NOVEMBER 1946
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America's First Aeronautical Magazine

AVIATION

IN THIS ISSUE

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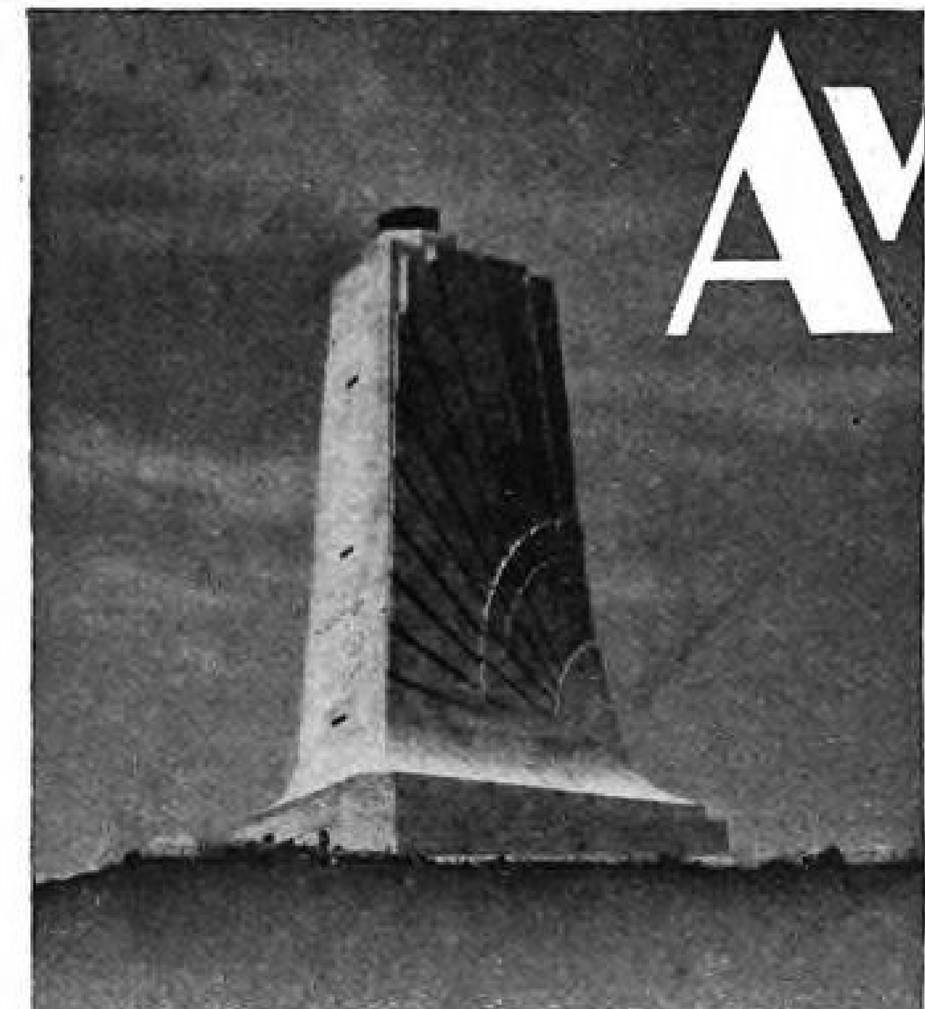

AVIATION

CONTENTS FOR NOVEMBER, 1946

Volume 45 • No. 11

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Those two Bendix personal planes have certainly been the cause of plenty of hangar flying—the rumors, "reports," and outright flat statements on Bendix' plans have been as varied as they've been numerous.

It is with considerable reportorial pleasure that we can give the right dope. Bendix has reached the decision "that it should stick to its knitting as a producer of those important parts which it has long supplied to the industry, and with added emphasis on similar equipment for the growing personal plane market." According to Malcolm P. Ferguson, Bendix Aviation's president, "the corporation felt, as have so many other corporations which have been confronted with the same decision, that over the long pull it should continue to grow as a partner to all plane manufacturing companies rather than to become—even in one small part of the industry—a competitor."

Reason Bendix ever built the planes is as interesting as it is logical. Over two years ago, back in the "postwar planning" days, Bendix decided to do a real research job on the personal plane field—engineering-wise as well as market forecasting-wise. Preliminary studies showed that development of improved low-cost components could be facilitated by actual personal plane design work; so a separate engineering group, under A. P. Fontaine, former assistant director of engineering for Convair, was set up. Success of the group, reports Mr. Ferguson, "exceeded the corporation's hopes and desires." But, the company maintains, Bendix isn't going into personal plane production.

Still the $64 question, as regards personal planes, is this: How many will be built and sold next year? One of the industry's most important parts producers dropped in the other day just after a swing around the country, so we immediately popped the question at him.

Always conservative—but plenty accurate in the past—he begged off on the whole year's figures. "The first six months is as far as I'll go," he declared adamantly. "I don't quite know how to express it, but I think the boys in Wall Street would say the market is a little 'soft' right now. And who knows what's going to happen to the country as a whole—too much depends on inflation, which the Administration at last seems to be admitting is more than a threat."

But he did get out his pencil and came up with this estimate for the first half of next year—24,000. That's a 48,000-per year rate, and would represent, if maintained, a gain of about 10,000 ships over this year's projected output.

Remember back in '41 when we thought 8,000-plus was really some business?

But, watch those inventories. The time has come for manufacturers to resist the strong temptation to buy large quantities of anything they need at any price, say bankers with a weather eye on their investments. Many finance men have grave fears for producers whose inventories are out of control; they see a possible downward price adjustment in six months or so, and hope their clients don't get left holding the bag. Of course, if you haven't been able to accumulate an inventory, you have nothing to worry about.

Gauntlets across the ocean. On his return to England from his recent American tour, Air Commodore Frank Whittle, father of British jet propulsion, is reported to have observed that American jet engines are approximately two years behind the British. That, it seems, is a real challenge to America—or at least to those responsible for allocation of research and development funds and facilities.

And in that same report was a challenge to British aircraft builders—a challenge we here in the U. S. know they're taking up. The Air Commodore made his flight to America in a Liberator (built in this country by Consolidated Vultee) and returned to England in a Constellation (built in this country by Lockheed).

Dial system for missiles. All you will have to do is set the dial—on Blohm & Voss, Hamburg, for example—and push the launching button. With technology taking care of the rest, the missile will soar on its way to the predetermined objective. Sounds fantastic, but it is the prediction of a practical dreamer whose company name is among the most familiar in American industry. Another possessor of practical imagination—fellow named Larry Bell—predicts the possibility of missiles guided by the stars and having speeds of 5-10,000 mph.

It's good we have men like this, because the Russians are losing no time in improving on German guided missile developments.

Built-in tailwind. Two generations of hangar flyers have talked about aircraft with built-in tailwinds. Now anybody can have one if he follows the technique of pressure avigation (see page 187, May 1945 AVIATION). This method of catching the tailwinds that lurk around the edges of low pressure areas has been demonstrated by the formidable flight of the Navy's Truculent Turtle. For the record, this Wright-powered Lockheed P2V Neptune patrol bomber flew nonstop from Perth, Australia, to Port Columbus, Ohio, a distance of 11,236 mi., in 55 hr., 15 min.

Too many companies. You don't need to be an Einstein to figure out that too many new companies plan to crash the personal aircraft field. In fact, there are too many in it now. If you simply divide the most optimistic market estimate by 200 you can see how little volume there will be for each one. The hour is growing late and it takes longer than you think to get started. So if you have ambitions to be president of your own lightplane company, you better buy an outfit already running. If you have a design so hot that it can't help capturing the lion's share of the market, you might do better for yourself and your sponsors if you sell the design to some going concern. Don't believe Emerson's bunk about customers beating a path to your door.

Down the Years in Aviation's Log

25 Yr. Ago (1921)—Bert Acosta wins Pulitzer Trophy in Curtiss CD-2 Navy racer, at 177 mph. . . . Army JL-12 Liberty-engined, heavily armored attack plane, carrying 30 machine guns, flies N. Y. to Washington in 2½ hr. against 60 mph. headwind. . . . Army builds 180,000 cu.ft. airship hangar at Aberdeen, Md. . . . Sgt. Chambers makes 24,850 ft. parachute jump at Fort Sill, Okla. . . . Gen. Mitchell breaks Dayton-N. Y. record in 3 hr. 35 min., flying DH-4 blind most of the way.

15 Yr. Ago (1931) — Pangborn and Herndon fly nonstop from Tokyo to Wenatchee, Wash., 4,588 mi. in 41 hr. 13 min. in P & W Wasp-powered Bellanca. . . . Ludington Line shows profit of $8,073 for year. . . . Airlines on West Coast cut rates to 3.9¢ per mile. . . . Japan now is sixth in air strength. . . . Crashed Junkers trans-Atlantic plane Esa kept afloat 158 hr. by wing fuel tanks.

NEW PRODUCTS

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Products and Practices

This selected information on new products and publications is offered by the "AVIATION" Reader's Service through cooperation with the manufacturers. It helps executives save valuable time, provides profit through convenience. To obtain additional data on new products described, or copies of literature, simply fill in form (on page 11 or 133), clip it to your letterhead, and mail. There is no cost, no obligation.

Aircraft Tachometer..............1

Described by company engineers as world's smallest, new electric aircraft tachometer has been developed by **General Electric Co.,** Schenectady, N. Y., on request of a large West Coast aircraft manufacturer. Instrument has scaleplate that is nearly one-third smaller in dia. than previous models. It is operated on magnetic drag principle, in which magnets rotate at a speed that is proportional to engine speed and cause a drag disk to drive pointer up a scale. Pointer on indicator comes to rest when torque exerted by drag disk equals torque of a calibrated control spring on pointer shaft.—**AVIATION, Nov., '46.**

New Goggles.....................2

Developed during war for Navy and now available for civilians, new aviation goggles are announced by **American Optical Co.,** Southbridge, Mass. Goggle is a one-piece chamois-lined unit featuring venturi tubes for controlled ventilation, has polished nickel finish of metal parts, also an extra-long, adjustable headband. It also has narrow eye wires and new bridge designed to give a greater field of vision. Goggle can be obtained with glare reducing, invisible ray-absorbing lenses or, if desired, with non-absorbing lenses where glare removal is not essential. It is optically ground and has polished 9.00 base curve lenses.—**AVIATION, Nov., '46.**

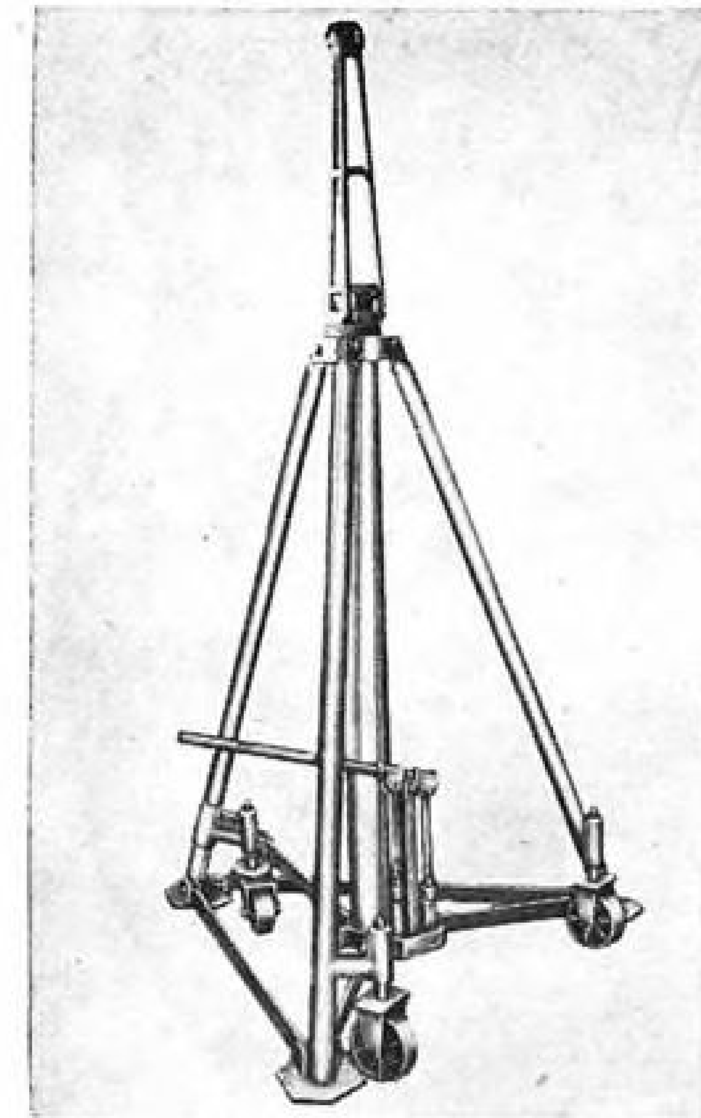
Meal Tray.........................3

Made of metal alloy with baked-on heat-and-cold-resistant finish, the new "Flite Tray," designed by **Martial & Scull,** New York City, weighs but 20 oz. It has cover which fits underneath, forming insulation space for use in deep freezing units and de-freezing ovens

when frozen foods are used. Indentures in tray provide locations for food containers. Fillers are cardboard or plastic and are designed to prevent spilling of liquids under rough flight conditions. Tray is 12¾ x 10⅝ x 1½ in.—**AVIATION, Nov., '46.**

Tripod Jack......................4

Hydraulically operated and having a working height from 56 to 112 in., new 10-ton tripod aerojack is made by **Air-**



quipment Co., Burbank, Cal. Unit is constructed of steel tubing, with tripod legs supported by spring casters for mobility. In operation, casters retract when load pressure reaches about 1,000 lb., setting jack on ground. Maximum lift height of basic unit is 95 in. Height can be increased to 112 in. by use of high adapter cap. Jack has grooved pins to facilitate assembly and disassembly. Ram movement is powered by manually operated hydraulic pump.—**AVIATION, Nov., '46.**

Aircraft Energizer................5

Stated to incorporate in its design specific recommendations of five major airlines, new aircraft energizer has been developed by **D. W. Onan & Sons,** Minneapolis, as a source of auxiliary electric power for on-ground servicing of large transport and passenger planes. It provides output for starting main engines at sub-zero temperatures, checking lighting circuits and wiring, testing radio equipment and landing gear, and operating heaters. Self-contained and enclosed in a sheet steel weather-proof housing, unit is mounted on a rubber tired three-wheel dolly. Generator, rated at 5,000w. and directly connected to two cylinder air-cooled gasoline engine, supplies either 12 or 24v. Four heavy duty batteries, installed as part of unit and recharged by energizer, are floated across line. With a continuous output rating of 200 amp. at 24v. it has a 5 min. maximum output of 600 amp. If power demands are unusually heavy, two units may be connected in parallel and combined output utilized.—**AVIATION, Nov., '46.**

Handlever Turret.................6

Made by **South Bend Lathe Works,** South Bend, Ind., for use on company's 9 in. lathes, new tailstock type handlever turret mounts on inside ways of bed in place of regular tailstock. Six station turret head accommodates tools with ⅝ in. dia. shanks. Index lock releases automatically at end of turret slide's return stroke, and indexing is done by hand. Length of cut at each station is regulated by means of an adjustable screw. Stop mechanism is geared to operate in unison with indexing of turret, and operations can be repeated or skipped at will. Turret slide has maximum stroke of 3¼ in.—**AVIATION, Nov., '46.**

Aircraft Relay....................7

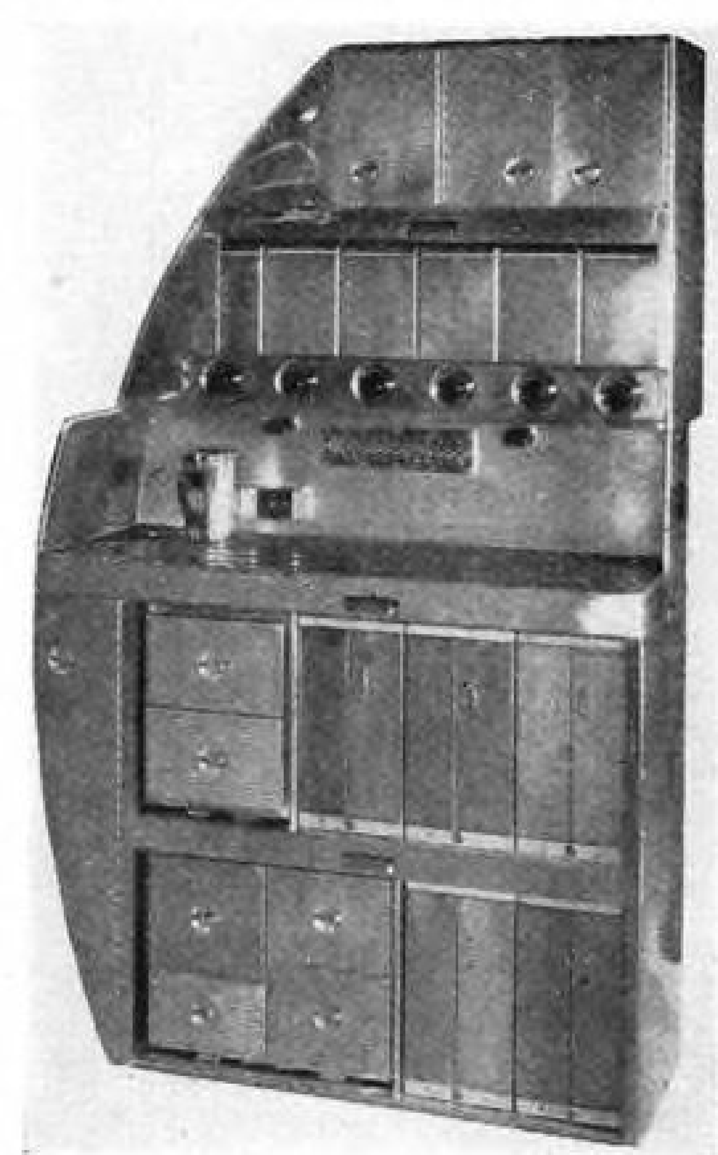
Protected against damaging action of humidity, sand, dust, and salt spray, and stated to meet operating conditions up to 10G vibration and acceleration, new direct current solenoid type relay now available from **Leach Relay Co.,** Los Angeles, was designed for feeder type planes and small personal aircraft. It is stated to be capable of operating at altitudes up to 50,000 ft. and at temperatures between minus 54 and plus 71 deg. C. Designated as type No. 7064-534, it is supplied with intermittent duty coils for motor starting applications. Type No. 7064-534 C has coils for battery switching, motor control, and aircraft radio switching and lighting. Contacts are made of silver alloy, are of ⅜ in. dia., and rated at 100 amp. at 12v. d.c. or 75 amp. at 24v. d.c. Dependent on voltage and operating requirements, coils have a resistance of from 9.5 to 110 ohms. On intermittent duty, coils consume about 15.12w. and 5.23 for continuous duty. Relay weighs about 8½ oz.—**AVIATION, Nov., '46.**

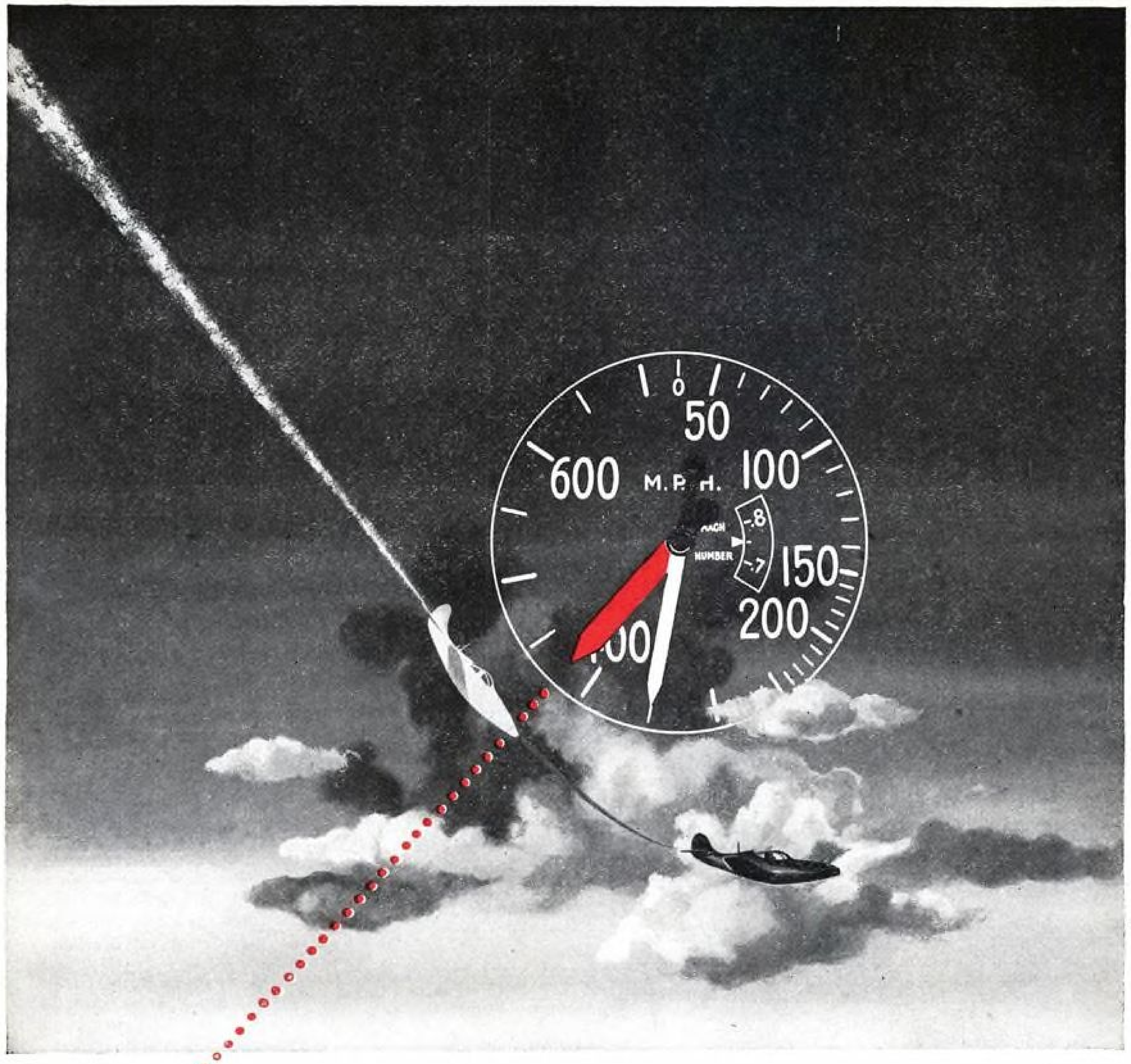
De-Icer Coating..................8

To give aircraft de-icers a protective summer coating, to be peeled off when icing weather returns, new spray-on material has been developed and is being further tested by **B. F. Goodrich Co.,** Akron, Ohio. Material is aluminum color, and is stated to curb sun's ultraviolet rays, which are chief factors in aging resulting from exposure. Color helps keep de-icers cooler by reflecting sun's heat. Time required to spray a plane size of DC-3 is stated to be less than three hours. Trials indicate this size plane would require about 1½ gal. of material.—**AVIATION, Nov., '46.**

Airliner Buffet....................9

Specially designed airliner dining buffets are being produced by **Harrington Mfg. Co.,** Mansfield, Ohio, one illustrated being exclusive company design





THE DANGER LINE for present day high speed aircraft has been the speed at which the plane enters the supersonic shock-wave pattern — a speed which varies with altitude. An important part of Kollsman's development program for the past several years has been instrumentation for high speed subsonic and supersonic flight. Among the developments is the new Kollsman Mach Air Speed Indicator. The broad red pointer moving over the dial of this indicator reports critical speed as it changes with altitude and thus gives the pilot constant warning of the point at which the plane will enter the dangerous compressibility pattern. Operating airspeed is indicated by means of the white pointer on the same dial. The relationship of operating airspeed to the critical speed is, therefore, constantly apparent at all altitudes. On the mechanism which actuates the red pointer, settings are provided both for the proper Mach Number and the maximum operational speed for the particular design of aircraft being flown.

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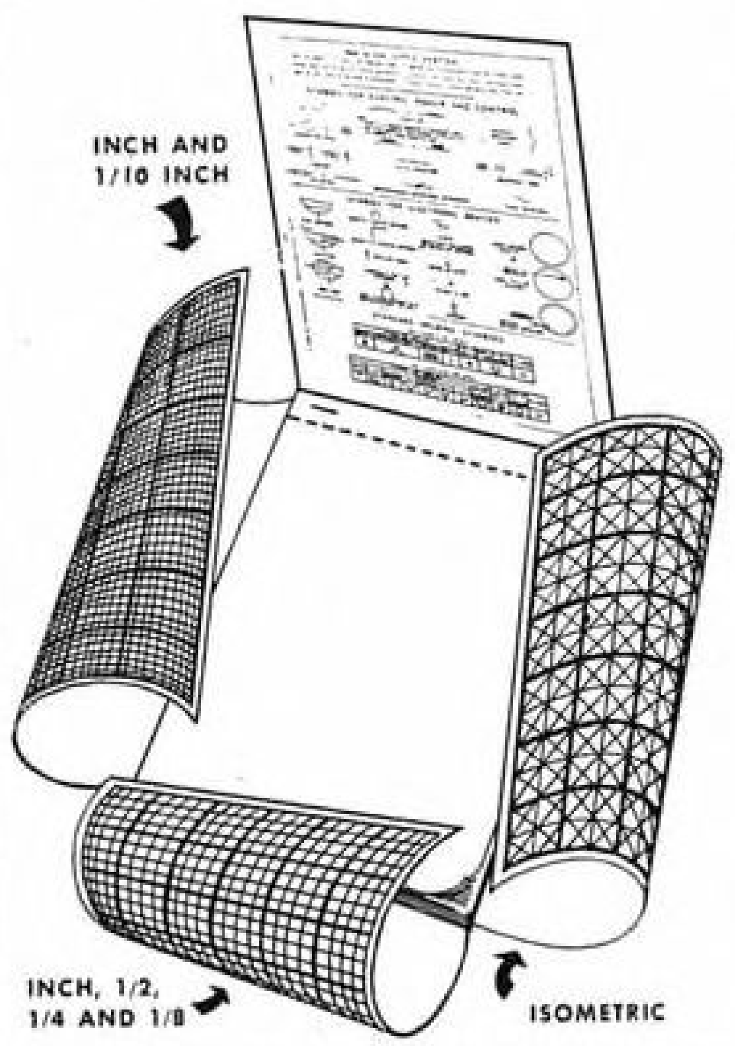
TUDOR II

for use in DC-6s for American Airlines. Buffet is made in two sections. Forward portion is pictured here; after section consists of locker space. It will be noted that side of unit is shaped to fit inner contour of plane.—**AVIATION, Nov., '46.**

Drawing Pad Scales Sketches......10

Designed for use by draftsmen, designers, and engineers, new scale drawing pad, offered by **Jiffy Sales Co.,** Cleveland, is made to enable properly proportioned drawings to be made without use of ruler, drafting board, or T-square. Pad contains 75 sheets of tracing tissue, enclosed within a cover jacket that consists of four cardboard flaps. Various scales are printed on three of flaps. Pad is used by folding back cover flap and placing tissue over scale to be used. Drawing is made to scale with aid of printed lines which show through tissue. Three scales given are: 1 in. and 1/10 in.: 1. ½. ¼. and ⅛ in.; and isometric. Drawings made on pad may be blueprinted. There are no



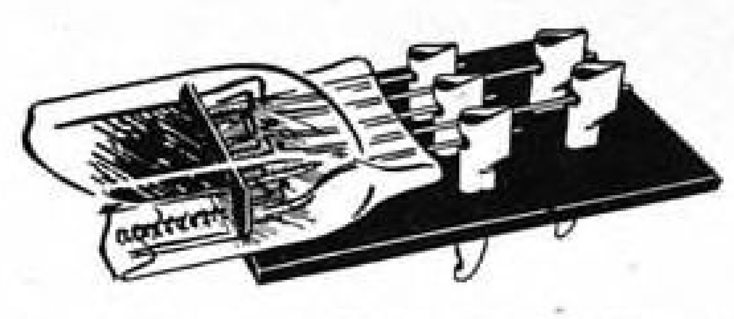
ruled lines on tissue. Pad measures 9 x 12 in. Information is printed on back of each cover flap, including basic mechanical drawing standards, electrical, welding, and architectural symbols, decimals of a foot, decimal equivalent of fractions, with circumferences and areas of circles.—**AVIATION, Nov., '46.**

Aircraft Instrument Oil...........11

The Texas Co., New York City, announces new oil specially developed for gyro instrument service in aircraft. Company states product meets requirements of Army-Navy Aero Specification AN-0-6a.—**AVIATION, Nov., '46.**

Vacuum Tube Socket.............12

Made by assembling required number of "flea" contacts in square holes pierced in a chassis of insulating material, new type of sub-miniature tube socket contact, stated to meet all electrical and mechanical requirements, is made by **Instrument Specialties Co.,** Little Falls, N. J. Contacts. designed for use with sub-miniature tubes having co-planer leads with a spacing of 0.50 in. or more, are made from beryllium



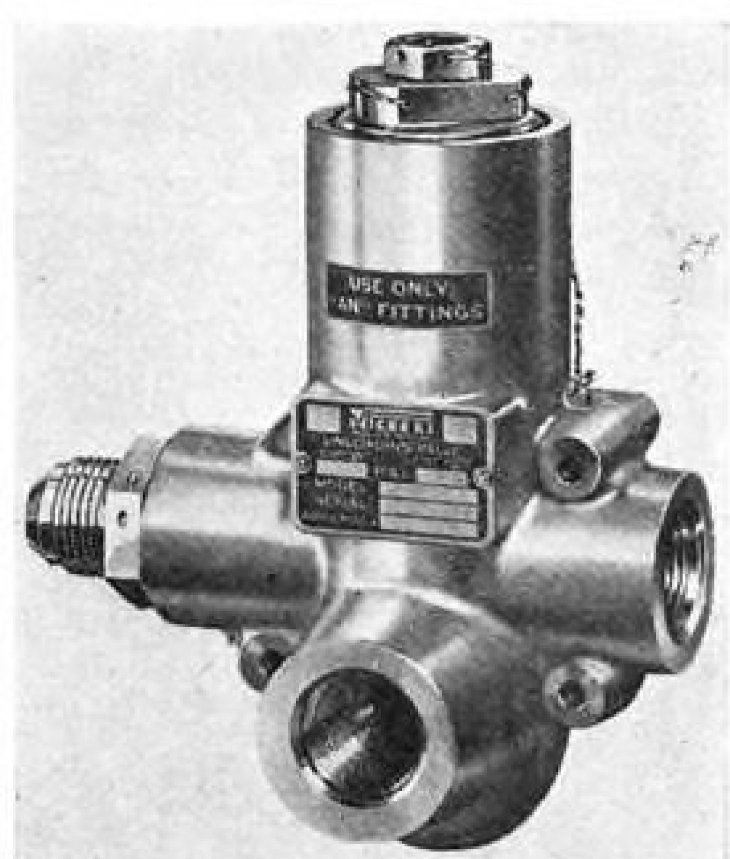
copper. Lower end of contact is formed into an open U section which permits pushing contact into square hole. This automatically wedges it in place to withstand a withdrawal force of 2 to 5 lb. per contact. Self aligning and self-cleaning, contacts are spaced far enough apart to permit wiring and soldering.—**AVIATION, Nov., '46.**

Rotary Actuator 13

Developed by **Lear, Inc.,** Grand Rapids, Mich., and finding applications in aircraft industry, new small rotary actuator, Model 181, weighs 0.60 lb. It has been made for loads ranging from 0.1 to 15.0 lb.-in., and speeds from 2.5 to 375 rpm. With limit switch and AN connector it weighs 0.75 lb. Unit incorporates new motor, the "G" frame, of intermittent duty, split series or single field type, developed for either reversible or continuous rotation. It has output ratings from 0.4 to 15w. at 24v. d.c. Motor is made in a.c., d.c., and universal types for wide range of voltages. Units are made available without limit switches and for multiple positioning. Where accurate positioning is required, a brake can be provided between motor and gear box. Magnetic disconnect clutch can be supplied for special applications requiring a free running output shaft when unit is not energized electrically. Actuator has been developed for such applications as remote valve operation for fuel, oil, and air systems; tuning motors for radios; and remote controls.—**AVIATION, Nov., '46.**

Unloading Valve 14

Functioning as a pressure regulator, automatically unloading pump as accumulators reach a predetermined maximum pressure, and used with accumulators to control maximum and minimum hydraulic system pressure, regardless of flow rate, new 3,000 psi. unloading valve is announced by **Vickers, Inc.,** Detroit. It has nominal rated capacity of 16 gpm. and has built-in accumulator line check valve. No external adjustments are required for installation, since unit is preset at factory.—**AVIATION, Nov., '46.**

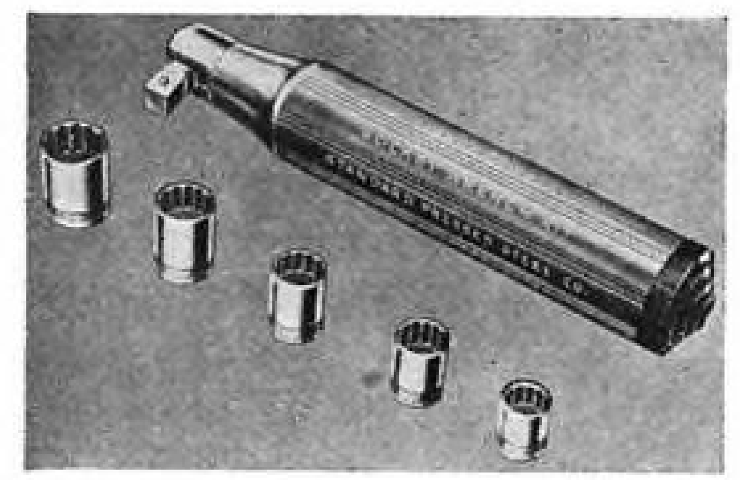


Flight Test Potentiometer..........15

Van Dyke Instruments Co., Tarzana, Cal., offers new potentiometer described as linear wire-wound resistor of helical type specially designed for flight test and allied instrumentation work where weight, size, and dependability are primary. Both five- and ten-turn units are available, and units having odd numbers of turns and special resistance values can be supplied. Also housings having collet type shaft locks can be provided on order. Standard ten-turn potentiometer has body length of 1⅞ in. and weight of less than 2 oz. Other specifications: Rotation, 3,600 deg. plus-or-minus 10 deg.; resistance, normal tolerance plus-or-minus 5% (values up to 6,000 ohms per turn can be supplied); linearity, better than .5%; and power rating, 1.5w. at 55 deg. C.—**AVIATION, Nov., '46.**

Tool Kits 16

Consisting of interchangeable tools carried in hollow Celanese plastic handles, new "Hallowell" tool kits are made by **Standard Pressed Steel Co.,** Jenkintown, Pa. Seven kits contain 50 tools, and three kits have swivel bit-chucks, which give five different driving or wrenching positions. Applicable kits are made up as follows: Socket screw kit, in two handle sizes with a swivel bit-chuck, containing keys for driving socket set, cap, Phillips, and slotted head screws; and socket wrench kit (illustrated), in two handle sizes, with swivel bit-chuck, containing 6 and 12 point box sockets from No. 4 up to and including ½ in.—**AVIATION, Nov., '46.**



Color Code Guide 17

For radio and electronic type resistors, new RMA-JAN color code guide is marketed by **Allied Radio Corp.,** Chicago. Three rotary disks are provided for setting code colors and corresponding resistance values, which are brought into line automatically. Included are data covering resistance tolerances and complete listing of RMA-JAN 10% resistor stock values.—**AVIATION, Nov., '46.**

Information Tips

ENGINEERING DATA

Ball Bearings 18

Series of three books issued by **New Departure Div., General Motors Corp.,** Bristol, Conn., cover principle bearing types, fundamentals of mounting practice, description of shaft and housing designs, and details of lubrication for all operating conditions.—**AVIATION, Nov., '46.**

Non-Metallic Materials 19

Bulletin No. GF 3 from **Continental Diamond Fiber Co.,** Newark, N. J., gives engineering and technical data on non-metallic materials, including Diamond, Dilecto, Vulcoid, Celeron, Micabond, and Dilectene.—**AVIATION, Nov., '46.**

Metal Protection 20

American Chemical Paint Co., Ambler, Pa., has issued Data Sheet No. 7-16-100 on rust proofing process for aluminum and its alloys, and Sheet No. P-100-21 on rust proofing chemicals, protective coat-

(*Continued on page* 131)

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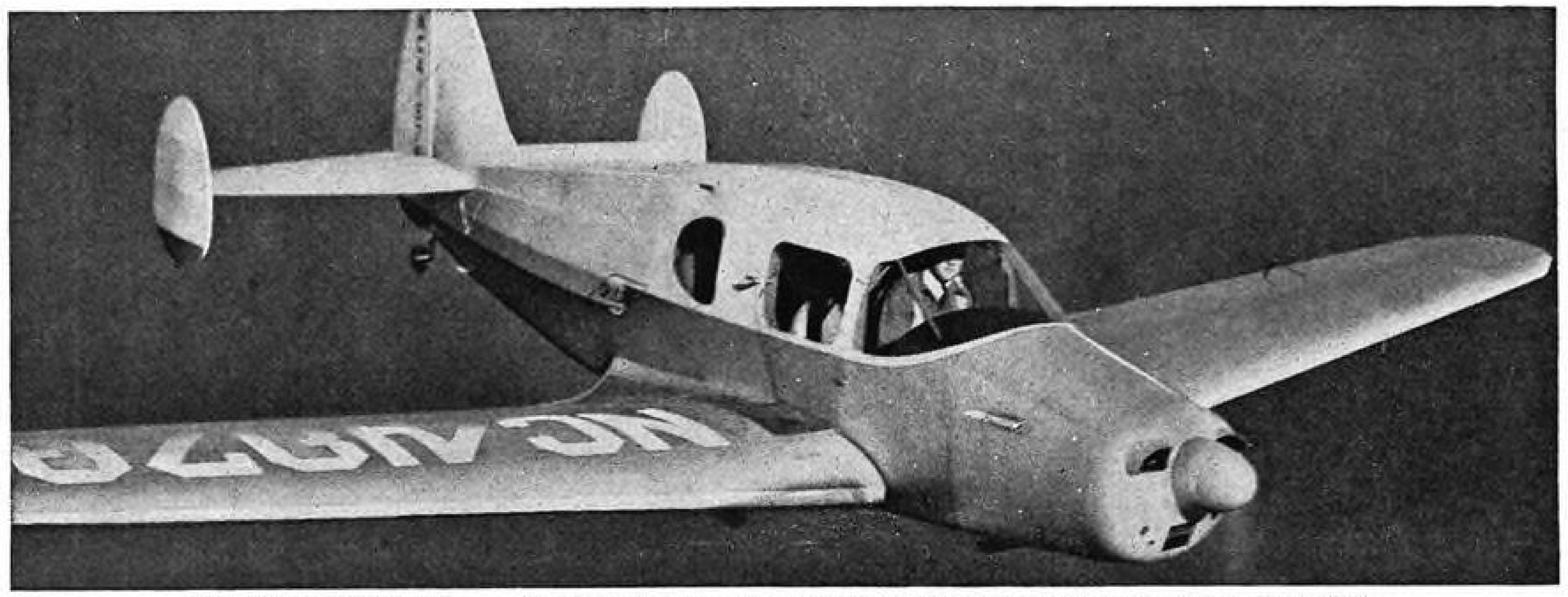

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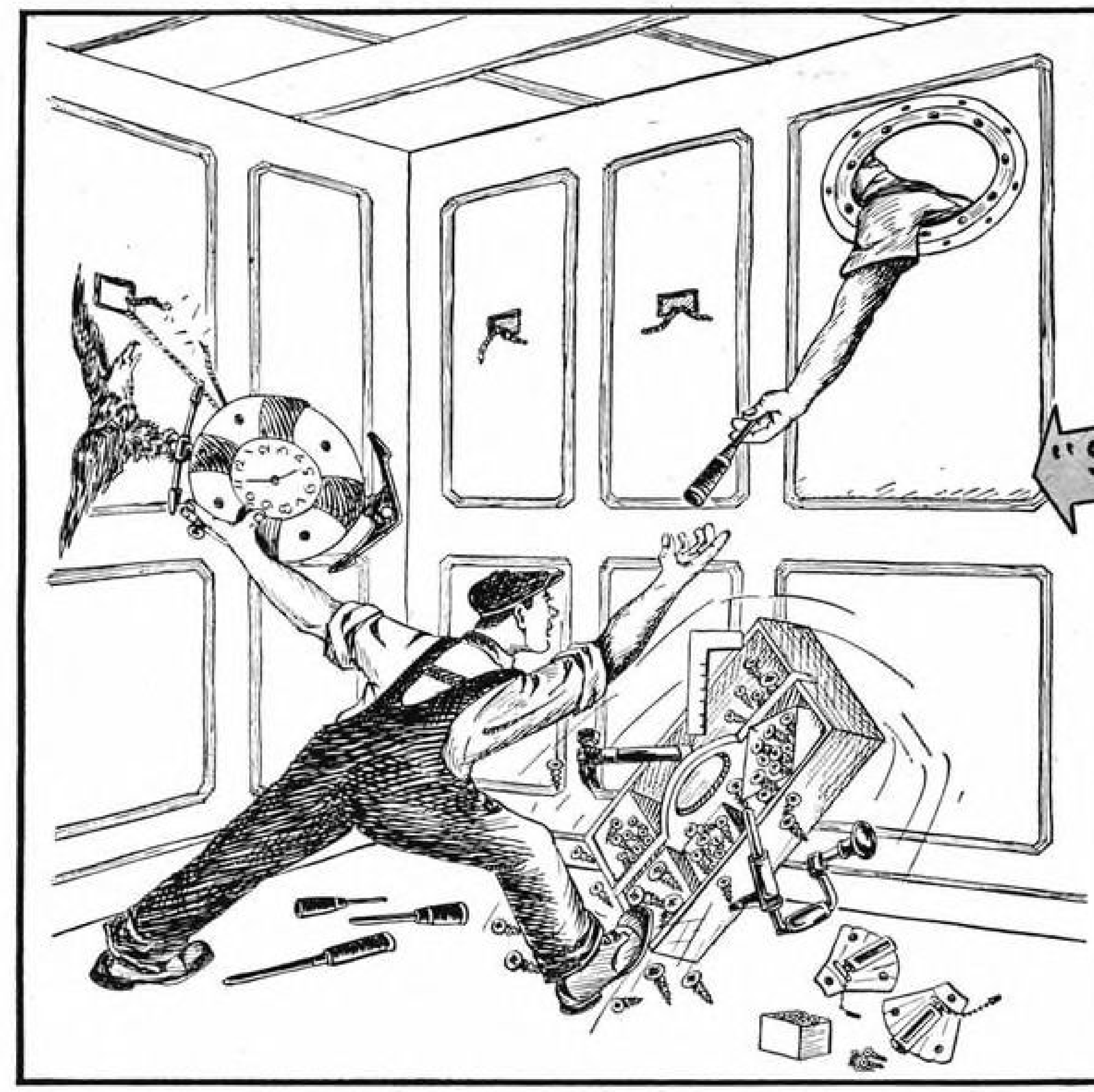

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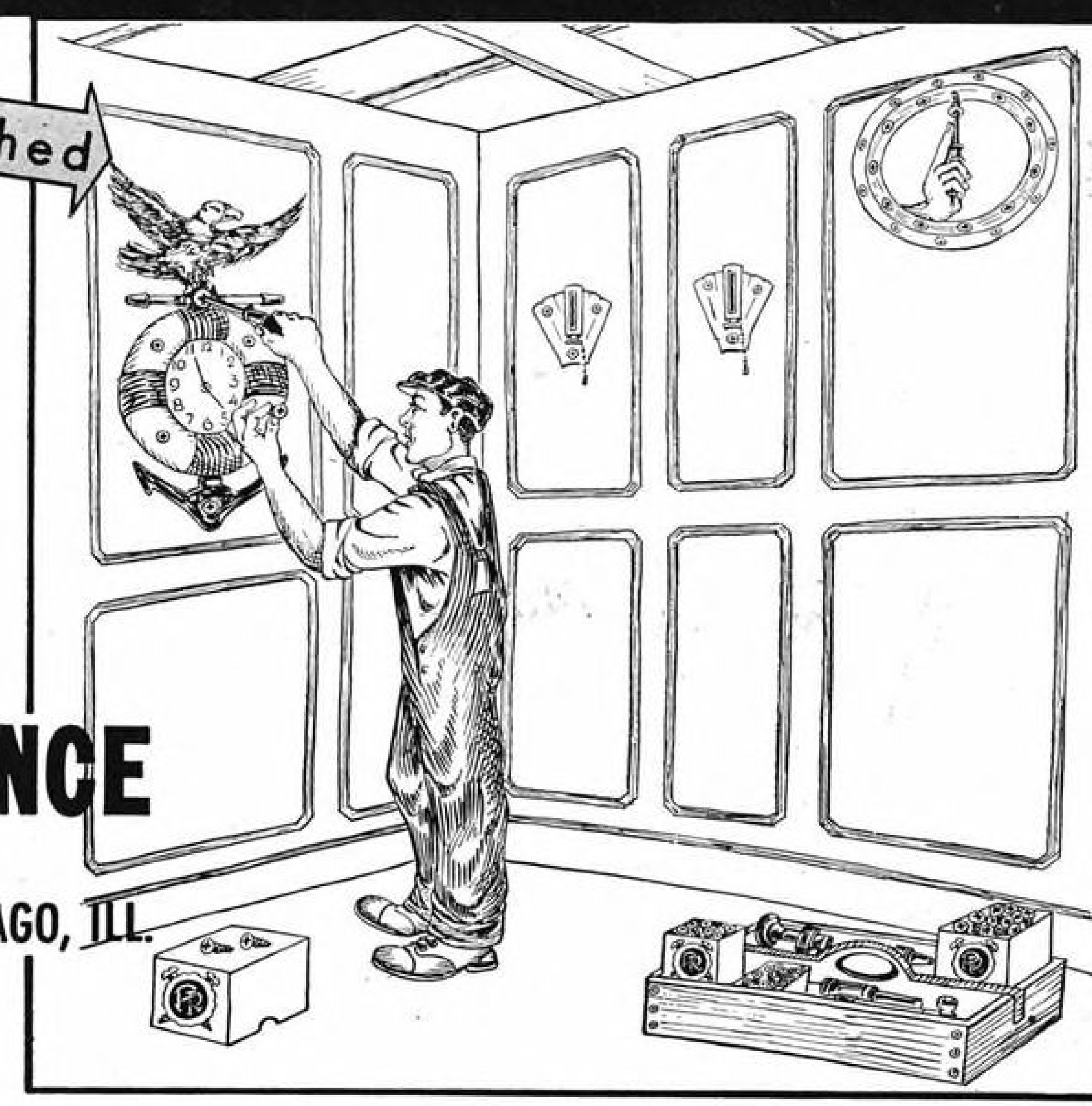

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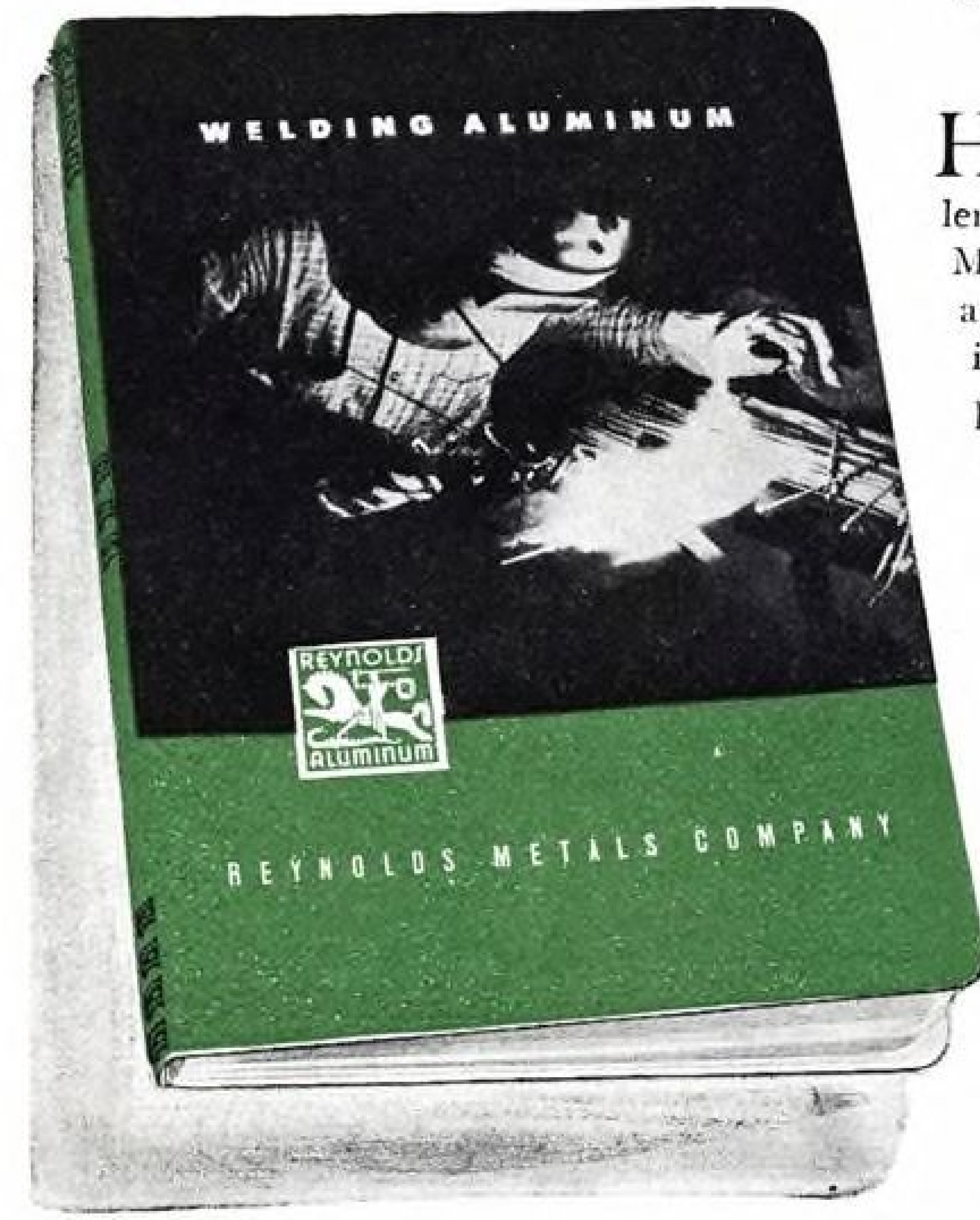
Are you welding aluminum now? Do you plan to weld aluminum in the future? If so, this book is for you!



HERE'S a new up-to-the-minute book, "Welding Aluminum," that presents a concise, authoritative discussion of problems dealing with welding aluminum and aluminum alloys. Many new war-developed applications are described. Under a single cover, in handy usable form, you will find detailed information on 11 aluminum welding processes, from edge preparation to finishing, a comprehensive discussion of aluminum alloys and tempers, and helpful tables on properties, gauges, sizes, and strengths.

"Welding Aluminum" is clearly illustrated with 44 interesting photographs and graphs of welding operations. If you work with aluminum, you'll find "Welding Aluminum", prepared by the technical staff of the Reynolds Metals Company, an invaluable reference book.

How do you get your copy? Simply fill out the coupon on this page and mail with your check or money order for one dollar, to cover the cost of printing and mailing, to Reynolds Metals Company, 2500 South Third Street, Louisville 1, Kentucky.

83 PAGES packed with accurate up-to-the-minute facts, figures, and photographs—about

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- Edge Preparation
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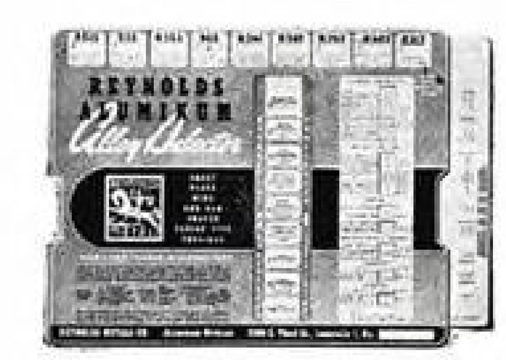

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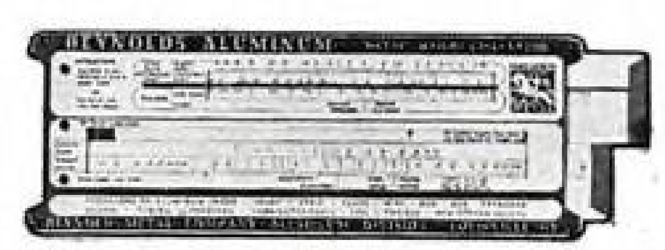

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( ) Please send me a Reynolds Aluminum Alloy Selector. I enclose $1.00.
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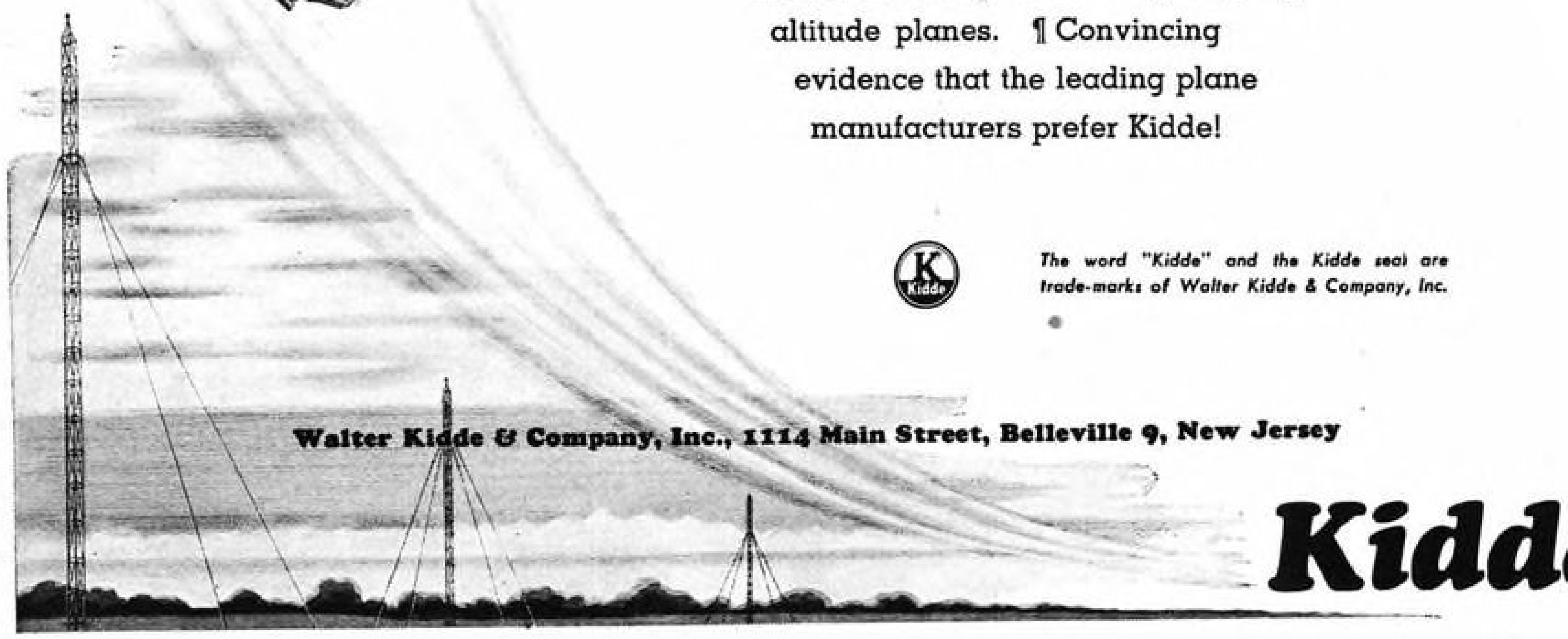
On many a famous-name plane, you'll find Kidde carbon dioxide extinguishing systems on guard against engine fires. ¶ Kidde systems are *standard* equipment on the production models of these outstanding aircraft types: BEECH MODEL 18, BENDIX MODEL "J" HELICOPTER, BOEING 377 (STRATOCRUISER), CONSOLIDATED 240, DOUGLAS DC-6, and the MARTIN 202. ¶ In addition, you will find Kidde systems on the experimental models of many other new, fast, high-altitude planes. ¶ Convincing evidence that the leading plane manufacturers prefer Kidde!

The word "Kidde" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.



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For conversions . . . maintenance . . . service . . . USE

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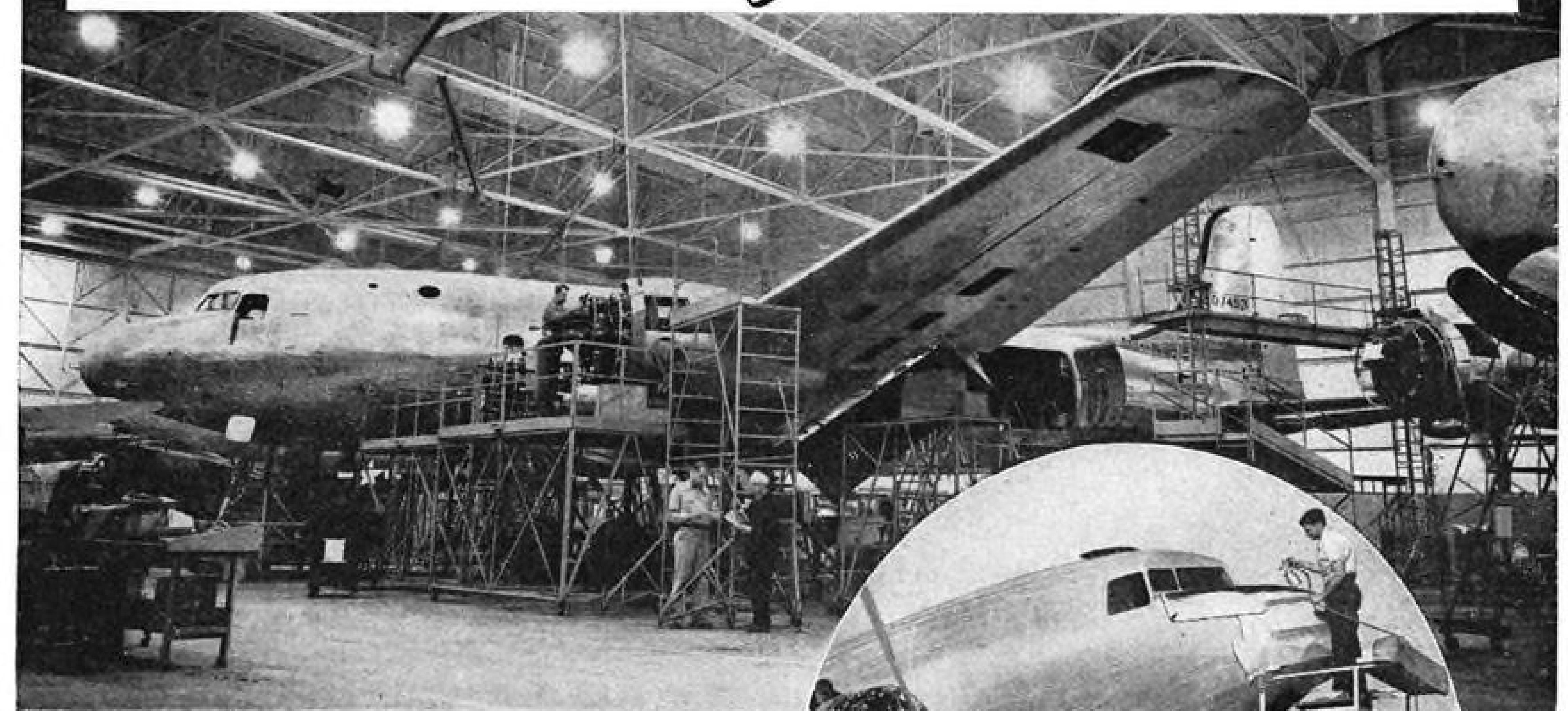

Only Douglas Approved Service Centers are equipped with Douglas Data and "Know-how"

To provide the operators of Douglas transport aircraft with reliable sources of conversion and overhaul work at reasonable cost, Douglas has designated throughout the world a number of conveniently located organizations known as Douglas Authorized Conversion Centers. And, as a necessary following service, providing quality routine maintenance and repairs, Douglas has also appointed Douglas Approved Service Centers.

Only these *authorized* centers have access to Douglas field and factory technical assistance, quality control methods, and a direct pipeline to the latest Douglas information vital in making top quality conversions and repairs.

Write: Service Manager, Douglas Aircraft Company, Inc., 3000 Ocean Park Boulevard, Santa Monica, California, for name of Douglas Authorized Conversion Center or Douglas Approved Service Center nearest you.

SPARE PARTS WARRANTY POLICY. This company's standard warranty policy as applicable to new spare parts will be extended only to parts manufactured by the Douglas Aircraft Company. Such warranty applies whether the parts are supplied directly by Douglas, obtained from Government sources and supplied through Douglas in accordance with the War Assets Administration agency agreement, or procured by the ultimate consumer through authorized dealers or agents of Douglas. Warranty adjustments, in all cases, will be handled through the procurement source.

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SMART APPEARANCE is an asset in any business. That's why it's wise to specify Reeves Army Twill for uniforms and work clothes that always look their best. Their high tensile strength assures rugged wearability. Vat dyed colors are fast to sun, water and perspiration. Sanforized Shrunk*, they retain their smart tailoring—even after repeated washings. Remember—over 90 million yards of this same cotton fabric helped equip America's fighting forces—exceeding Government specifications under the toughest combat conditions.

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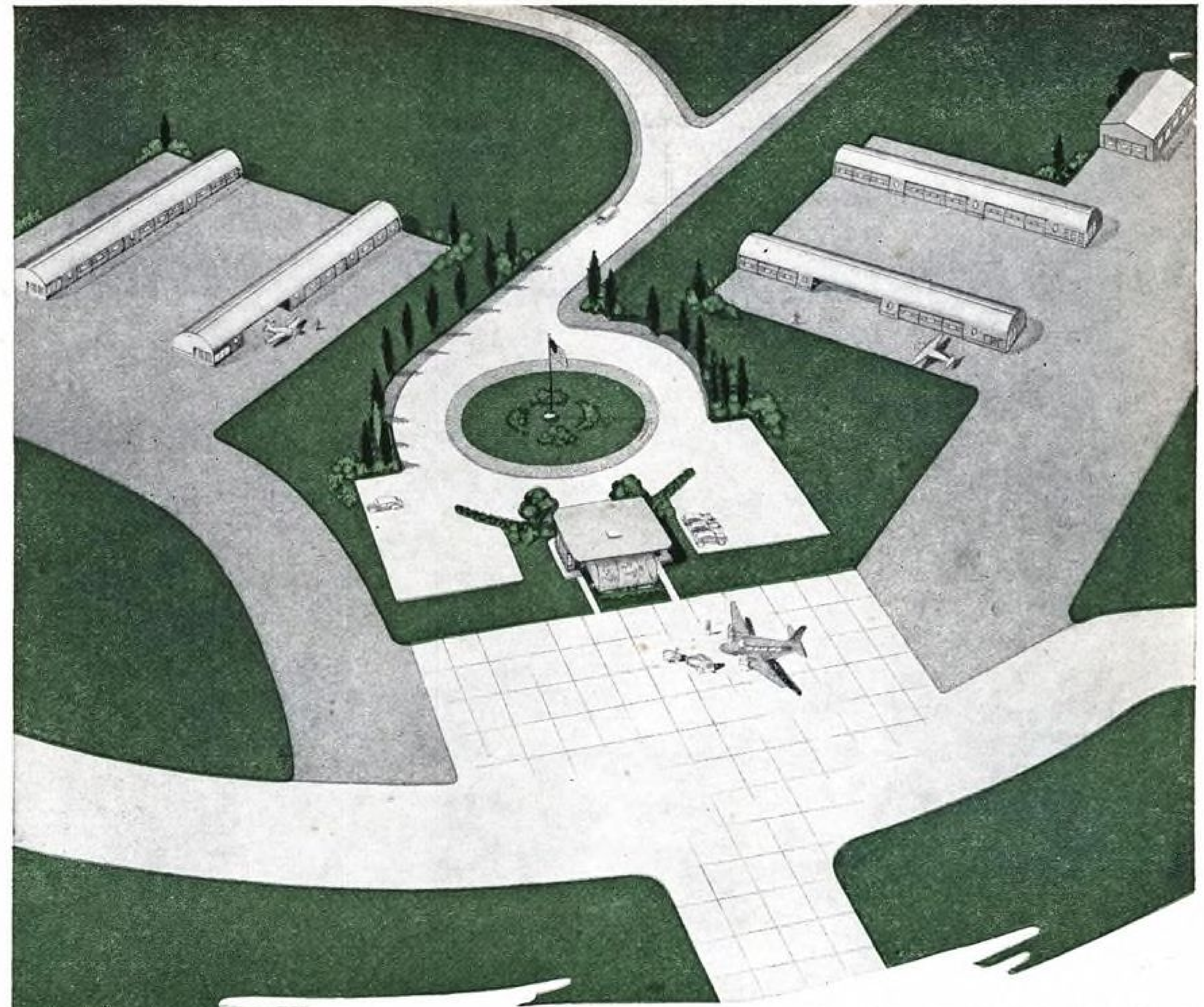
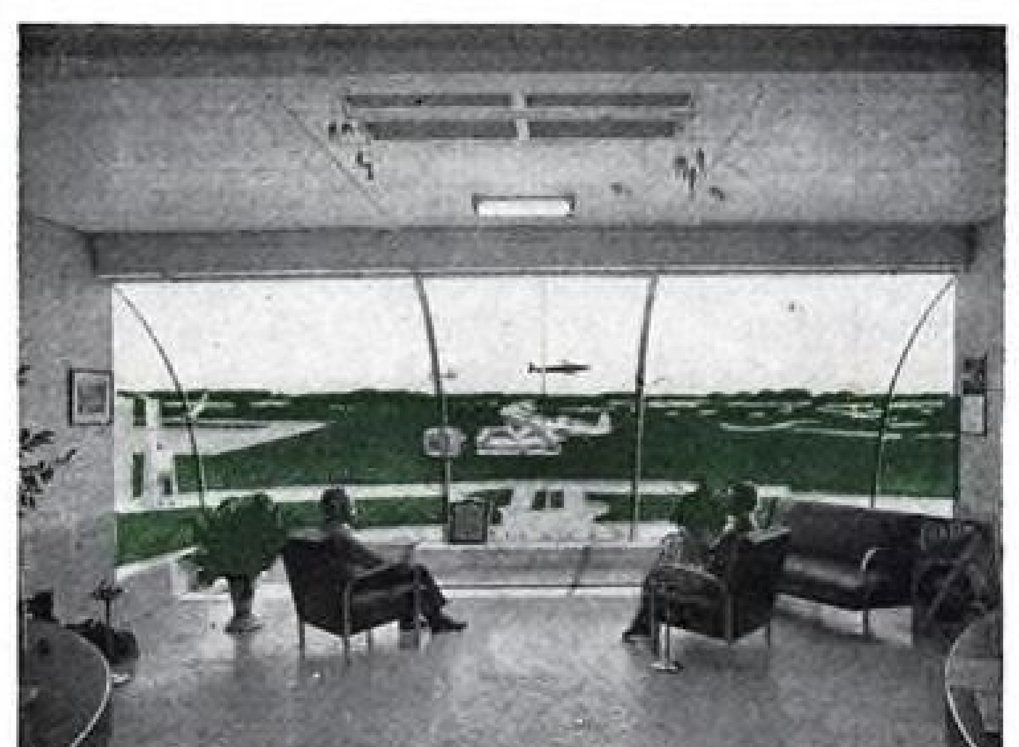


ANY AIRPORT LOOKS GOOD IN A FORCED LANDING, BUT...



At your airport or airpark you want planes to land, not just because they are forced to do so, but because their pilots and passengers want to enjoy the benefits of your facilities and accommodations.

It is yet hard to get the kind of modern facilities which will attract traffic in the future as more and more airports and airparks spring up to offer competition. However, waiting a little longer for your Butler-Built radial hangars and administration buildings will forstall future competition. Why? Simply because the advanced engineering and design of Butler-Built hangars and administration buildings dates them far ahead into the future.

Shortage of materials is the only reason why you cannot install today the buildings which will be the class of the airfields tomorrow. We hope they will be coming off the production lines in time to help take part in the spring clean-up of your airport.

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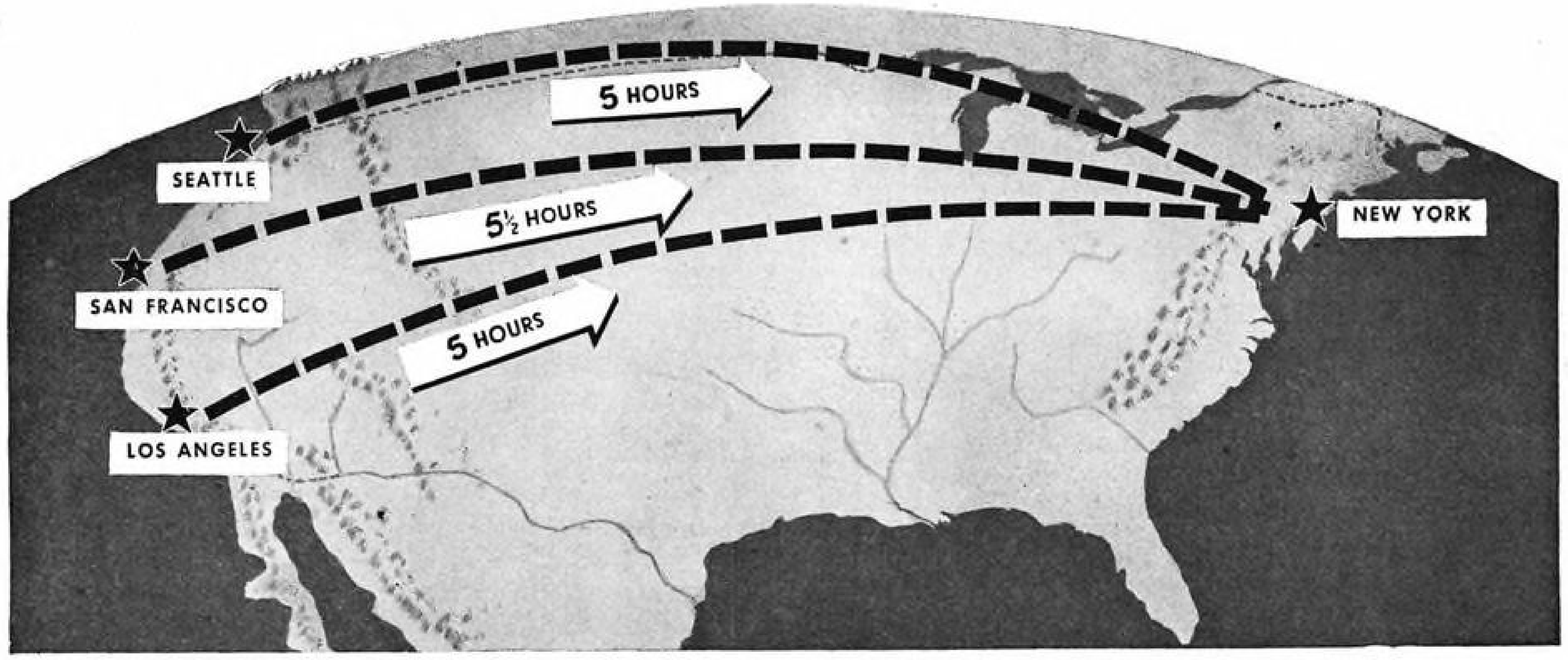
Once Again... *Pan American Pioneers*

Here's the kind of long-range, high-speed, nonstop service that America is looking for



Think what flying times like these will mean to you—for business, for pleasure!

EAST-BOUND

Pacific Coast

to New York . . . . 5¼ hours
to Baltimore . . . . 5 hours
to Washington . . . . 5 hours
to Boston . . . . 6 hours
to Chicago . . . . 4 hours
to Detroit . . . . 4½ hours

Gulf Coast

to New York . . . . 2¾ hours
to Baltimore . . . . 2½ hours
to Philadelphia . . . . . 2¾ hours
to Boston . . . . 3½ hours

WEST-BOUND

Because of the 3 hours' difference between Eastern and Pacific Coast Time, you'll be able to—

Leave New York **after breakfast—have lunch** in Los Angeles, or San Francisco, or Seattle.

The same will be true, West-bound, of Boston, Philadelphia, Baltimore, Washington, Detroit, or Chicago.

NORTH—SOUTH

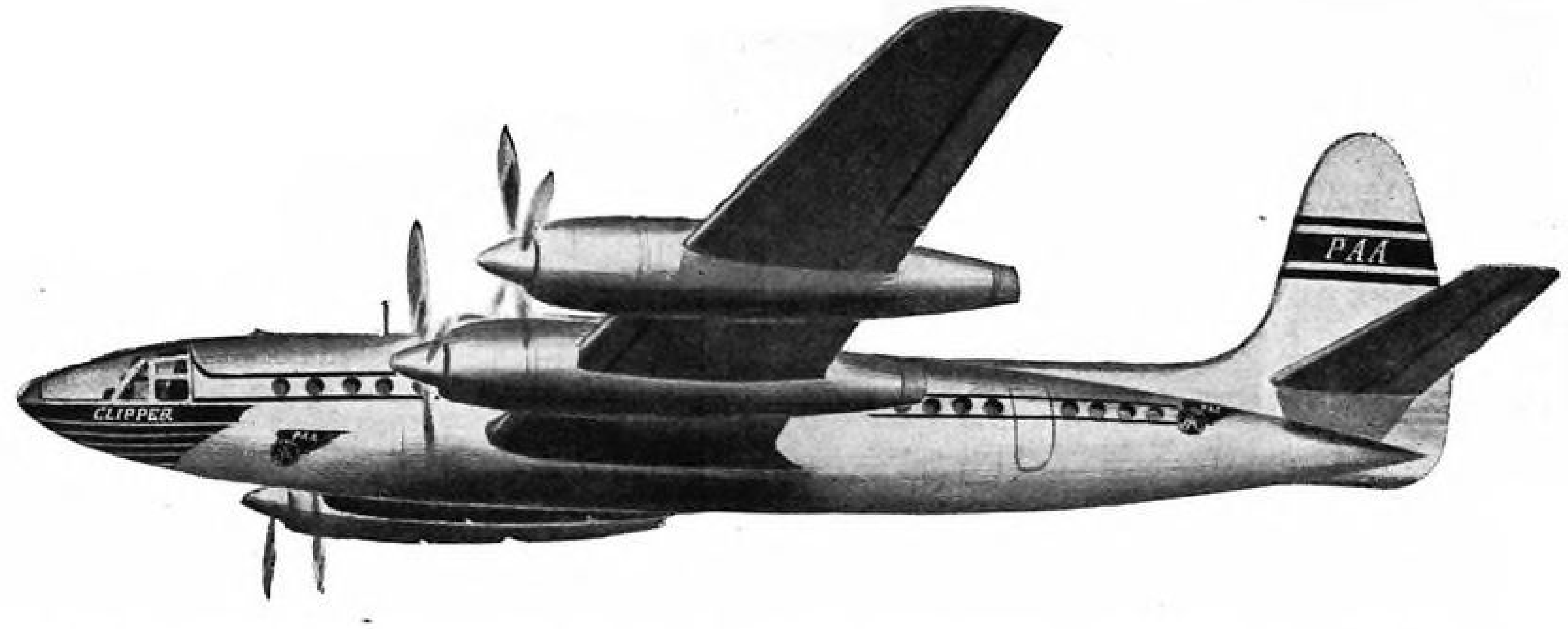
Chicago

to New Orleans . . . . . . 2 hours
to Houston . . . . 2½ hours
to Miami . . . . 2½ hours

New York

to Miami . . . . 3 hours
to New Orleans . . . . . 3¼ hours
to Houston . . . . 4 hours

PAN AMERICAN



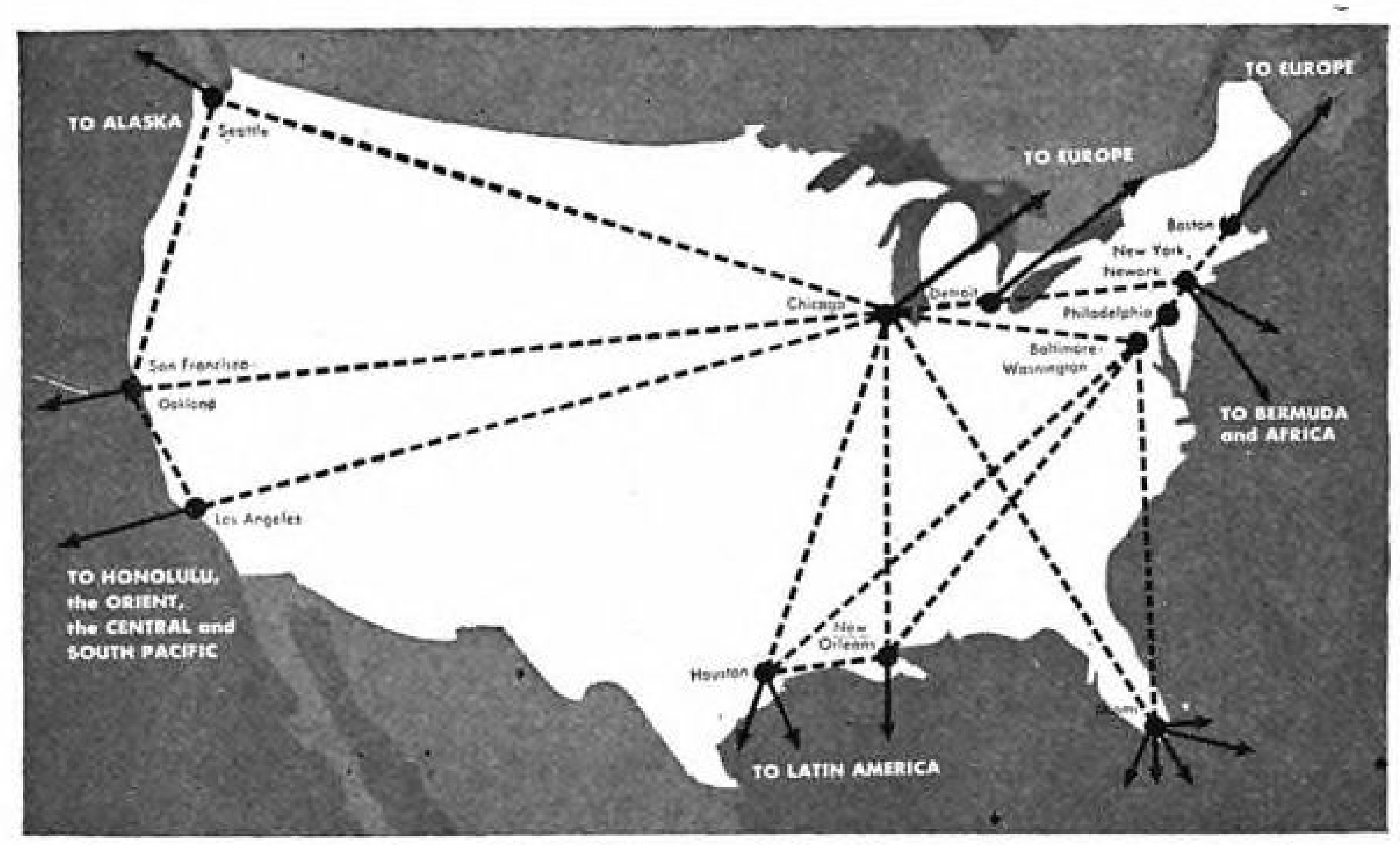
New, million-dollar Clippers to offer new luxury comfort at Pursuit-Plane Speeds . . . nonstop Coast to Coast, border to border

You who travel by air *know* how much faster you can reach distant destinations today than you could just a few years ago.

Yet even with the fine equipment offered by the airlines of 1946, today's demand for still faster, nonstop transcontinental schedules direct to the Coast cannot be met.

Pan American, the pioneer U. S. airline in long-range flying development, has been taking practical steps for some time to meet this demand.

Next year, assuming that authorization is obtained from the Civil Aeronautics Board, Pan American will put into operation an entirely new kind of Clipper which will offer nonstop, Coast-to-Coast flights *at Pursuit-Plane Speeds!* Other high-speed, long-range schedules will be offered too (please note map below).



This map shows, greatly simplified, the integrated plan for providing nonstop service between the cities which Pan American's overseas organization is already authorized to serve.

The "Clipper Rainbow" (shown above) and her sister ships, will be the fastest planes ever to offer commercial flights . . . faster *by more than 100 miles per hour* than any transport plane in service today. They will be comfortable, too, with roomy, luxurious interiors, soundproofed, and air-conditioned to provide living-room comfort at high altitudes.

Pan American first to offer these planes

Nine years before any other U. S. airline, Pan American bought and operated four-engined planes. *Again,* foreseeing the need for still better equipment in the postwar era Pan American was the *first* to place orders for planes of this type . . . and will be the *first* to receive them.

Surprisingly enough, the cost of this pursuit-plane-speed type of air travel will be actually *lower* than present Coast-to-Coast and other domestic fares.

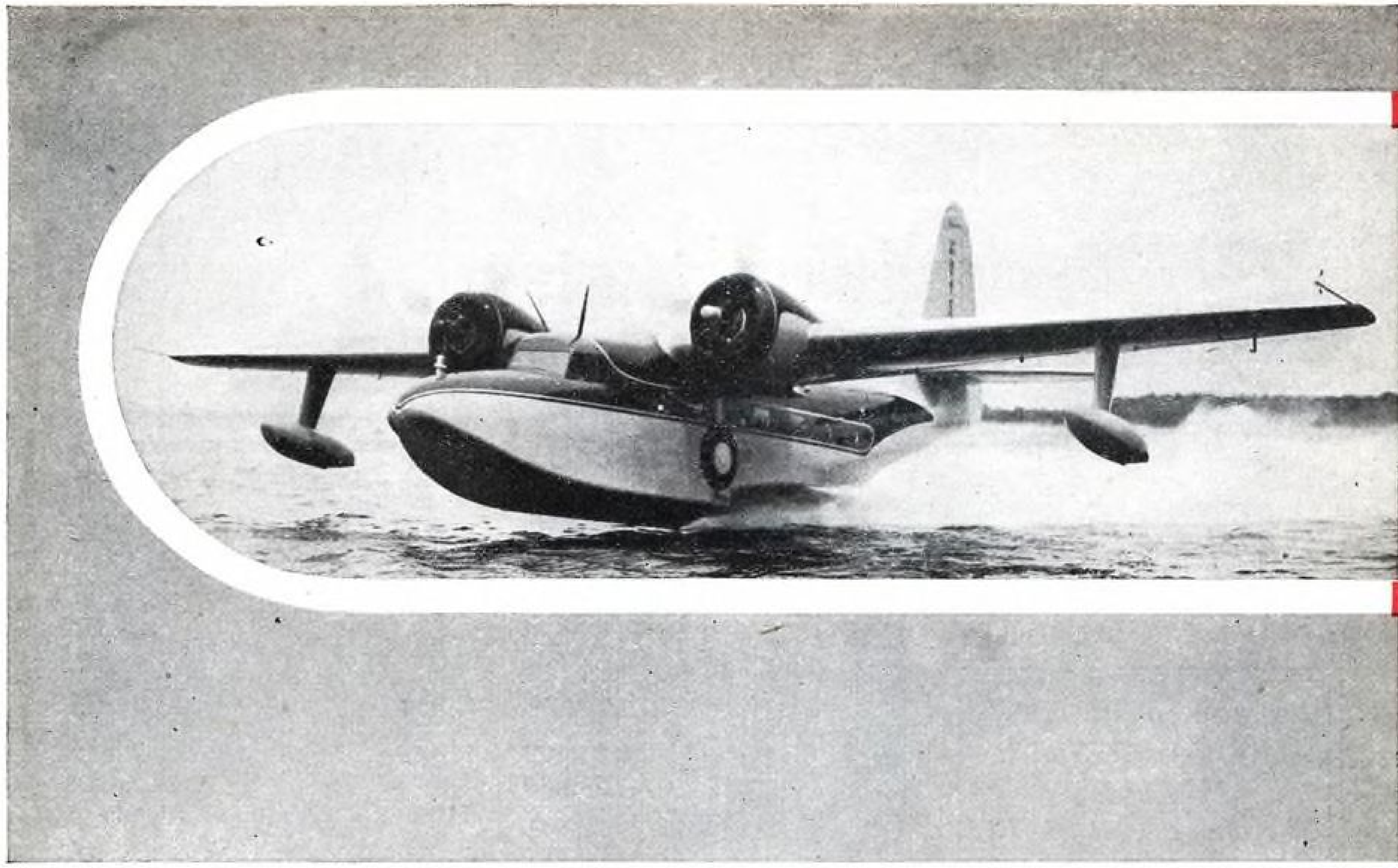
* * *

A PIONEER COMES HOME!

In line with the Government's postwar policy which permitted U. S. domestic airlines to operate abroad and which would permit the pioneer overseas system to operate domestically, Pan American ordered revolutionary aircraft never before available. Thus Pan American will be able to provide high-speed, nonstop service between distant cities within the United States. This map shows the proposed routes which will bring to the domestic field the "know-how," the trained personnel, and the competitive spirit which has helped Pan American win first place for America in the international field.

WORLD AIRWAYS

PAA — *The System of the Flying Clippers*



Grumman selects Janitrol for the new *Mallard*

Another great name in Aviation goes to Janitrol Combustion Heaters for their new plane

THE "Mallard", high-speed twin engined amphibian is Grumman's newest addition to their line of brilliant aircraft.

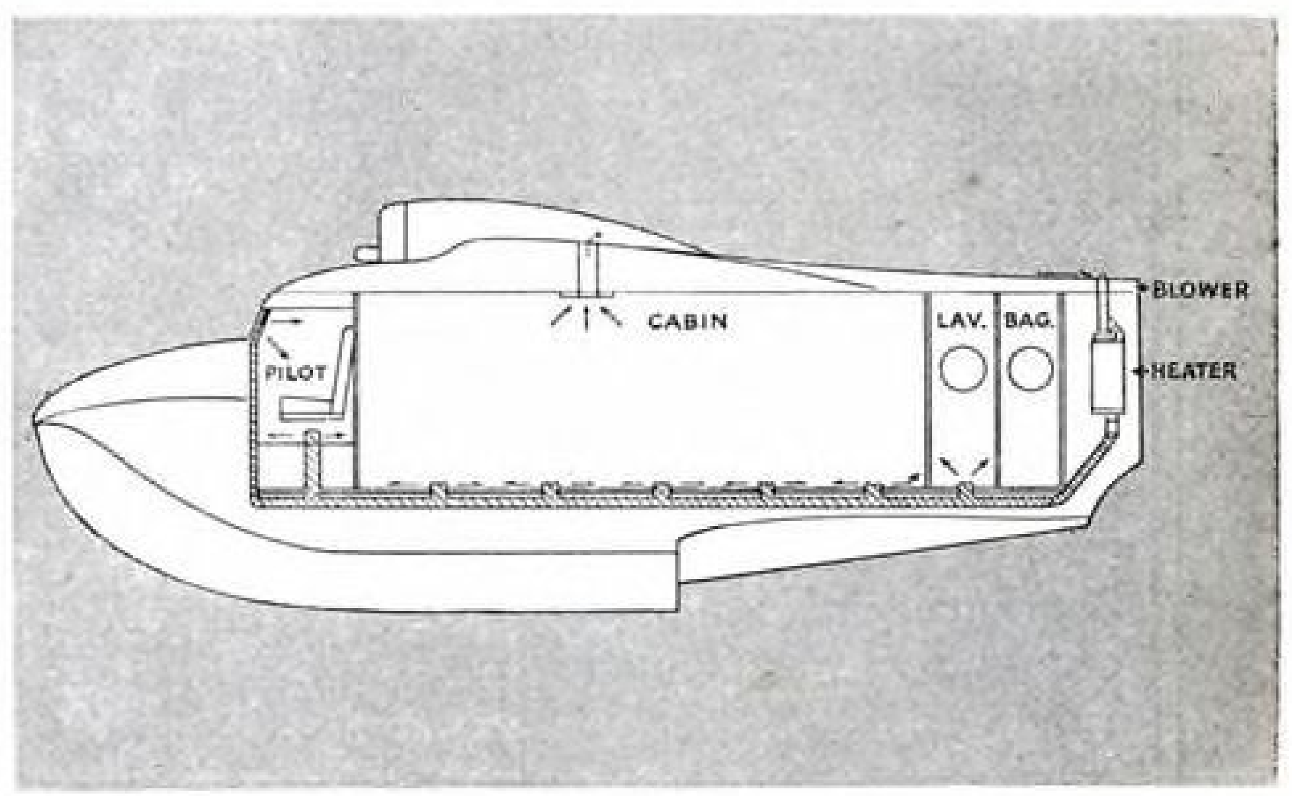
Into this new plane, Grumman has engineered every possible feature to provide the utmost in luxurious transportation.

One of their requirements to assure passenger comfort under all operating conditions called for a flexible and dependable heating and ventilating system . . . there had to be perfect comfort at all times. Provision is made for both automatic heating and ventilation when the plane is at rest or in flight.

From performance records of their famous Navy Tigercat and Avenger, Grumman engineers already knew about the reliability and efficiency of Janitrol Whirling Flame Combustion Heaters. But because the Mallard is a de luxe transport plane they decided to check with the leading airlines on their experience with Janitrols. The airlines were enthusiastic —result, Janitrol was selected.

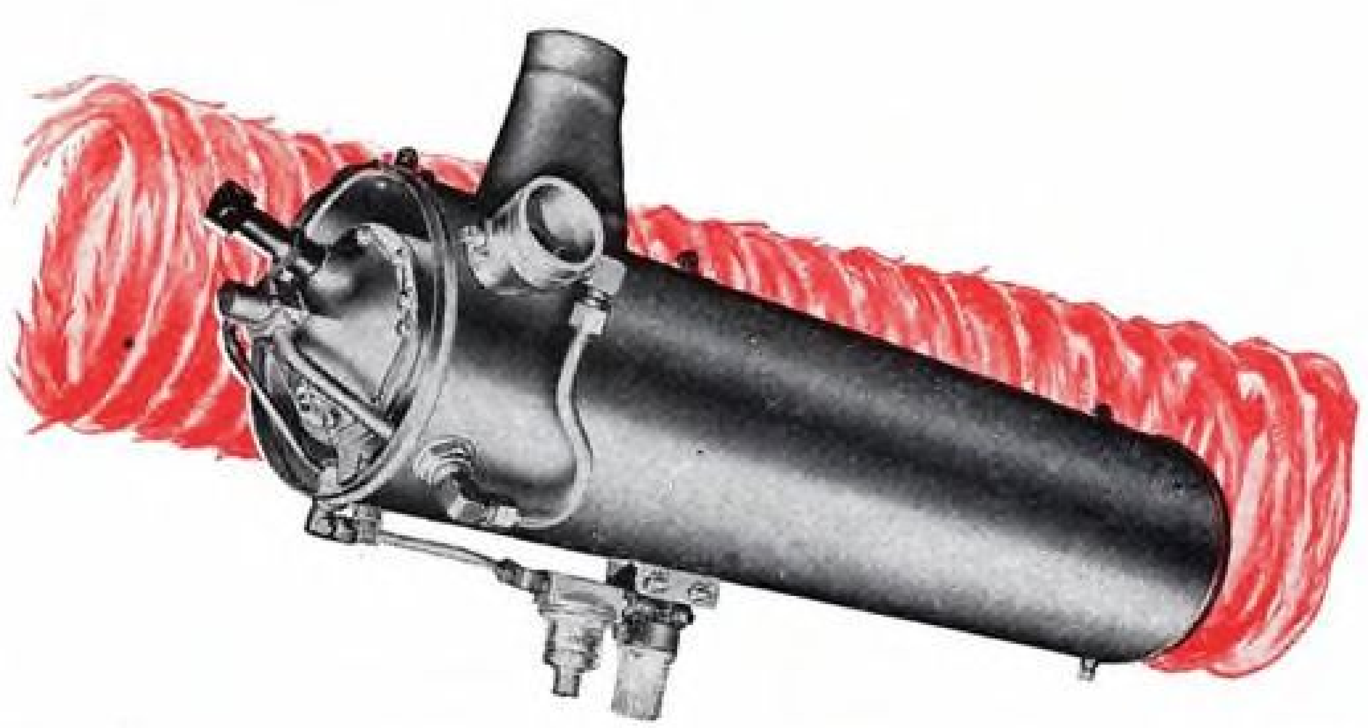
Just as the Janitrol Whirling Flame proved its outstanding advantages in wartime flying, today, this combustion principle is demonstrating its many advantages, in compact, complete heating packages for peace time planes, and as part of the air-conditioning systems of most of the largest transports.

Working with the Army and Navy, with aircraft manufacturers and airline operators, Janitrol engineers have gained more experience in answering the many problems of aircraft heating, than any other group of men. Their services are available to help you.



Luxurious comfort built into the Mallard calls for the ultimate in heating dependability. Heating systems in the finest modern homes can provide no better indoor comfort. This luxurious automatic "home comfort" heating system is completely cabin thermostat controlled. Fresh air is forced by ram pressure in flight, and by a blower when the ship is at rest through the Janitrol heater which is located aft of the baggage compartment.

Heated air is uniformly distributed through under floor ducts to diffusion outlets under each seat, also to the windshield for de-icing and de-fogging. Ventilating grills in passenger cabin discharge air overboard.



Janitrol Whirling Flame Combustion Type Heater; 100,000 Btu output per hour, compact, light-weight, easily serviced and maintained; high alloy steel used throughout, spark ignition system. Proved performance and dependability in thousands of military and commercial aircraft installations.

Janitrol

AIRCRAFT HEATER DIVISION • SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

all the world's its stage

What's this! The helicopter retrieves lost golf balls, mixes ice cream, paints the barn? No, it can't take credit for all that. But here you do see a new kind of flight. The Bell Helicopter is ready now to do a useful, a practical, a businesslike job for you.

A Bell Helicopter rescued fishermen from Lake Erie ice when all other means had failed. A second prospected with swift-winged ease in Canada's almost impassable mineral-rich "bush." Another wiped out pests at low cost per acre.

On the business scene, the Bell Helicopter can lift mail from the post-office roof. Set down a hurried passenger exactly where he wants to be. Hover where "X" marks the spot of news-in-the-making. Inspect far-flung power lines. Patrol forest, pipeline, highway.

There are good reasons why the Bell Helicopter can do hundreds of jobs like these with time and dollar saving facility. It can take off from or land in a space hardly larger than the ship itself . . . turn on its own axis . . . fly with sure stability at any speed from 0 to more than 100 mph. And so it cruises safely into all the nooks and crannies of the air.

For full facts about The Modern Magic Carpet* and Bell-schooled pilots to fly these ships, write Helicopter Division, Bell Aircraft Corporation, P. O. Box 1, Buffalo 5, New York.

BELL Aircraft CORPORATION

• Pioneers in jet-propulsion, radio-controlled flight and supersonic aircraft for the Army and Navy. Designers and builders of the world's first commercially licensed helicopter.

Needle Bearings can Boost Production, too!

One good way to give your production a lift is to simplify design problems and assembly operations through the use of Torrington Needle Bearings.

The compact unit construction of these modern anti-friction bearings speeds progress at every stage . . . from design to final installation. Needle Bearings require only a bore machined to proper dimensions for the housing . . . installation is a simple press fit operation . . . no retainers or spacers are necessary to hold them in position. Thus, there are fewer production and assembly steps, fewer parts to handle and control when Needle Bearings are employed.

Torrington Needle Bearings also help to improve product performance. Their high radial capacity and compact design saves space and weight, and their efficient lubrication means better operation, less maintenance, and less time out for servicing or overhauling. So, production is aided in this way too—by keeping tools, machinery and handling equipment on the job.

Let our engineering department show how you can boost *both your production and your product's efficiency* through these and other Needle Bearing advantages. Write for our informative Catalog No. 32.

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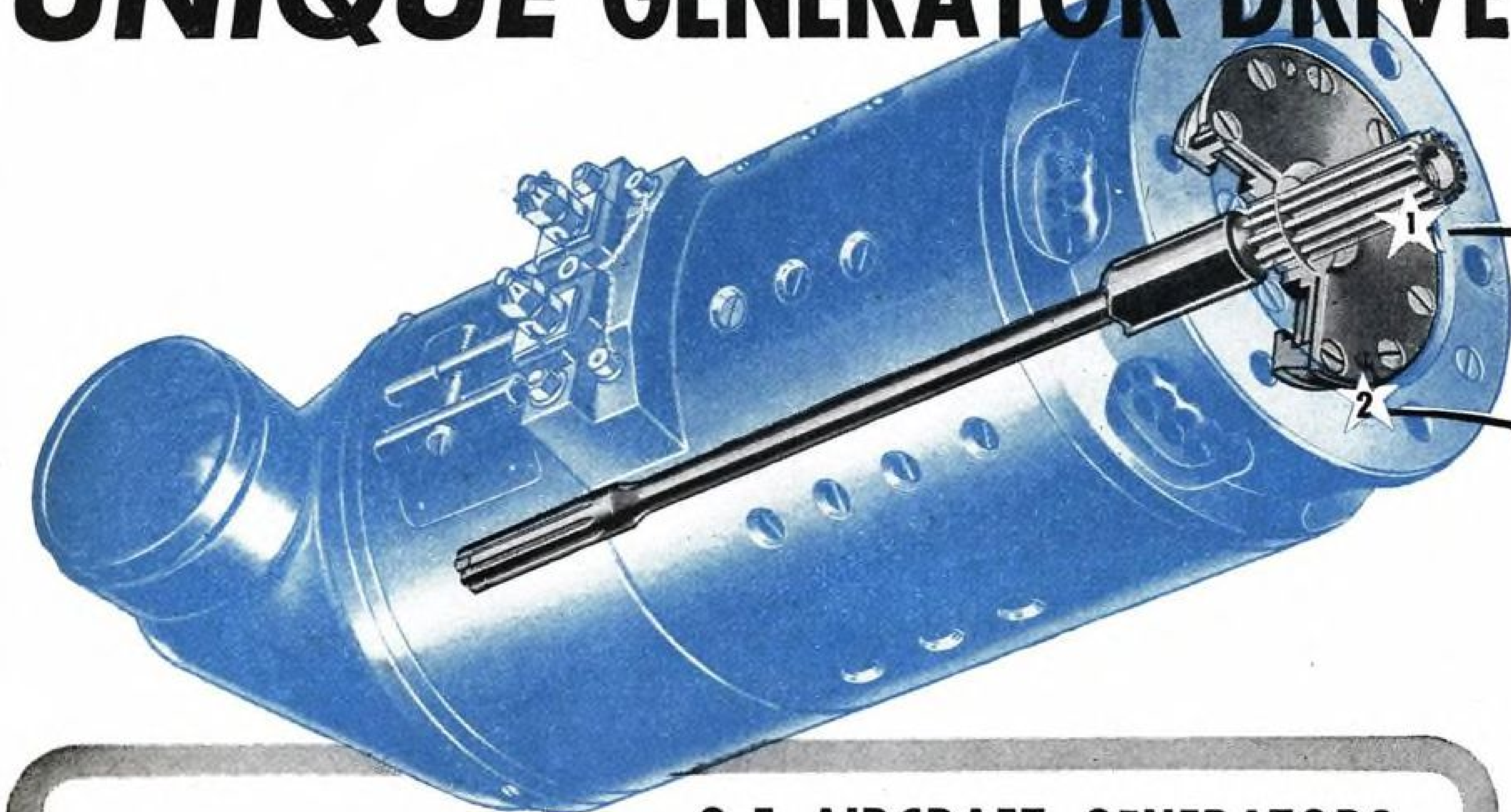


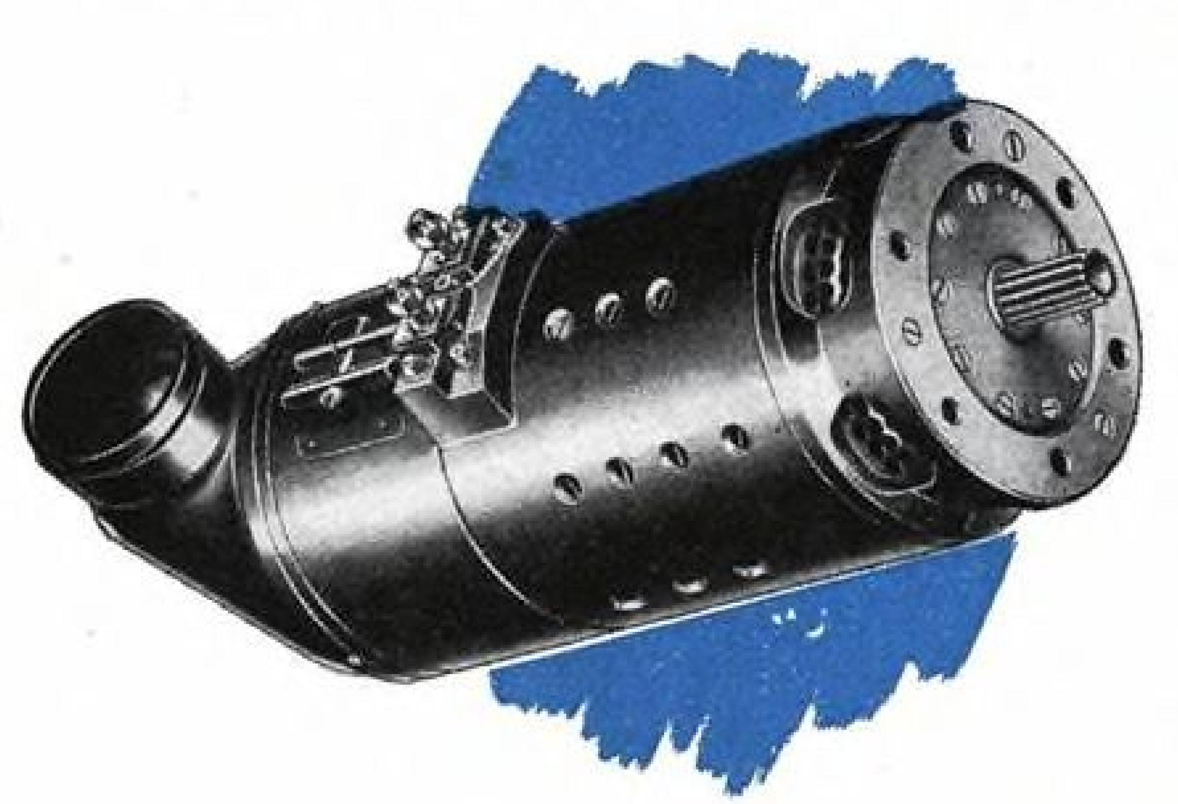
Double-dares VIBRATION!

First — because this exclusive quill shaft (1) acts as a cushion between engine and armature, smoothing out the ever-present fluctuations in main-engine speed.

Second — because this exclusive friction damper (2) literally "puts the brakes" on torsional vibration, limiting the vibration which reaches the quill shaft, protecting the shaft against breakage.

G-E AIRCRAFT GENERATORS

. . . RELIABLE POWER SOURCES FOR PLEASURE PLANE OR TRANSPORT



Direct-current GENERATORS

Used singly, G-E direct-current generators satisfy the power needs of the average single-engined aircraft. For heavier loads on multi-engined aircraft, two or more units can be used in parallel with voltage regulators. The type P-2 is rated 200 amperes at 30 volts and is available with speed ranges of 4400/8000 rpm or 3000/8000 rpm. Type R-1 is rated 300 amperes at 30 volts and is available in speed ranges of 4500/8000 rpm and also in 3000/8000 rpm. Type Q-1 is rated 400 amperes at 30 volts with a speed range of 4100/8000 rpm. All have a ventilating air-pressure value of 6 in. H_2O.

A-C constant frequency GENERATORS

Light-weight, a-c power systems, highly effective at high altitudes, are now made possible with G-E 400-cycle, constant-frequency generators. Capacities include 40 kva, 208/120 volts, 6000 rpm, and 20 kva, 208/120 volts, 8000 rpm.

A-C variable frequency GENERATORS

G.E. makes two basic types of variable-frequency a-c generators—a unit rated 200 amperes, 30 volts d-c (10 amperes, 120 volts a-c) 4400/8000 rpm, and one rated 10 kva, 208/120 volts (400-800 cycle a-c) 4000/8000 rpm.

Gas turbine STARTER-GENERATORS

G.E. also designs and builds gas-turbine starter-generators which deliver 400 amperes at 30 volts d-c, 3700/7200 rpm. As a starter, the unit develops 330 inch pounds torque at 1500 rpm, 340 amperes, 20 volts.

Big reason why G-E aircraft generators perform consistently well is the overall protection we give them against the destructive effects of engine vibration. Shielded against a hazard which can—and does—shake apart less carefully designed equipment, these generators provide a source of electric power you can always depend on. They require less maintenance. Their useful service life is above average. They add an extra margin of safety in aircraft operation.

Whether you want a single, low-output power source for a light plane, or a complex, high-output power system for a heavy, multi-engined ship, you'll be interested in the basic, "anti-vibration" features illustrated above.

Besides minimizing the transmission of small but continuous variations in engine speed to the armature assembly, the "shock absorber" inner shaft acts as a flexible coupling between the armature and engine. (Careful inspection of shafts by the Magnaflux method detects and eliminates those with flaws, cracks, or scratches which might create harmful stresses.)

Together, the flexible shaft and the vibration damper (mounted on its driving end), both exclusive G-E features, form a double barrier against harmful vibration in the rotating armature.

*Trade-mark reg. U.S. Pat. Off.

In addition to these primary safeguards, G-E aircraft generators are equipped with mounting flanges, forged of specially treated steel, to absorb pounding engine vibration. Thanks to a unique contour design, this flange is able to overcome high fatigue and static stresses.

Electrically Sound

Compensated shunt field windings in G-E aircraft generators permit transient overloads and sparkless commutation over the normal rated load range—an important factor in high-altitude operation. Moreover, by silver brazing the armature windings to the commutator and using glass insulation and Formex* wire throughout, we have raised the safe temperature ceiling for these generators—done it without increasing their size or weight.

Thousands of G-E aircraft generators of all types were used in the war under gruelling service conditions. That they turned in above-average performance records is further evidence of G.E.'s ability to design and produce electrical systems and individual components for aircraft applications. This valuable experience is offered to airframe builders, engine builders, and operators who are cordially invited to consult with G.E. on any electrical problem. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Precision AIRCRAFT GENERATORS

GENERAL ELECTRIC

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New equipment gets the right start

for a long life—

START your new machines and equipment out right—have a Gulf Lubrication Engineer "in the picture" just as soon as it's delivered.

This trained specialist will check over your machines and equipment, then recommend the proper oils and greases which will provide an extra margin of lubrication efficiency.

You will find that this progressive approach to effective lubrication results in better machine performance, less wear, lower maintenance costs, and extra years of useful life.

The helpful counsel of a Gulf Lubrication Engineer—and the Gulf line of more than 400 quality lubricants—are available to you in 30 states from Maine to New Mexico. Write, wire, or phone your nearest Gulf office today.

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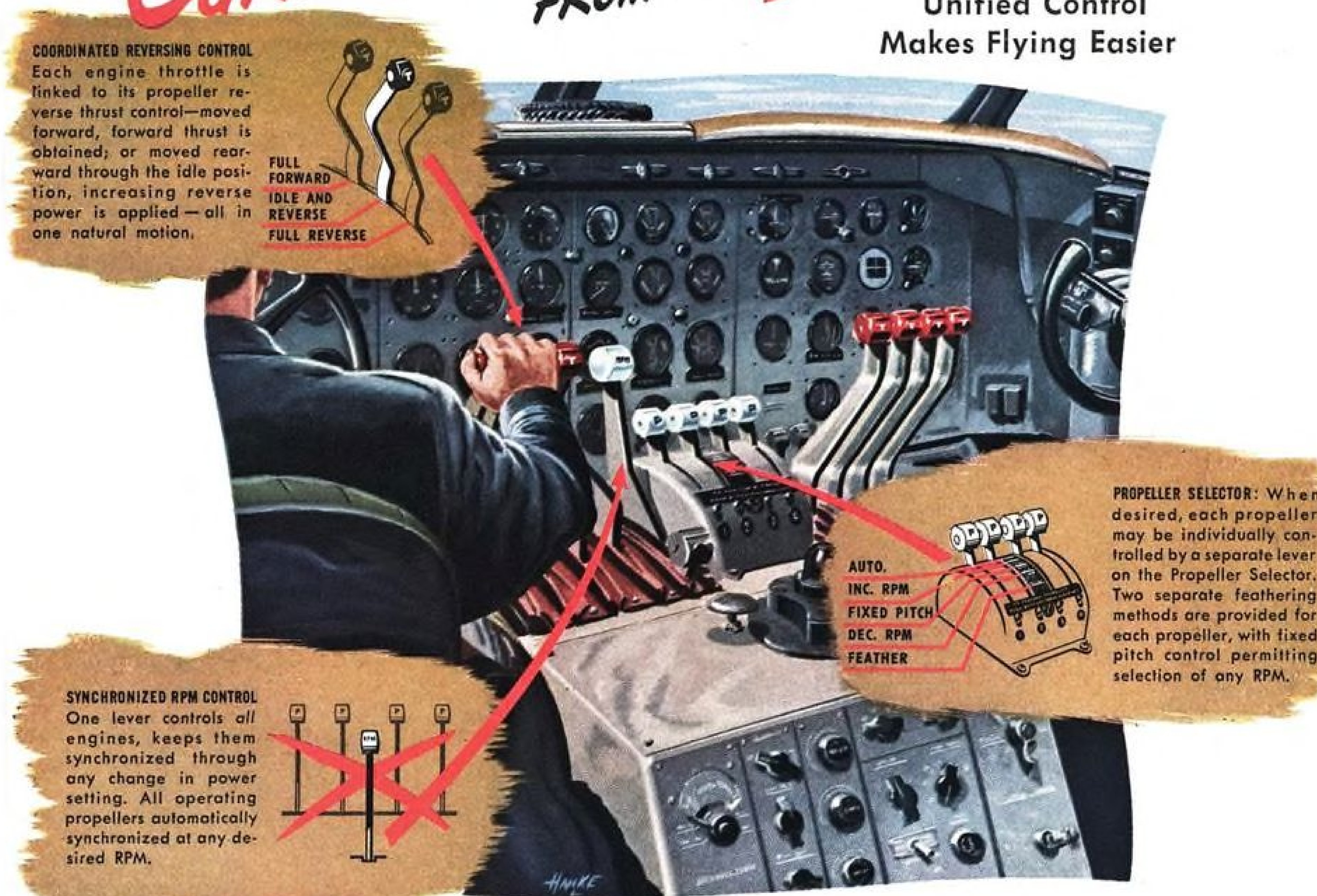
GULF INDUSTRIAL LUBRICATION

helps make machines produce more at lower cost

CURTISS PROPELLERS FROM THE PILOT'S VIEWPOINT!

Unified Control Makes Flying Easier



We call it Practical Engineering — the Curtiss cockpit installation is the result of millions of hours of operation on multi-engined military aircraft and valuable suggestions from top-notch airline pilots through many flight demonstrations and round-table discussions.

ALL propeller controls are at one location, designed to be "feelable" and in the line of vision — no need to hunt for the feathering switch or the reversing button.

Great care has been taken to make each movement natural, controlled by finger-tip pressure. One lever now provides precise RPM setting of all propellers.

Any or all propellers can be removed from constant speed operation by means of the Propeller Selector, to check power output when in the air or on the ground. Immediate synchronization is obtained when returned to automatic control from any RPM or power setting.

The Propeller Selector is another practical contribution for Curtiss — as were these outstanding features: — full feathering — reversible propellers — hollow steel blades — automatic synchronization — unit construction.

CURTISS PROPELLERS selected by

American Airlines System · TWA (Trans World Airline) · Pan American World Airways · Northwest Airlines · SILA (Swedish Intercontinental Airlines) · Air France · KNILM (Royal Netherlands Indies' Airways) · KLM (Royal Dutch Airline) · Aer Lingus Eoranta (Irish Air Lines) · United Air Lines · BOAC (British Overseas Airways Corporation).

provide these modern features:

Simplified controls · Reliable operation, including feathering at any altitude · Automatic synchronization · Independent fixed pitch control · Reverse thrust for positive braking and ground maneuverability · Unmatched durability of hollow steel blades.

CURTISS ELECTRIC PROPELLERS

A PRODUCT OF CURTISS WRIGHT
FIRST IN FLIGHT

Export Lethargy Will Lame Us

WHILE WE SIT BACK COMPLACENTLY almost every other major nation in the world has been building aviation export markets. Britain leads the field, and her position is understandable since foreign trade is vital to her economy. Even the Gloster Meteor, pride of her jet propelled fighters, is going to Sweden and other countries. The French government, with its production seriously handicapped by nationalized factories, has announced its intention to export aircraft.

There are some exceptions to the lethargy about exports in this country. Douglas has done a brilliant job of equipping Australian airlines. Piper will export a reasonable percentage of this year's production. And there are a few others. But the overall figures (see page 44, Sept. AVIATION) show that we are slipping far behind.

The general need for export business is one of the basic requirements of our national economy. But the need for aviation exports goes far beyond that important consideration. Every foreign order we get contributes to the preservation of our production facilities. A healthy export business in these times of dangerously low levels of military procurement could make the difference between a demobilized industry and one that could be expanded quickly in the time of need.

Manufacturers who close their eyes to export business in order to give exclusive attention to the domestic market are making a grave mistake. Its gravity is not alleviated by the State Department ban on export of combat planes.

The British are giving away their Meteor because they realize one fundamental fact in aviation progress —secrecy is more often a sign of weakness than assurance of security. There are of course a few designs that might properly be kept out of the hands of foreign nations. Their selection is not an easy decision, but it must be made. Yet the only safeguard for air superiority is a continuous flow of better and better aircraft. No nation has a corner on the best brains in any area of science. Only by tireless work can we or any nation keep ahead. We can afford to let anyone have almost all of our latest combat planes —if we are confident in our own minds that we have more effective ones coming along not too far behind them. A free export market serves notice on the whole world that we possess this confidence.

G-M-I Assures Guardian Air Power

HISTORY REPEATS ITSELF as the postwar program for aircraft production unfolds in France. The clear lessons of the incompatible mixture of private and state-controlled facilities seem to have been completely ignored. Once more nationalized aircraft plants are dependent upon private manufacturers for components and parts. Standardization is practically unknown, and production is painfully slow.

Long before the war, other nations were quick to sense the plight of the French aircraft industry under the Popular Front Government. Germany, whose plans for aggression hinged so heavily upon air power, could not afford the risk of a government-owned aircraft manufacturing industry. The valuable testimony of Dr. Albert Speer indicates how German aircraft manufacturing was excepted from the extreme totalitarian policy.

In the present period of labor unrest and industrial strife in this county, the old voices of those who believe our aircraft industry should be nationalized may be heard at any moment. The answer is the wartime record of the industry under private enterprise.

During the war the pattern of Government-Military-Industry cooperation was well perfected. It produced the greatest air power the world has ever known. Postwar conditions may indicate the desirability of minor modification of this formula, but the fundamental principles must remain unchanged. To tamper with them would be tantamount to inviting another war and courting military disaster.

Leslie E. Neville

EDITOR

America's first industry-wide aircraft and component exhibition of the postwar era has definite economic functions to perform. Here the director of this huge enterprise presents . . .

The Purposes of The National Aircraft Shows

By CLYDE M. VANDEBURG, *Director, National Aircraft Shows*

SHORTLY AFTER THE ARMISTICE in 1918, America's new-born aviation industry was all but wiped out by contract cancellations and settlements imposed by an economy-minded government. During World War I, aircraft manufacturers in this country produced more than 16,000 military planes—a surprising number considering that this period is often described as the stone age of aeronautical science.

There is little doubt that if both government and industry had possessed sufficient foresight in 1919 and 1920 many of the tribulations and much of the inertia that retarded aeronautical advance during the ensuing 20 yr. might have been avoided. Failure of the government and its military services to encourage a new world industry which had proved itself in the skies over the Western Front in those early days had an important bearing on the course of international affairs right up to World War II.

Most of the firms that produced the planes of the First World War soon disappeared or converted to other fields; the handful that continued the struggle found it heavy going. Although these pioneering firms had plenty of planes to sell, they failed in the all-important task of merchandising their products. Public enthusiasm engendered in 1917-18 was allowed to dwindle. It is true that few airports existed at the time, yet this need not have been an insurmountable obstacle. The automobile industry quickly realized it would never sell many motor cars unless new roads were built. By helping to underwrite construction of highways the auto manufacturers assured ultimate acceptance of the automobile as a popular mode of transportation.

End of World War II again finds the American aviation industry attempting to move forward after the debilitating impact of more than $26,000,000,000 of contract cancellations. Yet, in contrast with what happened at the end of World War I, all the major aircraft firms which produced planes in the recent war are still in business. Most have introduced new military or civil models in the 15 mo. since V-J Day.

Although economy again is the watchword in Washington, it seems likely that the government will not repeat its previous error. Sizeable appropriations for expanded research in guided missiles, rockets, pilotless planes, helicopters, flying wings, and long range jet propulsion aircraft seem certain of approval. There is no disposition to discount the role of air power in any future conflict.

For its part, the aviation industry also has learned the lesson that it cannot move ahead without a broad program of merchandising. The industry realizes it cannot assume the American people will remain airminded simply because military air power was a decisive factor in the Allied victory. For the past 5 yr. the airplane has been demonstrated as an instrument of terrifying destructive power. The job now is to prove conclusively that the airplane has sufficient utility to promote the well-being of all peoples in time of peace.

One of the first specific manifestations of this enlightened policy is the decision of the aviation industry and the military services to give the public a close view of the constructive side of the airplane of today and tomorrow.

To achieve this objective manufacturers, airlines, the Army and Navy, and various governmental and independent aeronautical organizations, will stage two mammoth expositions each year at which the beneficial influence of aviation can be demonstrated to large numbers of people. First of these National Aircraft Shows will be held at Cleveland from Nov. 15 to 24, the second at Los Angeles next spring.

These all-embracing expositions, operated on a strictly non-profit basis and bringing together for the first time every component in aviation, will go far beyond the conception of the ordinary trade show. Merchandising new aviation products must involve more than the static display of airplanes and equipment on the floor of the Exposition Hall. The products of aviation engineering and science must be portrayed as useful adjuncts to every-day living. It is necessary to show specifically how they can further commerce and industry and at the same time serve as the means to air power in time of war.

Glib claims have been made about the air consciousness of the American public. Yet six out of ten persons have never been inside an airplane. National Aircraft Shows will attempt to bring the airplane closer to the individual through practical demonstration. In such demonstrations, there is no place for the stunt type of exhibition for, while such events undoubtedly have contributed to aviation progress there can be no argument that the industry will win many more converts by emphasizing the safety of flying. During the Cleveland exposition hundreds of people will have the opportunity to ride in an airplane for the first time. They will see how modern scientific equipment operates to eliminate the hazards of flight.

This, broadly stated, is the overall purpose of National Aircraft Shows. Aviation has come of age and the time has come to act, rather than talk, about the utility, economy, safety, mobility, security, and essentiality of aircraft.

AVIATION'S

Guide to the First Annual National Aircraft Show

Subject to post-deadline changes

Engine & Accessory Section

Exhibitor	Booth
Adel Precision Products Corp.	H-1
Aeroproducts Div., Gen'l Motors	F-11, 12
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Air Associates, Inc.	H-3
Aircooled Motors	H-8
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The Buda Co.	E-13-14
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Cyril Baths Co.	J—part of 9; K-9, L-9
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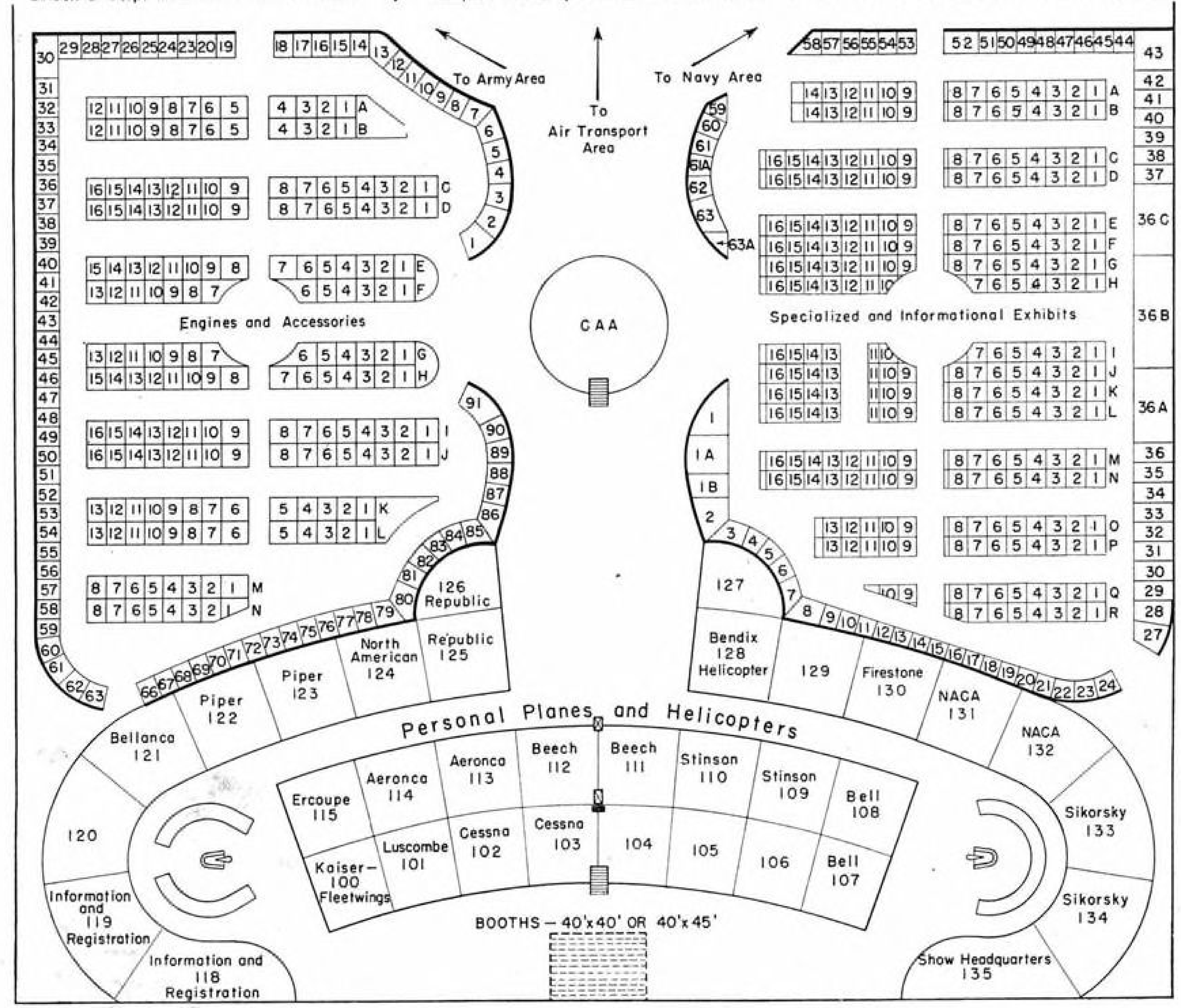
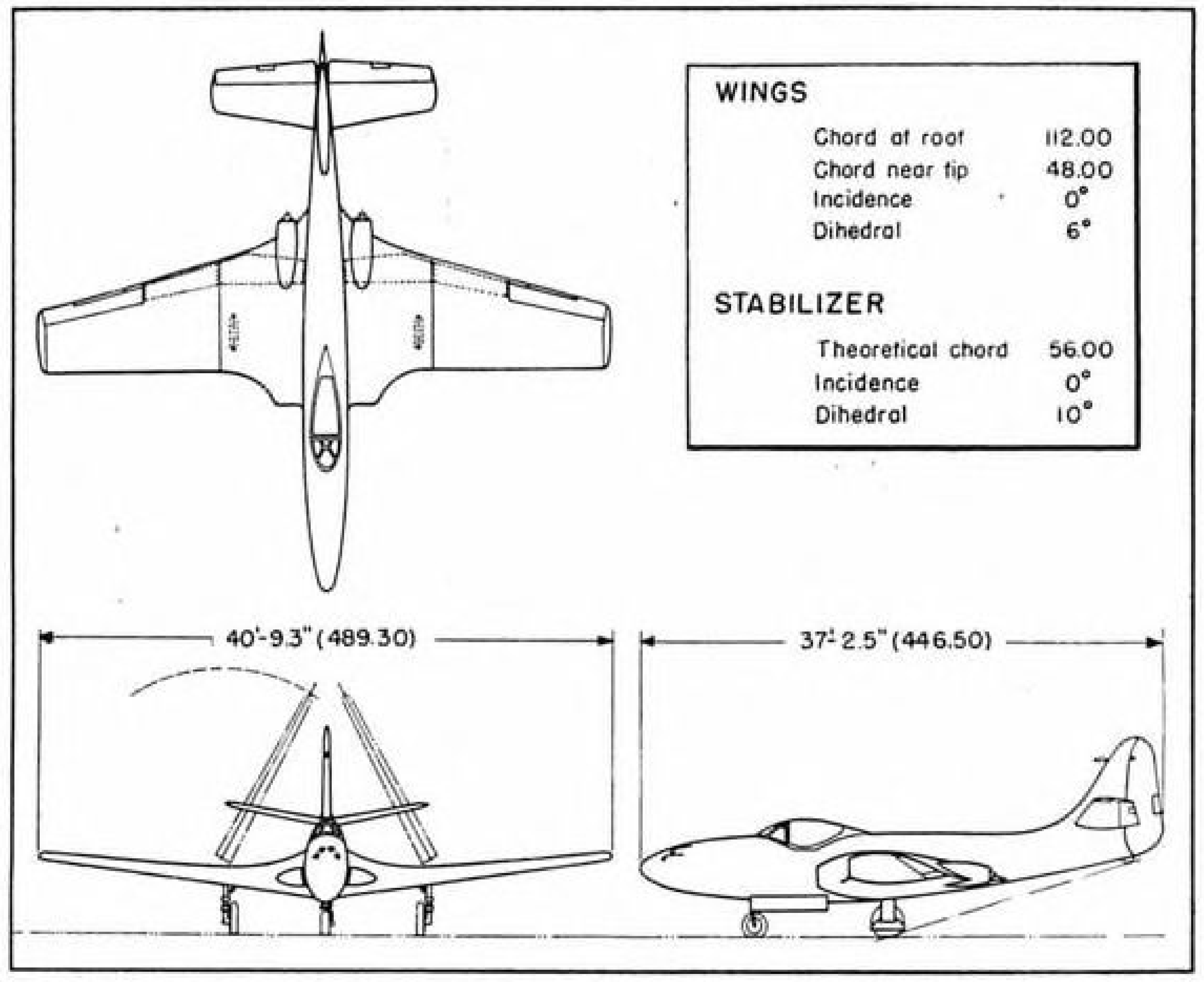


Design Development Of the McDonnell FD-1 Phantom

By KENDALL PERKINS, *Assistant Chief Engineer, McDonnell Aircraft Corp.*

Detailing for the first time the problems—and their solutions—of the U. S. Navy's first all-jet plane whose unusual structure points up new approaches to future high-speed military craft.

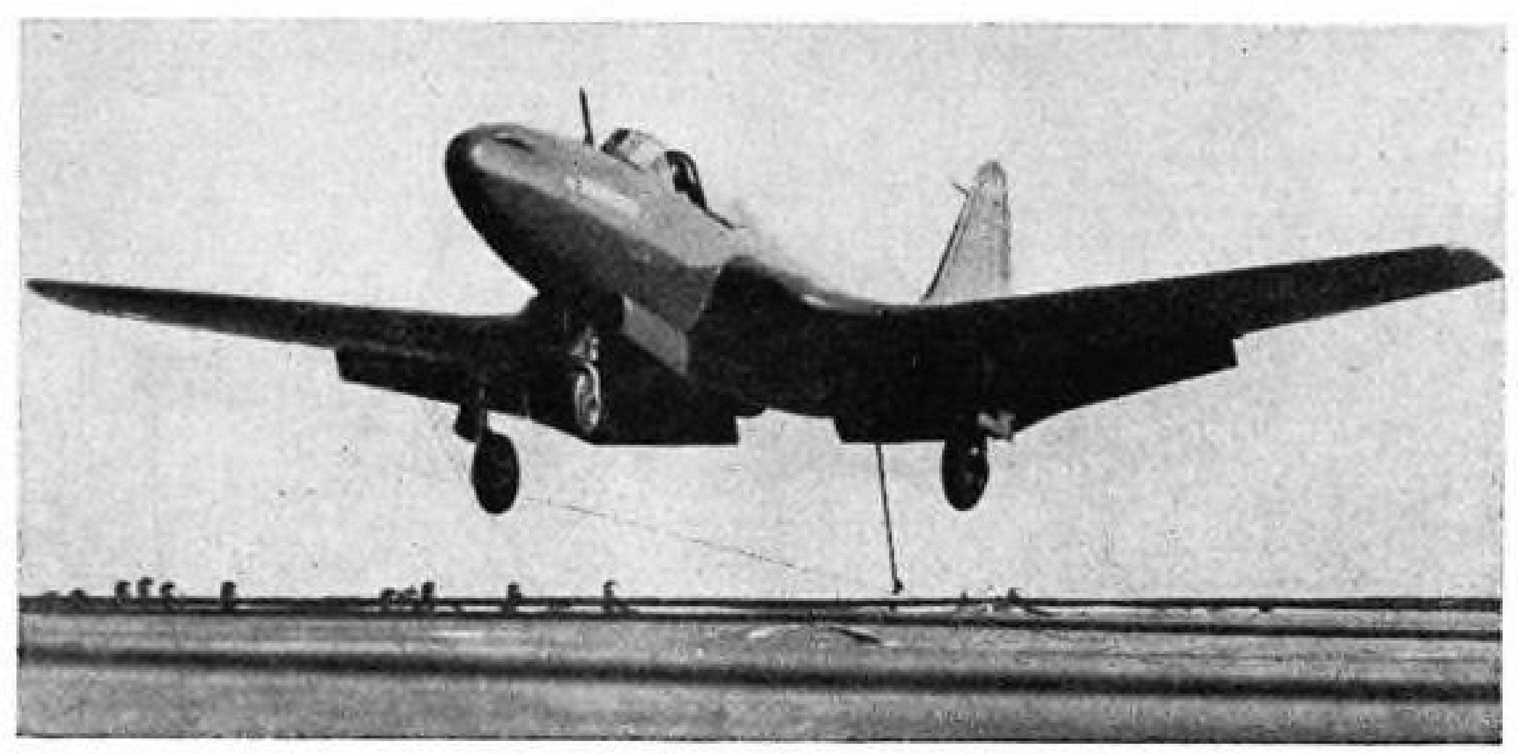


SHORTLY AFTER PEARL HARBOR, a small group of men in the Bureau of Aeronautics, U. S. Navy, recognized that jet propulsion offered a potential means for breaking through the speed limitations imposed by the size and drag of piston engines. Preliminary analytical studies were accordingly begun on the basis of the relatively meager amount of research data which could be found at that time.

As a result of these studies and of investigations made by Westinghouse Electric Corp., contracts were negotiated between the Bureau of Aeronautics and Westinghouse calling first for design studies and later for the construction of a small number of turbojet engines for test and experimental development. These engines were to incorporate axial flow multistage compressors and single-stage turbines and were expected to have an unusually small frontal area.

Soon thereafter it became evident that it would be desirable to parallel this engine development with an airplane design incorporating such a jet engine. This was to provide a tactically useful employment of the jet principle in a carrier airplane at the earliest feasible date. At the beginning of 1943, therefore, the McDonnell Aircraft Corp. was asked to cooperate with BuAer in working out a carrier-based fighter employing an engine of this type.

This airplane was called the XFD-1 and became the prototype for the phantom. The first engine was then in the preliminary layout stage only, and it was not until late in 1943 that the first reasonably complete engine installation drawing became available. (This developed into the Westinghouse 19-B turbojet, analyzed in Jan. 1946 AVIATION.) Throughout the development, the unusually close design coordination necessary was maintained between BuAer, Westinghouse, and McDonnell.



Design Policies

It was decided at an early stage that two fundamental design policies were to be followed throughout the development. First, the airplane was to be designed on a conservative basis in every respect, except for the engines and other special features dictated by the use of these engines. Second, when a close decision arose between a design which was simple to build, operate, and maintain, and one which was more complicated although somewhat more efficient on paper, the simple one would generally be chosen.

Conservative design applied to such an airplane in 1943 was considered by many to be inconsistent with the use of jet engines. It was reasoned, perhaps naturally, that since the engines were new and different the remainder of the airplane should be laid out along similarly advanced lines. The idea of making the airplane tailless, for example, was particularly attractive, since this avoided the problem of keeping the tail out of the jet blast. A tail first configuration was briefly considered for the same reason. A prone pilot arrangement was of interest to reduce drag even further and to make higher accelerations possible in pull-outs from dives.

Experience has repeatedly shown, however, that design features which have not been satisfactorily demonstrated on some earlier airplane always require a development period which may be critically long. Additional tunnel testing, laboratory testing, flight testing, and the changing and re-testing generally required often consume more time than expected. Progress cannot be made without going through this painful process where necessary, but when an airplane is built which incorporates too many innovations there is every likelihood that testing and development of the prototype will take so many years and cost so much money that when the job is finally done it is found that the tactical need for the type has changed or that for some other reason the airplane has become obsolete.

In many cases it has also been found that original specifications, wishfully agreed to, cannot be met; or the development proves to take so much longer than anticipated that the customer, or the contractor himself, becomes discouraged and the project is dropped. In framing this project there was little background of experience on use of jet engines. Installation of these engines also made it necessary to incorporate a number of other features, most of which had not previously been used, at least on carrier based aircraft.

In view of these considerations it was decided that all other characteristics of the airplane should be such as had been successfully used before. This decision has never been regretted. This article will discuss only the less conventional features, since they should be of the greatest interest.

Design simplicity is an intangible factor of considerably more importance than is generally realized even by some of the best designers. It is usually possible to present a convincing argument for an extra latch on a control to prevent operation at the wrong time, or for some more elaborate linkage which will improve efficiency of a mechanism, or for a more complicated truss which should theoretically save weight, or some extra switch in the circuit in case several things go wrong in the electrical system simultaneously, or for another instrument so the pilot will have some way of knowing why his engine quit or is about to quit.

The arguments against such things cannot be conclusive when applied to a single small item, but when taken collectively the elimination of unessential complications can make the difference between an airplane which is easy to build, maintain, and win battles, and one which is not. With this in mind it was decided to make a particular effort to keep the Phantom simple. This is believed to be sound general policy for any fighter project.

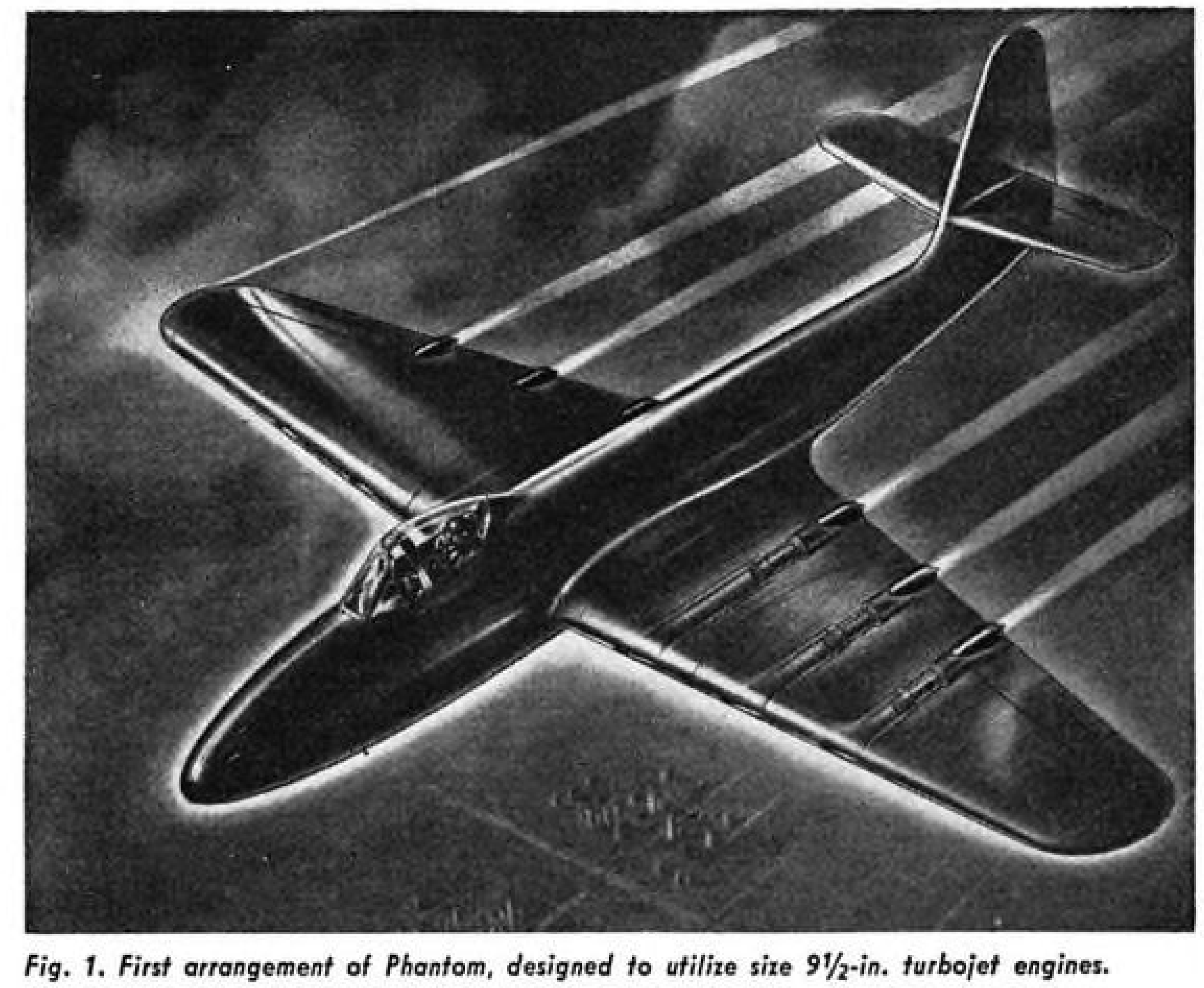


Fig. 1. First arrangement of Phantom, designed to utilize size $9\frac{1}{2}$-in. turbojet engines.

Military Requirements

In a more conventional case it would be common practice to begin by tabulating the required military characteristics on the basis of previous attainments with similar fighters extrapolated in the directions where combat experience had indicated the greatest needs. The designer would then call upon previous experience with the effects of power loading, wing loading, span loading, and drag loading, and could soon have a reasonably close first approximation of gross weight, wing area, engine size, and number of engines needed. In this case, however, military requirements had to depend to an unusual degree upon what was feasible to accomplish. The gross weight, engine size, and number of engines were yet to be determined.

The tactical mission first assumed was defensive combat air patrol operating from a carrier and patrolling at 15,000 ft. over or near the carrier. The problem was to take off, rendezvous with other airplanes, climb to altitude, patrol over the carrier, attack hostile aircraft when necessary, descend, and land aboard the carrier. The specific fuel consumption was calculated and found to be appallingly high judged by the usual lb. per hp.-hr. standards, particularly when flying at low speeds.

Everyone was then willing, however, to give this new type power plant every marginal advantage by assuming a minimum time for each phase of the tactical problem so as to hold the number of gallons of fuel reasonably close to customary limits. Later, as the design progressed, it was found that carrying large quantities of fuel was less critical than at first believed and the requirements were stiffened accordingly. The airplane is now expected to have a combat radius originally thought to be possible only with propeller-driven fighters.

It was expected that takeoff would be unusually troublesome since at takeoff speeds the thrust available would be less than that available on propellered fighters.

Three means for improving takeoff were looked upon as possible: First was the use of thrust augmentation. There are a number of ways to augment thrust for short periods (5 to 10 sec. would be sufficient). The one which originally seemed most promising was the injection of ammonia, or some other combination fuel and refrigerant, into the intake in order to make it possible to burn more fuel without exceeding turbine temperature limits made necessary by available metals.

A second method was to employ powder rockets (JATO) which were just then being developed for combat use.

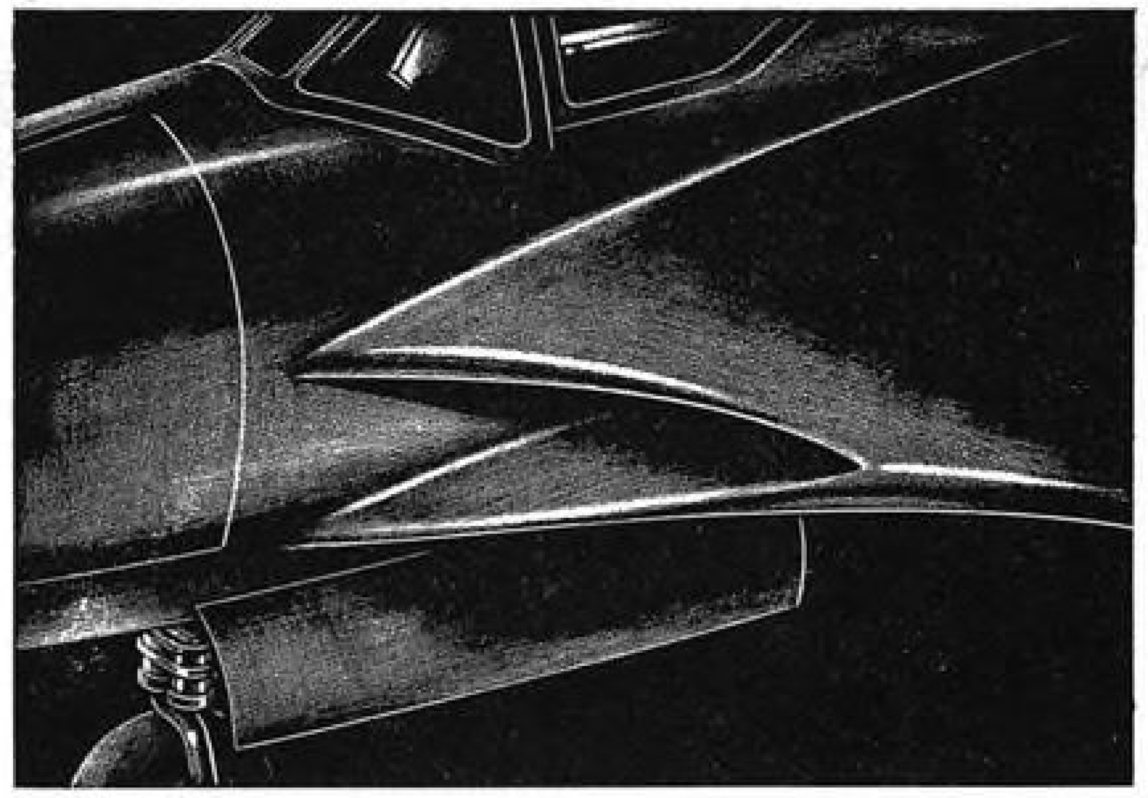


Fig. 2. Original shape of air inlet.

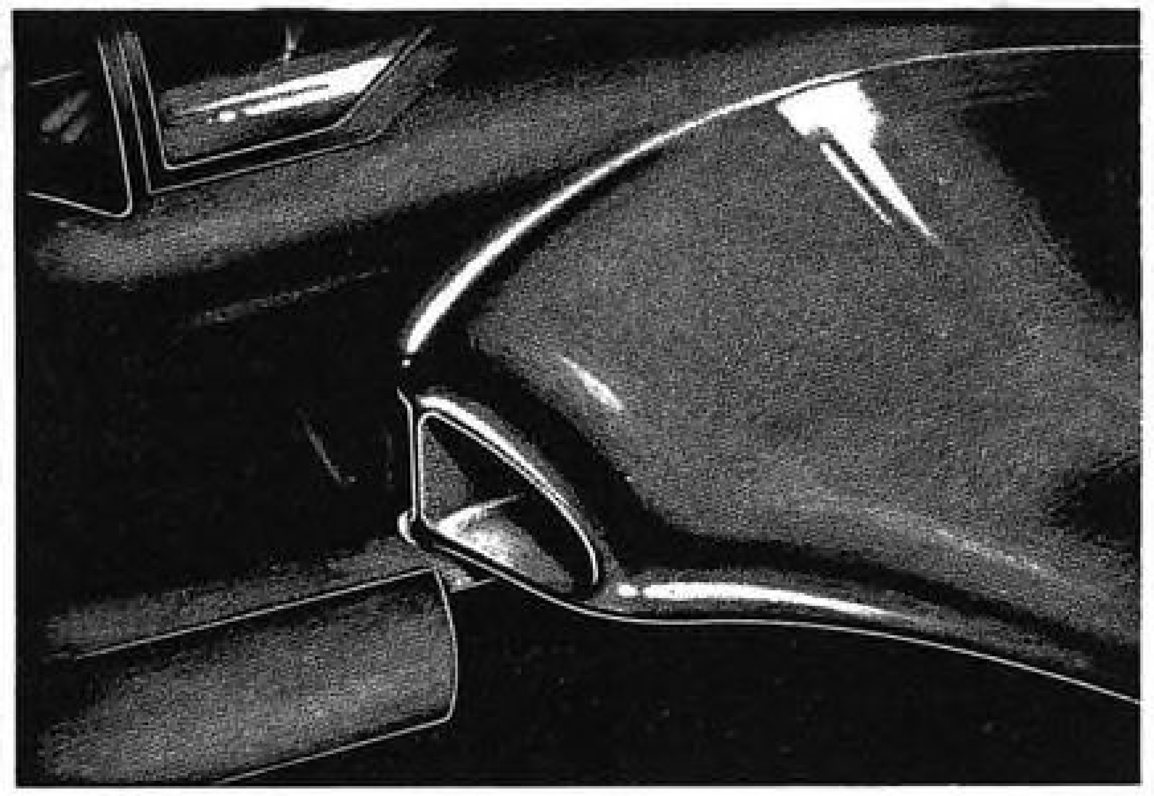


Fig. 3. Final shape of air inlet.

A third method, and one which was visualized as only feasible in the event that the others failed to work, was the use of flush deck catapults. It has since turned out that injection of ammonia has a number of objectionable characteristics, and this method has consequently been dropped. The use of powder rockets presented a supply problem and was found to be expensive as a regular procedure. Use of catapults, however, as a standard means of providing takeoff assistance was found to be not only a feasible method, but in some respects superior to takeoff without assistance, since it makes more of the carrier deck usable for spotting airplanes. This method was widely used by the U. S. Navy in the Pacific war. In the event that the catapults cannot be used, the powder rockets may be employed. Even this should seldom be necessary, since the takeoff without assistance has proved to be as good as the takeoff of some of the heavier types of conventional carrier aircraft.

Some concern was felt over the ability of the engines to accelerate rapidly enough to permit a good carrier wave-off and to decelerate rapidly enough for a good carrier landing. In the case of a carrier approach where the pilot has slowed down to near the stalling speed and at the last moment is waved off by the signal officer, it is essential that the pilot be able to promptly muster enough thrust to safely make a climbing turn without further loss in speed. Likewise when the pilot is cleared to land and cuts the throttle, it is necessary that the thrust drop rapidly to avoid any tendency to float over the arresting wires.

It was predicted that approach and landing techniques would have to be modified to allow for the deficiencies of the jet in these respects, but this has been found to be less critical than expected. The engines have the characteristic that, although the rpm. change is less rapid than with piston engines, the thrust itself can be increased or decreased quickly. Recent carrier trials with the Phantom have, in fact, been fully satisfactory in wave-offs and landings.

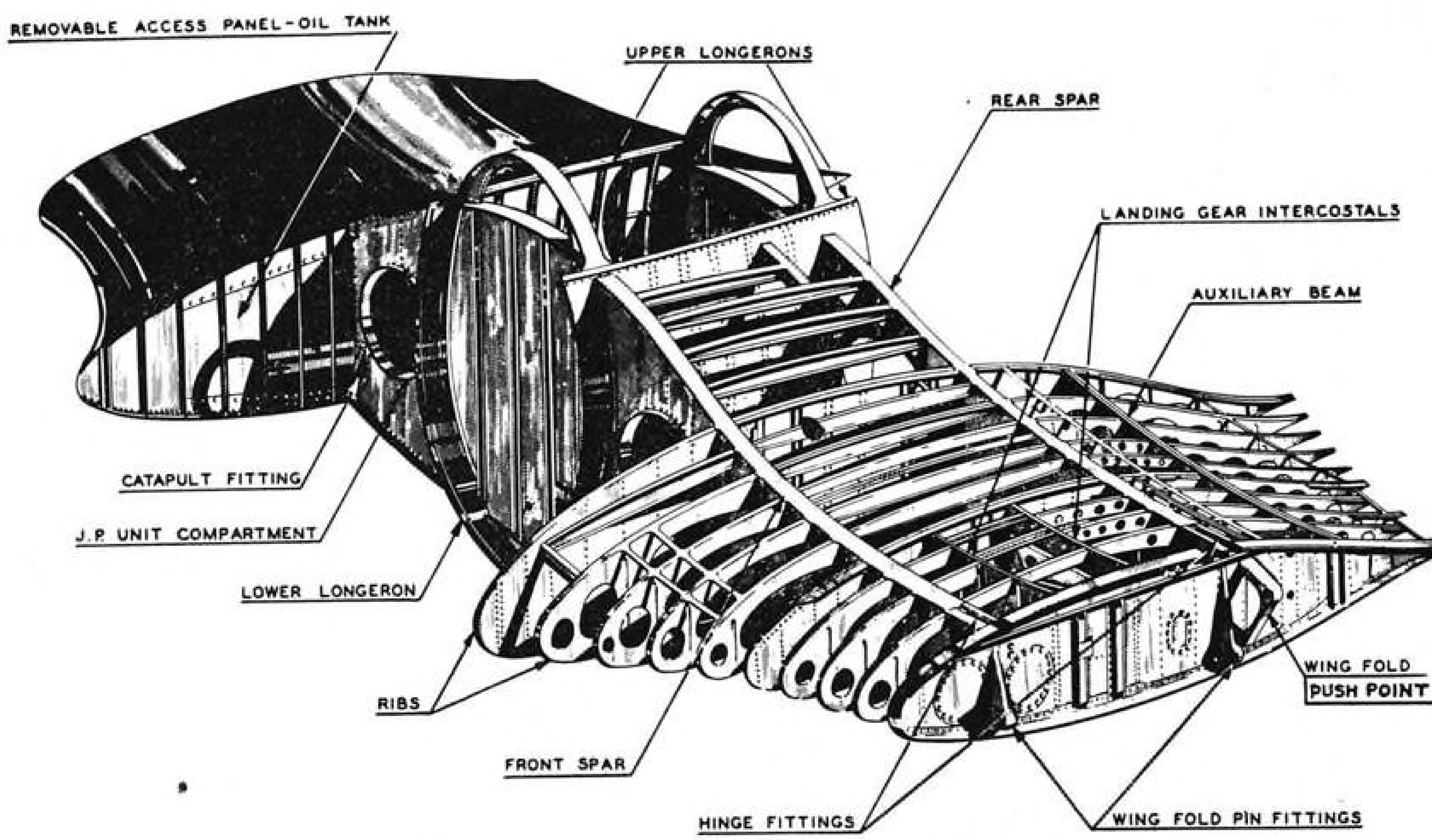


Fig. 4. Wing center section, showing how structure is designed around engines.

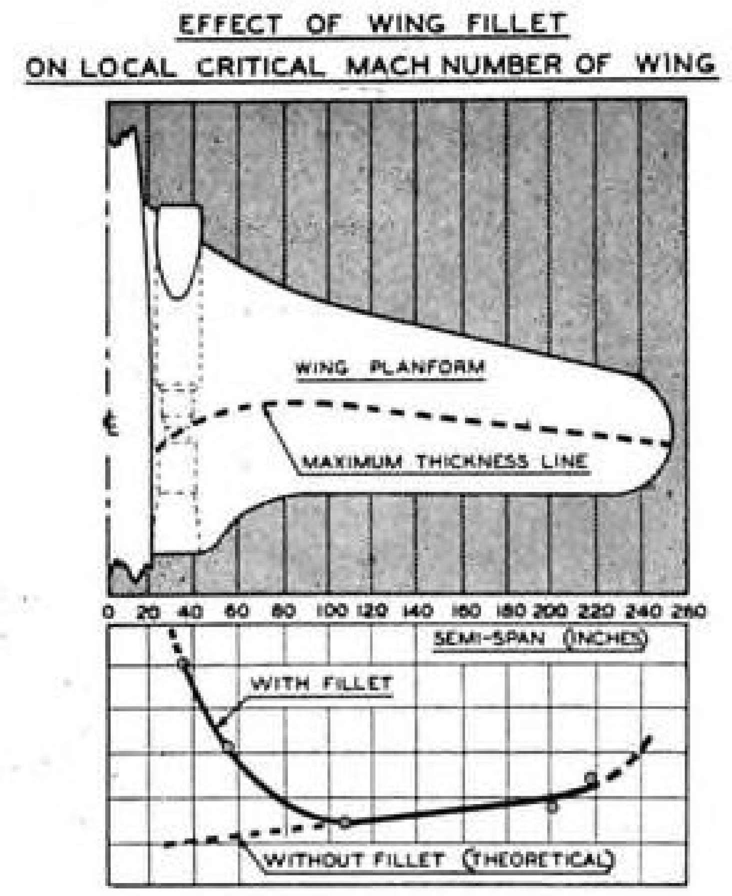


Fig. 6. Critical Mach number for the filleted wing.

Another fundamental consideration was that the airplane should be as small as possible and fold into the minimum space in order to make it possible to spot the greatest number on a given deck area. Obviously a carrier with 50 fighters aboard is more effective than one with only 25. It was assumed that one pilot and four .50-cal. guns should be carried so the airplane was, in one sense, designed as the minimum size fighter which would satisfactorily carry the pilot, guns, and ammunition for the required length of time, letting not only the gross weight and wing area, but the engine thrust as well, fall where they might.

Design Studies

With these considerations in mind, the initial conception was an airplane that looked about like Fig. 1. This was to employ six engines of 9.5 in. dia. providing a static thrust estimated to be from 275 to 340 lb. each. At high speeds this total thrust was somewhat more than was available in other fighters in service at that time. By stopping two of the six engines and operating the remaining four near their maximum continuous thrust rating, it was hoped that the best cruising economy could be achieved.

It was then assumed that on entering combat the airplane should carry enough fuel for 45 min. at maximum continuous rating and that the indicated stalling speed in this condition should not exceed 70 knots. These assumptions led to an estimated design gross weight of about 6,600 lb. and a wing area of 187 sq. ft. This arrangement had what was then considered quite acceptable speed and climb. However, when takeoff distance, wave-off rate of climb, and cruising efficiency were computed, it was found that the thrust loading and wing loading were both marginally high.

The next step was to compare 6-, 8-, and 10-engine arrangements having 230 sq. ft. of wing area. Following this a comparison was made between airplanes having eight 9.5-in. dia. engines, six 11-in. dia. engines, four 13.5-in. dia. engines, and two 19-in. dia. engines, all arrangements assumed to have the same total thrust. The first comparison indicated that the equivalent of eight 9.5-in. engines combined with the larger wing was apparently sufficient to meet low speed performance requirements, such as takeoff distance and wave-off rate of climb and provide a comfortable speed margin over propellered fighters.

The second comparison indicated that nearly 300 lb. could be saved by using two 19-in. dia. engines instead of the equivalent eight 9.5-in. engines. The weight difference was found primarily in nacelle structure, firewalls, engine mounts, engine accessories, engine controls, starters, oil coolers, and instruments.

A number of considerations other than weight also pointed to the desirability of two engines rather than some greater number. Among these the most important were simpler control and instrumentation problems from the pilot's standpoint, and simpler structure and equipment from the standpoint of design, manufacture, and maintenance.

These considerations were particularly convincing as applied to a plane with folding wings, since a large number of engines distributed along the wing would have required either that fuel lines, engine controls, and instrument lines pass through the fold joint, or that the folded span be undesirably large. If any of the engines were placed outboard of the fold joint, servicing of the outboard engines with the wings in the folded position would be awkward.

Use of one larger engine (rather

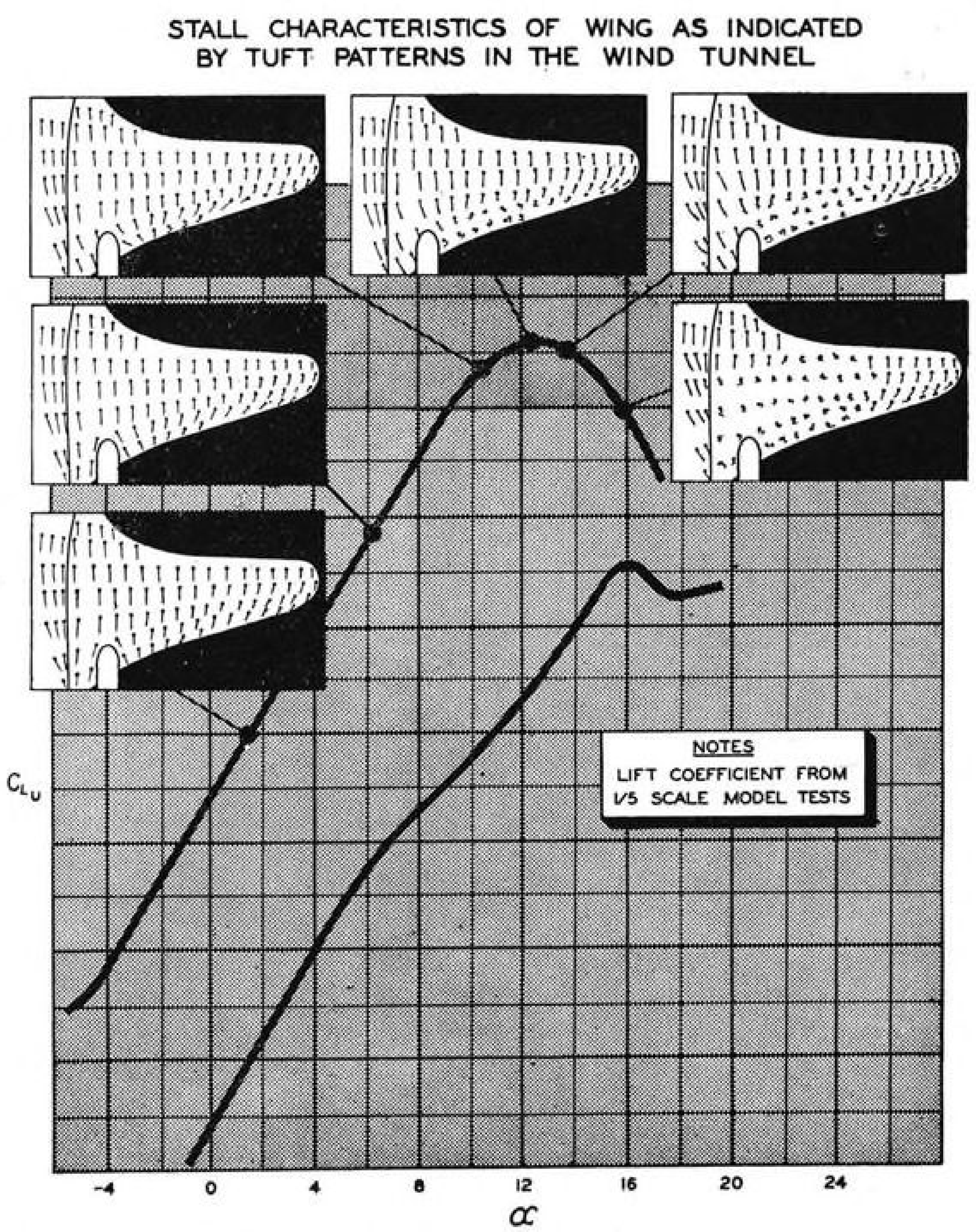


Fig. 5. Lift curve for the the filleted wing.

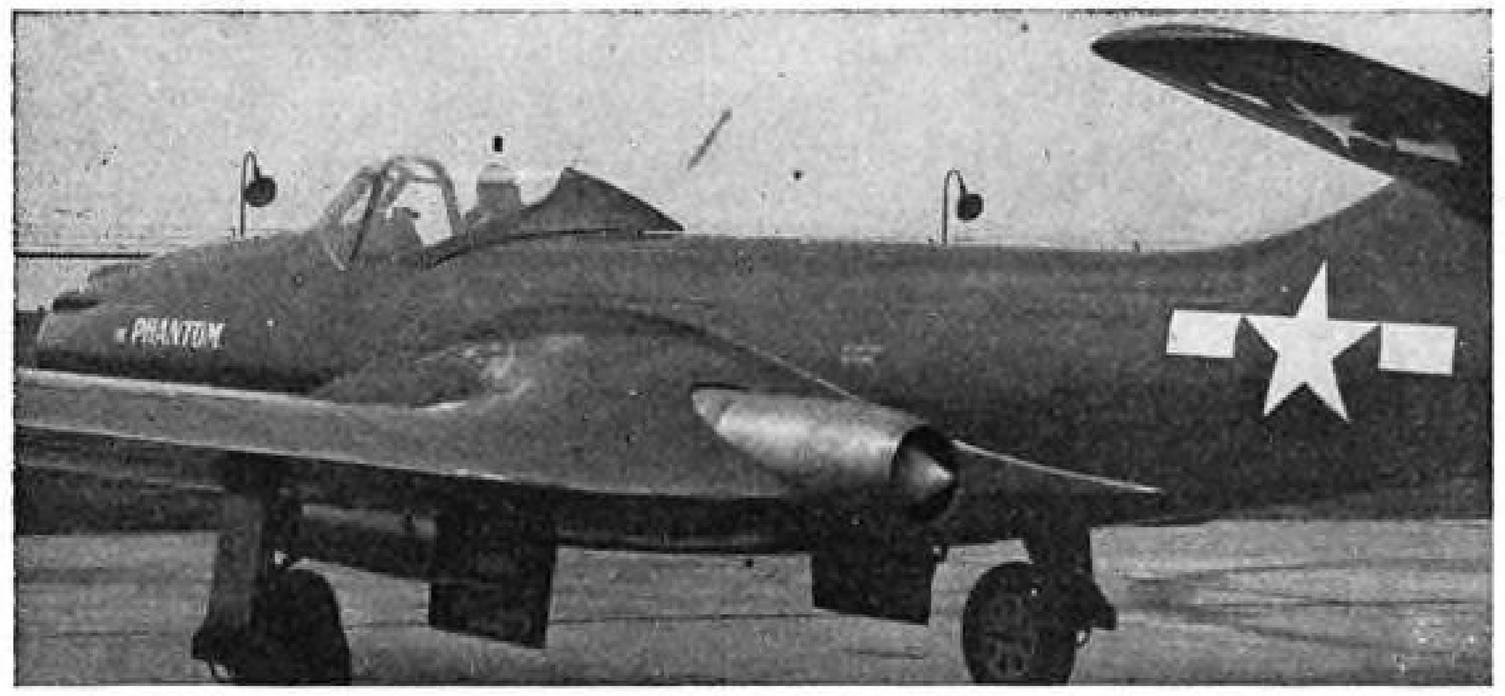


Fig. 7. Tailpipe location of one of two Westinghouse 19-B turbojets used in McDonnell Phantom.

than two 19-in. dia. engines) was given some consideration, but at that time such an engine appeared to be too big to consider for the initial development of a power plant type. Subsequent evolution has shown the need for larger and still larger engine units, but it is believed to have been wise not to have begun with a larger size. Comparison between one-engine and two engine arrangements also provided the following basic advantages of the two engine arrangement:

1. *Better Reliability.* It is particularly important to have an engine to spare when new and relatively untried power plants are being used. This is further emphasized in the case of a plane which is to be operated at any distance over the ocean. Combat experience has amply demonstrated the advantage of having more than one engine for the purpose of getting home after a fight.

2. *Cruising Economy.* It was calculated that between 10 and 20% of the fuel could be saved by cruising on one engine in a two-engine airplane at nearly full output rather than by cruising at low output in a single-engine plane. This saving amounts to a considerable reduction in weight when such large quantities of fuel are involved.

3. *More Efficient Air Inlet.* Turbojets must be supplied with extremely large quantities of air. This air must be delivered to the compressor inlet with a minimum of energy loss to prevent serious reduction of thrust, particularly if full advantage is to be taken of the efficiency of axial-flow compressors. If an airplane is equipped with one such engine in the fuselage, the design of an inlet of suitable efficiency is difficult. The designer is then faced with two major alternatives: He may take air in at the fuselage nose and provide a large smooth duct past the cockpit and nose wheel. Such a duct occupies considerable space in that portion of the fuselage which is generally the most crowded. Result is a considerable weight increase because of the duct itself and the larger fuselage required to house the duct. At the same time there is an aerodynamic loss because of both the long duct and the larger fuselage.

The designer may, on the other hand, choose the other alternative and take air in on each side of the fuselage, but this involves some loss in ram due to inducting boundary layer air, curvature at the inlet, and curvature of the ducts, with the result that there may be an appreciable thrust loss. This loss would be particularly pronounced when one engine is located in the center of the fuselage. When two engines are mounted beside the fuselage practically no duct is needed. What duct there is can be both short and straight and inlet losses are found to be negligible.

4. *More Efficient Jet Outlet.* When one engine is employed, the outlet must be either at the rear of the fuselage, underneath, or out the sides. The rear location has the disadvantage of requiring a long tail pipe, which is heavy and must be insulated or ventilated, and which interferes with structure and controls. The other possible outlet locations cause additional drag, require difficult fairing, and are more hazardous from the standpoint of fires on the ground while starting or stopping the engines. These conditions can be improved with two engines, particularly if they are located outboard of the fuselage, where practically no tail pipe extension is needed.

One objection often raised against conventional twin-engine fighters is lack of maneuverability, first because the total power plant weight is apt to be more, and second because this weight is generally distributed farther outboard.

With the Phantom, however, such objections do not apply, because the engines are unusually light and are located inboard. Maneuverability should be equal to that of a small single-engine fighter.

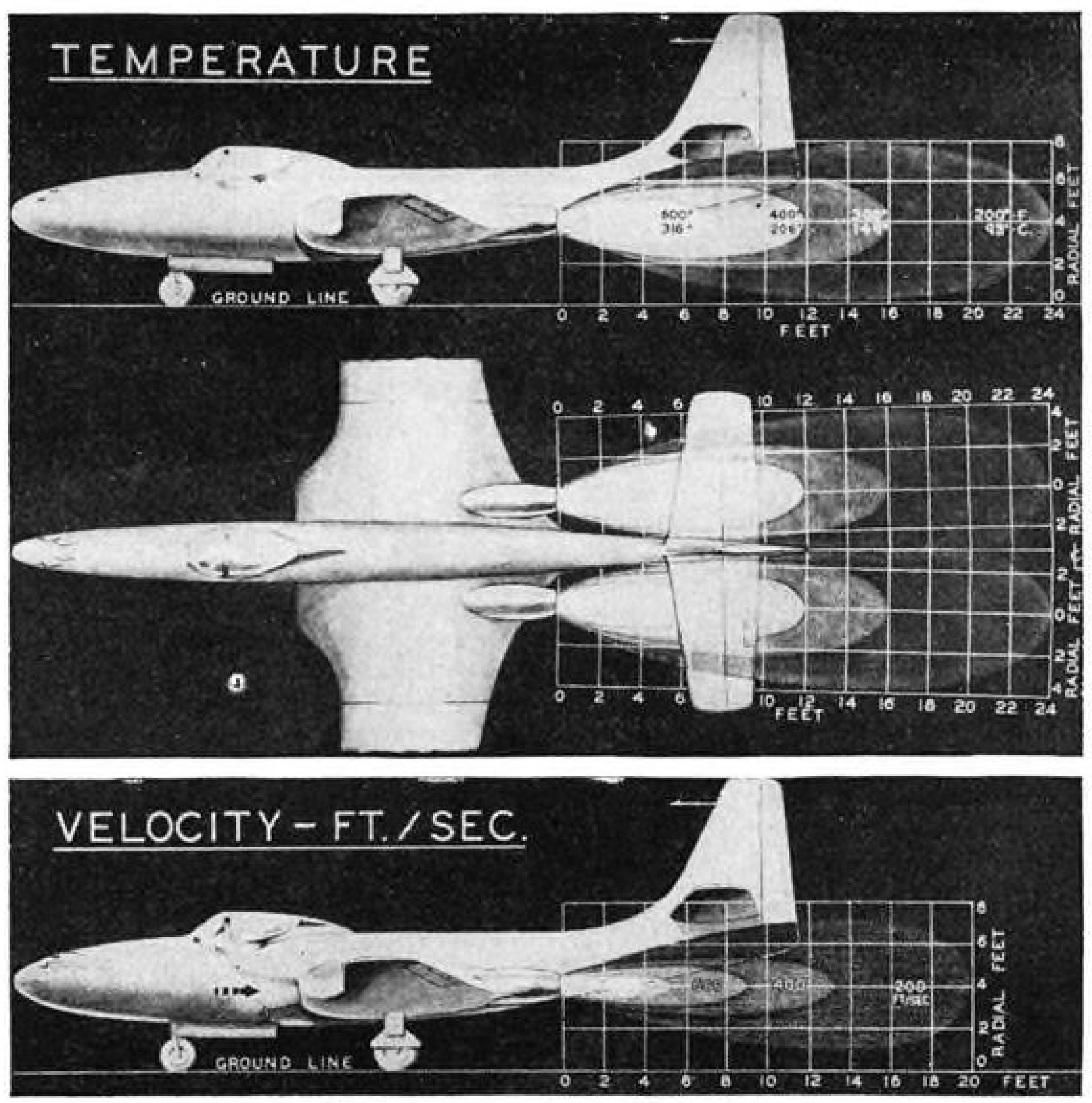


Fig. 8. Jet temperatures and velocities.

If a really fair comparison could ever be made between the performance of a single- and twin-engine jet fighter with the same total thrust and with all other things equal or equivalent, it is believed that the two-engine plane would have a very decided advantage. If the comparison were made with the same engine model, which would permit twice the total thrust in the two-engine fighter, it is felt that the performance advantage of the two-engine arrangement would be even more pronounced.

When the Phantom was first being designed there was a general feeling that, since jet engines were apparently a great deal simpler than reciprocating engines, and since one size engine could presumably be scaled up or down from another size, the past practice of designing planes to fit engines might advantageously be reversed and engines might be tailored to fit particular airplanes. This would be very helpful, indeed, to the designers of certain types of planes, particularly where the specifications call for a craft which must have an engine of non-existent size.

As it has turned out, however, development of new compressor and combustion chamber sizes is not the simple matter it was once assumed, and it now appears that for the present most jet airplanes will have to be tailored to fit previously developed engines. There is a good possibility that, as more is learned about turbine engine design, it may yet be feasible to fit the engine to the aircraft.

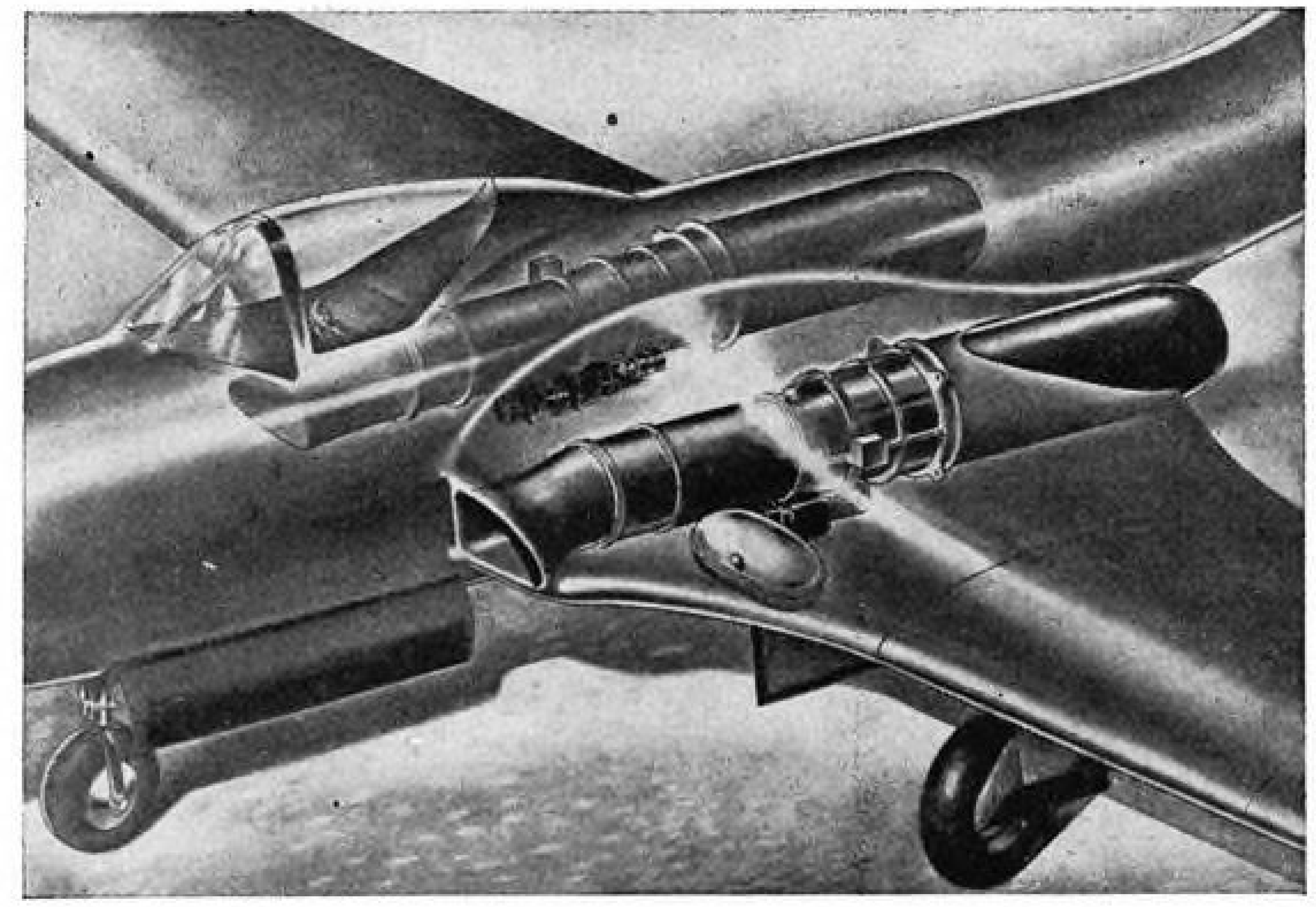


Fig. 9. Cutaway view showing engine installation in Phantom.

Engine Location

After deciding that two engines would be the most satisfactory number, there arose the problem of the best particular spanwise location. Most obvious place was in nacelles mounted on the wings in the customary manner. Nacelles were laid out at various distances from the fuselage, some inboard of the landing gear and some outboard. None seemed a happy combination in view of the objectionable effects which a fuselage plus two other bodies have on total frontal area, on wing interference drag, and on spanwise distribution of lift, and also because of the large yawing moment with one engine inoperative.

The next most obvious course was to put the engines side by side within the fuselage. A number of layouts of this configuration were made, trying by every conceivable means to avoid the necessity for long tail pipe extensions and either long or curved inlet ducts—but no neat solution was found. Furthermore, it was found that with the engines in the fuselage there was insufficient fuel space without putting tanks in the wings or making the fuselage abnormally large. In view of the amount of fuel required for a jet airplane (which at that time seemed abnormally large), and since unobstructed space was required for bullet-sealing tanks, it was felt that the fuselage could be put to better use to enclose fuel than to enclose engines.

Wing Fillets

Placement of the engines in wing root fillets was only considered after the other arrangements had been tried and found wanting. Had the engines been of much larger diameter, this could not have been as neatly done. One obvious drawback to this location is the cost of building a wing structure having double curvature, particularly where smooth contours for high speed are essential. Another apparent drawback was the possibility that this large thickness might give the section a low critical Mach number.

Our company had had experience, however, with both these problems as applied to somewhat similar enlarged fillets on the XP-67 airplane designed and built for the AAF. In that case the enlarged fuselage fillets had been used to provide space for fuel and ammunition, which should be located near the center of gravity. Large nacelle fillets also employed on that plane had provided space for engine cooling ducts, oil coolers, and intercoolers. During the development of these fillets and the leading edge inlets employed with them, a great deal was learned about achieving good ram recovery, interference drag, lift distribution, and critical Mach number. Experience was also gained in design and construction of such fillets without undue additional cost.

This expedient of enlarging the wing adjacent to the fuselage or nacelle has now been employed on several McDonnell planes. The impression has even arisen that our company prefers these "McDonnell flying fillets" in the same way that Packard prefers its distinctive radiator shape. Actually, large fillets have not been used either as a trademark, or in any belief that every plane would be a better craft if so equipped.

A considerable amount of tunnel testing has now been done on a number of models with and without wing fillets, and the general conclusion is drawn that where space is needed near the

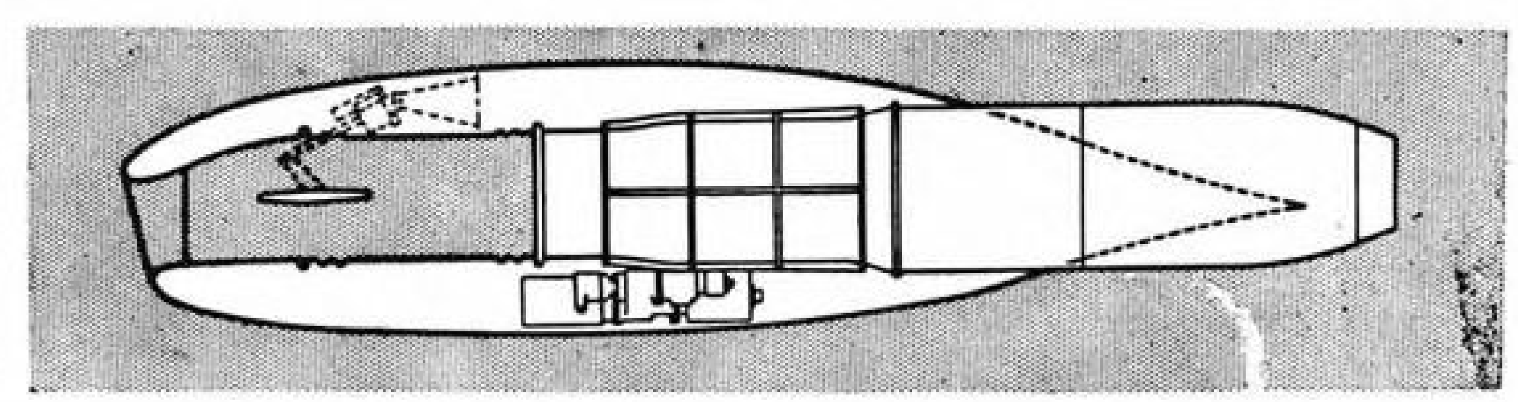


Fig. 10. Section through engine showing inlet duct and shut-off valve.

center of gravity for such things as fuel, ammunition, engines, and related components, or for landing gear retraction, this space can often (not always by any means) be designed for less drag and less weight by using an enlarged fillet than by the alternative means of enlarging the fuselage or thickening the wing enough to provide the equivalent space. This is often true even at very high Mach numbers if there is a duct inlet at the leading edge and air is entering this inlet at the proper velocity ratio.

The first fillet and air inlet looked about like Fig. 2. The airfoil contours were layed out so that maximum thickness—located at 45% chord on 66 series laminar flow airfoils—swept aft from the fuselage outward to the wing fold point. (This was done less to improve compressibility conditions than to provide space for structure and engine accessories where it was most needed, but it is believed to be beneficial.) The contours near the leading edge were originally based upon a series of NACA-developed airfoils with leading edge air inlets.

Wind tunnel tests were conducted at 1/5 scale and particular attention was paid to conditions in and around the duct inlets. One of the basic requirements set by the engine manufacturer was that the distribution of velocity head around the periphery of the inlet to the first compressor stage should not vary by more than plus or minus 5%. It was found in the tunnel that this requirement could not be met with the original inlet shape beause of a severe lateral flow which developed due to the plan-view angularity of the upper and lower lips.

Three other shapes were then tried, and one was further developed, in a series of tests at NACA laboratories, into the present shape as illustrated in Fig. 3. This inlet is so shaped that there is no local separation at any velocity ratio normally encountered. The inlet and duct together provide a ram recovery in excess of 99% so that both inlet and outlet losses are effectively eliminated with this installation.

There are several incidental advantages in employing large wing fillets. One is that the additional depth at the point of maximum wing bending (as illustrated by Fig. 4) materially improves wing rigidity. A comparison between the Phantom wing and an equivalent wing with straight taper indicates that the tip deflection due to a given load is reduced to less than half, and that the flutter frequencies are improved accordingly. Another incidental advantage is the additional depth which is provided locally for housing landing gear. This may prove to be a very real advantage for planes with even thinner wings.

Aerodynamically the large fillets have proved to be fully satisfactory. Fig. 5 gives a typical lift curve at model scale with stall patterns shown by tufts. The first stalling occurs at the trailing edge outboard of the engines and progresses from this point gradually forward, outboard, and inboard. The area over the engines and the area ahead of the ailerons do not stall until well past the lift curve peak.

Critical speed over the fillet is found to be better than over the remainder of the wing. Fig. 6 gives the variation of critical Mach number along the span, as revealed by high-speed wind tunnel tests conducted by NACA. Test results agree with predictions (based on two-dimensional data for corresponding thicknesses) almost exactly throughout the portion of the wing outboard of the fillets.

It will be seen that in the filleted area the critical Mach number is appreciably better than for the basic wing. This may be accounted for partly by the fact that air is taken in at the leading edge, thus effectively splitting the one thick wing into two aerodynamically thin ones, and partly by the fact that there is an effective sweepback in this area due to the curvature of the maximum thickness line in plain view. Fact that this portion has a very low aspect ratio effectively allowing three dimensional airflow, may also be helpful in this respect.

An unexpected advantage arose from the fact that the exhaust outlets were located near the wing trailing edge rather than at the rear end of the fuselage (as shown in Fig. 7). Flight tests revealed that stalling speed was improved by approximately 5 knots when full power was applied. This is an important improvement in performance during takeoff, either from a carrier or from land. It is also advantageous for a carrier based plane during a landing, in that the aircraft tends to settle to the deck more securely when the throttle is cut.

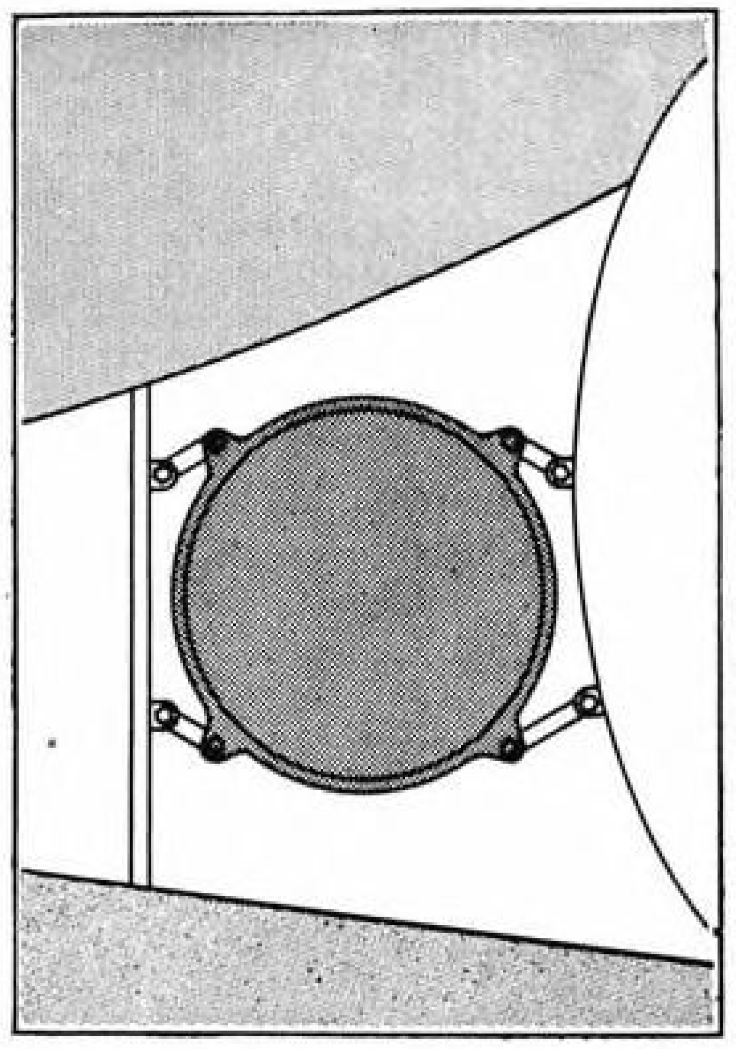


Fig. 11. Engine mounting links to provide for wing deflection.

This condition is apparently explained by jet-induced acceleration of the airflow over the inner portion of the wing, even though this area is unstalled with power off. It is understood that a similar condition exists in the case of the Me-262 (See Oct. and Nov. 1945 AVIATION), in which the jet outlet is also located near the wing trailing edge.

Power Plant Installation

Engines were located as close to the fuselage as was thought to be safe without permitting the jet to contact the fuselage skin. Fig. 8 illustrates the temperature and velocity fields behind the engine. Although these fields were not known at the time and had to be estimated, no heating of the fuselage or other deleterious effects have been observed. It is now believed that the engines might have been safely placed even a little farther inboard.

The thrustline is so close to the centerline of the airplane that stopping one engine in flight requires but a very small rudder tab adjustment. The yawing moment is so small, in fact, that the first plane, after a number of preliminary tests, made its initial hop (rising a shortway off the ground) before the second engine had been installed. This may well be the first time that a multi-engine airplane has actually got off the ground with only one engine. Twin-engine aircraft are generally not controllable on one engine near the stalling speed and few, if any, can take off on one engine.

Vertically the engines were located somewhat above the original wing chord plane—for two reasons. First, this made it possible to use a shorter main landing gear; and, second, it made it possible to keep the lower surface of the wing straight in the region of the landing flap and thus considerably simplify the flap structure. Longitudinally the engines were placed as far forward as the wing beams would permit. This was done for the purposes of balance even though it required that 19 in. extensions would be added to engine tail pipes.

Figs. 9 and 10, illustrating the power plant installation, show its unusual simplicity. The engines are supported by the wing structure behind the rear beam through four links (as illustrated by Fig. 11). The links are placed at such an angle that wing deflection cannot carry into the engine itself. When the wing bends due to up load, the upper beam cap is in compression, and hence the upper beam cap is in compression, and hence the upper link attachments move closer together, tending to displace the engine upward. At the same time the lower beam cap is in tension and the lower link attachments separate, also tending to displace the engine upward. Thus, wing bending merely moves the engines vertically by a slight amount.

The links are designed to resist longitudinal loads and thus take moments about the vertical and lateral axes. Such moments are of considerable magnitude, due largely to gyroscopic effects. In the production version, the engines are removed by unbolting the lower member of the rear wing beam and dropping the engine vertically onto a bomb dolly adapted to the purpose.

A shutoff butterfly valve is provided in the inlet duct, as illustrated in Fig. 10. This valve is normally open. It is closed when one engine is shut off for cruising to reduce drag otherwise involved in windmilling the inoperative engine. The drag reduction is sufficiently pronounced so that in flight the pilot can see the airspeed indication increase or decrease as this valve is closed or opened. It is necessary to provide against closing this valve when the engine is rotating at high speed, since this would result in blade stalling and would probably damage the compressor.

It was expected that it would be difficult to cool the engine compartment, but no trouble materialized from this source. As part of the development of the duct inlet to give a uniform velocity head, it had been thought best to provide a boundary layer bypass along the inboard edge of the inlet to drain off low speed air adjacent to the fuselage. This air was merely led into the engine accessory compartment and proved to be adequate for cooling. The cooling air was exhausted through the clearance space around the engine tailpipe.

On the ground, the direction of flow is reversed since there is then no dynamic pressure at the boundary layer inlet, but there is, instead, an adequate negative static pressure due to the induction of engine air. It might be expected that this reverse flow on the ground would tend to heat the accessory compartment rather than cool it, since the air is being drawn past the

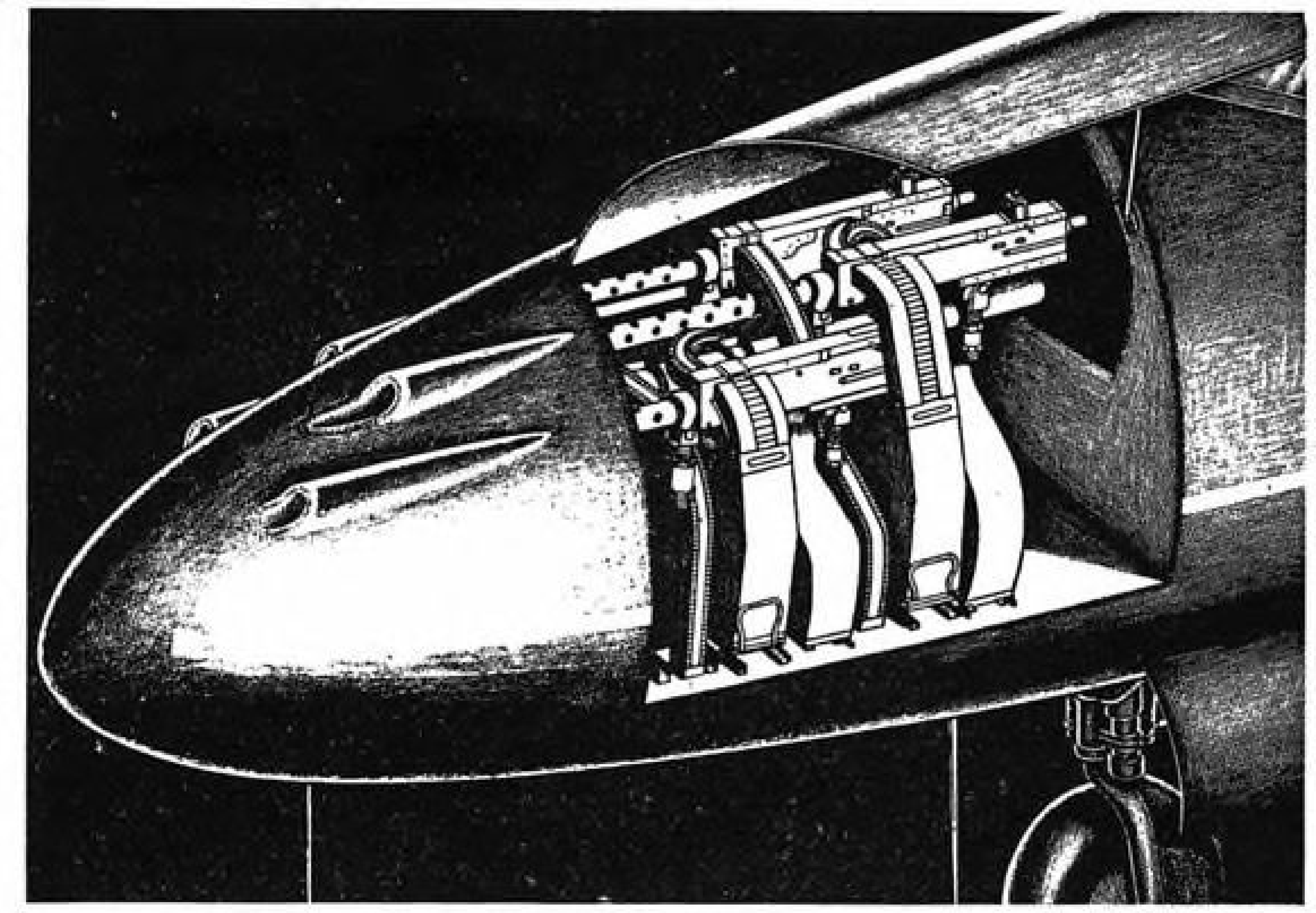


Fig. 12. Gun installation, which provides unusual accessibility.

hot tailpipe first. It is found, however, that the air thus brought in remains sufficiently cool for the purpose.

The problem of fire prevention was given particular consideration by the Bureau of Aeronautics and the manufacturer. In the accessory compartment between front and rear wing beams there are a number of lines carrying fuel at an unusually high pressure, so that a leak would supply fuel at a rapid rate. Condition in the compartment behind the rear spark, where the engine combustion chamber, turbine, and tailpipe are located, is such that a bullet hole or other leak would almost certainly ignite anything inflammable, because the pressure inside the engine is greater than the pressure outside.

Problem was therefore primarily one of keeping any source of ignition out of the forward compartment and keeping anything inflammable out of the rear compartment. The only sources of ignition in the forward compartment were various electrical accessories, and it was necessary to make sure that fire could not be started by means of an electric spark. As regards the rear compartment, the problem in flight differs from the problem when standing on the ground.

In flight a fuel or oil leak could cause an inflammable mixture in the rear compartment, but this wouldn't produce a fire unless there was also a puncture or leak in the engine. Such a simultaneous occurrence, together with a mixture neither too lean nor too rich to ignite, is rather remote. If such a fire did get started, it could readily be stopped by shutting off fuel to that engine.

On the ground the fact that the cooling air flows forward can be expected to keep fuel or oil from coming into contact with hot gases which might be leaking from the rear of the engine. It is felt that this installation should present less fire hazard than the average conventional power plant, because the area of portions of the power plant vulnerable to gunfire is considerably less and because the plane can be flown, if necessary, on one engine with the other shut off. aircraft built so far have been equipped with fire warning indicators, a CO^2 fire extinguisher system, and with stainless steel firewalls lining the rear compartment—although no occasion has arisen when these have been needed.

Other Design Features

A tricycle landing gear was clearly indicated, in spite of the fact that its weight is generally greater and that there had been little experience with this type for carrier operation. Preference for the tricycle undercarriage was based on the following reasoning:

1. It was not known how much the hot jet might damage wooden carrier decks if allowed to impinge directly on the planking during warmup. In view of this factor, and also in consideration of the standpoint of the deck crew, it seemed better to have the engines parallel with the deck when the airplane was at rest.

2. For deck landings, clearance was needed between the trailing edge of the fully deflected wing flaps and the arresting wires when the plane comes in with the tail well down. In the case of a conventional landing gear, where the

main wheels are placed ahead of the C. G., an appreciably longer gear would have been needed to insure this clearance. The extra weight of the longer main gear would have counteracted any savings in the use of a tail wheel. Since there is no propeller clearance problem, it was found that both the nose and main gear shock absorbers could be made quite short. Struts of such length were needed anyway to provide adequate energy absorption for smooth carrier landings.

3. It was felt that the characteristics of a tricycle gear (the nose tending to drop instead of the tail upon first contact with the deck) would be particularly beneficial in carrier operation. Aerodynamic bounce with conventional gears has caused many planes to miss the arresting wires entirely. This, of course, is highly undesirable, and this consideration alone should be sufficient to dictate tricycle gears for carrier aircraft.

Since the engines are necessarily located behind the c.g., the designers of all the jet airplanes have been confronted with the problem of keeping c.g. far enough forward, and all such aircraft have an unusually long fuselage nose in consequence. Such a long nose is objectionable from the standpoint of drag and longitudinal and directional stability, but it does have compensating advantages. One is that it makes it possible to place the pilot ahead of the wing leading edge, where his field of vision is excellent. Another is that it provides a place to put the guns where the barrels are close to the pilot's line of sight. The combination of such a cockpit and gun installation made possible with this engine arrangement is thus very nearly ideal from the viewpoint of the combat pilot.

Unusually good accessibility from the ground to the cockpit and to the guns is also permitted with this arrangement. Fig. 12 is a drawing of the gun installation with one of the two access doors open. A man standing directly on the ground can service, boresight the guns, and replace ammunition with a minimum of effort and time. At the same time, similar access is provided to radio, battery, and other equipment, through these same doors.

Fig. 13 illustrates how the components of the Phantom are broken down for production and replacement. This is a conventional breakdown, except that the fuselage is divided basically into three subassemblies—forward, center, and rear. The center portion is integral with, and is built as part of, the wing center section, so that the front and rear wing beams may carry across the fuselage without interruption at hinge joints. This results in a worthwhile weight saving and a considerably simplified wing structure.

The U. S. Navy has demonstrated with the Phantom that a jet plane can perform not only at high speeds, where the advantages of jet power are most pronounced, but can also perform well at the low speeds required for carrier operation. The Phantom is believed to represent the first step in a new series of naval aircraft to be powered with turbine engines and to have performance which will surpass our most optimistic predictions of a few years ago.

Tactically-useful jet planes have already demonstrated maximum speeds far beyond the ability of planes having piston engines. Much larger and more efficient turbine engines for both jet drive and propeller drive are under way in the United States and abroad. Unlike piston engines, there is no obvious upper limit to the size or output of the turbine engines which it will be possible to develop.

In the aerodynamic design of planes, means are being found for breaking through the barrier imposed by the characteristics of air near the speed of sound. We even look forward to tactical airplanes which will fly faster than sound. Whether the fighter aircraft of the future turn out to be flown with or without human pilots, it seems evident that as long as there is any risk of attack by hostile aircraft there will be need for fighters having the maximum practicable performance. With the help of turbine engines, fighters with ever increasing performance are not only possible but will undoubtedly be developed.

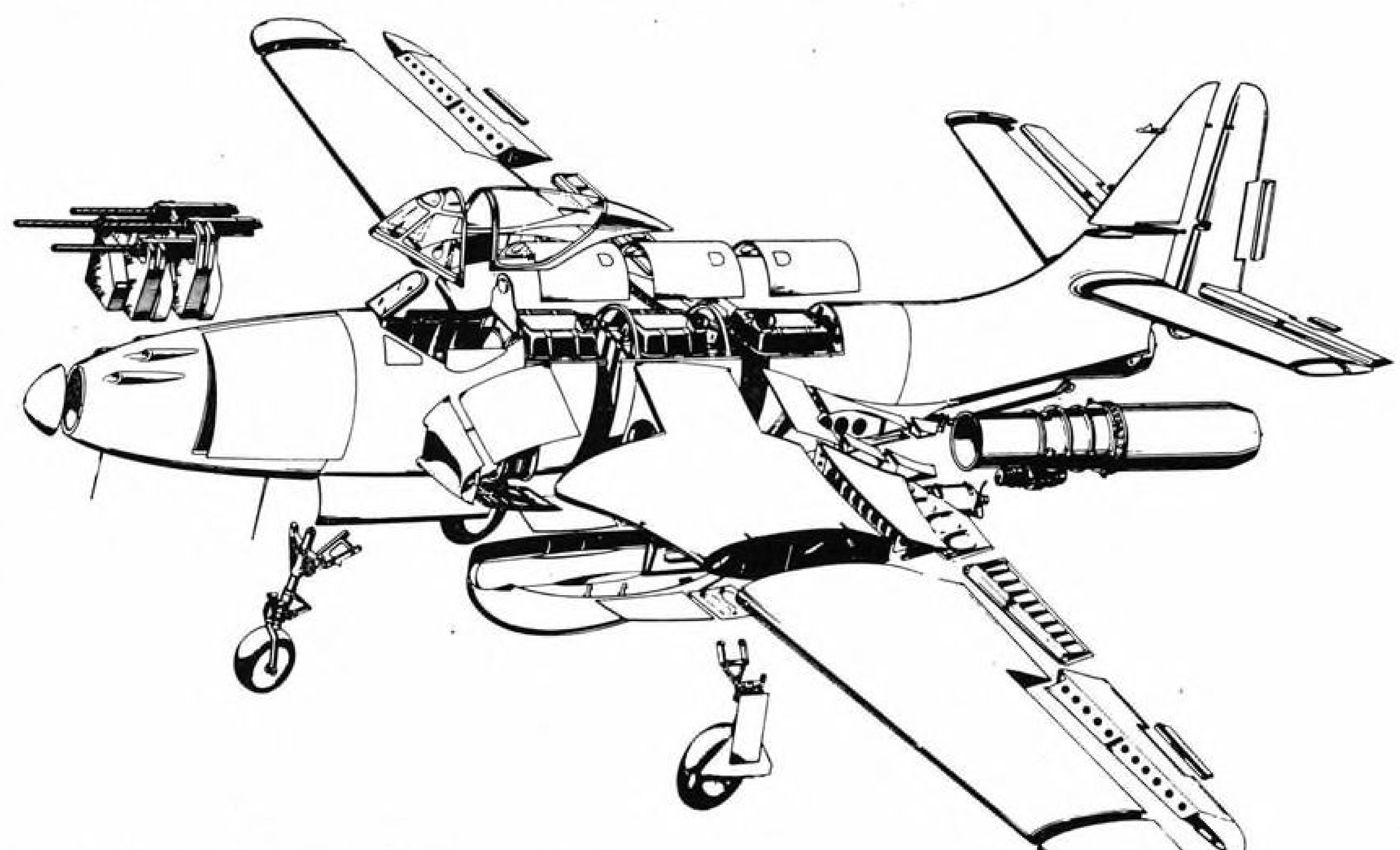
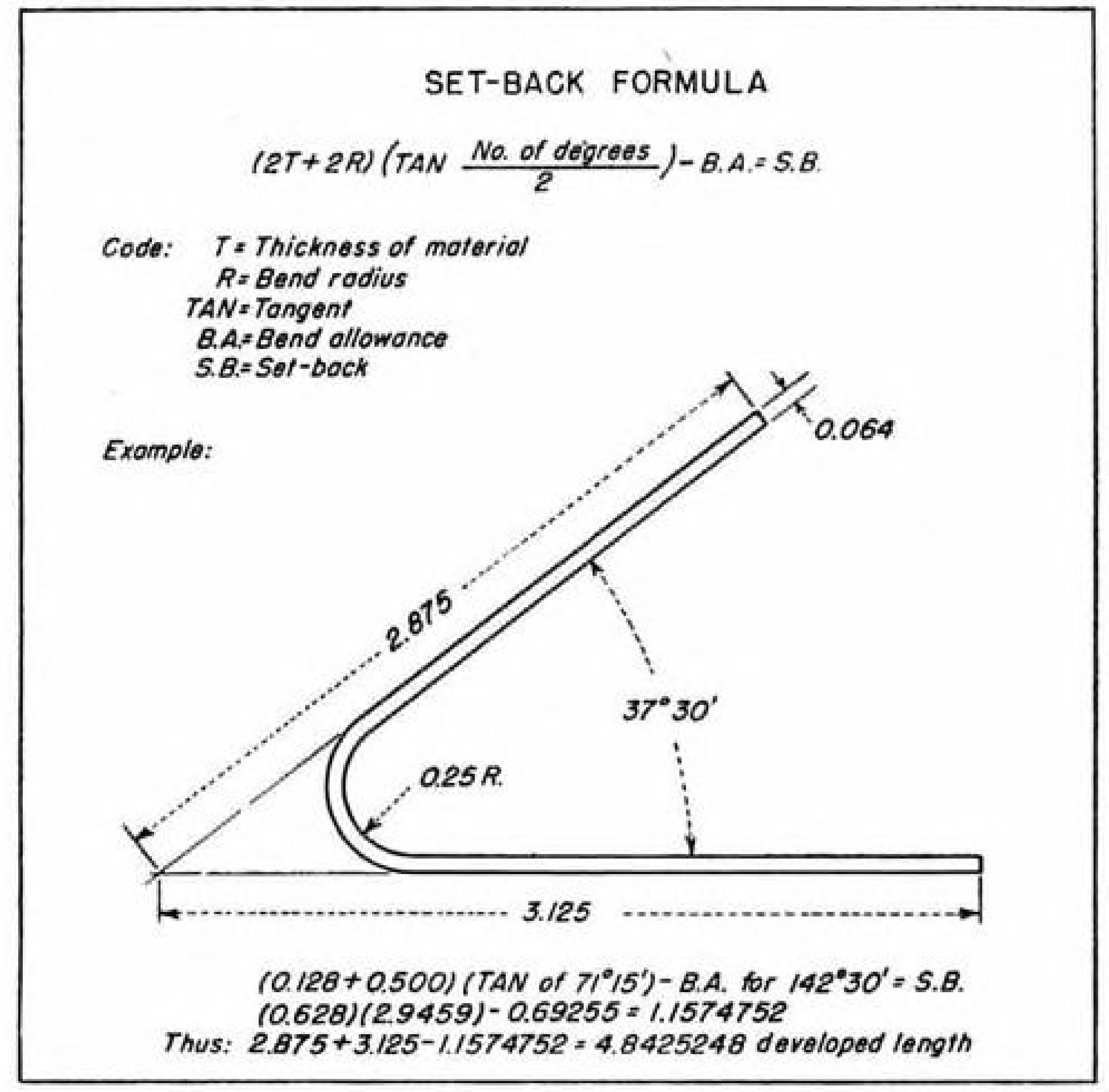


Fig. 13. Breakdown of McDonnell FD-1 Phantom major components.



Set-Back Formula Gives Precise Results

• Submitted by Leo R. Cole, this set-back formula enables precision computation to millionth of an inch. It has been used by him successfully in his work as sheet metal brake operator at McDonnell Aircraft Corp.

Simple Operation Plus Safety Featured in New Crimping Tool

• This ingenious device for crimping sheet metal up to 16-gage at bench or at installation, was perfected by Frank Lucarelli, Martin tool designer.

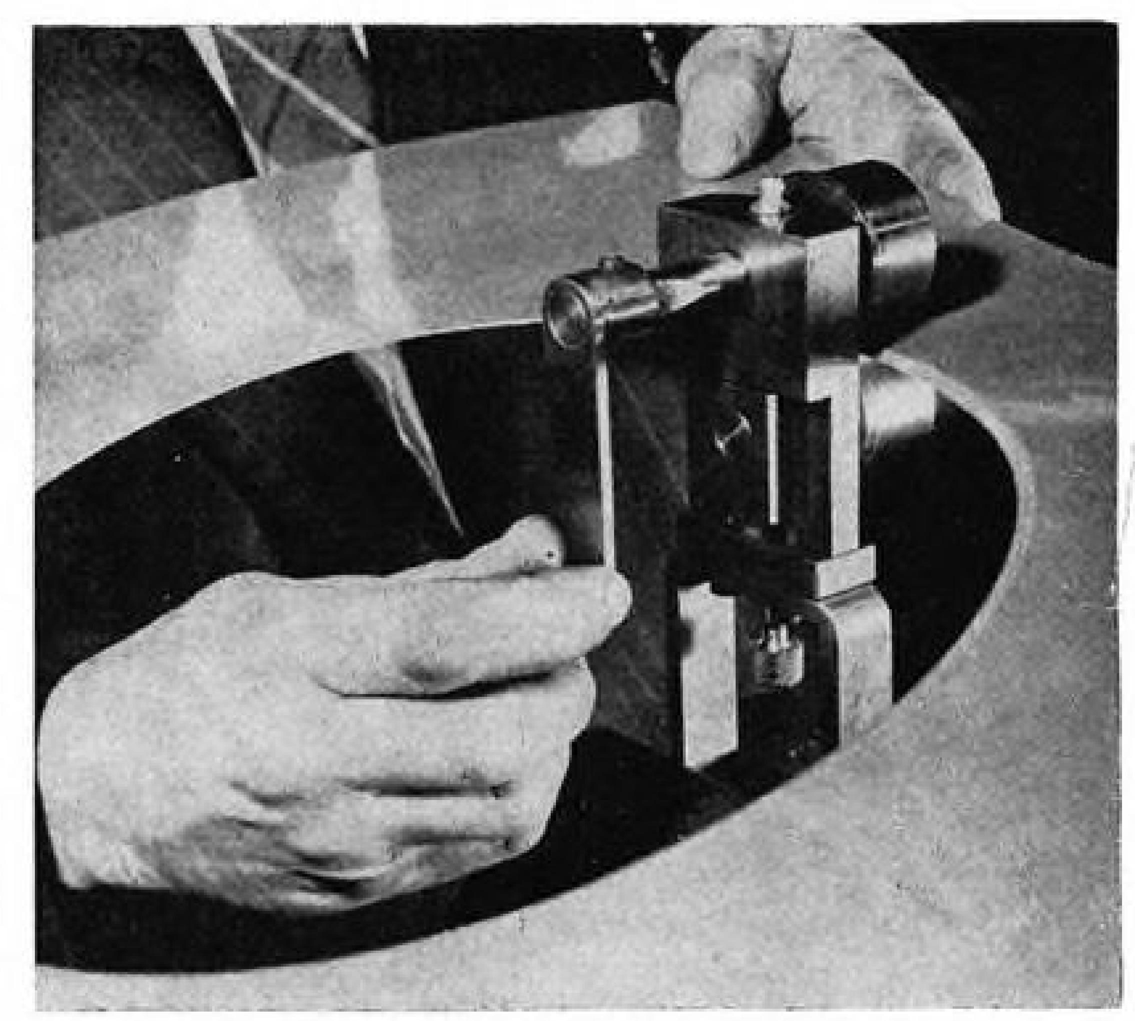
Most of previous methods required a tool looking somewhat like an oversize pliers which was literally pulled around edge of metal; and with no stationary guide, this did not always give satisfactory crimp. Also, procedure was dangerous, since tool could slip off with pulling force required and cut operator's arm. This hazard is entirely eliminated in new device.

The gadget will work equally well on straight-edged metal, sheets or pieces curved to any shape, or on inside of blanked-out holes.

Device consists of two round dies—one with projecting edge, other rounded to fit—held together by spring tension and an adjustable screw for fitting to various metal thicknesses.

Crank action pulls metal sheet between dies. Held firmly against guide, edge of metal is crimped to desired shape. Little effort is required, and time saved is at least half compared with usual hand tool for similar operation.

For bench work, tool may be clamped in a vise. And by substituting a wheel for handle (with little sacrifice in leverage), device also can be used on piece requiring crimping after it has been installed in craft, or a new crimp can be made on part without resorting to complete removal.



Rachet wheels may be installed so that there is no slipping, because, being small, and handling only thinner sheets of metal, gears will not unmesh sufficiently to become separated.

Compounding Aircraft Engines

By W. O. MECKLEY, *Aviation Div.*, and L. J. FISCHER, *Aircraft Gas Turbine Div.*,
General Electric Co.

A thought-provoking analysis of possibilities of increasing reciprocating engine powers and efficiencies—which indicates "up-and-down" engines shouldn't all be relegated to the boneyard.

THIS ARTICLE WILL DISCUSS some new possibilities of what a great many people nowadays are calling "those old fashioned up and down" reciprocating piston engines—those engines that have been and still are performing so efficiently and reliably on our military and commercial airplanes and which have been relegated by many to the graveyard in favor of the new forms of gas turbine types of power plants.

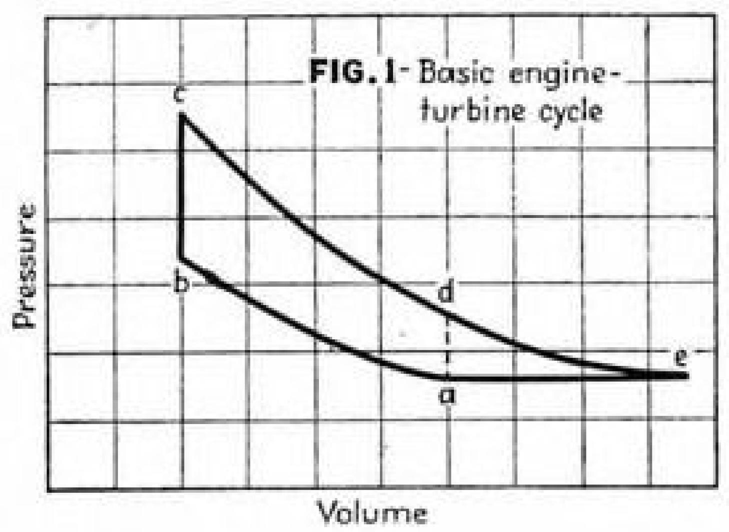


FIG. 1- Basic engine-turbine cycle

Important and extensive improvements in performance and utility will still be made with the piston engine by the addition of gas turbine elements that will keep this type of engine definitely in the running with its aircraft gas turbine competitor.

Compounding an exhaust gas turbine with a reciprocating piston engine has long presented intriguing possibilities. Just recently, development in this type of power plant has reached the stage where test data of various combinations of turbine and piston engines have been made available to check theoretical studies and to give assurance to the potentialities of compounding the piston engine. The general curves presented here have been prepared from analytical studies, but the relative magnitudes have been verified by test stand data.

In compounding, the piston engine may be thought of as being a topping unit for a gas turbine. To explain this simply, refer to Fig. 1 showing the familiar pressure-volume diagram. The engine acting through its compression, explosion, expansion cycle (a, b, and c) utilizes effectively its characteristic high-pressure, high-temperature operation, and expands exhaust gas to temperatures and pressures for which the turbine is well suited. The turbine in turn expands these exhaust gases from d to e, utilizing energy otherwise wasted.

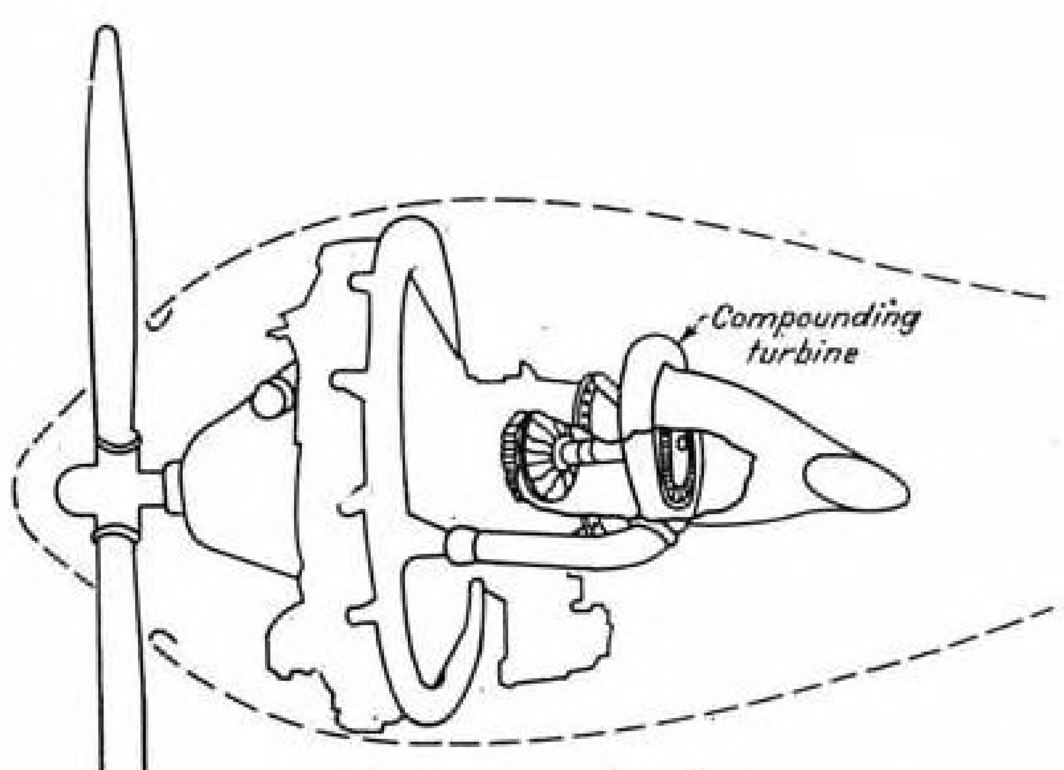


FIG. 2- Compound engine (Reciprocating engine with geared compounding turbine)

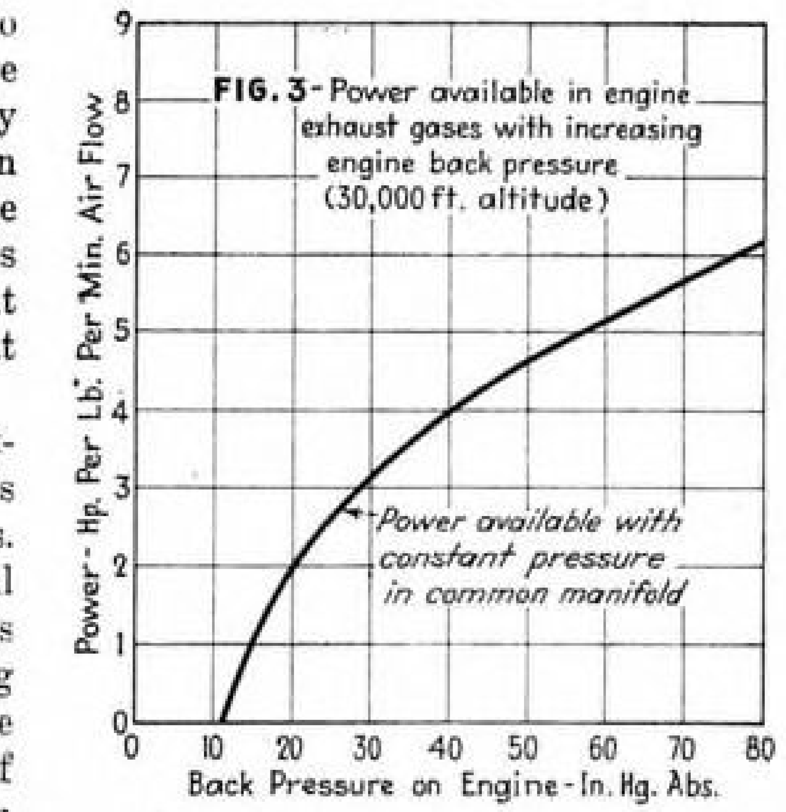
Utilizing the Power

This power available in the exhaust gases can be used through the turbine to drive electrical accessories, cabin superchargers or superchargers for the engine, as is done in the case of the turbosupercharger. The simplest and most direct way to utilize most completely this turbine power is to return it to the engine crankshaft. It is around this simple arrangement (shown in Fig. 2) that interest is centered now, and which will be covered here.

Three obstacles have prevented earlier use of this engine-turbine principle. First, effective compounding requires the use of engine pressures higher than have been thought practical by engine manufacturers. The continually increasing available horsepower with increasing engine back pressures can be seen by referring to Fig. 3. Adequate engine pressures have been approached in airplanes recently where turbosuperchargers have been used for high altitude operation; these lead the way for still higher pressures without fear of terrific development programs to keep engines running at these high back pressures.

Fig. 4 shows the trend in engine exhaust pressures over a period of years as encountered in military applications. It is expected that because of the real advantage in going to higher pressures with the addition of a compounding turbine that this trend will continue upward. Secondly, close coupling of the turbine to the engine results in hotter operating temperatures than the turbosupercharger has had to withstand, and materials which would withstand these temperatures have only recently become available. The most critical parts of the turbine, insofar as temperature and life are concerned, are the turbine wheel and turbine buckets.

Fig. 5 illustrates the relative improvements made in the life of the materials suitable for these parts over the past years. This curve was plotted for a constant exhaust gas temperature, but it is reasonable to assume that the improved materials will enable compounding turbine designs to operate at higher temperatures with satisfactory life. Finally, some added weight and complication results fom the fact that exhaust manifolds must be made stronger and tighter to hold exhaust gas leakage to a minimum at the higher pressures.



As noted from Fig. 3, increasing engine back pressure increases the available power in the exhaust gases. However, the bare engine power output tends to decrease with increasing back pressure. This power loss is small within a fairly wide range but increases rapidly at the higher pressures. This may be explained by considering that when the engine finishes the end of its expansion stroke the pressure in the cylinder is about 200-in. mercury absolute. The pressure ratio across the engine exhaust valve when it is opened, considering expansion to about 40-50 in. mercury absolute turbine inlet pressure, is consequently 4-5 to 1, well over the critical pressure ratio. The pressure downstream of the valve, therefore, has no effect on the rate of flow through the exhaust valve.

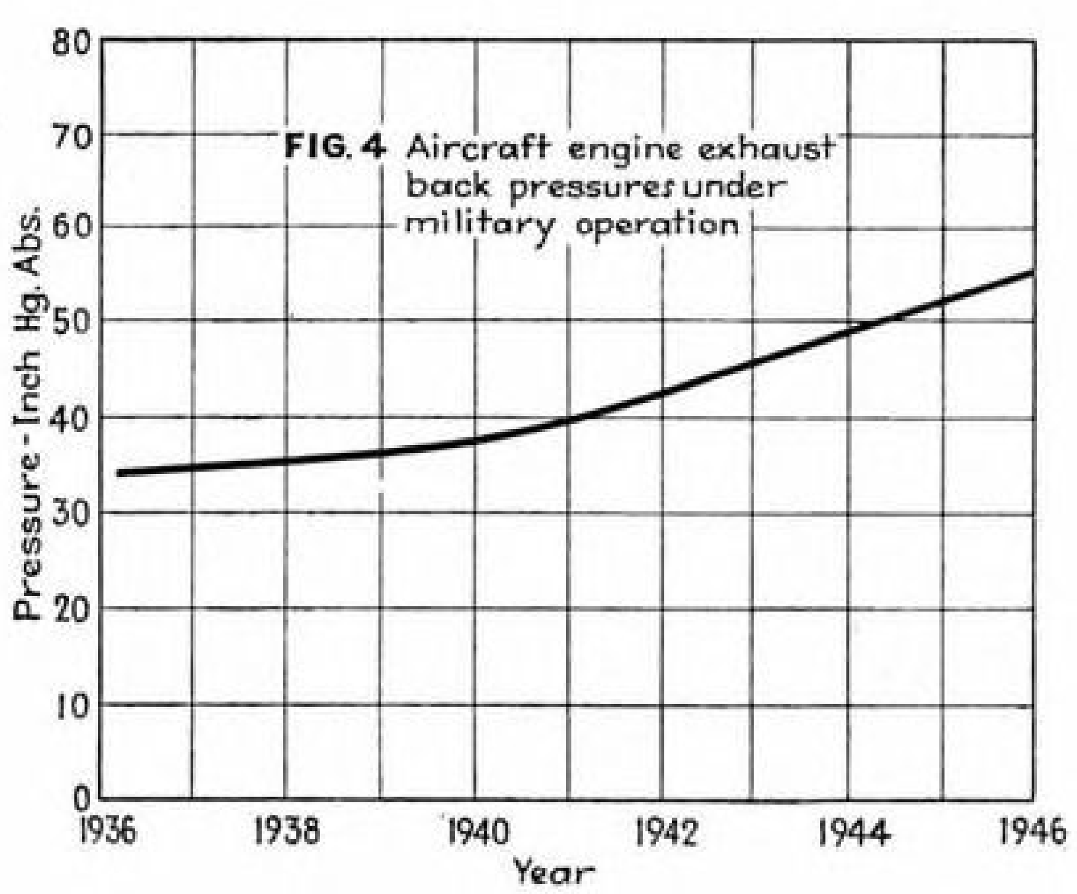
While slowing down this initial head of 200-in. mercury, the engine crankshaft is in the region of bottom dead center, and before the engine begins to expend work in pumping out the exhaust gases, more than 70% of the gases have escaped through the valve. The engine, therefore, pumps out one-quarter of the total flow utilized by the turbine, while three-quarters of the turbine flow is obtained at no cost in crankshaft power during the exhaust blow-down period. This fraction changes when back pressures increase closer to the critical pressure ratio across the exhaust valve and, therefore, more engine shaft power is used in supplying the turbine exhaust gas flow.

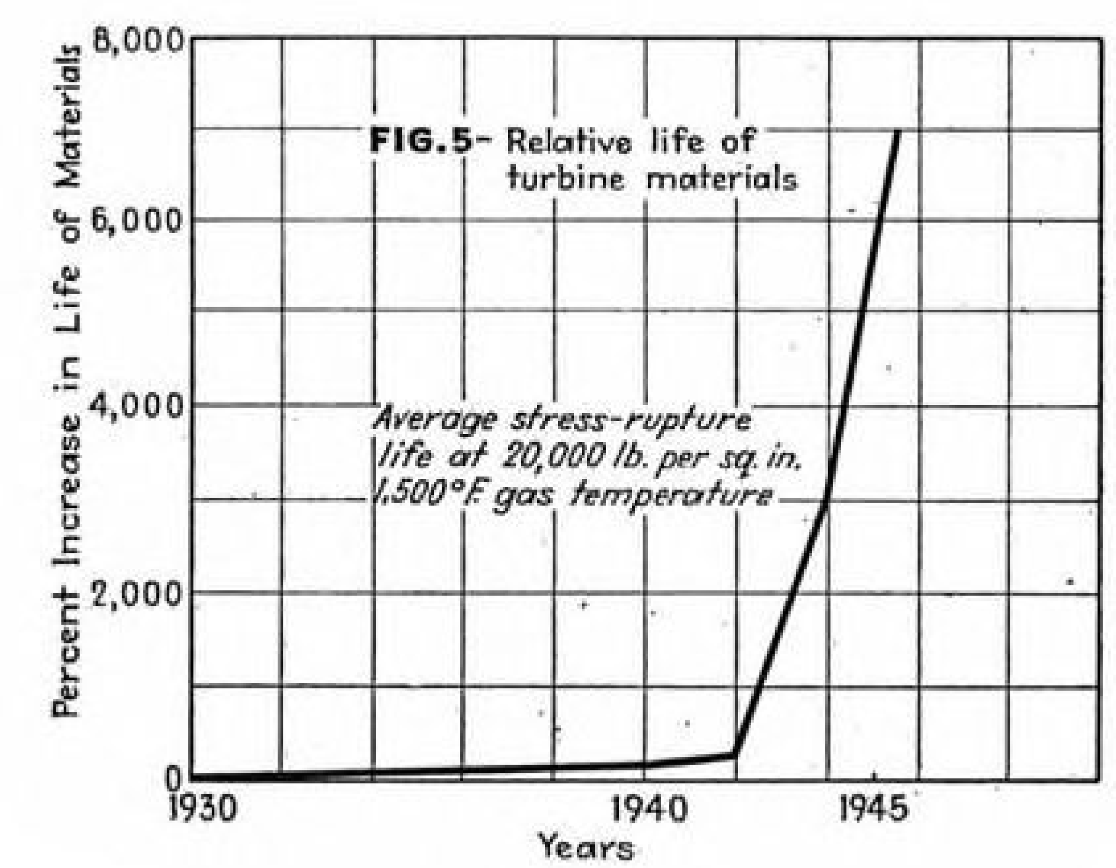
The net result is that up to optimum pressures the turbine has available a gas power that is four or five times as great as the crankshaft power taken to furnish the higher back pressures. With only 60 to 65% turbine efficiencies the turbine will recover two or three times the crankshaft power expended. With the higher turbine shaft efficiencies that now seem practical, this margin becomes even greater.

The turbine power returned to the engine in any installation can be increased by making the turbine nozzle area smaller. A decrease in this area causes an increase in the engine back pressure and thus some decrease in engine power as explained above. The turbine area is designed to give an optimum back pressure on the engine at which the sum of the turbine and engine power is a maximum or the engine specific fuel consumption is a minimum.

Fig. 6 shows the net horsepower, engine power, turbine power, and the required supercharger power of a typical compound engine plotted against the ratio of engine exhaust pressure to the inlet manifold pressure. This shows the balance of turbine power increase against brake engine power loss and illustrates the optimum back pressure in this case to be about 0.80. Consideration of valve overlap, spark setting, and cooling characteristics tends to shift this optimum point slightly, but detailed considerations of their effects will not be treated here.

The back pressure to inlet manifold pressure ratio for minimum specific fuel consumption is somewhat higher than that for maximum total shaft power output, and from Fig. 7 this optimum is seen to be about 1.0. This means that it pays for best cruising power fuel economy to operate with higher relative engine back pressures.





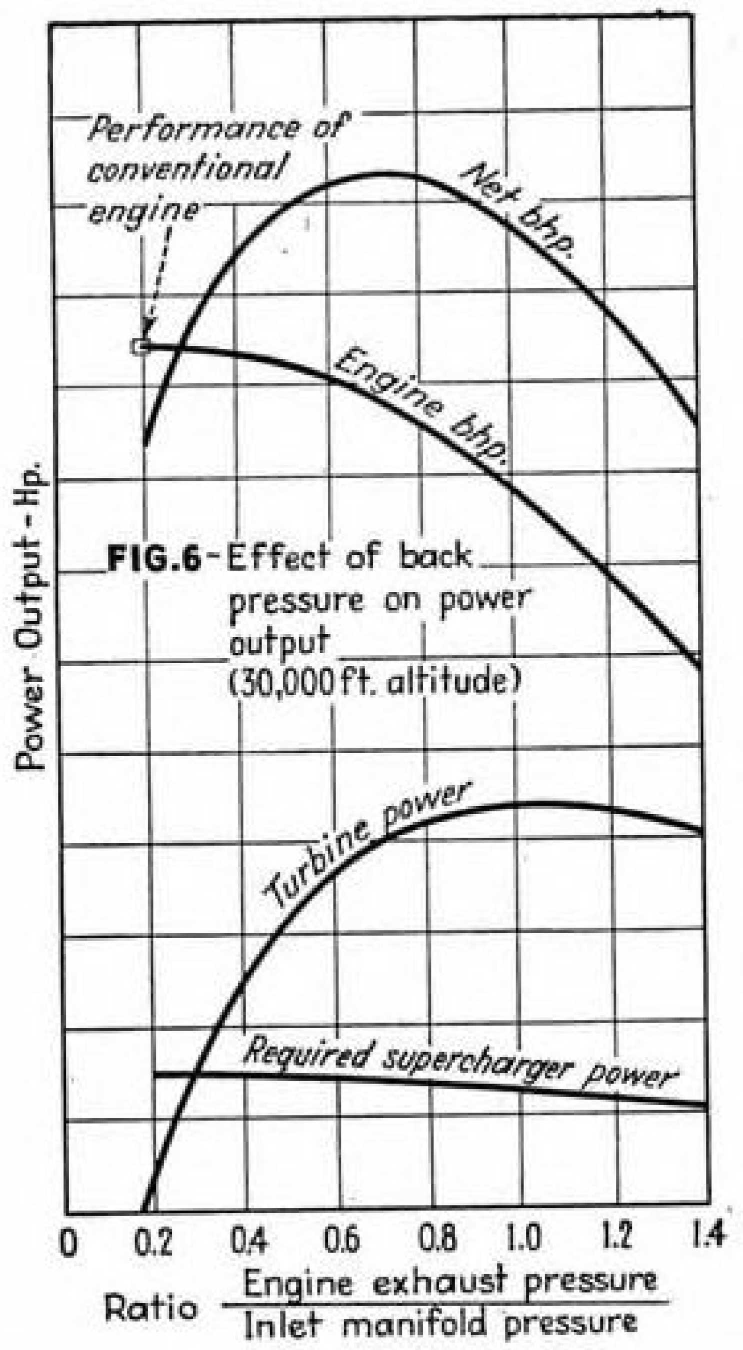


FIG. 6 - Effect of back pressure on power output (30,000 ft. altitude)

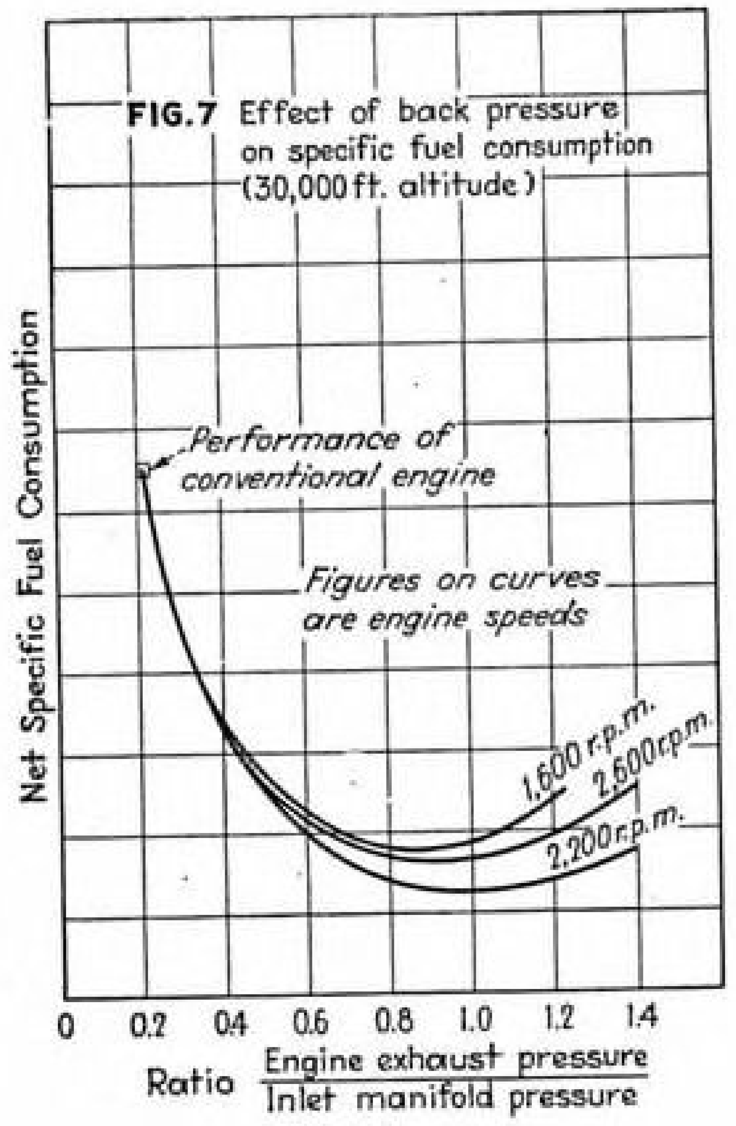


FIG. 7 Effect of back pressure on specific fuel consumption (30,000 ft. altitude)

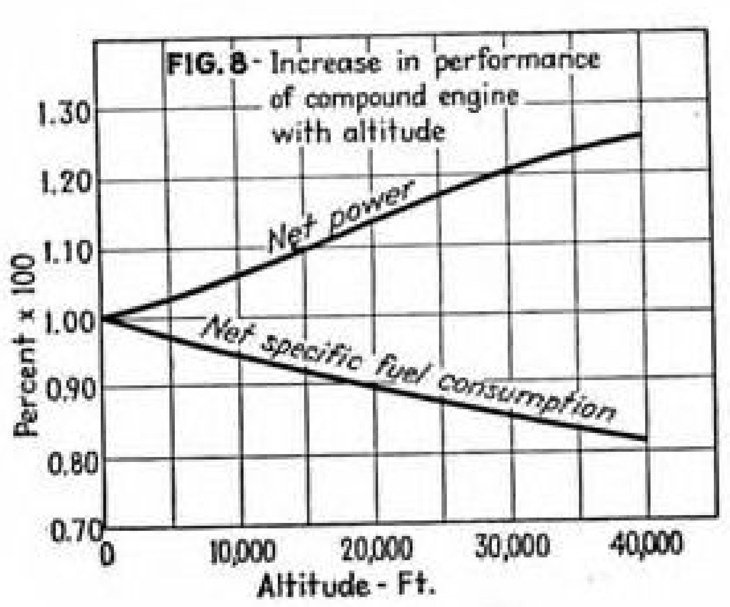


FIG. 8 - Increase in performance of compound engine with altitude

Fig. 7 brings out an important characteristic of the compound engine which makes it different from the conventional reciprocating engine. This difference is seen in the location of minimum specific fuel consumption on the engine operating curve in the compound engine at the high end of the engine cruising power range (or at high engine speeds) instead of at the low end as in the conventional engine. Formerly, engine friction was the determining factor in locating the minimum specific fuel consumption point, but in the compound engine the turbine which favors high power and high engine speed is of greater influence in determining optimum operation than engine friction. This factor makes it unprofitable to operate the engine much below maximum cruising power, which helps propeller performance by enabling operation of the propeller at a peak efficiency, coinciding with the engine's lowest specific fuel consumption. This is not the case on a conventional engine where the propeller speed has to be reduced markedly from its optimum to coincide with engine friction. In this respect the compound engine very closely resembles the propeller drive gas turbine.

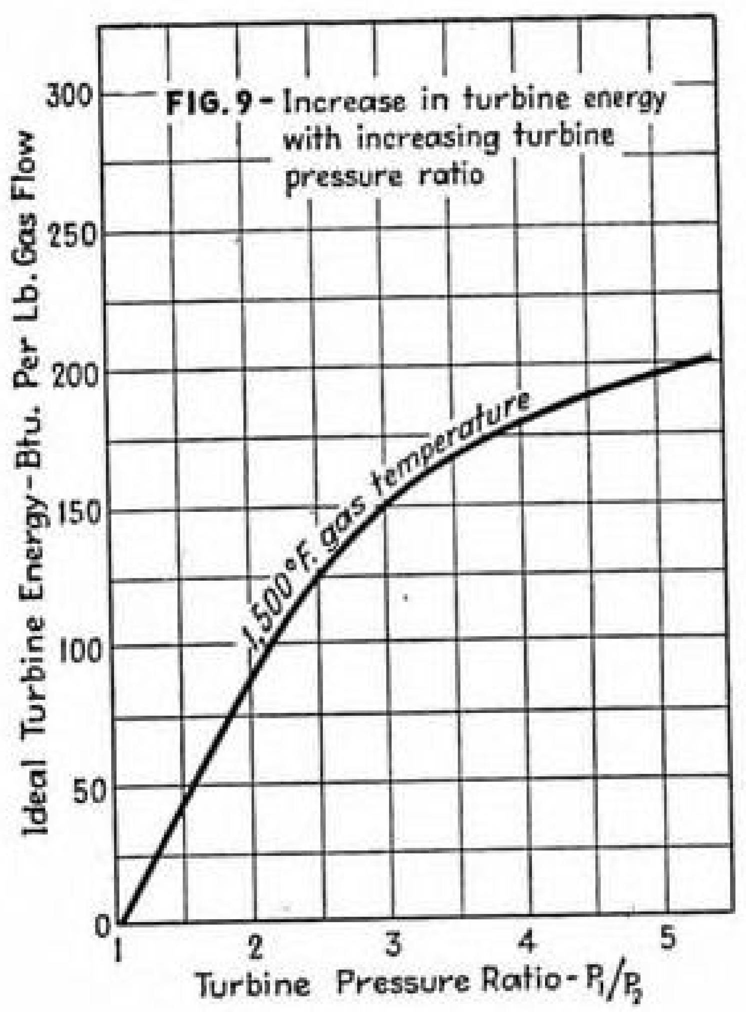


FIG. 9 - Increase in turbine energy with increasing turbine pressure ratio

The effect of altitude operation on compound engine performance is extremely favorable. Fig. 8 shows what may be expected with a compound engine equipped with suitable superchargers to hold basic engine ratings constant to 30,000 ft. The gas turbine cycle uses pressure ratio from turbine inlet to discharge with a profit, as seen in Fig. 9. The continual decrease in altitude pressure increases the turbine pressure ratio, and thus increases the turbine power returned to the engine crankshaft and improves the specific fuel consumption.

Fig. 10 compares the specific thrust in the ratio of lb. thrust/lb. engine wt. of the conventional engine and compound engine. The marked improvement in the compound engine is self evident. Specific thrust is an important evaluation of takeoff and climb performance, and it cannot be neglected when overall airplane performance is considered.

In summary, it is believed by the authors that the reciprocating aircraft engine is on the threshold of an important new development— a development which will provide enough margin in performance to keep the pure gas turbine from completely capturing the engine aircraft propulsion field, and which will supplant the aircraft gas turbine in certain types of aircraft.

The general data presented here represents what is obtainable with equipment and experience available. It should be emphasized that this picture is by no means the ultimate to which the compound engine can progress. It is more nearly true that reciprocating engine practice has just recently reached a pressure level that enables compounding to become practicable. As manifold and peak cylinder pressures continue to rise, compounding will magnify at a greater rate the gains in thermal efficiency and specific thrust that the bare engine experiences.

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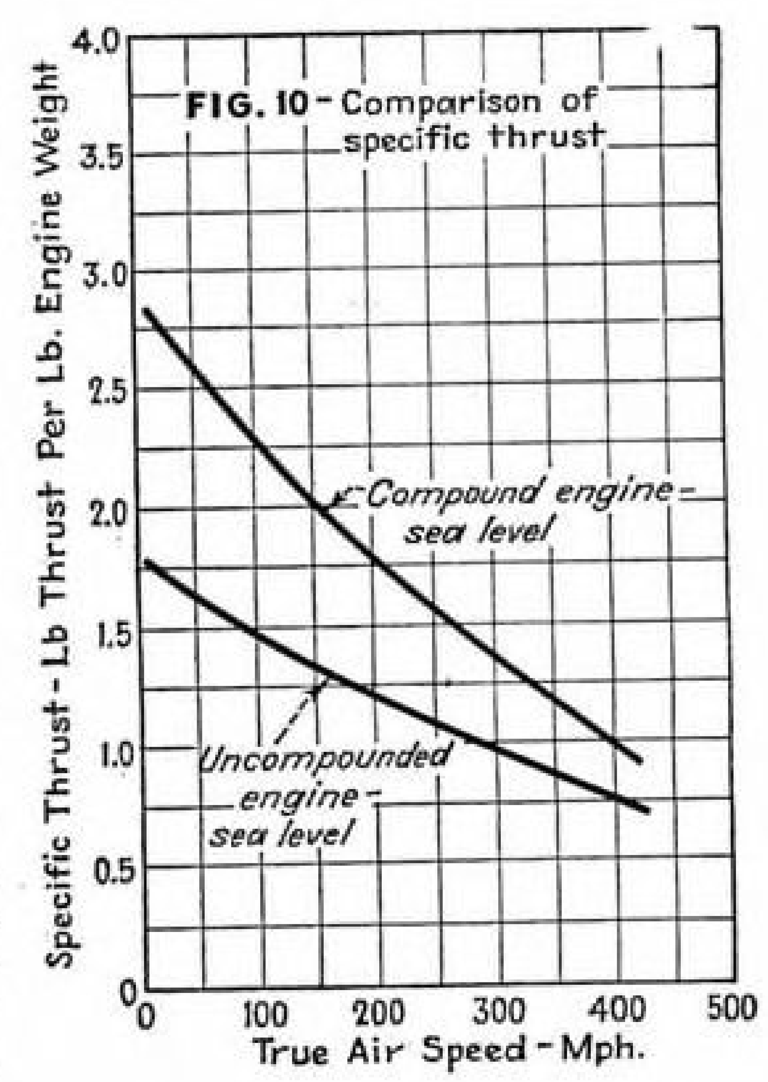
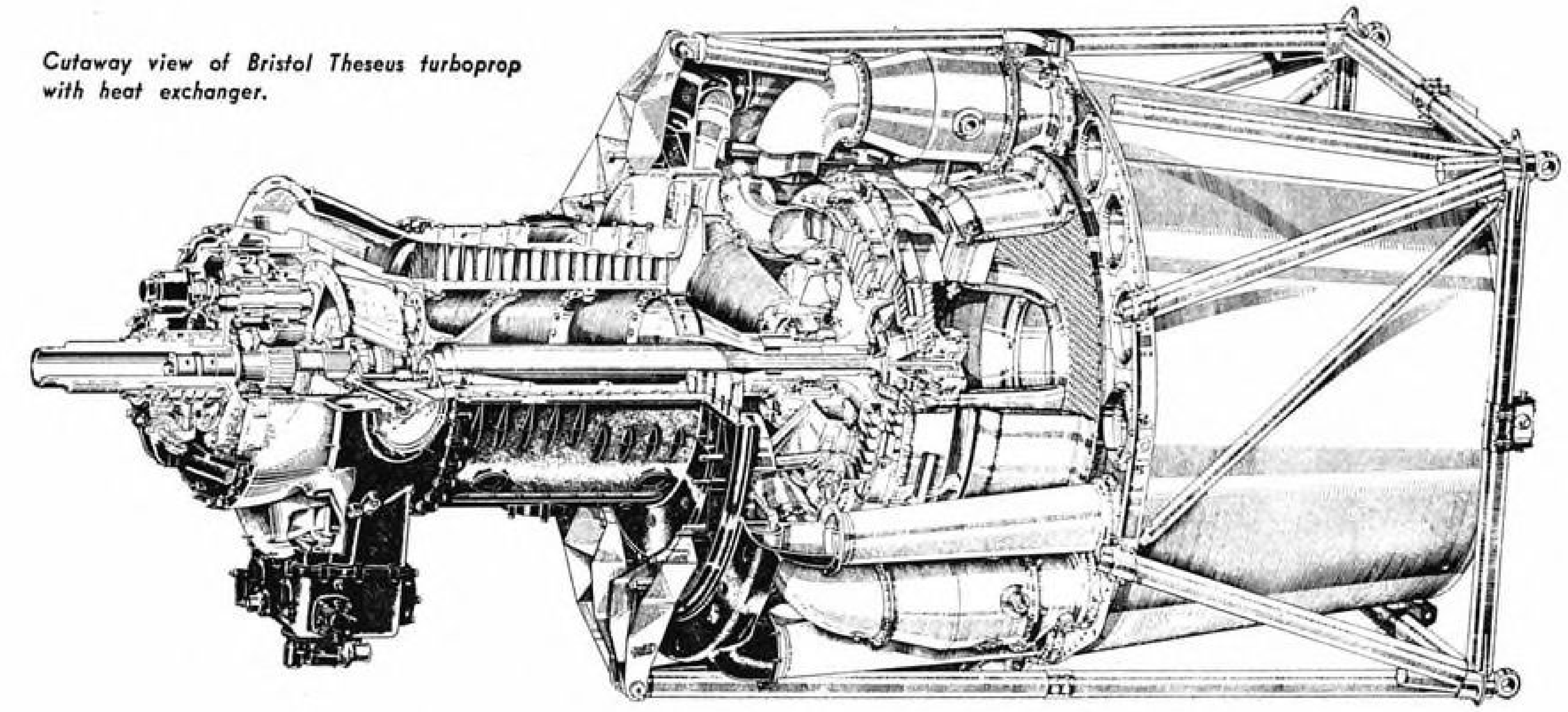


FIG. 10 - Comparison of specific thrust

Design Details Of Bristol Theseus Turboprop

Cutaway view of Bristol Theseus turboprop with heat exchanger.



Use of heat exchanger—said to be first in the aircraft field—brings fuel consumption comparable to reciprocating engines in gas turbine unit created specifically for medium-speed long-range transports.

Developed especially for long-range transport craft of 300-400-mph. speeds, the Bristol Theseus 1 turboprop is a combination nine-stage axial and single-stage centrifugal compressor unit, said to be the first aircraft application utilizing a heat exchanger.

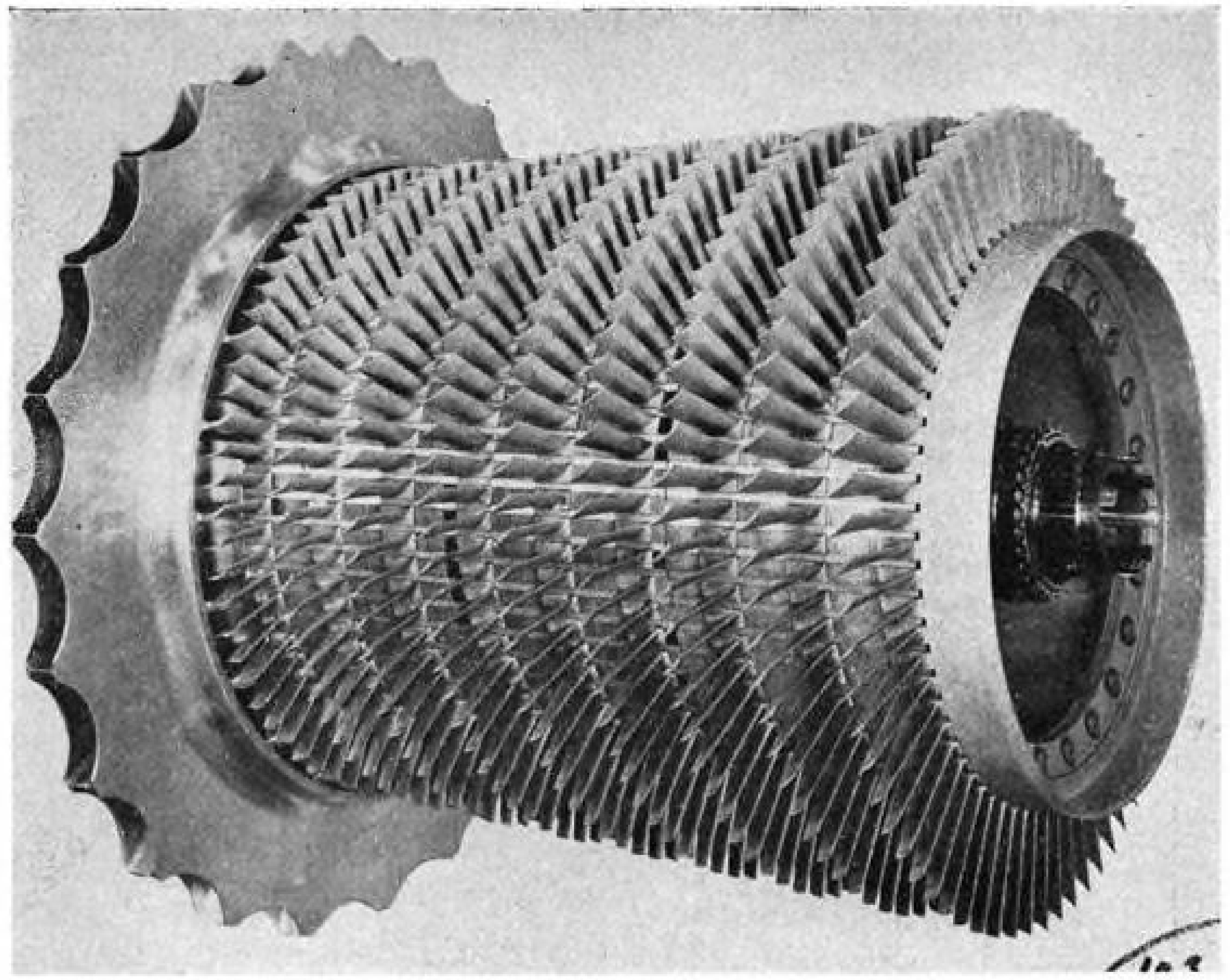
The design target was a unit which would give fuel consumption comparable to that of a piston engine at 300 mph. at 20,000 ft., but one in which stresses had been kept low enough to insure long service between overhauls.

Briefly, the airflow is as follows: First through the axial compressor and then through the centrifugal unit—resulting in overall compression ratio of about 5:1 at 20,000 ft.—then through the heat exchanger, in which temperatures are raised by exhaust gases; through the combustion chambers to a two-stage turbine driving the compressor; through an independently mounted single-stage turbine driving the propeller; and finally through the hot side of the heat exchanger to the exhaust nozzle.

Approximately 80% of the available power is used to drive the propeller at 300 mph. "Speeds of the two turbines," according to the manufacturer, "are maintained at a constant ratio by means of an ingenious mechanism which controls the pitch of the propeller blades."

Two prime reasons dictated use of both axial and centrifugal compressors: First, the centrifugal unit is an efficient means of getting the air from the small diameter of the axial unit to the diameter necessary for the heat exchanger; second, the producers feel that "although the axial compressor can be made to operate more efficiently at higher compression ratios than the centrifugal type, the latter has a wider operating range."

Air enters the unit through an annular intake just behind the propeller. The intake casing is an aluminum alloy casting having inner and outer shells connected by eight hollow vanes. The inner shell contains propeller reduction gear and accessory drive casing, with drive shafts extending laterally to the starter motor (mounted outside the outer shell) and downward



Nine-stage axial flow compressor is used in conjunction with centrifugal unit to give overall compression of approximately 5:1.

to the oil pump and sump, also mounted on the outer shell.

Aluminum alloy compressor casing is cast in halves bolted axially and supporting the intake casing through bolts in flanges. The axial section, and part of the centrifugal section, of the compressor casing is double skinned to relieve the portions of the compressor carrying stator blades from propeller load stresses. The aft portion of the compressor casing forms the front face of the centrifugal impeller chamber and, with the delivery manifold and rear casing, forms the centrifugal stage.

The aluminum forging axial compressor is drum construction, made up of three identical sections to simplify production and assembly. It is bolted to two conical steel shafts, the front one being carried by a roller bearing, the rear by a ball bearing which also supports the compressor turbine. Each compressor stage has 69 blades, made of aluminum stampings attached to the rotor drum by axial serrated slots. The centrifugal compressor is machined from a solid aluminum forging bolted to the axial rotor drum. It has 23 straight radial vanes, and is double shrouded.

At full throttle the compressor runs at 8,200 rpm., delivering 30 lb./sec. air at static sea level conditions, and requiring approximately 3,500 hp.

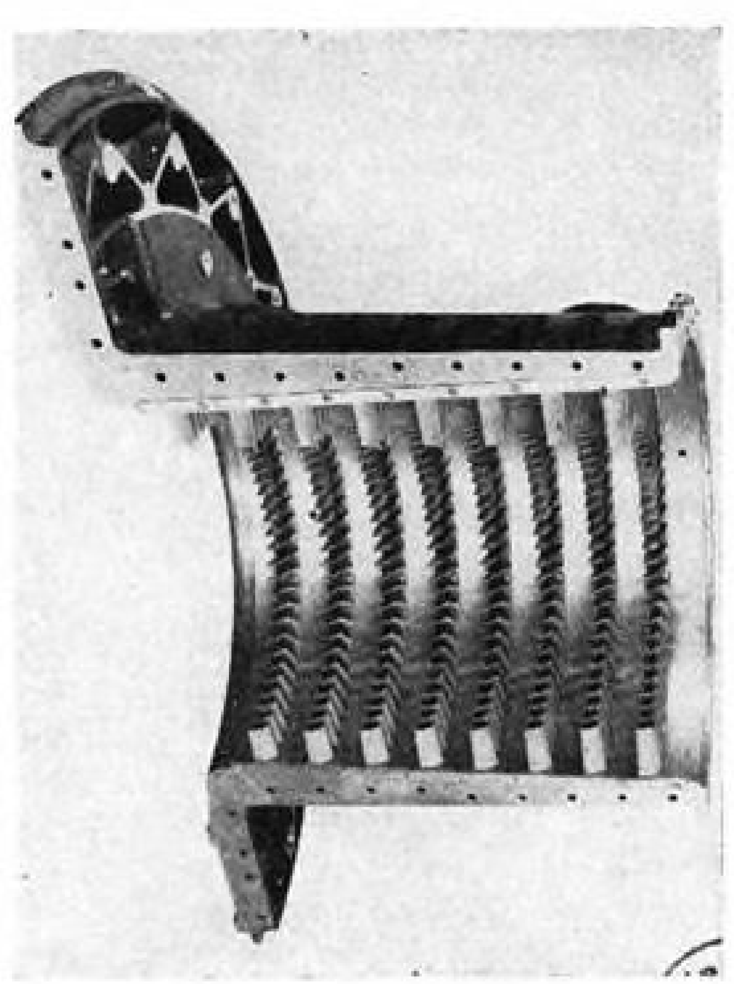
The delivery manifold is a one-piece magnesium casting in which the compressed air is sent to the two-piece magnesium casting diffuser vane ring, which passes the air to the cold side of the heat exchanger through eight transfer pipes spaced around the engine between combustion chambers.

Of matrix construction, the heat exchanger consists of hundreds of straight tubes set axially to offer the least resistance to passage of the hot gases. These tubes are arranged in 16 sets—8 outlet and 8 inlet, each group being separated by headers. Going through the exchanger the air is first headed radially inward, then reversed to the outlet headers.

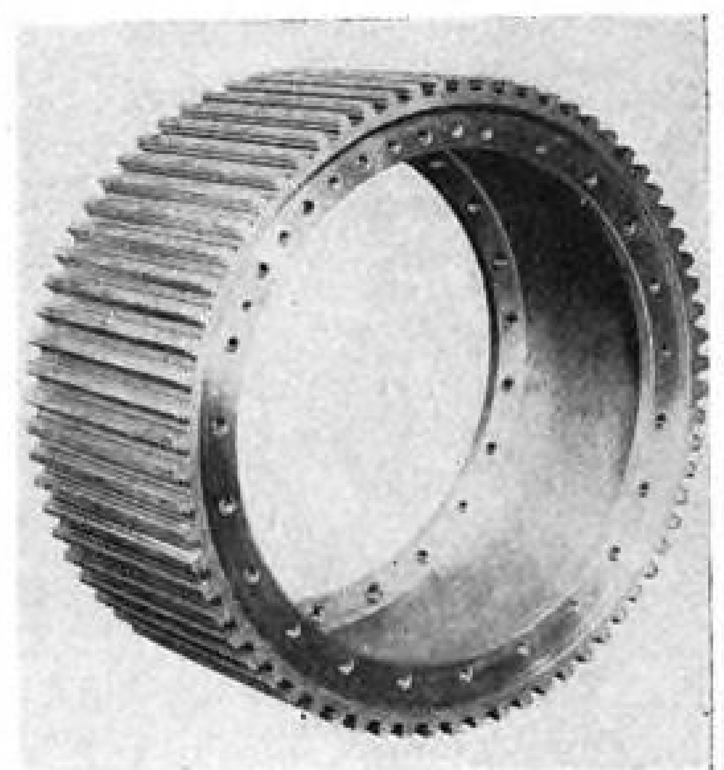
Weight of the heat exchangers is given as approximately 500 lb. The unit "requires some several hours flying in order to save its own weight in fuel, and this factor makes the heat exchanger version of the Theseus essentially a long-range power plant," according to Bristol reports. "This does not mean, however, that it cannot also be used on shorter journeys, since the heat exchanger can be omitted, resulting in a power plant having a slightly increased fuel consumption but with a considerably decreased weight. The fuel consumption even without the heat exchanger is very much less than that of contemporary jet engines and still of the same order as for reciprocating engines of similar power."

Sheet metal combustion chambers are of standard design, and provision is made for entry of cooling air to keep temperatures down.

From the combustion chambers the hot gases are delivered to the 48 first-stage nozz!·s through a tangential delivery manifold to the two-stage compressor and accessory turbine. The compressor turbine has a single wheel, the two sets of blades being mounted on a rim shoulder by Christmas tree serrated slots. The turbine disk is of forged heat-resistant steel with an integrally-forged hollow hub which is splined to transmit power to the compressor shaft. Blades are forged from precision castings.



Compressor casing is built in halves which bolt together longitudinally. Note how downstream end flares out to form front face of centrifugal compressor casing.



To simplify production and assembly, Bristol Theseus axial compressor rotor drum is built in three identical sections (one of which is shown here) bolted together. Compressor blades are attached by Christmas-tree type serrations (clearly shown in photo).

From the compressor turbine, the hot gases go through a third row of stator blades—also forged from precision castings—to the single-stage propeller-driving turbine, which has a maximum speed of 9,000 rpm. The disk is a Stayblade forging with an integrally-forged stub shaft going to the rear bearing. The propeller drive shaft bolts directly to the front face of the disk, and extends upstream through the compressor turbine and inside the compressor drum to the 8.4:1 epicyclic reduction gear.

Theseus compressor turbine is two-stage unit with both stages of blades attached to same disk on rim at shoulder. This compressor runs completely independently of propeller driving compressor.

The turbine casing is made up of three castings, the third stage casing also providing support for the propeller turbine's rear bearing through eight radial vanes similar to that in the intake casing.

The Theseus has six main bearings: Two carrying the compressor assembly; two for the propeller shaft; and two for the propeller turbine and its drive shaft. The rear compressor and rear turbine bearings are single-row ball units which also absorb thrust. The rear compressor bearing also absorbs some thrust, but not a great deal since the compressor and turbine thrusts are balanced as closely as possible.

Specifications and Data include:

Length .... 106 in.
Diameter .... 48 in.
Dry wt. .... 2,130 lb.
Propeller speed (max. power) 1,070 rpm.
Power: Static, sea level
1,950 bhp. + 500 lb. jet thrust
300 mph., sea level...2,300 equiv. bhp.*
300 mph., 20,000 ft...1,500 equiv. bhp.
Fuel cons., max. power, SL
0.57 lb./equiv. bhp./hr.
max power, 300 mph., 20,000 ft.
0.50 lb./equiv. bhp./hr.

* Equivalent bhp. defined as propeller shaft hp. + jet hp./propeller efficiency.

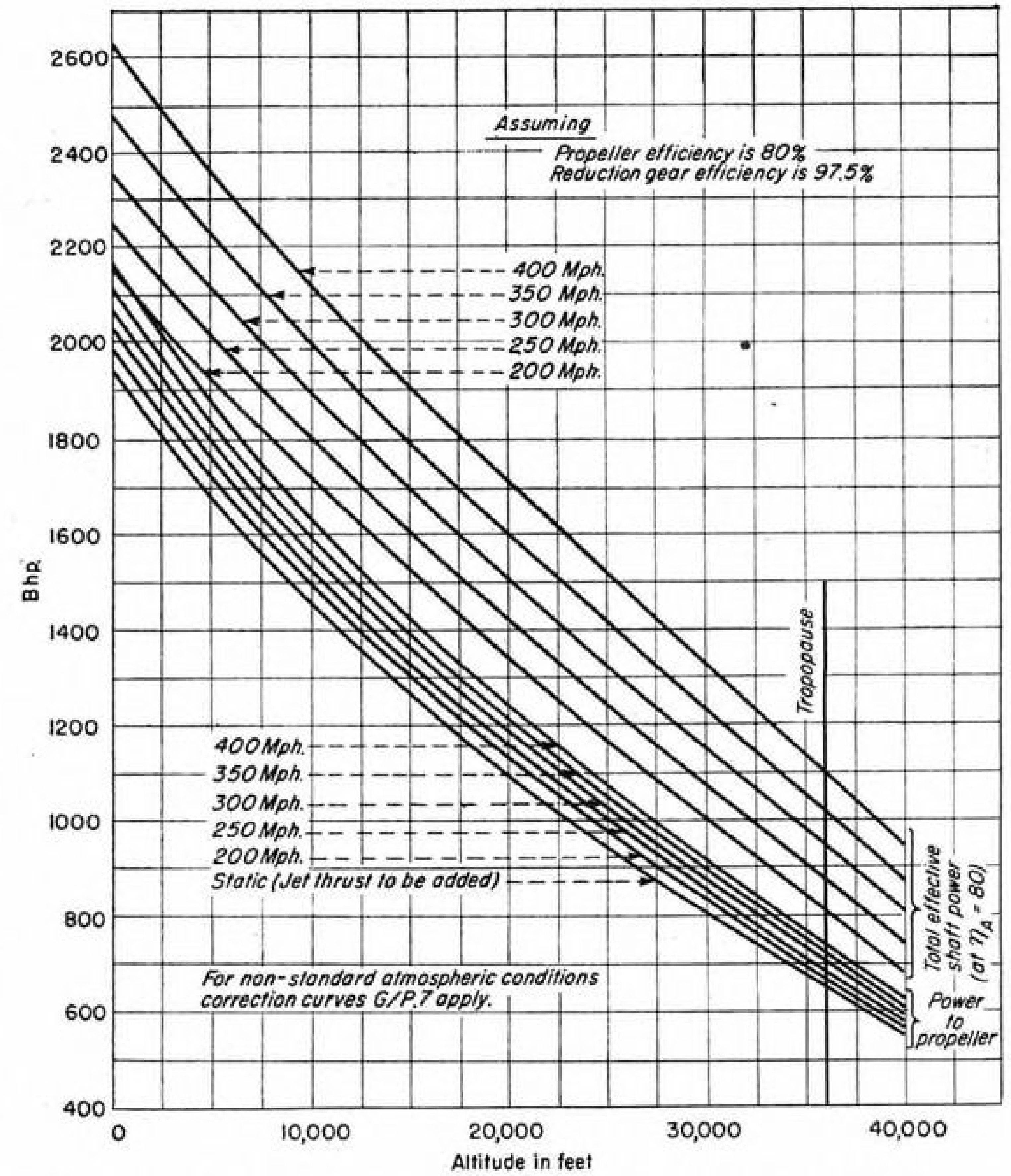
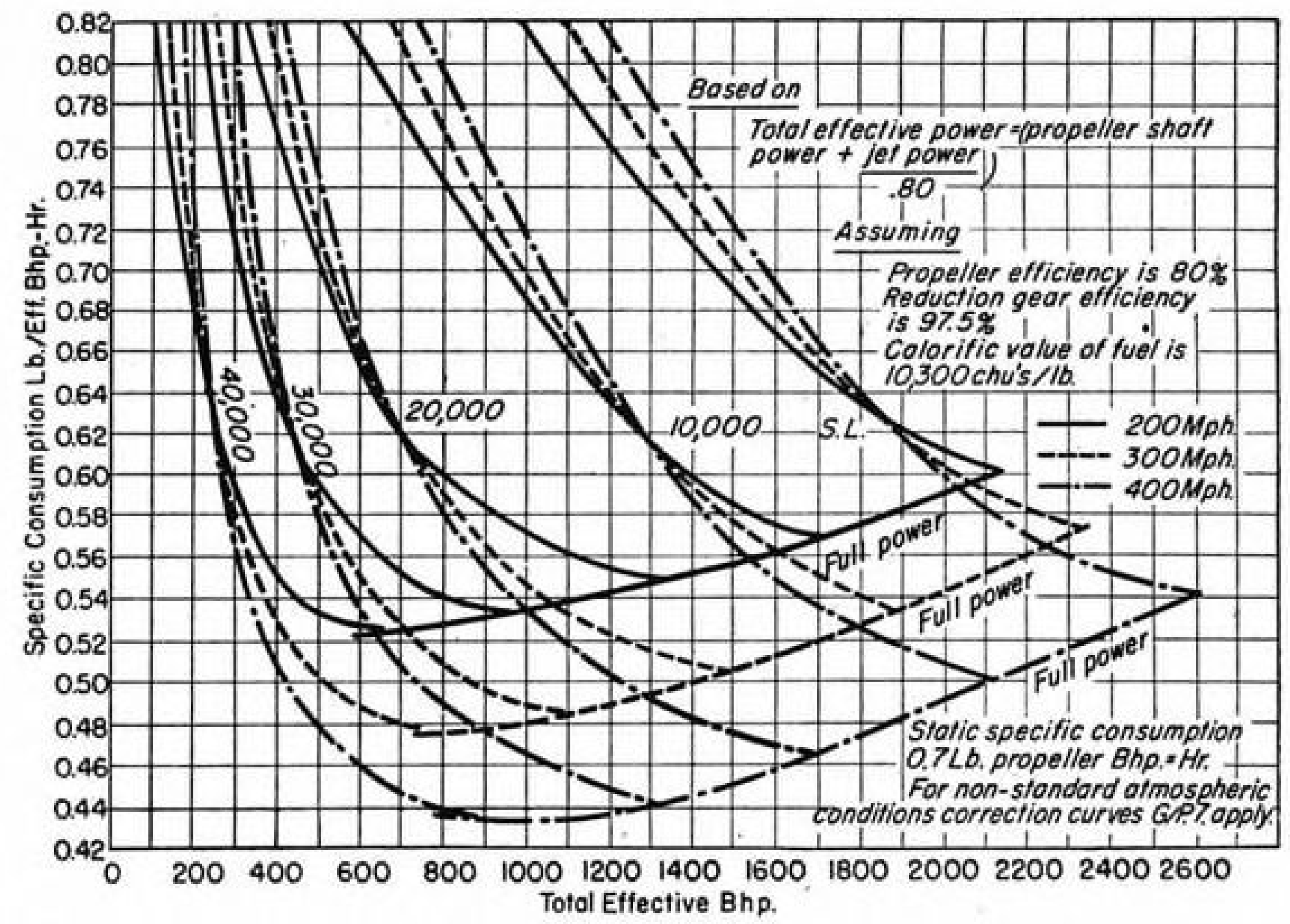
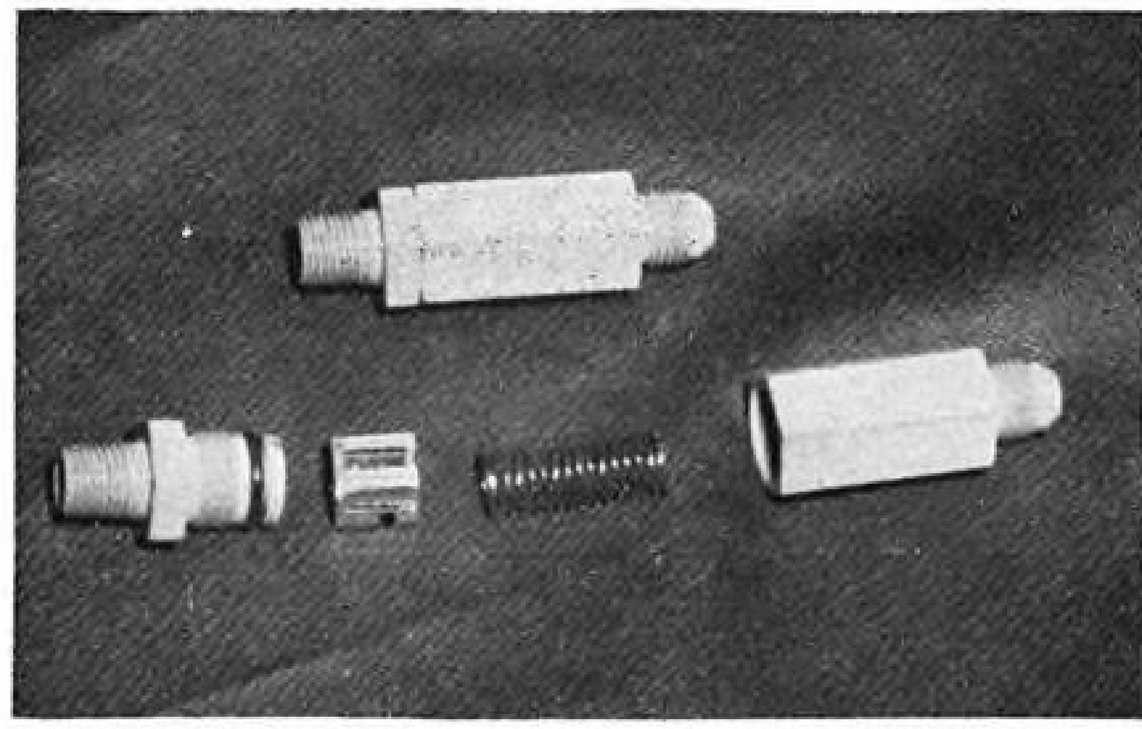


Chart showing preliminary calculations of propeller power and total effective power vs. altitude under ICAN conditions.

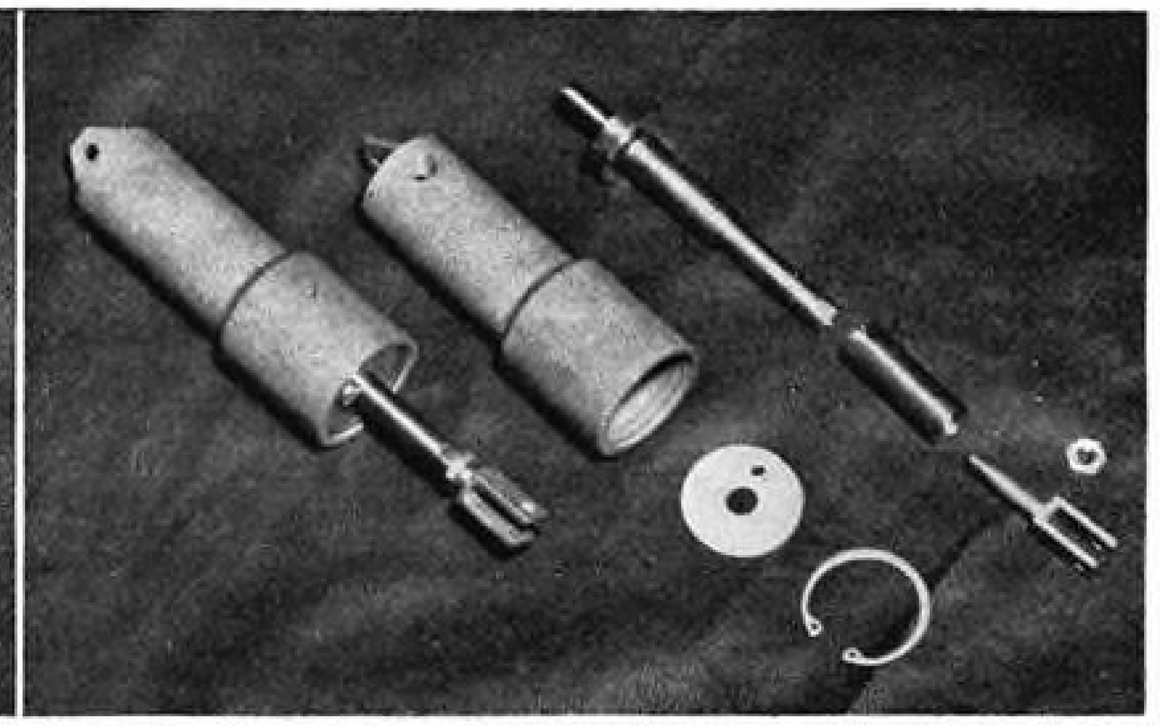


Preliminary calculations showing Bristol Theseus turboprop fuel consumption under ICAN conditions.



10 Min.

Electrol fuel line check valve contains six parts and requires but 10 min. machine time. Two O rings and spring are purchased parts, others are machined from standard bar stock. Assembly is simply a bench operation requiring no jigs or fixtures.



26 Min.

Master brake cylinder is shown assembled (left); components exploded (right). Cylinder reservoir is a drop forging requiring only simple machining; other parts require only simple turning or stamping operations. Unit is completed in 21 operations in 26 min.

CARVING COSTS IN HYDRAULICS PRODUCTION

How Electrol went back to basic design for simplified manufacturing and maintenance—and countered the trend of rising costs.

Fred Mall, assembly department foreman, is responsible for production time.

LIKE MARK TWAIN'S famous remark about the weather, everybody talks about the need for design and production engineers working together, but nobody seems to do anything about it.

In the case of Electrol hydraulic units being built for Republic's Seabee, however, something *has* been done. Result: Completely new units which, in some cases, cost only 25% as much as they would have by following conventional practices. The savings accruing to the ultimate consumer do not necessarily end with initial cost, though—for ease of service and maintenance have been as important design considerations as have production costs.

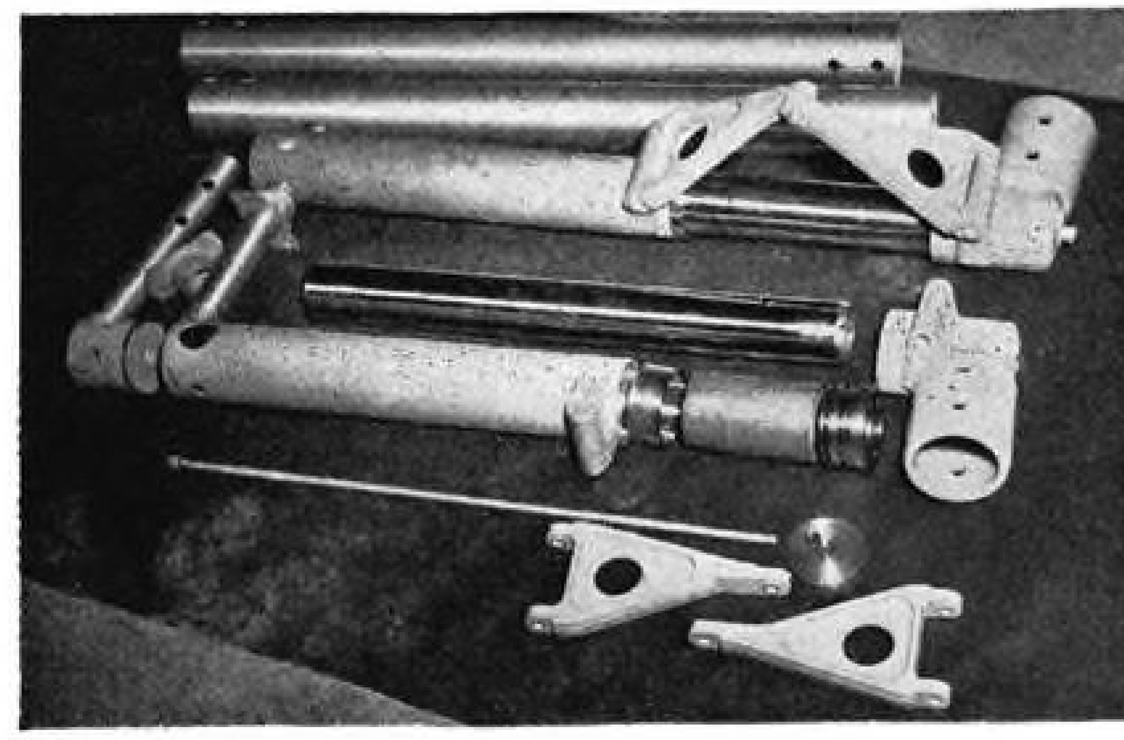
This philosophy of having design and production work closely together starts right with the plant layout—the experimental shop is adjacent to the engineering department. And the design engineer follows each of his new designs through every step of fabrication, working right with the production department. Once a unit has "gone through the mill" and is in production, a sample goes on the shelf alongside the designer's handbooks to serve as a constant reminder when he starts work on a similar project.

A further step—and a highly important one—is the use wherever possible of standard parts and stock sizes. For example in the Seabee landing gear, flap, and tail wheel actuating cylinders, approximately 80% of the tubing used is of stock size.

In every possible case, parts are designed for machining without the use of costly jigs and fixtures. When such fixtures are necessary, however, they are built in Electrol's own shop.

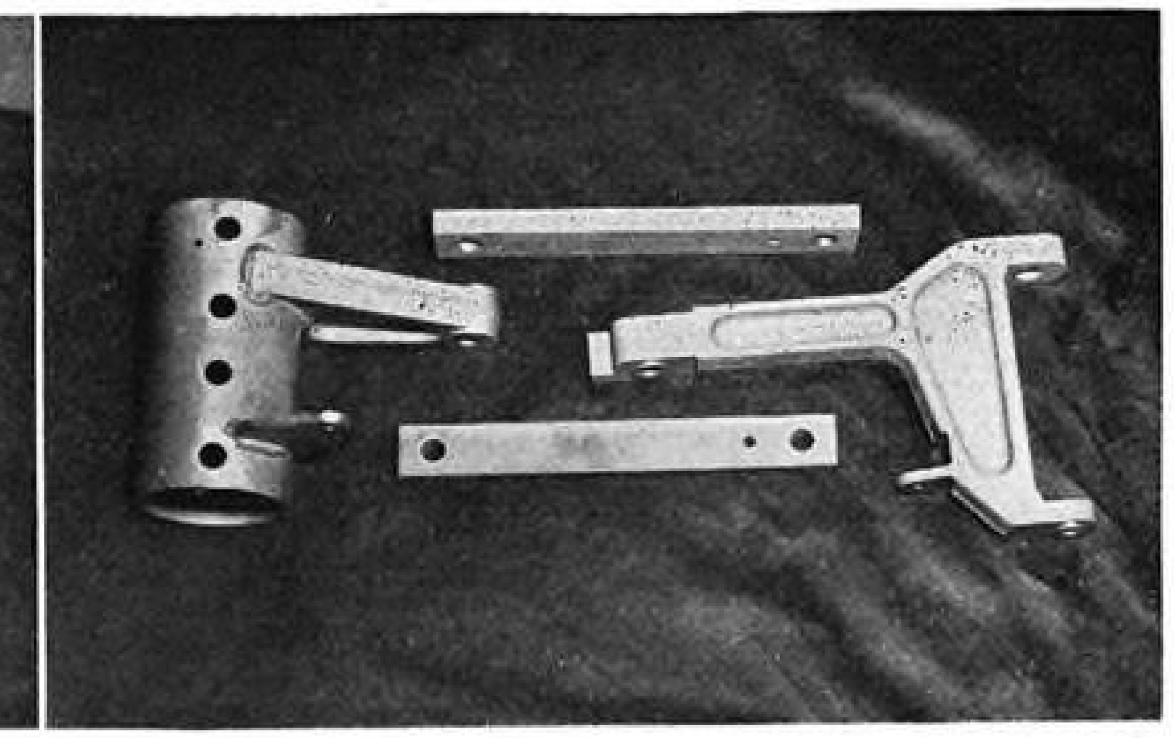
Assembly time on the Seabee units has been kept to a minimum by elimination of as many bolts as possible. In the landing gear, tail wheel, and flap actuating cylinders, for example, there are none; while the Powerpak—comprising reservoir, pump, and selector valves—contains only three bolts in a total of 154 parts.

Some of the results of designing-with-production are shown in the accompanying table, which gives the time and operation on the various parts.



5 Hr. 24 Min.

Main landing gear (without retracting cylinder or gear) has 168 parts for two sides, is completed in 108 operations in 5 hr. 24 min. machine time. Forgings are used where necessary to fit the particular installation, otherwise standard bar and tube stock is used. Resultant unit cost savings are reported to be very high.



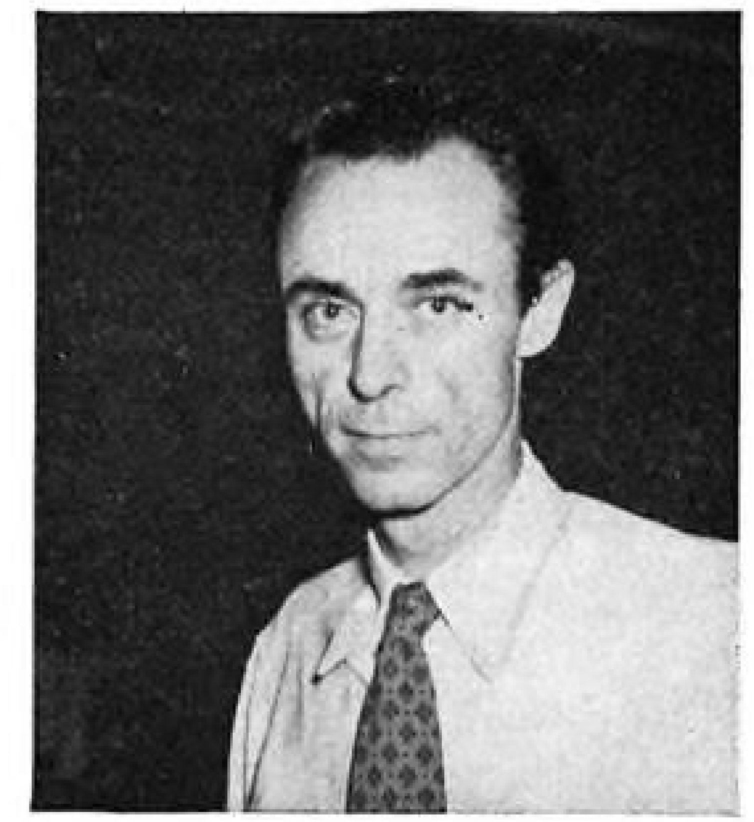
51 Min.

Electrol-designed Seabee landing gear retracting unit has 31 parts, of which 17 are shop-made, time required for 23 operations being 51 min. Unit at left comprises standard tubing with forging and stamping welded on; center units are of standard bar stock; forging at right—like other units in photo—has interchangeable bushings.

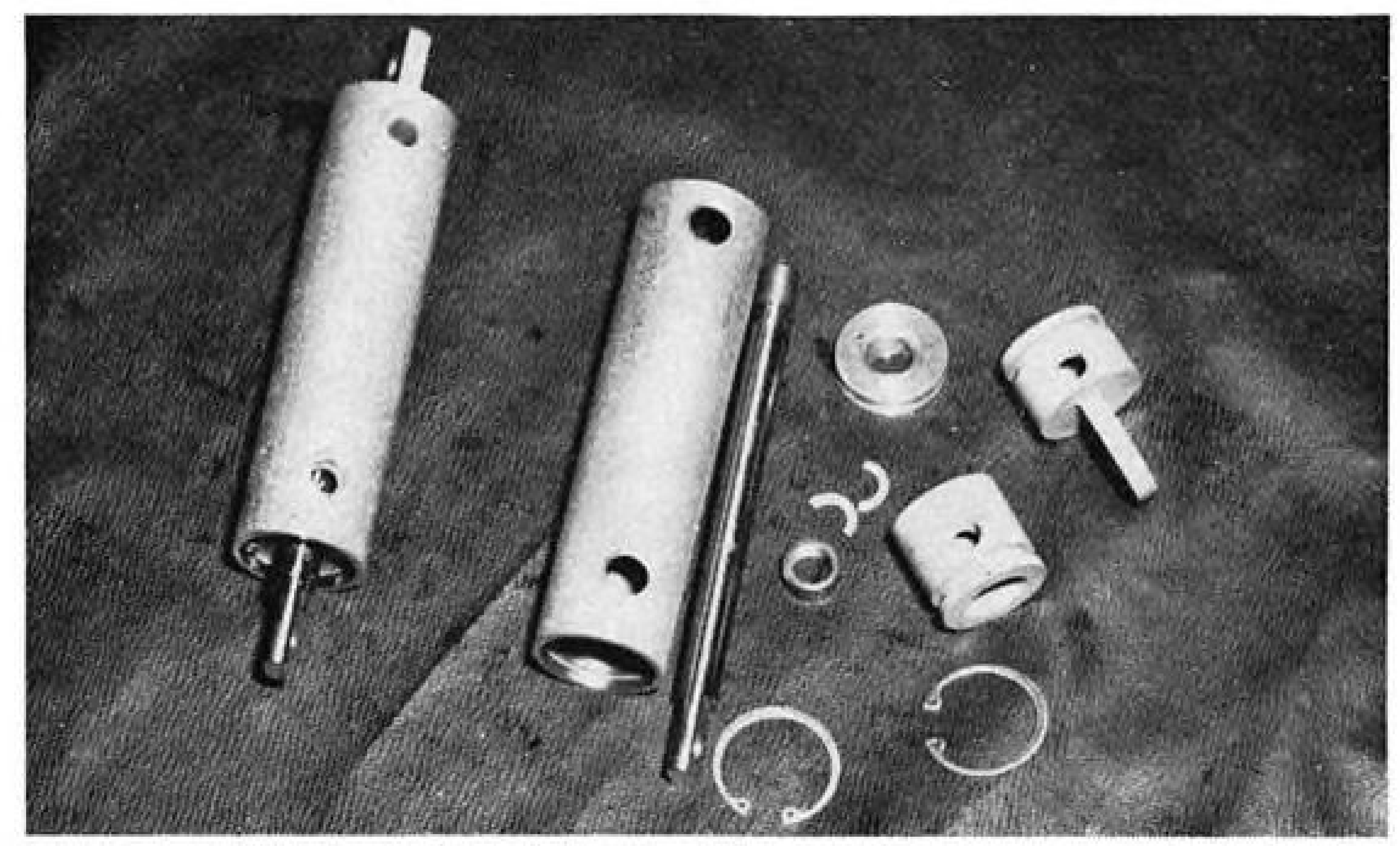
Time and Operations on Parts

Assembled Part	No. Parts Purchased	No. Parts Made	Total Parts	Machine Oper'ns	Assembly Oper'ns	Test Oper.	Total Oper.	Total Time Hr./Min.
Check valve	3	3	6*	9	1	1	11	0/10.2
Brake on-off valve	5	4	9*	8	1	1	10	0/23
Brake master cyl.	10	7	17*	19	1	1	21	0/26
Flap cylinder......	9	9	18*	24	1	1	26	0/41
Tailwheel cylinder	9	9	18*	24	1	1	26	0/41
L. G. retracting cyl.	9	12	21*	22	1	1	24	1/01
Landing gear, R.H.	52	32	84	52	1*	1*	54	2/42
Landing gear, L.H.	52	32	84	52	1	1	54	2/42
Retracting mech.	14	17	31	23	**	***	23	0/51
Powerpak.........	94	60	154*	114	1	1	116	4/12
	256	185	441*	347	9	9	365	13/49

* Exclusive of plastic caps and seals used to exclude dirt while shipping.
** Assembled on plane at Republic factory.
*** Tested after assembly at Republic factory; cylinder tested when made.



Victor E. Fletcher, of Electrol's estimating department, sets up schedules for shop work.



41 Min.

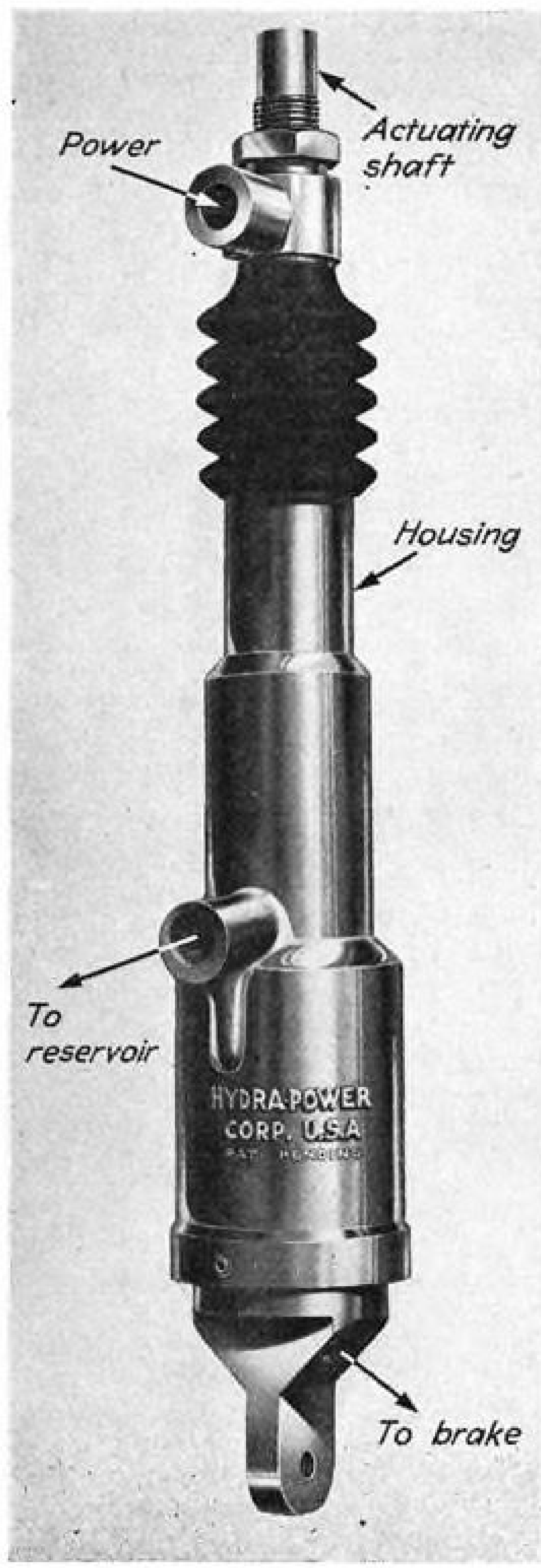
Tail wheel actuating cylinder (assembled at left) requires 26 operations taking 41 min. from raw material to completion. Cylinder body is standard tubing, machined inside. Piston rod is standard bar stock, centerless ground. Plugs are standard bar stock turned and tapped. Piston head is standard bar stock, simple turned. Cylinder ends are held by snap rings, sealed by standard O rings. Everything but rod is interchangeable with flap actuating cylinder, a feature designed-in by Electrol and Republic engineers working together.

New Hydraulic Cylinders Meet Rigid Operational Needs

By **CAPT. H. J. MARX, USNR,** *Technical Adviser, Mechanical Equipment Branch, BuAer, and*

J. J. MANCUSI, *Project Engineer, Hydra-Power Corp.*

Designed to afford top load-feel and emergency follow-up, these compounding cylinders—utilizing pilot's effort—are new answer to high-energy requirements for hydraulic operation of brakes and control surfaces.



Hydra-Power's compounding master brake cylinder

With the advent of high landing speeds and heavy aircraft, braking energy requirements have been increased to a point where the straight master cylinder is inadequate. It is impossible for pilot to exert sufficient force on the brake pedals to deliver, through a simple master cylinder, enough power to the brake to effect a stop.

There have been a few cases where pilots have demonstrated ability to exert as much as 350 lb. on the pedal, but it is generally agreed that maximum emergency effort requirement should not exceed 200 lb. An effort of about 60 lb., with good load feel, is desirable for normal operation.

Thus, it becomes apparent that wider use of some form of power braking must be made. Factors to be considered in design of power brakes include, in order of importance:

1. Ability to deliver and control required energy.
2. Load feel.
3. Some form of follow-up in event of power failure.

This last detail is handled in conventional power braking systems by insertion of an accumulator. Satisfaction of Item 1 is a matter of proper valving of fluid delivered by the pump, but provision for load feel presents more of a problem.

A new unit which handles this problem very efficiently, making full use of pilot's effort, is the power operated compounding brake master cylinder. Basic principle of compounding, as successfully used in the automotive industry, was first conceived in 1938, and has had a sound development and thorough testing. Application in aeronautics has been recognized, and has been considered acceptable for use in Naval aircraft.

The unit, as distinguished from other power brake valves, is not merely a valve, but is a master cylinder utilizing a secondary cylinder, within the primary piston, in which are generated high pressures required for brake actuation. Pressure developed in this section becomes a function of force applied at the actuating shaft, and is translated against rear of the primary piston (relatively larger in area than that of secondary or booster piston) producing a higher force. Into the space afforded by forward movement of primary piston, is forced system hydraulic fluid. Thus, fluid entering the secondary cylinder, backed by reaction of pilot's effort applied to booster piston, drives the primary piston against the head of fluid presented to the brake cavity. Energy boost then becomes a matter of relativity of areas.

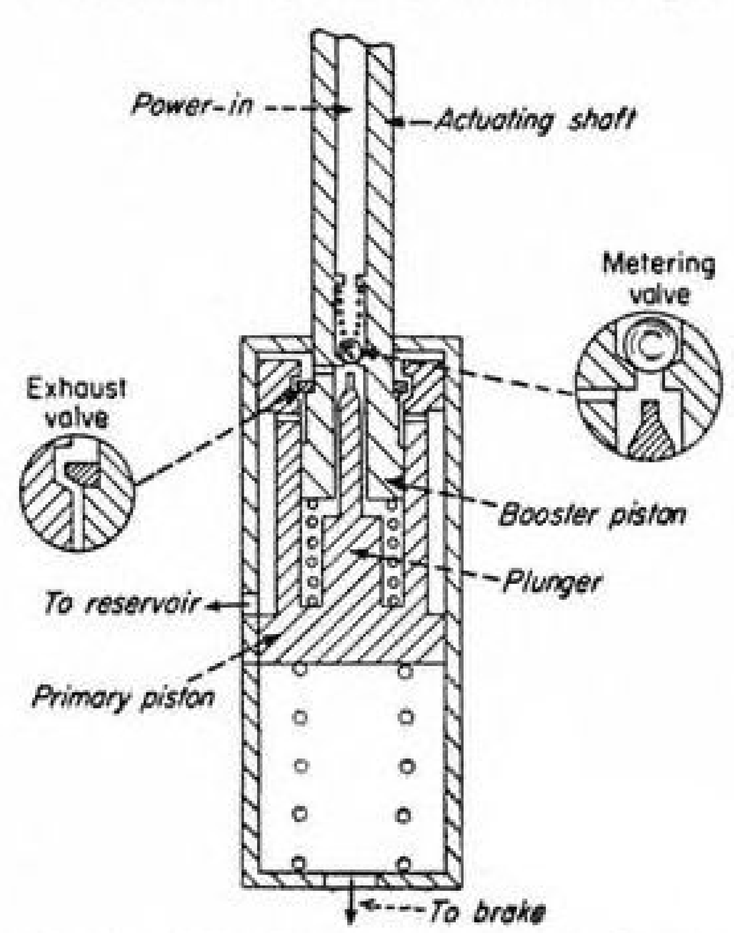
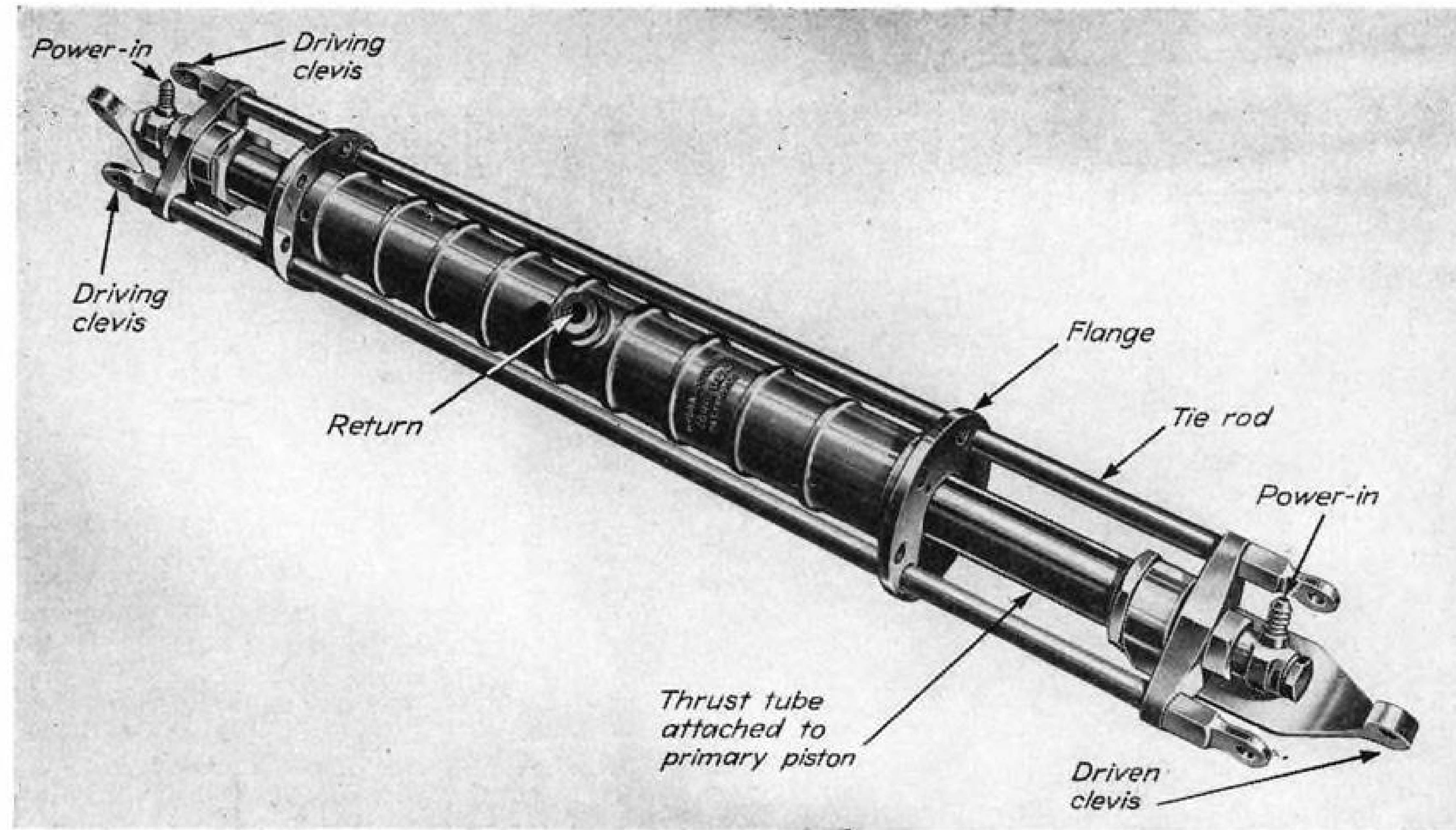


Fig. 1. Schematic representation of compounding master cylinder—retracted, or neutral, position.



Hydra-Power's control booster unit.

Quite simply, the compounding brake master cylinder is a device which affords a mechanical advantage, as does the hydraulic press or lever. With a lever, travel of the low effort arm is such that product of its length and force applied will equal product of the length and output of the other arm. Then, using a bar so as to obtain an advantage of 2:1, end of the low effort arm travels twice the distance of the other end.

For a compounding cylinder providing the same advantage, this does not hold, since the actuating shaft, analagous to the low effort arm, moves approximately the same distance as the primary piston. Energy required to do the balance of work is drawn from the engine-driven pump. Thus, pilot actually contributes half the effort and the hydraulic pump contributes the remainder.

In any compound master cylinder, pilot furnishes that part of the effort representing the low figure in the boost ratio of the cylinder. In the application cycle, pilot always shares directly in the work being done. Load feel is likewise direct, and pedal travel is an immediate index of amount of fluid forced into the brake cavity. This feature serves to indicate brake wear, and is a factor in load feel sensation. Though it is unnecessary for pilot to know the degree of separation of braking members in the wheel, he does associate pedal travel with amount of brake application, and often considers it as much an indication of feel as resistance to pedal movement.

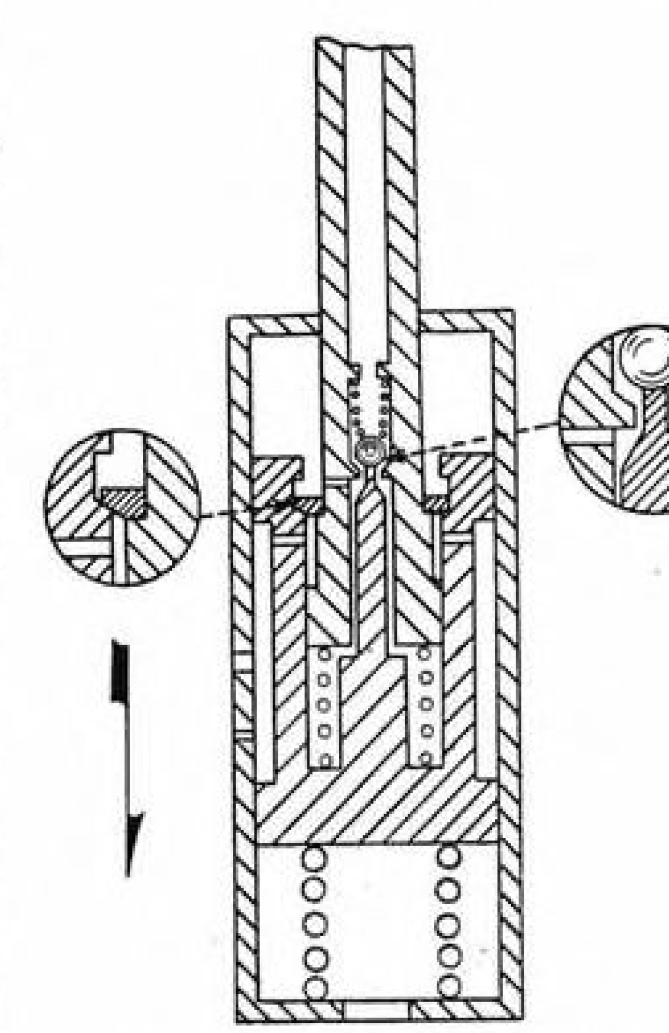


Fig. 2. Power stroke of cylinder.

A compounding master cylinder functions as a brake with power off. It can be designed to satisfy, without power or accumulator, any braking requirement that could be handled by a direct action master cylinder, and, in power-on operation, to provide any boost ratio.

Let us assume that a direct action cylinder were to be used on an airplane having these braking requirements:

Displacement, 2.00 cu. in., max.
Stroke, 1.00 in.
Pressure, 300 psi. max.

No consideration is given here for wear allowance, and, since the example is fashioned for convenience, we will say that mechanical advantage of the pedal linkage is 3:1. Best straight master cylinder design could satisfy these needs, but effort required for normal brake operation would be fatiguing to pilot, for he would have to exert a force of about 200 lb. And control would be poor.

For the conditions specified, a compounding master cylinder providing a 3:1 boost will satisfy the requirements with an effort of less than 70 lb.—about 1/3 that required with a direct action cylinder. Thus, pilot is afforded a sensitive, smooth-acting brake, demanding actuating forces he is easily capable

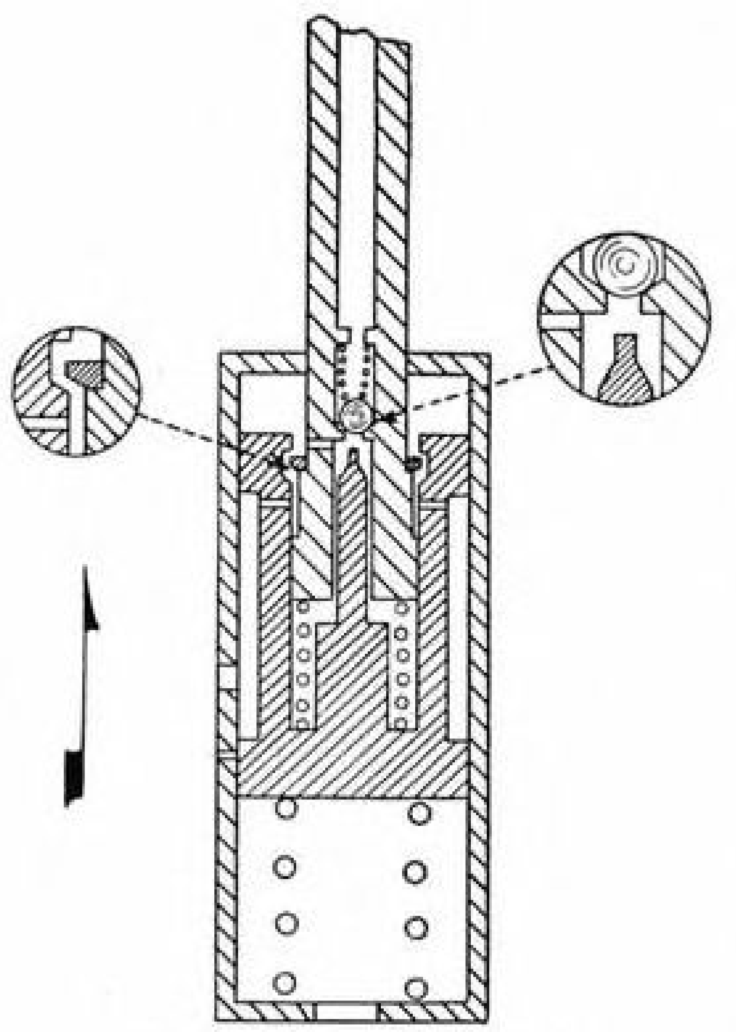


Fig. 3. Cylinder return stroke.

of initiating. He will have perfect load feel throughout the braking cycle and will experience no sensation of power kick-in, as is the case with ordinary power brakes.

Also, the compound cylinder can deliver any ultimate pressure and displacement available with a power brake valve, and deliver, without power or an accumulator, the braking energy afforded by a straight master cylinder. For a given accumulator capacity, however, the compound cylinder can be emergized a greater number of times than an ordinary power brake valve used in the same system, because pilot not only opens a valve but actually takes part in the satisfaction of the braking energy requirement.

In Fig. 1, the compound cylinder is shown, schematically, in retracted (neutral) position. The sleeve type exhaust valve is open, and the ball check metering valve is closed. It is to be noted that secondary piston is in no way mechanically joined to primary piston, in rear of which it operates. Travel of secondary piston is limited upwardly by the shoulder against which the exhaust valve bears in retracted position, and downwardly by shoulder on the plunger displaced through it. The plunger, located within secondary cylinder, rests on the bottom of this bore, providing a medium through which direct drive of the primary piston, by secondary piston and actuating shaft, can be accomplished. Thus, there can be relative movement between primary and secondary pistons (within limits described) and the two must move together when either limit of travel of secondary piston is reached.

Movement of actuating shaft (Fig. 2) results at first (for very short distance) in movement of secondary piston, and, since the exhaust valve closes (being carried to its seat by initial movement of secondary piston, then securely seated by pressure, the compounding effect starts. Since fluid behind primary piston no longer has egress to reservoir (because of exhaust valve closure), fluid displaced in moving secondary piston the distance from point at which exhaust valve closes to point at which metering valve makes contact with plunger, acts against rear of primary piston. Because this piston area is larger than effective area of secondary piston, and has translated against it the pressure generated by effort applied at the actuating shaft, the primary piston will move with the secondary piston, but only as far as the latter piston's fluid displacement acting against this larger area will drive it.

At this point in the cycle, continued effort at actuating shaft will cause plunger to urge ball check metering valve off its seat, so that further movement of secondary piston will allow system fluid into the chamber behind primary piston. Fluid entering through metering valve will cause reaction against effective area of secondary piston, tending to force it upward and close the valve, so that force applied at actuating shaft divided by effective area of secondary piston becomes the pressure value existing in the chambers behind primary piston. Hence, ratio of effective area of primary piston to effective area of secondary piston determines amount of boost or percentage of force that pilot must apply for any given output.

Since system pressure is 1,500 psi., it is obvious that fluid can be forced into the chamber behind primary piston so long as pressure reacting against booster piston does not exceed 1,500 psi. Actually, this pressure does not exceed ultimate pressure required for braking, by more than the ratio of effective area behind primary piston to effective area of the piston face offering fluid to the brake. There exists, then, a high pressure differential to provide rapid transfer of replenishing fluid in event of quick brake application. Since fluid is transferred only as needed, and since compounding begins before actual opening of metering valve, this opening action—start of the true power cycle—is imperceptible to pilot.

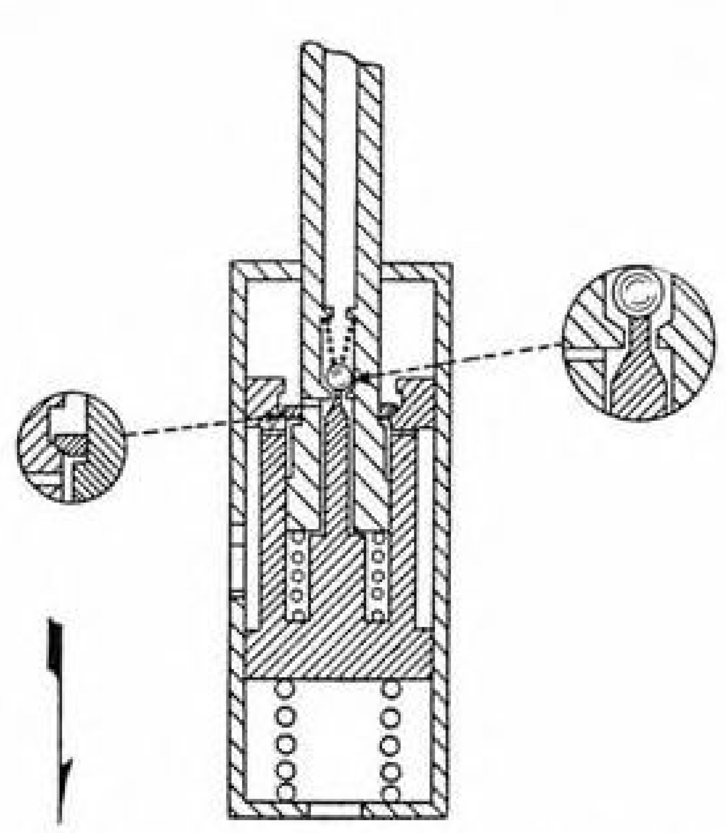


Fig. 4. Representation of power-off operation.

When actuating effort is removed from pedal, secondary piston is forced upward (Fig. 3), unseating the exhaust valve. Passage back to the reservoir for fluid behind primary piston is thus provided, and primary piston moves upward, urged to retracted position by the large spring. During initial relative movement between primary and secondary pistons, the plunger moves away from the metering valve, which is seated by the spring above it.

Power-off operation of the compound cylinder is comparatively simple. With accumulator installed, the cylinder would function in normal power-on manner. In this connection it is interesting to note that fluid drawn from the aircraft system is always less than the fluid displaced to the brake. A 2:1 boost cylinder will deliver 1 cu. in. of fluid for each .7 cu. in. drawn from main hydraulic system. These figures vary for each design, depending upon boost ratio and displacement. Fig. 4 shows how direct drive is achieved for the compound cylinder without power.

Comments of those who have used this type master cylinder in the field are uniformly good, and it has been favorably compared to an automobile brake in smoothness of action and feel. Designed for a specific braking requirement the compound cylinder offers a wide selection of pedal forces and provides dependable sensitive control. Feeling the load, and being able to deliver required power without exhausting effort, pilot can make smooth, fast stops, thus avoiding excessively long brake applications and minimizing brake wear.

Reports from a field at which three planes equipped with power-operated compounding master cylinders were tested over a period of about a year, contained these statements:

"All pilots are very enthusiastic over relative improvement of brake action with compounding master cylinders over brake cylinders now in use. They report a much better feel of the brake."

"Only maintenance required on these brakes during entire period was setting of brake clearance on routine checks.

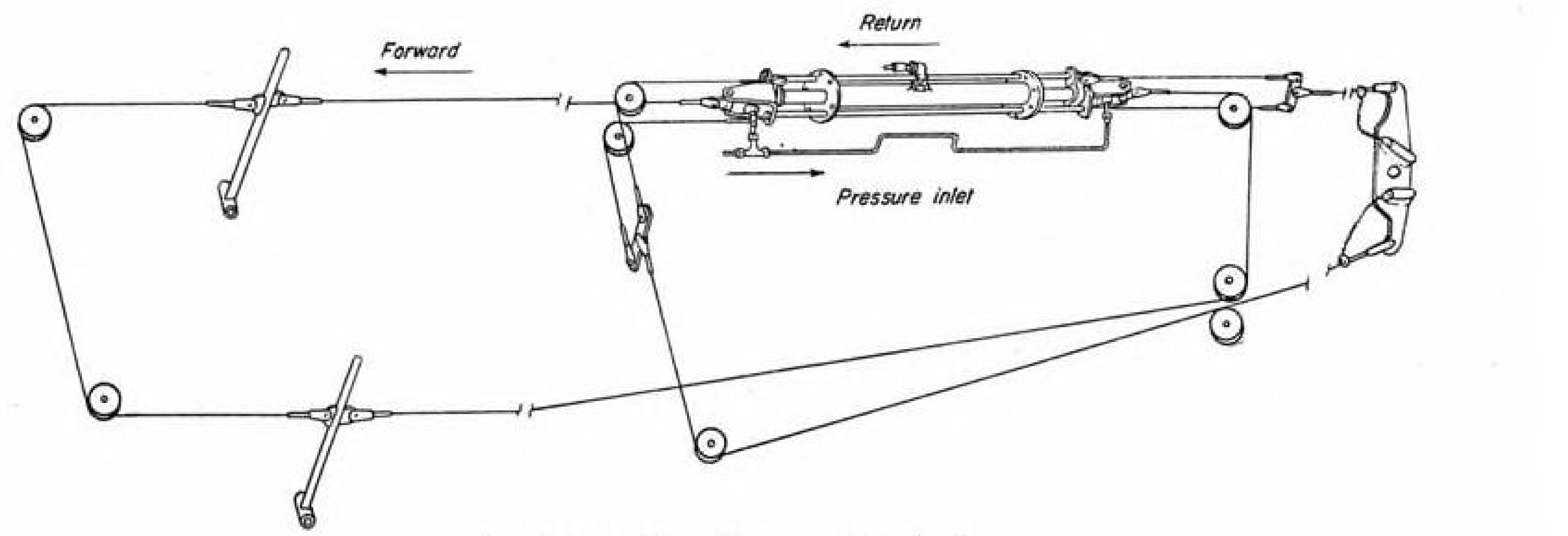


Fig. 5. Installation diagram of booster in rudder control.

Fewer settings were required than with cylinders previously used."

This same compounding principle has been applied in manufacture of a hydraulic control booster. In this device the boost pressure is again delivered to face of primary piston, but this element is integral with a thrust tube driving the cable or tube system for the particular control which is to receive the boost. Hydraulic power transmission and boost take place within the cylinder without interruption of mechanical integrity of control system rigging. Therefore with power loss, the unit acts as a mere mechanical link in the control system.

The control booster operates under the same principles as does the power operated master cylinder, but instead of driving a head of fluid, the system pressure and pilot's effort are directed to thrust tube linked to driven clevis.

The unit is secured by brackets accommodating the flanges at the housing end. It is unnecessary to bleed the booster after installation, since cycling a few times with power on serves to relieve it of air. Although this cylinder may be used to boost any control surface, typical installation drawings are shown only for rudder and elevator boost systems (Figs. 5 and 6). In the push-pull installation only half the clevising is required, there being need for only one driven and one driving clevis. There is slight inherent backlash in the cylinder—approximately $\frac{3}{32}$ in. in each direction—which does not affect rigging tension and is not perceptible in the controls. This free play is required for valve operation.

Tie rods are used to hold the two booster piston faces in fixed relationship to each other. Thus, any movement at either end of driving clevises attached to tie rod results in movement of both booster pistons—one being urged toward bottom of secondary cylinder as other is brought away from it. Then, exhaust port on one side opens wider as exhaust valve on other side closes and metering valve on this latter side opens.

These control boosters can be designed to provide any boost ratio desired. In event of power failure, boost is lost and the system reverts to 1:1 ratio. Here again, both load feel and position follow-up are provided.

The cylinder operates smoothly, evenly, and without chatter, regardless of manner of applying load—slowly or suddenly. It is a highly sensitive control, unaffected by surges in hydraulic system power supply.

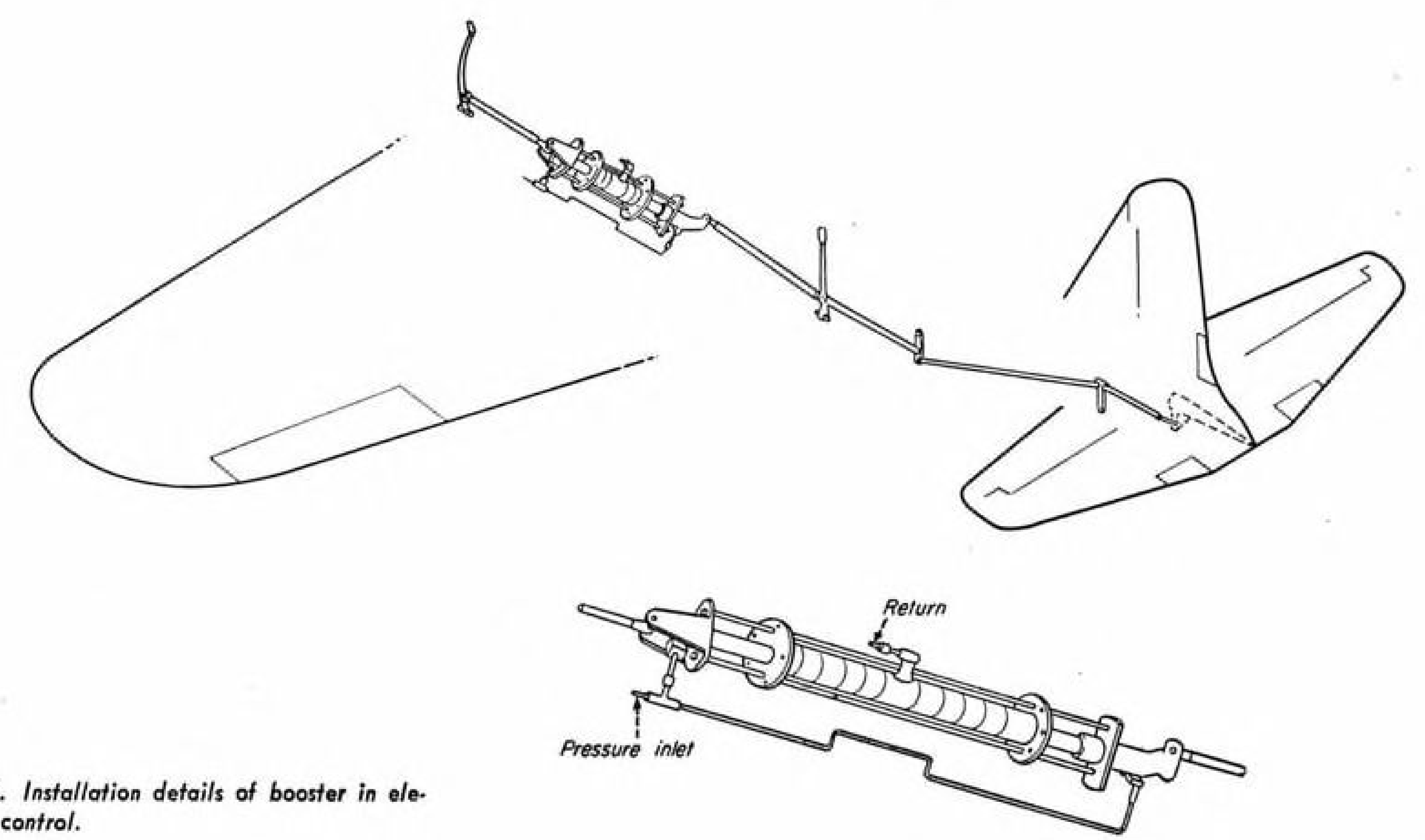


Fig. 6. Installation details of booster in elevator control.

PRACTICAL ENGINEERING OF ROTARY WING AIRCRAFT

PART V

By JOHN E. McDONALD, *Engineering Staff, Autogiro Company of America*

In his initial contribution to this valuable series, Engineer McDonald begins his discussion of vibratory phenomena in rotorcraft. Presented here, is a brief history of manifestations of vibration, classification of the phenomena, and development of flapping equations for a single rotor blade.

The modern rotary wing craft, with its multiple degrees of freedom, is so dynamically complex a machine that a completely unified vibration analysis is impossible. Fortunately, many of its dynamical elements are substantially isolated so that their individual treatment becomes a simple and fairly rigorous process.

However, reasonable discretion in separation must be exercised when there exists appreciable "coupling" between systems. For example, the very interesting phenomenon of "ground resonance" is an instance involving coupling between elements of the rotor, fuselage, and alighting gear. Analyses which over-simplify or treat with less than these three coupled elements would fail to reveal the functional relationships of the phenomenon.

The simple flapping hinge, as employed by Cierva in the earliest autogiros, introduced many interesting vibration phenomena associated with vertical "bouncing" and control azimuth response. Problems posed by pure flapping action were ordinary, and little coupling tendency with other modes was apparent.

In 1925, the drag hinge was adopted for the purpose of minimizing chordwise blade stresses engendered by air drag and non-uniform flapping action. In addition to the ordinary problems associated with such an additional mode of freedom, there was found to exist strong coupling between the blades and elements of the fuselage and landing gear. A spectacular instance of such coupling became apparent when early machines were taxied over rough ground prior to takeoff, when rotor vibration often developed to a degree that suppression was essential before the machine became airborne. While dynamical origin of this so-called resonance vibration was not known at the time, an effective pilot technique had been developed for its control, with the result that a potentially vicious phenomenon, ground resonance, was treated merely as an odd characteristic of the new aircraft.

During the early '30s, an extensive series of tests was performed to determine influence of rotor design upon flight and ground vibration characteristics. As a result of these and subsequent experiments, the following criteria were established for the design and construction of rotor blades which would be generally free of bouncing or other undesirable characteristics:

1. Flexibility in the flapping plane is desirable. The highly flexible blade, in large degree, minimizes non-uniform shear forces at the hub and so reduces bouncing tendency.
2. Substantial coincidence of chordwise C.G., C.P. of airfoil, and elastic centrum of blade at each element is advantageous as a minimum variation in torsional moment results.
3. An airfoil having a fixed C.P. is highly desirable. In high speed flight such an airfoil reduces diving tendency.
4. Blade loading should be as light as possible, consistent with obtaining the proper tip speed ratio for maximum speed.
5. Slight washout of blades is desirable as a means for minimizing bouncing and rotor "biting-in."
6. A thin airfoil is preferable, and the thickness ratio should reduce toward the tip. This is primarily a matter of efficiency attainment.
7. Drag hinge offset should be such that blade pendular frequency is approximately one-quarter rotor speed.

The Author . . .

John E. McDonald, who collaborates with Paul H. Stanley in this rotocraft engineering series, was chief aerodynamicist for G&A Aircraft from 1943 to 1945 and was responsible in a great measure for the feature of minimum vibration in the XR-9B helicopter. Later, he became associated with the Autogiro Company of America as engineering consultant.

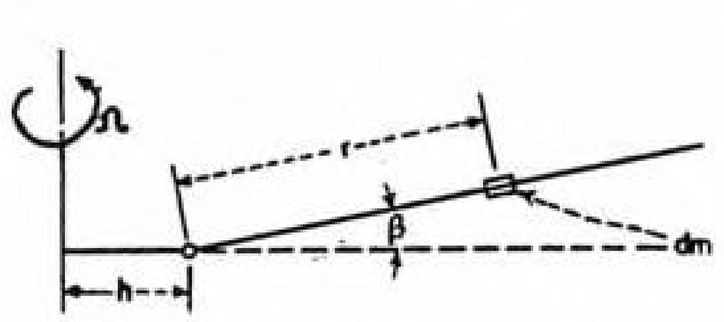


Fig. 1. Simplified diagram of flapping rotor blade.

Flapping of Single Blade

Natural flapping frequency of a freely hinged blade is influenced, to a major degree, by its rotational speed and extent of mechanical coupling between flapping and feathering displacements. It is affected, to a minor degree, by location of the flapping hinge, location of blade C.G., and mass moment of inertia of blade.

In Fig. 1, angle of flapping β is assumed to be small, so that $\beta = \sin\beta$ and $\cos\beta = 1.0$. Distance to the blade C.G. from hinge line is b.

In the idealized case when the blade is thin (considered as a rod), and aerodynamic forces are neglected, equation of centrifugal moments and inertia moments about the flapping axis gives

$$\ddot{\beta}\int_0^R r^2dm + \beta\int_0^R \Omega^2(r^2 + hr)dm = 0 \quad (1)$$

Since the free motion may be of the form $\beta_0 e^{i\omega_\beta t}$ where ω_β is the natural frequency, there results, by substitution in the foregoing,

$$\frac{\omega_\beta}{\Omega} = \sqrt{1 + \frac{\int_0^R hr\,dm}{\int_0^R r^2dm}} \quad (2)$$

Replacing $\int_0^R r dm$ by its equivalent mb and the moment of inertia $\int_0^R r^2dm$ by $m(b^2 + \rho^2)$

$$\frac{\omega_\beta}{\Omega} = \sqrt{1 + \frac{h}{b}\left(\frac{1}{1 + \rho^2/b^2}\right)} \quad (2a)$$

When $h = 0$ (flapping hinge on axis of rotation), the natural flapping frequency coincides with rotative speed, and the blade will complete one full oscillation in each revolution. It is conceivable that the ratio h/b might reach a value of .10 in practical designs. The ratio ρ/b would probably never be less than .60. With such a combination of design factors there would result a value ω_β/Ω of 1.037, the natural flapping frequency exceeding the rotative frequency by less than 4%.

There is incorporated in many designs a coupled feathering hinge or a skewed flapping hinge each of which contrives automatically to reduce the pitch of a blade as it increases its coning angle.

Referring to Figs. 2 and 3, it is assumed for simplicity, that the flapping hinge intersects the axis of rotation. If the angle between the flapping axis and the normal to the blade axis is δ_3, it is at once apparent that $\overline{OC}\,\Delta\beta = \overline{AC}\,\Delta\theta$, and hence

$$\tan\delta_3 = \frac{\overline{OC}}{\overline{AC}} = \frac{\Delta\theta}{\Delta\beta} \quad (3)$$

(pitch coning derivative)

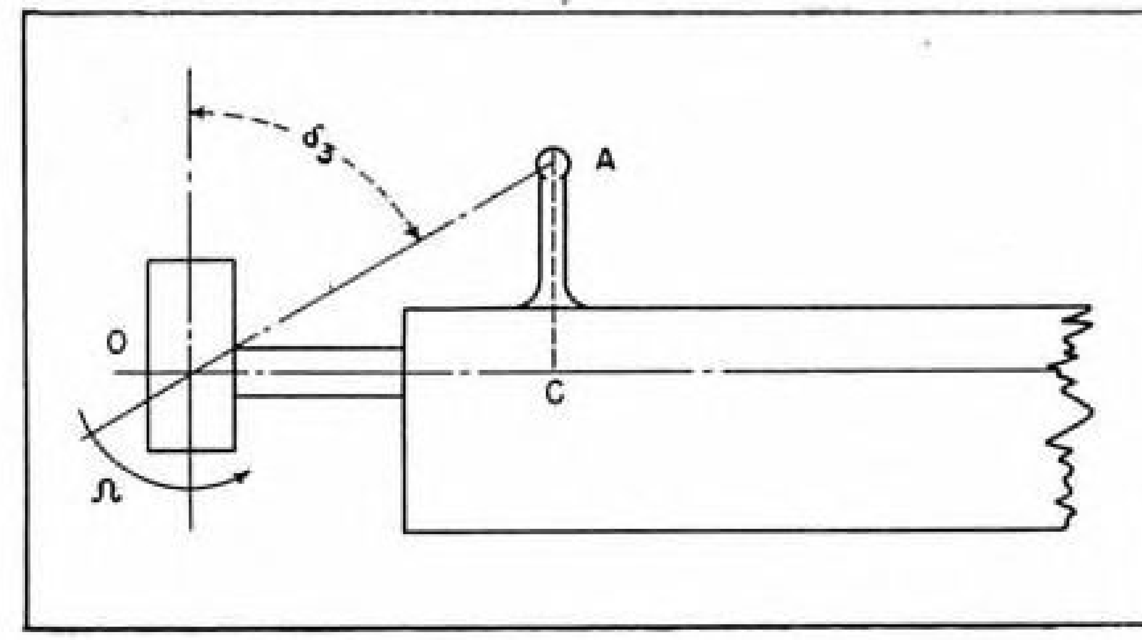


Fig. 2. Rotor blade with virtual δ_3 tilt of flapping hinge.

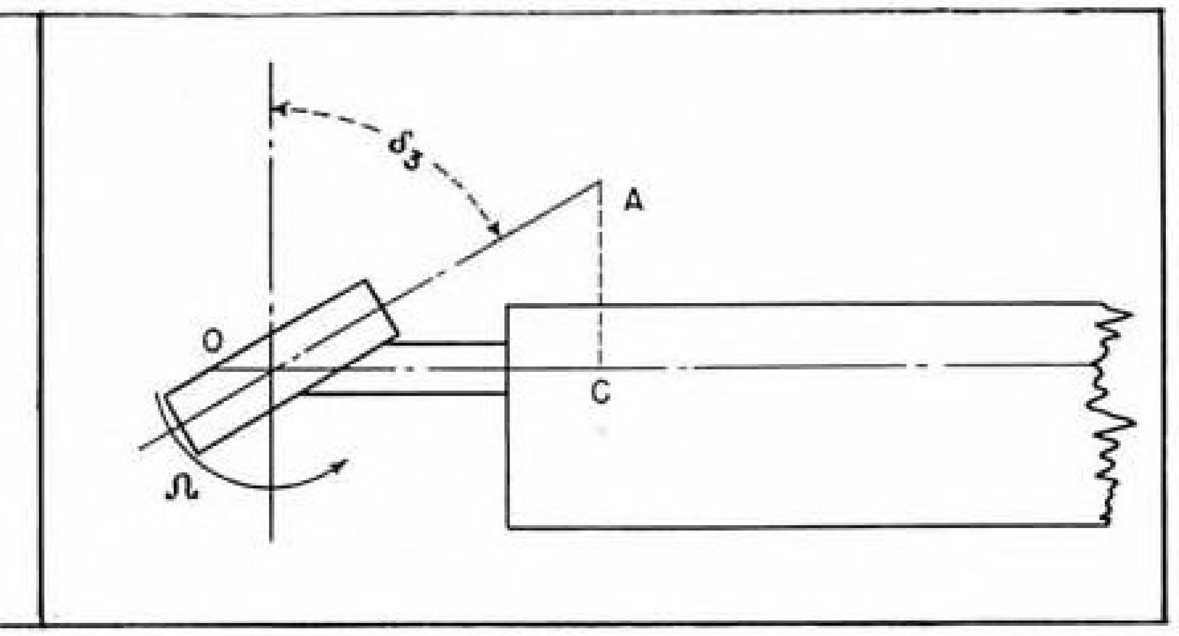


Fig. 3. Rotor blade with geometric δ_3 tilt of flapping hinge.

If such blades are subjected to a small flapping oscillation $\pm\Delta\beta$ they will also undergo a pitch variation $\pm\Delta\beta\tan\delta_3$

Because of the flapping velocity of the blade, its relative angle of attack is changed. A blade element at the radial position r for example, would, under flapping, possess an upward velocity $\dot{\beta}r$ and a tangential velocity Ωr. Consequently, the change in its angle of attack will be $\dot{\beta}/\Omega$, quite obviously independent of radius, and thus a constant along the blade.

Total change in angle of attack of a particular blade element will be the sum of the two changes:

$$\Delta\beta\tan\delta_3 + \dot{\beta}/\Omega$$

With some aerodynamic simplification, the variation in lift moment on a blade due to flapping may be written

$$\Delta M = \int_0^R \tfrac{1}{2}\rho_a\left(\frac{dC_L}{d\alpha}\right) c(\Omega r)^2 r\,dr\,(\Delta\beta\tan\delta_3 + \dot{\beta}/\Omega) \quad (4)$$

In the foregoing, c is the blade chord and $\left(\frac{dC_L}{d\alpha}\right)$ the slope of the lift curve. If it is assumed that c is constant along the blade span,

$$\Delta M = \tfrac{1}{2}\rho_a\left(\frac{dC_L}{d\alpha}\right)\frac{c\Omega^2R^4}{4}(\Delta\beta\tan\delta_3 + \dot{\beta}/\Omega) \quad (5)$$

The equilibrium equation of the blade will be

$$\ddot{\beta}\int_0^R r^2dm + \beta\left[\int_0^R \Omega^2r^2dm + \Omega^2\frac{\rho_a}{8}\left(\frac{dC_L}{d\alpha}\right)cR^4\tan\delta_3\right] + \dot{\beta}\frac{\Omega\rho_a}{8}\left(\frac{dC_L}{d\alpha}\right)cR^4 = 0 \quad (6)$$

If the specific mass of the blade W (mass/unit area) is assumed constant, the term $\int_0^R r^2dm$ may be written

$$\int_0^R cWr^2dr = \frac{cWR^3}{3}$$

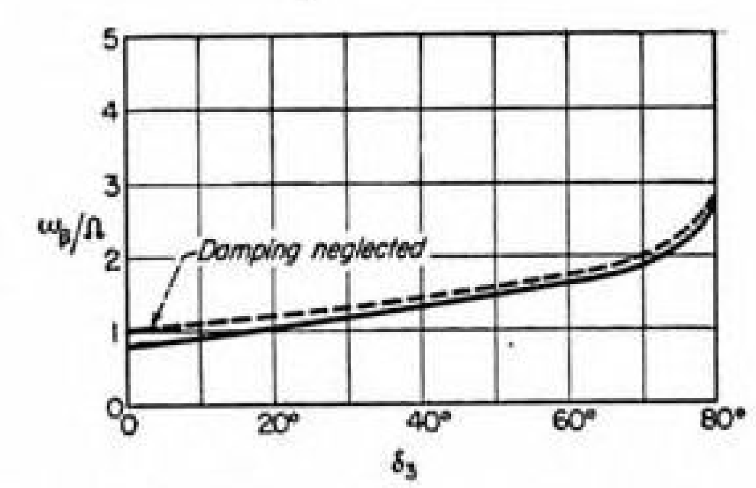


Fig. 4. Effect of δ_3 tilt on ratio ω_β/Ω.

Substitution and reforming of Eq. (6) gives

$$\ddot{\beta} + \Omega^2\beta\left[1 + \frac{3}{8}\rho_a\left(\frac{dC_L}{d\alpha}\right)\frac{R}{W}\tan\delta_3\right] + \Omega\dot{\beta}\frac{3}{8}\rho_a\left(\frac{dC_L}{d\alpha}\right)\frac{R}{W} = 0 \quad (6a)$$

Natural frequency for this case of free-damped vibration is

$$\frac{\omega_\beta}{\Omega} = \sqrt{1 + \frac{3}{8}\rho_a\left(\frac{dC_L}{d\alpha}\right)\frac{R}{W}\tan\delta_3 - \left(\frac{3}{16}\frac{\rho_a(dC_L/d\alpha)}{W}R\right)^2} \quad (7)$$

Fig. 4 is a plot of ω_β/Ω drawn for a blade having the following characteristics:

W = .084 slugs/sq. ft.,
$\left(\frac{dc_L}{d\alpha}\right) = 5.75$
R = 20 ft.
ρ_a = .00238 slugs/cu. ft
δ_3 = variable

It will be observed that the effect of the damping term $[\frac{3}{16}\rho_a(dC_L/d\alpha)\,R/W]$ upon the natural flapping frequency is very small throughout the range of δ_3 values.

Symbols

- Ω = Rotative speed of rotor
- ω_β = Natural flapping frequency of blade
- ω_γ = Natural lagging frequency of blade, rotor turning
- $\omega_{\gamma 0}$ = Natural lagging frequency of blade, rotor stopped
- β = Flapping angle of blade (displacement about horizontal hinge)
- γ = Lagging angle of blade (displacement about vertical hinge)
- θ = Blade pitch angle
- h = Radial offset of horizontal hinge
- a = Radial offset of vertical hinge
- r = Radial position to blade element (from hinge line)
- b = Radial position to blade C.G. (from hinge line)
- ρ = Radius of gyration of blade about C.G.
- ϵ^2 = $1 + \rho^2/b^2$
- $K\gamma$ = Angular spring rate of blade root spring
- ρ_a = Mass density of air
- n = Number of blades

Spotwelding Technique For Primary Structures

PART II

By FREDERICK S. DEVER, *Spotwelding Supervisor, Ryan Aeronautical Co.*

In this concluding installment on spotweld fabrication, Supervisor Dever discusses important operational factors pertinent to equipment, outlines Army and Navy weld specifications, and covers work-inspection procedures.

IN SPOTWELDING THE ASSEMBLY, the machine must first be set up. This consists of adjusting the arms, electrodes, and other elements. Settings are obtained from charts (previously established on certification tests of the machine) for the gage combinations to be spotwelded. After set-up is complete, sample test coupons are spotwelded and immediately tested. Obviously, sufficient time would not be available for a complete test and for this reason a shear test is sufficient to allow the work to proceed. After samples have been tested and approved by the inspector, the welder is ready for production.

Type and capacity of spotwelding machines will depend upon materials and thicknesses. It is recommended that machine capacity, in all cases, be sufficiently great so that a reserve capacity is present for all jobs. Operating near maximum current capacity of the machine is undesirable because machines are not too stable at upper limits of their rated capacities.

Approximate welding current required for 18-8 steels is about 4,750 amp. for two sheets of .016 in. material. For two .125-in. sheets, amperage required is about 13,500. Contrast this with aluminum alloys in which two sheets of .016 in. material will require approximately 14,000 amp., while two sheets of .125 in. material will require about 35,000 amp. This difference should be clearly understood, because it is on this basis that we can compare and establish the ease with which 18-8 steels can be spotwelded, also to emphasize again some of the more critical aspects of welding aluminum alloys.

Required secondary amperage may be obtained from either the a.c. transformer spotwelder or a stored energy type. If ample power supply is available, the a.c. welders will function satisfactorily within their rated capacity. However, since secondary or welding amperage is directly related to power input through the primary, it must be understood that any variation of current through the primary will either raise or lower secondary current used to form the spotweld. This variation may be sufficient to develop inconsistent spotwelds. Power variation has been a problem, and still causes considerable

Counterbalanced air-operated water-cooled spotwelder seen here is used at Ryan Aeronautical Co. for reaching high restricted locations.

trouble when the power lines are overloaded. Installation of a separate transformer for each welder will produce desired results of spotweld consistency but expense incurred must be considered. Another approach to this problem of current delivery and supply is by use of the interlocking system where two or more welders receive current supply from the same transformer. However, the timing controls flow of current so that only one welder can use the power input at any given time that a spotweld is made.

In cases where a heavy power loading is the general rule, it is the practice at Ryan to use a condenser-discharge or stored energy type of spotwelder. These welders—storing primary current until the condenser is loaded, before current can be discharged—have reached a high degree of popularity for aircraft spotwelding.

In addition to delivery of high amperage current, there is another extremely important factor—time interval, or weld time, during which current flows. Since welds are made because of heat this current develops, time that it flows will directly affect the spotweld. This flow is of very short duration and must be quite accurate. Two means are available for controlling this interval—the mechanical timer (governed by a synchronous speed motor) and the electronic control.

Governing Specifications

The spotwelding machine must be certified for each gage combination used. This certification is obtained by meeting the following requirements of specifications PW6 issued by U. S. Navy, BuAer:

1. Twenty-five specimens shall be made with a single spot on the gage combination to be certified.

2. Spotweld specimens shall equal or exceed the minimum shear value for the lightest gage in any combination being tested.

3. In 21 of the 25 specimens, the variation in strength shall not exceed 10% of the average value of the 25 specimens. The remaining 4 specimens

shall not vary over 20% of the group average.

4. Twenty-five single spot specimens shall be sectioned and etched to show the internal structure of the spotweld. These spotwelds shall be reasonably free from porosity and cracks. Certain minor defects may be allowed, providing they are within the specified limits.

There are additional requirements to be met in the specification, but the foregoing items are essentially the most important considerations. Requirements of the Army specification covering resistance welding, No. 20011-C, are very similar to those of the Navy specification.

The latter requires tension tests on spotwelds, which are not indicative of the service loads to be expected, but which will definitely establish such other factors as uniformity of spot diameter, penetration, and weld soundness. Army specification does not require tension tests on spotwelds.

From these specifications there are two conclusions which can be drawn—first, and of greatest importance, is that spot or resistance welding is an accepted method of fabrication; and second, that the process must be carefully controlled in normal, routine shop operation to be able, consistently, to meet requirements of the rigid tests covering certification of spotwelding equipment. It should also be noted that the amount of inspection to which this process is subjected, both in certification of the equipment and during fabrication, exceeds that required for arc and gas welding. Hence, it is logical to assume that considerable improvement can be expected to reduce the severe inspection requirements and point the way toward a demand that the equipment incorporate more foolproof characteristics.

It is the practice, for the aircraft companies, to set minimum shear strength requirements 5 to 10% above minima demanded by the Army and Navy specifications. This practice safeguards the fabricator so that in no case will a spotweld borderlining the company's minimum shear value fall below AN standards.

Shear strength values for a given gage combination, taken over a period of months, have proved that values from 10 to 15% above company minima are easiest to maintain. Adherence to these percentages will result in satisfactory spotweld consistency.

By holding to these figures the natural tendency toward obtaining extremely high values over the minimum requirements will be avoided. These extremely high values are undesirable because uniformity in shear values between individual spotwelds in the same

Ryan-designed electrodes are used to spotweld this somewhat inaccessible aluminum vane. Bottom electrode is copper, backed with steel for high strength.

assembly is difficult to maintain. Even though all of the values obtained are above minimum required, a wide variation in strengths above this minimum still represents spotweld inconsistency to be avoided. From company experience, we find that the larger the weld area, the less the ductility, and the extremely high spotweld values which can be obtained for a short time are accompanied by erratic results.

The operator must exercise care to keep the electrodes clean at all times. Aluminum alloys are prone to surface alloy with the copper alloy electrodes. When this occurs, increased resistance that develops at the point of the electrode makes for irregular welds and prevents uniform current delivery. Edge distance and spacing should be properly maintained, and spotweld pattern held symmetrical and uniform in size.

During production runs, the inspector checks the machine at regular intervals for shear strength and appearance of spotwelds. At longer intervals metallographic examinations are conducted. This examination can be conducted by the men in the shop by simply sectioning through the spotweld, etching lightly, and examining with a magnifying glass. In cases of doubt, parts can be referred to laboratory technicians for complete metallographic examination. Should the shear strengths be below allowable minima, or should internal defects such as cracks and inclusions exceed allowable percentages, the machine is removed from production until settings and adjustments are made that produce satisfactory results.

Because there are so many variables which can cause defective spots, a word of caution is offered here. In making setups, the operator or setup man should remember that improper cooling of electrodes, improperly dressed tips, too wide a variation from standard settings, improperly cleaned materials, as well as many other factors can produce spotwelds of unacceptable consistency. Thus, at this point in the operation, the production man can save himself considerable difficulty by exercising full ability to do a good job in setting up the machine.

Inspection Procedures

Inspection of spotwelded assemblies and parts is an important phase of the work. The inspector is confronted with the same problem facing an inspector of arc welded material, in that the method of inspection and testing is non-destructive. Listed here in sequence, are a few general suggestions which, if observed by the inspector, will give him sufficient information to accept or reject the part:

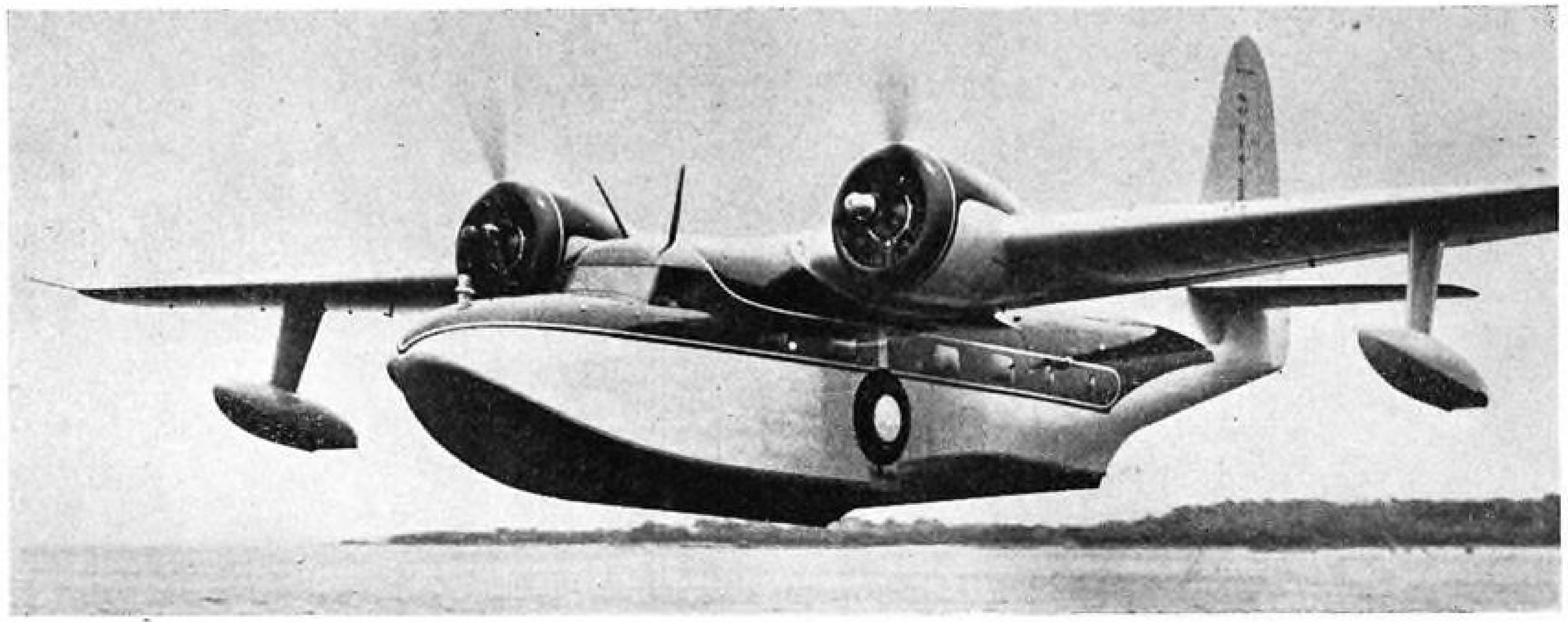
1. Inspect for appearance of the weld as to shape and size of spots.
2. Check spacing of spotwelds.
3. Inspect center of spots—it is here that cracks are more likely to occur.
4. Examine for flash, both internal and external.
5. Check for spotweld indentation.
6. Inspect for sheet separation.
7. Look for surface burning, and
8. Correlate the foregoing with shear test data and metallographic examination conducted earlier.

The inspector is cautioned to bear in mind that exterior appearance of a spot on the face of the sheet is not a true indication of the internal size of the spot. It is necessary to be factual and objective in the analysis.

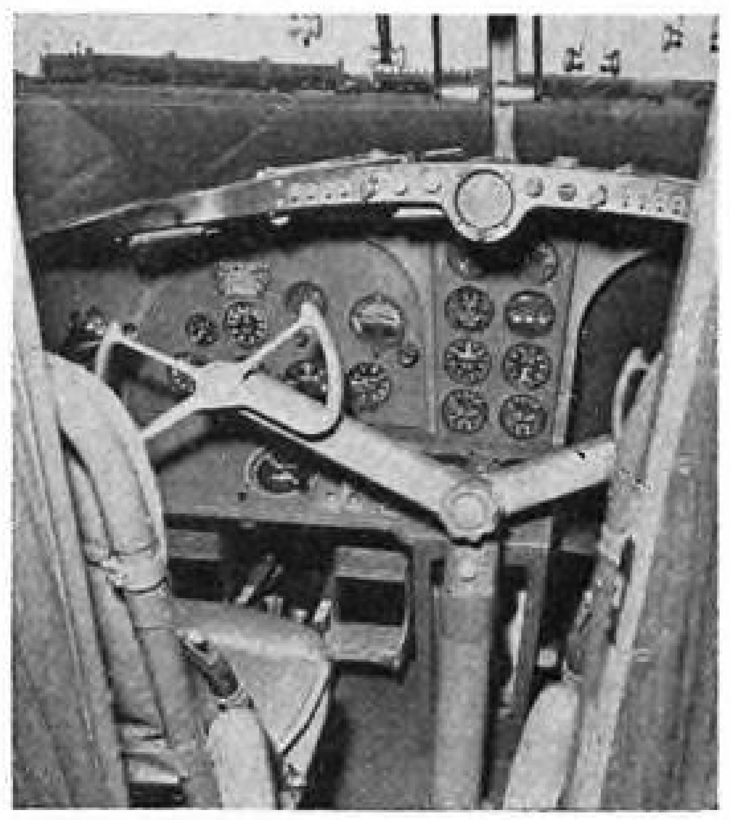
Should the inspections previously enumerated show the spotwelding to be within accepted allowances, the assembly should be approved.

There appears to be no reason why the field of spotwelding cannot be widened to include numerous primary structures. Many not now considered suitable for spotwelding can be rather easily modified to make them acceptable for this process. And manufacturers of spotwelding equipment are constantly improving the electrical systems to make the machines capable of more uniform and more consistent operation.

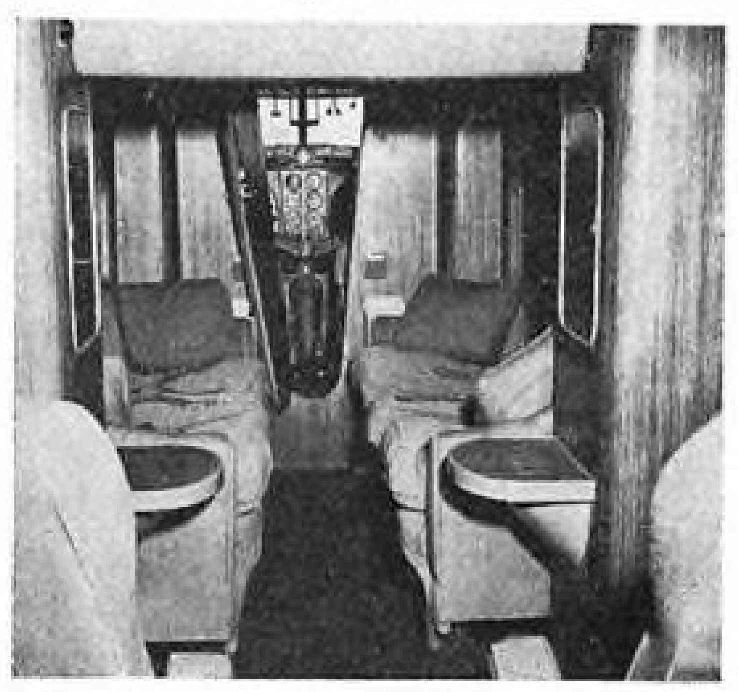
Flexibility of the equipment, speed and economy of the operation, together with the consideration that no weight is added, are powerful factors to prompt the designer and manufacturer to use this type of fabrication in a full measure.



Newest Grumman amphibian is Mallard, 8-10 passenger luxury craft now being delivered to airline, corporate, and individual customers. Note new hull lines featuring reverse flare for smoother takeoffs and landings.



Cockpit of Grumman Mallard, showing dual radio controls installed on panel at windshield base, also throttle, flap, and landing gear controls suspended from cockpit roof. Co-pilot's wheel is quickly detachable for easier access to forward hull compartment. (Martin & Kelman photo)



Mallard cabin interior looking forward from aft compartment which has four seats facing forward. Thermostat at upper left controls cabin temperature; panel at right encloses food compartment. Mid-sections of divan-type seats are easily removable to set up tables. (Martin & Kelman photo)

Mallard Amphibian Presented by Grumman

Deluxe high performance craft designed for both airline and executive transport shows smooth handling characteristics.

ANNOUNCED WITH INAUGURATION of deliveries is the Grumman Mallard, luxurious high performance 8-10 passenger amphibian designed for transport and personal operations. Powered by two 600-hp. Pratt & Whitney H Wasps, Mallard has high speed of 215 mph., cruising speed at 55% power of 180 mph., useful load of 3,375 lb., and range up to 1,228 mi.

Hull design features reverse flare and higher length-beam ratio than predecessor types, and tricycle landing gear has been installed to facilitate ground handling. Flush riveting is extensively used.

Forward cabin section has two full-length divans, mid-section of which can be removed to install tables. Aft cabin section has four deeply upholstered seats. Lavatory, set opposite entrance door, can be curtained from main cabin. Large baggage compartment is accessible in flight.

The craft has a single-engine ceiling of about 10,500 ft. and in press demonstration flights exhibited unusual one-engine performance. Company reports more than 40 single-engine takeoffs at gross weight of 12,500 lb.

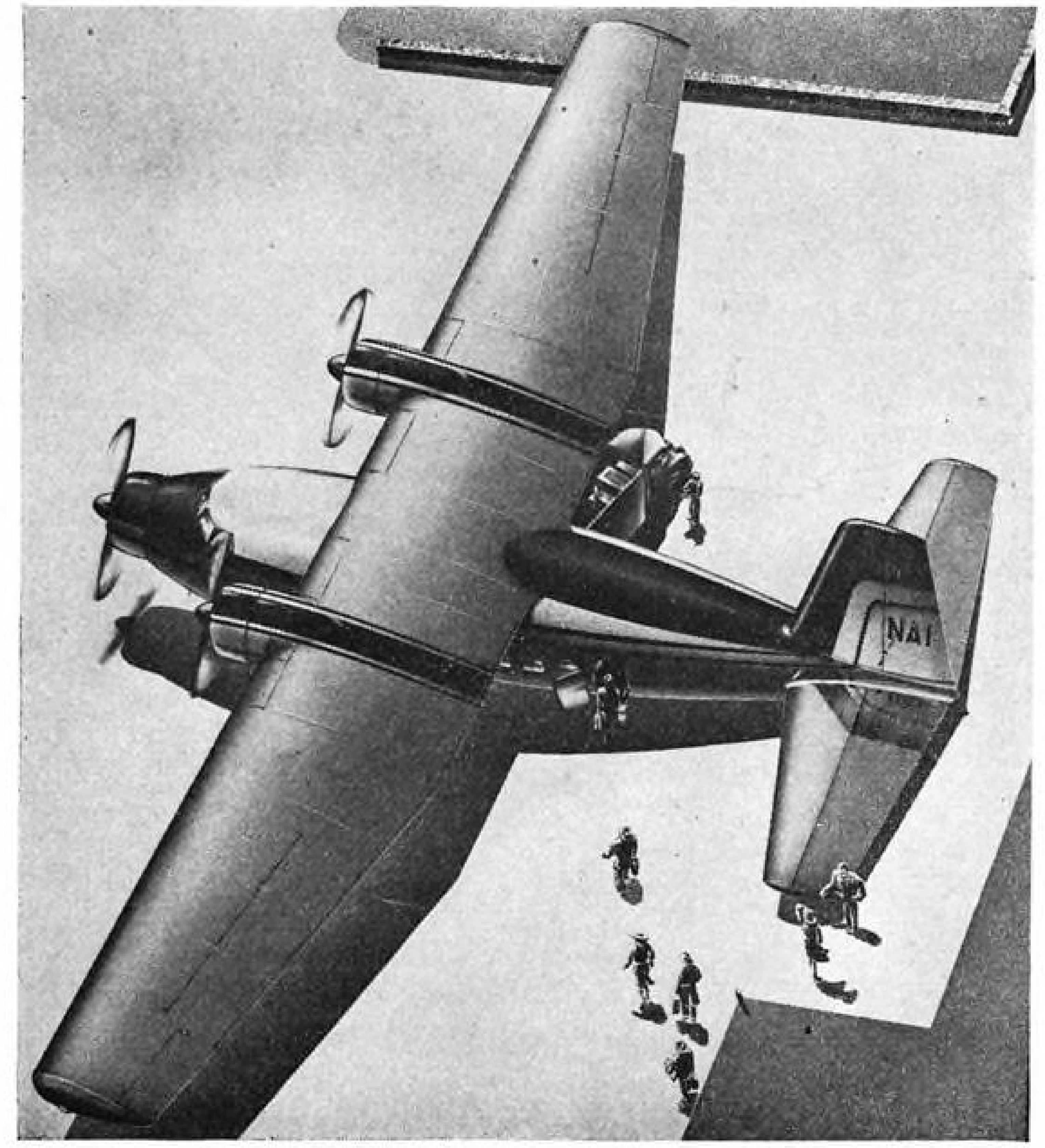
Price of the Mallard is $115,000, and Grumman reports reception of orders from airline, corporation, and individual sources.

Specifications and Data

Span	66 ft. 8 in.
Length	48 ft. 4 in.
Height	19 ft. 4 in.
Wing area	444 sq. ft.
Gross wt.	12,500 lb.
Empty wt. (less radio)	8,870 lb.
High speed	215 mph.
Cruising speed (55% power)	180 mph.
Climb (sea level)	1,320 fpm.
Single engine ceiling	10,500 ft.
Range, 2 crew,	
5 pass., 55 lb. baggage	1,128 mi.
6 pass., 200 lb. baggage	1,030 mi.
8 pass., 300 lb. baggage	695 mi.
Power plants	two 600 hp. Pratt & Whitney H Wasps
Propellers	Hamilton Standard constant speed Hydromatic

NORTHROP PIONEER IS TRIMOTOR WORKHORSE

Designed to get in and out of small, rough fields carrying heavy loads, craft is stated to be readily adaptable to carrying varied cargo-passenger loads at low operating cost.



Artist's view of Northrop Pioneer trimotor loading up passengers and cargo simultaneously. Note full-span split flaps, also retractable ailerons like those used on P-61. Pioneer's landing speed is estimated as slightly over 60 mph.

PLANNED to combine agility, capacity, and economical operation, Northrop's new Pioneer trimotor cargo-or-passenger carrier is specifically aimed at serving operators in rugged territories where all-around utility is prized over luxury and high speeds. The prototype is scheduled to fly this month.

General performance figures released by the company show that the craft is designed to take off in 700 ft. at a gross weight of 25,000 lb. (allowing 10,600 lb. useful load), while at the same weight it will land in 750 ft. Carrying 5,600 lb. useful load, landing and takeoff runs would be 450 ft. and 600 ft., respectively. It's further stated that the Pioneer is expected to carry an 8,500 lb. payload for 300 miles at a specially low cost per ton-mile. Fuel capacity is 1,000 gal., allowing a 1,750-mi. maximum range. Maximum cruising speed is estimated at 185 mph. at 10,000 ft., servicing ceiling as 21,000 ft., and absolute ceiling on one engine as 15,000 ft.

Either Wright 744C7BA1 engines rated at 800-hp. takeoff (600 meto hp.), or Pratt & Whitney R-1340s at 600 hp. each for takeoff and 550 meto, can be fitted. Both are package units, allowing quick demounting with use of simple tools.

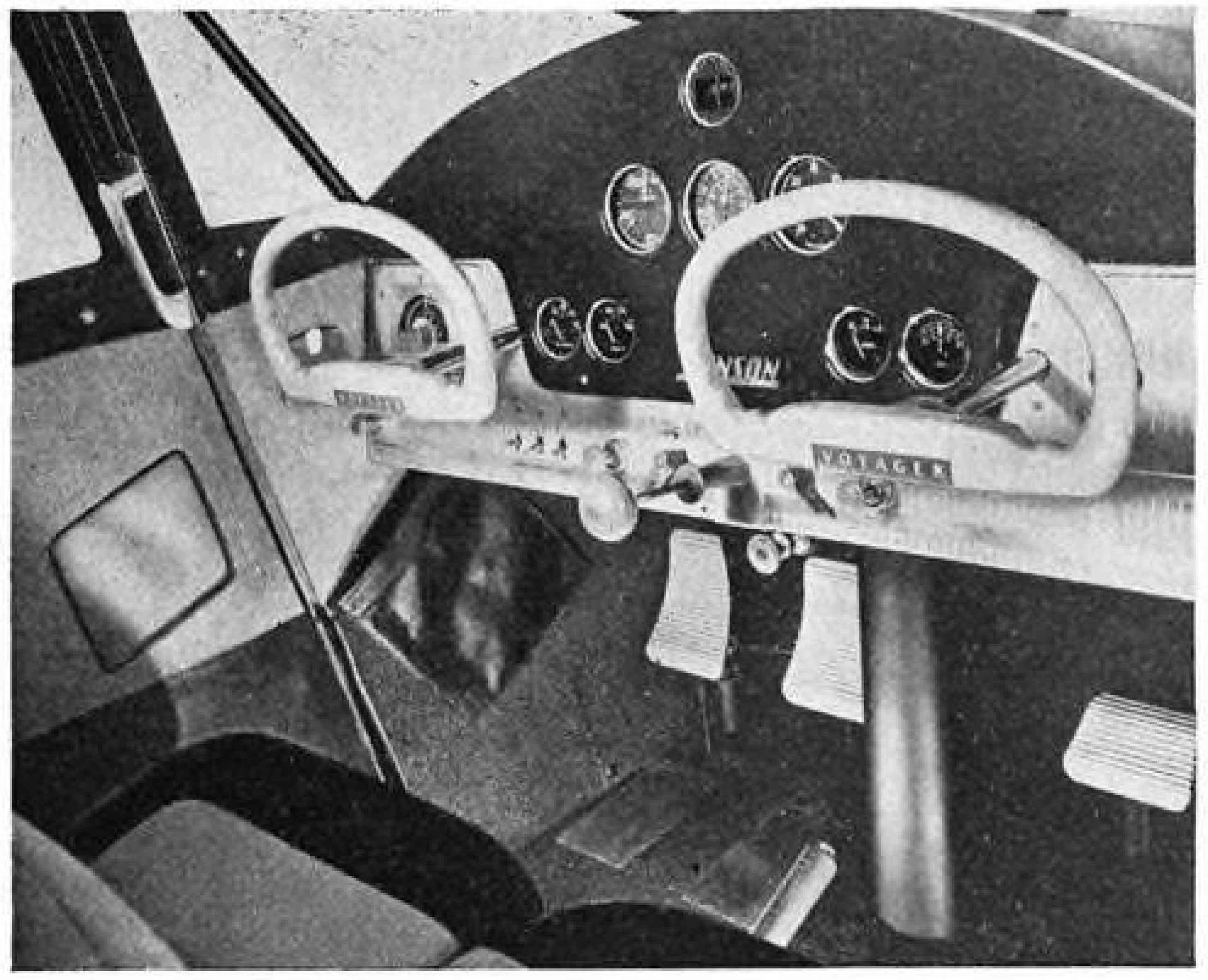
Cabin dimensions are generous, to permit bulk loading of varied cargos. Cabin height is given as 79 in., width up to 115 in., and the cargo door measures 72 x 70 in. This door is located near the plane's C.G., with the floor at truck-bed level. A hatch beneath the nose permits loading cargo up to 36 ft. in length. Floor angle is 6 deg. Up to 30 passengers may be carried in the Pioneer in addition to some cargo. Seats are said to be easily removable, and tie-down rings can be fitted within a very short time. Cabin floor is watertight and can be hosed down for cleaning.

Cockpit has been laid out as a roomy unit, yet with all controls grouped to allow one-man operation if necessary. Instruments are arranged to eliminate unnecessary eye "travel". Seats are fully adjustable, and the large windshield area has been designed for maximum visibility.

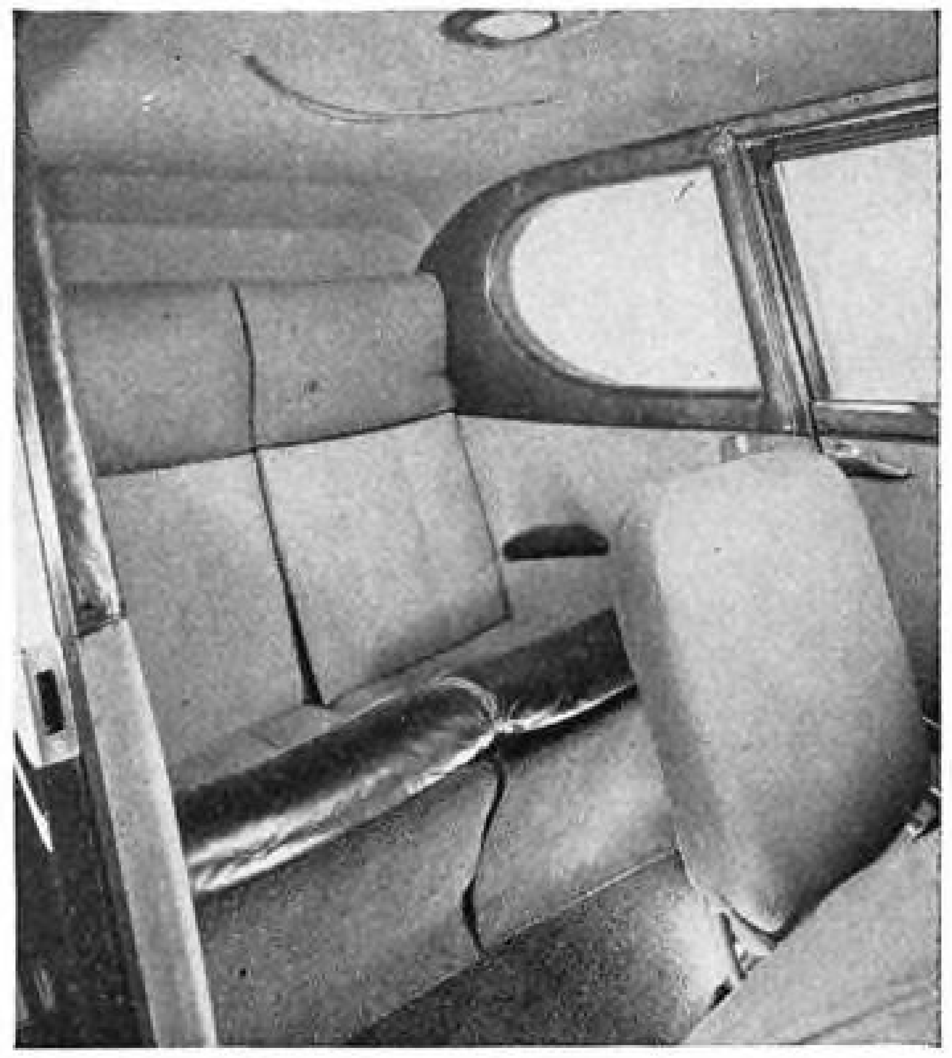
Wings are of multi-cellular stressed-skin construction, and the leading edges are hinged to permit easy access to controls, plumbing, wiring, etc., all of which are routed through this area. Mareng fuel cells are installed through the front spar, eliminating tank bay stress doors.

Landing gear is conventional fixed type, with oleo shock struts having 10 in. travel. This type of gear was selected as a result of surveys conducted on Central American cargo hauls, where Northrop technicians decided that fixed landing gears were most favored when strength and economy of operation were considered.

Dimensions: Span 85 ft., length 60 ft. 7 in., fuselage dia. 10 ft., landing gear tread 21 ft. 3 in., wheelbase 35 ft. 7 in., prop dia. 12 ft., wing root chord 15 ft. 6 in., tip chord 8 ft. 7 in., wing area 1,100 sq. ft., wing loading 22.72 lb./sq. ft., horizontal stabilizer span 32 ft. 6 in., and height of vertical fin 13 ft. 4 in.



Instrument panel and controls in 1947 Stinson Voyager, showing attractive usage of metal and plastics. At left end of panel is radio receiver and 3,105-kc. transmitter, and below these is map pocket, which also holds "mike". All fittings are satin metal, and front seats have foam-rubber cushions. Windshield and windows are of Plexiglas. Cruising speed is given as 125 mph., and useful load as 1,006 lb. Load figure represents 86% of craft's own weight.



Rear seats have padded hair and cotton cushions with Koroseal covered knee rolls and trim. In addition to fitting dual mufflers to 150-hp. Franklin, further cabin noise insulation is provided through use of 120-sq. ft. of Fiberglas blankets, weighing but 2½ lb. Note dome light and speaker in roof. Back seats can be readily removed and 600 lb. of cargo carried.

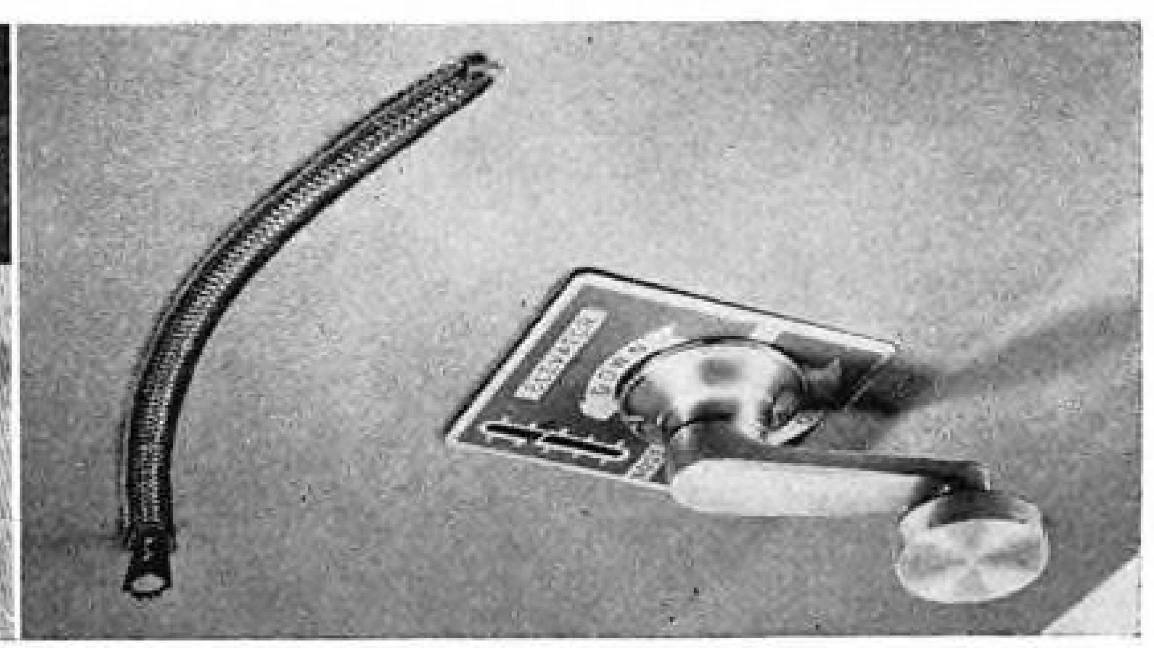
Stinson Reveals 1947 Voyager

Latest version of four-placer is deluxe combination personal plane or light cargo hauler.

First of next year's crop of personal planes to be announced are two new versions of the Stinson 150 Voyager—a deluxe four-seat family model, and a utility type named the Flying Station Wagon.

Standard equipment for the new craft is listed as follows: Two-way radio, antenna, fixed homing loop, sealed-beam landing lights, avigation lights, battery, starter, engine-driven generator, dual wheel controls, hydraulic brakes, cabin dome light and loudspeaker unit, ash trays, arm rests on the rear seats, and glove compartment.

Upholstery is tan pin-striped fabric. Shown here are ash tray and satin-finish door handle.



Neat design and workmanship extends to small details such as trim-tab control, which is mounted on cabin roof.

Dallas Firm Grooms Four-Seater

Exceptional stability, fast climb, and high speed are stated to feature Lycoming-powered Weatherly-Campbell Colt. Dual taper of wings is particularly noticeable in this flight view.

Weatherly-Campbell, fixed base operator and subcontractor, reveals new Colt high-wing all-metal craft, stated to be planned for mass output.

Scheduled for production early next year and tagged at about $5,000, a new four-place personal monoplane named the Colt is undergoing CAA flight tests by its maker, the Weatherly-Campbell Aircraft Co. of Dallas.

Performance data gained thus far show the Colt to cruise at 140 mph. at 8,000 ft. on a 190-hp. Lycoming using a fixed pitch prop. Top speed is said to be 160 mph., maximum range 750 mi., and, with a full load including radio, 120 lb. of baggage can be carried. A 185-hp. Continental is listed as an optional power plant.

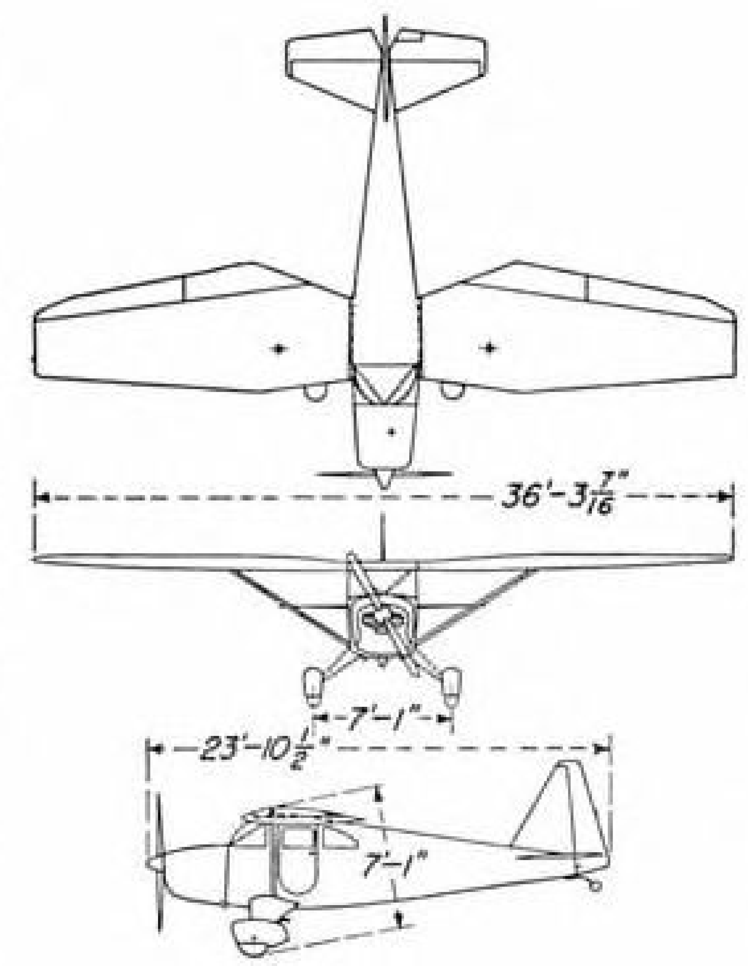
Originally designed by Don Luscombe and Fred Knack under Part .04 of CAR, Weatherly-Campbell re-engineered and simplified the basic design to comply with new CAR Part .03.

The Colt's fuselage is all-metal monocoque construction, and the wings are of metal monospar compound taper design, braced by a single strut on each side. One degree of dihedral is utilized. Flaps are mechanically operated and can be adjusted to any of three positions. With full flaps, landing speed is said to be 52 mph.

Cabin is fully soundproofed, and there are two seats in front (with hinged backs) and a rear double seat. Flight instruments are shock mounted. Easy taxiing, particularly over rough ground, is made possible by the wide tread (7 ft. 1 in.) of the streamlined pants-enclosed landing gear.

Simplification of the structure has been the aim in order to keep costs and price down. Extensive use of large, flat skin sections will eliminate need for formed sections and detail parts, thus permitting use of standard machine tools.

Raymond Weatherly and William Campbell have been active in aircraft sales, distribution, service, repair, construction, and design for a number of years. During the war, the company handled difficult subassembly fabrication for Lockheed, NAA, Convair, and others. Present Weatherly-Campbell hq. is at the new Highland Park Airport, north of Dallas.



Specifications and Data

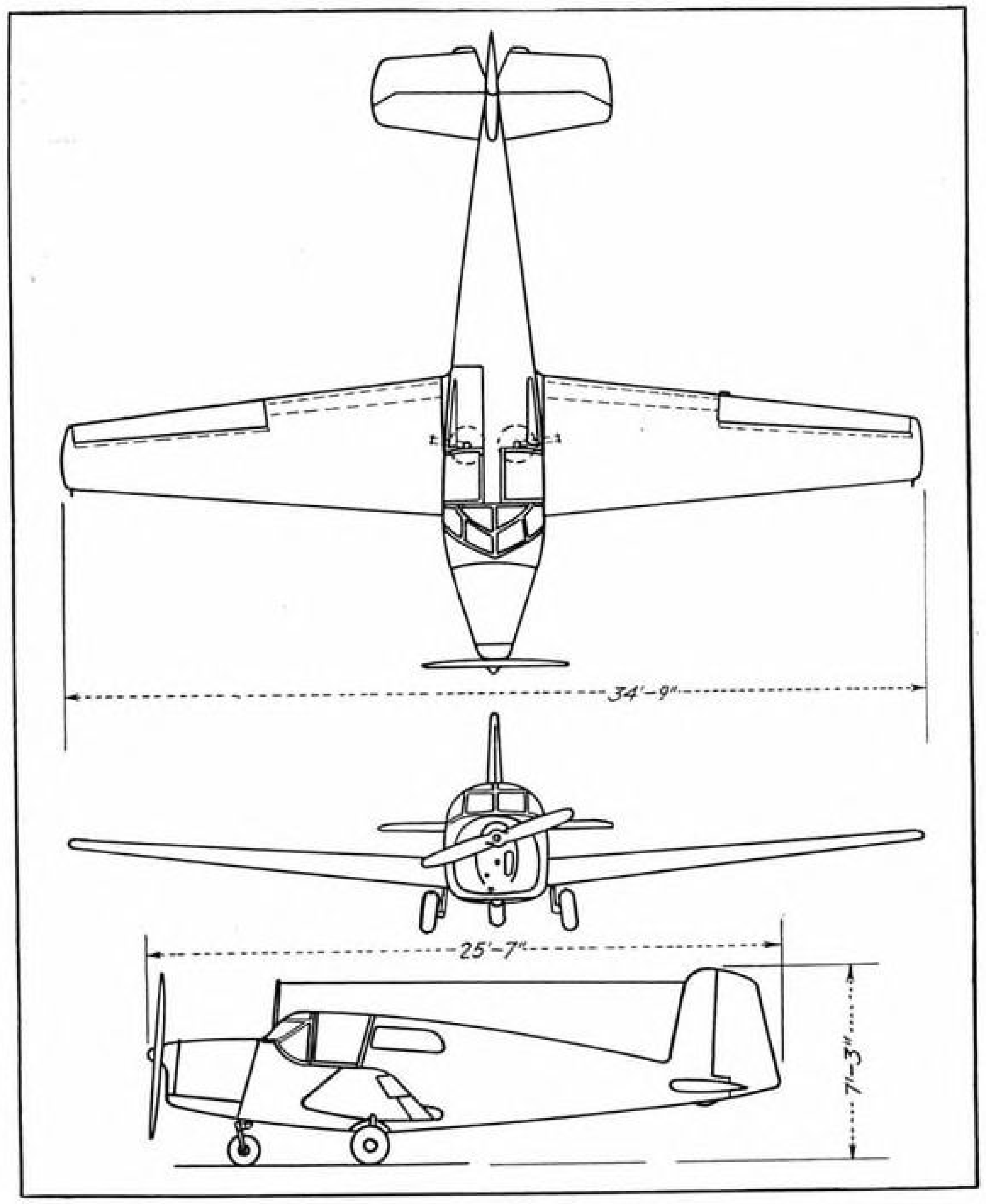
Span	36 ft. 3 in.
Length	23 ft. 10½ in.
Height	7 ft. 1 in.
Tread	7 ft. 1 in.
Wing area	186 sq. ft.
Wing loading	14 lb./sq. ft.
Power loading	13.7 lb./hp.
Gross weight	2,600 lb.
Empty weight	1,400 lb.
Baggage capacity	120 lb.
Top speed	160 mph.
Cruising speed	140 mph.
Landing speed	52 mph.
Initial rate of climb	1,000 fpm.
Range	750 mi.
Seating	4
Power	190-hp. Lycoming or 185-hp. Continental
Price	about $5,000

Swedish Concern Unveils Postwar Civil Planes

Svenska Aeroplan A.B. eases off on military output to produce light high-performance three-placer; also develops medium transport to U. S. design requirements.

With the end of hostilities, renewed activity in civilian aircraft production has been noted in Sweden. An example of this is the work being done by Svenska Aeroplan A. B. (Saab), of Linköping, which has the Saab-91 personal plane in production, and a medium-size 24-32 passenger airliner under development.

The small three-seater 91 Safir is a low-wing craft mostly of Alclad construction, powered by a 130-hp. DH Gipsy Major engine fitted with a fixed pitch prop. Single-spar cantilever wings are metal covered up to the spar, with rear portion fabric covered. Plan shape is tapered, with square wing tips, and base-to-tip chord ratio is given as 1:0.45. Washout is said to be considerable.



Saab-91 three-place personal plane with 130-hp. DH Gipsy Major.

Each wing is attached to the fuselage by means of a vertical and a horizontal bolt. Automatic wing-joint couplings of flap and aileron control rods, and of the pitot tube, make for simplified assembly or disassembly. Movable control surfaces are fabric-covered Alclad structures. All-metal split flaps are mechanically operated.

A tricycle undercarriage is utilized, mechanically retracted into the fuselage bottom, leaving a portion of the nosewheel protruding. Oleo-damped spring shock absorbers are used, and brakes are hydraulically operated by separate toe pedals.

Width of the cabin interior is said to be 4 ft. Accessibility is by means of three separate hinged panels, which may be released in emergency. Dual controls with adjustable rudder pedals are fitted. Ball bearings are used throughout the control mechanisms. Standard equipment includes airspeed indicator; altimeter; compass; rpm. indicator; fuel, fuel pressure, oil pressure and oil temperature gages; first aid kit; and fire extinguisher.

Fuel capacity is given as 38.4 gal., and fuel tank filler is stated to be easily accessible under a spring-lock shutter.

Specification figures give the Safir a top speed of 146 mph. at 2,350 rpm., cruising speed of 127 mph. at 2,100 rpm., and stalling speed of 50 mph. Takeoff from grass is stated to take 590 ft., while landing run is 500 ft. Rate of climb from sea level is 830 fpm., and maximum range at cruising speed is 650 mi. These figures are based on a gross weight of 2,200 lb. Weight empty is said to be 1,280-1,350 lb., depending upon overload carried, which may be up to 175 lb. under certain conditions.

Spanning 34 ft. 9 in., the Safir has wing area of 146 sq. ft., aspect ratio of 8.3, wing loading of 15 lb./sq. ft., and power loading of 17 lb./hp. Length is 25 ft. 7 in., and height 7 ft. 3 in.

Saab-90 Airliner

Named the Scandia, the Saab-90 design has been strongly influenced by U. S. practice; in fact this craft has been planned to meet ATA requirements and Civil Air Regulations.

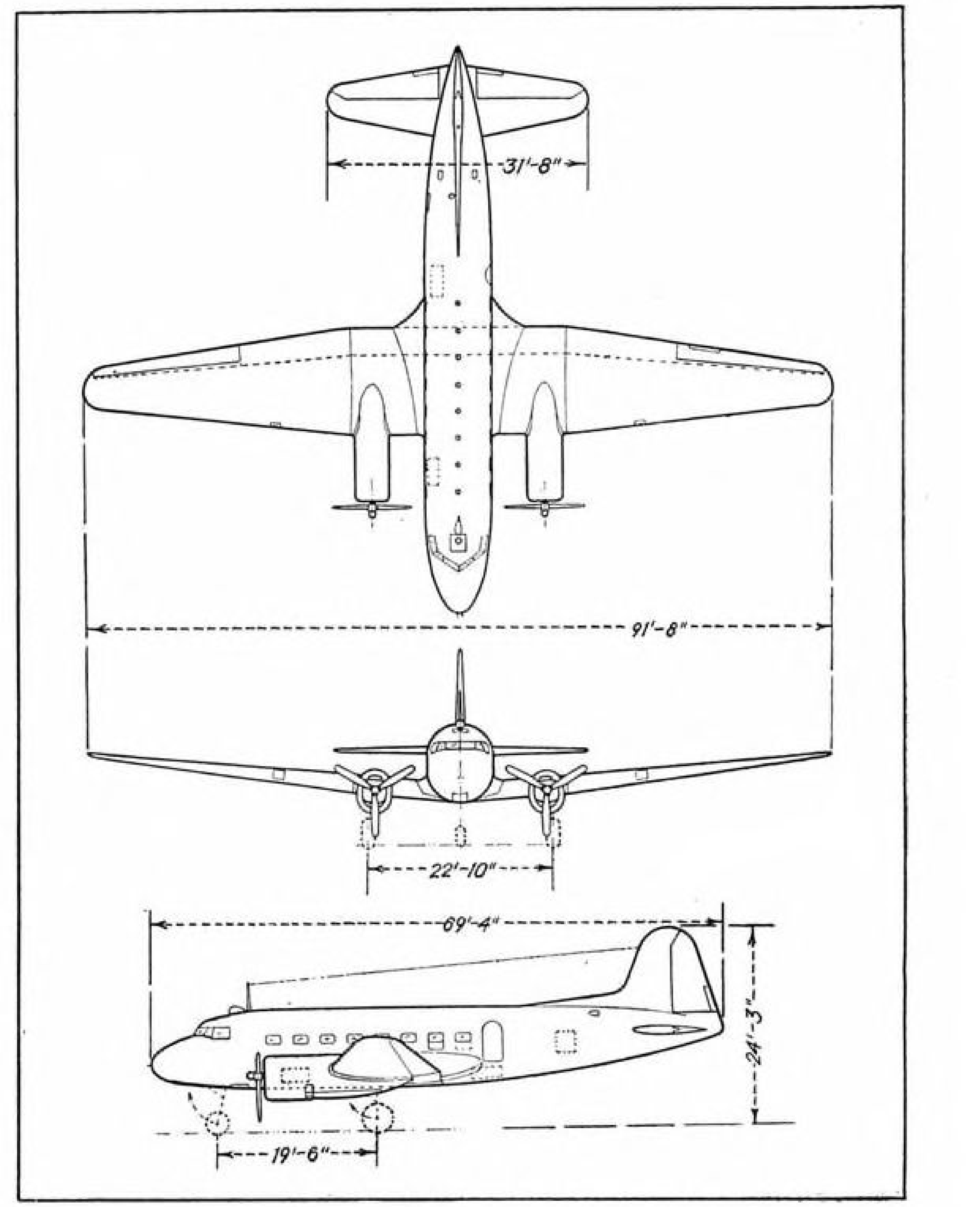
Construction is to be entirely of metal. Scandia performance is calculated on installation of two Pratt & Whitney R-2000-13 engines of 1,450 bhp. With a gross weight of 30,000 lb., empty weight of 18,900 lb., and disposable load of 10,220 lb., the craft would have a maximum speed of 251 mph., at critical altitude (6,800 ft.). Speed at 60% power would be 206 mph., and stalling speed is figured at 75 mph. Service ceiling with high impeller ratio is to be 27,800 ft., and under the same condition, one-engine ceiling is placed at 10,800 ft.

Span is to be 91 ft. 8 in., length 69 ft. 4 in., height 24 ft. 3 in., tread 22 ft. 10 in., and wheel base 19 ft. 6 in. Cabin door sill is to be 8 ft. 2 in. from the ground. Total wing area is planned at 922 sq. ft., flap area 167 sq. ft., aileron area 67 sq. ft., horizontal tail area 220 sq. ft., vertical tail area 115 sq. ft., and aspect ratio 9.15.

Total cargo capacity is to be 375 cu. ft., with 80 cu. ft. forward, 70 cu. ft. in the middle hold, and 225 cu. ft. in the aft hold.

Safety considerations have been provided for in the Scandia's characteristics. Anti-icing system would be of the thermal type along wing and empennage leading edges, between double windshields, and through the aerial mast. Propellers would be protected by anti-icing liquid. All fuel (765 gal. capacity) would be carried in the outer wing panels, and in event of emergency, fuel could be jettisoned through wing tip outlets by means of electrically driven pumps. Windshields would conform with CAR to sustain impact of birds.

Operating figures for the Scandia have been estimated under the following conditions: 30,000-lb. gross weight; 10,000-ft. cruising altitude; 10-mph. headwind; reserve fuel for 45-plus-min. at airspeed 25% above speed for maximum range; fuel and oil consumption computed with regard to consumption during climb to cruising altitude, corrected for 10 mph. headwind and sfc. 5% above that stated by engine maker; block-to-block speed calculated with regard to time required for climb to cruising altitude, plus about seven minutes for maneuvering; and passenger weight at 200 lb.



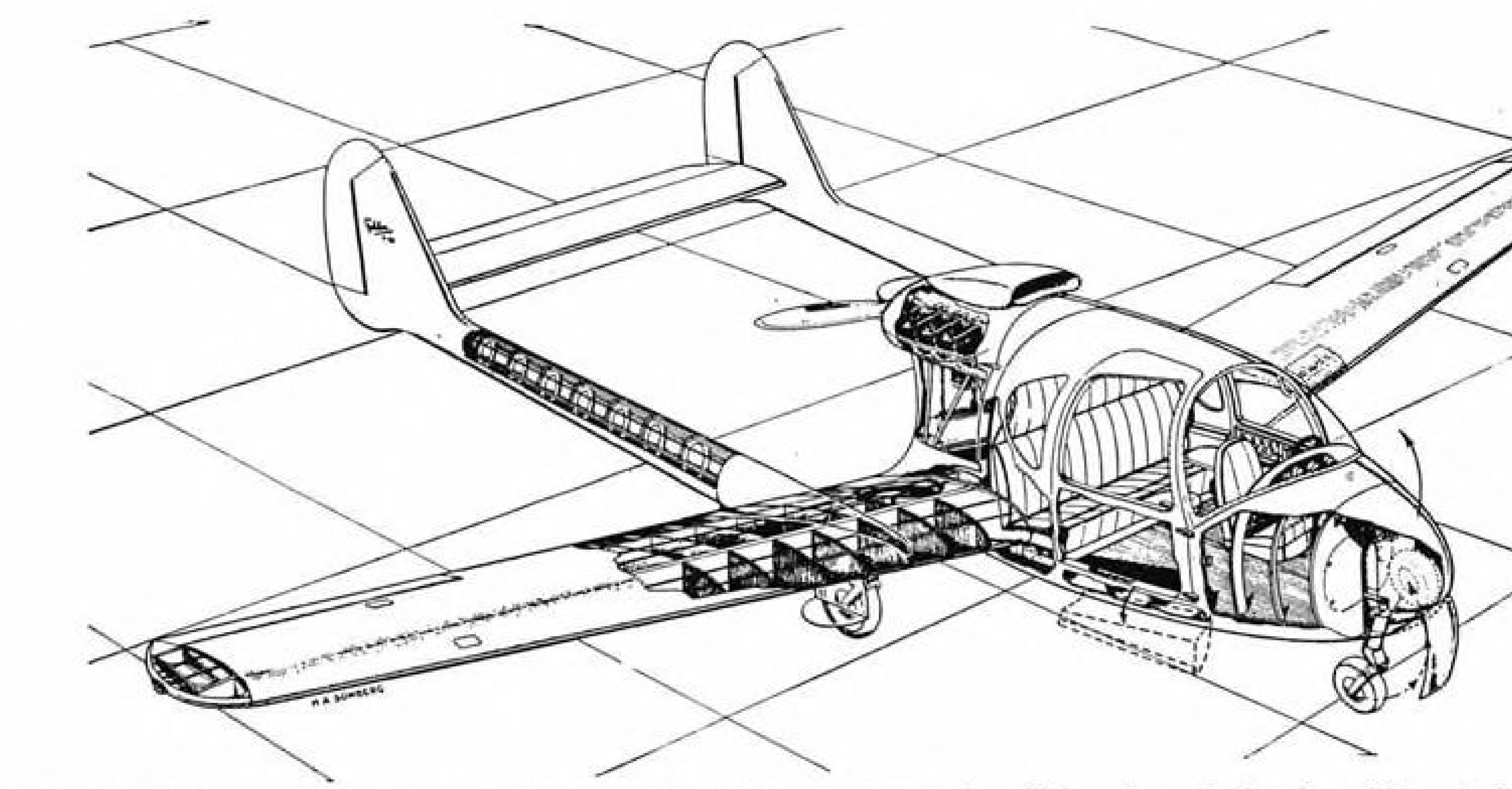
Proposed Saab-90, 24-32 passenger airliner with two 1,450-hp. P&W Twin Wasps.

Payload and block-to-block speed at 60% sea level rated meto power, 720-hp. each engine are given as follows for 200 and 620 mi. (latter figures in parenthesis): True airspeed 205 mph. (207 mph.); block-to-block speed 165 mph. (186 mph.); operating weight empty 19,780 lb. (same); reserve fuel 1,090 lb. (same); reserve oil 37 lb. (same); fuel consumption 913 lb. (2,350 lb.); oil consumption 29 lb. (77 lb.); and payload 8,151 lb. (6,666 lb.).

Company Background

Svenska Aeroplan A. B., with main office and a factory at Linköping, and another plant at Trollhättan, was founded in 1937. When the war began, the company's entire resources were scheduled to military craft for the Swedish Air Force. A firm foundation had already been established, since Saab had earlier experience in such design through having acquired licenses from North American Aviation and Northrop Div. of Douglas Aircraft. With this knowledge, the company began designs of its own, engaging temporarily the services of some 50 American designers to introduce stressed skin calculation methods.

During the war, Saab developed the Saab-17 single-engine and Saab-18 twin-engine dive bombers, and also the Saab-21 twin-boom pusher fighter. Also taken on was conversion of several Boeing B-17F and G Flying Fortresses into commercial transports. These latter craft had made forced landings in Sweden, were interned, and then were acquired by the government. They later made survey flights across the North and South Atlantic in preparation for scheduled service by Swedish Air Lines.



Sectioned drawing of new Fokker F.25 shows unusual seating arrangement for pilot and passengers, hinged built-in step, and twin-spar solid-rib construction of wing. Using U. S. engines of 185-190 hp., craft is said to have 134-135-mph. top speed and 530-mi. range.

Fokker Producing Personal Four-Placer

Netherlands concern building 100 F.25 Promotors. Craft is a twin-boom pusher model offered with choice of American engines.

Although extensively damaged during the war, N. V. Nederlandsche Vliegtuigenfabriek Fokker has by now reco[illegible]red sufficiently to have started produ[illegible]n of its first postwar aircraft, the t[illegible]-seater F.25 Promotor, of which [illegible]hundred are now being built for Fr[illegible] Diepen Vliegtuigen N. V., Fokker's [illegible]rldwide distributor for all is persona[illegible]lanes.

One [illegible] is the unusual seating arrangement, [illegible]ing a pilot at the left-hand side in th[illegible]forward part of the cabin and accomm[illegible]tions for three passengers on a loung[illegible] type seat located behind him. The pilot's seat is horizontally adjustable, and if but two people are occupying the rear seat, they may pull out a large arm rest that normally forms part of the back cushions. Since the cabin is located in front of the wing's leading edge, it's said that fine visibility is available to all. Two folding tables and three ash trays are provided, while on the left side of the fuselage is a [illegible]upboard for thermos flasks and [illegible]lasses.

Mixed wood-and-metal construction [illegible] utilized. The fuselage is built up of [illegible]od and has a metal nosepiece, which s[illegible]ts open. The rear part of the cabin, w[illegible]h mounts the engine in a welded ste[illegible]-tube frame, is covered with de[illegible] to provide accessibi[illegible]y to the power plant. The Fokker F.25 [illegible]s designed to use either a Lycoming 0-435 A, giving 190 hp. at 2,550 [illegible]pm., or a Continental E-185 of 185 hp. [illegible]2,300 rpm. Either engine would employ a two-blade two-position wood prop. Fuel capacity is given as 52.83 gal.

A ventilation and heating system is provided in the cabin, and luggage is stowed beneath the seats. Conventional wheel and pedal controls are fitted, and hydraulically operated brakes and flaps are standard. Instruments included are as follows: Sensitive altimeter, airspeed indicator, artificial horizon, directional gyro, tachometer, oil pressure and fuel pressure indicators, oil thermometer, fuel gage, ammeter, compass, and a watch.

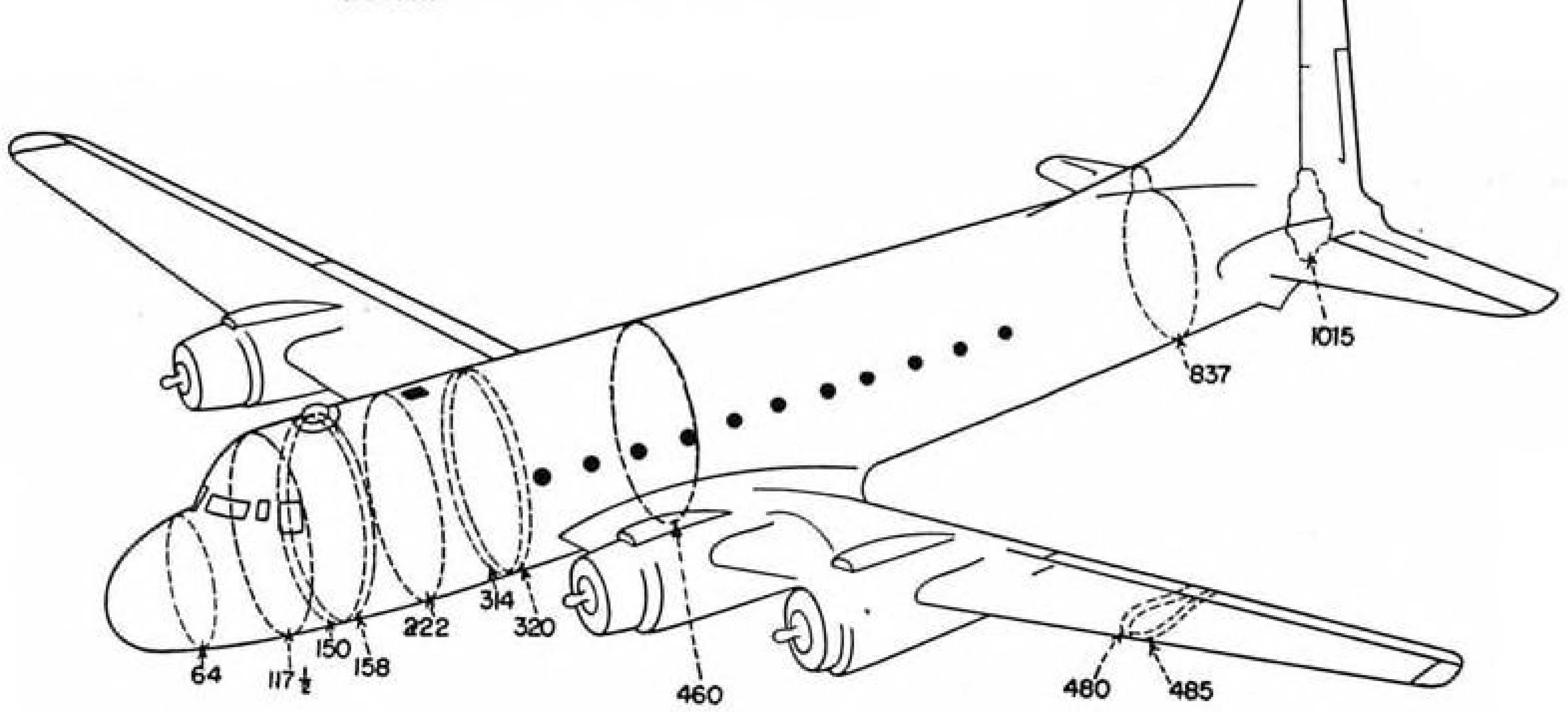
The low cantilever wing, made up in one unit, is of all-wood construction to permit low-cost easy repair in the field using simple tools. Two spars and plywood former ribs comprise the structure. Tailbooms and both vertical fins are of metal fabrication, while stabilizer, elevator and rudders are of wood with fabric covering. The elevator has a trim tab adjustable in flight.

Electrical equipment comprises a 12v. accumulator fed by an engine-driven generator. An electrical starter is combined with the generator, but an outside plug is also fitted so that it is not always necessary to use the accumulator for engine starts. Avigation, instrument, and cabin lights are provided, as well as signal lights to indicate positions of landing gear and flaps.

Specifications and Data

	190-hp. Lycoming	185-hp. Continental
Span	39.3 ft.	39.3 ft.
Length	27.8 ft.	27.8 ft.
Height	7.9 ft.	7.9 ft.
Wing area	188 sq. ft.	188 sq. ft.
Weight empty	2,032 lb.	1,988 lb.
Luggage	66 lb.	66 lb.
Gross weight	2,980 lb.	2,980 lb.
Power loading	15.7 lb./hp.	16.1 lb./hp.
Wing loading	15.9 lb./sq. ft.	15.9 lb./sq. ft
Top speed (sea level)	135 mph.	134 mph.
Cruising speed (3,300 ft.)	121 mph.	121 mph.
Range	530 mi.	530 mi.
Landing speed	56 mph.	56 mph.
Rate of climb (sea level)	550 fpm.	530 fpm.
Service ceiling	11,800 ft.	11,500 ft.
Absolute ceiling	14,400 ft.	14,000 ft.
Takeoff run	755 ft.	785 ft.
Landing run	490 ft.	490 ft.
Seating	4	4

Phantom view of Douglas DC-4, showing stations.



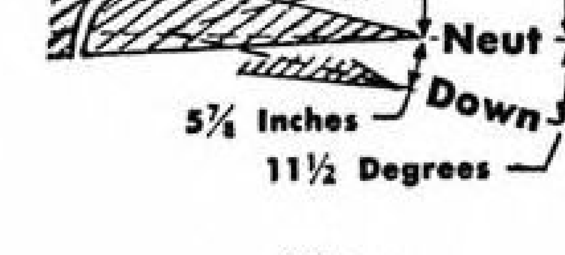
Up-To-Date Rigging For DC-4 Flight Controls

In view of the extensive utilization of the Douglas DC-4, and considering, too, the modifications this craft has undergone in the process of conversion necessitated by commercial requirements, these timely and concise rigging specifications are presented. Covering the latest procedure as compiled by Douglas Service, they will prove a valuable aid to maintenance men in eliminating time-consuming labor.

Ailerons

Aileron control wheels should be locked in *neutral* position by placing a board across four top points of control wheels. Angular clearance of 135 (±1) deg. should be obtained between all fixed stops at cable drums in control column head, before wheels are locked. Lock control sector, between center and rear spars, with gust lock cockpit control, or by using C-clamps on gust lock mechanism. Aileron bellcrank at wing Sta. 485 should be placed in *neutral* and locked with V-block jigs. Bellcrank is in a *neutral* position when ends are equally distant from wing Sta. 485. Aileron torque tube at fuselage Sta. 117½ is in *neutral* position when center of notch in the side of large right hand pulley is aligned with aft edge of pulley guard. It may be held in this position with jigs.

Adjust aileron push-pull rods attaching the bellcranks to ailerons, so that aileron trailing edges are aligned with flap and wing tip trailing edges. Push-pull rod must have equalized rotation on self-aligning bearing on bellcrank. Attach fuselage aileron control cable terminals in large torque tube pulleys. Rig cables aft to cross-arm,



Aileron.

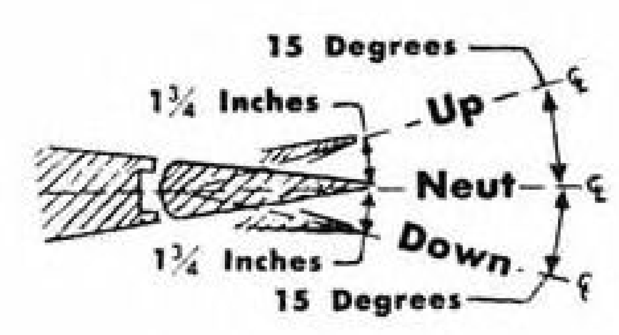
between center and rear spars so that aileron automatic pilot servo unit, which is connected in cable system on left side at Sta. 150 is in *neutral* position. With servo unit attaching bolts loosened, adjust servo piston until aft face of aft packing nut is 6⅜ (±⅛) in. from forward face of aft end fitting check nut. Servo unit attaching bolts should be tightened after proper tension has been placed on cables. Automatic pilot servo unit for all systems should be installed in this manner.

Rig cables from rear spar sector to wing bellcranks and adjust turnbuckles at wing Sta. 480 to proper cable tension. Cables routed to right wing bellcrank join and operate in bottom grooves of the sector. All turnbuckles in aileron cable system should have an equal amount of, but not over three, threads showing at each end of barrel.

If jigs are available, they should be installed on main outer wing bolts so that aileron travel can be checked. If not available, use protractors, tape, and a straight edge to set aileron throw. In checking aileron travel, hard throws should not be made until stops on outer wing aileron bellcrank bracket have been adjusted.

Aileron Tabs

In rigging cables for aileron tab, connect cables to turnbuckles in forward cargo compartment, Sta. 314; hell-hole, Sta. 320; wing, Sta. 222. On

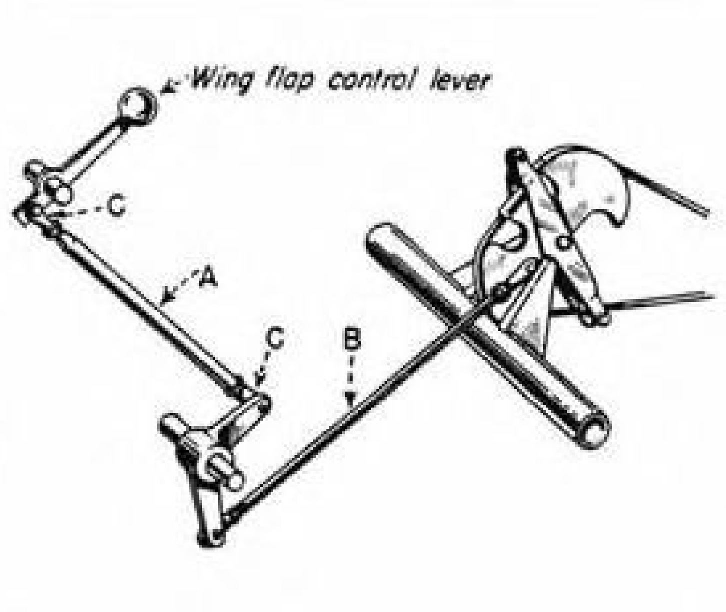


Aileron Trim Tab

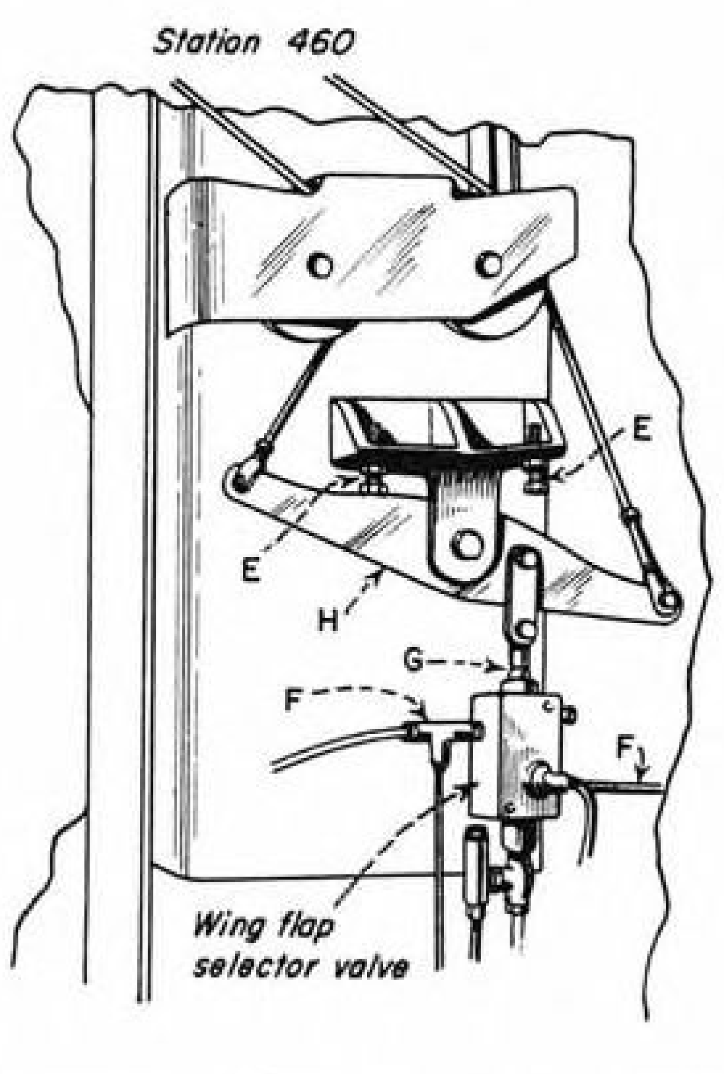
wing turnbuckles, threads should be buried flush. In hell-hole and forward cargo compartment, threads should be buried flush, plus three additional turns, and safetied. Set stops on tab control wheel to get equal and full throw on wheel. Wheel must rotate 6¼ turns. Turn wheel back 3⅛ turns and establish neutral point. With wheel in *neutral* position, check tab lock, and if adjustment is necessary, loosen rods at tab. Then, loosen locknuts on rod at cable drum and turn adjustment on rods so that when tab lines are up on inboard end, bolts at rod ends do not bind. Cable tension should then be checked and all turnbuckles safetied. Check for aileron tab throw.

Wing Flaps

Adjust control rods (A) and (B), so that rod (B) is as short as possible



and threads on rod (A) will just close witness hole in eyebolt (C). Control handle should then be placed in *neutral* position. Rig cables at turnbuckles in



lower cargo compartment to permit equal throw of control level in either direction from *neutral*. It may be necessary to adjust bellcrank stop-bolts (E). If this adjustment is necessary, disconnect the *up* and *down* lines (F) from valve. Operate hand pump slowly and move flap control level to bottom the piston (G) in valve. Stop-bolt should then be adjusted to bellcrank (H). Stop-bolt should be turned an additional half turn to prevent piston from bottoming, and lock nut tightened. Cables should then be rigged to tension.

With flaps in the full *down* position, connect inboard flap actuating strut yokes to flap actuating links and take up until approximately six or eight threads remain showing. Before raising flaps, be sure outboard strut pistons are up and cables clear. Flaps should then be raised slowly to the *up* position and a careful check made to insure that they do not rub or bind during this operation. With flaps in *up* position, again inspect cables to be sure they are not fouled, and are on pulleys. Tension should then be put on cables so that they will remain in position. While flap is in *up* position, check should also be made for proper venturi, trailing edge clearance, and flap droop.

Flap should then be placed in *down* position and adjustments made on actuating struts to get proper tolerances.

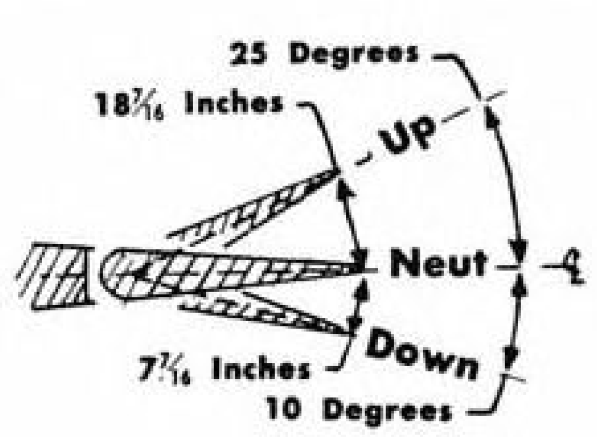
In connecting outboard struts, run yoke down on piston until holes in yoke align with wing flap hinge assemblies, and bolt will slip in place with least possible resistance. After securing all connections and proper clearance is obtained, rig cables to 250 +25 lb. and check for proper operation.

Elevators

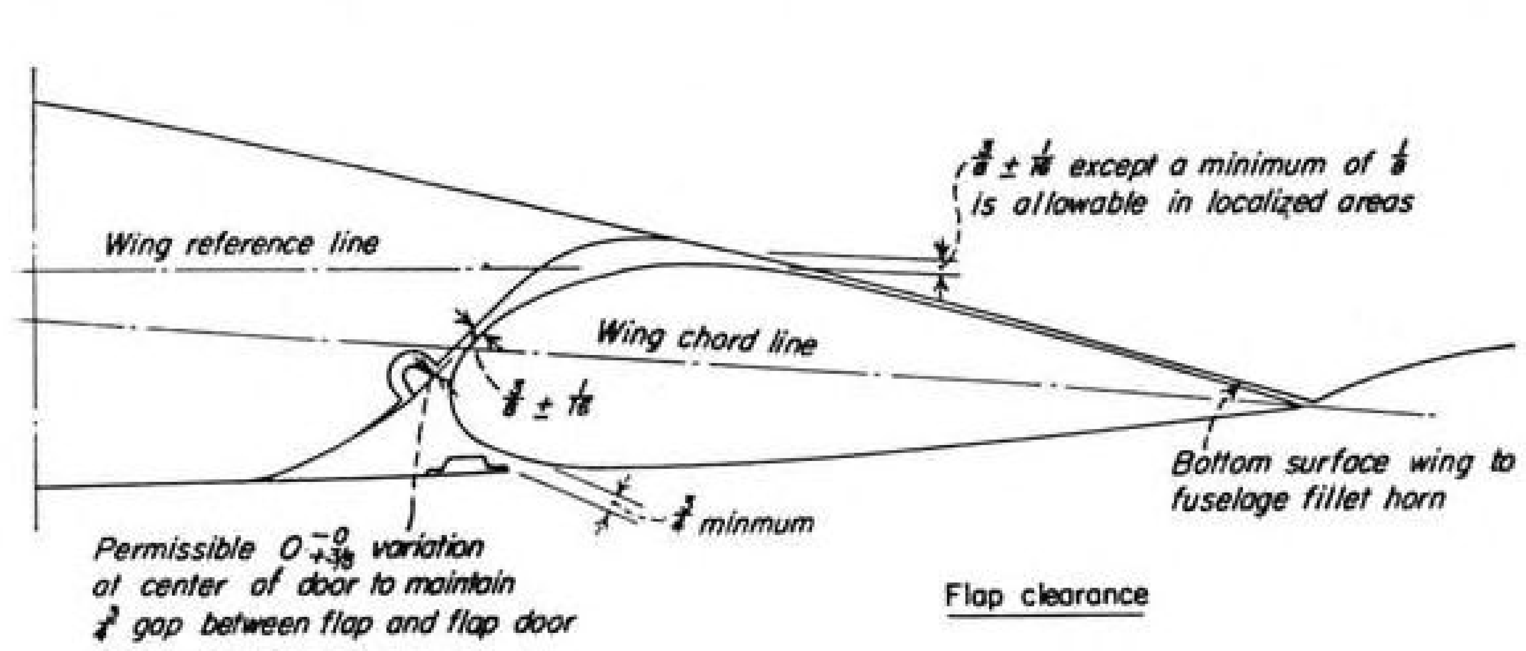
Elevator cables are generally connected up adjunctly with rudder cables as turnbuckles are in symmetrical alignment.

All control elements of elevator system should be locked. Move control column into *neutral* by positioning column posts 13½ (±½) deg. forward of vertical, and lock in position by using block jigs between movable stops on left column counterweight and rigid column stop. If elevator gust lock, located at Sta. 1015, has not been rigged and connot be locked in cockpit, it may be held locked by using C-clamps.

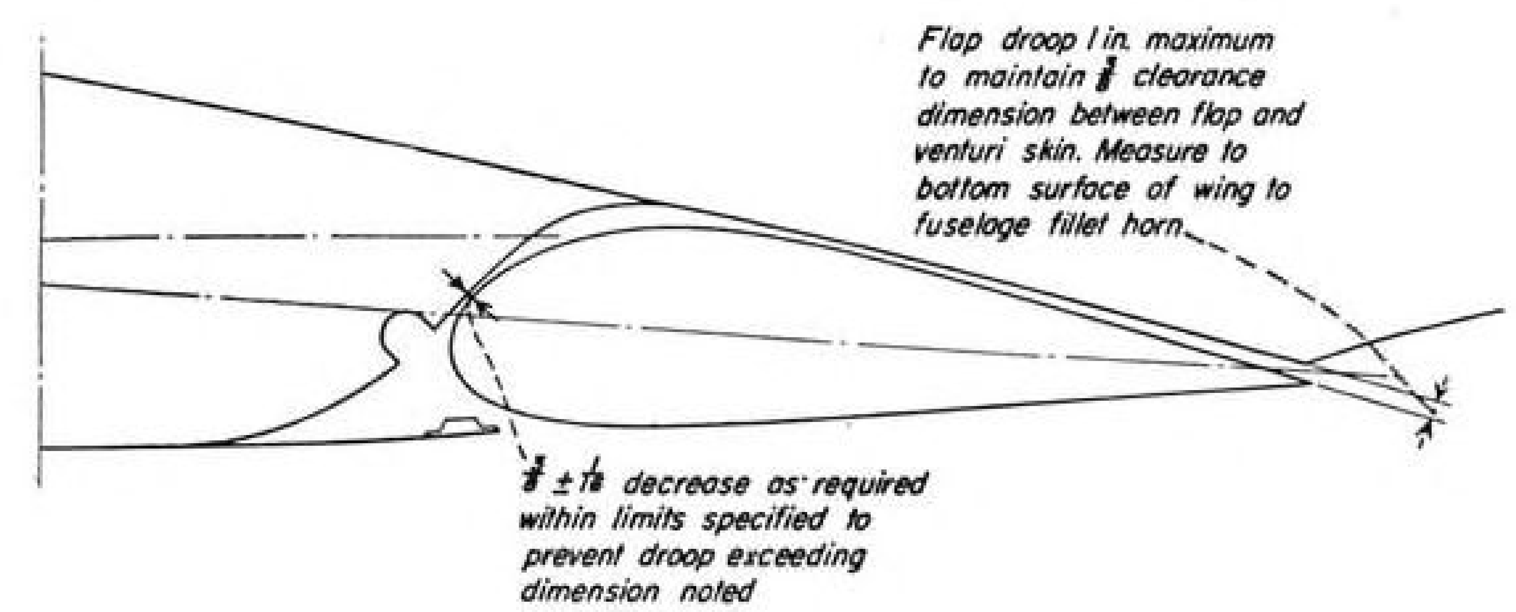
When placing proper tension on cables in forward cargo compartment, auto-pilot servo should be left free until cables are rigged. Slack in system



Elevator



Flap clearance

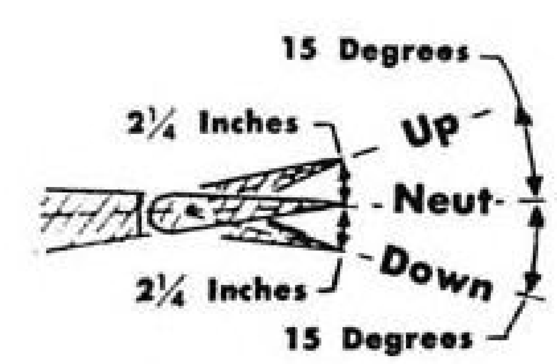


Flap clearance and droop data

may be taken up by turnbuckles at Stations 837 and 150. Cables should be checked for proper tension in aft section of forward cargo compartment. In checking for elevator throw, set stops for correct amount of travel for *up* and *down* positions in tailcone. Then check overthrow stops on pilot's control column with stick full forward, obtaining ½-in. clearance at stop aft and ⅛-in. clearance with stick full aft. If these adjustments are not obtainable, correction can be made on turnbuckles in forward cargo compartment. Check elevator for proper throw.

Elevator Tabs

Connect all cables and tighten tubes to proper tension as per cable chart installed in aft end of forward cargo compartment. All adjustments are



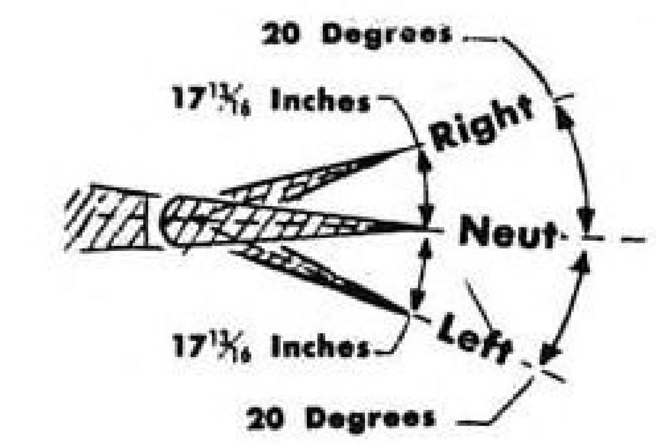
Elevator Trim Tab

made in the cargo compartment and tailcone.

Stops on pilot's and co-pilot's tab drum wheels on pedestal should be synchronized so that they will complete 6¼ turns. After *neutral* position is obtained by turning wheels back 3⅛ turns from stop, check should be made to insure 3⅛ turns in each direction. With wheel in this position, check tabs for *neutral* and proper alignment with elevators.

Rudder Cables

After all cables have been connected, lock rudder gust lock in *neutral*. Rudder pedals must be locked in *neutral* by placing flat board across pedals and clamping it in place with C-clamps. *Neutral* position will be obtained when pedals' pivot bolts are equally distant from bulkhead at Sta. 64. Adjust bus link and vertical push-rods so that vertical rod ends, torque tube centers, and torque pivot points are in alignment parallel to pilot's floor. *Neutral* position of rudder bellcrank at rudder hinge line is obtained by moving bottom yoke arm into vertical position. Bellcrank should be locked in this position with jigs. Take up cable tension on turnbuckles in forward cargo compartment at Sta. 158, at same time equalizing travel of rod at servo unit. If excessive adjustments are made, check throw rod on servo unit and adjust turnbuckles on each end so as to keep travel as even as possible. Throws may be set in tailcone by adding or subtracting washers under stop-bolts

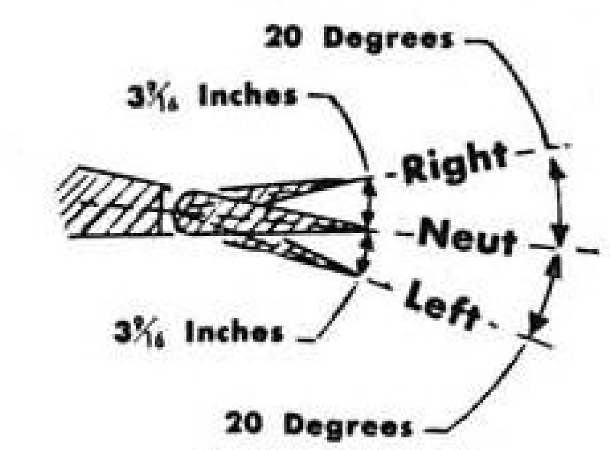


Rudder

until correct amount of travel is obtained. This is done by measuring from trailing edge of rudder to trailing edge of tailcone. Rudder pedals should then be checked to insure clearance of ½ in. between pedals and stops. This applies to all four pedals. Rudder should be checked for proper throw.

Rudder Tabs

All rudder tab connections are generally made when rudder cables are connected. This is done so that tab may be held in *neutral* while rudder rigging is being checked out. Rudder should

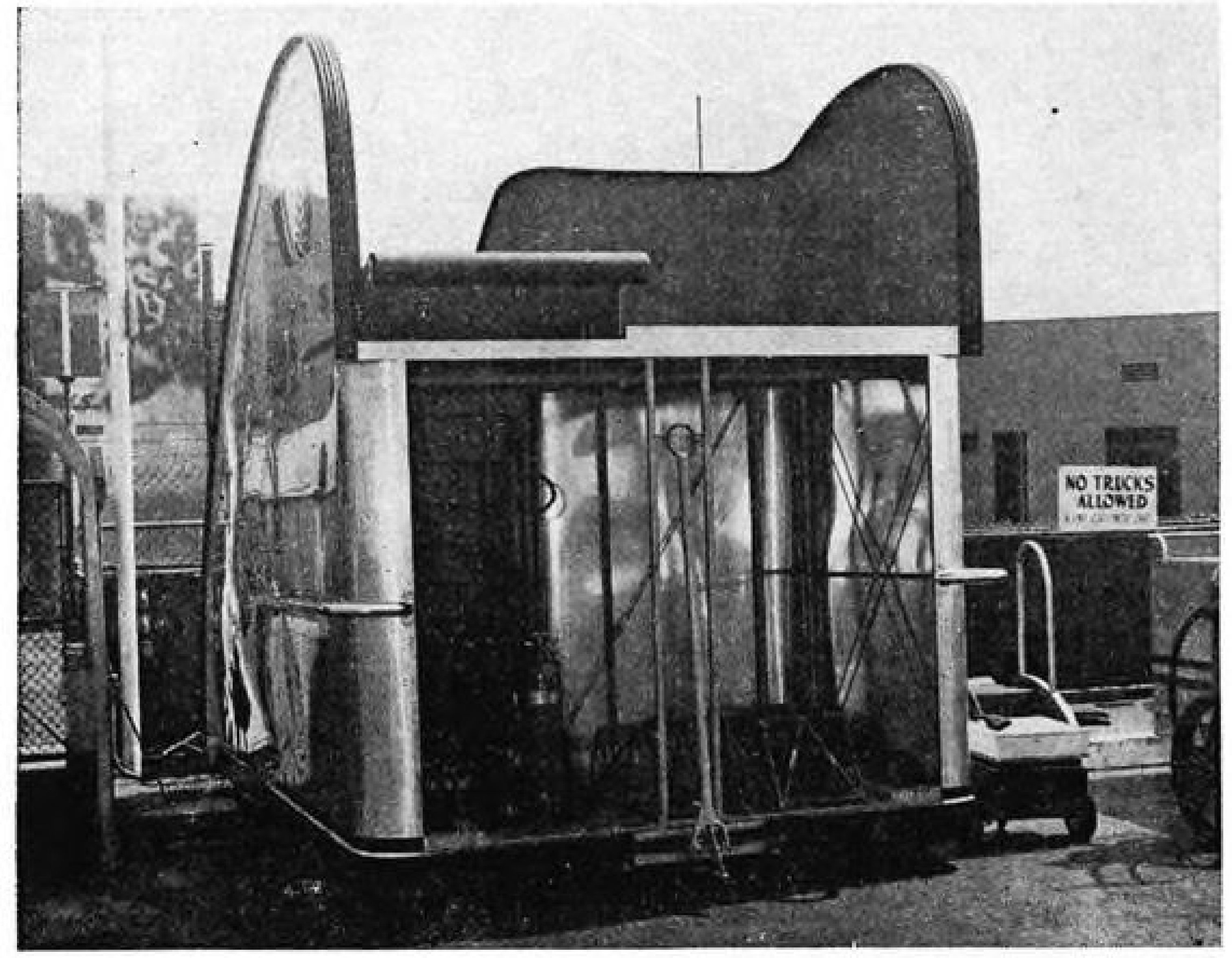


Rudder Trim Tab

be clamped in *neutral* position leaving tab free so that it can be checked for throw.

Rudder Flying Tabs

Rudder flying tab can only be checked by throw of rudder pedals with rudder in *neutral*. Flying tab and trim tab are incorporated in one unit, but are operated individually. Push right rudder pedal forward until rudder trailing edge has moved 20 (±1) deg. to right from *neutral*, and adjust right hand rudder stop on hinge line support to contact rigid stop. Push pedal still farther forward, and spring tab trailing edge should move to left 15 (±1) deg. from *neutral*. Tolerances to left are same, and there should be no play in the mechanism.



Loading-Stair Compartment Houses Ground Crew Equipment

•Utilizing what would ordinarily be waste space, this Douglas-designed loading stair features a rear storage compartment for handy and quick access to wheel chocks, portable fire extinguisher, landing gear locks, and other equipment for routine servicing and maintenance. Compartment also serves as standby shelter in inclement weather.

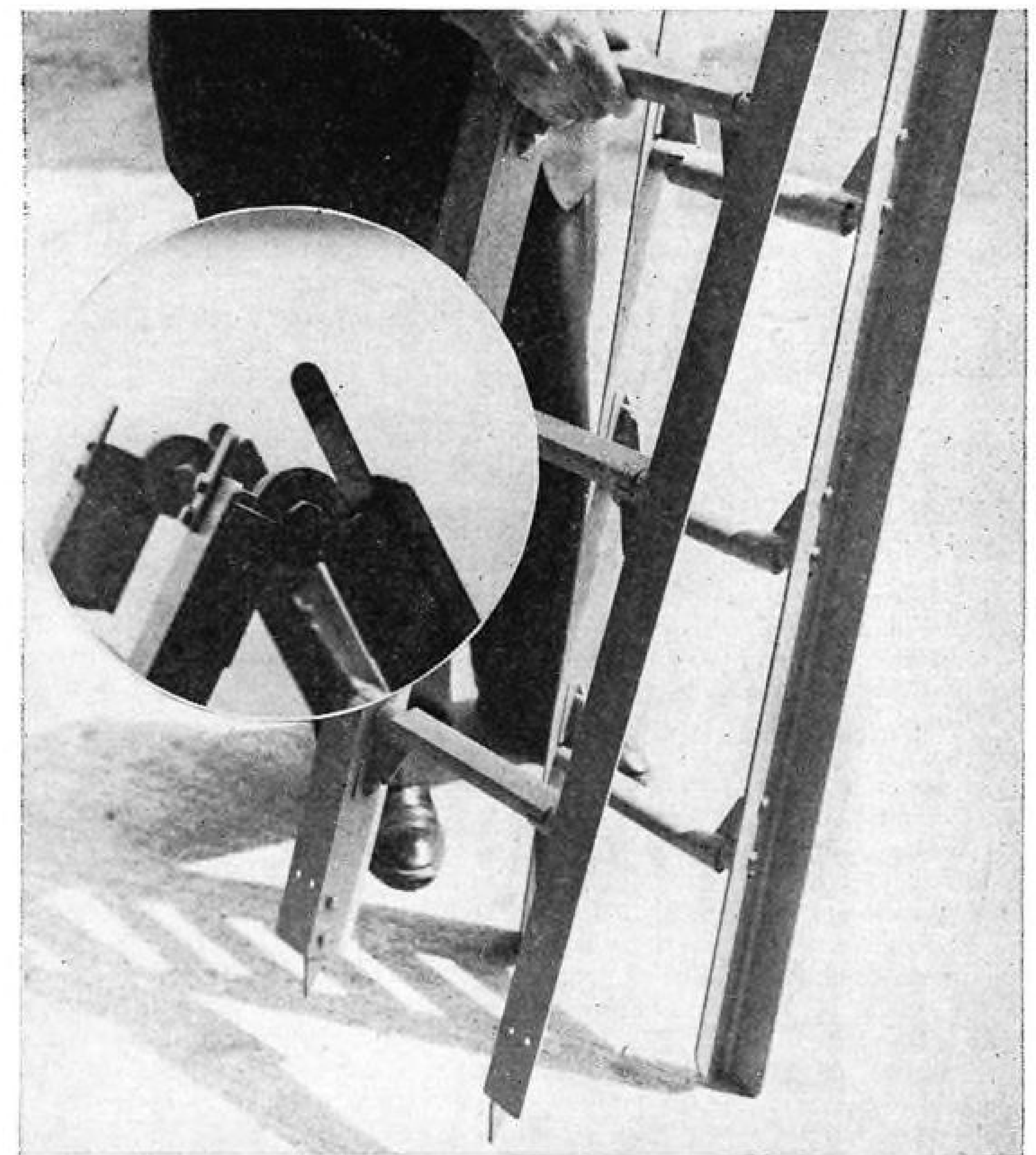
Unit is in test service with WAL at Burbank Air Terminal and with Air France.

Lightweight Folding Ladder Gives Firm Ground-Grip

•This jack-knife type ladder, offering interesting possibilities as a portable unit for on-the-spot maintenance, is constructed of magnesium and has metal-reinforced hickory rungs.

Weighing 21 lb.—approximately 10 lb. less than conventional wood ladder—it consists of two 5-ft. hinged sections automatically locked in open position by gravity-actuated sliding pins to provide strong 10-ft. length. Rung surfaces are flat on tread side and about 1 in. wide. Steel spikes at base afford secure setting for various types of terrain.

In service with AOA for emergency use, ladder was developed by line's Safety Engineer C. S. Hayward.



Maintenance Testing Of Automatic Direction Finders

By WAYNE E. PRICE and E. M. HASSELL, *Sperry Service Department, Sperry Gyroscope Co.*

Difficulty of attaining flight conditions in a shielded room posed a test and maintenance problem—but solution was found in development of an antenna simulator to reproduce artificially the signal received by a directional loop. Described here are this special simulator, its associated test equipment, and the simplified technique employed.

Present-day aircraft normally use a variety of radio receivers and radio avigational aids. This great variety of radio equipment has placed a difficult burden on radio maintenance because the special apparatus frequently requires test conditions simulating both installation and signal characteristics normally encountered in aircraft. This test and maintenance burden could partially be absorbed by the manufacturer if he supplied suitable maintenance apparatus for his particular equipment.

This article outlines the design and use of a test set for maintenance of automatic radio direction finders.

Many aircraft-type receivers employ a shielded loop antenna as a source of signal pickup for various functions of the particular equipment. Early aircraft receivers employed a fixed shielded loop for reduction of precipitation static and as an aural null radio compass device. Later types of equipment were improved by the addition of loop modulator stages and a right-left indicator to give indication of the loop null signal position. Modern devices use various motor systems to drive the loop coils to signal null and to indicate this relative loop position to the pilot as an avigational aid. Equipment of this nature was usually designed, tested, and maintained in a calibrated, shielded, or screened room.

Illustrated in Fig. 1 is a typical shielded room for testing the automatic radio direction finder in its various functions of (A) receiver with "T" or "L" antenna, (B) shielded loop receiver, (C) aural null compass, (D) automatic direction finder (adf) with sense antenna, and (E) automatic direction finder with shielded sense loop. Calibration of a screened room is controlled by relative position of the transmission line between the floor and ceiling, relative position of the adf loop to the transmission line, and the line loading resistor value.

Filtering of power lines entering the room presents a major problem along with electrical noises that may be generated by equipment operating inside the room. These filtering and isolation problems have become increasingly difficult with expanding use, near the maintenance shop, of radar equipment using pulse outputs of extremely high peak powers. These pulses will usually enter a wire mesh screen room with little or no attenuation. A modern automatic radio direction finder will operate on field strengths as low as 5 microvolts per meter, with the result that operation may be affected by very minute stray signals. Leakage through the case of the signal generator usually proves to be the most chronic source of interference and is most difficult to control.

As shown by Fig. 1, it is easily concluded that a test setup in a screen room adaptable to one particular equipment is not easily converted to other uses. Personnel at a radio laboratory and maintenance base would probably find it most convenient to maintain a screen room for special engineering tests, enabling performance of routine maintenance and alignment tests by suitable fixtures simulating screen room conditions. In maintenance, or production testing, of a right-left, or adf, there are two factors which must be controlled — namely, microvolts-per-meter field strength at the loop coils, and microvolts input to the antenna system. These considerations are further divided; the antenna system's pickup, or effective height, must be controlled in a specific relation to the loop pickup, and must be of a specific capacitance to ground. Control of these factors must be accurate and stable.

A test set suitable for performing all alignment, static, and dynamic tests on an adf receiver is shown in Fig. 2. Basic components of this test fixture are: (A) Loop and antenna simulator, (B) control unit and junction box, and (C) thyratron current meters. Miscellaneous accessories include: A short length of loop cable properly loaded to simulate that used in the aircraft; antenna transmission line that is double-shielded and loaded to the appropriate capacitance; tach shaft tuning control; power cable to the receiver; and radio-frequency (r-f) cable connecting to the signal generator. These various components may be placed and connected wherever required and in any manner convenient to the operator.

Loop Simulator

The loop simulator is shown in Fig. 3 with a schematic diagram as particularly applied to the Sperry Mark I Automatic Radio Direction Finder shown in Fig. 4. The detailed design of this equipment is necessarily controlled by the particular apparatus to which it is to be applied, but the principles employed are entirely similar for any other make of equipment.

A large dial in the center of the panel is connected through the loop coil and the slip ring assembly to the small electrostatically shielded signal radiation coil mounted in the center of the loop coils. The pointer over the rim of this dial connects to the loop coils and motor drive system. Because the signal fed to the loop coil is confined entirely to magnetic coupling, identical electrical conditions to those existing in a screen room are simulated. Figure 3 shows the loop slip rings and motor drive system taken from the Mark I Automatic Radio Direction Finder equipment. The loop coils contained in the circular shield are electrical replicas of coils normally used on standard equipment, reduced in physical size and with the electrostatic shields deleted. Fig. 4 shows the schematic diagram. A calibrating resistor is included which is adjusted by hand for convenience so that microvolts-per-meter field strength, introduced into the loop coils, can be read directly from the signal generator attenuator. Most measurements on this type of equipment must be converted to microvolts-per-meter; so the feature of reading it directly on the attenuator dials is advantageous to the operator.

The two small dials on the panel are used to control the antenna constants of effective height and reflected capacitance. The smaller capacitor (C1), controlled by the right-hand dial, is connected directly from the signal generator line to the antenna transformer input post. The larger capacitor (C2), controlled by the left-hand dial, is connected from the antenna transformer input post to ground. With this arrangement, capacitive feed to obtain the required signal phase shift is made to the transformer, controlled in signal intensity by the series capacitor (C1) while reflected antenna capacitance is controlled by the larger capacitor (C2). With this arrangement of magnetic coupling to the loop coils and capacitive coupling to the antenna transformer, no additional facilities need to be made for proper phase relation.

Our accompanying table shows a calibration chart to permit the operator to rapidly adjust C1 and C2 to obtain the desired simulated antenna constants of effective height and capacitance. The last line of this antenna setting chart shows a multiplication factor that must be applied to obtain true microvolt input to the antenna transformer when making measurements in the Rec-Ant function. It is felt that use of this correction for the Rec-Ant function would be less complex than using a third antenna capacitor and the additional required r-f circuit switching.

Control Box

The combination control panel and junction box is shown in the right foreground of Fig. 2. All controls which are normally used in operation of the Mark I receiver are duplicated, including a precision tuning dial. The Mark I Automatic Radio Direction Finder equipment is designed to operate on either 12 or 24v. input by switching; hence, a 12/24v. transfer switch with appropriate interlock circuits is included. Standard control components —i.e., function selector, volume sensitivity control, and loop motor drive circuits—are brought to a plug on the left of the cabinet to permit disconnecting the control unit circuits inside the cabinet so that a dual control unit or single control unit and indicator can be functionally tested independently of the circuits in the cabinet. This arrangement has the advantage of permitting a full control unit test while not requiring the use of an expensive piece of

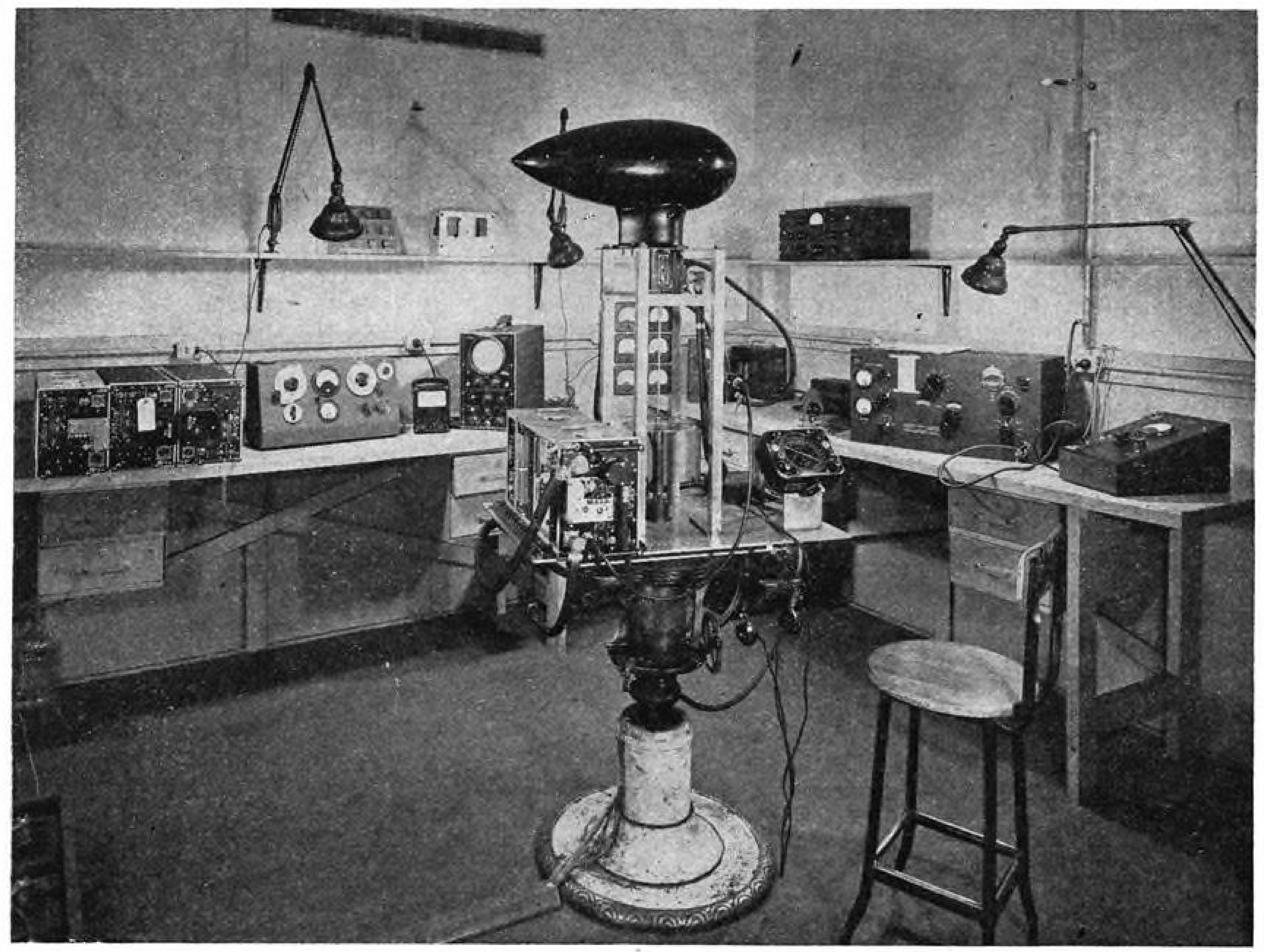


Fig. 1. Testing of automatic direction finders in a shielded room requires a special and complex setup.

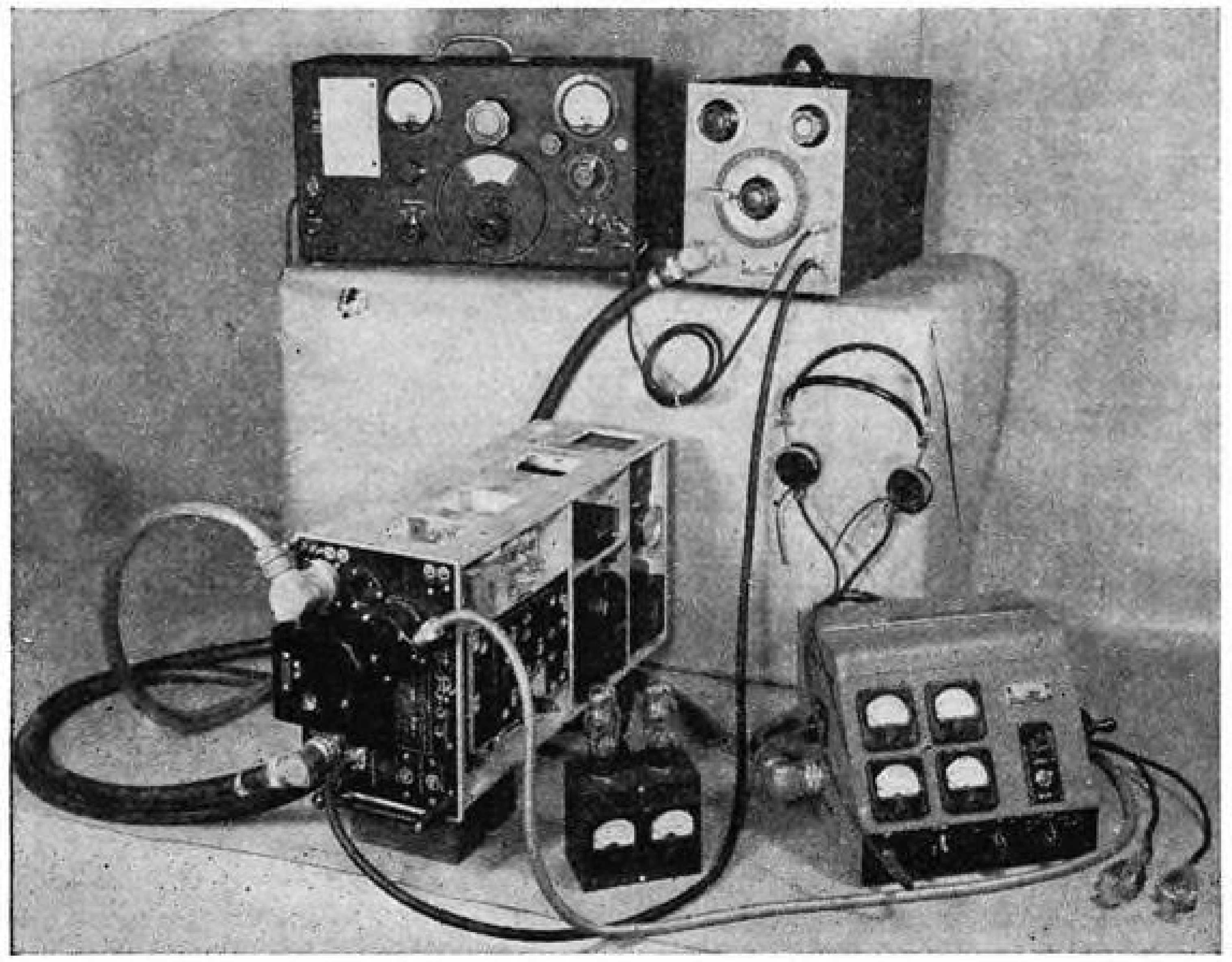


Fig. 2. Using a loop simulator (top right) and a special control box (lower right), automatic direction finders can be tested without resorting to a shielded room. Equipment is shown connected to a Sperry Mark I automatic direction finder radio receiver; a Ferris signal generator (top left) provides test signal.

operational equipment for receiver test and alignment.

Meters are installed in circuits as an aid to alignment and trouble-shooting. They include: (A) Input voltage meter, 20 or 40v. full scale; (B) input current ammeter, 10 amp. full scale; (C) output meter, 10 and 20v. a.c. full scale with 500 ohm load; and (D) tuning milliammeter for resonance indication, 25 ma full scale. The phone jack, provided on the front panel, is connected to one output circuit while the meter is connected to the opposing output line. As an aid to construction and maintenance, standard radio components are used wherever practical.

Another basic component of test set, the thyratron current meter (center foreground of Fig. 2), is used only for adjusting the thyratron standby bias and modulation signal phaser; hence, it is constructed as a separate unit to provide maximum flexibility and r-f shielding. The adapters and sockets are arranged for direct continuity of all circuits, excepting the plate lead, which is taken through a 50 ma meter in each tube. The Sperry Mark I Automatic Radio Direction Finder uses phase shift control thyratron drive to the loop motor, which differs only in minor detail from most loop drives.

Maintenance Tests

Many tests which are basic criteria of design need not be repeated in normal equipment maintenance. Experience has shown that simplified functional tests would be the greatest aid in maintaining automatic radio direction finder equipment to maximum performance. It is recognized that tests will vary to some extent with different types of equipment; so the tests listed here, as recommended for the Sperry Mark I, may be used as a maintenance guide for similar equipments.

I-f Alignment—Signal generator is connected to grid cap of mixer through a 0.25 mfd isolation capacitor. Intermediate-frequency (i-f) system should be tuned carefully at a low signal level to assure accurate peaking of each transformer. Upon completion of i-f alignment, microvolt input for standard output should be recorded.

I-f Attenuation—Signal generator should be connected to its input terminal on loop simulator panel and adjusted to 200 kc. Receiver should be tuned to signal generator in Rec-Ant function for standard output of 5v. Note attenuator setting on signal generator, then move signal generator dial to i-f (175 kc) and increase signal generator output for 5v. on output meter. Difference of two attenuator readings is RF system's i-f attenuation.

R-f Alignment—With this test set, r-f alignment of all circuits can be made with signal generator connected to loop simulator. Alignment instructions of particular equipment under test may be followed as outlined in instruction manual. It may be remembered that in many receivers most accurate alignment is obtained when using a signal generator output just sufficiently above noise level of receiver to obtain accurate indication of resonance. With this test set, as in case of a screen room, maximum signal is fed to loop circuits with loop signal coil pointer displaced 90 deg. from dial's zero on electrical null.

2050 Bias and Drive Test—In a phase-operated thyratron drive, two adjustments are required—i.e., standby bias and signal phase. In Mark I equipment, standby bias is checked by inserting the 2050s in thyratron meter sockets and adapters in 2050 sockets in receiver. Equipment is placed in Auto-Ant function and input grid of tone amplifier is shorted to chassis to exclude tone signal. A current reading of 3 to 7 ma should be observed on each tube. Variation of this current may be caused by a defective tube, or drift of circuit components, to where it would become necessary to change resistor component of bias phase network. Drive currents are checked by removal of short to tone amplifier and tuning receiver to a 250 microvolts-per-meter signal in each of its bands. Signal coil dial is then swung right and left to cause loop motor to drive full speed in each direction. During drive, thyratron currents are observed and signal phaser is adjusted to obtain maximum drive current on fired tube consistent with minimum back current in off tube. In this particular equipment, it is best not to permit back current of off tube to exceed 7 ma. Once phase of modulation signal has been adjusted for most satisfactory drive, thyratron meters should be removed to prevent scattering RF interference.

Sample Antenna Setting Chart

CAP. IN MMF	ANTENNA EFFECTIVE HEIGHT, METERS 0.1		0.15		0.2		0.25		0.3		0.35		0.4		0.45		0.5	
	Shunt, C2	Series, C1																
30					15	9.3	14	12	13.5	14.3	12.5	17	12	19.5	10.5	21.8	10	24.5
35			18	7.5	16.5	11.6	16	14	16	16.6	14	20	13	23	12	25.4	11	28.7
40			22	9.8	19	13.7	18.5	16.5	18	20	16	23.5	15	27	14	30	13	33.7
45			23	11.4	22	15.5	20	18.5	19	22.5	18	26.5	16	30	15	34	14	37.5
50	27	7	25	13.5	23	18.4	22	22	20	26.6	19	31.8	17	35.6	16	40.5	15	44.7
55	30	8	27	14.5	26	19.4	25	23	23	27.4	22	32	20	37	18	41.5	17	46.5
60	32	9.2	30	15.6	27	21	26	24.5	25	29.5	23	35	21	40	20	45	18	50
65	35	10.6	32	17.4	30	23	27	27.8	26	32.7	24	39	23	44.5	21	49.4	19	55.5
70	36	11.5	33	19	32	25	30	29.5	28	35.3	26	42	23	48	22	54.3	20	60.7
75	39	12.3	36	20	34	26.3	32	31.3	30	37.5	29	44	26	50.4	24	57	22	63.4
80	42	13.5	39	21.8	36	28.5	33	34	32	41	30	48.5	27	55.4	24	62.5	23	70
85	44	14.3	40	23	39	30	36	36.5	34	43.7	31	52.7	28	59.7	25	66.4	23	73.7
90	45	15	43	24	39	32	37	38.5	35	45.5	32	54	34	61.6	28	70	23	77.3
95	48	16.3	44	26.6	41	34.3	39	41.5	36	49	33	58.3	30	66.5	28	75	25	83.5
100	49	16.7	45	27	42	34.9	39	42	36	50.4	34	59	30	67.5	28	75.5	25	84.3
M Ant	× 10		× 7		× 5		× 4		× 3.3		× 2.8		× 2.5		× 2.2		× 2	

Right-hand Figure = Dial Setting, R. H. Capacitor
Left-hand Figure = Dial Setting, L. H. Capacitor

Signal-to-Noise Test—Proper function of an automatic radio direction finder system may be maintained in such a manner as to satisfy basic requirement of receiver in its functions as an automatic radio direction finder, but neglect of maintaining appropriate signal-to-noise ratios can easily lead to a pilot's complaint against equipment. To insure a minimum of operational complaints, it will be found advantageous to check equipment in functions normally used by manufacturer in his production test methods. A manufacturer will probably use several test points in each band, but routine maintenance can keep equipment in good order by using alignment points at each end of band and one center band frequency.

Brief tests are outlined as follows:

Rec-Ant Signal-to-Noise — Switch equipment to Rec-Ant function and by modulation on-off method, check and record signal-to-noise ratios to average characteristics as specified by manufacturer. In this function, signal generator attenuator must be set above desired signal corresponding to antenna effective height.

Rec-Loop Signal-to-Noise — Switch equipment to Rec-Loop function and rotate signal coil dial to 90 deg. or 270 deg. and record signal-to-noise ratios for 6 db output, reading signal generator attenuator directly as microvolts-per-meter.

Auto-Ant Signal-to-Noise — Switch equipment to Auto-Ant function and record Signal-to-Noise ratios as above. In this instance manufacturer's data may not be directly applicable; as in case of Mark I equipment, a 0.2 meter 50 mmf antenna is used in production tests. Increase of antenna capacitance, or effective height, will, of course, lower signal-to-noise ratio figures that are obtained.

Auto-Loop Signal-to-Noise—Switch receiver to Auto-Loop function and record signal-to-noise ratios which can be compared directly with data available from manufacturer as operation in this function is independent of antenna characteristics. In Auto-Loop function, loop cross-over test should be made by swinging signal coil 90 deg. and 270 deg. points under loop pointer to determine point in degrees to which drive reverses its direction. This test should be made in center of bands and at a field strength not exceeding 250 microvolts-per-meter. A sharp cross-over point within 10 deg. of 90 deg. from null insures proper operation of automatic modulation circular circuits.

In the original certification of an automatic radio direction finder, the static type accuracy tests are recorded in which the loop housing, or the signal source, is displaced in steps of 15 deg. throughout 360 deg. rotation, and the accuracy at which the loop returns to the true null is recorded. This test is made at varying field strengths from 50 microvolts-per-meter and up. In this type of test small inaccuracies and malfunctions are difficult to evaluate. Production testing of the Sperry Mark I Automatic Radio Direction Finder is done by a dynamic method in which the signal plane is moved away from the loop position at a speed of 3 deg. to 6 deg. per second. Whatever error has a tendency to exist in the equipment is read as lag and is greatly amplified for ease of recording. Weak or erratic drive, unbalance of drive torque, or various phase displacements, will show more readily in the dynamic type tests.

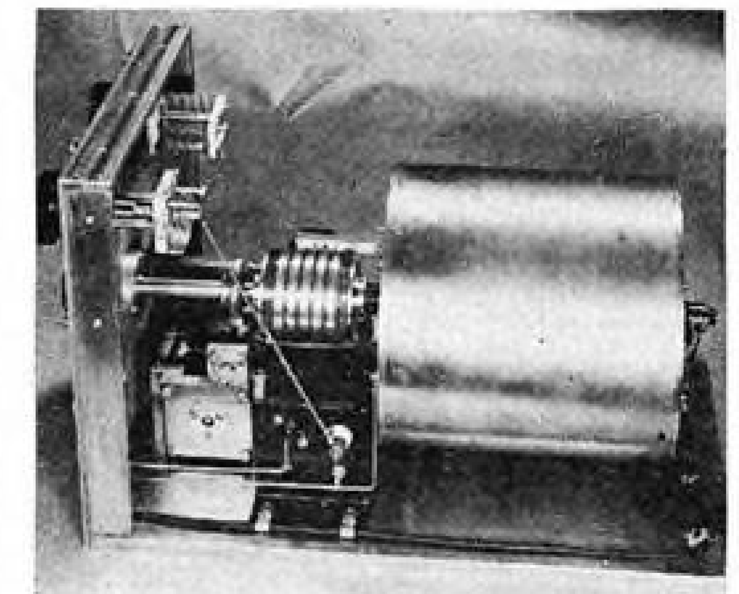


Fig. 3. Loop simulator consists of shielded pick-up loops rotated in field of exciter coils. Large drum contains coils. Connections are made through slip ring.

Auto-Ant Lag Test—Switch receiver to Auto-Ant function and tune carefully to signal generator in each frequency at approximately 25 microvolts-per-meter field strength. Rotate signal coil dial slowly and steadily first clockwise, then counterclockwise, at a speed of from 3 deg. to 6 deg. per second and record degrees lag or error of loop coil pointer from zero of signal coil dial. For maintenance test, it will be advisable to record data at 10, 25, and 1,000 microvolts-per-meter.

Auto-Loop Lag Test—Switch receiver to auto loop function and tune carefully by tuning meter to a signal of about 50 microvolts-per-meter field strength. Record lag at 25, 50, and 1,000 microvolts-per-meter. While on this function, it may be well to test drive speed and cross-over point to assure a good balance of pointer accuracy on each side of null.

It has been found that the production differences of a given series of Mark I Automatic Radio Direction Finder Receivers are very slight as may be assumed in any equipment manufactured in quantities. Maintenance personnel may readily find the use of manufacturer's test specifications and test system very advantageous. Recording of functional data from these tests for each receiver as it is serviced will insure uniform maintenance and immediate detection of abnormal operation. Such an equipment record will also aid in establishing requirements for spare parts, overhaul period, and time limits.

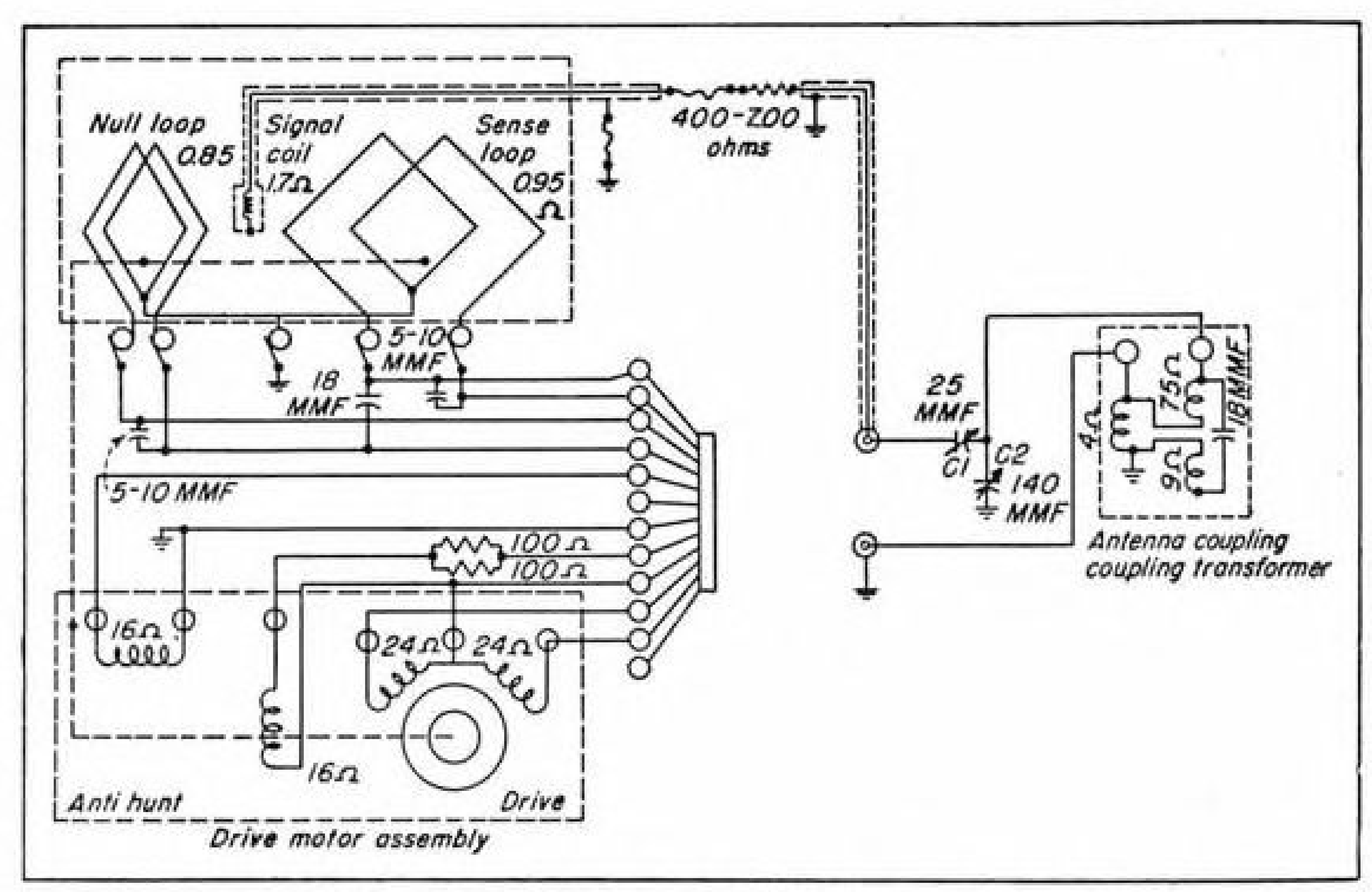


Fig. 4. Circuit of loop simulator shown in Fig. 3.

These Are the Export Markets

By RAYMOND L. HOADLEY, *Financial Editor, "Aviation"*

This up-to-the-minute survey shows just where U. S. plane, engine, and accessory producers can build vital foreign trade business, and keen pointers are given on competition today and tomorrow.

After looking over foreign markets, British manufacturers believe they can double prewar aircraft exports. That amount may be fine for them, but not good enough for us. For a survey of world markets indicates that American aircraft makers can do much better than that if they are willing to begin their long-term planning for permanent markets early enough.

Every other exporting nation is pushing its goods to foreign ports. The trade boom is on. And the best bet for American aircraft in this international gold-rush is to especially cultivate the markets of greatest future promise for us.

British aircraft constructors recently displayed their wares to 6,000 guests representing more than 30 different markets where the British felt their trade prospects were good. Prospects of our plane makers are good in an equal number of markets; not so promising in a lot of others. Let's see where we stand on permanent market possibilities:

Our best market lies right in our own hemisphere. It is not hard to spell out why. Our foreign trade bankers now estimate that Latin American nations have more than $4,500,000,000 in gold and dollar reserves. This means their available funds to spend in foreign purchases today are four times what they were before the war. Elsewhere in the world a nation's foreign purchases is pretty much limited by how much it can borrow from the United States and the new international bank.

But that's not all. Most of us feared that the Latin American boom would begin to peter out right after the war. To the contrary, these countries are striding ahead faster than ever. Prices of Latin American exports are steadily rising. Coffee, meat, lead, silver, tobacco, sugar, tin, and zinc are among the commodities still finding a ready, even eager, world market.

The recent hike in coffee prices, for example, will bring in an additional $225,000,000 to a half-dozen nations down there with 60% of it going to Brazil. Raw materials (like Chilean iron ore) that have not moved out in some time are again being exported. Finished manufactures have become an important item in their export trade. Industrial projects like hydroelectric plants and steel mills are under development, while new petroleum fields are being opened up.

Then there is the tourist trade. North Americans spent $125,000,000 in Latin America last year. And that is only the beginning of a huge postwar travel. So Latin America not only has the means today to buy abroad but bids fair to continue to have a steady stream of dollars and sterling flowing in for foreign trade use.

Argentina, where an airplane can be landed almost anywhere in the open country, heads the list of Latin American markets. She has the largest exchange balances and the least inflation. Yet we will have to put in our best licks there if we want to keep Argentina as a permanent market for American aircraft.

The reasons are both political and economic. Both Argentina and neighboring Uruguay fall rather naturally into the British sphere of influence. Their meats, grains, and other farm products, find their natural outlets in Great Britain and Europe.

That's why British plane makers began concentrating on this area the minute the war was over in Europe. We may have to accept second place in this market. It will depend on the changing political situation there as well as on our own initiative. But it is a market worth fighting for.

In Brazil the positions are reversed. There we are top-dog as that nation's largest supplier. Brazil has $650,000,000 in gold and exchange balances. Exports were $600,000,000 last year; may reach $800,000,000 in 1946. According to recent reports from distributors there, her airlines, wealthy land owners, and mining industry could use 700 planes now if they were available. Nowhere in South America has commercial aviation developed so rapidly in the last few years.

As a long-term market, Brazil is one of our best bets anywhere. With an area larger than the United States, she has vast unexplored territories inaccessible to her under-developed rail and highway systems. But she does have, already, the largest and most modern steel plant in Latin America, produces most of the consumer goods essential for life, and is building a modern merchant fleet to fly her flag in world trade. Her remarkable industrial progress during the war is an indication of what the future may hold. And it has been, and still presumably is, our State Department's policy to extend all possible aid to make Brazil a great nation.

Chile, third of the Latin American "big three", has large trade balances from the export of nitrates. Export managers report that British and Swedish traders are very active there and are offering keen price competition in many lines. Chile, of course is a rugged coastal country. Nevertheless, she is allocating gasoline taxes for airport development and probably could absorb several hundred personal planes.

Colombia, Bolivia, and Peru have more limited market possibilities. But even in these areas there will be a growing need for commercial type planes for freight hauling. With her heavy dollar balances, Colombia (also see page 84), is picked for the market of the group. Bolivia holds forth the least promise.

Venezuela, with its rich oil production, offers the most attraction farther north. Exports during the last 10 yr. were nearly $3,000,000,000, while imports were just over $1,000,000,000. The people cannot eat gold and they can't drink oil. They feel they have earned a much higher living standard than they have, and the new political leaders there are about to use the nation's wealth to improve the lot of the people. The concentration of wealth has limited the market for personal planes. But this little nation is like an awakening giant and is worth cultivating most carefully today. A little spade work now may pay rich dividends to our more enterprising aircraft exporters within the next few years.

Our nearest neighbor, Mexico, certainly will bear consideration. Gold and exchange balances have jumped from $34,000,000 in 1939 to $340,000,000 in 1946. There is an immediate market for several hundred personal planes. Mexico is rapidly industrializing and the plane market will grow as this program develops.

Central American countries like Panama, Costa Rica, and the rest, probably will purchase few planes, individually, but export authorities feel that the overall plane market there is worth looking into.

Europe is not as attractive a market as one might suppose, except for airliners. Most governments there have strict controls barring importation of everything but bare essentials of life these days. And by the time the import bars are let down we are likely to have tough competition not only from the British but also the Swedes, French, Hollanders and, possibly, the Russians. These countries intend to build their own aircraft and to export as well. No one, of course, would count on the Soviet satellites as promising export markets at this juncture.

In the Far East you have a more encouraging outlook over the long term than you do for the immediate future. Australia can be almost written off for several reasons. She is developing a highly protected aircraft industry of her own which may in time provide most of her needs. Meanwhile the British will have the preference. The Philippines may provide us a small but desirable market as the islands get back on their feet. Thailand (Siam), French Indo-China, and the East Indies have little to offer us marketwise.

But it's a different story with India and China. India is a rich country when it comes to exchange balances, and her traders maintain that she will be very definitely interested in American aircraft whenever the British unblock India's huge sterling balances. Great Britain is committed to negotiate a financial settlement with India within the next 9 mo. Dollars then will be available to the Indians, and American traders will have their first opportunity to really participate in India's industrialization and development.

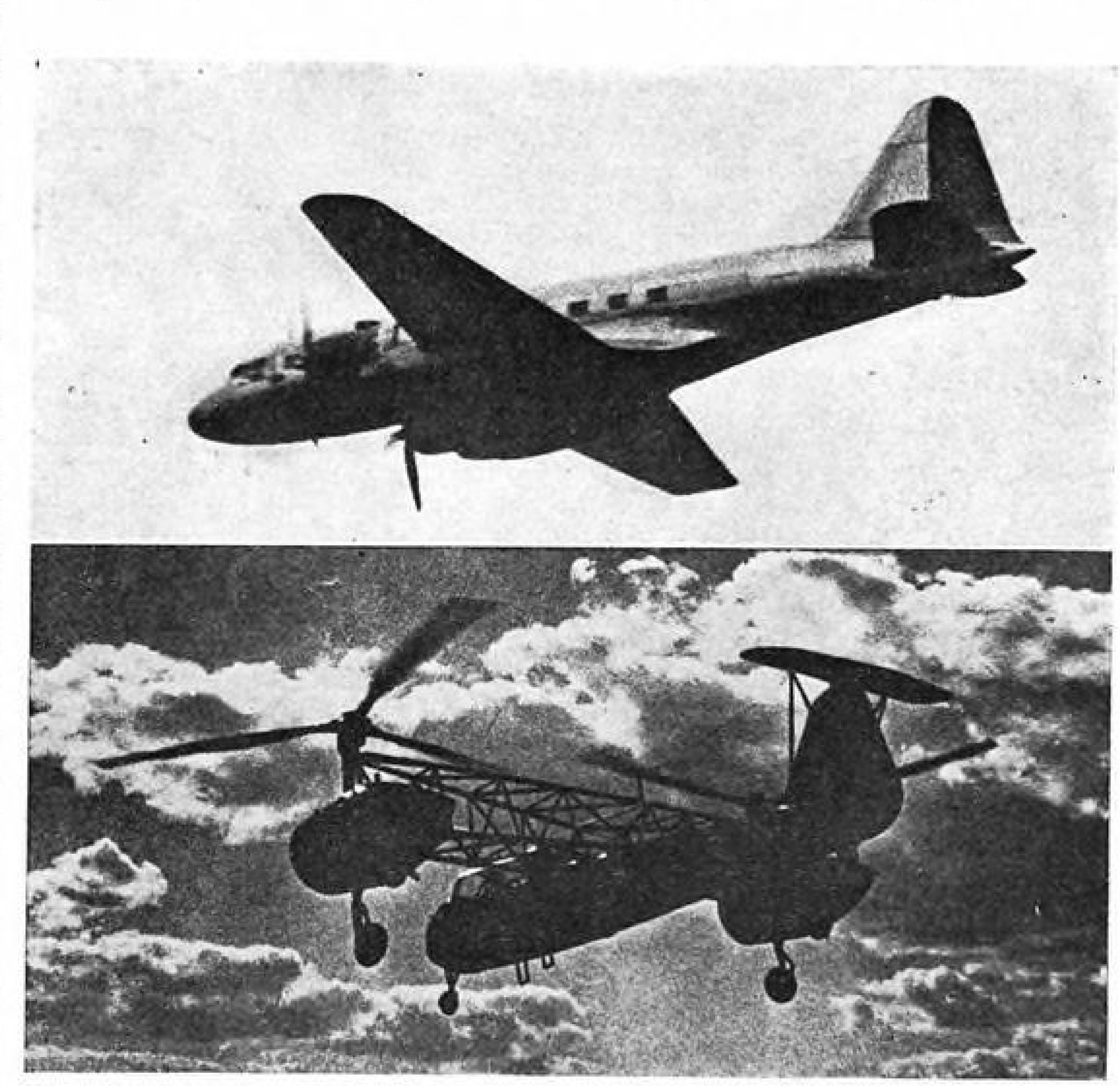
Long Termers

China and Korea both have attractive long term possibilities whenever the political situation straightens out in these respective countries. The Japanese had developed Korea into a quite highly industrialized nation, but one heard little of the nation economically since the Japs had kept a tight rein on the Koreans. But some day when commerce opens up again Korea will be a market worth investigating.

The Chinese are depending on aircraft to help solve their difficult transportation problems. Industrialization programs have been laid out by the government involving the use of thousands of planes. But it may be another 5-10 yr. before China becomes strong enough to really make a start on these programs, which are only so much paper work today.

Foreign traders have been arguing about Middle East markets for the last year. Some feel that we have a golden opportunity to get a toe-hold there. But the majority, including some of our former military commanders in that area, hold that these markets may buy some American goods for awhile but are likely to revert to the British and French in the long run.

Last but not least is airminded South Africa. Although the Union of South Africa is part of the British Empire, the whites there are shrewd traders and by no means adverse to buying American aircraft. Some feel South Africa is one of our best potential markets, since this land has always had a favorable balance of trade and has just opened new gold fields which should more than double the country's present purchasing power. South Africa has more landing strips today in proportion to its population than any other nation.



While Great Britain today is our most serious competitor for lucrative and essential aircraft export markets, we are certain to be hard pushed by other nations, possibly including the Soviet, Author Hoadley points out. Russians, with a state-owned industry, might well have a decided price advantage on craft developed from types shown here—IL-2, a twin engine transport believed to have evolved from DB-3F, and twin-engine twin-rotor helicopter having many design features reminiscent of Germany's Focke Achgelis FA-223. (Sovfotos)

Colombian Air Transport At Crossroads

By GEORGE M. GALSTER, *Latin American Analyst*

A rapid postwar expansion of passenger and cargo facilities has strained this South American country's airline resources to the point where up-to-date regulation is seen as the only method of avoiding a serious crisis.

Air transportation in Colombia is facing a period of unprecedented expansion—yet today, the industry is in a state of minor chaos because legislation has not kept pace with recent developments.

When surplus aircraft became available after the war, dozens of new companies started covering the country with a network of cargo and passenger routes. Lack of control, however, created irregularities potentially harmful to the industry as well as to the country's economy.

Chief among these difficulties has been the granting of concessions without adequately forecasting traffic and cargo potentials, resulting in poor distribution of service. Another has arisen from the haphazard method of defining carriers' rights and responsibilities. The whole situation is complicated further in that the new airlines are clamoring for immediate use of proprietary airports and elimination of alleged monopolies.

Last year, the Colombian government invited CAA to study the problem and recommend changes. Aviation circles in Bogota expect that recommendations will fall into two main divisions: 1. A new governing board should be set up, similar to CAA, with full authority to handle all concessions and permits, and this organization should be backed by new legislation defining various types of airline certificates and providing for inspection and licensing of aircraft; 2. new international airports should be constructed at Bogota and Leticia, and key airports at other points should be nationalized.

At present, civil aviation is controlled by the Ministry of War through Colombia's Department of Civil Aeronautics. This department, headed by Col. Jose Forero, has only ten people to handle its tremendous volume of work. Recently Col. Forero has been assisted by a member of the American Air Mission in certain problems similar to those encountered in the U. S.

This department will undoubtedly form the nucleus of a governing board and it is possible that CAA experts will assist in its formation. Some preliminary work of reorganization has already been accomplished by an interim council of three Air Force officers appointed in August.

The question of who is to manage and operate airports in Colombia is probably the most difficult phase of the whole problem. With the exception of Medellin, most larger cities have uneconomical duplication of airport facilities. In Bogota, for example, AVIANCA has exclusive use of Techo Airport, which is located close to the city and is fairly suitable for modernization. All other companies are using the old military airbase at Madrid, about 20 mi. from the capital. Even there, TACA de Colombia, LANSA, and VIARCO have separate passenger terminals. AVIANCA pioneered most of the country's air transport facilities and now feels no obligation to offer their use to competitors. Projected nationalization of airports does not imply government ownership, but rather some form of joint management where all companies would be represented.

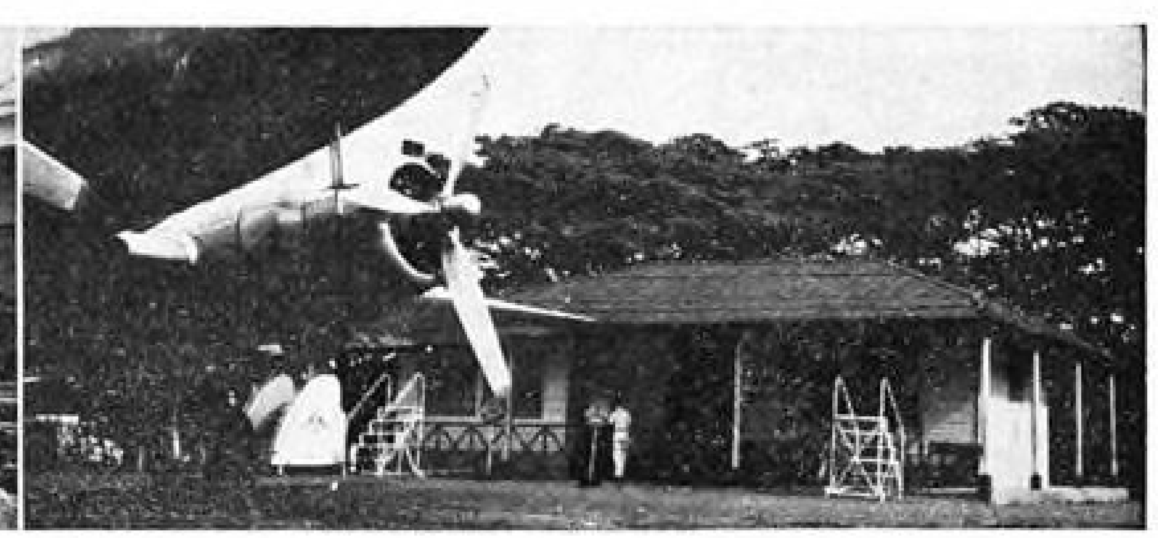
It is evident that the public is greatly interested in the proceedings. Newspapers recently played up the annual report made to Congress by Minister of War Luis Tamayo, who not only cited the need for a long range aviation policy but also presented a three-point program calling for immediate action.

Chief among these proposals was expansion of the flying school at Cali and the mechanics school at Madrid. At present, new airlines are permitted to hire American and Canadian personnel since there are not enough trained Colombians. In addition, the Minister urged unification of all radio and meteorological services, saying that the present system was inadequate and potentially dangerous. High mountains and low cloud cover around most Colombian cities emphasize the importance of this point. Finally, the program called for paving of runways at Turbo, Cucuta, Ipiales, and Tumaco, and lengthening of strips at other specific points.

Need for air service is evident when one considers that Colombia is divided by three great mountain ranges and that its richest cities are concentrated on high plateaus in the interior. Little river transport exists and only two railroad systems—unconnected—have been constructed, one originating at Bogota, the other at Cali.

From the international viewpoint, it is primary that Colombia's air trade prospects are among the best in South America because of the high value per pound of exports and the nearness to U. S. markets. The government is well aware of these considerations, and early action may be expected.

AVIANCA'S terminal building at Techo Airport, Bogota, with hangar at left, present attractive-looking installation.



VIARCO'S passenger building at Cali is typical of ground facilities being erected in Colombia.

DEPRESSION IN '47?
...controls can bring one

It is conventional for the American business man, who values freedom, to protest against government regulation. On this account, many people who do not know the facts in detail are inclined to discount current business protests against the post-war application of wartime economic controls. This is particularly true since in his report for the third quarter of this year, the Director of War Mobilization and Reconversion implied that business is in fine health by remarking that "business profits, after taxes, are at the highest point in history."

In complaining about government controls, however, the American business man is not crying wolf. These controls were an essential war weapon. Now, however, they are contributing decidedly to a twisting and distorting of the American economy in a degree which, if not soon corrected, may well start production and employment down the toboggan.

One general indication of how badly twisted our economic system has become is found in the wide disparities in the amounts by which different groups of prices have increased. Since 1941, for example, farm prices have advanced an average of about 125%. Industrial prices, more tightly controlled than any other group except rents, have increased only about 32%. Meanwhile, straight time hourly earnings of industrial workers have gone up about 60% and the cost of living about 43%.

The advances of individual prices within these groups have also varied enormously. Among industrial prices, that of finished steel has gone up only about 14% since 1941, while lumber has gone up over 50%. Hourly wage rates in the women's garment industry have gone up 116%, while those in the brewing industry have gone up only 33%. That share of the cost of living due to rent has gone up only 4%, while that due to the cost of clothing has gone up over 60%.

Well, What Of It?

At least four things of major importance:

1. Production, under the influence of price control, has been heavily concentrated in some lines to the neglect of others. Result—unbalanced production, unbalanced inventories, and a serious cut in the flow of goods to consumers.

2. More or less uniform post V-J Day wage increases, promoted by the federal government, have imposed a far more serious cost problem on some industries than on others. This is particularly true of some of the most basic industries.

3. While, as a whole, "business profits, after taxes, are at the highest point in history" (due in part to a temporary excess profit tax rebate arrangement) there are enormous disparities in the profits of different industries. Some key industries are making little or no profits.

4. If not corrected, the distortion of prices, wages and production, which has resulted in such a wide disparity of profits, can contribute decisively to a major business upset.

The most striking example of the distortion of production by controls was, of course, that provided by a metropolitan meat famine at a time when beef cattle crowded the ranges. This has now been recognized. But there are many other distortions. Abundance of sports clothes, acute shortage of more essential clothing made from the same kind of cloth. Successive shortages of critically important products like baling wire and nails as the price lid on steel is jiggled first this direction and then that.

Some of these distortions of production are due to material shortages. But a major contributor is uneven application of controls, and the total removal of some while others are held firm. Among the results are bulging inventories of partially completed assemblies and shut-downs while waiting for parts.

Wage Complications

While price controls, unevenly applied, have shunted production first this way and then that, the federal government has further complicated the situation by promoting uniform wage rate increases without regard to varying capacities to pay them. The greatest single contribution to this distortion was made by the President himself. In the course of unsuccessfully trying to mediate the dispute over steel wages last January he recommended a wage rate increase of 18½ cents an hour. Immediately that increase was accepted by organized labor as par for the first round of wage adjustments, having the sanction of the White House itself. The game then became to beat par.

But the capacity of different industries to pay wage increases varied greatly. During the war some had hiked their pay much more than others. Moreover, in some industries wages are a much larger element of total cost than in others. In 1939 (last year for which figures are available) wages ranged all the way from 2½% of total sales in cigarette manufacturing to 34.3% in hosiery manufacturing and 65.2% (for wages and salaries combined) in soft coal mining.

Under these circumstances, some industries were far less able to meet a uniform wage increase than others. Nonetheless, many of them had uniform wage increases imposed upon them. Then the price lid was held firm. This, coupled with material shortages and production difficulties which also choked output, squeezed the profit right out of those industries.

A Study In Contrasts

Some of the most important industries are making little or no profits while they bump along on a production volume which fails to meet consumer needs and prevents attainment of maximum efficiency. The automobile industry affords one conspicuous example. Another is electrical manufacturing, and rail equipment is yet a third. All of them are crucially important. Many other lines of business, of course, are extremely profitable. For example, the profits of a group of large retail stores were 150% higher during the first half of this year than they were a year ago; the profits of a group of motion picture companies were up 140%.

In the meantime, the workers in some of those low-profit industries are in no bed of roses. The increase in the cost of living since 1941 is now outstripping the increase in the hourly wage rate of workers in a number of industries, where wage rates have not risen as much as the average. On a weekly basis, a shorter work week, with less overtime, has combined with the recent upsurge in consumer prices, to place the living standards of some of these workers below the wartime level.

Such circumstances obviously create pressure in the ranks of these workers for another round of wage increases. But as long as the profit remains squeezed out of their industries wage increases, if any, must be translated either into higher prices, or, if the government sits tight on the price lid, into losses which will discourage production and ultimately cost workers their jobs.

What To Do?

Salvation both for the workers and for employers in the relatively profitless section, a peculiarly important group of industries, must be looked for primarily by increasing productivity, thereby decreasing the cost per unit. Part of this higher productivity can come only from individual efforts of the workers themselves. Another part can come from an elimination of bottlenecks in materials and parts which prevent the labor force from working most efficiently. Only by greater output per man-hour can workers and management solve their common problem.

Until productivity has been thus increased, it is hard to think how the federal government could do a greater disservice both to labor and to industry than to repeat its performance of promoting a uniform national wage increase. With the present distortion of the national economy, some industries might again take such an advance in their stride. With many others it would raise even greater havoc.

While avoiding like the plague promotion of another uniform wage adjustment, the federal government must make it a primary objective to relieve distortions caused by the uneven application of other controls, primarily price control. Nature has given a lift to the elimination of distortions by providing bumper grain crops which should in time reduce that staggering disparity between a 125% increase in farm prices and a 32% increase in industrial prices. But that process must be speeded as a matter of conscious policy. No element of such a policy is more important than expediting the decontrol of industrial prices. Such a course is clearly essential to achieve that balance in the production of materials and parts required for maximum output.

Business and labor both want a sustained prosperity in which all will share. Sustained prosperity can be achieved only if we eliminate the distortions in wages, prices and profits which now restrain so much vital production.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

THIS IS THE 52ND OF A SERIES

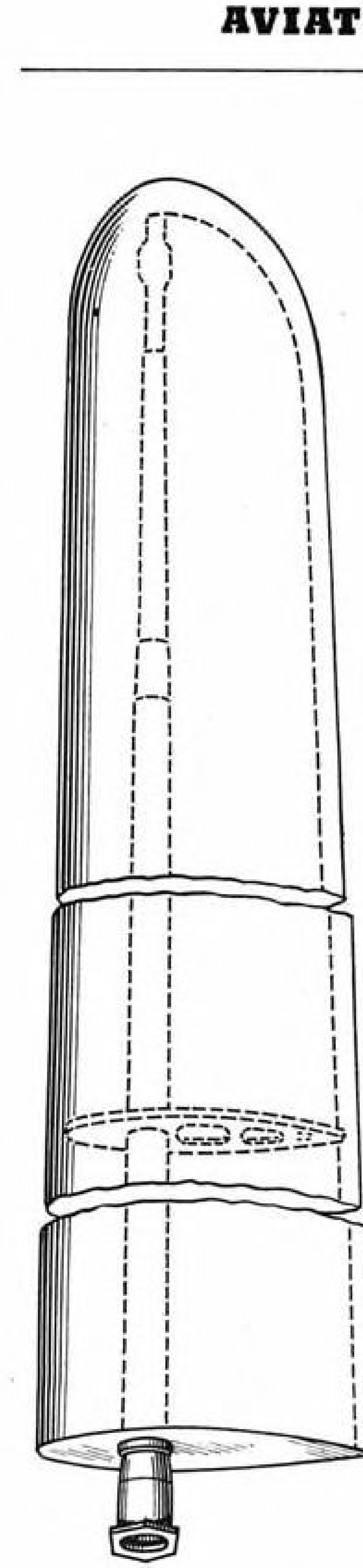
SHEET NUMBER .... *D-37 (Continued)*
CLASSIFICATION .... *Processes*
SUB CLASSIFICATION .... *Quantities*

Conversion Factors (General)

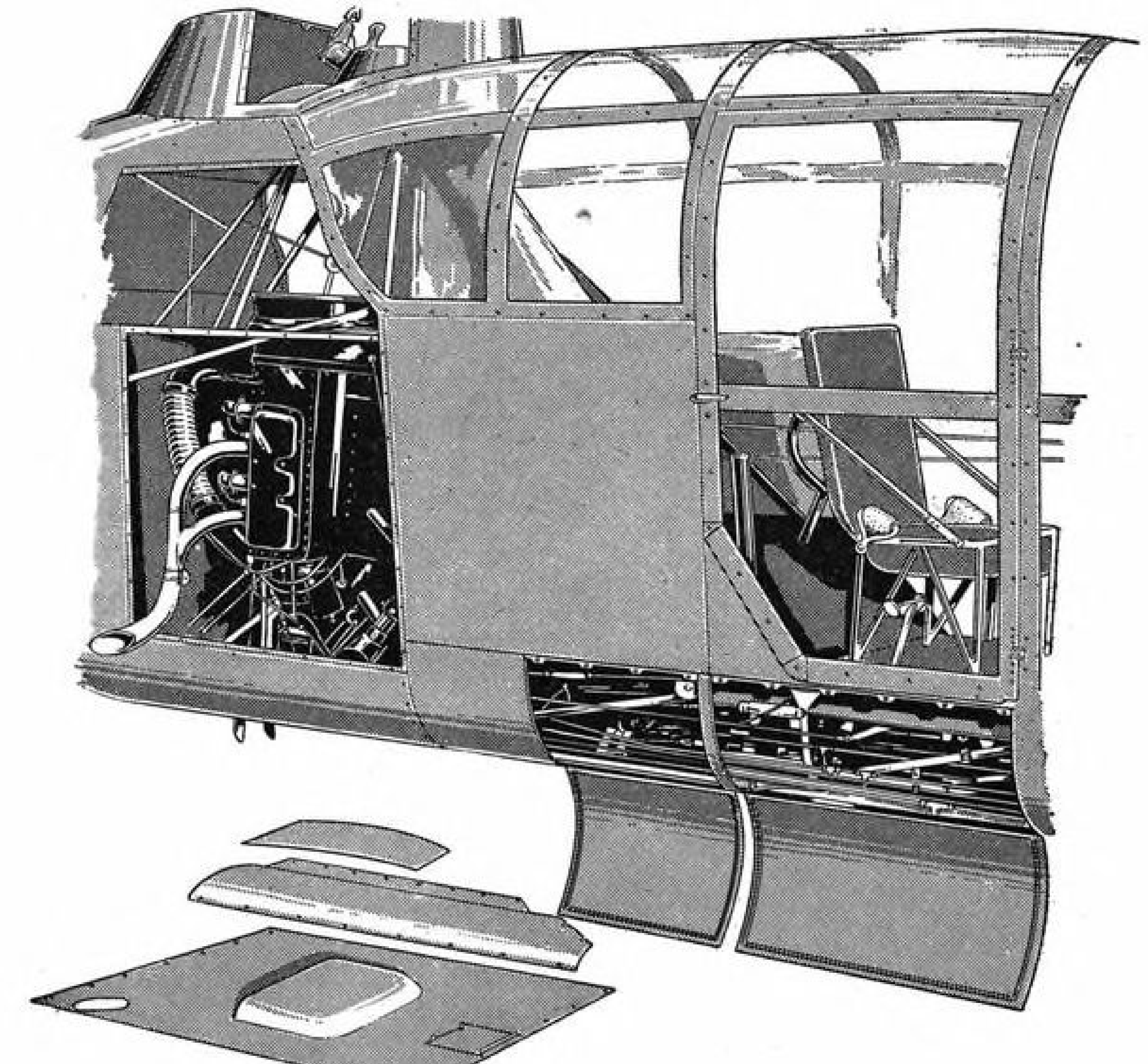
PART III

Unit	Multiplied by	Equals
Kg. cal./sq. m./hr./m./°C.	.00278	Gm. cal./sq. cm./sec./cm./°C.
Kg. cal./hr.	1.163	Watts
Kg. m.	7.2330	Ft.-lb.
Kg./m.	0.67197	Lb./ft.
Kg./sq. cm.	14.223	Psi.
Kg./sq. mm.	1422.3	Psi.
Kg./sq. mm.	0.635	Tons (long)/sq. in.
Km.	3280.83	Ft.
Km.	0.62137	Mi.
Km./hr.	0.9113	Ft./sec.
Km./hr.	0.6214	Mph.
Kw.	1.3410	Hp.
Kw.	1.3596	Hp. (metric)
Kw.	3413.04	Btu./hr.
Kw. hr./sq. m./hr./cm./°C.	41.83	Gm. cal./sq. cm./sec./cm./°C.
Kw. hr./sq. m./hr./cm./°C.	0.1	Watts/sq. cm./cm./°C.
Kw. hr./sq. ft./hr./in./°F.	0.8508	Gm. cal./sq. cm./sec./cm./°C.
Knots	1.152	Mph.
L.	1000.027	Cu. cm.
L.	0.035316	Cu. ft.
L.	61.025	Cu. in.
L.	33.814	Oz. (U. S. fl.)
L.	2.2046	Lb. Av. water—39.1°F.
L.	1.05668	Qt. (U. S. liq.)
M.	3.28083	Ft.
M.	39.3700	In.
M.	6.2137×10^{-4}	Mi. (std.)
M.	1.09361	Yd.
M. kg.	7.2329	Ft.-lb.
M./sec.	2.2369	Mph.
Microhms	1×10^{-6}	Ohms
Micro./cm. cu.	0.3937	Micro./in. cu.
Micro./cm. cu.	density ÷ 100	Ohms/Mg.
Micro./cm. cu.	6.0153	Ohms/cir. mil ft.
Microns	0.001	Mm.
Mils	0.001	In.
Mils	0.00254	Cm.
Mi. (U. S.)	5280	Ft.
Mi. (U. S.)	1.609347	Km.
Mi. (U. S.)	0.86836	Mi. (naut.)
Mi. (Brit.)	1.609343	Km.
Mph.	88	Ft./min.
Mph.	1.4667	Ft./sec.
Mph.	0.8684	Knots
Mph.	26.82	M./min.
Mg.	0.001	Gm.
Mm.	0.03937	In. (U. S.)
Mm.	0.001	M.
Mm.	1000	Microns
Mm.	39.37	Mils

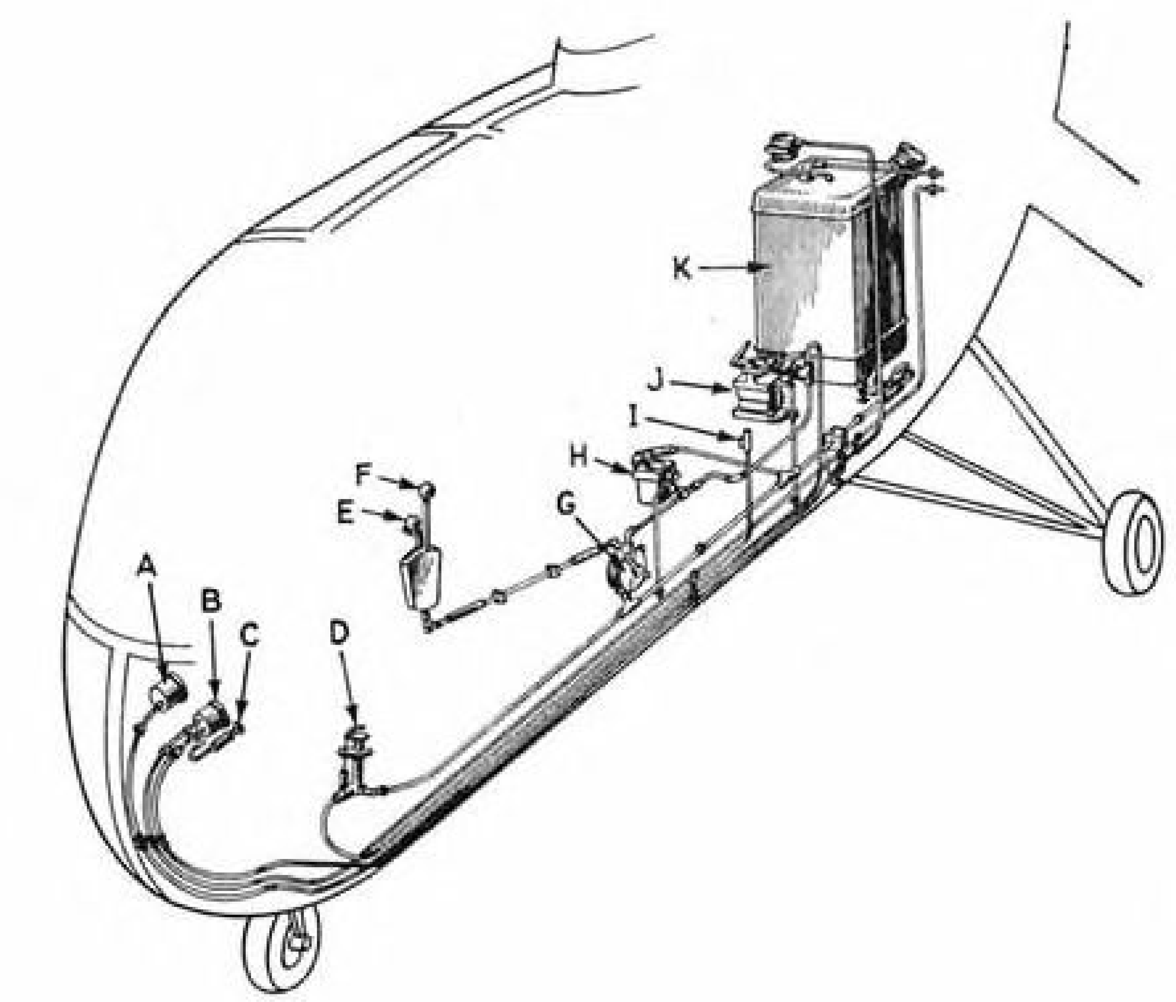
Courtesy: Reinhold Pub. Corp., *Metals & Alloys Data Book*, by S. L. Hoyt.



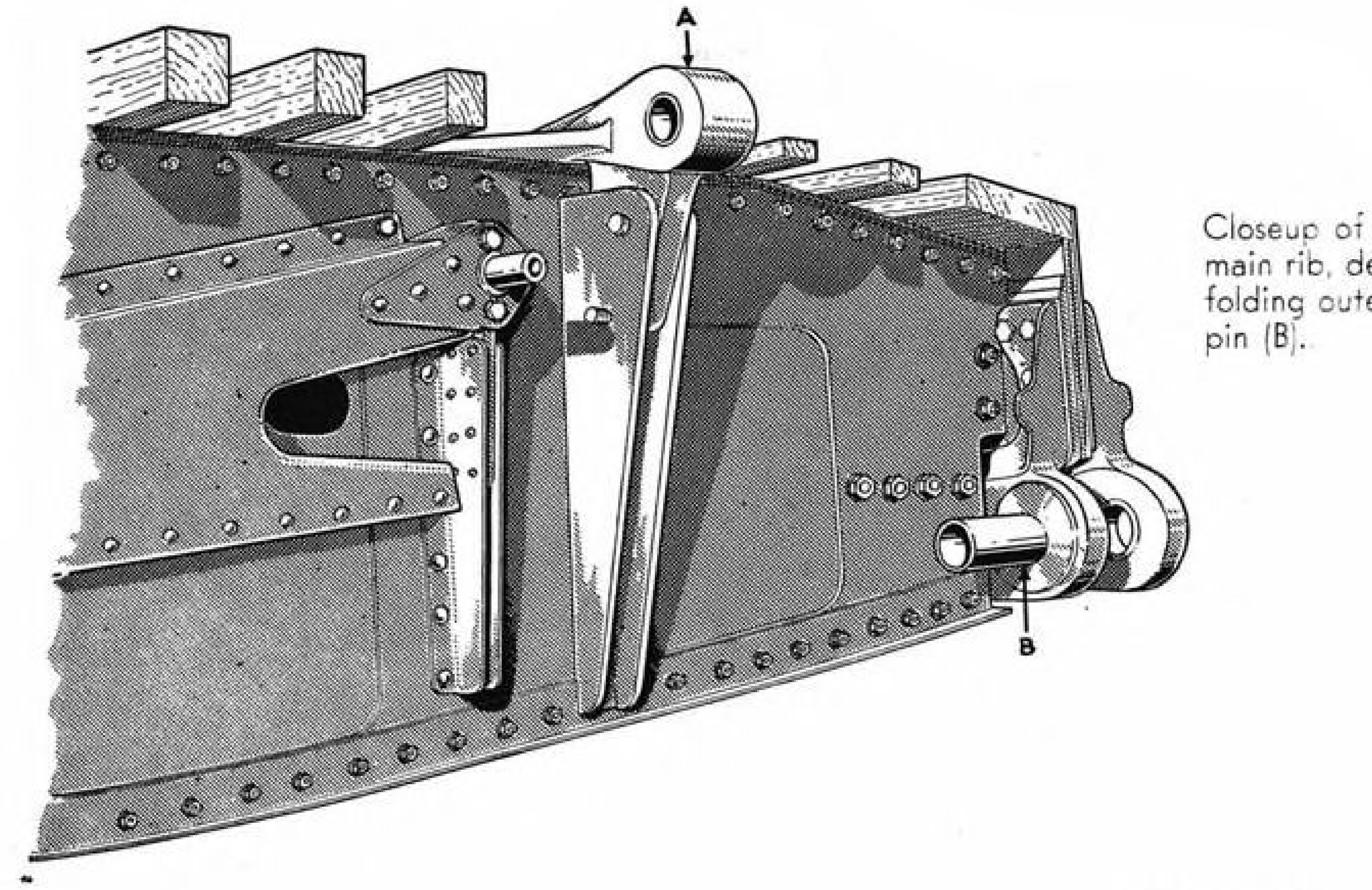
Phantom view of G & A (Firestone) XR-9B helicopter main rotor blade, which has step-tapered steel tube spar, to which 7/32-in. 5-ply ribs are attached by stainless steel collars. Cord at root is 15.25 in. and 8.5 in. at tip; blade area is 12.5 sq. ft. (Also see page 99, May "Aviation".)



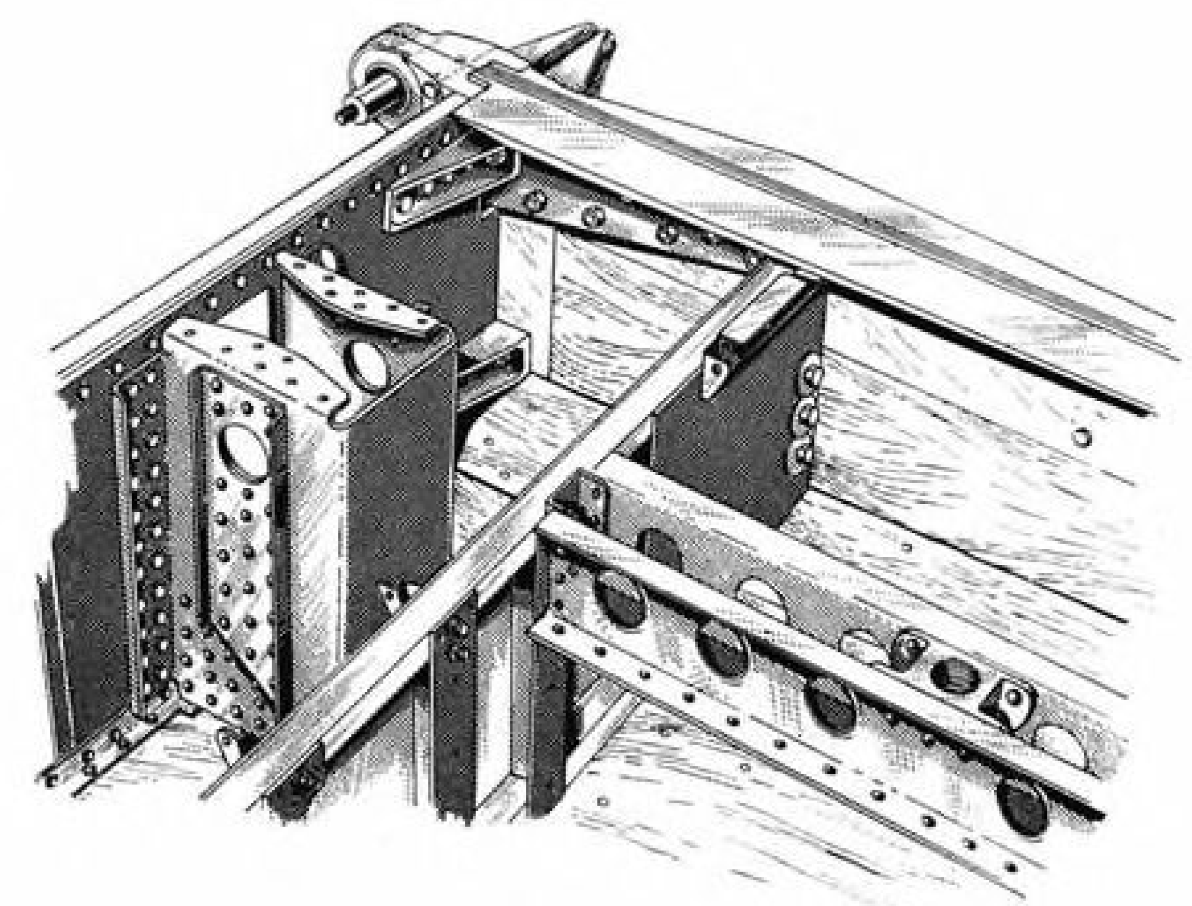
Closeup sketch of part of XR-9B helicopter, showing arrangement of access panels designed to speed inspection and maintenance of controls as well as power plant.



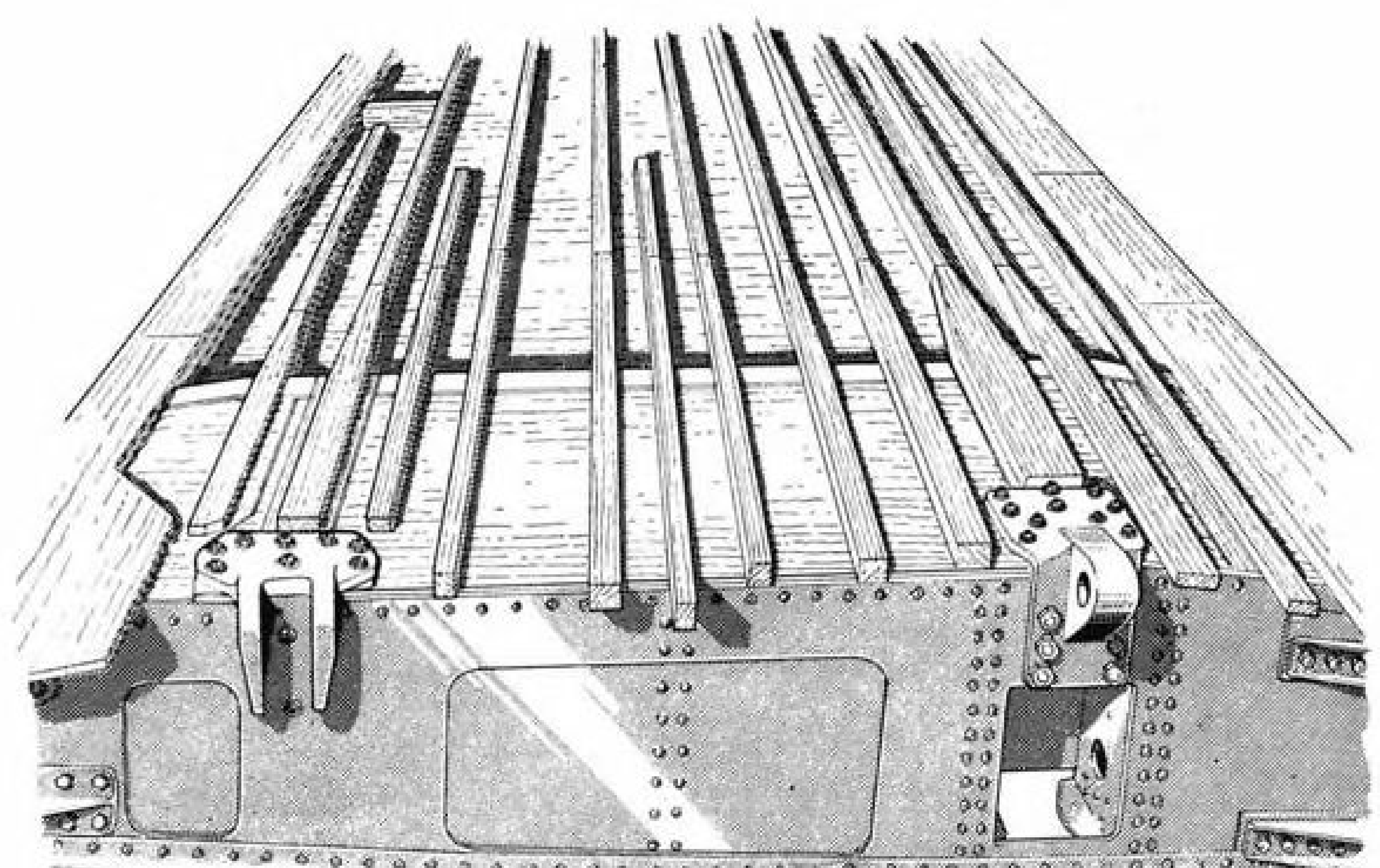
Phantom view XR-9B fuel system, showing (A) engine gage, (B) fuel quantity gage, (C) fuel gage pump, (D) primer pump, (E) mixture lever, (F) lever to actuate wobble pump (G), (H) fuel pump, (I) primer to cylinders, (J) carburetor, and (K) fuel tank.



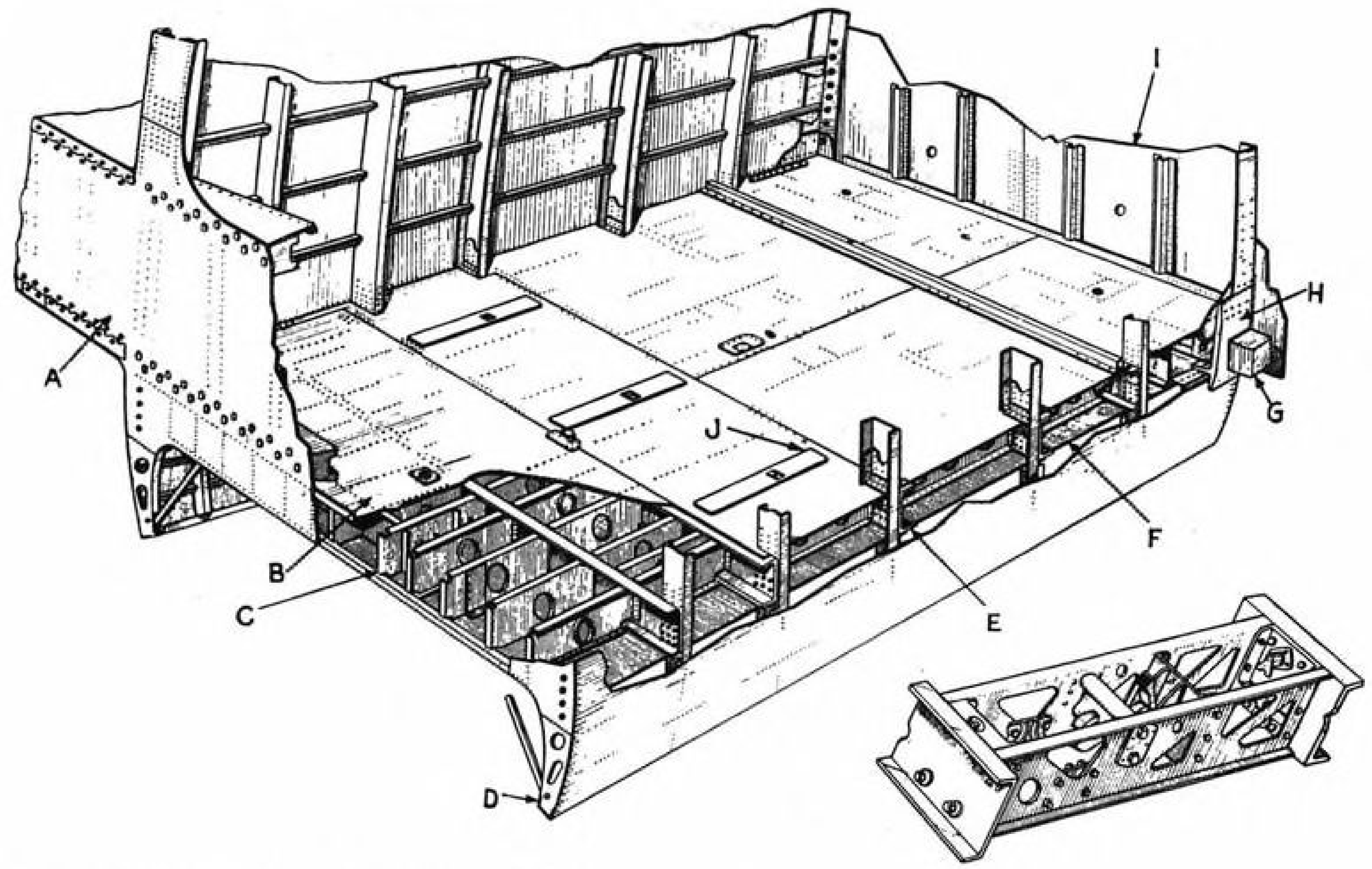
Closeup of deHavilland Hornet wing main rib, depicting rear hinge (A) for folding outer wing panel, and locking pin (B).



DeHavilland Hornet wing with lower skin removed, showing method of installing hinge reinforcing box.

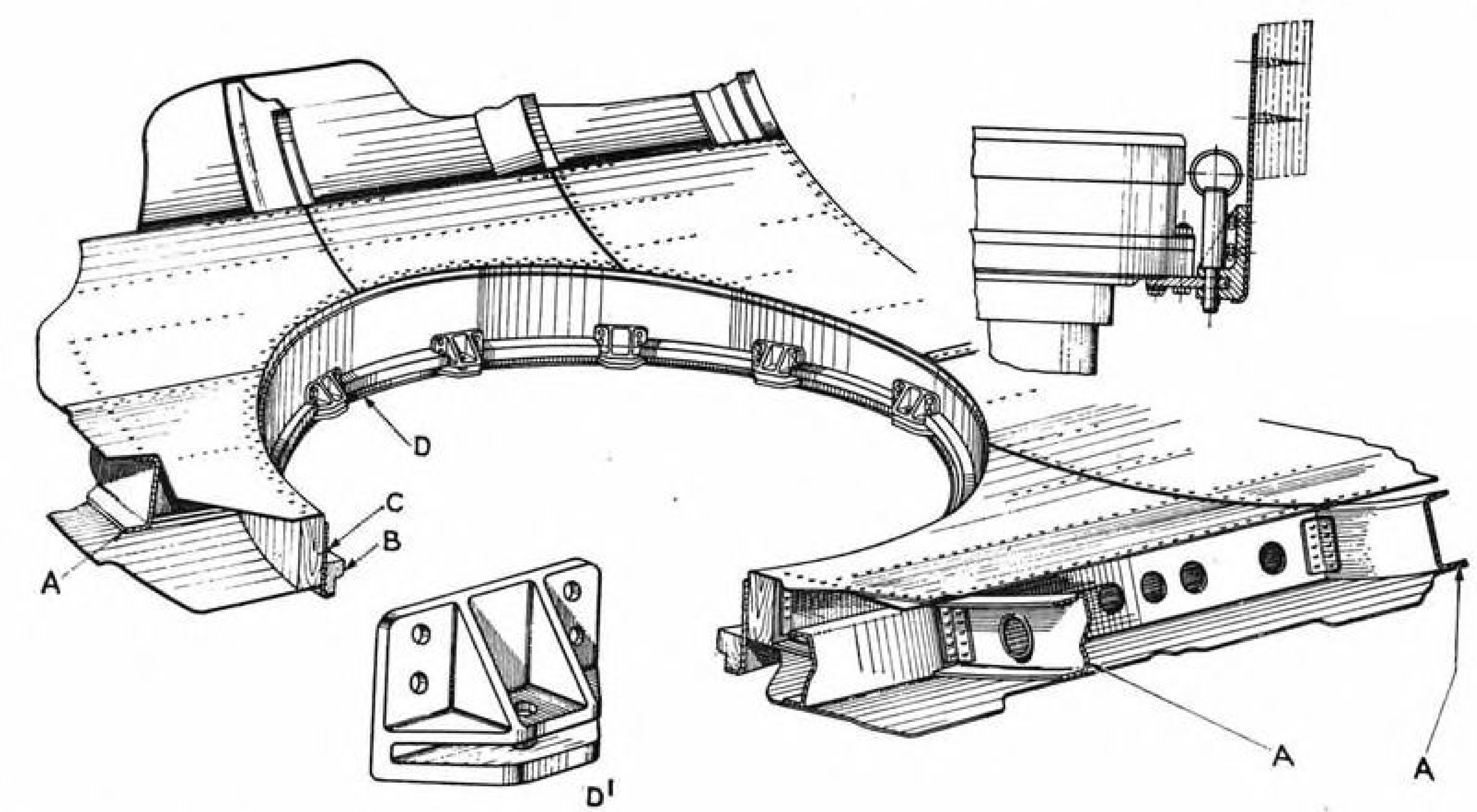


Portion of outer wing panel of Hornet, showing combination metal and wood construction. In this craft, single web wood spar is turned over at right angle along upper edge to pick up shear load directly to upper skin. This upper surface, as shown here, comprises an inner skin attached directly to spars and ribs, with another plywood outer skin to be cemented atop spanwise stringers.



Avro Lancaster floor construction over bomb bay, with front spar at (A); top skin of floor (B); typical intercostal (C); and bomb bay door hinge channel at (D). Typical floor cross member is shown at (E) and lower skin floor at (F). Rear spar bottom boom is at (G); longeron at (H); and rear spar at (I). Detail sketch at lower right shows bomb carrier housing below point (J).

Cutaway drawing showing mounting of mid-lower gun turret on Lancaster. Fuselage formers are at (A); sealing ring (B); wooden ring (C); turret mounting ring (D); turret support brackets (E)—also shown in detail sketch D.[1] Cross section sketch at upper right shows attachment of turret to support brackets.



RAPID HANDLING AND FACILE STOWAGE FEATURED IN FAST AIR FREIGHTER

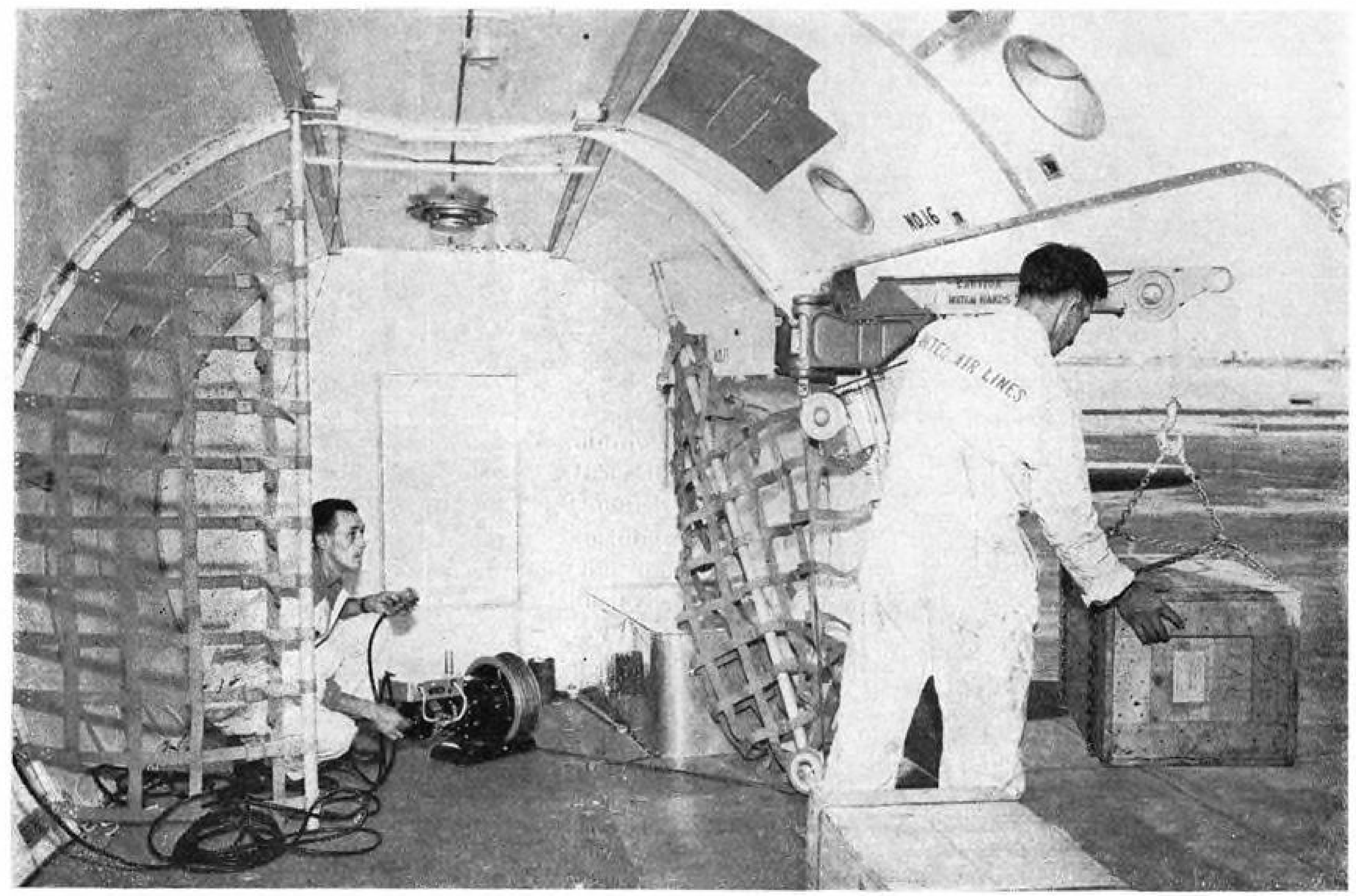
RECENTLY PLACED IN SERVICE, the all-cargo version of United Air Lines' Mainliner 230 passenger plane—the Cargoliner 230—is novelly fitted for efficient freight-handling by incorporation of heating and refrigerating devices, portable winch unit, and other freighter aids. A Douglas DC-4, the craft cruises at more than 230 mph., is capable of hauling a maximum load of 9 tons, and can span the continent in under 13 hrs.

Entirely lacking in windows along fuselage storage area, the plane is lined completely with white plastic laminated sheet Plyon in aluminum fittings, and has numerous lighting fixtures. Installation of the Plyon provides air spaces 1½ in. wide by 17 in. long between the Plyon lining and spun Fiberglas insulation against the outside skin. Known as hot panels, these spaces provide a duct for even distribution of heat or cold throughout the entire cargo area. Air is circulated through a passage in the ceiling, and from there, is diverted to the interior of the cargo compartment as well as through the hot panels—700 cu. ft. per min. passing through each section. Thus, there is no difference in temperature between center of compartment and walls.

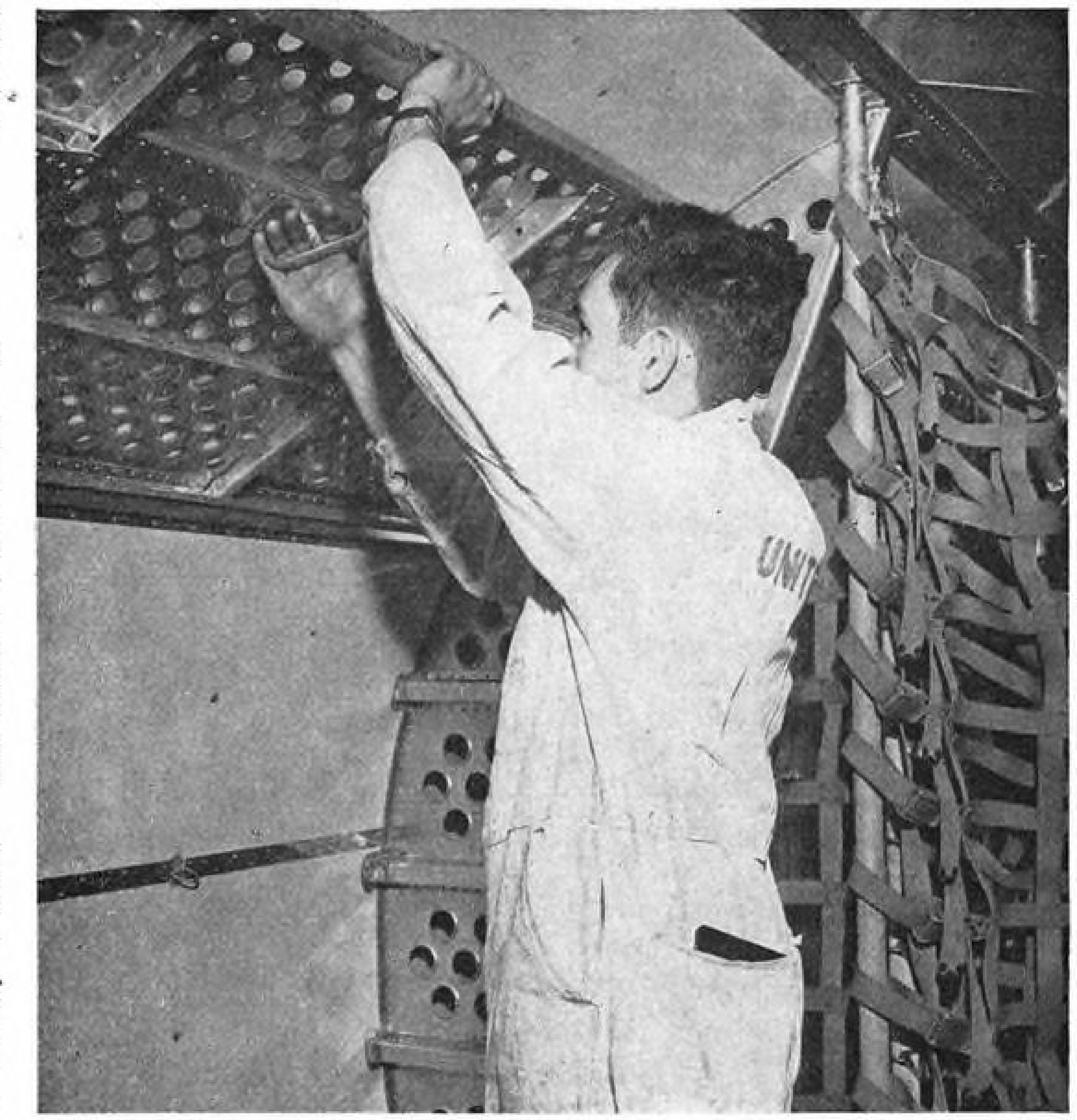
In addition, a new dry ice-methanol system provides complete refrigeration of entire interior. Located in the forward belly pit, the refrigeration equipment is tied in with the ventilation system and electronic thermostatic control to afford even, low temperatures, in flight or on the ground, for flowers, fruits, vegetables, and other perishable cargo.

Cold Room and Stowage

When it is desired to cool only a portion of the plane, aft section may be closed off with a thermo-sealed curtain equipped with dry-ice pockets pro-



This interior view of UAL's Cargoliner 230—Douglas DC-4—shows thermo-sealed curtain for shutting off aft section of plane to provide 300-cu. ft. refrigerated section. Movable electric winch, seen on floor operating cable to hoist-boom extending through door, may be moved to various locations in plane interior to facilitate movement of cargo to and from storage areas.



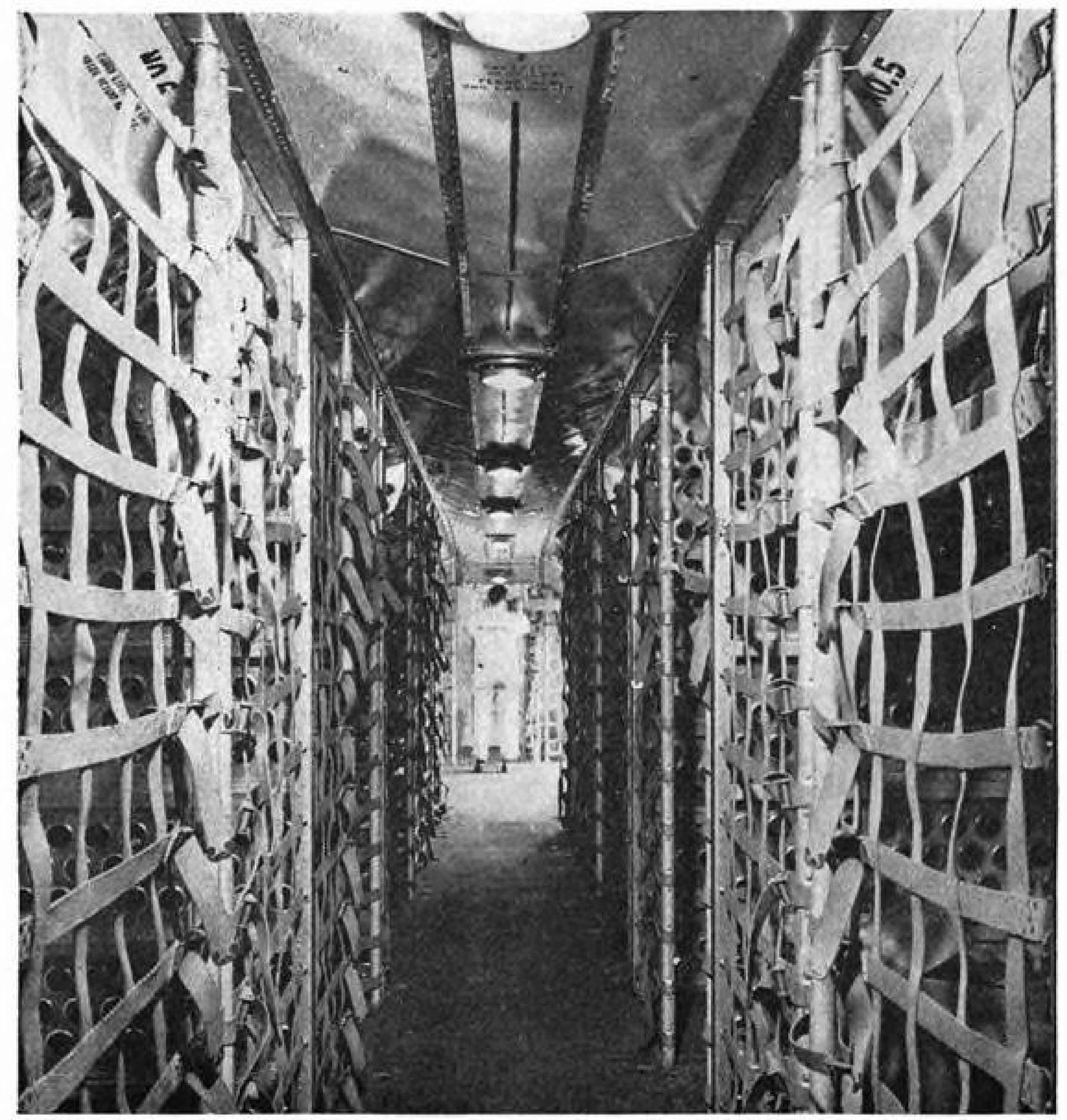
Hinged shelf in freighter's cargo "pit" may be utilized for small shipments or swung out of way and secured to wall. Stanchion (right) has been moved to side to afford open front for pit. Walls are lined with white plastic laminated sheet Plyon over air space.

viding refrigeration for more than 300 cu. ft. and a 1000-lb. capacity.

Stowing of cargo in each of the ten "pits"—compartments—is speeded by use of flexible gates. Once a pit is full, a cargo handler needs only to close the gate and secure spring-loaded pins. Former time-consuming tiedown procedures are eliminated, except when a pit is partially full. Also, the pits are equipped with hinged shelves which can be swung out of the way or used to stow small shipments. Each pit measures approximately 80 x 40 x 85 in.

When it is necessary to utilize more floor space for long or bulky articles, stanchions forming the side of the pits may be moved back to supply additional room.

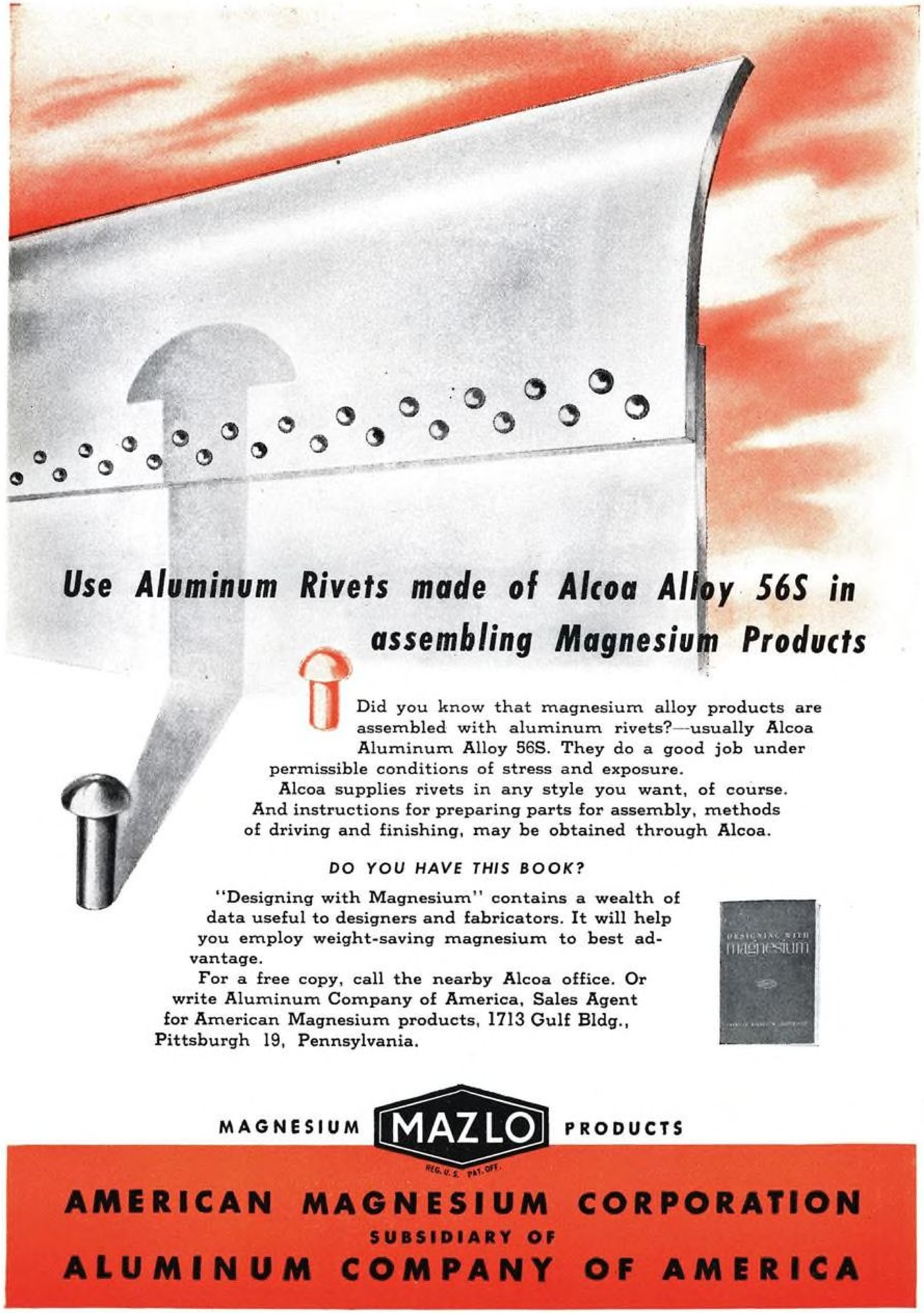
An auxiliary gasoline-driven power unit is installed in the forward section of cargo compartment to operate a movable electric winch, also to supply electricity for loading lights when the plane is on the ground at stations where outside auxiliary power is not available.



Compartmentation arrangement is seen in these rows of cargo pits, fronted with flexible gates, on either side of corridor. Refrigerated section is at rear.

Portable electric winch, coupled with 4-ft. hoist boom hinged to the upper aft corner of main cargo door, facilitates loading of heavy articles—especially at fields equipped with only a minimum of ground equipment. It may be moved to five different points in the plane and plugged into the electrical system. When attached to the hoist boom, the winch can lift 2,500 lb. at a rate of 30 fpm.; or attached to tiedown points inside the plane, it may be used to move heavy objects to and from stowage areas.

Night cargo loading is aided by two 32-cp. flexible floodlights on the upper inside section of each side of the main cargo door. With door open, these lights play over entire loading area outside the plane.



THE AVIATION NEWS

BLAINE STUBBLEFIELD, Washington · HERB POWELL, New York · E. J. BULBAN, New York

New Air Coordinating Committee Is Set Up; Prepare 5-Yr. Industrial Mobilization Plan

. . . To base 29s, 51s in Alaska . . . Re military-civil certifying . . . Simpler craft registration . . . Personal plane listings up . . . Warplanes go for scrap . . . Groom plane-rental service . . . Favor 'copter-taxi plan . . . Plane-test rule weighed . . . Medico total near 2,000 . . . Details federal airport aid.

New Air Coordinating Committee, succeeding old body set up in '45, has been established by Pres. Truman, will examine all aviation matters affecting more than one participating agency; give civil aviation direct contact with White House; work with U. S. representatives to PICAO; and set up Aviation Industry Advisory Panel, with members from manufacturing, transport, and private flying interests.

ACC will also study military aviation but will leave most decisions to A-N Munitions Board. Committee has representatives, from War, Navy, State, and Commerce Depts.' who are on old group, together with Post Office and CAB personnel, with non-voting observer from Budget Bureau. Chairman is W. L. Clayton, Undersec. of State, and co-chairman is CAB Chairman J. M. Laudis.

Sen. Hugh Mitchell's bill proposing air policy board would provide broader, more objective view, and he will continue to press for passage. New ACC embraces more agency authority, and it is supported by Executive order.

Prepare 5-Yr. Industrial Mobilization Plan

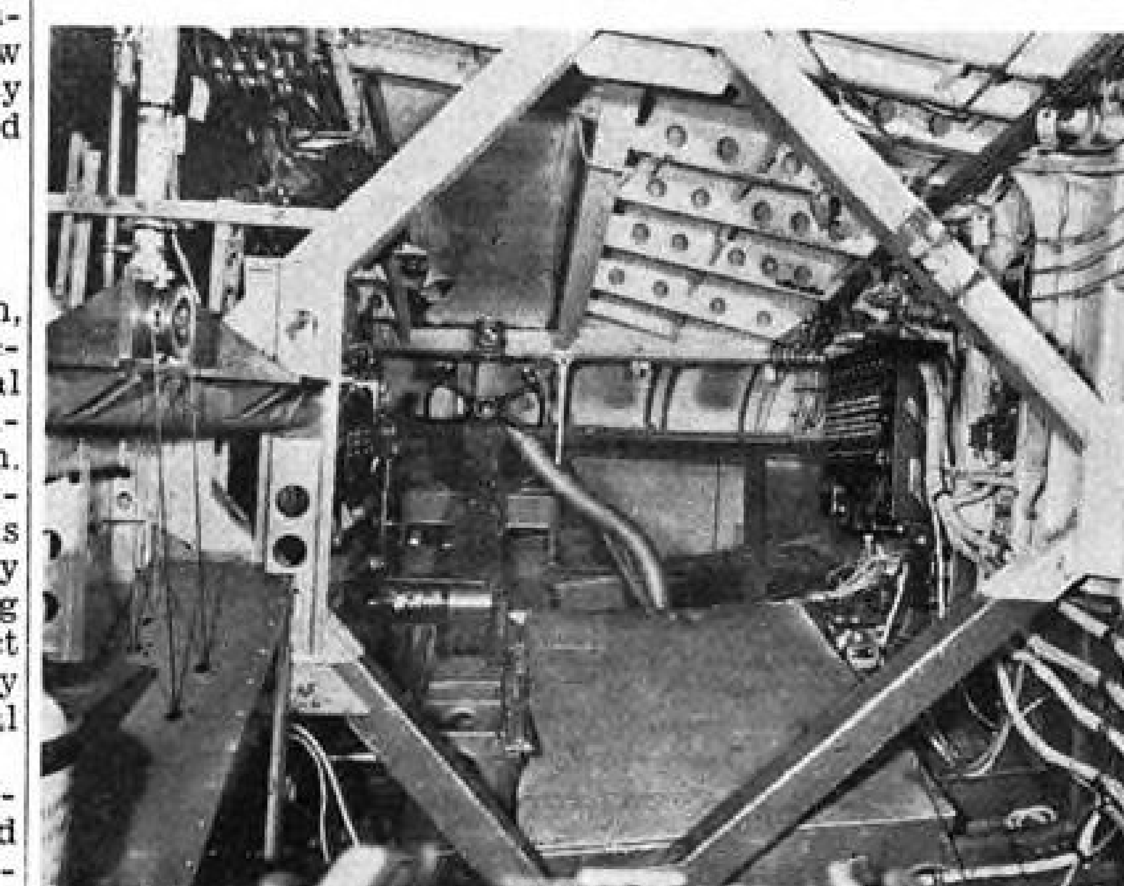
Due to international tension, Administration leaders are developing a 5-yr. industrial mobilization plan for presentation to 80th Congress in Jan. Mainspring of plan is to reserve rights in most surplus war plants sold or leased, by contract clauses forbidding changes which would obstruct conversion to original military production. Few plants vital to war have been released.

Plan calls for: (1) Administration mobilization board and staff in Washington; (2) coordination of all manufacturers in the industrial assembly system developed during war; (3) stockpiling vital metals and other materials; (4) educational orders for new designs such as jet power, rockets, radar, atomic warheads, guided missiles.

Recommended is setting up of small parallel production lines in most factories, to make educational amounts of war gear. Those advocating this mobilization say it is to insure preparedness.

To Base 29s, 51s in Alaska

A group of B-29 bombers and a squadron of P-51 fighters will soon base in Alaska for training, AAF Chief Gen. Spaatz announced. In a recent speech, he said U. S. is open to attack across the Polar cap. B-29s will replace B-17s in U. S. occupation forces in Europe. Soviet Union has protested both moves. Army personnel in Alaska numbers more than 4,000, some based at Ladd Field, engaged in cold weather testing of air and other equipment. Twenty-eighth Bomber Group will base at Elmendorf Field, Anchorage; fighter squadron from 56th Fighter Group at Ladd field.



XB-35'S INNER SANCTUM

Initial interior view of Northrop Flying Wing, looking forward in cabin toward co-pilot's position. Bombardier's panel is to immediate right of wheel, and large tube is ventilating duct used when working on interior. Cockpit windows are covered with protective paper. Giant craft is undergoing proving at AAF's Muroc Field. (Acme photo)

Assignment is 6 mo. temporary; other groups will rotate for experience. Some P-80 jets are cold weather testing in Alaska.

Re Military-Civil Certifying

A new CAR Part 9, providing for certification of military planes in civil use, is being circulated for comment by CAB. Air worthiness would be determined on basis of plane's compliance with military requirements instead of on requirements of Parts 03 and 04 of CAR. The limited certification would cover military airplanes, gliders, rotorcraft, and buoyant craft. Models accepted by the military would be eligible, but not models basically like those now holding regular certificates.

Personal Plane Listings Up

About 45,000 personal planes are now registered, and order backlogs and production rates indicate there will be well over 100,000 before end of '47. If so, prediction of CAA Administration, Wright, some 18 mo. ago, that the total would reach 75,000 in 1947 or 1948, will be far exceeded. Aircraft Industries Assn. reports that in August Aeronca shipped 798 planes, Beech 20, Cessna 547, Luscombe 280, Piper 798, Republic 20, Stinson 245, Taylorcraft 518, Texas Engineering & Mfg. 121—total by Personal Aircraft Council members 3,347; total all mfgrs., 4,350; total value of PAC member shipments \$8,554,000; and total unfilled orders \$53,264,000 (not counting Republic). Some producers already see slackening demand for personal planes. CAA and other authorities continue to urge utility improvements to step up volume sales.

Simpler Craft Registration

CAA and aircraft industry representatives are near agreement on a new aircraft registration system, eliminating duplication of recording by manufacturer, distributor, dealer, and customer. Plan calls for dealer registration cards, to be bought from CAA, transferable like auto tags. Dealer gives customer one copy of bill of sale; CAA gets other two and sends one back to customer, attesting plane's registration.

★ COMING UP ★

Nov. 7-8: SAE National Fuels & Lubricants Meeting, Mayo Hotel, Tulsa, Okla.
Nov. 8-11: Northwest Aircraft Show, Vancouver, Wash.
Nov. 15-24: National Aircraft Show, sponsored by AIA, former Fisher Bomber Plant, Cleveland.
Nov. 19: PICAO Communications Div. resumes meetings, Montreal.
Nov. 20-22: National Aviation Trades Association convention, Cleveland.
Nov. (Exact date unannounced): International Aero Exhibition, Paris, France.
Dec. 2-4: SAE National Air Transport Engineering meeting, Edgewater Beach Hotel, Chicago.
Dec. 9-11: Annual meeting Society for Experimental Stress Analysis, New Yorker Hotel, N. Y. C.
Dec. 12-15: International Aviation Celebration, El Paso, Tex., auspices Chamber of Commerce.
Dec. 17: Tenth Wright Brothers Lecture, Washington, D. C.
Dec. 17: Anniversary dinner, Aero Club, Statler Hotel, Washington, D. C.
Jan. 10-12 '47: All American Air Maneuvers, Miami, Fla.
Jan. 11-16: Aviation of Tomorrow Exhibit, Miami, Fla.
Jan. 28-30: Fifteenth annual meeting, IAS, N. Y. C.
Feb. 1-28: Inter-American lightplane cavalcade, Brownsville, Panama.
Apr. 18-27: Michigan Aviation Week, sponsored by Aero Club of Mich., Detroit.
Apr. '47: Western Air Show, Los Angeles.
May 9-17: Air Fair, sponsored by Aviation Council of Metropolitan St. Louis.

NEW TWIST FOR HIGH SPEEDS

Closeup view of C-W Propeller Div.'s experimental prop having sweptback blades for purpose of gaining greater high speed efficiency. Developed for AAF, new airscrew is part of swept-back-blade program, which it is anticipated will carry prop efficiencies at high speeds into 700-mph. range.

Warplanes Go for Scrap

WAA has approved biggest junk deal in history—sale of 21,000 surplus combat planes, initially costing $3,900,000,000, for $6,582,156. Purchasers agree not to fly planes; most will be scrapped, yielding 200,000,000 lb. secondary aluminum and other alloys. Successful bidders: Martin Wunderlich, Jefferson City, Mo.; Sherman Machine & Iron Works, Oklahoma City; Texas Railway Equipment Co., Houston; Compressed Steel Co., Denver; Sharp and Fellows Contracting Co., Los Angeles.

Groom Plane-Rental Service

National Airplane Rental Service, organized by John Geisse, former CAA deputy administrator for private flying, will cover about 300 cities with about 1,000 planes when in full operation. Mr. Geisse said service would be confined to one region through initial experimental period, probably the Northeast. Backers are prepared to invest over $2 million if expansion seems justified.

Geisse visualized 10,000 planes eventually in service. Using a basis of 500 hr. per year per plane, he estimated rent rate at 5¢ per seat-mile, with very little empty ferrying.

Favor for 'Copter-Taxi Plan

CAB examiners have recommended for the first time certification of helicopter services. If Board accepts recommendations, Yellow Cab Co., will operate two helicopter routes from Cleveland airport to downtown points, using 4-place Sikorskys. Interest in 'copters for passenger transport, mail, industrial, and military services is growing steadily.

Weigh Plane-Test Rule

CAB has received comment on its proposal that CAA require 100 hr. additional accelerated service tests on aircraft before certification, with transport planes requiring 150. Many manufacturers opposed idea, arguing additional testing will involve much redtape; that some manufacturers already run accelerated tests; that present involved procedures result in more testing than new proposal would require.

Medico Total Near 2,000

There are now 1926 medical examiners designated by CAA, including 600 ophthalmologists to give eye refraction tests. About 400 more appointments are being processed. In a recent survey, United Pilots & Mechanics Assn. found that 53% of persons holding commercial licenses had to travel an average of 46 mi. for medicals, seeming to indicate not nearly enough examiners have been appointed. UPMA found 97% of replies condemned CAA's increase in exam fee from $6 to $15; has already asked CAA to reconsider it.

Details Federal Airport Aid

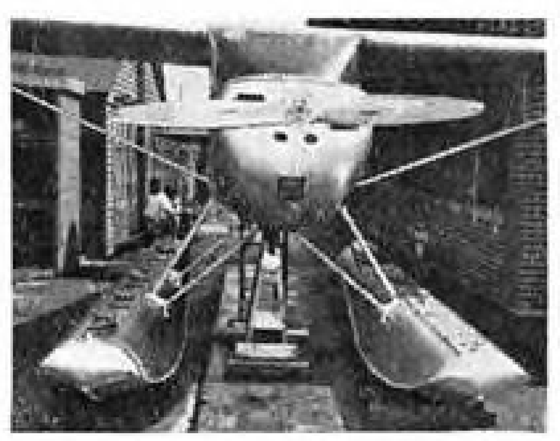
How communities can get federal aid for airport construction was told by CAA Administrator **Wright in his** speech before National Aviation Clinic, **Oklahoma City.** CAA will furnish instructions. Mr. Wright explained that local governments must take initiative to get funds, under the $520,000,000 field program authorized by Congress. Only $48,000,000 were appropriated, and less than that may be available, in line with curtailment of public works to check inflation and divert materials to much needed housing.

Funds to be made available in years to come will depend upon will of Congress and its view of aviation progress and needs.

Public hearings on rules and regulations under the airport law were held October 28.

Mr. Wright said that for Class 4 airports the federal share should be 5% on costs up to $2 million, and on each additional million up to $10 million, federal share would be reduced 5%.

He emphasized need to reduce plane noise, saying no amount of money can put an airport where residents don't want it. He also urged further development of cross-wind landing gear.



EDO IMPROVES SEALEGS

Model 1650 floats, as fitted for first time on Cessna 140, show several innovations over Edo's previous designs. Construction has been considerably simplified through use of large sheeting on float upper surface from chine to chine; longitudinal stiffeners down the length of floats also serve to provide platforms; and elimination of spreader bars cuts weight and adds to speed. Another feature is use of flat sheet for bottom surfaces, in place of concave design. (Aviation photo)

★ SPOT CHECKING ★

Vet Administration publicizes Dept. of Labor statistics on handicapped workers in aircraft industry, showing they suffer no more serious injuries, lose no more time on job, and are over 2% more efficient in similar duties than able bodied workers.

First venture of Douglas in small plane field is said to embody five-passenger craft with tail propeller driven by two 500-hp., Continentals for expected speed of 250 mph.

Newly developed 125-lb. search radar, APS-10, for lightplanes, is reported by AMC as eliminating flying hazard in dark or fog. Future plans call for 75-lb. unit giving greater range at less cost. Command also displayed world's largest aerial camera, effective from 10-mi. height, and weighing about 600 lb.

New American speed record of 611 mph. was achieved by Republic XP-84 Thunderjet at Muroc, Cal.

Expected acquisition by Empire Airlines includes 20-passengers-plus planes for hourly local and express service from La Guardia Field, N. Y., to 500-mi. inter-state points.

First CAA approved type certification for rocket motor was received by Aerojet Engineering Corp., with use of company's Jato unit permitted for any licensed aircraft.

Plastic packaging material, Seal-Peal, was transparent film placed on wide variety of products, including precision instruments, china, and food, for protection against abrasion, corrosion, moisture, temperature extremes, and altitude on round-world experimental flight recently scheduled from Detroit.

Contracts for 'copters, revealed by Piasecki, include advanced design XHJP-1 (PV-14) for Navy and transport XR-16 (PV-15) for Army. Another Navy project is HRP-1 (PV-3).

PICAO's recent demonstration at Indianapolis saw radio and radar devices revealed for first time to more than 250 foreign and American delegates. Later demonstration in Montreal featured Australian - developed radar equipment.

Installation of Hughes flying boat's 8 P&W R-4360 Wasp Majors, totaling over 24,000 hp., has been completed at Long Beach, Cal., harbor.

Practicability of submersible airplane is being considered by Navy. Craft strong enough to land at sea and submerge to evade attack is contemplated. It's to be powered by jet engine for flight, and auxiliary unit for underwater movement. Air vents would close automatically upon submergence.

In conjunction with purchase of Sikorsky S-51, experiments are announced by Hawaiian Airlines to test commercial possibilities of 'copter for intra-island service to supplement the line's inter-island Douglas runs.

New American distance record of 314 mi. for gliders was established in Schweizer two-place sailplane soaring between Prescott, Ariz., and Governador, N. M. Pilot was PAA's Dick Johnson.

Training of State police, new activity of CAA, is for purpose of aiding officers to identify and apprehend private pilots who violate regulations. CAA would like States to take over police function. Tryout school is in progress in Pa. Other states are also interested.

Interesting phase of NACA's work on boundary layer control is testing of sweptback wing with leading edge air intake slots arranged at various angles, and study is being projected into sonic flight range. NACA and Douglas are investigating possibilities of using air from slots to feed jet- and turbine-engines.

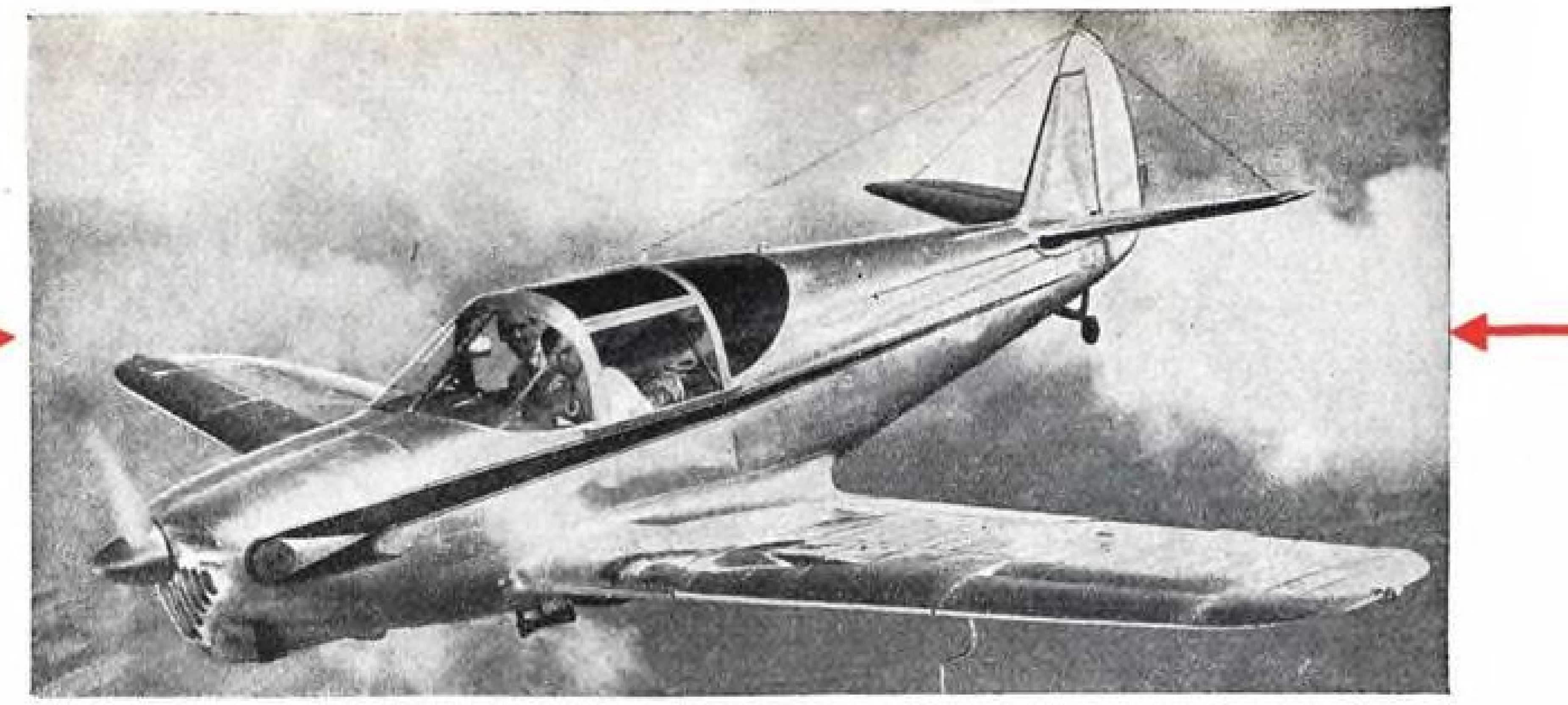
Training films and strips: Available to any recognized organization, "Report on Jet Propulsion" is 25-min. sound-color-film recently released by Bell Aircraft Corp., Motion Picture Div., Buffalo 5, N. Y. Depicting story of company's P-59 Airacomet, film traces jet principle from early applications to modern times. . . . "Wings to Ireland" is new sound-travelogue scheduled for Nov. release by Pan American Airways, 135 E. 42 St., N. Y. C. . . . CAA 35-mm. film strips with records for sound, now available for public use from Castle Films, 30 Rockefeller Plaza, N. Y. C., include: "Approach Control", "Air Traffic Rules", "CAA Communications System", "Federal Airways Service", and "Planned Developments".

Commonwealth temporarily curtailed Skyranger production, stating that increased costs made it uneconomical to produce further craft until some redesign and new price had been decided.

Boeing reports substantial additional AAF orders for new B-50 (improved B-29). Previous contract for craft called for delivery of 60.

Unfilled AAF orders with aviation industry totals $654,000,000 and covers 27 concerns. Experimental contracts run to $175,000,000.

Publications: Massachusetts Aeronautic Commission, Boston, has published "Three-Year Airport Development Plan", also, "Approved Airports, Landing Fields, and Seaplane Bases". . . . "New England Airport Map" is issued by New England Council, 1032 Statler Bldg., Boston, Mass. . . . "Air Potentials in New York Women's Apparel Industry" is 74-page pamphlet distributed as service to airfreight industry by Fairchild Aircraft Div., Hagerstown, Md. . . . "Peace Through Air Power" is 32-page illustrated report issued by Air Power League, Empire State Bldg., N. Y. C. . . . "State Aviation Motor Fuel Taxes, Refunds and Exemptions, and Law Provisions Relating Thereto" is 28-page state-by-state summary issued by American Petroleum Institute, 50 West 50th St., N. Y. C. . . . "Practical Way to Handle Grievances" is 58-page booklet issued by Labor Relations Institute, 1776 Broadway, N. Y. C.



* PLANES AT WORK *

In an effort to relieve areas of acute milk bottle shortage, Single Service Containers, Inc., paper milk container maker, is sending air express loads of containers by air to stricken cities.

Air shipments of plywood sheet and flooring was carried by UAL DC-4 from Oregon to Salt Lake City, and arrangements were made to fly door and window sashes from Portland to Salt Lake City.

Destined for Anthropoid Ape Research Foundation in Fla., 7,000 lb. of assorted animals were flown by ACT from Phila. to Miami for medical research and distribution to zoos.

About 120 Chevrolet auto hoods and miscellaneous parts were shipped by car-maker via Delta Air Lines' DC-3 from subassembly plant to avoid temporary stoppage of company's Atlanta assembly line.

Exchange agreement between American Broadcasting Co. and British BBC to trade films of special events for television broadcasting was inaugurated with aerial shipment of first lot to England via AOA DC-4.

Use of company plane to develop jobber salesman training program has been started by Hollingshead Corp. of N. J. Company flies salesmen from organizations to plant for intensive training course, then returns them.

A load of 36 pianos was air-shipped by Lester Piano Mfg. Co., Phila., to California and Miami, with shipper selecting air freight because of speed and east of handling.

Radio station WOR is using a Piper Super Cruiser for covering special events from aloft, with roomy rear seat accommodating station's announcer and his portable equipment.

Due to scarcity of washing machines, Apex Electrical Mfg. Co. is using air cargo whenever possible to expedite shipments to country's key areas. First load was flown from Cleveland to N. Y. by UAL recently.

* CANADIAN NOTES *

By James Montagnes

Industry Notes: A. V. Roe Canada is understood to be working on new transport models to replace cancellation of RCAF order for five Tudor II freighters. RCAF cancelled Tudor order because Canadair, Ltd., will be able to deliver DC-4 aircraft earlier. . . . DeHavilland Aircraft of Canada reported net profit for year ending Sept. 30, 1945, after income and excess profits, of $409,277, as compared to $152,102 in 1944.

Canadian Air Transport Board recently reported operating revenue for June of four Canadian scheduled and 19 non-scheduled air services as highest recorded to date. Net operating revenue in June was $115,000, with revenue totaling $1,994,000 and expenses being $1,879,000. During that month, Canadian airlines carried 55,000 passengers, 1,400 tons of goods, and 347,000 lb. of air-mail. Total of 17,000 revenue-hours were flown.

New air services in operation: First Canada-Australia flight by Australian Air Lines was made to Vancouver and return to Sydney. TCA has started daily service with Lodestars between Ft. William and Duluth. Initial Montreal-Vancouver transcontinent run has been made in both directions by Canadian-built Merlin-engined DC-4. TCA has begun using converted war surplus C-47s on main route, Montreal-Toronto-Winnipeg. Extension is planned to Edmonton before year-end. Further, TCA is to operate shuttle service from Prestwick to London, replacing service by Scottish Aviation, Ltd.

* CALLING NAMES *

Kenneth P. Bowen has been appointed asst. gen. mgr. for Fairchild Aircraft div.

Jervis Langdon has been named traffic mgr. for PCA in Wash.

EAL appointments: **Stuyvesant Peabody, Jr.**, has been elected to board of directors; **Frank E. Williams** has been appointed station mgr. at Newark; **U. D. McDonald** was made station mgr. at San Juan, Puerto Rico; and **Alberto Lebron** was appointed traffic mgr. at San Juan.

Col. Wallace S. Dawson has been appointed director of safety bureau of CAB.

L. W. Tixier has been made mgr. of industrial relations for Douglas.

B. V. Korvin-Kroukovsky, aeronautical engineer, has been named research professor in fluid dynamics at Stevens Institute of Technology.

James J. Wadsworth has been appointed director of governmental affairs dept. of Air Transport Assn.

Lt. Col. Harold F. Brown was named managing director of Air Transport Operators, assn. of charter airlines.

Everett A. Eisenberg has been made asst. to pres. of Empire Airlines, N.Y.C.

UAL appointments: **R. L. Mangold** was named supt. of freight sales; **J. William Denny** was appointed chief of cargo sales at Cleveland; **R. F. Dorsey** was made station mgr. at Wash.; **W. A. Bouve** was named station mgr. at Cleveland; **O. S. Pierce** was made station mgr. at Newark; **David H. Robertson** has been appointed eastern regional mgr. of passenger service; **Richard A. Ashby** has been named mgr. of passenger service at Honolulu; **Glen Evers** was named chief of cargo sales at N. Y.; **H. F. Barnes** has been made asst. to v.-p., passenger service, in charge of Pacific area; **G. S. Taylor** has been named western regional mgr. of passenger service; **John Brinkman** was named supt. of reservations service; and **R. C. F. Baer** was made special projects asst. to v.-p., passenger service.

James P. Cunningham, v.-p. in charge of production at Luscombe, has been elected to board of directors.

J. E. Flickinger has been appointed tech. sales head for Saval, aircraft hydraulic manufacturer.

Larry Avilla, Slick; **Richard G. McGinnis,** PAL; and **Jack M. North,** National Skyways Freight; have been appointed members of San Francisco Chamber of Commerce's aviation committee, under chairmanship of **George C. Tenney,** pres. of McGraw-Hill of Cal.

LATEST PLEASURE PLANES

A couple of new choices for personal flyers are presented by Fairchild (top) and Aeronca (above). Former is a four-five placer scheduled for production early next year in a new plant at Strother Field, Winfield, Kan. Company states craft is designed for long range and high performance. Aeronca Chum, seen here in first flight view, is low-wing two-placer with spinproof feature (under Weick license). Slated for production early in '47, Chum is powered by an 85-hp. engine, is said to have a top speed of 115 mph., cruising speed 105, and landing rate of 49. Range is set at 400 mi. (Hans Groenhoff photo)

Henry C. Hill has been made asst. director of power plant engineering div. of Menasco, and **Louis J. de Roze** has been named production liaison engr. on gas turbine engines.

Arthur F. Kelly has been made gen. traffic mgr. for WAL with hq. in Los Angeles.

Juan T. Trippe, pres. of PAA, has been awarded Medal for Merit by Pres. Truman for war-time services to U. S.

D. A. Forward has been elected to board of directors at Boeing. **Jack V. Sheehan** and **Ralph Bell** have joined company's sales engineering staff.

T. Claude Ryan, pres. of Ryan, was elected chairman of Western Region exec. committee of Aircraft Industries Assn. **William M. Allen**, Boeing, is vice-chairman.

Worth A. Johnson has been made district mgr. for TWA at Kansas City, and **E. M. Lepper** has been appointed district traffic mgr. at Albuquerque. **Kay Idso** has been appointed news bureau mgr. for PAA at Honolulu.

H. M. Horner, pres. United Aircraft, has been elected chairman of Eastern Region Aircraft Manufacturers Council of Aircraft Industries Assn. **J. Carlton Ward, Jr.**, pres. of Fairchild, is vice-chairman.

J. H. Cooper has been elected treasurer of C&S.

T. D. Neelands, Jr., has been elected director of Robinson Aviation.

Alvin C. Schweizer has been appointed regional sales mgr. of U. S. Airlines, West Coast div.

Elmer Basey has been appointed regional gen. traffic mgr. for PAL.

Vincent Ellis has been placed in charge of aircraft sales div. of Lord Manufacturing Co.

Dr. Merritt A. Williamson has been appointed head of Technical Research dept. of Solar Aircraft.

J. Seymour Kail has been named v.-p. in charge of operations and traffic of American Air Export-Import Co.

* OBITUARY *

H. Ainsley Highman, assistant to president of United Air Lines. Founder and president of Connecticut chapter of National Aeronautical Assn., he was widely traveled. Formerly, he was v.-p. of Raymond & Whitcomb, travel concern, and gen. mgr. of passenger dept. of French Line in N. Y.

Morris J. Stone, founder of Stone Propeller Co., and pioneer designer and manufacturer of wood propellers in U. S. During World War I, he served under Gen. Billy Mitchell as a dollar-a-year man, building initial experimental propellers for Army. He developed a hollow-steel fixed-pitch airscrew for lightplanes.

Samuel C. Lewis, pioneer aviator. Learning to fly in 1909 in flight-instruction course given by Glenn Curtiss at San Diego, he obtained International Pilot License 92. He early acted as instructor, teaching French, Turk, and Balkan airmen. During period of World War I, he founded Wittemann-Lewis Aircraft Co., which built Liberty airplane engines.

Aircraft Makers Report Consumer-Goods; AIA Urges End of Plane Export Controls

. . . Warplane output up . . . Military projects cramp NACA civil activity . . . NACA releases reports . . . Improvements sought in jet engine impeller.

War needs pulled much U. S. industrial capacity into aircraft output, to a maximum annual production of $16 billion. Now its aviation market having declined to where it will approximate $1 billion in 1946, aviation managements have discovered non-aircraft products to engage their skills and occupy expanded facilities.

About two dozen aircraft companies have given Aviation reports on these non-aircraft programs.

Some non-air items now planned or in production: *Ryan*—metal casket shells; equipment for oil, food, and wine industries; high-heat-resisting alloys. *Glenn Martin*—Marvinol resins; photo emulsion; light panel structural material. *Douglas, Grumman,* and *Fairchild*—small boats. In addition to plywood boats, *Fairchild's* Duramold div. makes radio cabinets and auto trailers. *Northrop* — motor scooter; other light metal goods; working with Joshua Hendy on gas turbine. *Vought*—Metalite structural material. *Curtiss-Wright* — owns Victor Animatograph Corp., 16-mm. movie equipment. *Bell*—radiator cases; file cabinet parts; musical instrument parts; coin changing machines; equipment for dry cleaners, tobacco processors; bottlers; 5 hp. gasoline engines. *Kellett*—food freezers; house and farm equipment. *Laister-Kauffman*—"Atom Racer" for kids; shelves and store setups. *G & A* — radio cabinets. *Spartan*—luxury trailer. *Timm* coin changer; cola drink dispenser; vacuum cleaner. All are trying to use aircraft technique. Most produce under contract with distributors.

Douglas, McDonnell, Goodyear, Convair, Ryan are most frequently mentioned in negotiations with NHA on prefab houses.

AIA Urges Dropping Of Plane Export Controls

Aircraft Industries Assn. is asking National Munitions Control Board and State Dept. to lift export controls on civilian aircraft. No other civil commodity now must be licensed for export. State Dept., which administers licensing, nearly always grants permits to ship the planes, but applications are delayed for months. Export control was set up in 1922 so that the President could embargo arms shipments. In the 1930s, Munitions Control Board was created to list equipment held to be armament, and everything aeronautical was included. The industry disagrees with theory that civil airplanes are now usable as weapons. It promises to see that no restricted material is exported. Army, Navy, or State, which with Commerce make up the Board, may contend that civil planes can be effective weapons in countries not equipped with standard warplanes.

Warplane Output Up

Military aircraft acceptances rose from 67 in July to 130 in Aug. breakdown: Two Martin PBM-5E; 1 Curtiss BT2C-1; 2 Douglas AD-1; 14 Lockheed P-80A and 16-YP-80A; 28 Grumman F8F and 26 F8F-1B; 21 Vought F4U-4B; 7 Curtiss-Wright SC-2; 5 Fairchild C-82A; 8 Sikorsky R-4D helicopters. Airframes in Aug. total 718,000 lb.; in July 516,000 lb.

Military Projects Cramp NACA Civil Activity

NACA research director John Crowley frankly stated at a Langley Field press conference that only a minor portion of NACA's time can be given to personal plane projects, due to pressure for research on guided missiles and supersonic aircraft.

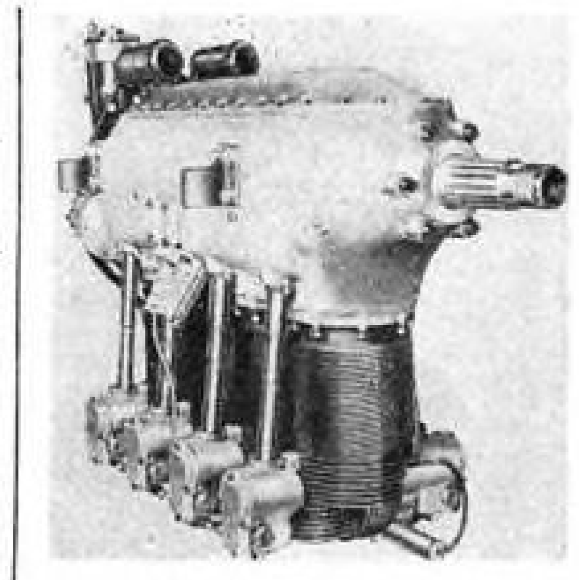
Nearly all of NACA's basic research data is applicable to guided missiles. Ames Laboratory at Sunnyvale, Cal., is working on shape of missile bodies and configuration of support and control surfaces. Cleveland Engine Lab is developing data for selection of power plants—ramjet, rocket, turbojet, resojet, and special types. Flight Test Station off Virginia coast is working on guidance and servo mechanisms.

NACA Releases Reports; Jet Prop Discussed

Though NACA cannot commit itself to many special lightplane projects, it's stated that much of the by-products of overall research is applicable to the lightplane industry. Index of 600 NACA technical reports has been compiled with that in view, and is now available. John Saunders, engineer of Cleveland Lab, said that small props driven by tip jets and prop-driving gas turbines warrant further study. Fuel efficiency of turbine prop stands at about 1.3 lb./hp. hr., probably can be reduced to 0.8 lb. Tip-jet prop is at 3 lb. but offers big advantage of eliminating engine weight. NACA has acquired components to build a tip-jet prop which will be tested. Reduction of noise by multi-bladed slower-turning props, with variable pitch, was emphasized.

Improvements Are Sought In Jet Engine Impeller

NACA's effort to improve efficiency of impeller blades in both jet and turbine aircraft engines is described in a report by Engineer W. K. Ritter. Difficulty arises chiefly from lack of experience in impeller flow theory, he said. Key to solution is blade curvature. Three designs, with parabolic, elliptical, and circular curvature are being tested. The parabolic blade is currently showing greatest range—i. e., volume of air delivery per hp. Taking as example the GE I-40, Ritter said it develops 16,000 lb. of thrust inside, while only 4,000 lb. is ejected. British researchers are concentrating on various centrifugal compressors, while NACA sticks to axial flow, which it believes will prove superior in long run.



CAMERON DESIGN STRESSES VALVE COOLING

A number of interesting features mark this new contender in personal plane power field. Of four-cylinder air-cooled design, it's rated at 125 hp. at 2,500 rpm. and is said to weigh little more than 1½ lb. per hp. Highlight is placement of valves in opposite sides of cylinders, operating in opposed directions. Exhaust valve is thus exposed to flow of incoming fuel-air mixture, and as cool charge impinges upon exhaust valve, valve is cooled by mixture, and mixture is effectively volatilized. Maker is new Cameron Aero Engine Corp. of Reading, Pa.

* INDUSTRY MEMOS *

Republic delivered first export Seabee of order for 75 from Mexican distributor, and states that export representative, Smith, Kirkpatrick & Co., has quota of 500 Seabees reserved for first year's sales abroad.

Bendix coordinated and expanded company's guided missiles and pilotless aircraft work through organization of new Special Products Development Group, which will operate one laboratory in Teterboro, N. J., and another in North Hollywood, Cal.

Luscombe's new all-metal-wing Silvaire has passed CAA tests. Craft features as standard equipment electric self starter, generator, battery, wheel pants, landing and position lights, soundproofing, and larger baggage compartment.

Martin received orders from Navy for 20 PBM-5A amphibians, with deliveries scheduled to begin in about a year with production at two airplanes monthly.

C-W has substantial contracts from Republic for production of major subassemblies and parts for latter company's P-84 Thunderjet fighters and Rainbow transports. Elevators, rudders, stabilizers, fins, and miscellaneous parts for P-84 will be made, while Rainbow sections will include wing panels, fuselage aft sections, stabilizers, rudders, fins, elevators, ailerons, flaps, engine mounts, and nacelle sections.

NAA Navion received ATC, and current production is 10 daily. Prior to receiving certificate, company produced 170 of craft and backlog is put at $7,500,000.

Lockheed has new Constellation orders from Aer Rianta Teoranta, Eire; Qantas Empire Airways, Australia; and KLM. This brings total present orders for craft to 132, with monetary value at $49,390,113.

Farnham Mfg. Co., 1646 Seneca St., Buffalo, N. Y., special machinery maker, has received contract from deHavilland Aircraft, England, for Farnham forming rolls to make wing leading edges. Company also is handling inquiries from Russia and China for spar milling machinery.

* FOR THE RECORD *

Adel Precision Products acquired new hydraulic unit production facilities via merger with Aerco Corp., Hollydale, Cal.

Pacific Airmotive's San Diego branch, formerly downtown, is now located at Gibbs Field, firm's first airport location in San Diego.

Fairchild Camera & Instrument Corp., Jamaica, L. I., N. Y., plans to open a wholly-owned subsidiary manufacturing company in Burlington, Vt., known as Fairchild Industries, Inc. New plant will make low-priced items, many in consumer field.

Air-Parts, Inc., announces new wholesale distributing point for aeronautical supplies at Hayward Municipal Airport, Hayward, Cal., 6 mi. south of Oakland.

Westchester Institute of Aero recently inaugurated opening at 10 Depot Plaza, White Plains, N. Y.

Suggest U.S. Integrate Transport Bodies; CAB May Delay Non-Scheds' 292.1 Hearing

. . . Cooperate to cut down winter air hazards . . . Air cargo fight continues . . . PICAO approves fields . . . Renew sea-air struggle.

Proposal by Senate Small Business Committee that a Dept. of Transportation, headed by a Cabinet officer, take over the functions of ICC and CAB, is one more of many moves in recent years toward integration of all U. S. transportation.

Powerful opposition by aviation forces will prevent early action along this line, but the Transportation Assn. of America, pressure front for the railroads, will carry on the fight. Sea-Air Committee, seeking "coordination" of air and ship lines in overseas service, may join forces with the railroads.

Small Business Committee warns that integration of air and surface transport would be dominated by railroad finances, and that any resulting reduction in rates might not be passed along to the public unless adequate government controls were provided to that end.

Committee called for redistribution of transport services so that instead of augmenting present congestion of highly industriaized areas, new regions would be opened for development of resources, for settlement, and for diffusion of the various employment opportunities.

CAB May Delay Non-Scheds' 292.1 Hearing

CAB was considering, at this writing, further postponement or oral argument on proposed amendment of Section 292.1 of CAR, exemption order affecting non-scheduled air carriers. Accordingly, observers believed a new version might be circularized.

Most severely criticized is provision that a carrier is not non-sched if it operates more than ten round trips per month between same two points for two consecutive months, and non-differentiation between non-scheduled freight and passenger operations.

Meanwhile a number of important contract and intrastate operators are not included among the 650 who registered, because they consider themselves beyond CAB jurisdiction. Many registrants have given incomplete data, either because they misunderstood requirement or did not want to reveal data to competitors. Sen. Pat McCarran, co-author of Act of 1938, has denounced CAB's restrictions on non-sched carriers as contrary to intent of Congress.

Cooperate to Cut Down Winter Air Hazards

Air Forces, CAA, and the airlines, have joined in a three-way effort to minimize irregular airplane operations this winter, due to terminal congestion in bad weather.

AAF has lent a number of GCA radar sets for use by CAA at Washington, Newark, and Chicago. CAA, ATA, ALPA, and some others, oppose GCA because it puts their safety in hands of ground personnel. But TWA is going ahead with GCA plans, with approval of pilots.

United is installing as standard equipment the Sperry A-12 Gyropilot, which automatically lands plane on CAA system of localizer and glide beams system. Latter is currently being rushed to completion.

Air Cargo Fight Continues

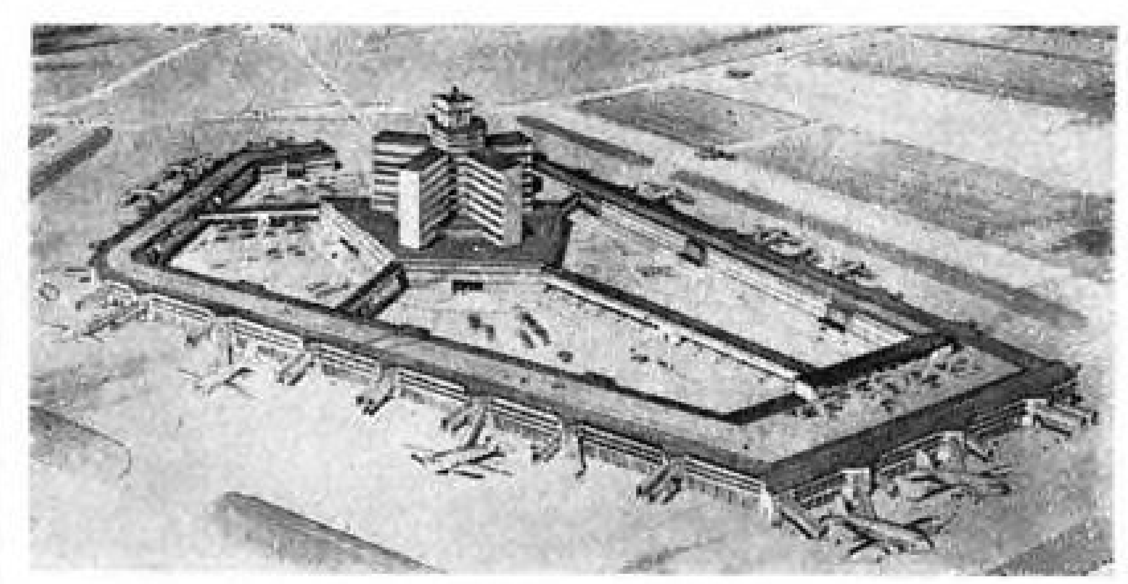
A dozen or more leading air freight carriers are battling the regular airlines for cargo business in Docket 810 before CAB. Air freighters contend they are entitled to certification as all-cargo or cargo-mail trunklines. Twelve or more existing major airlines have intervened, arguing they can handle freight cheaper than new lines. Air freight case was initially composed entirely of trunkline applicants for cargo certification back in 1942-43. Then newcomers, like ACT, U. S. Airlines, Slick, Riddle Aviation, and others, came in. The air freighters are engaging in a rate war, cutting tariffs as low as 10½¢ and 12½¢, while competitors contend there is no profit at less than 20¢ per ton-mile.

PICAO Approves Fields In Caribbean

A list of 108 airports, including 32 on U. S. soil, are recommended for international operations in the Caribbean area, by the Caribbean Regional Air Navigation Meeting of PICAO Soon 45 air carriers of 14 nations will be flying commercially in region. Thirty are already operating 189 airplanes of 23 types. Completion of list enabled committees to speed work on cooperative traffic control, meteorology, communications, rescue, all of which have relation to location of fields.

Renew Sea-Air Struggle

Maritime Commission, in a postwar planning report, has recommended joint sea-air operations to avoid "needless competition between American transport mediums." This brings CAB and the Commission, as well as air and sea operators, into conflict. The Commission's report is part of the Sea-Air Committee's campaign on behalf of ship operators for right to operate auxiliary airlines in face of CAB opposition. Meanwhile Waterman Steamship Corp. petitioned Circuit Court of Appeals to set aside CAB's Latin American case decision, which denied Waterman, and other lines, certificates in that region. Waterman has applied for temporary certificate, New Orleans to San Juan. As a result, CAB may investigate Waterman's non-scheduled activities. CAB has held hearings on a Sea-Air petition that question of sea-air operations be reopened.



PROJECTED PHILLY TERMINAL

Here's an architect's conception of terminal facilities to be available when Philadelphia's modern Southwest Municipal Airport is completed. Construction is slated to start this Fall on new field, which will cost over $30,000,000 and is designed to have an operations capacity of over six times that of Washington National Airport. Central terminal building is to house hotel, restaurants, motion picture theater, and garage. Plans provide for four sets of parallel runways.

Thermal Anti-Icing Plan Meets Opposition

A proposal by CAB that no commercial aircraft be flown into icing conditions unless equipped with approved thermal anti-icing apparatus has been postponed indefinitely because of opposition by airlines and by CAA engineers Air Forces also opined that thermal anti-icing is still experimental, and that forced installation might give unsatisfactory results.

Most new equipment for airlines will have thermal systems. ATA and CAA contended cost of converting existing aircraft to thermal anti-icing would be prohibitive. New wings, and extensive fuselage changes, would be needed to accommodate air ducts. Some thermal systems take heat through exchangers from exhaust, others burn gasoline. Much progress has been made, and engineers believe thermal anti-icing best prospect on which to concentrate.

★ CROSS COUNTRY ★

Formation of an airline terminal corporation for experimental purposes has been authorized by ATA members, with group empowered to operate terminal facilities for air transport. Board of directors, not yet chosen, is to determine first cities to try test servicing.

UAL is using facsimile transmission of weather maps between stations, with initial installations at Cheyenne and Denver. Special machines produce a 12x18-in. map in 20 min.

CAB approved following one-way fares from N. Y. to these foreign points: Gander $104, Shannon $292, Prestwick $305, London $325, Paris $345, Azores $274, Lisbon $331, and Bermuda $70.

Southern Arizona Airlines plans to take delivery on its first Bell 47 'copter and begin service this month. Airline's operating certificate is stated to give concern exclusive commercial helicopter operating privileges in Arizona.

ATA elected five new members: Empire Air Lines, Ida.; Florida Airways; Monarch Air Lines, Colo.; Southwest Airways, Cal.; and E. W. Wiggins, Mass.

AA and AOA changed Washington general administrative offices and district sales offices to 1437 K St., N. W., Washington, D. C.

C-2 automatic flight control system, weighing but 27 lb., and developed by Lear in cooperation with Wright Field, is now being tested. All-electric, and easily connected with other control devices, C-2 consists of three working units; Controller, amplifier containing vertical and directional gyroscopes, and triple output friction drive servo unit directly actuating all control surfaces.

★ INTERNATIONAL BRIEFS ★

ENGLAND—British European Airways expects to operate a fleet of 55 Vickers Vikings, 14 Bristol Wayfarers, 30 DH Rapides, and 10 Junker 52s by next spring. Services to continent will be operated exclusively with Vikings.

Armstrong Whitworth is developing Brabazon IIB, new jetprop airliner powered with four Mamba engines. Grossing 35,000 lb., new plane is designed to carry from 24 to 30 passengers up to 1,000 mi. at cruising speeds exceeding 300 mph.

Span of Meteor production models has been reduced by 4 ft. through elimination of wingtips. It is stated there is no appreciable increase in speed, and that change was made to increase rate of roll.

BOAC on July 1 operated 214 aircraft, of which 173 were landplanes, and 45 training or development craft. Fleet is composed of 21 different types of aircraft, and regular passenger services are operated with 13 different models. In year ending Mar. 31, BOAC flew 26 million miles and carried 144,000 passengers and 8,000 tons of mail over a 67,000 mi. network.

British charter and nonsched operators have formed British Air Charter Assn to protect their interests and represent them in difficulties expected to arise because of new aviation laws.

FRANCE—Tests continue with SE-200. Two of aircraft will probably be used on Air France routes to Buenos Aires. With 171 ft. span, gross weight is 158,000 lb., giving a 4,000-mi. range against a 30 mi. headwind. Powered by six Gnome & Rhone 1,320 hp. engines, cruising speed at 8,000 ft. is put at 185 mph.

NORWAY—New Continental Flyfish Co. has made experiments flying 5,000-lb. loads of fresh fish fillets from Trondheim to Paris and Zürich. Special lightweight containers have been developed. Contracts for regular loads are being completed with firms in both France and Switzerland.

CZECHOSLOVAKIA—Completion of bilateral agreement with France indicates the Czech airline plans to operate to Belgian Congo via Tunis, and to Rio de Janeiro via Algiers and Dakar. Line received permission to use French-owned airports and facilities on these routes.

SWITZERLAND—Negotiations are still underway for eventual merger of Swissair and Alpar, two main Swiss lines. In meantime, Alpar has announced it will concentrate on international services, while Swissair has started experimental flights across Atlantic prior to regular service.

In addition to new international airport at Basle, Kloten Airport is under construction at Zürich. To cost over $9,000,000, it is planned as most modern Swiss field.

IRAQ—Iraqi Airways is now serving Mosul and Kirkuk, in addition to other schedules. Baghdad is presently served by following airlines: BOAC, KLM, Misr Airline (Egypt), Middle East Airlines, Iranian Airways, and Iranian State Air Lines. Air France will shortly be added to the list, with operations to Teheran and French Indo China.

HOLLAND—KLM is planning additional survey flights to South Africa, prior to operation of full service in '47. This is continuation of program initiated in Dec. 1938. Present equipment will be DC-4s. Meanwhile, KLM West Indies Div. announces completion of plans for operation of four-engined equipment in Caribbean area.

INDIA—Government has approved conversion to regular production of Hindustan Aircraft Factory at Bangalore. Factory, now to be known as Central Aircraft, Ltd., will initially produce a trainer for RIAF.

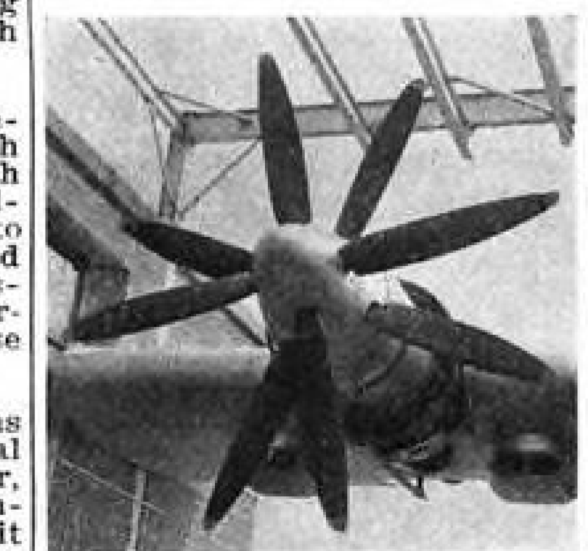
Capitalizing on impasse between U. S. and India which prevents TWA from operating to Bombay and other certificated points, BOAC has now upped its schedules to 13 per week, 10 of which are operated with Hythe boats and three with Lancasters.

Civil Aviation Directorate has developed two regional centers, at Karachi and Dum Dum, respectively. These points also are to be main international airports for country.

AFRICA—Ethiopian Imperial Airways is shortly expected to start service between Addis Ababa and Nairobi.

CEYLON—Plans are being made for service by a state-owned airline between Colombo and Karachi, to be extended later to England. Another contemplated route is between Colombo and Australia via Singapore. It has been recommended that internal services be operated by private enterprise without subsidy, in line with similar Indian plans.

AUSTRALIA—Plans have been completed for construction of a six million dollar airport at Adelaide. To cover over 1,500 acres, field is to feature parallel runways up to 2 mi. in length.



BIGGEST BRITISH PROPJET

One of Britain's newest power plants is Armstrong Siddeley Python propjet, seen here on a wing section mockup for testing. Fitted with an eight blade contra-rotating prop, it's said to turn out 3,670 shp. plus 1,150 lb. thrust at sea level for a fuel consumption of 359 gph. Maximum combat power is given as 5,520 shp. plus 280 lb. thrust at 8,000 rpm., burning 425 gph. Twin oil-cooling intakes beneath wing are necessary because of stationary installation. (McGraw-Hill World News photo)

WORLDATA . . . . By "VISTA"

Crash of the DH-108 Swallow in a test flight brought loss to the world of one of its best pilots, Geoffrey deHavilland. Craft was an experimental model developed out of the Vampire, with swept-back wings and large fin. The veteran deHavilland was a foremost airplane demonstrator and tester of new models produced by his father's company. It was but a few days before his death that he had delivered a Vampire to Switzerland, flying to Geneva in the record time of 71 min. Opinions varied as to the cause of the 108's failure.

Precedent was set when seats on the Vickers Viking for King George were installed facing backwards. Seeming to feel that very shortly all passenger aircraft will have the seats installed facing the tail, British constructors are proceeding with experiments tending to show survival in a crash is more probable in this position. Also, they say, the view is much better. Be that as it may, recent accidents appear to have shown that the lapstrap commonly used may cause more damage than good. Better anchoring of seats to the plane structure, and development of cushions to give support to the entire body from the hips up, probably combined with backward installation, comprise a development worthy of careful consideration.

Plans of Gen. Chennault and his associates to form a new China company, to be known as Chennault Air Transport, have received final approval from UNRRA and the Chinese Government. Officials of the National Skyway Freight Corp. have proceeded to Chungking to make an early start possible. While this new company will primarily transport UNRRA relief supplies, it will also carry passengers and such other shipments as it can obtain, thus in effect becoming the third Chinese airline. Possibility of a merger of this new company and CNAC has been rumored. Meanwhile, Russia protests this formation of an American airline in China, but supporters point to its primary use in distribution of relief supplies.

Continued lack of an Australia-U. S. air agreement is still prime topic. Australian National Airways is now flying to Vancouver, but a passenger to San Francisco must first fly to Canadian city, then buy regular airline ticket and retrace his flight to reach San Francisco.

Government-owned Trans Australia Airlines was expected to start operations in October, shortly after delivery of first DC-4. Lester Brain is gen. mgr. Over 100 pilots are in training.

Court action was taken by Australian National Airways to force issuance either of import licenses for purchase of surplus U. S. craft already in Australia, or a statement of policy by Government.

BRAZIL—Arco Iris Viacao Area, new company, has set up main base at Sao Paulo, and will operate two flights per day over a network totaling more than 1,000 mi. Seven DH Dragon Rapide planes have been ordered from England for use on these routes, and will be added to three converted B-25s and the commercial DH Mosquito now owned by line.

VENEZUELA—Government has allocated additional $1,500,000 to Linea Aeropostal Venezolana for expansion of its services, including new route to Canada. LAV will also operate a number of C-47s for Government's National Supply Commission, carrying meats and other foods to isolated towns.

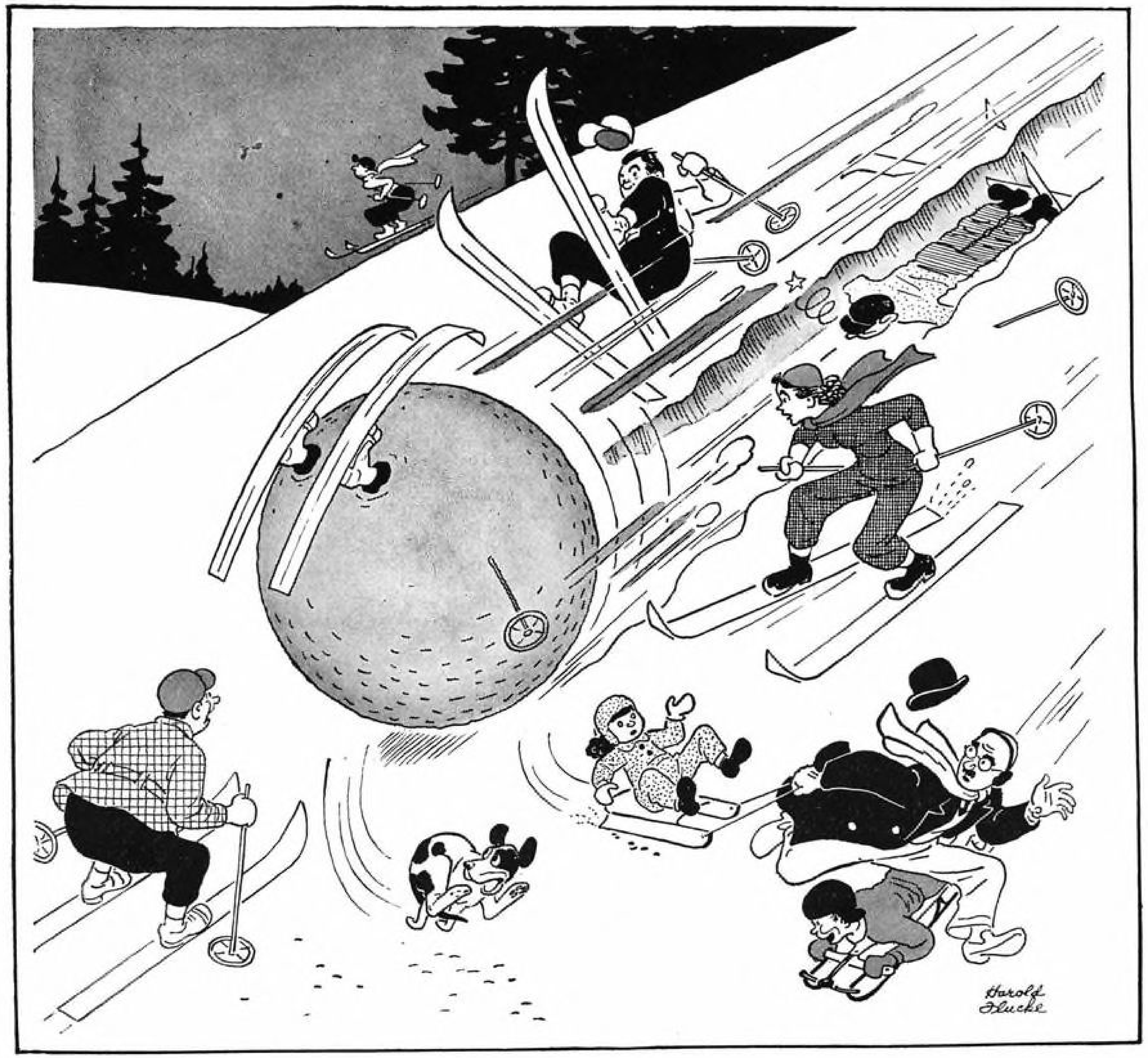
Aeronautical Radio, Inc. formed an affiliate named Compania de Servicio Aeronautico Venezolano, which will operate, control, and maintain radio services for all airlines operating in or through Venezuela.

GUATEMALA—Aviateca's existence as private company was ended by Government decree and ownership transferred to state. Existing stockholders will be reimbursed on basis of funds paid in. No change in scope of operations is presently anticipated.

MEXICO—Government pressure to eliminate as much foreign capital as possible forced Aerovias Braniff to increase its capital to 20 million pesos, most of which will be held by prominent Mexicans. T. E. Braniff is last American on Board of Directors, though there still are three American vice-presidents.

Panam is operating a series of special flights to Spain for Spanish nationals residing in Mexico, flying Mexico City-Miami - Gander - Azores - Lisbon. First flight covered run in 3 days.

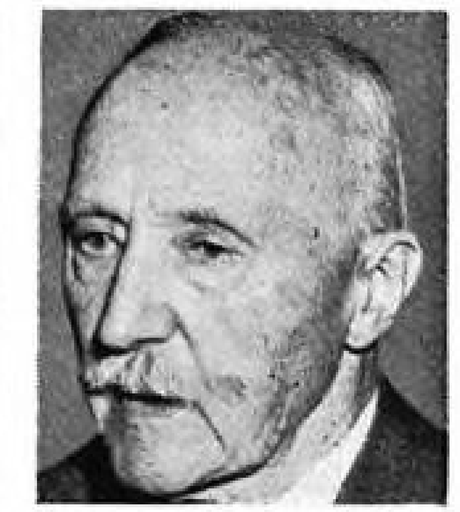
CMA is expanding its DC-4 services to include route to Merida and Havana, in addition to run to Los Angeles. Company also has asked permits for freight routes parallel to its present passenger routes. Under Mexican law, only express up to certain weight can be carried in a passenger plane. Larger shipments must go on separate aircraft.




HAROLD R. UHRICH (left) has been named chief analytical engineer for Aeromatic Aircraft Propeller dept. of Koppers Co., Inc. Previously, he was chief engineer with Sensenich Brothers for 9 yr. He was also associated with Platt-Le Page, where he was engaged in helicopter rotor stress and design work. **VERNON B. BENFER** (right) has been appointed sales engineer for Aeromatic dept. He was formerly with Glenn L. Martin, where he had been a service liaison engineer. In air training branch of Navy during war, he was also connected with Lockheed Overseas Corp. in British Isles in capacity of service engineer.

R. H. GLASSLEY has been appointed exec. vice-pres. in charge of operations for Puget Pacific Planes. He will direct production of company's Wheelair 111A personal airplane. Previously, he held similar production position with Columbia Aircraft Industries of Portland, Ore.

MATTHEW M. GOUGER has been named director of personnel relations at TWA. Graduate of Texas U., he has been a private pilot for 16 yr. He was formerly personnel director for Pittsburgh Plate Glass Co. In his new position, he will direct activities of airline's training div.



GODFREY LOWELL CABOT, distinguished Boston octogenarian, now continues as pres. of Federation Aeronautique Internationale in current reactivation of body after war years. He is a past pres. and has been governor of NAA since '24, and is an associate fellow of IAS.

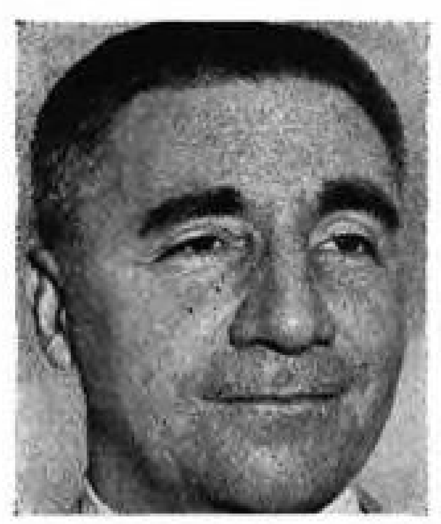
HARRY A. SUTTON has been named engineering adviser and asst. to pres. of Ryan. Previously, he was director of engineering for Convair. His duties will include liaison with Army and Navy on current aircraft contracts and on development work company will undertake for military services.

WILLIAM F. PRIGGE has been appointed asst. to v.-p., eastern region, of AA. His hq. will be in N. Y. With airline over 8 yr., he previously worked as mgr. for N. Y. ticket offices and was later employed as sales representative in Wash. A graduate of U. of Penn., he holds a B.S. degree in economics.

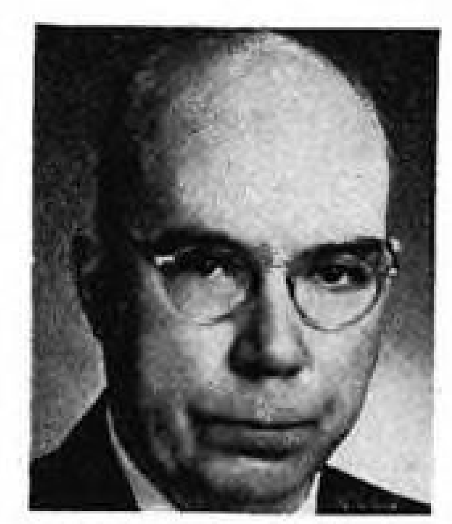
CHALMERS H. "SLICK" GOODLIN, Bell test pilot, is to make first power flights in XS-1, craft being groomed to attack supersonic barrier. Successor to late Jack Woolams, he was a lieutenant in U. S. Navy after earlier service with RCAF and RAF. He is a member of Caterpillar Club, QB, and IAA.

LEDYARD GARDNER has been appointed sales promotion mgr. for North American div. of KLM, Royal Dutch Airlines. Previously, he was exec. asst. to director of traffic for TACA, and before that was associated with UAL. He will be responsible for direction of airline's sales force in No. America.

F. J. GELHAUS has been appointed supt. of building and construction for EAL, with hq. in Miami. Former administrator - coordinator with Greater Miami Port Authority, he will have jurisdiction over building and alteration of all airline's ground facilities. He was formerly with PAA as airport engineer.



ALFREDO DE LOS RIOS has been appointed mgr. of Latin American Sales of Luscombe Airplane. Formerly in charge of personal plane sales in export div. of Fairchild, he was founder and exec. v.-p. of Inter-American Escadrille. He has been a pilot for 20 yr., and he is a member of AWA. (Laughead photo)



GEORGE H. LYON has been appointed pub. rel. mgr. for PAA's Atlantic div. Formerly deputy to director of OWI, he was assigned to coverage of war news, stationed in Gen. Eisenhower's hq. overseas. In his new post, he will be in charge of all pub. rel. matters pertaining to activities of div.



MAJ. GEN. H. R. OLDFIELD (left) has joined Boeing Aircraft's engineering staff as project supervisor and aerial combat trend adviser. His first assignment is on GAPA guided missiles. During war, he served as Gen. Arnold's adviser on anti-aircraft, and was awarded Distinguished Service Medal for his part in organization of flak analysis, and for directing commanders on anti-aircraft defense. **J. O. YEASTING** (center) has been appointed asst. to Pres. With company since '39, he was formerly asst. sec.-treas. In his new position, he will administer Boeing's budgetary cost control and organizational research activities. He is a graduate of University of Mich. **RICHARD M. MORGAN** (right) has been named mgr. of sales office at Wichita, where he will promote sales of Boeing 417 airliner. He received Bronze Star for outstanding assistance to 21st Bomber Command as company's chief service engineer on B-29 Superfortresses in Marianas during war.

Guard Your Airport Investment With Specialized Fire Equipment

Highly vulnerable to combustion, aviation equipment and materials should be carefully protected, particularly in view of scarcity of replacements.

AIRPORT OPERATORS, now enjoying a boom in personal flying and air transport activities, have at the same time inherited steadily increasing fire hazards. According to statistics compiled by the National Fire Protective Assn., airplane hangar blazes alone cost an estimated $38,000,000 last year—reported to be about 40 times the 1944 total and an all-time high for airport losses in a single year. Destruction by fire of individual aircraft on the flight line or following crashes were not included in this study, but here too, destruction admittedly has been large.

These sobering figures should give pause to every airport owner or executive, and, most important, should institute a spot check of the base's fire-fighting facilities and of precautions to keep damage to a minimum once a blaze has started. Since utilization of flying equipment is at a particularly high peak, fire may not only mean a loss on the original investment, but also an extended period of no revenue while hard-to-get replacements are sought.

Hangar blazes, as a rule, are the most extensive and costliest type of combustion. Experience points to the following factors as those which contribute most to these serious fires:

1. Too much dependence on distant public fire departments, not taking into consideration time element in response.

2. Absence of satisfactory water supply systems and mobile fire-fighting equipment where airport is outside municipal jurisdiction.

3. Lack of engineered fire protection.

4. Inferior hangar construction.

5. Failure to divide hangars into bays or divisions to limit area of fire; also reluctance to provide a series of small

National Aero-O-Foam unit is designed to be handled by one-man. Chemical is drawn up from can by suction and is mixed with water at butt of special nozzle held by operator. It's stated that one 5-gal. container can thus be diluted to make approximately 800-gal. of foam.

hangars in lieu of one large open structure.

6. Tendency to conduct maintenance operations in same area where aircraft are stored, disregarding fire hazards involved.

7. Presence of large quantities of fuel and other flammable liquids in stored aircraft.

8. Crowding planes with wings overlapping in a confined area.

9. Lack of opportunity to quickly remove aircraft exposed to fire.

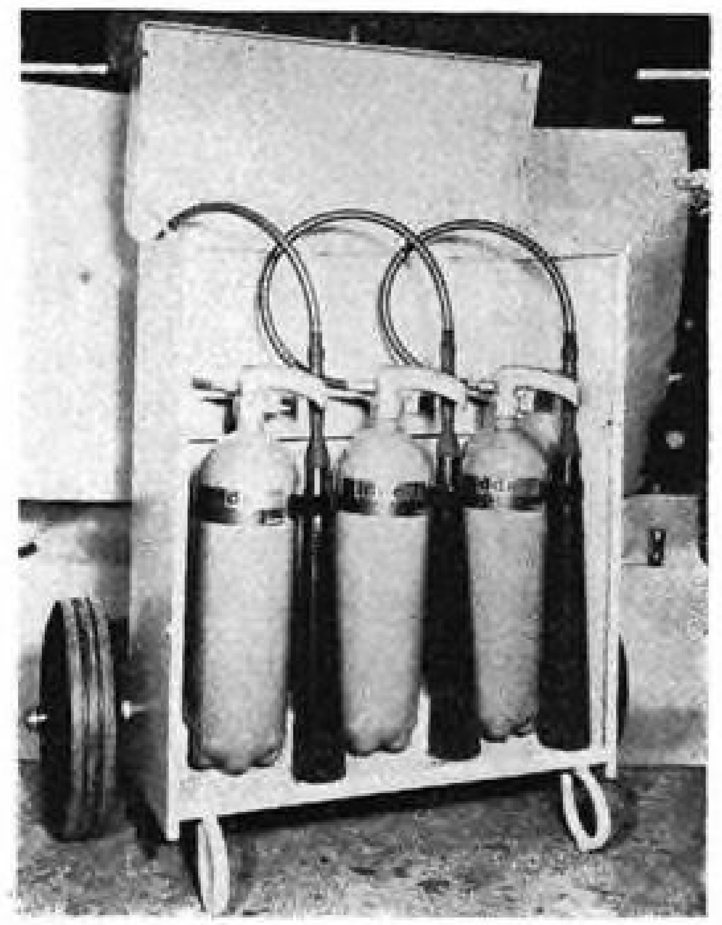
10. Unavoidable fact that flying operations introduce crash fire potentials.

Extinguishing Apparatus

Combustion occurring among parked aircraft is characterized by rapid spread and intensity of heat and flame.

This problem was recognized by the U. S. Navy early in the war. Aboard a congested carrier, fire could, if it got beyond control, be the cause for the loss of many lives and valuable fighting equipment, by being the means of detonating the large stores of munitions and high octane fuel normally carried.

Following the experience of petroleum producers and refiners in fire control, the Navy depends to a large extent upon the use of foam as an effective fire extinguisher. Foam's features are that it can be quickly transported to the scene of action, that relatively few men are needed to bring a fire under control, and that a small percentage of foam mixed with water and air (both plentiful) thoroughly blanketed and snuffed out the hottest fire. Approximately 800 gal. of foam can be quickly made by mixing either salt or fresh water with air and the contents of a 5 gal. can of special liquid, and the mixture has good staying qualities which even high winds do not effect.



Handy wheeled unit containing three 15-lb. carbon dioxide extinguishers designed by Walter Kidde & Co. primarily for airport use. Stored under high pressure, gas, when released, expands about 450 times its stored volume. Cart is fitted with puncture-proof tires.

National Foam System, Inc., of Philadelphia, became a major supplier of the product to the Navy during the war. Briefly, the mechanical mixing which produces the foam blanket is done in a special nozzle where water is mixed with the chemical. Produced is a smothering mass of snowy bubbles several inches thick which seals flammable gases in, oxygen out. Its sticky qualities enable it to adhere to vertical surfaces or angles.

Under the trade name Aer-O-Foam, this material is now being marketed for use by airport operators. Water pressure required for giving a good foam mixture at the nozzle varies from 30 to 125 lb., with best results obtained with pressures of 75 to 100 lb. The chemical liquid comes packed in 5 gal. containers, stated to resist deterioration indefinitely. Furthermore, it's said to have no harmful affects on aluminum; but containing a large percentage of water, it has the same affect as water on metal, fabrics, and wood.

Another flame blanketing material commonly used against petroleum fires, and also valuable in fighting electrical blazes, is carbon dioxide. This gas is housed under great pressure. The apparatus developed by Walter Kidde & Co., allows the gas, upon being released, to expand considerably, enveloping a fire and reducing normal

21% oxygen content of the air to 14 or 15%, at which point combustion cannot be sustained. Features of this equipment are good mobility and cleanliness, the gas having no effect upon the materials it blankets.

Intended especially for electrical flareups, but equally usable for Class B fires, carbon tetrachloride is most commonly contained in hand-operated extinguishers, such as those made by Pyrene or Fyr-Fyter, which expel the liquid by pumping, by air pressure, or by using CO_2 cartridges. Maximum effective range is 20 to 30 ft.

TAGGING THE BASES

First Region: Syracuse, N. Y., has taken over Syracuse Army Air Base under interim permit covering all aviation landing and taxi facilities, buildings, and equipment. Survey has been ordered to determine what is needed to open field. . . . Rochester, N. Y., Common Council has approved construction of four 9-plane hangars at $60,000, and improved lighting, paving, and drainage at another $40,000. . . . Annapolis, (Md.) Airport, Inc., built on 176-acre tract 2 mi. south of Annapolis on Bay Ridge Road, has been licensed and will be Class 2 field when present plans are carried out. . . . AAF recently turned over Millville (N.J.) Airport to that city, which leased facilities for 7 yr. to Tri-City Aviation Corp. Field has 5-mi.-long runways. It is to serve as base for cargo airlines with hangar and service station for commercial craft. Boris Golenkow is Tri-City pres., and Francis Hine is maintenance director. . . . Public auction of private airport was held recently at Leesburg, Va., with bidders arriving by plane. Arthur C. Hyde, owner and operator of Congressional Airport (at Rockville, Md.) and Hyde Field (Clinton, Md.) was high bidder. . . . George W. King and Harold J. Smith, operators of Tonawanda (N.Y.) Airport, plan to make field a mecca for private pilots, providing cabins, restaurants, and transportation to and from Buffalo. . . . Pocomoke Flying Club, Inc., Pocomoke City, Md., has opened Class 1 field. Operator is E. H. Nock. . . . WAA is returning Reading (Pa.) Airport to city, with exception of some government owned land east and north of field. Army intends to lease apron No. 1. . . . Tri-Cities Aviation School, Binghamton, N. Y., providing free aviation training to vets under GI Bill of Rights, has completed first 6 mo. operation with 105 registered. . . . Ross Airpark, Pulaski, N. Y., is undergoing improvement—runway extensions and addition of new office. C. Ross is owner and manager.

Second Region: K. G. Richards, ex-Navy pilot, is building Airport and Aero Court in Silver Springs, Fla. Three runways have been laid out, longest 2,600 ft. Plans call for administration building, 8 cottages with adjoining private hangars, lounge building for gathering of flyers, tennis and shuffleboard courts. Also, Richards plans charter, sightseeing, rental service, and flight instruction. K. G. Spence of Macon, Ga., will assist. . . . Hawthorne Flying Service's v.-p. Walter Phipps announces large scale building program at Columbia (S.C.) Municipal Airport, including 40 ft. x 60 ft. dope shop, 10 all-metal individual hangars, and 5 concrete stalls to accommodate planes of twin-engine Cessna size.

Third Region: Oliver L. Parks, pres. Parks Aircraft Sales & Service, has announced $275,000 development and beautification program at Hoosier-Parks Airpark, Indianapolis. Program for newly acquired 18.8-acre tract adjacent to field includes additional grading, extensive landscaping, and erection of 196 individual T-type storage hangars. . . . Cleveland Aviation Club is sponsoring plan for establishment of Cleveland Metropolitan Air Authority, which would have legal power to establish and operate airports in Greater Cleveland area. . . . Seymour Flying Club has been incorporated at Seymour, Wis., with L. A. Nelson pres.; Jarvis N. Sellberg, v.-p.; Marvin Kuehne, sec.-treas.; Robert Juhin, Oconto, Wis., flight instructor. . . . Work has started at Rice Lake (Wis.) Municipal Airport on a 40 x 100 ft. permanent steel hangar and shop building. . . . Chaplin's Airpark, just outside city limits of Plymouth, Wis., was recently opened, offering flight instruction, charter service, and scenic rides. Company also has Sheboygan County Piper agency. Incorporators are Harvey, Johanna, and Harry Chaplin of Plymouth; Erle Chaplin, Waldo; and Clyde and Maria Kaiser, Adell. . . . Capitol Air Service, Weir Cook Municipal Airport, Indianapolis, has been sold to Plainfield Airport, Inc., Wm. Hylton, pres. . . . Minnesota airports' fixed base operators, giving flight instruction, selling aircraft, maintenance and repair, have announced formation of Minnesota Aviation Trades Assn. with headquarters at 813 North-Western Bank Building, Minneapolis. Frank B. Cliff is exec.-dir. . . . Gregory, Mich., pop. 200, has 60 members in its Airport Club, 24 students under GI flight training, and 40 others either taking lessons or already flying own planes. Pres. of club is Charles Showerman.

Fourth Region: An $8000 hangar capable of accommodating 8 planes, has been purchased for Llano (Tex.) Airport. . . . Installation of parking lot with tables, bus service, resurfacing of tennis courts, and reopening of swimming pool are among proposals to make New Orleans airport more attractive for private flying. . . . The 1568-acre Harlingen (Tex.) Army Air Field was recently re-dedicated as civilian All-Valley Airport. Field has two 6,000 ft. runways and three about 1 mi. in length. . . . Spring Valley, Wis., has new flying club, with airport ½ mi. from city. President is Wayne Reid, while Henry A. Friede is v.-p. and Harold Olson is sec.

Fifth Region: Brayton Flying Service Lambert-St. Louis Field, has purchased old McDonnell Aircraft Corp. buildings at north end of field for $90,000, to be used for expansion of aircraft and mechanics school, for servicing, and to provide space for sale of aircraft tools and parts. Pres. is Clyde Brayton. . . . Residents of greater St. Louis area recently were guests of Greater St. Louis Aviation Operators Assn. in series of Sunday open house tours to eight airports. Flying exhibits and displays were run off to promote more inter-airport private flying. Fields visited: Meremac, Weiss, Sylvan Beach, Lakeside, Parks Metropolitan, Kratz, St. Charles, and Lambert.

Sixth Region: Some thousand flyers participated in second annual Ensenada (Mexico) Air Tour, starting Oct. 5 from Vail Field, Los Angeles, which was port of entry, with customs officials available to eliminate border stops. Second Annual Arizona Aviation Conference was scheduled at Phoenix at press time.

Seventh Region: Oregon board of aeronautics approved following airports: Skyhaven Airport, Salem; Williamette Airpark, Eugene; Harrisburg Airport; Klamath Falls Municipal Airport; Lexington Municipal Airport; Troh's Skyport, Portland; Adams Airport, Silverton; Sutherlin Skyranch, Sutherland; Cottage Grove Airport; Florence Airport; Tillamook County Airport, Tillamook. Oregon board also approved following flight schools for pilot instruction: Cascade Airways, Lebanon Airport; Oregon Aircraft, Hillsboro; "HAPS" Flying Service, Hillsboro; Coastways School, Tillamook Co. Airport, Tillamook and Pendleton Airways, Pendleton Airport.

Beating the Airport Noise Bogey

Serious impediment to airpark program—and thus to production and distribution—comes from public misunderstanding of noise sources. Here's how "grassroots" education can be conducted.

By FRANK R. BRINE

AIRPORTS HAVE LONG had a reputation for being noisy, but the problems of this decibel association haven't heretofore been too bad.

Today, however, these difficulties are rising with greater and greater frequency to plague the whole industry—from the manufacturer clear through to the man who wants to establish himself as a dealer. In fact, the noise reputation presents a serious threat to the industry's further development, for CAA officials are finding many communities refusing to allow any type of landing facility under the new Federal Airport Act because these proposed airports would "constitute a noisy nuisance."

To counteract the largely-unfounded belief that *lightplane* airports are noisy has, therefore, become a major issue in which all phases of the industry and government are being joined. But it is in the "grassroots" area—with the individual operators themselves—that the burden of the work must be done.

Just what are the facts? Are all airports really noisy?

Basis of the problem is the fact that the average person makes no distinction between military and transport airports and small ports devoted to lightplanes. Thus, in many cases, the operator of a small airport gets blamed by an irate public for a nuisance which is in no way his fault.

There is, for example, the recent experience of "Speed" Hanzlik, who operates Flushing Airport not far from over-crowded LaGuardia Field. He was sharply criticized in local newspapers for conducting a noisy operation; things went so far that a town meeting was called to look into the matter.

Hanzlik surprised a lot of people by attending that meeting. There he explained that he operated a small airport for personal flyers whose planes ranged from 50 to 200 mph. He told the irate citizens that pilots operating from his field were required to fly as high and far away from the town as possible, to observe all traffic rules, and to keep noise to a minimum. By answering a few simple questions Hanzlik was able to convince the property owners that it was not the 65- and 85-hp. engines from his field, but the 1,000- to 2,000-hp. transports and military craft from nearby LaGuardia that were generating the objectionable noises.

Hanzlik's conduct at that meeting—and others to which he was invited—so impressed the people involved that his name was proposed for the job of Aviation Director of Flushing, a post he now holds.

Another case in a nearby area was that encountered by Steven W. Saloy, who operates Brooklyn Sky Port, located in Mill Basin not far from the Navy's Floyd Bennett Field.

Every time the phone rang and an angry resident complained, Saloy courteously and patiently asked for a description of the plane. Invariably it turned out to be a military craft. Each time Saloy explained that the float-fitted Piper Cubs he operated couldn't possibly have made the noise of which the neighbors were complaining; he explained the difference between 65-hp. engines and power plants developing up to 2,000 hp. with controllable pitch propellers.

It was not long before the nearby residents had all been well educated to the differences between small lightplanes and military craft—and Saloy had firmly impressed on a great many minds that he was in business near them where they could also enjoy flying.

These two examples are not isolated cases of the type of missionary work which must be done all over the country. In some other places it has been done, and done well. But many more operators must make sure that nearby residents don't acquire the easy habit of placing blame where it doesn't belong.

The idea that all airports, regardless of size, are noisy, must be driven from the public mind; the average man and woman must be taught to discriminate. As E. W. Cullinan, Jr., CAA superintendent of airports for New York, says, "The public must be made to realize that it isn't the airport but who uses it that makes the difference."

Recent tests have shown that the noise of a lightplane landing at, or taking off from, an airpark close to a residential district has a sound level generally no greater than passing street vehicles.

These tests were conducted by the Bureau of Standards, which set up a sound-level meter in St. Petersburg, Fla., where the municipal airport is scarcely nine blocks from the city's business district and on the edge of a residential section. The lightplane used in the test gave a reading of between 70 and 80 decibels, depending on its altitude. On a busy street where the noise level consistently hangs around 80 decibels the plane could not even be heard passing directly overhead.

Since only lightplanes can be operated with a minimum of noise, W. T. Piper, pres. of Piper Aircraft Corp., believes that such planes should be the only ones permitted to use "close-in" airports where neighboring residents might be bothered by noise of high-powered craft.

Already there is a tendency on the part of some operators to adhere to this thinking and to limit use of their facilities. Some operators, for example, have banned certain government surplus training craft with adjustable pitch propellers; others are limiting the number of craft which may be flown from the field to such planes as are already based there.

Some operators have found it advisable to curb—at the home port—the student activity of shooting landings. They have found it expedient to pick a field far enough out so that noise is not an issue and have their students fly there for such flight work. This type of operation has the added advantage of eliminating considerable traffic at the home port, making it more attractive to transient business.

Another operator requires all pilots —before each flight—to sign a form binding them to "avoid wide open throttles, low flying, and direct take-offs over close-in neighboring homes." Violators of the agreement are grounded so far as that field is concerned.

That the general noise problem is truly serious for the industry as a whole is evidenced by the fact that many government officials point out that before the campaign to get more close-in airports is over an elaborate system of airport licensing may become necessary. Such licensing would make it possible for the government to control operators who refuse to conduct their operations in such a way as to minimize noise.

REVIEW OF PATENTS

By ELTON H. BROWN, JR.
Registered Patent Agent

Following are digests of some of the more interesting patents on aviation developments granted through the U. S. Patent Office. Mr. Brown will be happy to answer questions on patents for the reader. Address inquiries to him, care AVIATION, 330 West 42nd St., New York 18, N. Y. Printed copies of any patents listed are obtainable at a cost of 25¢ each, directly from U. S. Patent Office, Washington, D. C.

★ ★ ★

Aircraft Pickup System, designed for lifting messages and light loads, is intended to minimize effect of aerodynamic disturbances so as to allow "fish" unit to travel at desired point below craft. Fish comprises solid tear-drop body having vertical and horizontal stabilizing fins, low wing with inverted dihedral and cambered undersurface, and tow rope attached to upper side of body, near C. G. Fin and wing angles of incidence are such as to cause aerodynamic forces to aid gravity.—2,402,879, filed Oct. 25, '41, pat. June 25, '46, R. C. du Pont, assignor to All American Aviation, Inc.

Breathing Apparatus, designed to incorporate improvements in demand-type regulator is intended to control mixture according to altitude, pure air being fed at ground level, with oxygen content being gradually increased until pure oxygen is fed at 33,000 ft.—2,403,508, filed Jan. 26, '43, pat. July 9, '46, G. M. Deming, assignor to Air Reduction Co., Inc.

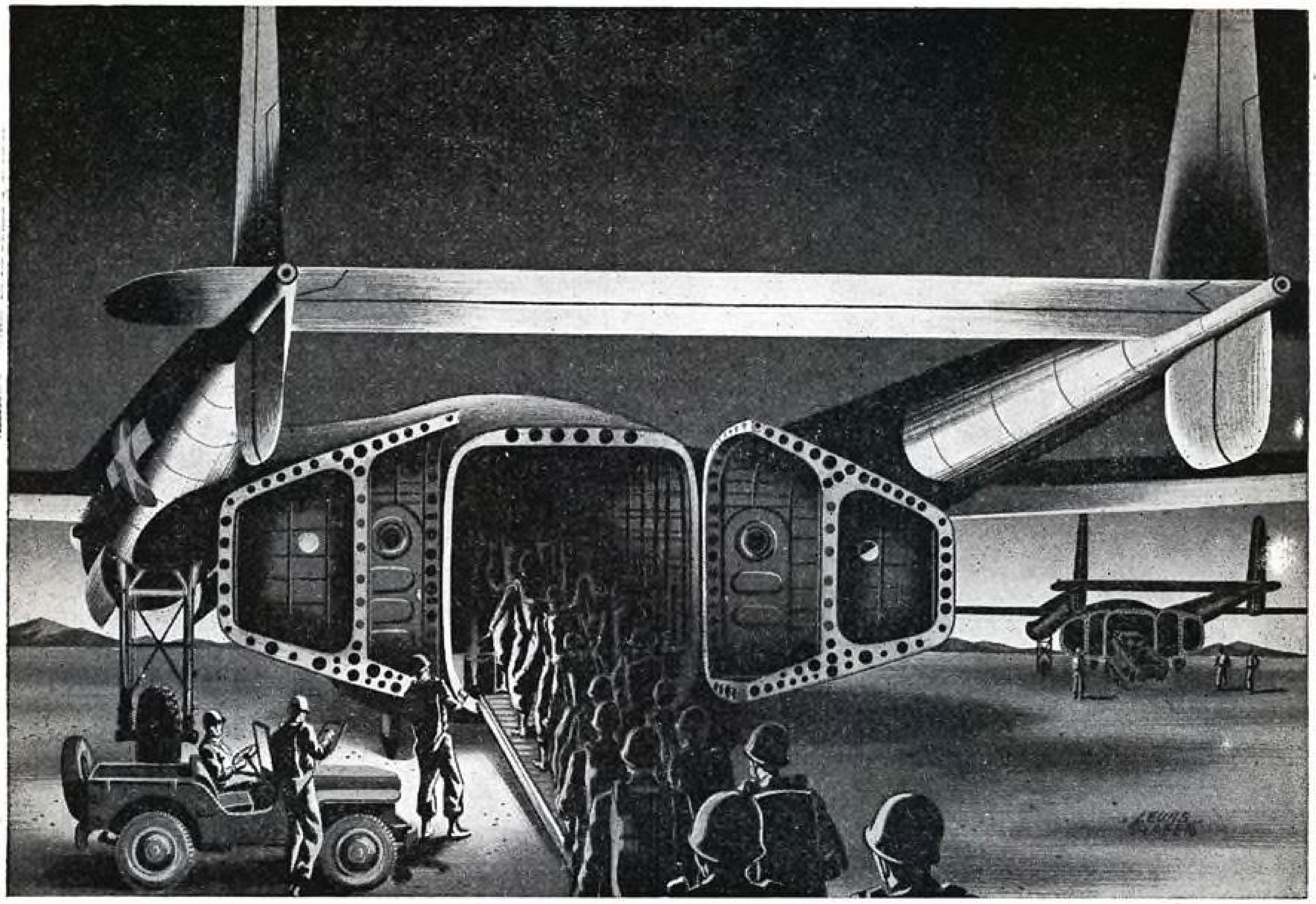
Control Surface Structure, intended to embody improved torsional rigidity through use of lightweight, high-strength sections, is also designed to permit rapid assembly by affording unobstructed access of welding tools for spotwelding.—2,403,568, filed Mar. 6, '43, pat. July 9, '46, M. Watter, assignor to Edward G. Budd Mfg. Co.

Synchronizing Mechanism is particularly adapted for controlling flap movement to effect equalization of displacement. Included are plural phase motors for shifting the flaps, together with automatic phase-charging means for relatively varying torque produced by motors and synchronizing flaps when latter unequally load motors.—2,403,577, filed Nov. 23, '44, pat. July 9, '46, C. J. Breitwieser, assignor to Consolidated Vultee Aircraft Corp.

Seaplane Droppable Sponson, providing additional fuel storage space to give increased range, compensates for additional fuel weight by affording increased planing area during takeoff. Sponson is built in sections, all but one of which may be installed on shore while craft is supported by beaching gear; after craft is afloat, and gear removed, remaining section is installed.—2,403,754, filed Feb. 9, '44, pat. July 9, '46, J. D. Pierson, assignor to Glenn L. Martin Co.

Propeller Pitch and Diameter Mechanism for controlling, at will, maneuvering capabilities of craft, is particularly adaptable to dual-engine installations driving single propeller shaft. Propeller hub is provided with a socket for receiving blade shank secured by screw adjusting means.—2,403,899, filed Oct. 6, '41, pat. July 16, '46, F. DuP. Ammen.

Swivelly mounted radial engines, are featured in new aircraft design. Series of power plants are adjustable for varying direction of driving force, to assist in sharp takeoffs and slow descents without sacrificing driving force in horizontal



flight when desired altitude is reached.—2,403,936, filed Mar. 11, '44, pat. July 16, '46, E. A. Loback.

Air-Duct Fitted Helicopter is designed for rapid ascent and descent and easy control. It incorporates central air duct extending vertically with respect to rotors to permit thrust air to be directed downward through duct.—2,404,014, filed Feb. 1, '43, pat. July 16, '46, F. Thornes.

Pre-Rotation Landing Gear Drive to start wheels turning prior to touching ground, features vanes for driving wheel, and vane housing with air inlet and outlet openings adjustable for varying wheel speed to synchronize with plane's ground speed. Instrument on panel indicates wheel speed.—2,404,018, filed Mar. 23, '44, pat. July 16, '46, E. Yaggy.

Pressurized Suit and Helmet, designed to allow application of air pressure when flying at altitude, also affords means for supplying breathing mixture. Helmet is sufficiently large to permit turning of head for all-around vision, and suit is provided with easily flexed joints for ease of movement.—2,404,020, filed Mar. 10, '43, pat. July 16, '46, J. D. Akerman.

Airfoil Mounting Mechanism is intended to afford actuation via pivot arrangement to obtain change in wing camber and, by simultaneous horizontal movement, to open slot. Airfoil may be moved either rearwardly, or downwardly, or in both directions.—2,404,045, filed Nov. 20, '43, pat. July 16, '46, F. E. Flader, assignor to Curtiss-Wright Corp.

Rapid-Loading Cargo Plane has overhead monorail extending through cargo compartment to tail. Rear door is secured to monorail and moves away from compartment along rail.—2,404,195, filed June 29, '43, pat. July 16, '46, E. W. Schlieben, assignor to York Research Corp.

Arresting Hook, for engaging retarder cables on carrier deck, has means to release cable under tension to permit quick clearance from deck. Cable-operated lever is mounted to hook so that pressure displaces arresting cable from position in hook.—2,404,381, filed June 20, '46, pat. July 23, '46, C. H. Jolly.

Engine-Heating Shield for aircraft has hinged member cut to shape of cowl, and slot to permit positioning over propeller. Openings are provided to receive warm air pipes from engine preheating device.—2,404,394, filed July 9, '45, pat. July 23, '46, R. F. Miller.

Reduced-Shock Parachute has diagonally positioned vents in each panel in end-to-end relation and reversed in direction to those of adjacent panel. When 'chute holds excess air, vents open and reduce initial shock, then close as excess air is reduced.—2,404,672, filed May 21, '42, pat. July 23, '46, C. A. Volf.

Variable Wing Structure, designed to provide additional takeoff and landing lift, with no reduction in cruising speed, consists of track-supported airfoil contained in wing trailing edge, which may be extended or retracted by pilot through cable and pulley system.—2,404,895, filed Jan. 19, '42, pat. July 30, '46, E. F. Jap.

Jet or Rocket Power Plant for aircraft incorporates electric-motor-driven impeller operating at extremely high speed to obtain greater efficiency in supplying air to turbine.—2,404,954, filed Feb. 2, '43, pat. July 30, '46, F. W. Godsey, Jr., assignor to Westinghouse Electric Corp.

Pusher-Helicopter Design has separate horizontal-propulsion system of pusher type, also twin tail booms. Main wheels of tricycle landing gear are positioned in plane of propeller arc so that low- or high-tail landings will not damage propeller.—2,405,244, filed May 19, '42, pat. Aug. 6, '46, P. H. Stanley, assignor to Autogiro Co. of America.

Two-Speed Parachute, for permitting fast initial descent and normal final descent, comprises small 'chute in breast pack for initial descent, releasable from harness to act as "pilot" for large chute.—2,405,333, filed Aug. 6, '42, pat. Aug. 6, '46, H. W. Sheridan.

De-Icer Unloading Valve controls venting of conduits to atmosphere, and is operated by pressure medium within conduit under control of second valve operated by pilot.—2,405,362, filed Aug. 11, '43, pat. Aug. 6, '46, S. K. Lehman and M. L. Taylor, assignors to Bendix Aviation Corp.

Recent Books

Thumbnail reviews of selected aviation books and pertinent business and industrial texts.

TERMINAL AIRPORT FINANCING & MANAGEMENT, Harvard Business School, Boston, Mass. 385 pages. $4.25.

This work represents an intimate and intensive study of financial and administrative procedure at 51 airports, supplemented by numerous conferences with city, state, and CAA officials, as well as airline executives and representatives of various associations in the transport field. Aiming to lay foundation for attainment of efficient development, book is divided into four parts consolidating subject.

THE AIRCRAFT MANUFACTURING INDUSTRY, Present and Future Prospects by Col. George B. Woods. Published by White, Weld & Co., New York City. Illustrated. 119 pages.

Privately printed by a firm member of New York Stock Exchange, this book is a comprehensive financial and economic study. It appraises prospects of industry as a whole and of aircraft manufacturing stocks in general, analyzing individual positions of over 30 companies engaged in production of aircraft and parts. Included is a consideration of development of "push button" aerial warfare.

AIR TRANSPORT, by E. D. Weiss, Art & Educational Publishers, Ltd., London, Eng. Illustrated. 59 pages.

This concise booklet affords compact account of current major issues relative to air transportation field.

AIRPORT REFERENCE—1946-1947. Occidental Publishing Co., Los Angeles, Cal. Illustrated. 104 pages. $2.00.

Intelligent planning of any airport must begin with analysis of community to be served and an attempt to project its airport requirements into future. Various chapters of this volume are devoted to advancing such data. For guidance of airport organizations involved in litigation, or wishing to avoid it, selection of higher court decisions involving airfields has been incorporated at end of book. Among subjects covered are planning, surfacing, lighting, buildings, communications, and administration. A buyer's guide is also included.

THE INDUSTRIAL REPUBLIC, by Paul W. Litchfield, Goodyear Tire & Rubber Co., Akron, Ohio. 201 pages. $4.00.

Mr. Litchfield's book, which is supplementally titled "Reflections of an Industrial Lieutenant", presents views he has gained through a half century of industrial experience. After discussing wages, profits, taxes, government controls, and methods employed by dictator governments, he outlines a plan for American production—industrial democracy.

RECOMMENDATIONS FOR STANDARDS, PRACTICES AND PROCEDURES. Published by PICAO, Publications & Documents Section, Montreal, Can. 123 pages. $1.50.

This work treats of airworthiness standards applied to passenger aircraft flying scheduled international services. Relative to instituting code of requirements in this classification, to be effective after Jan. 1, 1951, volume considers recommended standards under two headings: First, general procedures for issuing and renewing certificates of airworthiness; and second, technical airworthiness requirements, including flight, structural design, and construction requirements, reciprocating engines, propellers, power plants, equipment, and operating limitations.

AERODYNAMICS, by A. Wiley Sherwood, McGraw-Hill Book Co., New York City. Illustrated, 220 pages. $2.75.

Book covers practical aspects of both theory and experiment in field of aerodynamics, with special emphasis on physical phase of theory to provide a general background suitable for more intensive mathematical work in subject. Description of important wind-tunnel corrections is included.

Information Tips

(*Continued from page 11*)

bolts and nuts, studs, and extension couplers.—AVIATION, Nov., '46.

Profile Grinding Machine..........32

Information is available frim **Cosa Corp.,** New York City, on profile grinding machine made in Switzerland. Unit is stated to grind profiles on hardened work pieces to plus or minus 0.0002 in.—AVIATION, Nov., '46.

Drills 33

Circulars are available from **Chicago-Latrobe Twist Drill Works,** Chicago, covering line of drills from ½ to 1½ in.—AVIATION, Nov., '46.

Pipe Bender 34

Edition 1, Bulletin No. A-7 from **Watson-Stillman Co.,** Roselle, N. J., describes portable hydraulic pipe bender which has dies for bending pipe from ⅜ to 3 in. dia. —AVIATION, Nov., '46.

Tube End Forming.................35

Vaill Engineering Co., Waterbury, Conn., has issued Bulletin No. G-1 covering line of tube end forming equipment. Type of work that can be performed is illustrated.—AVIATION, Nov., '46.

Wheel Dresser 36

Combining pantograph diamond dressing and roll-crushing for dressing grinding wheels, new wheel dresser, "Panto-Crush", is detailed in folder from **Moors Special Tool Co.,** Bridgeport, Conn.—AVIATION, Nov., '46.

Lathe 37

Incorporating individual motor-operated tool slides, new "Uni-Matic" lathe made by **Monarch Machine Tool Co.,** Sidney, Ohio, is dealt with in Bulletin No. 1701. Also described are electrical features and timing devices incorporated in unit.—AVIATION, Nov., '46.

Hydraulic Equipment 38

Bulletin No. 460 published by **Hydro-Power, Inc.,** Springfield, Ohio, contains information and specifications of line of hydraulic high pressure pumps, valves, controls, boosters, and power units.—AVIATION, Nov., '46.

ELECTRICAL

Remote Control Motor 39

Containing performance chart, new catalog page from **Transicoil Corp.,** New York City, describes 60 cycle, 2 phase, low inertia "Servo-Motor" for remote control applications. It can be wound to operate from 10 to 80v.—AVIATION, Nov., '46.

Electrical Connectors 40

Booklet No. 466 from **National Electric Corp.,** Pittsburgh, describes "Gorilla Grip" electrical connectors and contains cutaway models, schematic drawings, and analysis of mechanics involved.—AVIATION, Nov., '46.

Electrical Test Equipment.........41

Literature from **Unadco Mfg. Co.,** New Haven, Conn., describes line of aircraft electrical test equipment including units for testing generators, inverters, voltage regulators, and reverse current relays.—AVIATION, Nov., '46.

Motor Control 42

Connected in parallel with normal electric motor control and operated by means of single knob, new pulsing drive control described in bulletin from **Yardeny Laboratories,** New York City, is designed to control direction of rotation, amount of rotation to as little as ¼ turn, or to let motor run at full speed. It can be used with either fractional or integral horsepower motors.—AVIATION, Nov., '46.

AIRCRAFT & ACCESSORIES

Rubber Cushioning 43

Available in any size, shape, or design required, and adaptable for use in aircraft. "Restfoam", new development in foam rubber cushioning, is described in folder from **Hewitt Rubber,** Buffalo. Material is supplied as molded cushions or in slabs or sheets.—AVIATION, Nov., '46.

AIRPORTS

Hydraulic Test Machine...........44

Containing specifications and a schematic layout diagram, literature issued by **Greer Hydraulics,** Brooklyn, N. Y., describes Model AIP-1 anti-icer pump and de-icer valve test machine.—AVIATION, Nov., '46.

MERCHANDISING

Sales Program 45

New profusely illustrated, spiral bound, color brochure has been issued by **Pacific Airmotive Corp.,** Glendale, Cal., announcing company's new authorized sales and service dealer program to help educate and improve service of dealers on individual airports.—AVIATION, Nov., '46.

PLASTICS & SYNTHETICS

Protective Strip Coatings.........46

Leaflet titled "Protective Strip Coatings of Eastman Cellulose Acetate Butyrate" describes preparations and application of continuous coatings for protection of metal parts from corrosion and abrasion. This literature is available from **Tennessee Eastman Corp.,** New York City. —AVIATION, Nov., '46.

PLANT SERVICE

Re Illumination 47

"Data for Designing Interior Illumination" is new booklet issued by **Westinghouse Electric Corp.,** Bloomfield, N. J., Provided are tables covering various types of luminaires, lamps, and ballasts. —AVIATION, Nov., '46.

Hose Reels 48

Information is available from **Walter Kidde & Co.,** Belleville, N. J., on hose reel equipment for use in conjunction with company's carbon dioxide fire fighting systems.—AVIATION, Nov., '46.

Fire Protection Handbook 49

Twenty-four page handbook, "How to Fight Fires and Protect Property", has been published by **Randolph Laboratories,** Chicago. Explained is latest technique in fighting fires with carbon dioxide and other type extinguishers.—AVIATION, Nov., '46.

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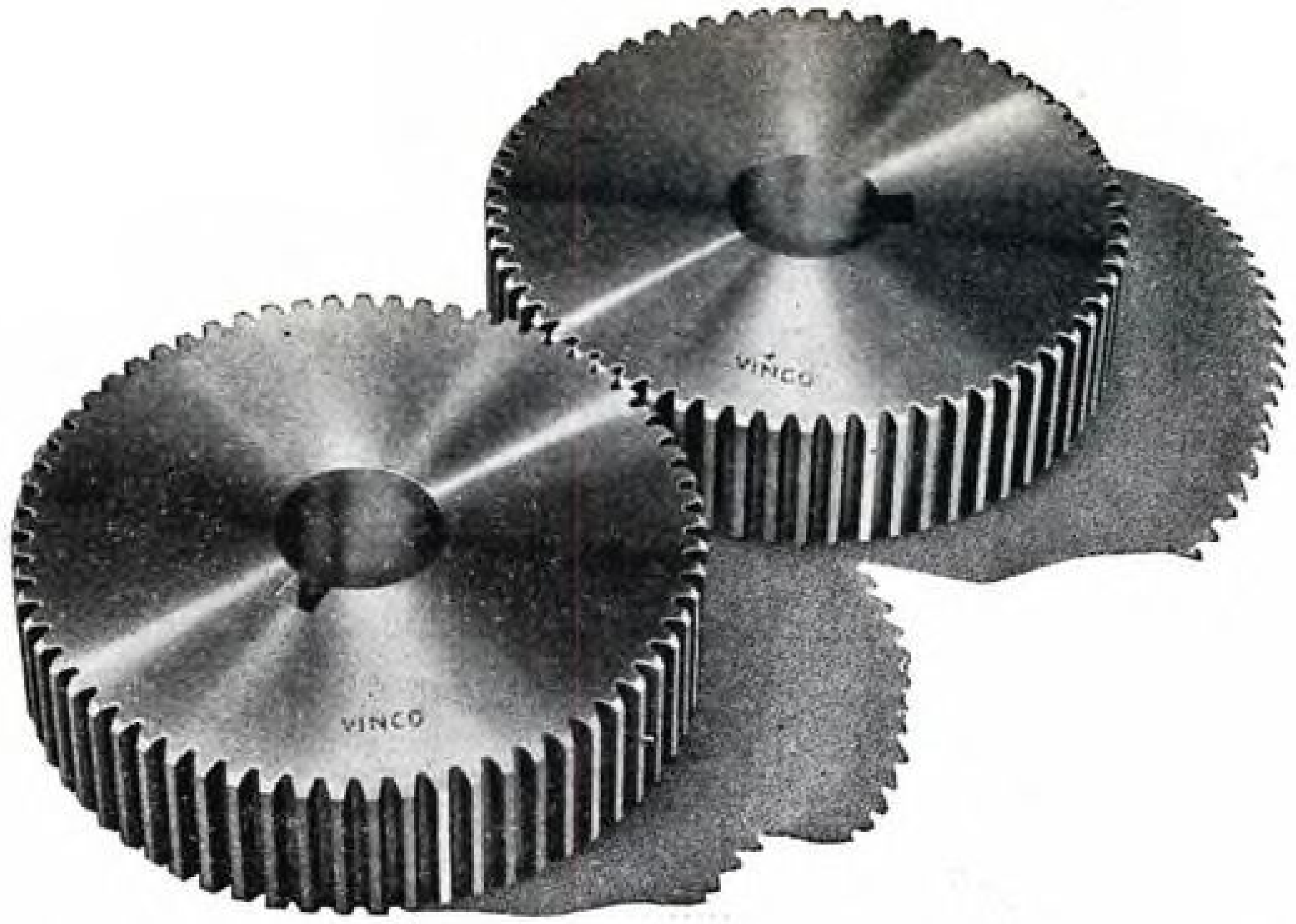

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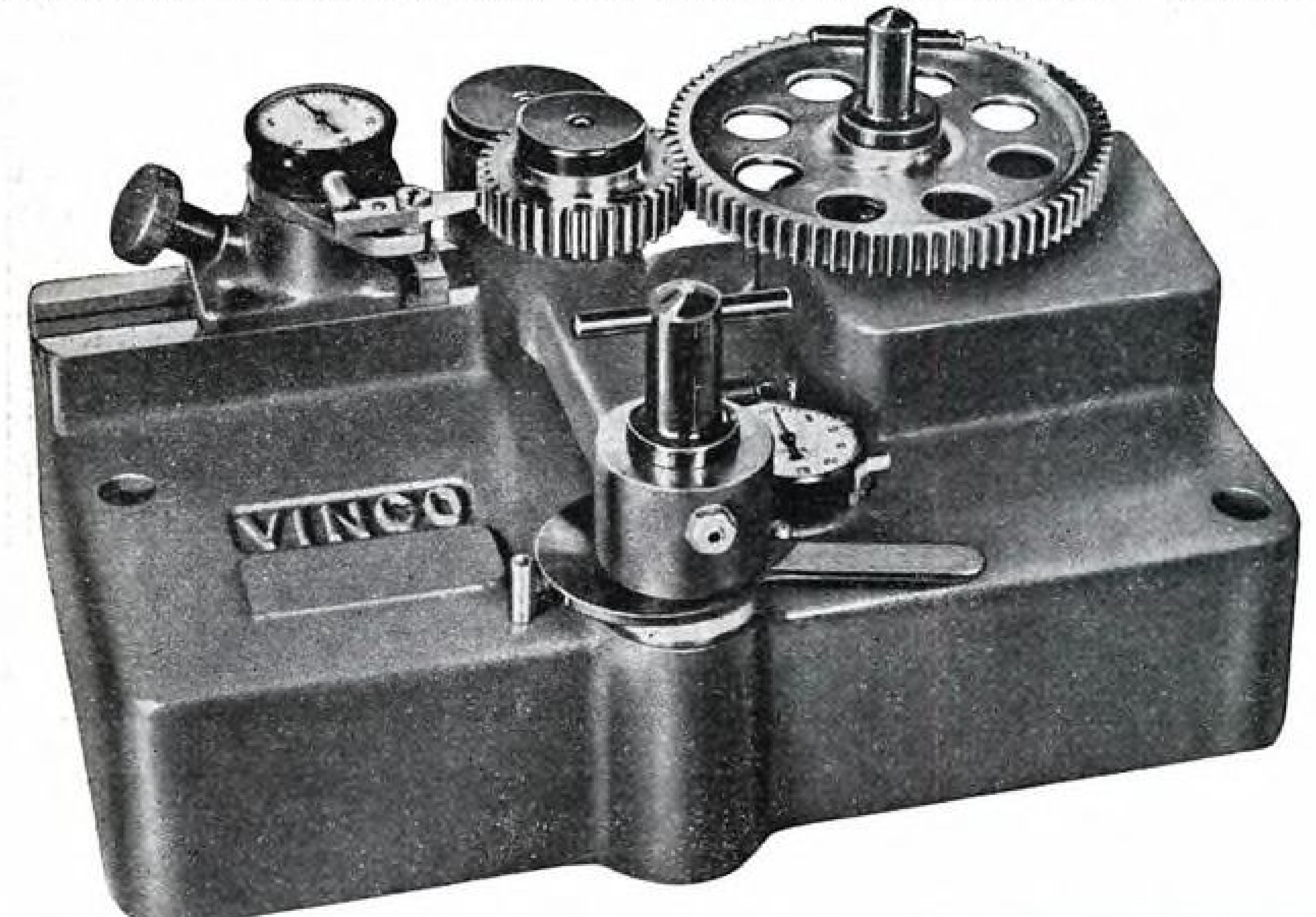

The photo, at left, shows a Dual-Purpose Type Gear Rolling Inspection Fixture in position to check backlash. For general purposes VINCO Gear Rolling Fixtures are made in two types — the Dual-Purpose for gears being manufactured in quantity production, and the Dual-Purpose Adjustable for the inspection of different gears, with similar mounting conditions, being produced in short runs. Both types will allow a 100% or spot check.

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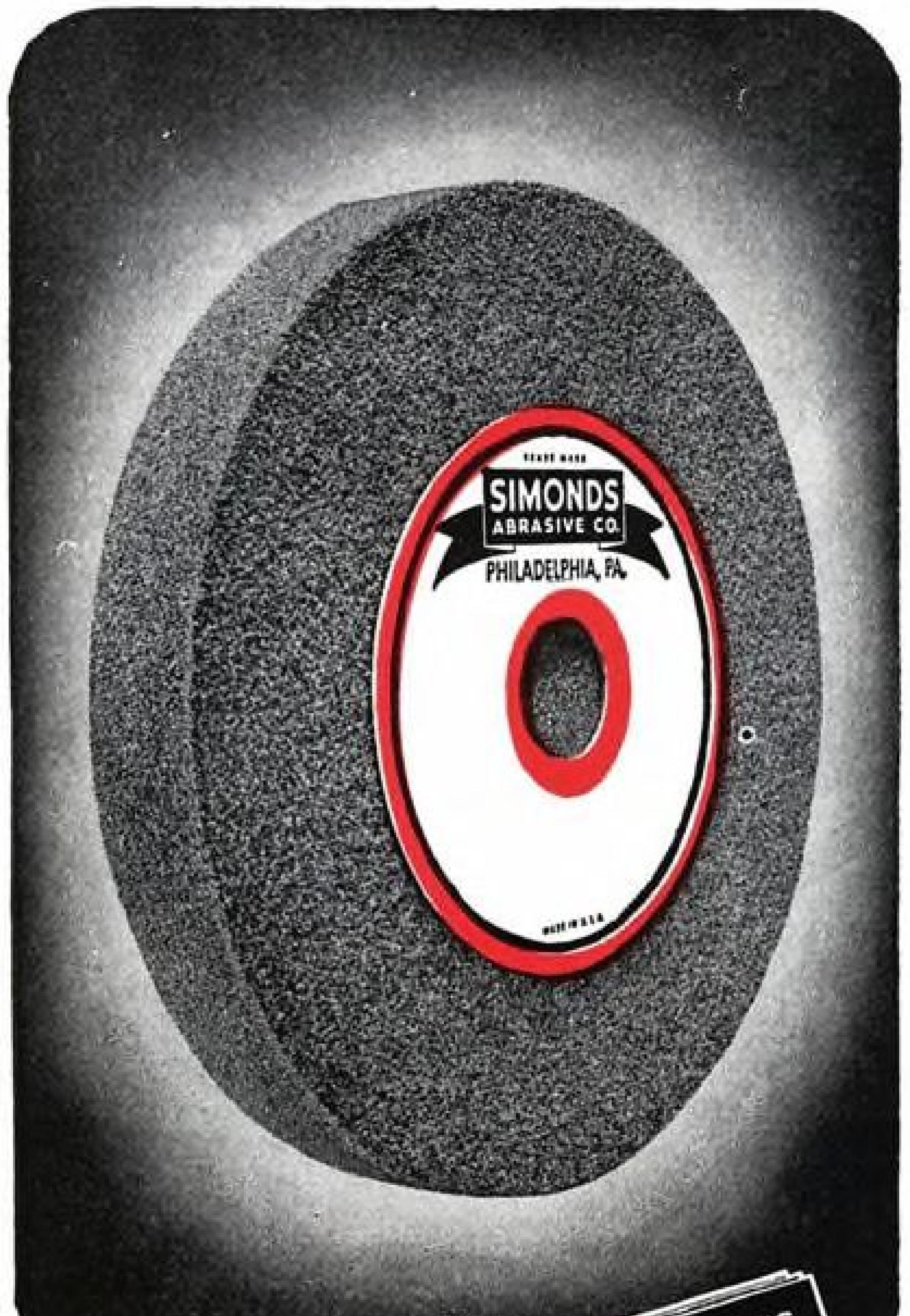

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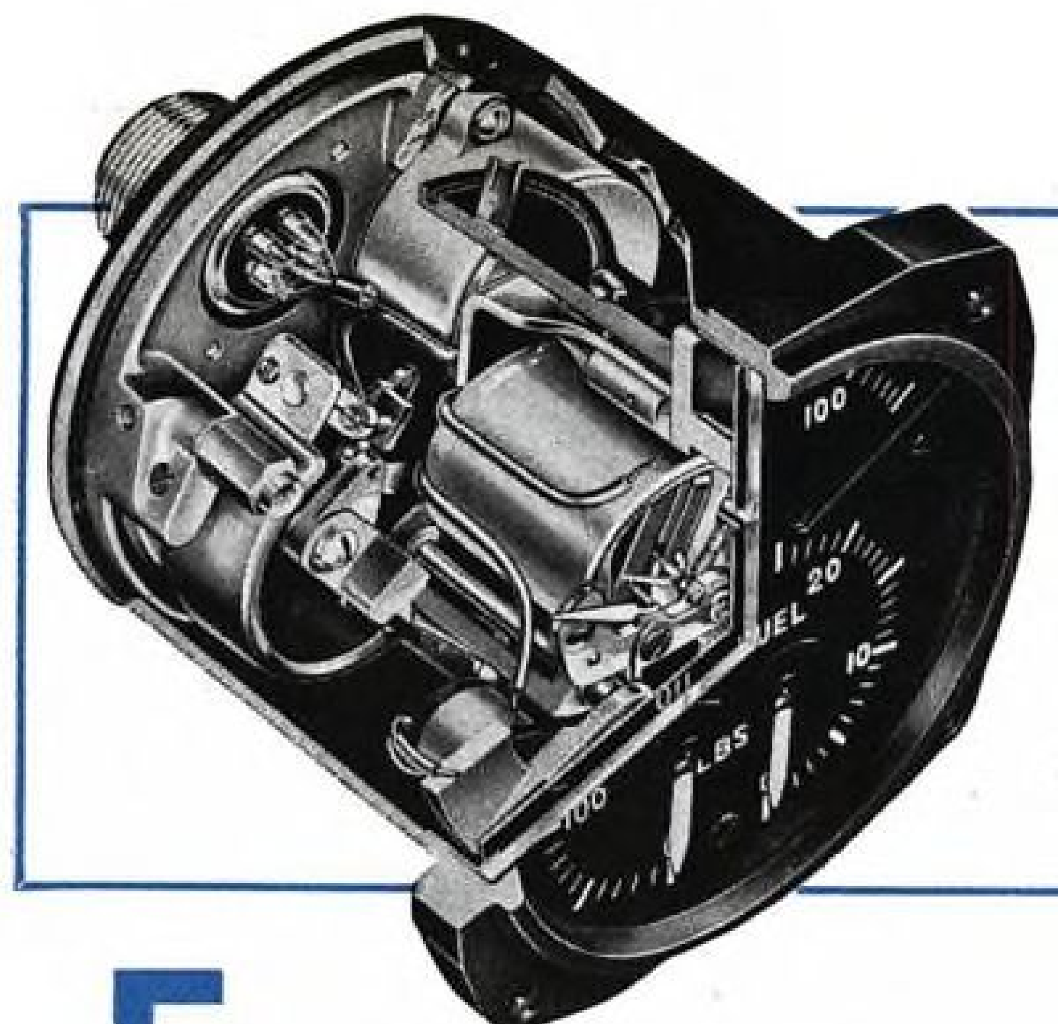

ENGINE HEALTH
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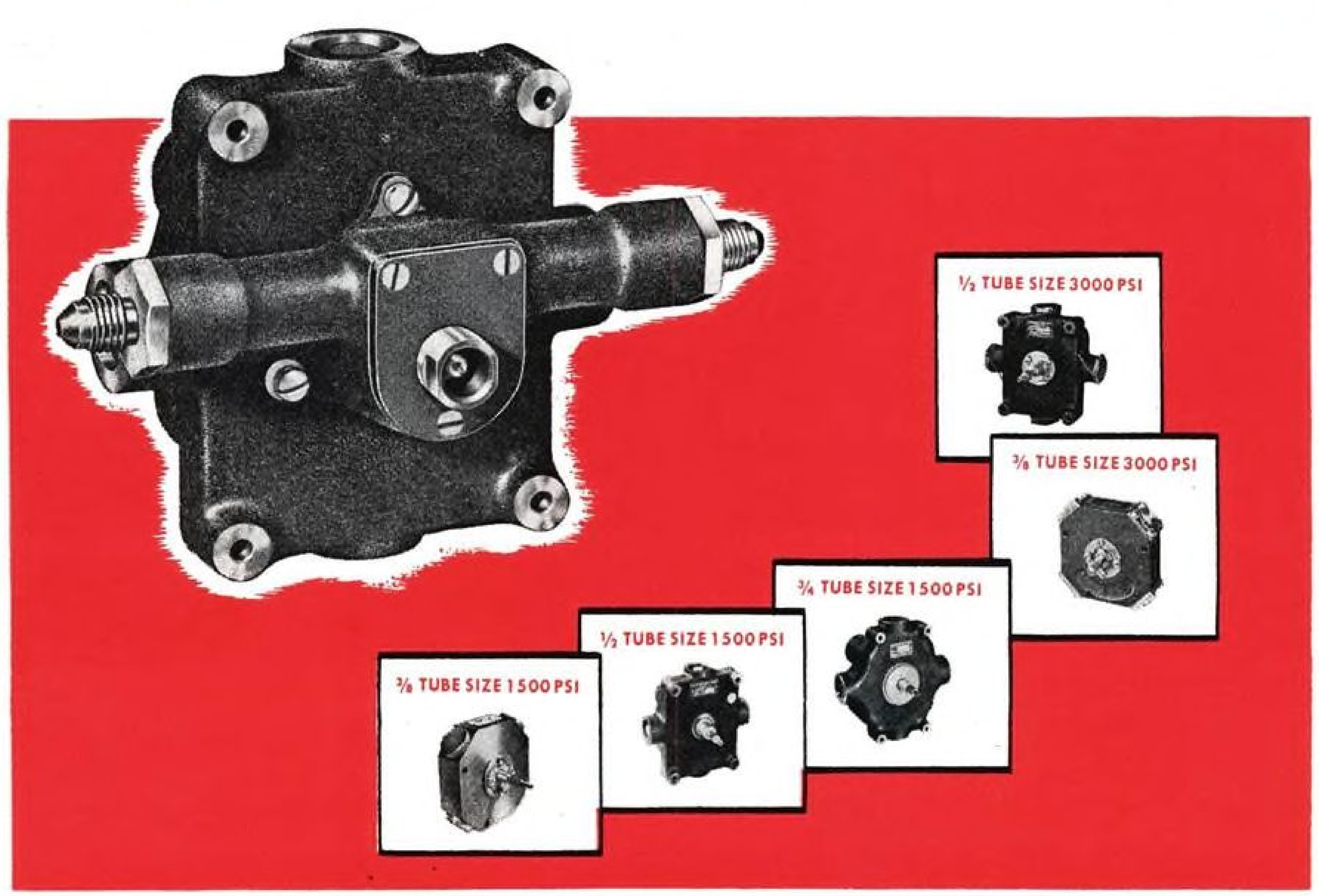

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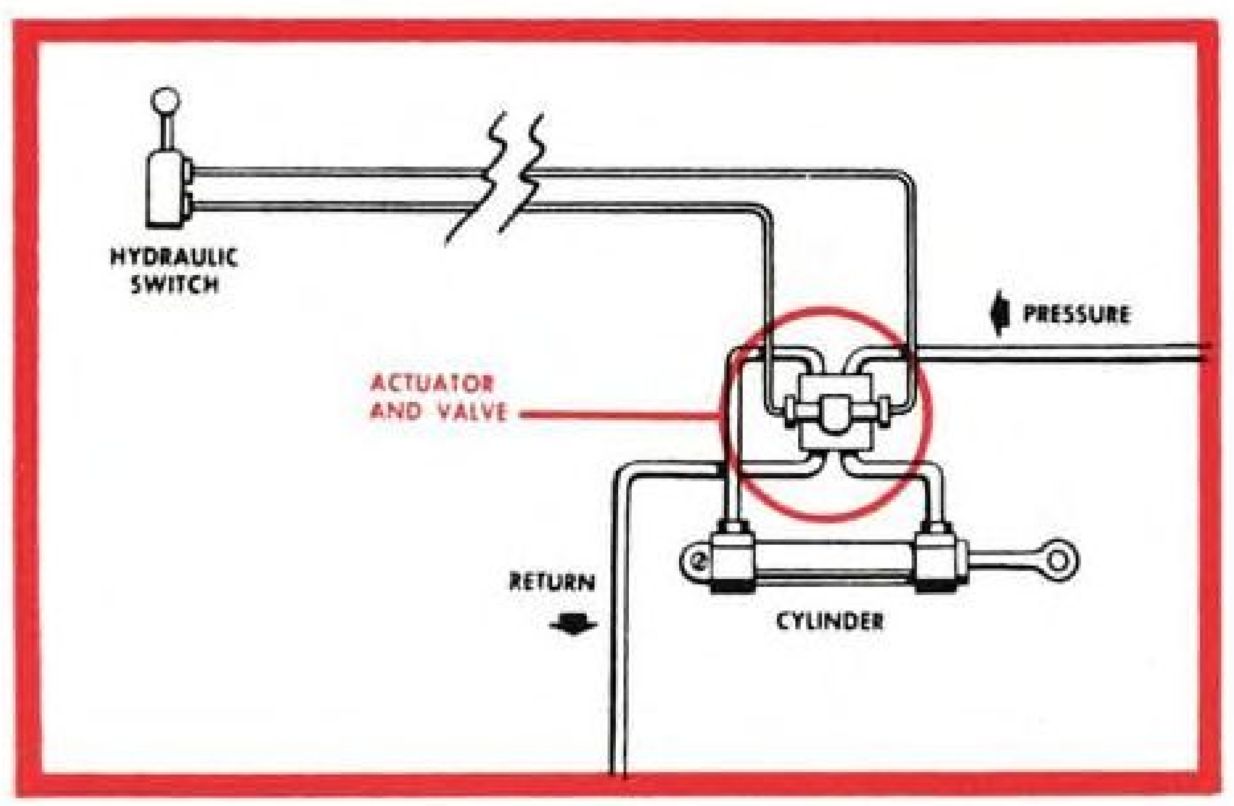
Noteworthy features of the new Actuator are instant response, provision for manual operation, minimum weight, minimum space and unfailing reliability.

Detailed specifications of the new Actuator are available on request.



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Pacific Division
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HANSEN Couplings ...ACE INDUSTRY

HANSEN PUSH-TITE COUPLING

is composed of two parts —socket and detachable plug. They come in a wide range of standard sizes and are used for air, oil and grease. Socket and plug can be had with either male or female ends.

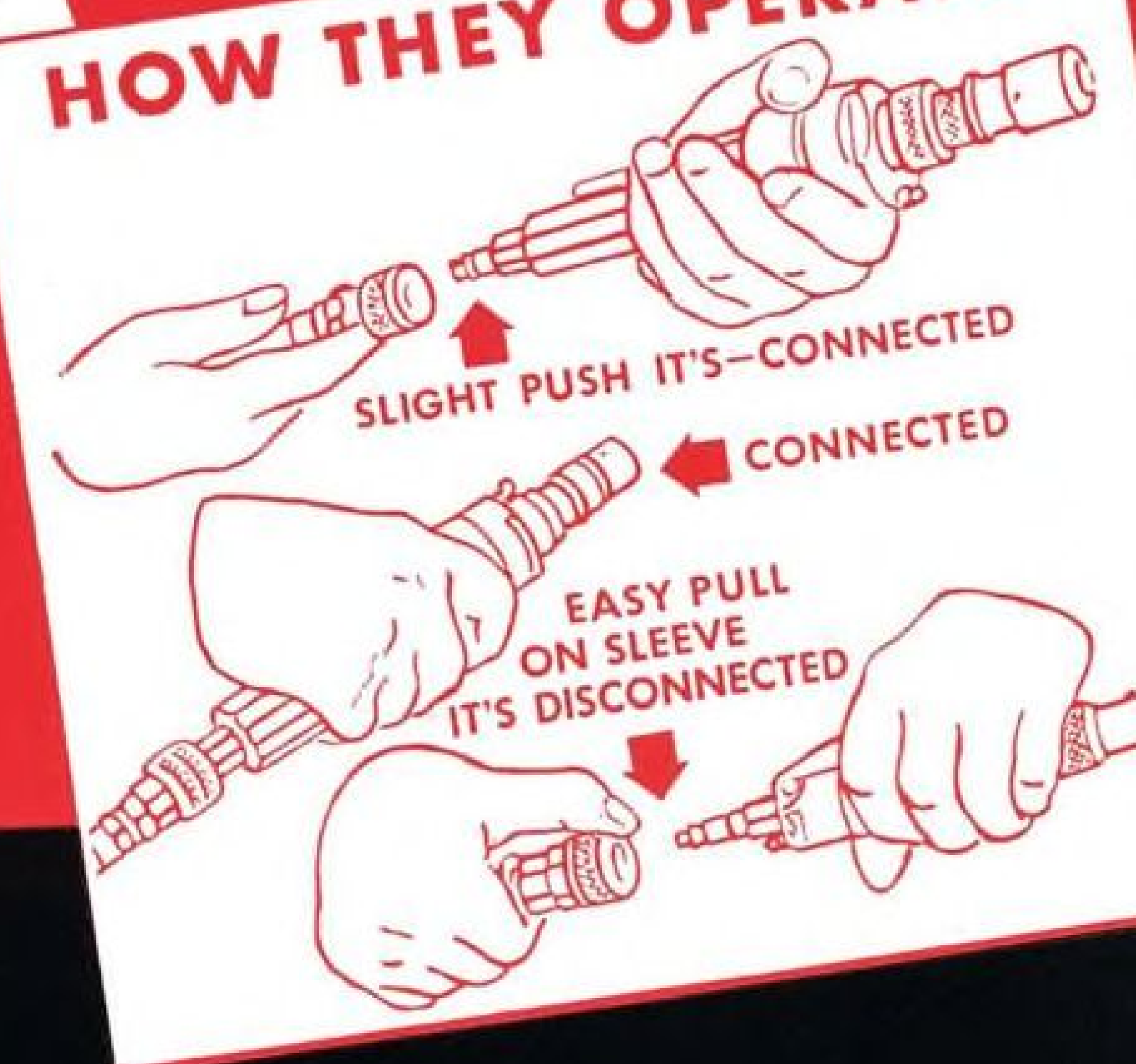
HANSEN 100 SERIES GASOLINE COUPLING

is composed of two parts —socket and detachable plug. Comes in a wide range of standard sizes. Both coupling and plug can be had with either male or female ends.

HANSEN 600 SERIES OXYGEN COUPLING

consists of socket and detachable plug and like the other Hansen Couplings they can be had in regular standard sizes with either male or female ends on socket and plug.

HOW THEY OPERATE!



HANSEN 700 SERIES ACETYLENE COUPLING

is composed of socket and detachable plug and comes equipped with standard left hand acetylene thread. Sockets and plugs can be had with either male or female ends in standard sizes.

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HANSEN MANUFACTURING CO.
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WHEN KINGSFORD-SMITH FLEW FROM CALIFORNIA TO AUSTRALIA

WOLF'S HEAD WAS FORTY-NINE YEARS OLD

In 1928 Charles Kingsford-Smith blazed his amazing air trail from San Francisco via Honolulu and the islands of the South Seas to Australia. 1928 was also the year Wolf's Head completed its forty-ninth year as refiners of quality oil products.

Almost from the very beginning of aviation history Wolf's Head research men have kept an eye peeled to the development and special requirements of aircraft engines. Their findings and observations have been consistently incorporated into Wolf's Head Aviation Oil with the result that Wolf's Head is the aviation oil specified by leading aircraft engine builders for block tests and trial runs.

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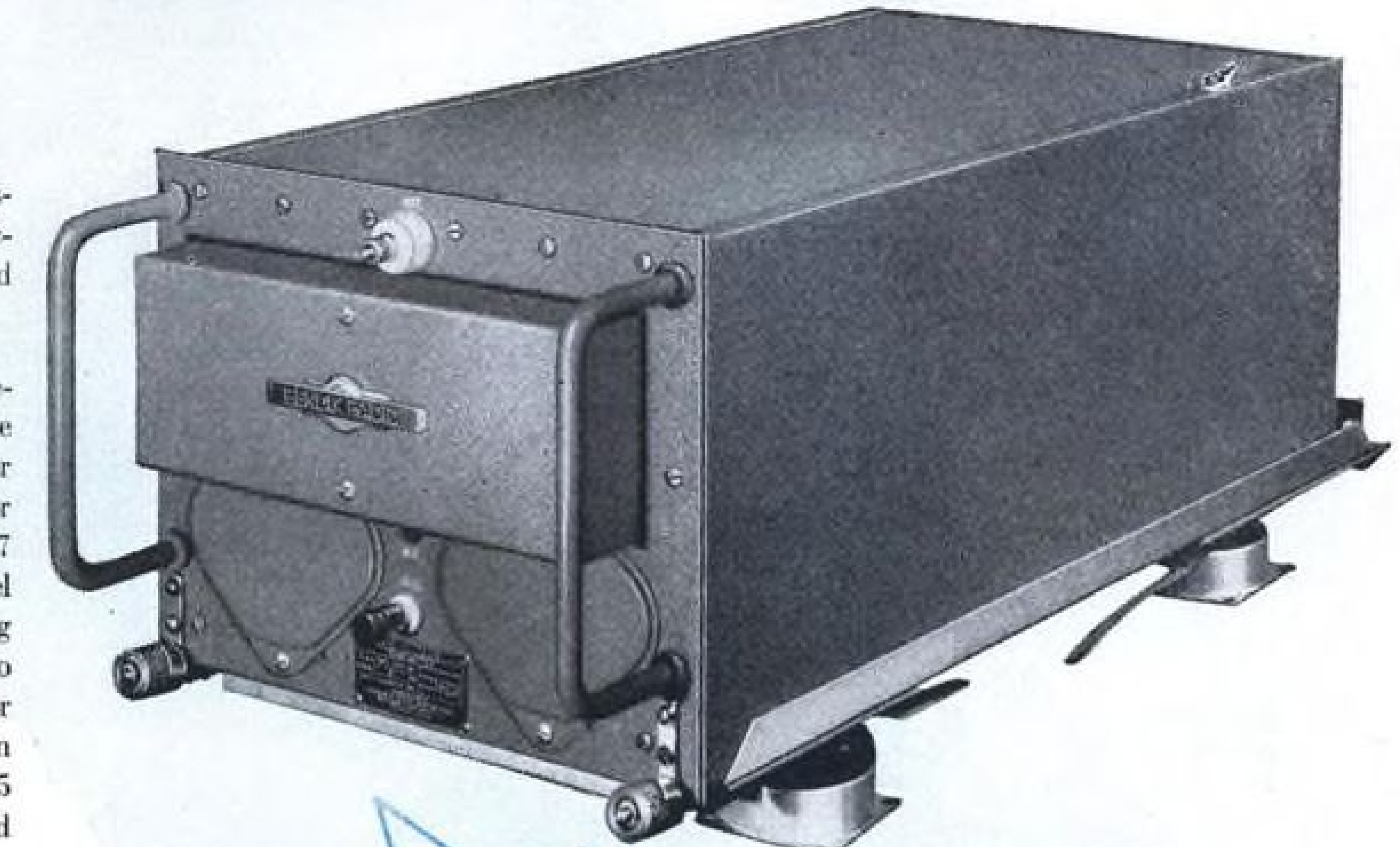
lightweight and compact!

The Bendix Radio Type TA-17 Transmitter is now available to manufacturers and operators of feeder line and executive type aircraft.

Built to rigid performance requirements—requirements that have made Bendix Radio the acknowledged leader in equipment and systems design for large air transport services—the TA-17 is a powerful, lightweight, multi-channel high frequency transmitter; making precision radio equipment available to the feeder line and charter operator without a proportionate sacrifice in potential payload. Weighing only 35 lbs., complete with shockmount and built-in power supply, the TA-17 Transmitter delivers a full 50 watts output on four crystal-controlled channels at any frequency between 2850 kc. and 12,500 kc.

It utilizes standard single ATR/JAN-C172 case, chassis and shockmount design. All antenna tuning adjustments are accessible from the front panel, greatly simplifying the antenna tuning problem. A cover plate protects the tuning controls in normal operation.



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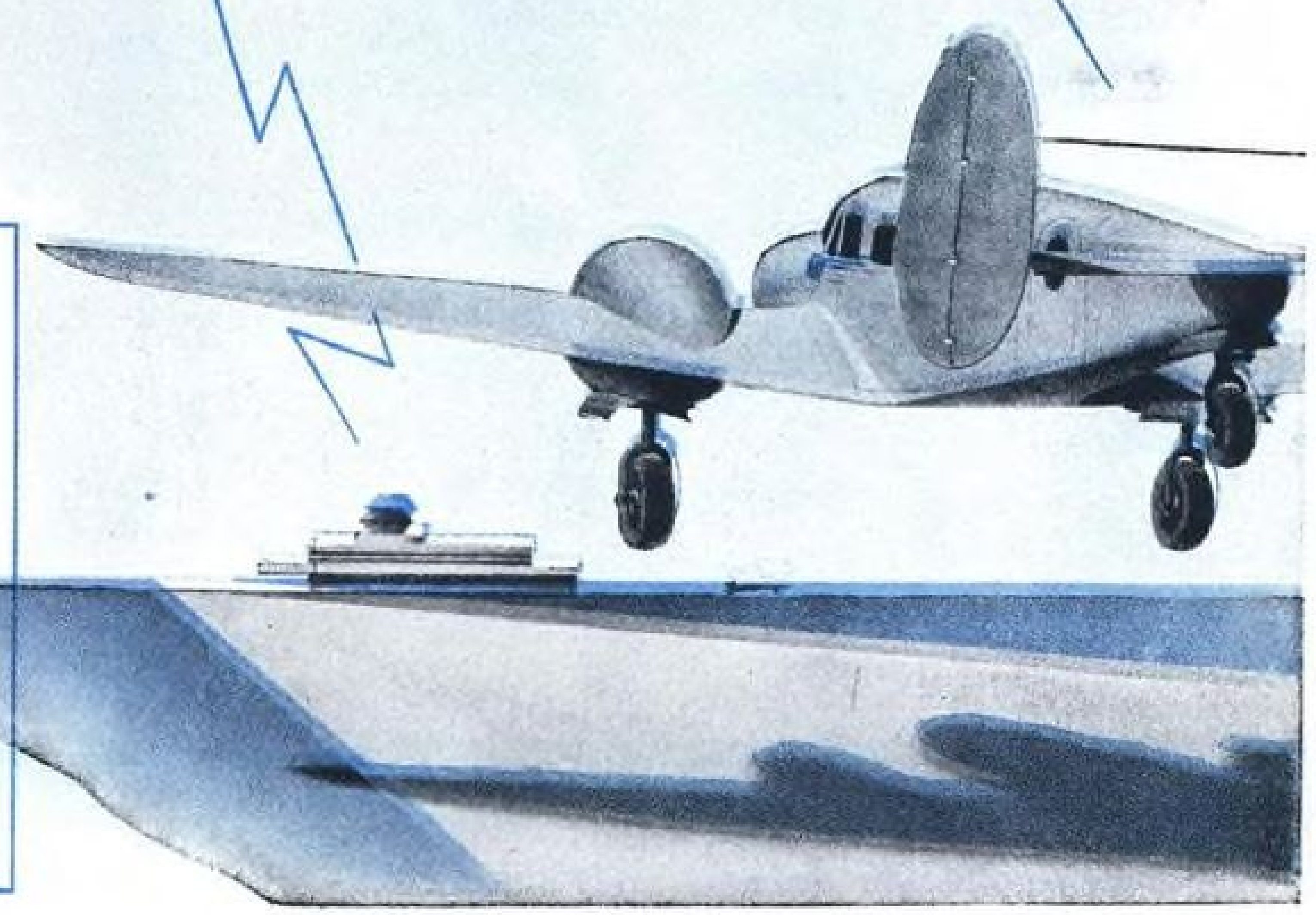
BENDIX RADIO DIVISION
BENDIX AVIATION CORPORATION
BALTIMORE 4, MARYLAND



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PRODUCT OF Bendix AVIATION CORPORATION

OPEN COAT
16
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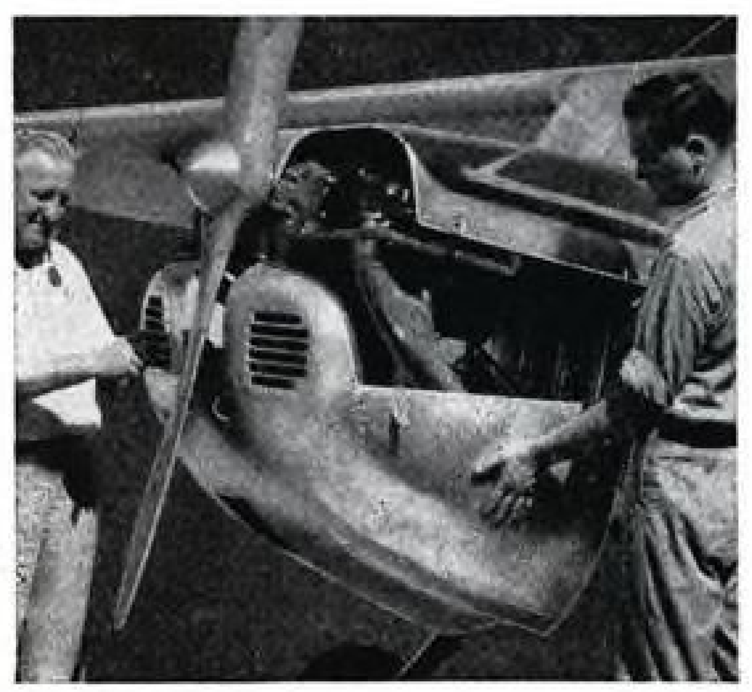
25 Gallons Of Fuel carried in twin wing tanks take you over 450 miles non-stop...over 4½ hours of flight. And there is a lot of room to take along plenty of luggage for 2 people for 2 weeks...up to 80 pounds.



Upkeep Is Lower...maintenance time reduced ...with a Cessna. The engine cowling is easily removed for quick service without touching the propeller. And the safety landing gear requires a minimum of service.

You'll Fly More Days a year in a Cessna. With the 140's safety landing gear, steerable tail wheel and full-size hydraulic brakes, you can taxi safely on windy days when other light planes are grounded.

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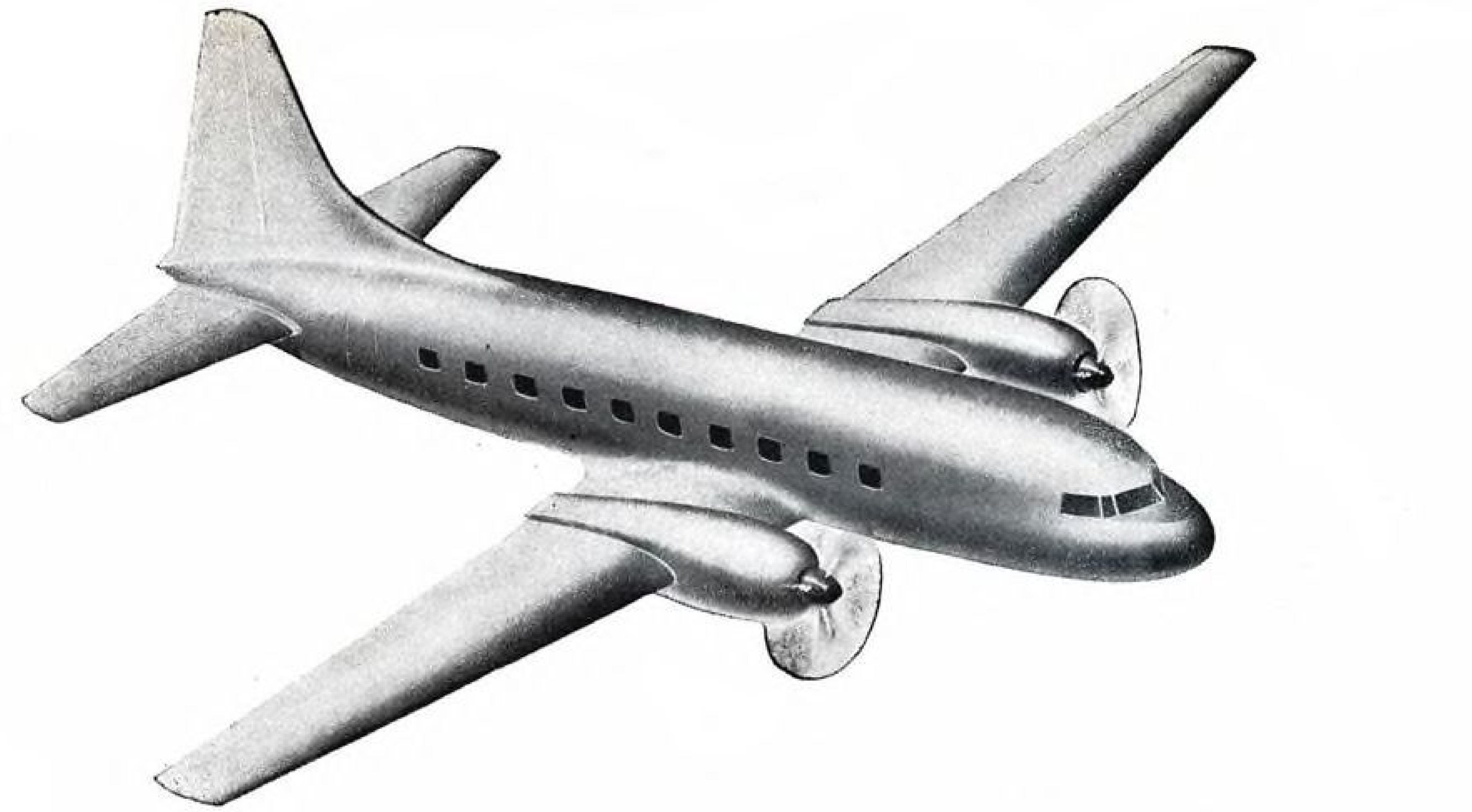
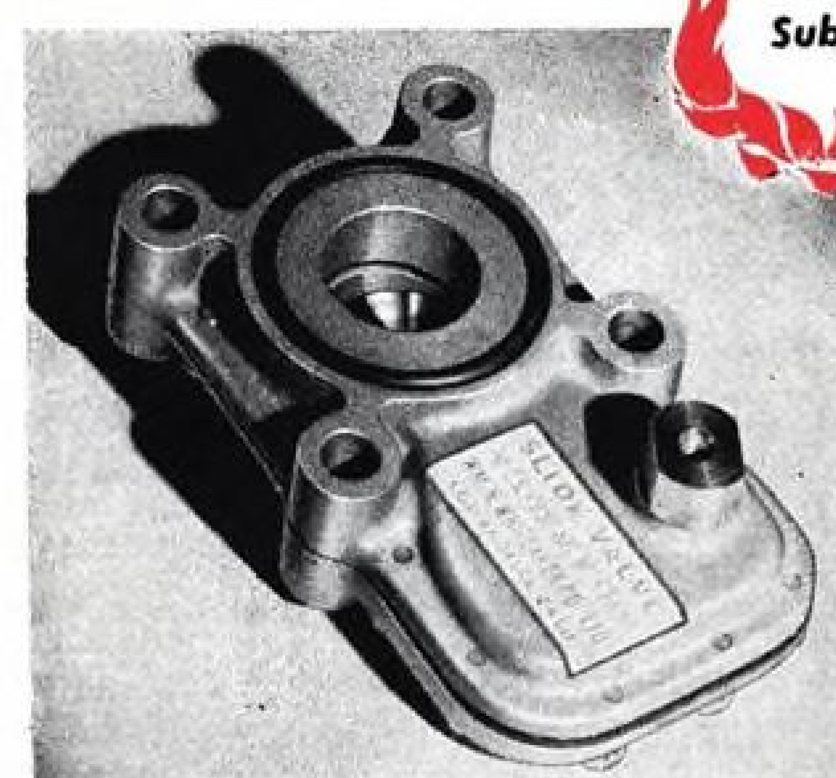
Cessna
THE PILOT'S AIRPLANE
ARMY E NAVY

CESSNA AIRCRAFT COMPANY, DEPT. A, WICHITA, KANSAS



Consolidated-Vultee 240 TO FLY WITH

C·A·A· FIRE-TESTED SHUT-OFF VALVES



Whittaker sliding gate shut-off valves are ideal for fuel, oil, air, water or vacuum lines. A synthetic rubber "O" ring seal with no metal-to-metal contact permits quick positive shut-offs with extremely low handle torque. Sliding gate shut-off valves also available in motor-operated model.

Subjected to flame of 2000° Fahrenheit —and did not leak a drop.

Yes...the C.A.A. requirements for fire-proof shut-off valves are tough. But Whittaker valves are tougher. The first to successfully pass the C.A.A. fire-resistant and fire-proof tests, the Whittaker sliding gate shut-off valve becomes the first C.A.A. fire-approved valve.

But this is not the only first for Whittaker. For, the painstaking care used in the design and engineering, the use of the highest quality materials and workmanship have given Whittaker products leading recognition in the aircraft industry. That's why Consolidated-Vultee engineers specify C.A.A. fire-approved Whittaker shut-off valves for the Consolidated-Vultee 240—the new, 300 m.p.h. jet exhaust passenger plane soon to be put into commercial service.

Detailed information on Whittaker shut-off valves and copies of the C.A.A. Fire-proof and Fire-resistant test report available on request. WM. R. WHITTAKER CO., LTD., 915 North Citrus Avenue, Los Angeles 38, California. Eastern Representatives—AERO ENGINEERING COMPANY, Cleveland, Ohio.

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This Bendix-developed Direct Injection Fuel System was used on wartime B-29s that delivered the atomic bombs . . . the "Pacusan Dreamboat" that flew over the top of the world and later set a new Paris to United States speed record . . . and today is in use on the great airliners that span the Atlantic and Pacific.

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Turbo-Jet and Turbo-Propeller Engine Fuel Systems
Stromberg* Injection Carburetors
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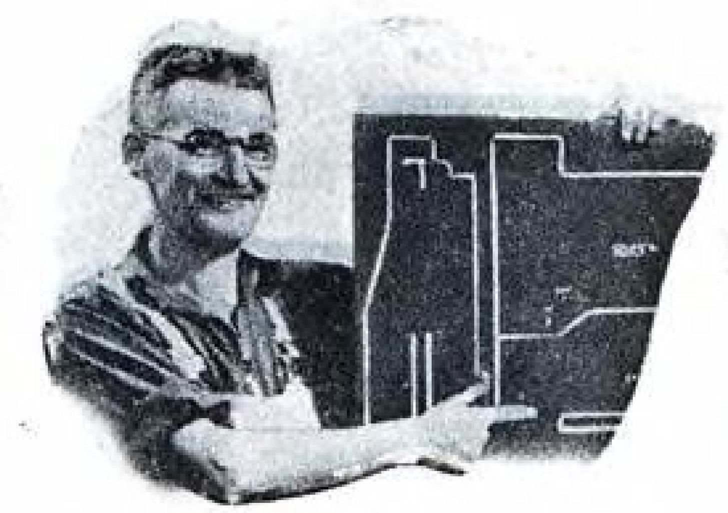

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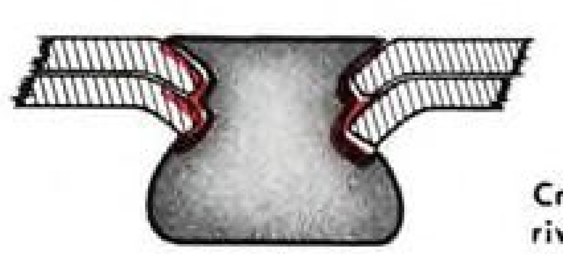
SLEEVE RIVETS
NOW AVAILABLE

Sleeve rivets, an invention of the Douglas Aircraft Company, after two years of research and experimentation, are now available to the aircraft industry through the Vic Pastushin Industries, Inc., licensed manufacturers and distributors.

HERE ARE THE ENGINEERING FACTS

COUNTERSINK SLEEVE RIVET

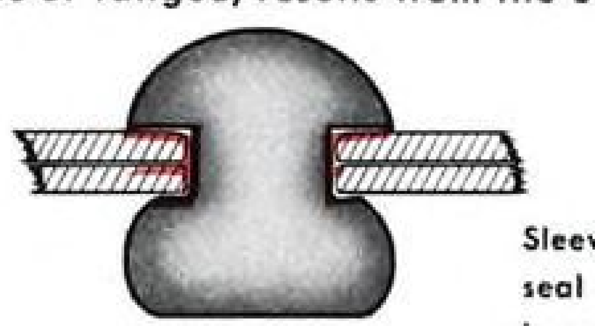
A sleeve rivet is a standard aircraft aluminum rivet, the shank of which is covered with a sleeve of dead soft aluminum tubing with a wall thickness of .004 inch. The head end of the sleeve is flared to match the head of the rivet and the tail end is peened to cover the radius end of the rivet shank. Sleeve rivets are available in round head, countersink head, and flat head types. Sleeve rivets are used in such assemblies as integral fuel tanks, oil tanks, etc., where fluid tight joints are required. Employing conventional riveting methods, the soft sleeve flows under force of rivet expansion, filling all hole irregularities and bonding itself to the aluminum sheet, extrusion, etc., to form a fluid tight seal. In the fabrication of flush dimple assemblies the countersink sleeve rivet is extremely adaptable, as the sleeve, in addition to its bonding qualities, compensates for irregularities in the dimples of sheet metal.



Cross section of countersunk sleeve rivet showing flow (indicated by red) of sleeve after assembly. Note compensation for hole and dimple irregularities.

ROUNDHEAD SLEEVE RIVET

Photomicrographs, after assembly, show that the sleeve in a sleeve rivet permeates into all hole irregularities, under the head and under the hammered end of the rivet, beveled edges of sheet skin, dull drill serrations in holes, etc. Specific manufacturing errors which sleeve rivets tend to compensate are—holes too large; holes out of round; improper burring; mis-match of holes; improper fit in dimples and countersinks; and poor driving technique. No loss of strength, either static or fatigue, results from the use of sleeve rivets.



Sleeve (indicated by red) provides seal under head as well as under hammered shank of rivet.

Sleeve rivets are the result of two years of research and "shake-down" tests. Their dependability for assemblies where fluid tightness is mandatory is thoroughly proven. Sleeve rivets are being used on the Douglas DC-4, the new Douglas DC-6, new type of military airplanes, and commercial airplanes of foreign manufacture Check your requirements—order your sleeve rivets today.

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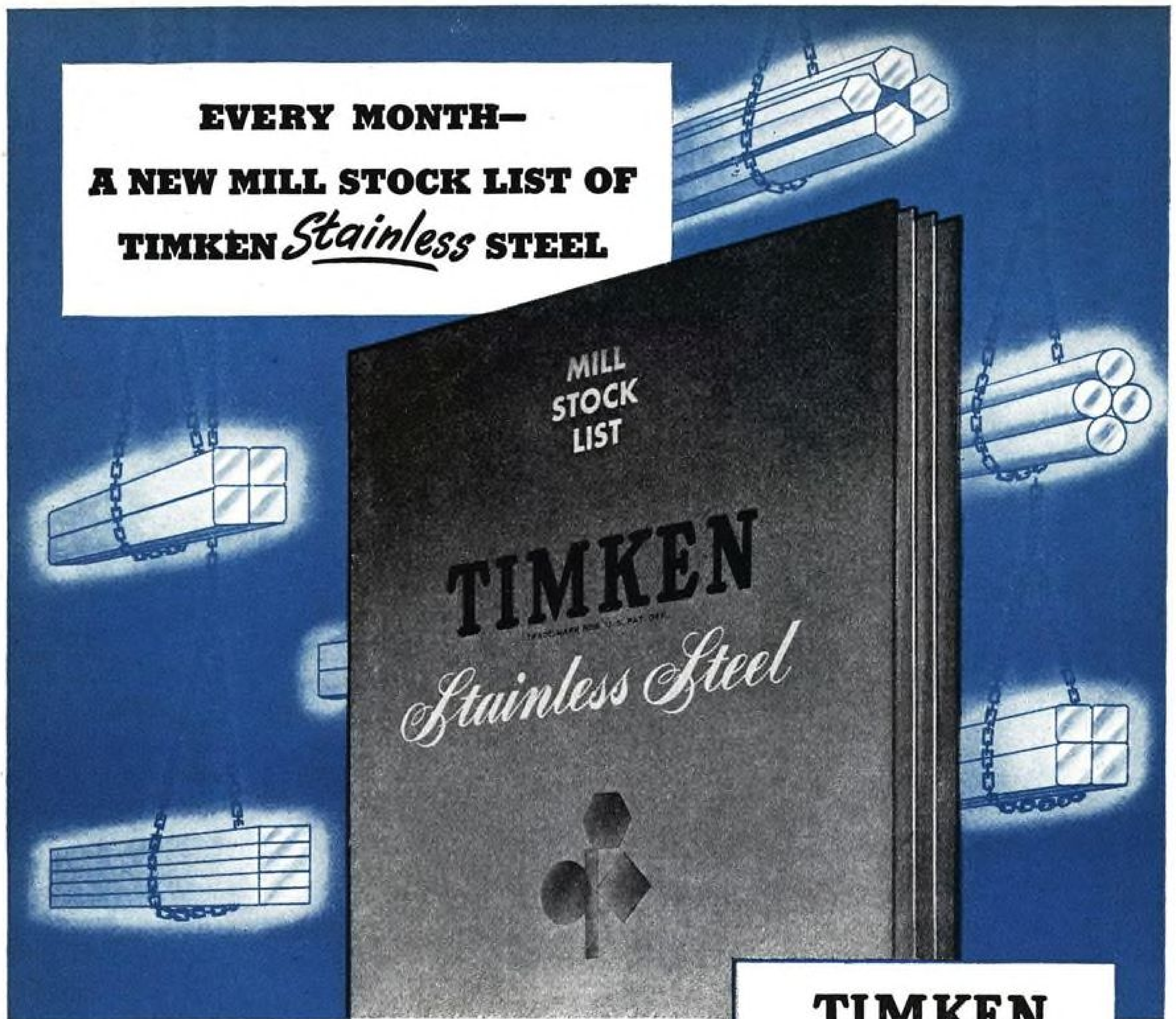

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■ Seal up a stream of electrons in a vacuum tube...and you have a space-defying genie that vitalizes industry ...and can save countless lives!

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■ From then on electronics was employed whenever it could extend the usefulness and performance of Sperry products—as in automatic pilots, gun fire control devices, navigation instruments, both aeronautical and marine. And in 1939, came the Klystron, "heart-beat" of Radar.

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■ Sperry pioneered in helping develop these and many other services for mankind. But "pioneering" isn't enough. And that's why Sperry research and practical applications of electronics go endlessly on . . . in that search for something better which we call *product improvement.*

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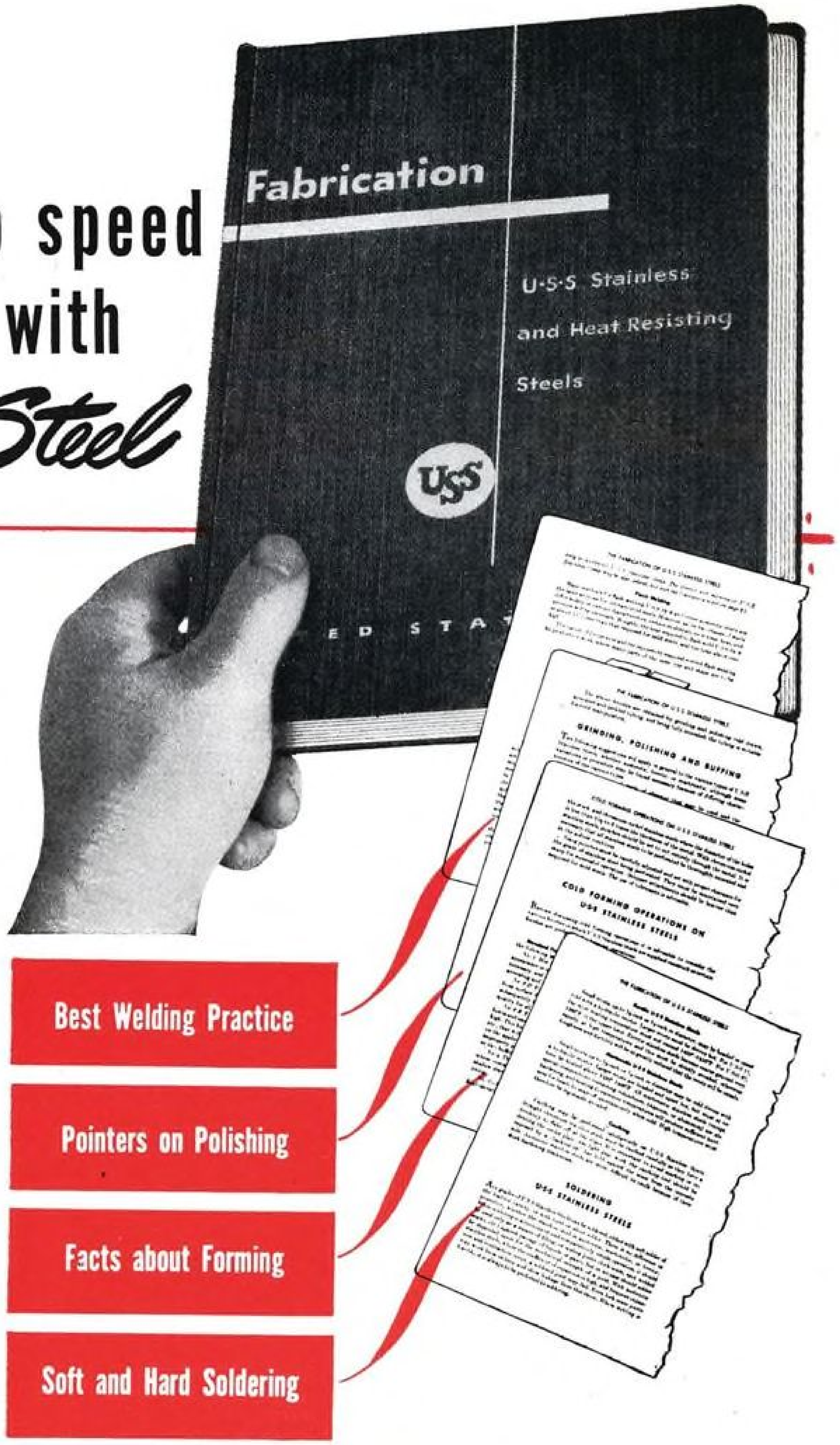
Here's help to speed your work with *Stainless Steel*



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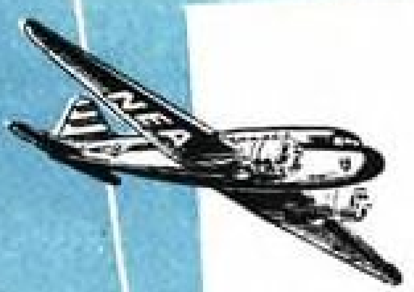
For every type of Airline Operation



NORTHEAST AIRLINES

Please address reply to:
Roy K. Brown

Logan International Airport
East Boston, Mass.
September 15, 1946

The BG Corporation
136 West 52nd Street
New York 19, New York

Gentlemen:

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1. Superior and unequaled performance during tests conducted on several different types of spark plugs.
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We feel that we should express our appreciation to you for engineering a product of such durability and performance.

Sincerely,

Northeast Airlines, Inc.

Roy K. Brown
Supt. of Maintenance and Engineering

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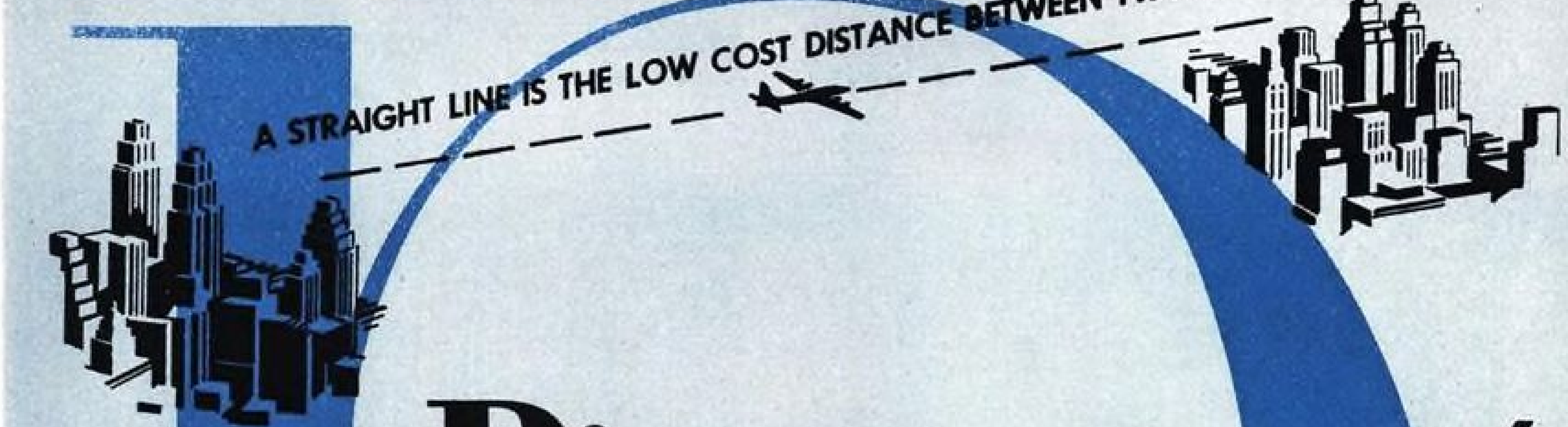


That's why Pioneer *presents* the new Dual Radio and Magnetic Compass

REG. U.S. PAT. OFF.

Pioneer again points the way, with the first flight instrument to provide simultaneous magnetic compass indication and dual radio direction! In one instrument, the pilot can now read stabilized magnetic direction and radio direction from two stations. By precomputing his flight, the pilot has continuous running fixes without switching from one station to another. Rapid changes of course without calculating new headings are possible, and even drift angle can be read at a glance without use of a driftmeter. For economical, "straight-as-a-string" flight, and navigational certainty that relieves the pilot of undue strain, the Pioneer Dual Radio and Magnetic Compass is a vast step forward in the science of flight control—flight control that pays off! A Pioneering step in fact as in name!

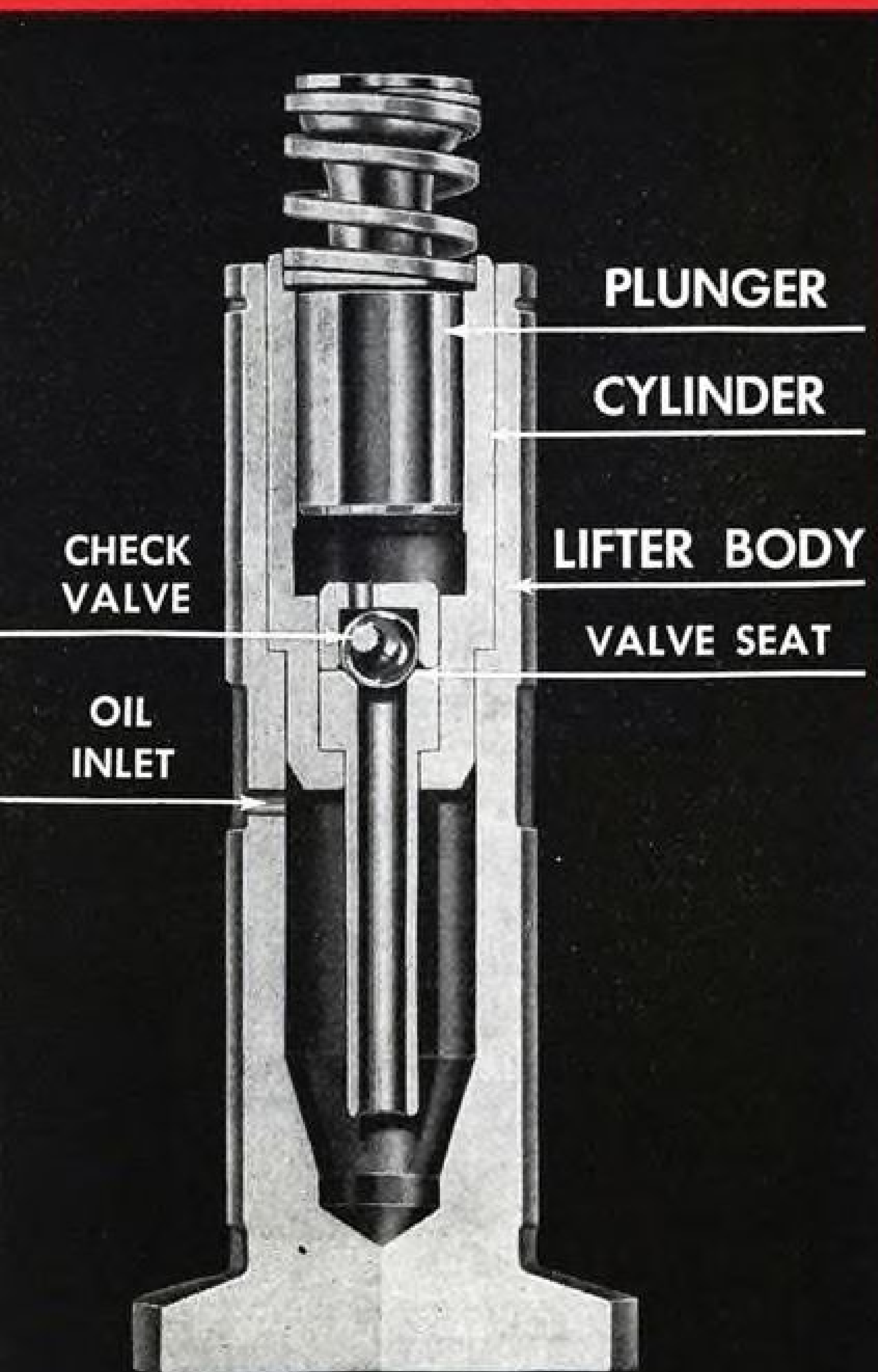
Eclipse-Pioneer Division of Bendix Aviation Corporation TETERBORO, NEW JERSEY

PRODUCT OF Bendix AVIATION CORPORATION

HERE'S HOW

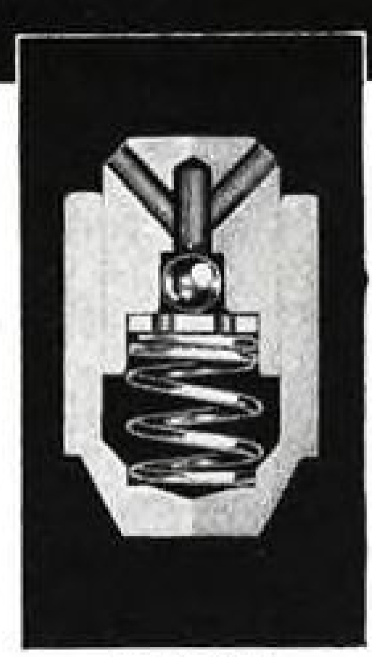
Zero-Lash HYDRAULIC VALVE LIFTERS

Registered U. S. Patent Office



MUSHROOM TYPE

BARREL TYPE



STUB TYPE

give

- ★ **Accurate Valve Timing and Perfect Seating at All Engine Speeds and Temperatures.**
- ★ **Longer Life for Valves and Seats.**
- ★ **Freedom from Tappet Adjustments for the Life of the Engine.**
- ★ **Silent Valve Train Operation.**

The *Zero-Lash* Hydraulic Valve Lifter is a simple, positive-action device which automatically adjusts its own length during each revolution of the camshaft, to compensate for expansion or contraction in the valve train. Here's how it works:

The hydraulic unit consists of a plunger operating in a cylinder. The plunger is held in its outermost position against the push rod, or valve stem, by a light spring. The chamber below the plunger is kept filled with oil by pressure from the engine lubricating system. When the check valve is closed, the column of oil in the chamber being noncompressible, lifts the push rod or valve stem as positively as if the lifter were a solid unit.

Accurately determined clearance is provided between the plunger and cylinder wall permitting the escape of a small amount of oil from the chamber. This leakage automatically compensates for expansion in the valve train allowing for positive valve seating.

On the other hand, when the valve train *contracts,* the spring holds the plunger in its outermost position. This relieves pressure in the chamber, opening the check valve and permitting the intake of oil from the lubricating system. Thus the lifter corrects its own length each time the valve closes, to maintain zero clearance.

Zero-Lash Hydraulic Valve Lifters are available in three basic types (mushroom, barrel, and stub) for all types of internal combustion engines—gasoline and Diesel.

Eaton Engineers will be glad to discuss the application of Zero-Lash Hydraulic Valve Lifters to engines now in design.

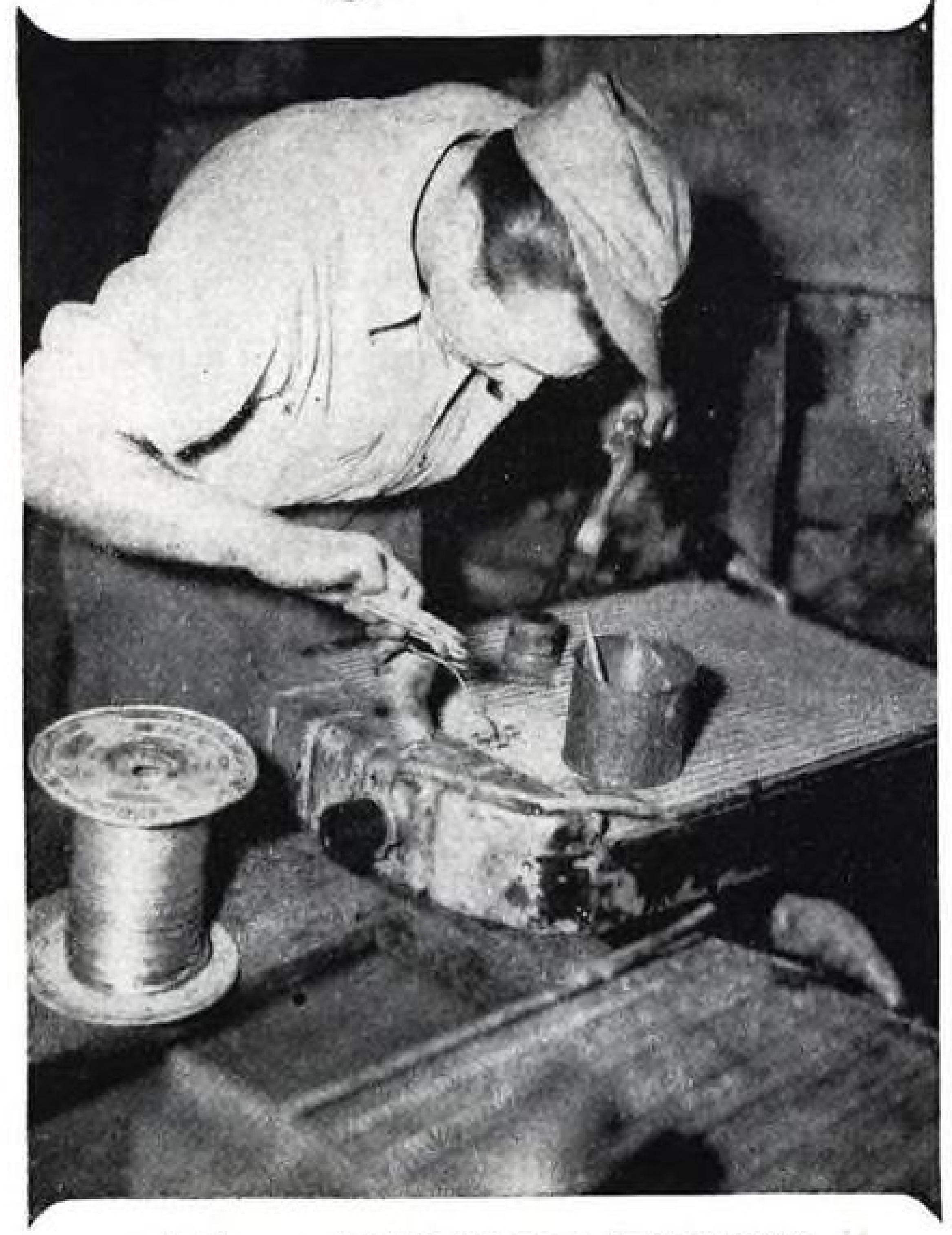
★

Illustrated literature covering the design and operation of Zero-Lash Hydraulic Valve Lifters, including reports of outstanding service records, will be furnished upon request.

EATON

MANUFACTURING COMPANY
WILCOX-RICH DIVISION
9771 French Road • Detroit 13, Michigan

KESTER FLUXES
Take Tough Jobs in Stride



The RIGHT FLUX for every solder job!

● There's a wide difference in solder fluxes . . . where one works perfectly another won't, and vice versa. If there is a soldering operation in your production that requires a separate flux, you can depend on Kester to supply exactly the right formula to do that job best.

● For nearly half a century Kester engineers have specialized on solder. In the field and in the laboratory they have studied, and supplied the exacting needs of industry.

● Their huge fund of experience and knowledge is at your disposal. Write Kester fully, at any time and without obligation, for prompt assistance on any solder question.

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Solder Fluxes
STANDARD FOR INDUSTRY

. . . and self-lubricating packing both are made of versatile Vistex

Vistex was developed originally as a peak or visor for caps. Later Vistex was perfected as a reciprocating seal for aviation shock absorbers. It is the strong new member of the American Felt family of versatile, felt base materials.

Vistex is sheet laminated in multiple ply thicknesses or synthetic or natural rubber impregnated felt, available in four standard types for varying applications. High operating and maintenance efficiency are assured . . . without danger of premature failure from overheating, accelerated aging, decomposition or dimensional distortion in maintenance reassembly.

Controlled ratio of felt fibre to impregnant in Vistex, plus standard density for all thicknesses, provides a self-lubricating sealing material that is well adapted to packing-washers and heavy-duty-bearing seal applications.

Please write, on your letterhead, and ask for Data Sheet No. 14, "Vistex Packings — Gasket — Seals."

AMERICAN FELT COMPANY DATA SHEETS

Write for those you need to complete your Felt reference file.

- No. 1—Felt Density and Hardness
- No. 2—Adhesives for Felt Application
- No. 3—"K" Felt—Sound Absorption and Thermal Insulation
- No. 4—Special Felt Treatments
- No. 5—S.A.E. Specifications and U. S. Navy 27F7
- No. 6—Felt and Lubrication
- No. 7—A.S.T.M. Methods of Test for Wool Felt, D461
- No. 8—U. S. Army Specification Nc. 8-15G
- No. 9—Sheet Felts, Standard Grades and Specifications
- No. 10—Vibration Isolation With Felt
- No. 11—Felt Seals, Their Design And Application
- No. 12—Flame-proofed Felt
- No. 13—Felt in Compression
- No. 14—Vistex—Packings, Gaskets, Seals

American Felt Company
TRADE MARK

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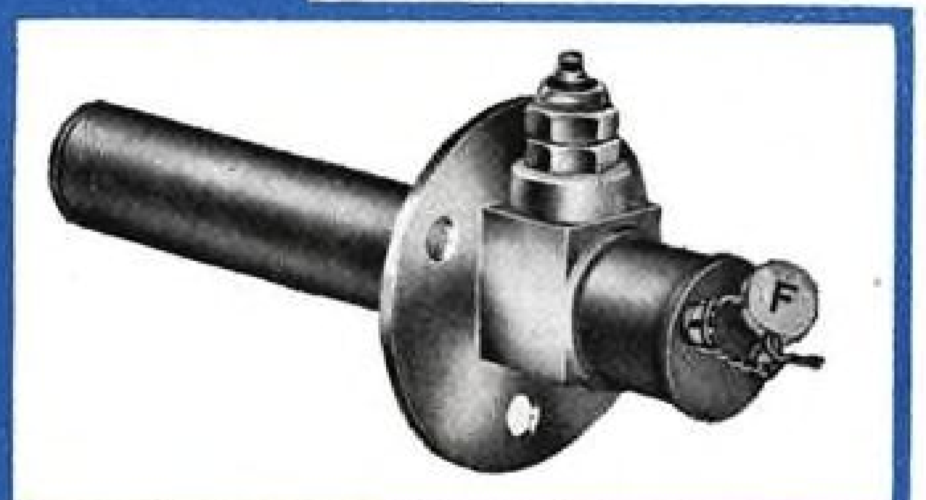
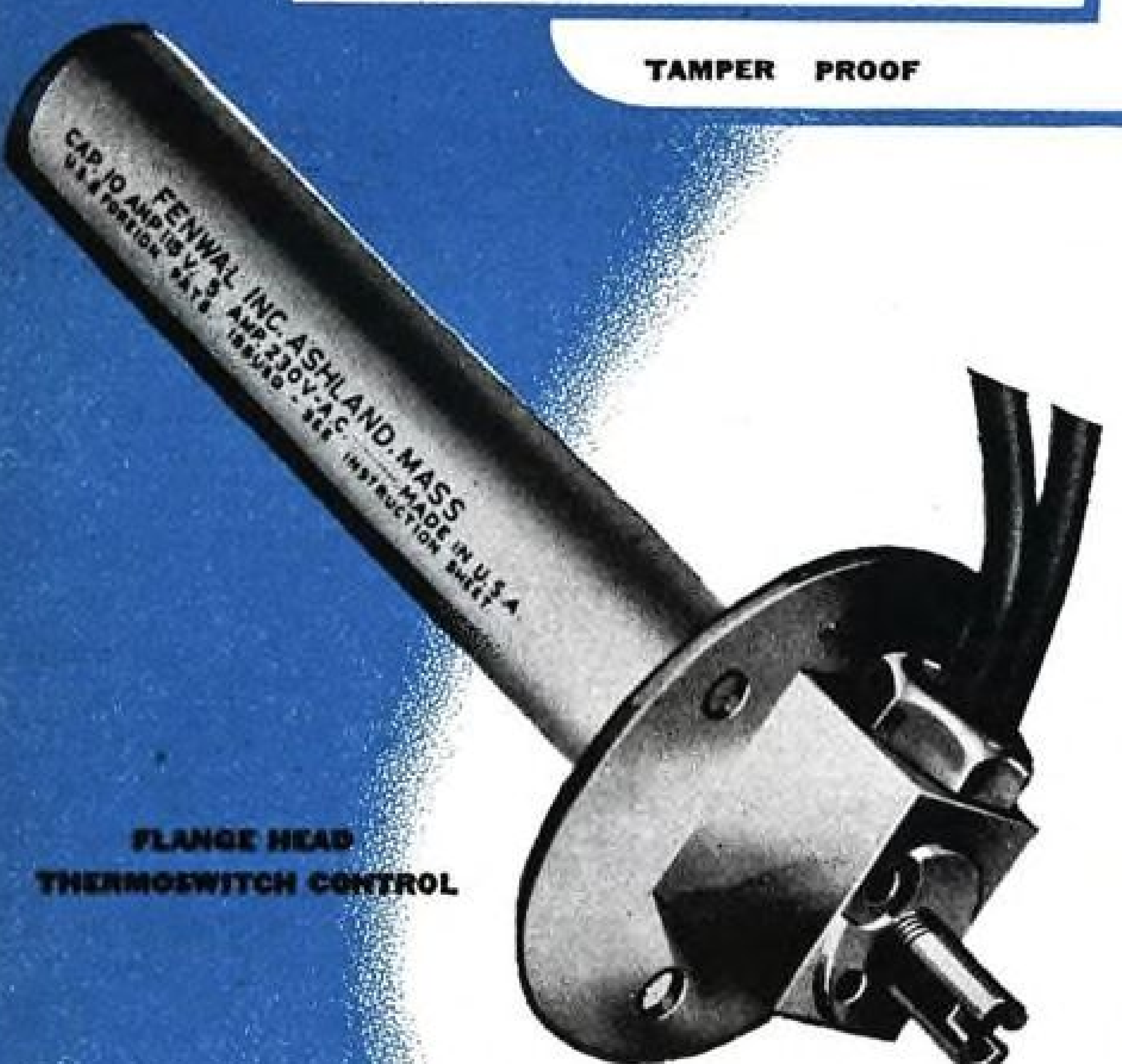
To insure continuous, accurate temperature control, the controlling thermostat should be tamper proof. Unauthorized tampering with the thermostat mechanism or changes in setting may be dangerous and can slow up production and impair quality. The contact assembly of the Fenwal THERMOSWITCH Control is completely protected by the temperature sensitive outer shell. It is impossible to tamper with the internal mechanism of the THERMOSWITCH Control. The only means of changing the temperature setting is by turning the adjusting sleeve. Tampering with the adjusting sleeve may be eliminated by the addition of a tamper proof cap with wire and lead seal.

Illustration shows a THERMOSWITCH Control with tamper proof cap and wire and lead seal. Combining this feature with the completely enclosed electrical assembly of the THERMOSWITCH Control insures all-around protection from unauthorized tampering with the control unit.



TAMPER PROOF

Investigate the modifications and special features available for your use with the Fenwal THERMOSWITCH Control. *Study the "Fourteen Facts in Fenwal's Favor" in our Thermotechnics Booklet. Write for your copy.*



FLANGE HEAD THERMOSWITCH CONTROL

FOURTEEN FACTS IN FENWAL'S FAVOR

1.—Fast reaction time
2.—Large heat sensitive area, small heat storage
3.—Short heat transfer path
4.—Small temperature differential
5.—Built-in temperature anticipation
6.—Enclosed assembly
7.—Minimal vibration effects
8.—Tamper-proof and sealed
9.—Rugged construction
10.—Adjustable over wide temperature range
11.—Minimum size
12.—Directly responsive to radiant heat
13.—Uniform sensitivity over adjustable temperature range
14.—Readily installed

*#8 of "14 Facts in Fenwal's Favor"

Fenwal

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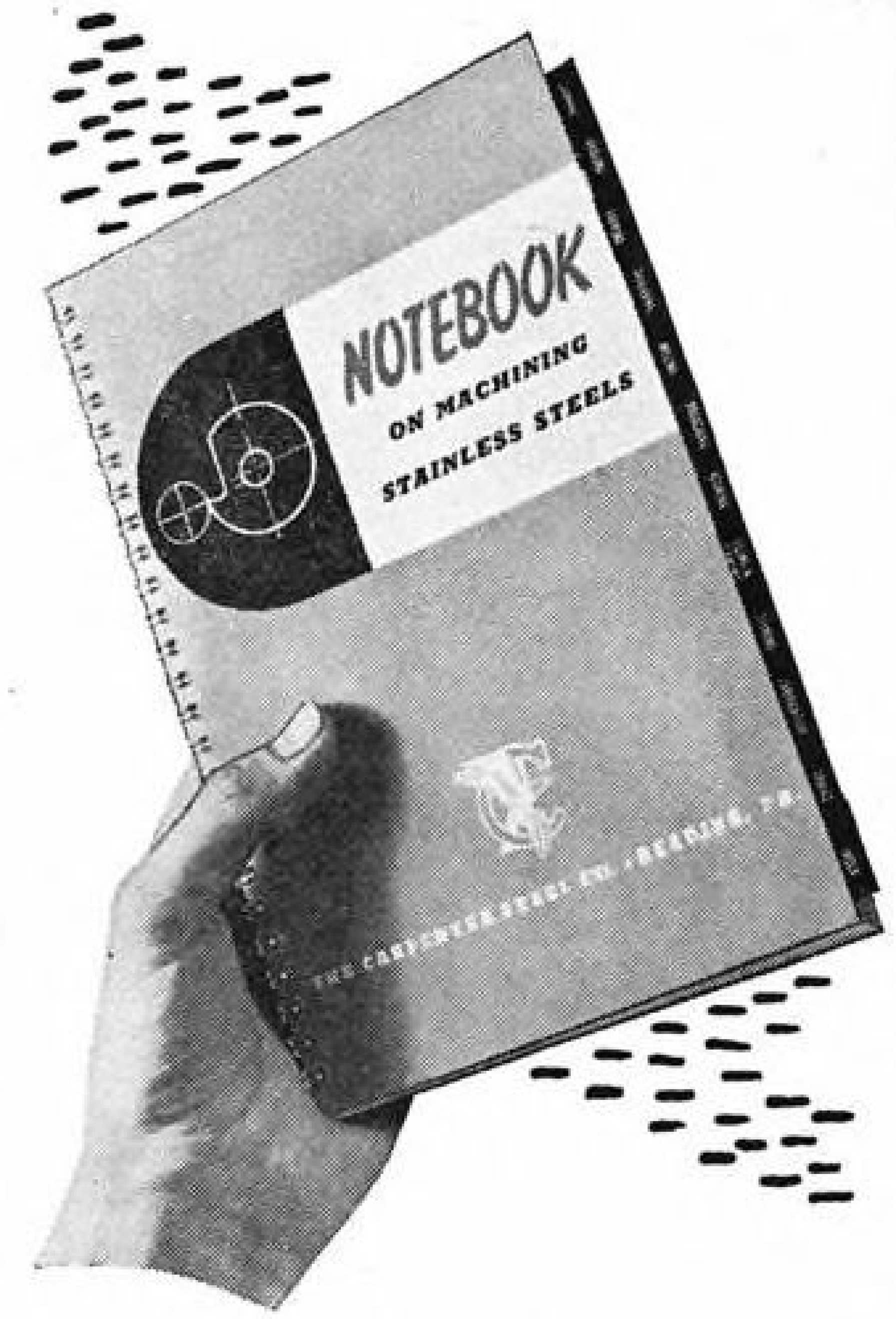
17 PLEASANT STREET
ASHLAND MASSACHUSETTS
Thermotechnics for Complete Temperature Regulation



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In this new "NOTEBOOK on Machining Stainless Steels" you'll find page after page of useful information, much of it never before published.

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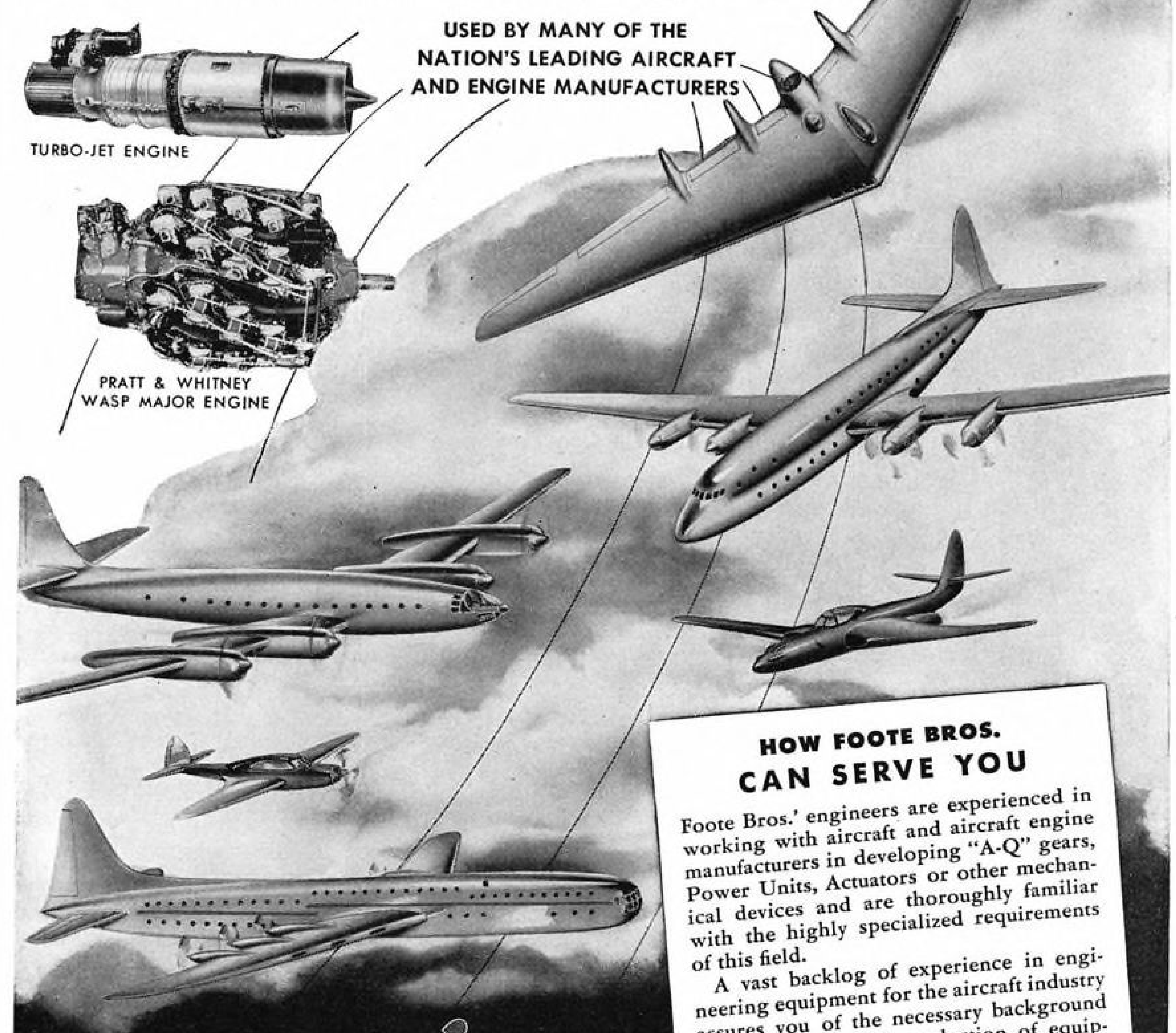
Many manufacturers today look to Foote Bros. for gears that closely approach theoretical perfection. These "A-Q" (aircraft quality) gears were produced by the millions during the war for use in Pratt & Whitney aircraft engines and for other applications. They permit operation at extremely high speeds, assure light weight and great compactness and bring the advantages of lower noise level and maximum efficiency.

Foote Bros.' knowledge of the aircraft field and vast experience in manufacturing power transmission equipment led aircraft and engine manufacturers to call on this company for specially engineered Power Units, employing the precision gears Foote Bros. developed. These units assured the extremely accurate mounting so essential if the full benefit of "A-Q" gears is to be realized. The satisfactory service this equipment is rendering is evidenced by the large number of ships on which Foote Bros. equipment is included.



FOOTE BROS.

Better Power Transmission Through Better Gears

HOW FOOTE BROS. CAN SERVE YOU

Foote Bros.' engineers are experienced in working with aircraft and aircraft engine manufacturers in developing "A-Q" gears, Power Units, Actuators or other mechanical devices and are thoroughly familiar with the highly specialized requirements of this field.

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Leece-Neville

HELPS SET THE PACE FOR AVIATION PROGRESS

● Just after World War I, Leece-Neville made news with an aircraft generator rated at 35 amperes, 15 volts, which weighed 46¼ pounds. A Leece-Neville generator widely used in World War II—popular now, in peace—is rated at 100 amperes, 28.5 volts . . . and weighs *only 32¼ pounds!* This story of greater current output with less weight is typical of the many contributions of Leece-Neville to aviation progress.

The foresighted engineering which has credited history-making "firsts" to Leece-Neville over the years, plus traditional adherence of this pioneering firm to the highest attainable standards of quality in manufacturing, give present-day aviation one solid guarantee. Aircraft electrical equipment bearing the name Leece-Neville is the most advanced and the best available anywhere.

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Pioneer and STILL Quality Leader

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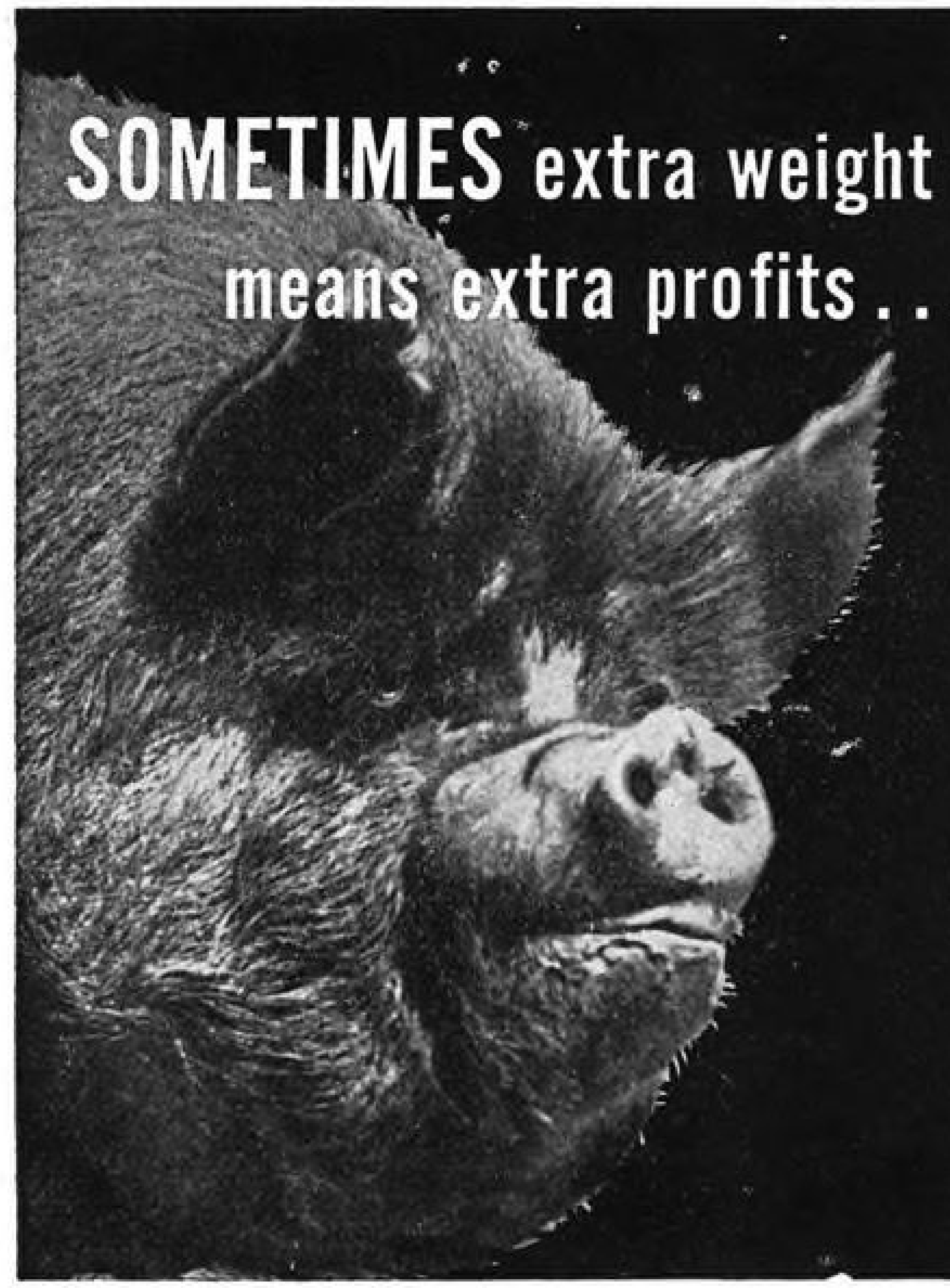
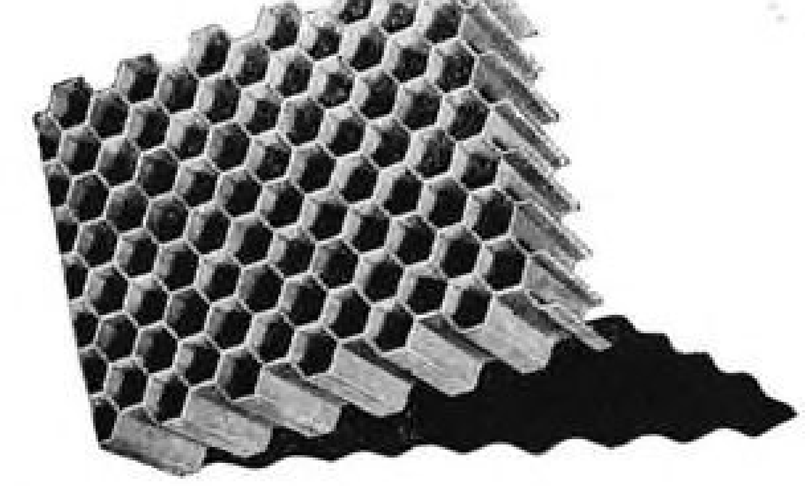


. . . but not in airplanes!

1. . . . for extra weight in plane construction cuts down pay loads . . . hinders operation . . . reduces airline profits.

That's why the designers of the new Martin 2-0-2 plane took special care to keep this plane's net weight 'way down . . . make it lighter than any other of equivalent horsepower and lifting capacity.



2. This great weight-saving in the Martin 2-0-2 is due to weight-saving engineering involving the extensive use of a lightweight structural material called Armorply Honeycomb . . . for floors, partitions, wing ribs, spars, doors and tank liners.

This material has an amazing strength/weight ratio. Weighing less than 4 lbs. per cu. ft., Honeycomb core may be used in sandwich constructions of any practical thickness.

Honeycomb cores (see illustration) may be made of cotton, Fiberglas, paper or other material, faced with aluminum alloys, plywood, stainless steel or decorative plastics. The skins are bonded securely with a new thermosetting adhesive of greater tensile strength than any other material for similar use.

3. Lightweight Honeycomb construction, with its resulting economy, is an important reason why the Martin 2-0-2 has been selected by these leading airlines:

Meantime, Martin engineers are planning still more extensive use of Armorply and Weldwood Honeycomb in their forthcoming jet-augmented plane . . . the Martin 3-0-3.

Detailed engineering data concerning Weldwood and Armorply Honeycomb are now available. Write for full information today.

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U. S. Army A. A. F. Photo

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To help keep the many thousands of army and navy war planes "on ice" in case of future need is one of the important jobs being performed by CECO Protek Plugs. They assure a new high standard of protection against the presence of moisture within aircraft engine cylinders.

The unique construction of these plugs guarantees complete protection at all times. The highly-absorbent silica gel is enclosed in a metal-seated glass chamber. This eliminates moisture penetration from the outside and at the same time gives a clear picture of moisture conditions within the cylinder. The silica gel is treated with the blue dye which gradually turns pink as the plugs reach saturation indicating exactly when they should be replaced.

Full details about these low-cost, high-protection plugs will be sent promptly. Just write to the address below.

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STEPS in making a safe plane safer

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ERCOUPE—the certified spin-proof plane—in flight. All ERCOUPE's are now equipped with Inconel mufflers.

"*So fool-proof, it almost flies itself*" . . . that's Ercoupe.

But its reputation for safety goes far beyond good design of controls. ENGINEERING AND RESEARCH CORPORATION has designed *all* parts of this certified spin-proof plane for safety and long life.

Take, for example, the exhaust muffler.

ERCO engineers tested many metals for the exhaust muffler. It was not until they decided to investigate the INCO Nickel Alloys that they found one fully able to withstand the combined attack of exhaust heat and corrosive fumes.

Inconel . . . an 80 Nickel—14 Chromium alloy with a reputation for long life in all kinds of high temperature applications . . . had been used for exhaust manifolds on many of the "big" planes for years.

Test results showed that it offered all the properties needed . . . thermal endurance . . . resistance to the corrosive exhaust gases . . . freedom from rusting . . . resistance to vibration fatigue. In addition, Inconel's workability fitted it to all the necessary forming and welding operations.

Today, the Ercoupe flies with an Inconel muffler guarding against the escape of inflammable exhaust gases. Mr. Fred Weick, ERCO's Vice-President in Charge of Engineering, says—

"Inconel has been used in the muffler of the postwar Ercoupe and has given completely trouble-free performance."

You always build in EXTRA performance when you use an INCO Nickel Alloy!

For more information on Inconel write for "ENGINEERING PROPERTIES OF INCONEL"

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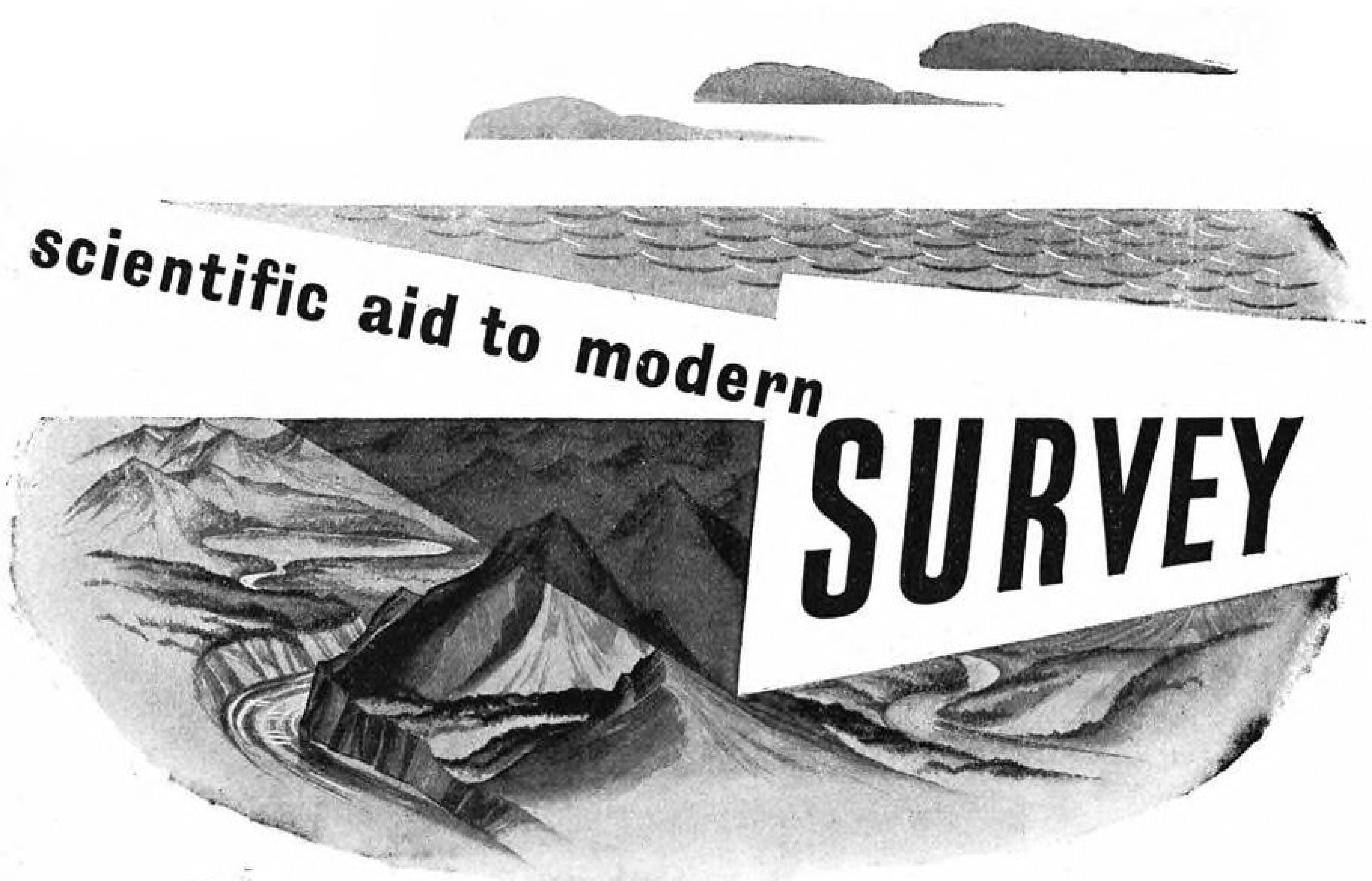
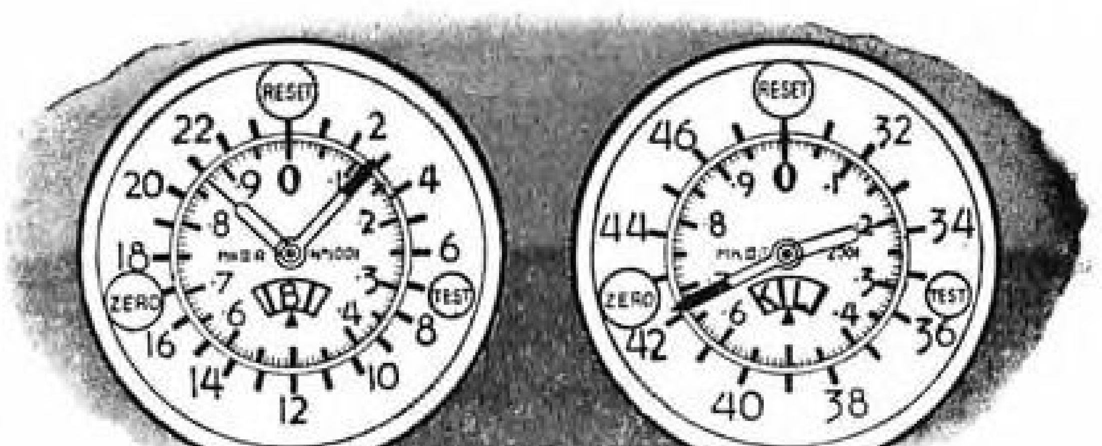
scientific aid to modern SURVEY



One month instead of ten . . . one year instead of ten. That's the time-saving for a surveyor using the Decca Navigator. Vast areas of land or sea can be mapped to a degree of accuracy and at a time-cost so low as to revolutionise the whole practice of surveying. The Decca Navigator is the latest development of radio science for survey work. It is simple to operate and, working from an easily erected transportable transmitting station, it gives a continuous *fix* of position on direct reading dials for boat, 'plane or mobile party. Remember with the Decca Navigator any estimated surveying time can be divided by ten.

The Decca Survey Department will gladly quote you for a Navigator equipment to suit your specific needs if you will tell them the nature of your business and the areas you propose to survey. If required, a Decca Engineer will be sent to discuss the matter with you. No obligation will be incurred.



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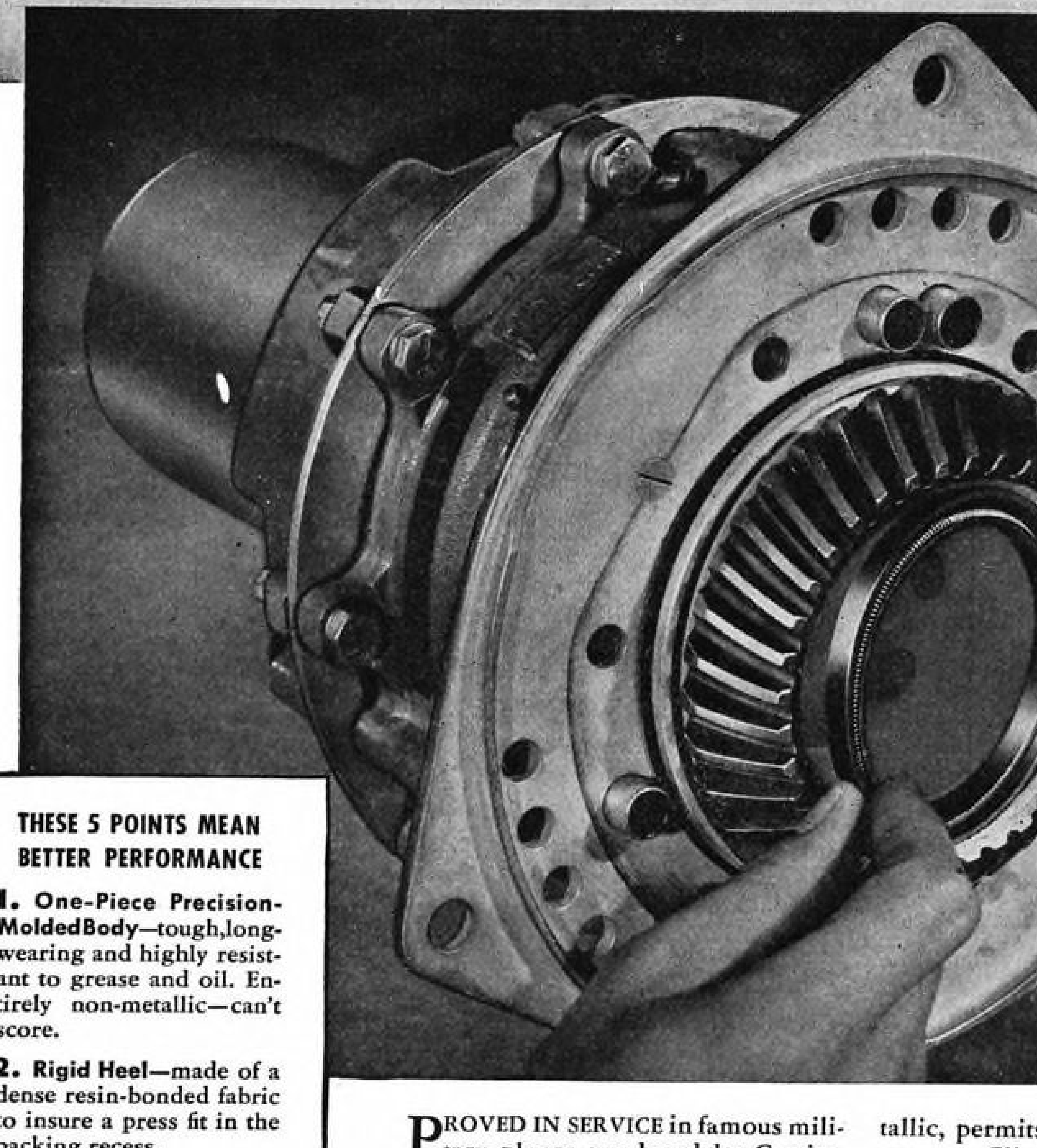
5-POINT PROTECTION

WITH J-M CLIPPER SEAL



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3. **Flexible Lip**—an integral part of the seal. Makes possible accurate control of pressure against shaft by means of self-adjusting garter spring.
4. **Large Bearing Area**—reduces wear on shaft to a minimum.
5. **Self-Adjusting Garter Spring**—permits accurate control of pressures and provides a positive contact with shaft at all times, even as wear progresses.

PROVED IN SERVICE in famous military planes produced by Curtiss-Wright and other manufacturers—the new Johns-Manville Clipper Seal simplifies design problems and reduces bearing maintenance in all types of aircraft.

Clipper Seal's unique 5-point construction means extra protection for bearings . . . longer wear for shafts, because lubrication is *sealed in* . . . dirt is *sealed out!*

Its one-piece precision-made body, concentrically molded and non-metallic, permits liberal machining tolerances. Clipper Seals are automatic in operation, easily adapted to a wide range of service conditions.

J-M Clipper Seals are made in sizes for shafts from 1 5/16 to 37" diameter, in endless and split types. Special designs may be had for extreme temperature, pressure or special lubricating conditions in either Clipper Seal or in other types of molded packings. Write Johns-Manville, 22 E. 40th St., New York 16, N. Y.

Photo above shows installing a Johns-Manville Clipper Seal in the rear of a Curtiss Electric propeller power unit.

—Johns-Manville—

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Here are some typical "Pittsburgh" developments:

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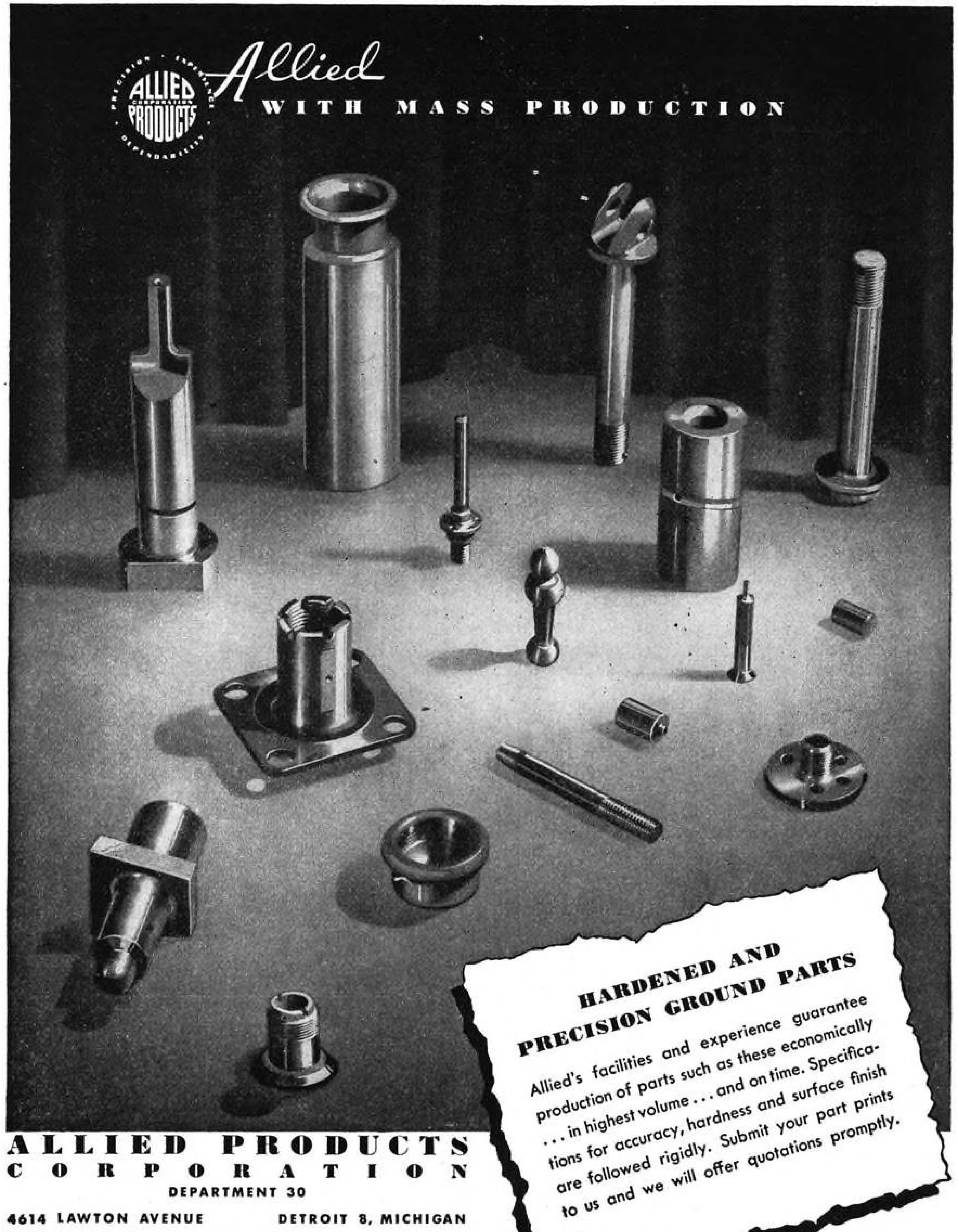
2. Development of a new technique for semi-tempering glass, resulting in weight saving up to 50% as compared to regularly annealed glass.
3. Development of Flexseal Safety Glass to reduce breakage from torsional stresses and frame inaccuracies.
4. Development of bent bullet-resisting glass (Multiplate).
5. Development of Flexseal Double-Glazed Units.
6. Development of improved methods for mounting glass and plastic in aircraft enclosures, including pressurized cabins.
7. Special glasses such as: ultra-violet absorbing glasses, aerial filter glasses, gunsight reflector glasses, gun sight sun screens, airplane camera windows, a special coating to increase reflectivity.
8. Development of special techniques for determining optical characteristics.
9. Development of offset construction for flush mounting of glass.
10. Development of windshield glass which withstands impact of flying birds and other heavy objects.
11. Development of windshields, electrically heated to prevent icing and fogging.

If you have any problem concerned with airplane glass or glazing, we invite you to write us. Address Pittsburgh Plate Glass Company, 2462-6 Grant Building, Pittsburgh, Penna.

"PITTSBURGH" *stands for Quality Glass and Paint*

PITTSBURGH PLATE GLASS COMPANY

SPECIALISTS IN AIRPLANE GLASS · MAKERS OF DUPLATE AND FLEXSEAL SAFETY GLASS AND OF MULTIPLATE BULLET-RESISTING GLASS



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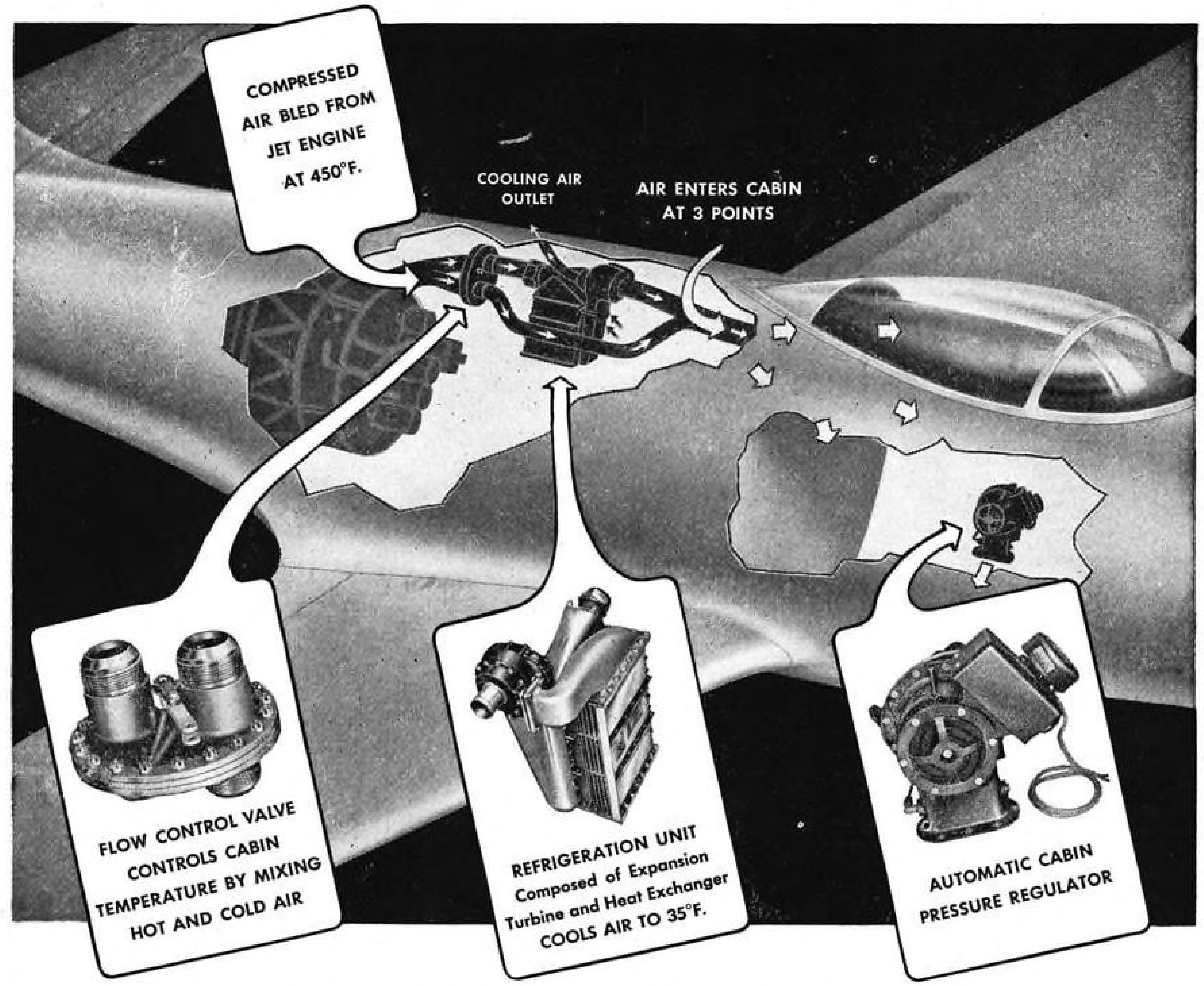
"Cabin Comfort" for Jet Fighters



AiResearch provides full, automatic control of cockpit pressure and temperature

A difficult problem in air conditioning is inherent in jet airplanes . . . it is that of controlling the heat caused by compression and high speed. Operating at high altitudes, the planes must be pressurized, but the only compressed air available comes directly from the jet engines—at temperatures above 400°F. Added to this is the great heat generated in the fuselage by air friction due to high speed. Before this hot, compressed air reaches the cockpit, it must be cooled to as low as 40°F.

With "Cabin Comfort" systems, including pressurization and cooling, AiResearch solves this and other problems of air conditioning for designers of all types of new airplanes. All parts, controls and accessories are provided for complete installations.

AiResearch leadership in aircraft *air control* is backed by seven years of pioneering research and production. Call upon this unique background to solve your AIRCRAFT air conditioning problems.

AiResearch Manufacturing Company, Los Angeles 45, California.

MIDGET TURBINE COOLS AIR 140°F.

Revolutionary development in the jet fighter "Cabin Comfort" system is the 3-lb. AiResearch expansion turbine. Operating at speeds up to 100,000 RPM, it cools air 140°F. at 7 lbs. airflow per minute. Another AiResearch *first!*

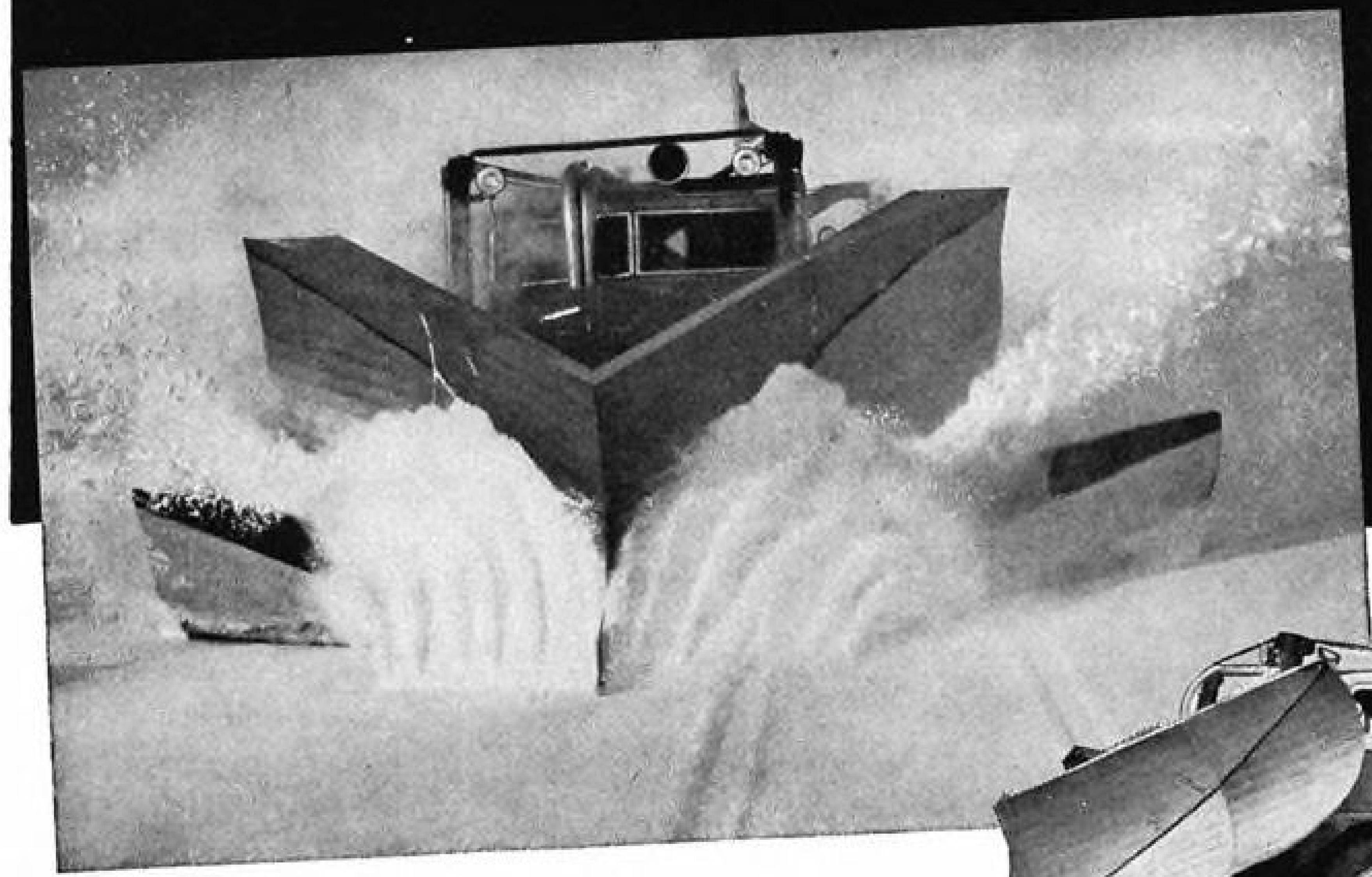
• *AiResearch "Cabin Comfort" equipment will condition the newest Lockheed Constellation, to fly late this year, and the newest planes of Consolidated Vultee, Douglas, North American, Republic, Northrop.*

AiResearch
DIVISION OF
THE GARRETT CORPORATION

Sales Representatives: NEW YORK, Aero Engineering, Inc., Room 1014, 160 Broadway. ☆ CLEVELAND, Aero Engineering, Inc., 1051 Power Avenue. ☆ SEATTLE, C & H Supply Company, 2723 First Avenue South. ☆ WICHITA, N. S. Chapin, 815 East Gilbert

WHEN PLANES CAN'T GO UP—

YOUR INCOME GOES DOWN!



GROUNDED planes mean lost dollars . . . for airlines and airports, alike. So make sure your runways are clear all winter. Get Walter Snow Fighters, the fastest, surest method of runway clearance. The high speed and power of these huge units enable them to keep ahead of the storm. Runways are kept open for emergency landings while the snow is falling . . . ready for takeoffs when it stops.

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Accidents happen in winter, too. Equip your airport with Walter Crash Trucks for year 'round safety. They cross not only snow and ice but also bogs, dumps, soft dirt and steep grades—fast. Walter Crash Trucks maintain full tractive power on any surface conditions. Get details.

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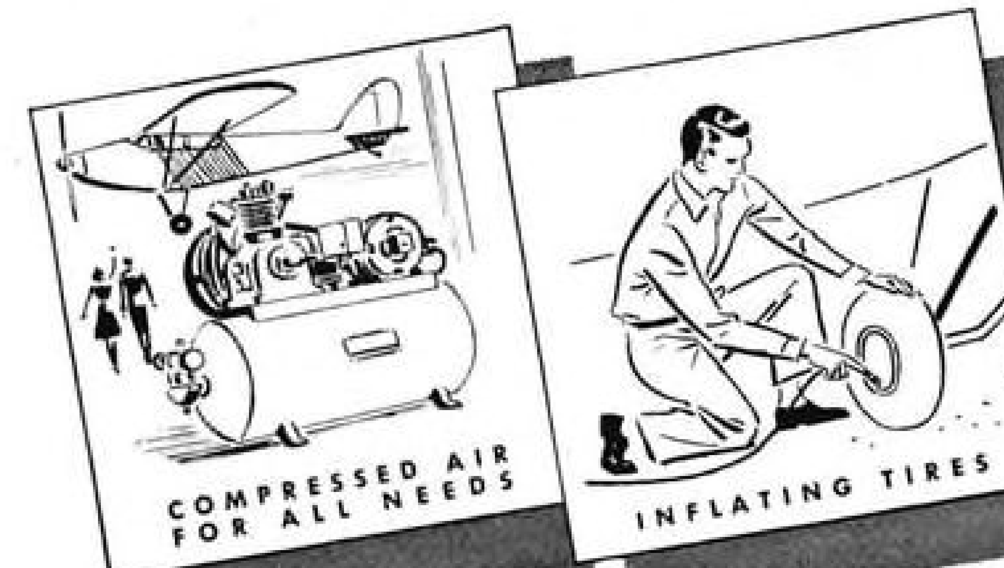

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We do, Sergeant, but...

Yes, those P-38's you serviced as crew chief in the South Pacific *were* equipped with sturdy, long-lasting Solar exhaust systems. Many a plane relies on them. In fact, Solar is the leader in the production of intricate stainless steel aircraft parts.

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"Ready-made" for runways 1800 ft. to 7000 ft. Installation requirements are simple. Plug-in all connections from the power receptacle all the way through to the runway lamps.

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DESIGNED TO FIT THE SPECIFIC NEEDS OF PLANES OF EVERY KIND

SPECIFICATIONS

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		Amp. Hrs. 5 Hr. Rate	Amperes 20 Min. Rate	Amperes 5 Min. Rate	Length	Width	Height	
PERSONAL PLANES—6 VOLTS								
3AC-7	6	10	15	36	4 1/8	3 7/8	7 11/16	8 1/4
3TAS-9B	6	34	54	144	4 7/8	4 15/16	9	16 1/2
PERSONAL PLANES—12 VOLTS								
6AC-7	12	10	15	36	8 1/16	3 7/8	6 13/16	17
6TS-7-1	12	17	27	72	7 11/16	5 3/16	11 9/32	26
6TS-9F	12	24	36	100	10 1/8	5 13/32	7 5/8	28
6TAS-9B	12	34	54	144	10 1/8	5 13/32	9 3/16	33 1/2
TRANSPORT PLANES								
6FHG-13	12	88	141	368	13 15/16	7 1/4	10 13/16	78
6FHM-13	12	88	141	368	13 15/16	7 1/4	10 13/16	78
12TAS-13	24	51	81	216	15 5/16	10 17/32	9 9/16	104
SHIELDED MILITARY TYPES								
6TS-9L	12	34	54	144	12 11/32	8 7/16*	10 9/32	40
6TAS-17	12	68	108	288	16 7/8	9 9/16*	10 5/32	71
12TS-7H	24	17	27	72	10 11/32	13 5/16*	8 25/32	50
12TS-9L	24	34	54	144	12 1/2	13 5/16*	10 9/32	77

*NOTE: DIMENSION DOES NOT INCLUDE TERMINAL BOX

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12 Volts
AIR TRANSPORT BATTERY
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For lights, radio and starting

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7½ inches long . . . net weight 4¾ lbs.

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mean time saved and money made to you!

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The "Unbrako" Socket Head Cap Screw is of superior strength—can be used 'most anywhere. Its knurled head provides a slip- and fumble-proof grip, even for oily fingers, while its internal wrenching feature facilitates compact design.

The "Unbrako" Internal Wrenching Bolt and the 100° Flush-Head Socket Screw are inspected to meet the extreme degree of precision, tensile, and fatigue demanded by the aircraft industry — our modern precision and metallurgical equipment and skilled craftsmen make this possible.

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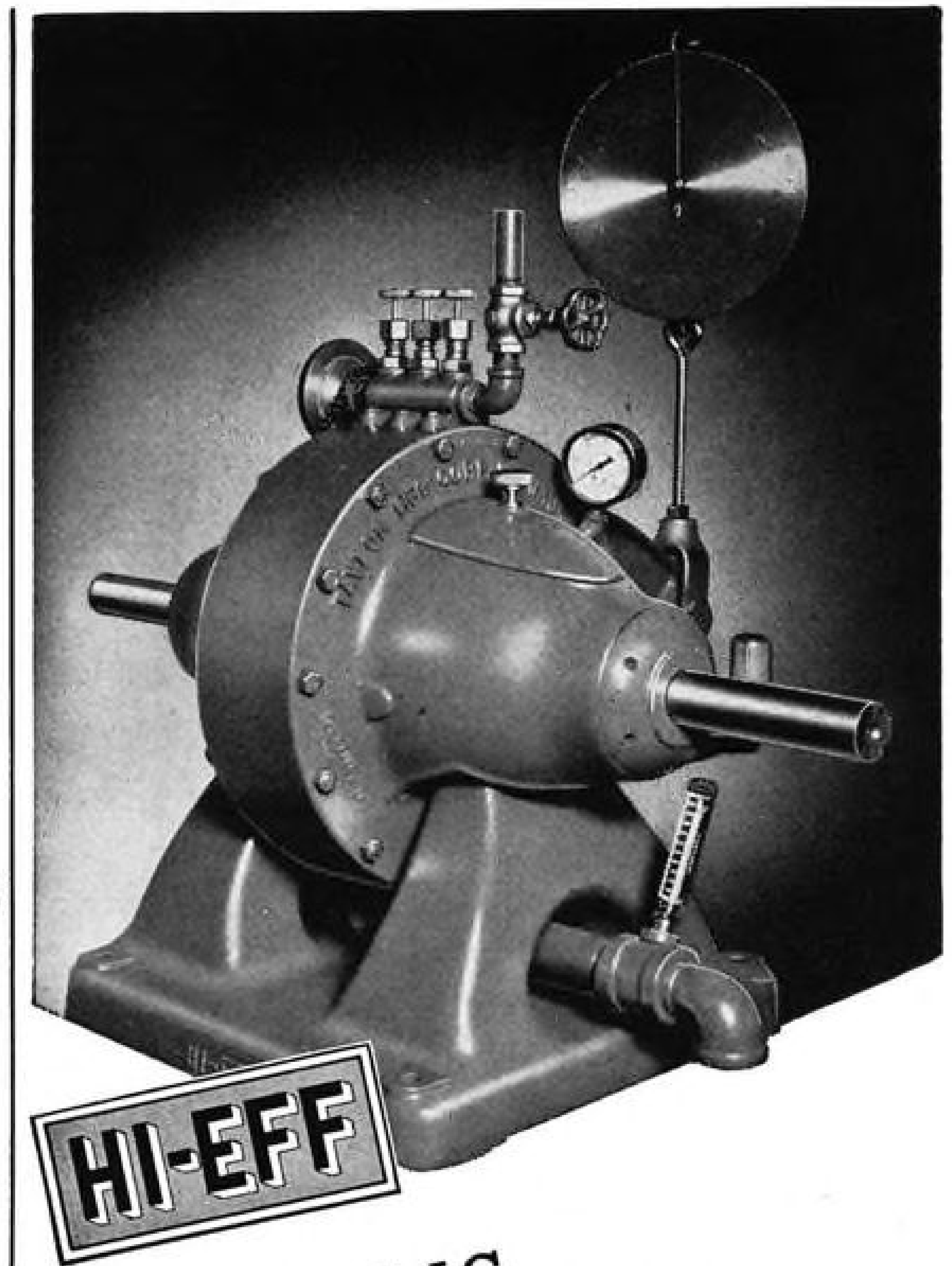

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- **EFFICIENT**
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You can depend on the performance data taken off a "HI-EFF" hydraulic dynamometer. All frictional and torque losses, except of cradle bearing, are measured on the scale, giving an accuracy approximately 99.7% perfect. This high degree of accuracy is maintained with all capacities to 6,500 H.P.—speeds to 25,000 R.P.M.

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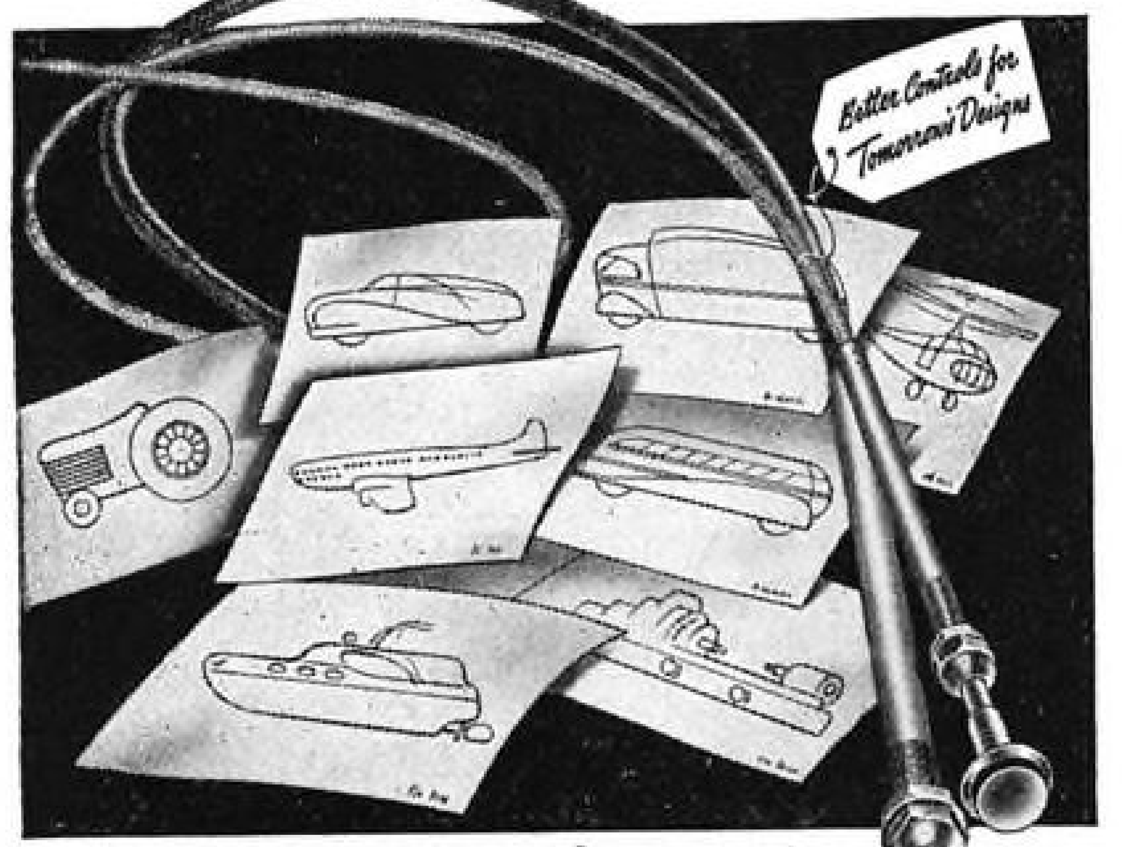
Static Balancing Machines—Sensitive Drilling Machines

ARENS *Flexible*

REMOTE CONTROLS



● If remote controls are a part of your present product or included in the design of your new product you can be assured of better performance with Arens Flexible or Rigid Remote Controls. Arens Controls are the result of 25 years experience in building controls to perform vital functions at maximum efficiency even under the most adverse operating conditions.

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PHYSICISTS
with advanced mathematics and physics background for work on dynamic-servo-control analysis.

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OPPORTUNITY to participate in development work arising from the application of advanced types of airplane power plants and resulting high speed performance.

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Blueprints $40 each				Blueprints $20 each			

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(Prefabricated steel hangars available soon)

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as well as develop the first sandwich aircraft surface in the United States, desires connections as consultant for advice on research, development and production of sandwich-type aircraft surfaces and interiors. An outstanding and specialized staff of engineers is also available for stress analysis and design.

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NEW TIRES: Post War—Goodyear Available Immediate delivery. We wholesale and carry large stocks. Propellers. Spark Plugs, Batteries, Tailwheel Assemblies, Windshield Pyralin, Dope, Fabric. Bob Trader Aero Supply, 909 Liberty Ave., Pittsburgh, Pa.

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Aircraft Engineers with experience in design and development of aircraft or aircraft equipment needed as Layout Draftsmen, Designers, Stress Analysts and Aerodynamicists. These are not just jobs but well-paid careers with big futures.

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Aer Rianta (Irish Airways)

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2. Substantial knowledge of an achievement in Air Transport development and operation generally are essential qualifications, while experience of transatlantic operations is highly desirable. The successful applicant will require to be in a position to take complete charge of operational engineering and all allied matters.
3. Applicants should state the range of salary expected and should give particulars of age, experience and qualifications including educational attainments. The salary that will be offered will be commensurate with the standing of the successful candidate and the importance of the post.
4. Applications should reach The Secretary, Aer Rianta Tta., Transatlantic Division, 43 Upper O'Connell Street, Dublin, Eire not later than Wednesday, 11th December 1946.

Additional Employment Advertising on Page 196

AER RIANTA (Irish Airways)

TRANSATLANTIC DIVISION

Aer Rianta (Irish Airways), Transatlantic Division, invites applications for the following posts:

(1) Operations Superintendent
Applicants should possess or have possessed—
(a) A commercial pilot's license and navigator's license.
(b) Considerable flying experience of four-engined aircraft.
(c) Experience of Transatlantic Operations and
(d) Wide experience in control and organization of flying operations generally.

(2) Chief Engineer
Applicants should have a University degree (or its equivalent) and considerable experience in—
(a) Operation and maintenance of civilian four-engined aircraft.
(b) Performance analysis and stores calculations.
(c) Organization, control of staff and administration generally.

(3) Telecommunications Engineer
Applicants should possess—
(a) A University degree (or its equivalent) in Engineering or Science, the course for which included electrical subjects or physics.
(b) Wide and responsible experience of aeronautical radio and of modern radio technique generally, including at least 5 years experience in a responsible capacity in the design, construction, installation, testing and maintenance of aeronautical radio equipment for communications and as aids to air navigation.
(c) Considerable experience in organization, control of staff, and administration generally.

(4) Flight Controllers
Applicants should have—
(a) A minimum of 300 hours flying experience.
(b) A 2nd Class Navigator's License.
(c) Experience of flying control or operations officer's duties, including control of aircraft on long distance flights and
(d) A sound knowledge of meteorology.

(5) Chief Inspector
Applicants should have current C.A.A. or A.R.B. Inspection Licenses for four-engined aircraft and considerable experience in—
(a) Line maintenance.
(b) Organization and handling of personnel.

Applications must be in writing and must state age, experience, educational and other qualifications, range of salary expected, the date on which candidates are free to take up duty if selected, and names of two persons who can be quoted as references. The applications must reach the Secretary, Aer Rianta, Tta., (Transatlantic Division) 43 Upper O'Connell Street, Dublin, Eire, not later than Wednesday, 11 December 1946.

McDONNELL AIRCRAFT CORP.

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has positions available for
Design Engineers

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OPERATIONS MANAGER

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We are looking for an active, experienced man who can handle personnel and who will be a credit to, and one who is willing to grow with this organization.

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Engineers wanted for interesting work in Chicago Area, involving design studies and testing of Radio Controlled Aircraft, Jet powered.

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ADMINISTRATIVE ENGINEERS
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AERO DYNAMICISTS
CHIEF TOOL DESIGNERS AND PLANNERS

Aircraft experience preferred—Location East Coast—Send complete details to

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Additional Employment Advertising on Page 195

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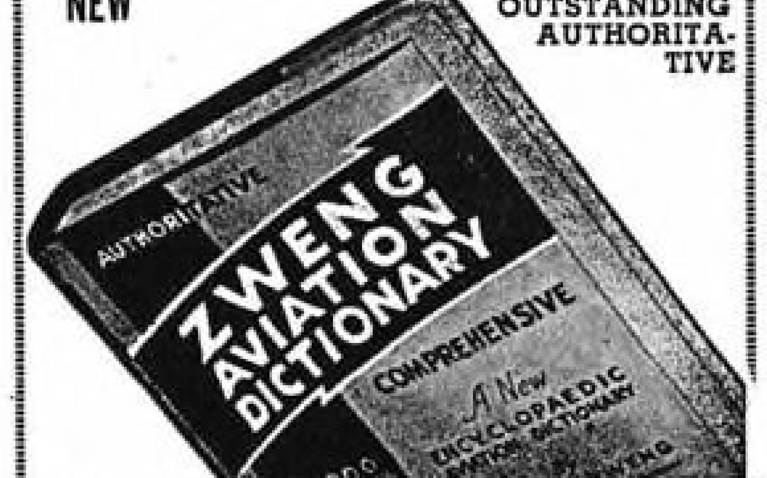

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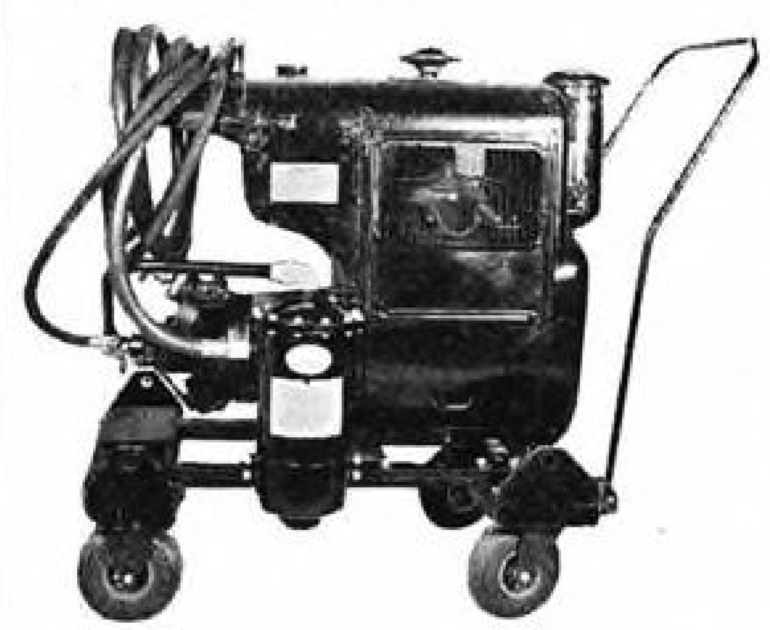

GASOLINE ENGINE DRIVEN STANDS

Designed for installations where electric power is not readily available, these gasoline powered test stands were built to exacting government requirements. Completely portable because the stand and engine are mounted on welded, structural steel base which is on four pneumatic tired wheels, this unit can be easily moved or towed anywhere on the maintenance line. 15 HP Wisconsin Engine is equipped with constant speed governor. Engine direct drives variable volume hydraulic pump (Denison axial piston type 3000 psi, 3.2 GPM at 1200 RPM). Stand has hydraulic pressure gage, filter, connector hoses (pressure and suction) and needle valve to control fluid flow. Canvas cover with tie strings to protect unit from weather included. Price: $450.00 each.

Stands are available for immediate shipment

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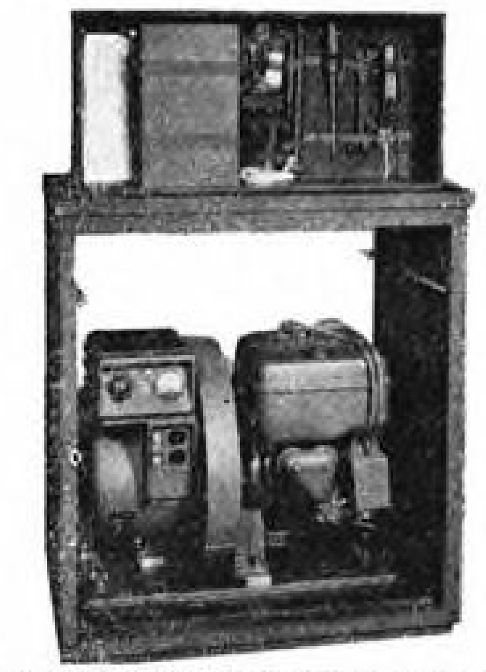

PORTABLE ELECTRIC POWER PLANTS

These sturdy, dependable units have hundreds of uses around the maintenance line and hangars for lighting and miscellaneous power supply for electric power tools, drop lights, soldering irons, etc., etc. Unit has automatic voltage regulation which is selective through a double pole, double-throw toggle switch. 6 HP. two cylinder, two stroke, air cooled engine drives AC Generator which puts out 115 Volts, 60 Cycles Single Phase, has rated load current of 21.7 amperes—2500 watts. Complete with kit of maintenance tools and replacement parts.

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Generate your own oxygen and acetylene on the spot! Designed to generate oxygen and acetylene for welding and cutting operations. These units are proving invaluable around the maintenance line and shops for on-the-spot welding or cutting without the necessity of handling heavy, cumbersome cylinders. Acetylene generator may be used for emergency lighting operations. Unit comes complete with 2 cans of chemicals for each generator. Gas generation may be regulated to provide automatic pressure up to the limit of the unit, or hand regulated operation may be chosen. Both generators have direct reading pressure gages for accurate control of pressure.

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Make accurate checks of CO-2 bottles with this scale designed for the purpose. Scale comes with weights as shown—has capacity of 35 lbs. Easily read fan type dial is graduated in 1/10 lbs., up to 2 lbs. Cradle is stainless steel, while scale is finished in black crackle enamel.

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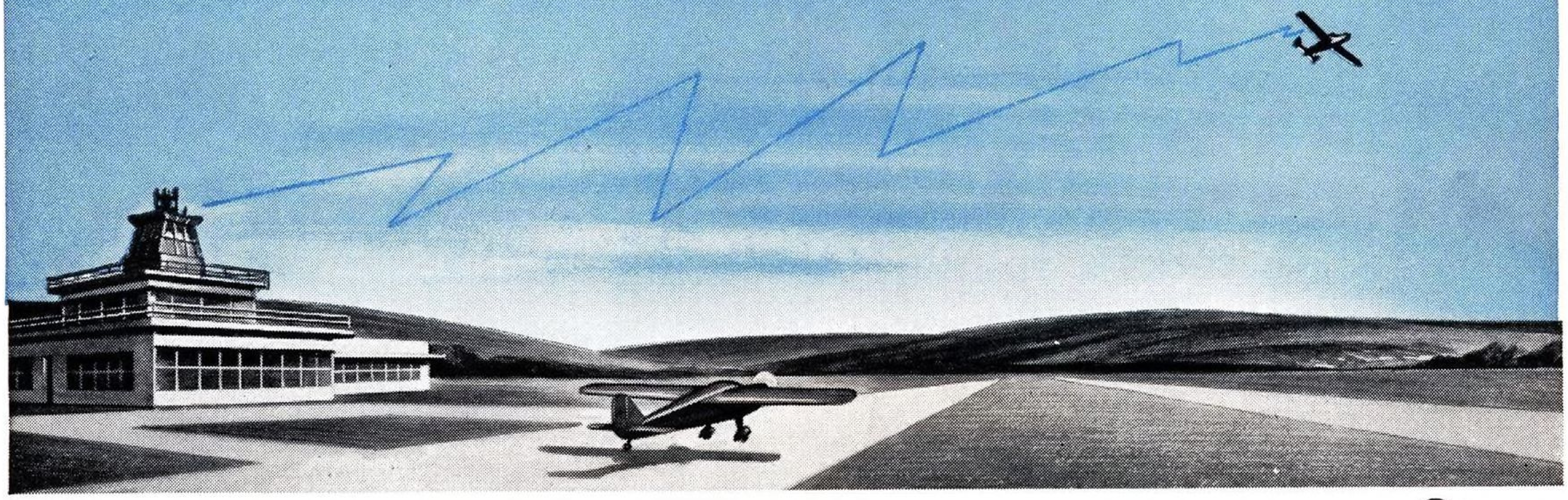

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