Corporation, plants in Akron, Ohio, and Litchfield Park, Arizona.

They're Doing Big Things at

GOODYEAR AIRCRAFT





New . . . Lighter, Smaller Synchronizer For BENDIX Weather Radar System

This new SYN-1B Synchronizer—heart of the Bendix* RDR-1 Weather Radar System—represents the ultimate in lightweight design for this type of equipment. It weighs only 21 pounds—27 pounds less than its larger predecessor. The number of vacuum tubes used has been reduced from 32 to 19.

The SYN-1B Synchronizer is but one of several advancements incorporated in the Bendix RDR-1 Weather Radar System. Four types of antennas are available. Improved contour circuitry in the Transmitter-Receiver unit assures even greater trouble-free operation. All relays are protected against dust particles by easily accessible, removable covers.

Get the full story on Bendix Weather Radar. Find out why it is fast becoming the leader in its field. Contact your local Bendix Aviation Radio Representative. Or write the factory direct. Address below.

* Reg. U. S. Pat. Off.

BENDIX RADIO DIVISION • BALTIMORE 4, MARYLAND

West Coast Sales: 10500 Magnolia Blvd., North Hollywood, California
Export Sales and Service: Bendix International Division, 205 E. 42nd St., N. Y. 17, N. Y., U.S.A.
Canadian Distributor: Aviation Electric, 200 Laurentian Boulevard, Montreal, Quebec

Bendix AVIATION Radio

Bendix AVIATION CORPORATION

AVIATION CALENDAR

Jan. 12—Conference on Airport Financing Problems in California, sponsored by Institute of Transportation and Traffic Engineering & University Extension, International House, University of California, Berkeley, Calif.

Jan. 19-21—National Simulation Conference sponsored by Dallas-Fort Worth Chapter of Institute of Radio Engineers' Group on Electronic Computers, Dallas, Tex.

Jan. 23-25—Helicopter Association of America, Inc., annual convention, Sheraton-Palace Hotel, San Francisco, Calif.

Jan. 23-26—Institute of the Aeronautical Sciences, 24th annual meeting, Sheraton-Astor Hotel, New York, N. Y. Jan. 23—Honors Night Dinner.

Jan. 23-26—Plant Maintenance & Engineering Show and Conference, Convention Hall, Philadelphia.

Jan. 30-31—Industrial Economics Conference, Statler Hotel, Los Angeles.

Jan. 30-Feb. 3—American Institute of Electrical Engineers, winter general meeting, Hotel Statler, New York, N. Y.

Feb. 2-3—National Symposium on Microwave Techniques, sponsored by Institute of Radio Engineers' Antenna & Propagation Group, and Theory & Techniques Group, Philadelphia.

Feb. 7-9—Society of the Plastics Industry, 11th annual Reinforced Plastics Div., conference, Chalfonte-Haddon Hall, Atlantic City, N. J.

Mar. 19-21—Society of Automotive Engineers, national production meeting and forum, Hotel Statler, Cleveland, Ohio.

Mar. 19-22—Institute of Radio Engineers, national convention, Waldorf-Astoria Hotel & Kingsbridge Armory, New York, N. Y.

Apr. 9-12—Society of Automotive Engineers, national aeronautic meeting, aeronautic production forum and aircraft engineering display, Hotel Statler, New York, N. Y.

Apr. 10-11—Symposium for Management on Applications of Analog Computers, sponsored by Midwest Research Institute, University of Kansas City, Kansas City, Mo.

Apr. 18-19—First Annual National Industrial Research Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology, Hotel Sherman, Chicago.

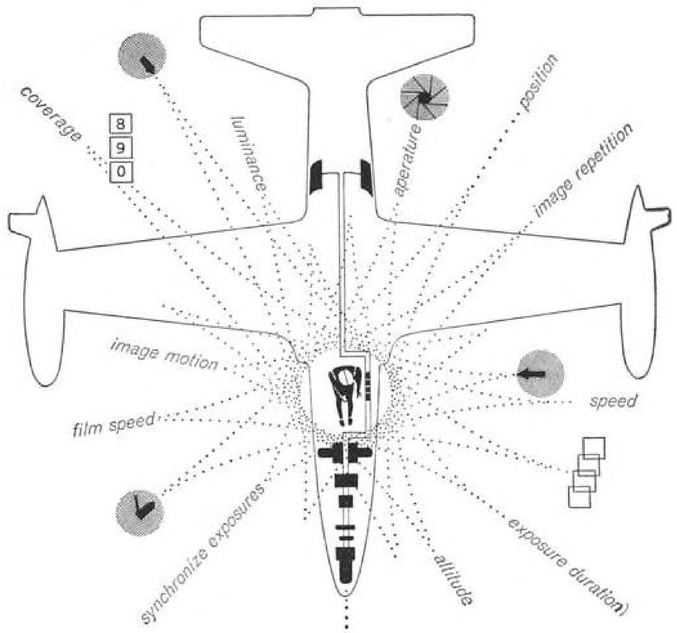
Published weekly with an additional issue in December by the McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription Offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices: 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice President; Joseph A. Gerardi, Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising; J. E. Blackburn, Jr., Vice President and Circulation Director.

Subscription: Address correspondence to AVIATION WEEK—Subscription Service, 99-129 North Broadway, Albany 1, N. Y. or 330 West 42nd St., New York 36, N. Y. Allow 10 days for change of address.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation. Position and company connection must be indicated on subscription orders.

Single copies 50¢. Subscription rates—United States and possessions, $6 a year; $9 for two years; $12 for three years. Canada $8 a year; $12 for two years; $16 for three years, payable in Canadian currency at par. Other Western Hemisphere and the Philippines $10 a year; $16 for two years; $20 for three years. All other countries $20 a year; $30 for two years; $40 for three years. Second class mail privileges authorized at Albany 1, N. Y. Printed in U. S. A. Copyright 1956 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved. Cable Address: "McGraw-Hill New York". Publications combined with AVIATION WEEK are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Jet age photo reconnaissance is a seemingly impossible one man job!



But . . . C.A.I. makes it easy as flicking a switch

In this day of supersonic speeds, piloting a plane is a full time job. Add the dozens of factors inherent in precision photography and you have an almost impossible situation! But Chicago Aerial Industries Photographic Control Systems change impossibility to simplicity . . . automatically obtaining, coordinating, synchronizing and computing myriads of these constantly changing factors to take technically exact pictures. This is the reason why America's newest recon jets rely on C.A.I. control systems . . . only one facet of Chicago Aerials advanced research and production in the fields of optics, mechanics and electronics.

The interesting, colorful C.A.I. brochure, "Advancing Horizons," will be sent to you upon request. Learn more about our advanced research and manufacture of aerial equipment—write for your copy today!

CHICAGO AERIAL INDUSTRIES

1980 Hawthorne Avenue, Melrose Park, Illinois
Chicago office: 332 S. Michigan Avenue, Chicago 4, Illinois

99.7%
Reliability Factor
for

VICKERS®

VARIABLE DISPLACEMENT
3000 PSI PUMPS

IS EXPERIENCED BY

TWA

ON
749 Constellations

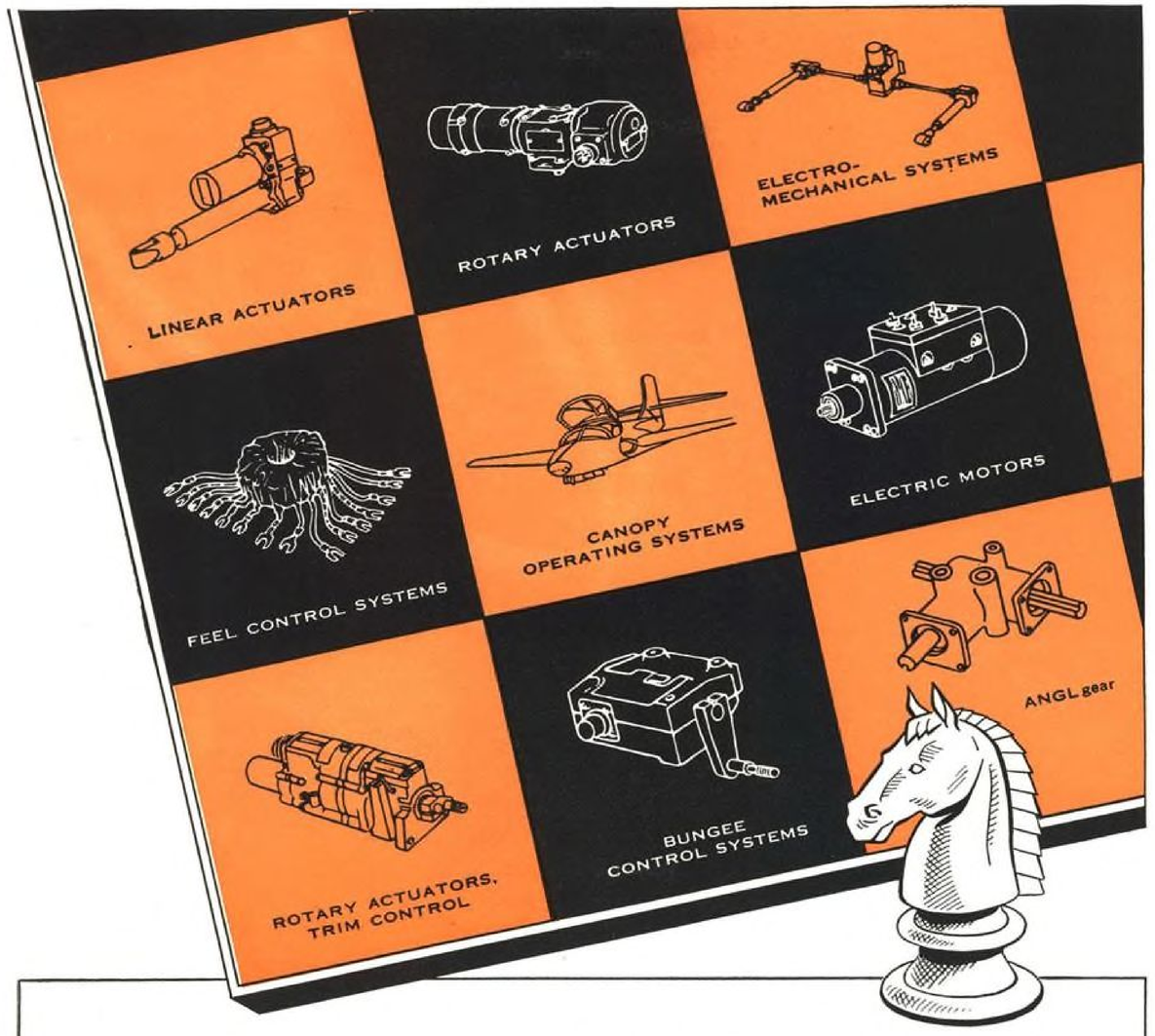
only 7 malfunctions in 2,026,064 pump hours

During a 5½ year period (July 1, 1949 to December 31, 1954) the TWA Accessory Shop overhauled 3000 Vickers Variable Displacement Pumps used on the cabin supercharger drives in their 749 Constellations. Of these, there were only seven malfunctions . . . all others were routine overhauls. In other words, only one of every 428 pumps scheduled for overhaul was for a malfunction. For the last three years the scheduled overhaul period for these pumps has been 1700 airplane hours.

Such reliability is another one of the reasons why TWA and other great airlines are large users of Vickers hydraulic equipment. For further information, ask for Bulletin A5203-A.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
1462 OAKMAN BLVD. • DETROIT 32, MICH.
Application Engineering and Service Offices: El Segundo, California, 2160 E. Imperial Highway • Detroit 32, Michigan, 1400 Oakman Blvd. Arlington, Texas, P.O. Box 213 • Washington 5, D.C., 624-7 Wyatt Bldg. • *Additional Service facilities at:* Miami Springs, Florida, 641 De Soto Drive
7344 TELEGRAMS: Vickers WUX Detroit • TELETYPE "TWX" DE89 • CABLE: Videt Detroit
OVERSEAS REPRESENTATIVE: The Sperry Gyroscope Co., Ltd.—Great West Road, Brentford, Middx., England

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



Your move

If you play chess, you know how specialized and versatile the 16 pieces can be. Each has its prescribed function, yet can be employed in endless strategies to effect a checkmate.

The Airborne products shown above are similarly specialized, equally versatile. Each was designed to solve a particular problem in aircraft technology, and has proved adaptable to many other engineering needs.

Airborne service to aircraft manufacturers is completely integrated, from design engineering to production and follow-up in the field. We even make the many basic components of our products, such as motors, magnetic amplifiers, R.F. filters, and starting capacitors.

When you're ready for your next move, call on us. We're anxious to serve you.

LINEATOR® • ROTORAC® • TRIM TROL® • ROTORETTE® • ANGLGEAR ROTOLOK

AIRBORNE
ACCESSORIES CORPORATION
HILLSIDE 5, NEW JERSEY

NEW AIRBORNE CATALOG
Contains full information on the Airborne line of electromechanical actuators and feel systems. Write for your copy today.

The manufacture of circular weldments — rings and bands — has been an American Welding specialty for 37 years. Here you will find the men, the know-how and the equipment to form, weld and machine circular components for a wide variety of end products. Big ones (96 inches) or small ones (6 inches), of ferrous or non-ferrous metals including Titanium* or Aluminum, in production runs of hundreds, thousands, or ten thousands.

If your problem is "round and metallic" consult our Industrial Products Division. Write or call today — we will be glad to work with you.

*First successful Production Welding of Titanium Alloy was accomplished by American Welding in 1949.

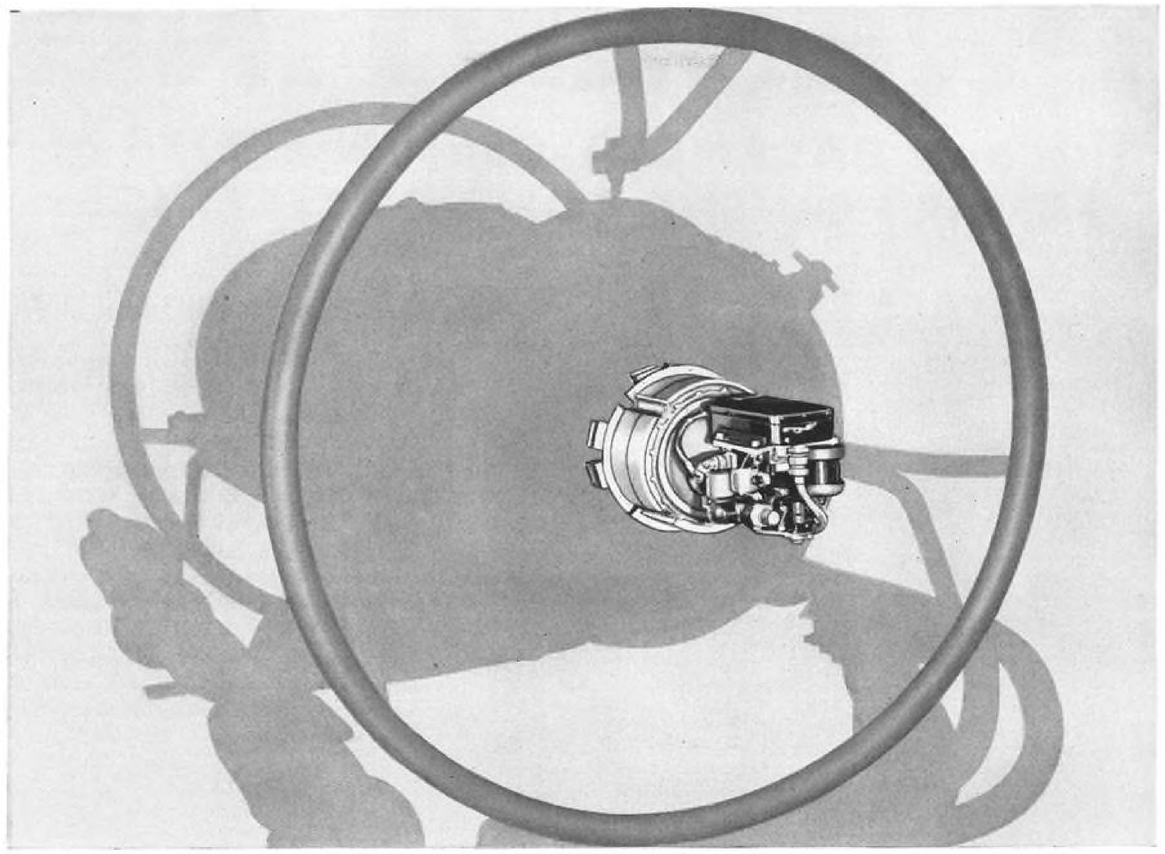
Production Facilities Catalog

Find out what American Welding can do for you. Send for FREE Catalog today.

AMERICAN WELDING

THE AMERICAN WELDING AND MANUFACTURING CO. • 420 DIETZ RD. • WARREN, OHIO

Important things are happening at Bendix-Utica



Here's the fuel-air combustion starter . . .

BY Bendix...THAT BLAZED THE TRAIL!

You're looking at the first fuel-air combustion starter ever successfully developed and mass produced for jet aircraft. As recently as 1952, this 79-lb. starter was considered a marvel of engineering advancement and efficiency. This still-widely-used starter was "right on target."

Since then, turbine specialists at the Utica, N. Y., Division have continued to score bull's-eyes. Good as the first starter was, our newest models are even better. New Bendix fuel-air combustion starters have been made more compact and weigh 40% less than original models still used throughout the world. Newest starters are adaptable to latest, more powerful jet engines.

Current plans at Utica concern development of models to start the jet engines which, in the not too distant future, will power our commercial airliners.

At the Utica Division are the specialized facilities and man power required to produce constantly better turbine and other aviation components and accessories for today's . . . and tomorrow's . . . aircraft.

West Coast Office: 117 East Providencia Ave., Burbank, Calif.

Export Sales and Service:
Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

Specialists in turbine-driven and advanced aviation accessories and components

STARTERS • TURBINE PRODUCTS • PUMPS • DE-ICING SYSTEMS
AIRBORNE AIR CONDITIONING • ENGINE CONTROLS

Utica DIVISION

Bendix AVIATION CORPORATION

PRESENTING

the new BALANCED-DESIGN SERIES of FAFNIR ROD END CONTROL BEARINGS

A Complete Family of 5 sizes

Designed specifically with bearing capacity, shank strength, and bolt strength all in balance, the new Fafnir series of rod ends is the direct result of an NASC study in which Fafnir engineers participated. Every member of this rod end family is completely new, carefully engineered and tested. Together, they represent the first series of rod ends developed with a significant relationship between bearing capacity, shank and bolt strength. What's more, Fafnir Balanced Design Rod Ends are made to withstand column action under compression with angularity as high as 9°.

Even the shank threads of the new rod ends are precision rolled with rounded roots to assure maximum strength and fatigue life.

A Special Bulletin is available that fully describes design and constructional advantages . . . also shows dimensions and load-life ratings. FOR PROMPT RESPONSE ask for Balanced Design Rod End Bulletin. The Fafnir Bearing Company, New Britain, Connecticut.

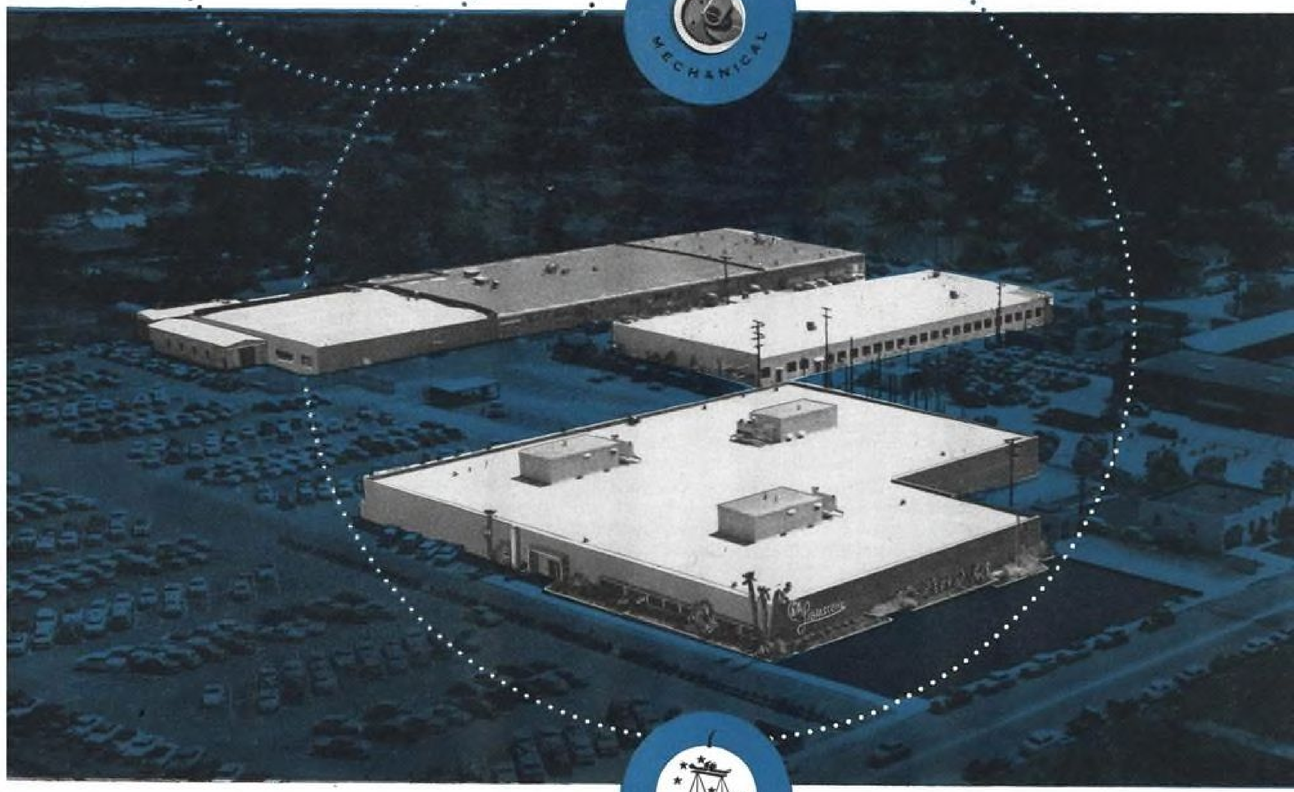
FAFNIR
AIRCRAFT BEARINGS
FIRST . . . at the turning points in aircraft design

The Capacity for Achievement

Since 1937 Librascope has earned and achieved—on an ever expanding scale—a position of leadership in the design, development and manufacture of computers, automatic controls and data handling systems for military and industrial applications.

Librascope, through a unique combination of electronic, magnetic, mechanical and optical techniques, consistently demonstrates an outstanding facility for the production of precision instrumentation and devices.

The creative ability of an exceptional engineering staff and the production capacity of a superbly equipped 200,000 sq. ft. plant facility can be focused on *your* computer-control problem. Consult Librascope today.



ENGINEERS . . . *learn about Librascope's new creative "Project Development Teams" . . . write Mac McKeague, Personnel Director*

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

LIBRASCOPE

LIBRASCOPE, INC. • 808 WESTERN AVE. • GLENDALE • CALIFORNIA

UNLIMITED HORIZONS

THE NEW LIGHTWEIGHT U.S.A.F. J4 COMPASS SYSTEM PERMITS PRECISE FIGHTER NAVIGATION AT ALL LATITUDES

ANOTHER MAJOR GYRO PROBLEM SOLVED BY WEAPONS GUIDANCE LAB. U.S.A.F. AND KEARFOTT

This miniature Kearfott Directional Gyro is the heart of the U.S.A.F. J4 Compass System. The System provides both latitude corrected and magnetic slaved directional gyro heading information. Suitable output transmitters are incorporated to supply compass data to autopilots, course indicators, and other systems requiring this information. This system provides all the functions of the Kearfott designed U.S.A.F. N1 Compass System with little loss in accuracy despite a 66% reduction in weight. The J4 Compass System as designed by Kearfott was selected by the Air Force ". . . due to its adaptability to product improvement and Kearfott's ability to meet the urgent requirements of the Air Force."

U.S.A.F. J4 Directional Gyro
Random drift rate 3° per hour max.
Weight 7½ lbs.

OTHER KEARFOTT GYROS IN PRODUCTION

VERTICAL GYROS: Precise verticals with 2 mins. vertical accuracy (Bench) weigh 7 pounds and measure 5⅛" diam. x 6⅜" high. Miniature verticals with 15 mins. vertical accuracy weigh 3.5 pounds and measure 3" x 3" x 4" approx.

FREE GYROS: Designed specifically for missile applications with 1° per minute drift. Under 2000 cps vibration at 3G drift will not exceed 5°/ min. The gyro withstands 60G shock.

FLOATED RATE INTEGRATING GYROS: Designs include 2.5 x 10^6, 2 x 10^4 and 6 x 10^6 wheels. Representative random drift rate .25°/ hour on day-to-day basis. Standard deviation for one day run .05°/ hour.

STABLE PLATFORMS: 3 gyro, 3 and 4 gimbal designs now in development, flight test or production are suitable for primary gyro reference or for inertial applications.

There is a Kearfott Gyro suitable for every aircraft and missile application. Write today for detailed technical data.

KEARFOTT COMPANY, LITTLE FALLS, N. J.

Sales & Engineering Offices: 1378 Main Ave., Clifton, N. J.
Midwest Office: 188 West Randolph St., Chicago, Ill.
South Central Office: 6115 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Ave., Pasadena, Calif.

Kearfott

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

Hostile aircraft are "Sitting Ducks"

Weapons equipped with
Maxson-developed, Maxson-built fire-control
electronic gear and computers
make "sitting ducks"
of enemy aircraft.

Top-caliber engineers will find exceptional opportunities at Maxson. For details, contact G. R. Pratt.

MAXSON develops and manufactures systems, subsystems, and components in armament, navigation, electronics, and special devices.
Ask for facilities report.

MAXSON

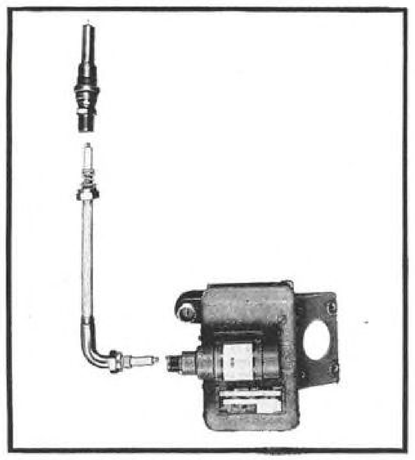
THE W. L. MAXSON CORP.

460 WEST 34th STREET, NEW YORK 1, N. Y.

Plants at Old Forge, Penn. and Long Island City and New York, N. Y.

Bendix Leading Producer of Aviation Ignition

Presents the latest and best in JET IGNITION



Only Bendix provides the complete ignition system for jet engines—Ignition Unit, Igniter Plug Leads, Igniter Plugs and Control Harness.

It is only natural that the world's leading builders of jet engines should look to Bendix* as the logical source of the latest and best in jet ignition.

For Bendix—and only Bendix—has, since the early days of aviation, specialized in the development of every type of ignition to meet constantly changing, higher-performance flight requirements.

Thus, to the solution of today's problems in jet ignition, Bendix brings unparalleled experience in research, engineering, manufacturing and service. From blue print stage to field service follow-through, you can depend on Bendix—the most trusted name in ignition—for the best in jet ignition for today's planes or tomorrow's plans. *TRADE-MARK

SCINTILLA DIVISION,
BENDIX AVIATION CORPORATION,
SIDNEY, NEW YORK

Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

FACTORY BRANCH OFFICES: 117 E. Providencia Avenue, Burbank, California • 512 West Avenue, Jenkintown, Pennsylvania • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan • 5906 North Port Washington Road, Milwaukee 17, Wisconsin • American Building, 4 S. Main St., Dayton 2, Ohio • 8401 Cedar Springs Road, Dallas 19, Texas • Boeing Field, Seattle 8, Washington • 1701 "K" Street, N. W., Washington 6, D. C.

Bendix
SCINTILLA DIVISION
Bendix
AVIATION CORPORATION

TORTURE TEST!

7 DAYS of accelerated heat aging

28 DAYS of fuel aging

40 PSIG cycling pressure

63,540 shear misalignment CYCLES (amplitudes thru .50")

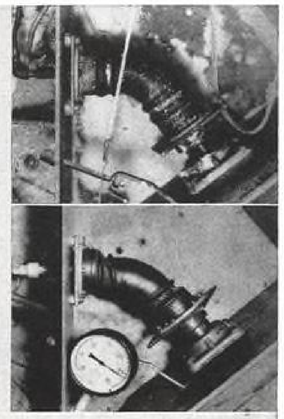
–65° to +160° temperatures

26" OF MERCURY negative cycling pressure

PROVES *FLEXIBLE* FLO-FLEX FLUID CONNECTOR

WITHSTAND VIBRATION, FLEXING MOTIONS AND MISALIGNMENT

Exhaustive tests were made subjecting the flexible Flo-Flex Fluid Connector to cycling motions at temperatures ranging from —65° to +160° F. and at various pressures ranging from 60 psig internal pressure to a vacuum pressure of 26 inches of mercury. No leakage or measurable material fatigue was apparent.



NO LEAKAGE! NO MATERIAL FATIGUE!

These are variations of flexible Flo-Flex Fluid Connectors used on aircraft fuel and oil systems. Fluorocarbon lined constructions are available for some sizes.

FOR HANDLING AIRCRAFT FUELS and oils this new flexible Flo-Flex Fluid Connector is the first to answer the problems of vibration, extreme flexing motions and shear axial misalignment encountered in aircraft fuel systems. Exhaustive tests thru temperature ranges of —65° to +160° F. and at pressures ranging from 60 psig internal pressure to a vacuum of 26" of mercury proved there was no measurable material fatigue from these destructive motions.

The Flo-Flex Connector tube is made of rubber impregnated fiberglass with a seamless liner of specially compounded synthetic elastomers. This tube is cured under 2000 psig pressure and the layers of fiberglass and synthetic resins are fused together to make a leak-proof connector to satisfy the requirements of USAF Memoranda Report MCREXP-524-1854 Add. 1 in handling aromatic fuels Mil-H-3136 Type I or Type III.

Flexible Flo-Flex Fluid Connectors are made in all diameters and lengths with various degrees of flexibility, see the various adaptations below. Ends fitted with floating or fixed, bolted or V-band flanges. Flange sealing is by "O" ring seal or integral gasket on flange face.

Write for Engineering Bulletin No. 350 for complete information and design factors.

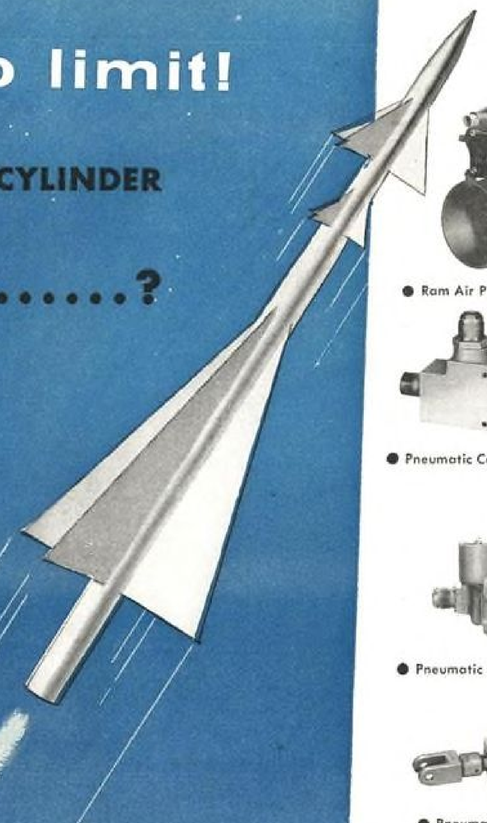
ARROWHEAD RUBBER COMPANY | Division of National Motor Bearing Company, Inc.

2330 CURRY STREET, LONG BEACH, CALIFORNIA

the sky's no limit!

TODAY, A LAUNCHER CYLINDER FOR THE NIKE! TOMORROW.....?

Whatever the need for precision units, INTERSTATE engineers will design and build them!



For almost two decades, INTERSTATE has been noted for quality of design, production standards and ability to meet exacting schedules. In the '30's, as one of the largest producers of light aircraft, INTERSTATE played a vital role in the development of America's aviation training program. During World War II, INTERSTATE produced over $50 million worth of material for the Armed Forces, including actuating cylinders that opened the bomb bay doors of the B-29 carrying the atom bomb over Hiroshima. In post war years, INTERSTATE has been a factor in precision aircraft parts manufacturing, as well as in production of airframe components. Today, products from our highly skilled engineering design group are used by every major airline throughout the world.

● Ram Air Pressure Regulator

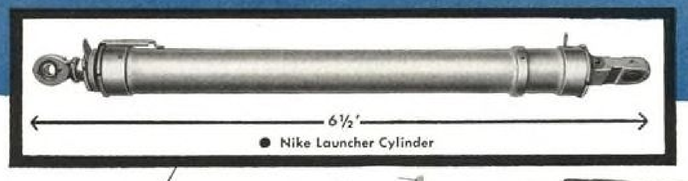
● Pneumatic Canopy Release Valve

● Pneumatic Anti-G Blackout Valve

● Pneumatic Selector Valve

● Pneumatic Air Valve (rotating)

● Hydraulic Actuating Cylinder

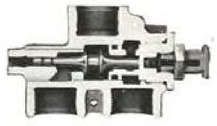


● Nike Launcher Cylinder

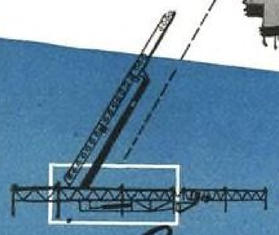
● Hydraulic Fuel-selector Valve

● AD-6 Navy Dive Bomber Fuselage

● Hydraulic Door-catch Cylinder



● Hydraulic By-pass Valve



INTERSTATE has complete facilities for assembly work, and for all jobs requiring precision machine work, including hydraulic, pneumatic and fuel systems. Also at your service is our Environmental Laboratory, with a new hydraulic test facility for measurement of heat, cold, altitude and vibration phenomena under controlled military specifications.

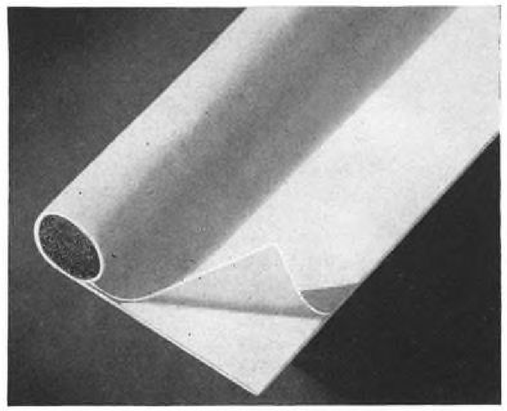
PHONE, WIRE OR WRITE FOR COMPLETE BROCHURE DETAILING OUR EQUIPMENT AND PRODUCTION BACKGROUND

Interstate **ENGINEERING CORPORATION** (Dept. 50) 2250 E. Imperial Highway El Segundo, California

*COHRLASTIC

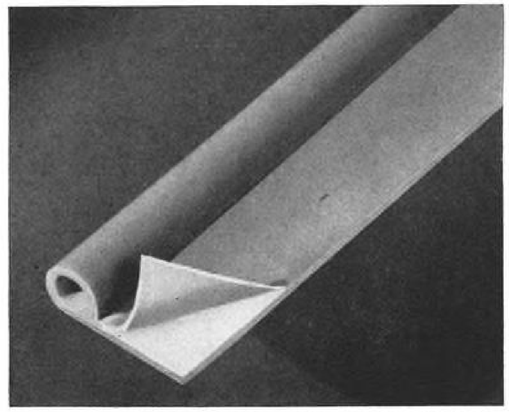
**Registered Trade Mark of CHR*

NEW PRODUCTS



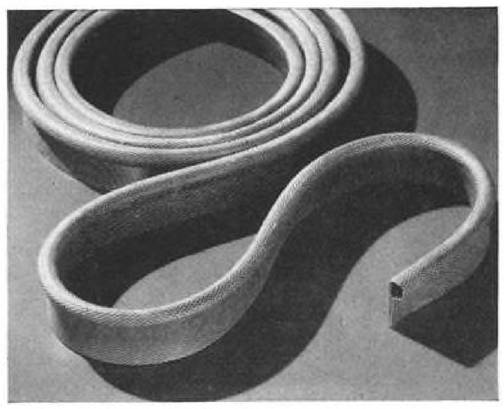
TEFLON COVERED SILICONE RUBBER SEALS

The non-adhesive quality of Teflon Covered Seals is best utilized where smooth, sliding action is desired. Teflon is bonded securely to the rubber, giving excellent impact and tear strength. Hydraulic fluids, jet fuel, gasoline and washdown fluids have no effect. Suitable for use at extreme temperatures ranging from 450°F. to —100°F. Available with hollow or silicone sponge rubber cores and with any type of slab.



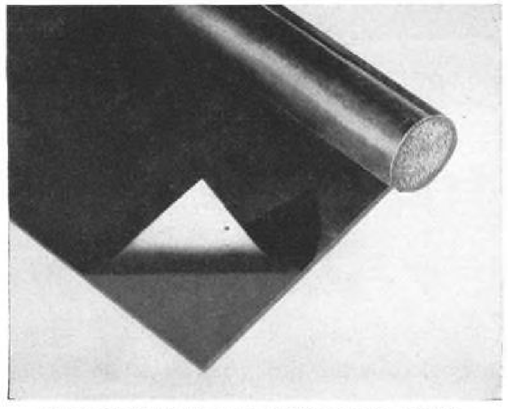
HT 600 SILICONE RUBBER SEAL WITH DACRON REINFORCED TAIL

High tensile and elongation properties, approximately double the best comparable properties offered in other silicone rubbers, make this new HT Silicone Rubber Seal ideal for many sealing applications. Abrasion and tear resistance has been vastly increased by the Dacron-reinforced tail, which prevents the seal from tearing loose from rivets. In addition, the materials used offer a broad range of temperature serviceability (—100°F. to 400°F.), and good resistance to oils, lubricants, and hydraulic fluids. Hollow or sponge cores; any type tab.



MYLAR COVERED SILICONE RUBBER SEALS ARE CHEMICALLY INERT

Hydraulic fluids, anti-freeze solutions, washdown solutions, gasoline, jet fuels have no harmful effect upon this Mylar bonded-to-silicone-rubber seal. Completely inert to virtually all chemicals and solvents, it can best be utilized around any enclosure where seepage of destructive fluids is a problem. COHRlastic Mylar Seals are extremely tough and offer dependable service in temperature extremes of —100°F, to 300°F. Available in any lengths with hollow or sponge rubber cores. Tabs as desired.



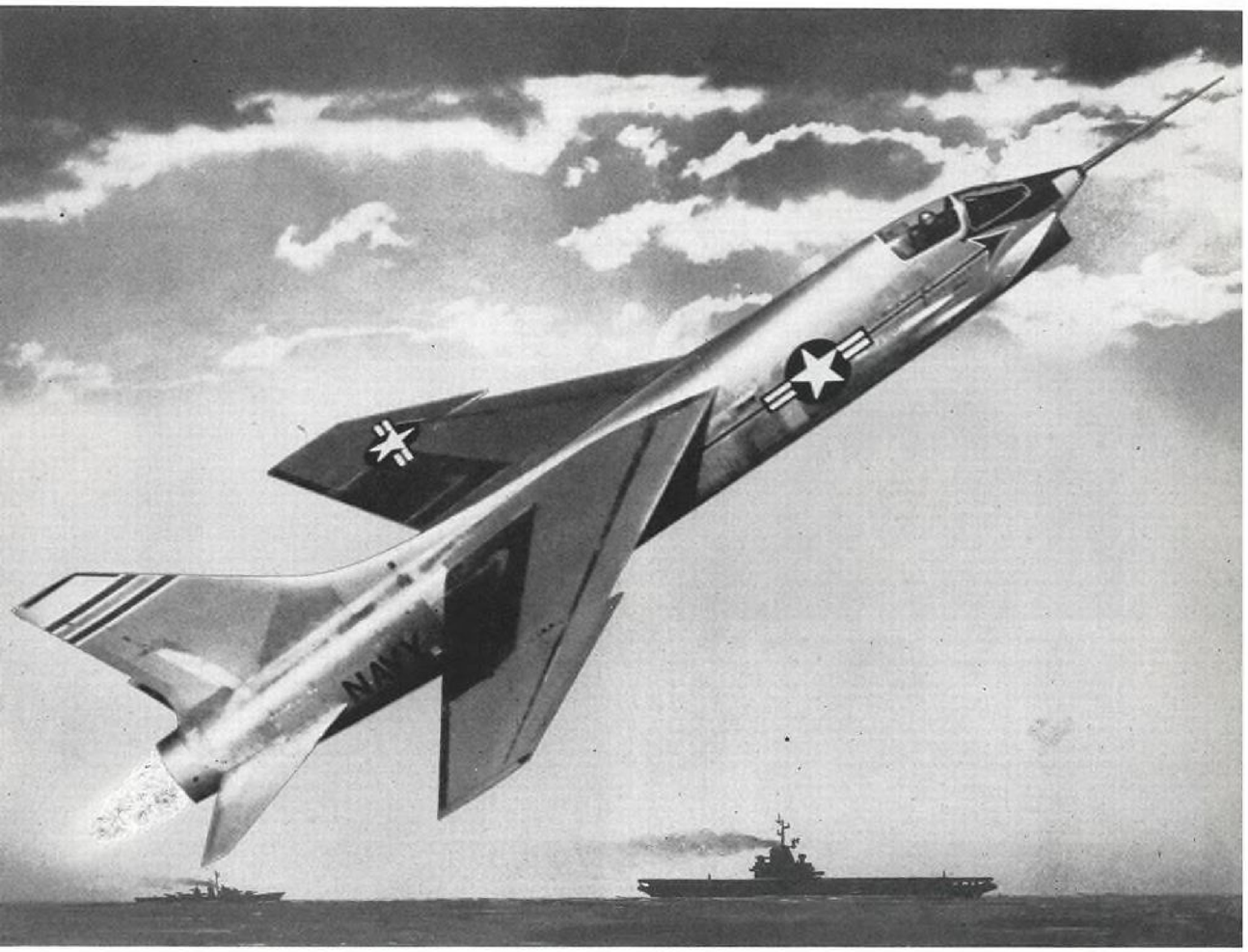
DACRON-FABRIC REINFORCED SEAL BENDS WITHOUT KINKING

COHRlastic's new Dacron-Reinforced Silicone Rubber Seal has excellent abrasion resistance and its reinforcement stretches to allow bending around corners without kinking. This stretchable seal possesses good tear strength, resists weathering conditions, and is suitable for continuous use in temperatures of —100°F. to 350°F. Can be furnished with hollow or silicone sponge rubber cores and any type tab desired in lengths up to 10 feet.

For additional data on the properties of these Seals, please write to:

THE CONNECTICUT HARD RUBBER COMPANY

407 EAST STREET • NEW HAVEN CONNECTICUT



The Navy's "Crusader" Carries a Zenith Plastic Shield

This shield is the nose radome of the Chance Vought F8U, protecting the latest contributions of science to its fighting efficiency in the air.

These ultra-sensitive electronic devices help to make it possible for this fastest of Navy fighters to stab through the sonic barrier in level flight straight to the heart of an enemy intruder.

Zenith Aircraft is proud of the part its specialized skill in radome construction has enabled it to play in our country's defense.

For the latest and most effective developments in reinforced plastic applications in aircraft, fuel tanks and guided missiles, consult the Engineering Research Division of

ZENITH AIRCRAFT *division of Zenith Plastics Company* **Z gardena, calif.**

WORLD'S LARGEST PLANT PRODUCING REINFORCED PLASTICS FOR AIRCRAFT

JANUARY 9, 1956

AVIATION WEEK

VOL. 64, NO. 2

Editorial Offices
New York 36—330 W. 42nd St., Phone LOngacre 4-3000 (Night LO 4-3035)
Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630
Los Angeles 17—1111 Wilshire Blvd., Phone MAdison 6-4323

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....Alpheus W. Jessup
ASST. MANAGING EDITOR (TECHNICAL) David A. Anderton
WASHINGTON.....G. J. McAllister
NEW YORK.....Cecil Brownlow
ENGINEERING....Irving Stone, Henry Lefer, Robert H. Cushman
AVIONICS.....Philip J. Klass
CONGRESS.....Katherine Johnsen
MILITARY.....Claude O. Witze
TRANSPORT.....Craig Lewis, Preble Staver
EQUIPMENT.....G. L. Christian
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
EDITORIAL PRODUCTION....Jerome E. Kelley
EDITORIAL ASSISTANTS Bernie Lang, Betty Hein
LIBRARIAN.....Jeanne Rabstejnek

FOREIGN NEWS SERVICE

EDITOR.....John Wilhelm
LONDON.....William J. Coughlin
PARIS.....John O. Coppock
BONN.....Gerald W. Schroder
MEXICO CITY.....John H. Kearney
RIO DE JANEIRO.....Peter Weaver
TOKYO.....Dan Kurzman
BOMBAY.....Gordon Graham

DOMESTIC NEWS BUREAUS

ATLANTA 3.....801 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.
LOS ANGELES 17.....1111 Wilshire Blvd.
SAN FRANCISCO 4.....68 Post St.
WASHINGTON 4...1189 National Press Bldg.

SALES

ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
PROMOTION and RESEARCH MANAGER T. B. Olsen
ATLANTA.....William D. Lanier, Jr.
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS D. T. Brennan, J. S. Costello
CLEVELAND.....H. P. Johnson
DALLAS.....James Cash
DETROIT.....C. A. Ransdell
LOS ANGELES C. F. McReynolds, Gordon Jones
NEW YORK.....J. C. Anthony
PHILADELPHIA....W. S. Hessey, J. D. Willis
SAN FRANCISCO.....T. Evans Wycoff

BUSINESS

BUSINESS MANAGER.....J. G. Johnson
PRODUCTION MANAGER.....W. V. Cockren

RESEARCH AND MARKETING

Mary Whitney Fenton, Elinore Eisenson.

U. S. Will Spur Industrial Dispersion 26
► Civil Defense study criticizes lack of progress, warns of intercontinental missiles, superbombs.

Old Idea Opens Door to Inertial Guidance 42
► The "84-minute pendulum," key to inertial navigation, is described in the second article of an Aviation Week series.

Airlines' High Credit Eases Jet Financing 96
► Once-shy investors now optimistic about airlines' future, offer ready backing to expansion plans.

AERONAUTICAL ENGINEERING

Russia's MiG-17 28
New Snecma Nozzle for Turbojet Control 58
Northrop Plans Engineering Center.... 59

AVIONICS

New Avionics Firms..... 47
New System Speeds Radar Plotting... 49
New Avionic Products..... 49

EQUIPMENT

Unitized Actuators Simplify Systems.. 54
World's Largest Nuclear "Microscope" 57
Coating Cuts Boundary Layer Drag... 58
Strain Gage Cells Measure High Thrust 59
Off the Line..... 61
New Aviation Products..... 68
Also on the Market..... 71

PRODUCTION

New Process Speeds Aluminum Cutting 64
Production Briefing 64

BUSINESS FLYING

Helicopter Succeeds as Uranium Hunter 74
Aero Design Backlog Equals 1955 Sales 75
Business and Utility Plane Shipments.. 75
Private Lines 75

TRANSPORT

Lee Still Puzzled Over Ouster..... 30
Fokker F-27 Leads as DC-3 Replacement 33
CAB Upholds Four Major-Case Decisions 97
Andrews AFB Plan Stirs Opposition.... 98
Airlines May Get DC-7Cs This Summer 99
Irregulars' Status Still in Doubt.....101
Airlines Prepare for New Routes.....102
Controversy Delays New York Heliport.105
Special Cargo Code Developed by IATA.106
CAB Orders 106
Shortlines 106

FINANCIAL

Stock Transactions 76
USAF Contracts 122

SAFETY

Fire, Crash Follow Cylinder Failure.... 79

MANAGEMENT

State of the Union Message..... 27
Army Buys Aerocycles 31
Organizations List Lobby Expenses.... 34
Civilians to Leave Lake Charles AFB... 53
Lockheed Sponsors Graduate Fellowships 58
Who's Where 23, 53
Industry Observer..... 23
Washington Roundup 25

Calendar 5
Letters 122

EDITORIAL

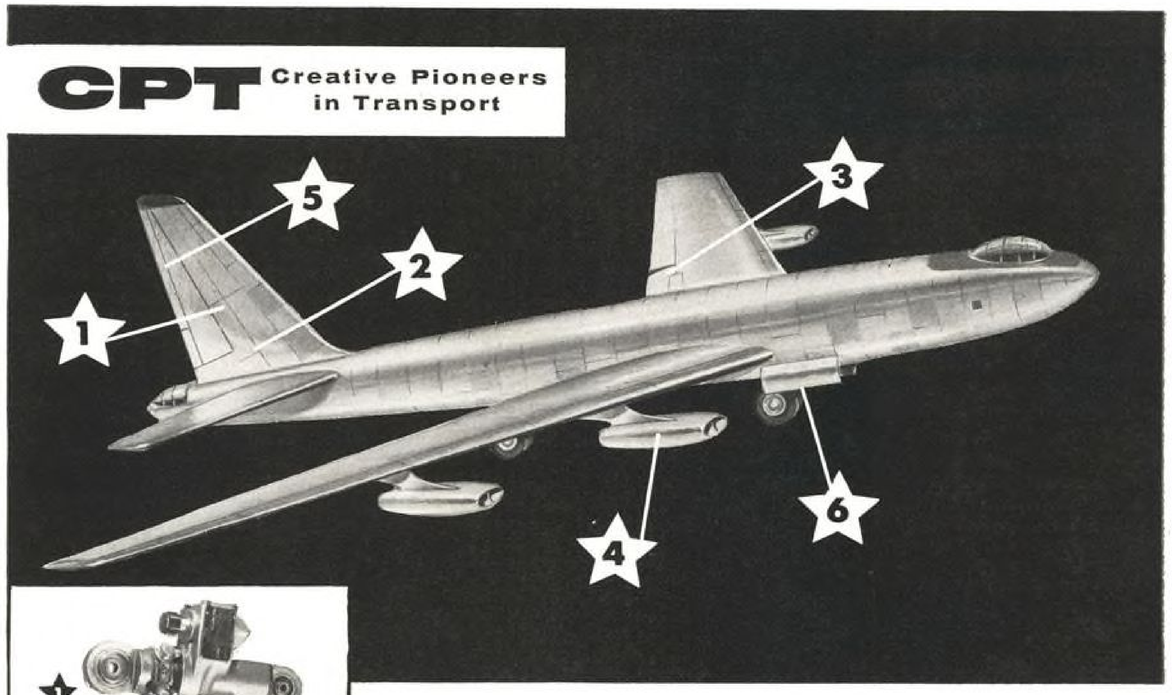
Are We Losing the Missile Race?..... 21

COVER: Douglas DC-7C on one of its first test flights over the California Coast. The "Seven Seas" will carry up to 85 passengers. With a range of over 5,000 mi., it was designed for service on long-range international routes.

59,202 copies of this issue printed

AVIATION WEEK • JANUARY 9, 1956 • Vol. 64, No. 2
Member ABP and ABC

CPT Creative Pioneers in Transport



1 CPT Stabilizer Control Actuator

2 CPT Structural Fin Fitting

3 CPT Ball-screw Flap Actuator

4 CPT Afterburner Actuator

5 CPT Rudder Control Actuator

6 CPT Landing Gear

CPT STARS IN AIRCRAFT LANDING GEAR ACTUATORS AND STRUCTURAL COMPONENTS

More aircraft rely on CPT Landing Gears than all other makes combined.

More vital aircraft equipment is operated by CPT ball-screw mechanisms than all other makes combined.

CPT has a unique combination of experiences. Engineering and production facilities have led all the top aircraft builders in bringing their designs to CPT. They rely on CPT for finished assemblies on schedule..

You can count on CPT's experience as the pioneer in landing gears. And the leading producer of all types of ballscrews. And the outstanding designer of actuators. You can also make good use of CPT's outstanding facilities for large-scale resistance welding, heat treatment, Kellering, and special machining. Call us before you begin your project.

CPT

CLEVELAND PNEUMATIC

TOOL COMPANY • Dept. C-156 • Cleveland 5, Ohio

For additional information write to any of the sales offices listed below:
Los Angeles; Levittown, L. I.; Fort Worth—Dallas.

CPT Abilities and Facilities Assure the finest in Precision Performance

EDITORIAL

Are We Losing the Missile Race?

There are disturbing indications that the United States may be losing the race to produce the first ballistic missiles with intercontinental range. Some senators, including Stuart Symington of Missouri, have been broadcasting warnings on this score for some time. Because of an unusual combination of Pentagon double-talk, poor intelligence and military security, it has been difficult to obtain a reliable fix on the relative progress of the United States and Russia in this critical field.

Now we have two fairly definite statements on the subject from both sides of the Iron Curtain. Defense Secretary Charles E. Wilson has estimated that the U. S. intercontinental ballistic missile is about five years away. Soviet Premier Nikolai Bulganin hinted that the Russians have developed an intercontinental missile, although they have not yet made their first test-firing.

Wilson vs. Bulganin

This, of course, is not conclusive evidence that the Russians are five years ahead of us in this crucial effort. However, in recent years the Russian leaders have been remarkably frank and accurate in their public statements on weapons development. Mr. Wilson, on the other hand, has earned a reputation for consistently underestimating the pace of scientific progress in weapons development—both our own and the Russians. Looking back at the course of missile development in Russia and the United States since the end of World War II provides a perspective that indicates it would be surprising indeed if the Russians were not in the lead on long-range, rocket-powered missiles.

The Russians had considerable short-range rocket development experience during World War II and brought an effective rocket weapon to the battlefield long before we did. Since the end of the war they have pursued a strong and consistent rocket-powered missile development program with the help of German scientists and V-2 data. We know this from fragmentary references in Russian publications and reports of German scientists who have returned from Russia. Their missile program was carried on parallel to and not in competition with their aircraft development program, and it apparently never suffered seriously from policy vacillation.

Missile Doldrums

Our missile program also had its beginnings during World War II but drifted in the doldrums during the post-war years. What little money was available for missile development was diluted among a hundred projects spread among four departments of the Army, Navy and Air Force, many of them duplicating functions and many tied to old-fashioned military concepts. The missile program received inadequate financial support until the Korean shooting began in mid-1950, and the Congressional appropriations procedures were such that no real flow of money reached the missile developers until 1952. Before 1952 we lacked even adequately instrumented ranges to test missiles of over 100 miles range. In addition a half dozen top level surveys were made of our tangled missiles development programs in an effort to pare the least promising developments and concentrate available resources on development lines that promised the biggest pay-off in military performance. These surveys, though necessary, added to the time lag in the missile development cycle.

Even with the urgency of the Korean war there was no special push behind the USAF family of long-range missiles—Northrop's Snark, North American's Navaho and Convair's Atlas. Snark is a subsonic cruise missile. Navaho is designed to cruise at Mach 3 and 65,000 ft. altitude, powered by ramjets. Atlas is a ballistic missile, powered by several stages of rocket motors, to carry the warhead 5,000 miles. Snark is now well along in flight testing and may go into production soon. Navaho is about to be flight tested, but Atlas is still in the experimental shops.

Atlas Rescued

With the advent of Mr. Wilson as Secretary of Defense in 1953, serious consideration was given to canceling the Atlas project along with the atomic powered aircraft and other advanced projects considered as "too visionary" by the engine expert from Detroit. Only through the courageous efforts of Trevor Gardner, Assistant USAF Secretary for Research and Development, was the Atlas program rescued, revived and given some real impetus. Even now the Atlas program is not proceeding on the "crash" basis necessary to achieve maximum results in minimum time. A group of Air Research and Development Command specialists organized as the Western Development Division have taken over system managing responsibilities, and only a few months ago the Glenn L. Martin Co. was given a second intercontinental ballistics missile development program as a backup for Atlas. The Martin missile is to be built in a Denver factory that has not yet been built.

Not even the most optimistic reviewer of our long-range missile development program could conclude that we are making maximum progress in minimum time. The real sense of urgency involved in the intercontinental ballistics missile race seems to have escaped all but a few of our responsible officials.

For the intercontinental ballistic missile with a uranium bomb warhead is a great strategic prize. Its influence in enforcing peace, waging war and abetting international blackmail will be as potent in the future as that of the USAF combination of atomic weapons and the intercontinental B-36 delivery system during the past seven years. The effect of one nation's monopoly or continued superiority in intercontinental weapons on allies, neutrals and enemies can hardly be overestimated.

We badly underestimated the Russian development pace on atomic weapons, supersonic jet aircraft, long-range jet bombers and the hydrogen bomb. Have we also underestimated their development of the intercontinental ballistic missile?

—Robert Hotz

How DIT-MCO Circuit Analyzers Help Keep the Martin Matador on Target!

This DIT-MCO Circuit Analyzer checks 200 Martin Matador wiring harness circuits in twenty seconds.

AUTOMATIC ANALYZERS TEST COMPLEX CABLING SYSTEMS WITH PERFECT ACCURACY!

No pilot rides the Matador to help guide it to its destination. Every movement, from take-off to target, is a result of remote control electrical impulses. The Matador must interpret *all* signals correctly or fail in its mission.

That's why DIT-MCO Automatic Electrical Circuit Analyzers play such an important part in keeping the Matador on target. These remarkable analyzers automatically test complex, interconnected cabling systems with perfect accuracy, at a speed of 200 circuits every 20 seconds. While performing at this tremendous speed, the DIT-MCO analyzer can detect minute errors in continuity resistance and insulation resistance.

In spite of its speed and accuracy, the analyzer is wonderfully easy to operate. An exclusive matrix system pinpoints errors so clearly that non-technical personnel can operate the machine perfectly after a few minutes of instruction. Elimination of the need for "slave units" makes circuit testing a one-man operation. Simple, straightforward adapter cables allow the tester to be used for several different kinds of tests without modification.

The DIT-MCO analyzer saves time, cuts costs, and practically eliminates errors in wiring harnesses to help put the Matador on target every time.

If Your Product Involves Complex Electrical Circuitry, DIT-MCO Can Help You Make It Better and Faster, at Less Cost. Write Today for Full Details.

DIT★MCO **DIT-MCO, INC. ELECTRONICS DIVISION**

Phone HArrison 1-8484 Box 01-11 • 911 Broadway • Kansas City 5, Missouri

WHO'S WHERE

In the Front Office

A. R. Weckel, vice president, has been named manager, Special Missile Systems Division, Sperry Gyroscope Co., Great Neck, N. Y. He will handle all engineering, manufacturing and contracts on Sparrow I Navy air-to-air missile.

Joseph A. Frabutt, vice president, Federal Telephone & Radio Co.'s Pacific Division, Los Angeles, in charge of all operations.

George W. Hunter, assistant to vice president, traffic & sales, Eastern Air Lines. **Ernest Black,** administrative assistant to vice president-traffic and sales.

Robert G. Rosenbaum, vice president-general manager, Florida Flight Engineering Corp., Miami.

Myron Youdin, vice president-assistant director, research and development, Anton Electronic Laboratories, Brooklyn, N. Y. **Adolph Lovoff,** general manager, Instrument Division.

Lynn Eaton, vice president, National Co., Inc., electronics firm, has been appointed assistant to the president.

Edmund M. Wise, assistant to vice president-manager of Development & Research Division, International Nickel Co., Inc., N. Y. C., N. Y., specializing in platinum metals and applied physics.

George Link, vice president of Link Aviation, Inc., has been named to the board of General Precision Corp.

Merrill E. Prichard, assistant to the president, C. P. Clare & Co., Chicago, Ill., maker of custom-built relays and switches.

Woodford D. Miller, executive vice president, Robertshaw-Fulton Controls Co., in charge of the firm's eastern operations. **Frank H. Post,** vice president-general manager of Thermostat Division, succeeding Mr. Miller; **George Mertz,** assistant to general manager of the Thermostat Division; **Freeman G. Cross,** vice president-general manager, Fulton Sylphon Division, succeeding executive vice president **Jean V. Giesler,** who retires in February, but continues to serve as a consultant.

W. C. Loeman, vice president-manufacturing, Parker Aircraft Co., Los Angeles, Calif. Other Parker appointments: **C. E. Cleminshaw,** vice president-engineering; **W. B. McCarthy,** division manager, Check Valve and Fitting Division; **C. L. Wright,** comptroller and **Russel Gates,** Hydraulic Division sales manager.

Herbert Patchel, Jr., assistant to the president, Babb Co., Phoenix, Ariz.

Changes

Donald G. Sturges, manager, New Products Branch, Research & Development Division, Carborundum Co., Niagara Falls, N. Y.

Milton A. Chaffee, director of electronics and systems research, Fairchild Camera & Instrument Corp., Syossett, N. Y., formerly deputy director of systems, Cambridge Research Center.

Louis Campani, chief administrative engineer, Liquidometer Corp., Long Island City, N. Y.

(*Continued on page 53*)

INDUSTRY OBSERVER

► Pentagon observers are speculating on whether the recent Russian hydrogen bomb explosion indicates the Soviets have perfected a droppable weapon. Soviet announcement said the hydrogen bomb was exploded at a high altitude. USAF has not yet dropped a hydrogen bomb from an aircraft. A Strategic Air Command B-36 that was in the air at 20 miles slant range from the 15-megaton hydrogen test device exploded on the ground at Eniwetok suffered extensive heat and blast damage, including melting of wing skin, loss of propeller spinners and bomb bay doors blown off.

► Trans Australia Airlines desire to obtain a DC-6B for use on its route between the East and West coasts of Australia will be vetoed by the Australian government. TAA will order instead one or two Vickers Vanguards. TAA's fleet of five Vickers Viscounts have operated at a load factor of 86% during the year, carrying 230,000 passengers 116,279,000 passenger-miles on 6,263 flights.

► Air Force and Navy must decide soon on the future development of an air traffic control radar beacon system for common civil-military use. Interference and unsynchronized returns have been greater than anticipated on the radar unit being tested. The military may find it necessary to change the requirements developed in 1953.

► Trans World Airlines would still like to find a turboprop engine for the Lockheed 1649A. The airline would settle for an engine with a fuel consumption of between .5 to .6 lb. per equivalent shaft horsepower/hr. Lockheed's L-1449 turboprop Constellation proposal, a forerunner of the 1649A design, was cancelled because the fuel consumption of the Pratt & Whitney T34 was .87 lb. per eshp., which TWA considered highly uneconomical.

► Bristol Orpheus engine has run at over 5,000 lb. static thrust using external fuel system. At this thrust Orpheus was stall and surge free during acceleration from idle to takeoff rpm. in just under four seconds.

► Bristol Britannia turboprop transport has been awarded an airworthiness certificate by Britain's Aircraft Registration Board and the first two Britannias were delivered to British Overseas Airways Corp. They will be used in BOAC's African service.

► Bristol is building a free turbine version of the Orpheus in an effort to save its Type 191 helicopter. British Ministry of Supply has cut orders for the twin-engine helicopter from 100 to 30 to three because of the unavailability of adequate engines. Bristol hopes the free turbine Orpheus will deliver 1,600 hp. for cruise and 2,000 hp. under emergency power, with an engine weight of 550 lb.

► Air Navigation Development Board is not ready to recommend the airborne radar transponder beacon in its present form as a common system item although the units have been developed and produced by three manufacturers—Bendix, Collins and Wilcox—on the strength of specifications furnished by Aeronautical Radio, Inc.

► U. S. Army will grant a series of research and development contracts soon to spur work on aircraft with short takeoff and landing characteristics. There may be as many as 12 contracts awarded.

► New inertial guidance techniques now being investigated by Bell Aircraft Co. may produce a "minor technological breakthrough," opening the way to much improved accuracy. Program is sponsored by the Air Force.

► Latest evaluation tests of Tacan reveal that the short range navigation aid is better than first tests indicated. The findings have made Tacan a stronger contender as the civil-military common navigation system.

DOW CORNING CORPORATION

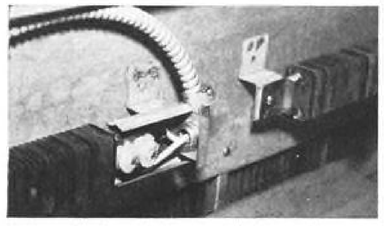
Silicone News

FOR DESIGN ENGINEERS

FAST RELIABLE DEFROSTING WITH SILASTIC INSULATED LEAD WIRE

Take temperatures low enough to preserve frozen foods in an open display case and high enough to defrost the case in a hurry, and you have an ideal climate for Silastic*. Serviceable at temperatures ranging from —100 to 500 F, Silastic insulated lead wire solved the problem of a fast and reliable defrosting system for Tyler Refrigeration Corporation.

Originator and leading producer of open frozen food display cases, Tyler employs high-powered strip heaters for fast, automatic defrosting. Twice daily, temperatures at the terminal connections may jump from a low of —30 F to a high of 212 F and remain there for 30 to 50 minutes at a time. At such temperatures, the organic rubber insulation on conventional lead wire deteriorates rapidly. Unexpected failure could mean the loss of hundreds of dollars worth of frozen foods.

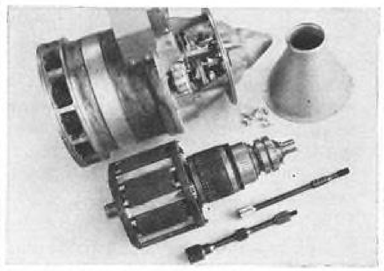


Tyler eliminated the possibility of insulation failure due to high temperatures, and gained Underwriters' approval at the same time, by specifying lead wire insulated with Silastic. In the thousands of frozen food cases that have been put into service since 1951, no lead wire failures have ever been reported.

For extra protection against moisture condensation, Tyler coats the connection between the terminal strip and the bare wire with Dow Corning 4, a non-melting waterproof silicone dielectric compound. *No. 63*

*T.M. REG. U.S. PAT. OFF.

Silastic, the Dow Corning silicone rubber, keeps its shape, stays resilient from —100 to 500 F; resists hot oils and chemicals; withstands weathering ozone and corona; and is an ideal dielectric material. Properties of Silastic are fully detailed in new reference brochure. *No. 64*



OVEN-HOT AIR USED TO COOL SILICONE INSULATED EQUIPMENT

Cool electrical equipment with air that has a temperature of 250 F? Yes you can, providing the equipment is protected with Dow Corning silicone insulation. Here's how Westinghouse engineers put 250 F air to work cooling their new 40 kva, 400 cycle alternators or a-c generators for jet planes.

When a jet plane is hurtling through low altitude atmosphere at the speed of sound, air available for cooling purposes may have a temperature as high as 250 F. Far from cooling organic electrical insulating materials, these high ambients cause them to burn up in short order. At high altitudes, air temperature drops to —70 F, but the air is so thin, it has less heat-absorbing power than at low altitudes.

That's why Westinghouse uses silicone (Class H) insulation in their jet plane alternator. Operable at temperatures in the range of 480 F and higher, the silicone insulation is actually cooled by air hot enough to cause rapid failure of ordinary insulating materials.

To provide maximum cooling effect at any altitude, the Westinghouse alternator is fitted with a cone and hood combination that directs air to the critical pole and rear bearing areas. Because of its exceptional oxidation resistance and thermal stability, Dow Corning 44 Grease is used to lubricate the bearings. *No. 65*

New 1956 Reference Guide to Dow Corning silicone products briefly reviews properties and applications of silicone products most widely used. Indexed by application, this all-new guide will prove a definite aid to design engineers concerned with product improvement and cost reduction. *No. 66*

Pressure Sensitive Silicone Tape 'Welds' Seam in Hot Water Heater

New opportunities for product improvement and production economies have been opened up by the introduction of heat-stable, waterproof tapes made with pressure sensitive Dow Corning Adhesives. Such tape forms a water resistant seal that retains adhesive strength at temperatures from —100 to 550 F. Here's how White Products Corp., Middleville, Mich., replaced a welded joint; saved production time and cut unit costs with such tape.

A leading producer of hot water heaters, White frequently found it necessary to operate their tank plant overtime to meet production demands. One of the most time consuming jobs in the plant was hand welding a combustion-chamber skirt to the base of each heater to comply with American Gas Association requirements for the prevention of flue gas escape.

In 1954, at the suggestion of Mystik Adhesive Products Co., White production men tried sealing this 48-inch seam with a new Mystik tape coated with Dow Corning Adhesive. The seal passed all AGA tests, including constant high fire and surface temperatures in the range of 520 F. With this new tape, White realized material savings amounting to 7c a unit. Production in the tank plant has doubled. *No. 67*

Design Edition 16

DOW CORNING CORPORATION - Dept. 0901-A
Midland, Michigan

Please send me 63 64 65 66 67

NAME _____

TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

Canada: Dow Corning Silicones Ltd., Toronto; **Great Britain:** Midland Silicones Ltd., London; **France:** St. Gobain, Paris

Washington Roundup

Aircraft Profits

Watch for a tougher policy on aircraft profit allowances in renegotiations as a result of House Armed Services Committee's investigation which will move into public hearings next week. The policies of the Renegotiation Board, as well as Air Force and Navy, will be judged.

Since the Board's decision last fall over-ruling the Los Angeles Regional Board and ordering a $10 million refund by Boeing Airplane Co., it is understood, two other regional decisions have been over-ruled by the Board and refunds ordered.

First companies expected to appear at the public hearings are Boeing, the Glenn L. Martin Co., McDonnell Aircraft Corp., Republic Aviation Corp., and Grumman Aircraft Engineering Corp. The first session will probably be Jan. 18.

Formally announcing the hearings, House Armed Services Committee's Chairman Carl Vinson (D.-Ga.), said:

"We are not going to conduct a punitive expedition nor imperil national security, nor jeopardize this industry. However, both parties to these contracts should sit down and look over figures on performance, production, and profits, and share that information with the American people who are paying these bills.

"We have quite a partnership with this industry. The paid-in private capital of the 15 major producers exclusively in aircraft production is $211 million; the Government has advanced to them tools, machines, plants and the like, of $822 million, as I compute it."

The hearings will be held by the investigating subcommittee headed by Rep. Edward Hebert (D.-La). Vinson, a veteran of several other aircraft profits investigations, will participate.

Another CAB Candidate

Latest entrant in the race for Ross Rizley's job as chairman of the Civil Aeronautics Board is Whitney Gillilland, chairman of the Foreign Claims Settlement Commission. Gillilland has developed a strong campaign for the position and is reported to have the backing of a top White House aide.

The CAB candidate is a former Iowa circuit judge and Republican State Chairman. He came to Washington in 1952 to work for the Republican National Committee, then shifted to the Department of Agriculture as an assistant to Secretary Ezra Taft Benson. From Agriculture, Gillilland was named chairman of the Foreign Claims Settlement Commission and received Senate approval for the job.

Atomic Engine

Reports that a nuclear airplane engine has been built can be discounted. Some say it has undergone ground tests, others that it soon will be tested over Idaho. The atomic engine project is progressing, but not that fast. USAF's reluctance to discuss experiments carrying a nuclear reactor aloft in the belly—not the nose—of a B-36 and the status of General Electric's work on an engine goes back to the honesty of USAF Secretary Donald Quarles. A recent effort by Defense Department to break a report to the public was stopped by Secretary Quarles, who made it clear he did not object to the proposal on grounds of security. He objected, he said, for the simple reason that there is no worthwhile accomplishment to talk about.

Contract Legislation

Both House and Senate are moving quickly to curb the trend toward military procurement by negotiated contracts, instead of competitive bidding.

House Armed Services Committee will open hearings this week on legislation introduced by Chairman Carl Vinson (D.-Ga.) which would ban negotiations on "national emergency" grounds, unless the emergency were declared by Congress. A committee study (AW Dec. 26, p. 14) showed that 94% of the military contracts let from Jan. 1, 1953 through June 30, 1955 were negotiated and that a major portion of these were justified by the emergency declared by former President Truman in mid-1950. Over this period, 99.5% of the dollar-volume of Air Force contracts were negotiated.

A companion to the Vinson measure will be introduced in the Senate by members of the Small Business Committee which also plans comprehensive hearings in the near future.

Job Opening

Nobody expects Defense Department to replace R. Karl Honaman, partly because it is not easy to find someone who wants the job. His duties as Deputy Assistant Secretary for Public Affairs will be assumed by his former chief, Robert Tripp Ross, Assistant Secretary of Defense for Legislative and Public Affairs. Ross, a Republican and former member of Congress from Queens, N. Y., appears to depend heavily on Lee M. Hargus, Deputy Director of the Office of Security Review, for decisions involving release of information. Hargus is a civil service employe of several years standing who has filled a number of jobs in the information and security review offices. Security Review officers are not free to make suggestions, but they would prefer to have Ross take his advice from Herschel Schooley, Director of the Office of Public Information.

Airline Hiring

The airline industry's record on lack of discrimination in hiring is good, Secretary of Labor James Mitchell told industry representatives and the President's Committee for Fair Employment Practices at their first meeting.

But he said further efforts are needed to eliminate hiring bias. Next in importance, he said, is the need to see that opportunities for promotion are available. It was noted that American Airlines and Pan American World Airways lead the industry in hiring Negroes and that they also provide advancement opportunities.

The Eisenhower Administration is extending its ban on discrimination in hiring to Government contractors throughout the transportation industry (AW Sept. 26, 1955, p. 13) but before it does so it is holding meetings to explain to industry the results it hopes to achieve.

—Washington staff

U.S. Will Spur Dispersion of Industry

Civil Defense study criticizes lack of progress, warns of intercontinental missiles, superbombs.

By Claude Witze

Washington—Action to spur the U.S. industrial dispersion program to meet the fast-growing menace of super-hydrogen bombs and intercontinental missiles was promised last week by the Federal Civil Defense Administration with the support of the Department of Defense and the Office of Defense Mobilization.

This followed a 1955 review of Project East River by a civilian committee warning that an intercontinental ballistic missile attack with the destructive power of 50 million tons of TNT is possible in less than six years. Project East River is a report concerning civil defense measures. This viewpoint received support from other developments:

• **Russian Premier Nikolai Bulganin's** statement that the Soviets have developed an intercontinental missile. If their program is more advanced than anticipated by U.S. observers, it conforms to the pattern set by the Russians in development of long-range bombers, fast fighter planes and nuclear weapons.

• **USAF Secretary Donald Quarles'** statement in Hong Kong that "I don't believe there will be any aggression by the Communists until they feel they can profit by global aggression." All-out nuclear attack generally is considered part of any global aggression plan.

• **Sen. Henry M. Jackson (D.-Wash),** chairman of the Atomic Energy Military Applications Subcommittee, said the Russians are working on weapons "even more fantastic" than the ICBM and that Moscow has given these projects "the highest priority."

• **Renewed emphasis on dispersion** will face the aircraft industry in 1956 along with the planning necessary to conform to the new USAF Industrial Production Readiness Policy (AW Jan. 2, p. 18).

New Approach Required

The civilian committee report, a survey of what has been done in the civilian defense field since 1952, favors expansion of the industrial dispersion program outside of purely defense industries. The original program, the report says, "has been far too limited." In addition, the original plan called for dispersion of new key defense plants at least 10 miles beyond the limit of the target zone.

In view of what is now known about the effect of radioactive fallout and the wide territory that can be contaminated, a new approach is needed. The aim, the committee says, should be to achieve within ten years the relocation of a "properly balanced portion of our total national production" outside of metropolitan target zones.

The three Federal offices receiving the committee report immediately adopted the recommendation that defense planning will be based on metropolitan target zones rather than cities and towns.

It was made clear that industry will have an important role in this planning program.

Critical of Military

Among the committee's planning recommendations:

• **The Federal Government** will finance a study and Civil Defense plan for each of 14 metropolitan target zones.

• **Each zone will have** a non-military defense committee, with $100,000 in funds to prepare local defense plans.

• **There will be an annual revision** of each metropolitan plan along with the local budget. Local and state governments will share the cost.

The 14 major metropolitan areas listed by the Civil Defense are New York, Chicago, Philadelphia, Washington, Boston, Baltimore, Cleveland, Detroit, Milwaukee, St. Louis, Buffalo, Atlanta, Los Angeles and San Francisco.

The civilian committee was critical of the fact that the Army, Navy and Air Force have their own disaster plans. All of these are classified, the report points out, with the result that state and local Civil Defense officials do not know the details.

It recommends that non-military disaster plans be integrated with those of the armed forces.

Key to Mobilization

The plans must include continued dispersion of military production, the report says, "But there are other facets that may be of greater importance.

"The principal production problem in the United States in the event of war may well be not the manufacture of military supplies and weapons but the production of those basic items needed for the rehabilitation of the civilian economy and for the reestablishment of our entire economic structure. Thus, dispersion must be applied in a much broader sense."

In this, the report appeared to complement the new USAF production Readiness Policy, which assumes that in an all-out atomic war production of key weapons will be limited to what is in stock in plants which escape the initial assault.

While emphasis in the readiness policy, like that in the report on civilian defense measures, is on the devastation that will come in the initial assault, both of them put equal interest in the longer pull. In this connection, it was clear that USAF's program for production acceleration capability, like the proposal to disperse civil as well as defense industries, may be the most important part of mobilization planning for nuclear war.

Cutting Lead Time

USAF's acceleration program is designed to bring faster production of tactical and supporting systems to a predetermined peak. This clearly would simplify and economize the effort to achieve a buildup in event of another Korean or peripheral war. It is estimated in the Pentagon that the new USAF program would cut up to a year off the lead time for production of weapons placed under the acceleration program.

According to the readiness policy, USAF plans to study all its production sources to determine their vulnerability and the adequacy of dispersal.

However, USAF set up in the policy some standards and criteria to govern its program:

• **USAF will seek a practical solution** to dispersal problems, giving full consideration to such items as cost, social dislocation, production delays.

• **When multiple sources are practical,** dispersal will be a key factor in selecting the sources.

• **Dispersal will be a prime consideration** in the location of new facilities, particularly when USAF provides finances.

• **All facilities in being** will be maintained in use as required.

All of these aims are taken from a recent Defense Department Instruction (No. 5220.5) on dispersal (AW Nov. 28, p. 18).

The 1955 review committee was headed by Gen. Otto L. Nelson, Jr., a retired army officer who now is a vice-president of the New York Life Insurance Co.

Readiness Policy Basic to USAF Mission

Some Air Force procurement officials are annoyed by efforts to show that their Industrial Production Readiness Policy (AW Jan. 2, p. 18) was adopted because a new Joint Mid-Range Strategic Plan has been accepted by the National Security Council and become official Defense Department policy.

The short war concept is a doctrine native to the Air Force and the service long has urged its adoption as a national policy. The Industrial Production Readiness Policy has been in the draft stage for more than seven months and work on it was started by Roger Lewis, former Assistant USAF Secretary for Materiel, because he was convinced it is essential to the Air Force mission.

USAF spokesmen point out that the readiness policy is compatible with all top-level plans and was approved by the Department of Defense. They do not urge its adoption by the Navy or Army, although it is possible the principles could be used to good advantage in planning wartime production of certain items, such as Bureau of Aeronautics procurement.

Added Range for Stratojets

Several hundred Strategic Air Command B-47 Stratojets are each being equipped with two giant external fuel pods capable of adding several hundred miles to the bomber's range. Attached between the inboard and outboard engine nacelles, the pods are equipped with eight-ft. parachutes that open from the tail cone and can rip the cells off the aircraft in an emergency. Pods can be installed within a few hours and probably carry 1,700 gal. each. They are being fitted on the aircraft at Lockheed Aircraft Corp.'s Marietta, Ga., facility.

Aircraft, Missile Programs Key Defense Aspects, President Says

Washington—President Eisenhower emphasized that accelerated aircraft and guided missile programs are key aspects of the Administration's defense plans in his State of the Union message to Congress last week.

He said: "We continue to push the production of the most modern military aircraft. The development of long-range missiles has been on an accelerated basis for some time. We are moving as rapidly as practicable towards nuclear-powered aircraft and ships."

The President summed up defense progress under his Administration with the statement that "our defenses have been reinforced at sharply reduced costs."

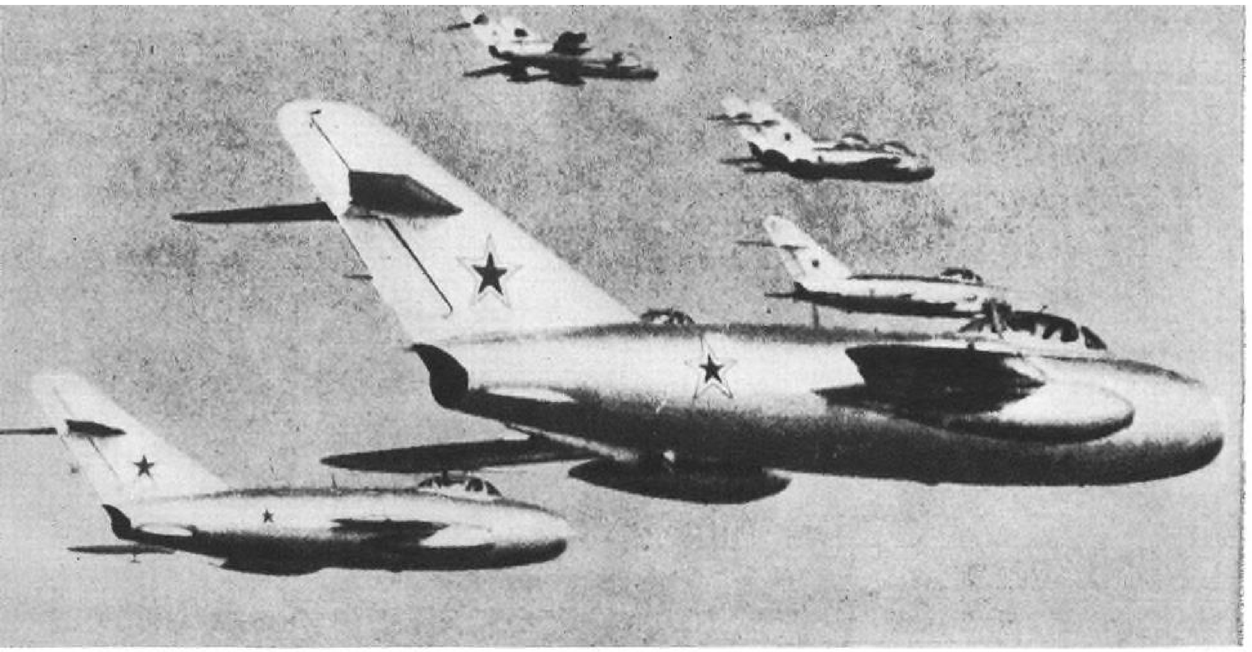
This will run into criticism from Democrats who maintain that the Administration has cutback military strength in several vital areas, including the Air Force in 1953, dragged its feet in accelerating guided missile development and that the "big business" management of Defense Department has overlooked areas for savings, notably in procurement.

The President described the military program of his Administration as following a desirable middle-road between inadequacy and excessiveness. He told Congress:

"Short of war, we have never had military strength better adapted to our needs with improved readiness for emergency use. The maintenance of this strong military capability for the indefinite future will continue to call for a large share of our national budget. Our military programs must meet the needs of today. To build less would expose the nation to aggression. To build excessively, under the influence of fear, could defeat our purposes and impair or destroy the very freedom and economic system our military defenses are designed to protect."

On continental defense, the President said that "great progress is being made in extending surveillance of the Arctic, the Atlantic and the Pacific approaches to North America."

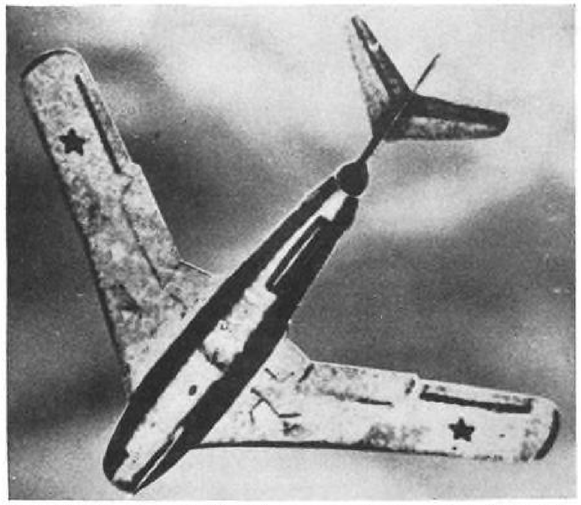
The President also called for extension of the Defense Production Act, due to expire June 30, as necessary to keep the mobilization base flexible to meet changing requirements.



FRESCO FLIGHT: Russian naval MiG-17s in loose formation. Note the two-plane elements, a combat technique the Reds learned from the USAF in Korea. Fresco (MiG-17) differs in detail from the MiG-15; vertical tail is larger, of revised shape and higher aspect ratio, with base faired into the tailpipe rather than overhanging it. Speed brakes on aft fuselage have been bulged externally, and arrester gear has been added. Radio mast has been moved aft from cockpit and reduced in height.

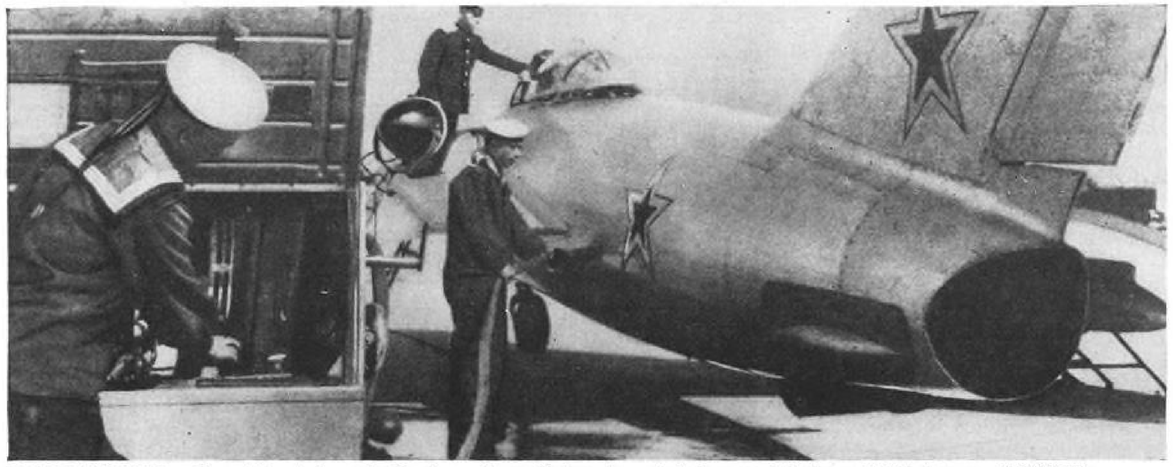
MiG-17s: New Power for Soviet Navy

FAGOT FLIGHT: Russian MiG-15s in the solid color markings of Moscow air defense squadrons are shown over Moscow University. These pictures, released by Naval Aviation News, apparently were copied from rotogravure prints in a Russian periodical.

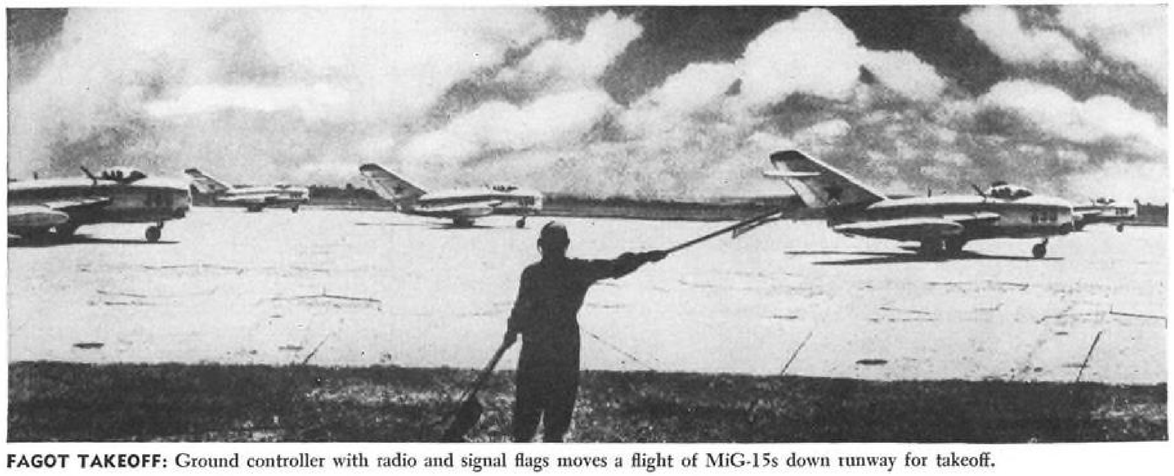


PLANFORM shows leading-edge sweep change and trailing-edge filler, major differences on MiG-17 wing. Picture is composite.

RED NAVAL rating replaces cover over MiG-15 camera gun housing. Pictures indicate both -15s and -17s are in naval service.



FRESCO FUELING and servicing is done by Russian sailors. Picture shows tailpipe, speed brake and tail changes of MiG-17.



FAGOT TAKEOFF: Ground controller with radio and signal flags moves a flight of MiG-15s down runway for takeoff.

Lee Still Puzzled Over Firing, Defends Actions at Hearing

Washington—Fred B. Lee, former Civil Aeronautics Administrator, told Senate investigators he still does not know why he was fired by the Eisenhower Administration (AW Dec. 19, p. 7).

Lee was the opening witness last week at public Senate hearings called to investigate his "forced" resignation. Testifying under oath, he declared that his departure from the CAA post was not a voluntary resignation.

Sen. Mike Monroney (D.-Okla.), chairman of Senate Commerce Committee's Aviation Subcommittee, said the hearings would serve two purposes:

- **Inquiry into the circumstances** and situation surrounding Lee's ouster.
- **Review Monroney's bill** to take CAA out of the Commerce Department and make it an independent agency.

Rothschild's Request

Sen. Monroney indicated he was not defending Lee but would use his testimony in building up a record to support passage of the CAA legislation. He said he wanted first to get the full story on Lee's firing and then hear Commerce Department officials and others on his bill.

Lee told the subcommittee his difficulties began "last Oct. 17 when Commerce Under Secretary (Louis) Rothschild requested my resignation as CAA Administrator." Lee said he was not prepared to resign then because he had been given no reasons for the request.

He said Rothschild's only comment was to the effect: "Fred, we don't get along. I don't think we're ever going to get along. We've come to a parting of the way."

The next episode Lee related was an Oct. 29 meeting with Secretary of Commerce Sinclair Weeks. He said his resigning was not mentioned but "we discussed the entire situation at length." A full report on the accomplishments of CAA was made to the Secretary, which Lee said included the following points:

- **The job being done** with the limited resources available.
- **The technical advances** made by CAA.
- **CAA's excellent relations** with industry.
- **Record of full cooperation** with the Commerce Department.

No Specific Complaints

Lee said he was unable to obtain any specific complaints against himself. However, Lee reported, the request for his resignation was repeated once again on Nov. 29 and Rothschild gave him only five hours to get it in.

Lee said he considered the resignation request "unfair and unjust" and asked to discuss the matter with the White House (AW Dec. 12, p. 132). He had a meeting with Presidential Assistant Sherman Adams, which was arranged by Weeks. His resignation was accepted anyway, and announced by the President on Dec. 10.

Lee acknowledged that he had eventually submitted his resignation to the President, but he stressed that both Rothschild and Weeks presented the original request as their own and never mentioned having discussed it with the White House.

Motivation

Both Sen. Fred Payne (R.-Me.) and Sen. Andrew Schoeppel (R.-Kan.) reminded the subcommittee there is no question that Presidential appointees serve at the pleasure of the President.

"That I agree with," Monroney replied, "But I think the testimony shows that the motivation for the discharge of Lee did not originate at the White House."

Monroney contended there was no attempt to question the right of the President to act in his own or constitutional right. But he said: "I don't feel it's right for Presidential prerogatives to be assumed by persons purporting to act for the President. I think as the hearings develop it will become crystal clear that this was happening in the Commerce Department."

Monroney declared it should be obvious that Lee's firing was carried out in the Commerce Department by persons who "assumed Presidential powers during the President's illness."

'Ground-Minded'

Antipathy Monroney holds for Weeks and Rothschild—whom he has labelled—a "ground-minded" clique attempting to grab control of civil aviation—is part of the reason for his desire to take CAA out of their department.

Lee traced his difficulties with Rothschild back to last spring, when he testified on a Monroney-sponsored bill for additional Federal airport-aid.

He said that because the Administration opposed the legislation, his testimony was limited to the "need" and did not cover the question of whether more aid would solve the problem. However, Lee continued, "Rothschild called me afterwards and complained that my testimony had been too favorable to the bill."

The next indication that things were not going right, Lee said, was an abrupt phone call from Rothschild informing him that "your new deputy is on the way over."

The new deputy was Charles J. Lowen, Jr., a Colorado Republican, who has succeeded Lee as CAA Administrator.

Lowen received an interim appointment and his nomination is to be reviewed by the Monroney subcommittee before it comes up for Senate confirmation.

Review by Lowen

Lowen was a stranger to him, Lee said.

"I knew he had some political support, but never discussed his appointment with Rothschild," Lee told Monroney. "I never knew what duties Lowen assumed as Deputy Administrator because he seemed to work on assignment for Rothschild."

Lee said he was sure that one of Lowen's first assignments was to review an organizational survey of CAA that had been made by the management consulting firm of Cresap, McCormick and Paget.

The survey, which cost $104,000, was made over his objections, Lee said, but he said he had signed the contract with CMP on orders from Rothschild's predecessor, Robert B. Murray.

The subcommittee asked the Commerce Department to produce a copy of the controversial report, which has been classified since its completion in June 1954.

'Overnight Experts'

Five major recommendations are contained in the report, Lee revealed. He said two deal with Federal Airways and the others with safety, airports and internal organization. Lee told Monroney the consulting firm knew nothing about aviation and indicated he shared the senator's amazement that "overnight, they (the consulting firm) became aviation experts."

Sen. Monroney drew an admission from Lee that Rothschild was critical of CAA planning and particularly objected to a recent five-year airway program "as going too far without clearing with Commerce." Rothschild is in charge of the department's transportation policy and controls CAA.

Rothschild's public explanation of Lee's discharge included the statement "that some one better suited in leadership talent and teamwork was required." Lee contends the amount of his leadership was limited by the ceiling put on CAA by Commerce-dictated budgets, plus a requirement for clearing all personnel actions through the department.

Sen. Monroney sarcastically asked if there had been any offer of "demotion," once Lee's leadership talent was questioned. Lee replied that there was a suggestion he accept a consulting post for a few months but this was rejected.

Lee has intimated he will support Monroney's bill to re-establish CAA as an independent agency.

The subcommittee expects to explore thoroughly charges that CAA has not kept abreast of vast technical advancements in aviation, with a result of near-chaos in air traffic control. CAA has been subject to vigorous criticism in recent months for failure to meet the growing crisis on the nation's airways.

The critics have included the military, scheduled airlines and pilots. The constant criticism leveled at CAA has nettled the Commerce Department.

Fireworks have been predicted as the hearings continue this week with Rothschild scheduled to testify as the official Commerce spokesman. Other witnesses will include representatives from the Air Line Pilots Assn., Aircraft Owners and Pilots Assn., Airport Operators Council, Air Transport Assn., Flight Engineers International Assn., and National Association of State Aviation Officials.

Members of the Senate Aviation Subcommittee, in addition to Chairman Monroney, are Sens. George Smathers (D.-Fla.), Alan Bible (D.-Nev.), Andrew Schoeppel (R.-Kan.) and Fred Payne (R.-Me.).

Aviation Gasoline

Bids for more than 39 million barrels of jet fuel for the six-month period April-September 1956 have been requested by the Armed Services Petroleum Purchasing Agency by Jan. 18.

Here is a breakdown in barrels by areas and services on requirements for three grades:

Areas	JP-3	JP-4	JP-5
East Coast			
Air Force	.....	2,881,000	.....
Navy	642,800	511,300	14,300
Total	642,800	3,392,300	14,300
Gulf Coast			
Air Force	.....	12,174,800	.....
Navy	1,197,100	1,372,000	.....
Total	1,197,100	13,546,800	.....
Inland			
Air Force	.....	8,861,700	.....
Navy	34,000	683,100	.....
Total	34,000	9,544,800	.....
West Coast			
Air Force	.....	8,152,700	.....
Navy	1,114,500	1,640,800	14,300
Total	1,114,500	9,793,500	14,300
Total			
Air Force	.....	32,070,200	.....
Navy	2,988,400	4,207,200	28,600
Grand Total	2,988,400	36,277,400	28,600

Army Buys Aerocycles For Infantry Testing

Washington—U. S. Army has ordered a test quantity of 12 De Lackner Aerocycles, the one-man flying platform developed about a year ago to compete for a Navy contract.

Army says it will experiment with the machines to improve battlefield mobility for the combat infantryman. The Marine Corps has maintained its interest in the project as well as in the Hiller Flying Platform developed for the Office of Naval Research.

The De Lackner device originally was known as the Helivector (AW, April 4, 1955, p. 7). Initial Army tests were made at Camp Kilmer, N. J., where it was proved that soldiers with no previous flying experience could become proficient operators in 20 minutes.

Major handicap of conventional one-man helicopters is that they demand a high degree of skill in operation. The Aerocycle has no conventional controls. The pilot stands on a platform over the rotor blades and steers by leaning.

Army says the De Lackner machine, powered by a 44 hp. Mercury outboard motor, weighs 200 lb. and will carry a payload of 300 lb. Maximum speed is 65 mph. and range is 150 miles. Equipped with floats, it can land on land or sea.

Aircraft, Missiles Cause Land Purchase Increase

"Unusual land requirements" for jet aircraft guided missiles sent the Government's land buying to a five-year high in 1955.

Meanwhile, Rep. Clair Engle (D.-Cal.) chairman of the House Committee on Interior and Insular Affairs began a study of how the Defense Department uses its extensive land holdings and why it wants more.

The Lands Division of the Justice Department reported that new condemnation proceedings were filed on about 12,000 tracts of land last year, more than double 1954's figure.

LOGGERS IN SWEDISH LAPLAND have adopted the helicopter to help in the fight against costly, time-consuming log jams as shown in pictures above. At left, helicopter hovers over the jammed logs, then lowers lumberman to plant an explosive charge (right).

Helicopter Battles Swedish Log Jam

FUSE SET, the logger climbs hurriedly back into helicopter. Forty seconds after his departure, the jam is broken.

Fokker F-27 Leads as DC-3 Replacement

By Craig Lewis

Washington—The turboprop Fokker F-27 Friendship is in the lead in the race to capture the large market for a replacement for the venerable DC-3.

A solid indication of the Friendship's lead in the U. S. market came last month with the signing of an option agreement for six aircraft between West Coast Airlines and the Fairchild Engine and Airplane Corp. (AW Dec. 19, p. 92)

Fairchild has U. S. manufacturing rights for the F-27. If the company decides to go into production, plans call for delivery of the first aircraft in the fall of 1957.

Conversion engineering on the turboprop transport has been started by Fokker in the Netherlands. The prototype F-27 made its first flight last November.

Two airframes will be destroyed by the Dutch manufacturer in static and pressure testing, and two production aircraft have been ordered by KLM Royal Dutch Airlines.

F-27 Advantages

The need for a modern, more efficient replacement for the DC-3 has been apparent for several years, but the pressure has increased as the low capacity DC-3 becomes increasingly expensive to operate.

Local airlines are hardest hit by the advancing obsolescence of the DC-3 since they have no other equipment available. Most airline experts agree that the local service carriers will have to put a new aircraft into service before they can eliminate subsidy.

A major advantage held by the F-27 over its competitors is that it is powered by the service-tested Rolls-Royce RDa.6 turboprop engine. Most airlines would prefer to make the switch to turbine power in one step rather than move to an advanced piston transport now, then have to make the jump to the turboprop later.

Since the Lockheed Electra has evolved into a long-range transport and the Vickers Viscount is designed for operation over the longer route segments, the F-27 is the only turboprop transport in production or planned for production that meets short-range requirements.

Fuselage Stretched

Operators of both trunk and feeder services feel they need a 40-passenger transport, and the F-27 fuselage has been stretched 36 in. to provide seating area for up to 40 passengers.

Pressurization and a high-wing configuration are other features the airlines consider attractive in replacing the DC-3.

Currently, operators must go to the heavier, longer range and much more expensive Convairs or the Martin 4-0-4 to find pressurized aircraft for short route operation.

The current F-27, an expansion of earlier versions, is designed for a maximum cruising speed of 280 mph. at 20,000 ft. and 13,800 rpm. Economical cruising speed is quoted at 275 mph. at 20,000 ft. and 13,600 rpm., 272 mph. at 10,000 ft. and 13,600 rpm., and 267 mph. at 5,000 ft. and 13,600 rpm. Rate of climb at sea level and standard temperature is 1,500 ft. per min. and 1,220 ft. per min. at sea level and standard temperature plus 15 degrees centigrade.

Service ceiling of the F-27 is 36,000 ft. and operating altitude on one engine is 12,500 ft. Normal stage distance with reserve is 300 miles and maximum stage distance is 1,000 miles. Stage speed for normal stage distance is 203 mph.

Takeoff distance with two engines is 2,400 ft. . . . International Civil Aviation Organization takeoff and landing field lengths are 3,800 ft.

Performance

The F-27 fuselage is 73 ft. long, and will be 76 ft. when the production model is stretched 36 in. Diameter of the fuselage is 8 ft. 10 in. and cabin height is 6 ft. 8 in. The pressurized section of the fuselage is 50 ft. long.

Wingspan is 95 ft. The wing area totals 754 ft. and the aspect ratio is 12. The aircraft is equipped with double slotted compound type flaps and a tricycle landing gear with a 23 ft. 7 in. tread.

Gross takeoff weight is 34,200 lb. and maximum landing weight is 30,860 lb. Maximum zero fuel weight is 32,630 lb.

The manufacturer's weight empty of the 36-passenger version is 20,950 lb., and weight at maximum payload is 7,668 lb. for passengers and 1,507 lb. for cargo.

A sample F-27 operation over a hypothetical route produces the results shown in the box below. The operation is based on a 300-mile route with segments of 75, 100 and 125 miles.

Cost per flight mile for such an F-27 operation is estimated at 56.35 cents for the three-stage flight and 48.5 cents for the 300 mile nonstop flight, compared to an average local airline DC-3 cost of 48.1 cents. These costs break down to 1.57 cents per available seat-mile for the three-stage F-27 flight, 1.35 cents for the F-27 nonstop and 2 cents for the DC-3.

Flight Costs

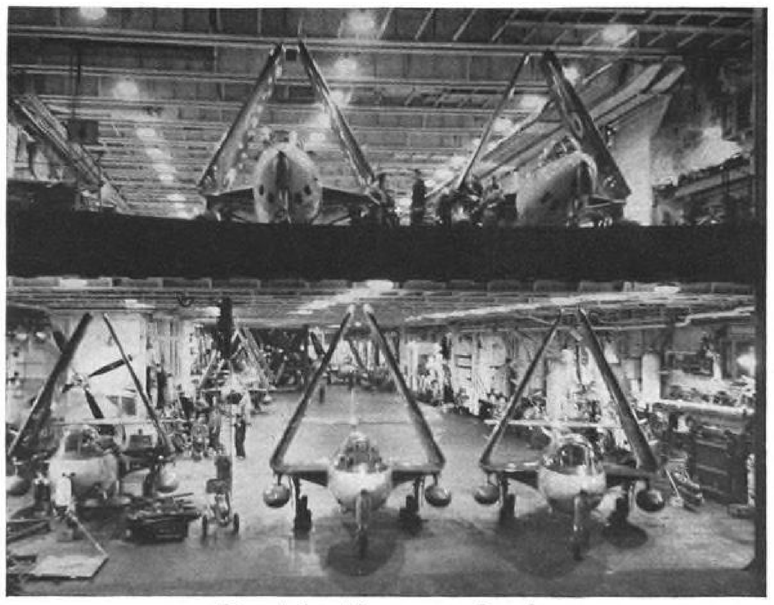
Breakeven number of passengers on the basis of a 6-cent per passenger-mile yield is 9.4 for the three-stage F-27 flight, 8.1 for the nonstop F-27 flight and 8 for the DC-3. These cost figures are based on a 36-passenger F-27 and a 24-passenger DC-3. A 40-passenger F-27 would cut seat-mile costs and improve revenue potential about 10%.

In order to produce 10 million seat-miles, the F-27 three-stage flight would cost $157,000 in direct expense, the F-27 nonstop would cost $135,000 and the DC-3 costs $200,000. Conversely, $200,000 in direct expense is estimated to produce 12,739,000 seat-miles on the three-stage flight, 14,815,000 seat-miles on the nonstop flight and 10 million seat-miles for the DC-3.

Direct operating cost for the three-stage flight includes 28.8 cents per mile for flight costs, 18.39 cents a mile for maintenance and ⅞ cents for depreciа-

F-27 Operating Times

	Distance (in Miles)		Flight Time (in Minutes)			Fuel Consumed (in Pounds)
	Segment	Cumulative	Off to On	Block to Block	Total Time	
Assumed Local Route						
Origin 1st City	125	125	:35	:40	:42	895
2nd City	100	225	:29	:33	1:17	770
Destination	75	300	:23	:27	1:46	628
Totals	300	...	1:27	1:40	...	2293
Average Distance and Speed	100	...	207	180	170	...
Assumed 300 Mile						
Non-Stop	300	300	1:19	1.24	1:24	1601
Speed	...	...	228	214	214	...



Double Hangar Decks

The two hangar decks of the British aircraft carrier, HMS Ark Royal, are shown in this unusual photograph. Aircraft positioned near the elevator well, from which the picture was taken, are Hawker Sea Hawks Mark 4s produced by Armstrong Whitworth Aircraft Ltd.

tion, totaling 56.35 cents. Costs for the nonstop flight are 23.49 cents for flight operation, 16.69 cents for maintenance and 8.32 cents for depreciation, a total of 48.5 cents per mile.

Cost estimates are based on an aircraft price of $540,000, including $89,700 for engines and $19,550 for propellers.

Depreciation based on a 7-year writeoff, residual value of 10% and an 8-hour daily utilization is estimated at $18.97 per hour.

PanAm Forecasts Atlantic Cargo Gains

Pan American World Airways is doubling its cargo advertising in anticipation of its first 10 million lb. traffic year on the Atlantic.

The carrier is launching an intensified cargo sales program based on a cargo traffic forecast that is 35% higher than last year and double the 1954 volume.

The Pan American cargo sales staff is being increased 30%. The 100% increase in advertising program expenditures is the second time that this program has been doubled in the past two years.

Most of the increased business is expected as the result of recent cuts in Atlantic cargo rates, according to Willis G. Lipscomb, Pan American vice president.

He also feels that simplification of specific cargo categories and removal of value limitations will make air cargo more attractive to shippers.

Pan American claims it has taken over 90% of the traffic carried by Airwork, the British cargo airline, before it quit flying Atlantic routes. According to the airline, Pan American will have about 30% of the total market this year, compared with a 25% share in 1955.

Pan American plans a year-round schedule of 12 weekly cargo flights across the Atlantic, a 40% increase in capacity.

Delivery of the airline's DC-7s this year will increase schedules to 150 flights a week during the peak season, raising cargo capacity on combination services.

New Republic Consultants

Republic Aviation Corp. has engaged Systems Research Corp. of Los Angeles, formed by scientists who quit Lockheed Aircraft Corp. in a dispute over control of research projects (AW Dec. 19, p. 16), as reported by Aviation Week (Jan. 2, p. 15).

Systems Research will serve as consultants to conduct specific research and advanced studies on advanced weapon and guided missile systems and to assist various engineering activities, Republic said.

Defense Briefings

House Armed Services Committee plans executive briefing sessions with top defense officials on the relative status of the U. S. missile programs and the striking power of the Strategic Air Command.

Rep. William Bray (R.-Ind.) proposed the scrutiny in the missile field and Rep. Melvin Price (D.-Ill.) the inquiry into SAC.

Chairman Carl Vinson (D.-Ga.) approved both suggestions, and said, "We want to know if any other country is ahead of us."

Aviation Organizations List Lobby Expenses

Aircraft Industries Assn. reported receipt of $4,433 for legislative activities during the July-September quarter and expenditure of the same amount.

In addition, Harold Mosier reported receipt of $3,750 and expenditure of $456.25 as an AIA representative. Two other AIA representatives, Harry Brashear and D. C. Ramsey, reported no receipts or expenditures.

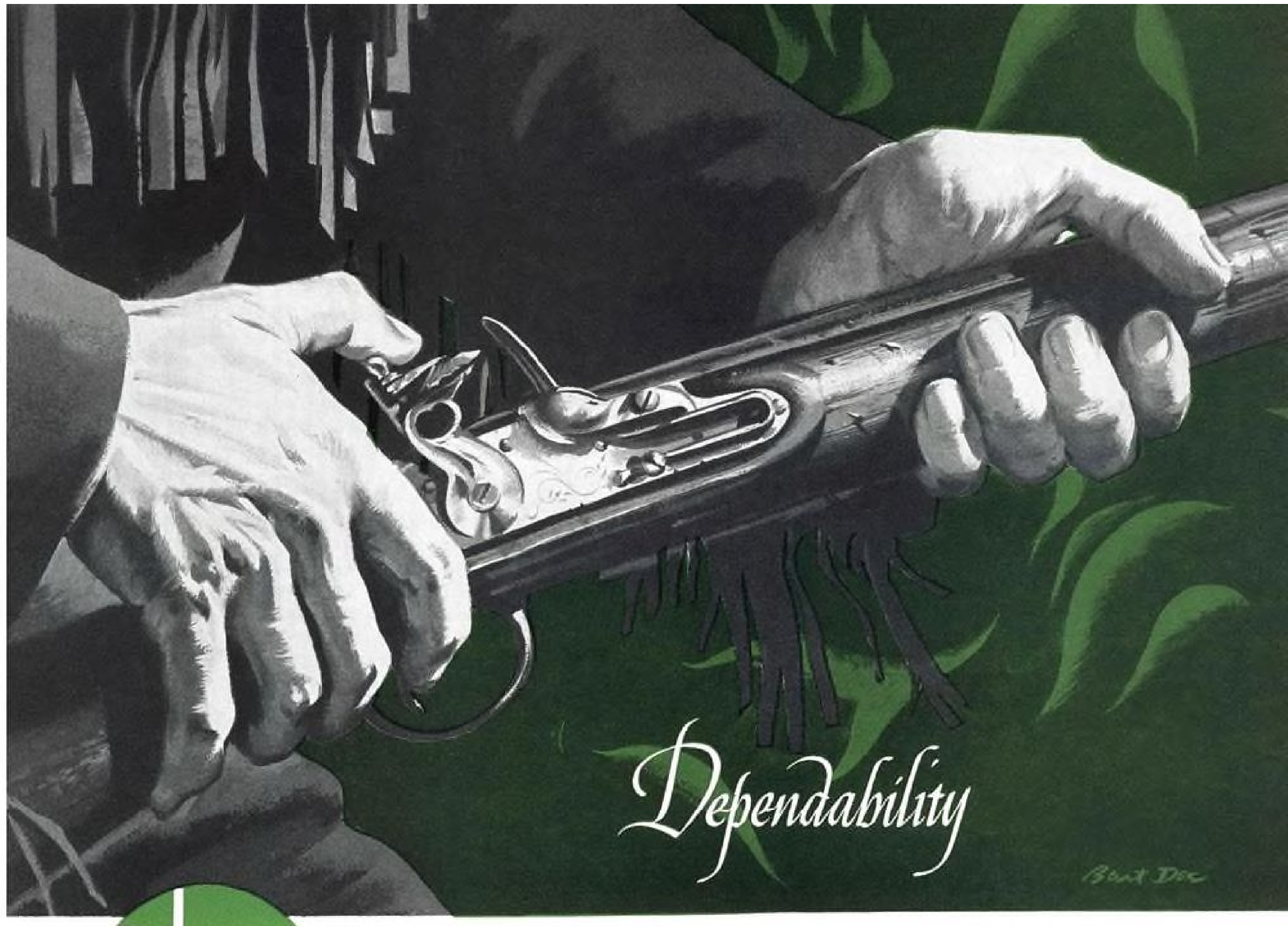
Other reports covering the third quarter filed under the 1946 Lobbying Registration Act included:

- **Air Transport Assn.** Edward Rodgers reported receipt of $1,250 and expenditure of $31; Stuart Tipton reported receipt of $367.79 and expenditure of $31.52.
- **Conference of Local Airlines.** John Floberg reported no receipts or expenditures.
- **Air Line Pilots Assn.** Larry Cates reported receipts of $2,592.10 and no expenditures.
- **Aeronautical Training Society.** Wayne Weishaar reported receipts of $3,300 and expenditures of $5.48.

Sperry Research Center To Locate in Arizona

Sperry-Rand Corp. will build an advanced flight research center and engineering-manufacturing facility in Phoenix, Ariz., bringing its avionics facilities closer to the West Coast airframe industry. Hangar and shop space for flight testing will be constructed on a 40-acre tract at Sky Harbor Airport, whose 7,800 foot east-west runway will be extended to handle large jet and commercial aircraft types.

Sperry also has leased the former Luke AFB Auxiliary Airfield No. 2, 25 miles northwest of Phoenix, for flight tests and other activities of a classified nature. Construction of the engineering-manufacturing facility is expected to begin within 12 months.



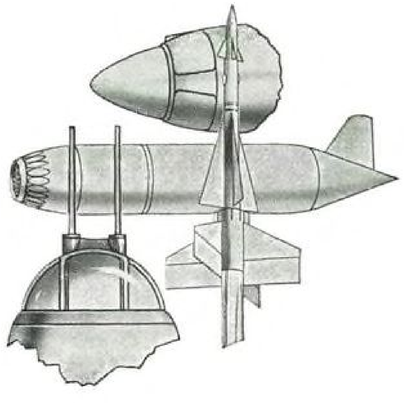
Rheem

GOVERNMENT PRODUCTS DIVISION

Just as early Americans depended on the sturdy heart and the steady hands of pioneers like Daniel Boone to lead them safely to new frontiers, so today do Americans depend on present day pioneers in science and industry to lead them safely to new frontiers of security, through progress.

At Rheem we are proud to play a part in this progress and proud, too, of the record of dependability we have established in research, engineering and production. Low per-unit cost and on-time completion schedules are routine at Rheem.

Rheem's integrated Government Products facilities are presently in quality development and production on air frames, missile and jet-engine components, airborne ordnance, electronics and ordnance materiel.



YOU CAN RELY ON RHEEM

Rheem Manufacturing Company • GOVERNMENT PRODUCTS DIVISION

DOWNEY, CALIF. • SAN PABLO, CALIF. • WASHINGTON, D.C. • PHILADELPHIA, PA. • BURLINGTON, N.J.

LEAR PRODUCES *for the precision needs of aviation*

This roster of Lear aviation products is, of necessity, incomplete. Many of these products are frequently combined to form an infinite variety of additional products or systems. Only enough typical devices are shown here to demonstrate Lear's mastery of a field of science and technology that uses thousands of such building blocks for meeting the highly specialized requirements of modern aircraft and missiles.

δ *flight control systems*

Automatic altitude controllers
Automatic approach couplers
Automatic Mach number controllers
Automatic pilots (lightplane)
Automatic pilots (high-performance)
Automatic pitch, yaw, and roll dampers
Automatic rudder controllers
Automatic wing flap systems
Missile control systems
Test equipment

σ *flight reference systems*

No-gimbal-lock vertical gyro indicators
Stable platforms
Test equipment
Three-axis gyro indicators
Vertical gyro indicators

γ *navigational systems*

Automatic radio direction finders
Glide slope receivers
High-latitude gyro compass systems
Integrated ADF-magnetic compass systems
Localizer receivers
Marker beacon receivers
VHF Omnirange receivers

ξ *electro-mechanical systems*

Artificial feel systems
Camera positioners
Canopy control systems
Carburetor air door controllers
Convertiplane rotor positioning systems
Cowl flap positioners
De-icing valve positioners
Engine throttle controllers
Gas, hydraulic, fuel, valve positioners
Inlet screen retraction systems
Inlet vane angle controllers
Jettison systems
Landing gear lock systems
Mechanical advantage ratio changers
Oil cooler flap controllers
Parachute door systems
Precision remote positioning systems
Supercharger blower shifters
Test equipment
Throttle friction controllers
Trim tab positioners
Turbo-prop clutch valve controllers
Wing flap positioning systems

λ *electro-mechanical components*

Linear actuators
Rotary actuators
Servo actuators
Power units
Actuator controls
Alternators
Capstans
Freewheeling clutches
Friction clutches
Magnetic clutches
Slip overload clutches
Electromagnetic brakes
Flex drive H's, hex's, L's, and T's
Flexible shafts
Gearboxes
Handcranks
Motors (AC and DC)
Enclosed fan motors
Explosion proof motors
Gearhead motors
High frequency motors
High temperature motors
Miniature motors
Pneumatic motors
Servo motors
Torque motors
Screwjacks
Load limit switches
Position limit switches
Programming switches

ζ *instruments*

ADF indicators
Attitude indicators, 2-axis
Attitude indicators, 3-axis
Directional indicators
ILS indicators
Integrated ADF-magnetic indicators
Trim indicators
Tuning meters
Omnirange indicators

μ *instrument components*

Altitude transducers
Vacuum tube amplifiers
Magnetic amplifiers
Printed and etched circuit amplifiers
Transistor amplifiers
Displacement gyros
Dynamic pressure transducers
Gravity-sensing switches
Magnetic modulators
Magnetic powder clutches
AC and DC servo motors
Electric gyro motors
Flag motors
High-frequency motors
Torque motors
Power converters
Rate generators
Rate gyros
Resolvers
Synchros
Synchro repeaters

ψ *communications systems*

UHF, VHF, HF, MF, and LF receivers
VHF transceivers
VHF, HF, and MF transmitters
ADF receivers
Airport traffic transceivers
Monitoring transceivers
Portable transceivers
Telemetering receivers
Test equipment

ε *communications components*

Audio frequency amplifiers
Vacuum tube amplifiers
Magnetic amplifiers
Power amplifiers
Printed and etched circuit amplifiers
Transistor amplifiers
Aircraft broadband antennas
Ground plane antennas
LF-MF whip antennas
Loop antennas
Mobile antennas
Trailing wire antennas
UHF-VHF whip antennas
VHF Omnirange antennas
Antenna fairleads
Antenna reels
Antenna tuning coils
Cable assemblies
Coil assemblies
Crystals
Dynamotors
Headsets
Loudspeakers
Amplifying loudspeakers
Noise-cancelling microphones
Radio noise filters

φ *test equipment*

Bench test cable assemblies
Electronic test sets
Field strength meters
Pressurizing test kits
Universal electro-mechanical test stands
Universal motor test stands

η *fluid handling equipment*

Absolute pressure switches
Bombsight and instrument desiccators
Canopy seal pressurizing kits
Cooling units for electronic assemblies
Dehydrators
Fuel flow dividers
Pneumatic actuators
Pressurizing control panels
Alcohol pumps
Anti-detonant injection pumps
Ballast pumps
Bilge and refueling pumps
Dry air pumps
Electric motor driven pumps
Ethylene glycol and coolant pumps
Ethylene oxide pumps
Fuel pumps
Fuel booster pumps
Fuel filter de-icer pumps
Fuel transfer pumps
Hand operated pumps
Heater fuel pumps
Hydraulic pumps
Hydraulic oil booster pumps
Hydrogen peroxide pumps
Lube oil and scavenge pumps
Multiple-element pumps
Oil transfer pumps
Scavenge pumps
Smoke pumps
Submerged fuel booster pumps
Vacuum pumps
Water pumps
Radar pressurizing kits
Rocket engine fueling nozzles
Air relief valves
Check valves
Hydraulic valves
Hydraulic servo valves
Isobaric relief valves
Pressure regulating valves
Vacuum valves

π *miscellaneous*

Airborne television installations
Airplane brake modernization kits
Auxiliary power supplies
Electronic chassis assemblies
Executive airplanes
Periscope prism selectors
Precision remote positioners
Printed circuits
Radomes
Wire harnesses

LEAR Lear

CP-13

Executive Offices: Santa Monica, Calif. • Grand Rapids Division: Grand Rapids, Mich. • LearCal Division: Santa Monica, Calif. • Lear-Romec Division: Elyria, Ohio • Aircraft Engineering Division: Santa Monica, Calif. • Lear International, Inc.: N.Y.C.

CUT THAT COST PER POUND!

HOT AIR SHUT-OFF VALVE #2043A1
(POPPET-TYPE Solenoid Pilot Operated, Normally Closed)

OPERATING PRESSURE: 225 P.S.I.G.
OPERATING TEMPERATURE: +275°F. NORMAL 400°F. MAX.
AMBIENT TEMPERATURE: −65°F. TO +225°F.
LEAKAGE: .10 LBS/MIN. MAX. AT 400°F.
PRESSURE: 8 TO 225 P.S.I.G.
½ PORT SIZE
SOLENOID: CONTINUOUS DUTY 22 TO 30 VDC
1.0 AMP. AT 28 V AT 78°F.
WEIGHT: .8 LBS.
FULLY QUALIFIED

com·air
PRODUCTS INC.
1201 RIO VISTA, LOS ANGELES 23, CALIFORNIA
43 Locust St., Floral Park, Long Island, N.Y.
813 Evans Avenue, Kirkwood 22, Missouri

DESIGNERS AND MANUFACTURERS OF HYDRAULIC, PNEUMATIC AND FUEL CONTROLS

Business Investment Holds Key To Both Growth and Stability

What federal tax policy will best promote both growth and stability in the American economy? The Joint Economic Committee of Congress has been asking this crucially important question in public hearings. This editorial suggests one vital part of the answer.

The proposition advanced here is that—

> Tax policy must encourage a continuing high level of business investment in new plant and equipment, because such investment makes a special contribution to *both* economic growth and economic stability.

Growth Needed for Security

We must have both growth and stability.

A vigorous economic growth is essential to our national security. As Congressman Wilbur D. Mills said in launching the Joint Committee's hearings, "The present complexion of world affairs places a premium upon strength and growth in our national economy." Growth is likewise a major ingredient of a healthy domestic economy. Growing enterprises and growing communities offer far more opportunities for satisfying careers than those which are not growing.

A reasonably stable economy, without violent ups and downs, is also essential to our national welfare. Extravagant booms and their more or less inevitable result, severe depressions, waste labor and resources and cause great human misery. Both major political parties have accepted the obligation imposed by the Employment Act of 1946, that the federal government work to maintain high and stable employment.

There is general agreement that **the key to economic growth is investment in new plant and equipment.** Growth depends decisively on new facilities to increase production, and also to produce new and better products in new and better ways. At the same time, new plant investment provides employment for the important, and well-paid, one-fourth of our industrial workers who manufacture and build new production facilities. So if the process of business investment is kept on an even keel, the result is not only growth but also stability in a substantial sector of our economy.

But authorities disagree on the possibility of maintaining a high level of business investment for any great length of time. Some fear that it will lead to an excess of producing capacity and the glutting of markets, with recession or depression not far behind.

The history of our country offers some basis for the fear that it is dangerous to maintain a very high level of business investment. There have been times when the economy has suffered under the weight of excess producing capacity. **This fear, however, has been made obsolete by the recent course of our economic history which, in its earlier phases, nourished the fear.**

The World Has Changed

Here are some of the major considerations, cited at the Joint Committee hearings, which support the conclusion that we not only *can have* a high level of business investment and economic stability but that we actually *need* a high level of such investment to assure stability.

(1) Over the next 20 years our population is expected to increase by about one-third. But most of the population increase will come in age groups younger or older than normal working ages, and people will probably work fewer hours per week. Thus hours worked are not expected to increase more than 15%. Consequently, we must have a relatively large increase in the amount of production equipment per worker if our standard of living is not to suffer. This means a high level of new investment.

(2) About half of our present business investment goes to replace worn-out equipment, rather than to expand capacity as was true during the early stages of our industrial development.

(3) Thanks largely to the impact of organized research—for which we as a nation now spend about $4 billion a year—a large share of capital investment now goes to provide new products and new processes, rather than to expand existing capacity.

These developments make it unlikely that we shall develop the burden of excess capacity that plagued the economy in earlier periods. **Moreover, most capital investment plans are now made on a long-range basis. Companies are building facilities to anticipate their needs for several years ahead.** This increase in long-range planning has reduced the disturbing effects of temporary shortages and excesses in producing capacity.

The record of recent years speaks for itself. Business spending for new plant and equipment in 1955 was over $29 billion. This continued the high level of investment that has been maintained for the past ten years—a decade remarkable for both impressive growth and gratifying stability. A McGraw-Hill survey of preliminary plans for 1956 indicates another year of increasing investment, and expanding business activity.

Tax policy, to be successful, must consider this impressive contribution of business investment to both growth and stability.

Of course, the level of investment depends on many factors other than federal tax policy. The degree of business confidence is important. So is the strength of consumer markets. So is the attitude of organized labor toward the use of more efficient machinery. But tax policy is a crucially important factor. And it is becoming more so with new developments in our changing economy. These developments indicate that tax policy **must be geared to foster a high level of business investment, if the dual objectives of economic growth and economic stability are surely to be attained.**

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

With MATS, his supply line can never be more than hours long

No matter where our men may be, Military Air Transport—MATS—insures that supplies can reach them within hours . . . practically *anywhere*.

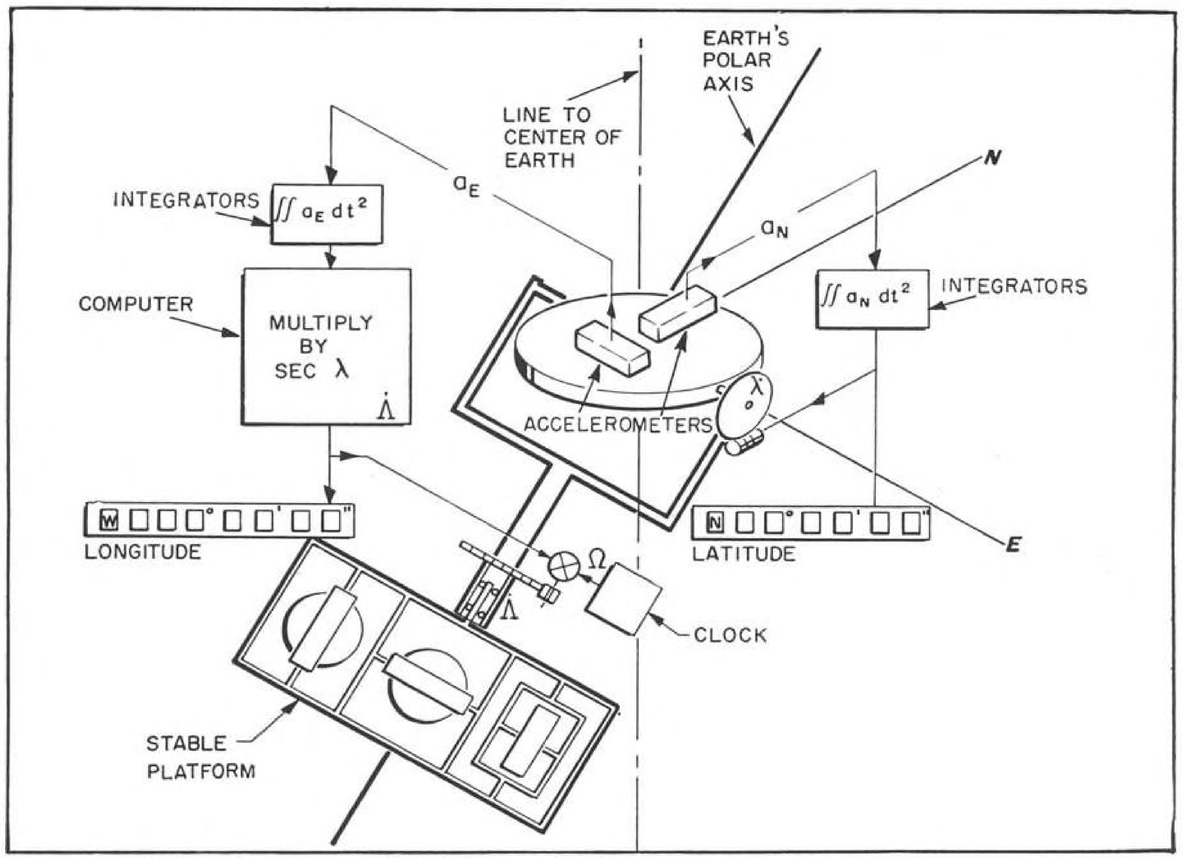
Essential here is the Douglas C-124, largest operational cargo transport. Able to fly 2000 miles non-stop with a 25-ton payload, the C-124 can handle 96% of all military equipment *without disassembly*. During Korea it not only flew high-priority cargo, but worked as a hospital plane evacuating the wounded.

Looking to tomorrow, Douglas will have even larger and faster cargo transports.

BASIC TO MATS OPERATIONS—THE DOUGLAS C-124

Defense is everybody's business. Development of the C-124 shows how Douglas works with military planners to have aircraft ready when needed. But human skills are also needed to fly and service these planes. If you want a career, the Air Force offers opportunity.

Depend on *DOUGLAS* First in Aviation



INERTIAL NAVIGATOR, shown schematically, includes gyro-stabilized platform to prevent vehicle's pitch, roll and yaw motions from disturbing position of accelerometers on equatorial mount. As vehicle travels, mount moves to keep accelerometers horizontal.

Inertial Guidance: Part II

Old Idea Opens Door to Inertial Guidance

By Philip J. Klass

The "84-minute pendulum," an idea first suggested in 1923 by Dr. Maxmilian Schuler, a German professor of applied mechanics, has unlocked the door to practical inertial navigation systems for missiles and aircraft. The concept is used in all known inertial systems.

The principle, sometimes called the "Schuler pendulum" or "earth's pendulum," makes it possible to accurately establish the direction of gravity (vertical) in a moving vehicle regardless of its accelerations. A pendulum with vertical determination characteristics independent of vehicle movement would have a length equal to the radius of the earth, giving it an 84-minute natural period. In practice, the inertial system is made to behave as if it were an 84-minute pendulum.

Application of this principle prevents the intolerable build-up errors in computed position which otherwise would result from gyro drift, accelerometer unbalance and certain other instrumentation errors (See box next page).

84-Minute Pendulum Theory

The fundamental principle of the 84-minute pendulum, translated from Dr. Schuler's original article, "Aberration of Pendulum and Gyroscope Instruments Due to Acceleration of the Transporting Craft," in Physik. Zeitschr. (Vol. 24, p. 344), is as follows:

"Vertical accelerations do not disturb the equilibrium position of an ordinary string pendulum. Under horizontal accelerations of its point of suspension, however, it will start to swing, even if previously at rest. As soon as a railway train, for example, is set in motion, a pendulum suspended in it will swing toward the rear.

"A change in direction of motion will suffice to produce a violent deflection of the pendulum, even if the speed remains the same." This undesirable condition can be avoided, Dr. Schuler pointed out, *"only if the length of the pendulum were equal to the radius of the earth.*

"In that case it would be possible to move the point of suspension around at will on the earth's surface without disturbing the pendulum (bob) in the slightest. *This is because the pendulum's center of gravity would always remain at the center of the earth, and hence at rest."*

Actually the earth is not a perfect sphere, Schuler pointed out, so the length of such an "earth pendulum" would have to be varied slightly with latitude. However, this is a second-order correction which is compensated for in present inertial systems.

Impossible But Useful

"Naturally, no such string pendulum (with a length equal to the earth's radius) can be constructed," Schuler said. *"But the same effect is obtained with a physical pendulum having the same period of oscillation as a string pendulum of length equal to the radius of the earth."*

This period of oscillation works out to approximately 84 minutes, using the fundamental equation for the natural period of a pendulum and substituting the radius of the earth (3,963 miles at the equator) for the length of the pendulum, and 32 ft./sec./sec. for gravity, and converting to appropriate units.

$$T = 2\pi\sqrt{L/g}$$

$$= 2\pi\sqrt{\frac{(3{,}963)\ (5{,}280)}{(32)\ (3{,}600)}}$$

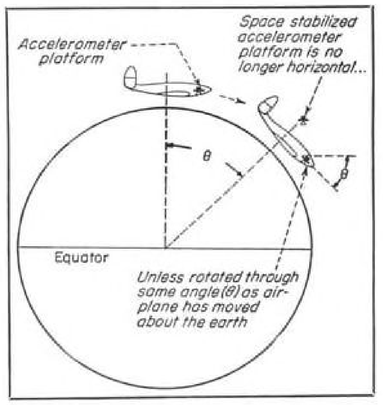
$$= 84 \text{ minutes}$$

"Such a pendulum," Schuler said, "once it has come to rest, will always remain in equilibrium position and indicates the vertical obtaining at the particular point of the earth's surface, regardless of the manner in which the vehicle moves."

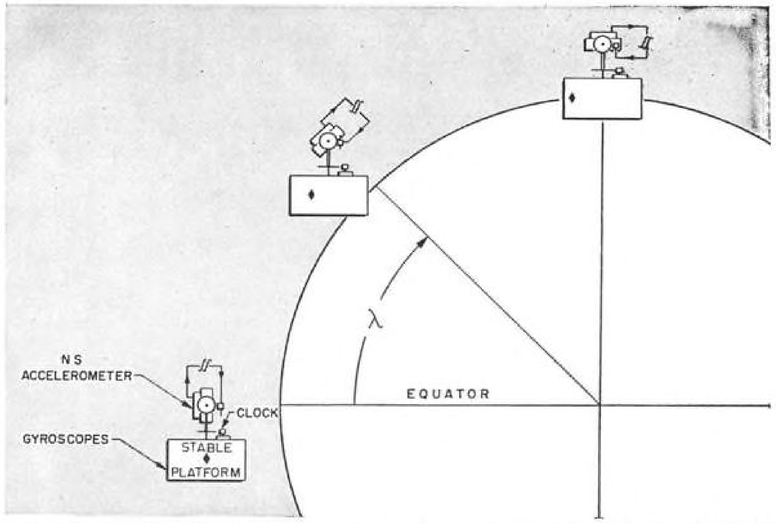
(Schuler then went on to discuss the application of the 84-minute pendulum principle to both artificial horizons and gyro compasses. Although he suggested the possibility of using two contra-rotating 84-minute-period pendulum horizon gyros to indicate vehicle displacement, as well as true vertical and horizontal, he did not suggest the possibility of a completely self-contained inertial navigator. Schuler envisioned that the major benefit from his idea would be an extremely accurate artificial horizon which could be used in obtaining accurate celestial fixes.)

The gyro-stabilized platform upon which the accelerometers are mounted will prevent their being displaced from the desired horizontal position by rolling, pitching or yawing motions of the vehicle. However, because the gyros attempt to stabilize the platform position *in space*, any movement of the vehicle around the earth will in itself result in the accelerometers being displaced from the vehicle's "local vertical" (a line connecting the vehicle and the center of the earth).

This is illustrated in the sketch below, which shows how a space-stabilized accelerometer platform deviates from the local horizontal due to vehicle displacement around the earth.



If, on the other hand, the accelerometers are aligned horizontally at the start of a flight and then are continuously rotated (about suitable axes) relative to the stabilized platform so that they move through the same angle as the vehicle moves about the earth, then the accelerometers will remain in the



EQUATORIAL MOUNT is continuously tipped and rotated as vehicle travels about the earth to keep accelerometers perpendicular to gravity and to compensate for earth's rotation.

The Problem 84-Minute Pendulum Solves

An inertial guidance system determines an aircraft or missile's displacement from its starting point by twice integrating the signal obtained from accelerometers which measure the vehicle's accelerations relative to the earth, as described in the first installment of this series (Jan. 2, p. 32).

The acceleration-sensing devices must be isolated from vehicle pitching, rolling and yawing motions. This is accomplished by mounting the accelerometers on a gyro-stabilized platform.

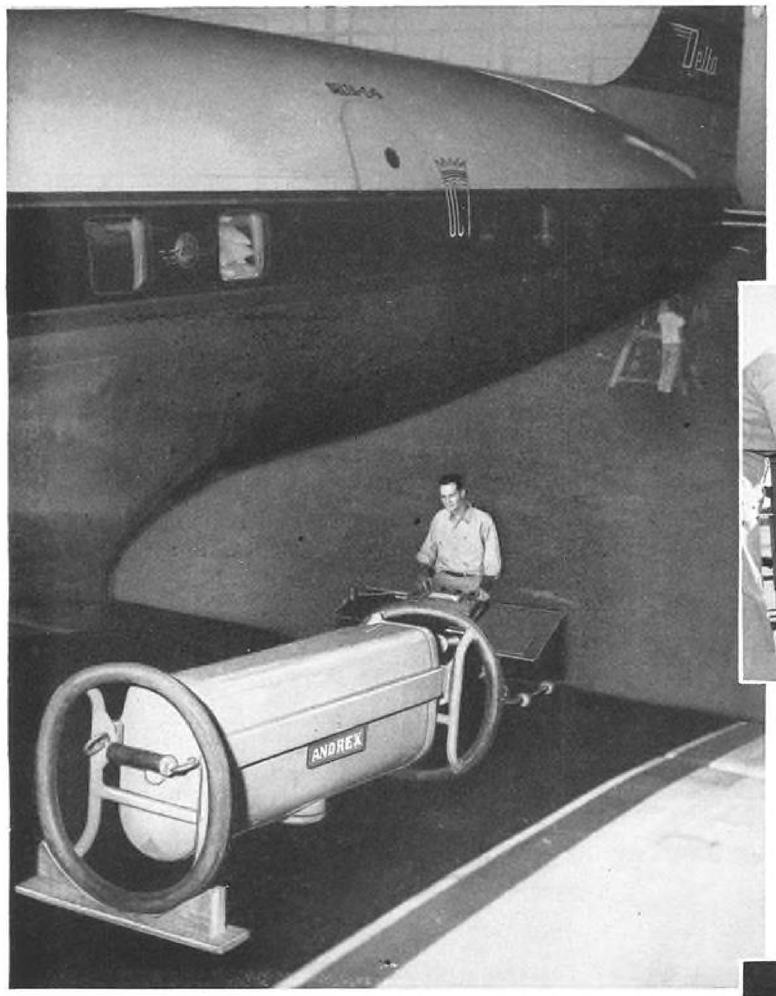
Equally important, the sensitive axes of the accelerometers must be maintained accurately at right angles to the direction of gravity so they will not measure a component of gravity, mistaking it for a vehicle acceleration, and producing errors in calculated vehicle displacement.

For example, if the accelerometer is tipped off the horizontal by as little as 1/60 degree (one minute of arc), this spurious gravity acceleration alone would introduce an error of 12 miles at the end of a one hour mission.

Unfortunately it is not possible to use the simple pendulum arrangement commonly employed in an aircraft horizon gyro to keep its spin axis aligned to the vertical and its indicating pointers truly horizontal. The reason is that such a pendulum is itself affected by lateral accelerations of the vehicle, causing it to erect the gyro to a false vertical.

However, by applying the principle of the 84-minute pendulum, the stabilized platform can not only be made to continuously seek out the true vertical, and thereby align the accelerometers perpendicular to the vertical, but the cumulative build-up of many types of instrumentation error can be restricted.

Airlines adopt portable ANDREX X-ray for low-cost inspection without disassembly



PAN-AMERICAN WORLD AIRWAYS

8,429 ANDREX x-ray shots taken in 5 month PAA prop inspection. Blades are x-rayed before going into service and at each 1400 hour and 2800 hour interval. PAA uses ANDREX x-ray extensively in engine and fuselage inspection on both heavy structural steel and light metal members.

BRANIFF INTERNATIONAL AIRWAYS

1 hour to inspect leading edge heater duct and attachment clamps and brackets in horizontal stabilizer on DC-6. No disassembly. Approximately 3 feet inspected per each 1 minute exposure. Hidden defects or any serious corrosion caused by leaking gases can be detected at same time.

DELTA-C&S AIR LINES. Wing stringer inspection time cut to 8 hours for entire bottom wing structure from station 421 left to 421 right of DC-7. ANDREX x-ray is replacing visual inspection in general maintenance of entire Delta-C&S fleet. 1000 man-hours alone saved per year by not opening and closing wings.

• *Write for further information* •

ANDREX X-RAY

PIONEERED, SOLD AND SERVICED BY

HOLGER ANDREASEN, INC.

703 MARKET, SAN FRANCISCO 3, CALIF.

Canadian representatives: Non-Destructive Testing Corp., Ltd., 983 Bay, Toronto 5, Canada

desired horizontal position relative to local gravity.

This effect can be accomplished in several ways. For example, the platform mounting the accelerometers can be rotated in accordance with signals from:

• **First integrator output,** which is proportional to vehicle velocity, thereby causing the accelerometers to be rotated continuously at a **rate** which is identical to the **angular velocity** of the vehicle about the earth.

• **Second integrator output,** which is proportional to vehicle displacement, so as to cause the accelerometers to be rotated continuously through an **angle** which is identical to the **angular displacement** of the vehicle relative to the earth.

When such a signal is fed back to the accelerometer platform, the combination of stabilized platform, accelerometers, integrators and feedback behaves like an undamped pendulum. When the system scale factors are properly selected, the system will behave like the classical Schuler pendulum, exhibiting an 84-minute natural period.

Like the classical 84-minute pendulum, the inertial system will seek out the local vertical and maintain (or oscillate about) this position, despite motions of the vehicle.

Another important advantage is that many of the instrumentation errors are constrained from building up as the square of time and instead are oscillatory in their build-up.

Limits Error Build-Up

The oscillatory characteristic of the 84-minute pendulum system, which enables it to limit the build-up of the certain types of instrumentation errors, can be demonstrated by visualizing a single-axis stabilized platform and accelerometer in a stationary vehicle located at the North Pole. Assume that the accelerometer has a slight unbalance error, which displaces its mass slightly to the left of center and generates a small signal, despite the fact that the vehicle and accelerometer are at rest (see Fig. A in column 3).

This spurious output signal is indistinguishable from the signal which would result if the vehicle started to move to the right, or clockwise around the earth. This accelerometer signal is integrated twice, and the result indicates an apparent change in the vehicle's latitude. When this is fed back to a servo motor, it starts rotating the accelerometer platform in a clockwise direction.

As the platform tips away from the horizontal, the accelerometer mass is subjected to the effect of gravity, which acts on the mass to oppose the initial accelerometer unbalance. When the platform has been rotated to the point where the effect of gravity just cancels out the initial unbalance (Fig. B), the accelerometer signal will drop to zero.

The output of the first (velocity) integrator momentarily drops to zero, but the second integrator interprets this as meaning that the vehicle is continuing to move in a clockwise direction at constant velocity, so it continues to increase its output of "distance traveled." This in turn causes the platform and accelerometer to continue to rotate in a CW direction.

The Pendulum Swings

As the platform continues its rotation, the accelerometer mass is further displaced to the right by gravity. This produces an acceleration signal of the opposite polarity, as if the vehicle were actually decelerating. When the platform has tipped through an angle such that the mass is displaced from center by an amount equal (and opposite) to the original spurious displacement (Fig. C), the output of the velocity integrator will have decreased past zero and begun to reverse, as if the vehicle itself had reversed direction.

This will now cause the output of the second (distance) integrator to start decreasing, which causes the platform to start rotating in the opposite (counter clockwise) direction. The platform will continue its CCW rotation past the position shown in Fig. D until it reaches its original position (Fig. E), after which the entire cycle will be repeated.

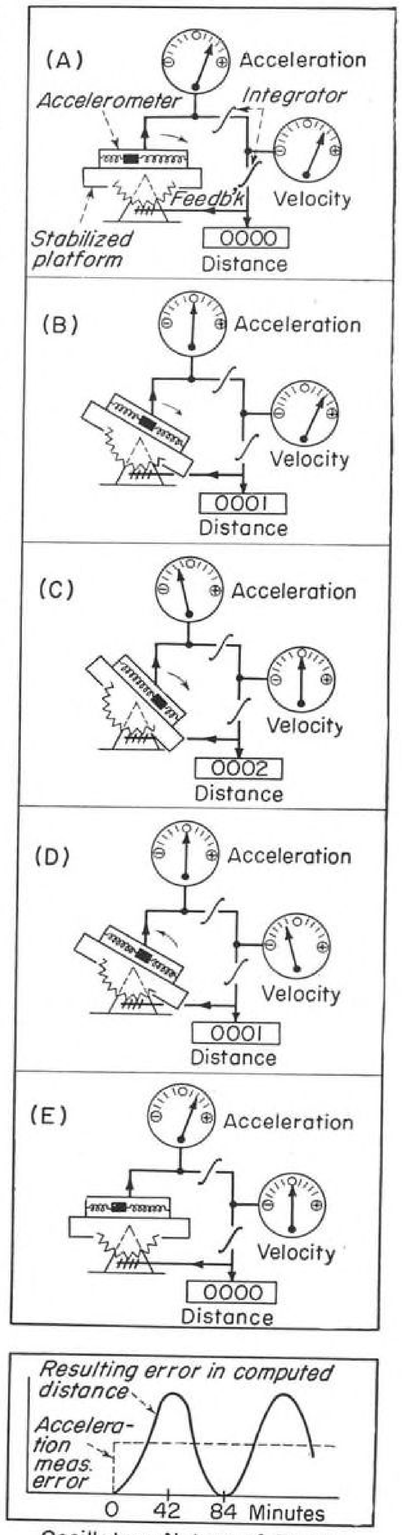
The period of this oscillation will be Schuler's 84-minute interval. The error in computed distance traveled also oscillates with an 84-minute period.

The amplitude of this error oscillation will depend upon the sensitivity and accuracy of the accelerometer, stabilized platform gyros and servo systems and the integrators.

The foregoing description has considered the movement of the aircraft/missile relative to a stationary earth. Because the earth rotates about its polar axis at 15 degrees per hour, the same angular rotation must be added to (or subtracted from) the vehicle's east-west motion. (If the vehicle stands still in space while the earth rotates, it is the same as if the earth were stationary and the vehicle were moving west at 15 degrees per hour.)

Correction for the earth's rotation can be introduced, for example, by rotating the accelerometers about an axis parallel to the earth's axis, at the rate of 15 degrees per hour. This can be accomplished by using an a.c. driving motor powered from a constant frequency source.

The basic inertial building blocks can be assembled into a variety of different systems. One typical inertial system, described before a recent meet-



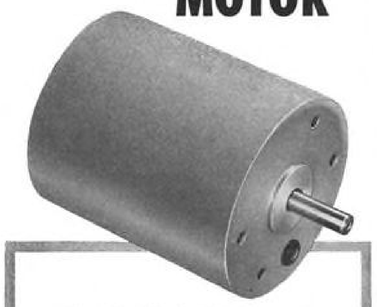
Oscillatory Nature of Errors

SCHULER Pendulum avoids sharp build-up of system errors. (See text left.)

American Electric

CAMERA DRIVE MOTOR

Model 341



For Guided Missile and Aircraft Applications

Built to U.S.A.F. 32466 and MIL-E-5272

For aerial survey work 1/35 hp at 7200 rpm, intermittent duty. 115 V. 1 ph. 400 cps. Induction type. Weighs 25 oz. Totally enclosed. Ambient −65°C to +85°C. Class H insulation. 2.5" dia.

MODEL 398B TIMER CONTROL SYNCHRONOUS MOTOR—Built to MIL-M-7969 Spec. Develops 1/150 hp at 8000 rpm, continuous duty. 3 in. oz. torque at full load. Weighs 21 oz. Ambient −65°C to 125°C. Teflon insulated. Totally enclosed, externally cooled. Frame 1.750" dia. 115 V. line to line, 3 ph. 400 cps.

MODEL 228 AIRCRAFT ANTENNA SCAN DRIVE MOTOR—Built to MIL-M-7969. 1/40 hp at 7200 rpm, continuous duty. 115 V. 1 ph. 400 cps. Induction type. Ambient −65°C to +55°C. Totally enclosed, externally cooled. Class H insulation. 2.5" dia. Weighs 1 lb. 10.5 oz.

MODEL 318A DRIVE MOTOR for Standard No. 2½ CENTRIFUGAL WHEEL—Built to U.S.A.F. 32590 and 41065A. 1/70 hp at 7200 rpm, continuous duty. 115 V. 1 ph. 400 cps. Induction type. Ambient −65°C to +40°C. Class A insulation. 2" dia. Weighs 1 lb.

MODEL 183A RADAR SPIN MOTOR—Pressurized against 35 psi. 1/18 hp at 9500 rpm min., continuous duty. 5 in. oz. stall torque. 115 V. 1 ph. 400 cps. Induction type. Ambient −65°C to +85°C. Totally enclosed. 1.675" dia.

MANY OTHER MODELS FULLY DEVELOPED

American Electric Miniatures are available for operation on 60, 400, 1600, or 2000 cps or on variable frequencies from 320 to 1000 cps.

TWO TYPES: **INDUCTION**—Output torque range from ½ in. oz. to 120 in. oz.
SYNCHRONOUS (Hysteresis or Reluctance Models)—Output torque range from ½ in. oz. to 120 in. oz.

Ask for quotations on special requirements!

American Electric Motors, Inc.
Miniature Components Division of
AMERICAN ELECTRONICS INC.
4811 Telegraph Road, Los Angeles 22, California

FIELD ENGINEERING OFFICES in principal industrial areas.

ing of the Dayton section of the Institute of Radio Engineers by North American Aviation's John M. Slater, is as follows:

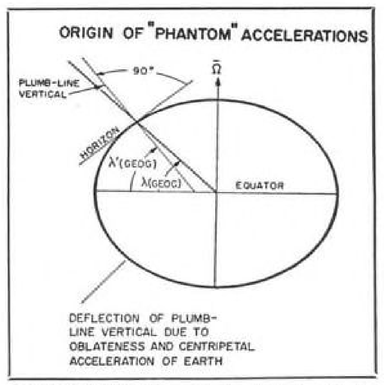
The aircraft/missile carries a three-gyro stabilized platform, upon which is mounted a set of two accelerometers, to make the acceleration sensing devices independent of vehicle pitching, rolling and yawing motions. The accelerometers are attached to the platform by means of a equatorial mount (see sketch, p. 42), whose vertical axis is aligned parallel to the earth's polar axis. This permits the N-S accelerometer to be aligned along a longitude meridian, while the E-W accelerometer is aligned along a latitude meridian.

The output of the N-S accelerometer is integrated twice to give distance covered along the meridian. This N-S distance covered is added to (or subtracted from) the initial starting latitude to indicate present vehicle position. A signal proportional to this distance traveled also is fed back to the latitude axis servo motor on the equatorial mount, which causes the accelerometer table to be rotated through a corresponding angular displacement (λ).

The output of the E-W accelerometer also is twice integrated. Because the relation between distance and longitude angle varies with latitude, the output of the second integrator must be multiplied by the secant of the vehicle's latitude. The result then is added to (or subtracted from) the vehicle's starting position on the longitude counter.

A signal proportional to this change in longitude is fed to the motor which rotates the equatorial mount and accelerometer about its vertical axis. To this rotation also is added the 15 degree/hour rotation of the earth as shown in the sketch.

The sketch on p. 43 illustrates the operation of the system for a flight starting at the equator and proceeding to the North Pole. It will be seen that the stabilized platform retains its position in space throughout the flight, while the accelerometer table rotates through an angle corresponding to the vehicle's angular displacement. In this way, the accelerometers always remain horizontal, i.e. at a right angle to gravity.



COMPENSATION must be introduced for "phantom" accelerations which exist because earth is not a perfect sphere.

'Intuitively Obvious'

The concept of the 84-minute pendulum, which makes it independent of accelerations resulting from vehicle movement, is sometimes called "intuitively obvious," and after a little thought on the subject together with a bit of sketching, Aviation Week readers may agree.

However, Dr. Maximilian Schuler, who conceived the idea, wrote in his original disclosure that "It is perhaps characteristic of human endeavor that it was precisely by computation through the complicated and unintuitive equations of the gyrocompass that I was led to perceive this simple and clear relationship."

Dr. Schuler is teaching at Goettingen University, Goettingen, Germany.

Phantom Accelerations

To the basic system described must be added provisions for compensating for errors which result because the earth is not a perfect sphere and for what is commonly known as the Coriolis effect.

If the earth were a perfect sphere, the vertical position established by a plumb line (or 84-minute pendulum) would be the same as a line from that point on the earth's surface to its center. Because of the earth's oblateness, however, a difference of up to approximately 11 minutes of arc exists (at 45 degrees latitude) between the plumb-line vertical and the true line to the earth's center (see sketch, above). This produces a spurious acceleration in the N-S accelerometer which is equal to $(\Omega)^2$ (sin 2λ), where Ω is the earth's rotation velocity, and λ is the vehicle's latitude.

The Coriolis effect, Slater told the Dayton IRE, "is an elusive thing to get a 'feel' for. It exists because of the fact that we are doing our navigation on a rotating base." This can be illustrated as follows:

If the earth were not rotating, a vehicle flying a straight ground course from the equator to the North Pole would also make a straight track *in space*, as seen in the sketch at right. Because the earth is rotating, however, an observer in space looking down on the earth would see that the airplane really has to fly a curved track *in space* in order to make good the desired straight ground over the earth (see sketch). Relative to space, the airplane must continuously change the magnitude and direction of its tangential velocity.

To compensate for this Coriolis acceleration, a correction factor is introduced into the output signals of the N-S and E-W accelerometers which is equal to: (2) (Ω) (V_{N-S} or $_{E-W}$) (sin λ).

As before, the Ω and λ represent the earth's rotation velocity and the vehicle's latitude, respectively. The term V_{N-S} or V_{E-W} represents the vehicle's ground velocity, measured in the north-south or east-west direction.

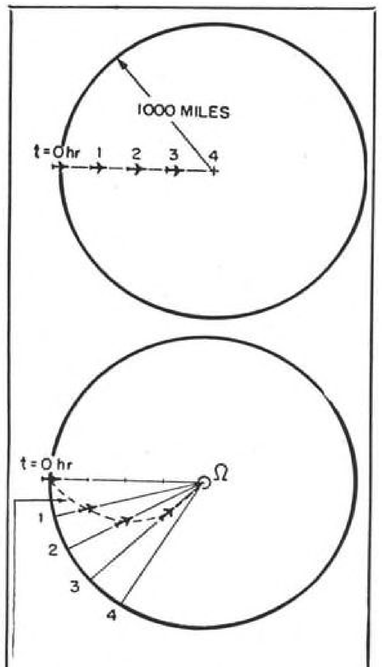
Component Accuracy the Key

In some types of navigation systems, such as those which employ ground-based radio facilities, continuing efforts at component accuracy improvement soon reach the point of diminishing returns. For instance, there is little overall improvement of navigational accuracy to be gained solely by reducing the errors in present airborne VOR receivers, because of the propagation and siting errors which exist in the ground-based equipment and installation.

Inertial systems are significantly different in this respect. Every improvement in airborne component accuracy buys an important increase in overall system accuracy. Another significant characteristic of inertial systems is that unless extremely accurate components are available, it is impossible to obtain even moderately acceptable system performance.

For this reason, the design of new and more accurate gyros, accelerometers, integrators, computers and servo systems holds the key to reducing the size, weight and complexity, as well as improving the accuracy, of inertial navigation systems. There probably is no more challenging design problem today anywhere in the avionics field, demanding as it does the utmost in mechanical and electronics ingenuity, coupled with patient attention to small but vitally important design details.

(The third article in this series will describe some of the inertial system building blocks, and the associated component design problems.)



CORIOLIS EFFECT, another "phantom" acceleration, occurs because vehicle must fly a curved path in space to make a straight ground track on rotating earth.

New Avionics Firms

International Business Machines Corp. has set up a new autonomous Military Products Division to handle a growing volume of defense business, including both airborne bombing-navigation systems and large ground-based digital computers for use in the continental air defense network (SAGE).

The company has acquired 672 acres at Oswego, N. Y., to provide for possible expansion of its military labs and manufacturing facilities. Other recent expansions in the avionics industry:

• **Systems Engineering, Inc.,** Lexington, Mass., a newly-formed organization devoted to the development and design of electronic and electromechanical systems, as well as engineering analysis and consultation in these fields. S. J. O'Neil is president of the new firm. Address: Box 225.

• **Cambridge Engineering Laboratory,** Cambridge, Mass., a newly-formed facility of the Sterling Precision Instrument Corp., Flushing, N. Y. Headed by John J. Jarosh, the new laboratory will specialize in gyros, accelerometers, and other inertial system components. Address: 229 Binney St.

• **National Aircraft Corp.,** Burbank, Calif., has acquired Mag-Electric Products, Inc., Hawthorne, maker of magnetic amplifiers, power supplies, delay lines and test equipment. New subsidiary will be operated at its present location.

• **Electron Products, Inc.,** a subsidiary of Preco Inc., makers of miniature capacitors and radio noise filters, is moving to a new 12,000-sq. ft. facility in Pasadena (Calif.) Instrument Park. Address: 430 North Halstead St.

General Electric Offers a Complete Line of Instruments for Both Commercial and Military Aviation

ELECTRICAL QUANTITIES
Voltmeters and Ammeters
Frequency Meters
Watt-Var Meters
Line Test Sets

ENGINE SPEED
Tachometer Generators
Tachometer Indicators

POSITION
Transmitters
Indicators

FUEL FLOW
Transmitters
Indicators
Power Supply

NAVIGATION
Directional Compass Systems
Remote Compass Transmitters
Gyros

LIQUID LEVEL
Transmitters
Indicators

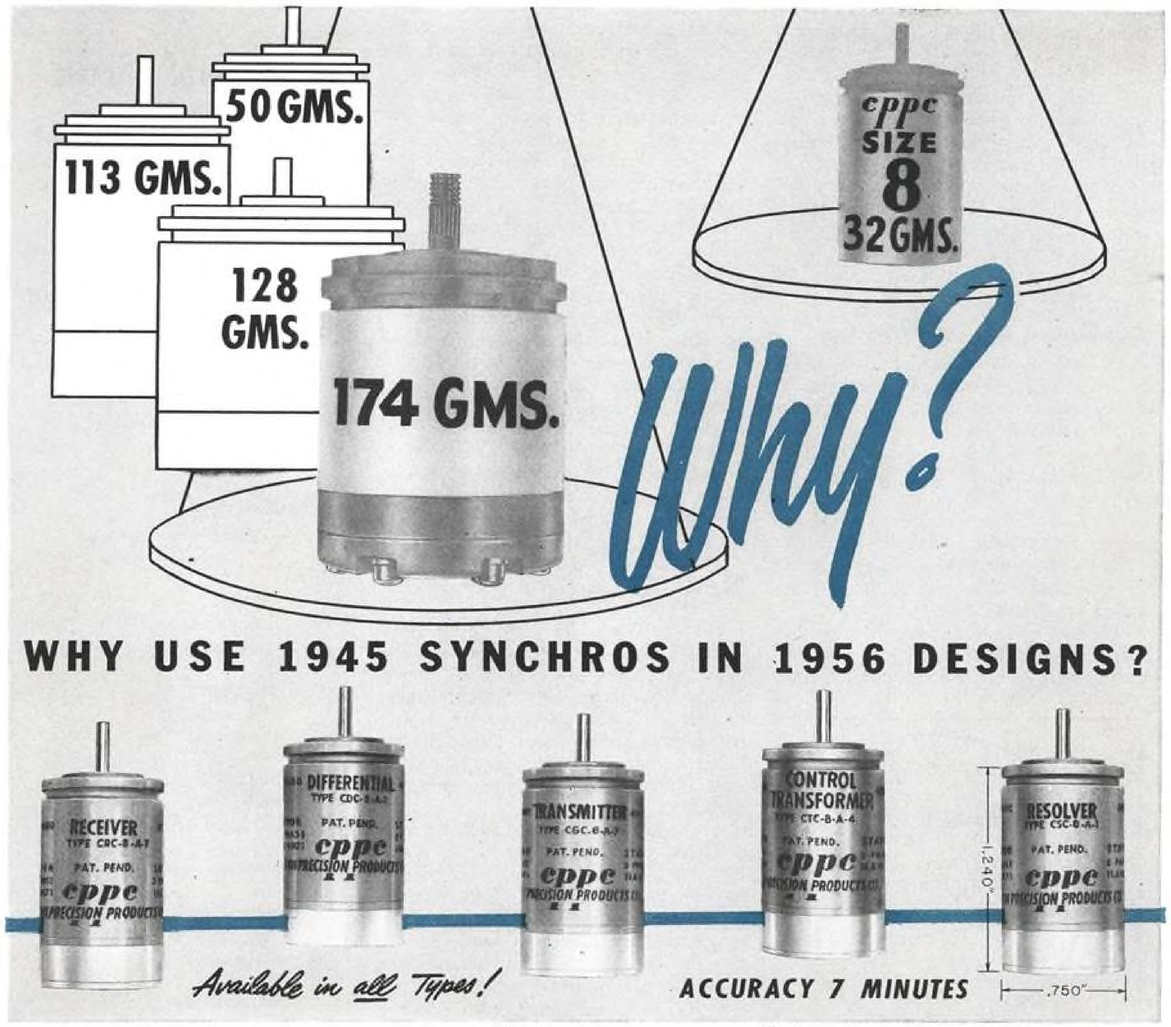
TEMPERATURE
Servo-indication Systems
Thermocouple Assemblies
Thermocouple Harnesses

COMPONENTS
Position Elements
Speed Elements
Servo Motors
Temperature Elements
Gyro Motors

TRANSFORMERS FOR AIRCRAFT

For further information on any of the complete line of General Electric aircraft instruments, contact your nearest G-E Apparatus Sales Office or write Section 586-9, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC



Function	Type Number	Primary Element	Excitation Voltage 400 cy.	Input Current (ma.)	Input Power (Watts)	Primary Impedance Secondary Open (Phase)	Primary Resistance (line)	Secondary Element	Output Voltage	Secondary Impedance Primary Open (Phase)	Secondary Impedance Primary Shorted	Secondary Resistance (line)	Phase Shift Degrees	Sensitivity mv./deg.	Accuracy Minutes Max.
Transmitter	CGC-8-A-7	Rotor 1 Phase	26.0	100	.50	54+ j260	37.0	Stator 3 Phase	11.8	12+ j45	15+ j3.5	11.8	8.0	200	7
Control Transformer	CTC-8-A-1	Stator 3 Phase	11.8	90	.23	28+ j110	24.7	Rotor 1 Phase	23.6	220+ j740	246+ j60	143	8.5	400	7
Control Transformer	CTC-8-A-4	Stator 3 Phase	11.8	37	.09	67+ j270	59.5	Rotor 1 Phase	24.0	508+ j1680	640+ j190	381	9.2	400	7
Resolver	CSC-8-A-1	Stator 2 Phase	11.8	84	.27	38+ j136	27.0	Rotor 2 Phase	23.2	280+ j600	344+ j75	230	11	400	7
		Rotor 2 Phase	26.0	39	.43	280+ j600	230	Stator 2 Phase	10.6	38+ j136	70+ j29	27.0	20	180	7
Repeater	CRC-8-A-1	Rotor 1 Phase	26.0	100	.50	54+ j260	37.0	Stator 3 Phase	11.8	12+ j45	15+ j3.5	11.8	8.0	200	30*
Differential	CDC-8-A-1	Stator 3 Phase	11.8	85	.21	27+ j120	25.0	Rotor 3 Phase	11.8	38+ j122	47+ j14	36.0	9.0	200	7 Rotor 7 Stator

Total Null max. 30mv for each unit

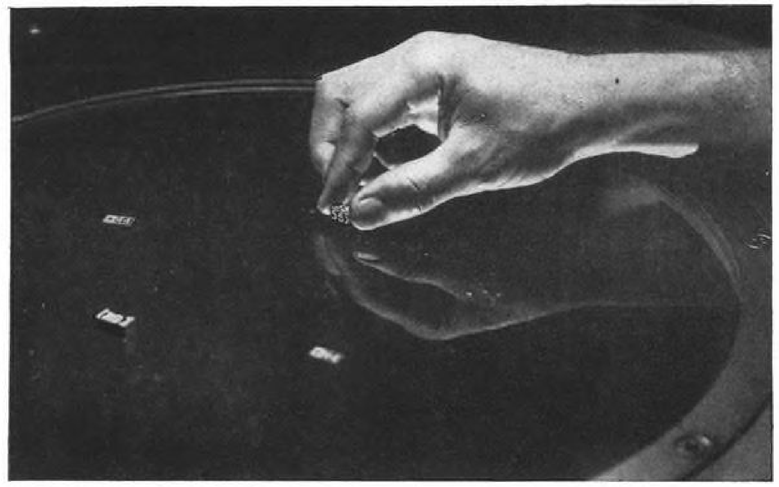
*Torque 2600 mg.-mm./degree from CGC-8-A-7

Also available in 115v 400 cy. primary, 90v secondary Transmitters, C.T.'s, Receivers

LOOK TO cppc FOR SYNCHRO PROGRESS

In equipment which must be flown, why load on extra weight? Clifton's new Size 8 Synchros can take the place of larger units at very significant saving in bulk and weight. These new Size 8's are now in use in some of the latest and lightest avionic equipment. Samples are available from stock, quantities from the production line.

CLIFTON PRECISION PRODUCTS CO. INC.
CLIFTON HEIGHTS PENNSYLVANIA



RADAR PATTERN reflected on plotting surface guides placement of glass markers.

TECHNICIAN cleans beam-splitting mirror used to project image of glass markers onto large surveillance screen.

CLOSEUP shows heart of Sky Screen system.

New Optical System Speeds Radar Plotting

A new optical device, called Sky Screen, is expected to speed the display and identification of radar-detected aircraft for military and possibly civil air traffic control operations.

Sky Screen enables a single operator to handle several times as many aircraft as previously possible, according to Northrop Aircraft Co., whose Anaheim (Calif.) Division is now producing the device. It is based on initial work carried out by the University of Illinois' Control System Lab and prototype models developed by the Rome Air Development Center.

Aircraft radar "blips" which appear on a radar tube mounted atop the device, are optically transferred onto a 16-inch plotting surface. An operator then places a small rectangular glass-chip marker over each target, moving the marker as the radar blip moves. The glass markers contain an arrow to show direction of aircraft movement, and identifying numerals. Each side of the marker is painted with a different fluorescent color. The color of the marker side turned up indicates whether the aircraft is enemy or friendly.

An optical system then projects this plotting surface display onto a large screen, which shows aircraft position, heading and identification.

Previously, plotting systems required specially trained personnel to translate radar blip position into verbal directions, which were transmitted by interphone to other personnel who plotted it (in reverse) on a transparent surveillance screen.

Sky Screen is designed to be disassembled into five sections for airborne shipment. Total weight, including packing cases, is 1,140 lb.

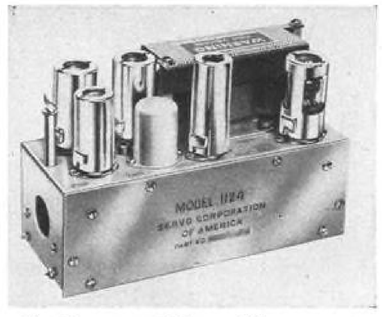
NEW AVIONIC PRODUCTS

Components & Devices

• **Heating elements,** cartridge type, maintain constant temperature of instruments and controls. Standard units are available rated 40 to 1,500 watts, with maximum surface temperature of 1,250F. Units are encased in stainless steel sheaths. Hotwatt Inc., 16 Gould St., Danvers, Mass.

• **Crystal filters** can now be designed in less time and at lower cost with newly developed technique, according to Hycon Eastern, Inc. Company says a wide range of characteristics are now available in quartz crystal filters, at any frequency from 10 kc. to 10 mc., with attenuation characteristics tailored to almost any desired specs, within the bandwidth limits of 0.01% to 14% of center frequency. New bulletin describes selectivity curves and other data on new filters. Address: 75 Cambridge Parkway, Cambridge 42, Mass.

• **Lightweight servo amplifiers** are available in two models, for either a.c. or d.c. input signals. Model 1123 accepts a 400-cps. phase reversible signal. Model 1123 accepts a single d.c. input, or takes the difference between two such inputs. A 400-cps. chopper converts the d.c. signal to a.c. Both models



will drive any 115-v., 400-cps. motor rated at 8 watts or less, and are designed for high-altitude operation. Bulletin TDS-1120-4 gives application data. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, L.I., N. Y.

• **60-cycle synchro torque transmitter-receiver,** Type 3J-4222, has pull-out torque of 1.7 oz.-in. minimum over a speed range of 0 to 1,600 rpm. at 25C, according to manufacturer. Electrical accuracy is ±1 deg., input voltage is 115 v., and the two units weigh 3 lb. John Oster Manuf. Co., Avionic Div., 1 Main St., Racine, Wis.

• **Deposited carbon resistors** with 100% factory inspection for resistance value

SHIMS

THE **LAMINUM®** SHIM

THE **LAMISOL®** SHIM

PACKAGED SHIM STOCK

LAMINUM® and LAMISOL® Shims are also made of ALUMINUM; layers are .003".

FLASH! *LAMINUM® now available in STAINLESS STEEL with layers of .002" or .003".*

SHIM HEADQUARTERS SINCE 1913

Check Our Stampings Division For Your Stamped Parts Requirements

SHIM

MAIL TODAY!

LAMINATED SHIM COMPANY, INC.
5101 UNION STREET, GARDENDALE, CONN.

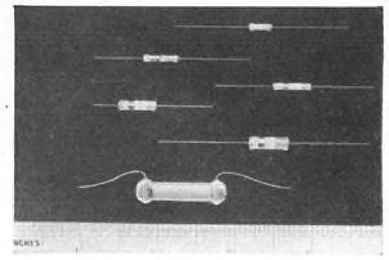
Please send me more information on:

☐ SHIMS ☐ STAMPINGS ☐ BOTH

☐ We'd like to discuss our problems with one of your Sales Engineers.

NAME

COMPANY



and noise are available in power ratings of 1/20 to 2 watts, in standard tolerances of 2, 5, and 10%. Electroseal Products, Inc., 22 East 40th St., New York 16, N. Y.

Power Supplies

• **Regulated high voltage,** Model PS-22, supplies 500-1,500 v. at 1 and 2½ ma., with less than a 0.01% change in output voltage from zero to full load, and with less than a 0.05% change for a 10% change in input voltage. Ripple is quoted at less than 0.003%. Scientific Specialties Corp., Snow & Union Sts., Boston 35 (Brighton), Mass.

• **Regulated 115 v. a.c.** is reportedly maintained within 0.25% for any combination of input voltage or load. Output voltage is adjustable between 110 and 120 v. Wave form distortion is quoted at 3% maximum, response time at 0.2 seconds, and maximum load is 1 kva. Regulator uses no tubes. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

• **Transistor circuit supply,** Model TR100A, has an output voltage range of 0-10 and 0-100, with a current range of 0-100 ma. Ripple is quoted at less than 2 mv., transient response at 0.1 millisecond, and regulation to 0.1 volt. Internally regulated power supply serves as reference for regulation. Input voltage is 115 v., at 50 to 500 cps. Universal Electronics Co., 1720 Twenty-second St., Santa Monica, Calif.

Flight Angle Computer

New flight angle computing system is capable of measuring angle-of-attack and/or angle-of-yaw with error as low as 0.1 degree over a range of ±20 degrees at speeds up to Mach 2.0. System employs no tubes or moving parts. Manufacturer is G. M. Giannini & Co., Inc., Airborne Systems Div., 918 E. Green St., Pasadena 1, Calif.

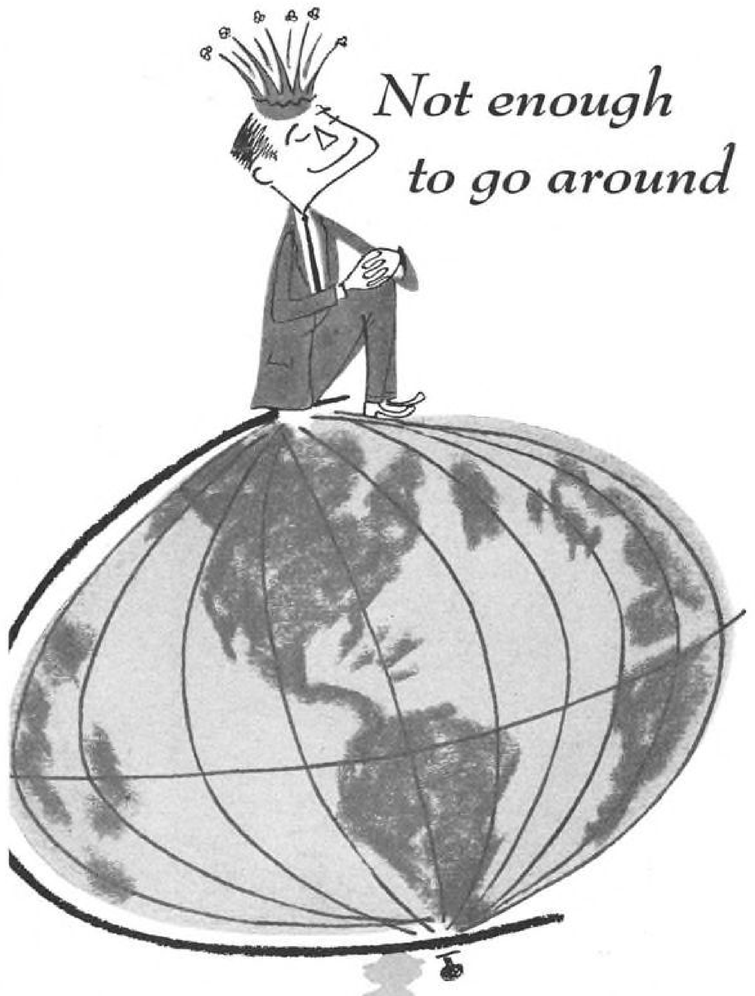
Computers & Data Processing

• **Low-cost analog computer,** priced at $6-8,000, can operate on "real" or "repetitive" time (50 times as fast) wherein monitoring can be held instantaneously at any point, then resumed without breaking sequence. Computer also employs simplified problem board which is factory-wired for a specific order of problem, greatly simplifying the computer set-up. Computer is built into desk-type console. Weber Aircraft Corp., Electronics Div., 2820 Ontario St., Burbank, Calif.

• **Low-cost digital computer,** Model LGP-30, is a general-purpose serial, one-address, fixed-binary point, stored-program, magnetic-drum machine. Computer offers 16 orders, 4,096-word magnetic drum storage, and a Flexowriter punched paper tape input-output system. Word length is 30 bits plus sign, clock frequency is 120 kc. and memory access time is 2 to 17 milliseconds. Addition time is 0.26 ms., and multiplication time is 17 ms., excluding access time. Librascope, Inc. 808 Western Ave., Glendale 1, Calif.

Laboratory Equipment

• **Low-cost microwave generator,** Model 10X, provides a CW energy source in the frequency range of 8.5 to 9.6 kmc. Power output is 10 mw., short-term deviation is one part in 10^7, and long-term deviation is one part in 10^6 relative to reference cavity. Device weighs only 15 lb. and is easily portable. Microwave Development Laboratories, Inc., 92 Broad St., Babson Park, Wellesley 57, Mass.



You have it. But it was not always that way.

Not so very long ago, an engineer struggled to obtain a degree. Yet afterwards you drove a truck. You just could not find a job that would let you utilize your hard-earned knowledge, much less start to build a career.

Times change, though. The pattern of events, focused around World War II, caused a shift in the balance. The demand for engineers began to exceed the supply . . . so much so that today there are not enough of you to go around.

We need engineers and skilled technicians. That hundreds of other companies do, too, is extremely well evidenced merely by thumbing through the pages of any trade journal. Why should you choose us above them? Perhaps you should not. Neither should you come to that decision without first becoming fully aware of our record . . . who we are, what we do, where our future lies. We would like to tell you about our company. We hope, too, that you will reciprocate and give us the opportunity to evaluate you. You can do this by writing to Mr. Richard Auten, Engineering Personnel.

ONE OF THE DIVISIONS OF
UNITED AIRCRAFT CORPORATION

SIKORSKY AIRCRAFT

BRIDGEPORT 1, CONNECTICUT

Now...a Ready-Reference Panel of Aircraft Switches and Accessories

The Cutler-Hammer Ready-Reference Panel of aircraft switches and accessories comes complete with all devices mounted in place. Proper identifications, both government drawing numbers and catalog numbers, appear below each device on both sides of the panel. Code for identification of constructions is shown at the bottom of the panel on both sides.

THERE are many times when men involved in aircraft circuitry want to see, operate or check one of a dozen things about a device shown in some drawings or being considered in plans. This new Cutler-Hammer Ready-Reference Panel puts all the answers right where they are wanted, in the engineering department, drafting room or laboratory, without delays or any possible confusion. Each device is identified by the Cutler-Hammer catalog number and the government drawing number.

Cutler-Hammer offers this ready-reference component panel as a further service to the aircraft industry, at a cost far less than the value of the devices mounted on the panel. The wasted time it saves is likely to more than pay for its cost the very first time it is used. Order Aircraft Switch Display No. 90-1895. All orders must be on company order forms. The price is $18.75 net, delivered; U. S. A. only. CUTLER-HAMMER, Inc., 1471 St. Paul Avenue, Milwaukee 1, Wis.

CUTLER-HAMMER
AIRCRAFT CONTROL
C-H

CUTLER-HAMMER COMPONENTS MOUNTED ON THIS REFERENCE PANEL:

1. **AN3021-1**—One-hole mounted toggle switch (SPDT) with panel seal and switch guard.
2. **AN3021-3**—One-hole mounted toggle switch (SPDT) with non-rotating lever and with panel seal.
3. **AN3027-7**—One-hole mounted toggle switch (DPDT) with panel seal—momentary contacts in two directions.
4. **MS25068-5**—One-hole mounted toggle switch 4 pole double throw with panel seal. Switch guard allows lever to be in center position or can be moved to the position at maximum distance from guard hinge.
5. **8857K1**—One-hole mounted toggle switch (SPDT) with lever lock and panel seal.
6. **8859K15**—One-hole mounted toggle switch 4 pole double throw with lever lock and momentary contact in one direction. With panel seal.
7. **AN3022-4B**—Flush mounting toggle switch (SPST) with three fluorescent tips.
8. **AN3023-2**—Flush mounting toggle switch (DPST) with two screw mounted switch guard.
9. **AN3226-3**—Flush mounted toggle switch 3 pole double throw without "off" position. Fluorescent attachable tip.
10. **AN3227-10**—Flush mounted toggle switch 4 pole single throw momentary contact with 2 screw mounting switch guard.
11. **MS25028-1**—Flush mounting toggle switch (SPDT) with lever lock.
12. **MS25029-3**—Flush mounting toggle switch (DPST) with lever lock.
13. **E-1441-5**—Flush mounting circuit breaker (SPST) 5 amp. Radioactive attachable tip.
14. **MS25002-1**—One-hole mounting rotary switch 8 position with "off" position. Adjustable stops.
15. **MS25128-1**—Flush mounting toggle switch single pole, 4 position, with momentary contact in two directions, maintained contact in one direction and center off. Switch guard attached.
16. **MS25039-1**—Flush mounting microphone switch single pole momentary "on."
17. **8912K47**—One-hole mounting rotary switch (DPST).
18. **AN3160-25**—Flush mounting circuit breaker (SPST) 25 amp. with 2 screw mounting switch guard. Guarded in "on" position.

Civilians to Leave Lake Charles AFB

Discontinuance of joint civil-military use of the Lake Charles AFB, La., has been recommended by the Airport Use Panel of the Air Coordinating Committee.

The change will be made as soon as adequate facilities become available to serve the needs of civil aviation. The present air base is eventually intended for exclusive use by the Air Force once a new civil airport is developed in the Calcaieu Parish.

Meanwhile, the Airport Panel has scheduled a public hearing for Jan. 25 on a proposal for joint civil-military use of the Myrtle Beach AFB, S. C. The hearing is to determine whether the needs of civil aviation will be adequately satisfied under the terms of an agreement between the City of Myrtle Beach and the Air Force providing for the civil use of Myrtle Beach AFB.

WHO'S WHERE

(*Continued from page 23*)

Frederick C. Gronemeyer and **James C. Cochran** have joined Atomics International, Division of North American Aviation, Inc.

Frank F. Davis, on the staff of corporate director, commercial sales, Lockheed Aircraft Corp., Burbank, Calif.; Erle M. Constable, corporate finance manager.

L. S. Preston, engineering manager, Los Angeles Division, Electronic Engineering Company of California; **Charles A. Atherton**, manufacturing manager and **Arthur R. Harman**, purchasing agent.

Omar C. Walley, chief project engineer, all engineering sections handling alternating current electric systems; **Robert G. Dobbin**, chief project engineer, all engineering sections developing direct current generators, actuators, engine starters, inverters and aircraft and commercial motors, Jack & Heintz, Inc., Cleveland, Ohio.

Frederick C. March, special projects sales engineer, Burndy Engineering Co., Inc., Norwalk, Conn.

Armand (Tony) Brunelle, Newark (N. J.) sales engineering office, Transitron Electronic Corp., Melrose, Mass.

W. V. Neisius, director, computing applications department, J. B. Rae Co., Santa Monica, Calif.

H. Koppenhafer, sales manager, Hydraulic Research & Manufacturing Co., Burbank, Calif., subsidiary of Bell Aircraft Corp.

Edwin P. Watkins, assistant sales manager, Wac Engineering Co., Dayton, Ohio, electronics firm. **Jess Marsh**, plant manager and **John Velesky**, chief engineer.

Axel T. Peterson, Canadian branch manager, Allen Electric & Equipment Co., Kalamazoo, Mich.; **Thurrell D. Lyle**, manager, Southwestern Sales Division, Kansas City, Mo.

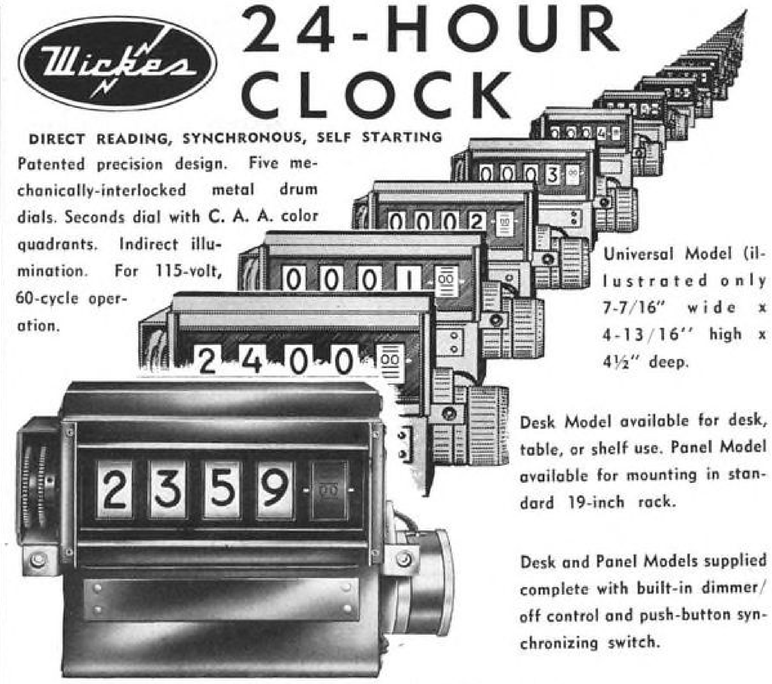
Prentiss Cleaves, aviation sales manager, Lemert Engineering Co., Inc., Plymouth, Ind.

Wicks

24-HOUR CLOCK

DIRECT READING, SYNCHRONOUS, SELF STARTING

Patented precision design. Five mechanically-interlocked metal drum dials. Seconds dial with C. A. A. color quadrants. Indirect illumination. For 115-volt, 60-cycle operation.



Universal Model (illustrated only 7-7/16" wide x 4-13/16" high x 4½" deep.

Desk Model available for desk, table, or shelf use. Panel Model available for mounting in standard 19-inch rack.

Desk and Panel Models supplied complete with built-in dimmer/off control and push-button synchronizing switch.

Write for Descriptive Literature

Wicks ENGINEERING AND CONSTRUCTION COMPANY
ESTABLISHED 1920
12TH STREET AND FERRY AVENUE — CAMDEN 4, NEW JERSEY

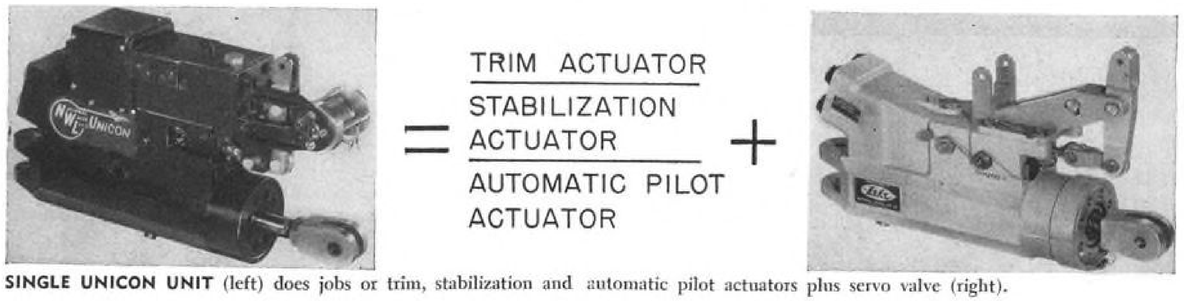
CONVAIR SPECIFIES NEMS-CLARKE ALL-PURPOSE RECEIVERS

NEMS-CLARKE Special Purpose Receivers are designed for optimum performance in telemetering, guided-missile monitoring and radiosonde reception and many other applications calling for superior performance. These Receivers are now in use by most of the leading aircraft companies.

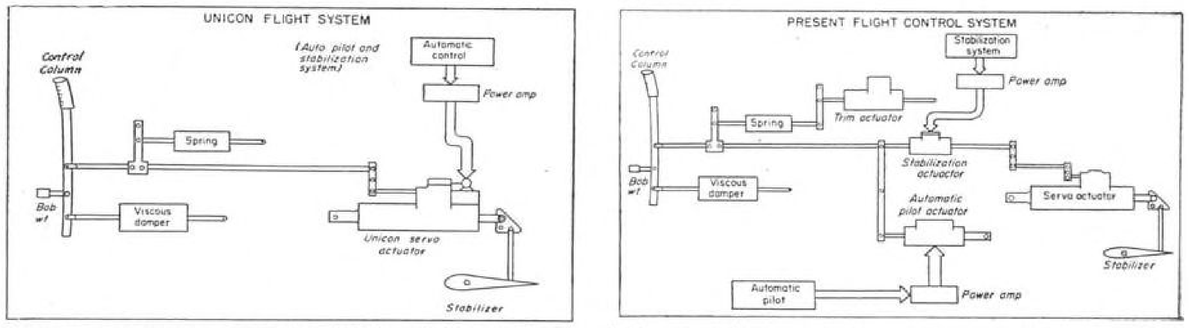
Above photo shows portion of telemeter ground station test unit of Convair's Guided Missile Plant in Pomona, Cal., using the NEMS-CLARKE Receiver.

For further details Write Dept. B-2

NEMS-CLARKE Incorporated
PRECISION ELECTRONIC INSTRUMENTS
SILVER SPRING, MARYLAND



SINGLE UNICON UNIT (left) does jobs or trim, stabilization and automatic pilot actuators plus servo valve (right).



SCHEMATICS SHOW SIMPLICITY of Unicon flight control system (left), compared to present-type control systems (right).

Unitized Actuators Simplify Systems

By George L. Christian

Kalamazoo, Mich. — Unitized hydraulic flight control system actuators—single units which do several jobs—may help reverse the trend towards increasing control system complexity. Typical of this new approach is a whole family of such combined actuators, called Unicons, developed by National Water Lift Co.

In a typical installation, one Unicon combines the functions of trim, stabilization, autopilot and servo actuators. Stabilization and autopilot inputs feed through a power amplifier into the Unicon servo actuator, as do control forces from the pilot's stick. Output from the Unicon actuates a flight control surface.

Combining the four servo actuators into one results not only in greater simplicity, but in a considerable weight and space saving for hydraulic lines, fittings, linkages, support brackets and miscellaneous equipment.

Unicon for New Aircraft

The Unicon concept appears to be one answer to the complaint voiced recently by J. E. Sullivan, director of the Bureau of Aeronautics' Airborne Equipment division: "If we had a long-range research program . . . in flight control systems, we would not be in the chaotic condition we now find ourselves, wherein we add bob weight to bob weight, very critical hydraulic servos to servos, bell cranks to bell cranks, etc., with the result that we now have to operate and maintain very complex control systems in practically all of our modern, high-performance aircraft."

A National Water Lift official said that Unicon is being proposed for these new fixed- and rotary-wing aircraft: McDonnel F4H and F-101B, Grumman F11F-1, Republic F-103 and Piasecki's HUP-4 and YH-16.

Misadjustment and Backlash

National's Unicon actuators offer another benefit. They incorporate a single-valve servo which meters both the normal and emergency system fluid. This eliminates misadjustment and backlash, two major problems associated with mechanical linkages.

• **Misadjustment.** Prior to its single-valve servo, normal and emergency hydraulic units consisted of two mechanically linked valves, National points out. It was essential, but difficult, to keep the valves in phase. If a slight misadjustment crept into the linkage, one valve might work against the other. The resultant pressures, coupled with control surface aerodynamic feedback loads, could build system pressure surges up to 11,000-12,000 psi. This is high enough to destroy the actuator and possibly cause loss of the aircraft.

• **Backlash.** An engineer closely associated with one of today's production supersonic fighters told AVIATION WEEK that his company was having trouble with the mechanical input linkage in the directional control trim and damping surface, because of "slop" (backlash) and resultant lag in response. "Any bearing 'slop' is too much 'slop' for that airplane," he said.

He added that in limited instances backlash could be avoided by pre-loading the linkage. But this "fix" is not a positive cure, he said. For instance, if linkage load exceeds pre-load, in effect there is no pre-load.

Three Types

Unicon incorporates a primary and secondary channel. The primary is controlled by the pilot through mechanical linkage. The secondary, or servo channel, operates the primary system differentially, or in parallel, since secondary channel inputs are superimposed on the primary system.

The secondary channel usually consists of a torque motor, solenoid valve, a servo valve and servo piston and an electrical potentiometer-type feedback signal.

National currently has three basic types of Unicon actuators available:

• **Type I** integrates flight stabilization and manual control.

• **Type II** integrates automatic and manual control.

• **Type III** integrates both flight stabilization and automatic control with manual control.

Unicons may be actuated by mechanical displacement signals initiated by the pilot, by an electrical signal initiated by an automatic system, or by both types of signal simultaneously.

Fail Safe

In case of electrical failure, it is possible to revert to manual hydraulic power control in all of the Unicon designs.

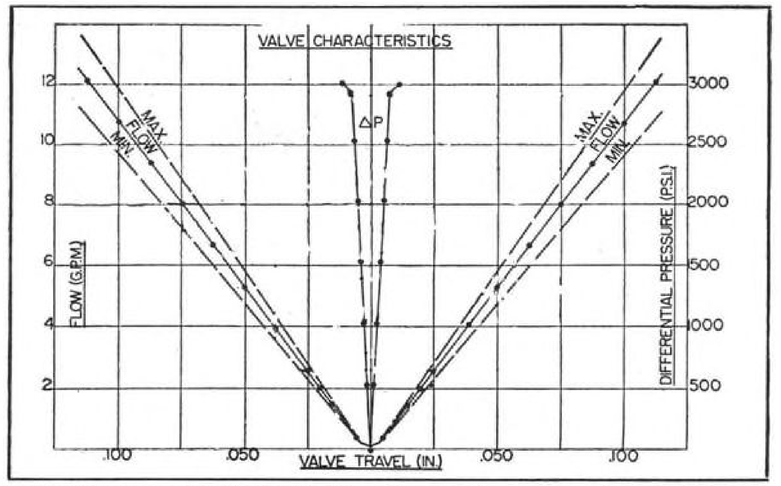
If the hydraulic system, which powers the secondary servo, fails, the secondary channel piston is centered and locked in neutral position. The pilot may actuate the primary valve for single-system operation, because a valve in the inoperative hydraulic system opens, allowing the fluid to be bypassed from one side of the piston to the other. This offers little resistance to the operating system.

Unicon units can also be designed as dual units so that automatic control is preserved in case one hydraulic system fails.

"With the availability of Unicon, present manual control systems may be made semi-automatic by using a computer to determine signals necessary to the feel, ratio changer and power control sub-systems," the firm says.

"Many sensing elements of the manual control system are similar to those used by an automatic pilot. Therefore, integration techniques may be used to 'marry' the manual and autopilot systems. It is believed that this type of system would result in instrumentation savings and further simplify present flight control systems."

Clifford E. Willis, vice president and general manager, says his company has refined the design and production of hydraulic valve components to the point where negligible friction between moving and stationary parts exists, eliminating the need for "dither" (a high frequency, oscillatory force of minute amplitude applied to a valve plunger to keep it from "sticking" to a cylinder wall). Need for very high rate of response makes it mandatory that the valve move the instant a force is applied to it.



LINEARITY AND SIMILARITY of NWL-made valve's flow curve are shown in this graph.

Elimination of dither greatly simplifies control circuit design and does away with need for dither-exciting equipment.

Also, valves built to the precision standards set by National have almost complete flow linearity which is essential to correct valve operation (see graph above).

To manufacture such exact parts in production qualities poses problems. Minute bleed holes, as small as .002 in., have to be located and drilled with great precision. Slots as thin as .0055 in. have to be cut with dead sharp corners; a ten-millionth radius on a metering land can change fluid flow pattern. Valves must maintain an exact hydraulic balance to avoid instability which might cause control surface flutter and destroy the aircraft.

Norman C. Bryan, sales and contracts manager, pointed out that a ¼ lb. force exerted on a valve plunger could result in output forces of tens of thousands of pounds.

Positioner and Synchronizer

Among other aircraft components produced by National is a hydraulic positioner and synchronizer for wing flaps on the Cessna T-37 twin-jet trainer. It can also be used on other planes, to position and synchronize the movement of two or more remotely controlled components such as wing flaps, dive brakes or afterburner eyelids.

The unit consists of a four-way hydraulic valve which senses an input signal coming from the flap control in the cockpit. The input link meters oil to a synchronizing valve which controls oil flow to the actuating cylinders.

A mechanical feedback, such as a pair of Teleflex cables, links each actuating cylinder to a differential, mechanical sensing device and positions the metering valve to speed up the lagging component and retard the advancing component. One of the cables also erases the input signal when component has reached its selected position. If hydraulic system failure occurs, flaps remain synchronized, but they may retract.

Bryan claims the device can synchronize very closely movement of units being actuated, yet simpler than most comparable units. An installation feature is that Teleflex cable can be readily run around buried jet engine installations (such as on the T-37 or B-57) where there is no room for relatively bulky push rods and bell cranks.

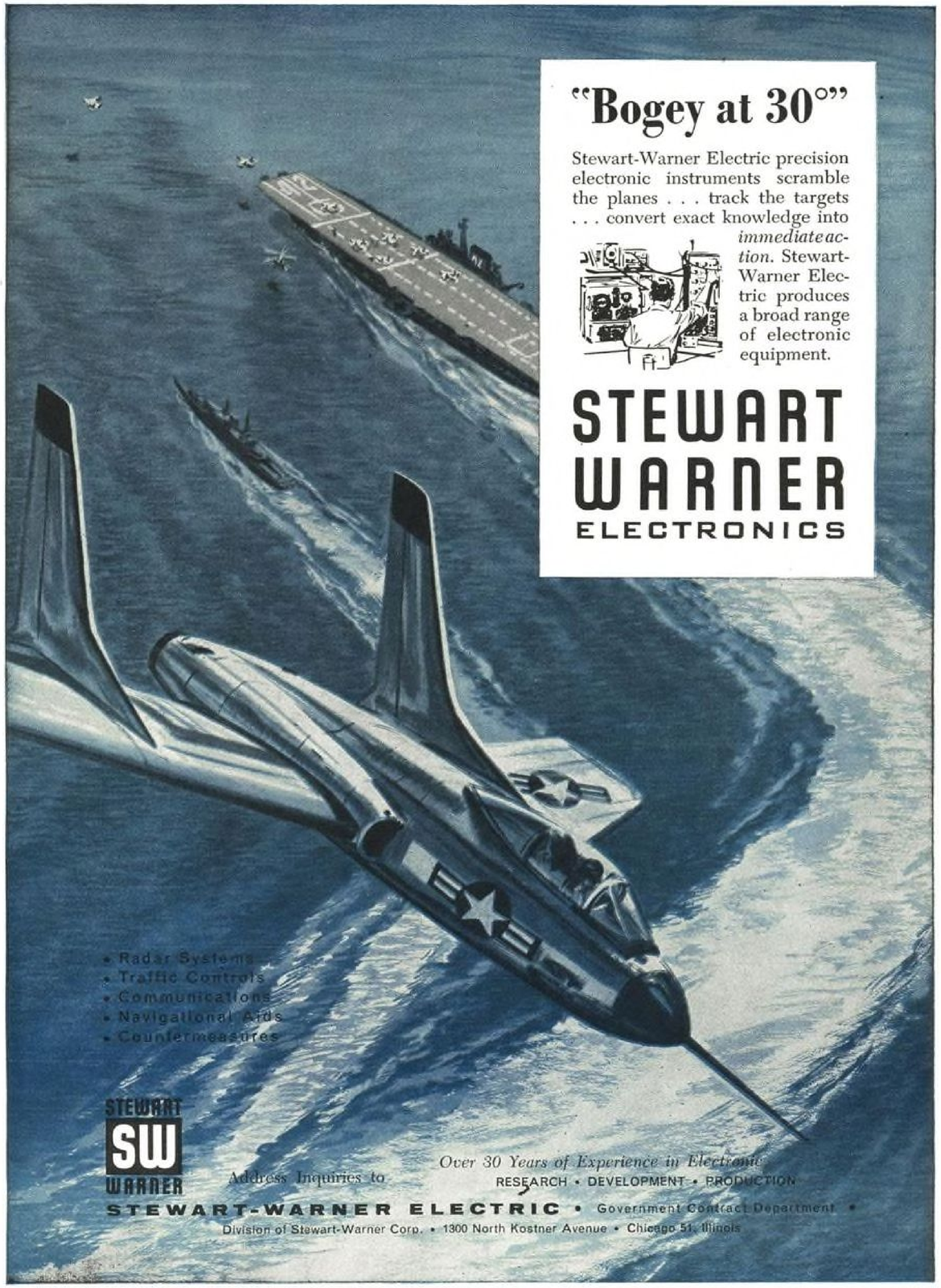
To keep pace with the increasing intrusion of aircraft into the high-tem-

Unitized Control Systems

Two aircraft control system manufacturers, in addition to National Water Lift Co., are known to be working on unitized control developments:

• Weston Hydraulics, Ltd. "We have been developing unitized flight control systems for approximately a year. First prototype units are now being tested and several other proposals for new aircraft are now being designed or evaluated by customers."

• Minneapolis-Honeywell Regulator Co. This company is developing a power valve for Canada's supersonic CF-105 fighter. If required, Minneapolis-Honeywell is ready to couple this power valve with autopilot transfer and servo valves (which it makes for such planes as the F-100 Super Sabre), stepping into the unitized control system field.



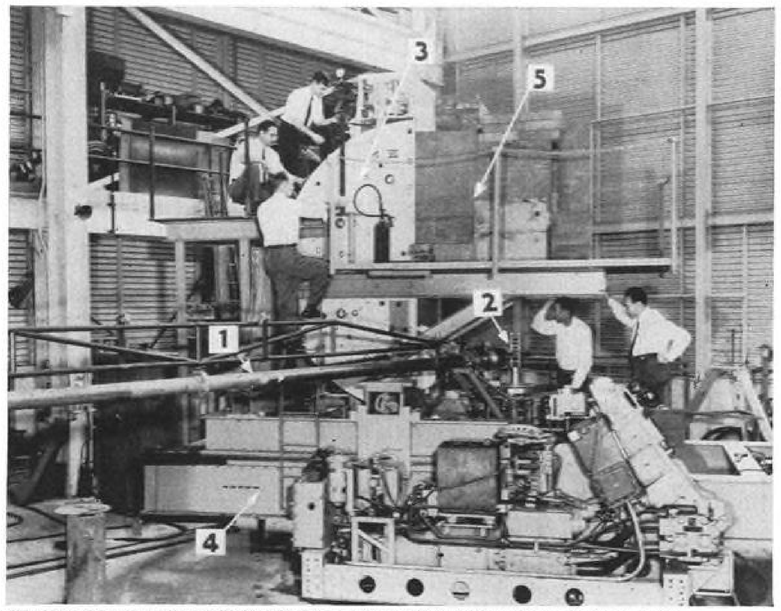
perature region, National engineers are developing new actuators which will operate at 500F and above. To avoid high-temperature seal problems, the actuators use no seals, having lapped mating parts instead.

Other aircraft equipment of a less precise nature made by NWL includes a series of pumps used for circulating cooling fluid for B-52 radar; scavenging oil for J47 turbojets, and water injection for T56 turboprops.

The company is branching into the missile field by starting production of electro-hydraulic actuating valves for the Hughes Falcon and unidentified units for the Martin Matador.

National Water Lift, originally manufacturers of the "Kalamazoo Line" of domestic water pumps, is now completely engaged in the business of designing and manufacturing precision aircraft controls.

The company's volume was $4.5-million in 1955; officials expect this to jump to $6.5-million in 1956.



STANFORD UNIVERSITY 'MICROSCOPE' employs high-voltage electron beam.

Atomic Nucleus Yields Secrets To New Research 'Microscope'

The world's largest nuclear "microscope," jointly sponsored by ARDC's Office of Scientific Research, the Atomic Energy Commission and the Navy, is currently extending knowledge of nuclear structure. The "microscope," a Stanford University project, is giving new data on the size of protons, the smallest known bits of matter inside atomic nuclei.

Unlike the graphic picture from optical or electron microscopes, results are obtained by statistical analysis of "unseeable" phenomena with dimensions of the order of $4x10^{-15}$ in. A 220-ft. linear accelerator, not shown in the picture above, sends a 550-million-electron-volt stream of electrons down the beam pipe (1), at the specimen-target (2).

Most electrons in the beam pass through the target and into the room, which is both shielded and empty of personnel. Those electrons which hit nuclei, however, are scattered by the strong electric fields in a fashion crudely analogous to billiard balls. The 55-ton spectrometer (3), which has been OSR's share of the project hardware, can be angled around on its gun-mount carriage (4) to "scoop" up the scattered electrons. The spectrometer's magnetic field curves some of these electrons up to the crystal counter located behind the lead shielding (5). Here sensitive photo-multipliers count the scintillations each time the crystal is struck by an electron.

From analysis of count distribution versus gun-mount angles, researchers are able to work back to a "picture" of the nucleus. One of the first results of the study is verification of the theory that the skin density of atomic nuclei tapers off toward its outer surface.

The study will cost OSR $68,000 in Fiscal 1955 and $95,000 in 1956.

BLONDE, BRUNETTE, OR REDHEAD?

A TOUGH CHOICE FOR ANY DESIGNER —

but the answers to the problems of design compatability between the fastener and the material to be fastened are

hi-shear® RIVETS!

because of the wide choice of materials available for rivet pin and collar combinations.

STRENGTH
45,000 psi shear (75ST) to 125,000 psi shear (431 Stainless Steel) for minimum size and quality.

WEIGHT SAVING
75ST Aluminum Alloy and stainless steels for best weight ratio.

HEAT RESISTANCE
350°F (75ST) to 2200°F (cobalt alloys) for resistance to scale.

CORROSION RESISTANCE
Stainless steels and cobalt alloys to withstand electrolytic reactions.

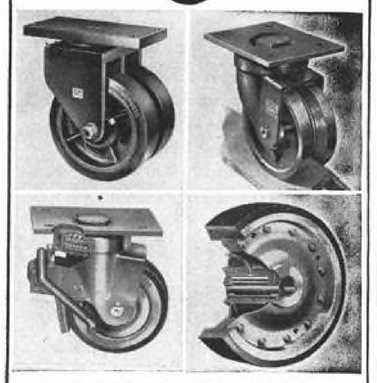
NON-MAGNETIC
75ST and 302 stainless for instrument areas.

Write for the hi-shear® Standards Manual for complete material specifications.

U.S. and foreign patents—Trademark registered.

hi-shear RIVET TOOL COMPANY
8924 BELLANCA AVE., LOS ANGELES 45, CALIFORNIA

Are you looking
for any of these
CASTERS & WHEELS
?



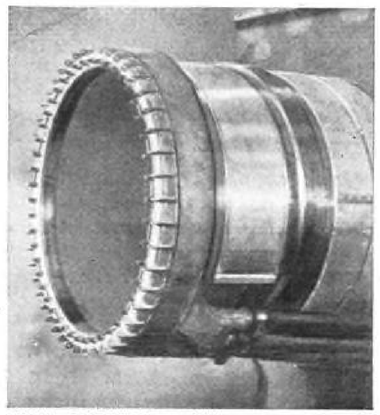
DARNELL
Serving the
AVIATION INDUSTRY
with
OVER 4000 TYPES OF CASTERS & WHEELS FOR EVERY USE!

All types of rubber treads—soft, medium and hard—for smooth operation on all kinds of floors. Featuring Neoprene rubber treads - resistant to oxidation, oils and waxes as well as being unaffected by most chemicals - expertly compounded to Darnell standards.

All casters, whether steel or rubber tread, available in swivel and stationary models with various top plates, stems and fittings for any type application.

Send for Free
DARNELL MANUAL
It's NEW!

DARNELL CORPORATION, LTD.
DOWNEY (LOS ANGELES COUNTY) CALIFORNIA
60 WALKER STREET, NEW YORK 13, NEW YORK
36 NORTH CLINTON STREET, CHICAGO 6, ILLINOIS



NEW SNECMA variable-area nozzle for precise control of turbojet engines.

New Snecma Nozzle For Turbojet Control

A new variable-area nozzle for precise control of turbojets under all conditions of flight speed and altitude has been developed by the French engine firm on Snecma and is at present in squadron service on Snecma Atar 101D turbojets.

First planes equipped with the nozzle for flight control are Dassault Mystere 2s with a fighter squadron based at Creil.

Basis of the nozzle—not to be confused with the simpler area control used with afterburner engines—is pneumatic rather than mechanical restriction of the main exhaust jet. Auxiliary air under pressure is injected at right angles to the main jet and forms a local restriction that acts as a nozzle throat.

The concept of variable area control by pneumatic means grew out of fluid flow control work that earlier produced the Snecma thrust reverser.

Snecma stresses the point that the injected air produces a dynamic action on the exhaust, and that it is not simply a matter of cold-air dilution of the jet.

Air supply for the device comes from the downstream end of the compressor, at the collector just ahead of the combustion chambers. The high-pressure air is piped through three parallel lines to a second collector built at the extreme end of the engine tailpipe. A row of slots in that collector feed the air at right angles to the main jet stream.

Three butterfly valves at the outlet of the combustion-chamber collector control the air supply. The valves are actuated hydraulically in response to signals from the engine control unit.

A ring of lugs has been incorporated on the tailpipe collector unit so that the Snecma thrust reverser can be fitted rapidly.

Earlier experimental work by the engine firm produced a clamshell area controller as a replacement for the sliding bullet plug inherited from the wartime German BMW 003 engine which was the design predecessor of the Atar series.

Surface Coating Cuts Boundary Layer Drag

A reduction in boundary layer drag through use of a special surface coating is indicated by recent laboratory tests made at Coleman Engineering Co., Los Angeles.

The tests were conducted by Coleman's technical director, Dr. Max O. Kramer, who predicts a substantial reduction in drag in hydrodynamic applications.

First application of the drag reduction method will be in the water, but Kramer says it will apply equally well in the air, making it possible to fly farther on less fuel.

While patent applications are pending, results of the tests have been disclosed on a voluntary basis by Coleman to the Navy and the United States Air Force.

Kramer, an aerodynamicist, was engaged in guided missile work in Germany, later worked at the Navy's Air Development Center, Johnsville, Pa. Now an American citizen, he joined Coleman's staff in 1952.

Lockheed Sponsors Graduate Fellowships

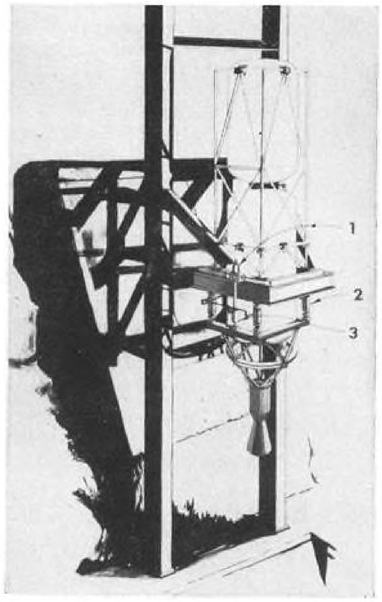
Lockheed Aircraft Corp. has established three graduate fellowships, paying up to $2,500 each, as part of its Leadership Fund program. The fund is already sponsoring scholarships for 58 undergraduate students.

Selection of the graduate fellows rests with the three schools chosen by Lockheed: California Institute of Technology (structures), Princeton (theoretical physics) and Massachusetts Institute of Technology (aerodynamics). Princeton and MIT have already chosen their fellows; the CIT award is yet to be made.

The undergraduate program, which has been operating for two years, sponsors scholarships in engineering at Stanford, Purdue, Cornell, Georgia Tech, University of Michigan, Rensselaer, North Carolina State, Carnegie, CIT and MIT.

Non-technical scholarships leading to careers in business and industry are awarded at Harvard, Emory, Pomona, Northwestern and the University of Southern California.

Twenty of the scholarship winners worked at Lockheed during the summer vacation.



Strain Gage Cells Measure High Thrust

Thrust measurement by means of strain gage cells has replaced the use of proving rings at the Army Ordnance Corp.'s White Sands Proving Ground, N.M.

Calibration time for the thrust system has been shortened to a few minutes and accuracy of thrust measurement has been checked out to within 0.1% of actual load.

In one system, four SR-4 load cells, made by Baldwin-Lima-Hamilton Corp., are mounted at the corners of the thrust mount, with two precision SR-4 load cells on opposite sides of the frame. The precision cells are used for calibration of the system, and the other four cells for actual test measurements. They can take both tension and compression loads, and therefore can serve as structural supports for the rocket motor under test.

Thrust to 200,000 lb. can be measured with the units.

System Measures Plane Weight, Thrust

A combined thrust measurement and weighing system for jet aircraft is to be designed and built for the USAF by Bristol Engineering Corp., Bristol, Pa., at Edwards AFB, Calif. The company believes this will be the largest installation of its type in the world.

Four large platforms will handle the aircraft being tested. An underground, air-conditioned test house with periscopic observation of the test stand will be the control center for the tests.

The test stand is to be mounted flush with the hangar apron so that a plane can be towed directly onto the stand and secured with minimum effort.

Northrop Plans New Engineering Center

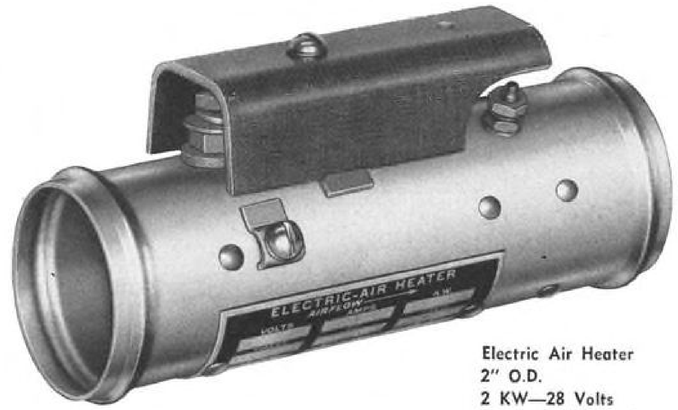
Hawthorne, Calif.—Northrop Aircraft, Inc. soon will begin an $8-million facilities program to construct a new scientific and engineering research center, engineering test laboratory and low-speed wind tunnel.

It also will supervise construction for the USAF of a new guided missile engine test facility and an environmental and electrical test laboratory to be used by the company under Air Force contracts. Target date for completion of these facilities is late 1956.

Core of the development program will be a new 250,000-sq. ft. engineering center valued at $5,335,000. The firm of Pereira & Luckman also is completing a long-term master plan to make the company's physical installation the most efficient in the airframe industry, Whitley C. Collins, Northrop's president, says.

Some of the projects the company ex-

Cole Electric Co.
8439 STELLER DRIVE • CULVER CITY, CALIFORNIA • TEXAS 0-4701



Electric Air Heater
2" O.D.
2 KW—28 Volts
Air Flow, 6 lbs. min.
Thermostat Controlled
Fusible Link

DESIGNING, ENGINEERING AND PRODUCTION FOR THE AIRCRAFT INDUSTRY

- Switches
- Heaters
- Intervalometers
- Frequency Relays
- Power Relays
- Transformers
- Rectifiers
- Rocket Releases
- Rocket Indicator Switches
- Bomb Racks
- Air Circuit Breakers
- Oil Circuit Breakers
- Switch Housings
- Throttle Switches
- Limit Switches
- Switchboards

. . . and many other products. Specialists in mass spectrometer hermetic sealing. Write us regarding your requirements.

AV-1 Electromagnetic Shut-off Valve Normally Closed

AV-2 Electromagnetic Shut-off Valve Normally Open

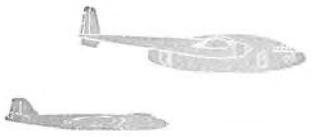
AV-16 Gate Valve Manual or Motor-driven Designs

For shut-off applications

They Qualify

when the standard's high

GENERAL CONTROLS HI-G SOLENOID and GATE VALVES



...two flight veterans available in many variations to meet your exact needs

General Controls hi-g® SHUT-OFF VALVES

Compactness, lightweight, reliability...for these reasons commercial and military authorities alike have qualified General Controls' shut-off valves for flight duty on today's most famous aircraft. Just as important in new plane design is the ability of General Controls to adapt and produce these basic, flight-proved valves in many variations to meet the exact demands of your specifications. When you think of control systems for pressurized liquids and gases—think first of *General Controls*—and you won't have to give the problem a second thought. Write for Catalog 53A—today!

50 YEARS 1905 1955 GOLDEN JUBILEE YEAR G C

GENERAL CONTROLS

MANUFACTURERS OF AUTOMATIC CONTROLS FOR HOME, INDUSTRY AND THE MILITARY

GENERAL CONTROLS • PERFEX CONTROLS

40 FACTORY BRANCH OFFICES SERVING THE UNITED STATES AND CANADA

FIVE PLANTS: IRON MOUNTAIN, MICHIGAN • GLENDALE, CALIFORNIA • BURBANK, CALIFORNIA • SKOKIE, ILLINOIS • GUELPH, CANADA

pects to undertake in the new facility include further exploration of the "thermal barrier" and of the new types of guided missiles.

The science center—a two-story building with a six-story tower—will house Northrop's aeronautical engineering and scientific personnel working in electronics, optics, guidance systems for unmanned aircraft and other precision equipment. It will be steel, concrete, aluminum and glass, designed for economical future expansion.

The new wind tunnel will operate at higher speeds with a lower turbulence level than the company's present tunnel and will incorporate a new and improved balance system.

OFF THE LINE

Kelvin Hughes periscopic sextants will be installed on the five Central African Airways Vickers 748 Viscounts to be delivered in early 1956. CAA is one of the first airlines to order the sextant with the new bubble assembly, which is said to treble the instrument's overhaul life. Other purchasers: El Al Israel Airlines will use the instrument in its three Bristol Britannias scheduled for mid-1957 delivery and its South African Airways on its DC-6 Bs.

Overhaul life of de Havilland propellers installed on British European Airways' Ambassadors has been increased to 1,500 hr. from 1,250 hr. by the Air Registration Board. Initial overhaul time was 400 hr.

MC-1 mobile ground support trailer being built for the Convair F-102-A interceptor by Bogue Electric Manufacturing Co. provides a variety of electrical services. A synchronous motor drives dual generators to supply 37.5-kva., 150/200-v., three-phase 400-cycle a. c. power and 500-amp., 28-v. d. c. current. The MC-1 will be used to start and test F-102. Bogue says it has supplied 38 similar units to Lockheed for use with RC-121-C and -D picket planes.

New method of testing the color of aviation gasoline determines easily and accurately if the fuel's color falls within specification limits. Developed by Ethyl Corp. and approved by BuAer, the method uses permanent glass standards which show the maximum and minimum color intensities of the standard red, blue, green, brown and purple used in aviation gasoline. Samples of the fuel are compared with the glass standards. Hellige, Inc., Garden City, N. Y., worked with Ethyl in developing the technique.

JET PROPULSION LABORATORY

OF THE

CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, California

jpl

STRESS ENGINEERS

Responsibilities include solving particular dynamics problems arising in the design of missile shipping containers and investigations into the best methods of protecting a missile from the shock and vibration environments encountered during shipment and handling. The problems are sufficiently complex that men with advanced degrees and applicable experience will find them challenging.

MECHANICAL ENGINEERS

To participate in a program for the design of highly mobile missile launching and handling equipment. Size and weight limitations on the equipment are such that advanced design techniques are required.

Airmail your summary of qualifications to:

CALTECH | JET PROPULSION LABORATORY

4800 Oak Grove Drive, Pasadena, California

One of the complete galleys in Skyline's regular production.

SKYLINE

PRECISION SHEET METAL & MACHINE PARTS
COMPLETE ENGINEERING SERVICE
A.F. CERTIFIED SPOT WELDING & OTHER WELDING PHASES
ELECTRONIC PARTS AND EQUIPMENT
AIRCRAFT FABRIC COVERING
GALLEYS AND COMMISSARY EQUIPMENT
GROUND SERVICING EQUIPMENT

SKYLINE PRODUCTS INC.

GRAND BOULEVARD, DEER PARK, NEW YORK

Now!...the NEW ROBINSON WIRE TWISTER with DIAGONAL GRIP-HEAD

Faster, more efficient than ever! The new, slendernose DIAGONAL GRIP-HEAD is designed especially for those narrow- hard-to-reach places. Split-second whirling action safety-wires 3 engines in time required for one by any other method . . . saves as much as $140 per engine assembled.

3-TOOLS-IN-1 . . . pliers-cutters-twisters. Side-cutting, oil-tempered head. Permanent bronze bearing. No adjustments. Jaws lock on wire, can't slip off. Perfect, uniform twist every time.

12" —for assembly line safety wiring, 15 oz. $21.50

9" —for bench work, sub-assemblies, 12 oz. $20.50

Unconditional Money-Back Guarantee. Send for complete details.

RALPH C. ROBINSON CO.
Box 494W No. Sacramento 15, Calif.

Canadian Distributor, Gensales, Ltd., Malton, Ont.

AIRBORNE

Where they're made. This is an aerial view of the main Aero Division plant in Minneapolis. Over 15,000 square feet of its 12 acres of modern plant are devoted to gyro assembly alone. Over 5,000 people work on aeronautical controls. Hundreds of these work exclusively on gyros, making Honeywell a leading specialist in the gyro business.

GYROS

Why they're so dependable. Honeywell gyros are assembled in air conditioned, pressurized rooms guarded by a double air lock. To control lint and dust, workers are required to wear special caps and gowns. With test and production facilities unequalled in the business, Honeywell produces thousands of precision gyros a month.

How to find out all about them. Honeywell gyros are available to manufacturers who require precision performance. For details write on your business letterhead to Dept. 1000, at the address given below. Or, if you'd rather, pick up the telephone and call Sterling 1-8011 in Minneapolis.

by HONEYWELL

2600 Ridgway Road, Minneapolis 13, Minnesota

VERTICAL

Cageable Vertical Gyro, JG7044

Ideal as a vertical reference. For use in radar stabilizarion, fire control, bombing, navigation and flight control systems. Uncages in 3 seconds—cages in 10 seconds.

Vertical Gyro, GG33

A proven vertical reference gyro with unusual reliability and sensitivity. Presently being used on missiles, radar stabilization and navigation systems.

No single gyro can meet all applications. One of these should match your needs.

FLOATED

HIG-4 Gyro, GG14

Lightweight, extremely accurate floated gyro being used on the latest fire control systems. Most accurate and sensitive of the miniature gyros.

HIG-5 Gyro, GG1

Most popular of the fully floated integrating gyros. There are over 15,000 of these versatile, precision gyros in use.

HIG-6 Gyro, GG12

The world's most accurate production gyro. Yet a very small package that gives the extreme sensitivity and accuracy required for inertial stabilization.

RATE

Rate Gyro, JG7005

A general application rate gyro whose dependability and accuracy has been proven through many years of service in a multitude of different aircraft control systems.

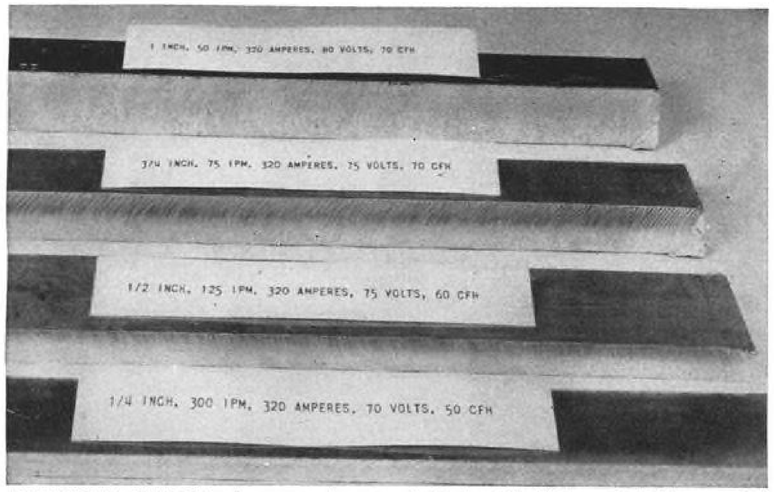
Rate Gyro, GG13

Gives the ultimate in performance for a non-floated, damped Rate Gyro. Extremely rugged and light in weight.

Miniature Rate Gyro, GG16

A viscous damped, spring restrained rate gyro giving the qualities of high precision, small size and ruggedness needed for missile and flight control applications.

MINNEAPOLIS
Honeywell
Aeronautical Division



ALUMINUM SAMPLES show smooth cuts obtained with high-speed Heliarc method.

Heliarc Cutting Process Speeds, Simplifies Aluminum Fabrication

A new process for cutting non-ferrous metals promises to substantially speed and simplify fabrication of aluminum in the aviation industry.

Linde Air Products Co., developer of the new Heliarc cutting technique, says the process will mean to non-ferrous cutting what oxygen-cutting means to steel. In addition to speed, the new process offers ease of application mechanically and manually, smooth cut surfaces, high efficiency and easy adaptibility to position and contour. It reduces cutting and edge-preparation costs.

Jet-Action Arc

The company now plans to widen its investigation of Heliarc cutting to the field of metal fabrication in general, including cutting of ferrous metal.

A very high temperature, high velocity, constricted arc between a tungsten electrode and the work piece does the cutting. The concentrated, jet-like arc melts and ejects a thin stream of metal. The jet action removes the metal mechanically, while the gas atmosphere prevents oxidation of the cut face.

Non-ferrous metals cannot be cut easily, despite the fact that they are relatively soft, Linde points out. Until now, saws and planers have been used, although they are generally limited to straight-line cuts and are fairly expensive. Where irregular or curved shapes had to be cut, bandsaws, drilling or hand-chipping have been used.

Heliarc cutting, however, can produce straight lines, bevels, circles and shapes. It does this in a small fraction of the time required by previous methods. In a typical case, involving the fabrication of ⅝-in.-thick aluminum plate, the average cutting speed, using a combination of burning and chipping or drilling and chipping, is about 1 in./min.

In addition, the average machine-planning speed for edge preparation, including set-up time, is about 10 in./min. Mechanized Heliarc cutting speed for this thickness plate is about 100 in./min., and a smooth saw-quality cut is produced.

Speed and quality of manual Heliarc cuts depends on the operator's skill, but should average about 60 in./min. for ½-in. aluminum plate, Linde says.

For machine cutting, the best gas mixture appears to be 65% argon and 35% hydrogen. For manual cutting, 80% argon-20% hydrogen is recommended.

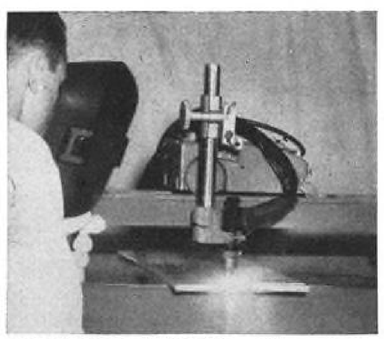
The lower hydrogen content for manual cutting provides a greater tolerance to variations in arc length.

Easy Conversion

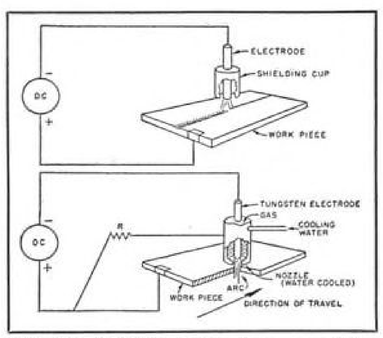
Existing Heliarc welding equipment is easily converted to cutting equipment. A new collet and collet body are installed on the welding torch, making the unit compact and placing the necessary water-cooling tubes for the nozzle inside the torch body. A new type of nozzle, with a replaceable hard-drawn copper O-ring insert, is also used.

An additional electric circuit, called the "pilot arc" circuit is used to initiate the cutting arc. This circuit incorporates a resistor to limit the current from the power supply to the nozzle. Open circuit voltage should be at least 80 v., and preferably 100 v.

For mechanized Heliarc cutting, a travel mechanism is required.



MECHANIZED HELIARC cutting rate for ¼-in. aluminum is 300 in./min.



SIMPLE CONVERSION changes welding (top) to cutting unit (below).

PRODUCTION BRIEFING

► **A $700,000 plant and facilities expansion** is being completed by H. W. Loud Machine Works, Inc., Pomona, Calif., maker of aircraft assemblies. The firm has added six Cincinnati automatic duplicating Hydrotels, giving it 16 of these machines.

► **Vacuum brazing,** reported by National Advisory Committee for Aeronautics as resulting in metal joints having shear strengths of 63,000 psi.—50% higher than joints processed in dry hydrogen—is being investigated by a number of U.S. firms. Pratt & Whit-

To see defense jobs through from scratch

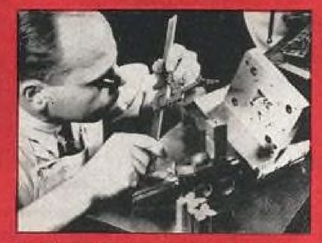
The abilities and facilities to take charge from inception to completion—from research through development, engineering and tooling, production, testing, field service and training—qualify Burroughs to assume the complete responsibility for fulfillment of complex defense assignments.

This coordination enables Burroughs to handle, from start to finish, the most important defense projects in the exacting fields of instrumentation, control systems, communications, electronic computation and data processing.

This coordination, too, underlines Burroughs' ability as a prime contractor for assignments of a highly classified nature. Inquiries welcomed. Burroughs Corporation, Detroit 32, Michigan.

1. RESEARCH

2. DEVELOPMENT


3. ENGINEERING & TOOLING

4. PRODUCTION

5. TESTING

6. FIELD SERVICE & TRAINING

Burroughs

BURROUGHS INTEGRATED DEFENSE FACILITIES INCLUDE:
Burroughs Corporation plants in Detroit and Plymouth, Michigan
Burroughs Electronic Instruments Division, Philadelphia, Pa.
Haydu Brothers of New Jersey, Plainfield, New Jersey
Control Instrument Company, Brooklyn, New York
Burroughs Research Center, Paoli, Pa.

Looking to future expansion, Burroughs invites inquiries from qualified engineers.

Today LeTourneau Builds the CORPORAL LOADER

Another Machine for America's Defense Powered By LeTourneau Electric Wheels

Supersonic speed and terrific striking power are only two of the big advantages built into the Corporal Guided Missile Weapons System.

Key factor in making this sleek new missile a successful tactical support weapon is *ground mobility* – the prime function of the *LeTourneau Corporal Loader.*

This powerful vehicle picks up the missile in rear storage areas, carries it "piggy-back" over highway or battlefield terrain to any forward area launching site, and erects it on the missile launcher for firing.

All these functions are handled with the same positive system of electric driving power and electric control that is now being utilized on other LeTourneau machines for America's defense, as well as for exploration, logging, land clearing, and other heavy industries. Corporal Loaders are now being delivered to troops.

The engineering and manufacturing facilities of R. G. LeTourneau, Inc., are ready now to help solve *your* problem. The Corporal Loader is substantial evidence that it *CAN* be done . . . with LeTourneau.

These photos show how Corporal Loader handles missile for delivery to launching site. This machine was designed and built in conjunction with Firestone Tire & Rubber Co., producers of the Corporal Guided Missile.

R. G. LE TOURNEAU INC

General Offices: 2601 S. MacArthur, Longview, Texas

Cable Address: BOBLETORNO

advanced technique

AVIONICS

guided missile instrumentation by AVION

Subminiature radar beacons of extreme ruggedness for
X–Band
C–Band
S–Band
Developed by AVION for the Signal Corps, these beacons feature selective receivers and pulse decoders to assure interrogation reliability.

Avion's flexibility and ingenuity, coupled with extensive experience in Electronics, Mechanics and Optics can better serve you.

Investigate the career opportunities in our expanding organization.

AVION DIVISION
ACF INDUSTRIES INCORPORATED
299 State Highway #17, Paramus, N. J.

ney Aircraft has been trying the process in making jet engine components, such as fuel manifolds. P&WA is using a new vacuum furnace developed by P. J. Stokes Machine Co., Inc., Philadelphia, Pa., in its investigation. Data on the process may be found in NACA Technical Note 3450, published May 1955.

► **New small jet-powered airplane** and reinforced plastic items for the aviation industry will be built by newly organized Florida Flight Engineering Corp., 4051 N. W. 26th St., Miami 42. Harold D. Coonley is president of the firm, which is composed mainly of ex-Eastern Air Lines personnel.

► **Added research, development** and qualification testing facilities for components have been occupied by California Testing Laboratories, Inc., 1724 Trinity St., Los Angeles.

► **Estimated saving of $2.8 million** was made in 1955 by Republic Aviation Corp., Farmingdale, N. Y., as a result of its conservation program for materials, machinery and methods.

► **Entire rolling mill** at Niles, Ohio, has been purchased by Mallory-Sharon Titanium Corp. as the first step in a company expansion program to double titanium production during 1956.

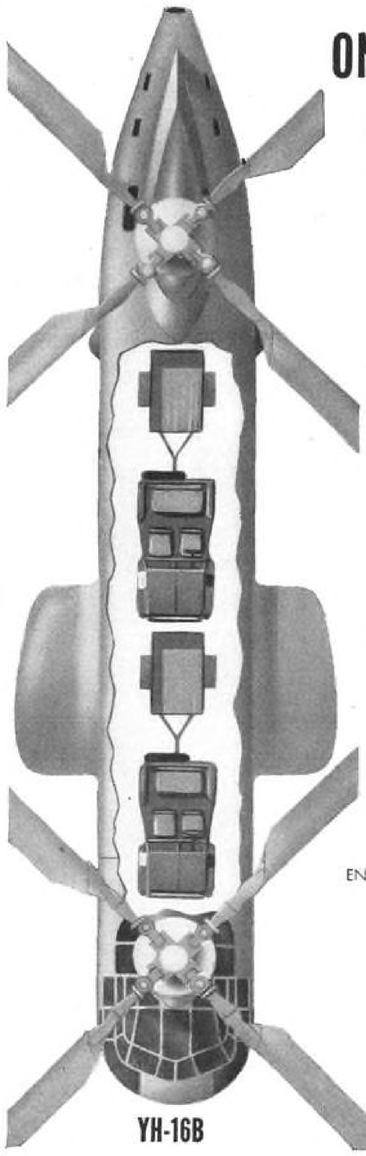
► **All phases of Teflon processing** are being handled by newly organized Balfor Industries, Inc., 1815 Webster Ave., New York 57, N. Y. The firm has a separate division to handle application of Teflon spray and dip coating. President is Donald E. Ballot.

► **New investment casting facilities** are being erected in Muskegon, Mich., by Misco Precision Casting Co., Whitehall, Mich., to meet increased demands by the aviation industry. The new plant will cover 85,000 sq. ft. and employ 1,200 people. Misco now employs 825 in two plants totaling 75,000 sq. ft.

► **Magnetic particle inspection** using water as a solvent is now being applied at General Electric Co.'s jet engine plant near Cincinnati. Advantages over conventional petroleum-based method: virtual elimination of a fire hazard, solvent used is not a skin irritant, equivalent sensitivity in detecting defects, and cost reduction of about $20,000 annually. GE engineers found that they could use water for the inspection method when a suitable rust inhibitor and wetting agent were added.

► **Sixth plant has been opened** in Burbank, Calif., by Century Engineers, Inc. New 11,000-sq.-ft. building houses the electro-mechanical branch. Firm now has a backlog of over $6 million in control devices.

Piasecki's YH-16A Turbo-Transporter



YH-16B

ONLY THE BEGINNING IN THE LOGISTICS REVOLUTION

The new Piasecki YH-16A is the world's largest turbine-powered transport helicopter, capable of the greatest ton-mile delivery in rotary wing aviation. Yet it is only the forerunner of the ultimate in military troop and cargo helicopters. It is an aeronautical fact-finder that is enabling Piasecki engineers to proceed to the final step—the YH-16B, a far more powerful turbine-powered helicopter with substantially greater capacity and speed. In addition to its internal troop and cargo carrying capability, the YH-16B can haul heavy tactical equipment externally as a *flying crane.*

These engineering steps are leading to a logistics revolution—these helicopters will deliver more men and more material—in force—to tight spots where and when they are needed. Another example of where Piasecki is picked for the *toughest jobs.*

ENGINEERS NEEDED FOR: DESIGN • AERODYNAMICS TESTING • STRESS ANALYSIS • AIRFRAMES

Send resume to John Tannone, Jr., Employment Representative

Piasecki
HELICOPTER CORP.
MORTON, PENNSYLVANIA

NEW AVIATION PRODUCTS

Actuator Motor Weighs 5 Lb.

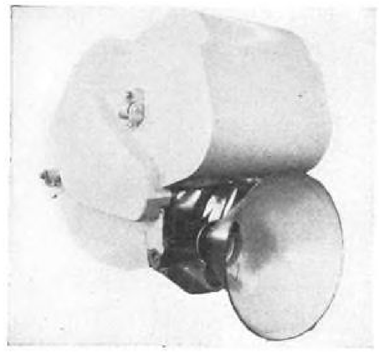
SESVA aircraft actuator motor weighs 5 lb. and has 22 in.-lb. starting torque. Totally enclosed and explosion-proof, the unit is designed to work under severe environmental conditions.

SESVA operates on three-phase 400-cycle 200-v. a.c. up to 50,000-ft. altitudes. It delivers 2.2 hp. intermittently at 8,400 rpm. Duty cycle is on for 15 sec., off for 3 min., on for 15 sec., off for 15 min., repeated continuously.

U. S. Electrical Motors, Inc., Aircraft Division, Box 2058, Terminal Annex, Los Angeles 54, Calif.

Probe-and-Drogue Refueler

Model A-16 probe-and-drogue air-to-air refueling unit is designed to work with high-speed jets and has a fueling capacity "several times" greater than current production model, the manufacturer says.

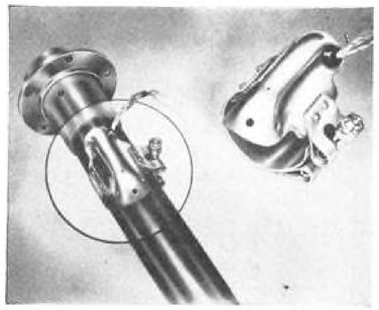


Unit has been completely ground tested and will undergo air trials soon. Qualification test reports have been submitted to Wright Air Development Center. Operation is basically similar to earlier A-12 model being mass-produced for USAF and Navy.

Flight Refueling, Inc., Friendship International Airport, Baltimore 3, Md.

Unit Measures Atomic Fallout

Trailer-mounted monitoring system for measuring airborne radioactivity or fallout is designed for industrial concerns or government agencies working with nuclear materials or with defense agencies. Model AM-5 can operate automatically for 10 days unattended, providing continuous record on filter paper tape of radioactivity in the area, plus complete weather data. Also available are mobile AM-2A and AM-3 mobile units. Prices: AM-5, $15,000; AM-2A, $3,950 and AM-3, $3,950. Manufacturer is Nuclear Measurement Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.



Fuel Level Unit Easy to Mount

Liquid level switch that can be used with any fuel gage to provide level control for tank switching, balancing and other fuel management functions, features a "piggyback" sensor that clamps on tank probes without altering existing equipment.

In addition to a thermistor-type sensor, the system has an external control unit employing a bridge circuit and sensitive relay to operate pumps, valves or warning lights. The unit can also be bracket-mounted to bulkheads, pump housings or other internal tank structure.

Level switch unit operates over a temperature range of −65F to 200F. Operating time is less than one second covering and less than three seconds uncovering. Power needs are 0.13 amp. from a 28-v. d.c. supply. Total system weight: 0.4 lb.

Avien, Inc., 58-15 Northern Boulevard, Woodside 77, N. Y.

Tone Signal Warns Pilot

Warning signal generates a raucous tone to be fed into the headset when an unsafe condition, such as retracted landing gear during landing, dangerous airspeed, fire conditions, etc., is present. It will also flash a panel light.

The unit, an electro-mechanical device, is designed to meet MIL-S-9320. It weighs 14.7 oz. and measures 5 x 2¼ x 1⅝ in. Input power is 17 watts at 28 v. d.c.

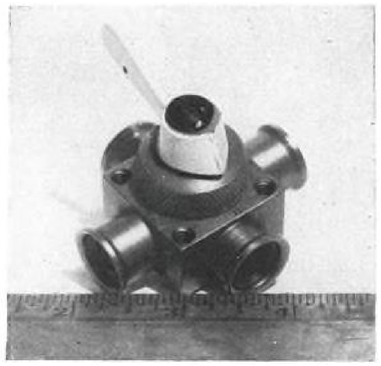
Seabroad Electric Co., 417-421 Canal St., New York 13, N. Y.

Miniaturized Selector Valve

Select-O-Mite, a new miniaturized, stainless steel selector valve for hydraulic or pneumatic applications, is now being produced at Wm. R. Whittaker Co., Ltd. The valve is manually operated.

Design is simple—basically a rotor in a valve body, with contacting surfaces lapped to a high finish. The valve holds hydraulic pressure leakage to less than a drop a minute at pressures from 0 to 3,000 psi. Pneumatic leakage is 1 cc./min. at 3,000 psi., rising to 140 cc. at 250 psi. Clearance between the plug and valve body is reduced as valve is pressurized, accounting for lower leakage at high pressures.

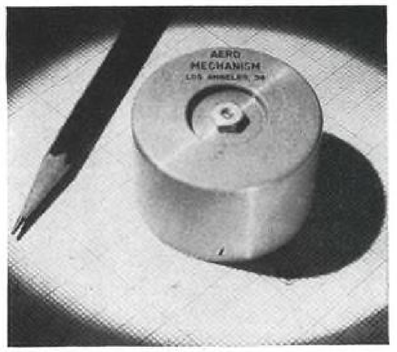
The value, which qualifies under specifications MIL-V-5529A, can be provided in more than 90 flow pattern configurations. Interflow characteristics,



type of fluid or gas, stops, detents and handle or shaft provisions can be varied. The only non-stainless steel parts are the four O-rings and two Teflon back-up rings.

Specifications: Operating pressure, 0-3,000 psi.; tube sizes, ¼, ⅜ and ½ in.; ports, AND 10050 or AND 10056.

Wm. R. Whittaker Co., Ltd., Los Angeles, Calif.



Miniature Pressure Switch

Miniature pressure switch actuates on very small changes in altitude and can be set to operate anywhere from 2,000 ft. to 50,000 ft., with accuracy of 2% of range setting, the manufacturer reports.

Rated at 10 amp. a.c. or d.c., the unit can be obtained as an absolute ambient, absolute or differential pressure switch with standard fittings.

Aero Mechanisms, Inc., Dept. AW-6, Los Angeles, Calif.

Oscillograph Recordings

Indicator for oscillograph recordings of pressures on aircraft engines, rocket motors and hydraulic systems features a quartz crystal transducer and a patented composite diaphragm. The diaphragm has a soft corrugated Inconel ring to seal off combustion gases, while pressure is resisted by tiny wedge-shaped steel pieces bridging the gap between housing and inner element.

This construction is capable of

detecting pressure variations in sound waves generated by a human voice, it is claimed.

The SLM gage used with the in-

For long life under extreme conditions of shock, vibration, corrosion, humidity and temperature

Bendix **W** TYPE

HEAVY-DUTY

ELECTRICAL CONNECTOR

Intended for use with jacketed cable and not requiring ground return through mating surfaces, this connector incorporates sealing gaskets at all mating joints.

W-Type Bendix* Connectors also incorporate standard Scinflex resilient inserts in established AN contact arrangements. Shell components are thick sectioned high-grade aluminum for maximum strength. All aluminum surfaces are grey anodized for protection against corrosion.

It will pay you to remember that for the really tough jobs, where ordinary electrical connectors just won't do, be sure to specify the W-Type Connector.

Complete specifications and details on request.

*REG. TRADE-MARK

Bendix **SCINTILLA DIVISION of SIDNEY, NEW YORK** Bendix AVIATION CORPORATION

Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

FACTORY BRANCH OFFICES: 117 E. Providencia Avenue, Burbank, California • 512 West Avenue, Jenkintown, Pennsylvania • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan • 5906 North Port Washington Road, Milwaukee 17, Wisconsin • American Building, 4 S. Main St., Dayton 2, Ohio • 8401 Cedar Springs Road, Dallas 19, Texas • Boeing Field, Seattle 8, Washington • 1701 "K" Street, N. W., Washington 6, D. C.

Introducing another NEW B&H Instrument...

TAKCAL

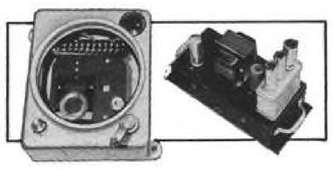
· COMPACT
· LIGHTWEIGHT
· RUGGED

Reads Jet Engine Speed to Guaranteed Accuracy of 10 RPM in 10,000 RPM (±0.1%)

The new B&H TACKAL incorporates a refinement of the frequency meter principle. It operates in the low (0 to 1000 cps) range, reading the frequency of the tachometer generator on a scale calibrated in percent RPM corresponding to the engine's RPM. In addition the TAKCAL checks the tach system. The TAKCAL circuit and tachometer are parallel so that readings can be made simultaneously to determine the accuracy (or inaccuracy) of the aircraft's tach system. The TAKCAL operates during the engine run to properly set up engine controls for maximum economy and safety.

Originally developed as a component part of the J-Model JETCAL ANALYZER, the TAKCAL is now available as a separate unit for use with all earlier models of the JETCAL TESTER.

The TAKCAL operates accurately in all ambient temperatures from −40°F. to 140°F. Low in cost for an instrument of such extreme accuracy, it is adaptable to application in many other fields.



Explosion-proof TAKCAL for special applications. Measures 200 to 7500 RPM, direct reading, with ±0.1% accuracy.

For full information write or wire . . .

TAKCAL

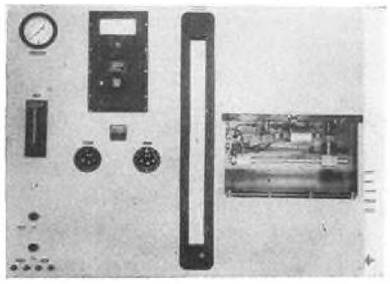
B & H INSTRUMENT Co., Inc.

1009 Norwood • FORT WORTH 7, TEXAS

dicator measures pressures from 0.1 psi. to over 3,000 psi.; with a high-pressure adapter, range is extended to above 20,000 psi. The same gage also measures vacuum.

Price for the complete indicator system, including cable, is $525. The unit is imported from Switzerland.

Kistler Instrument Co., 15 Webster St., Tonowanda, N. Y.



Lab Unit Tests Jet Fuels

New laboratory test units for evaluating thermal stability of jet engine fuels has been developed with the aid of aircraft engine manufacturers, refiners and other organizations.

Test fuel is pumped through an annular heat exchanger, then through a heated sintered steel precision filter. Fuel flow rate and temperature and filter temperature can be varied over a wide range to control test severity. The time to achieve a given pressure drop across the filter is a measure of fuel stability.

Erdco Engineering Corp., Addison, Ill.

Wind Marker for Heliports

Heliwindindicator, designed specifically to guide helicopters while landing, is a junior-size version of standard wind indicators currently used for conventional planes.

Unit is 36 in. long and is made up of an aluminum frame supporting plastic panels illuminated from inside by two fluorescent lights. It swings freely in winds of 3 mph. and is said to be visible from 1,000 ft.

Developed jointly by Van Dusen Aircraft Supplies and Westinghouse Electric Corp., a pilot model of the new tetrahedron is currently installed at LaGuardia Airport, N. Y., for use by New York Airways pilots.

Van Dusen Aircraft Supplies, Teterboro Airport, N. J.

ALSO ON THE MARKET

Single-turn Teflon backup ring S-11248 with 22-deg. cut is suitable for temperatures over 250F. Back-ups are interchangeable with standard two-turn rings.—Shamban Engineering Co., Culver City, Calif.

Three-unit fuel gage equipment incorporating lightweight tank units and vacuum tube bridge-amplifiers has been approved by Wright Air Development Center for USAF aircraft.—Avien, Inc., Woodside, N. Y.

Leakproof metering valve is said to give fingertip hairline control of a water manometer when connected directly to pressures of 6,000 psi. Service tem-

perature range is −100F to 500F.—Robbins & Associates, 1735 W. Florence Ave., Los Angeles, Calif.

Pressure-sealing spring-loaded thermocouples for checking bearing and surface temperatures provide fast response. Internal vacuum or pressure is sealed to 200 psi. Units are available in either iron or copper-constantan calibrations.—Conax Corp., Buffalo 21, N. Y.

Fatigue tester with total force capacity of 12,000 lb. has two stations—for high force and for high amplitude. Torque bar is used instead of coiled springs to obviate errors normally due to temperature changes. IVY-12 has 71x79-

CERAMICAST*

Typical of the intricate design and thin metal sections possible with the CERAMICAST process is this backing plate for a jet aircraft brake.

Lebanon's new casting process for...

CLOSE TOLERANCE STEEL CASTINGS AT LOW COST

FOR QUALITY ✓
- **TOLERANCES as close as** ±.003″ to .005″ per inch.
- **INTRICATE SHAPES:** Ideal for castings of complex design.
- **THIN SECTIONS:** Metal sections to 3/32 of an inch. Knife-like edges to .030″ or less.
- **SMOOTH SURFACES:** Variations held to 125 micro-inches or better.

FOR PRICE ✓
- **LOWER PRODUCTION COSTS:** Jobbing wood or metal patterns can be used. Design changes quick and inexpensive.
- **REDUCED MACHINING COSTS:** Smooth, accurate castings greatly reduce or eliminate machining.
- **SHORT LEAD TIME:**

ADAPTABLE TO MANY CASTING SIZES AND ALLOYS—casting weights up to one hundred pounds or more. Carbon steel, conventional low alloys, stainless steels and the superalloys.

SEND US YOUR BLUEPRINTS. Our sales engineering department will show you how the revolutionary Lebanon CERAMICAST Process can be adapted to your project design.

*produced under licensing agreement with Shaw Processes, Ltd., London, England.

CIRCLE L ®

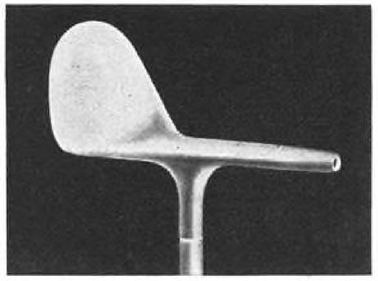
LEBANON STEEL FOUNDRY

63 LEHMAN STREET LEBANON, PENNSYLVANIA

CARBON, LOW ALLOY AND STAINLESS STEEL CASTINGS

in. table surface. Unit is seismically mounted.—Ivy Co., Norwalk, Conn.

Precision miniature gears have tooth-to-tooth composite clearance of 0.0003 in. Journal diameter clearance is ± 0.0001 in. Gear teeth and bearing diameters are burnished.—Washington Machine & Tool Works, Inc., 1001 Washington Ave. South, Minneapolis 15, Minn.

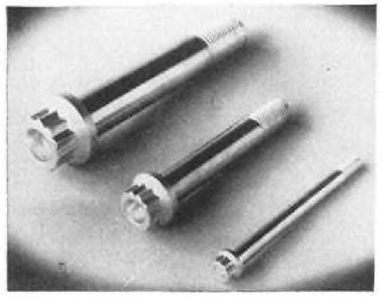


Jet-Vane measures 3 to 200-mph. velocities and has no rotating cups or propellers to induce friction and lag errors. Sensing elements are short butt-welded noble-metal thermocouples, self-compensating for temperature changes. Recording unit is available. Price, with wind-velocity indicator for wall mounting, $195.—Hastings Instrument Co., Inc., Hampton, Va.

Dynamic strain gage indicator featuring 17-in. rectangular screen display oscilloscope and eight input channels measures displacement, velocity, acceleration and pressure. All channels are scanned each half-second.—Electromac, Inc., Los Angeles 39, Calif.

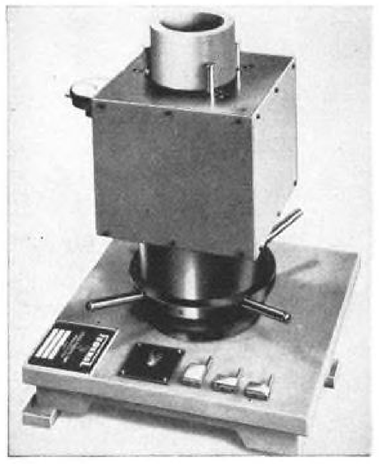
Portable high-frequency inert gas welding unit provides automatic control of torch and back-up gas, torch and fixture cooling water, high-frequency starting spark and welding current.—Flexweld Manufacturing Co., Depot St., Buckland, Conn.

Steel external wrenching bolt for aircraft has tensile strength from 180,000-200,000 lb./sq. in. and also high resistance to dynamic fatigue and wrenching. EWB-18 12-point threaded units are



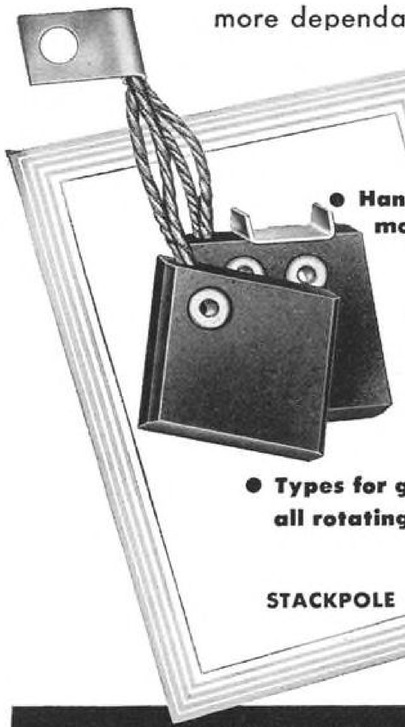
made in standard diameters from ¼ to 1½ in.—Standard Pressed Steel Co., Jenkintown, Pa.

Indicating gage for aircraft shops checks engine bearing sleeves from ½-in. to 5-in. i. d. No electrical or air connections are needed.—Federal Products Corp., 1144 Eddy St., Providence 1, R. I.



STACKPOLE *Brushes*

for longer, more dependable service at higher and still higher altitudes



- **Handle 500 amperes or more per square inch on intermittent applications.**
- **Silver-soldered connections available on certain grades**
- **Specially reinforced shunts available where required**
- **Types for generators, inverters and all rotating electrical equipment.**

STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT • VOLTAGE REGULATOR DISCS • BRAZING FURNACE BOATS • CARBON, GRAPHITE and PRECIOUS METAL CONTACTS • CLUTCH RINGS • FRICTION SEGMENTS • ANODES • RESISTANCE WELDING TIPS • SEAL RINGS . . . and dozens of other carbon-graphite specialties.

another example of how **RYAN BUILDS BETTER**

RECORD SIX YEAR PRODUCTION PAVES WAY FOR NEW GIANTS

Largest airframe assembly subcontracted. Ryan is producing huge aft fuselage sections for the Boeing KC-135 jet tanker-transport. This new project follows six years of continuous on-time production of fuselage sections for Boeing's KC-97.

It's a tail of two cities. The huge structures built by Ryan in San Diego must mate perfectly with sections produced at Boeing's Seattle-Renton plants. This demands precision manufacturing, perfect planning and flawless coordination.

Techniques, planning and skill save money. Ryan reduced costs 40% during production of KC-97 assemblies. This saving was passed on to Boeing and the Air Force — to provide more aircraft per defense dollar. This is just one example of the outstanding cost-performance at Ryan. The same manufacturing efficiency and smooth integration is found in the production of fuselage sections for Sabre Jet fighters and other military and commercial airframe components such as fuel tanks, control surfaces, wing sections.

Established, financially stable. Ryan performs subcontracts without progress payments from customers. A veteran of 33 years exclusively in the aircraft business, Ryan understands the industry's problems as only an aircraft company can. It has the modern facilities, most advanced manufacturing techniques, and highly skilled engineering and technical personnel needed to produce the industry's most difficult production assignments.

For 33 years, Ryan has excelled in designing and producing high quality aircraft, power plants and avionics—built at low cost, delivered on time.

RYAN
AERONAUTICAL COMPANY
SAN DIEGO 12, CALIFORNIA

HELICOPTER CAN LAND in rugged terrain, enabling geologist to immediately erect monument and measure claim area for staking.

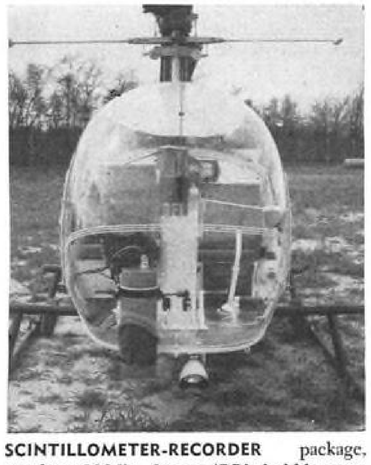
Helicopter Succeeds as Uranium Hunter

The many-faceted helicopter has shown that it also can serve as a versatile uranium hunter.

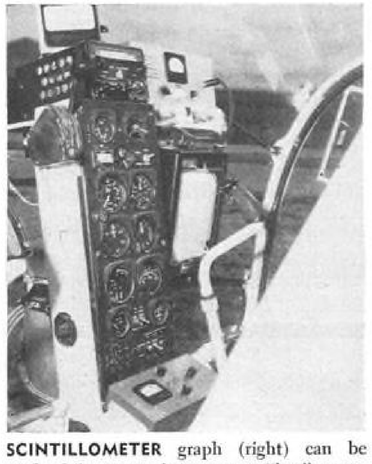
The rotary wing aircraft proved its worth during a recently-completed eight-month field trial conducted by the Bell Exploration & Development Corp. The test also showed, however, that geological and geophysical instrumentation must be improved if the aircraft is to reach its full potential in this field.

Bell Exploration & Development Corp., a market research organization operating under Bell Aircraft Corp.'s Helicopter Division, carried out its test in the Southwest (AW Apr. 4, 1955, p. 26), using both the 200-hp. Franklin-powered Bell 47G and the Model 47G-2 with a 260-hp. Lycoming derated to 200 hp.

Ben Bowyer, former U. S. Government geologist and a member of the Bell subsidiary, said the tests were hampered somewhat because there are few uranium-hunting instruments available that were specifically designed for helicopter operation.



SCINTILLOMETER-RECORDER package, weighing 100-lb., fits on 47G's bubble nose.



SCINTILLOMETER graph (right) can be read while copter hovers over "hot" spots.

Scanning an Area

Magnetometers are not available in weight packages equal to airborne scintillation equipment, Bowyer said, but a full utilization of the current state of the electronic art (such as application of transistors) would aid this problem immeasurably.

Lightweight strip recorders are another item needed by rotary wing uranium hunters.

Bell has installed a Nuclear Enterprises Mk. VIA scintillometer in front of the geologist observer. Two meters, one in front of the geologist, the other in front of the pilot, interpret the amount of radioactivity change over a given area. Meters are readable in either counts/second or milli-roentgens/hour.

An Esterline-Angus AW recorder is on the observer's side of the cockpit to provide a continuous, permanent record of radioactivity along the traverse.

The entire equipment, including scintillometer, detector probe, recorder, panel and mount can be removed to provide greater payload for hauling supplies, drilling equipment or other necessities.

Survey flight speeds vary from 35 to 60 mph. The lower speed is preferred by geologists when flying rim canyon outcroppings. Flying by survey grid, close to the ground and following contour eliminates the need for a radio altimeter and data reduction instruments, according to Bell personnel.

Survey Flight Speeds

By flying a pre-planned traverse with the equipment recording, the geologist can visually inspect terrain for significant signs that indicate mineral deposits. This technique permits a geologist to cover at least 125 miles of traverse a day with a high degree of accuracy and completeness. A similar survey from the ground would require weeks.

The helicopter's speed also pays off in allowing better utilization of the limited number of experienced geologists.

Promising anomalies shown by the airborne detection equipment can be checked on the spot by landing in the area. The location can then be staked out and claims filed at the local courthouse within a few hours.

After Bell Exploration & Development Corp. completes its education job of familiarizing the industry in the field with the helicopter's worth in uranium hunting, the parent company will dissolve it.

Aero Design Backlog Equals 1955 Sales

Aero Design & Engineering Co. reported sales of $7.5 million during 1955 and an order backlog of another $7.5 million at the year's end for 560A and 680 Super Commander business transports. The backlog commits Aero Design's production for most of 1956.

Aero Commander deliveries last year totaled 42 Model 560s, phased out early in the year, 34 Model 560As and 13 L-26Bs. It also expected to complete four of the new highspeed 680 Supers by year's end, but since these were to be assigned to engineering and sales departments, they would not be included in delivery totals. Last year Aero Design production reached a peak of 12½ airplanes a month; 1956 output is expected to be kept at about 12 airplanes monthly, considered maximum production at the company's current facility. The company has purchased 34 acres near Tulakes Airport, Okla., for future expansion. Personnel have been increased from 425 at the start of 1955 to 600 at the end of the year.

Aero Design recently put a new version of the 560A on the market, providing a choice of two engines in this model. The new (HC)560A has Lycoming GO480-C1B6 high-compression engines with a takeoff rating of 295 hp. and normal rated 280 hp. Compression ratio has been increased to 8.7:1 and the powerplants have chrome-plated cylinders, longer pistons and heavier bearings. It uses 100/130 octane fuel.

Price of the new (HC)560A is $76,500 compared with $74,500 for the standard 560A with 270-hp. Lycoming GO480-D1A engines.

BUSINESS AND UTILITY PLANE SHIPMENTS

October 1955

Shipment of 316 one-to-ten-place business and utility planes by six companies in October was valued at $5,297,000, based on manufacturer's net billing prices. Excluded from these shipments are military aircraft, helicopters and gliders.

	Complete Aircraft			Builder's Net Billing Price (000's omitted)		
	Jan.-Oct.	Oct.	Sept.	Jan.-Oct.	Oct.	Sept.
Aero Design						
560	42*					
560A	16	3	9	$4,076*	$224	$671
Beech						
Bonanza F35	373	35	26			
D18S	1	1				
E18S	73	4	6	21,363	2,071	1,774
Twin-Bonanza C50	112	16	12			
Model 45 Trainer	25					
Callair						
Model A5A	2					
Model A4	4			34		
Model S1B1	1					
Cessna						
170B	412	32	15			
180	813	41	58			
195	15			17,877	1,516	1,679
195B	1		1			
305	1					
310	179	23	25			
Mooney						
M18C	31	1	6	118	33	18
M20	3	3				
Piper						
Super Cub	499	52	47			
Pacer & Tri-Pacer	799	73	84	13,023	1,443	1,243
Apache	237	31	21			
Taylorcraft						
Tourist 15A	4			90	10	9
20	7	1	1			
Totals	3,650*	316	311	$56,581*	$5,297	$5,394

* Includes six Aero Commander 560's shipped by Aero Design in June 1955, valued at $417,000.

Source: Aircraft Industries Assn., Utility Airplane Council.

PRIVATE LINES

Radiation, Inc., Melbourne, Fla., is seeking a C-46 or C-47 to be used in an equipment flight test program being planned by the electronics manufacturer.

Aviation Distributors & Manufacturers Assn. plans to hold its 27th meeting at Grove Park Inn, Asheville, N. C., next June 21-22. Program will include two business sessions. Two afternoons will be given to private discussions between association members.

November exports of civil planes weighing 6,000 lb. and less totaled 53 units valued at $468,229, bringing to 595 the number of this category aircraft exported in 1955, with total value of $1,002,314.

Production of 50,000th aluminum propeller has been achieved by McCauley Industrial Corp., Dayton, Ohio. The McCauley firm first started volume aluminum propeller production in 1947.

National Business Aircraft Assn. will hold its ninth annual meeting and

Quantity Production for C-130s

Four 62-ton Hercules C-130 turbo-prop transports line up outside Lockheed Aircraft Corp.'s Marietta Division to await delivery to the Air Force. Now in quantity production, the aircraft can take off or land in 18 seconds with payloads of up to 20 tons.

forum in Miami, Fla., next October. Host city committee chairman is William Lawford, L. B. Smith Aircraft Corp., Miami International Airport.

Two Canso amphibians, belonging to Photographic Survey Corp., Canada, have left to map 50,000 sq. mi. in the Grahamland Peninsula, Antarctic for the British Government. The project will also utilize two Sikorsky S-51 helicopters to fly ground surveyors to establish ground control for the aerial mapping operation.

Stock Transactions

Washington—Acquisition of 30,000 common shares of Bell Aircraft Corp. stock, through an exercise of option by Lawrence D. Bell, an officer and director, is reported in the latest securities and exchange stock transactions summary. His total holding is now 32,000 shares. Leston P. Fancuf, officer, acquired 100 common shares, his total holding.

Other transactions from Oct. 11-Nov. 10, 1955, include:

Aero Supply Mfg. Co. Inc. Acquisition of 15,985 common shares by Leo Strauss, director, making a direct holding of 7,893 and an indirect holding of 22,685.

Air Associates Inc. Acquisition of 1,600 common shares by C. Keneth Baxter, director, making a holding of 2,600.

Allegheny Airlines. Acquisition of 100 common shares by Leslie O. Barnes, officer and director, making a holding of 20,900.

Avco Mfg. Corp. Acquisition of 100 common shares by William I. Myers, director, making a holding of 500; acquisition of 100 common shares by E. R. Piore, officer, his total holding.

Braniff Airways Inc. Acquisition of 39,000 common shares by William A. Blakley, director, making a holding of 129,270; acquisition of 461 common shares by Milton McGrevy, director, making a holding of 1,992; disposal of 1,000 common shares by Thomas F. Ryan III, director, leaving a holding of 39,000.

Capital Airlines. Acquisition of 525 capital shares through exercise of option by Robert J. Wilson, officer, making a holding of 760.

Eastern Air Lines. Disposal of 100 common shares and acquisition of 300 common shares by Stuyvesant Peabody, director, making a direct holding of 100 and an indirect holding of 300; acquisition of 3,000 common shares by Laurance S. Rockefeller, director, making a holding of 88,000.

Fairchild Engine & Airplane Corp. Acquisition of 100 common shares by Robert B. Carney, director, his total holding; acquisition of 300 common shares by William Preston Lane, Jr., director, making a holding of 900.

Flying Tiger Line. Acquisition of $10,000 of 5½% convertible debentures by William E. Bartling, officer, making a holding of $60,000; acquisition of $20,000 of 5½% convertible debentures by Frank B. Lynott, officer, his total holding.

General Electric Co. Acquisition of 1,350 common shares by George E. Bureans, officer, making a holding of 2,700; acquisition of 2,700 common shares by Harold E. Strang, officer, making a holding of 5,363.

Irving Air Chute Co. Acquisition of 1,980 Class A common shares by C. H. Pulley, officer, making a holding of 2,100.

Lear Inc. Disposal of 3,500 common shares by Albus Durham, officer, leaving a holding of 256.

Glenn L. Martin Co. Acquisition of 5,000 common shares by John L. Sullivan, director, making a holding of 8,300; disposal of 600 common shares by Jess W. Sweetser, officer, leaving a holding of 7,100.

McDonnell Aircraft Corp. Disposal of 100 common shares by Kendall Perkins, officer and director, leaving a holding of 1,000; acquisition of 100 common shares by James E. Webb, director, making a holding of 300.

National Airlines. Acquisition of 200 common shares through exercise of option by Jerome M. Rosenthal, officer, making a holding of 2,700.

National Aviation Corp. Acquisition of 100 common shares and disposal of 100 common shares by John G. Pennypacker, director, leaving no holding; disposal of 200 common shares by Frederick F. Robinson, officer, leaving a holding of 200.

Northrop Aircraft Inc. Acquisition of 1,330 common shares through exercise of option and disposal of 1,392 common shares by Kenneth P. Bowen, officer, leaving a holding of 1,330; acquisition of 824 common shares through exercise of option by George Gore, officer, his total holding; acquisition of 100 common shares by Richard W. Milar, director, making a holding of 100.

Northwest Airlines. Acquisition of 100 common shares by Wheelock Whitney, director, making a direct holding of 600 and an indirect holding of 1,400.

Radio Corp. of America. Acquisition of 100 common shares by Mildred Horton, director, making a holding of 300; acquisition of 260 common shares by L. W. Teegarden, officer, making a holding of 501.

Ryan Aeronautical Co. Acquisition of 300 common shares by Emtor, Inc., beneficial owner, making a holding of 87,400.

Solar Aircraft Co. Acquisition of 100 common shares by Ewart W. Godwin, director, making an indirect holding of 410; acquisition of 100 common shares by Richard R. Rollins, director, making a holding of 500.

United Air Lines. Acquisition of 100 common shares by Paul A. Bissinger, director, making a holding of 600; acquisition of 1,000 common shares by Otis E. Kline, officer, making a holding of 10,000; acquisition of 700 common shares through exercise of option by Hal E. Nourse, officer, making a holding of 1,780; acquisition of 2,000 common shares by Dick R. Petty, officer, making a holding of 2,090.

United Aircraft Corp. Acquisition of 100 shares of 4% preference stock and disposal of 30 shares of 4% preference stock by William P. Gwinn, officer, leaving a holding of 70.

Western Air Lines. Disposal of 1,000 capital shares by D. P. Renda, officer, leaving a holding of 1,500.

ENGINEERS

THE TREND IS UP!

M.A.C. has enjoyed a phenomenal growth during the past six years—and—the trend is still upward. We invite you to join us and grow with us.

New contracts have created four additional, complete project organizations in our Engineering Divisions within the past year. Many positions of technical leadership are still available.

FISCAL YEAR ENDING JUNE 30

1950		1955
	SALES	
$38,688,383		$154,588,816
	EARNINGS COMMON SHARE	
$4.13		$6.33
	BACKLOG	
$62,695,281		$305,438,023*
	TOTAL PERSONNEL	
5,560		13,786
	ENGINEERS	
961		2,654

* Backlog has since virtually doubled

Needed now are experienced engineers in:

DESIGN • AERODYNAMICS • AIR LOADS
STRUCTURES • CONTROL DYNAMICS (Flutter & Vibration)
MISSILE FLIGHT TEST—Dept. Head
MISSILE AEROELASTICITY & FLUTTER—Dept. Head

To secure our Annual Report and additional information write:

TECHNICAL PLACEMENT SUPERVISOR
P. O. Box 516 • St. Louis 3, Missouri

McDONNELL Aircraft Corporation

Overhaul Procedure Blamed in American Airlines' Convair Crash

Fire, Crash Follow Cylinder Failure

American Airlines Flight 476, a Convair 240, N 94221, crashed at approximately 1223*, August 4, 1955, about one-half mile northwest of runway 14, Forney Field, Fort Leonard Wood, Missouri. The three crew members and all 27 passengers were fatally injured; the aircraft was destroyed by impact and fire.

Flight 476 of August 4 was a scheduled operation between Tulsa, Oklahoma, and La Guardia Field, New York, with several intermediate stops including Joplin, Springfield, and St. Louis, Missouri. The flight departed Tulsa at 1006 (one minute behind schedule) with Captain Hugh C. Barron, First Officer William G. Gates, and Stewardess Thelma R. Ballard as crew.

En route stops were made at Joplin and Springfield, and no discrepancies were reported or noted at either point. However, a traffic delay in the Joplin area resulted in the flight arriving and departing Springfield 21 minutes behind schedule.

Two of the eight passengers deplaned at Springfield; 21 passengers boarded the flight there. Gross weight of the aircraft at takeoff was 38,663 pounds, 2,302 pounds under that allowable, and the center of gravity was located within prescribed limits.

Engine on Fire

Flight 476 departed Springfield VFR for St. Louis, its next scheduled stop, at 1153 via Victor Airway 14 to cruise at 7,000 feet. It was off the ground at 1156. Twenty-one minutes later (1217) the crew initiated a general call asking, "Does anyone read 476?" Springfield company radio acknowledged but received no reply. Two other American Airlines flights, one cruising in the vicinity of Springfield at 7,000 feet, the other 30 miles north-northeast of St. Louis, heard a transmission from Flight 476 that No. 2 engine was on fire. This message was also heard by American's ground station at St. Louis.

Three minutes later the American flight in the Springfield area intercepted the following message, "Springfield, are you reading 476? We have bad engine fire." This was the last message heard from the flight. All transmissions were on company frequency.

During this interval numerous witnesses on the ground back along the flight path saw the aircraft with smoke and flames coming from the right engine. The aircraft was also tracked by a military radar installation near Springfield until it disappeared from the scope in the vicinity of Fort Leonard Wood.

At approximately 1222 the operations officer on duty at Forney Field, Fort Leonard Wood, received a radio message from an Army pilot flying nearby that a two-engine aircraft with a fire in the right engine was on final approach to runway 14. The tower operator at Forney Field saw the approaching aircraft and gave it clearance to land. Before the operations officer could alert the crash crew another call from the Army pilot informed him that the airplane had crashed short of the runway. The time was 1223.

Army personnel with portable fire-fighting equipment reached the wreckage on foot. There were no survivors. Heavy fire-fighting equipment and ambulances could not reach the scene until the Army engineers had bulldozed a road through the densely wooded area in which the crash occurred.

* All times referred to herein are Central Standard and based on the 24-hour clock.

INVESTIGATION

Investigation at the scene revealed that the right wing, right engine, right landing gear and associated parts had separated from the aircraft in flight and that bits and pieces, including the right inboard landing gear door, had fallen from the aircraft before the wing came off. The remainder of the aircraft struck the ground approximately 300 feet beyond where the right wing fell.

Ground fire and impact damage was extensive and much of the wreckage consisted of burned rubble only.

All major components, however, were accounted for at the accident site. Evidence indicated that the landing gear had not been extended, and that the flaps were in the full-up position.

The right wing lay inverted. Its upper skin between the spars had separated approximately 120 inches outboard from the centerline of the fuselage near the inboard side of the nacelle, the inboard portion remaining with the fuselage; the lower wing skin, stringers, spar rails and front and rear spar webs to approximately 170 inches outboard from the centerline of the fuselage had been destroyed by fire.

The right propeller dome cap, a rocker box cover interconnector boss and pieces of engine cylinder baffle were found underneath the right wing; the engine itself was approximately 90 feet away.

Examination of the right engine showed that the No. 12 cylinder had broken circumferentially just above the hold-down flange. The flange portion remained with the engine; the remainder of the cylinder, with the piston jammed in the open end of the barrel, was found approximately 70 feet distant.

The piston pin eye of the No. 12 link rod was broken and the piston pin lay about 30 feet from the engine. Damage to the link rod was relatively minor. Other parts associated with the right engine nacelle were scattered throughout this general area. Two blades of the right propeller, which had been feathered, were broken at impact.

It was determined that the aircraft was properly dispatched and that weather was not a factor.

All parts believed to be pertinent to continued investigation of the accident were removed by the Board's investigators to American Airlines' Overhaul and Supply Depot at Tulsa for more detailed examination.

At Tulsa the right engine, landing gear and associated wing structure were assembled in approximately their relative flight positions for the purpose of tracing the fire path. Fire originated in zone 1* between Nos. 11 and 13 cylinders and progressed directly rearward into zone 2 at the diaphragm outer edge seal. The pattern of heaviest fire damage extended directly back from No. 12 cylinder.

Fire passed out of zone 2 forward of the firewall at the mating surfaces of the lower and inboard cowls, and of the lower and outboard cowls. It entered zone 3 immediately aft of the firewall on the inboard side of the nacelle. Burned-through fuel, hydraulic, and cabin compressor oil lines in zone 3 released combustibles, and fire of increased intensity progressed rearward along the inboard side of the nacelle to the front spar.

The upper and lower rails and web of the front spar were heated to the point where material was weakened and the lower rail failed in tension, resulting in separation of the right wing from the aircraft.

Impact and fire damage was such that the condition of the fire seal between zones 1 and 2 prior to the accident could not be determined. Effective sealing in this area depends on contact between a neoprene asbestos seal attached to the periphery of the diaphragm and the inner surface of the orange peel cowl.

Fire Seals Replaced

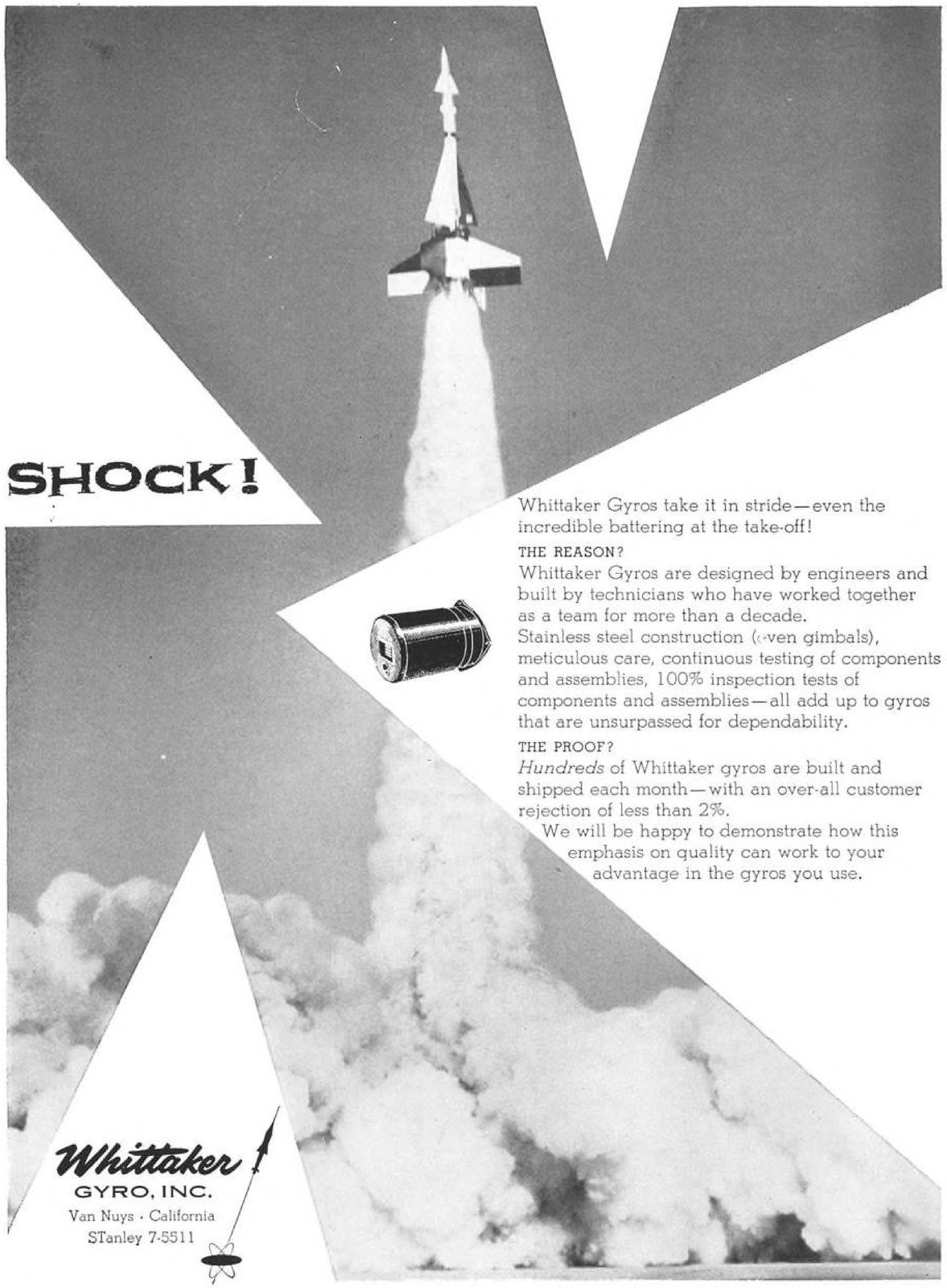
After the accident the carrier ordered an inspection of its Convair fleet to determine if specific undesirable conditions existed with respect to this fire seal, and corrective action was taken in all cases where such conditions were found. Seals are now being renewed every overhaul instead of upon condition or approximately every other overhaul, as was done previously.

In addition, a chalk test is being made upon installation to determine more conclusively if there is proper mating between the diaphragm and the orange peel cowl.

Fire Detector System

In 1952 American Airlines modified the fire detector system in all of its Convair 240s for the purpose of obtaining quicker fire warnings. This modification was worked out with the manufacturer and is essentially the same as the system that is standard on the Convair 340s. A single light in the cockpit shows the crew which powerplant

* Zone 1—Engine power section; zone 2—accessory section; zone 3—aft of the firewall.



Whittaker Gyros take it in stride—even the incredible battering at the take-off!

THE REASON?

Whittaker Gyros are designed by engineers and built by technicians who have worked together as a team for more than a decade. Stainless steel construction (even gimbals), meticulous care, continuous testing of components and assemblies, 100% inspection tests of components and assemblies—all add up to gyros that are unsurpassed for dependability.

THE PROOF?

Hundreds of Whittaker gyros are built and shipped each month—with an over-all customer rejection of less than 2%.

We will be happy to demonstrate how this emphasis on quality can work to your advantage in the gyros you use.

Whittaker
GYRO, INC.
Van Nuys · California
STanley 7-5511

a fire is in but does not indicate the zone. Emergency procedures are to be initiated by the crew as soon as a fire warning is received. These include actuating the extinguishing system, which discharges in zones 2 and 3 only.

During the investigation of this accident it was not possible to make a functional check of the fire detector system for the right engine and nacelle because of extreme fire and impact damage. Also, the fire extinguisher control panel in the cockpit was so damaged that no information pertinent to the accident could be obtained from it. All CO_2 bottles were recovered, however, with their heads, including the thermal discs, intact, and when weighed were found to be empty. The CO_2 retention door in the zone 2 chimney was found closed.

Control linkages to the right side firewall shutoff valves were broken and detached, and the valves showed impact and fire damage. The engine oil, cabin compressor oil, and hydraulic fluid valves were found closed; the fuel shutoff valve was so damaged that its position could not be determined. All of the firewall shutoff valves, however, are mechanically linked to one common control handle.

The electrically operated right main tank fuel shutoff valve, located in zone 3, was recovered in the open position; all wiring had been burned from its electrical connector.

Fatigue Cracks

After preliminary examination at Tulsa the No. 12 cylinder, piston, piston pin, and link rod were sent to the National Bureau of Standards for laboratory study.

This study revealed that several fatigue cracks, starting at the outside surface of the cylinder wall, had joined to form a single large crack that extended around approximately one-third of the circumference before the cylinder failed completely.

It did not reveal any abnormalities in the composition or microstructure of the steel that could have contributed to the cause of failure. Fractures on the link rod and piston appeared to be secondary ones caused by stresses above the yield strength of the material.

Cylinder Stud Failures

A review of the history of the failed cylinder disclosed that it was installed new in the No. 18 location on another engine in October 1954 and had operated there for approximately 1,052 hours when eight of its hold-down studs failed, seven of which were adjacent to each other. These failed studs were found during an inspection at Detroit, following which the engine was removed from the aircraft and sent in to American's overhaul base at Tulsa.

At the time the cylinder was removed in engine disassembly at the overhaul base a special cylinder stud failure form required by American was made out for the engineering department, and a notation was made on the front sheet of the engine inspection log that eight of the hold-down studs for this cylinder had failed. On another page of this same log the cylinder was marked as "O.K." by inspection. The next record of this cylinder was an inspection card showing an inside and outside inspection with no indication of whether a check had been made for warpage of the flange.

Three days after this cylinder was removed from the engine in which the stud failures had occurred it was put back in service in the No. 12 location on another engine undergoing overhaul at the Tulsa base.

When N 94221, the aircraft involved in this accident, arrived at Tulsa for a pattern 1 overhaul (conducted by American every 2,100 hours of operation), this engine was installed as a replacement for the No. 2 engine removed from the aircraft. The aircraft was test flown and released for service on August 3; the cylinder failed on August 4 after slightly less than six hours of operation.

During the check on the history of this cylinder several discrepancies were noted in the carrier's engine overhaul records. One of these was showing cylinders being removed from the rear row and reinstalled on the front row, which is an impossibility. It was testified that these were clerical errors; that the primary purpose of the records was to maintain historical data on the use of parts and they were not used as a crosscheck to help insure that unairworthy parts were not returned to service.

American Airlines' procedures provided that any cylinder which had been operated with more than two adjacent hold-down studs broken or the nuts loose should be scrapped or returned to the manufacturer for rebarrelling.

Such a cylinder was to be tagged in engine disassembly to alert inspection that

Royal
AMPHIBIAN NEWS

Notes on America's outstanding utility amphibian for business flying and charter service operation

ROYAL GULL FIRST FOREIGN AIRCRAFT TO BE AWARDED CAA TYPE CERTIFICATE

Another highlight in aviation progress became history when Mr. W. Henry Weeks, Chief of CAA Aircraft Engineering handed Type Certificate of Airworthiness No. 813 to Dr. A. Piaggio. Dr. Piaggio received this certificate for the Royal Gull, a new twin-engine, five-place, gull-wing amphibian which is being assembled and equipped in this country by the Royal Aircraft Corporation, a subsidiary of Kearney & Trecker Corp., Milwaukee.

In welcoming the Royal Gull to the American fleet of executive aircraft, Mr. Weeks cited its good performance and skilled workmanship. He said, "The Royal Gull should be popular with all who fly it . . . and I speak from personal experience as I have enjoyed the gratification of flying it."

W. Henry Weeks (left) makes presentation to Dr. A. Piaggio

DISTRIBUTOR NAMED FOR WEST COAST

Leo Yoder's Aircraft Sales and Brokerage Co., Long Beach, Cal., an associate distributor of Vest Aircraft and Finance Co., Denver, will handle Royal Gull sales on the West Coast. Photo shows Aircraft Sales' pilot accepting keys for new Royal Gull from Max Black, Royal Aircraft's general manager.

NEW BULLETIN

. . . with detailed performance, construction and feature details is yours for the asking. Simply fill out and mail coupon below to

Royal AIRCRAFT CORPORATION
MILWAUKEE 1, WISCONSIN
A subsidiary of Kearney & Trecker Corp.

ROYAL AIRCRAFT CORPORATION
6781 W. National Ave., Milwaukee 14, Wis.

Please send me the 8-page illustrated Bulletin on the new Royal Gull.

Name.....

Firm.....Title.....

Address.....

City.....Zone.....State.....

VISCOUNTS IN NORTH AMERICA

Capital Airlines and

Trans-Canada Air Lines

are operating

VICKERS VISCOUNTS

powered by

ROLLS-ROYCE

DART

propeller turbine engines

FOR SPEED AND RELIABILITY

ROLLS-ROYCE LIMITED · DERBY · ENGLAND

the cylinder was to have special handling. For this purpose a blank aluminum tag, approximately one-half inch wide and two inches long, was affixed to the cylinder with the same metal safety pin that carried another and larger tag bearing the serial number of the engine from which the cylinder had been removed. Inspection decided whether the cylinder should be scrapped or rebarreled.

Overhaul Manual Not Followed

American Airlines' overhaul manual specified and the engine manufacturer recommended that the flanges of all cylinders going through overhaul be inspected for flatness by use of a surface plate and feeler gage.

If there was warpage of .005 inch or less, the cylinder was to be lapped; if there was warpage in excess of that amount the cylinder was to be rebarreled.

Company personnel testified that this method of inspection had not been followed for some time and that flanges were checked visually instead. They said they considered this visual check sufficient unless an abnormal wear pattern was evident, in which case the procedure called for in the manual was followed.

An inspector testified that this particular technique was "handed down" to him by the more experienced inspector who trained him for this operation.

Supervisory and engineering personnel of the company testified that based on experience they considered this visual inspection to be equivalent to the procedure specified in their overhaul manual and recommended by the manufacturer and that omission of the feeler gage check by inspection was with the knowledge and concurrence of the engineering department.

CAA Unaware of Procedure

There were no written instructions concerning this revised procedure and the Civil Aeronautics Administration had not been informed of it.*

CAA maintenance agents assigned to American Airlines' system maintenance at Tulsa testified that the operations there are under constant surveillance and that in addition to daily contacts a general inspection is run every six months, the last one being approximately two months prior to the accident. They all testified, however, that they were not aware of the revised procedure for inspecting cylinder barrel flanges.

No one seemed to know exactly when this procedure was put into effect but it was estimated by an American Airlines offi-

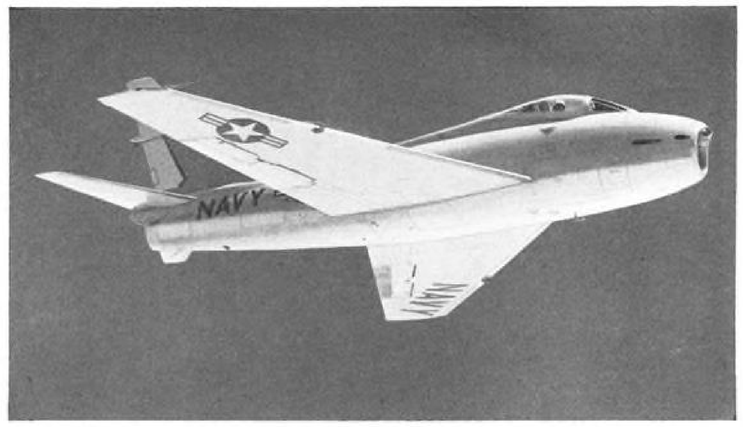
---

***CAR Part 40.50. Preparation of manual.** The air carrier shall prepare and keep current a manual for the use and guidance of flight and ground operations personnel in the conduct of its operations.

CAR Part 40.52. Distribution of manual. (a) Copies of the entire manual, or appropriate portions thereof, together with revisions thereto shall be furnished to the following: (1) Appropriate ground operations and maintenance personnel of the air carrier, (2) Flight crew members, (3) Authorized representatives of the Administrator assigned to the air carrier to act as aviation safety agents. (b) All copies of the manual shall be kept up to date.

CAR Part 18.30. Standard of performance, general. All maintenance, repairs, and alterations shall be accomplished in accordance proved by or acceptable to the Administrator.

NORTH AMERICAN'S
Columbus Division



gives Experienced ENGINEERS the most modern facilities for AIRPLANE DESIGN in OHIO

North American's Columbus Division is a complete airplane design, development and manufacturing organization . . . now in full production . . . in Ohio.

To many engineers, this has been particularly good news. It has meant career opportunities in the Middle West where complete airframe manufacturers are few. North American's Columbus Division still has a few openings for experienced engineers.

Comparatively young, North American's Columbus Division has already gained success that has established the organization's future: The highly-regarded FJ-4 Navy FURY JET* is a Columbus product... from concept, through development to line production. Naturally, personal opportunity is excellent in a younger organization; with opportunity goes stability because of the association with North American Aviation, the company that has built more airplanes than any other in the world.

A SELECT FEW POSITIONS ARE OPEN IN EACH OF THESE FIELDS:

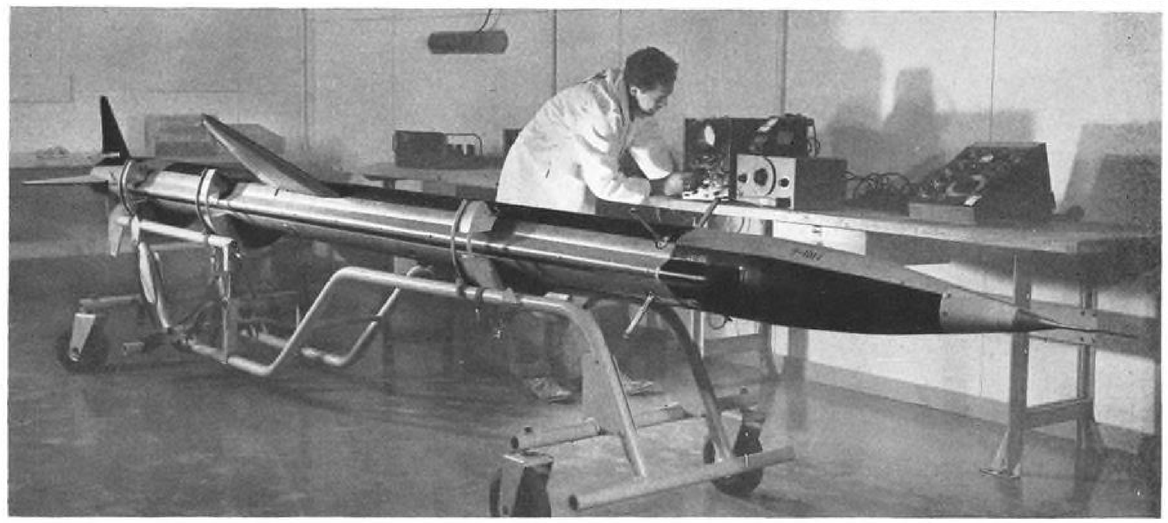
Aerodynamicists, Thermodynamicists, Dynamicists, Stress Engineers, Structural Test Engineers, Flight Test Engineers, Mechanical and Structural Designers, Electrical and Electronic Engineers, Wind Tunnel Model Designers and Builders, Power Plant Engineers, Research and Development Engineers, Weights Engineers.

For the Full Story On Your Ohio Future, Write Today: Mr. J. H. Papin, Personnel Manager, Dept. 56-AW, North American Aviation Inc., Columbus 16, Ohio.

ENGINEERING AHEAD FOR A BETTER TOMORROW

NORTH AMERICAN AVIATION, INC.
COLUMBUS DIVISION

*Reg. U.S. Pat. Off.



Boeing engineers are insiders on top-secret work

Engineers are doing vital work on significant new developments at Boeing. For example, the Boeing BOMARC IM-99 pilotless interceptor. Its predecessor, the Boeing GAPA, is shown here, because photographs of BOMARC are highly classified. BOMARC is a supersonic long-range missile that spearheads an entirely new weapons system. It is a key weapon in America's defense planning.

BOMARC, as well as other "years ahead" Boeing projects, which cannot be discussed here, are complex challenges to all kinds of engineers. These men find real creative interest in the problems of very high speed flight: heat, compressibility, vibration, rocket, jet and nuclear power, miniaturization, electronic control, and others. Their goal is to design structures and components that will "weigh nothing and take no space," yet withstand extreme velocities and altitudes.

The prestige of Boeing engineers is second to none. They have created such recent aviation milestones as the B-52 global jet bomber, the 707 jet transport, and the B-47. There are superb facilities at Boeing: the multi-million-dollar new Flight Test Center, the world's most versatile privately owned wind tunnel, the latest electronic computers, and more.

Boeing engineers enjoy exceptional opportunities for career stability and growth. There are more than twice as many engineers with the firm now as at the peak of World War II. Living is pleasant in the progressive, comfortable-size communities of Seattle and Wichita.

There is room for top engineering talent on Boeing research, design and production teams. If you feel that *you* belong with aviation's leader, it will pay you to fill out the coupon below.

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Co., Dept. C-47, Seattle 14, Wash.

R. J. B. HOFFMAN, Administrative Engineer
Boeing Airplane Co., Dept. C-47, Wichita, Kansas

If you are interested in the advantages of a career with Boeing, please send coupon to either of the above addresses.

Name_____

College(s)_____ Degree(s)____ Year(s)____

Address_____

City_____ Zone____ State_____

Telephone number_____

BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS

cial to have been the latter part of 1953. Engineering personnel also testified that a cylinder operated with approximately one-half of its studs broken or the hold-down stud nuts loose would show a wear pattern obvious to visual inspection, and that there would be definite warpage of the flange.

Pratt & Whitney Recommendation

A Pratt & Whitney representative testified that his company's recommendation concerning inspection of flanges for flatness applied to all cylinders going through overhaul and that a visual check could not be considered equivalent to the precise measurement obtained through use of the surface plate and feeler gauge. He stated further that in most cases warpage and a peculiar wear pattern on the flange would result from operation with loost hold-down nuts or broken studs, the amount being dependent on the length of such operation.

In-service failure of cylinder barrels has been correlated with operation with broken studs and/or loose hold-down nuts. After the accident Pratt & Whitney reproduced the failure on a test stand by simulating, on a new cylinder, failure of the same studs in operation, followed by operation of the cylinder with all studs secure and the hold-down nuts properly torqued. A fatigue crack developed on the outside of the cylinder barrel after three hours of operation at takeoff power with the studs secure. A check before the hold-down nuts were tightened showed .0085 inch warpage of the flange.

A check of records after the accident revealed that 23 other cylinders operated with broken studs and/or loose hold-down nuts had been passed by inspection and returned to service without being rebarreled. They were immediately removed from the engines on which they had been installed. One of the 23, which had experienced a four-stud failure, was installed in the No. 16 location of the engine involved in this accident. It was marked "O. K." in the inspection log.

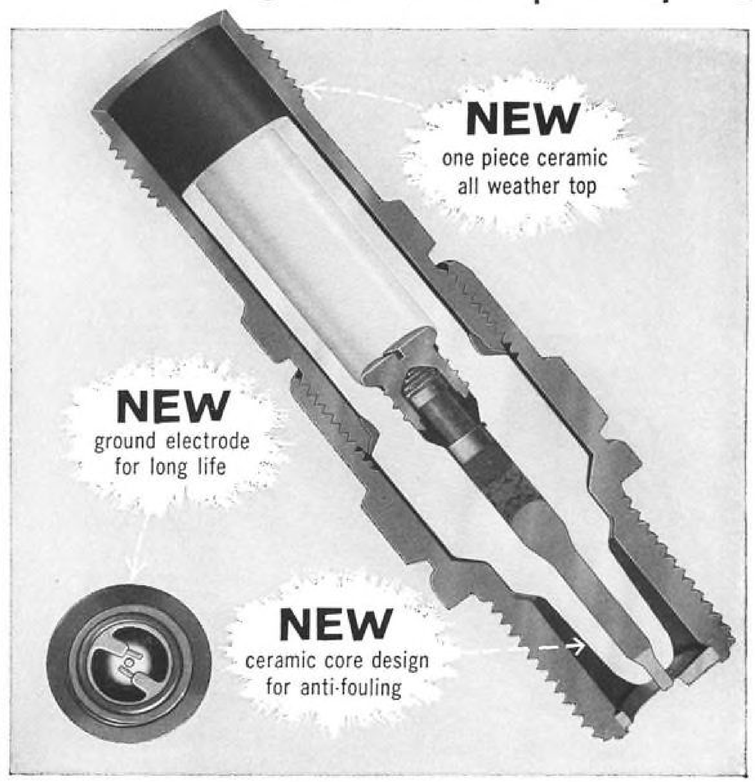
Sixteen of these cylinders, plus two others that were in the overhaul shop but not yet installed on engines, were sent by American Airlines to Pratt & Whitney for examination. Pratt & Whitney's report showed that the flanges of eleven of them were "fretted and galled"; two were "severely fretted"; and one other showed "heavy fretting and galling." This latter cylinder, removed from an engine with no operating time since overhaul, showed crack indications when magnetically inspected.

One of the cylinders, on which eight studs had failed, showed flange warpage of .006 inch; flange warpage in the others varied from .0015 inch to .0035 inch.

American Airlines officials testified that despite an intensive effort to determine where a breakdown occurred that permitted such cylinders to be put back in service, they had not been able to pinpoint it closer than one of three locations: (1) engine disassembly, where affixing of the blank metal tag could have been omitted; (2) cleaning, where the alert tag could have been lost from the cylinder (there was testimony that considerable difficulty had been experienced for some time with aluminum tags being mutilated or lost in the cleaning process, and the carrier was experimenting with the

ANNOUNCING

a new long life **BG** spark plug



The new BG platinum electrode spark plug – RB 39R – has now been CAA approved for Pratt & Whitney's R4360, R2800, R2000, R1830 series engines.

Designed in the tradition of quality established by BG, a leader in the field since 1917, the RB 39R features a new anti-fouling ceramic core design, an all weather top, and a new ground electrode design for long life.

As an added service, BG maintains a facility for factory overhaul of all platinum electrode spark plugs. Factory overhaul combines economy with long life and trouble free service.

the name that is first with aircraft engineering and maintenance personnel

For information concerning the RB 39R and other BG products, write to:

THE BG CORPORATION
321 BROAD AVENUE • RIDGEFIELD, NEW JERSEY

leading a dog's life?

Well, then, this might be a good time to get out of the dog house and on your way to a big career at Fairchild to assist in the engineering of several airplane prototypes now scheduled.

Investigate the list of categories below. See where you fit in.

Aircraft Engineers with supervisory experience in one or more of these positions:

- Design Project Engineers
- Design Coordinators
- Design Engineers for Sheet Metal Structure, Hydraulic Systems, Landing Gears, Control Systems, Equipment and Furnishings, Electrical and Electronics Installations, Power Plant Installations
- Stress Engineers for both Sheet Metal Structures and Mechanical Systems
- Weight Control

Layout Designers and Draftsmen

Project Coordinators and Administrators

You'll like working at Fairchild, and you'll like living in Hagerstown, Maryland—excellent housing, schools, recreational facilities . . . close to urban Baltimore and Washington.

Send your resume today to Lou Fahnestock, Director of Engineering.

A Division of Fairchild Engine and Airplane Corporation

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

FAIRCHILD

AIRCRAFT DIVISION • HAGERSTOWN, MARYLAND

SAFETY

use of brass tags in an effort to correct the difficulty); and (3) inspection, where the alert tag could have been overlooked.

Procedures Changed

Shortly after the accident American Airlines initiated a series of changes in overhaul procedures and in personnel assignments, all pointed toward more stringent supervisory control of work done.

The change most directly concerned with this accident involves the handiing of cylinders going through overhaul. Cylinders that had been operated with loose hold-down nuts or broken studs now have their barrels mutilated as soon as they are removed from an engine, thus making it impossible for them to be returned to service without first being rebarreled. Such mutilation is witnessed by at least one other person.

Further, the check of all cylinder barrel flanges by means of the surface plate and feeler gauge has been resumed, and the warpage tolerance has been reduced from .005 to .003 inch, in accordance with a recommendation issued by the manufacturer after the accident.

ANALYSIS

Failure of the cylinder was accompanied by the release of combustibles consisting of a fuel-air mixture from the disrupted intake pipe and oil from the crankcase section. The most likely source of ignition was the exhaust manifold which is routed rearward of the cylinders.

No. 12 cylinder straddles the mating line of the lower and inboard side orange peel cowls. After the cylinder failed fire passed rearward into zone 2 at the lower left corner of the diaphragm, which is aft of No. 12 cylinder. It is believed that fire progressed into zone 2 quite rapidly. The fire path in that zone is in accord with the zone 2 air flow pattern and the location of original entry of fire into zone 2.

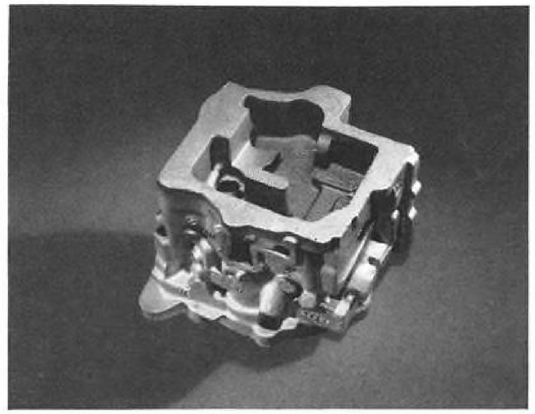
More significant is the exit of fire from zone 2, which occurred at the mating line between the lower cowl and both side cowls at and behind the rearmost fasteners. Fire on the inboard side burned the aluminum nacelle skin back of the firewall and between the upper and lower nacelle longerons, permitting fire entry into zone 3.

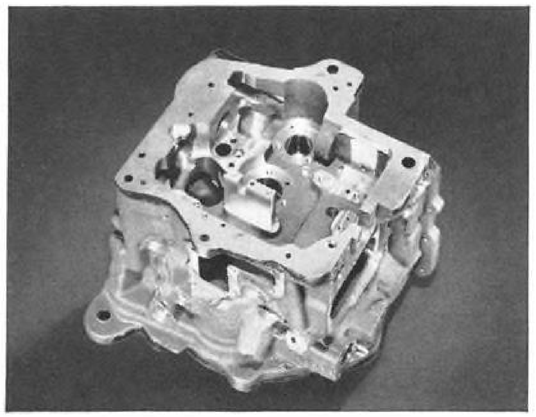
The crew must have become aware of the engine difficulty and initiated emergency procedures at once. Relatively minor damage to the No. 12 link rod, which was free to flail after the cylinder let go, indicates an almost immediate feathering of the propeller. This would halt the release of combustibles in zone 1 and account for the comparatively light fire damage in that area.

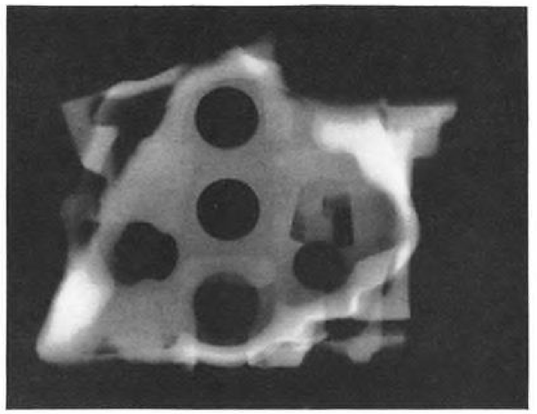
That CO_2 was discharged in flight is evidenced by the fact that all CO_2 bottles were found empty with their heads, including the thermal discs, intact. It is therefore reasonable to assume that the fire extinguishing system was actuated at the time called for in the emergency procedure checklist.

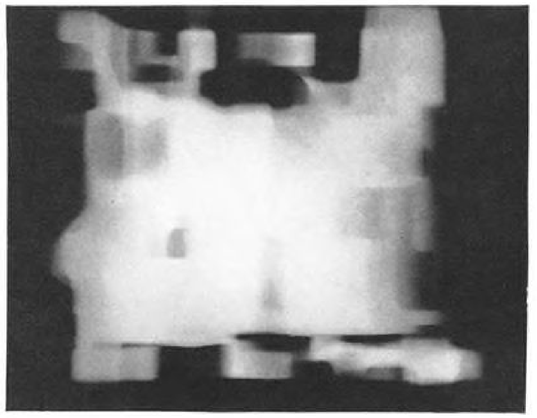
Fuel Tank Shutoff Procedure

The emergency procedure for inflight fire consists of two phases, the second part being a "cleanup" list of items considered less urgent than those directly related to con-









Sound casting yield jumped from 50% to 96%...

when radiography pointed the way

A jet plane fuel pump called for this intricate casting. The alloy was 355 AMS4214—often prone to gas holes and shrinkage. Rejects from the initial supplier ran as high as 50 per cent.

Then Oberdorfer Foundries undertook to do the job. By studying radiographs made of pilot castings, they developed new methods of gating and position of chills. Sound casting yield rose to 96 per cent. Costs dropped. And an enthusiastic customer became a firm friend.

This is typical of the ways radiography can improve foundry operations. It points ways to better castings. It saves countless hours of expensive machining by exposing castings not worth the work.

If you'd like to talk about radiography—discuss how it could help you, get in touch with your x-ray dealer. Or if you like, send for a free copy of our booklet, "Radiography as a Foundry Tool."

EASTMAN KODAK COMPANY
X-ray Division
Rochester 4, N.Y.

RADIOGRAPHY...
another important example of Photography at Work

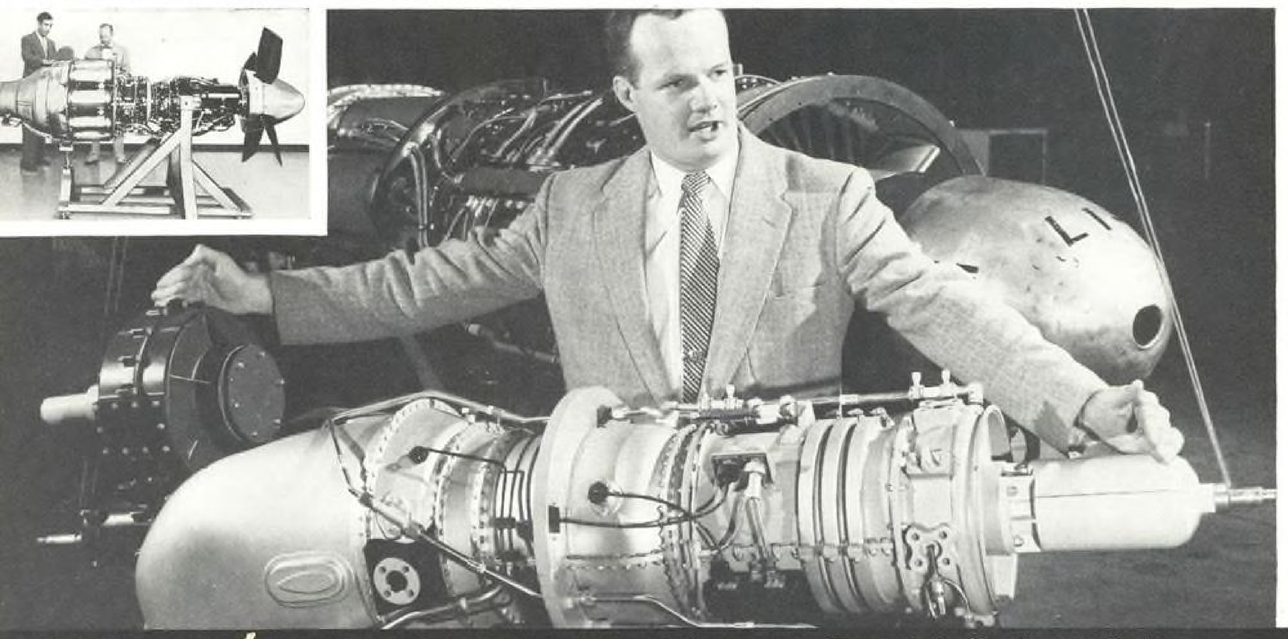
Kodak
TRADE MARK

Four examples of how General in world-wide race

In 1942, G-E jet engines powered America's first jet aircraft, the Bell P-59A. Today, more G-E jets power Air Force planes than all other jet engines combined. The sleek Boeing B-47 bomber uses six G-E J47's. In addition, J47's power the nation's jet fighter mainstay, the North American Aviation F-86 Sabre Jet.

Progress Is Our Most Important Product

GENERAL ELECTRIC

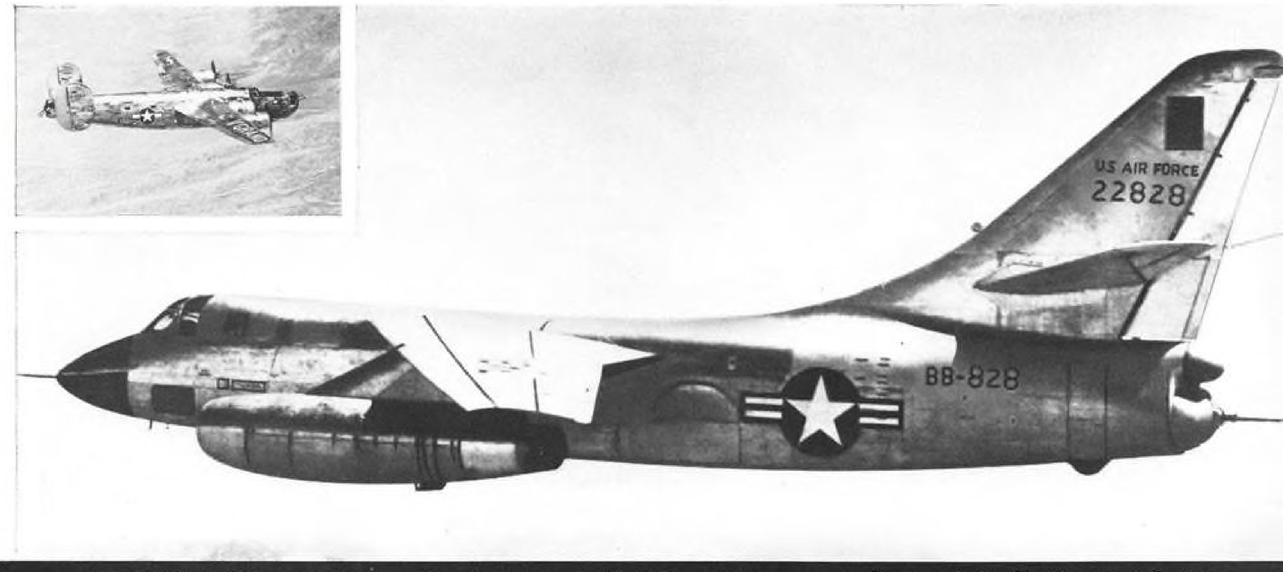


First American turboprop engine built by G.E. had 2150 hp. Today, smaller, more efficient gas turbines promise better, power-to-weight ratio for helicopter and other aircraft applications.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Electric helps U.S. progress for air superiority



World War II "Liberator" had gun turrets powered with G-E amplidyne drives, directed and fired manually. Today, newest TAC bomber B-66 has G-E fire control system which is radar directed by remote control.

Progress Is Our Most Important Product

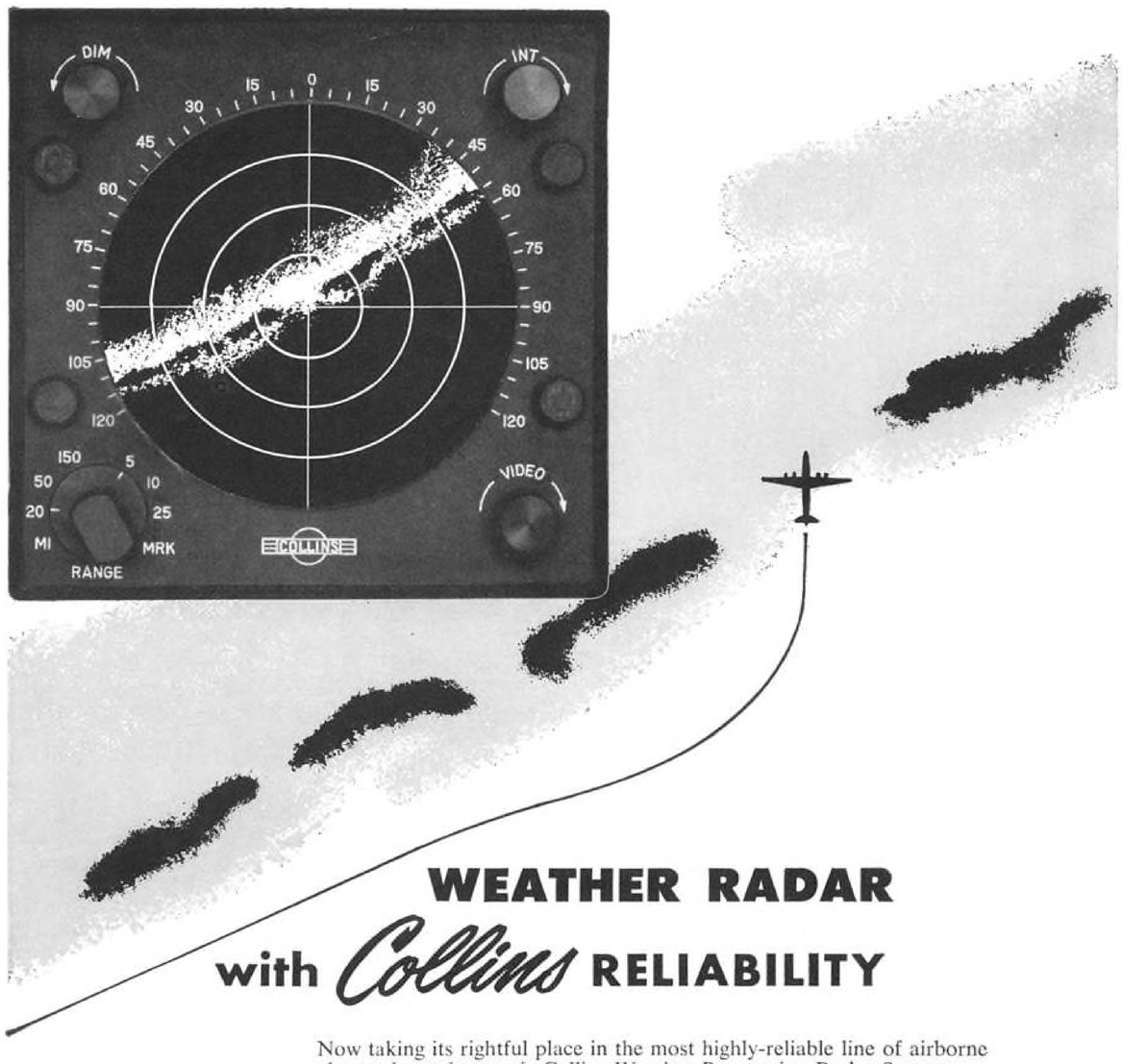
GENERAL ELECTRIC

G.E. supervised test development of V-2 rocket, shown above in first launching from U.S. aircraft carrier. Today, advanced G-E design rockets like the RV-A-10 provide new data on large solid propellant rocket motors for use on guided missiles.

Progress Is Our Most Important Product

GENERAL ELECTRIC

210-98A



WEATHER RADAR
with *Collins* RELIABILITY

Now taking its rightful place in the most highly-reliable line of airborne electronic equipment is Collins Weather Penetrating Radar System, the WP-101. Lightweight and compact, the new System is designed to Arinc specifications and includes in its features: (1) Printed wiring to cut weight and space, to provide uniformity and easier maintenance and to improve reliability (2) A load isolator to minimize the effects of high VSWR with long wave guide runs, thus assuring long life for the magnetron (3) Magnetic amplifier-regulated power supplies to reduce tube requirements, and (4) Modular plug-in type design with readily-accessible test points for simplified maintenance.

Write for Collins WP-101 brochure.

Collins RADIO COMPANY

CREATIVE LEADER IN AVIATION ELECTRONICS

855 35th Street N.E., CEDAR RAPIDS, IOWA
1930 Hi-Line Drive, DALLAS 2, TEXAS
2700 W. Olive Avenue, BURBANK, CALIFORNIA
261 Madison Avenue, NEW YORK 16, NEW YORK
1200 18th Street N.W., WASHINGTON, D.C.

COLLINS RADIO COMPANY OF CANADA, LTD.
77 Metcalfe Street, OTTAWA, ONTARIO

COLLINS RADIO CO. OF ENGLAND, LTD.
Sunflex Works, Colham Mill Road
West Drayton, MIDDLESEX, ENGLAND

SAFETY

trolling and putting out the fire.

One of the items near the end of this list is to close the main fuel tank shutoff valve. Construction of this valve, which was found open, precludes any likelihood of its position being changed because of impact forces. There is no way of determining whether the crew did not reach this item on the checklist or whether by the time they attempted to close the valve its electrical wiring had been so damaged by fire that it was no longer operable. The latter seems the more likely of the two. This valve remaining open unquestionably contributed to the intensity and duration of fire in zone 3 since it permitted gasoline to be released at an appreciable rate.

The Board is of the opinion that consideration should be given to making the closing of this valve one of the first of the "cleanup" items called for in emergency procedures to be followed in the event of fire warning.

Radar tracking of the aircraft showed a change of course to the right approximately 17½ nautical miles from Forney Field, which was probably when the decision was made to attempt an emergency landing there. Inasmuch as the zone 3 fire was not visible from the cockpit, the pilots could not have been aware of its extreme severity. Had they been able to recognize the proximity of fire to the wing spar they undoubtedly would have tried to land immediately, regardless of the facilities available.

Visual Inspection Inadequate

The Board has given much consideration to the evidence in an effort to determine just how an unairworthy cylinder could have been put back in service.

If, as testified, a wear pattern caused by operation of cylinders with broken studs or loose hold-down nuts would be evident to visual inspection, there seems no logical reason why this and other cylinders so operated were passed by inspection regardless of whether the alert tag was on the cylinder when it reached the inspection station. In addition, the reported long-existing difficulty with the metal alert tags should have emphasized the importance of rigid inspection to avoid the possibility of passing faulty cylinders.

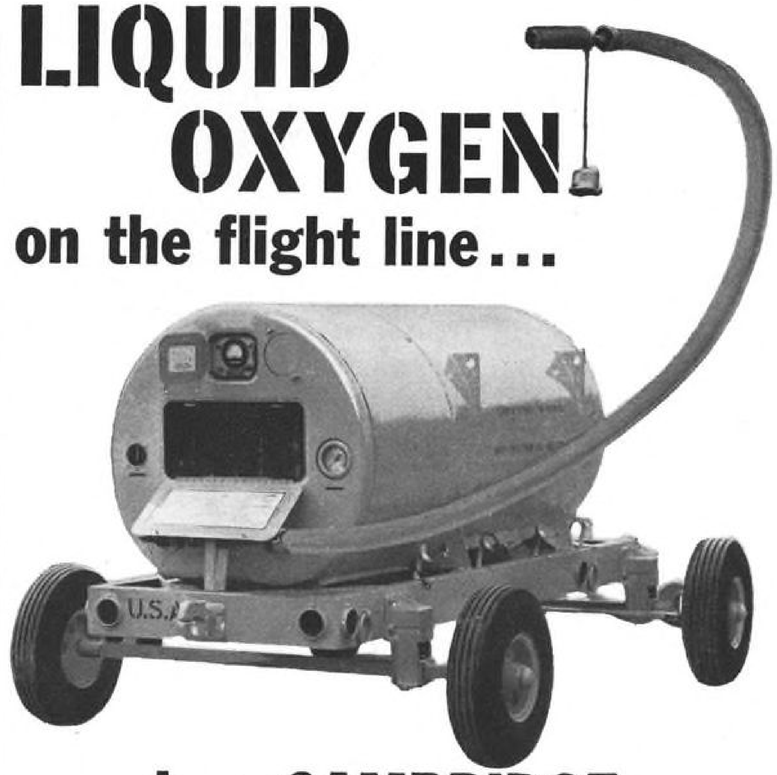
From the fact that cylinders which should have been rejected were returned to service instead, it is obvious that visual inspection alone, dependent on the judgment and evaluation of an individual, is inadequate.

After the accident American Airlines was able from its records to locate these cylinders and remove them from service. However, prior to that time no use was made of the records as a crosscheck to prevent the installation of cylinders that should have been rejected by inspection.

Pratt & Whitney's recommendation that the barrel flanges of all cylinders going through overhaul be checked by use of a surface plate and feeler gauge points up the inadequacy of visual inspection. The Board is of the opinion that had the method of inspection specified in the carrier's overhaul manual and recommended by the manufacturer been followed, cylinders with warped barrel flanges could not have been returned to service inadvertently.

The Board feels that the carrier should have informed the Civil Aeronautics Administration of the revised procedure for

LIQUID OXYGEN
on the flight line...



in a CAMBRIDGE 50 GALLON TRANSPORT DEWAR

Cambridge offers a fully engineered and production proved line of storage and transport dewars for liquified gases. The illustrated example is our 50 gallon liquid oxygen unit featuring quick pressure build up, highly efficient vacuum insulation, and constantly low evaporation rate. Trailer mounting assures mobility and utility.

Cambridge transport dewars provide *liquid oxygen* "ON TAP" on the flight line, when and where you want it. These units are now in volume production for the United States Air Forces.

- **Fully Vacuum insulated...**
- **Additional insulation for reducing radiation loss...**
- **Less than 2.5% evaporation loss per day...**
- **Vacuum leak rate less than one times ten to the minus eight c.c. per second...**
- **Operating pressure build up in less than 1 minute...**
- **Fully protected by relief valves and safety heads...**
- **Excellent Roadability...**
- **Ideal for refilling high altitude breathing apparatus...**

Cambridge

CAMBRIDGE CORPORATION
INDUSTRIAL PARK
LOWELL, MASSACHUSETTS

A PRODUCTION SERVICE TO INDUSTRY

MORE "BARK" THAN "BITE"
in this front . . .
with RCA's new WEATHER RADAR in your plane!

When the weather ahead looks like this, the old rule book says "go around!" But not when you have RCA's AVQ-10 Weather Radar in the business aircraft you are operating. Its scope will point out to you, night or day, or in IFR conditions, nonturbulent paths through or between storm areas that may save time-wasting, costly detours and give you and your traveling companions a smoother, more comfortable ride.

In addition to giving you this "look-see" into the weather as far as 150 miles ahead, the AVQ-10 provides detailed ground-mapping information. It is the first weather radar to use the "C-Band" (5.6 cm) frequency, ideal for storm detection and penetration. Because of its lightness, efficiency and dependability, the AVQ-10 has been specified as standard equipment by many of the world's leading air lines and by operators of business aircraft.

for further information, contact

RADIO CORPORATION of AMERICA
WESTERN OPERATIONS
AVIATION SALES
11819 West Olympic Boulevard Los Angeles, California

SAFETY

inspecting cylinder barrel flanges in order to determine whether it was acceptable to the Administrator.

However, it is difficult to understand why, in their routine inspections, the CAA agents did not become aware that for a period of nearly two years such flanges were not being inspected in accordance with the carrier's overhaul manual.

Following this accident American Airlines took immediate corrective action with respect to its cylinder and fire seal overhaul and inspection procedures.

As previously stated in this report, the barrels of cylinders operated with loose holddown nuts and/or broken studs are now being mutilated upon removal from an engine to preclude the possibility of their being returned to service without rebarreling.

New fire seals are being installed at every overhaul and a more positive check is being made to ensure the effectiveness of the seal.

The aircraft manufacturer also initiated a program to improve the nacelle fire protection in all Convair aircraft, and will issue Service Bulletins on these improvements as they are developed.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The carrier, aircraft, and crew were currently certificated.
2. The gross weight of the aircraft was less than that allowable, and the load was distributed so that the center of gravity was within approved limits.
3. The flight was properly dispatched.
4. Weather was not a factor.
5. No. 12 cylinder of the right engine was not airworthy and failed near its base after less than six hours of operation, causing a fire that the crew could not control.
6. Visual inspection procedures being used by the carrier did not reveal the unairworthy condition of the cylinder.
7. The right main tank fuel shutoff valve was open, which greatly increased the intensity and duration of the fire.
8. Fire damage prevented the closing of this valve.
9. Procedures recommended by the manufacturer and specified in the carrier's overhaul manual had been countermanded by verbal instructions approved by the carrier's engineering department and were not being followed by the carrier's inspectors with respect to the handling of cylinders.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was installation of an unairworthy cylinder, the failure of which resulted in an uncontrollable fire and subsequent loss of a wing in flight.

By the Civil Aeronautics Board:

Ross Rizley
Joseph P. Adams
Josh Lee
Chan Gurney
Harmar D. Denny

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident at 1305 CST, August 4, 1955. An investigation was immediately initiated in accordance with the provisions

If Your Government Contract . . .

. . . or Your Regular Product

Requires MANUALS

- OPERATION
- SERVICE
- OVERHAUL
- PARTS CATALOG
- TRAINING

Call in the McGraw-Hill Technical Writing Service

Whether you need one or a set of manuals written and illustrated precisely to meet Government specifications or whether your products are such that instructions on their proper installation, operation, and service must be provided — Technical Writing Service can do the job for you . . . efficiently . . . effectively . . . economically. Technical knowledge and writing skill are the keynotes of our service.

Write or Phone

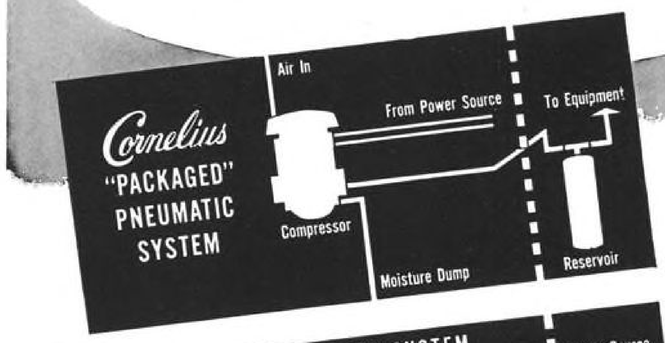
TECHNICAL WRITING SERVICE
McGraw-Hill Book Company, Inc.
330 West 42nd Street
New York 36, New York

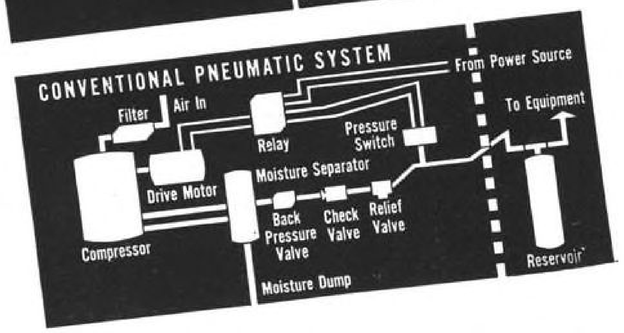
Tel: LOngacre 4-3000

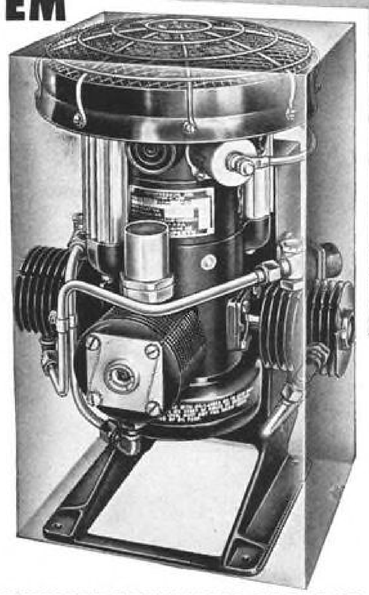
Cornelius

"PACKAGED" PNEUMATIC SYSTEM SAVES WEIGHT and SPACE

In fighters, bombers, aerial tankers, transports, trainers and helicopters







COMPLETE PNEUMATIC PACKAGE

*The Cornelius Compressor, Model 130, 2CFM, 3000 PSI, is used in the McDonnell F2H-3 and F3H, North American FJ-2 and FJ-3, Chance Vought F7U-3, and Grumman F11F-1. Also on order for the Lockheed P2V, Grumman S2F, Martin P5M, Boeing KC135, Boeing B52, Convair Turboprop Airliner and Canadair Britannia. Thousands of service hours under all operational conditions are proof of outstanding performance.

The Cornelius Model 130 compressor* is the heart of the complete Cornelius "packaged" pneumatic system which includes inlet air filter, starting relay, radio noise filter, moisture separator with automatic condensate dump and heating element, back pressure valve, check valve, relief valve and pressure switch.

Compact Design Saves Space—Entire air supply system occupies only slightly more space than compressor alone in conventional system.

Weight Savings of 5 pounds or more are possible by eliminating separate system components, associated tubing, fittings and flare connections.

System Leakage Is Reduced to a minimum because integration of components removes possible leakage sources such as flare connections and o-ring sealed fittings.

System Reliability Is Assured because each integral component is designed specifically to give optimum performance in combination with the other components.

Time Saved by installation and servicing of *one* unit is another valuable benefit which only Cornelius "packaged" pneumatic systems offer.

The Cornelius "packaged" pneumatic systems are available with either DC, AC or hydraulic motor drives. Please write us in order that a Sales Engineer may discuss with you the application of this "packaged" system as well as the many other pneumatic components which we manufacture.

THE CORNELIUS COMPANY 550 - 39th Ave. N. E., Minneapolis 21, Minnesota

SAFETY

of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended, and a public hearing was held in Springfield, Missouri, October 4 and 5, 1955.

Air Carrier

American Airlines, Inc., is a scheduled air carrier incorporated in the State of Delaware with principal offices in New York.

This carrier operates under a currently effective certificate of convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the transportation by air of persons, property, and mail between various points in the United States, including the route on which this accident occurred.

Flight Personnel

Captain Hugh C. Barron, age 45, held a currently effective airline transport certificate with an appropriate rating for the aircraft involved. He was employed by American Airlines on September 1, 1942, and was promoted to captain on June 24, 1945. His flying time totaled about 15,540 hours, approximately 5,000 of which were on CV-240 aircraft.

Captain Barron's last CAA physical examination was April 28, 1955, and his last company physical was May 18, 1955. He had had a rest period of 58 hours prior to his assignment to Flight 476 of August 4, 1955. His last checks on emergency procedures were given April 19, 1955 (oral), and March 29, 1955 (actual practice).

First Officer William G. Gates, age 35, held a currently effective airline transport certificate with an appropriate rating for the aircraft involved. He had flown approximately 8,500 hours, including 2,500 hours in CV-240's. He was employed by American Airlines on July 31, 1944, and qualified as a first officer on October 27, 1944.

First Officer Gates' last CAA physical examination was June 30, 1955, and his last company physical was March 14, 1955. His rest period prior to assignment to Flight 476 of August 4 totaled 58 hours. His last checks on emergency procedures were given June 1, 1955 (oral), and May 26, 1955 (actual practice).

Stewardess Thelma R. Ballard, age 21, was employed by American Airlines on May 21, 1955. Her last check on emergency procedures was given June 10, 1955.

The Aircraft

N 94221, a Convair CV-240, serial No. 40, was manufactured February 28, 1948, and was delivered to American Airlines on March 23, 1948. The airframe had accumulated 14,865 hours, including approximately 6 hours since coming out of American's overhaul base at Tulsa, Oklahoma, on August 3, 1955.

The aircraft was equipped with Pratt & Whitney R-2800-83AM4A engines and Hamilton 43E60 propellers. The left engine, serial No. 54291, had a total time of 13,436 hours, including 31 hours since overhaul. The right engine, serial No. 54484, had a total time of 12,875 hours, with approximately 6 hours since overhaul. It was installed on N 94221 as a replacement engine during the last maintenance-overhaul operation at Tulsa.

DESIGN ENGINEERS
TOOL ENGINEERS
CHEMICAL PROCESS ENGINEERS
STRESS ENGINEERS
WEIGHT ENGINEERS

THE WORLD'S LARGEST PRODUCER OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES INVITES YOU TO ENJOY YOUR WORK AND YOUR LIFE NEAR

beautiful

SAN DIEGO CALIFORNIA

LOFTSMEN
ENGINEERING DRAFTSMEN
TOOL DESIGNERS

ROHR
AIRCRAFT CORPORATION

Please write giving complete details and we will answer immediately.

Mr. Ned DeWitt, *Personnel Department* 23
Rohr Aircraft Corporation
Chula Vista, California

9 miles south of San Diego on sunny San Diego Bay.

Airlines' High Credit Eases Jet Financing

Once-shy investors now optimistic about airlines' future, offer ready backing to expansion plans.

By Alpheus W. Jessup

New York—Finance will not hobble the U. S. air transport industry during its rapid expansion into the jet age.

Between now and the end of 1965, the scheduled and non-scheduled airlines and the all-cargo carriers will receive well over $3 billion in new aircraft of all types. But they will have little difficulty obtaining the cash needed to pay the aircraft manufacturers.

With unexpected speed, arrangements have been completed or are assured to finance payments of $1.5 billion for the Douglas DC-8 and Boeing 707 turbojet and Lockheed Electra turboprop fleets ordered by the airlines in the last nine months.

Why Financing Comes Easy

What's behind the ease with which this multi-billion-dollar expansion is being solved?

Foremost among the many factors, credit ratings in the airline industry at last are on a par with the best of the older, mature industries. Insurance companies, Wall St. investment firms and even the banks agree that the credit of the airlines has never been higher.

Other bases are:

• **Phenomenal growth potential** of air transport. Conservative estimators say the volume of business will double by 1965. Optimists in the industry believe the doubling of 1955's volume of cargo and passenger traffic (AW Jan. 2, p. 56) will come earlier, perhaps by 1961.

• **The short-term assurance** of continued high-load factors, high gross earnings and high net profits. Surprisingly few new transports will be added to the domestic fleets in the next two years. The 129 four-engine and 18 twin-engine transports scheduled for delivery in 1956 will provide fewer seat-miles than the expected increase in seat-mile sales. The same prospect is in store for 1957. This means higher load factors for each of these years and, of course, higher net profits. Importantly, it also means practically no competitive pressure to reduce fares.

• **The limited risk** in purchasing the new, and, as yet untried turbine equipment. If the turboprop and turbojet airliners pan out as promised, the airlines will have more economical transports for high volume operations. If they don't, the airlines' present fleets of piston-engined aircraft (DC-6s, DC-7s, Constellations and Super Constellations) will have a new high earning power.

• **Recognition that the air transport industry** is here to stay. In the past, most investors and executives of investing institutions (such as the insurance companies) have considered the air carriers highly speculative. Suddenly, they have become aware that air transportation is mass transportation, that the industry is big, vital and growing and in need of investment support. They also see that it is backed by a decade of achievement—assets more than doubled to $1.5 billion and net worth tripled to $750 million.

Cost of equipment now on order exceeds the industry's net assets and is more than double its net worth. This and the very size of the purchase sums are forcing the industry into a new, for it, pattern of long-term financing.

In the past, equipment was paid for out of earnings, cash accumulations from fast depreciation and tax amortization certificates, equity financing and short-term bank credits. Even the latter were liquidated rapidly out of earnings. Only infrequently were these methods supplemented by long-term debt, and then the maximum term was 20 years.

Now, the airlines are arranging to borrow money for terms ranging up to 40 years. Bulk of the credits are from insurance companies, and insurance money may be supplemented by bank credits (usually for terms longer than the banks formerly were willing to grant). Later, convertible debentures and equity financing may be used. None of the airlines have expressed interest in the convertible issue (sale of debentures which are convertible at purchasers' option into stock), although Charles Schwartz, of Wall St.'s Bache & Co., says his firm would be willing to handle a convertible issue for any of several airlines.

Equity Financing Unpopular

Equity financing is unattractive for most airlines at this time. Before their stock issues are increased, airline managements believe they must establish satisfactory income (dividend) earnings for owners of outstanding stock.

The long term financing with the insurance companies gives the airlines an opportunity to do just that. By planning financial commitments for new equipment over long periods with stable interest charges and fixed annual repayments, an airline should be able to plan adequate dividend payments. Financing arrangements completed so far include:

• **United Air Lines.** Three insurance companies—Prudential Insurance Co. of America, Mutual Life Insurance Co. of New York and Metropolitan Life Insurance Co. will buy up to $120 million of 4% debentures as needed. Thirty-eight banks, headed by the First National City Bank of New York, are making $30 million credits available until Dec. 31, 1960. The debentures are to be paid off in 1981, and the bank credits over a five-year term after being drawn.

• **Eastern Air Lines.** Equitable is providing Eastern with $90 million at 3.75% interest. The first $50 million was drawn by Eastern last month to retire short-term debts and to make payments on new aircraft. The remaining $40 million will be applied to Eastern's purchase of 40 Lockheed Electras as needed. None of the Equitable money is going for the 18 DC-8s which Eastern has ordered. When advance payments are due, Eastern will use bank credits or seek additional insurance money. Also available are cash and marketable securities in excess of $50 million.

• **American Air Lines.** Metropolitan Life is advancing American $75 million at 4% interest with payments stretched over a thirty year period beginning in 10 years. American also has cash and marketable securities in excess of $50 million available for immediate use.

Pan American World Airways with 45 DC-8s and Boeing 707 Jet Airliners on order has not completed its financing plans. It does not need money until later this year. One factor holding up its financing plans has been the uncertainty regarding subsidies. PAA's financial program is expected to include both insurance and bank money.

Also unheard from is Trans World Airlines which has not yet made commitments for jet aircraft.

Funds For All

Among the smaller airlines, Braniff has obtained assurances of long-term credits from regional banks. Continental Air Lines has given Chase Bank, which has handled its earlier bank loans, the opportunity to come up with a financing plan for its future equipment requirements. Lehman Bros., a Wall St. firm, has assured Continental that other investment sources will be available if the bank declines.

Investment authorities believe that feeder lines, non-scheduled operators and cargo carriers will find ready cash available for their equipment plans. Either medium term credits will be available from local bank groups, or lease-back arrangements can be negotiated with an investing group or possibly with insurance companies. Lease-back deals are attractive inasmuch as the operator can conserve his cash reserves and charge the rental cost off as a direct operating expense.

BEFORE PLACING its $175 million order for 30 Douglas DC-8 jet transports, United Air Lines built this 85-ft.-long wooden mockup of the airliner's fuselage at its San Francisco facility to study seat arrangements, window sizes and passenger facilities.

Board Issues Orders Upholding Decisions in Four Major Cases

Washington—Civil Aeronautics Board upheld nearly all of its original decisions in cases which came up for reconsideration at the end of last year.

The Board made comparatively minor changes when it reconsidered its decisions in the Denver service case, the Southwest renewal case and the New York-Chicago case.

Action was taken by the CAB on several cases in the last few days of 1955. The decisions represented the last action of the 1955 Board, since member Josh Lee's term ended Dec. 31. The year-end rush of decisions produced these results:

• **In the Denver case,** Continental Air Lines' Chicago-Los Angeles nonstop award was upheld, United Air Lines' Kansas City restriction was modified and Western Air Lines' Denver-San Francisco service was further restricted.

• **In the Southwest renewal case,** United Air Lines was permitted to Monterey and Santa Barbara but will still be suspended at Eureka, and Southwest Airways' skip-stop authority was liberalized.

• **In the New York-Chicago case,** United's Pittsburgh restriction was modified and Trans World Airlines was turned down on Pittsburgh-Cleveland service.

• **The system mail rates** proposed for Pan American World Airways were made final.

Permits Development

The CAB rejects contentions that the Chicago-Los Angeles authority granted to Continental in the Denver case was beyond the legal bounds of the proceeding. The Board said that in establishing new services to cover a demonstrated need, it has often included other services in the general route description for which no specific need has been found.

The general policy of the CAB is to award new authority in terms broad enough to permit full development of the new services. Thus, the nonstop authority is included in the new route awarded to Continental, although the route was primarily granted to improve regional service to the points between Chicago and Los Angeles.

The objections of United to the authority granted Western in the case are found to have more merit. The Board has decided to further limit Western's new route to prohibit service to cities north and east of Denver on flights serving both Salt Lake City and Denver.

Western also will be restricted from serving Los Angeles, Las Vegas and San Diego from Denver through Salt Lake City. The Board refused to restrict Western again providing through-plane service via San Francisco from Reno to points north and south of Reno.

Closed Door Restriction

When Kansas City was added to United's system in the Denver case, the carrier was restricted from serving Denver or Chicago on flights serving Kansas City. This restriction is replaced with a closed door restriction which allows United to serve Denver or Chicago on Kansas City flights but prohibits carriage of local traffic between the points.

In modifying the restriction, the Board agrees with United that long-haul service at Kansas City will benefit from the support of Denver and Chicago traffic. Admitting that the closed door restriction is a reversal of recent policy against such devices, the CAB imposed it because it feels there is no other practical alternative which will improve long-haul service and protect Braniff Airways and Continental from diversion of local traffic.

The Board also closed a loophole in the original decision by restricting United from serving Kansas City on flights serving Lincoln, Omaha or Des Moines.

CAB members Chan Gurney and Harmar D. Denny repeated earlier objections to Continental's Denver-Chicago award and TWA's Denver-San Francisco service. They also said they felt that Board acted too hastily in disposing of the petitions for reconsideration before adequate time was allowed for deliberation.

Split Vote

In considering its action in the Southwest renewal case, the Board decided by a 2-2 vote to let United back into the Monterey and Santa Barbara markets. But the four members did agree to reverse their decision on Eureka, Cal., and continue United's suspension at that point for three years.

The Board also decided to allow Southwest a more flexible skip-stop authority. The local airline is permitted to overfly points between terminals as long as the points are scheduled for at least two roundtrip flights a day and as long as flights stop at a minimum of two intermediate points between terminals.

Vice Chairman Joseph P. Adams filed a statement with the decision in which he favored the continued suspen-

sion of United at Monterey and Santa Barbara. In view of the fact that the suspension is lifted, Adams would lift Southwest's operating restrictions to a greater degree in an effort to make the local airline more competitive with United in the two California markets.

Former CAB member Josh Lee decided to reverse his previous action in the case and favor suspension of United at Monterey and Santa Barbara, as well as Eureka. Since United will serve the two points, Lee concurred in the relaxing of restrictions on Southwest, although he doesn't believe such action will make Southwest genuinely competitive with United.

United Route Modified

The Board also modified its decision in the Southwest permanent certification case to make Stockton, Calif., a permanent point in the carrier's system. The action was taken in view of recent traffic records which show that Stockton meets minimum requirements for permanency.

The decision on the New York-Chicago case is actually reconsideration of the issue of Pittsburgh service, deferred from the case for decision with the Denver case. At that time, CAB added Pittsburgh to United's system with the provision that serving the new point originate or terminate west of Chicago.

Pointing out that its intention was to improve service between Pittsburgh and points in the western states and the Pacific Coast rather than build United as a competitor in eastern markets, the Board has decided to modify the restriction to require that flights serving Pittsburgh must originate or terminate at Omaha or beyond.

United will inaugurate service at Pittsburgh Jan. 22.

In its reconsideration of the United award, CAB decided to deny a TWA application for service between Cleveland and Pittsburgh. Observing that recent modification of TWA's routes provided for long-haul services at both Cleveland and Pittsburgh, the Board finds no reason to allow the carrier to provide local service between the two points.

The CAB took final action on Pan American's mail rates after the reply period in its show cause order had elapsed. The Board set final rates for Pan American's entire system for the first time. The new rates per mile are 84.29 cents for the Alaska Division, 50.9 cents for the Atlantic Division, 37.87 cents for the Latin American Division and 47.91 cents for the Pacific Division.

The new rates are effective Jan. 1, 1955. Pan American's mail pay is reduced $8,471,000 for 1955 to reflect gains from equipment sales.

Joint Use of Andrews AFB Stirs Congressional, Airline Opposition

Washington—Commerce Department's plan to use Andrews AFB, Md., as an alternative airport for Washington is headed for strong Congressional and airline opposition.

In a report requested by the Senate Commerce Committee, Secretary of Commerce Sinclair Weeks estimated that Andrews could be expanded over the next four years at a cost of $30 million to accommodate Washington's fast-growing civil air transportation requirements.

Weeks conceded that "joint use might be limiting to a degree to both the civil and the military, but would be feasible for many years to come—to approximately 1980." He argued that "a better operation from an air traffic control standpoint may be had with two airports in the Washington area than with three."

His second choice—a new airport at Burke, Va.—would take an estimated $48 million to develop over the next four years.

Public Authority

Baltimore's Friendship Airport can be used temporarily as a supplementary facility, Weeks said, but is not the long-range solution because it is too far from Washington. In addition, Weeks anticipated that the growth of air traffic will gradually fill Friendship to capacity.

Weeks re-endorsed the idea of a public authority to operate Washington National and the new commercial airport at Andrews on a self-supporting basis.

Sen. Mike Monroney (D.-Okla.), chairman of the Commerce Aviation Subcommittee, pointed out that both House and Senate have already rejected such a plan. Monroney said, "It looks as though we're on the same old merry-go-round." He objects that the delay involved in setting up an authority would mean acute congestion and "invite disaster."

It would require, initially Congressional action, then state legislative action, and finally state participation in financing.

Antagonistic to Andrews

Weeks replied that "the Washington National Airport is not now and will not be operated in the future beyond its safe capacity."

Monroney is also antagonistic to the Andrews location because it would require commercial planes to operate in the same area with military turbojet aircraft.

The Air Force also is expected to oppose joint use of Andrews.

The Commerce recommendation has not yet been approved by the Budget Bureau, but Weeks said that approval "is indicated."

Air Transport Assn. is opposed to both operation by an authority and joint military-civil operations at Andrews.

In addition, Maryland congressmen, are continuing their drive to make Friendship the alternate Washington airport.

Other Opposition

Under Commerce's plan for a $30 million expansion at Andrews, $14 million would be for paving and $8 million for a terminal building.

Monroney claims that former Civil Aeronautics Administrator Fred Lee's opposition to operation by an authority was a major factor in his ouster. In a letter to Weeks, he also referred to premature news stories on the Commerce plan and commented:

"The sudden burst of energy and leaks to the press would seem to indicate that the Department of Commerce, which let the National Airport project smolder for some two years with the threat of a major disaster hanging over the heads of every air traveler every day until our committee stepped in and demanded prompt action, is now trying its best to get out from under the censure that was incurred by its inaction."

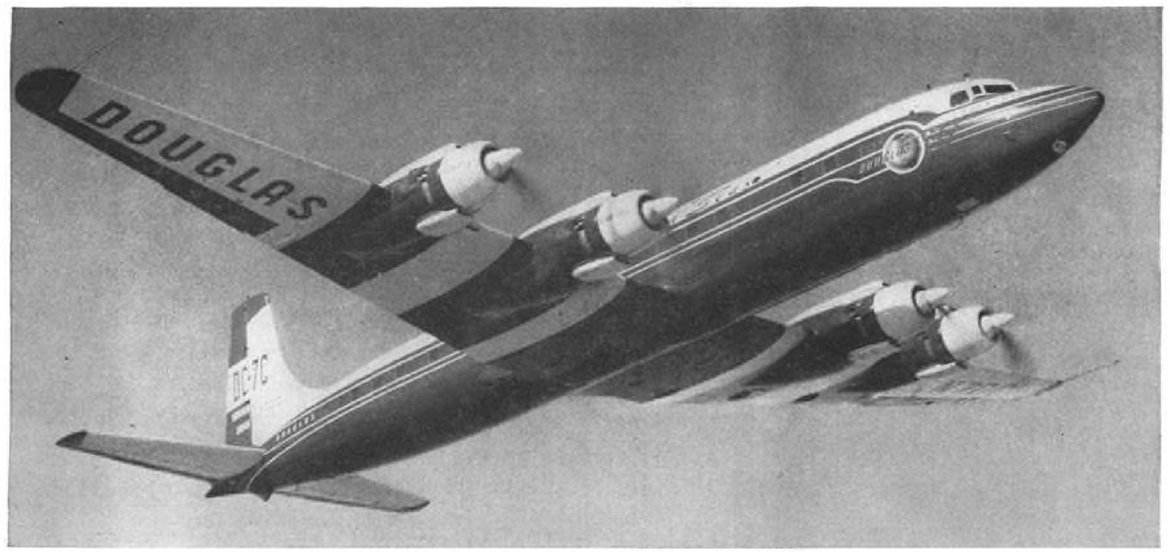
CAA Certificates Doman Helicopter

The Civil Aeronautics Administration last week certificated Doman Helicopters, Inc.'s eight-place LZ-5 helicopter, and the company announced it will begin production of the aircraft without awaiting firm orders.

In the course of its certification reliability trials, the LZ-5, flew approximately 30 hr. over New York Airways routes to fulfill a CAA requirement that it duplicate a typical airline operation.

Doman, who expects orders from several civilian customers now that certification is final, plans to obtain additional financing to enlarge its present plant area.

A company spokesman said that the Air Force also has said it would like to evaluate one of the two Army YH-31 counterparts of the LZ-5 built under a research and development contract.



DOUGLAS has received orders from 10 airlines for its Douglas DC-7C "Seven Seas" whose prototype made its first flight late last month.

Douglas Plans to Place DC-7Cs On Airline Runs by Late Summer

Santa Monica, Calif.—Douglas Aircraft Co. is speeding the test program of its newest long-range transport, the DC-7C "Seven Seas," in order to place the aircraft on regular airline runs by late summer.

The DC-7C prototype, which made its first flight in late December (AW Dec. 26, p. 80), will be joined shortly by at least two more production models so that various phases of the testing program can be carried out simultaneously, thereby reducing the time required to place the "Seven Seas" in airline service. The airliner, incorporating a greater wing span and longer fuselage than any previous Douglas transport, was designed primarily for overseas service. It is scheduled to follow an exhaustive test program requiring 200 hours in the air.

Orders for DC-7Cs have already been placed by Pan American World Airways, Braniff, British Overseas Airways Corp., Swissair, Sabena Belgian, Mexico's CMA, Scandinavian Airlines System, Northwest, Alitalia and KLM.

The new transport has a wing span of 127 ft. 6 in., 10 ft. greater than the DC-7, and an overall length of 112 ft. 3 in., three ft. longer than its predecessors; it's height is 31 ft. 10 in., three ft. taller than the DC-7 vertical tail structure.

The only change in the new transport's specifications from those published when the "Seven Seas" was still on the drawing board (AW Nov. 1, 1954, p. 11) is an added inch to the vertical tail.

The DC-7C will carry up to 85 passengers in various configurations and cruise at 350 mph. over a range of more than 5,000 miles. It will be equipped with weather mapping radar.

Engineering Advances

Major engineering advances incorporated in the DC-7C include:

- **Increased wing span,** added to the center wing section, raises the fuel capacity to 7,860 gallons, compared with the 6,400 gallon capacity of the DC-7B.
- **Engines and propellers** are located five feet further from the fuselage, resulting in a reduction in cabin noise.

Four Wright R-3350 turbo-compound-type engines power the new intercontinental air transport yielding a total of 13,600 take-off horsepower, or a total of 500 greater climb horsepower than the current turbo-compound powerplants. Propellers are four-bladed Hamilton Standards with a 14 ft. diameter.

The "Seven Seas" has been designed for 140,000 lb. take-off and 109,000 lb. landing weight. The deluxe version will carry up to 62 passengers plus baggage, cargo and mail.

Design Refinements

Douglas says the 7C is "one of the aerodynamically cleanest transports ever built." The parasite drag of the Seven Seas head-on is no greater than that of a cylinder, 2.2 in. in diameter, the same length as the wingspan.

The company says this low parasite drag was attained by such various design refinements as:

- **Installation of cowl liners** and aerodynamic spinners, which encase propeller hubs and reduce drag while making more-efficient use of engine cooling air.
- **Two ADF loop antennae,** formerly external appendages, were enclosed within a semi-flush-fiberglas fairing on the under side of the fuselage.
- **The rear navigation light** was streamlined to reduce the drag to one-fifth of that of the light previously used.
- **A measurable gain in speed** was obtained by changing the direction of flow and reducing the orifice for the cabin air exhaust to obtain thrust.
- **The aspect ratio** of the new wing—five feet added on each side of the fuselage inboard the engines—is higher; therefore the wing is aerodynamically more efficient than the old. While the wing and its load of fuel is heavier, the added area gives greater lift.
- **The wing flap linkage** on the "Seven Seas" is the same as the DC-7B with the addition of the two five-foot inboard flaps. These new flaps have 20 in. cut from the outer tips to provide space for an extension of the ailerons to provide additional lateral control.

Typical non-stop commercial routes possible with the "Seven Seas:"

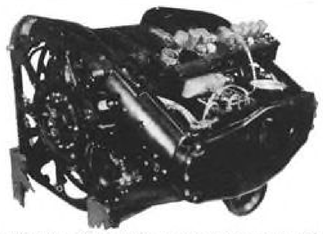
- **Los Angeles to Lima** 4,159 miles; outbound, 12.46 hr., inbound, 12.50.
- **New York to Rio de Janeiro** 4,746 miles; outbound 17.57 hr., inbound 16.52.
- **New York to Paris** 3,620 miles; outbound, 10.01 hr., inbound, 12.44.

for any in-flight refueling system.....

look to the pioneer and leader

FLIGHT REFUELING, INC.

THESE FLIGHT REFUELING, INC., COMPONENTS MAKE UP THE PROBE AND DROGUE REFUELING SYSTEM



A-12 Hose Reel Unit—several hundred gallons per minute rate. Qualification test reports have been submitted to WADC. Standard U. S. Navy equipment, modification available for wing-tip mounting.

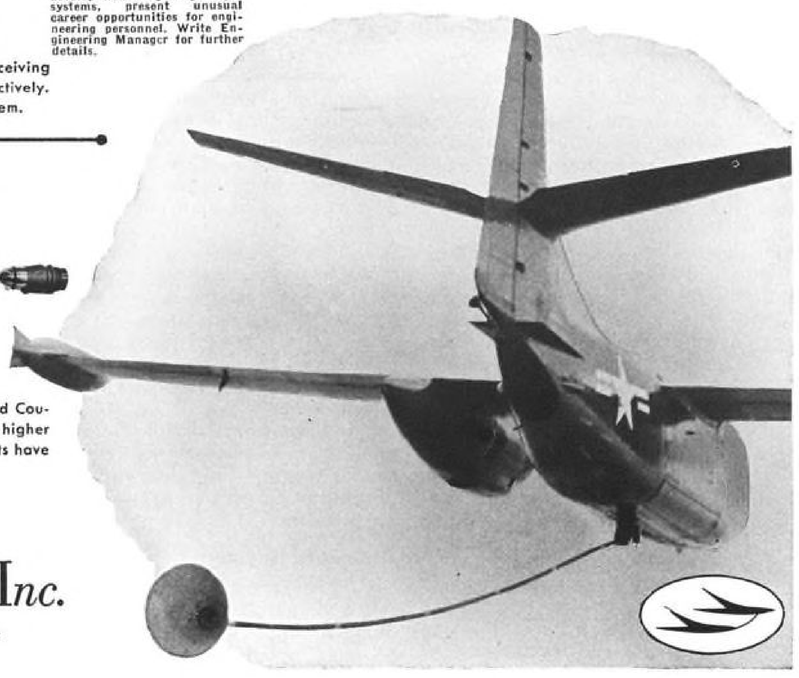
A-1 Nozzle, A-3 Coupling used in receiving aircraft and in drogue tanker respectively. In use with U. S. Navy refueling system.

MA-2 Nozzle for receiver aircraft and Coupling, mounted in drogue unit, with higher rate of flow. Qualification test reports have been submitted to WADC.

The Probe and Drogue refueling system, developed and manufactured by Flight Refueling, Inc., has been used extensively by the United States Navy. This system employs the A-12 hose reel unit, the A-1 nozzle, A-3 coupling, and drogue unit. In addition, Flight Refueling, Inc., has submitted qualification test reports to the USAF for an improved A-12 type refueling unit for multi-point tanker installation, and likewise for a refueling unit of even higher capacity. These units are already in production and will shortly go into service in aircraft of the Tactical Air Command.

Flight Refueling's engineering department is working closely with many leading aircraft manufacturers to assist them in developing new refueling systems, today's universal requirement to give modern jets extended range and load-carrying capacity. If you would like more information on Flight Refueling, Inc.'s equipment or facilities, just drop a note to Contracts Administration Department.

ATTENTION ENGINEERS
Fascinating, new projects to develop new long-range flight systems, present unusual career opportunities for engineering personnel. Write Engineering Manager for further details.



Flight Refueling, Inc.

FRIENDSHIP INTERNATIONAL AIRPORT
Baltimore 3, Maryland

Scheduled Lines Appeal to Court:

Status of Irregulars Remains in Doubt

Washington—Civil Aeronautics Board is standing by its controversial decision in the Large Irregular Case, but the status of the new Supplemental Air Carriers remains in doubt as the scheduled airlines carried their fight into the U.S. Court of Appeals.

The Board upheld its irregular carrier decision by a 3-2 vote after refusing to extend procedural deadlines into the new year. The reconsideration action came at the end of 1955 as the term of member Josh Lee, one of the majority, ended.

On the last business day of the year, the Court of Appeals issued a restraining order, requested by certificated carriers, which stayed effectiveness of the decision until Jan. 15. The order was issued with the consent of the CAB.

During the 15-day period, the Court will hear arguments on a stay requested by scheduled airlines which have asked for judicial review of the decision.

Submitted to White House

In a separate action, the Board stayed sections of the decision relating to international operations of the Supplemental Air Carriers for possible White House review. These sections are stayed until the White House either declines to comment or submits an opinion for CAB action.

The Board found that Presidential approval isn't necessary, but the international portion of the decision is being submitted to the White House for comment because it may affect military or foreign affairs. The irregular carriers are authorized to operate in the international sphere under their old exemption authority until the issue is settled.

On reconsideration of its decision in the air exchange case, the Board decided to reverse its earlier position and allow the certificated cargo carriers to participate in exchange activities. The exchange plans submitted by the Aircoach Transport Assn. and the Independent Military Air Transport Assn. were approved with some modification.

In its appeal to the Court, American Airlines asked that the large irregular decision be set aside. The carrier claims the decision is based on an incomplete record, as well as "erroneous readings of the evidence of record, misconception of the facts, findings which are not supported by the evidence and findings which are contrary to the evidence."

American said that the CAB action is a grant which is not authorized by any provision of the Civil Aeronautics Act and which permits a type of operation not contemplated by the proceeding.

American also attacked the Board for not allowing additional time to prepare reconsideration petitions and for not postponing the effective date of the decision.

In a dissent filed with the reconsideration order, CAB members Chan Gurney and Harmar Denny said they felt "it is unreasonable and unfair to have proceeded with such haste" in disposing of the issues raised in the petitions for reconsiderations.

Gurney and Denny said the Board should have proceeded with more deliberation in its reconsideration action. The two dissenting members pointed out that the Board met Dec. 16, the day after petitions were filed, and instructed the staff to prepare a final order. The deadline for answers was Dec. 27, and the Board met Dec. 29 to ratify its earlier decision. Gurney and Denny noted that "it is most unusual for the Board to attempt to dispose of major issues on reconsideration in such hasty, cursory fashion."

Answering these charges, the majority said it thinks the public and the applicants are entitled to prompt and expeditious disposition of the case. The opinion points out that after oral argument was held last July, the case was under consideration until November when the decision was issued. Then the usual thirty day period was provided for petitions for reconsideration and ten days for answers to the petitions.

Petitions Refused

The majority points out that it was after these procedural periods that final decision was reached and that the Board members had full opportunity to appraise all the documents and present their views. "Neither due process nor any other principles of fairness require any more," they said.

In turning down the petitions for reconsideration, the CAB majority strongly reaffirmed its findings in the original decision, and denied that the authority granted was outside the scope of the case. "Whether the operating authority we have granted is additional and supplemental is not a matter of semantics or of refined academic definition. Rather, it is to be determined by the need and function to be served by such authority and by the economic impact which it would have on the certificated carriers," the majority said.

Exclusion from the case of the possibility of granting of authority to operate about the same number of flights authorized under the old regulations would have been pre-judging the case before a hearing was held, according to the Board, which concluded that the ten flight rule is within the scope of the case.

The CAB also rejects contentions that the new authority will allow the supplemental carriers to flood air markets with individually sold business. The Board observes that the petitions repeat arguments that suplemental carriers will be able to operate 490 flights a month between pairs of points.

'Curious Results'

Noting that American Airlines calculates that three supplemental carriers could duplicate the best current coach schedules in 59 markets, the Board said "such hypothetical perversion of the factual realities leads to curious results. It must be remembered that each of the 63 irregulars who held operating authority at the inception of this proceeding was permitted to operate a minimum of approximately eight flights per month in each direction between any pair of points, or a total of 504 such flights per month."

"In other words, under their existing authorizations, but subject to prohibitions against individual regularity, they could have flooded the market with more frequencies than it is argued they would do under the new authorizations. Yet they have not done so for the simple reason that it would have been uneconomical for them to attempt such operations in the face of established certificated competition," the CAB said.

The Board said the certificated carriers haven't paid sufficient attention to the fact that the CAB has retained power to decrease the frequencies al-

Ralph S. Damon

Ralph S. Damon, 58, president of Trans World Airlines since 1949 and a leading aviation figure for the last 25 years, died of pneumonia last week at Nassau Hospital, Mineola, L. I., N. Y.

Before assuming the presidency of TWA, Damon had served as president of American Airlines (1945-1949), Republic Aviation Corp. (during World War II) and of the Curtiss Aeroplane and Motor Co. He was a member of the National Advisory Committee for Aeronautics and a recipient of the Spirit of St. Louis Medal awarded by the American Society of Mechanical Engineers. Surviving are his wife and four children.

NOTHING STRIKES so brutally at human lives as a slum.

Yet of America's many millions of homes, the blot that is a slum covers more than 1 out of every 10 . . . and nearly one-half of all our homes are urgently in need of repair and basic improvements.

Will the blot go on spreading? Or will a concerted, nationwide attack on the causes of slums shrink it, year by year, until it is wiped out? Today, this is a challenge to every American . . . a challenge that *must* be met.

Your community . . . your problem!

A slum reaches across blocks, across miles, to sit on your doorstep and demand a price.

You pay it in the threat of crime and juvenile delinquency to your family. You pay the price in higher personal property taxes to fight the disease and crime and poverty that are slum-bred. You pay personally when the value of your home sinks as community deterioration takes another step closer.

Your *firm* pays when the community where you do business goes downhill. Slums automatically mean lower purchasing power and less effective labor.

Good citizenship is good business

It's good citizenship and good business both for your firm to join efforts to check housing decay . . . to stop slums before they start. In fact, it's the *responsibility* of every business, as it is of every other good citizen, to support community improvement efforts.

Some slums are beyond repair. They should be torn down and a fresh start made. Others can be remodeled, made to conform to better living standards. So it is up to you to get behind every sound program which seeks to provide adequate housing for all our people.

Adding your support to the efforts of the millions already attacking the problem, your firm can help stop slums cold and put America's housing standards at a new height.

How to get into action

A group of Americans from every walk of life has formed a new, non-profit organization to help combat home and community deterioration — The American Council To Improve Our Neighborhoods . . . A.C.T.I.O.N.

Send for a free copy of "ACTION." It explains what A.C.T.I.O.N. is and proposes to do. It also lists booklets, research reports, check-lists, and other material which can help you protect the housing health of your community. Address P. O. Box 500, Radio City Station, New York 20, N. Y.

ACTION

American Council To Improve Our Neighborhoods

lowed to the supplemental carriers. The petitions of the scheduled airlines virtually ignore this power and argue as if the Board no longer could regulate the operations of supplemental carriers, the opinion said.

The Board criticized the petitioners for attempting to split the supplemental carriers into various categories, such as domestic and international. The CAB said it has always regarded these carriers as a single class of airlines which perform a wide variety of services and have the flexibility to switch from one area or type of service to another as the demand for air service shifts.

Increases Flexibility

The original order in the case was altered to provide for the effectiveness of cease and desist or suspension orders against irregular carriers listed in the decision for the new authority.

In the air exchange case, the CAB originally decided to exclude the certificated cargo airlines which are IMATA members from participating in the air exchange. The Board decided to reverse this stand and permit the cargo lines to join the exchanges.

In changing its position, the Board reasoned that there is little fear that Slick Airways or Flying Tiger Line will dominate the exchange or curtail their independent sales efforts. The use of the exchange by the cargo lines will increase flexibility of both civilian and military charter activities and provide a wider choice of equipment to the chartering public, according to the CAB.

When it approved the air exchange concept, the Board instructed ACTA and IMATA to submit more detailed plans for operation of their exchanges. These plans have been filed and the Board approved them subject to several conditions designed to protect the individual rights of the carriers involved.

Delta, Braniff, TWA Ready New Services Between East, Southwest

Three airlines will inaugurate service on new routes between the East and points in the West and Southwest next month.

The new services, announced by Trans World Airlines, Delta Air Lines and Braniff Airways, stem from route awards made by the Civil Aeronautics Board in the recent Southwest-Northeast and Denver Service cases.

On Feb. 1, Delta will begin first-class and coach service to New York and Washington from Dallas, Ft. Worth, New Orleans and Atlanta, using DC-6s and DC-7s. In April, Houston, Charlotte, Baltimore, Philadelphia and other cities on Delta's routes will be added to the New York schedule. Other services will be added as new aircraft are delivered, beginning this summer.

TWA will start 10 new flights Feb. 1, serving Denver, Oklahoma City and Tulsa. This will give Denver its first competitive service to the East and West Coasts. Until now United Air Lines has had exclusive transcontinental service there. TWA has had a similar monopoly in Kansas City, but United was awarded the point in the Denver case.

Initially, Denver will get six first-class and tourist flights using Constellations and Super Constellations, including nonstop flights to and from Los Angeles, San Francisco and Chicago. Nonstop flights to New York and Washington will be added later with Super-G Constellations.

Two new first-class and two new tourist flights daily, all on Constellations, will link Oklahoma City and Tulsa with such intermediate points as Cleveland, St. Louis and Pittsburgh, and will include a nonstop from Tulsa to New York. Spring and summer schedules will bring additional service.

Braniff will begin daily round trip flights to New York from San Antonio, Ft. Worth and Dallas on Feb. 15, using DC-6s.

The first-class San Antonio flight will stop in Dallas and then fly nonstop. The Ft. Worth flight, also first-class, will stop in Dallas, Nashville and Washington. A coach flight from Dallas will stop only in Washington.

Return flights are New York to Dallas and on to Ft. Worth; New York to San Antonio via Washington, Nashville, Dallas and Ft. Worth; and a coach flight from New York to Dallas via Washington.

Braniff will serve New York through Newark airport. In April, Braniff will put Convair 340s into service from San Antonio to Chattanooga via Austin, Waco, Ft. Worth, Dallas and Memphis. Additional service to Memphis and Chattanooga and on to Washington and New York will be added when more equipment is available.

United Air Lines to Add N. Y.-Pittsburgh Service

United Air Lines will inaugurate service between New York and Pittsburgh beginning Jan. 22 first class, coach passenger and cargo services will be offered. United will use DC-7s, DC-6s and ConvairLiners on this route.

CAA Will Modify Airport Radar Units

Washington—Civil Aeronautics Administration will modify 25 airport surveillance radars (ASR) by conversion to circular polarization. The modification program, ordered by Charles J. Lowen, CAA Administrator, will start in June when kits have been manufactured.

CAA expects to issue specifications for the kits and invite bids in about six weeks. In the meantime, a joint Air Force-Air Navigation Development Board test evaluation is to be completed with equipment manufactured by Airborne Instrument Laboratory.

Purpose of CAA's modification program is to improve displays on ASR under unfavorable weather conditions. At the present time an aircraft behind or in a storm front often fails to show as a "return" on the radar scope. Circular polarization of the radar antenna is a partial answer to this problem. Technically, the modification changes the existing method of polarization from vertical or horizontal to an omnidirectional combination or circular polarization.

When the radars are converted to circular polarization, aircraft operating in the vicinity of storms will be seen more clearly by CAA traffic controllers and thus permit better and more efficient traffic control when it is most needed. There are 25 existing ASR installations programmed for the change.

Initially, however, CAA will modify eight radars at these high density locations: Boston, Cleveland, Chicago (O'Hare), Atlanta, New York (LaGuardia and Idlewild), Washington and Los Angeles.

Houston-California Interchange Approved

Renewal of two Houston-California interchange operations has been recommended by Civil Aeronautics Board Examiner Ferdinand D. Moran.

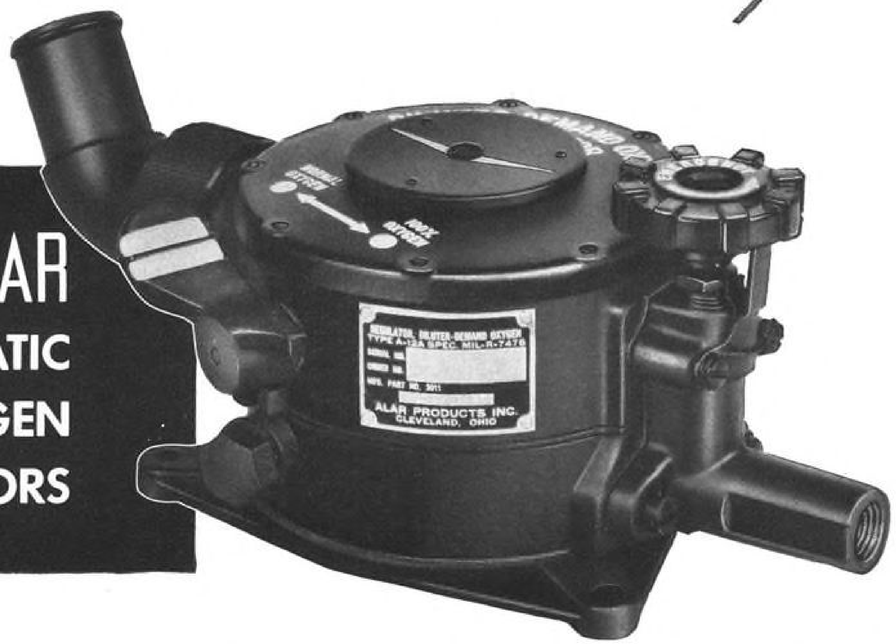
The examiner favors renewal of Continental Air Lines' authority to the West Coast has CAB approval.

Moran also recommends that approval of the Trans World Airlines-Braniff Airways interchange from Houston to California be extended for an indefinite period. He favors lifting of a frequency limitation on the TWA-Braniff interchange.

The report suggests that the Board retain jurisdiction over the TWA-Braniff interchange to the extent of requiring the carriers to file periodic reports on results in future operations.

Continental and American started their interchange operations between Houston and Los Angeles via San Antonio and El Paso in 1951.

crewmen *breathe easy...*



with ALAR AUTOMATIC OXYGEN REGULATORS

Passengers and crewmen breathe freely and think clearly . . . in planes equipped with Alar. Because regardless of the altitude, Alar Regulators automatically supply the oxygen needed to properly maintain muscular and mental coordination. Manufactured in a full range of models to meet every requirement . . . Alar regulating units are precision made to insure absolute dependability . . . and field-proven by millions of hours under all kinds of flying conditions. Write for illustrated catalog today.

The Alar instruments shown below, include, left to right . . . (1) Diluter Demand Oxygen Regulator; (2) Automatic Low Pressure Continuous Flow Oxygen Regulator, 15 man capacity; (3) Pressure Breathing Oxygen Regulator; (4) Automatic High Pressure Oxygen Regulator, 20 man capacity; (5) Anti-G Suit Pressure Regulating Valve; (6) Automatic High Pressure Oxygen Regulator with added port for emergency use.

Specialists in the design and development of dependable pressure regulating instruments

ALAR PRODUCTS • INC.

1071 POWER AVENUE • CLEVELAND 14, OHIO

New York Heliport Development Stymied By Inter-Agency Battle

By Henry Lefer

New York—Whether or not New York Airways will be able to operate helicopters from a downtown passenger heliport within the near future depends upon the resolution of a two-year-old squabble between New York's Commissioner of Marine and Aviation and the Port of New York Authority over the form such a heliport should take (AW Aug. 29, p. 85).

However, a conflicting series of moves and countermoves by the contesting parties as 1955 came to a close made it appear that this was one resolution the new year might not bring. Among them:

• **Commissioner Vincent A. G. O'Connor** said the CAA had "expressed clear-cut approval" of the Department of Marine and Aviation's proposal for a rooftop heliport at the foot of 30th St. and the Hudson River, as shown by a favorable report by Regional Administrator Ora W. Young on a study prepared for the department by a firm of engineering consultants.

• **CAA Administrator Charles J. Lowen** denied that his agency had taken any official position with regard to New York's heliport. He said: "CAA's only official connection with a heliport site will be when we are asked to approve air carrier operations to such a point." In the meantime, he urged that a site be selected at the earliest possible date, pointing out that European cities already are enjoying downtown helicopter service.

• **Austin J. Tobin,** executive director of the Port Authority, denounced O'Connor's plan as "juvenile" and "a waste of the taxpayers' money," questioned the competence of the consulting engineers who prepared the study for O'Connor's department, and quoted a number of helicopter experts in support of the Port Authority's proposal for a ground-level strip on the river's edge.

• **Robert L. Cummings, Jr.,** president of New York Airways, Jack E. Gallagher, NYA's chief engineer and operations manager, and D. Leroy du Vivier, Sabena Belgian World Airlines' general manager for North America came out strongly in favor of the Port Authority's proposal.

Rooftop Proposal

The main points made by the Department of Marine and Aviation's report are that operations from a rooftop heliport situated over the water would be safer because of the proximity of the West Side Elevated Highway, would permit greater frequency of operation and would permit use of the building under the heliport as a rent-producing riverside freight terminal.

'Outstanding Reputation'

O'Connor said the firm which prepared the report, Frederic R. Harris, Inc., "has an outstanding and world-wide reputation for the design of aircraft landing fields . . . and is leading a team of engineering firms in the design of a $500-million air base program for the United States Government in Spain." O'Connor also said the Harris firm "served as consultants to the Port of New York Authority on maintenance and rehabilitation of La-Guardia and Newark Airports."

Maj Alexander P. de Seversky, retained by the Harris firm, supports the Department of Marine and Aviation proposal as being safer and more suitable for future expansion than the Port Authority's plan.

Howard S. Cullman, honorary director of the Port Authority, claimed that to his knowledge the Harris firm "is not recognized as an expert on aeronautical or helicopter operations." Adm. Harris, now deceased, was employed in a personal capacity by the Port Authority, Cullman said, with regard to soil stabilization problems, but "the firm has never advised the Port Authority on aeronautical operations. We have not and would not engage it as an aeronautical consultant."

Ground-Level Strip

A point-by-point rebuttal of the Harris report's conclusions was made by New York Airways' Gallagher at a meeting that was called by the Port Authority.

He claimed that the Harris firm, being unaware of helicopter operations problems, ignored the important "ground cushion" effect. When this is taken into account, he said, all of the factors which appear to favor the rooftop heliport proposal actually favor the ground landing strip.

The Port Authority landing strip would be nothing more than a landing pad, Gallagher said, with the helicopters "water-taxiing" in on the ground cushion of air to the street-level landing field.

All landing and takeoff maneuvers would be over water. In case of engine failure, the helicopter could drop the few feet to the water with no damage to its flotation gear.

On the other hand, Gallagher said, operating from the elevated rooftop site proposed by O'Connor would be potentially dangerous. In case of power failure on takeoff, the 30-ft. drop to the water could be very serious. Furthermore, Gallagher blasted the Harris report as being based on the performance of the Sikorsky S-55, whereas New York Airways expects to be operating more powerful S-58s by the end of the summer.

Gallagher said that comparison of New York Airways' proposed operation from the river shore with Sabena's helicopter service at Liege shows that wind conditions would be similar, and that these indicate that use of a ground-level strip would be safer and permit greater frequency of service than the rooftop heliport.

Tobin pointed out that to combine a freight-forwarding terminal and a heliport would be unwise from two standpoints: safety and the congestion of freight vehicles and helicopter terminal traffic.

He further suggested that a freight terminal could be built along the river near the heliport, so the city would not lose the rental from the freight forwarding company.

Temporary Heliport

Both the Port Authority and New York Airways see the proposed heliport as a temporary affair, to gather operational data before a larger permanent field is built. As the data is developed, it may be necessary to build the heliport 10 ft. or 50 ft. above ground level, Tobin said. "We just don't know now," he added.

For this reason, the Port Authority believes it is much wiser to build its own version of a heliport, costing $50,000, rather than the Department of Marine and Aviation's $1-million freight terminal-heliport, which may not lend itself to expansion to meet the needs of helicopter passenger traffic a few years from now.

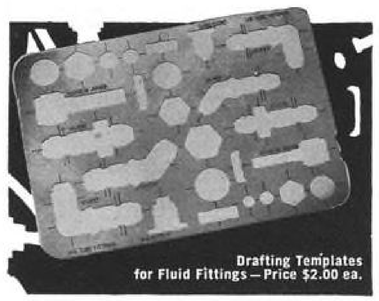
The Port Authority says most helicopter experts back its proposal for a ground-level strip.

20 Lockheed Electras Ordered by National

National Airlines has ordered 20 Lockheed Electra turboprop transports for delivery beginning in April, 1959.

This brings the orders for Electras to 104. Eastern Air Lines has ordered 40, American Airlines 35 and Braniff Airways 9, Eastern holds options for 30 and American for 35.

National had announced orders for six Douglas DC-8 turbojet transports as part of a $100 million jet equipment program. It expects delivery of four DC-8s and 12 Electras in 1959 and the balance in 1960.



ENGINEERS, DRAFTSMEN—

Draw fluid fittings in 1/10 the time with TWOMEY DRAFTING TEMPLATES

Strict conformance to military and engineering specifications. Precise, economical and easy to use. Four fluid fitting size ranges—each on a separate template, sizes and numbers as follows: 3/16" & 5/16"—#17. ¼" & ⅜"—#18, ½"—#19, ¾"—#20. Pay for themselves in no time. Help you produce better, faster, more accurate work with less fatigue. Many other types of templates available—circles, ellipses, nuts and bolts, tooling, lettering, sheet thickness, etc.—the most complete line on the market. Designed by Douglas Aircraft Co., Inc.—now used in all industries. Save time, money and temper. Write today for complete information, or see your engineering supply dealer.

Drafting Templates for All Purposes

DEALER INQUIRIES INVITED

E.F. TWOMEY CO. Inc.
726 W. 10th Place
Los Angeles 15, Calif.

changed

your

ADDRESS?

Let us know so that we can keep copies of AVIATION WEEK coming promptly.

To: AVIATION WEEK,
Subscription Service,
330 West 42nd St.,
New York 36, N. Y.

Please change the address of my AVIATION WEEK subscription.

Name .....

OLD Address .....

NEW Address .....

New Company Connection .....

New Title or Position .....

Special Cargo Code Developed by IATA

Scheduled airline members of the International Air Transport Assn. have put into effect the first world-wide code governing the carriage, handling and labelling of special cargoes of airfreight.

The code, which includes standard designs for special symbols to label various types of cargo, has been approved by the various interested governments. It was developed over a five-year period.

The code lists more than 2,000 types of cargo which require special handling and prescribes proper packing, handling methods, stowage and labelling for each.

IATA's special labels are basically pictorial in order to avoid any confusion of language on the worldwide air transport network. Poisons are represented by a skull and bones, explosives by a bursting bomb, radioactive substances by a cloud emitting jagged lightning rays.

As a result of the acceptance of the IATA code, it is now possible to move shipments of these so-called "restricted articles" freely over interline routings involving the services of more than one airline, without repacking or re-labelling and with complete understanding by all personnel.

CAB Orders

(Dec. 22-28)

GRANTED:

Allegheny Airlines an extension of its exemption to overfly Altoona and Johnstown, Pa. Allegheny must serve the two cities on at least four roundtrip flights daily and must provide a daily westbound flight from Clearfield-Dubois-Philipsburg to Pittsburgh via Johnstown, as well as one daily single-plane roundtrip flight between Johnstown and Altoona, and Scranton/Wilkes Barre and New York/Newark.

Delta Air Lines an extension of the effective date of its suspension at Tyler and Longview/Kilgore/Gladewater from Dec. 31, 1955 to Jan. 1, 1956 to coincide with a periodic schedule revision.

Aero Finance an exemption to perform three round trip charter flights from Sarasota, Fla., to Havana pursuant to a contract with Ringling Bros., Barnum and Bailey Circus.

APPROVED:

Seaboard and Western Airlines' revision of its service plan to include Nuremburg and Wiesbaden, Germany.

ORDERED:

Action deferred on resolutions between various carriers adopted by the International Air Transport Assn. relating to changes in fares. Parties to the agreements are allowed 15 days to comment.

Suspension and investigation of excursion fares between Burbank, Cal., and Newark, New York and Philadelphia filed by Aero Finance Corp. and Peninsular Air Transport.

DENIED:

Currey Air Transport and Great Lakes Airlines' petition for reconsideration of a CAB decision to explore the relationship, if any, between the two carriers.

Shortlines

► **British Overseas Airways Corp.** reported a net profit of $750,400 for the first eight months of operation on the current fiscal year.

► **Guest Airways,** first Mexican airline to receive the right to fly into Canada, will initiate service between Mexico City and Windsor, Canada, on Feb. 2. Beginning with twice weekly service over the six hr., 55 min. route, Guest hopes to add a third round-trip flight next summer.

► **KLM Royal Dutch Airlines** has increased all-cargo service across the North Atlantic to three flights a week. Cargo service on the Amsterdam-London route has been increased to 12 flights a week.

► **Lebanon** is pressing a policy of not employing foreigners except in emergencies, and the directors of the Lebanese Civil Airport have decided to discharge several foreign experts and hire Lebanese to replace them.

► **Sabena Belgian World Airlines** has opened a second office in Canada, at 67 Yonge St., Toronto. Sabena is expanding its traffic development activities in Canada, although no flights as yet originate at either Toronto or Montreal where its first office is located.

► **Trans World Airlines** has started combination-class Super-G Constellation service between New York and Paris and Rome with three flights a week in each direction.

► **Trans World Airlines** started selling package theatre tours Jan. 2. The tours, which start at $49.50, include theatre tickets, hotel accommodations and transportation. Capital Airlines started a similar service on a charter basis in October (AW Nov. 21, p. 111).

► **Western Air Lines** has a special sales program aimed at convention delegates. Direct mail and personal contact are used by the airline to convince delegates they should use Western in traveling to their meetings. Western reports about a third of the delegates contacted traveled on Western.

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

RATES

UNDISPLAYED: $2.10 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
BOX NUMBERS count as one line additional in undisplayed ads.
DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads.

DISPLAYED: The advertising rate is $21.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

Closing date is 11 days before issue date, subject to space limitations. Send new ads to New York office, 330 W. 42nd St., New York 36, N. Y.

keep your weather eye out for
Weather Eye
smaller lighter Flight RADAR
custom fitted to your plane
P. O. Box Bridgeton, Mo.

SPECIAL SERVICES TO THE AVIATION INDUSTRY

OVERHAUL & MAINTENANCE

Remmert-Werner
Inc. of ST. LOUIS Lambert Field — Inc. of TOLEDO Express Airport
Specialists in
DC3
LODESTAR — TWIN BEECH
Maintenance Inspection — Overhaul Conversion

PARTS & SUPPLIES

PBY PARTS—*NEW!*
Power Egg components immediately available at our warehouse

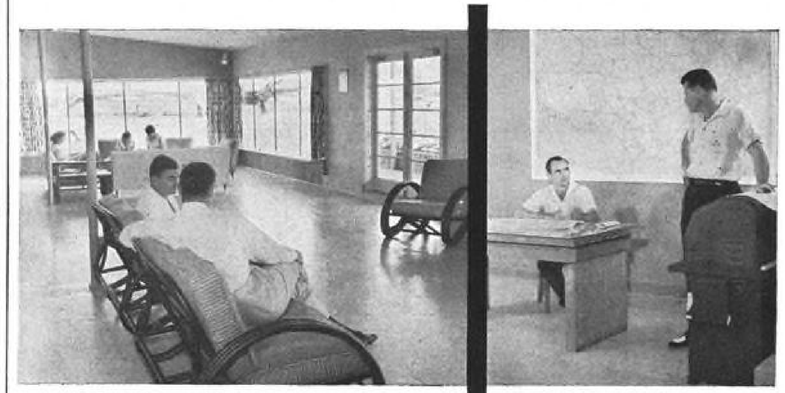
28-P-5100	Quick Change units
28-P-5142	Exhaust Collectors
28D5000-3	Cowlings complete, L or R
U6012CS130	Oil Coolers
28-P-5520	Oil Cooler Scoops
28-P-5000	Engine Mounts
3P207JA	Vacuum Pumps

New detail parts of all these components also available at big savings—write for quotations

Lund Aviation, inc.
230 Park Ave., N.Y.C. MUrray Hill 9-3620

NAVCO INC. Lambert Field, St. Louis, Mo. PErshing 1-1710
Has all Parts and Supplies for Executive DC-3 LODESTAR BEECH
Airframe — Engines — Radios
A.R.C. Bendix Collins Lear Sperry Wilcox
P&W Continental Wright Goodrich Goodyear

NOW IN MIAMI
NEW! Service for Executive Aircraft Owners, Passengers, Pilots



Spacious, Air-Conditioned LOUNGE — Pilot Flight-Planning FACILITIES

Taxi up . . . park . . . and step into our cool, comfortable lounge—especially designed for you. Open 24 hours a day—every day—and offering every convenience to passenger and pilot. Weather maps and teletype, rent-a-car service, hotel reservations.

L. B. Smith AIRCRAFT CORPORATION
INTERNATIONAL AIRPORT, MIAMI 48, FLORIDA

For Lease
- Executive flying office
- 265 MPH Cruising speed
- Reclining chairs, couch, galley, lav.
- Complete instrumentation, radio, auto pilot.

Lockheed PV-1 Ventura
No long term contracts necessary. For complete details write for brochure.
A. J. Ming
TRADE-AYER COMPANY
Linden Airport Linden, N. J.
Hunter 6-7690

Immediate Delivery
We stock, overhaul and install
WRIGHT R1820 —202, —56, —72 R2000 R1340
PRATT & WHITNEY R1830 —75, —92, —94 R985
and our most popular DC3 engine R1830 - SUPER - 92
ENGINE WORKS
Lambert Field Inc. St. Louis, Mo.

FOR SALE—LODESTAR
Stripped for conversion
R18-20-56 Engines & Propellers "O" SMOH
This aircraft is in Excellent Condition.
Minnesota Airmotive, Inc.
Wold Chamberlain Field
Minneapolis, Minn. *Phone: PA 9-8388*

BEECHCRAFT C-18-S
R985-14B engines. Const. speed props. Dual gyro panel. New tires and brakes. Nose tank. Good radio. 5 chairs in cabin. Painted cream and blue. Licensed to 5/20.56. Price $15,500.00.
W. CLAYTON LEMON
Woodrum Field Roanoke, Virginia
Phone 6-0333

C47s

Low Time

201 to 6402 hrs. total

fresh from complete disassembly and 8000 hour overhaul, new ship guarantee, NTSO engines.

RADAR

Bendix or RCA
X-Band or C-Band

It will pay for itself *with* fewer cancellations and detours shorter, smoother flight paths less crew and passenger fatigue

and eliminates any need for heavy, costly, pressurization by allowing lower and safer operating altitudes.

Custom 18

Conversion

- big, easy vision windows
- special, reclining chairs
- adjustable headrests
- spacious interior
- roomy cockpit
- open design
- clean, modern lines
- bright, restful decor

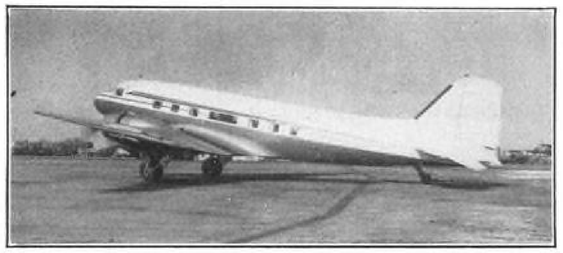
Immediately available, or will convert your own

Super-92 DC3

for January delivery

with your choice of engines
Super-92
Pratt & Whitney R1830-75, -94. R2000
Wright R1820-56, -72

Bendix or Collins radio, new ship guarantee, complete 8000 hour overhaul, beautiful custom interior, big windows, 200 mph.



Specialists in

DC-3

Inspections
Maintenance

Lodestar

Overhaul
Conversions

D18S

Radios
Engines

Sales
Parts

Remmert-Werner

Inc. of
Toledo
Express Airport

Inc. of
St. Louis
Lambert Field

AIRCRAFT PARTS!

ALL UNUSED! Immediate delivery from one of the world's largest stocks of aircraft parts!

202 PARTS

Pieces	202 No.	Mnf. No.	Mfgr.	Description
444	2021A80043	UJ-236	Apex	Univ. Joint
484	A80047	W-238	Apex	Univ. Joint
26	A80178	U5151-9	Adams Rite	Lock
178	A80265	EYLC2334	Barber Coleman	Motor
385	A80268	450	Skinner	Filter
38	A80270	AW1 ¼-9F		Gauge
261	A80271	1033-4E1	White-Rodgers	Switch
153	A80273	921-B	Stewart Warner	Heater
24	A80278-01	98048	Vapor Car	Control Box
61	A80283	981280	Kidde	Cylinder
94	A80286	966679	Kidde	Pressure Control
130	A80288	982056	Kidde	Valve
225	A80290	981591	Kidde	Valve
12	A80307	46B361	Vapor Car	Compensator
35	A80314	PG208AS7	Minn. Honeywell	Switch
8	A80320	2227-11-D3A	Eclipse-Pioneer	Tachometer
40	A803322	10078-1AG-A1	Eclipse-Pioneer	Compass
68	A80347	828-13Z-2	Weston	Oil Temp. Indicator
36	A80348	828-12Z-2	Weston	Air Temp. Indicator
8	A80451	BC733D	Belmont	Receiver
19	A80522	36001-1C-3-A1	Eclipse Pioneer	Direction Indicator
34	A80551	146102	Bendix	Power Brake
233	A80559	1265-900	Airex	Valve
22	A80561	AA31400	Vickers	Valve
21	A80565	HC2109	Air Associates	Cylinder
40	A80566	AN6203-3	Bendix	Accumulator
6	A80585	HC2110	Air Associates	Cylinder
227	2021D80604	6141-H69	C-H	Cir. Breaker
66	D80620	M862A	Pollack	Switch
804	D80628	58G926	G.E.	Ballast
395	D80642	58G946	G.E.	Ballast
29	A80654	4150-1-¼-3S	Parker	Fuel Selector Valve
32	A80661	1408	Hydro-Aire	Valve
54	A80681	25432	Airesearch	Control Cable
1	A80686	AN4116-R6A	Jack & Heintz	Starter
19	D80688	117-10	Edison	Control Box
72	A80709	1416-12	Eclipse-Pioneer	Starter
53	D80731	MS-52A	Bendix	Fitting
37	D80744-	21846	Isolantite	Antenna Mast
85	A80877	727-72-Z2	Weston	Air Temp. Gauge
87	A80878	727-73-Z2	Weston	Air Temp. Gauge
83	A80879	727-74-Z2	Weston	Air Temp. Gauge
49	A80898	715E	Fulton Syphon	Temp. Control
46	A80958	M870036B	Kidde	Fire Ext.
9	A80960	982499	Kidde	Valve
35	A81002	923748	Kidde	Oxygen Cylinder
13	A81035	8DJ-29AAy	G.E.	Cowl Flap Indicator
44	A81058	979270	Kidde	Control
438	A81125	33786-2	Edison	Thermocouple
129	D81336	AN3200-450	Westinghouse	Shunt
42	D81337	AX31	Westinghouse	Ammeter
76	D81356	C768696-1	Pioneer	Transformer
686	D81406	L6861		Luminator
282	D81407	L6863		Night Light
67	D81560	58G927	G.E.	Ballast
262	2021D81567	L6993		Lights
239	D81568	L6998		Lights
29	D81587	AX31	Westinghouse	Ammeter
69	A81714	25435A	Kidde	Bracket
12	A81750	15701-1A	Pioneer	Controller
37	A81804	EYLC2434	Aircraft Control	Motor
17	A81813	4582AA-6C	Dynamic Air	Blower
10	A81815	FYLD2516	Barber Coleman	Thermostat
116	D81912	EA-1	Airpax	Vibrator
50	D81923	AYLZ22845	Barber Coleman	Micropositioner
21	A81976-01	72400	Hamilton Standard	Control
30	A82109	18784	Adel	Valve
18	A82708			Antenna Mast
9	A82827	366-2LH	Warren McArthur	Seats
12	A82828	366-2RH	Warren McArthur	Seats

C119 AND C123 PARTS

Pieces			Pieces			Pieces			Pieces		
12	189 W	Actuator	14	0443	Control	6	4116-24D	Valve	40	4811-14-1	Gear
1	R110-M6-3	Actuator	377	G464	Cog	11	5222-2	Valve	2	870187	Fire Extg.
10	R170-M1	Actuator	20	A6602	Connector	6	5718	Valve	15	981564	Fire Bottles
1	R174-M6-9	Actuator	5	AFB129-100	Heater	40	7201-2	Valve	3	981565	Fire Bottles
2	R174-M6-10	Actuator	2	C97A49	Heater	19	10003	Valve	35	LD10W	Thermostat
1	R174-M6-11	Actuator	7	C97A28	Heater	4	10058-3	Valve	10	3094	Thermostat
1	M8684	Actuator	2	DJ11	Indicator	8	12782	Valve	20	412292-AA	Fuel Indicator
1	M8691	Actuator	2	930FM9835	Indicator	5	12880-2	Valve	3	119408-21B	Relay
3	D15485-15	Actuator	2	8DJ1ECB	Indicator	10	17585-2	Valve	111	10-55085-1	Filter Unit
6	D15485-16	Actuator	1	8DJ4PGC	Indicator	5	14517-2	Valve	34	810911	Thermocouple
7	100-322C	Air Compressor	3	8DJ11GAD	Indicator	12	20168	Valve	16	CNX-11	Relay
3	AVR524D702	Blower	2	8DJ12GAA	Indicator	1	20173	Valve	10	DE17	Thermostat
12	3A410012-1	Bushing	2	8DJ26AAA	Indicator	1	24402	Valve	12	A55A00	Regulator
14	3A410012-2	Bushing	2	4774-55-10	Indicator	1	29951	Valve	73	AL599	Drive Assy.
5	3A720123	Barrels	1	12121-1A	Inverter	11	90420	Valve	5	A4237	Rheostat
6	3A111310-2	Bushing	8	C-17021	Insulator	8	90420-2-50	Valve	27	A4496	Rheostat
36	3A111310-3	Bushing	16	C-17022	Insulator	7	314894	Valve	17	JG7013-A34	Tank Unit
5	729-23	Brace	3	C-17023	Insulator	3	401473-3	Valve	22	JG7013-A35	Tank Unit
2	729-25	Brace	190	RD206-5B-8	Inserts	3	401856-3	Valve	17	JG7011-A36	Tank Unit
150	4508-6	Bearing	4	83-1AC	Switch	6	840104	Valve	24	FCD19265-1-1	Wood Rib
179	AT-8	Bearing	4	8712-R4	Switch	1	14517-4	Valve	5	FCD19265-1-2	Wood Rib
429	B-539	Bearing	3	555-2058	Switch	10	9530493	Valve	18	FCD19265-2-1	Wood Rib
8	8-201R	Coupling	11	A800B2-7	Switch	6	R135-D1	Valve	18	A4427	Lamps
3	8-301	Coupling	2	A800J2-7	Switch	28	D1100-D-1	Valve	25	A5075	Light Ends
7	8-301R	Coupling	3	ST-2N	Switch	10	D1100-D-1A	Valve	97	B3581	Lamp Cover
19	8-310	Coupling	10	C200JB-4R-19	Switch	16	D1100-D-2	Valve	138	B4755	Light Fixture
13	8-834	Coupling	5	W7927-16-D2	Switch	3	L-3	Valve	13	B4756	Light Fixture
23	424 AG2	Coupling	7	S-201	Switch	25	M654	Valve	274	B04756-80	Light Fixture
6	223602-2	Control	9	801 RC	Switch	9	A34220	Valve	246	B4788	Light Fixture
23	2209-5	Cap & Chain	5	M102	Switch	3	C361-1-2	Valve	330	TTS1A	Light Fixture
193	9760-22	Cap & Chain	19	A35-8U	Switch	3	C361-HV	Valve	19	52-314	Bulb
194	9760-32	Cap & Chain	4	W-7927-20-D	Switch	1	HC3600-M5	Valve	64	A-11	Lamp Assy.
3	62240	Cylinder	22	92990	Valve	232	IV40-210	Valve	124	T6-360BL	Bulb
17	982-C	Control	17	6-585	Valve	2	AN6277-6	Valve	17	B479	Light Fixture
4	982-E-1	Control	2	3834-2	Valve	5	40A-31	Valve			
3	0441	Control	13	3934	Valve	6	577P	Screw Jack			

ENGINES

WRIGHT

268	No. 2600-20
10	No. 1820-54
4	No. 1820-60
4	No. 3350-57

PRATT-WHITNEY

1	No. 1830-43

LIQUID ANTI-ICING SYSTEM

Pieces				Pieces			
72	162B72801	G.L.M.	Reservoir	129	AN3155-50-100	Ohmite	Rheostat
82	P4CA-2A	Parker	Primer	20	B12306	Marquette	Selector Valve
250	J2.5-24D3	Adel	Metering Pump	144	702-FG-6D	Kohler	Selector Valve
123	J2.5-27.5D-4	Adel	Metering Pump	31	702-FG-8D	Kohler	Selector Valve
11	J2.5-27	Adel	Metering Pump	5	715-FT-6D	Parker	Selector Valve
4	J2.5-24D-4	Adel	Metering Pump	18	AN771-P1	Weatherhead	Selector Valve
4	J2.5-27.5D-4	Adel	Metering Pump	5	37D6114	United Aircraft	Selector Valve
37	J5.0-24S-7	Adel	Metering Pump	12	525-LFG-1/8D	Parker	Check Valves
32	J5.0-27.5S-7	Adel	Metering Pump	17	404-LFG-1/8D	Parker	Check Valves
5	B52415-6	Eclipse	Rheostat	21	A8182-6	Adel	Relief Valves
78	AN3155-25-100	Ohmite	Rheostat				

Our catalog of AN hardware will be sent on request. Contact us for your requirements.

COMMERCIAL AIRCRAFT PARTS CO.

4101 CURTIS AVE., BALTIMORE 26, MARYLAND • TELEPHONE: CURTIS 7-3300

FOR SALE OR LEASE

Seven (7) DeHavilland Doves . . . New Mark II engines. All notes and modifications complied with. These airplanes are the equivalent to Model 5A Dove—which allows 8800 lb. gross. Airframe zero time. Spare engines and spare parts available. Interior and radio to customer requirements.

* * * *

Douglas A-20 . . . Four place interior. Aircraft now in fly away condition.

* * * *

Douglas B-26 . . . Now in overhaul and modification to executive type airplane. Radio and interior to customer specifications.

* * * *

One (1) Lockheed Lodestar . . . Now in 8000 hour overhaul. Optional zero time engines. Radio and interior to customer specification. Airplane will be available for delivery in February 1956.

* * * *

These aircraft can be inspected at:

NATIONAL AIRCRAFT CORPORATION
(Aircraft Division)
7901 Woodley Avenue, Van Nuys, California.

Write for information:

NATIONAL AIRCRAFT CORPORATION
3411 Tulare Avenue, Burbank, California.

C-47 - DC-3C DOUGLAS AIRCRAFT

26 and 28 airline passenger aircraft for immediate delivery on lease-purchase, long term payment purchase or straight cash purchase at below market price. Aircraft in excellent condition having airstair door, outside baggage compartment.

Call, write or wire . . . .

WILLIAM C. WOLD ASSOCIATES
516 Fifth Ave. New York 36, N. Y.
Cable: BILLWOLD Tel. MUrray Hill 7-2050

Aircraft Exchange Wanted

Douglas C.47 wanted against Curtiss Commando C.46 E Cargo equipment 7000 Hours since new.

AIGLE AZUR INDOCHINE
70, Champs Elysees Paris, France

We Buy DC-3 and C-47

—also components, fuselages, center sections. Prefer runout or needing work, airline, passenger, or cargo, Pratt & Whitney or Wright. State price, time, quantity, type engines.

We are not brokers
REMMERT-WERNER, INC.
Lambert Field St. Louis, Mo.

FOR SALE

For your Wright powered Executive Aircraft. New part No. 424306 (R1820-76), 420587 (R1820-72) Cylinders complete with factory installed pressed in exhaust seats and cast iron guide. *Immediate Delivery!* Write, wire or phone AERODEX, INC., Box 123, Miami 48, Fla. Ph. TU 8-3411.

AIRPLANES WANTED

Need 50 Bonanzas, Navions, 180's, 190's, 170's, Aero Commanders, Twin Navions, Twin Beeches, etc.
Will Buy Dealers' Stocks New or Used
Vest Aircraft Co.'s Skyranch
BOX 5306, DENVER 17, COLORADO

WANTED

EXECUTIVE DC-3, C-47 or HULL
LARGE MANUFACTURING COMPANY
W-8633, Aviation Week
520 N. Michigan Ave., Chicago 11, Ill.

RAS INCORPORATED ***"Take a Heading for Reading"***
for the BEST MAINTENANCE • OVERHAUL • MODIFICATION • INSTALLATION
READING AVIATION SERVICE, INC.
Municipal Airport Phone 3-5255 Reading, Pennsylvania

FOR SALE

For Sale—Beechcraft D-18S 80 gal. nose tank. Hamilton Standard Hydromatics, anti-icers, deicers, complete radios including ILS, Glideslope, OMNI, 30 channels V.H.F. Total A/C time 2699:15, 317:10 since overhaul on each engine. Cabin has 3 seats, table and couch. Broadcast receiver. Mechanically perfect and exceptionally fast. All A/D notes and bulletins complied with. Two spare zero time chrome jug 14-B engines plus other miscellaneous spares. Price $55,000. Pearl Brewing Company, P. O. Box 1661, San Antonio, Texas.

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual etc.

Positions Vacant
Positions Wanted
Part Time Work
Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered
Employment Agencies
Employment Services
Labor Bureaus

RATES

DISPLAYED

The advertising rate is $27.60 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column — 3 columns — 30 inches to a page.
Subject to Agency Commission.

UNDISPLAYED

$2.10 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions. Not subject to Agency Commission.

Send NEW ADS to AVIATION WEEK, 330 W. 42nd St., N. Y. 36, N. Y. for January 23rd issue closing January 12th.

ASSISTANT TO MANAGER

Aircraft Heat Transfer Department

The Trane Company, a leading manufacturer of heat transfer, air conditioning, heating and ventilating equipment, has a permanent position available for a graduate engineer who wants to develop capacity for executive responsibility. Work to be performed will include heat transfer engineering, sales and administration. From 2 to 5 years' experience with aircraft systems, components of systems or heat transfer equipment is desired, but not essential. Excellent opportunity to advance while working with new and rapidly developing products—brazed aluminum and stainless steel heat exchangers—in a rapidly expanding concern. Chance to work away from crowded industrial areas where outdoor recreation is at your door. Submit resume to:

Manager of Staff Employment,
THE TRANE COMPANY
La Crosse, Wisconsin

ENGINEERS

NEW 2-FOLD RETIREMENT INCOME PLAN

for Aviation and Missile Engineers

It's natural that a long-time leader in aviation, like Republic—with many firsts to its credit—should be a leader, too, in providing for the welfare of its staff. Right in line with this forward-looking policy is the remarkable new Republic Retirement Income Plan. Here is how it works:

PART 1 *is a basic Retirement Income plan paid for* entirely *by Republic Aviation.*

PART 2 *is a cooperative effort. It is completely optional. But if an engineer wishes to increase his retirement fund, by making a small monthly payment, Republic will* MORE THAN MATCH *his contribution.*

Take the case of a hypothetical engineer who joins Republic on January 1st, 1956, averages $8,000 a year for 15 years; then retires aged 65. If he elected PART 2 of the plan, he will have a total *monthly retirement income of $225.80,* including his social security. For this he himself will contribute *only $8.50 a month* to the Republic Retirement Income Plan.

Of course, the MORE YOU EARN, the HIGHER your Retirement Income will be. And Republic pays a top salary scale in the industry.

...RETIREMENT PLAN JUST ONE OF MANY PLUS FACTORS POINTING TO A REPUBLIC CAREER

FIRST —there's the interest and prestige of working for a pioneer in aircraft design, creator of such famous planes as the F-84 Thunderjet, the F-84F Thunderstreak, RF-84F Thunderflash and XF-84H. (Soon to be followed on the production line by the new F-103, F-105 and RF-105.)

SECOND —the company is expanding sharply, providing frequent opportunities for able men to advance. In fact a $12,000,000 increase in the Research and Development Program has just been announced.

THIRD —an All-Expense Paid Relocation Plan for qualified engineers living outside the New York City and Long Island areas, which makes it easy to move to Republic. Other liberal benefits: Life, Accident and Health Insurance; Hospital-Surgical Benefits for the whole family; educational aid covering ⅔ the cost of collegiate and graduate study.

Serve your own best interests. Make full inquiries into the many advantages of joining Republic now, not the least of which is living on Long Island—the Playground of the East.

Important engineering positions are now open at all levels:

STAFF ENGINEERING
PRELIMINARY DESIGN
ELECTRONICS
WEAPONS SYSTEMS PROPOSALS
OPERATIONS RESEARCH
SYSTEMS
MATHEMATICAL ANALYSES
AERODYNAMICS
TECHNICAL WRITING
DYNAMICS
ELECTRO-MECHANICAL DESIGN
FLIGHT TEST
RESEARCH
THERMODYNAMICS
FLUTTER & VIBRATIONS
STRESS
AIRCRAFT DESIGN
WEIGHTS
DESIGNERS: Electrical Airframe Mechanical

Please address complete resume outlining details of your technical background to:

REPUBLIC AVIATION

AIRCRAFT
Assistant Chief Engineer, Administration **Mr. R. L. Bortner,** Farmingdale, Long Island, N. Y.

MISSILES
Administrative Engineer, Mr. Robert R. Reissig Hicksville, Long Island, N. Y.

Lockheed diversification in action...

At right: engineers and scientists work on some of the 46 major projects in progress at Lockheed

Operations Research discussion on continental defense

Operations Research openings

Electronics Specialists
Fire Control and Guidance Specialists
Aerodynamics Engineers
Physicists

Fatigue test on Super Constellation skin.

Structural Engineering openings

Research Specialists
Structures Engineers
Stress Analysts
Weight Engineers

Why Lockheed offers Engineers better careers

There are three main reasons:

1. More opportunity for promotion because there are more supervisory positions to be filled with 46 major projects underway, including 13 models of aircraft on assembly lines.

2. More career security because Lockheed activities cover virtually the entire spectrum of aeronautical endeavor.

3. Life in Southern California
Scenic beauty, unmatched climate, wide recreational opportunities enhance life in the San Fernando Valley.

To Engineers who lack aircraft experience

Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering–at full pay.

Coupon below is for your convenience in requesting application form and more information on how Lockheed's expanding program can advance your career.

Design study on hydraulic requirements of new transport

Design openings

Design positions are open at all levels in controls, electrical, hydraulics, mechanical, power plant and structures fields.

IBM 701 applied to jet transport flutter problem

Math. Analysis openings

Math. Engineers
Math. Specialists
Math. Analysts

In-flight test on air speed performance

Flight Test Engineering openings

Flight Test Engineers
Flight Test Analysts
Instrumentation Engineers
Electrical Research Engineers

Aerodynamic meeting on high-speed fighter

Aerodynamics openings

Aerodynamics Engineers
Aerodynamicists
Dynamics Engineers
Wind Tunnel Test Engineers

E. W. Des Lauriers, Dept. C-3-1
LOCKHEED AIRCRAFT CORPORATION
CALIFORNIA DIVISION • BURBANK, CALIFORNIA

Please send me a brochure describing life and work at Lockheed and an application form.

Name

Field of Engineering

Street Address

Home Phone

City and State

LOCKHEED
California Division
AIRCRAFT CORPORATION
BURBANK **CALIFORNIA**

ADVANCE YOUR POSITION IN GUIDED MISSILE ELECTRONICS

Apply your wealth of engineering experience at RCA!

PROJECT ENGINEERING

You will direct and coordinate the work of a group charged with developing complex systems. You'll administer programs which result in systems that meet military requirements. Your wide experience in equipment development and design, and sound management background will be fully utilized.

Project Engineering Fields include:

Radar • Data Handling and Transmission • Computers

SYSTEMS ENGINEERING

Advanced Systems Analysis—You will create from basic military requirements new guided missile systems which utilize the latest advances in electronics. Close contact is maintained with basic research developments at RCA and other research centers.

Systems Development—You will view systems as a whole in order to anticipate and optimize problems. You'll develop design criteria for major components which increase operational reliability of over-all systems. Your broad technical experience and thorough understanding of the systems approach will be applied.

ENJOY ALL OF RCA's DESIRABLE CAREER ADVANTAGES . . .

Please send resume of education and experience to:

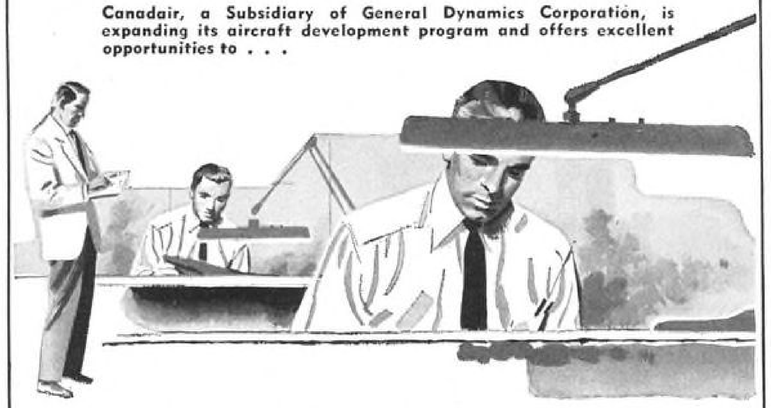
Mr. John R. Weld
Employment Manager, Dept. B-2A
Radio Corporation of America
30 Rockefeller Plaza
New York 20, New York

RCA® *RADIO CORPORATION of AMERICA*
ENGINEERING PRODUCTS DIVISION

ENGINEERS grow with Canada

You can see it in the growth statistics, Canada is growing and Canada's largest aircraft producer is growing too!

Canadair, a Subsidiary of General Dynamics Corporation, is expanding its aircraft development program and offers excellent opportunities to . . .



PRELIMINARY DESIGN ENGINEERING

Requires a B.S. Degree in Aeronautical or Mechanical Engineering plus considerable experience in the technical aspects of modern aircraft design and the application of this experience and creative ability to the conception of new projects.

AERODYNAMICISTS

Requires a B.S.A.E. and a minimum of three years' experience in development of methods of analysis, project airloads analysis, performance prediction, and stability and control.

If you have experience and initiative in these fields, there is real promise for you. Canadair builds the world famous Sabre jet, is now producing the CL28, the largest aircraft ever built in Canada, and is actively engaged in advanced work and development on new aircraft as well as in Canada's guided missile program. Every encouragement is given to the man who wants to "break new ground" at Canadair.

CANADAIR OFFERS:—

- An excellent salary commensurate with the high responsibility of these positions.
- Excellent pension and insurance plans.
- Liberal relocation allowances.
- Convenient, expense paid, interviews for qualified applicants.

Exellent summer and winter sports are close by in Canada and the U. S. and you'll enjoy the cultural and educational advantages of Montreal, a city famous for its interesting, cosmopolitan way of life.

Send a resume of qualifications including salary history to:

L. Wiebe, Dept. E.
CANADAIR LIMITED
P. O. Box 6087,
Montreal, Canada

C-L CANADAIR LIMITED

CANADAIR
— AIRCRAFT MANUFACTURERS —
LIMITED, MONTREAL, CANADA

A subsidiary of GENERAL DYNAMICS CORPORATION, New York, N.Y. — Washington, D.C.

AERONAUTICAL or MECHANICAL ENGINEER

Familar with jet engine instrumentation. Specializing in the design, test and manufacture of thermocouple, pressure probes and airflow measuring instrumentation. A new rapidly expanding Chicago company specializing in engineering services and products. Salary is open.

P-8815, Aviation Week
520 N. Michigan Ave., Chicago 11, Ill.

Become a Flight Officer with United Air Lines

New booklet tells you how

United Air Lines—the nation's fastest growing airline—offers unusual career opportunities for Flight Officers.

To qualify, you must have a commercial pilot's license with 165 hours or more (no multi-engine time required); be a U. S. citizen and a high school graduate between the ages of 21 and 30; between 5'7" and 6'4" in height; and able to pass a flight physical without waivers. Applicants with C.A.A. instrument rating or flight engineer examination written portion passed will be accepted through age 31; with both, through 32. Successful applicants attend United's Flight Training Center at Denver and receive pay while training.

Excellent pay . . . you get $485 a month on assignment to line, and from then on, your pay increases at regular intervals.

United Air Lines Offers security, too, as well as good pay and rapid advancement. You enjoy a broad insurance program, retirement income plan and many other generous benefits.

To get a booklet giving you all the details about your career opportunities with United Air Lines, simply fill in the coupon and mail. Remember, even if you are not immediately available, United's continuing growth will maintain the need for qualified men for years to come. Get the booklet and plan your future now!

C. M. Urbach, Supt. of Placement
UNITED AIR LINES
Operating Base, Dept. Avia-1
Stapleton Airfield, Denver, Colorado

Please send me your booklet that tells me how I can become a Flight Officer with United Air Lines.

Name_____

Address_____

City_____ Zone____ State____

RESEARCH PROJECTS in the SUPERSONIC AND HYPERSONIC RANGE

One of the nation's leading organizations in the field of aeronautical research, the Cornell Aeronautical Laboratory, is currently engaged in extensive investigation of the problems associated with flight at supersonic and hypersonic speeds. As these programs develop, opportunities become available to technically competent men to join our staff.

Two openings are described below. If you are interested in receiving more information about these specific assignments, or if you would like to inquire about other possibilities of employment, we shall be pleased to hear from you.

STRUCTURAL PROBLEMS CAUSED BY AERODYNAMIC HEATING

A major problem in the design of vehicles that will travel at the very high speeds of hypersonic flight is the prediction of their structural integrity under the high heat loading conditions to which they will be subjected. Analytical and experimental research is underway at Cornell aimed at obtaining a fuller understanding of this "Thermal Barrier" and the structural problems associated with it. Men selected for assignment on the structural phase of the program will work closely with a group that is making major contributions to the store of available data on hypersonic flow. At least five years experience in the field of structures is desired.

STRESS AND VIBRATION ANALYSIS

The Laboratory has recently developed and installed a new experimental apparatus for use in our program of supersonic propeller blade research. We are seeking young engineers with good backgrounds in either theoretical or experimental stress analysis for assignments in this project.

CORNELL AERONAUTICAL LABORATORY, INC.

BUFFALO 21, NEW YORK

99.07* ENGINEERS and DESIGNERS

Stay with

AC

THE ELECTRONICS DIVISION OF GENERAL MOTORS

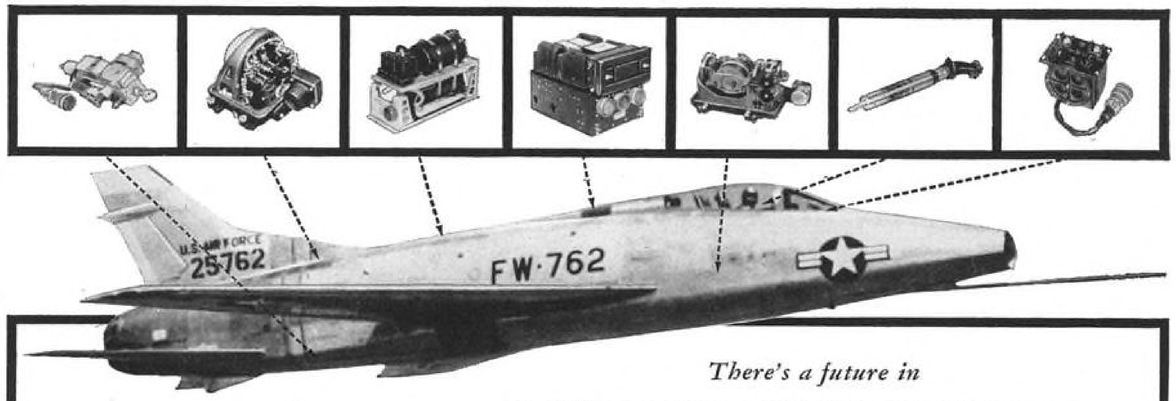
* Our current monthly turnover figures are phenomenally good. Have been, we are proud to say, for years. It speaks well for the job opportunities, working conditions and the wages we pay our Engineers and Designers. Investigate for your future. Write us today.

PIONEERING OPPORTUNITIES in the following fields!

- MISSILE GUIDANCE SYSTEMS
- JET and TURBO PROP ENGINE CONTROLS
- BOMBING NAVIGATIONAL COMPUTER SYSTEMS
- AIRBORNE FIRE CONTROL
- U.H.F. COMMUNICATIONS
- MICRO-WAVE EQUIPMENT

Write today for Employment Application:
Mr. Louis R. Berks, Supervisor of Employment

AC SPARK PLUG • THE ELECTRONICS DIVISION
GENERAL MOTORS CORPORATION
MILWAUKEE 2, WISCONSIN



There's a future in

CONTROLS BY HONEYWELL

THIS is the age of automatic control. And automatic control is Honeywell's business. A pioneer and leader in the aircraft control field, Minneapolis-Honeywell has produced more autopilots than any other company. Honeywell manufactures other systems and products so highly diversified that you are promised exciting opportunities for creative achievements and personal advancement. Constantly expanding research and development of new concepts promise you unlimited possibilities for growth.

Consider these selective openings:

RESEARCH AND DEVELOPMENT:

Graduate engineers are needed in these related fields and product lines:

Autopilots
Hydraulics
Aircraft Dynamics
Gyros
Nuclear Controls
Servomechanisms
Electronics
Instrumentation
Inertial Guidance
Digital Computers
Applied Mechanics
Thermodynamics
Systems Engineering
Jet Engine Controls

PRODUCTION ENGINEERS

Openings for engineers with 5 years experience, including process planning on new products. Thorough knowledge of tooling, estimating, metals fabrication, manufacturing and assembly operations. Experience must have been on products such as precision mechanical, electrical or hydraulic equipment, electro-mechanical controls, electric motors, instruments, or gyros.

And consider these advantages:

Ideal suburban living in friendly, uncrowded Minneapolis, famous for cultural activities and recreational facilities.

Generous employee benefits include broad company-paid insurance and pension plans, liberal tuition allowances for advanced study.

Travel and family moving expenses paid.

Please send résumé of your background including salary requirements, to

J. A. Hill — Engineering Placement Manager
Minneapolis-Honeywell Regulator Company
2753 4th Ave. South, Minneapolis 8, Minn.

STRESS ANALYSTS AND STRUCTURES ENGINEERS

Growing engineering research and development organization needs men with one to five years experience preferably in thermal and stress analysis, aircraft or missile structural work.

Send resume to Personnel Department.

Aerophysics Development Corporation
(Subsidiary of Studebaker-Packard)
Box 949 Santa Monica, California

WANTED
Pilots — Mechanics
EXPERIENCED ON BELL, PIASECKI & SIKORSKY HELICOPTERS

For operations both in the States and in Alaska. High wages—bonuses—expenses paid. Pilots must have 200 hours in helicopters. Mechanics must have some helicopter experience. Year around operation. Employment permanent for those qualified. Opportunities for advancement.

Rick Helicopters, Inc.
P. O. Box 217, Airport Branch
San Francisco International Airport
San Francisco, California

A *SAFETY* MUST . . .
A SKILLED PILOT

Get the right man! Consult "P-E-A". We'll supply him . . . carefully screened . . . psychologically tested. Complete consultation service.

PILOTS EMPLOYMENT AGENCY
Teterboro (N. J.) Airport, Hasbrouck Heights 8-1214
Lockheed Air Term., Burbank, Cal., THornwall 4-3646

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1111 Wilshire Blvd. (17)

POSITIONS VACANT

Helicopter Pilot—A. & E., Mountain experience, and salesmanship. New Bell. Reply P-8669, Aviation Week.

First pilot for Model 18 Beechcraft. Eastern corporation operating number of airplanes. Give full particulars as to ratings, age, etc. to P-8782, Aviation Week.

Mechanical, Aeronautical and electrical design engineers for aircraft training equipment. Excellent opportunity. Forward complete resume to L. Gale, Burton-Rodgers, Technical Training Aids, Inc. Blade and Helen Sts., Cincinnati (16) Ohio.

POSITION WANTED

Engineer. 11 years experience aircraft equipment, structures and hardware. Desires sales engineering. PW-8806, Aviation Week.

ENGINEERS

PERMANENT CREATIVE OPPORTUNITIES FOR

ELECTRICAL AND MECHANICAL ENGINEERS

AT

Bendix

Immediate openings for . . . .

SENIOR COMPUTER ENGINEER

At least five years experience with analog computers with control applications. A degree in electrical engineering, or math and physics required. Activity is in the field of aircraft and missile power plant controls, including gas turbine, ram jet, and rocket types. Work will be with hydra-mechanical, pneumatic and electrical components. The fuel metering research facility includes an analog computer and jet engine simulators.

MAGNETIC AMPLIFIER SYSTEMS ENGINEER

Electrical engineer supervisory capacity on research and development of magnetic amplifier circuitry, control systems, and component design and testing, supervising other engineers and technicians.

COMPUTER ENGINEER

Graduate engineers thoroughly qualified as a digital computer programmer, capable of handling engineering and production calculations, to train present personnel in preparation of data for computer applications. Set up new applications. Work with complex dynamics and control problems characteristic of the jet engine fuel system and landing gear fields.

LIQUID PROPELLANT ROCKET CONTROLS ENGINEER

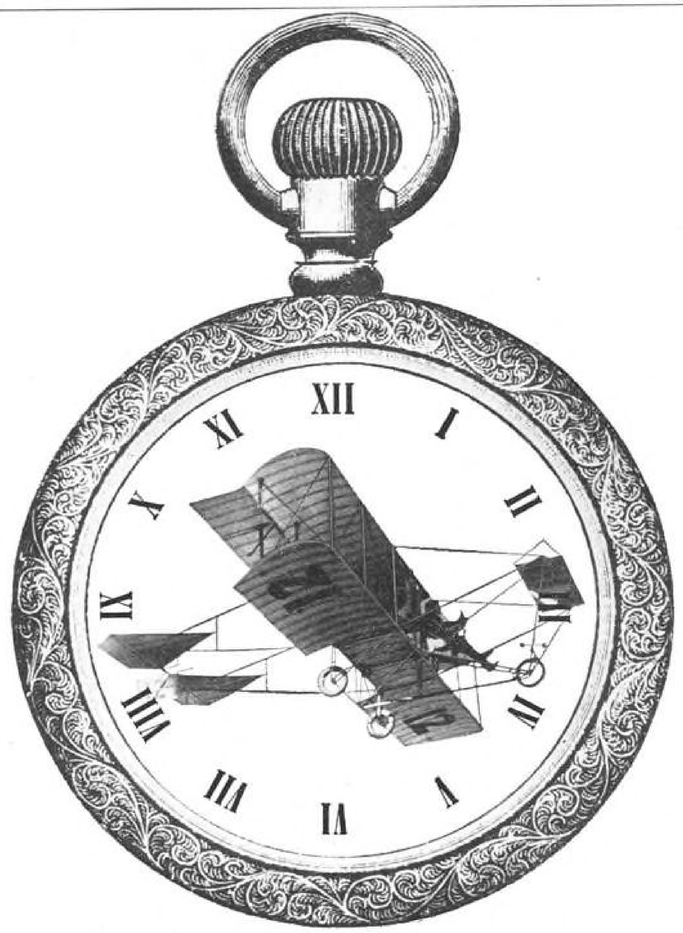
Mechanical or electrical engineer to supervise the research and development of liquid propellant rocket controls, systems design, component design, development and testing.

The salary of these positions will be determined by your ability and experience.

Send detailed resume listing education, engineering experience, and salary requirement to:

TECHNICAL EMPLOYMENT DEPARTMENT
BENDIX PRODUCTS DIVISION OF
BENDIX AVIATION CORPORATION
401 North Bendix Drive
South Bend 20, Indiana

We guarantee you an immediate reply—



92,000 hours from now!

It is difficult to realize that this historic "flying machine" is just 92,000 working hours old.

From that 1910 beginning to today's new multi-jet Navy XP6M SeaMaster, Martin has developed and produced a new aircraft design every 1500 hours of the working calendar.

On this backlog of experience—unmatched by any other aircraft company in the world—one of the youngest and most dynamic managements in the industry is engineering new methods that are thousands of hours ahead of the aircraft calendar.

You would do well to find out what's happening at Martin—and what the opportunities there in AERODYNAMICS, ELECTRONICS, STRUCTURES, PROPULSION and NUCLEAR POWER might do to speed up your own calendar of progress.

Contact J. M. Hollyday, Dept. A-1, The Martin Company, Baltimore 3, Maryland.

MARTIN
BALTIMORE

ENGINEERS

HERE'S BIGGER OPPORTUNITY WITH A GROWING COMPANY IN JET VTO

Look to the future with Ryan — a stable, growing aircraft company with 33 years of experience—where you'll never feel "lost in the shuffle." Join our select staff of engineers and work on challenging, diversified projects like Ryan's new automatic navigation system and the world's first jet VTO aircraft!

You'll like working at Ryan and you'll enjoy living in San Diego — a year-round playground with the nation's finest climate. Write today to Engineering Professional Placement, Engineering Division for full information. Your inquiry will be held in strictest confidence.

IMMEDIATE OPENINGS FOR:

Aircraft Designers Electronics Engineers Aerodynamicists Systems Analysts
Structures and Weight Control Engineers Power Plant Engineers

RYAN AERONAUTICAL COMPANY
2703 Harbor Drive · San Diego 12, California

LOCKHEED
Aircraft Corporation
Georgia Division

INSTRUMENTATION MECHANICS

are needed in the Engineering Flight Test Division.

To qualify, two years experience is required in one or more of the following:

1. Recording Oscillographs.
2. Continuous Balance Recording Potentiometers.
3. Telemetering.
4. Flight Instruments.
5. Strain Gauges.

Also should be familiar with circuits associated with this equipment.

Write in complete confidence
Dept. AW-1226

LOCKHEED AIRCRAFT CORPORATION

761 Peachtree St., N.E., Atlanta, Georgia

SENIOR AERONAUTICAL ENGINEERS

These career opportunities concern themselves with Stress Analysis and Wind Tunnel testing, the use of Strain Gages and allied instrumentation in both high and low speed aerodynamics. Also, new designs must be conceived for Airframe Housing of Fire Control and Radar Systems. In addition, research will be conducted in Radar Screens, Aircraft Turrets, Ground Mounted Radar Systems and Guided Missile Systems, to name a few. Our steady expansion over the past decade is now entering a new and important phase. *Now* is the time to find out what we mean when we say . . . *"You* and *Crosley*—a Partnership in Opportunity".

Please send resume to:

Mr. Bruce Bunten
EMPLOYMENT MANAGER

Crosley DIVISION
AVCO
MANUFACTURING CORPORATION

2630 Glendale-Milford Road
Evendale, Cincinnati 15, Ohio

FLIGHT ENGINEERS

Immediate openings for flight engineers desiring international flight career (New York Base), with

PAN AMERICAN WORLD AIRWAYS

Beginning salary $5670. Employee benefits include retirement & life insurance plans, 30-day vacations per yr., discount travel, etc.

Applicants must be U. S. citizens, maximum age thru 31 yrs., H.S. grads, college engineers preferred, able to pass flight physical, ht. 5'6" to 6'4".

Must have A&E Licenses and qualify for CAA Flight Engineer Exam, OR, have completed CAA Flight Engineer written examination.

Contact your nearest employment office:

28-19 Bridge Plaza North, LIC, N.Y. ST 6-5858
Int'l Airport, Miami, Fla. Tel. 64-5411
Int'l Airport, San Francisco, Cal. PL 5-7000
Seattle/Tacoma Int'l Airport, Seattle, Wash.
CHERRY 3-400
or
Asst. Chief Flight Engineer, Int'l Airport
Houston, Texas. OLIVE 4-2673

START THE **NEW YEAR** with a

FINE NEW CAREER

To any engineer, it must be evident that the best chances for a promising career in aviation depend on these things:

1. He should be engaged in a phase of aviation which is expanding and vital.
2. His role in a project should give him a chance to think for himself, and see his own ideas take shape.
3. He should be on the staff of a company strongly established, with a proven background of experience and an assured long-range future.
4. He should be associated with a capable, forward-thinking team.
5. His job should be located where his family can enjoy good housing, good recreational facilities, good schools, good environment.

A position at Flight Refueling, Inc. meets all of these conditions *plus* more.

Long-range projects for long-range flight now getting underway at Flight Refueling Inc. present new career opportunities for engineering personnel in the following categories:

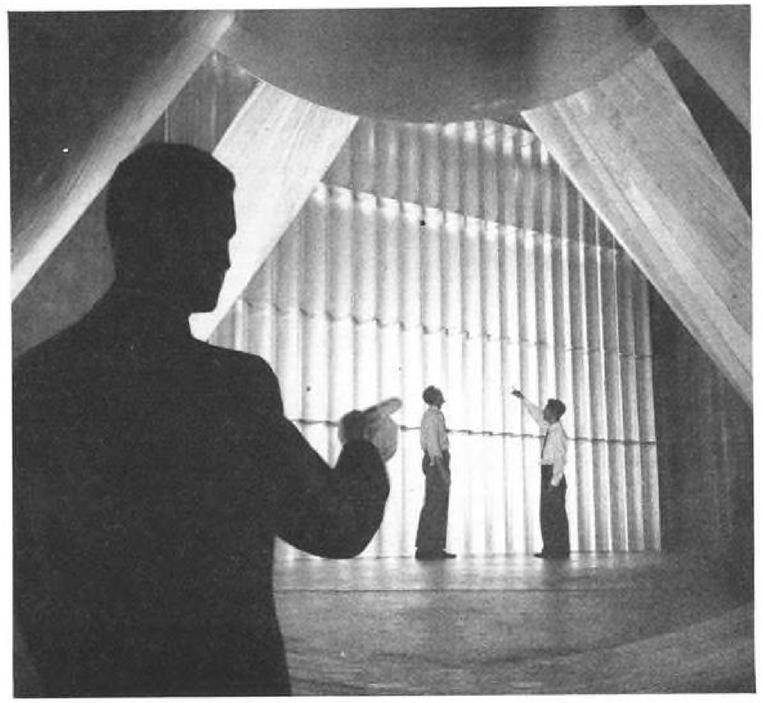
- STRESS ANALYSTS
- STRUCTURAL DESIGNERS
- MECHANICAL DESIGNERS
- DESIGN CHECKERS
- HYDRAULIC AND FUEL SYSTEMS ENGINEERS
- MISSILE SYSTEMS ENGINEERS
- MECHANICAL DRAFTSMEN

EXTEND YOUR RANGE WITH

FLIGHT REFUELING Inc.

Send your resume to:
Personnel Director
Flight Refueling Inc.
Box 1701
Baltimore 3, Md.

TO THE FINE ENGINEERING MIND SEEKING THE CHALLENGING PROJECTS IN



AERODYNAMICS

AERODYNAMIC ENGINEERS AND SCIENTISTS are urgently needed now at Convair in beautiful, sunny San Diego, California. Excellent career opportunities exist for junior and senior engineers for aerodynamics, performance and heat transfer analyses related to advanced projects in the supersonic Mach number range. A balanced background in experimental and theoretical aerodynamics is ideal for these positions. Analytical aerodynamic studies using analogue and digital computers are an integral part of this work. Challenging positions are also available for aerodynamicists experienced in research and development wind tunnel and firing range tests.

CONVAIR offers you an imaginative, explorative, energetic engineering department . . . truly the "engineer's" engineering department to challenge your mind, your skills, your abilities in solving the complex problems of vital, new, long-range programs. You will find salaries, facilities, engineering policies, educational opportunities and personal advantages excellent.

SMOG-FREE SAN DIEGO, lovely, sunny city on the coast of Southern California, offers you and your family a wonderful, new way of life . . . a way of life judged by most as the Nation's finest for climate, natural beauty and easy (indoor-outdoor) living. Housing is plentiful and reasonable.

Generous travel allowances to engineers who are accepted. Write at once enclosing full resume to:

H. T. Brooks, Engineering Personnel Dept. 113

CONVAIR

A Division of General Dynamics Corporation

3302 PACIFIC HIGHWAY SAN DIEGO, CALIFORNIA

RADIATION Inc.

Electronic RESEARCH · DEVELOPMENT · PRODUCTION

Melbourne Fla. Orlando Fla.

Many outstanding opportunities are available for qualified electronic, mechanical, nuclear, and aeronautical engineers in the fields of electronics, avionics, and instrumentation.

- Aircraft Positioning Development
- Special Weapons Instrumentation
- Solid-State Circuit Development
- Analog-to-Digital Conversion
- Missile Checkout Equipment
- Special Radar Developments
- Aircraft Instrumentation
- Digital Data Recording
- Pulse Code Telemetry
- Low-Level Switching
- FM-FM Telemetry
- Aircraft Guidance

Address your inquiry to

Ralph L. Bickford, Director of Personnel
RADIATION, Inc., Melbourne, Florida

SENIOR ENGINEER

For Ceramic Research

With the Metallurgical and Ceramic Engineering Groups of the Aircraft Nuclear Propulsion Department.

An unusual and responsible career opportunity in the new field of aircraft nuclear propulsion is open to a qualified engineer. He will be responsible for the development of improved materials for use in aircraft nuclear power plants. The extensive facilities and resources of the company will be available to him in this work.

At least 8 to 10 years' experience is required, involving nonmetallic inorganic materials for use at high temperatures. (If directly related, time spent in obtaining an advanced degree may be considered part of this experience.) Applicant must be a graduate physical chemist, metallurgical engineer, or ceramic engineer, preferably with Ph.D. or equivalent.

Publication of Research Results in the Appropriate Classified or Open Literature is Encouraged.

OPENINGS IN CINCINNATI, OHIO, AND IDAHO FALLS, IDAHO

Address replies to location you prefer.

Aircraft Nuclear Propulsion Dept.

Mr. W. J. Kelly — Mr. L. A. Munther

GENERAL ELECTRIC

P. O. Box 132, Cincinnati 15, Ohio
P. O. Box 535, Idaho Falls, Idaho

KAMAN AIRCRAFT CORP.

requires an experienced

SR. AERODYNAMICIST

FOR FIXED WING AIRCRAFT

New development program requires an Aeronautical Engineer with broad experience in:

- PERFORMANCE
- STABILITY AND CONTROL
- AIRLOADS ANALYSIS

On Subsonic and Transonic Fixed Wing Aircraft.

Degree in Aeronautical Engineering plus 4-5 years experience desired.
Position also provides excellent opportunity to gain valuable Rotary Wing experience.
Other excellent opportunities exist for Aerodynamicists on a Jr and Intermediate level.

Forward resume of experience to: W. M. TYNAN, Administrative Engineer

THE KAMAN AIRCRAFT CORPORATION
BLOOMFIELD CONNECTICUT

ENGINEERS

THE APPLIED PHYSICS LABORATORY OF THE JOHNS HOPKINS UNIVERSITY offers an exceptional opportunity for professional advancement in a well-established Laboratory with a reputation for the encouragement of individual responsibility and self-direction.

Our program of

GUIDED MISSILE RESEARCH and DEVELOPMENT

provides such an opportunity for men in:

SUPERSONIC MISSILE DESIGN
WIND TUNNEL TESTS AND DATA ANALYSIS
RAMJET DESIGN AND ANALYSIS
MISSILE SYSTEMS DEVELOPMENT
DESIGN AND LAYOUT OF MISSILE COMPONENTS
RESEARCH AND ANALYSIS IN AERODYNAMIC STABILITY & CONTROL

Please send resume to:
Professional Staff Appointments

APPLIED PHYSICS LABORATORY
THE JOHNS HOPKINS UNIVERSITY
8615 Georgia Avenue
Silver Spring, Maryland

USE NATIONAL CLASSIFIED ADVERTISING

for bringing business needs or opportunities to the attention of men associated in administrative, executive, management, sales and responsible technical, engineering and operating capacities within the industries served by Aviation Week. For advertising rates or other information write:

Classified Advertising Division—Aviation Week, 330 West 42nd St., New York 36, N. Y.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK—JANUARY 9, 1956

AIRBORNE ACCESSORIES CORP. 7
Agency—Gray & Rogers Adv.
ALAR PRODUCTS, INC. 104
Agency—C. D. Heiser Adv.
ALLISON DIV., GENERAL MOTORS CORP. ..... Fourth Cover
Agency—Kudner Agency, Inc.
AMERICAN ELECTRONICS, INC. (MINIATURE COMPONENTS DIV.) 46
Agency—Clyde D. Graham Adv.
AMERICAN WELDING & MFG. CO. 8
Agency—The Bayless-Kerr Co.
ARROWHEAD RUBBER CO., A DIV. OF NATIONAL MOTOR BEARING CO., INC. 15
Agency—Dan Ebberts Adv. Service
AVION DIVISION ACF INDUSTRIES, INC. 66
Agency—Charles W. Curts Adv.

B G CORPORATION, THE 85
Agency—Gaynor, Colman Prentis & Varley, Inc.
B & H INSTRUMENT CO., INC. 70
Agency—The Kotula Company
BENDIX RADIO DIV., BENDIX AVIATION CORP. 4
Agency—MacManus, John & Adams, Inc.
BOEING AIRPLANE COMPANY 84
Agency—N. W. Ayer & Son, Inc.
BOWERS BATTERY & SPARK PLUG CO. 121
Agency—Beaumont, Heller & Speeling, Inc.
BURROUGHS CORPORATION 65
Agency—Campbell-Ewald Co.

CALTECH-JET PROPULSION LABORATORY 61
Agency—The Perrett Co.
CAMBRIDGE CORPORATION 91
Agency—Mahoney & Howard, Inc.
CHICAGO AERIAL INDUSTRIES 5
Agency—Leonard Advertising
CLEVELAND PNEUMATIC TOOL CO. 20
Agency—Meldrum & Fewsmith, Inc.
CLIFTON PRECISION PRODUCTS CO., INC. 48
Agency—Ivey Advertising Company
COLLINS RADIO COMPANY 90
Agency—W. D. Lyon Co., Inc.
COM-AIR PRODUCTS, INC. 38
Agency—McHugh-Gather Adv. Agency, Inc.
CONNECTICUT HARD RUBBER COMPANY 17
Agency—Troland, Inc.
COLE ELECTRIC COMPANY 59
Agency—Taggart & Young, Inc.
CORNELIUS COMPANY, THE 94
Agency—Scrymiger & Osterhelt Adv.
CUTLER-HAMMER, INC. 52
Agency—Kirkgasser-Drew Adv.

DARNELL CORP., LTD. 58
Agency—Henry L. Rhea Adv.
DIT-MCO, INC. (ELECTRONIC DIV.) 22
Agency—Jones & Hanger, Inc.
DOUGLAS AIRCRAFT CO., INC. 41
Agency—J. Walter Thompson Co.
DOW CORNING CORPORATION 24
Agency—Church & Guisewite Adv., Inc.

EASTMAN KODAK CO. (X-RAY DIV.) 87
Agency—J. Walter Thompson Co.

FAFNIR BEARING CO., THE 10
Agency—Horton-Noyes Co.
FAIRCHILD ENGINE & AIRPLANE CORP. 86
Agency—Gaynor, Colman Prentis & Varley, Inc.
FLIGHT REFUELING, INC. 100
Agency—Davis, Parsons & Strohmeier, Inc.

GENERAL CONTROLS CO. 60
Agency—Hixson & Jorgensen, Inc.
GENERAL ELECTRIC COMPANY 47, 88, 89
Agency—G. M. Basford Company
GOODYEAR AIRCRAFT CORP. 3
Agency—Kudner Agency, Inc.
GYROMECHANISMS, INC. 106
Agency—Duncan-Brooks, Inc.

HARVEY ALUMINUM DIV. OF HARVEY MACHINE CO., INC. ..... Third Cover
Agency—Hixson & Jorgensen, Inc.
HI-SHEAR RIVET TOOL COMPANY, THE 57
HOLGER ANDREASEN, INC. 44
Agency—Norton M. Jacobs Adv.

INTERSTATE ENGINEERING CORP. 11
Agency—Wade Adv. Agency, Inc.

KAYNAR COMPANY, THE KAYLOCK DIV. ..... Second Cover
Agency—J. H. Strauss & Co.
KEARFOTT COMPANY, INC. 12
Agency—E. M. Freystadt Assoc., Inc.

LAMINATED SHIM CO., INC. 50
Agency—Wilson, Haight, Welch & Grover, Inc.
LEBANON STEEL FOUNDRY 71
Agency—Howard E. Marshall, Inc.
LEAR, INC. 36, 37
Agency—Buchanan & Co., Inc.
LETOURNEAU, INC., R. G. 66
Agency—Evans & Associates Adv.
LIBRASCOPE, INCORPORATED 11
Agency—Western Advertising Agency, Inc.
LOCKHEED AIRCRAFT CORP. 78
Agency—Donahue & Coe, Inc.

MAXSON CORP., THE W. L. 13
Agency—Engineered Advertising
McDONNELL AIRCRAFT CORP. 77
MINNEAPOLIS HONEYWELL REGULATOR CO. 62, 63
Agency—Foote, Cone & Belding

NEMS-CLARKE, INC. 53
Agency—John E. Waterfield Adv.
NORTH AMERICAN AVIATION, INC. 83
Agency—Batten, Barton, Durstine & Osborn, Inc.

PIASECKI HELICOPTER CORP. 67
Agency—Gaynor, Colman Prentis & Varley, Inc.

RADIO CORP. OF AMERICA, (AVIATION SALES) 92
Agency—Al Paul Lefton Co., Inc.
REVERE CORPORATION OF AMERICA 93
Agency—W. L. Towne Adv.
RHEEM MFG. COMPANY, GOVT. PRODUCTS DIV. 35
Agency—Campbell-Ewald Co.
ROBINSON CO., RALPH C. 61
Agency—Chapin-Damm Adv.
ROHR AIRCRAFT CORPORATION 95
Agency—Barnes Chase Company
ROLLS-ROYCE LTD. 82
Agency—The Wesley Associates
ROYAL AIRCRAFT CORPORATION 81
Agency—Klau-Van Pietersom-Dunlap, Inc.
RYAN AERONAUTICAL COMPANY 73
Agency—Batten, Barton, Durstine & Osborn, Inc.

SCINTILLA MAGNETO DIV., BENDIX AVIATION CORP. 14, 69
Agency—MacManus, John & Adams, Inc.
SEARCHLIGHT SECTION 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120
SIKORSKY AIRCRAFT DIV., UNITED AIRCRAFT CORP. 51
Agency—G. F. Sweet & Co., Inc.
SKYLINE PRODUCTS, INC. (AVIATION DIV.) 61
Agency—Triton Adv.
STACKPOLE CARBON COMPANY 72
Agency—The Harry P. Bridge Co.
STEWART WARNER CORP. (ELECTRONICS DIV.) 56
Agency—O'Grady-Andersen-Gray, Inc.

TWOMEY CO., INC., E. F. 106
Agency—Willard G. Gregory & Co.

UTICA DIV. BENDIX AVIATION CORP. 9
Agency—MacManus, John & Adams, Inc.

VICKERS, INC., DIV. OF SPERRY RAND CORP. 6
Agency—Witte & Burden Adv.

WEMAC COMPANY 121
Agency—McKee-Burns Adv.
WHITTAKER GYRO, INC. 80
Agency—Mogge-Privett, Inc.
WICKES ENGINEERING & CONSTRUCTION CORP. 53

ZENITH AIRCRAFT CO., DIVISION OF ZENITH PLASTICS 18
Agency—Francis D. Gonda Co.

CLASSIFIED ADVERTISING
F. J. Eberle, Ass't. Mgr.

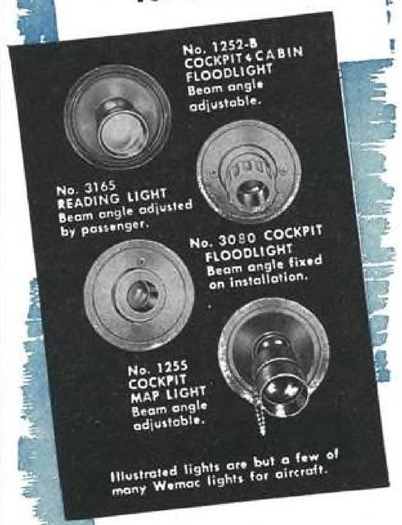
EMPLOYMENT OPPORTUNITIES 110-120
SPECIAL SERVICES TO THE INDUSTRY 107
PLANES—EQUIPMENT (Used or Surplus New) For Sale 107-110
WANTED Planes—Equipment 110

BOWERS BATTERIES

Always Better

BOWERS BATTERY & SPARK PLUG CO., READING, PA.

Adjustable READING LIGHTS and CABIN FLOODLIGHTS for Aircraft



Wemac Lights are designed for efficient heat dissipation and simple bulb replacement. They permit a wide range of locations using a standard unit.

Desired beam angle established on installation or adjustable. One standard light may be stocked as a spare for use in several locations, each requiring a different beam angle.

We also manufacture:

- SHADOW-LESS PANEL LIGHTS
- TUBULAR ELECTRIC HEATERS
- ADJUSTABLE AIR VALVES

Our design and Engineering Staff is at your service. We'll be glad to hear from you about your lighting problems. *No obligation of course.*

Wemac

designers & manufacturers

502 South Isis Avenue
Inglewood, California

Representatives:
George E. Harris & Co., Inc. — 1734 North Hillside, Wichita, Kansas
Edward Marekof George E. Harris & Co., Inc. — 444 Dexer Horton Building, Seattle, Washington

LETTERS

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.

On Coanda Effect

The latest flurry of interest in the Coanda effect was touched off by recent confirmation of USAF's Air Research and Development Command sponsorship of a development in Canada which "could result in a disc-shaped aircraft somewhat similar to the popular concept of a flying saucer." The October 31 issue of AVIATION WEEK in discussing the unconventional design, described the crucial role which is played by application of M. Henri Coanda's principle to the problem of flight control. Announcement two weeks later in the Industry Observer column of ARDC's support of independent research on Coanda effects in three dimensions can be taken as an indication of the importance which is being attached to this basic flow phenomenon. It is clear that the effect merits further elucidation.

A curious fact in this connection stems from an unusual state of affairs in the technical literature now available and well known to American engineers: there is a conspicuous absence of statements or claims of any kind by the inventor-engineer himself. Nor, indeed, are any specific references to Coanda's representations to be found in the papers which by now have become the accepted classics on the subject. The consequence which is then not so surprising is that there is still no general agreement on what is meant by the Coanda effect, beyond acknowledgment that the sharp edges introduced by Coanda have somehow a profound influence on the prevention of flow separation from the surfaces of divergent channels. The wide disagreement among different researchers as to the physical mechanism which underlies the effect is apparent from the totally different hypotheses they assume and the prevalence of all shades of opinion, sometimes hotly defended, at one extreme questioning whether an effect exists at all and at the other extreme presenting claims of success in rather extravagant terms. One cannot escape the conclusion that either some of the noted authorities have failed to grasp the essence of M. Coanda's ideas or else others grossly exaggerate their importance.

M. Coanda himself has avoided open criticism of any of the technical discussions which have appeared in the journals of the learned societies and seems satisfied with what appear to be simple but forceful demonstrations of high-performing devices such as thrust augmentors operating in water. Among less well-known applications of his techniques which he has developed is a novel process for converting sea water to potable form by utilizing solar energy, eliminating the usual procedures of evaporation and condensation. At a pilot plant in southern France, it has been reported that several tons of fresh water are being produced daily in this manner. Such striking results at the hands of the inventor constitute ample proof, to the practical-minded, of the existence of the Coanda effect.

IRVING MICHELSON
Odin Associates

Eight-Day Clock

In the October issue I came across an article about a "new" eight-day aircraft clock to keep track of estimated time of arrival. Device used a set of dummy hands painted on the crystal with another set attached to a center knob that could be moved.

In 1940, Elgin National Watch Co., designed an eight-day aircraft clock with a set of dummy hands on a center knob, which could be set for estimated time of arrival at take-off. Regular geared hands then indicated "time-distance." When the two sets of hands matched, pilot knew he was over target or destination.

This clock, by the way, was used successfully throughout World War II by the Air Forces. Elgin could equip any of its A-11 clocks in this way.

GEORGE W. FRAKER
Elgin National Watch Company
Elgin, Illinois.

'Pilot Error'

I wonder if your readers realize the tremendous untiring efforts put forth by the NWA pilots and ALPA officials in "persuading" the CAB to revise their report on the Sandspit accident. This industry cannot progress so long as official accident investigations are concluded with the familiar "pilot error" to explain probable cause. Admittedly, the much abused "pilot error" is the easy out, white-washing the bureaucratic bungling and designers' defaults—but nothing constructive comes from this type report.

The professional pilots follow CAB accident reports; always hoping to gain a grain of knowledge—perhaps someday destined to prevent another accident. The service your magazine provides in verbatim CAB reports is of utmost value, and we enlist your support in removing the phony and non-constructive probable cause finding the CAB calls "pilot error."

R. F. ADICKES, Chairman
TWA Central Air Safety Comm.
1240 Blue Road, Coral Gables, Florida

Not A B-29

That picture on page 7 of your Dec. 12 issue of AVIATION WEEK looks like a B-50 to me.

JOHN LAWSON
Republic Aviation Corp.
Edwards AFB

ED. NOTE: It is. Lawson and other sharp-eyed readers who pointed out distinguishing air scoops of B-50 are right.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices :

OGDEN AMA, Hill Air Force Base, Utah.

Federal Aircraft Works, 3456 N. Mississippi Drive, Minneapolis, Minn., modification kits for installation of plastic bottom skis for C-47 aircraft, (RFP49439), 60 sets, $90,991; miscellaneous class 03B items applicable to L-20A aircraft, (RFP-56-7518-TCSMC-03B), $34,641.

Del Mar Engineering Laboratories, 2322 Sawtelle Boulevard, Los Angeles 64, Calif., launcher receptacles P/N 2004 for frangible tow targets, 93 ea., commercial manuals engineering data, table 250, 191 ea., and spare parts for launcher, (REP497267), $167,465.

SACRAMENTO AMA, McClellan Air Force Base, McClellan, Calif.

Heller-Campbell-Erickson-Lawrence Construction Co., a joint venture, 4671-24th Street Road, P. O. Box 1672, Sacramento, Calif., non-personal services to construct technical laboratory building and appurtenant facilities, (P/R 56-5095), lump sum, $468,328.

WARNER ROBINS AMA, Robins Air Force Base, Georgia.

Georgia Ports Authority, 1413 Healey Bldg., Savannah, Ga., warehousing, preservation, handling and shipping gov.-owned property, (PR-402099), $139,044.

Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J., repair and modification of gyroscopes for FCS, (PR-584384, 734842), $189,821.

Curtiss-Wright Corp., Caldwell, N. J., repair and modification of propellers, (PR-584517, 734814), $20,000; repair and modification of propellers, (PR-584481, 734815), $230,029; repair, modification, test, packaging and shipping synchronizer assemblies, (PR-584397), $251,720.

Iron Fireman Mfg. Co., 2838 S. E. Ninth St., Portland 2, Ore., repair, modification, test and preparation for storage of vertical gyroscopes, (PR-584385, 734834), $48,475.

HEADQUARTERS, AMC, Wright-Patterson Air Force Base, Ohio.

General Tire & Rubber Co., 1708 Englewood Ave., Akron, Ohio, nose wheel assemblies, spare parts and data, (PR PE-635-760), $40,624.

Lockheed Aircraft Corp., Marietta, Ga., facilities for production of C-130 aircraft and modification of B-47 aircraft, (PR's 636422 and 672962), $875,000.

General Motors Corp., Delco Products, Dayton, Ohio, storage and maintenance of facilities, (PR 226083), $126,000.

Ramo-Wooldridge Corp., 8820 Bellanca Ave., Los Angeles 45, Calif., purchase of real property to be provided contractor under facilities contract, (PR 672964), $1,230,000.

Continental Aviation and Engineering Corp., Detroit 32, Mich., conversion of facilities for the testing of J69 engines and MA-1 gas turbine air compressors, (PR 636466), $40,000.

United Aircraft Corp., Pratt & Whitney Engine Div., East Hartford 8, Conn., manufacture, design, acquisition, supply and installation of facilities, (PR 225933), $589,000.

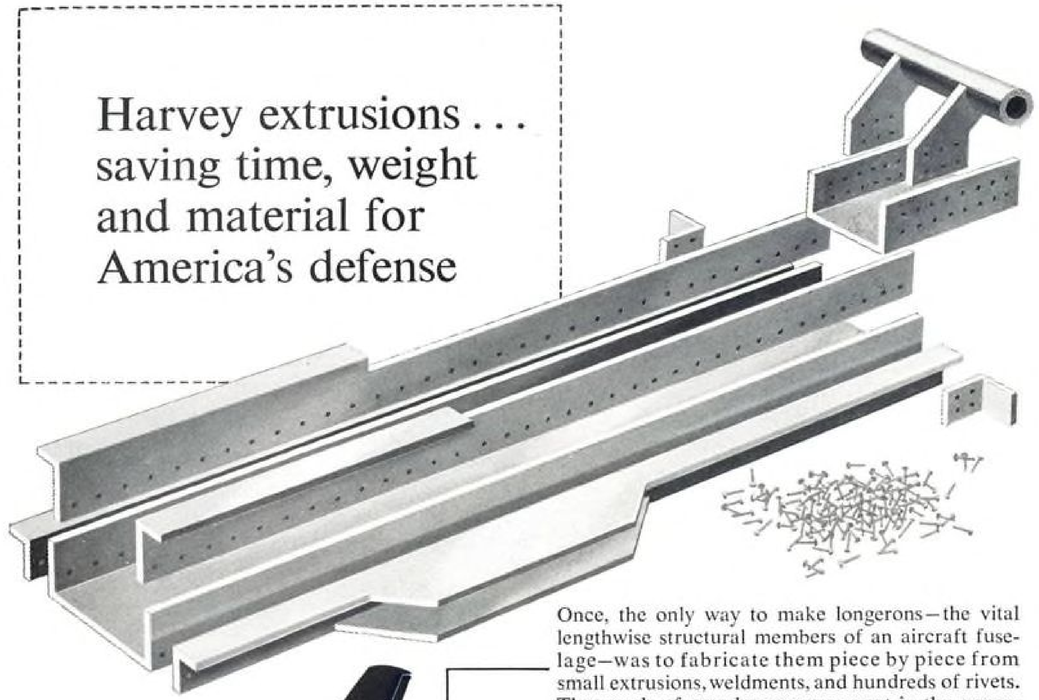
Boeing Airplane Co., Wichita, Kan., repair and rework of GFAE for the B-47 production program, (PR PA-210550), $236,622.

Westinghouse Air Brake Co., Union Switch and Signal, Swissvale, Pa., modification of F-86D flight simulator, spare parts, (PR 498015), $52,242.

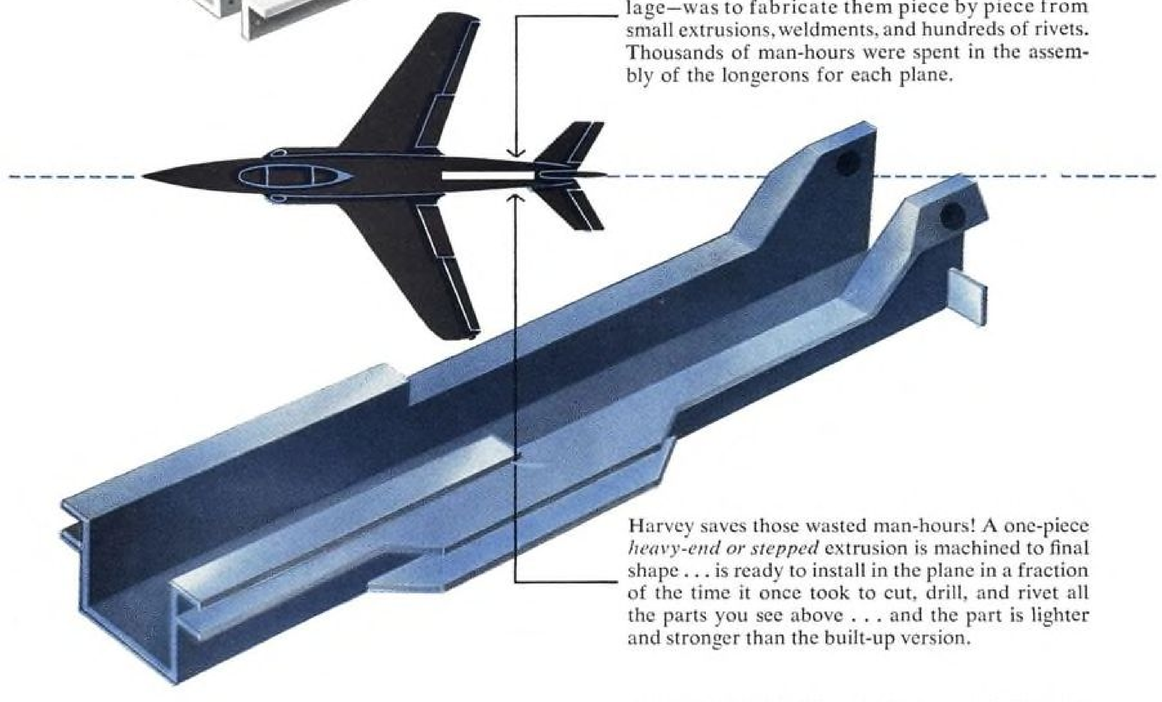
DAYTON AFD, Gentile Air Force Station, Dayton, Ohio.

Fisher Engineering, Inc., 2060 U. S. 24 East, P. O. Box 327, Huntinton, Ind., transformer pulse Fisher P/N M12J42U8P equivalent to G. E. P/N ML7010212G1, 1,000 ea., RFP 33-604-55-3895, $23,215.

Harvey extrusions . . .
saving time, weight
and material for
America's defense



Once, the only way to make longerons—the vital lengthwise structural members of an aircraft fuselage—was to fabricate them piece by piece from small extrusions, weldments, and hundreds of rivets. Thousands of man-hours were spent in the assembly of the longerons for each plane.



Harvey saves those wasted man-hours! A one-piece *heavy-end or stepped* extrusion is machined to final shape . . . is ready to install in the plane in a fraction of the time it once took to cut, drill, and rivet all the parts you see above . . . and the part is lighter and stronger than the built-up version.

Harvey is a leading independent producer of aluminum extrusions in all alloys and all sizes, special extrusions, press forgings, hollow sections, structurals, rod and bar, forging stock, pipe, tube, impact extrusions, aluminum screw machine products and related products. Also similar products in alloy steel and titanium on application.

MAKING THE MOST OF ALUMINUM . . . FOR EVERYONE

HARVEY Aluminum

HARVEY ALUMINUM SALES, INC., TORRANCE, CALIFORNIA—BRANCH OFFICES IN PRINCIPAL CITIES

Allison Turbines power new Piasecki "Transporter"

The world's largest turbine-powered transport helicopter, the 40-passenger Piasecki YH-16A "Turbo-Transporter" is powered by two Allison T38 engines driving its giant rotors. These two T38 engines, capable of a total of 5300 shaft horsepower, give the 16-ton "Turbo-Transporter" a speed of approximately 150 mph.

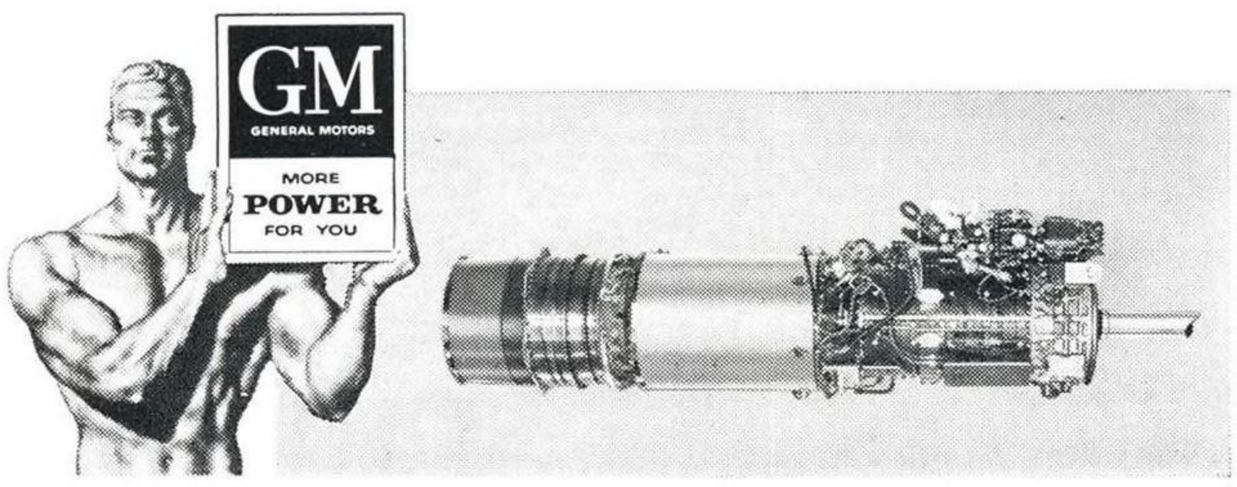
Two Allison T56 engines, capable of a total of 6900 shaft horsepower, will be used in the larger, more powerful production version of the "Turbo-Transporter," the YH-16B, which will carry a greater payload, or 69 passengers, at a higher speed.

Besides being smaller and lighter than piston engines of comparable power, which allows the helicopter to carry more passengers or cargo, gas turbine engines offer several other advantages: they need no extensive ground warm-up, are easier to service and maintain, and provide greater comfort for passengers and crew.

Improved Fuel Economy

With helicopters demanding high power for take-off and hovering for extensive periods of time, the turbine engine operates at its optimum efficiency. With the added advantage of the turbine engine using cheaper fuel, the over-all fuel economy is better than its piston-powered counterpart.

The new era in American air travel offers increasing opportunities for helicopters, and powerful, compact Allison engines ideally meet the requirements of this service. They are backed by more than seven million hours of turbine engine flight time—*experience where it counts most—in the air!*



ALLISON

DIVISION OF GENERAL MOTORS,
Indianapolis, Indiana

Builder of Turbo-Jet and Turbo-Prop Aircraft Engines