OCTOBER 1944
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AVIATION

The Oldest American Aeronautical Magazine

IN THIS ISSUE

RESEARCH FOR SECURITY
—Only continued development to keep air supremacy can maintain the peace.

★

MORE SMALL AIRPORTS
—Charles I. Stanton says we need double our present 3,000, mostly for personal flyers.

★

WHITE ELEPHANTS OR ASSETS?
—A practical plan to keep surplus plants working in the American way.

★

THE FOCKE-WULF 190
—Aviation's Design Analysis No. 9, written and illustrated right "on the spot."

★

IT'S A MAN'S JOB
—Termination's too important —and can be too costly—to be handled by any but key men.

★

FLYING TO LATIN AMERICA?
—Our southern neighbors will be good customers for both transport service and products —IF our thinking's right.

★

MAGNETO SERVICING
—Practical, illustrated procedure for getting and keeping maximum efficiency.

★

FOR BETTER DESIGN
—Our new feature gives more ideas for building and maintaining finer aircraft.

McGRAW-HILL
PUBLISHING COMPANY, INC.

Pratt & Whitney
Powers New Douglas Airliners

Faster and more convenient air travel came a step nearer last month when American Airlines, Pan American-Grace Airways and United Air Lines ordered fleets of new, big Douglas DC-4 and DC-6 transports.

Pratt & Whitney Twin Wasp and Double Wasp engines will power these fast four-engined airliners.

PRATT & WHITNEY AIRCRAFT
EAST HARTFORD, CONNECTICUT
ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION

Getting 'Em Back, INTO THE BLUE!

A FIGHTING plane or bomber *in the air* is one of our most potent weapons; *on the ground,* as a weapon of attack or defense, it is worthless. The air corps begrudges every minute that a plane is tied up for reconditioning or repairs.

That is why a quick-disconnect coupling, developed by Thompson and now being made in great quantities for aircraft engine builders, is such an important contribution. With this new coupling, no time is wasted in bleeding the many fluid lines when making repairs. Oil, gasoline and anti-freeze lines disconnect with a quick turn and seal automatically as they uncouple. Power units can be lifted out, repaired or replaced—and precious time saved in keeping planes fit to fight.

The Thompson quick-disconnect coupling is only one item among hundreds of different precision parts and accessories made by Thompson workers. In this—a mechanized war—these parts are needed for every type of military equipment that uses internal combustion power. Thompson workers have the satisfaction of knowing that they have a part—a vital part—in every battle, on land, sea, or in the air.

The Thompson quick-disconnect coupling, originally designed for aircraft, is being adapted to other military mechanisms that use internal combustion power. When peace comes its use will be broadened far beyond its present military applications.

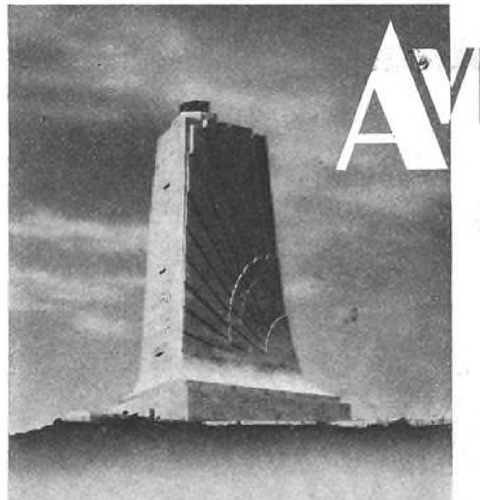


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MANUFACTURERS OF AUTOMOTIVE AND AIRCRAFT PARTS
GENERAL OFFICES: CLEVELAND. PLANTS IN OHIO,
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BEATING PRODUCTION SCHEDULES ON VITAL PARTS FOR PLANES, TANKS, SUBMARINES, PT BOATS, TORPEDOES, JEEPS, HALF-TRACKS, TRACTORS, AND TRUCKS



AVIATION

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Aviation is indexed in Guide to Periodical Literature and in Industrial Arts Index.

Until perpetual motion is here . . .



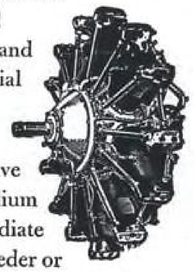
BUY MORE WAR BONDS!

"Until perpetual motion is here, gimme the Jacobs," says T/Sgt. Jinks. "I tended teakettles in this man's Army when they thought the JN-4 was a hot plane. I remember jobs that needed two hours in the shop for every one in the air. An' I'm here to tell you that this baby has fewer headaches and less hard work in it than any plane engine I ever met! You grease monkeys get a break because this outfit has Jacobs, and I want you to treat 'em right respectful—see?"

Technical Sergeant Jinks has almost as many hash marks as stripes and rockers on his sleeve. And when it comes to rating aircraft engines, his opinion is as good as they come.

Ground crews in training squadrons are powerfully partisan to the Jacobs. Three years ago, regulations specified 350 flight hours as the maximum service period between major overhauls. That period has been gradually extended to 1200 flight hours! And the Jacobs rarely leaves its nacelle between majors.

YET these Jacobs in the twin-engine trainers that school the bomber pilots, are handled by students, make more take-offs, spend more time at full throttle than any engine in combat service—or commercial operation!



This record of the Jacobs will stand the closest scrutiny of any commercial operation for low maintenance cost and dependable performance . . . After the war, Jacobs will also have new models for light planes and medium transports . . . well worth the immediate attention of plane manufacturers, feeder or freight line operators, private fliers . . . Jacobs Aircraft Engine Co., Pottstown, Pa.

JACOBS • **Pottstown, Pa.**

Briefing for October

Remember the old slogan, "Lest we forget?"—and how we did forget and practically starve the aviation industry? Unfortunately, the country could do the same thing again but, lest we forget, it takes research to guarantee national security. Maj. Gen. Follett Bradley and R. E. Gillmor, Sperry prexy, present on page 114 the strongest of cases for continuing—on a decent-sized scale—aeronautical research to keep America supreme in the air.

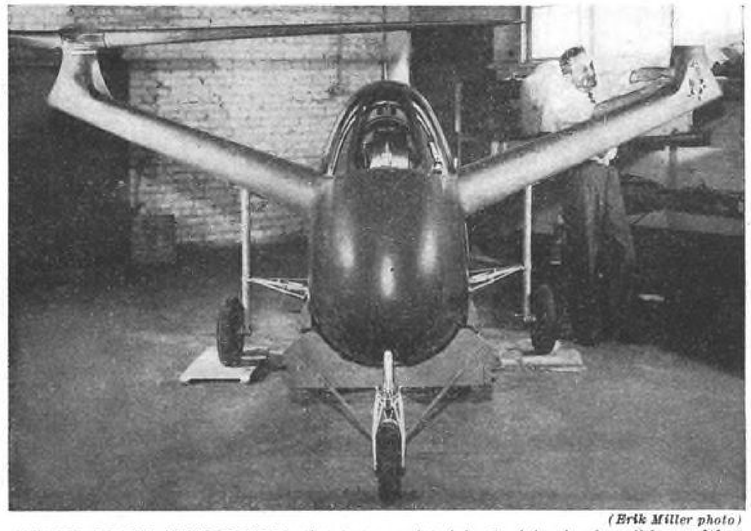
Charles I. Stanton, CAA Administrator, realizes perhaps as well as anyone else that this country can't develop a big personal plane-building industry if the planes haven't anywhere to go. And since no one would like more than he to see real numbers of personal planes built and sold, he has spoken up for plenty more airports—at least double our present 3,000. His ideas on this vital subject are presented on Page 118.

Assuming we have the airports, "How Will Postwar Planes Be Sold?" That's still the $64 marketing question. Veteran Jim Wales comes up this month with a good, solid article packed with the information that everyone concerned with sales will find of real value. It's in our regular Marketing section—see page 124.

Many of your letters have declared "AVIATION'S Design Analyses are great—but how about some on foreign planes?" Our answer is, "Definitely yes," for on page 127 you'll find the most complete study ever published on the Focke-Wulf 190, the Lutwaffe's toughest fighter. We're especially proud of this job on which Managing Editor Foster and Detroit Editor Ricker took typewriter and sketching pad right to the planes. (They had a whale of a time crawling all over, under, and inside not one but several 190's with calipers, measuring tapes, and a fistful of tools.) And right now we promise more such articles on top ranking enemy aircraft by this writing-illustrating team.

Will surplus war plants become white elephants or community assets? They can and should be assets, says Clinton R. Harrower (page 116). When traveling throughout Europe as Foreign Editor of the *Wall Street Journal*, this expert saw the successful fruition of an industrial experiment which, with "Americanizing" adapations, he feels can be used to create American jobs in the American way. As the article itself says, "it presents a challenge to the industrial and civic leadership of every warplant community."

W. J. Griffey, Senior Weight Engineer for Glenn L. Martin, maintains that traditional methods are most economical in calculating seacraft trim, draft, and lateral stability. In his article on page 159 he literally builds a flying boat by way of illustration.



(Erik Miller photo)

NEWEST OF THE HELICOPTERS is that just completed by Fred Landgraf, well-known West Coast designer, seen here putting final touches on the sleek little job, which is loaded with unusual design and construction features. AVIATION'S West Coast editor, Bill Nelson, has done the first complete engineering study of this new 'copter. You'll find it on page 186.

War has naturally speeded many engineering developments that will have plenty of non-combat uses. One of these is a new laminate for pressurized cabins which confines bullet—or other—shattering to a very small area. Beginning on page 153, G. M. Kuettel of the duPont plastics department, presents the first complete story of the development, together with data on design, attachment, tests, and strength factors.

Down the Years in AVIATION'S Log

25 Yr. Ago (1919)—British Air Ministry offers prizes of $20,000 and $50,000 for improved small and large seaplane designs . . . Lts. Killgore, Rugh, and Nelson fly first planes over Continental Divide at 16,000 ft. . . . NACA plans engine dynamometer test laboratory costing $15,000 . . . Lt.-Comdr. White and Lt. Barin break seaplane record, flying 270 mi. in 135 min. . . Chicago announces first U.S. air show ever to be held outside NYC . . . Maj. R. W. Schroeder breaks two-seat altitude record at 28,500 ft. in Liberty-engined LePere biplane. And Rohlfs, in Curtiss "Wasp" single seater, climbs to 34,610 ft. . . Caleb Bragg and Cole Younger make seaplane altitude record of 18,500 ft.

15 Yr. Ago (1929)—There are now 7,466 pilots and 6,432 mechanics licensed in U.S. . . Daily airline mileage for month is over 74,000 . . . Army balloon wins Gordon Bennett Race, traveling 348 mi. . . Dictionary admits "enplane" and "deplane" into American language . . . Lt. Doolittle takes off "blind", flies 15 mi., returns and lands in all-instrument demonstration . . . Aero Supply buys and equips plane as "flying sample case" . . . Moscow-N.Y. plane arrives in U.S. . . . Boston University opens aeronautics course for public school teachers . . Aeronautical engineering course at Iowa State College increases enrolments 35 percent . . . Army orders 90 high-speed Boeing pursuits . . . Australian Aero Club, with over 240 flying members, plans air tour.

10 Yr. Ago (1934)—Roscoe Turner wins Thompson Trophy Race at 248 mph. . . Navy XP2H-1 flying boat takes off weighing 43,000 lb. and flies at 140 mph. . . War Dept. assigns more flying officers to General Staff . . . Carriers *Enterprise* and *Yorktown* will each have 108 planes . . . AA uses new Vultee transports . . PAA places six new Douglas transport planes on its South American service.



THE KOLLSMAN TRUE AIRSPEED INDICATOR is a triumph of instrument-making skill, giving immediate dial indication of *true* airspeed and relieving the pilot or navigator of the task—and the hazard—of computing this vital factor in air navigation. This new Kollsman instrument combines airspeed indicator, altimeter and thermometer into one interacting assembly. By this means, indicated airspeed is continuously and automatically corrected for altitude, temperature and compressibility factor. True airspeed is read directly from its dial. In thus simplifying air navigation and ridding it of a source of possible error, Kollsman engineering makes another noteworthy contribution to aviation progress.

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GET YOUR "HOW TO FLY" BOOKLET

New booklet, "How to Fly a Piper Cub," covers the fundamentals of flying with over 50 step-by-step photos and descriptions. Many other facts, full-color pictures of Piper Cubs. Send 10c in stamps or coin for postage-handling. Write Piper Aircraft Corporation, Dept. A104, Lock Haven, Penna.

IS YOUR TOWN READY TO FLY?

It should plan landing facilities now—for its citizens and its future. The booklet, "What Your Town Needs for the Coming Air Age," illustrates various types. It covers benefits, where to build and how to start. For your free copy, write Piper Aircraft Corporation, Dept. A104W, Lock Haven, Pennsylvania.

16 mm. SOUND FILM—"The Construction of a Light Airplane." For distribution points write: Supervisor, Audio-Visual Aids, Extension Services, Pennsylvania State College, State College, Pennsylvania.

PIPER "PLANE QUIZ"

1. How long does it take to learn to fly a Piper Cub?
   8 hours instruction required before soloing.
2. How much will a peacetime Piper Cub cost?
   About the same as a medium-priced automobile.
3. How much gasoline and oil does a Piper Cub use?
   Less than the average automobile.
4. How much space does a Piper Cub need for landing or taking off?
   A strip about 100 feet wide and 1,800 feet long.

NOTE—These lessons obviously can explain only the fundamentals. See your Piper Cub dealer for actual flying instruction. Write us what "Plane Quiz" questions you would like answered.

PIPER AIRCRAFT CORPORATION—LOCK HAVEN, PENNA.

PIPER CUB

Points the Way to Wings for ALL Americans

GOODYEAR AIRCRAFT PRODUCTION REPORT



CONTRACTS: 76928 - LL91367

GRUMMAN TBF-1 (Avenger)

3,000 Sets, Empennages

DESIGN CONTRACT RECEIVED: *SEPTEMBER 1940*

FIRST PRODUCTION UNIT DELIVERED: *OCTOBER 1941*

100TH PRODUCTION UNIT DELIVERED: *MAY 1942*

CONTRACTS COMPLETED: *NOVEMBER 1943*

Remarks: Production history of these contracts includes detailed structural design prior to tooling and manufacture of entire empennage. Battle history of these carrier-based Navy fighters embraces epic achievements at Midway and Coral Sea; fighting testimony of sound construction and of Goodyear Aircraft Corporation's ability to deliver mass production of important components on rapid schedule.

Goodyear is building components for sixteen different Army-Navy types of aircraft, including complete Corsair fighters and airships.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AVIATION INDUSTRY

1. By constructing components to manufacturers' specifications.

2. By designing parts for all types of airplanes.

3. By re-engineering parts for mass production.

4. By building complete airplanes and airships.

5. By extending facilities of Goodyear research laboratories to aid the solution of any design or engineering problem.

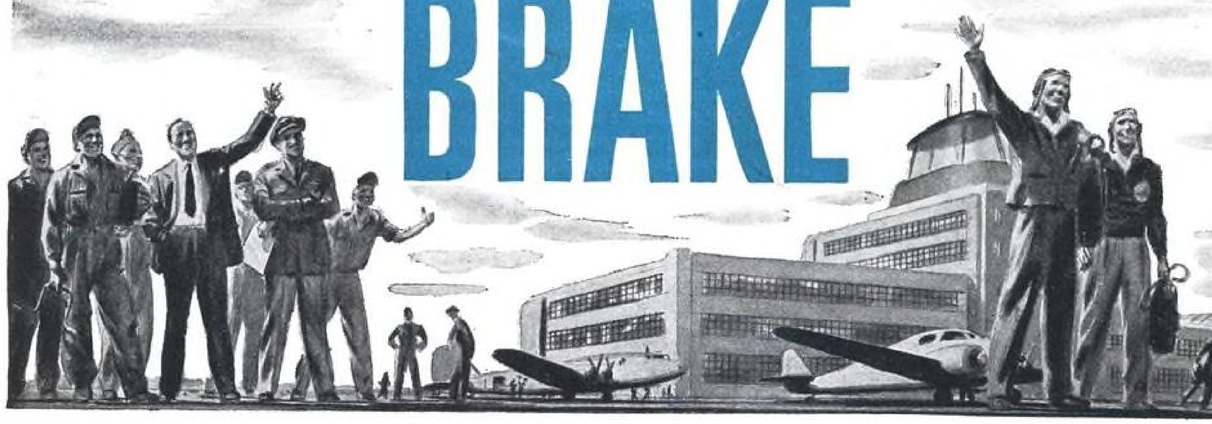
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A GREAT NAME IN AIRCRAFT

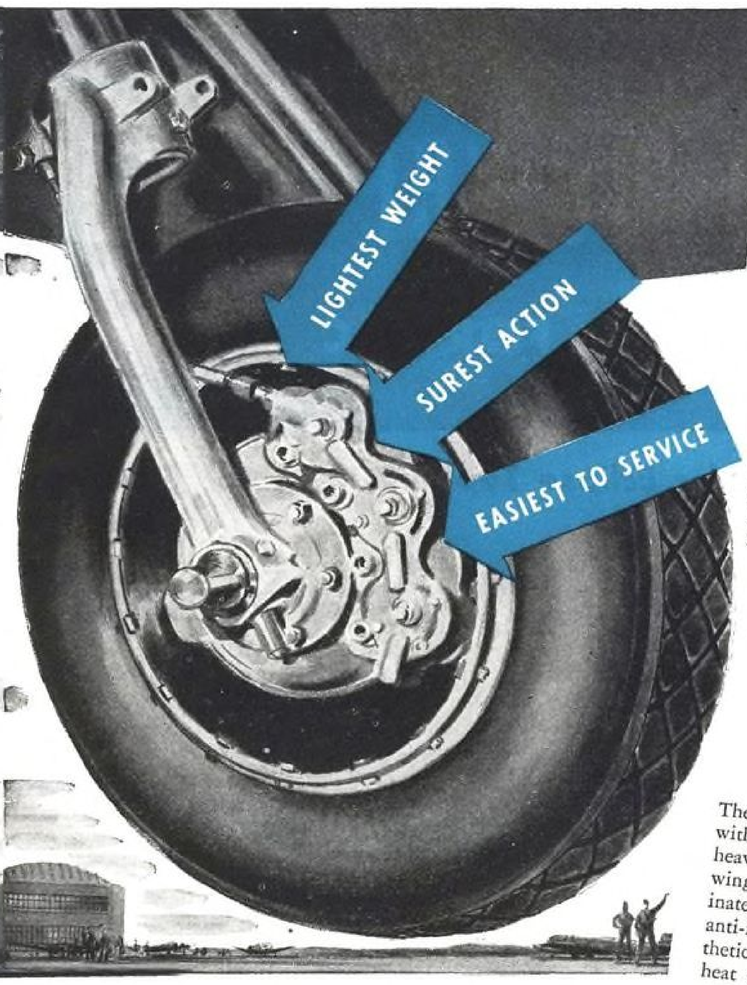
Akron, Ohio — Litchfield Park, Arizona

WAR BONDS BUY THE WINGS OF VICTORY

DESIGNERS, PILOTS, GROUND CREWS
ALL SAY "ROGER" TO THE NEW

SINGLE DISC BRAKE





There are solid reasons why Goodyear's stand-out new Single Disc Brake is winning quick acceptance on many types of ships — trainers, helicopters, medium bombers and transports and even larger aircraft. The men who build them, fly them and service them all like these features:

FROM THE DESIGNER'S ANGLE — It's the lightest, high-power brake: simple, compact assembly, fitted within magnesium wheel, makes for low weight unit.

Both hydraulic and mechanical types have been awarded Approved Type Certificates.

FROM THE PILOT'S ANGLE — It's the surest: large steel disc rotates between two rugged brake shoes, mounted in unique clamp which applies smooth, equalized pressure — with ample reserve power.

It's the coolest: brake disc mounted flush with wheel rim, exposed to slip stream, insures quicker heat dissipation, longer brake-lining life.

FROM THE SERVICE ANGLE — It's easy to install and it's the simplest: fewer parts than other brakes, less chance of failure. Simple exterior screw adjustment. Relining takes only a few minutes, requires no special tools.

FROM THE ENGINEERING ANGLE — Whether you should specify the new Goodyear Single Disc Brake or its famed companion Multiple Disc Brake depends upon the type of ship and its performance characteristics. Our engineers will be glad to consult with you in determining the proper choice.

GOODYEAR
THE GREATEST NAME IN RUBBER

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What's new in rubber for American aircraft



A NEW HIGH IN VIBRATION DAMPENING

Goodyear engine mounts are used on all types of aircraft from Flying Forts to light trainers. Lighter, simpler in construction, they hold down vibration below operational ranges, improve flight characteristics and instrument operation, make a steadier gunnery platform and lessen strain on crews.



IT "BOOTS" ICE OFF PROPS

The hazard of ice forming on propellers, with its attendant reduction in "air bite," heavier strain on engines and danger to wings from thrown chunks, is now eliminated positively by the new Goodyear anti-ice Propeller Boot. Made of synthetic rubber, specially compounded to heat electrically from small generator mounted in hub. Light weight!





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Backed by the resources of the finest laboratory in the industry, and more than 30 years' experience in developing airplane tires, tubes, wheels, brakes and other accessories, Goodyear engineers invite your consultation on any problem. Address: Goodyear, Aeronautics Dept., Akron 16, Ohio or Los Angeles 54, California.

BUY
WAR BONDS
BUY
FOR KEEPS

Aviation power supply systems

MOTOR GENERATORS FOR AC EQUIPMENTOPERATION

Design Check Chart for Eclipse Type †800 Motor Generators

APPLICATION

Eclipse Type 800 Motor Generators are designed to operate from the aircraft DC electrical system to provide a source of 800 cycle constant frequency alternating current independent of engine driven generators, for radio equipment and other AC accessory operation.

PERFORMANCE

Operation of the Motor Generator is fully automatic on closing the remote control switch.

An integral carbon pile voltage regulator maintains a constant AC supply at 115 volts over the entire rated operating range of the motor generator.

The performance rating of the Eclipse Type 800 Motor Generator is as follows:

	INPUT	*OUTPUT
Volts	28 DC	115 AC
Current-Amps	75	10.5
Power-Watts (AC)	—	1200
Power Factor	—	.9
Phase	—	Single
Frequency	—	800 cycles
Duty	—	continuous

**Output specifications shown are based on the use of a 17 mfd condenser in series with resistance load.*

DESIGN

The Type 800 is essentially a DC motor and alternator with rotors on a common shaft.

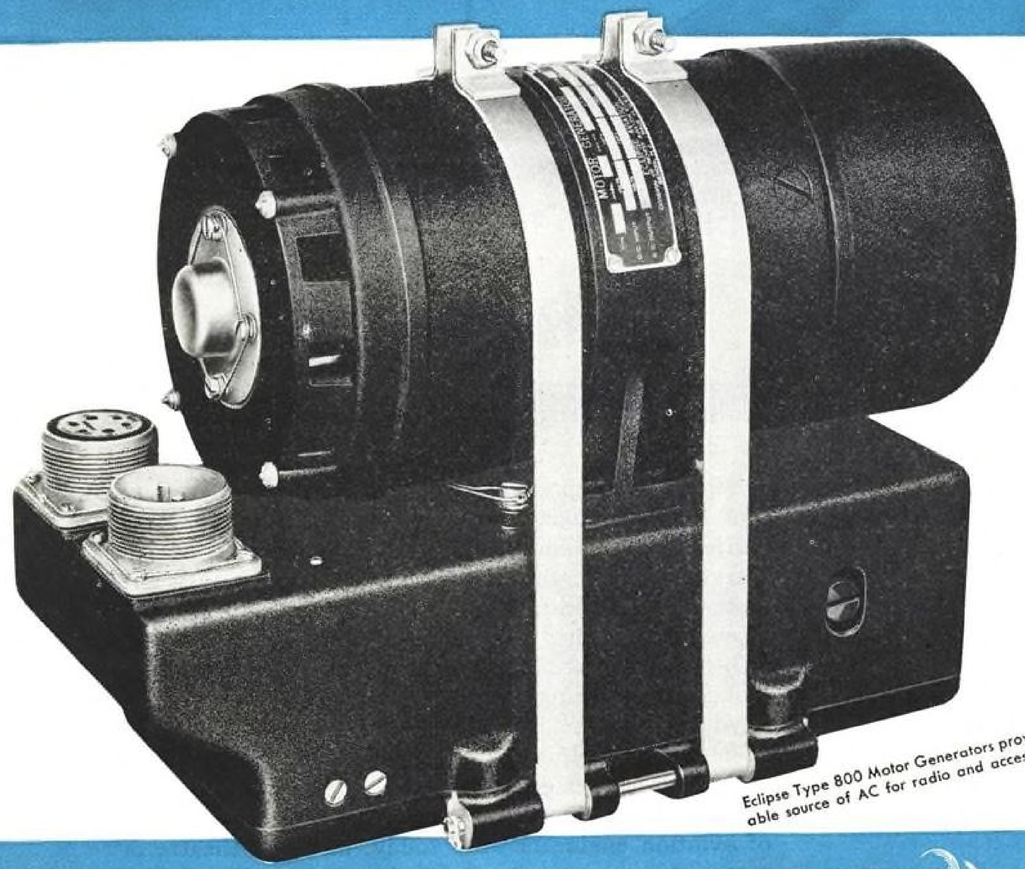
Rotating field inductor and stationary windings eliminate use of collector brushes.

Integral control box houses a carbon pile voltage regulator, solenoid starting switch, selenium rectifier and variable resistors.

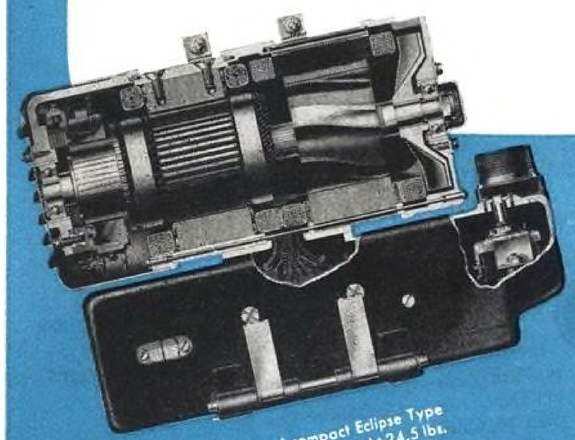
Compact, light weight, it measures 11 13/16" long, 8 1/32" high, 5 1/2" wide, and weighs 24.5 pounds.

★ Eclipse Creative Engineering and years of power supply development assure dependable AC Power Supply Systems. Let Eclipse Engineers recommend the power supply equipment for the postwar plane or the airplane undergoing reconversion.

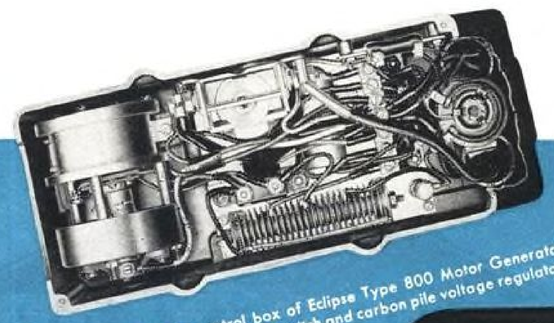
†*Available for Government War Emergency use only.*



Eclipse Type 800 Motor Generators provide a dependable source of AC for radio and accessory operation.



Sectional view of compact Eclipse Type 800 Motor Generators, weight 24.5 lbs.



View showing the control box of Eclipse Type 800 Motor Generator with integral solenoid starting switch and carbon pile voltage regulator.

Save His Life!
Give Blood to the Red Cross

THE INVISIBLE CREW Bendix Aviation Corporation

"ECLIPSE" AND "BENDIX" ARE TRADE-MARKS OF BENDIX AVIATION CORPORATION

Eclipse AVIATION ACCESSORIES

ECLIPSE-PIONEER DIVISION • TETERBORO, N. J. • LOS ANGELES 36, CALIFORNIA

BOEING B-29

"Superfortress"



"THE BATTLESHIP OF THE AIR"



is equipped with

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With a wing spread of over 140 feet and powered by four 2200 HP engines, the new Boeing "Superfortress" carries a heavier bomb load farther and faster, and with a greater service altitude, than any other military aircraft in the world. Now in quantity production by Boeing and other aircraft manufacturers, NORMA-HOFFMANN PRECISION BEARINGS are employed "where the bearings MUST NOT FAIL"—as they long have been in the Boeing "Flying Fortress" that has been making history on all the air fronts.

From the earliest days of aviation, NORMA-HOFFMANN PRECISION BEARINGS have enjoyed the confidence of aviation engineers. And today, in every theatre of war and in practically every American-built plane—for fighting, bombing, transport, patrol and training service—they are maintaining their reputation for reliability and high anti-friction performance.

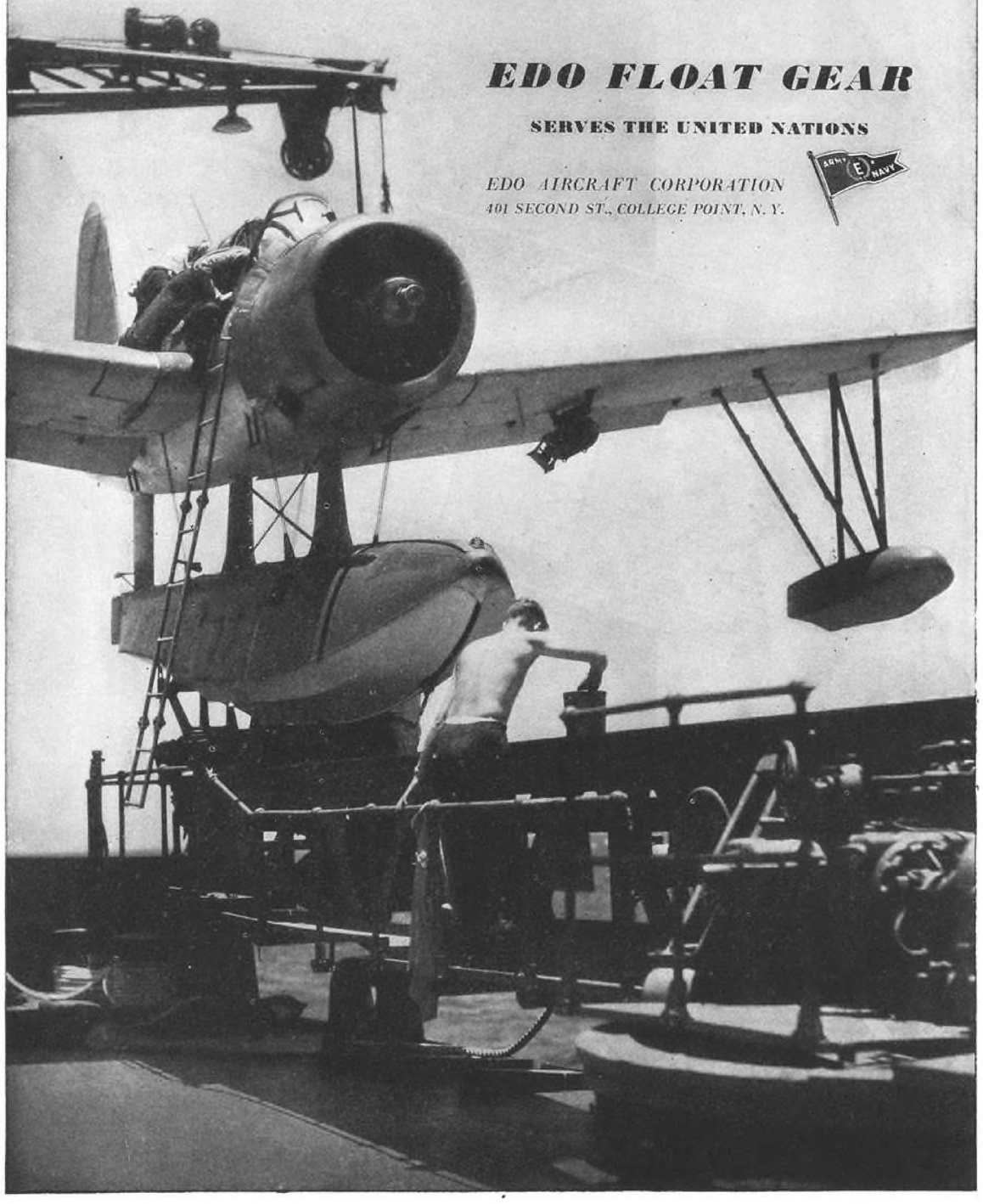
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TO WIN THE WAR: WORK—FIGHT—BUY WAR SAVINGS BONDS!

THIS IS THE SHIP... that has done the big job in scouting, spotting and rescue work at sea ... the Fleet's famed OS2U Kingfisher, Edo-equipped.



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Carpenter MATCHED TOOL STEELS

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The Standard Tool Steels of Industry

HERE'S ONE WAY TO CUT COSTS, REDUCE "DOWN" TIME AND INCREASE OUTPUT

. . . correct heat treating data safeguards your tool performance

Whether you get 100% tool performance or 10% tool performance may depend upon the final heat treatment. Since excessive costs, frequent machine shutdowns and decreased output can result from improper heat treatment, proper tool hardening is of utmost importance.

Carpenter has always made available to the tool designers and tool engineers complete information on the heat treatment of the Matched Tool Steels. The new Heat Treating Guide presents this information in handy slide chart form for your heat treaters ready reference.

The compact tabulation tells at a glance for each matched tool steel:

Type analysis
Forging heat
Normalizing heat
Annealing treatment
Hardening treatment
Recommended drawing range

It specifies definite temperatures and procedures. Operating tips are given on quenching, how to estimate oxidizing atmospheres, heating time and heating speed for drawing. Important information on the effect of drawing temperature on hardness is presented in a new manner which shows at a glance the hardness for different drawing temperatures.

All this information is available in this pocket size Heat Treating Guide. Every man responsible for the heat treatment of Carpenter Matched Tool Steels should have one. It will help get the best production results out of your tools by minimizing heat treating errors.

Just as the Carpenter Matched Set enables the tool steel user to get maximum results in the selection of the proper tool steel, the specific hardening data of the Heat Treating Guide enables the heat treater to get maximum hardening results. Just fill in the coupon and mail it to us or write on your company letterhead for your Heat Treating Guide. (Free to tool steel users in the U. S. A.)

THE CARPENTER STEEL COMPANY
128 W. Bern St., Reading, Penna.

Please send me free, and without obligation, the new Carpenter Tool Steel Heat Treating Guide.

NAME_____ TITLE_____

COMPANY_____

STREET_____

CITY_____ ZONE_____ STATE_____

(PLEASE PRINT)



Photo by American Airlines, Inc.

SPEED MAINTENANCE CLEANING the Kelite way!

A soak in KELITE SUPER KETREX speeds the cleaning of aircraft pistons and many other engine parts. SUPER KETREX penetrates and loosens sludge and carbon. It's a powerful, effective cleaner, yet is completely *safe* for aluminum, magnesium and ferrous metals.

KELITE PROTEXOL mixes with solvent like soap mixes with water, removes light oils, grease and soil by spraying or wiping. It is harmless to painted surfaces as well as all metals. KELITE KDL No. 28, a sudsy-solvent cleaner developed to wipe off exhaust stains, does this specialized job amazingly well.

KELITE REGAL REMOVER strips paint, lacquer, enamel and zinc chromate with surprising speed. KELITE REMOVER, an effective stripper, does not attack metals and will not raise the grain of wood to any marked degree.

KELITE KDL No. 1 speeds hot tank cleaning of aluminum and simplifies all subsequent operations on the processed parts by cleaning thoroughly and rinsing free. KDL No. 1 reaches a pH high enough for rapid cleaning, yet it is 100% safe on aluminum.

This combination of quick action with complete safety for the surface being cleaned is a feature of the specialized materials which KELITE has developed through the application of scientific pH Control to chemical processing and cleaning. It is one of the reasons why KELITE materials are the number one choice of the aircraft industry.

To speed up your maintenance cleaning the *safe*, *sure* way, take advantage of the materials and methods offered by your Kelite service engineer.

Chart Copyrighted 1942, Kelite Products Inc., 909 E. 60th St., Los Angeles 1.

KELITE

SCIENTIFIC CLEANING THROUGH pH CONTROL

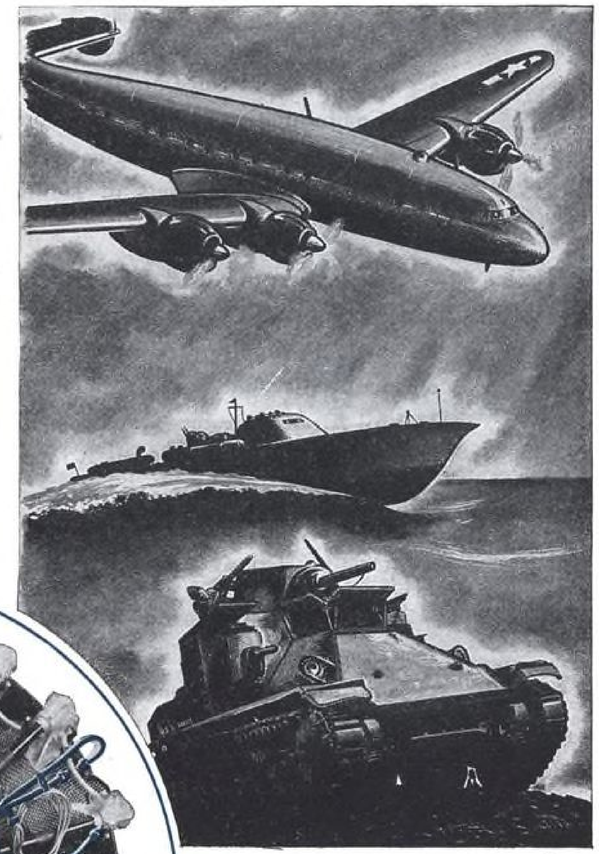
KELITE pH Control

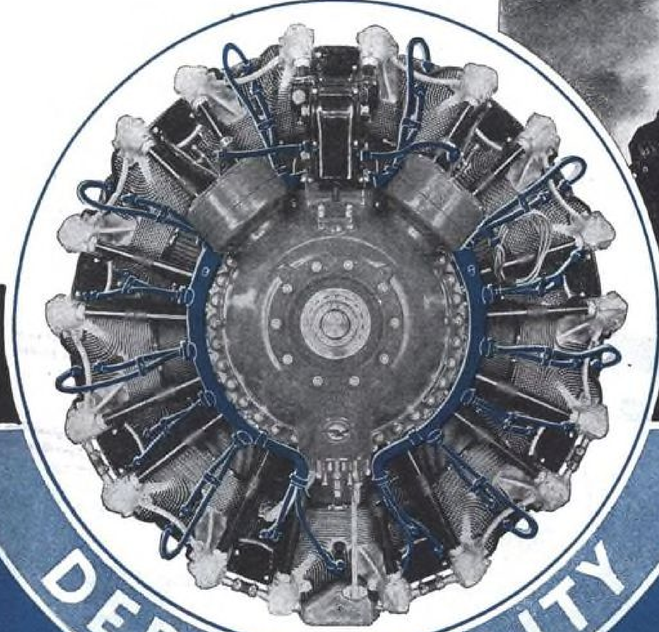
Mfg. Plants in LOS ANGELES, CHICAGO, PERTH AMBOY, HOUSTON
Branches in all Principal Cities.

BOLTON

RADIO SHIELDED IGNITION ASSEMBLIES *for* Combat Engines

B





BOLTON MFG. CORP'N
WEST HAVEN
CONN.

DEPENDABILITY

Maintenance and Service Engineering

● In recognition of the importance of service and maintenance programs, Surface Combustion maintains a large and growing staff of trained engineers for cooperation with all users of Janitrol Aircraft Heaters.

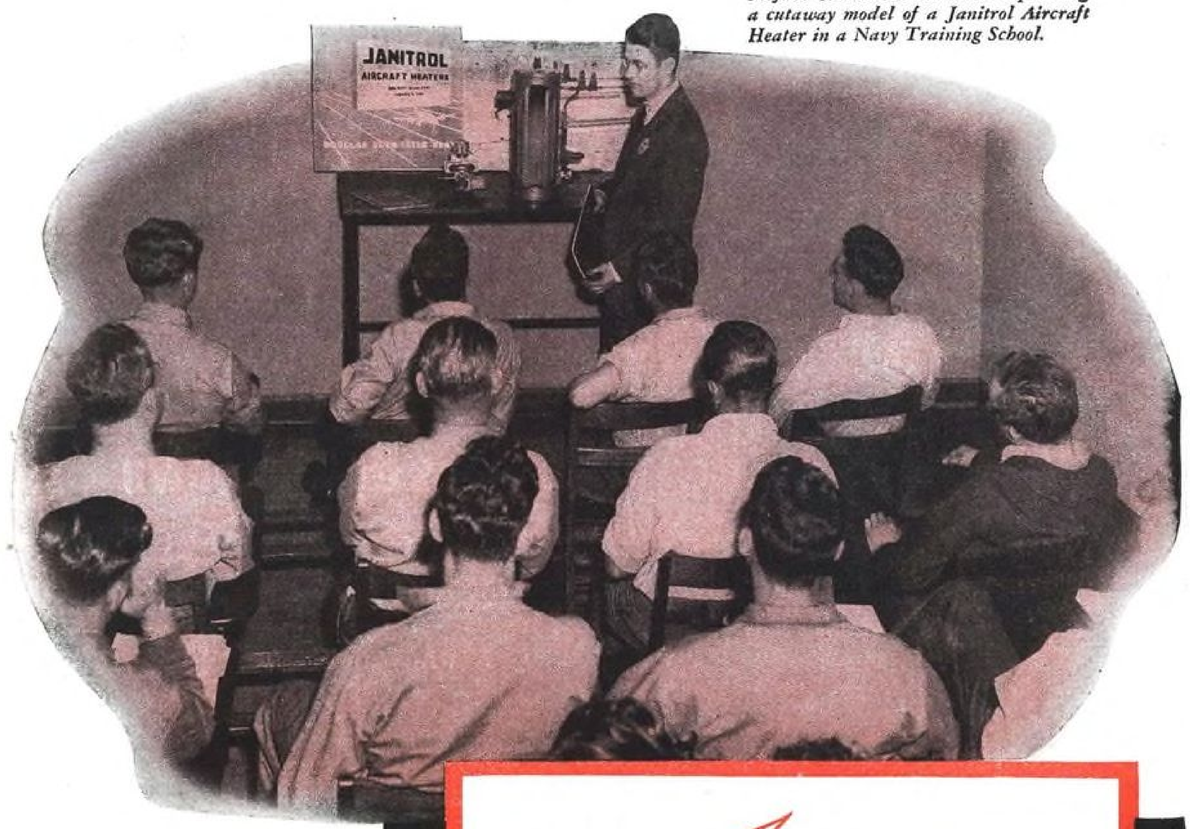
As one phase of this activity, comprehensive Army and Navy training courses to explain the simple operating and maintenance details of the Surface Combustion Janitrol Aircraft Heaters are now being held in our own plants as well as in aircraft manufacturers' plants and in many government and airline service centers and training stations.

This consistently expanding company service matches the rapidly growing use of Janitrol heaters in thousands of allied ships in all theaters of war. These heaters as well as the Janitrol Portable Ground Heaters operate on the "Whirling Flame" principle, which insures fast lighting at low temperatures, positive performance at all altitudes.

Equipment data sheets, service bulletins, engineering specifications, drawings, application data, service and instruction manuals, and general descriptive catalogs are available to officially approved users. Film strips, charts, mock-ups, and cutaway models of heaters and other classroom materials are also utilized in training programs.

These training aids and personnel are part of the service offered by Surface Combustion. Surface Combustion engineers will be glad to work with you on all heating problems for aircraft now being built or in the planning stages. Where possible it is advisable to consider the heating system at an early stage of planning. Write to Surface Combustion, Toledo 1, Ohio, Aircraft Heater Division.

Surface Combustion instructor explaining a cutaway model of a Janitrol Aircraft Heater in a Navy Training School.

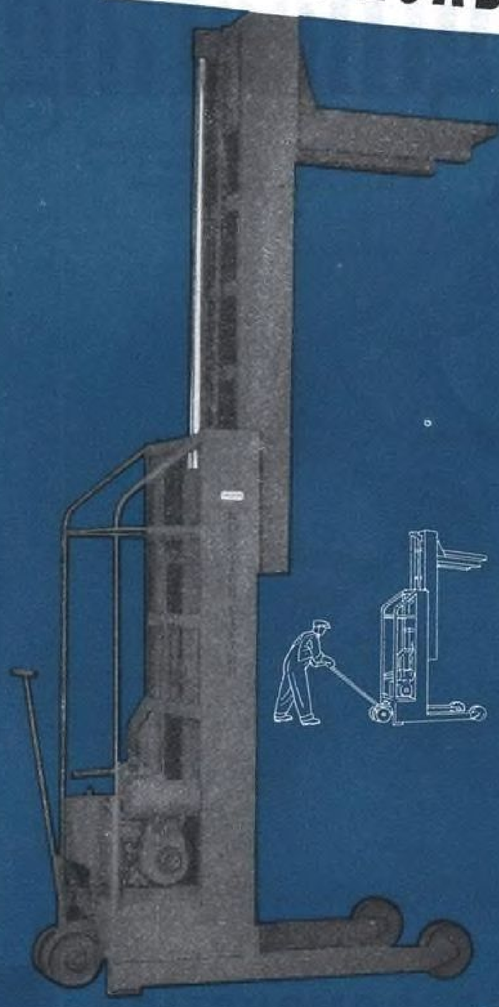


Official U. S. Navy photograph.



SURFACE COMBUSTION
Janitrol
AIRCRAFT HEATERS
with the whirling flame

LIFT A LOAD OFF YOUR MIND





A Table That Moves Up and Down

Moving assemblies or dies or other heavy units from one bench to another *and leveling off to the right* height is easy with a Service "Liftable." Lifts loads up to 5,000 lbs. up to 42" or down to 28". In several types in addition to the unit shown.

See Our Display at NEW YORK POWER SHOW Madison Square Gardens Nov. 27 to Dec. 2

A Lifter That Goes Anywhere

Have the time and work saving advantages of hydraulic lifting *even where power lines don't reach*. Use a Service Gas-Engine Lifter. Capacity, 1,000 or 2,000 lbs. Lift 8' 8". Lifting speed, 5 to 10 feet per minute. Special capacities and sizes built to order.

It's a load off a superintendent or manager's mind—and a load off workmen's backs—when the right type of lifting equipment is available. Is there lifting to be done away from power outlets? Or half-ton dies to be moved and raised to bench height? The two Service lifting units shown are ideal for those jobs. Read about them, remembering they are just two of the wide line of Service engineered-to-the-job units. Write for further information.

ARMY E NAVY

SERVICE

SERVICE CASTER & TRUCK DIVISION
OF DOMESTIC INDUSTRIES, INC.
510 N. Brownswood Avenue, Albion, Michigan
Eastern Factory: 428 Somerville Ave., Somerville (Boston) Mass.
Toronto, Canada: United Steel Corporation, Ltd., SC&T Co. Division

TRUCKS, CASTERS AND SPECIALLY DESIGNED LIFTING AND HAULING UNITS

PERFECTION
assured by quality control



You can be sure your wiring harnesses are okay--if Whitaker produces them

Skilled technicians, utilizing specially designed testing equipment, check every assembly produced by Whitaker. Hundreds of individual tests are made on some assemblies—and when passed by our experts, you can be sure the job is okay.

If your production needs include wiring harnessess, bonding jumpers, or cable assemblies—it will pay you to get in touch with us...Whitaker Cable Corporation, 1301 Burlington Ave., Kansas City 16, Mo. . . St. Joseph, Mo. . . Philadelphia . . Oakland.

WHITAKER

Cables, Wiring Harnesses and Assemblies for Automotive, Aircraft, Marine and Radio Equipment

METAL · MODERN · *Magnificent!*

You'll always eye your SILVAIRE pridefully. Gleaming, enduring metal, like today's rugged and victorious battleplanes. Built to fly comfortably, frequently, far. Designed to elicit envying regard. The SILVAIRE has been *proved* by wartime use in the C.A.A.-War Training Service, Civil Air Patrol, in the Armed Forces. It has had hard use the world over. It has long been *approved* by discriminating owners and pilots for its all-metal construction, efficient aerodynamic design, its beauty. Your SILVAIRE *will be improved* by our experience in fabricating warplane assemblies. It will again be styled to magnificence by America's top designers. And it is wisdom to enjoy its low depreciation and operating cost, its easy repairability, freedom from maintenance and high resale value. These less obvious excellences also further your long run pleasure in the possession of The Luscombe SILVAIRE.

WAR WORK for the duration is our business. Our job continues to be the production of such vital parts as tail assemblies, ammunition boxes, bomb bay doors, engine enclosures, gunners' seats, carburetor assemblies, machined parts and dozens of other elements for such famous war planes as are pictured here. *However, the War Production Board has released an ample supply of parts for the maintenance of the four-year pre-war production of* SILVAIRES *now in daily use.*



EASTERN TBM "Avenger"

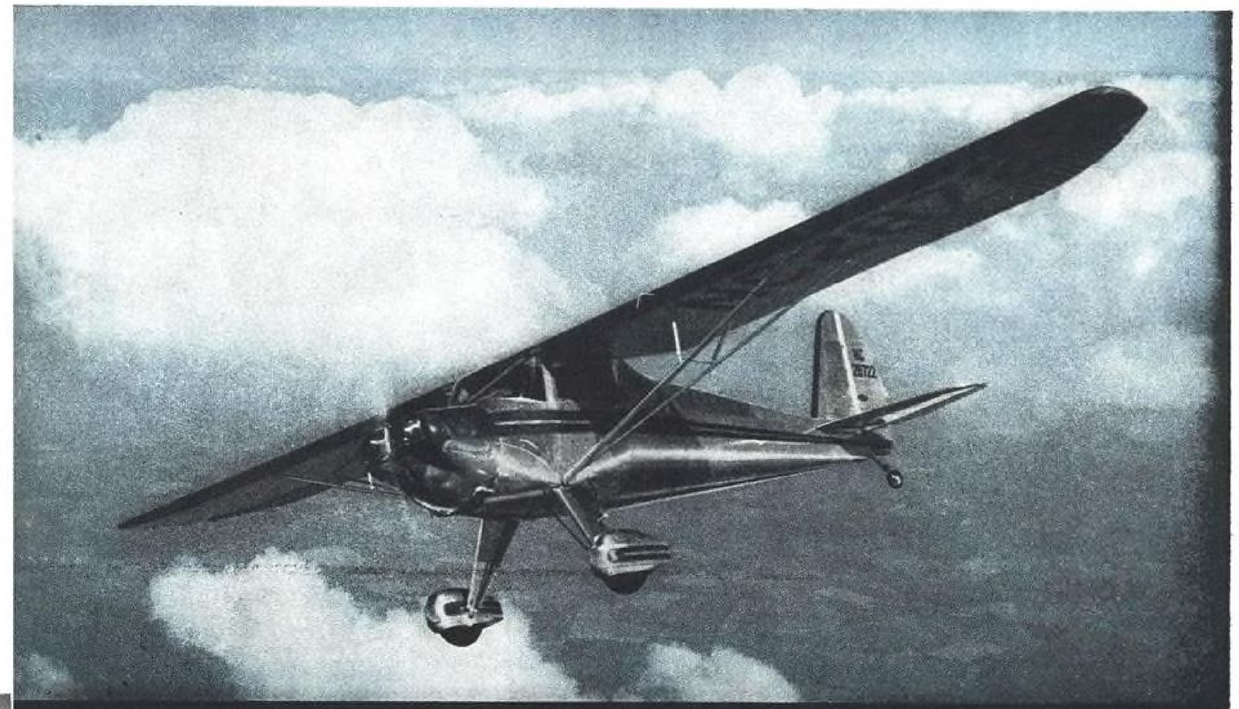


CURTISS C-46 "Commando"



GRUMMAN F6F "Hellcat"

These are a few of the planes for which Luscombe is fabricating metal assemblies.



The Luscombe SILVAIRE

YOURS WHEN THE WAR IS WON, the new and distinguished Luscombe SILVAIRE is the finished product derivative of a long line of all-metal planes . . . proved, improved, smartly styled. You are invited to write for full information NOW.

Please direct your inquiry to Department F

LUSCOMBE AIRPLANE CORPORATION

★ ★

Trenton 7, New Jersey

A CHANGE-OVER "MUST"...



"Cleaning and preserving of production equipment shall be accomplished with minimum delay after 'shut down'."

Army Service Forces Bulletin, P.S. No. 300

AS Government contracts are terminated, millions of dollars worth of idle Government and privately-owned machinery, precision tools, and other production equipment will have to be promptly protected against damaging rust for periods ranging from weeks to years.

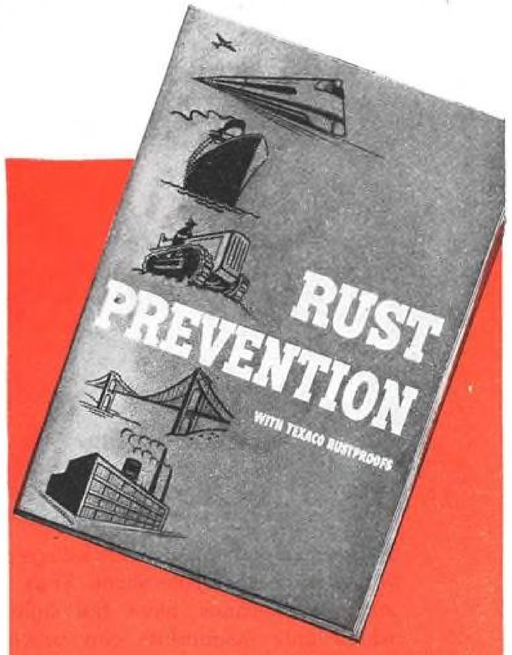
That is why *Texaco Rustproof Compounds* and other Texaco rust preventives should be available for prompt use when change-over time arrives. These effective products meet Government specifications for exterior and interior application, and are available for immediate delivery. By ordering NOW you will eliminate possible last-minute delays and disappointments.

For exterior application, *Texaco Rustproof Compounds* provide penetrating, self-sealing films which are not only waterproof but highly resistant to chemicals and fumes. Easily applied with brush or spray gun, they remain soft, healing over any scratches and abrasions. *Texaco Rustproof Compounds* are long lasting and very economical.

In many cases where rusting already exists, costly chipping and scaling is eliminated because *Texaco Rustproof Compounds* penetrate and loosen the scale so thoroughly that removal is greatly facilitated.

Texaco Rustproof Compounds have proven highly successful in protecting all types of parts and equipment from weather and salt water in overseas shipments.

Texaco Lubrication Engineering Service and Texaco Products for *interior* and *exterior* rustproofing are available to you through more than 2300 Texaco distributing points in the 48 States. The Texas Company, 135 East 42nd St., New York, 17, N. Y.



FREE! Send for this 36-page booklet today. Tells *how* Texaco Rustproof Compounds prevent rust, *where* and *how* to apply them and *why* they are so successful. A single suggestion in this booklet may save thousands of dollars.

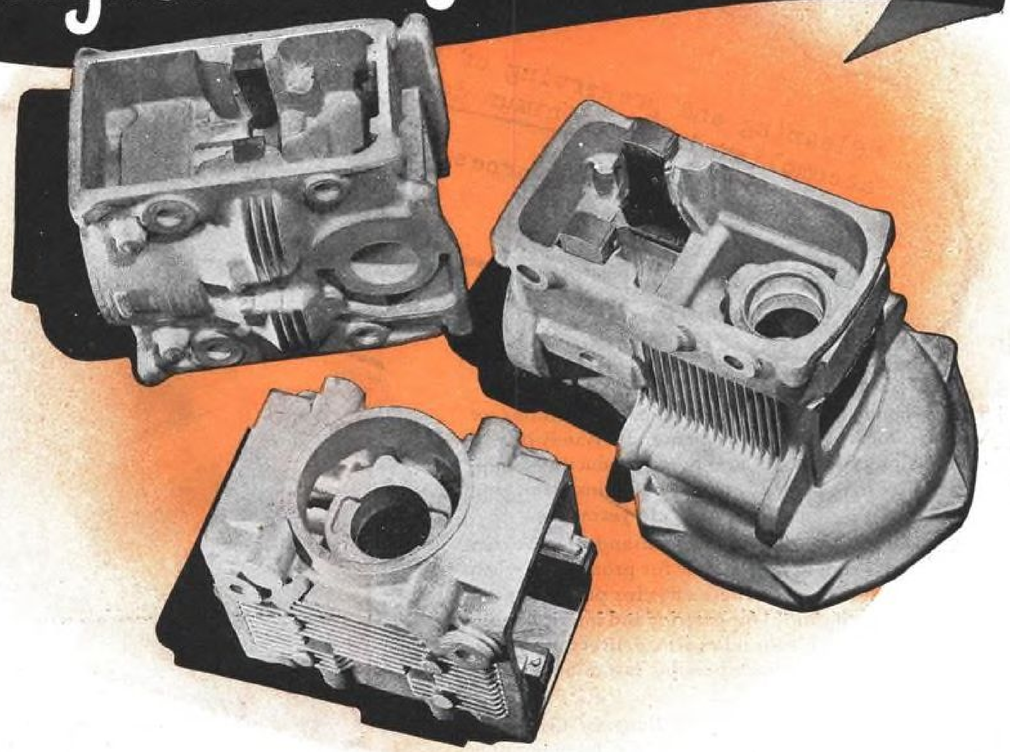
TEXACO

TEXACO Rustproofing Products

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT—CBS

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

Magnetic Magnesium? *No, but..*



Magnesium permanent-mold castings are made with cast-in steel pole shoes. Thus, airplane magneto housings have the light weight which only magnesium can provide, plus steel's magnetic qualities.

Inserts of other metals, when required, are but one of the advantages offered by Mazlo Magnesium permanent-mold castings. Surfaces are smoother than sand castings and grain structures finer. Dimensional tolerances are closer; parts can have thinner walls. Less metal to machine away, resulting in lower fabricating costs.

Consider the use of permanent-mold castings where quantities are sufficient to warrant the making of molds. Magnesium is now available to manufacturers of other-than-war products, upon WPB approval.

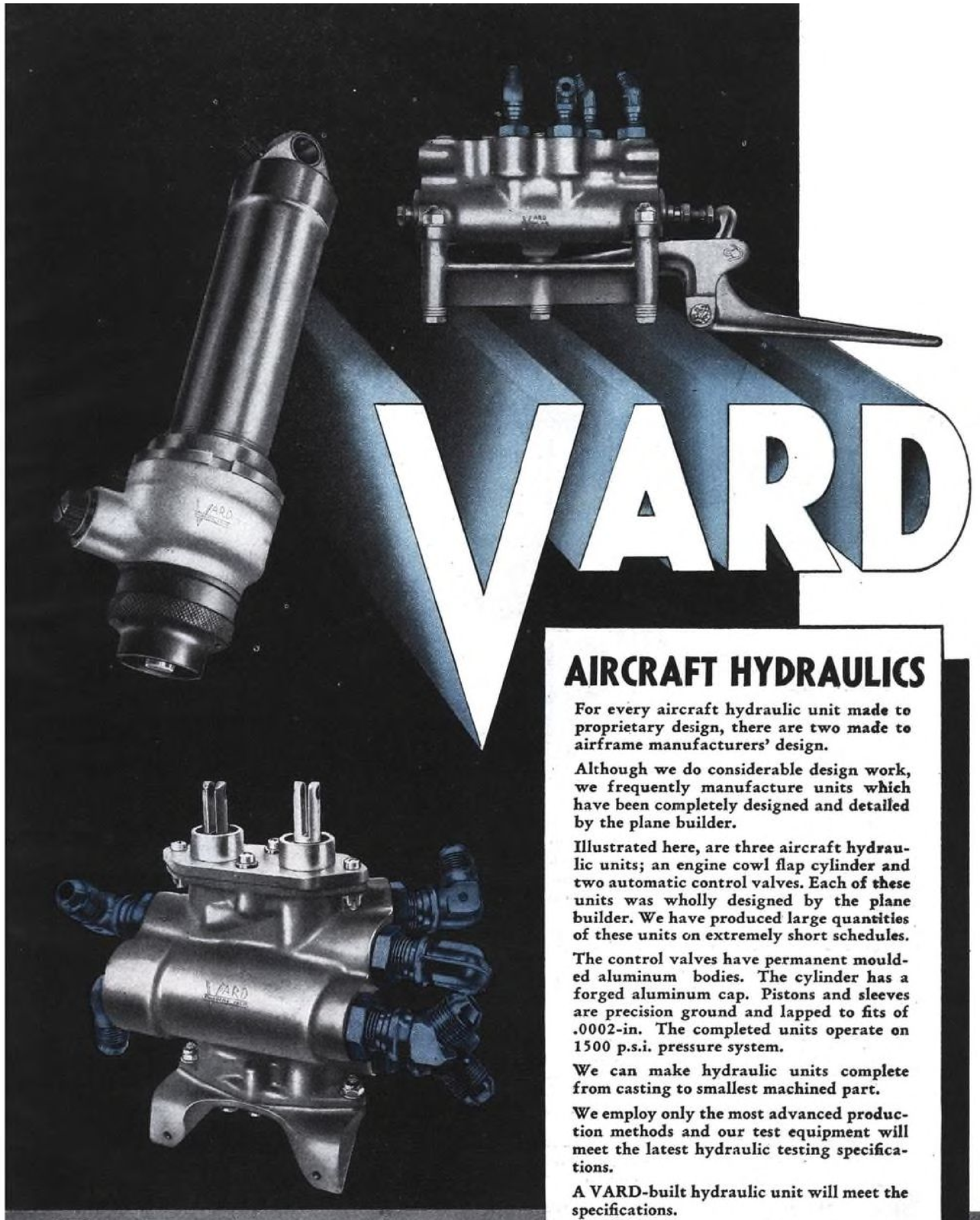
American Magnesium Corporation can take care of your requirements for permanent-mold die and sand castings, forgings, extruded shapes and sheet. For information on the availability of magnesium products, call the nearest office of Aluminum Company of America (Sales Agent for Mazlo Magnesium Products) 1713 Gulf Bldg., Pittsburgh 19, Pa.

MAGNESIUM MAZLO PRODUCTS

REG. U.S. PAT. OFF.

AMERICAN MAGNESIUM CORPORATION

SUBSIDIARY OF ALUMINUM COMPANY OF AMERICA



VARD

AIRCRAFT HYDRAULICS

For every aircraft hydraulic unit made to proprietary design, there are two made to airframe manufacturers' design.

Although we do considerable design work, we frequently manufacture units which have been completely designed and detailed by the plane builder.

Illustrated here, are three aircraft hydraulic units; an engine cowl flap cylinder and two automatic control valves. Each of these units was wholly designed by the plane builder. We have produced large quantities of these units on extremely short schedules.

The control valves have permanent moulded aluminum bodies. The cylinder has a forged aluminum cap. Pistons and sleeves are precision ground and lapped to fits of .0002-in. The completed units operate on 1500 p.s.i. pressure system.

We can make hydraulic units complete from casting to smallest machined part.

We employ only the most advanced production methods and our test equipment will meet the latest hydraulic testing specifications.

A VARD-built hydraulic unit will meet the specifications.

ARMY-NAVY E

VARD INC. PASADENA 8, CALIF.

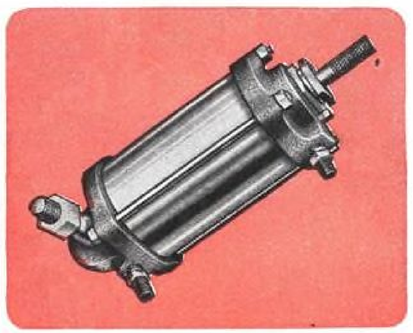


Air, controlled and at work puts the "sock" in a windsock. Compressed air, Schrader-controlled, puts a "sock" into industrial operations, makes shorter, easier, safer work of them.

Schrader Air Controls cut costs, save time and labor by reducing or eliminating tiring and hazardous muscular operations. Using thrifty controlled intermittent air blasts instead of wasteful continuous flow, Schrader controls also enable you to enjoy the advantages of Schrader devices without—in many cases—adding to your existing compressor capacity.

The first cost of Schrader Air Controls and devices is so small and the return on the investment so consistently high that you can hardly afford to risk a return to reconversion production schedules and costs without serious consideration of them.

A highly practical example of Schrader air devices is the Schrader Air Cylinder, an air "muscle" with a thousand uses. Schrader Air Cylinders do tough, tiring, lifting, lowering, pushing or pulling jobs better, faster and cheaper than they can be done manually.



THERE ARE HUNDREDS OF USES for Schrader Air Cylinders. Cost very little. Easy to install and operate with Schrader Control Valves. Many types, single or double-acting, and in a variety of lengths, diameters and mountings for every purpose.

Send for the new Air Cylinder Bulletin A-8H and see the many Cylinders, Operating Valves, etc., you can use to save the time and energy of your workers.



Air Valves 2, 3, 4-way • Blow Guns • Machine Operating Air Controls • Quick-acting Couplers • Safety Operating Controls • Air Ejection Sets • Hydraulic Gauges

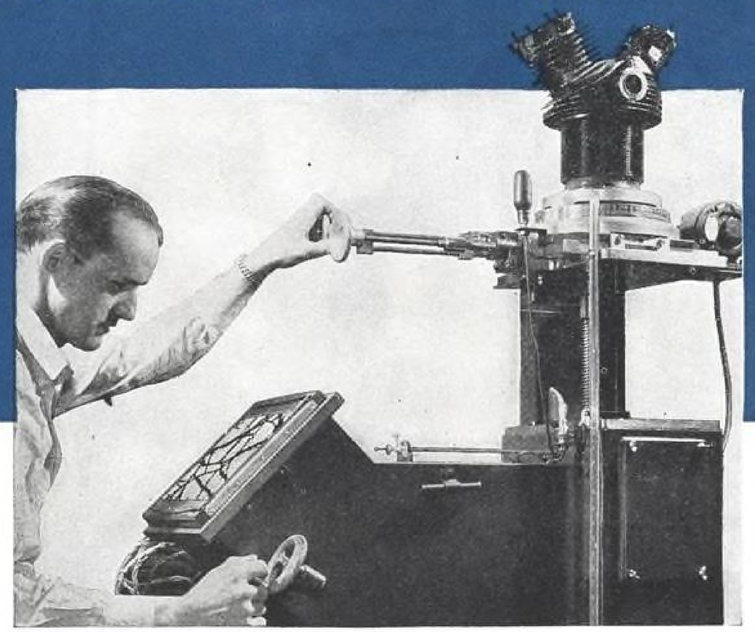
Schrader
REG. U.S. PAT. OFF.
CONTROLS THE AIR

MADE BY THE MAKERS OF SCHRADER TIRE VALVES AND GAUGES

A. SCHRADER'S SON, *Division of Scovill Manufacturing Company, Incorporated,* **BROOKLYN, NEW YORK**

PORUS-KROME*

the precision application of chromium



Every step in the production of PORUS-KROME is a precision operation . . . and each one is carefully checked. Each operation adds its peculiar influence to the characteristics of the finished product.

So important are the surface characteristics of PORUS-KROME that it requires precision optical instruments like the recording internal viewing machine shown above to adequately check them.

The percentage of porosity and its uniform distribution are particularly important in cylinders for airplanes . . . where piston speeds, brake mean effective pressures, and temperatures are high.

Van der Horst personnel are specially trained and thoroughly experienced in this precision work through having processed thousands upon thousands of cylinders, both Diesel and gasoline, for the Army and Navy in the past four years.

Let PORUS-KROME give greater reliability and longer cylinder life to *your* engines. Write for full information.

PORUS - KROME

Good for the Life of your Engines

VAN DER HORST
U. S. PATENTS 2,048,178 AND 2,324,604

VAN DER HORST CORPORATION OF AMERICA OLEAN • NEW YORK CLEVELAND 11 • OHIO
AN AFFILIATE OF DRESSER INDUSTRIES

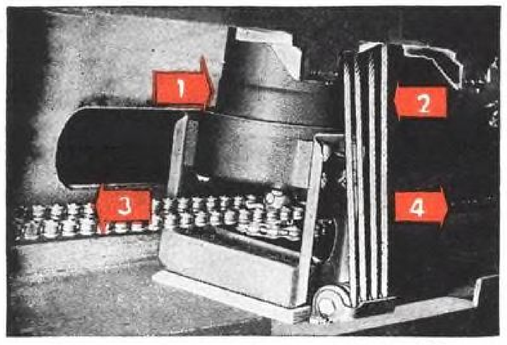


"EASY, JOE!"



Cadets setting her down easy for a first solo landing are really "sweating it out" on a test they anticipate with apprehension and look back on with relief! Once past this test they feel they are "on their way", but they still face hours of landing practice to perfect this fundamental, though all-important operation. Constant landing imposes a greater workload on the wing flaps, or air-brakes of trainer planes than they ever receive on other plane types—and each wing flap part must be designed to take this extra strain.

The Dumore Wing Flap Motor designed for the Cessna AT 17 Bobcat bomber trainer is an example of a part designed for service "beyond the normal call of duty". It does the job. The basic Dumore motor has been distinguished for a quarter-century by quality construction and dependable performance. Special features, such as drive or control elements, enclosures and protective devices, have been developed by Dumore engineers to meet the specific requirements of individual aircraft applications. These features combine with a basic motor to comprise a well-coordinated, compact, efficient power unit. Bearing, lubrication and commutation are conditioned to assure reliable operation at all flying levels and over a temperature range of—65° to 160° F. Unified responsibility, simplified assembly and service, and more efficient operation are among the advantages offered builders and operators alike. Dumore engineers will gladly aid you to apply Dumore Motors to your designs. Ask for the Aeromotor Catalog, with full specifications and engineering data—write today to The Dumore Company, Motor Division, Dept. MK15, Racine, Wisconsin.



1. Dumore Wing Flap Aeromotor
2. Rudder Cables
3. To Left Wing Flap
4. To Right Wing Flap

DUMORE WING FLAP MOTOR, E1Y1P

Illustration shows the motor, mounted in the center of the fuselage of a Cessna AT17 Bobcat, driving the wing flap mechanism through roller chains. Impregnated, sintered iron reduction gears are self-lubricating at temperatures down to—65° F. Ball bearings lubricated with grease approved for similar low temperatures. Totally enclosed, and supplied with AN connector. Can be furnished with built-in magnetic clutches and brakes.

FOR *Extra* POWER HOURS

DUMORE

HEADQUARTERS FOR FRACTIONAL HORSEPOWER MOTORS



LIGHT WEIGHT

Is An Outstanding Advantage of

RBC NEEDLE BEARINGS

Here is a very significant factor for consideration in your post-war planning. The large-capacity light-weight ratio of R B C CYCLOPS and 20TH CENTURY NEEDLE BEARINGS meets the needs of the design engineer at the most critical point.

Since these bearings are designed for minimum overall dimensions and maximum carrying capacity, this light weight feature is extremely important in such applications as drills, spindles and all kinds of modern portable and stationary equipment.

Illustrated above is the high-capacity light-weight R B C CYCLOPS NEEDLE BEARING. Left hand illustration shows the bearing equipped with solid inner race. Right hand illustrates bearing as used in equipment where it is possible to harden the shaft. No inner race is necessary.

R B C's ENGINEERING STAFF WILL HELP YOU IN SELECTING THE RIGHT BEARING, AND IN FOLLOWING OUT THE CORRECT BEARING PROCEDURE. LET US KNOW YOUR PROBLEMS.

ROLLER BEARING CO. OF AMERICA
TRENTON, NEW JERSEY



Many a paratrooper learned years ago on the football field, that it takes teamwork to make touchdowns. That's one of the reasons for the spectacular successes scored by our Airborne Troops.

For although each paratrooper is a highly trained and skilled specialist with a definite and predetermined objective, all men in each unit work together as a team. That goes for their fighter plane escort as well. Each pilot is part of a protective team. All have a part in advancing the ball.

And that's equally true of America's aircraft industry. Individual company research, engineering, design, manufacturing and production techniques, testing methods, plant facilities, personnel, and specialized skills have been pooled into one great team—to work together to produce more planes and better planes—to hasten Victory.

At McDonnell, in addition to making planes and plastics for war, it has been our privilege to contribute substantially to the success of some of America's outstanding planes, through the fabrication of vital parts and assemblies.

To mention only two—we have finished many, many thousands of *empennages*—complete tail assemblies—for that dependable work horse of the war, the twin motored Douglas ship known in its various versions as the C-53 Troop Carrier, the Navy RD4, and the C-47 Cargo Carrier—and many more thousands of *anti-drag ring cowls* for the famous Douglas A-20 Attack Bomber.

Other equally noteworthy production contracts on parts and assemblies are being executed—as well as research and development projects for the Army and Navy. Aircraft of our own design and manufacture represent another important phase of our activities—but for reasons of security, details concerning these projects cannot be disclosed at this time.

But until Victory comes—we're glad to work as part of a winning team—with Uncle Sam calling the signals.

McDONNELL *Aircraft Corporation*

Manufacturers of PLANES · PARTS · PLASTICS ★ SAINT LOUIS - MEMPHIS ★

Delco Radio Products *Mean Dependability*

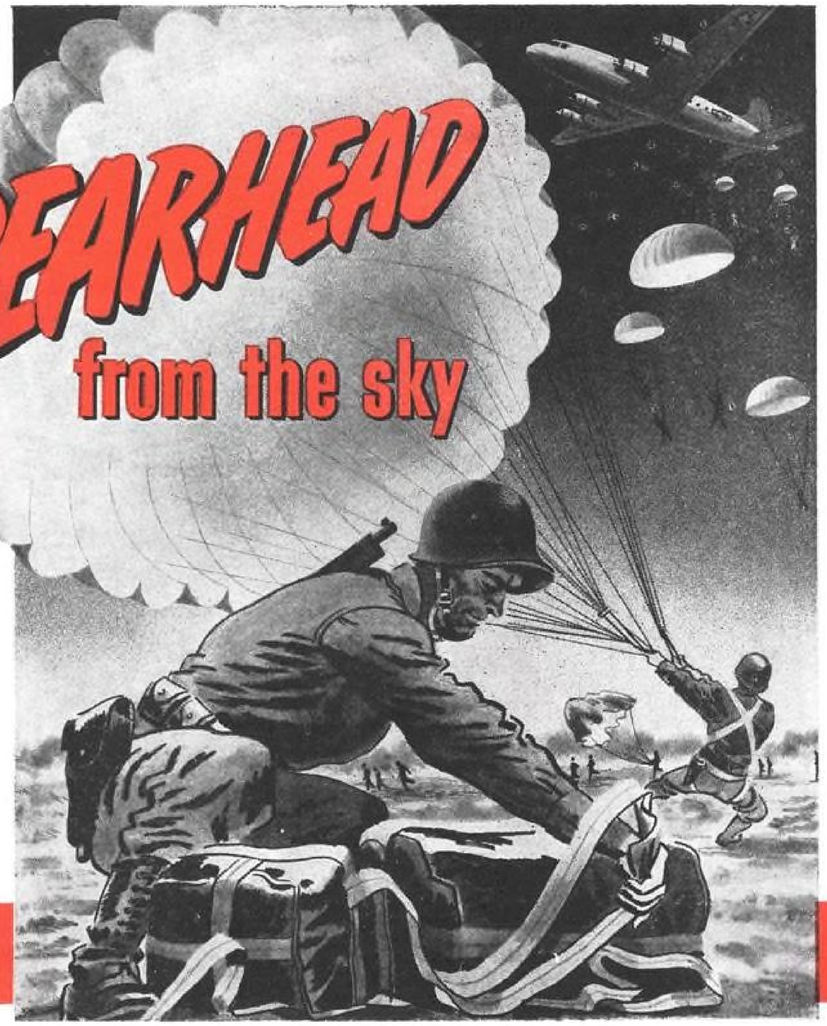


All over the world Delco Radio products are in useful service. They prove daily that the name Delco Radio means dependability . . . dependable designs developed with care and imagination; dependable products built with craftsmanship and skill. In radio and electronic equipment, the name Delco Radio stands for engineering vision—manufacturing precision.

MAKE YOUR DOLLARS FIGHT—BUY MORE WAR BONDS

Delco Radio
DIVISION OF
GENERAL MOTORS

SPEARHEAD from the sky



BACK THE ATTACK
WITH
WAR BONDS

Bedlam begins for the enemy. The silent spearhead has struck—according to plan.

Wire and cable have helped carry out that plan . . . wire that helps send and receive messages on the inter-com. . . . wire and cable for ignition, for lights and for instruments that help keep troop and supply ships on split-second schedule.

Information on Auto-Lite aircraft wire and cable should be in your files. Form No. 838 covers low tension wire and cable. Form No. C-503 gives complete details about Steelductor, the high tension wire that is famous for better performance, and economy. A request on your letterhead will bring both Bulletins.



THE ELECTRIC AUTO-LITE COMPANY
Wire & Cable Division

SARNIA, ONTARIO — PORT HURON, MICH.

AUTO-LITE *AIRCRAFT* **WIRE and CABLE**

TUNE IN "EVERYTHING FOR THE BOYS" STARRING DICK HAYMES—EVERY TUESDAY NIGHT—NBC NETWORK



EVERY *Logan* LATHE GETS THIS FINAL INSPECTION

The outstanding performance of Logan Lathes in sustained accuracy and speed results from the exacting care that goes into every detail of construction. In the final inspection, a point-by-point check of the entire machine assures a completed assembly ready for production service. Of equal importance, all individual parts and all sub-assemblies are thoroughly tested as they are manufactured to prevent incorporation in the machine of any part not up to standard. The rigorous checking of parts, sub-assemblies, and the final inspection, strictly control the consistent accuracy and quality characteristics of Logan Lathes. Ask your nearby Logan Lathe dealer, or write for latest catalog describing all models of Logan Lathes.

Logan LOGAN ENGINEERING CO.
CHICAGO 30, ILLINOIS
A NAME TO REMEMBER WHEN YOU THINK OF LATHES



A 16-inch diameter shaft seal, for a secret military application.



1/16" Shaft diam.

WHEREVER there is a rotating shaft that must be sealed against the escape of gas, air or liquid—there is a Sylphon Shaft Seal to meet the individual requirements. Compressors, pumps, washing machines, hydraulic transmissions and a host of similar applications have conclusively demonstrated the unique advantages of Sylphon Shaft Seals.

A Sylphon Shaft Seal, properly installed, rarely requires any further attention. The seal nose is machined to "thousandth-of-an-inch" tolerance, and the heart of the seal is the Sylphon Bellows . . . positive assurance of perfect, trouble-free sealing.

Friction loss is reduced to a minimum by using anti-friction metals such as leaded bronze, oil impregnated porous bronze and graphited bearing bronze.

A wide variety of types and sizes are available, and many applications have been made to machines originally designed to carry other types of seals.

Investigate Sylphon Shaft Seals. Send for Bulletin TA-825.

• • •

SIZES—Sylphon Shaft Seals have been made in sizes from 1/16" to 16" shaft diameter.

PRESSURES—Correct engineering, accurate machining and careful balance produce a perfect seal against any pressure up to hundreds of pounds, with a minimum of friction.

SPEEDS—Generally used for shaft speeds up to 400 RPM, but successful at much higher speeds.

CORROSION—Highly resistant to fluids and gases which affect ordinary packing materials.

FULTON SYLPHON



TEMPERATURE CONTROLS
BELLOWS . . . BELLOWS ASSEMBLIES

THE FULTON SYLPHON CO., KNOXVILLE 4, TENNESSEE
Canadian Representatives, Darling Brothers, Montreal

...TOOK AWAY ONE *and* DOUBLED *the* MARGIN of SAFETY

New G-E high-tension ignition system reduces number of units from three to two—gives the added protection of two magnetos—and doesn't require supercharging

Skilled pilots who've nursed battered planes back across the Channel warmly praise the combat "staying power" of American aircraft. One thing now contributing to this stamina is the G-E high-tension ignition system, in which the functions of magneto and distributor have been *combined* into a single, integral unit.

Two of these units replace the three—one magneto and two distributors—found in most coventional systems. Since each magneto is capable of keeping all cylinders firing, both must be put out of action before the engine quits.

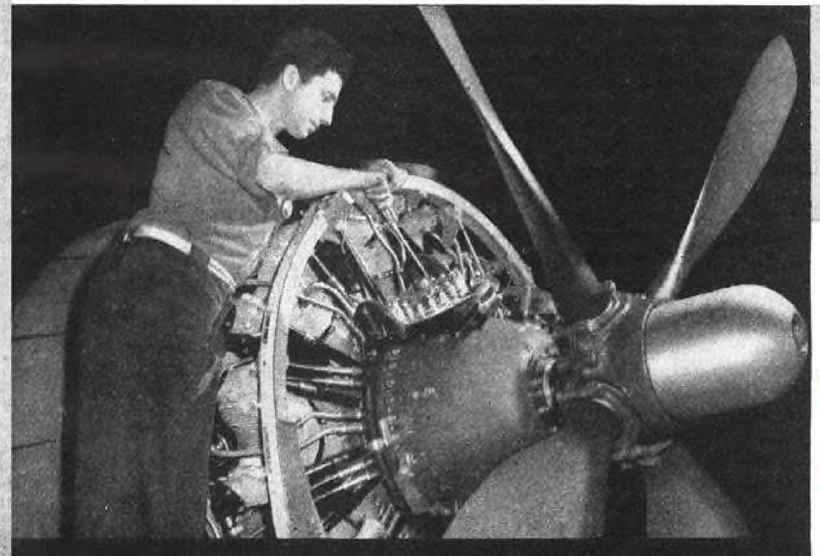
SIMPLIFIED MAINTENANCE

From the ground crew's standpoint, this reduction in the number of units to be serviced is also important. So is the fact that either of the two self-contained, interchangeable magneto-distributors can be detached without removing other parts of the system.

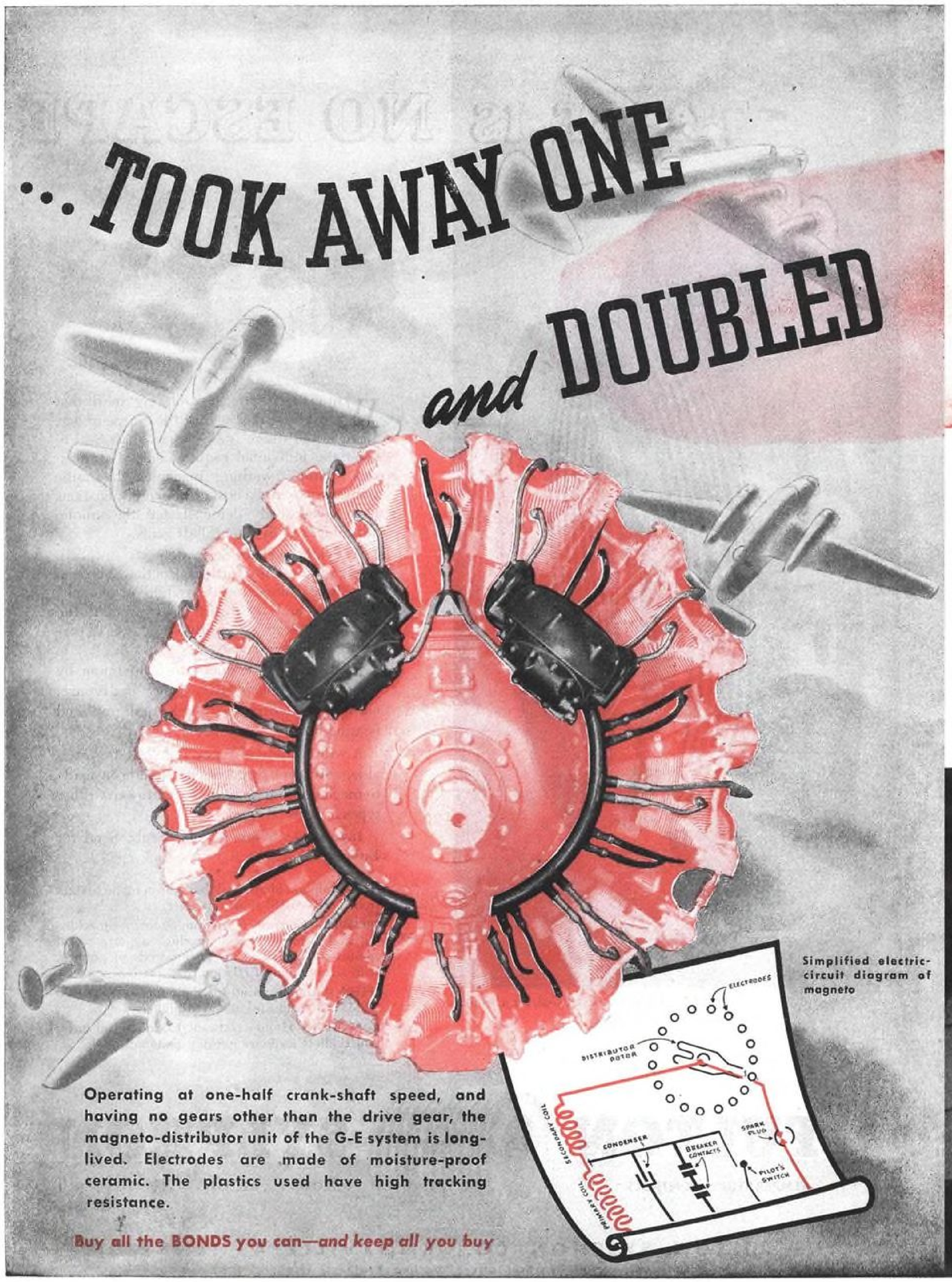
FLIES HIGH *WITHOUT* SUPERCHARGING

Ample clearances in the magneto and solid, though flexible, impregnation of the harness eliminate the need for supercharging at high altitudes. And—the simplified design of the entire system facilitates effective radio-noise shielding.

This high-tension ignition system is one of several G-E systems which give aircraft manufacturers substantial savings in engineering man-hours and assembly time. We'll gladly consult with you on the possibilities of adapting one of these pre-engineered systems—or of designing something entirely new—to fit the projects you are planning. Just call the G-E office near you. *General Electric Co., Schenectady 5, N. Y.*



Check inspections of the magneto-distributor can readily be made *on the engine*. The entire system is designed for ease of installation, timing, maintenance, and repair. It is shown here installed on the Pratt and Whitney Aircraft engine of Republic's Thunderbolt (P-47).



Simplified electric-circuit diagram of magneto

Operating at one-half crank-shaft speed, and having no gears other than the drive gear, the magneto-distributor unit of the G-E system is long-lived. Electrodes are made of moisture-proof ceramic. The plastics used have high tracking resistance.

Buy all the BONDS you can—*and keep all you buy*

PRECISION PRODUCTS AND ENGINEERED SYSTEMS FOR AIRCRAFT

GENERAL ELECTRIC

674-20



"TO THE LIMIT OF OUR ABILITY."

This poster, prepared by the Army Air Forces and placed by them in each of the big Douglas plants turning out C-54s, is a tribute to a great airplane and to the workers who are building it. With this tribute comes a challenge. The entire Douglas organization, already engaged in the night and day production of planes for Victory, has only one answer to the Army's appeal for more C-54s..."it shall be done...to the limit of our ability."

YOUR WAR BONDS
BUY MORE C-54's

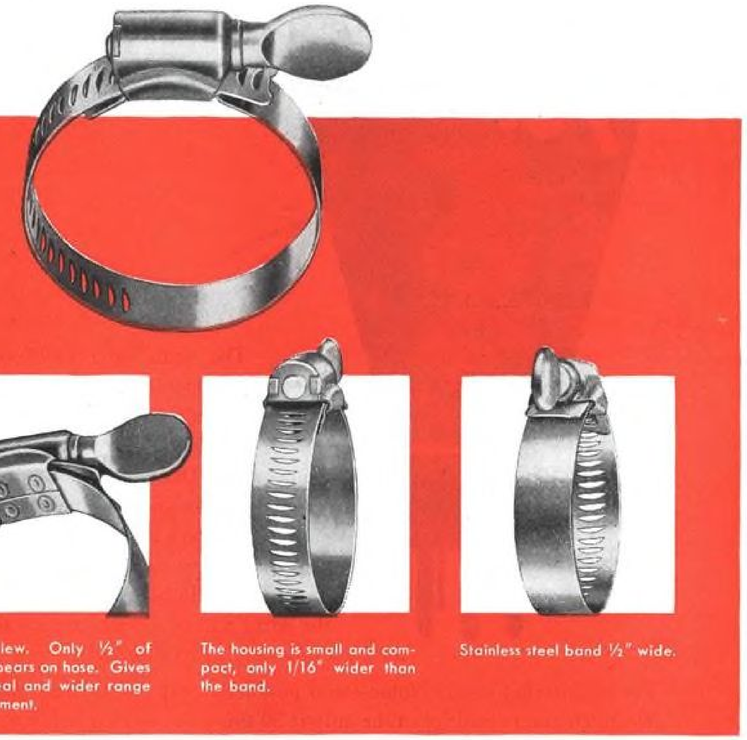
First AROUND THE WORLD · *First* THE WORLD OVER

Douglas
AIRCRAFT

It's Stainless Steel!

THE NEW WITTEK

Worm Drive Hose Clamp



Stainless steel housing seen from above. Only 9/16" wide at widest point. Fully enclosed screw.

Under view. Only ½" of housing bears on hose. Gives better seal and wider range of adjustment.

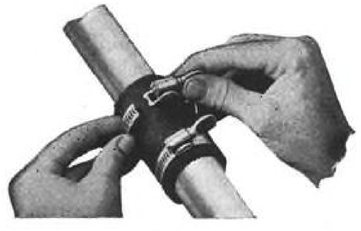
The housing is small and compact, only 1/16" wider than the band.

Stainless steel band ½" wide.

Strong
Light
Compact

This new Wittek stainless steel Worm Drive Hose Clamp is built to comply with the requirements of specification AN-FF-C-406A. Streamlined, compact, strong and light . . . it is superbly engineered to utilize the superior physical properties of stainless steel to provide a hose clamp having performance characteristics in excess of the specification requirements.

With the addition of this new Worm Drive Hose Clamp, Wittek now offers a diversified line of aviation hose clamps to meet all requirements of the industry.



War Bonds for Victory—Buy MORE in '44!

ARMY E NAVY

WITTEK
MANUFACTURING CO.
4305-15 West 24th Place, Chicago 23, Ill.

Aviation HOSE CLAMPS

WESTINGHOUSE ELECTRONIC TUBES . . . DOING A JOB ON EVERY FRONT, IN EVERY BATTLE, IN EVERY WAR INDUSTRY



THE TUBE THAT COULDN'T BE MADE BUT IT WAS!

The Army came to Westinghouse for a very complex, completely new type of electronic tube. Our engineers didn't say it couldn't be made, but they thought just that. However, when the Army asks for it, you do the impossible. Our engineers sweated it out. They designed, built, tested and shipped the new tube. Then word came back: "It won't work." Instead of making the tube over, we got permission to redesign the apparatus in which the tube was to be used. Result: tube 100% perfect in new apparatus which the Army agreed did a better job than the original—and an order for 2000 tubes *exactly as supplied!*

The engineering resourcefulness and production expansion which made this possible have enabled Westinghouse to multiply tube output 30 times . . . so that today we're not only meeting time and quality "musts" on all Government contracts, but we're also continuing to meet the heavy needs of war industry. Your nearest Westinghouse office or Westinghouse Electronic Tube Distributor will be glad to receive your inquiries. Westinghouse Electric & Manufacturing Company, Bloomfield, N. J.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

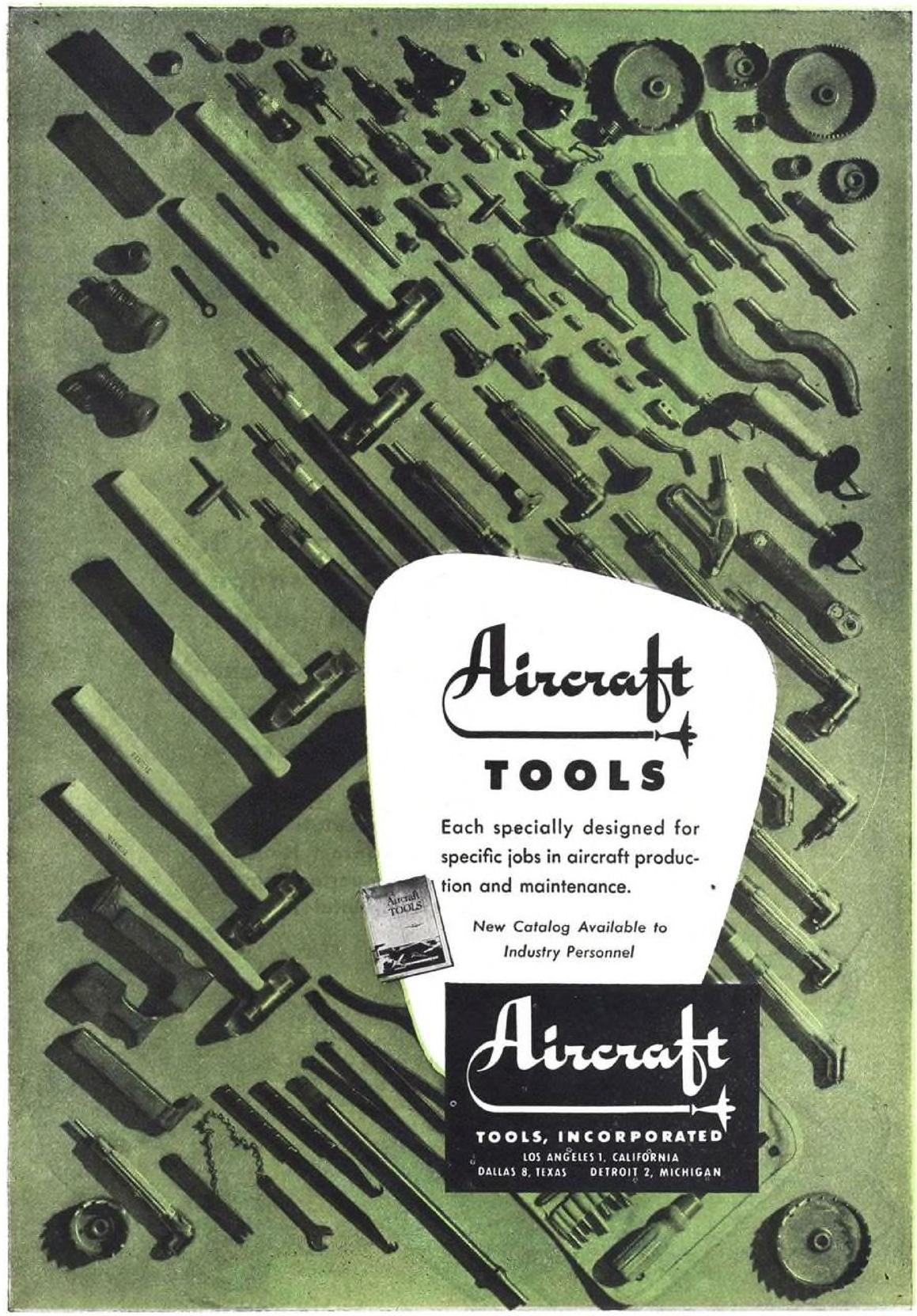
Electronic Tubes at Work



QUICK LOCAL SERVICE ON INDUSTRIAL ELECTRONIC TUBES

Looking ahead to continued development of electronic equipment in industry, postwar, we now have a plan to make Westinghouse Electronic Tubes quickly and easily available. Stocks of the most widely used tubes are now available through Westinghouse Electronic Tube Distributors and Westinghouse District Warehouses. As rapidly as possible additional types will be added to local stocks to make a complete line of Quality Controlled Westinghouse Electronic Tubes available to everyone.

Westinghouse Presents—John Charles Thomas, Sunday 2:30 E.W.T., NBC. Ted Malone, Monday, Wednesday, Friday 10:15 P.M., E.W.T., Blue Network



FLEXIBLE ELECTRIC HEAT IS OUR STORY

. . . in units that can be made in nearly every conceivable shape, size, contour and thermal output.

More than 500,000 in use, maintaining exact temperatures . . . even in sub-zero conditions, if necessary.



Send for our new booklet: "Controlled Electric Contact Heat." Write H. & A. Engineering Dept., 86-100 Leroy Ave., Buffalo 14, N.Y.

H & A
Manufacturing Co. Inc.
PLANTS IN BINGHAMTON AND BUFFALO, N. Y.





● Even counting all the days—and nights—put into planning and preparation by designers, builders and suppliers, B-29 still represents a miracle in achievement—the number of days still seem far too few for the undertaking.

Built to carry loads beyond former limits, at speeds never before considered, and safeguarded as no fighting plane before it, the Super-Fortress history-maker represents a new high in co-ordination between those who plan and those who build.

Leaders among manufacturers—known for quality of products and ability to deliver on schedule the various types of equipment needed, were asked to pledge their co-operation in this twenty-four hour a day job. Amphenol is proud to have been chosen to furnish the electronic connectors and parts for this great weapon.

Engineers in these plants from coast to coast worked simultaneously in designing parts that would meet the requirements set. Each production department set up a time table of the dates on which it would make first and subsequent deliveries. And B-29 progressed by the clock.

The first take off was on schedule. Japan was bombed on schedule. And today, American flyers have a marvelous weapon which gives their talents full play.



● SEND FOR THIS BOOK. Twenty-four illustrated pages of suggestions on dependable wiring—directly from the benches. These are things that other practical men have worked out and by which you or your wiring department can benefit. Send for a copy—you will enjoy reading it.

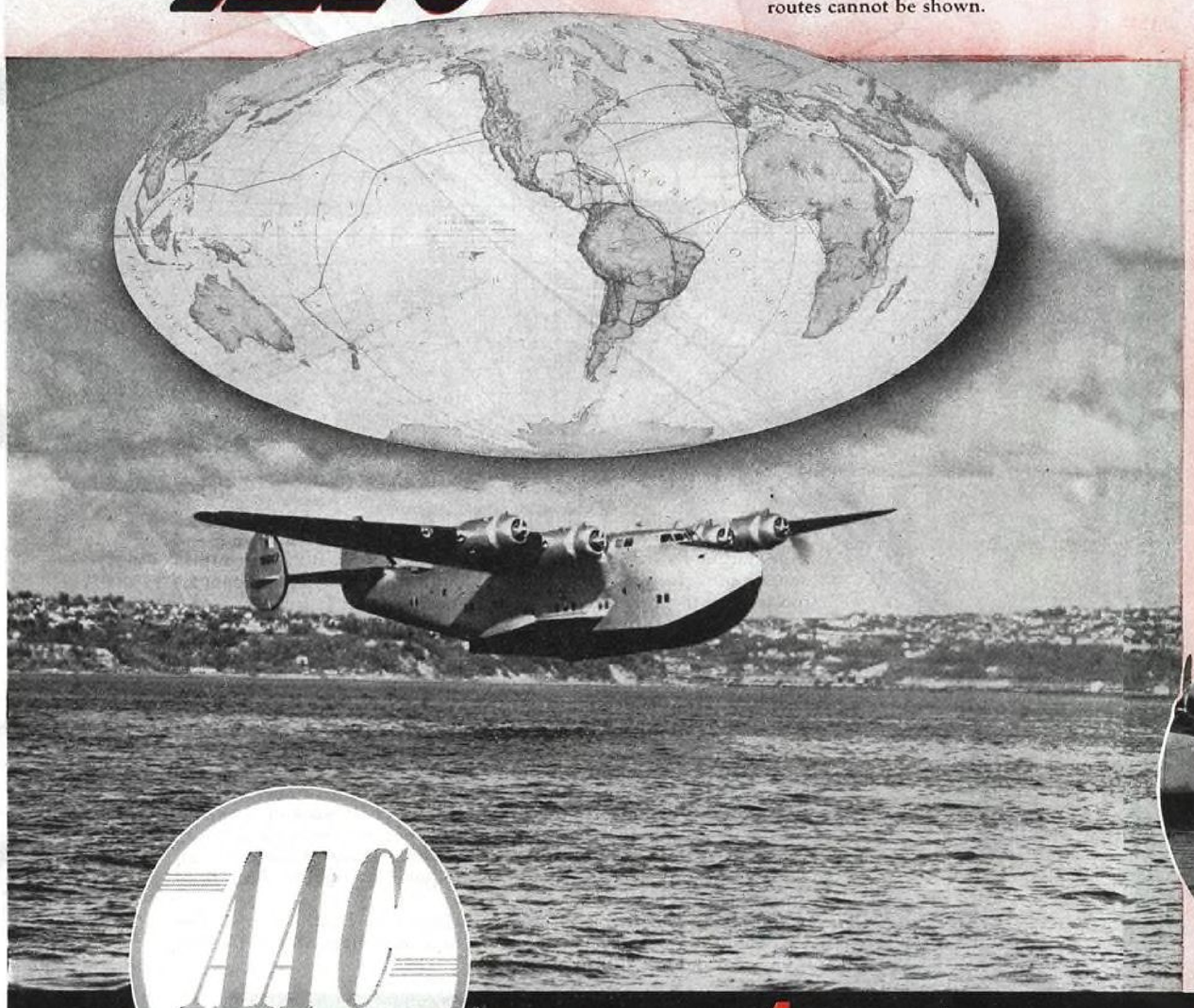
Depend upon
AMPHENOL
Quality
AMERICAN PHENOLIC CORPORATION
1830 S. 54th Avenue, Chicago 50, Illinois
IN CANADA · AMPHENOL LIMITED · TORONTO

Makers of Connectors (AN, British, UHF), Fittings, Conduit (Flexible Metal and Plastic), Cable Assemblies, UHF (RG) Cable, Radio Parts, Plastics for Industry.

AAC PRECISION RADIO PRODUCTS

Serve PAA

* The Pan American World Airways routes shown below are those in existence on December 7th, 1941. Present routes cannot be shown.

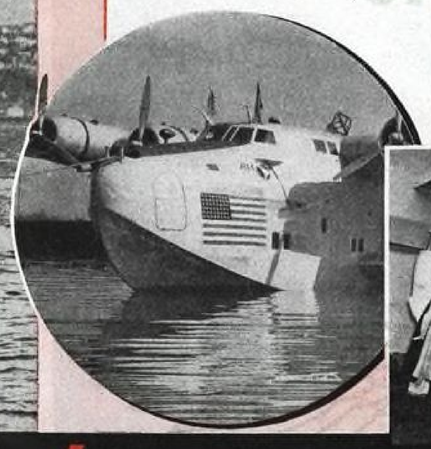


PAN AMERICAN WORLD AIRWAYS continues to perform a vital wartime service by speeding men and materials to every U. S. front and outpost . . . and AAC Precision Radio Products play an important part in this service.

As the giant *Clippers* spread their wings across the world, AAC Products help to maintain communications along the lifelines of this vast system which flies to every continent on the globe. These products are in use at operations bases, both here and overseas.

This is just one example of how the engineering and production skill of Aircraft Accessories Corporation serves the world's great airlines—as well as various branches of the armed forces. As one of America's largest producers of transmitters and other precision radio equipment, AAC offers the services of its Engineering Department in designing special equipment for you, without obligation.

ELECTRONICS DIVISION
KANSAS CITY, KANSAS





In war as in peace the PAA Clippers serve humanity. Here 1810 pounds of medical supplies go aboard at LaGuardia Field.

(E-54)

AAC Products

AIRCRAFT ACCESSORIES CORPORATION
PRECISION RADIO and ELECTRONICS • ENGINEERED POWER CONTROLS
Kansas City, Kans. New York, N. Y. Burbank, Calif. Cable Address: AACPRO

Phillips---

has recently completed the first and only U.S. plant to produce CENSORED a new secret component of 100-plus octane aviation gasoline

Phillips
AVIATION GASOLINE

PHILLIPS PETROLEUM COMPANY, BARTLESVILLE, OKLAHOMA

A major supplier of 100 octane gasoline to the Army, Navy, and United Nations air forces



DESIGNERS:

ONE OF THESE *Heli-Coil* APPLICATIONS MAY SUGGEST THE ANSWER TO YOUR FASTENING PROBLEM!

Tapped threads are often a weak spot in light metal or plastics products. But they needn't be! Aircraft manufacturers have solved this problem—and you can too—by protecting tapped threads with "Heli-Coil" Screw Thread Inserts.

"Heli-Coil" Inserts are precision-shaped helical coils of stainless steel or phosphor bronze wire. They engage tapped threads of the American National System, protecting them against abrasion, stripping and seizing.

"Heli-Coil" Inserts weigh about 1/5 as much as solid metal bushings, and occupy about 1/2 as much cross sectional area in the boss. They are installed much easier and faster than solid bushings.

Today, "Heli-Coil" Inserts are used for original installations in Army, Navy and transport aircraft engines, accessories and parts . . . as well as in salvage, maintenance and field servicing operations. What "Heli-Coil" Inserts have done in these applications, they can do for your products! Write today for detailed engineering literature.

FOR HIGHLY-STRESSED THREADED PARTS, A VARIATION OF THIS INSERT, KNOWN AS THE "AERO-THREAD" SYSTEM, IS AVAILABLE.

U.S. and Foreign Patents Issued and Pending

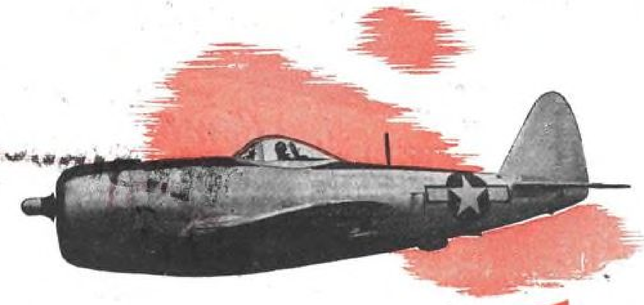
AERO-THREAD

THE SCREW SYSTEM WITH THE ANTI-FRICTION THREAD LINING

AIRCRAFT SCREW PRODUCTS COMPANY, INC.
47-23 35th STREET • LONG ISLAND CITY, 1, N.Y.



✓Stratosphere Fighter
✓Long Distance Escort
✓Dive Bomber
✓Ground Strafer



OSTUCO Flies with The THUNDERBOLT on its 'round-the-clock missions!

PHOTOS COURTESY OF REPUBLIC AVIATION CORPORATION

On mission after mission American pilots ride with the advantages of advanced aircraft engineering. For the newest planes, for *every* plane, OSTUCO meets strict military and naval specifications, and supplies seamless steel tubing for dozens of applications, such as: tube fitting for starter shafts; engine mounts; tail wheel yoke assemblies; strut assemblies, crash skid, journal flange hinge outboard.

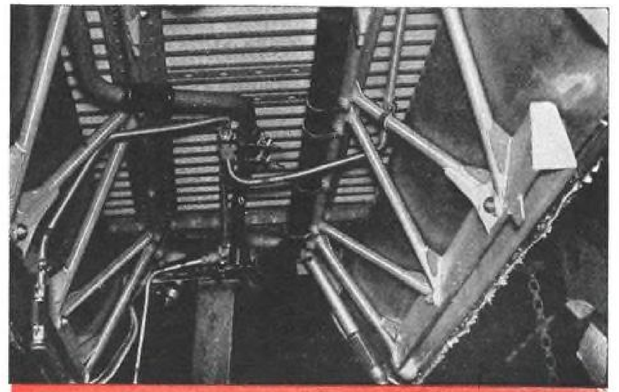
OSTUCO—with years of *specialized experience* in tubing applications—has built an outstanding record for low rejects, furnishing *quality* tubing where specifications call for high flexibility, machinability, and careful attention to the strength-weight factor.

Keeping pace with today's fast-moving developments, places OSTUCO in a favorable position to help you meet your post-victory competition on every count—quality, delivery, engineering, cost.

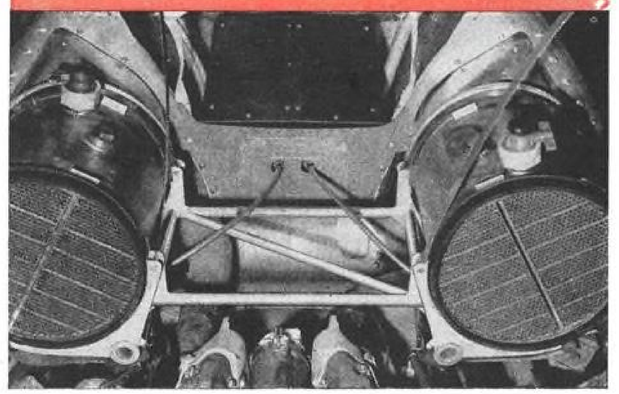
• • •

THESE SALES OFFICES ARE READY TO SERVE YOU

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ABOVE: *Crash skids and (below) mounts for oil coolers showing parts made of OSTUCO seamless steel tubing.*



SHELBY OSTUCO OHIO

THE OHIO SEAMLESS TUBE COMPANY

MANUFACTURERS OF SEAMLESS AND ELECTRIC-WELD STEEL TUBING

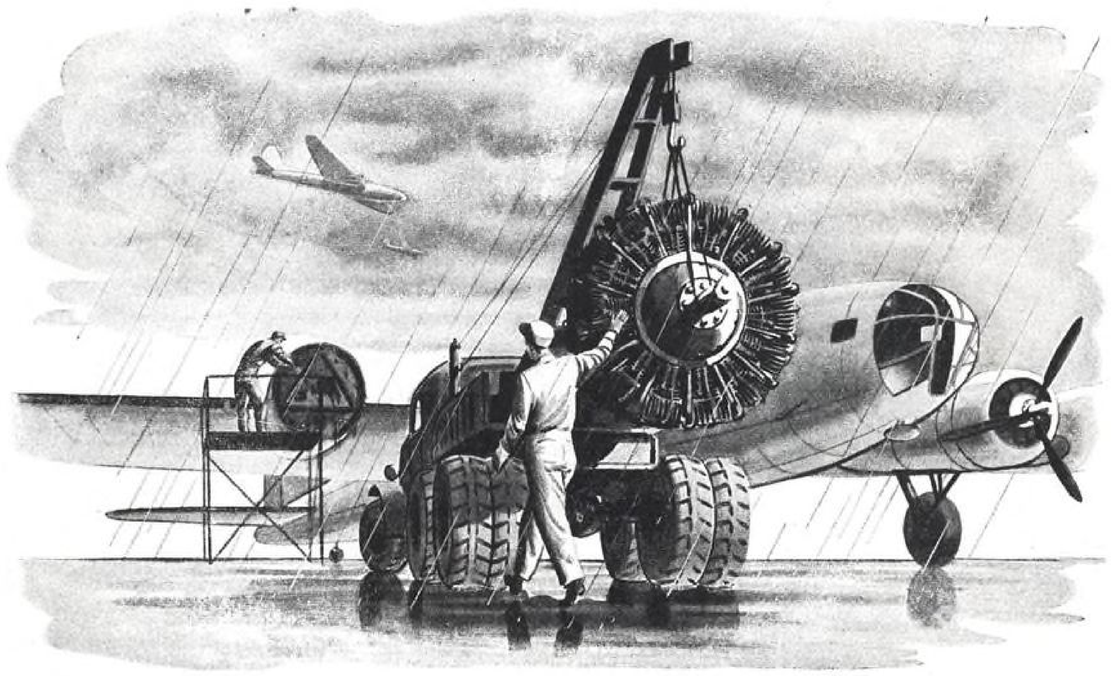
There's a Complete Line of
NORTON OPEN STRUCTURE
Wheels and Segments . . .

Norton Open Structure Grinding Wheels in complete range of sizes —20″ x 6″ or 24″ x 4″ and all the way down to the small internal sizes. And segments too in all the popular shapes and sizes.

Norton Open Structure Grinding Wheels are available for your jobs that require large pore space—jobs where contact is broad or where extra coolness of cut is essential. Norton abrasive engineers in all the industrial centers will help you with specific recommendations to meet your production requirements.

NORTON CO., Worcester 6, Mass.
Behr-Manning, Troy, N. Y., is a Norton Division





Waterproofing Power Eggs

The practice of building aircraft engines and mountings into complete units for quick replacement of damaged motors has materially reduced time lost from repairs.

To protect the working surfaces of these replacement units, or "power eggs", against rust from condensation of air moisture, many leading Pacific Coast aircraft companies now process them with Stop Rust B.

Stop Rust B—a product of Union Oil Company—is a detergent and rust-preventive oil developed especially for the internal protection of aircraft engines. It forms a non-drying, non-hardening film which adheres to the metal and stops rust formation.

Stop Rust B meets specification AN-VV-C-576a and is used in accordance with standard military instructions governing processing of engines.



Engines protected with Stop Rust B may be placed in service immediately without special cleaning or servicing. This outstanding new product mixes readily with all commercial lubricants and is, itself, an excellent lubricant. Because of its detergent qualities, engines operated on the recommended mixture of Stop Rust B and oil will remain clean and free from sludge. That way, corrosive acid residues from fuel combustion are neutralized.

To get a supply of Stop Rust B, phone your local Union Oil representative or write Union Oil Company, 617 West Seventh Street, Los Angeles 14, Calif.

Remember! Stop Rust B protects your engines from rust and corrosion—keeps them clean—permits instant use!

STOP RUST B

Another
UNION OIL
Success-Tested Product



ANOTHER EXAMPLE OF

CREATIVE ELECTRICAL ENGINEERING

» LELAND is more than a motor name plate. LELAND stands for *Creative Electrical Engineering*—the technical ingenuity to design and build a power unit for your specific application to deliver peak efficiency and performance.

This inverter, for example, was built to meet a special need. The problems involved and their solution point up LELAND'S special skill in *Creative Electrical Engineering*. We invite you to consult with us.

THE Leland *ELECTRIC COMPANY*

DAYTON 1, OHIO

In Canada, Leland Electric Canada, Ltd., Guelph, Ontario

★

AIRBORNE POWER INVERTER—D.C. drive from aircraft electrical system, high frequency A.C. output up to 2,500 volt amperes used as power supply for electronic equipment.

FOR THAT *Extra*

BURST OF POWER..



THE ROMEC R.D.7500 WATER INJECTION PUMP

This pump develops EXTRA Horsepower, when needed in any emergency. How?

By adding water, vaporized in the combustion chamber, to step up engine performance. Pump is inserted through bottom of supply tank. No more vapor forming in suction lines at high altitude because both suction and bleeder lines are eliminated. That saves weight too. Unit stays cool because the pumping mechanism is submerged and heat is quickly dissipated. Relief valve discharges directly into tank. This agitation greatly reduces freezing hazard.

Engineered for wide temperature ranges. Non-corrosive throughout. It's performing mechanical miracles now. Write for details.

Romec

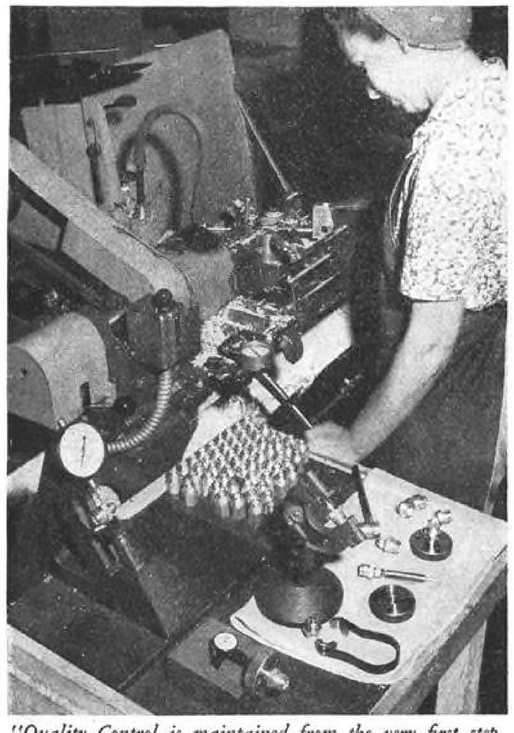
PUMP COMPANY

117 ABBEY ROAD ELYRIA, OHIO, U. S. A.





Quality CONTROL



"Quality Control is maintained from the very first step through every operation"

Quality Control was old when Grandma was a little girl. Great-grandmother's school of thought was "An ounce of prevention is worth a pound of cure." That philosophy governs at Masters where 99% *plus* perfection is maintained, not for one or two or a few isolated periods, but month in and month out.

How do we do it? Not by wasting time, energy and material in inspecting, reinspecting, segregating and re-working a lot of defective parts. Quality Control is maintained from the very first step through every operation. Result: rework and scrap in factory about 1%. Rejects from customers less than 1/10th of 1%.

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FACTORY: 3035 ANDRITA ST., LOS ANGELES, 41, CALIF. • FIELD OFFICES: 30 N. 15TH ST., EAST ORANGE, N. J. • S. C. STERLING, 67 YONGE ST., TORONTO, ONTARIO, CANADA • 4TH AND CHERRY BUILDING, SEATTLE, WASH. • 215 W. 7TH ST., LOS ANGELES, 14, CALIF.

America's Most Versatile Fitting Factory • Short Runs and Long Runs

How many machine tool operations help to make him

the safest flyer in the world . . .

America spends more time, more money, more effort to protect the life of a flyer than any other country in the world . . . He is the unexpendable.

Into a single engine of his plane go as many as 84,000 individual manufacturing operations . . . to accuracies as fine as four-millionths of an inch.

And of all the machine tools in use by the aviation industry, none is more basic or more vital than the internal grinding machine.

Bryant engineers have helped the men of government and of industry to plan the most desperate and gigantic production program of all time . . . and they can help those same men in planning today for the peace that must be won after the war is won!

We invite you to send for a Bryant man today.



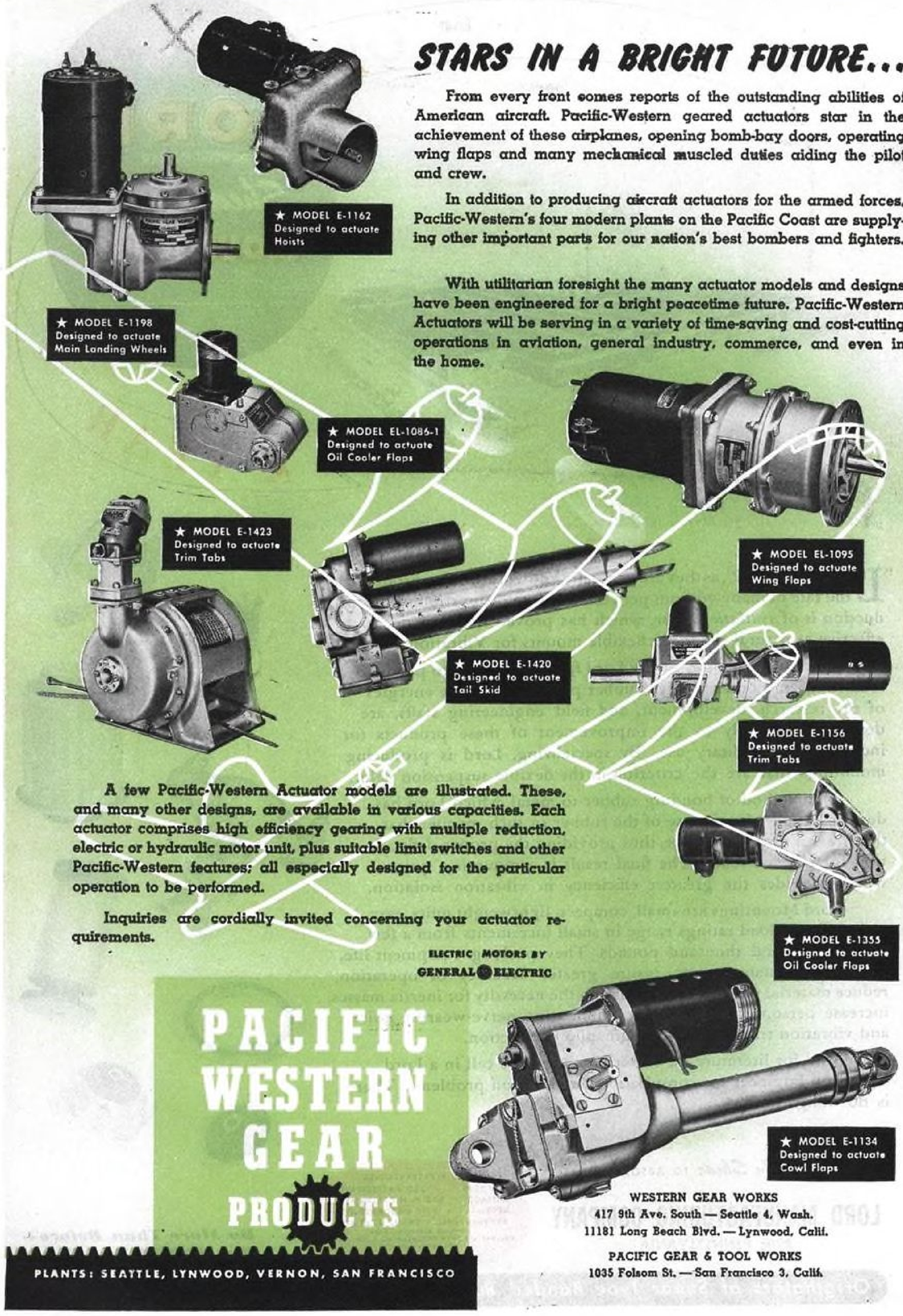
BRYANT CHUCKING GRINDER CO.
SPRINGFIELD, VERMONT, U. S. A.

STARS IN A BRIGHT FUTURE...

From every front comes reports of the outstanding abilities of American aircraft. Pacific-Western geared actuators star in the achievement of these airplanes, opening bomb-bay doors, operating wing flaps and many mechanical muscled duties aiding the pilot and crew.

In addition to producing aircraft actuators for the armed forces, Pacific-Western's four modern plants on the Pacific Coast are supplying other important parts for our nation's best bombers and fighters.

With utilitarian foresight the many actuator models and designs have been engineered for a bright peacetime future. Pacific-Western Actuators will be serving in a variety of time-saving and cost-cutting operations in aviation, general industry, commerce, and even in the home.



A few Pacific-Western Actuator models are illustrated. These, and many other designs, are available in various capacities. Each actuator comprises high efficiency gearing with multiple reduction, electric or hydraulic motor unit, plus suitable limit switches and other Pacific-Western features; all especially designed for the particular operation to be performed.

Inquiries are cordially invited concerning your actuator requirements.

ELECTRIC MOTORS BY GENERAL ELECTRIC

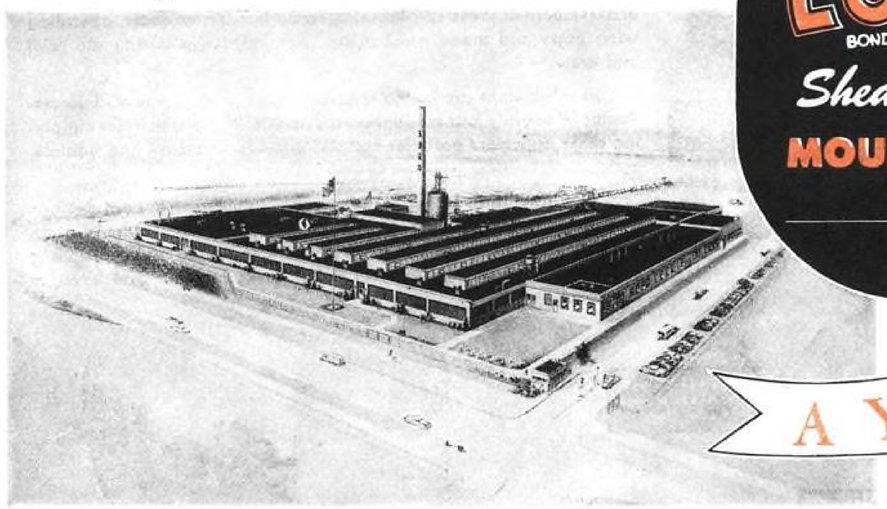
PACIFIC WESTERN GEAR PRODUCTS

PLANTS: SEATTLE, LYNWOOD, VERNON, SAN FRANCISCO

WESTERN GEAR WORKS
417 9th Ave. South — Seattle 4, Wash.
11181 Long Beach Blvd. — Lynwood, Calif.

PACIFIC GEAR & TOOL WORKS
1035 Folsom St. — San Francisco 3, Calif.

MILLIONS OF



LORD
BONDED RUBBER
Shear Type
MOUNTINGS

A YEAR



"LORD MOUNTS", as they are generally known, are being produced at the rate of many millions per year. A large proportion of this production is of *synthetic rubber*, which has proved in the main, to be as effective as natural rubber in flexible mounts for Vibration Control.

The entire facilities of the Lord factory are used to produce mountings and other bonded rubber products, and the energies of the research, development, and field engineering staffs, are devoted exclusively to the improvement of these products for industrial and military use. By specializing, Lord is producing mountings that are the criterion in the flexible suspension field.

The method of bonding rubber to metal, which Lord has developed, permits the use of the rubber in such manner that the stress is always in shear, thus providing the proper deflection for a given load. The final result is a mounting system which provides the greatest efficiency in vibration isolation.

Lord Mountings are small, compact, lightweight units, easy to install and load ratings range in small increments from a few ounces to several thousand pounds. They prolong equipment life, lower maintenance costs, insure greater accuracy of operation, reduce material weights by eliminating the necessity for inertia masses, increase personnel efficiency by eliminating nerve-wearing noise and vibration transmitted through solid conduction.

Send for literature on vibration control or call in a Lord Vibration Engineer for consultation on vibration problems. There is no obligation.

IT TAKES RUBBER *In Shear* TO ABSORB VIBRATION

LORD MANUFACTURING COMPANY
ERIE, PENNSYLVANIA

SALES REPRESENTATIVES
NEW YORK - - 280 MADISON AVE.
CHICAGO - 520 N. MICHIGAN AVE.
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BURBANK, CAL. - 245 E. OLIVE AVE.
CANADIAN REPRESENTATIVES
RAILWAY & POWER ENGINEERING CORP., LTD.
TORONTO, CANADA

Originators of Shear Type Bonded Rubber Mountings

Do More Than Before—
Buy EXTRA War Bonds

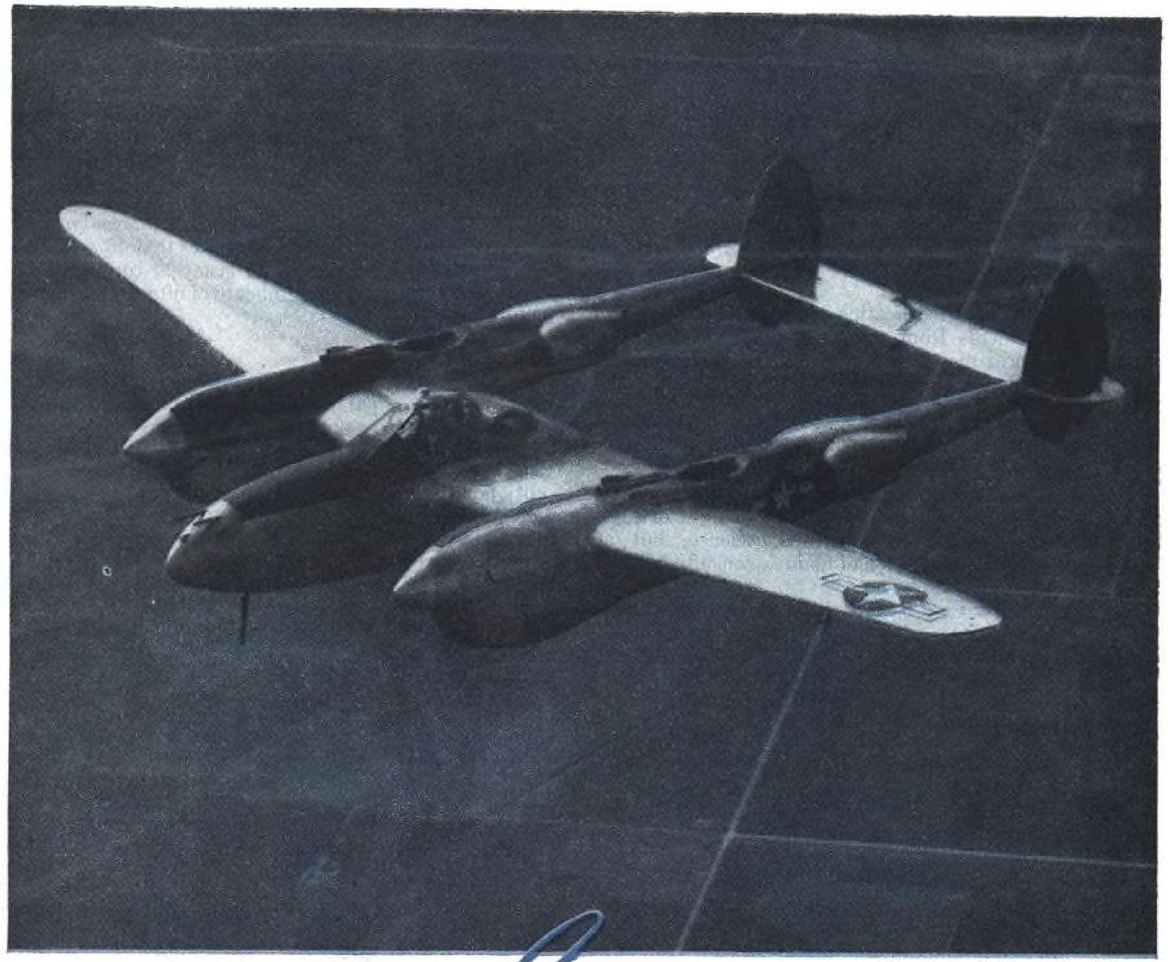


Photo courtesy Lockheed Aircraft Corp.

STROKE OF *Lightning* IN THE SKY

...RIDING ON LUNGS OF SPECIAL ALLOY STEEL

FOR the superior high-altitude performance of the Lightning and other first-line American warplanes, give primary credit to their engine "lungs"—the GE Turbo-Supercharger—a milestone in research and design, and a triumph in metallurgy and production.

Allegheny Ludlum collaborated on turbo-supercharger research for years before the war. Our chief contribution was the development of a commercial technique to centrifugally cast the supercharger diaphragm—an intricate shape which was formerly laboriously fabricated by welding. This casting, made of a highly complex alloy steel which maintains its strength at red-hot temperatures, was much stronger, more durable and more efficient than the fabricated article. And, even more important, the way had been opened for quantity production.

Already, in gas turbine work and other directions, these developments are bearing additional fruit. Just remember that the function of Allegheny Metal and our other special steels is either to do the thing that once seemed impossible, or to do better what is already being done. Let us help you apply these materials to your needs. ● Allegheny Ludlum Steel Corporation, Brackenridge, Pa.

Allegheny Metal is also handled and stocked by all Joseph T Ryerson & Son, Inc. warehouses

W&D 9494-B

ALLEGHENY METAL
The Time-Tested Stainless Steel

REMEMBER THE NAME TODAY FOR THE NEEDS OF TOMORROW

The CONE AUTOMATIC MACHINE COMPANY
sees many
GOOD THINGS AHEAD

It is reported that . . . . . .

A recently patented heating plate has two elements from which four degrees of heat may be obtained by using them singly or in combination as well as in series or parallel.

get ready with CONE for tomorrow

A new patent covers the use of perforated plates at the bow of a small, fast motorboat which permits the hull to ride on a cushion of foam.

get ready with CONE for tomorrow

Spraying the interior of a freight car or truck with dry ice is being tried as an inexpensive method of refrigeration.

get ready with CONE for tomorrow

Serious consideration is being given to the making of illuminating gas near the coal mines and its delivery by pipe line.

get ready with CONE for tomorrow

Cigarette paper, formerly a French monopoly, is now being successfully made in this country.

get ready with CONE for tomorrow

A capsule has been developed that is said to be effective in the prevention of seasickness in about 75% of the cases tested.

get ready with CONE for tomorrow

Cloth is being made from shredded redwood bark mixed with wool.

get ready with CONE for tomorrow

Experiments are being made to determine the suitability of animal blood for human transfusion.

get ready with CONE for tomorrow

Shafts for generators are now being squeezed into shape with dies.

get ready with CONE for tomorrow

A new plant processes 25,000 pounds of milkweed floss per day.

Shoal draft boats with tunnel sterns are made more efficient by the use of a small stand-pipe over the propeller which is kept full of water by a vacuum pump. The propeller is thus constantly surrounded by water although above the water level.

get ready with CONE for tomorrow

Anthropology is not popularly thought of as a commercially useful science, but anthropologists were consulted in designing seats for aircraft, gas masks, and goggles, and they might well be turned loose on the problems of private and public furniture after the war.

get ready with CONE for tomorrow

Airplane propellers are now being made of sponge rubber over a metal core.

Apparatus now in use by our army is expected to make it possible for civilians to forecast weather accurately as much as 24 hours ahead.

get ready with CONE for tomorrow

One of the country's largest chemical companies states that 46% of its gross sales for last year consisted of products unheard of fifteen years ago.

get ready with CONE for tomorrow

Rayon is being used for tire cord, parachutes, paint brushes, pump packing, bullet-proof gas tanks, lint-free gloves, electrical insulation, gas-proof clothing, cartridge bags, felt, and rugs.

get ready with CONE for tomorrow

Optimistic producers of synthetic rubber say that, in the future, people will buy new automobiles to go with their old tires.

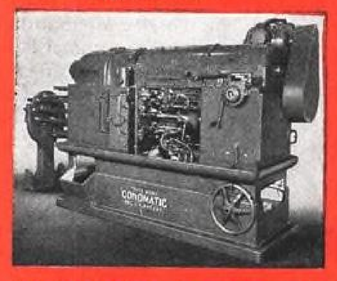
get ready with CONE for tomorrow

Ball bearings are now being made small enough to replace the jewels used in many precision instruments.



Tomorrow's production should eliminate second operations

The 8-Spindle Conomatic produces these wheel hub bolts from SAE 1030 in 34 seconds each. Slot milling in the large diameter and stamping the letter on the end are done without stopping the spindle. Conomatics reduce costs, save time, and eliminate second operations.



CONE

AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U. S. A.

10



New aircraft cleaner prevents scale formation on coils and valves of steam-cleaning equipment

In aviation maintenance bases, steam-cleaning equipment quickly clogged up with deposits of lime, magnesium and other minerals present in the water. Turco chemists, called on to apply the results of their research, so compounded Steam-Aero that it would sequester (hold in solution) these scale-forming minerals. This method of forestalling precipitation and deposit has also provided steam-cleaning guns with a form of insurance against the kicking and sputtering caused by scale. It has cut down equipment servicing time, saved fuel in the making of steam, prolonged the usefulness of the equipment itself.

This is the same sequestration quality that answers the need for elimination of mineral deposits which etch or injure delicate plane surfaces. Steam-Aero has a rich, neutral foam that cleans aluminum as safely as it cleans it thoroughly. It is scientifically balanced so that it rapidly emulsifies oil and grease, and the surface rinses free. It may be used to clean well-bonded paint safely.

Turco technicians saw the importance of producing a high foam with exceptionally tough bubble walls. Tough bubble walls cling better to vertical surfaces, for longer soaking; and operators, accustomed to judging the strength by the foam and inclined to use more of a compound that is "flat" than one which lathers richly, are not so apt to waste the compound.

It's simple, it's easy to use Turco Steam-Aero. Half an ounce per gallon of water (slightly more for hard water) is usually all that is necessary. In any concentration, Steam-Aero retains its perfect balance.

Write for free bulletins.

Other Turco Products for Aircraft Maintenance

Wulsine... for cold water cleaning of surfaces, engines and parts. Used with water alone, or with petroleum solvents; rinses free.

Plasti-Glyst... the safe, fast cleaner for plastic glass. Approved by makers of Plexi-Glas.

Carbrax... cleans pistons fast and thoroughly; removes carbon, 'varnish,' etc.

Penetrol... emulsifies sludge; removes carbon deposits; strips primers and engine enamel.

Fuzee... cleans aluminum cylinder heads, carburetors, etc.

Turco W. O. No. 1... Government-approved for weather-resistant bonding of aircraft paints in the field.

TURCO Turco
INDUSTRIAL CHEMICAL COMPOUNDS

TURCO PRODUCTS, INC. • Main Office and Factory: 6135 S. Central Ave., Los Angeles 1 • Offices and Factories: 1606 Henderson St., Houston 10, Texas 125 West 46th Street, Chicago 9 • Offices and Warehouses: New York City, Atlanta, Kansas City, Seattle, Denver, San Francisco, and all Principal Cities

Not a Lemon in a Blue Moon

A very good reason exists why you'll have a hard time finding a mounted point or wheel with hard and soft spots among those bearing the Bay State *blue flash* trademark.

Bay State manufactures mounted points and wheels in *blank* form then shapes, trues and sizes them after mounting on the mandrel. The finished product is sharp, smooth-running the instant you touch it to the work —no wasteful "breaking-in" period required.

In a broad range of abrasive products, Bay State offers extra advantages... the finest honing and superfinishing stones ever manufactured... portable snagging wheels with extra safety features... precision grinding wheels in fractional grades...etc. Plus engineering assistance to help you get the most from grinding.

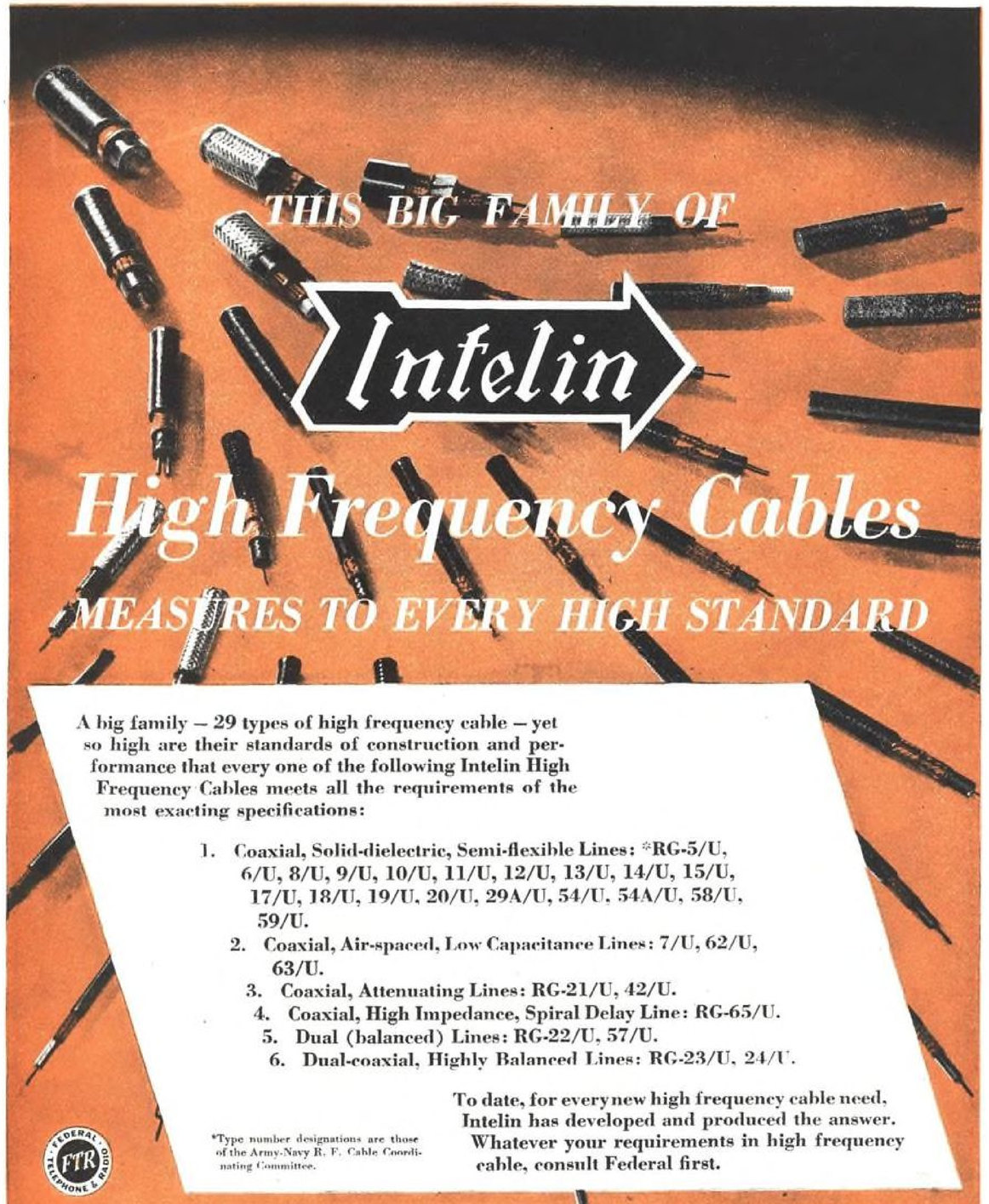
Do you have the handy, pocket-sized catalog of Bay State Mounted Wheels and Points? If not, send right away, for Catalog D.

BAY STATE ABRASIVE PRODUCTS CO.
WESTBORO, MASS.



BLUE FLASH GRINDING WHEELS *FAST and COOL*

HONING AND SUPERFINISHING STONES · CUT-OFF WHEELS · INSERTED-NUT DISCS · AND CYLINDERS
PORTABLE SNAGGING WHEELS · MOUNTED WHEELS · AND POINTS · GRINDING WHEELS



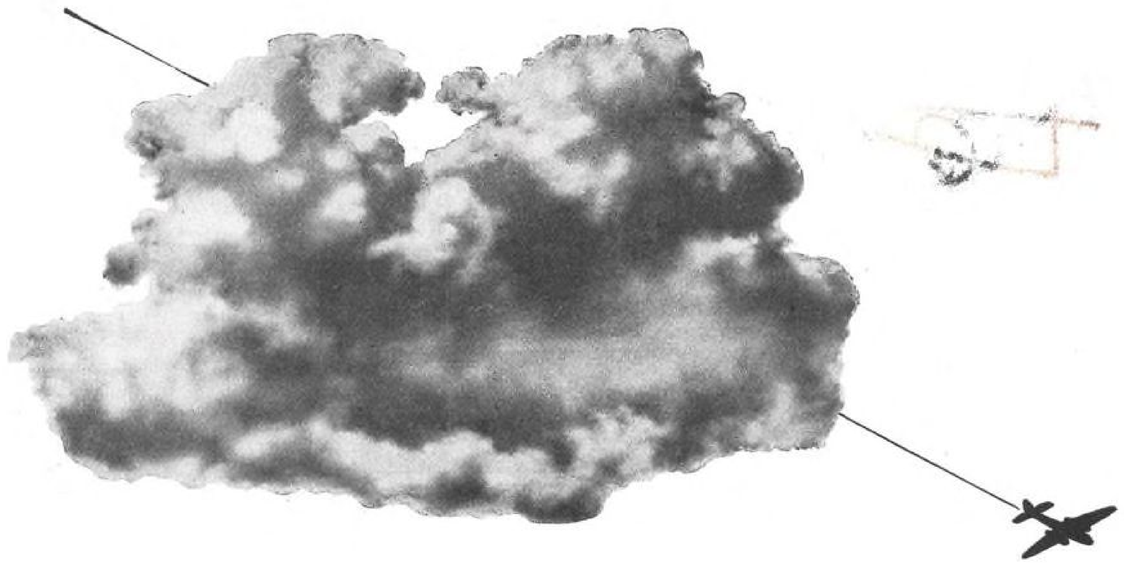
A big family — 29 types of high frequency cable — yet so high are their standards of construction and performance that every one of the following Intelin High Frequency Cables meets all the requirements of the most exacting specifications:

1. Coaxial, Solid-dielectric, Semi-flexible Lines: *RG-5/U, 6/U, 8/U, 9/U, 10/U, 11/U, 12/U, 13/U, 14/U, 15/U, 17/U, 18/U, 19/U, 20/U, 29A/U, 54/U, 54A/U, 58/U, 59/U.
2. Coaxial, Air-spaced, Low Capacitance Lines: 7/U, 62/U, 63/U.
3. Coaxial, Attenuating Lines: RG-21/U, 42/U.
4. Coaxial, High Impedance, Spiral Delay Line: RG-65/U.
5. Dual (balanced) Lines: RG-22/U, 57/U.
6. Dual-coaxial, Highly Balanced Lines: RG-23/U, 24/U.

*Type number designations are those of the Army-Navy R. F. Cable Coordinating Committee.

To date, for every new high frequency cable need, Intelin has developed and produced the answer. Whatever your requirements in high frequency cable, consult Federal first.

Federal Telephone and Radio Corporation
AN IT&T ASSOCIATE
Newark 1, N. J.



The history of aviation proves that *quality spark plugs* assure not only better performance but also greater operating economy, requiring many fewer man-hours in servicing. And in an industry whose life-span is most often measured merely in years, **BG AVIATION SPARK PLUGS** have demonstrated their outstanding quality *for decades*— since 1917.

THE BG CORPORATION
136 WEST 52nd STREET, NEW YORK 19, N. Y.

Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders



In 1919, despite the turmoil of demobilization and reconversion, Wright Aeronautical, a direct descendant of the original Wright Company, began specialized development of aircraft engines. In the next 25 years, Wright research became a fountain-head of development which gave the world the air-cooled radial engine — the engine which brought world air commerce into being and gives power to Allied Air Forces today. Now problems of re-adjustment again loom ahead. But as in 1919, Wright stands ready, with new skill and facilities born of war, to provide power leadership in the Air Age of tomorrow.



WRITE FOR FREE COPY *of 40 page special anniversary issue of Trade Winds, covering 25 years of aviation progress.*

WRIGHT AERONAUTICAL CORPORATION
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SINCE 1919 AVIATION'S FIRST NAME

WRIGHT
Aircraft Engines

Wright Aeronautical Corporation • Division of Curtiss-Wright Corporation • Paterson, N. J., U. S. A.

"Braniff Airways Estimates Each Pound Saved Worth $108 in 1943"



BOOTS NUTS SAVE UP TO 60 LBS. PER PLANE

- Although LIGHTER, these all-metal nuts are TOUGHER and SAFER than other nuts.
- Now used on every type of military aircraft.
- Will be standard on commercial planes in peacetime.
- Can be used time and time again.
- "Outlast the plane."
- Approved by all government aviation agencies.

SEND FOR FREE BOOTS WEIGHT-SAVING BOOKLET TODAY! Actual weights of over 250 different self-locking nuts used in aircraft, comprehensively reviewed for the convenience of aircraft designers, engineers, operating and maintenance personnel. Copy will be sent you, free, on request.

BOOTS STEEL ANCHOR NUT



(W2S #8-32) This all-metal, self-locking nut is 60% lighter than a comparable fibre nut.

BOOTS *SELF-LOCKING NUTS*

"They Fly With Their Boots On—Lighter"

Motion Picture—"All Work And No Play"—16 mm. sound—30 minutes. Write for information.

Boots Aircraft Nut Corporation, General Offices, New Canaan, Conn., Dept. I

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Why HANSEN COUPLINGS ARE *FIRST CHOICE* IN ALL TYPES OF INDUSTRY THROUGHOUT THE COUNTRY





They're FASTER, EASIER TO OPERATE, LEAKPROOF!

The present manufacturing picture will change from production for production sake to the approaching peace time picture of economy production to meet competition. Production must keep at peak, costs must come down, the two combined mean lower selling prices, larger sales volume, more profits.

Hansen Push-Tite couplings not only increase production, but lower operating costs considerably. They're the fastest, easiest to operate and safest coupling on the market. Operator merely inserts plug into socket, connection is made instantly, no twisting, turning or locking, air is automatically turned on and he is ready to work. Once plug is inserted into socket, it is locked, absolutely leakproof, no wastage. To disconnect, operator merely moves sleeve back, plug is ejected and air is automatically turned off. Careless operator cannot waste air.

There is a Hansen coupling made for air, oil, grease, oxygen, gasoline and acetylene.

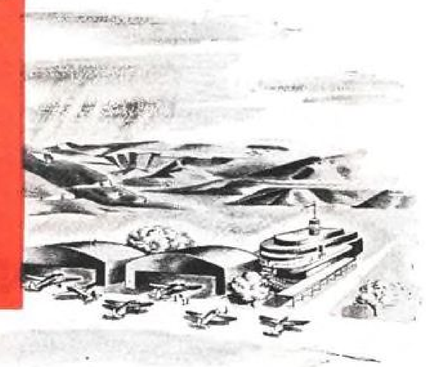
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IMPORTANT

P.S.*

Postscript to the purchase and maintenance of any aircraft is the availability of engine • • •



...*PARTS AND SERVICE

Right there is where Kinner really moves out in front. For, Kinner parts and service are *always* available. Not since the company built its first 3-cylinder engine 25 years ago has a Kinner ever been orphaned. Genuine Kinner parts are as close as an air-mail letter or wire. Kinner service is standing by, ready to help keep engines operating economically, keep planes in the air.



Kinner OMO* manuals are available—there's a new one just out on the R-56 engine. Kinner backs up aircraft owners and operators with a sound service and repair policy. Put your postwar flying on a sound basis with engines that are dependable and economical. Install Kinners—be sure you can *always* get engine parts and service. KINNER MOTORS, INC., Glendale, Calif., U.S.A.

* Operation, Maintenance, Overhaul

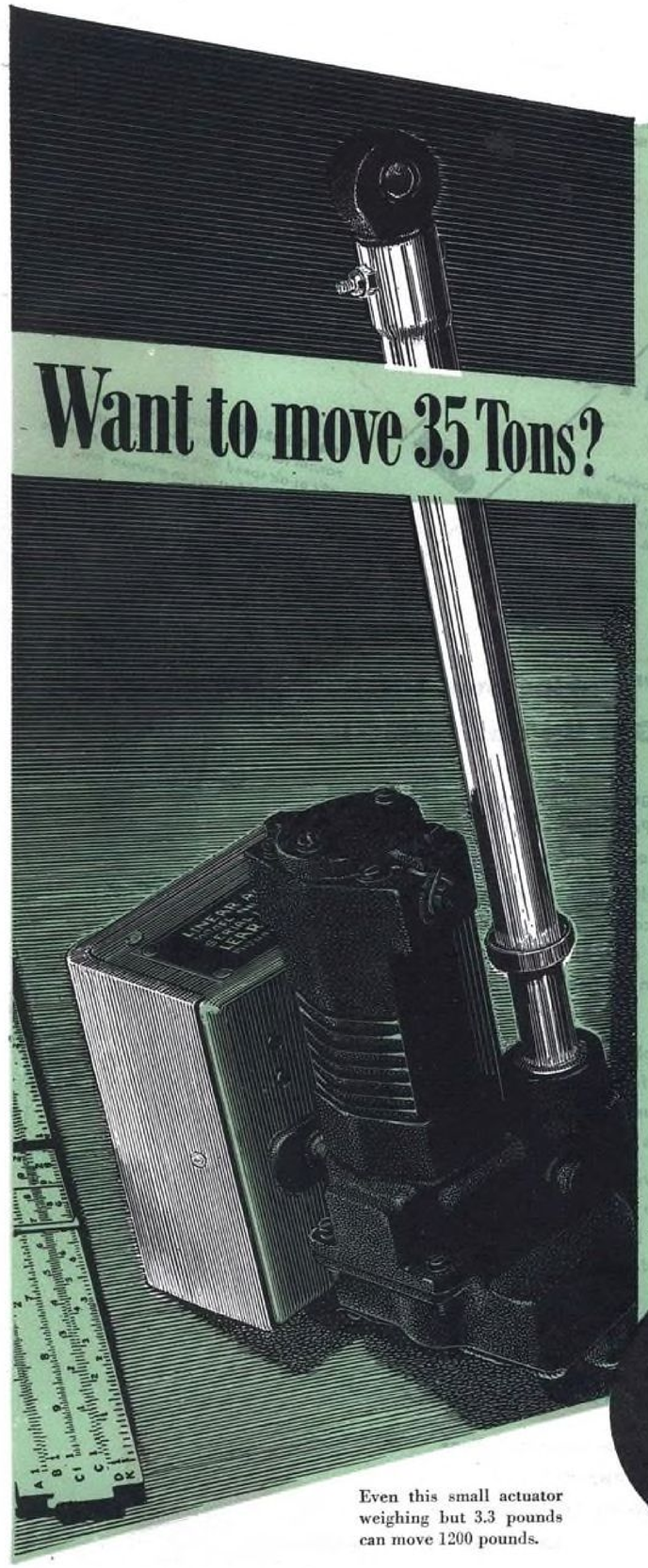


Send for your copy of "Ode to Perseverance." Story in verse of an engine at war with a world at war.

BUY WAR BONDS

Kinner

1919—BUILDERS OF DEPENDABLE AIRCRAFT ENGINES FOR A QUARTER CENTURY—1944



Want to move 35 Tons?

WE wouldn't tell you how fast America's fighting planes go. That's a military secret.

But we've all read it's well over 300 miles an hour.

We've read too how they hit 700 or 800 miles an hour in dives. And how paint was peeled by the air pressure.

Did you ever stop to think that the plane's flaps and controls have to work surely, smoothly and dependably against pressures like that?

It's done by such mechanisms as you see in the picture.

They are called Lear Actuators.

They are powerful. Some can push up to 75,000 pounds.

They are light. That's a "must" in aircraft.

They are small. They have to fit in available space.

A good many preconceived notions had to go by the board to meet all these requirements. For example, the little electric motor that runs them is full of revolutionary engineering refinements.

Every man and every minute we have now can't make all the motors and actuators that we would like to deliver for Uncle Sam's aircraft.

But the day is coming when they will have different jobs to do. New jobs on peacetime products—perhaps like steering ocean liners, or parking cars, or things we've never thought of.

That is one reason for this advertisement. We want to know who can use an actuator or a motor like these.

Another reason is, we want you to know that there is available the kind of thinking and engineering which have produced these and some 250 other Lear products.

Even this small actuator weighing but 3.3 pounds can move 1200 pounds.

LEAR AVIA INC. PIQUA • OHIO

FOR CRUISING, Aeromatic automatically maintains the most advantageous pitch . . . assures top cruising performance on minimum fuel consumption at any level up to critical altitude.

FOR TAKEOFF, with engine at full throttle, Aeromatic Propeller assumes low pitch automatically . . . gets plane off ground quickly . . . allows use of full takeoff power.

Here's Variable Pitch Performance . . . Automatically!

FOR CLIMBING, Aeromatic responds to natural forces . . . increases pitch automatically as air speed increases . . . gets plane to cruising level fast . . . on minimum fuel.

FOR LANDING, Aeromatic adjusts its pitch automatically for a long, flat glide . . . moves to low pitch instantly for quick pickup if pilot overshoots field.

"Propeller with a Brain" varies own Pitch → Gives Planes Real Get Up and GO!

TAKE a good look at those diagrams. They give you some idea of what the unique Aeromatic Propeller holds in store for buyers and flyers of the private planes of tomorrow.

Completely self-contained and self-acting, the Aeromatic Propeller requires no instruments . . . no controls . . . nothing for the pilot to watch or do. Responding to natural forces, it automatically assumes the correct pitch position for peak performance under all flight conditions.

That means a fully-responsive plane all the way . . . great flyability and flexibility . . . use of full engine power at rated speed . . . minimum engine wear and fuel consumption . . . simple, safe, economical operation that makes flying real fun.

Now seven years old . . . conceived, built, approved by CAA and test-flown for 5,000 hours before Pearl Harbor . . . the Aeromatic Propeller today is being used in military aircraft from 100 to 450 HP. Complete technical information and engineering cooperation are available now.

Aeromatic

The Propeller with a Brain — for Tomorrow's Plane

Air Controlled — *Automatic Propeller*

Licensed under Patents of Everel Propeller Corporation

KOPPERS Company • Bartlett Hayward Division • Baltimore 3, Maryland.

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set new standards of accuracy and strength in aircraft fasteners



CLEVELAND *Top Quality* **FASTENERS**

The Cleveland Cap Screw Company

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ALLOY AND AIRCRAFT PARTS DIVISION

MADE BY THE ORIGINATORS OF THE KAUFMAN PROCESS FOR GREATER STRENGTH AND ACCURACY

If you're asking for a "better connection"

★ Whether on the telephone line over which you are talking to a customer or on the air, oil, gasoline or water line of your plane—*it's good to have a good connection!*

Plane builders who have used AFCO Fittings have discovered they are more than simply connections for tube, pipe and hose. Threads are cleaner and sharper. Holes are perfectly reamed. Trying to find chaser marks, so evident on fittings produced by speed alone, is as useless as searching for the needle in the haystack. And that bright, protective finish—as well as threads—is guarded in shipment by individual paper caps and special spacers which prevent cutting, nicking and burrs.

Many leading aircraft manufacturers have shown decided preference for AFCO Fittings. They have chosen fittings bearing this quality mark for every type of plane from small private models to the largest bombers and cargo carriers. Right now, some of these wartime customers also have AFCO working on their problems of special fittings for the sky ships of tomorrow.

It probably will not be too long before that postwar plane must go into production. So, if you're asking for a "better connection" . . . *better ask AFCO!*



AFCO *Fittings*

NEW "AN" TUBE, PIPE AND HOSE FITTINGS

FITTINGS OF QUALITY FOR PLANES OF WAR AND PEACE

The Aircraft Fitting Company • 1400 East 30th Street • Cleveland 14, Ohio

AIRCRAFT INSTRUMENTS

by GENERAL ELECTRIC



Third in a series showing a few of the many AIRCRAFT INSTRUMENTS that G-E is now producing

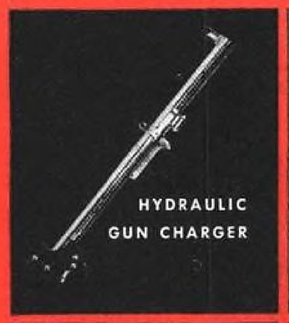
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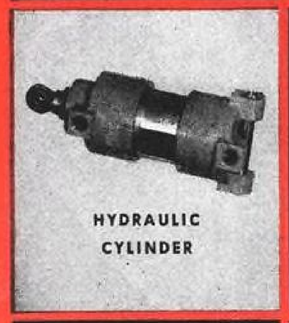
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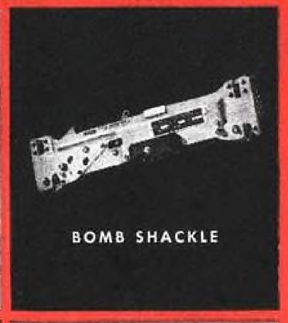
Interstate

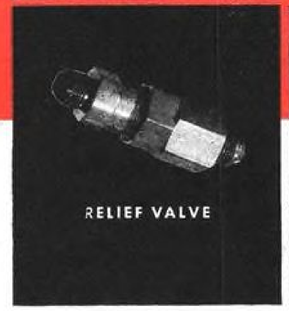
DESIGNS THEM

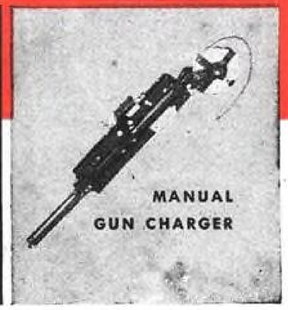

HYDRAULIC GUN CHARGER


3-WAY SELECTOR VALVE


HYDRAULIC CYLINDER


BOMB SHACKLE

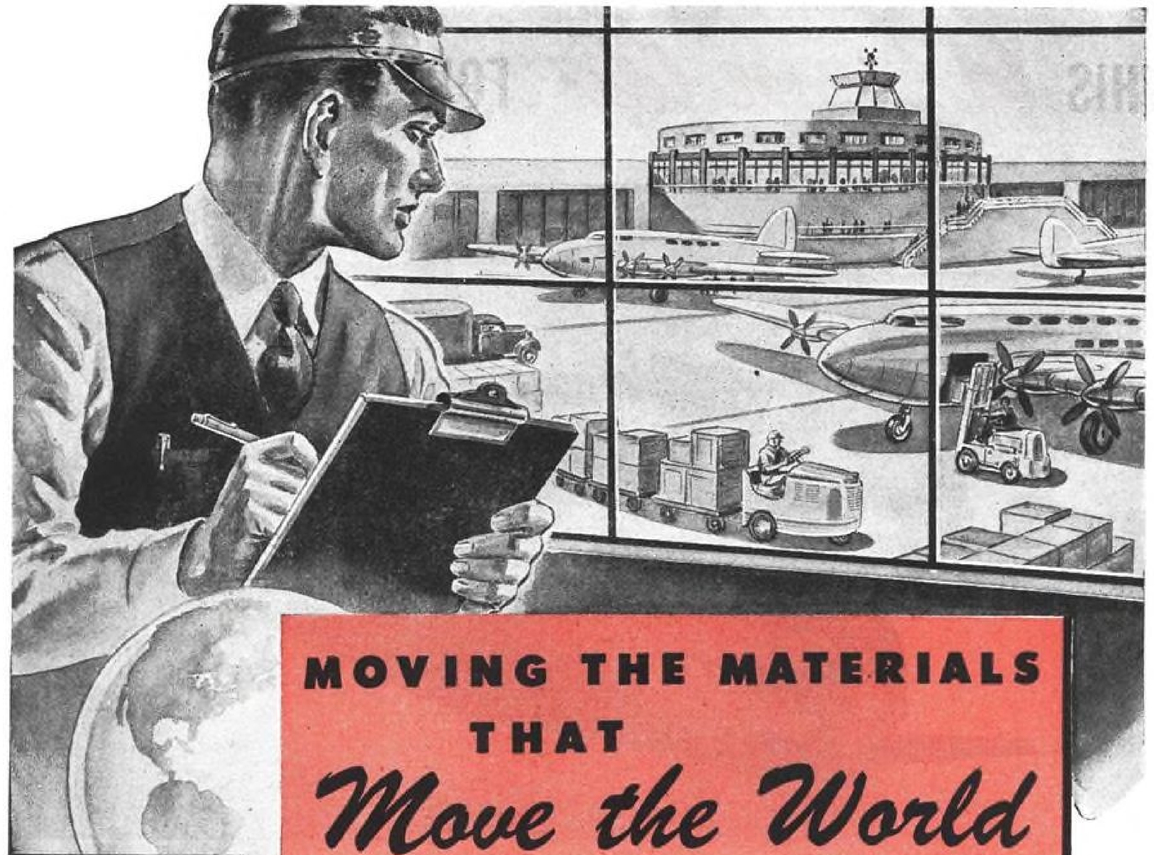

RELIEF VALVE


MANUAL GUN CHARGER

BUILDS THEM

Here are a half dozen typical examples... not only of Interstate's precision-production but original engineering. In each instance Interstate engineers designed the complete unit... to meet a definite aircraft need. In each instance the unit has proved its outstanding performance in thousands of installations. For detailed information about these and other precision units, address Sales Department...

INTERSTATE AIRCRAFT AND ENGINEERING CORPORATION • EL SEGUNDO, CALIFORNIA



MOVING THE MATERIALS THAT *Move the World*









PLANNED materials handling go hand in hand with planned production—

—Costs go down, manpower is saved, time conserved and more floor space is available when Clark Fork Trucks and Tractors are on the job.

"Unskilled labor adds nothing to a product except cost."

Postwar engineering help is available NOW. Write, as we are ready to serve you.

***A Product of* CLARK EQUIPMENT COMPANY**

CLARK TRUCTRACTOR
DIVISION OF CLARK EQUIPMENT COMPANY
BATTLE CREEK, MICHIGAN, U.S.A.

THIS *Warm Up* FOR "HOT SHIPS"...



needs controls that can take it!

WHEN aviation cadets begin simulated combat work, practice cross-country and tight-formation flying and learn how to land on small fields in these advanced trainers, plane controls really come in for a beating.

Controls must function not only as perfectly and sensitively as in the finest combat planes but they must have an extra margin of strength to take the punishment a heavy, unaccustomed hand on the stick can deal out.

That's why American Tiger Brand Control Cables are used in these famous trainers.

With ample strength to handle maximum loads, these high-quality cables combine lightness, minimum stretch, excellent flexibility and superior resistance to fatigue, wear and corrosion. They are of Excellay Preformed construction which further assures flawless performance. You'll find them used in America's most famous combat and commercial planes.



AMERICAN *Tiger Brand* **CONTROL CABLES**

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

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LIQUID PACKAGING *for Aircraft Parts!*

WHIZ RUST PREVENTIVE COMPOUNDS (Thin Film, Polar Type)

WHIZ AIRCRAFT PRESERVATIVE COMPOUND (Paralketone Type)

WHIZ RUST PREVENTIVE COMPOUND (Paralketone Type)

WHIZ CORROSION PREVENTIVE COMPOUND (For Aircraft Engines and Parts)

AND OTHER SPECIAL COMPOUNDS

A complete line of rust and corrosion preventive compounds is manufactured by R. M. Hollingshead Corporation, a major supplier for Army and Navy aircraft. There are WHIZ compounds—conforming fully to Government specifications—for the protection of internal and external surfaces.

Applied to plane parts and weapons by spraying, swabbing, or dipping—depending on type—this "liquid packaging" eliminates the risk of rust and corrosion from factory to battleline . . . is easily, quickly removed—*if* removal is required.

Your inquiries about these protective compounds will receive prompt attention. Our engineers are ready to work with your engineers in designing special chemical products to meet your particular needs. *R. M. Hollingshead Corporation, Camden, N. J.; Toronto, Canada.*

Also makers of Whiz Hydraulic Fluids, Compounded Lubricants, Lubricating Oils, and Cleaning Compounds for aircraft.

Whiz **Hollingshead**

LEADER IN MAINTENANCE PRODUCTS

BUY ORE WAR BONDS AND STAMPS NOW!

When Victory is Won!

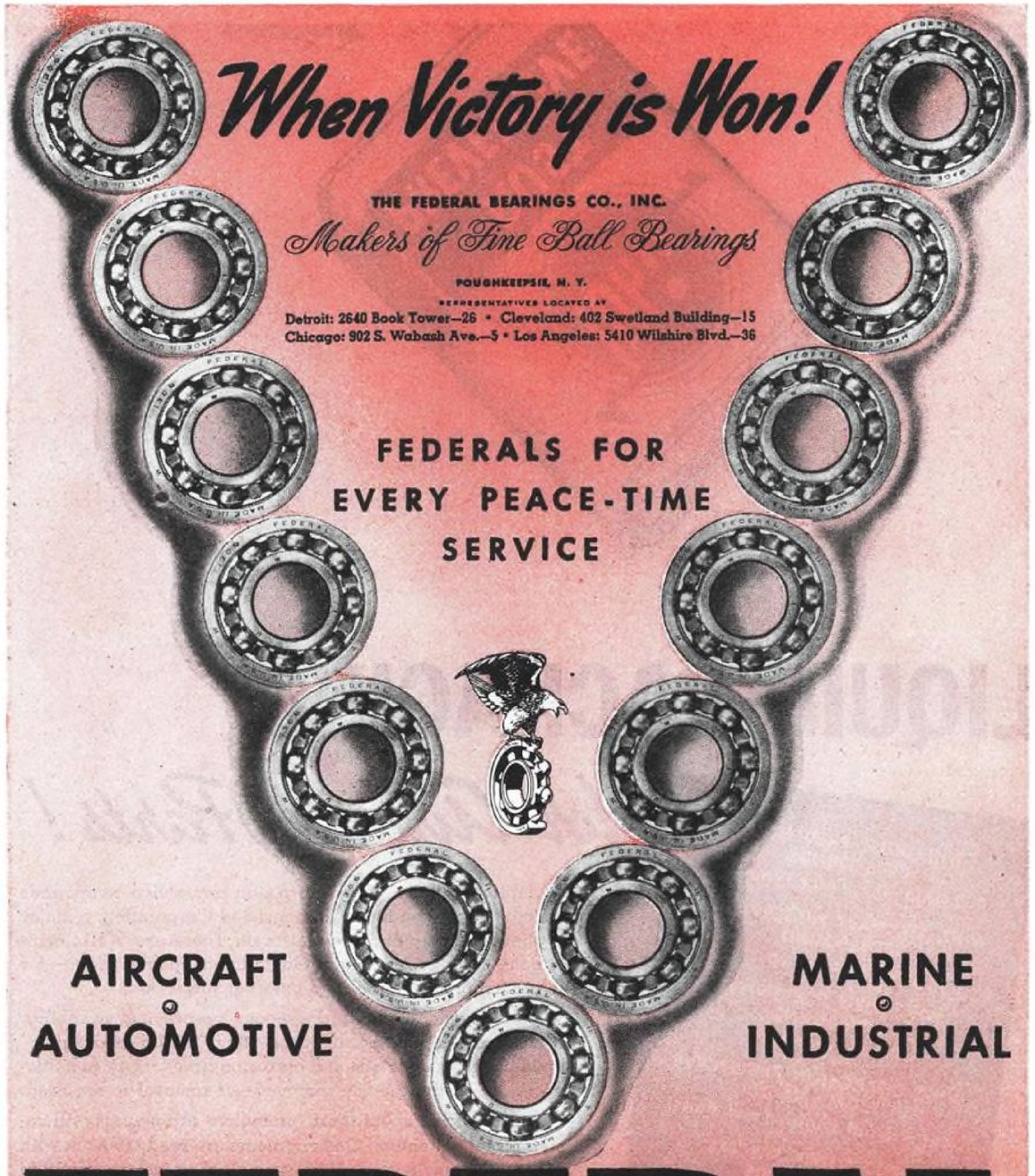
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Makers of Fine Ball Bearings

POUGHKEEPSIE, N. Y.

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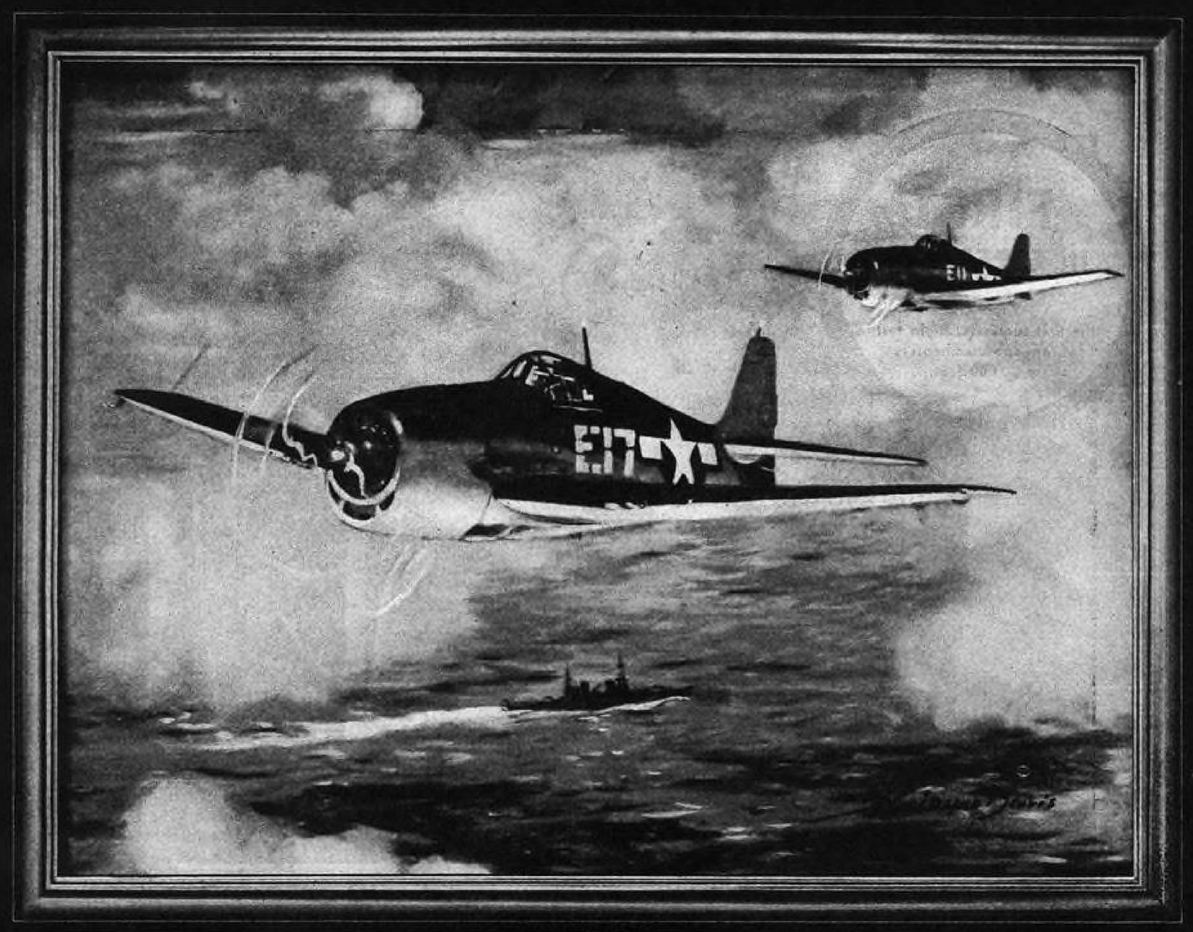


FEDERALS FOR EVERY PEACE-TIME SERVICE

AIRCRAFT
AUTOMOTIVE
MARINE
INDUSTRIAL

FEDERAL
BALL BEARINGS

Grumman



U. S. Navy's Grumman Hellcats in Action off Saipan

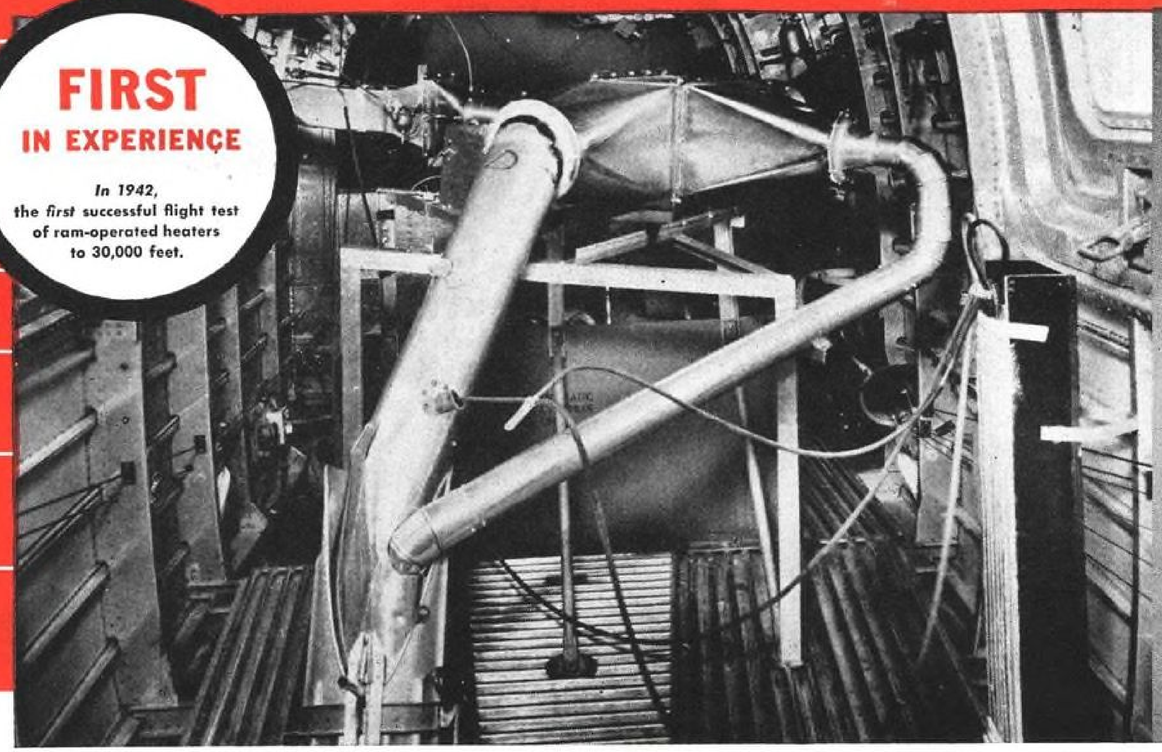
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AIRCRAFT ENGINEERING CORPORATION, Bethpage, L. I., N. Y.

South Wind . . . . . FIRST IN HEATING

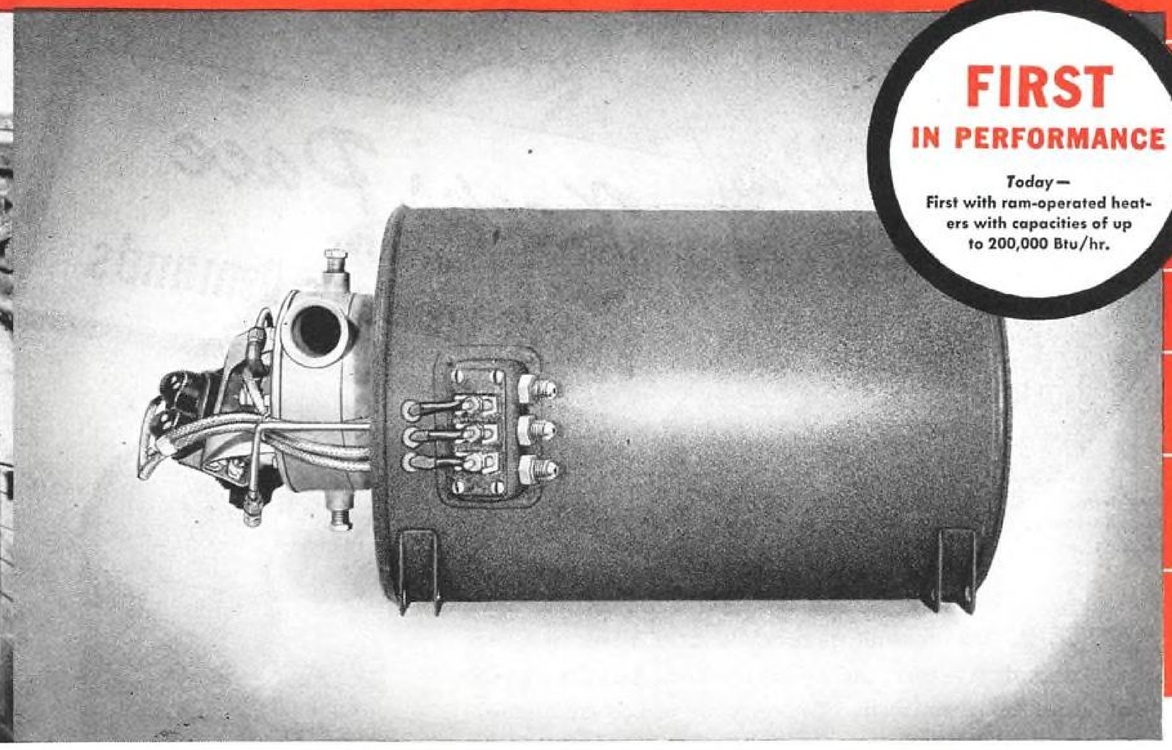
FIRST
IN EXPERIENCE

In 1942,
the *first* successful flight test
of ram-operated heaters
to 30,000 feet.



FIRST
IN PERFORMANCE

Today—
First with ram-operated heaters with capacities of up to 200,000 Btu/hr.



Test set-up for flight described below. COURTESY OF CONSOLIDATED-VULTEE AIRCRAFT CORPORATION

CRUDE and ungainly by present-day standards, the tube bundle type ram-operated heater shown above represented another South Wind "first" in the development of aircraft heating equipment. Installed in a B-24 Bomber for test purposes, it demonstrated that a ram-operated heater, completely independent of the aircraft engines, could operate under flight conditions at altitudes as high as 30,000 feet. In the Spring of 1942, that was news.

The results of this historic test flight were above expectations, with the result that plans were made for the first production installation of a ram-operated heater—the empennage anti-icing heater in the PBY airplane.

Improvements that put today's South Winds far ahead have followed steadily—and still continue. But again, that "famous first" showed South Wind FIRST IN EXPERIENCE, FIRST IN PRODUCTION, FIRST IN PERFORMANCE—a leadership that has yet to be seriously challenged!

TODAY, South Wind's leadership in development of ram-air operation has resulted in a whole series of additional "firsts"... both in heaters and in important accessories like the South Wind Fuel Metering Control.

South Wind Model 911-A, for instance, with its revolutionary heat-to-weight ratio of nearly 10,000 Btu/lb., is an example of South Wind's leadership in performance today. Scarcely larger than an office waste basket, this dependable South Wind has been designed to be as simple and sturdy as could be—yet it can deliver over 200,000 Btu/hr.

Whatever your heating needs, South Wind engineers can put at your service more experience—more flight and laboratory data—higher-performance equipment than any other source. Call on South Wind for the engineering service, and production that has delivered more aircraft heating capacity than all other makers combined. Remember—South Wind is the "first" in heating.

Another Product of STEWART WARNER

South Wind
REG. U. S. PAT. OFF.
Heating

HEATER DIVISION, STEWART-WARNER CORPORATION, CHICAGO 14, ILL.

West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service
1273 Westwood Boulevard, West Los Angeles, California

CLECO PRODUCTION...



Keeps Pace with the Aircraft Industry's Demands

A Cleco riveter working on the famous Lockheed "Lightning"

THERE are dozens of models and sizes of Cleco aircraft riveters, many styles with handles made of steel or aluminum. These tools strike accurately controlled blows, causing the rivet metal to flow uniformly without structural deterioration. Their use insures tight rivets, and avoids damage to the metal being riveted. Write for Bulletin 85.

OTHER CLECO RIVETING EQUIPMENT

We also make an extensive line of squeeze riveters. Let us tell you about the new Type "P" triple-safe Cleco sheet holders. Our new RIV-N-JECTORS, for inserting rivets, save 90% of the rivets lost when handled by hand. Write for information.

BUY U. S. WAR BONDS AND STAMPS

POPULAR CLECO AIRCRAFT RIVETERS





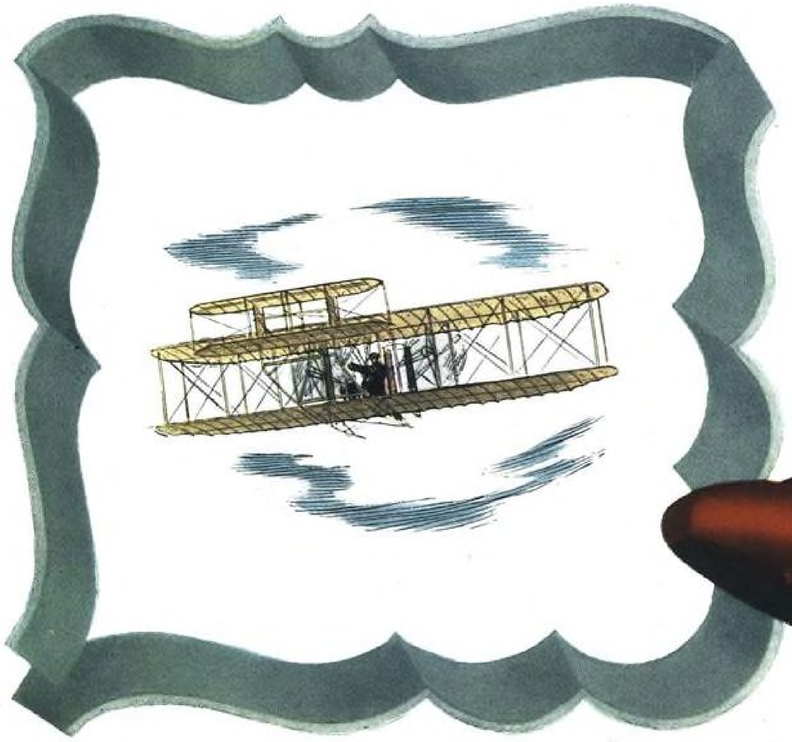
Inserting Cleco Type "P" Sheet Holders

THE CLEVELAND PNEUMATIC TOOL CO.
3781 East 77th Street Cleveland 5, Ohio
Branch Offices in All Principal Cities



NEW STANDARDS IN AIR TRANSPORTATION

1903—First standards for "flying machines" were set by the Wright brothers at Kitty Hawk when their fragile biplane stayed in the air for twelve long seconds and flew the unbelievable distance of 120 feet.



1944 Lockheed Constellation

SETS NEW WORLD STANDARDS IN PERFORMANCE

Air transportation has reached a remarkable degree of efficiency since the Wright brothers first flew 41 years ago — progress which has reached a new peak in Lockheed's Constellation.

After the war, when it flies the airlines of the world, the new standards set by the Constellation will help make all countries neighbors. Town connector, continent spanner and empire blazer, it not only shrinks space and time, but brings new safety, comfort and economy to air travel.



LEADERSHIP IN PERFORMANCE

Highest cruising speed of any transport ★ Longest range of any transport ★ Greatest load-carrying ability of any transport ★ Highest rate of climb of any transport ★ And these performances make the Constellation the safest of any transport



QUESTIONS

Q. Was special equipment used on the Constellation to set the 7-hour transcontinental speed record?
—L. R. K., Mobile

A. *No. It was a production line Constellation flying at cruising speed. Could do better if pushed.*

Q. Could the Constellation stop at our town's airport?
—S. K., Webb City, Mo.

A. *If an airliner can stop there now, the field is big enough for a Constellation.*

Q. How far can the Constellation fly — non-stop?
—Gene K., Kansas City, Mo.

A. *Actual figures are still secret. But it will span a continent with range to spare.*

Q. What does cabin pressurization mean? —L. S., Boston

A. *It means greater passenger comfort. "Pressurization" means that no matter how high the plane flies, comfortable cabin pressure is maintained at varying altitudes—controlled by the flight engineer—independently of how fast the airplane climbs or descends.*

Send in your questions. Address: Lockheed Aircraft Corporation, Department 69-55, Burbank, California

LOCKHEED

FOR DEPENDABILITY IN FLIGHT

LOOK TO *Lockheed* FOR LEADERSHIP



Interior of an Airfreighter. Tubular articles up to 12 feet long and bulk articles up to 26 x 36 x 72 inches can be handled.

New Wings FOR AIR FREIGHT



American Airlines' new Flagship Airfreighters are making coast-to-coast freight delivery a smooth one-day achievement. With facilities adapted to both bulky and fragile shipments, the Airfreighters have the greatest cargo capacity of present commercial planes.

That means new tonnage records for American in air transportation of east and westbound transcontinental cargoes.

These big Airfreighters and American's great fleet of 21-passenger Flagships are lubricated with Sinclair Pennsylvania Motor Oil. American Airlines has used Sinclair Pennsylvania exclusively for more than 10 years.

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FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

Meeting the most exacting requirement of AIRCRAFT MANUFACTURE . . .



FASTENERS { Bolts, Nuts, Rivets, Screws

Prove their absolute dependability and long-range economy

Proved in the most exacting manufacturing program the world has ever seen, Industrial Fasteners provide economical and dependable security wherever metal parts are joined.

When aircraft and engine manufacturers responded so magnificently to the call for airplanes—and more airplanes—they needed bolts, screws and rivets in unheard-of quantities and of the highest degree of uniformity and quality. To produce these, the fasteners industry responded enthusiastically—installing new equipment and establishing manufacturing procedures that would turn out by the millions, fasteners of all types and sizes meeting the rigid specifications.

Without this ample supply of dependable fasteners, the present system of sectional airplane assemblies, precision-made and bolted or riveted together, would have been impossible. Here again, American ingenuity, initiative and manufacturing skill have contributed the dependability and security needed for one important phase of our war effort.

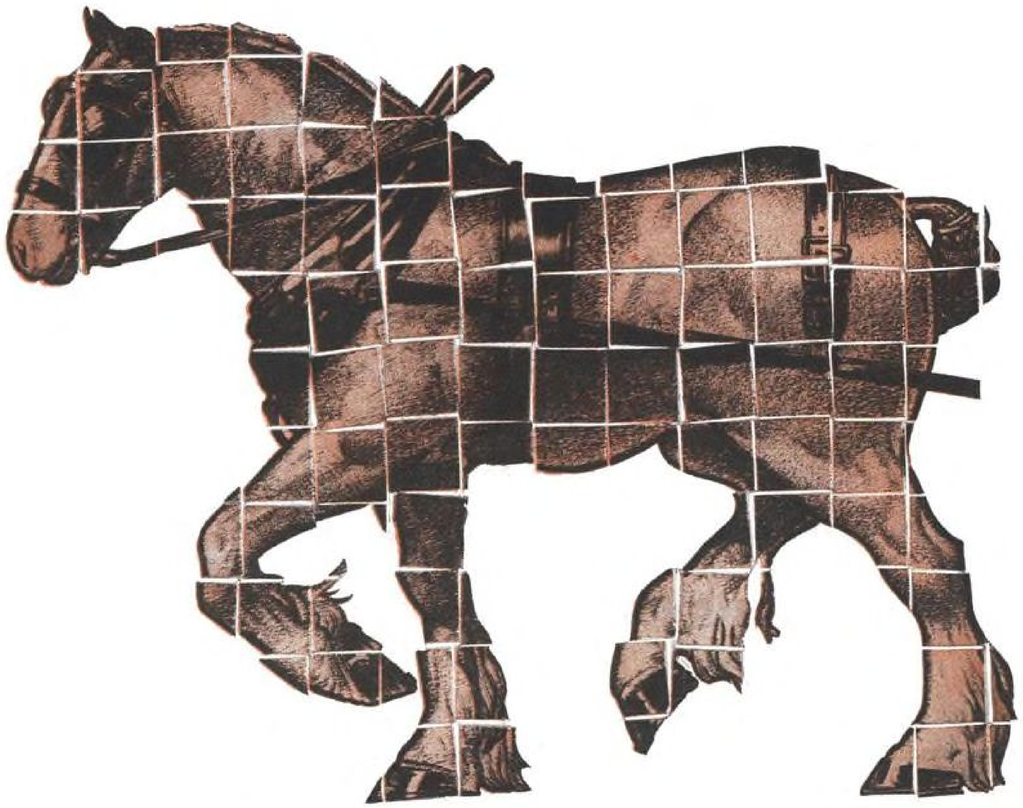
American Institute of Bolt, Nut and Rivet Manufacturers

1550 Hanna Building

CLEVELAND 15, OHIO

TECHNICAL DATA published regularly in FASTENERS, free to operating and engineering men. Write today.





James Watt's **horse** has been divided into 100 parts

For centuries "One Horsepower" had meant simply the work that one horse could do.

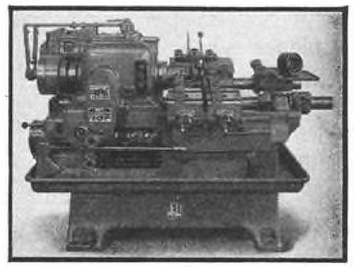
Then, 175 years ago, James Watt gave the term its modern meaning when he borrowed a husky dray horse from an obliging brewer and put the animal to the test. By means of tackles and weights, and some paper work, he determined that the horse could raise 1000 pounds at the rate of 33 feet per minute. So we got our familiar equation, ... 1 horsepower = 33,000 foot pounds per minute.

This was a lot of power—ideal for draught work—useless for the smaller, more tedious tasks such as operating a razor, a needle, a fan or an egg beater. Only a visionary would have thought of this.

But, the advent and development of electrical power condensed Watt's horse and divided him into a hundred tiny fractions. Power far greater than his is now packed into less than a cubic foot, and fractions of him fit neatly into the palm of your hand.

Tomorrow, these tiny, useful fractions of horsepower will take over more and more of our trivial, but tedious, work. For, today, men with ideas have the help of the makers of modern, fast, accurate machine tools.

For over a century, Jones & Lamson engineers have been helping our most progressive manufacturers to put their newest ideas into profitable production. This accumulation of experience and knowledge is at your service today.



A Jones & Lamson Fay Automatic Lathe tooled to machine the frame for a small electric motor. Fay Automatic Lathes are used extensively to machine parts for all kinds of domestic appliances, that add to our comfort and lighten our work.

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MACHINE COMPANY
Springfield, Vermont, U.S.A.

Profit-producing Machine Tools

Manufacturers of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.



Motor "Job Analysis" provides smooth, compact power

Blue-print machine powered by a Holtzer-Cabot motor

Experience proves that by giving advance consideration to such operating factors as torque, load cycles, starting load, reversibility, acceleration, quietness . . . then building a motor that meets the exact performance conditions . . . machines operate more efficiently and economically with less maintenance.

Since standard off-the-shelf motors cannot meet all performance requirements, the solution is a special motor . . . designed and built by Holtzer-Cabot.

For over 50 years Holtzer-Cabot has concentrated its energies in designing and building special motors to meet special operating conditions.

Today, our plant facilities are being utilized for manufacturing special fractional H.P. motors for war products, but our motor development engineers will gladly discuss your post-war fractional H.P. motor problems and requirements with you.

SPECIAL MOTORS DESIGNED TO FIT THE APPLICATION

HOLTZER-CABOT
Division of First Industrial Corporation

Designers and Builders of Special Fractional HP Motors and Electrical Apparatus

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U. S. Patent Re 18144

WALDES TRUARC RETAINING RING

Waldes Truarc presents a significant advance in retaining rings.

It spreads or contracts without distortion; always retaining its perfectly fitting circular contour.

For thrust-load fixing, shaft and housing applications, Waldes Truarc provides distinct advantages over nuts and bolts or wedges and washers. It reduces dimension and weight, saves material, cuts manufacturing time . . . simplifies assembly and dis-assembly.

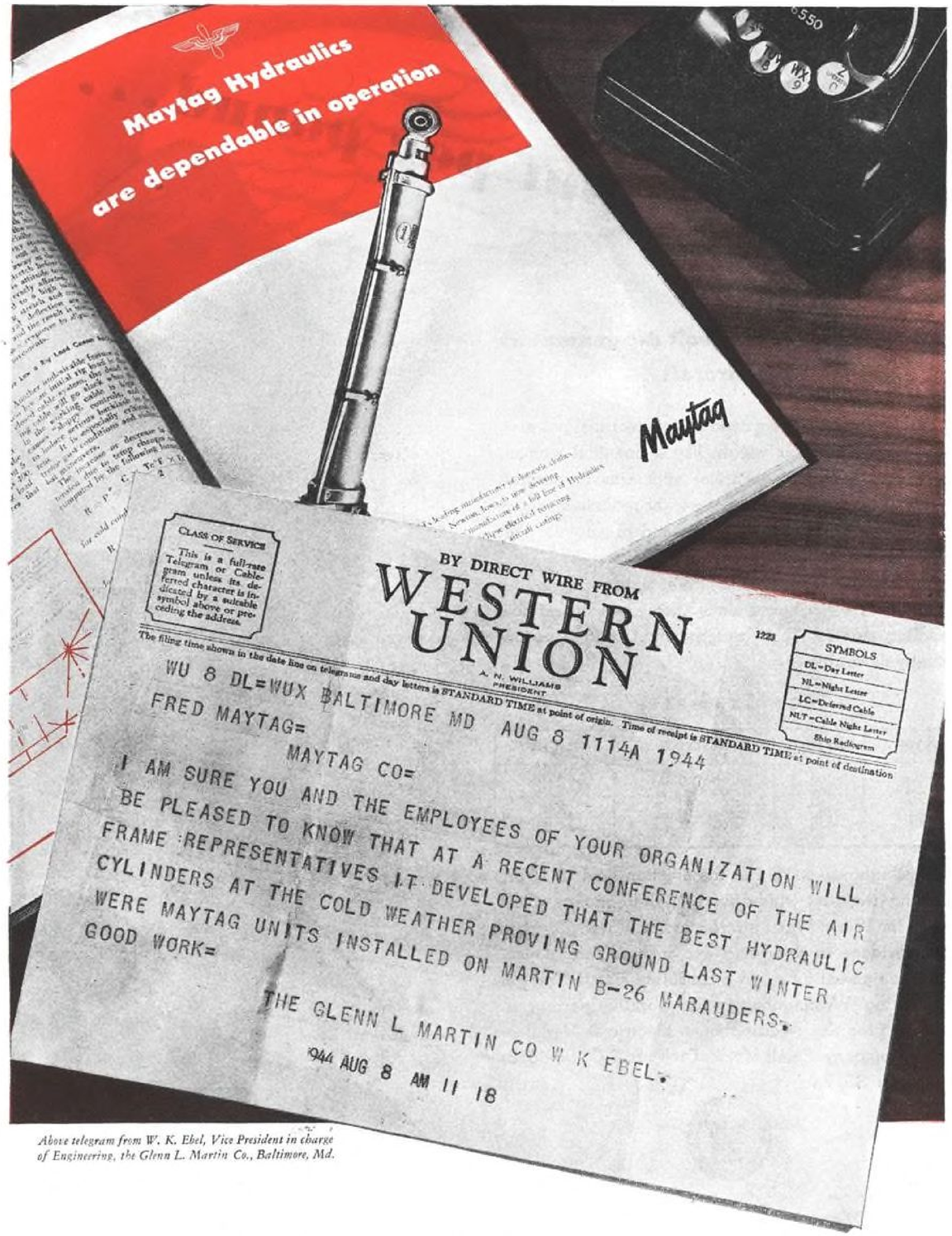
On request, we will gladly furnish samples and full data for your tests.



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Sole Manufacturers in U. S. A.

CANADIAN REPRESENTATIVES: Prenco Progress & Engineering Corp., Ltd., 72-74 Stafford St., Toronto



Above telegram from W. K. Ebel, Vice President in charge of Engineering, the Glenn L. Martin Co., Baltimore, Md.

FOR MANY YEARS the world's leading manufacturer of domestic clothes washers, The Maytag Company, Newton, Iowa, is now devoting all of its efforts and facilities to the manufacture of a full line of Hydraulics of exclusive design . . . together with Eclipse electrical retracting units . . . and many types of aluminum alloy aircraft castings.

Maytag

More output per pound . . .

with this line of 28.5-volt d-c generators for aircraft

Fighters and bombers need lots of electrical power—but they watch their weight like a beautiful woman.

Yet the design of electrical apparatus for aircraft must consider more than just weight reduction—there are factors of vibration, cooling, and brush wear that must be met.

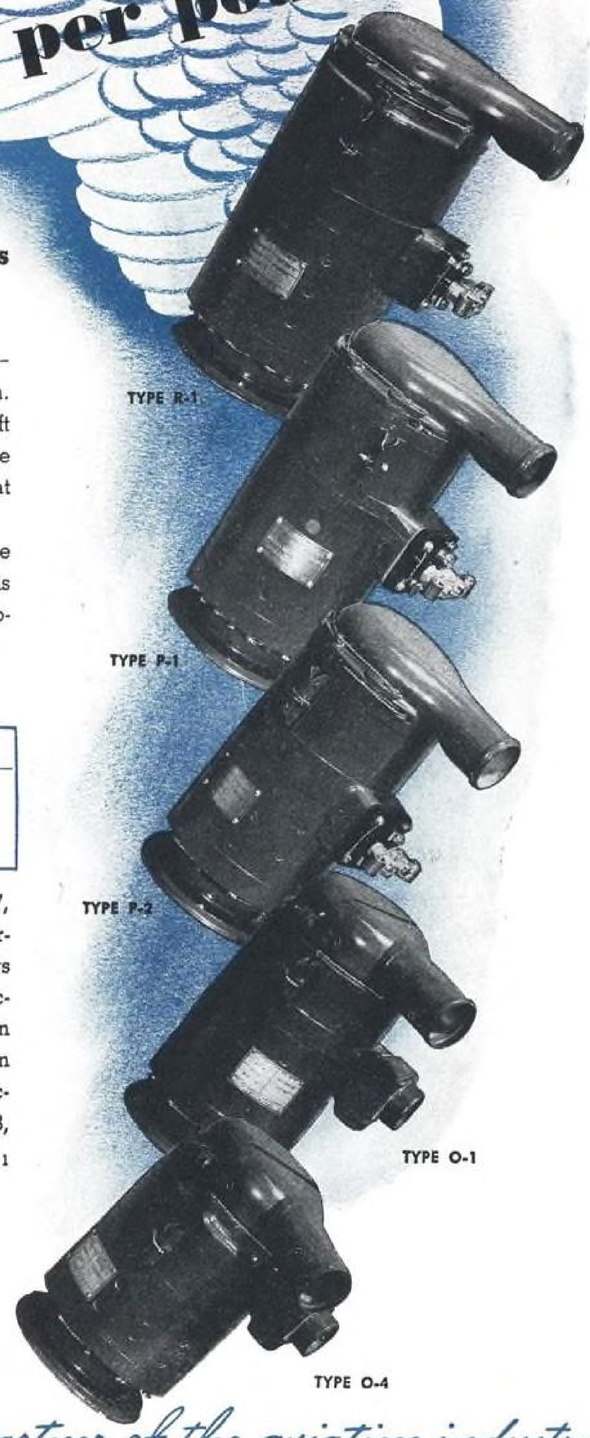
The five d-c generators shown at right represent the range of Westinghouse units that are meeting this exacting service. Their weight-output ratio is exceptionally favorable.

FOR EXAMPLE:

TYPE	AMPERES	SPEED	WEIGHT
O-4	100	4000/8000 rpm	23 lbs.
O-1	100	2500/4500 rpm	33 lbs.
P-2	200	4000/8000 rpm	37 lbs.
P-1	200	2500/4500 rpm	44½ lbs.
R-1	300	4400/8800 rpm	48¼ lbs.

Westinghouse started in the aviation field in 1917, building the first wind-driven, high-frequency alternators for World War I aircraft radios. These 27 years of experience in designing and manufacturing electrical equipment for aircraft constitute a sound reason for making Westinghouse your working partner in aviation progress. Westinghouse Electric & Manufacturing Company, Small Motor Division, P.O. Box 868, Pittsburgh 30, Pa.

J-03211



Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

for 27 years the electrical partner of the aviation industry

Safeguard Product Performance with

MORAINE POROUS METAL

(Commonly known as POREX)





Filter Out Harmful Particles—
Separate Undesirable Fluids—
Protect Precision Parts and Fine Surfaces

If your product by the very nature of its design requires a clean actuating or lubricating medium, such as fuel, air or oil, you should by all means investigate Moraine Porous Metal, commonly known as Porex.

To put it simply, this unique metal can be put to work where it is desirable to *keep something out* and *let something else in*. Examples: A *filter* element to protect fine orifices of Diesel injector nozzles from dirt in the fuel, or to protect bearings from dirt in lubricating oil; a *separation* element to remove oil from the refrigerant; a *breather vent* to allow for motor breathing and at the same time prevent a spark from igniting combustible air outside an explosion-proof electric motor.

Whether the function is filtration, separation, diffusion or flow control, Moraine Porous Metal (Porex) provides exceptional efficiency because of its *tortuous flow passages*—the result of unique structure attained by powder metallurgy. Moraine Products Division, General Motors Corporation, Dayton, Ohio.

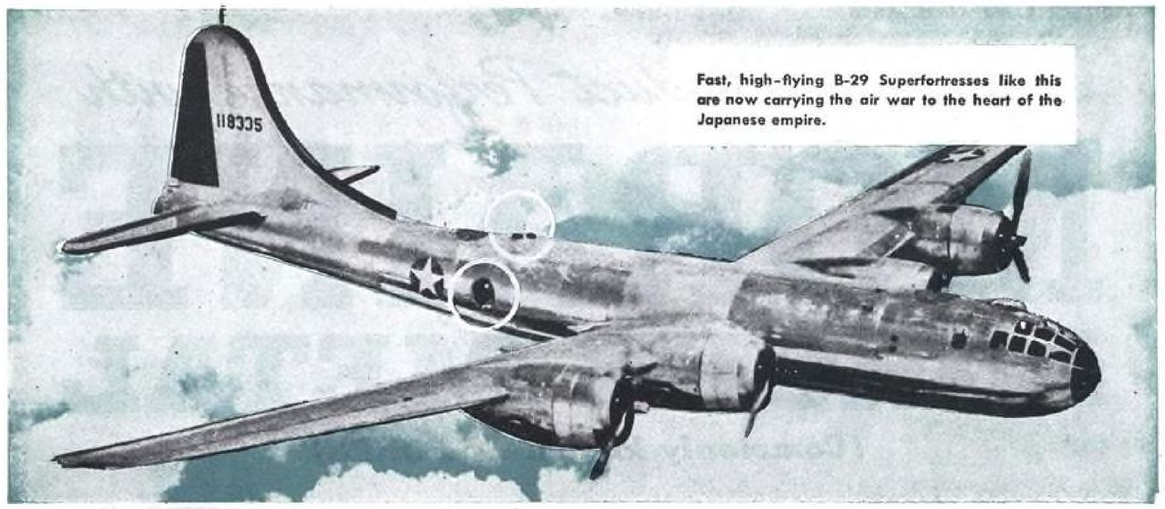






WAR BONDS SAVE LIVES

MORAINE PRODUCTS DIVISION OF GENERAL MOTORS
DAYTON, OHIO



Fast, high-flying B-29 Superfortresses like this are now carrying the air war to the heart of the Japanese empire.

Crew of new B-29 gain better protection during pressurized high altitude flying

WITH ENCLOSURES OF LAMINATED "LUCITE"-"BUTACITE"!

CREWS of the Boeing B-29 Superfortresses fly long distances at heights of 30,000 feet and in more comfort and warmth because of the superbomber's pressurized cabin.

Unprecedented in military planes, the pressurized cabin allows temperatures to be maintained at normal or near-normal—no matter how high the altitude.

Top and side turrets of Du Pont laminated "Lucite"-"Butacite" afford clear vision for the crew. Also the possibility of a major rupture by flak or bullets is eliminated, due to tendency of the interlayer of "Butacite" to seal a bullet hole or limit it to a small area even under pressure.

In the event of penetration, the hole is confined to the area of the actual point of impact, and it can be easily and quickly patched in flight with a prepared disc of "Butacite."

In addition to these advantages, the light weight and ease of forming and mounting make enclosures of laminated "Lucite" methyl methacrylate resin and "Butacite" polyvinyl butyral resin sheeting applicable to a wide variety of aircraft uses.

FULL FACTS: A new 28-page "Progress Report" on this laminate gives technical information on proof tests, property graphs, and application. For the designing, specification, forming or fabrication of transparent plane enclosures, address E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., on your business letterhead for a free copy. Canadians write to Canadian Industries, Ltd., Box 10, Montreal.

• • •

A girl employee at the Boeing factory poses in one of the laminated "Lucite"-"Butacite" gunner's turrets in a B-29.

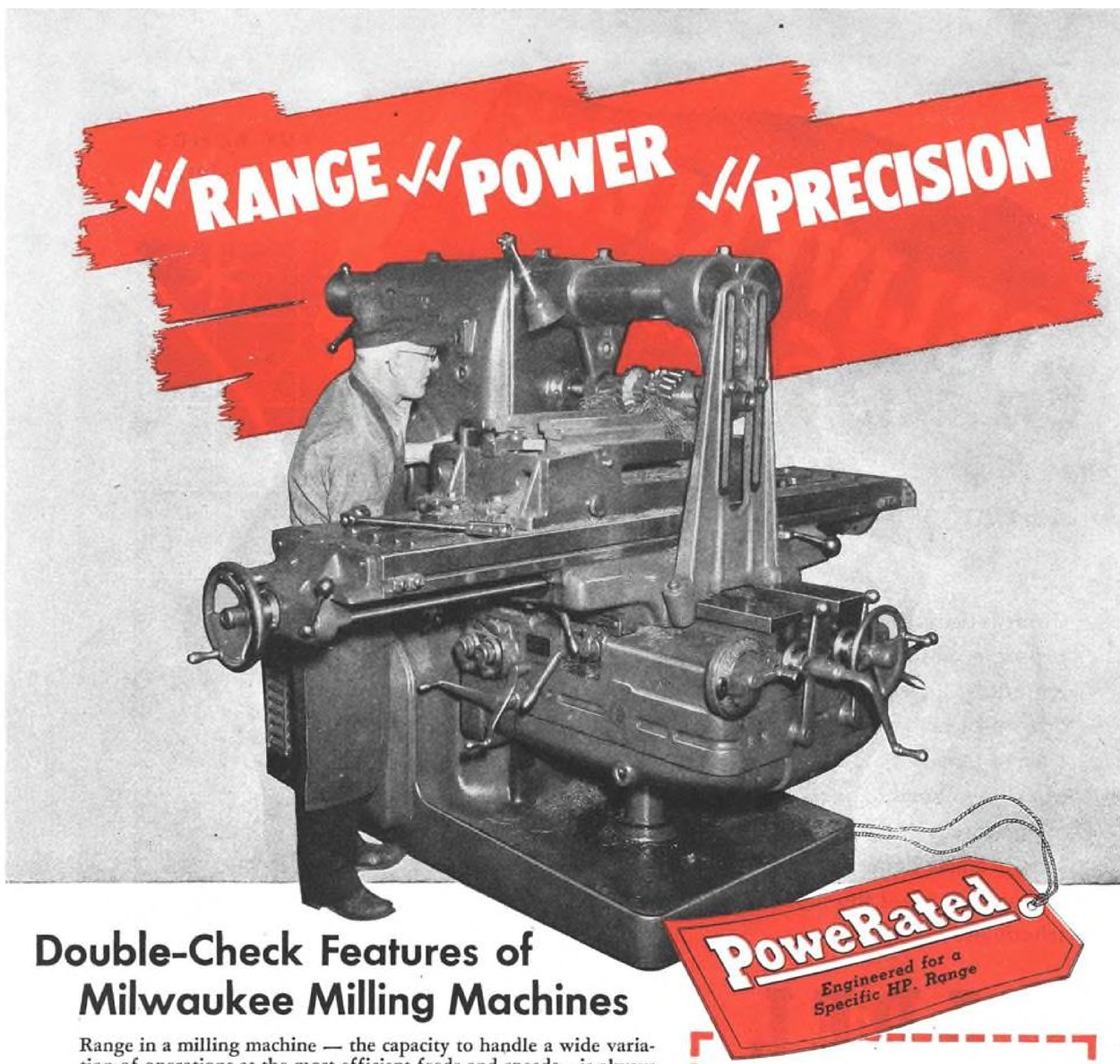


INVEST IN VICTORY—BUY WAR BONDS

DU PONT
REG. U.S. PAT. OFF.

DU PONT PLASTICS

Better Things for Better Living . . . *Through Chemistry*



Double-Check Features of Milwaukee Milling Machines

Range in a milling machine — the capacity to handle a wide variation of operations at the most efficient feeds and speeds—is always an important factor.

But today — with advancements in cutting tools — motor hp. is the important feature to be checked when purchasing milling equipment. Be sure the milling machine you are considering is power-engineered to do the job — designed and built in relation to and with ample motor power for the work for which it is intended.

There is no need to resort to the unsound practice of substituting a higher hp. motor to gain power. The range of models of Milwaukee Milling Machines makes available a machine PoweRated and properly engineered for every class of job.

All Milwaukees are PoweRated — power-engineered in keeping with their rated motor hp. plus the normal overloads. They are precision-built and are capable of sustained precision-performance throughout a long productive life.

Remember — think of feed and speed range for light cuts — adequate motor power for heavy cuts — the need for sustained precision performance at all times. Check with a Kearney & Trecker field engineer in deciding which PoweRated Milwaukee is best suited to your specific needs.

MEANS EVERY MILWAUKEE MACHINE IS POWER ENGINEERED TO DO THE JOB

Milwaukee PoweRated Milling Machines

- Standard Models — Horizontal, Vertical and Bed Types — available in Motor ranges from 3 to 25 HP.
- C.S.M. (Carbide Steel Milling) machines 20 to 50 HP.
- Special Machines—Consult K & T engineers.



Milwaukee Machine Tools

KEARNEY & TRECKER CORPORATION

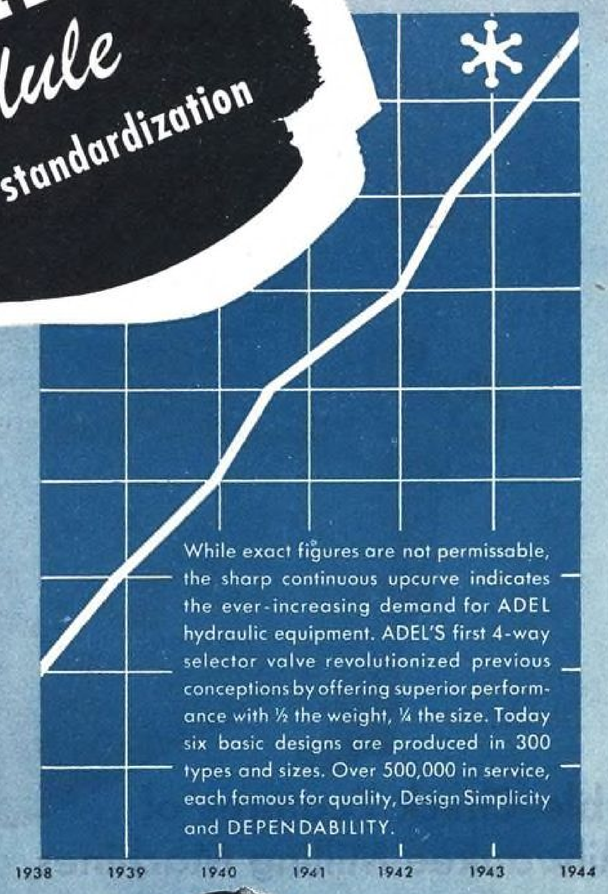
MILWAUKEE 14 WISCONSIN

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for Victory

DELIVERIES* on Schedule

thanks to customers' standardization

Completion of ADEL'S expansion program plus freer flow of essential materials, standardization of methods and reduction of worker turnover to a point below pre-war averages have combined to put an end to temporary congestion and permit us to promise deliveries on all *standard units* to meet the most exacting schedules.

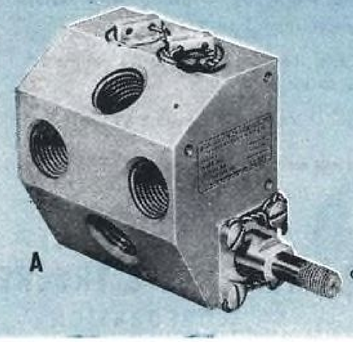


While exact figures are not permissable, the sharp continuous upcurve indicates the ever-increasing demand for ADEL hydraulic equipment. ADEL'S first 4-way selector valve revolutionized previous conceptions by offering superior performance with ½ the weight, ¼ the size. Today six basic designs are produced in 300 types and sizes. Over 500,000 in service, each famous for quality, Design Simplicity and DEPENDABILITY.

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A ADEL D10150 4-Way Selector AN 6210 "Mighty Midget" Weight 0.7 lb. Measures 1½" x 2¼" x 2¼" left or right hand available. Stacking units recommended for multiple controls.

B ADEL D8818 Fluid Metering Pump AN 6100 & 6102 Veteran of 7 years global service at all temperature extremes. Weight 2.75 lb., Capacity 2.5—30 GPH.

C ADEL Solenoid 4-way Pneumatic Valve No. 13381. Measures 3½" x 3-13/16" x 9" including handle. Opens bomb bay doors in 65/100th of a second—30 times faster than previous method.

After VICTORY . . . *the* ADEL-AGE

Threading Problems?

CALL "THE GREENFIELD MAN"



★ Located in every industrial area in the United States, "The Greenfield Man" is probably only a few minutes or hours from *your* plant. He is ready to bring you expert advice on any of your threading operations.

★ By maintaining the largest staff of specialized field men in the industry, the Greenfield Tap and Die Corporation *brings to you* its complete and extensive engineering, research and manufacturing experience and facilities.

★ Call *your* "Greenfield Man", through *your* Greenfield distributor, whenever you want help in any phase of threading.

Greenfield literature available on screw threading includes: "Facts About Tapping," "Choosing the Right Tap," and the new "Greenfield Catalog No. 44." Write for copies or any other specific information today.



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GREENFIELD TAP and DIE CORPORATION
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Firestone

PRODUCING FOR WAR .... PREPARING FOR PEACE



Of Course YOUR NEW PLANE WILL BE SAFE IN THE AIR ....

But HOW ABOUT ON THE GROUND?

TOMORROW'S passenger and cargo planes will fly the skyways of the world. They will touch their wheels upon the soil of many countries. But not every airport will be as smooth or as safe as La Guardia or Croydon or Le Bourget. Many emergency fields will be little better than clearings, often small and covered with mud. And tomorrow's planes must be able to land and take off safely on the WORST of these fields as well as on the best of them.

That is why so many aircraft designers have their eyes on the Channel Tread Airplane Tire, developed and pioneered by Firestone. They know that this remarkable tire gives maximum flotation and superior traction on wet and muddy fields and permits quicker braking on landing. They know it has been tried and proved on combat planes operating out of all kinds of fields during the war and that it is famous for long life and dependability.

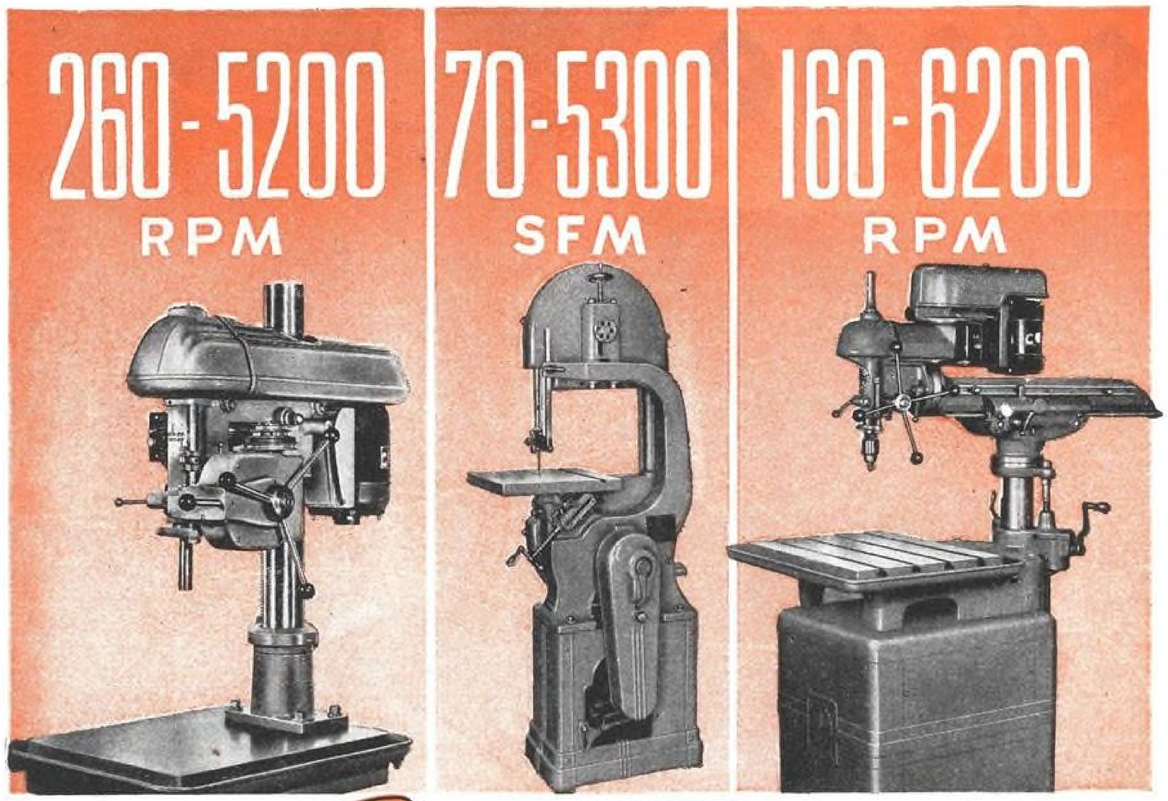
Would *you* like full information about Firestone Channel Tread Tires for *your* postwar planes and plans? A letter, wire or phone call will bring a trained Firestone aircraft engineer without obligation.

Listen to the Voice of Firestone with Richard Crooks and the Firestone Symphony Orchestra, under the direction of Howard Barlow, Monday evenings, over N. B. C.



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WITH WALKER-TURNER MACHINE TOOLS!

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Walker-Turner Machine Tools — because of their exceptionally wide ranges of cutting speeds — enable production men to hit the correct speed "on the button"! This gives Walker-Turner Machine Tools versatility for handling all materials in all types of operations . . . from every-day production to complicated, special tooling set-ups. These qualities may prove the answer to your own problems. Write for our catalog today!

WALKER-TURNER CO., Inc., Plainfield, N. J.

Walker-Turner
Machine Tools Offer These Advantages:

- Versatility
- Rugged construction
- Safe, simplified operation
- Low power consumption
- Low capital investment
- Low operating and maintenance cost

RADIAL DRILL — Drills to center of 62" circle. Head tilts 45° right or left. Maximum distance nose of chuck to table, 13½". Spindle traverse, 3¾". Chuck capacity, ½".

METAL-CUTTING BAND SAW — 14" and 16" models. Geared speed reducer. Table tilts to 45° and has mitre gauge groove. Blade tensioning device has spring cushions to absorb shocks.

20-INCH DRILL PRESS — Hand or power feed. Bench or floor, single or multi-spindle models. Drills to center of 20" circle. Feed 6". Capacity 1" in cast iron, ¾" in steel.

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MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

The Economic Reconstruction of Europe

THE time is fast approaching when allied and enemy populations alike will demand a blueprint for the economic reconstruction of Europe. The peace plans following this World War will be written piecemeal, and by experts, at a series of continuing conferences, such as Hot Springs, Bretton Woods, Dumbarton Oaks and Quebec, each tracing a new pattern for negotiation and each dealing with a single, specific problem. In the drawing of these plans, the United States, as owner of more than half of the world's industrial capacity, controller of the only great credit reservoir, and possessor of the largest force of highly skilled technicians and management engineers, has heavy responsibilities which its industrial, financial, agricultural and labor leaders cannot evade.

☆ ☆ ☆

Just what is the problem which the world's business leaders must help solve in Europe?

The best safeguard of peace is economic opportunity — a good chance for all peoples to raise their standard of living by their own ingenuity, foresight and industry.

Frustrated and disappointed peoples, who view the future with misgiving rather than hope, breed fanatical demagogues who seek to divert nations from their ills and disappointments by promising military glory and conquests.

Consequently, an important step in building a secure and lasting peace is to open the doors of opportunity to the peoples of Europe.

The greatest obstacle to opportunity in Europe has been economic nationalism.

The economic tradition of the Continent always has been highly nationalistic. The national feeling generated by the first World War, and the political autonomy conferred upon many peoples by the peace treaties, led to a great growth of economic restrictions. This trend was accentuated by the depression and by the military plans of the Fascists and Nazis. Hitler had to show his people they could be fed even if a blockade was imposed again. The inevitable result of these influences was to carry self-sufficiency to tragic extremes.

Economic nationalism holds down the standard of living of Europe in two ways:

1. It prevents the rise in most European countries of low-cost mass production.
2. It operates against an efficient geographical division of labor, preventing nations from doing what each can do best.

Great machines require great markets. One great machine of which the United States has many and Europe few is the continuous strip steel mill. At the outbreak of the war we had twenty-eight such mills of various sizes, England but one, and Continental Europe one. A building containing one of these machines is more than a quarter of a mile long and the minimum cost of the mill is almost $25,000,000. Only the prospect of a mass market justifies production on this vast, but highly economic basis.

The wasteful geographical distribution of production is shown by the agricultural policies of Italy, France and Germany.

In the 1930's, when lard sold for less than 8¢ a lb. in the United States, it cost 32¢ a lb. in Germany. In Italy and Germany imports of wheat were banned and its production at home was heavily subsidized. By the middle of the 1930's, wheat sold for $1.55 a bushel in France, $1.97 in Czechoslovakia, $2.29 in Germany, and $2.47 in Italy. At the same time the United States and the other efficient world producers and exporters (Canada, Australia and Argentina) were *restricting* production and were unable to average more than about 75¢ a bushel for their wheat.

Economic unity in Europe must ultimately mean a freedom to trade not greatly different from what we have within the United States. Given economic unity and the large markets which go with it, efficient mass production will develop. With Europe receiving cheap supplies of such staple foods as wheat, pork, lard and dried fruits from overseas, European farmers can prosper by specializing in producing fresh foods — butter, cheese, eggs, fruits, vegetables.

Then European agriculture will be more prosperous producing its specialties, and our agriculture (and that of the other great efficient surplus-producing countries as well) will have greatly expanded markets for our staples.

With a cheaper food supply for Europe — yet one yielding a better price for our agriculture — European labor will live better. Labor now used uneconomically for agricultural production will be released for industry. With big machines and semi-automatic processes European labor can produce more steel, automobiles, furnaces, plumbing and electrical appliances to advance its standard of living in coming decades, as the United States has done in past decades.

A rising standard of living in Europe will bring

Europeans to view peace with optimism and hope. And world trade grows as confidence and prosperity widen.

☆ ☆ ☆

How would a Europe which possesses economic unity appear to us on this side of the Atlantic?

It would be a prosperous Europe that would have strength in its advancing industries, but as the single great agricultural deficit area of the world, it would be dependent upon overseas supplies for vital agricultural staples. This dependence upon overseas agricultural supplies would be greatest for industrial Germany. Some people believe that a strong Europe would be a threat to world peace. More important, however, is the fact that a strong and prosperous Europe would not be a frustrated Europe. It would have found a way to achieve a rising standard of living. Furthermore, a prosperous Europe would, economically, be a dependent Europe because, although the European industrial worker would use more and cheaper food, he would have it only as long as he maintained the peace.

A prosperous Europe would be of special advantage to American agriculture (if we do not keep on pricing ourselves out of the market) and of great advantage to American industry.

The British policy of buying agricultural staples from abroad, for example, made her, a nation of only 45,000,000, the purchaser, in 1937, of $250,000,000 of all kinds of agricultural products from the United States. In the same year the rest of Europe (exclusive of Russia), with a population of 325,000,000 purchased only $300,000,000 of our agricultural products. But with more sensible organization of its agriculture, Europe could be expected to buy more than one billion dollars of agricultural products from us.

By far the greatest market for an expanded European industry will be Europe itself.

For American industry, there will be growing markets in Europe as industry expands. Experience shows that the trade between different highly industrialized areas is large. This country's biggest export markets have been with its keenest competitors—Britain, Canada, Japan, France and Germany.

Before the war, Europe, with two and one-half times the population of the United States, had only one-sixth as many automobiles.

If Europe (exclusive of Britain and Russia) were to motorize proportionately, it would need 75,000,000 automobiles. With normal depreciation this would ultimately mean 10,000,000 cars to be produced annually to replace worn out cars.

If one still wonders about the immense number of things Europe might produce *for herself*, let him calculate the highway expenditures, the filling and repair station businesses that must be equipped and maintained; and the doubling of the steel production that would be required to make the automobiles themselves and to reinforce with steel even a moderate amount of additional concrete highways.

Another example is the electrification of Europe. With two and one-half times our population Europe's consumption of electrical energy would be 175 million electrical H.P., if the European worker were to have the advantage of as many H.P. as the American. Yet, just prior to the war, Europe's installed operating capacity was only about 40 per cent of this figure.

☆ ☆ ☆

What has been sketched for Europe is actually much more nearly a page from the economic history of the United States than it is mere prophecy about a desirable future for a Europe at peace. But how can it be achieved? And what is our part to be in helping to bring it about?

Economic unity can be provided for the sovereign states of Western Europe by the peace treaty or treaties adopted at the end of the war. The provisions for securing *economic unity* in Europe should specifically cover:

1. Substantial freedom for persons and enterprises to do business anywhere in Europe.
2. Reasonably free movement throughout Europe of persons for employment, recreation and education.
3. Greatly increased freedom of trade:
   a. Within Europe—through the application of a Europe-wide agreement reducing the tariffs among all European countries to a maximum of 10 or 15 per cent.
   b. With the rest of the world—through reduction of European tariffs on goods bought from overseas. This would call for generally lower levels on manufactured goods, and for the removal (after a reasonable period of progressive reduction) of tariffs on all agricultural foodstuffs and most industrial raw materials.
4. A special currency provision requiring as nearly as practicable complete currency stabilization for all countries of Western Europe among each other.
5. Creation of an agency (with adequate revenues) through which all Europe-wide business and other affairs affected by these agreements would be administered for a minimum period of twenty-five years.

This would permit the economic unity of Europe to be substantially achieved. During this period, assistance in administering the provisions would be given by officials of the United Nations.

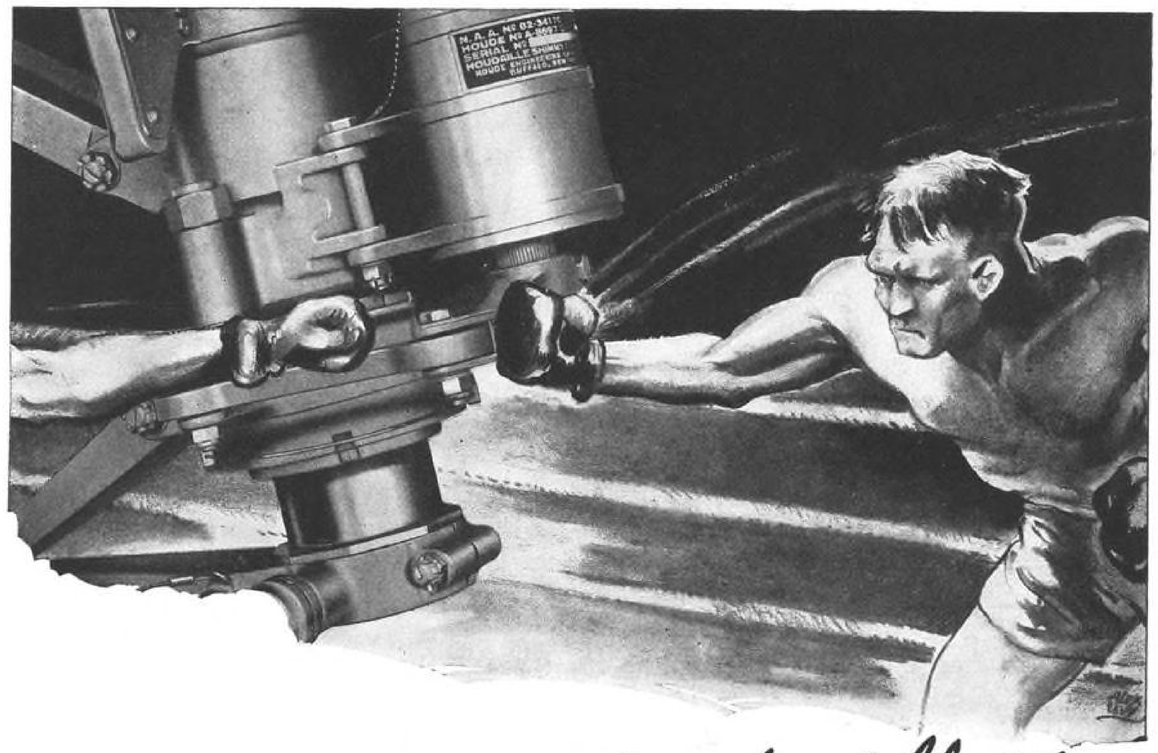
Near the end of such a period arrangements could be made for a vote in the European countries on whether or not to continue the "unification provisions." If the vote were in the negative, the United Nations would have proper warning that additional safeguards would be necessary to prevent war.

The suggestions made in this statement aim at securing economic unification of Europe and thereby promoting the possibilities of permanent peace in Europe.

The realization of these possibilities throughout the postwar years requires a freely expressed public opinion in Europe to guide all who share the responsibility for bringing peace to Europe and to the world.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.



Light jabs or knockout blows

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The job of an airplane shimmy damper is to absorb shocks.

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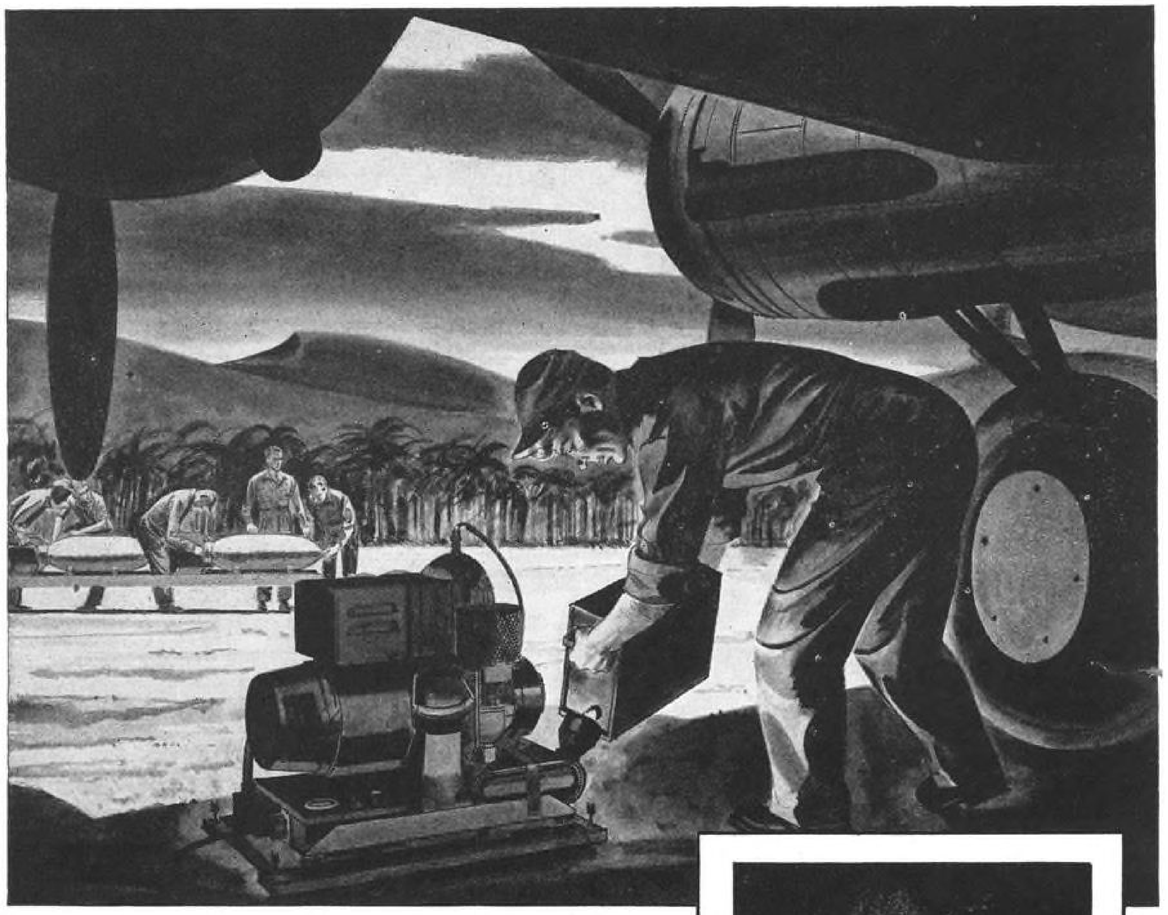
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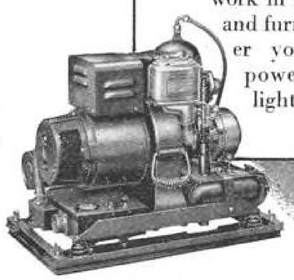
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It eats the same grub as planes

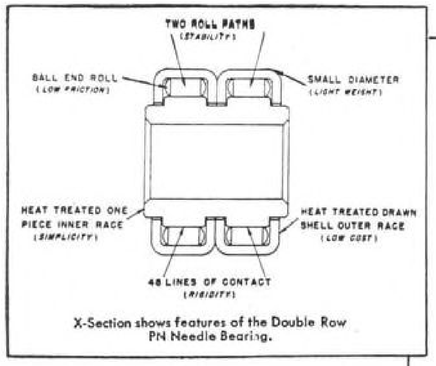
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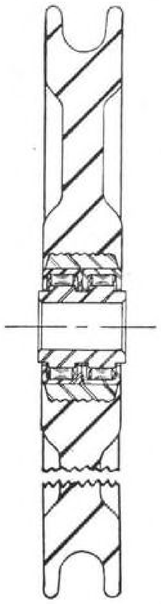
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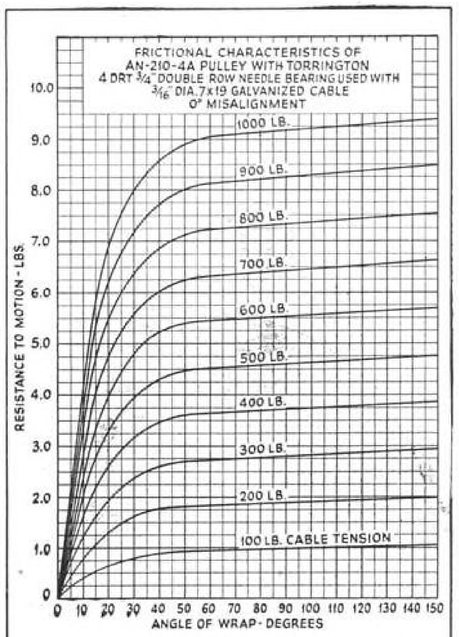
PN Needle Bearing Minimizes Friction in Aircraft Pulleys



X-Section shows features of the Double Row PN Needle Bearing.



Double Row PN Needle Bearing in Aircraft Pulley.



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Research Can Keep the Peace

VICTORY IS IN THE AIR. For the war with Germany approaches its end. When that end comes, however, we should be fervently thankful but not jubilant lest we forget that there is yet another war to be won.

These victories in these wars are the most important events in our lifetime. They represent the very narrowest escape from catastrophe that the civilized world has yet experienced.

But this escape does not preclude the possibility of our extinction at some future time.

It is a sad commentary on what we call human intelligence that we should suspend the use of our brains long enough for a demented paperhanger and a few roustabouts to get so well started toward running the world. It is an unhappy prospect for the future that our great minds have not advanced beyond those of infants who build ornate castles out of blocks for the supreme satisfaction of knocking them apart. It is dismal to contemplate that man has devoted his greatest efforts and his highest ingenuity to the methodical destruction of his fellow men and of the monuments mankind creates.

Yet there is one conquest by man that transcends his wars, which are paltry by contrast. And here there are no breathing spells between the battles. This is the everlasting struggle of mankind to isolate and harness nature's forces—a never-ending fight which has now reached the threshold of an era in which superhuman forces are to be unleashed.

FROM THE VIEWPOINT OF WAR, the robot airplane, the atomic bomb, the electronic devices that enable us to see through fog and darkness are only symbols of deadlier things to come. But they are sufficient to enable us to foresee that neither darkness nor distance, nor any other medium of protection yet devised by man can save us from the future possibility of annihilation if these and other devices are in the wrong hands.

Twice in a quarter-century this nation has become involved in conflicts for which it was unprepared. The current war is being won because of a succession of miracles in its earlier stages. Where would we be now if Hitler had kept on from Dunkirk? What would our Continental invasion have cost in time and lives if German robots had descended upon England two weeks earlier when ports were jammed with men and ships?

THE WORLD has grown too small, the weapons in men's hands too deadly for us to relax after victory. In fact we must never again relax with dependence upon Providence and our allies to protect us. We must preserve our armed forces at a strength sufficient to command the respect and the awe of all other nations. We must supplement those forces by an armament industry sufficiently large and effective to provide them with any possible need. We must remain in the forefront of technological research and development so that our weapons are always a little more deadly than those of anyone else and so that we have effective antidotes for all weapons.

On page 114 is a pointed article written by two men who know whereof they speak—a soldier and a manufacturer of fine aeronautical equipment. Both of the authors are men of rare foresight and students of world industry. They tell us with clarity and straightforwardness what must be done if America is to avoid future defeat.

Take time out to read that article and reflect upon it in the privacy of your home. If you have sons or daughters in this war or if you have children below military age, think what research for security means to their future. Then resolve to do your part to make this country secure for the coming generations of Americans.

Leslie E. Neville

EDITOR

Knowledge and experience are fundamental requirements for winning wars. So, say these eminent men, let us keep from having wars by making sure we have—

RESEARCH FOR SECURITY

By MAJ. GEN. FOLLETT BRADLEY, USA (Ret.), *and*
R. E. GILLMOR, *President, Sperry Gyroscope Co., Inc.*

THIS ARTICLE IS PROPAGANDA. Propaganda is the dissemination of particular doctrines or principles. The particular principles for which we stand are based on our belief that unless American scientific research and industrial preparedness is kept on a "paying basis," there will be another war—in which the United States will be defeated.

It is not within the scope of this article to discuss the many causes of war. We mention only that human nature is much the same today as it has been ever since man first began to leave records. Wars will continue to recur until human nature changes or unless positive and effective steps are taken to prevent them. There is no hope for an overnight change in our nature but there is much hope that the international organization now being developed may prevent war *if*—and *only if*—it is kept everlastingly implemented.

The evolution of social organization is much slower than the evolution of weapons depending, as they do, on scientific knowledge. It is significant that all plans now being discussed to prevent war include as a major feature armed force or the threat of armed force under benevolent control. Dependence alone on peace treaties and international good example has been succeeded by a more realistic approach.

World War II, like World War I, will be succeeded by international frustrations, tensions and ambitions which will create the conditions for another war, and which will lead to war unless the facts be realistically faced. We cannot now foresee how the peoples of the world will realign themselves or what economic or ideological conflicts will arise in the future. But we do know that war has always been the means of resolving such conflicts. We know that international organization and moral force alone will not deter future would-be world conquerors from starting another war.

The people of the United States must be particularly certain that their security is assured. It has become obvious that a slow war cannot win against the United States. The world has twice learned that if the United States has sufficient time in which to prepare for war, she cannot be beaten. In World War I, it was approximately 18 months from the declaration of war against the central powers before American might was felt on European battlefields. Although our productive capacity had been increased in some respects by foreign orders prior to our entry in the war, we fought that war with cannon and airplanes made by and purchased from our allies.

In World War II it was more than two years from the beginning of the war in Europe, and more than four years from the beginning of the war in China, before the United States entered the conflict. During much of this time American industry had partially prepared for war production through foreign orders for war material and equipment. In spite of this headstart, however, American forces were not able to gain the initiative until over a year after Pearl Harbor.

Germany knew before starting this war that she could not win if the United States were permitted to bring the full power of her might to bear. Germany devised her blitzkrieg and planned to win before the United States could make her influence felt. Airplanes, tanks, rapid transportation and good communications made possible the lightning war which nearly succeeded for Germany in 1940. Except for Germany's blunders, her lightning war would have been successful at that time.

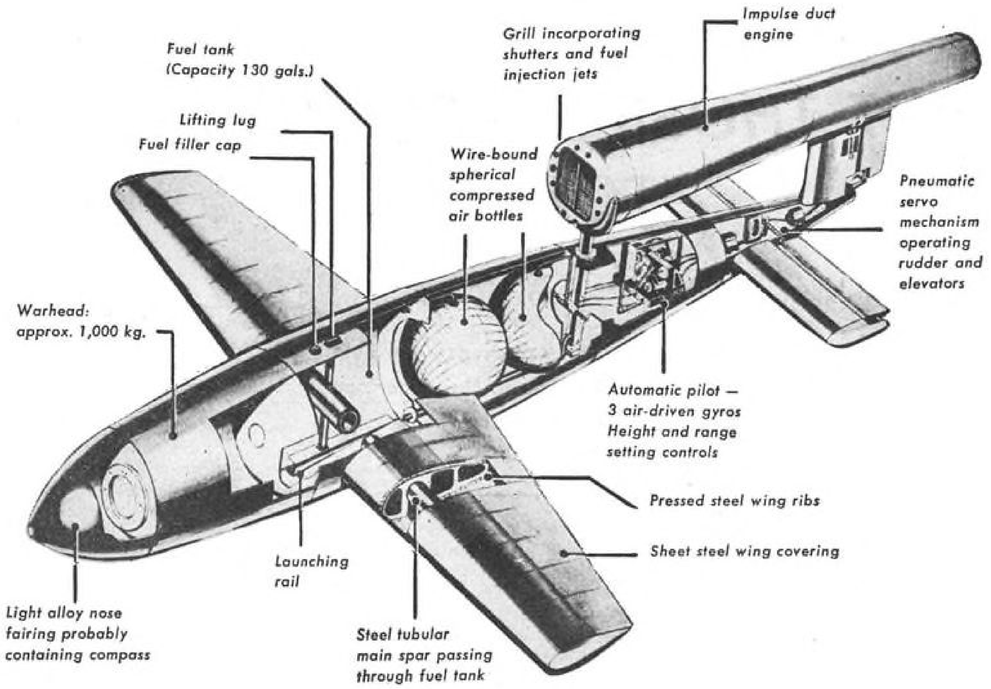
Since the future Napoleon or Hitler will be sure that the ponderous might of the United States is suddenly crushed before it can gather momentum, the best hope for a lasting peace is preparedness by the United States to defend her security, and world knowledge that the United States is so prepared.

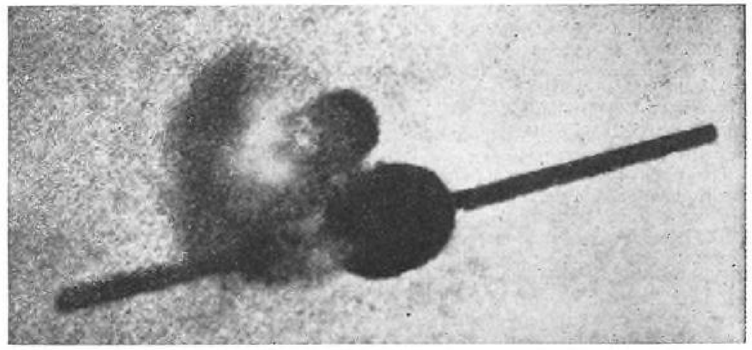
If there still be people who think the Atlantic and Pacific Oceans afford security to the United States, and if they believe that lightning war cannot be waged against us, let them realize that sufficient scientific knowledge exists right now to develop and produce weapons which could completely paralyze this country within a few hours. If any nation should devote from five to ten years of preparation thus to destroy the United States, she could do so—unless adequate controls and counter measures are provided.

General scientific knowledge in peace time is rapidly disseminated throughout the world by scientific papers, technical magazines, patents and other media. It is impossible, and in fact undesirable, to prevent the free exchange of such knowledge which can be gained only through research. Just as the airplane today is either a peaceful instrument of civilization or an infernal engine of war, so the development of other machines and devices may be peaceful or harmful depending on the line of development or the application of the pure knowledge involved.



"The only way for the United States to be secure is through intensive scientific research and readiness for immediate production, say authors, Maj. Gen. Follett Bradley (left) and R. E. Gillmor (right). "Whether we use the weapons we develop or merely hold them as a deterrent force in being, it is essential for us to develop them in order to devise and develop the remedy."





"Compared to what could be developed from knowledge now at hand, the robot bomb which has caused so much damage and heartache in England is a crude and unreliable weapon. . . . If there still be people who think the Atlantic and Pacific oceans afford security to the United States, let them realize that sufficient scientific knowledge exists right now to develop and produce weapons which could completely paralyze this country within a few hours." (British Combine photo)

As one example of the sinister development and application of innocent scientific knowledge, there is the robot bomb. But, compared to what *could* be developed from knowledge now at hand, the robot bomb which has caused so much damage and heartache in England is a crude and unreliable weapon.

New and monster rocket torpedoes could contain many tons of explosive. They could be launched from platforms thousands of miles away and navigated without human pilots to the general vicinity of their targets. Upon arrival in the general vicinity other devices in each torpedo would take over and guide it to a still smaller area enclosing its target. Still another device would finally plunge the bomb against its specific target such as Grand Central Station in New York, the Willow Run plant, or the Navy Yard at Bremerton on Puget Sound.

If any nation had the time, the opportunity and the will to develop such engines of destruction, it could prepare and launch 1,000—10,000 if need be. Launched from another continent and timed to strike precisely at a pre-determined instant, they could paralyze centers of manufacture, transportation, communication and war supply throughout the United States. They would be accompanied by thousands of large long-range air transports with loads of infantry, artillery and auxiliary troops to consolidate the advantage of the initial strike—and the war would be over.

For more than 100 years up to Dec. 7, 1941, the United States had never fought a defensive war. She will never fight a defensive war if she has the means to take the offensive. In this most terrible of all wars, she did not have the means for over a year. We must never again be caught like that. We must have weapons more modern and more destructive than those of any other nation.

The authors are not war mongers or "merchants of death" nor are we alarmists. We only know that, from the purely scientific point of view, such automatons as we have sketched are much less visionary than were—say, ten or fifteen years ago—the wonders which we today accept as commonplace. We know that knowledge now exists to devise other weapons equally sinister and deadly.

We wish to spread our belief that the only way for the United States to be secure is through intensive scientific research and readiness for immediate production. Whether we use the weapons we develop or merely hold them as a deterrent force in being, it is essential for us to develop them in order to devise and develop the remedy.

It is said, usually complacently, that every new weapon has its antidote or counter measure. That statement is true, but complacency has no place in the contemplation of the rubble heaps and mangled bodies of robot-bombed London. The development of the counter measures takes much time—and time is the one irreplaceable factor in war.

(*Turn to page* 303)

PUT THOSE SURPLUS PLANTS TO WORK

By CLINTON R. HARROWER

Here's a practical plan—based on successful experience—to help provide postwar jobs and business opportunities in the American way. It presents a challenge to the industrial and civic leadership of every war-plant community.

FAR FROM BECOMING idle and burdensome white elephants in peacetime, our war-built plants—each of which contains all the elements of valuable national assets—can make a contribution in providing jobs in the postwar world.

A movement fast gaining momentum in England just before the war gives a clue to the solution of our surplus plant problem. This was the development of what was there called the *trading estate*. The term becomes more comprehensible here if we Americanize that word "trading"—to make it *business estate*, in short, a large area devoted to business.

First, what was meant by trading estate and what was its purpose?

The trading estate first appeared in British industrial life about half a century ago, but it wasn't until the depression of the '30's that it came into prominence as a means of combatting unemployment. The estate idea is based primarily on the fact that a great number of potential small employers came to be employed by others. They are men having sound ideas for manufacture or business but have never been able to strike out for themselves because they lacked the financial resources to set up manufacturing and marketing facilities. If these facilities are made available to them they will create jobs for others and, if enough of these can be brought together in a certain association of effort, together they can afford facilities which normally would be associated only with big enterprises.

Purpose of the trading estate is to give these potential industrialists a chance to get started, and the results up to the outbreak of war in 1939 were distinctly worthwhile.

For intsance, Team Valley, located near Newcastle, England, and managed by the North Eastern Trading Estates, Ltd., was organized in May, 1936. Its first step was to acquire an "estate"—in this case a parcel of land of approximately 700 acres—strategically situated with respect to labor supplies, raw materials, transportation, and markets. It then set out to provide manufacturing facilities for those who could use them profitably.

To do this, its architects designed "standard" factories to be rented to industrial tenants. These were completely equipped factory units erected on the estate. The tenant had merely to move in his machinery and start to work. Architects were always ready to discuss special problems so that, in effect, the tenant had a tailor-made factory.

The standard factories came in three sizes (6,000, 8,000, and 12,000 sq. ft.) and were rented on a yearly lease. Rents were kept as low as possible—a 6,000-sq. ft. plant being available at approximately $1,125 per year while 12,000 ft. could be had for $2,125. There were also tiny units available of only 1,500 sq. ft. with several units in the same building. These went on a 2-yr. lease at about $5 per week.

If the standard factories did not meet the tenants' requirements, the estate was prepared to build special facilities designed in accordance with the special needs. These went on a 7-yr. lease.

Because it operated on a scale larger than any single tenant, the estate could offer the small factory operator the economies and advantages normally possible only to a larger unit. For example, all coal, gas, electricity, and water consumed by the tenants was purchased through the estate. Buying in bulk made it possible for the tenants to effect important savings. Likewise shared was cost of railroad sidings, highways, and other services.

The interest of the estate in the welfare of its tenants went still further. A central administrative building provided clubs and restaurants for directors and executives. London banks established branches there to provide banking facilities. A telephone exchange, a labor bureau, and conference rooms were also supplied, as well as retail shops, show rooms, and hospital facilities. In short, a tenant moved into a fully equipped establishment with no commitment save that for his machinery and his annual rent.

Once accepted by the estate, a tenant could even get financial assistance if he could show reasonable prospects, although such loans could not be used to pay off other bank loans and could be obtained only when the tenant had been turned down elsewhere.

The estate's interest extended to the workers as well. Growth was planned in such fashion as to provide employees' canteens, open lawns, and landscaped gardens in a definite ratio to the factory space. In addition there were football and cricket fields, also a recreation center with a swimming pool, tennis courts, and a skating rink.

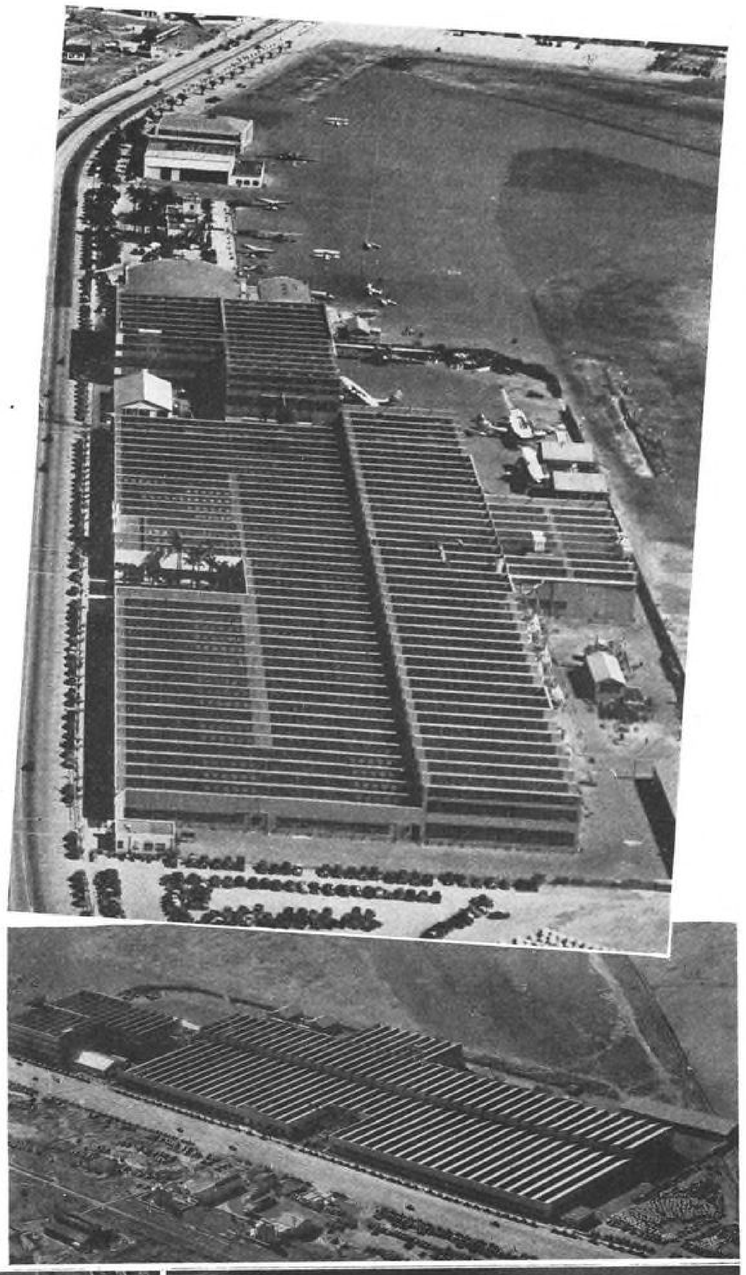
In other words, the estate deliberately set out to make a garden spot out of an industrial area. To insure this, it exercised strict control over tenants, requiring premises to be kept neat at all times. Attention was being paid to neighboring real estate values.

Up to the war, the trading estates were showing great promise. In the spring of 1939, Team Valley had 131 factories completed or scheduled, with 96 occupied. Predictions were being made that eventually it would house 500 factories employing 40,000 workers.

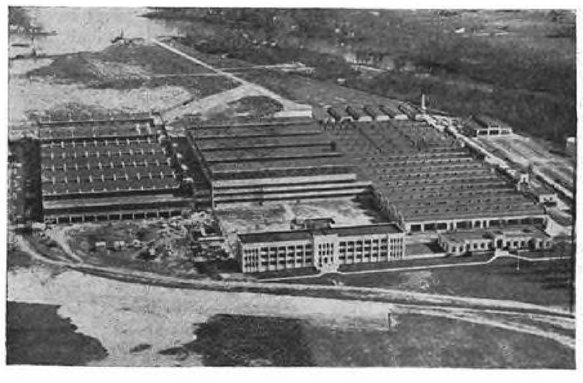
Important was the wide variety of tenants attracted, providing a highly diversified industrial community. Here is a partial list of businesses at Team Valley: Potato chips, clothing, veneer plywoods, cellulose products, chemical products for the building industry, candy, laminated glass, fiber board containers, machine tools, toys, wooden wares, meat pies and sausages, motor car bodies, bottles, bakery, commercial photography, electrical engineering, "incorporated practitioners in advertising," concrete reinforcement metal, mining machinery, and even importers of fancy Continental cheeses.

The principle, of course, was modified to meet special conditions in various communities. One modification, to which we shall refer later, was known as the "nest

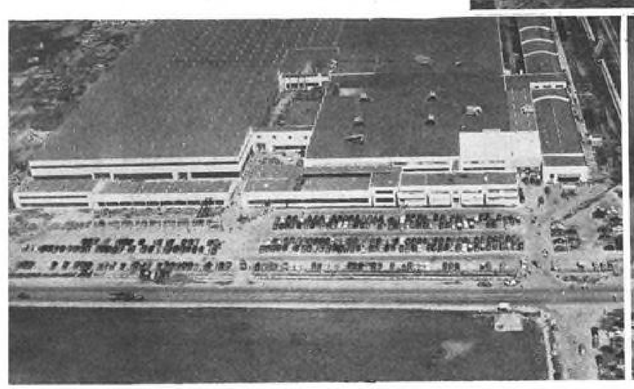
(*Turn to page 279*)



• Large war-born plants such as these present countless opportunities for creating postwar jobs under the "business estate" plan proposed here—for they have all necessary facilities for new small businesses. States the author: "Utilization of these facilities to create jobs depends on whether the community in which they are located regards them as potential assets to be exploited, or as white elephants to add to the thousand and one problems of the postwar era." Certainly, he contends, they can be exploited—and properly exploited —under the American system of free enterprise.









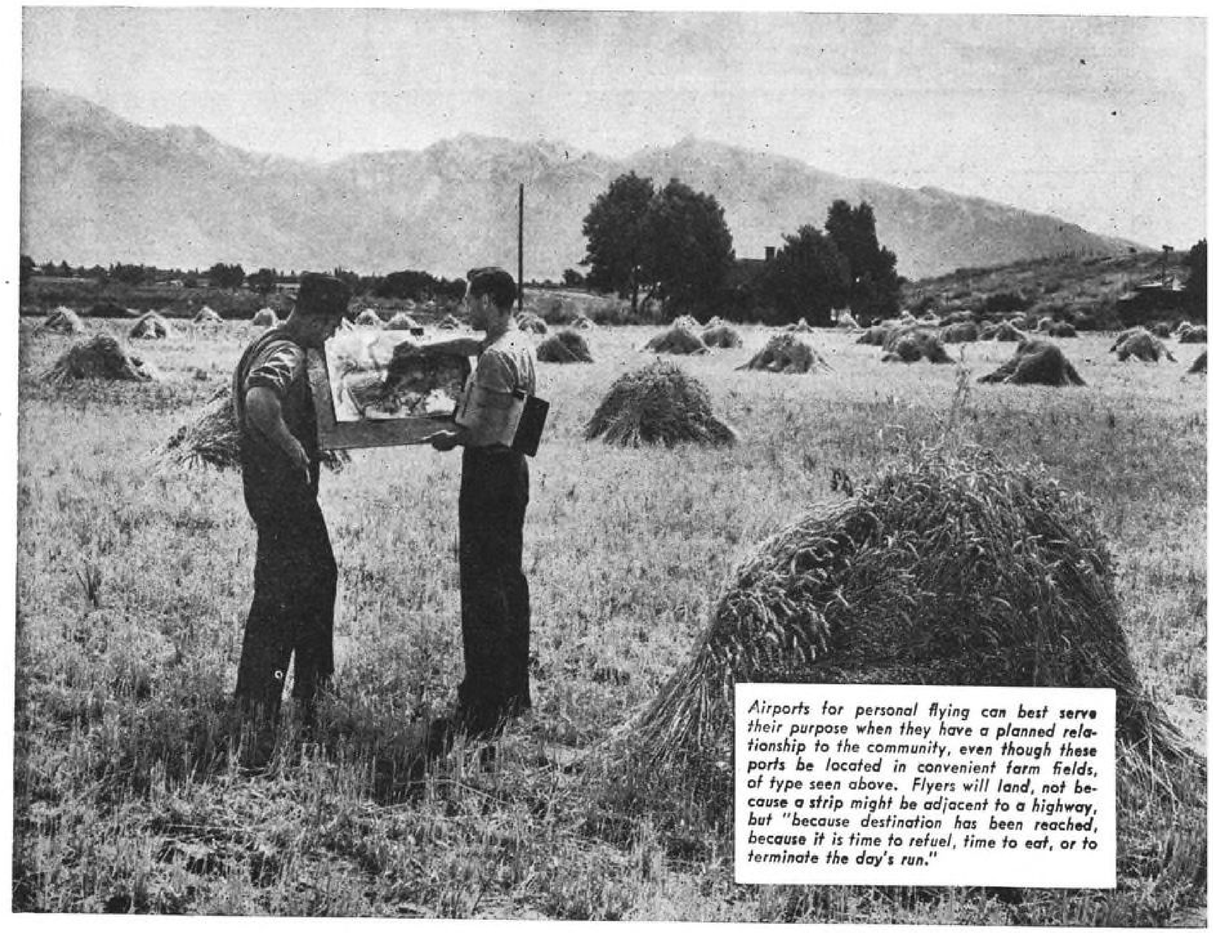
Personal plane use and ownership can increase only when Mr. and Mrs. Public have plenty of places to land where they want to. Here a veteran career man in the service of aviation points out just why we must have —

MORE AIRPORTS FOR THE PERSONAL FLYER

By **CHARLES I. STANTON,** *Civil Aeronautics Administrator*

THIS country's basic airline terminal system will cover the field pretty well when airports built by the Civil Aeronautics Administration for wartime use by the military air services are turned over for civilian operations after the war. Of course, additional capacity will have to be built into existing fields and into new fields for scheduled air services throughout the foreseeable future, in accordance with the growth and development of air transportation.

While the main frame of landing facilities for the carriers is over the hump of its development, the airport program for private flying is just beginning. Early in the peace period, many of us believe, the numerical tally of personal aircraft will exceed carrier planes at least 100 to one.



Airports for personal flying can best serve their purpose when they have a planned relationship to the community, even though these ports be located in convenient farm fields, of type seen above. Flyers will land, not because a strip might be adjacent to a highway, but "because destination has been reached, because it is time to refuel, time to eat, or to terminate the day's run."

On middle ground are the charter, taxi and contract services of fixed base operators. Some fixed base airplanes will be suitably equipped with radio and instruments, and will operate from the large and medium terminals used by the scheduled airlines. Some of them will operate exclusively on small fields for light aircraft, alongside of private aviation.

A fourth group in any classification of flying with regard to airports is commonly called feeder lines. It is not possible to say at just what point on the descending scale of length, or volume of traffic, an airline becomes a feeder line. The Civil Aeronautics Board and the Post Office Department both have urged caution in the expansion of the airline tributary system, lest unreasonable subsidies be required to support them. It is easy to imagine, nevertheless, that ambitious communities would, if they could, bring about feeder expansion on a huge scale. In either case, most feeder operations undoubtedly will use the scheduled air terminals to make connections with main lines.

Feeder lines include pickup operations, brought to a high degree of efficiency by All American Aviation. Applications are on file to network all populous regions of the country with pickup and other feeder services. Present regulations do not permit them to carry passengers. If they eventually undertake to carry passengers, they will need landing fields. If they do not, the mail service still may stimulate the communities' desire for passenger connections which will require airports.

In the minds of some ingenious men are plans which may eventually practically eliminate airline landing areas as we know them today. Those plans would eliminate landing gear which, on large planes, weighs many tons, is used only a few minutes per day, and thus is expensive to haul around. They would like to put some sort of skids or keels in the bottom of high wing hulls which could be stopped quickly with arresting gear on a suitable platform, and be catapulted for takeoff. They would even try to make the same hull amphibious, for operation on and off water. Rotating wings or other devices might in the future reduce need for ground runs and clearances by light craft also. But we cannot wait for whatever success may be at the end of these interesting and worthwhile efforts.

Aviation based on airports is already a proved success, promising much in many phases of human progress. Even if certain types of aircraft are successfully designed to operate without runways, there will always be many planes that use airports in the old-fashioned way.

Right now available brainpower, musclepower and materials for a civil airport program are limited. We cannot even buckle down to full scale planning on paper, quite yet. But interested groups and persons have been sketching in the rough at odd moments, and I want to review briefly what they are doing.

As the agency charged by Congress with responsibility for planned growth of the civil airport system, and for wartime construction of civil ports for military use, the Civil Aeronautics Administration is taking the lead, also under instructions from Congress, in proposing the postwar landing area program.



Charles I. Stanton, Civil Aeronautics Administrator, looks to the personal airplane to create "a big job-making industry. But to do so, it must have plentiful and convenient ground facilities." In the accompanying article he points out why airports for the flying public must take a high place on America's flight facility program. (CAA photo)

For more than a year, CAA experts have been analyzing the travel and traffic of the United States, studying industrial and population trends, considering possible defense problems, checking on possible aircraft developments—trying insofar as is humanly possible to foresee the needs of aviation in the years to come. Our recommendation is almost complete, and will soon be submitted to Congress.

Mr. William A. M. Burden, Assistant Secretary of Commerce, has publicly discussed some important features of our findings. He declared that the CAA estimates the cost of necessary construction, exclusive of buildings and land, at $1,000,000,000. About 3,000 ports would be added to our existing 2,942, bringing the total to around 6,000. All but 100 of the 3,000 new ports would be intended largely for private and local commercial flying. The program would include improvements upon 1,625 of the existing fields.

At present, only 286 cities are certified as airlines stops, and the fields at 174 of these are in need of improvements to meet safety and efficiency requirements. The suggested program, plus existing facilities, would provide more than 1,800 cities with fields adequate for commercial operations considered to be appropriate for the particular community, including transcontinental express services, and many charter and feeder terminals.

Construction or improvement of fields for commercial operations, many of them small airports also serving private flying, would cost about $630,000,000. But these fields would serve about 5,000 additional nearby communities. Balance of the billion dollars suggested would be for small fields or airparks exclusively for private flying.

Rep. Jennings Randolph, of West Virginia, recently introduced a bill which would authorize appropriation of $100,000,000 per year for ten years, beginning in 1945, to be apportioned among the states under a formula similar to that used in the construction of this country's highway system. The formula would take into consideration the population, area in

(*Turn to page 260*)

Our Navy Builds FLAT-TOP MASTERY

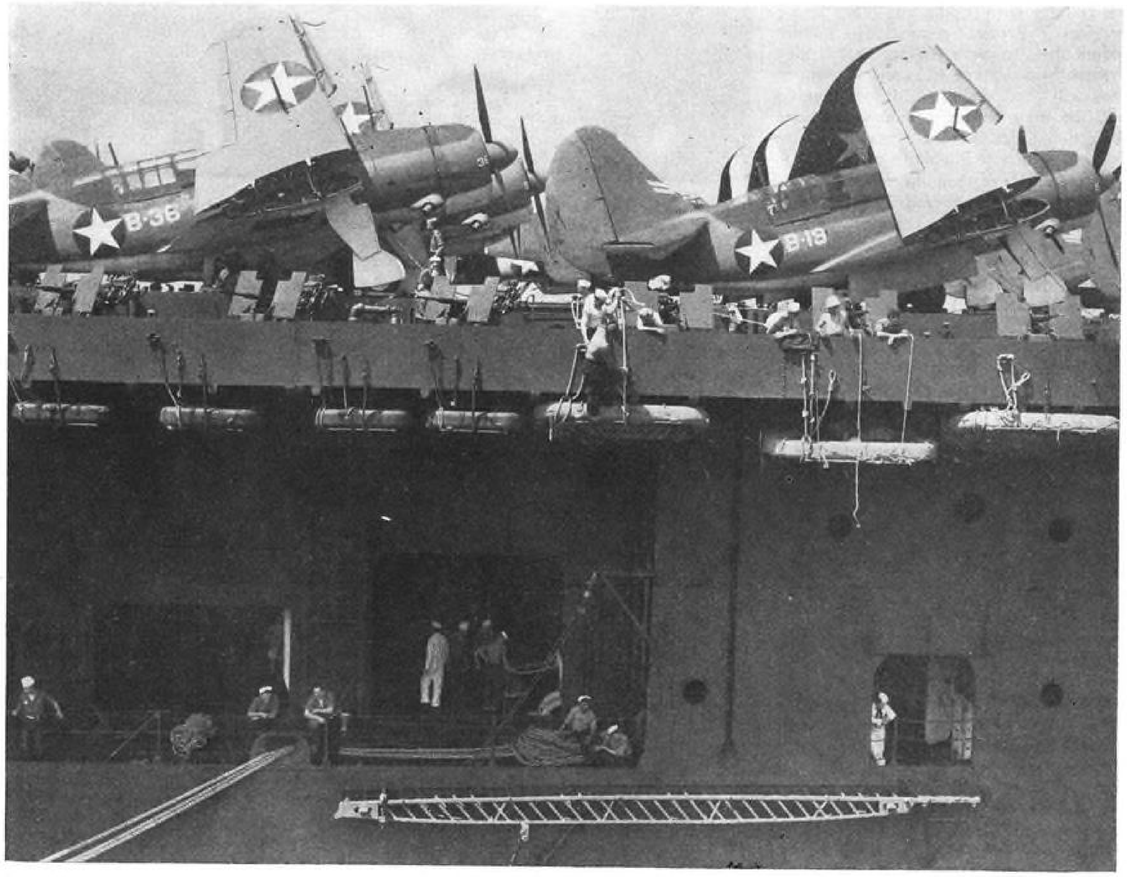
By **REAR-ADMIRAL E. L. COCHRANE, USN,** *Chief of the Bureau of Ships*

By first punching the foe off balance and now smashing his last holds on the ocean, our aircraft carriers have proved modern speeders of Victory. Here "Bushipsˮ chief details how we've come from a mere seven to more than a hundred of these sky-sweepers.

DECEMBER 7, 1941, the United States had on hand seven full-sized aircraft carriers, the *Lexington, Saratoga, Ranger, Yorktown, Enterprise, Wasp,* and the *Hornet,* also the small escort carrier, *Long Island.* Of these the *Lexington, Yorktown, Wasp,* and *Hornet* have since been lost. For every one of those veterans lost, however, there has been built and are now at sea, nearly 30 replacements (including the escort carriers transferred to our allies).

In the two and a half years since Pearl Harbor, the number of carriers on hand (excluding the 38 transferred by lend-lease to the British) has been increased to 90, totaling more than 1,400,000 tons. During this same period the combatant vessels of our Navy in all categories have more than tripled—going from 345 vessels, totaling 1,382,755 tons, to 1071 units, totaling 3,434,762 tons.

With the outbreak of war and following the heavy carrier losses in 1942, the desperate need for carrier strength in the Pacific and the growing demands for fighter transports pushed six vessels of the aircraft carrier program into top priority. With first call on the nation's scarce materials and components, the inauguration of shift work, and the seven-day week, actual completions surpassed even the most optimistic forecasts.



Curtiss SB2C's to carry the offense to the enemy; countless 20-mm.'s to keep him away from the carrier. These are two elements going to build up unparalleled sea-borne airpower, two elements which are result of cooperation between many divisions of our Navy.

Carriers thus got off to a good start and remained at the top of the pyramid until May 1942 when the joint Chiefs of Staff gave an over-riding priority of landing craft for the North African invasion. Even when the first landing craft program expanded into another, the carriers continued to have the nod over the great bulk of larger naval vessel construction.

The completion of the *Essex* only 17 mo. after keel laying, and the comparable building periods for the new *Yorktown* and *Intrepid* as compared with initial estimates of three to four years, bespeak the effectiveness of the wartime efforts to accelerate shipbuilding when backed by this position of priority. The pushing up of the destroyer-escort program to top priority in the fall of 1942 to meet the growing submarine menace had little effect on the carrier program because by that time the large proportion of the necessary materials had been procured.

The big push on carriers came largely in 1942, but the full results did not show up until the late spring of 1943. Fortunately the preliminary designs and the contract plans for the *Essex*-class carriers had been started in 1939 following the Naval Expansion Act of May 17, 1938, which authorized the expansion of the U. S. naval aircraft carrier tonnage from 135,000 to 175,000 tons. Although this was not implemented by contractual authority and appropritions for the construction of one large carrier until the regular Navy Appropriation Act of 1941 was approved on June 11, 1940, those charged with the Navy's shipbuilding had already gone earnestly to work.

Innumerable studies were made, tests were run on proposed carrier designs, models were towed, and details were refined and improved. Because of this advance work the Bureau of Ships had contract plans prepared and was ready when the 11 and 70 percent expansion programs followed in June and July, 1940, closely after the "go aheadˮ had been given for the first of this class. Before the actual contract was let for the *Essex* to be built at Newport News Shipbuilding & Dry Dock Co., it was decided to increase the contract to three vessels.

It is fortunate for the Navy's program that the general board of the Navy had considered and approved the preliminary plans prepared by the Bureau of Ships for use in the event that it was decided to convert any of the *Cleveland*-class light cruisers into aircraft carriers. *There was difference of opinion in the Navy on this scheme.* Adm. H. R. Stark, USN, then chief of Naval Operations, was one of the farsighted exponents of this type which is now proving very valuable. With the plans provided by the Bureau of Ships, the New York Shipbuilding Co., was able to convert and complete what would have been a cruiser into a carrier by Jan. 1st, 1943, less than a year after the company received the contract plans for the conversion.



"Carrier design and construction must not only meet the exacting requirements involved in all combatant ship construction, but it must incorporate the essentials demanded by the Navy's flying arm."

Before the end of 1943, all of this class were completed by New York Ship and had been commissioned as aircraft carriers some 20 mo. before the last vessel had been scheduled for completion as a light cruiser. The speed of this performance was due in part to over-riding priorities for materials established for the first two vessels, but in the main to the enthusiasm and energy with which the shipbuilders did their work.

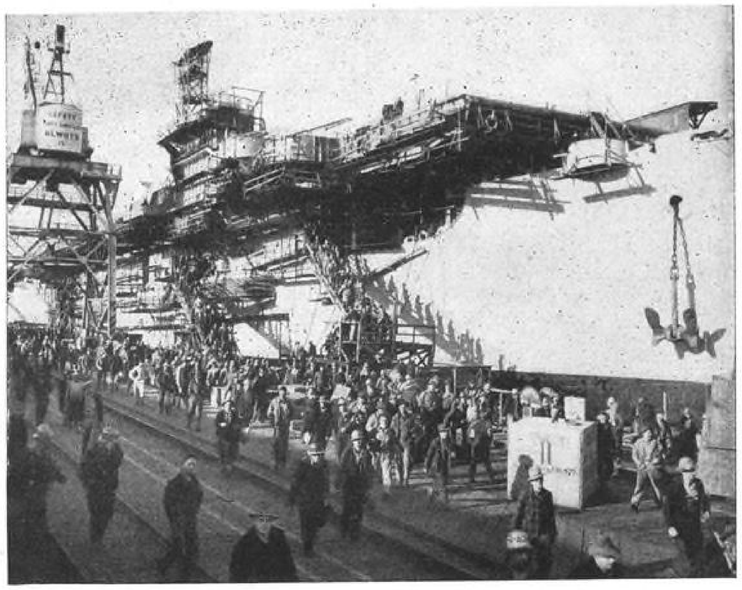
CVE Program

The long building periods experienced in completing pre-*Essex* large aircraft carriers, coupled with the growing needs of our allies for aircraft transports and for other purposes led the Navy early in 1941 to experiment with the installation of a flight deck on one of the rapidly multiplying C-3 type Maritime Commission ships and their quick conversion into the now famous "baby flat-tops." The shortage in merchant tonnage at this time, however, prohibited any large scale conversion program until the actual outbreak of war.

In addition to the pre-Pearl Harbor conversion of the C-3 SS. *Mormacmail* to the *USS. Long Island,* the Navy by the



Even greater flat-top mastery is being swiftly created by U. S. as workmen shown here forge ahead on Navy's first super-carrier, a 45,000-ton mobile airbase capable of handling twin engine bombers.

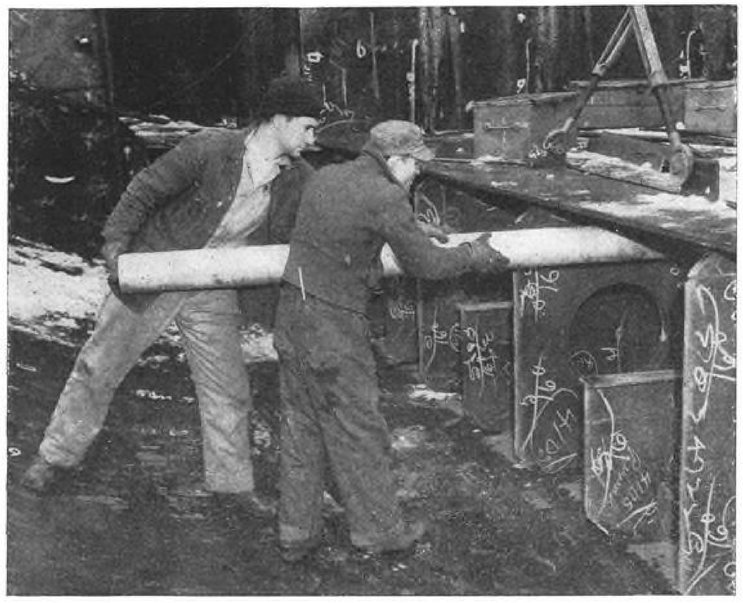


Carriers proved their strategic value early in the war, proved it so effectively that they got top priorities for men and material. Result: Actual completions topped even most optimistic forecasts.

outbreak of the war, had completed one conversion for the British and had in progress the conversion of five more fighter transports. By incorporating items developed for the regular Navy carriers and making use of equipment such as catapults and arresting gear, which had been ordered in anticipation of the needs of the large carriers but which they would not require for some months, the early conversions were pushed ahead to completion in record time.

Demands for the baby carriers for escort and other duty, as well as the vastly growing needs for more aircraft transport capacity, brought Henry Kaiser into the carrier picture in May 1942. A special class of airplane transports, which are in fact complete escort carriers, since known as Kaiser Carriers, was designed from the keel up.

This was a Maritime Commission construction project with the Navy acting as consultant on purely naval matters. Naval material, such as catapults, arresting gear, armament, etc., was furnished by the Navy. The 50th CVE was accepted by the Navy on July 8, 1944.



Need for carriers was so great that even cargo vessels were converted. Result of this Navy-industry adaptability was quick acquisition of what has proved potent weapon, the now-famous "baby flat-top." (All official U. S. Navy photos)

Design Procedure

In peacetime the Bureau of Ships submits, for the approval of the General Board, preliminary designs or "spring styles" of the types of naval ships being considered for the building program. In wartime the initiative generally comes from the needs of the Fleet. The chief of Naval Operations, with the approval of the Secretary of the Navy, may direct the Bureau of Ships to construct certain vessels and may establish their required characteristics if there are no approved characteristics which satisfy the need.

Operations may, for example, direct that the vessel carry a stipulated number of planes, have a large enough deck and vessel speed sufficient to fly-off and fly-on a certain type of aircraft. The Bureau of Ships prepares preliminary drawings incorporating the general characteristics, checks them for stability, etc., and presents them to operations and the general board, members of which consider them and indicate any further changes they consider necessary.

The design people then make the indicated changes, develop the design in consultation with the other Bureaus, build and tow a model, study the structural stresses, and work up a set of contract plans. These plans will be cleared again with the Office of the chief of Naval Operations and—for a carrier—with the Bureaus of Aeronautics and Ordnance. This procedure is repeated until a satisfactory design is evolved. Thus, in effect, the operational forces submit a broad outline of the job the vessel must do and rely on the technical Bureaus (here the Bureau of Ships, the Bureau of Aeronautics, and the Bureau of Ordnance) to fill the bill.

Problems of Carrier Design

Carrier design and construction must not only meet the exacting requirements involved in all combatant ship construction, but they must incorporate the essentials demanded by Navy's flying arm and carry the approval of the Bureau of Aeronautics on the features that affect the vessel's effectiveness as a mobile airfield. The carrier must have as large a deck as possible at a height above the water that will insure dryness. It must be fast enough for planes to fly off and on during the maximum proportion of the time, and it must have the required mobility to effect surprise attacks and successful withdrawals after the attack.

Another construction problem is to find space not only for the ships' officers and crew, which are as numerous on an *Essex*-class carrier as on a *North Carolina*-class battleship, but in addition to make room for the additional aviation personnel and their planes and equipment. The requirements for avigational and ship control, gunnery control, and flight operations control has made the island or con-

(*Turn to page* 309)

AMES LABORATORY CROWNS NACA PROGRESS*

By DR. WILLIAM F. DURAND,

Professor Emeritus, Stanford University; Member, National Advisory Committee for Aeronautics and National Research Council; and Honorary Fellow, Institute of the Aeronautical Sciences

Laying the basis for future accomplishments in aeronautical science, the Advisory Committee's Moffett Field installation attests great achievement won by hard effort.

OF THE NUMEROUS PROGRESSIVE STEPS which American aviation is making in these present notable years, surely none is more striking than the achievement of the Ames Aeronautical Laboratory at Moffett Field, Calif.

In these superb facilities we have provided a foundation for major developments which are to come. Yet it is only by marking the painstaking efforts through the past decades that we gain true perspectives of this accomplishment.

Accordingly, I wish to take this opportunity to consider the role of the National Advisory Committee for Aeronautics—to relate how it came into being, to touch briefly upon its functions, and to highlight the extent to which it has grown in modern days from its very modest beginnings in 1915. And in these considerations we pay tribute to the distinguished scientist—the late Dr. Joseph Sweetman Ames—whose great contributions to the work of the Committee and to the cause of aeronautic science are memorialized by the Laboratory at Moffett Field.

It appears safe to say that 35 yr. ago there could have been no one whose vision could have encompassed the vast extent of the domain which air transport has since that time acquired, both for the purposes of war and of peace. Nevertheless, both in this country and in England and continental Europe, there were already coming from men of vision, some gleams of this future growth, and coupled with this a steadily deepening appreciation of the essential need for careful and systematic scientific studies of the manifold problems connected with this new mode of transport.

Growing out of these convictions there was organized in England in 1909 an official scientific body under the presidency of Lord Rayleigh, the function of which was to undertake and carry on studies of this character.

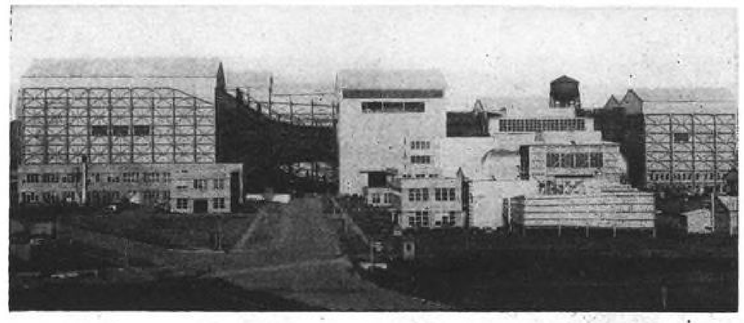
Foundation of this committee was, of course, known in the United States, already conditioned for a response to such stimulus by the earlier scientific pioneer work in this country. And so, in the closing years of the Taft administration, and with a view to the exploration of these broad questions, the President, at the instigation of a few scientists headed by the late Dr. Charles D. Walcott, then secretary of the Smithsonian Institution, called a conference in Washington of scientists who were assumed to have some competence in matters relating to the problems of flight.

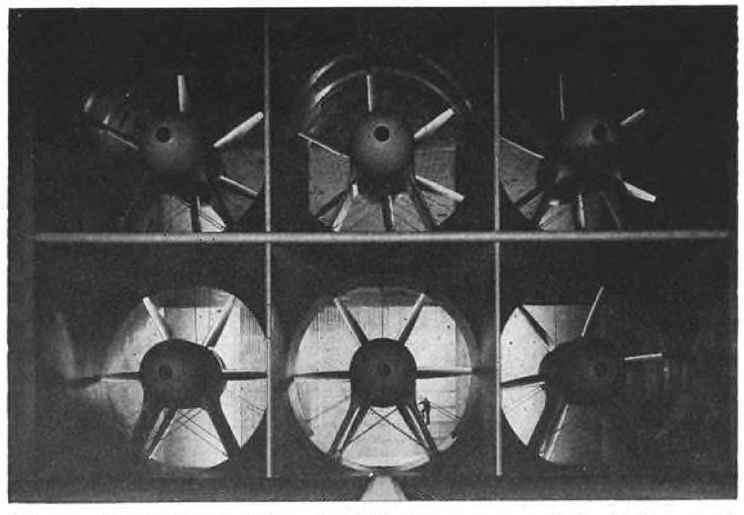
The general situation in the United States with regard to the study of these problems was discussed, importance of the problems was evaluated, and various conclusions were reached. It developed later, however, that in calling this conference President Taft had exceeded his legal authority and the findings and conclusions of this conference were devoid therefore of official effect.

Shortly after, however, in the early years of the first Wilson administration,

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* From the author's dedicatory remarks at the official opening of the Ames Aeronautical Laboratory, Moffett Field, Calif.





Side view of Laboratory's wind tunnel—world's largest—is seen (top). Airplane section (left of center in this photo) has 80x40-ft. throat capable of testing craft with spans up to 75 ft., and measurements can be made of lift forces of 180,000 lb. and drag forces of 32,000 lb. In foreground at right is 7x10-ft. tunnel, and directly behind it is 16-ft. tunnel and other facilities. Lower panel shows six propeller drive units of 80x40 tunnel. Each has 6,000-hp. Westinghouse motor, and together they circulate 24,000 cu. ft. of air through huge structure. Note comparative size of man (lower-center installation). In high-speed 16-ft. chamber, two 13,500-hp. General Electric motors power fans which can develop wind surpassing 600 mph.

HOW WILL POSTWAR PLANES BE SOLD?

By JAMES A. WALES, JR., *Assistant to General Manager, Aircraft Div., Fairchild Engine & Airplane Corp.*

To the aircraft maker, that "how" is packed with importance. For when V-day brings the grand scramble to land on Start-Selling Runway, some mighty costly circling will face the manufacturer who hasn't already implemented a thoroughgoing customer-serving distribution plan. This article details three ways to attack the problem.



Caring for the customer is a major consideration. The author emphasizes the fact that the plane buyer "spends a lot of hard-earned cash and has a right to expect some attention after getting his ship." Modern methods, he says, must banish the old tendency of some salesmen "to run away from the customer immediately after the plane is delivered and the commission pocketed."

OFTEN HEARD today is a remark that goes something like this: "When this war is over, I'm going to sell airplanes and make some real dough—because everybody will be flying, and I can cash in if I plan it right and get in on the ground floor."

In order to "get in on the ground floor" the prospective airplane "distributor" writes the manufacturers, explaining just what he plans to do and what a wonderful market his particular area will afford to the company receiving his enthusiastic letter. The volume of such mail has become so heavy that some plants have assigned one or more people solely to take care of these postwar inquiries. Each letter is answered courteously and the correspondence is filed by market areas and generally cross-indexed geographically and alphabetically.

Some manufacturers are even now making spot checks on the financial standing of promising prospects so that when the go-ahead signal is flashed, it will be only a matter of weeks before their distribution systems will be ready to function full blast.

Almost without exception the letters ask complete details on every postwar model which the manufacturer proposes to produce, including prices and plans for distributorship and dealership, as well as service and maintenance. Such letters have been received by many companies from Army privates overseas, Marines and Navy men.

Oddly enough the bulk of this mail from service men comes from members of ground crews and not from the pilots or flight crews.

Yes, a tremendous desire to sell airplanes certainly exists—even though the expected airplanes do not! Of course, these would-be dealers and distributors are seeking the "fastest selling" line. And the craft leading the line, they hope, will be a miracle plane which will back all competition off the map in its appeal to the prospective private owner. Meanwhile, thousands upon thousands of words have been printed in the press about the "wonderful superplanes of tomorrow," hence the public is in a tailspin of enthusiastic expectancy.

Surely, there will be plenty of planes to sell when the war is over. We've learned to turn 'em out like flapjacks. But the airplanes which are produced for the private pilot will have to do what the customer expects of them if they are to sell in quantities consistent with the prices which some manufacturers have already predicted.

Today every forward-thinking aircraft engineer is scratching his head trying to figure how to make a horsepower carry more weight faster. These fellows are striving for higher performance, less noise, more comfort, easier entrance and exit and, in general, more utility in the private planes of tomorrow. Assuming a normal improvement in design, we are certain to have planes soon after the war which will appeal to the private owner far more than those to which we became accustomed before the war. But just how near they will come to the elaborate predictions now being made for them remains to be seen.

Unfortunately there has already been so much over-selling that it will have an immediate effect upon the distribution problems which the industry will face at the conclusion of hostilities—an effect which will complicate a normal growth and tend to delay the complete success of any sound distribution plan. To sell an airplane, a dealer may first have to refute the prospect's erroneous conceptions of what that airplane will do for him. After all, the customer who feels he has been taken into camp will be of no true value to the dealer. Such a customer will just turn around and sell his ship, and private flying will lose another potential devotee.

One of the biggest faults of prewar aircraft distribution was that some salesmen developed a tendency to run away from the customer immediately after the plane was delivered and the commission pocketed. However, those dealers who continued to cultivate owners found that it paid well. The buyer had spent a lot of hard earned cash, and he had a right to expect that he would receive some attention after getting his ship. Over-selling in the way of unfulfilled service expectations is just as dangerous as building up false impressions of the aircraft itself.

Distribution — which definitely costs money—can, if properly executed, become an investment which will return big dividends in increased sales. But if improperly handled, it is the exact opposite—and no fooling. Among the manufacturers of the largest-selling private planes before the war, the usual practice was to allow the distributor a 25 percent discount from the list price. And the dealer was supposed to get a portion of this for having actually made the sale in his own locality and for handling details of all sorts relative to the sale.

Sometimes the dealer and/or the distributor had "bird dogs" who furnished leads and who had to be paid off with a portion of the commission once the sale was put through. With extent of their contribution the criterion, some dealers would get no more than 10 percent, while others might get up to 23 percent.

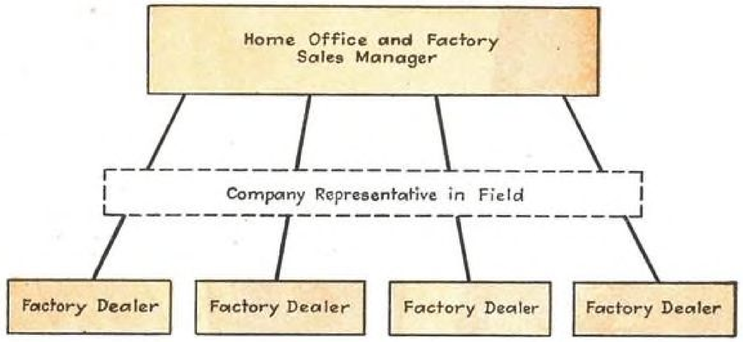
In several instances the distributor was actually little more than a sort of district sales manager, taking care of the paper work, keeping an airplane or two in stock for quick delivery, and seeing to it that his dealers made the sales. Though the practice was approaching extinction when the war came, many dealers and even some distributors would make deals which involved a discount to individual purchasers just to underbid competition and sew up the tougher sales. If any questions were asked, the "tough customer" automatically became a "dealer" in his town, for the more planes of a particular make used successfully in one community, the more likelihood of their continued sale there in the future. And so, the first two or three buyers of a new make of ship in any community could occasionally name their price and get away with it.

Usually the manufacturer was too busy

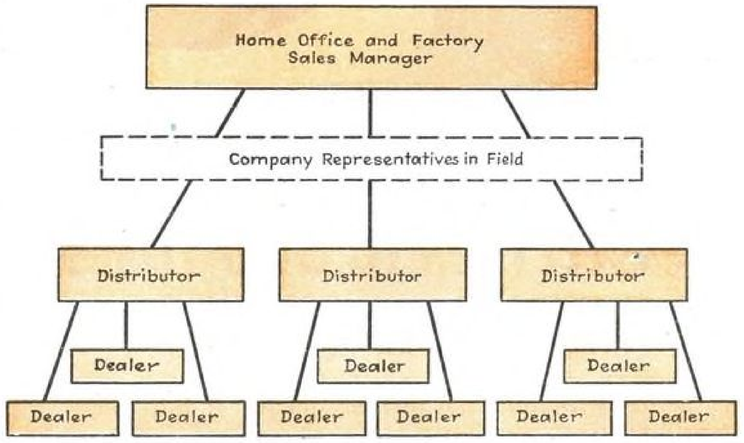
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THREE DISTRIBUTION SYSTEMS

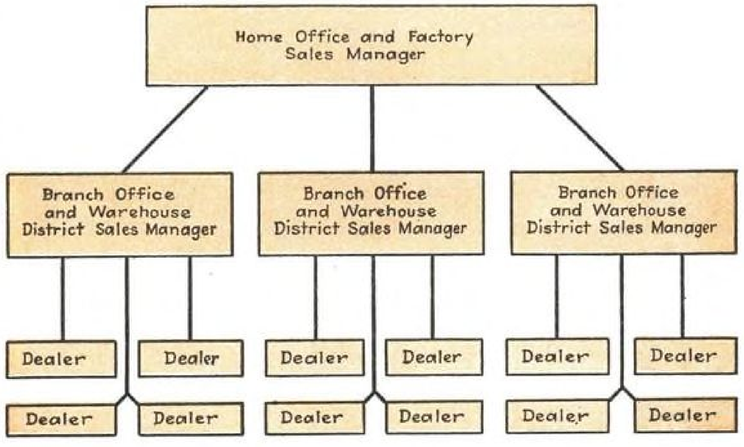
1. DEALER PLAN



2. DISTRIBUTOR PLAN



3. DISTRICT SALES OFFICE PLAN





THIS TIMKEN BEARING
***Carries* 10,000 TIMES**
ITS WEIGHT . . . . .

But strength is not the only quality of this special bearing. Its surface must be finished incredibly smooth to insure correct feathering. It must be able to withstand a centrifugal load of more than fifty tons, yet permit the blade to swivel freely when pitch is altered.

It must take into consideration the tilting forces caused by inertia, heavy propelling thrust, and gyroscopic effects. And it must carry *all* these forces, applied at long leverage, by a few rollers on opposite sides of a base with only a 6¾" span.

If you have a propeller feathering problem, we'll be glad to help solve it. Don't hesitate to consult us. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

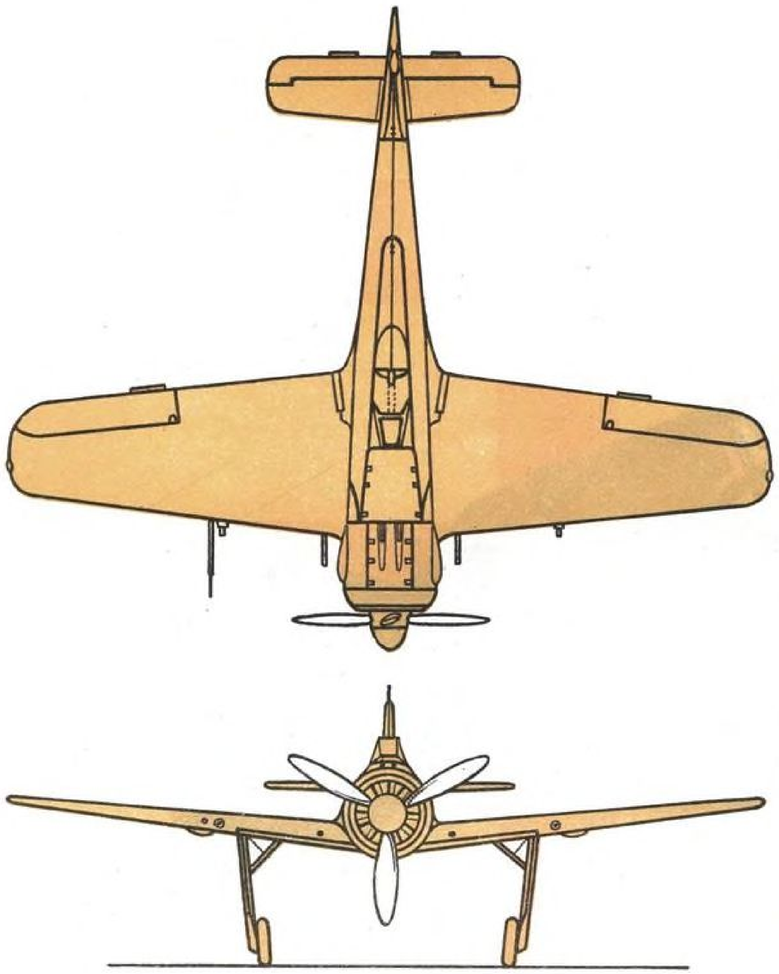


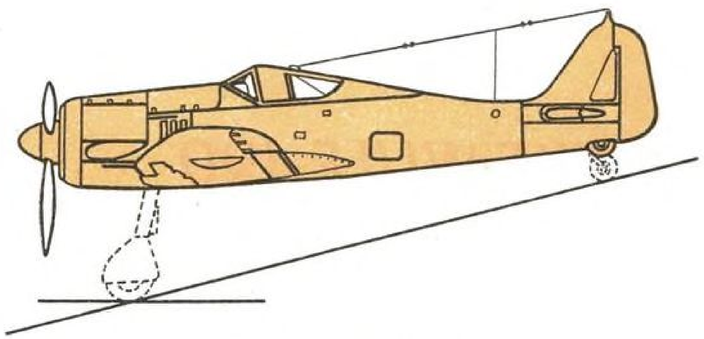
DESIGN ANALYSIS NO. 9

THE FOCKE-WULF 190

By **JOHN FOSTER, Jr.,** *Managing Editor, "Aviation," and*
CHESTER S. RICKER, *Detroit Editor, "Aviation," who also drew the field sketches.*

Here is the most comprehensive engineering report ever published on the Luftwaffe's top-ranking fighter, revealing for the first time many structural features and Nazi design theories. Presented with AVIATION'S inimitable wealth of detail and on-the-spot sketches.





Specifications and Design Data

Span	34 ft. 6 in.	Power loading	5.36 lb./bhp.
Length	29 ft. 1 in.	Aileron area, total	20.1 sq. ft.
Height	12 ft.	Percentage balance	28.8
Gross wt., normal load	8,600 lb.	Angles of movement	±17 deg.
Gross wt., maximum load	10,350 lb.	Stick gearing; deg./in	3.2
Wt., empty	7,500 lb.	Flaps, type	Split
Wing area	203 sq. ft.	Max. angle	60 deg.
Airfoil	Conventional, max. thickness, 25–30% of chord; ave. thickness/chord ratio, 12 %	Fin and rudder area	24.3 sq. ft.
Aspect ratio	5.8	Rudder action, angle each side	16 deg.
Dihedral	5 deg.	Percentage balance	4.6
Sweepback, ¼ chord line	5.5 deg.	Pedal gearing, deg./in	6
Chord, root	7.45 ft.	Stabilizer area, total	31.6 sq. ft.
Chord, tip	4.05 ft.	Elevator action angle, up	31 deg.
Mean chord	5.95 ft.	Elevator action angle, down	26 deg.
Wing loading	41.7 lb./sq./ft.	Percentage balance	9.1
		Stick gearing, deg./in	4.1

GERMANY'S FOCKE-WULF 190 presents an apparently strange combination of simple, yet sturdy, construction, paralleled by highly complex components. Analysis of the craft reveals, however, that it has been designed for the pilot and the field maintenance man. What often appears initially to be an unnecessarily complex small unit turns out to be a well designed, self-contained, and quickly removable component.

Underlying theory of the entire design appears to be to reduce field maintenance time to a minimum, as though the plane had been created with the idea that it's quicker to get parts of the plane replaced than to repair the parts themselves.

Then, too, the design is such that the craft can be built through widespread use of subcontracting or dispersal plants. The fuselage, for example, is comprised of two major components, the fore section extending from the firewall, or what the Germans call bulkhead No. 1, to bulkhead No. 8 aft of the pilot's seat, and the aft section extending from bulkhead 8 to the empennage.

The fore fuselage section is the heart of the plane and is, in effect, a double-deck box type structure, with the top section making up the pilot's cockpit and the lower section serving as the fuel tank bays.

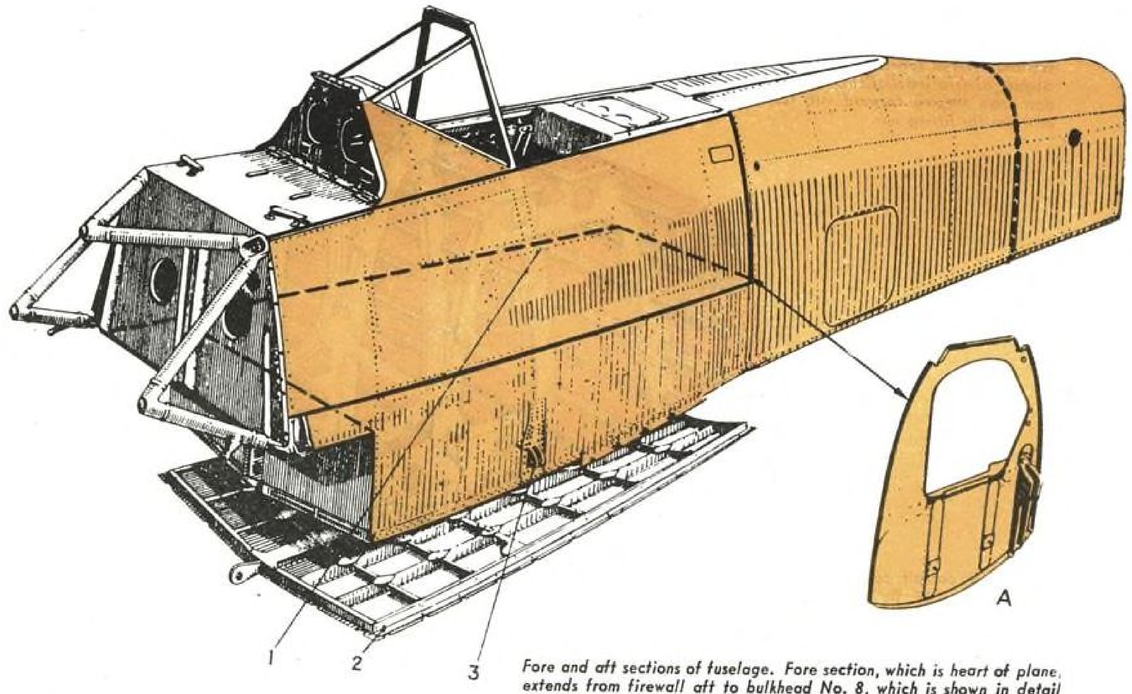
The firewall, or No. 1 bulkhead, is built up of light sheet steel backed by sheet aluminum alloy riveted to built-up flanges extending from the two top forged engine mount fittings down to forged fittings which serve as attaching points for both lower side engine mounts and front wing spar.

Longerons run aft from these four points to No. 8 bulkhead, where they are spliced to lighter ones in the aft section. Top longerons are 1¾-in.

ACKNOWLEDGEMENT

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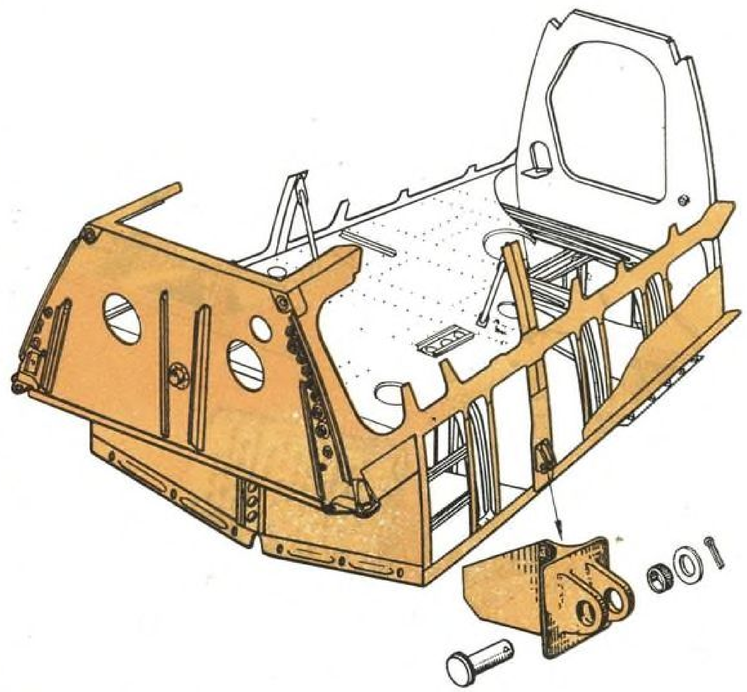
For unstinting cooperation and help, special thanks to: Major D. L. Hancock, Lt. J. E. Arnoult and Mr. M. Llacera of the Technical Data Laboratory; Capt. Howard M. Spickler, chief, and Lts. Joseph Becker, W. N. Wilson and A. J. Shank of the Captured Equipment Unit, AC/AS, Int. W.D.C., and Lt. Col. G. R. Johnston, Chief, Public Relations Section, and Mr. D. P. Kelly.



Fore and aft sections of fuselage. Fore section, which is heart of plane, extends from firewall aft to bulkhead No. 8, which is shown in detail A. This section is divided into upper and lower sections, separated by cockpit floor, which is indicated by dotted lines 1. Lower section contains fuel tank bays which are covered by single skin panel 2. This is quickly detachable by loosening nine screws along each side and five in each end. Rear spar fuselage attachment fitting is shown at 3.

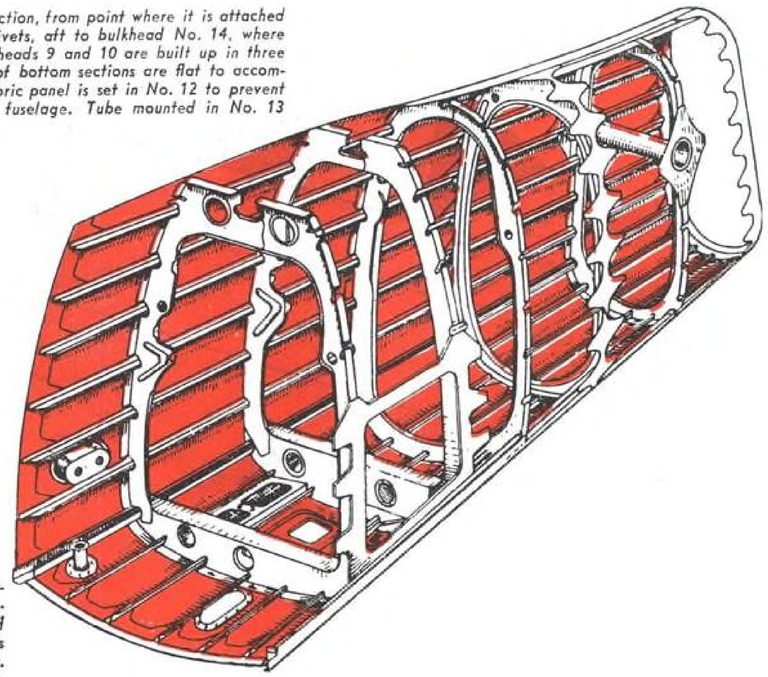
wide U-sections made up of $\frac{3}{16}$-in. thick aluminum alloy and serve as tracks in which the cockpit canopy travels. One hat-shaped stringer on each side, 10½ in. below the top longerons, make up the only horizontal stiffeners in the top part of the fuselage. Aluminum alloy sheet, riveted to the lower longerons, forms the cockpit floor, separating it from the fuel tank bays.

Bulkheads in the upper fore fuselage section are not uniformly spaced, nor are they all of the same construction. No. 2, of conventional stamped flanged construction, is 12½ in. aft of No. 1; No. 3. some 6⅝ in. farther aft. is directly beneath the front windshield base. No. 4, also of conventional construction, is 10⅝ in. farther aft. No. 5, directly under the rear end of the fixed windshield and above the rear spar fitting, is angle shaped against the skin, and extends above the floor only to the stringer. It is braced by a ¾ in. tubular section flattened at each end for riveting to the bulkhead and cockpit floor. No. 6 is an A-frame structure, the base of the fore part being 12 in. aft of the No. 5 bulkhead, the top 18½ in. farther aft. The sloping fore part is a channel section in which the pilot's adjustable seat is supported. The vertical member, set 5 in. aft of the top, is conventional stamped, flanged construction, riveted to the fore part at the top by a web plate of aluminum alloy. No. 7 is conventional construction, set 12 in. aft of the rear part of No. 6, and No. 8 is a built-up stamped flanged member

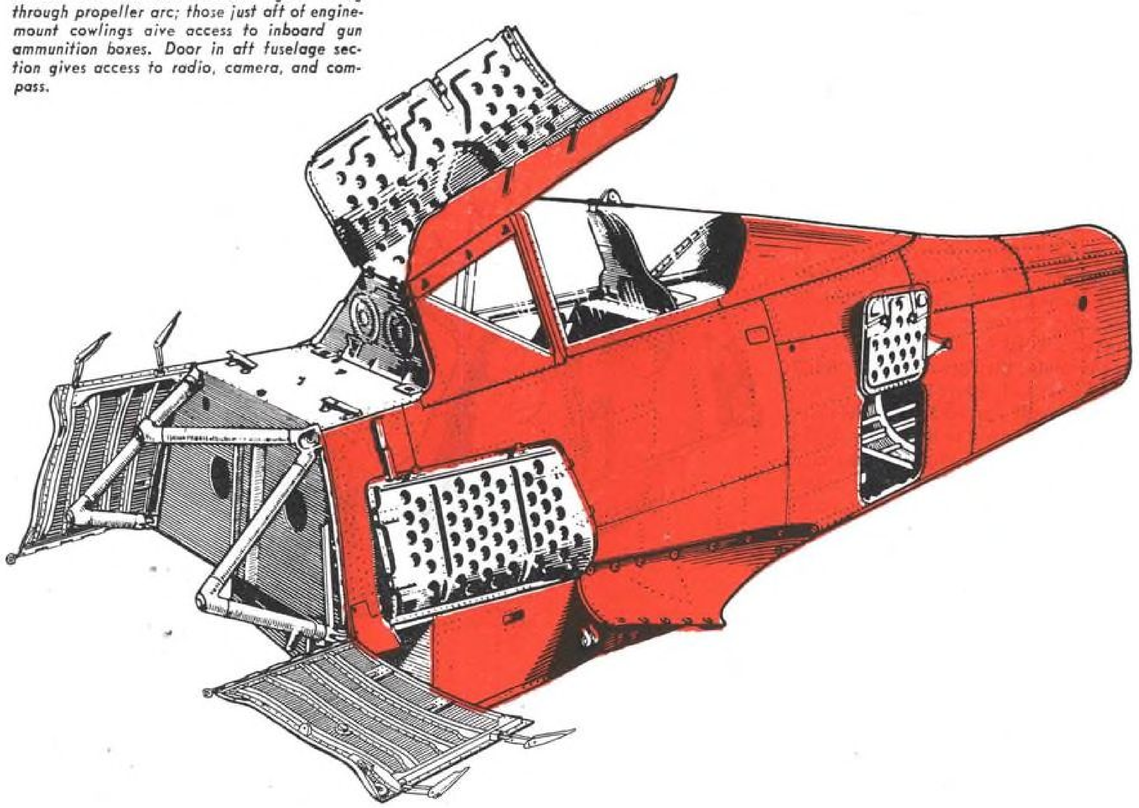


Details of fore fuselage section between firewall-bulkhead No. 1 and bulkhead No. 8, with top longerons cut away. This detail shows how bulkheads are unevenly spaced and vary in construction. Forged rear spar attachment fitting, shown in detail drawing, is attached to build-up web tie-through member, which also serves to separate two fuel tanks.

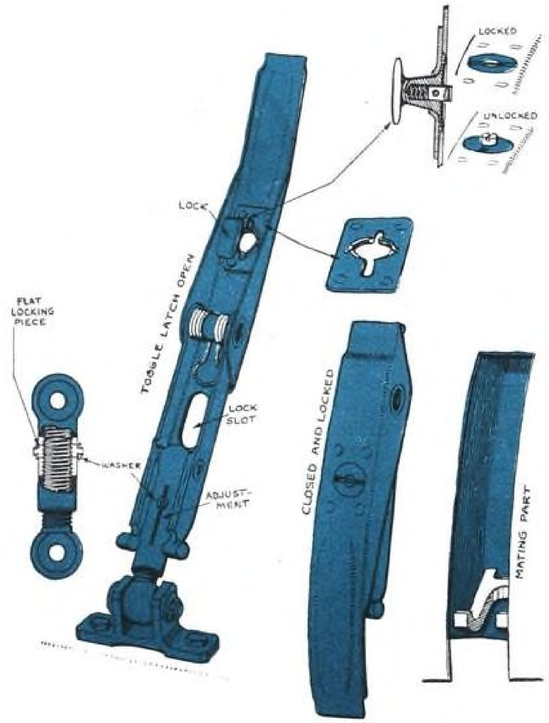
Cut-away view of aft fuselage section, from point where it is attached to fore section by double row rivets, aft to bulkhead No. 14, where empennage is bolted to it. Bulkheads 9 and 10 are built up in three sections, riveted together. Tops of bottom sections are flat to accommodate camera installations. Fabric panel is set in No. 12 to prevent dust from seeping forward into fuselage. Tube mounted in No. 13 provides for lifting bar.

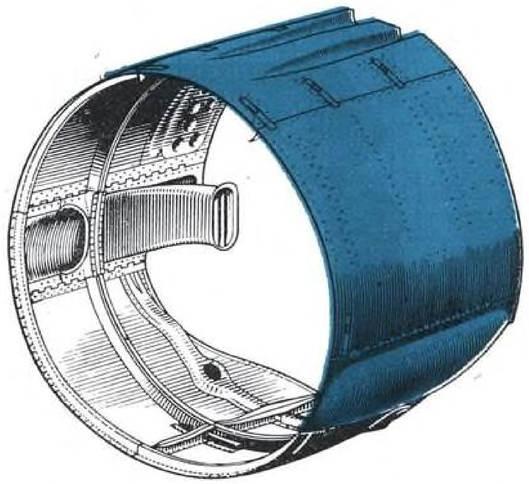


FW-190 fuselage with cockpit canopy, fairings and doors in place. "Waffle" type construction, in which two skins are riveted together by one rivet in each dimple, brings cowling weight to about 1.75 lb. per sq. ft. (compared with 1.25 for American and British cowlings), but reflect German design philosophy of keeping fairings attached and in place for hurried locking. Fairings hinged at bottom of engine mount, giving access to accessory compartment, serve as work stands. Top fairing, seen folded back over windshield, covers two 7.9-mm. machine guns firing through propeller arc; those just aft of engine-mount cowlings give access to inboard gun ammunition boxes. Door in aft fuselage section gives access to radio, camera, and compass.



Field sketch showing details of heavy toggle latches which hold cowling and fairing in place. They are strong enough to spring fairing into place even if it is distorted. Tension adjustment, with small flat bar lock, is shown at left. Center sketch shows toggle in closed position, and slot in mating piece is at right. Sketches at upper right reveal details of lock. Locking plate has two depth slots, so center indicator pin sticks up when latch is unlocked; it is flush when locked.





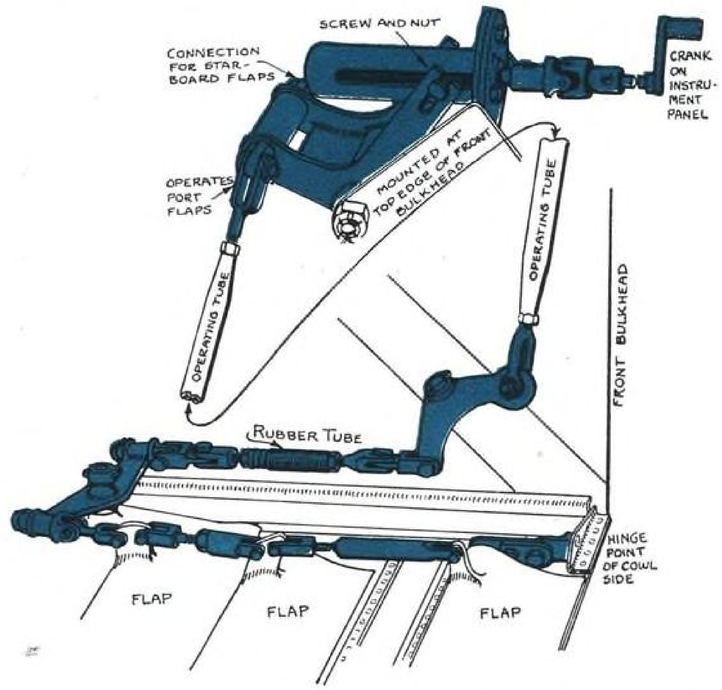
Heavy toggles are also used on engine cowling, this sketch showing them at top. Piano-type hinges, with eye for easy removal and inspection, are used at bottom.

extending the full depth of the fuselage, and forms the joining point for fore and aft fuselage sections.

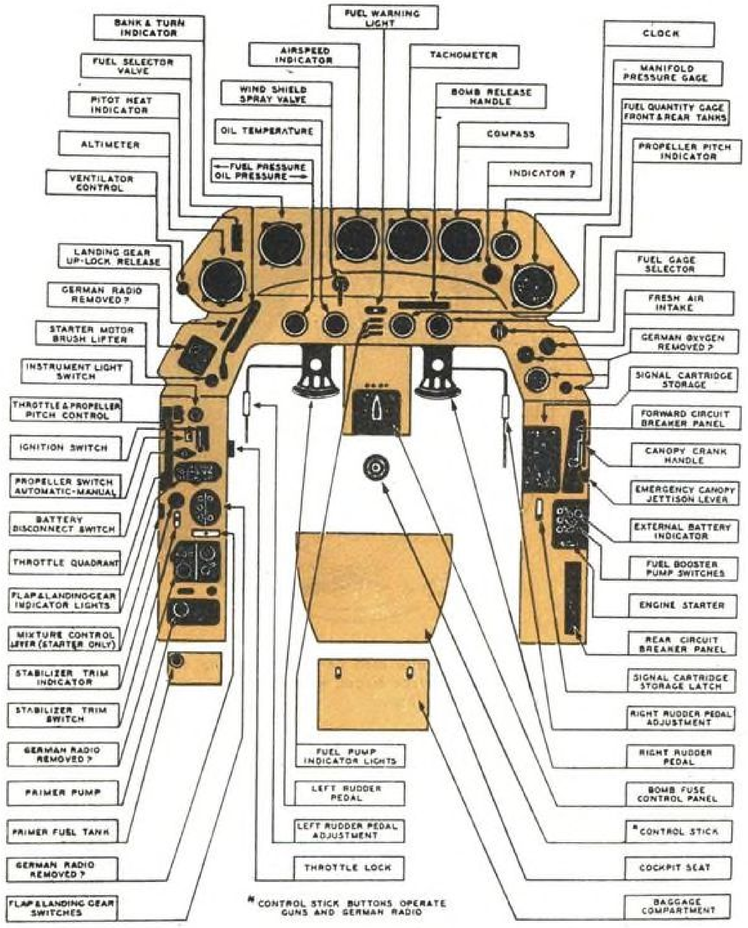
The lower fore fuselage, or fuel bay section, has but six bulkheads. No. 1 forms the front end, being right aft of the front wing spar. No. 2, which is in reality a contour rib, is 10 in. aft and is a continuation of No. 3 from the upper section. Lower No. 3, set 5⅞ in. farther aft, is also a contour rib and joins the longeron between Nos. 3 and 4 of the upper section. No. 4, of built-up web construction, is the tie-through member between rear spar fittings, and separates the two fuel tank bays. No. 5 is set below the forepart of the A-frame No. 6 of the upper section and, like lower No. 6, which is set 11 in. aft, is contour-rib type.

One belly skin panel, attached to longitudinal and transverse angle shaped stiffeners, is attached to the lower fuselage section by nine screws along each side and five on each end, thus giving quick access to the two selfsealing fuel tanks, which are suspended from the contour rib-bulkheads by heavy web straps.

On the upper fore fuselage section, immediately aft of the top engine mount fittings, the fuselage structure is flat, forming a shelf to which are bolted mounts for the twin 7.9 mm. machine guns that fire through the propeller. Back of this gun mount shelf the fuselage sides extend up to form the base



Three adjustable air outlet flaps, mounted in doors hinged at bottom, are set on each side of engine cowling. To operate them, a screw-and-nut mechanism is attached to forward side of firewall and is connected to each side door by tubes. Latter are connected to linkage on doors by levers and bell cranks so arranged that they do not have to be removed or adjusted when doors are opened.



DIAGRAMMATIC COCKPIT LAYOUT



for the windshield, the front panel of which is 1¼ in. bulletproof glass.

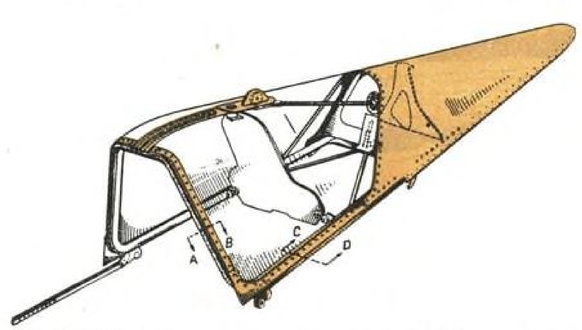
At the base of this front panel is hinged the fairing to cover the guns just mentioned. This fairing, which hinges up and back for access to the guns, is of "waffle" type construction, with the two skins being fastened together by one rivet in each inner skin dimple. Three heavy locking toggle switches—typical of those installed throughout the plane—are used on each side to hold the fairing in place.

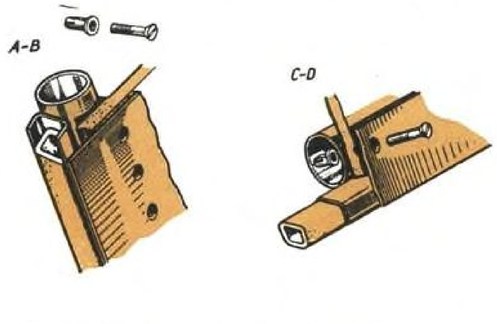
Such heavy cowling—and easily removable hinges to keep it in place—naturally adds what seems unnecessary weight. It is, however, in keeping with the apparent design theory; the cowling is always on the craft ready for locking and a quick takeoff. It is heavy enough to stand hard wear; in fact, the side panels swinging downward around the engine mount are used as work platforms. Too, in case the cowling is bent a bit, the toggles are sturdy enough to pull it into place for quick locking.

Cowling on the FW-190 averages about 1.75 lb. per sq. ft., compared with about 1.25 for British and American craft, but the German's persistent use of the type through several model numbers indicates their belief the beatings it can take and the speed with which it can be locked in place make it worth the added weight.

The cockpit cover and its fairing are built as an integral unit. Base of the structure is a ⅝-in. tubular member bent into an inverted U at the front to fit into the windshield. The plastic glass of the cover is mounted between two strips of buna and a flat aluminum strip, held by screws driven into self-locking nuts in the tube. At the rear of the plastic glass a stamped, flanged aluminium A-frame sets between the tube-frame ends, and is riveted to aluminum alloy fairing mounted on a ¾-in. tube extending aft. The whole structure rides on three ball bearing rollers; one on each side at the front of the plastic glass section in the top fuselage longerons, and one attached to the tube, running in a channel section (which serves as top longeron) set in the fuselage turtle deck.

The cockpit cover can be operated only from inside by a crank attached to a sprocket which engages a pin ratchet attached to the front end of the tubular frame. Emergency exit can be effected by pushing down on a small handle located near the crank. This disengages the sprocket and then, through a series of rods and shafts, releases a latch holding the firing pin. A cartridge explodes and blows the rear end of the canopy backward far enough to let the slip stream get under and pull it away. The explosive charge—about the size of a 12-gage shotgun shell—is located aft of a silhouette of ¼ in. armor plate back of the pilot's head. This armor is attached to the cockpit cover tubular member by links attached to studs welded to the armor plate.





Cockpit canopy details, showing method of fastening plastic glass to tubular frame. Entire canopy slides on ball bearing rollers in tracks formed by upper fore fuselage longerons and in track formed by upper aft fuselage longeron. Canopy can be operated only from inside cockpit, by crank on right side attached to sprocket engaging pin ratchet (seen at left above) attached to front end of tubular frame. Note silhouette armor plate mounted in canopy frame; it slides forward to just behind pilot's head.

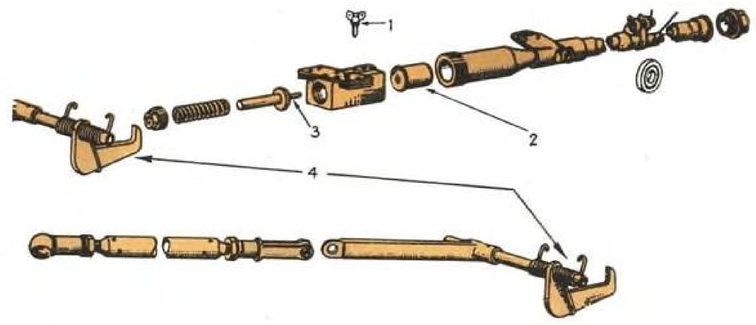
An interesting angle of the cockpit cover is its connection with the radio antenna, which leads in from the vertical fin to and over a pulley set in the plastic glass just behind the armor plate, then over another pulley set in the aft end of the cover fairing, then forward again to an insulated lead-in to the radio mounted just behind No. 8 bulkhead. Thus, regardless of whether the cockpit cover is open or closed, the radio antenna has the same tension.

While the cockpit itself does not give the appearance of being overcrowded there is, nevertheless, no waste space. Flight and engine instruments are arranged on two panels beneath the windshield and on horizontal panels on each side, as shown in the accompanying diagrammatic layout. The pilot's seat, the back of which is made of armor plate, is only adjustable up and down 4-in. and is designed for seat pack parachutes.

The aft fuselage—from bulkhead 8 through 14—is semi-monocoque construction, and is attached to the fore section by a double row of rivets through both skins and the flanged portion of bulkhead 8. An examination of several different craft, including more than one model, indicates these two sections are not jig-drilled prior to mating. Apparently the two sections are brought together in a mating jig and both drilling and riveting done there, for variations in rivet locations are readily apparent. This same type of assembly is rather widely used, as will be noted in the discussion of other components.

Bulkheads No. 9 and 10 of the aft fuselage section are built up in three sections, the bottom ones being heavy channel sections with flat tops to support camera installations. Upper portions of both are conventional stamped flanged construction, riveted together and to the bottom sections.

Numbers 11, 12, and 13 are of lighter construction and follow conventional practice, being built in halves and riveted together at top and bottom. No. 13 contains a cross tube for lifting the fuselage. In No. 12 there is set a fabric panel to keep dust from seeping forward to the radio, camera and master magnetic compass with its contact for control of the repeater on the instrument panel.



Here are details of mechanism which blows canopy away for emergency release. Mounted in aft tube (behind armor plate) which rolls in aft fuselage section top longeron, it is operated by lever at pilot's right hand. A safety (1) is provided in firing block. Explosive charge (2) looks like ordinary shotgun shell. Firing pin is shown at (3) and release at (4).

Bulkhead No. 14 is heavy flanged construction for bolting the empennage to the aft section.

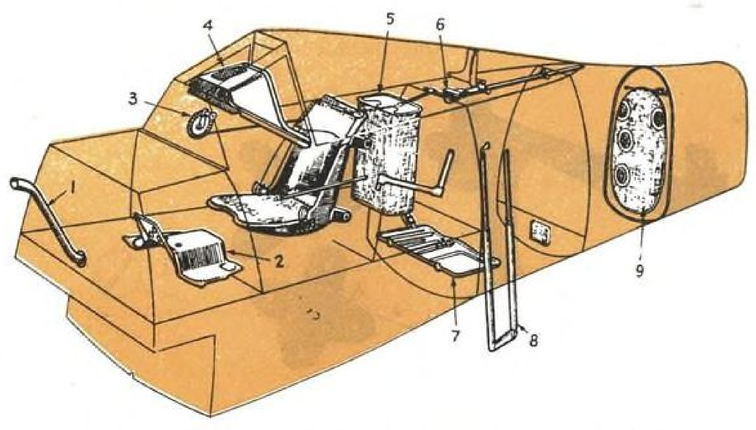
There are two upper side channel-shaped longerons, riveted to those from the fore fuselage section by 6-in. splices and they extend to aft of bulkhead No. 11. A channel-shaped top longeron extends the full length of the aft section, between bulkheads 8 and 11 serving to support the cockpit cover fairing track. There are six Z-shaped stringers with rolled edges on each side of this section of the fuselage and five in the bottom in addition to two heavy U-shaped stringers where side and bottom sections are joined.

The aft fuselage skin—like that in the fore section—is slightly lighter than our 24ST, but no evidence of wrinkling was found in the several craft studied. Flush riveting is used on every surface of the craft.

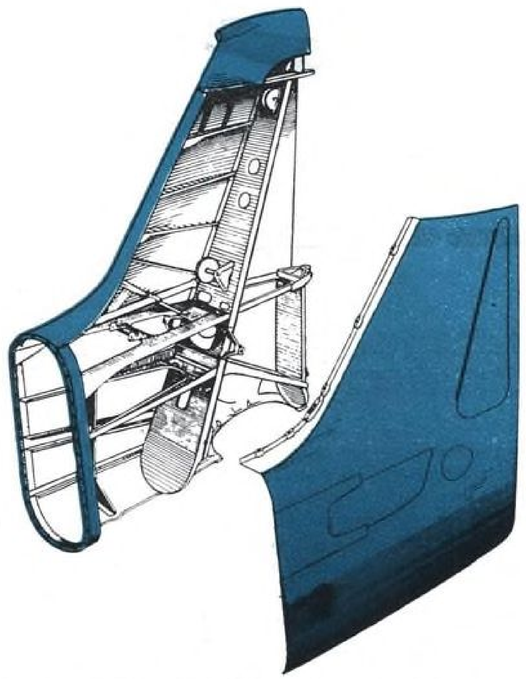
One of the outstanding examples of simple, yet sturdy construction found in the Focke-Wulf 190 is the empennage. It is attached to the aft fuselage section at bulkhead 14 by mating, flanged bulkheads through a series of closely-spaced bolts.

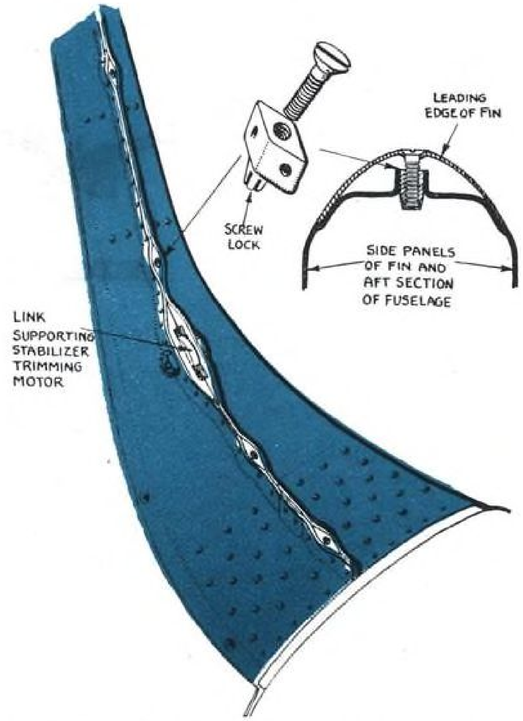
Leading aft from this bulkhead, some 5 in. from the top skin, is a stamped flanged rib with lightening holes, extending from side to side, and seven and three eighths inches lower is another full-width rib. The stabilizer goes through the fuselage between these ribs.

Both ribs intersect a diagonal member which is the heart of the empennage, for it carries tail wheel loads on the ground and, once the craft is airborne, carries both fin-and-rudder and stabilizer-and-elevator loads.



Accessories in Focke-Wulf 190 fuselage section. (1) Is hot air supply to cockpit; (2) is cover over fuel pumps and electric junction boxes; (3) is handle moving canopy; (4) is armor and bullet-proof glass; (5) is battery; (6) is explosive canopy release; (7) is camera mount; (8) step which telescopes up into fuselage; and (9) fabric panel in bulkhead No. 12 to protect instruments located in aft fuselage section.

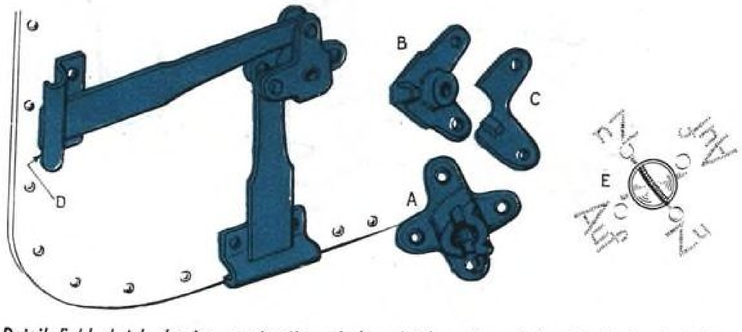




Cut-away view (left) of empennage and integral vertical fin. This section bolts to aft fuselage section at bulkhead 14. Diagonal structural member is heart of this section, for it supports tail wheel loads when craft is on ground and supports fin, rudder, stabilizer, and elevator loads when ship is airborne. Two skins, extending from the bottom of fuselage to top horizontal rib at base of fin tip, are riveted together at top along a vertical flange. Aft of diagonal member and above middle horizontal rib, skins are of "waffle" construction. Hinged inspection door—30 in. high by 15 in. across base—is locked in place by special screwdriver-operated fasteners. Piano hinge and springs are protected by fabric covering. Field sketch (above) gives detail of fin leading edge, showing how two skins are riveted together along vertical flange. Single formed aluminum alloy fairing is fastened over flange by flush screws driven into diamond-shaped safety nuts riveted between flange. Same method is used for leading edge of stabilizer.

Starting at the bottom skin 18¾ in. aft of the attaching bulkhead, this member extends up and aft 63½ in. to the top vertical fin rib (which extends aft to support the top rudder hinge) at the base of the detachable vertical fin tip. Nine inches from this members' lower end, on the aft side, is riveted a fitting to which is attached the front end of the tail wheel drag yoke. On the front face, between the two horizontal ribs previously noted, is riveted a forged hexagonal fitting to which the stabilizer rear spar attaches.

Above the top horizontal rib, on the aft face, is riveted a 20-in. double channel member which forms the guide rails for the tail wheel retracting unit, which will be detailed later. The channel member is surmounted by a plate bearing a pulley which is part of the retracting unit, and the top fin rib.



Detail field sketch showing construction of door latches. Forged bracket A, is riveted to door. Operating bell crank is made in two parts: Stop piece B, which limits throw; and latch piece C, which drops into slot in bracket when locked. Latch is turned with screw driver at E. Spring keeps screw head flush when in locked position. It must be pressed inward to release. Guide bracket D is soft enough so it can be bent with pliers to tighten lock.

The topmost of the two horizontal ribs extends aft of the diagonal member 16¼ in., the middle rudder hinge being mounted at its end. The other horizontal rib, aft of the diagonal, extends downward at approximately 28 deg. from the base of the stabilizer fitting to the bottom of the tail cone to support the lower rudder hinge. A vertical web plate of stamped flanged alloy connects the two ribs at their aft ends.

Below the two horizontal ribs, three Z-shaped stringers on each side run from bulkhead 14 to the diagonal member, and a similar number are employed above.

At the leading edge of the fin, the skin is crimped and riveted together, with a series of 5 diamond-shaped, self locking nuts inserted and riveted between the crimping. The leading edge skin, a single sheet of formed aluminum alloy, can then be fastened in place with flush flat head screws driven into the diamond-nuts. Drilling of the two fin skin surfaces apparently is not a jig operation, for study of several



craft showed uneven spacing and lack of rivet alignment. In one plane, as a matter of fact, even a difference in rivet sizes was evident.

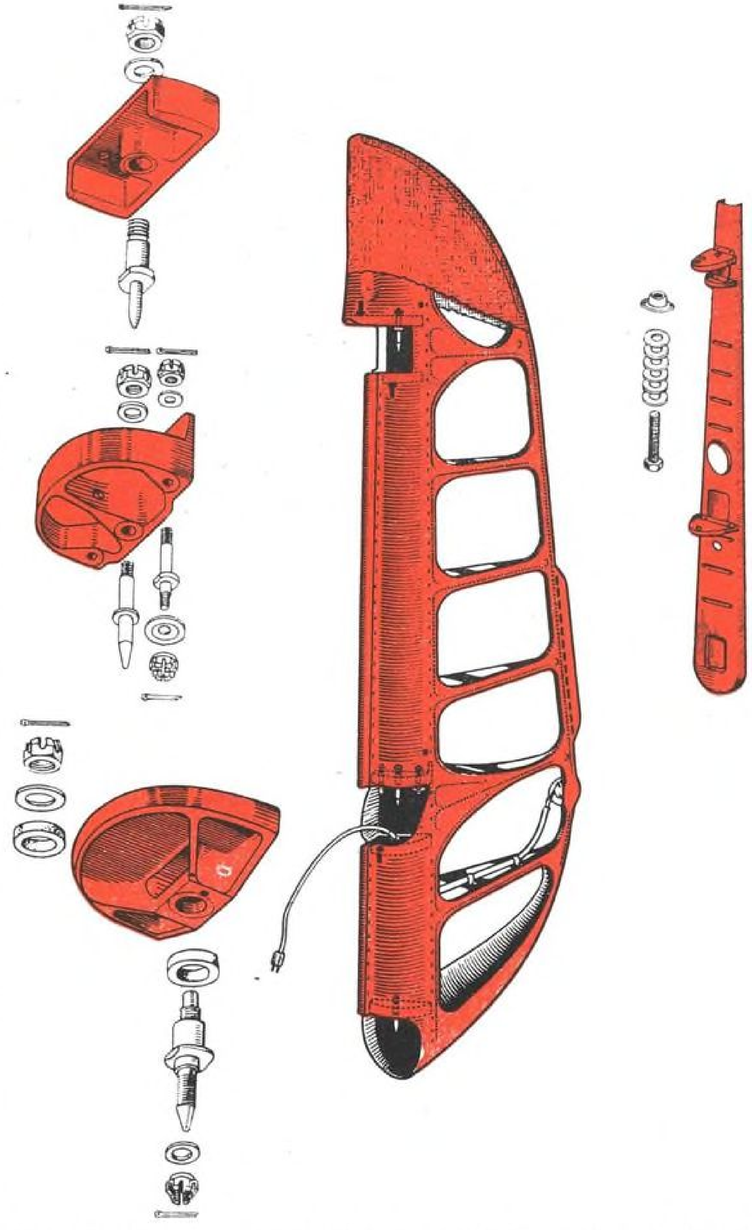
Skin aft of the diagonal member—between it and rudder hinge points—is of the familiar double skin "waffle" construction, eliminating the need for stringers. A triangular inspection door—30 in. high by 15 in. across the base set in the left side of the fin gives quick access to the tail wheel retracting unit and top of the oleo shock strut. Two screw driven locks are used. The piano hinge along the forward edge carries hinge springs to keep the door closed. These and the hinge are sealed in fabric.

Apparently deterioration of pilot quality, well-prepared airports, or some other causes have resulted in failures in the empennage, for examination of later models of the 190 reveals that additional web plates have been installed between the horizontal ribs behind and below the stabilizer fitting to better distribute the stabilizer-elevator and tail wheel loads.

The dynamic and mass balanced rudder is built around a single spar of stamped flanged aluminum to which are riveted the three hinge fittings. Leading edge is flush riveted to the spar, and ribs have rounded gusset plates. Trailing edge is also of metal, with the entire unit being fabric covered. Unlike most modern fighters, the 190's rudder trim tab is adjustable only on the ground. It consists simply of a 15 x 1 in. metal strip riveted into the trailing edge, with a series of perforations to facilitate bending to the desired degree. Two types of tabs are used; some with slotted perforations, some with round holes.

The stabilizer is full cantilever single spar all-metal construction, built as one unit except for detachable tips. There are seven floating ribs on each side. Stabilizer attaches at the aft edge to the diagonal member of the fin through the forged fitting previously noted, and hinges on pins that go into self aligning trunnions, for vertical trim of the craft is effected through adjusting the stabilizer.

On the center of the stabilizer's leading edge is a fitting attached to a yoke

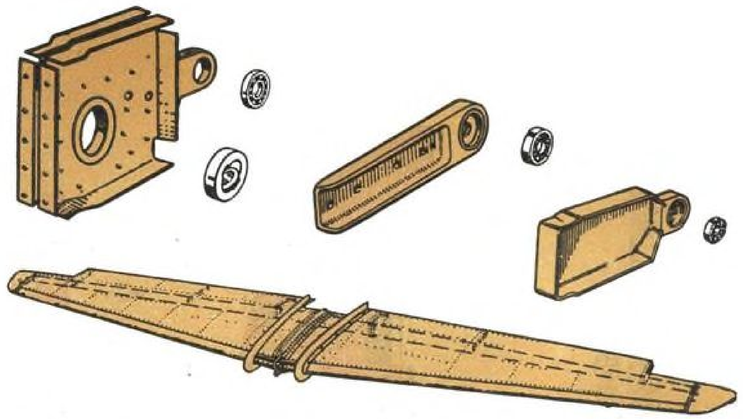


Fabric-covered rudder is built around single spar (shown in detail at right). Top, center, and bottom bearings are shown in deails at left. Rudder operating cables are attached to outer holes shown in middle bearing detail. Note how hinge pins are tapered to facilitate assembly. Rudder is secured by bolt on lower hinge pin. Trim tab is adjustable only on ground. It consists simply of 15 x 1-in. metal strip riveted into trailing edge, with row of perforations to facilitate bending to desired angle.

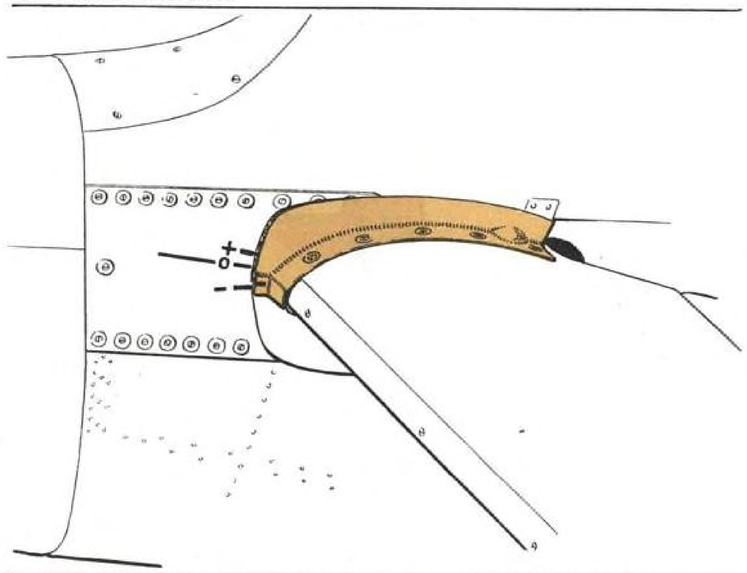
which, in turn, fastens to a screw jack and electric motor suspended by a ball and socket joint from the leading edge of the vertical fin. This motor, which turns up 14,000 rpm., has six trains of gears with 533 to 1 reduction. It moves the stabilizer leading edge 4.1 in. per min., or over the full arc of adjustment in about 20 sec. A magnetic brake is provided to prevent motor overrunning when current is cut off.

In the stabilizer, as in the leading edge of the vertical fin, the upper and lower skins are crimped and riveted together and the leading edge screwed in place via six of the diamond-shaped nuts. In this unit too, rivet alignment and spacing are both irregular along the crimped skin.

Elevators, like the rudder, generally

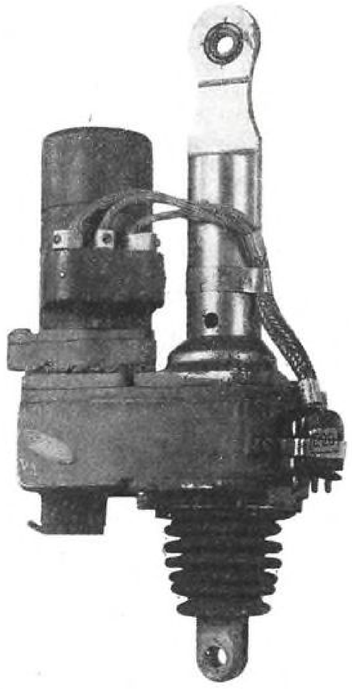


Focke-Wulf 190 stabilizer is single-spar full cantilever structure built in two halves and bolted together at center line. Top and bottom skins are flanged and riveted together to form front spar. Leading edge is attached like fairing on vertical fin. Three ball bearing supports for elevators are provided on each side (shown in detail in sketches at top). Formed tips are screwed into place with flat-head screws in counter sunk washers. Captured nuts in flange of outer rib hold them in place.

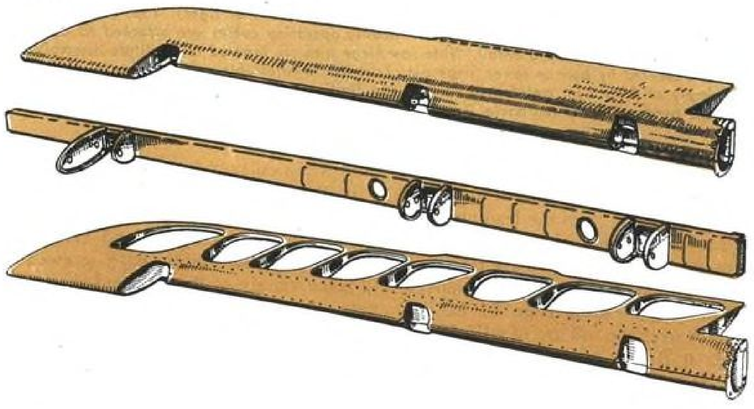


Stabilizer angle of attack is adjusted by electric motor-driven screw jack mounted in leading edge of vertical fin, with hinge point along spar at trailing edge. Electric indicator is attached to stabilizer so that its position is shown on instrument panel. This field sketch shows adjustment marks on fuselage and fairing.



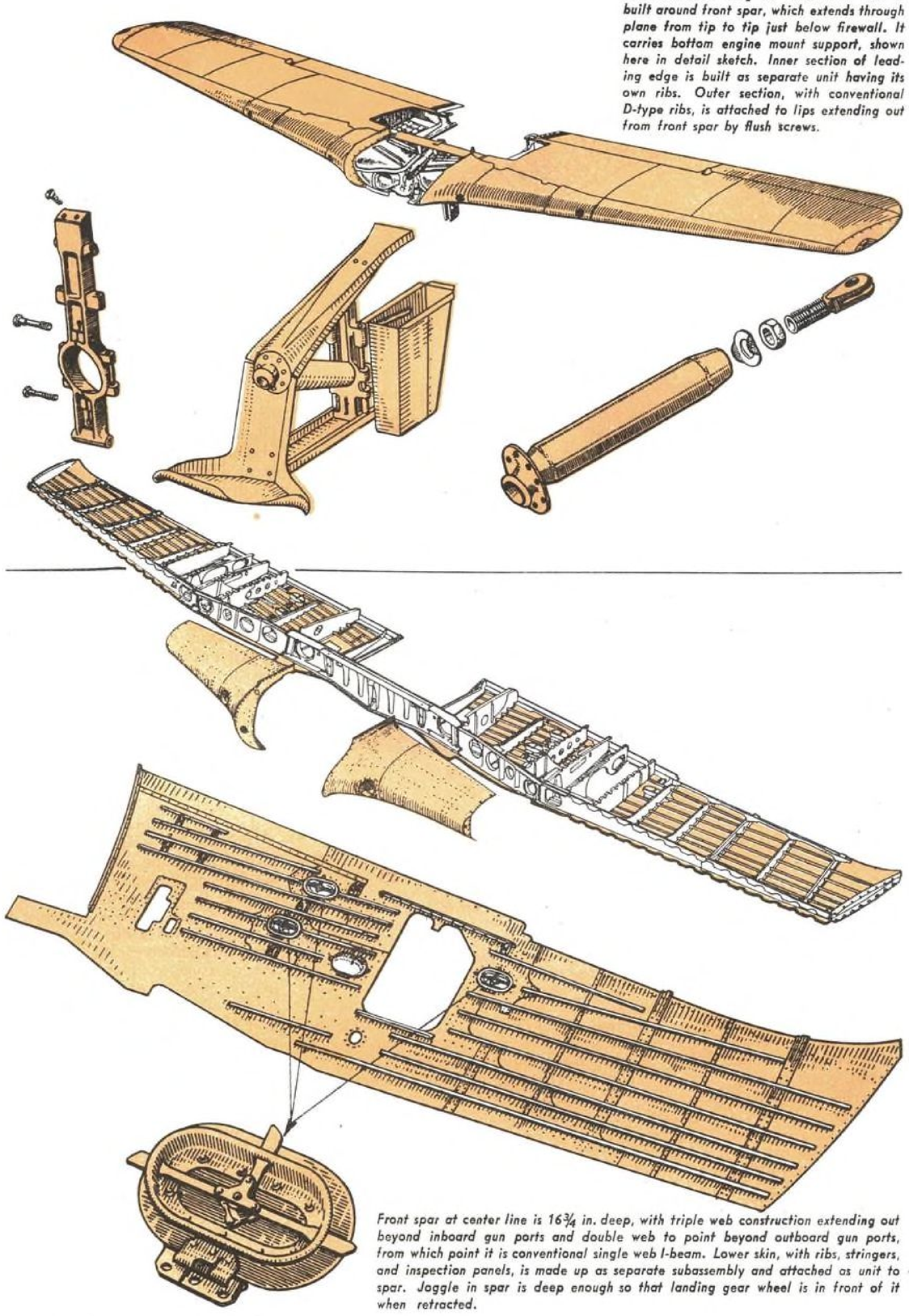


Stabilizer adjusting unit, with ball-and-socket at top for attaching to inside of fin leading edge and fitting at bottom for attaching to stabilizer. Electric motor runs at 14,000 rpm. and, through six gear trains with 533-to-1 reduction gear, moves stabilizer over full adjustment arc in about 20 sec. Magnetic brake keeps it from over-running when current is turned off. Bellows type rubber sleeve at bottom of screw jack keeps it clean.

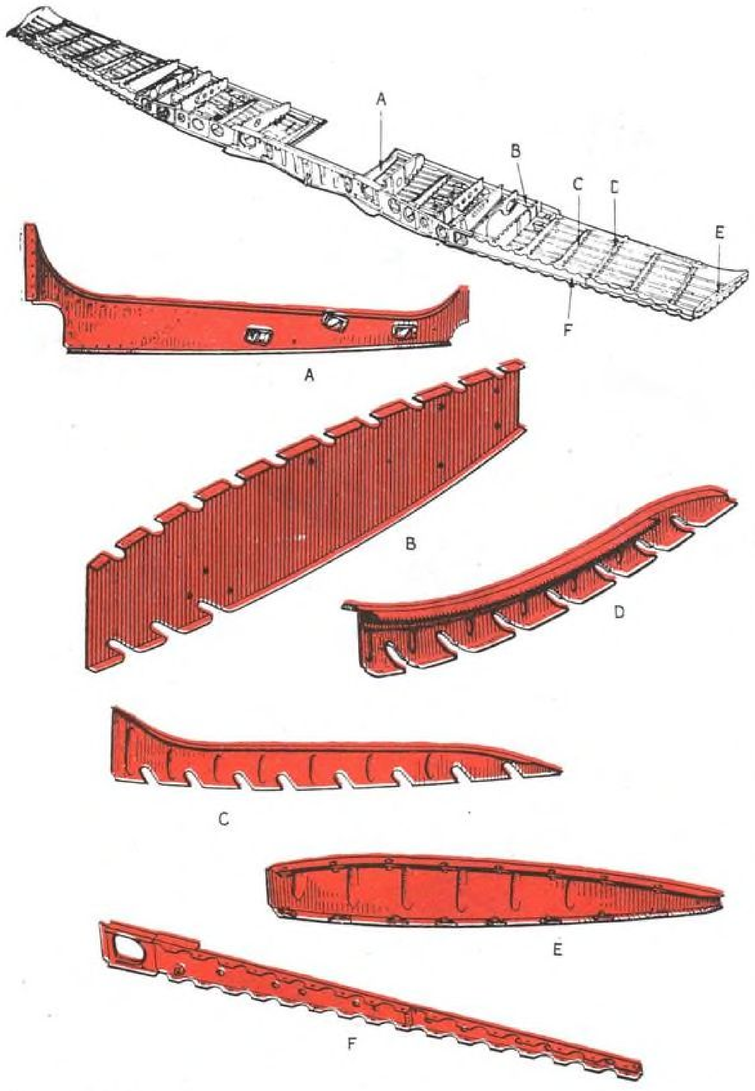


Elevators are built around single spar (shown in center) with metal leading edge, ribs, and trailing edge. Whole unit is fabric covered, fabric being stitched in place with wire loops. Even though stabilizer is adjustable in flight, right elevator (shown here) has perforated trailing edge trim tab—adjustable only on ground—similar to that found on rudder.

Full cantilever wing on Focke-Wulf 190 is built around front spar, which extends through plane from tip to tip just below firewall. It carries bottom engine mount support, shown here in detail sketch. Inner section of leading edge is built as separate unit having its own ribs. Outer section, with conventional D-type ribs, is attached to lips extending out from front spar by flush screws.



Front spar at center line is 16¾ in. deep, with triple web construction extending out beyond inboard gun ports and double web to point beyond outboard gun ports, from which point it is conventional single web I-beam. Lower skin, with ribs, stringers, and inspection panels, is made up as separate subassembly and attached as unit to spar. Joggle in spar is deep enough so that landing gear wheel is in front of it when retracted.



Wing ribs of FW-190 vary in construction and only six are attached to both top and bottom skins. Top detail sketch A shows rib adjacent to fuselage, with reinforcement forgings; B is outboard-most "solid" rib; C and D are typical floating ribs; E is outboard rib to which formed tips are attached wih flush screws. F illustrates construction of spar from outboard cannon port to wingtip, showing forward-extending lips, to which leading edge is screwed.



follow conventional practice with a single spar, metal leading edge, metal ribs with the familiar rounded gusset plates, metal trailing edge and fabric covering. Despite the fact that the stabilizer is adjustable, the right elevator has a perforated trailing edge trim tab like that on the rudder.

The elevator hinges to the stabilizer at three points and, although all three fittings are different, each hinge has a self aligning ball bearing unit.

A departure from conventional construction shows up in the 190 wing, for it is built as a single unit from tip to tip. Thus, if it is damaged structurally any place between the detachable tips, the entire unit, rather than say, one panel, must be replaced.

The integral center section of the tapering front spar is a very heavy member, for it takes the weight of the two lower side and bottom engine mounts, fuselage fitting attachments, four 20 mm. cannon, and main landing gear. At the center line it is a built-up triple-web I-beam 16¾ in. deep, reinforced by a heavy vertical channel-shaped member embracing, at its lower end, a forged fitting for the lower engine mount structure, a combined tubular-and-channel truss unit. Between the center line and side engine mounts, set 24-in. out, are two vertical hat shaped stiffeners. Engine mount members themselves are of similar shape, but are heavier and are riveted rather than bolted to the spar.

At these side engine mounts the spar is bent forward 14 deg., with this angle being maintained 64½ in. to the main landing gear fittings, from which point it parallels the center section. The bend permits the landing gear wheel to retract in and up ahead of the spar. This section of the spar has, in addition to the cannon ports, three lightning holes and three vertical angle stiffeners.

The triple-web construction continues beyond the bend to just outboard of the port for the barrel of the inboard cannon. Immediately outboard of the landing gear fittings, where the spar again bends, it is reinforced by a heavy riveted gusset extending some 12 in. beyond the outboard cannon port, from which point to the tips the spar is single web I-beam with 1½ in. lightening holes. For the full length of this outer portion the spar has lips top and bottom to which the leading edge is screwed.

The leading edge, from engine cowl outboard to the landing gear, is built as one unit and is attached by screws to the spar. The main member, just outboard of the gun port, is a double, stamped flanged rib with cutout for the landing gear strut. Two feet farther out is another contour rib of I-beam construction and between them a stamped flanged upper contour rib. Tip-end of this section also has a stamped flanged rib with cutout for the landing gear strut. Remainder of the leading edge is built as one unit, consisting of formed aluminum sheet reinforced by conventional stamped flanged D-type nose ribs.

Only five 'tween spars ribs on each side, besides those at the wingtips, are attached to both top and bottom skins. Of conventional stamped, flanged construction, they are located just outboard of the inboard cannon; on either side of the landing gear fittings to form a torque box; on either side of the outboard cannon ports; and at the outer end of the reinforcing gusset around these ports.

At top is shown inverted view of central wing leading edge subassembly, with details of its major ribs given below.

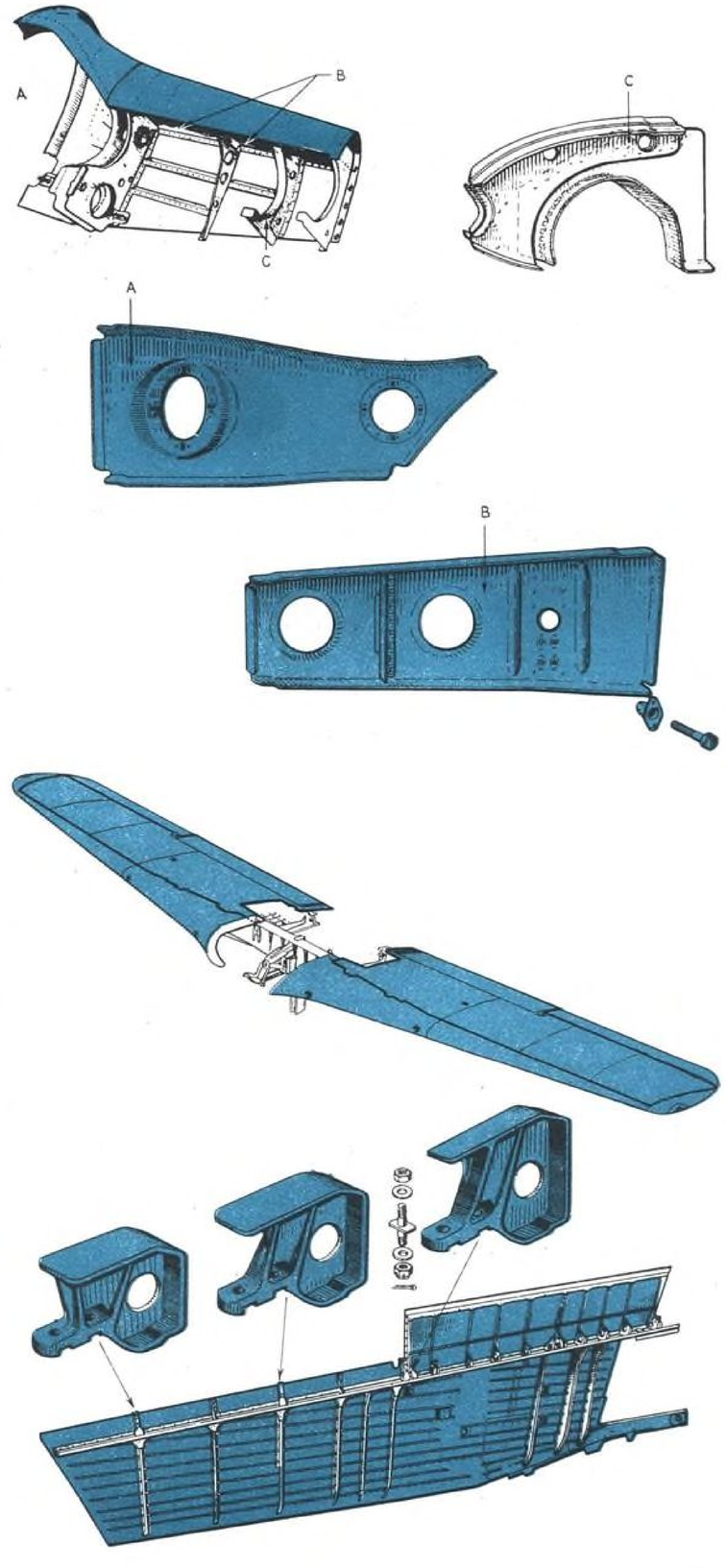
The rear spar, a conventional tapering I-beam, extends from top and bottom forged fuselage attachment fittings to the tips, and carries both flaps and ailerons. It is double web for 32 in. from the fuselage fittings, single from there to the tips.

It would appear that the rear spar and the top skin panel (forward to the front spar) are built as an integral unit, with blind riveting being necessary only for attaching the five top-to-bottom or "solid" ribs previously mentioned. Three stamped, flanged contour ribs are located between the "solid" ribs and six are utilized between the outer flap hinge and the tip rib. All these ribs have cutouts for Z-shaped spanwise stringers, of which there are nine outboard of the flap, and eleven between the "solid" ribs. Skin aft of the rear spar, above the flap, is a separate subassembly attached by ten contour ribs riveted to the spar web, with one contiuous stringer between the spar and trailing edge.

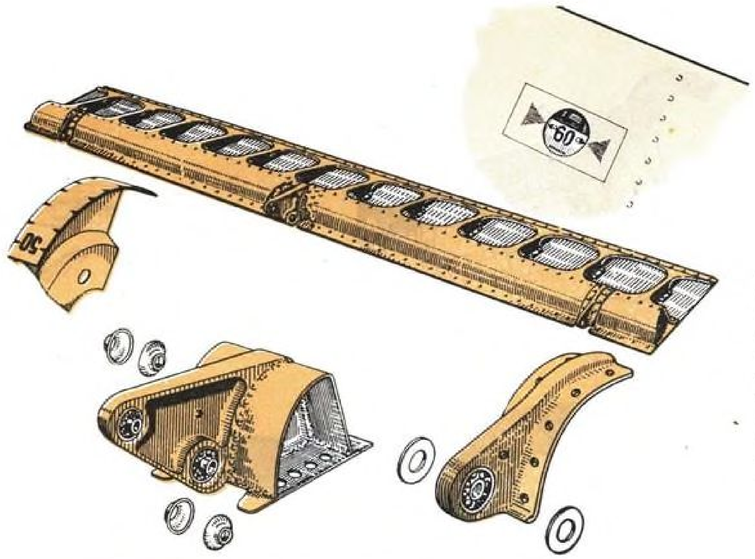
Also built as a unit is the bottom skin panel, which screws to front and rear spars. One contour rib is located at the fuselage attachment fittings, one between the cannon and landing gear ports, and five between the outer "solid" rib and the tips. All these ribs have diagonal cutouts for Z-shaped stringers similar to those in the upper panel.

An interesting development found on later 190 models is the addition of aluminum strips, .032-in. thick and ¾-in. wide, riveted to the ribs and skin, much like diagonal braces between joists in a house to prevent side sway. This addition has been made to both top and bottom skin panels, and appears to be a modification made in production rather than in the field.

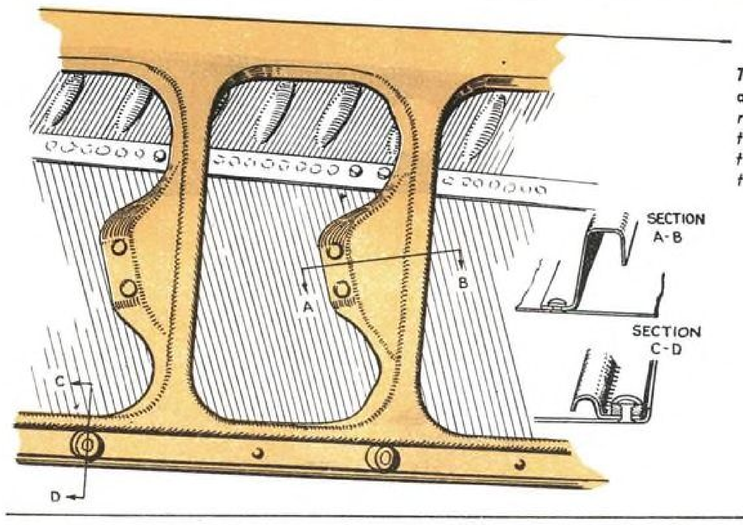
Split type flaps follow conventional practice, with the monospar being made up of a rolled section with beaded stiffeners. Top skin section is cutout in the familiar rounded gusset pattern; ribs are normal stamped flanged construction. Top and bottom sections are



Top skin, with its floating ribs and stringers, is made up as complete subassembly and riveted to rear spar and, finally, skin above split-type flap with its ribs is attached to rear of spar. Aileron brackets (shown in the detail sketches) are also riveted to aft face of rear spar. Note that space is left for the few ribs fastening to both top and bottom skins; they are attached to this top skin by blind riveting.

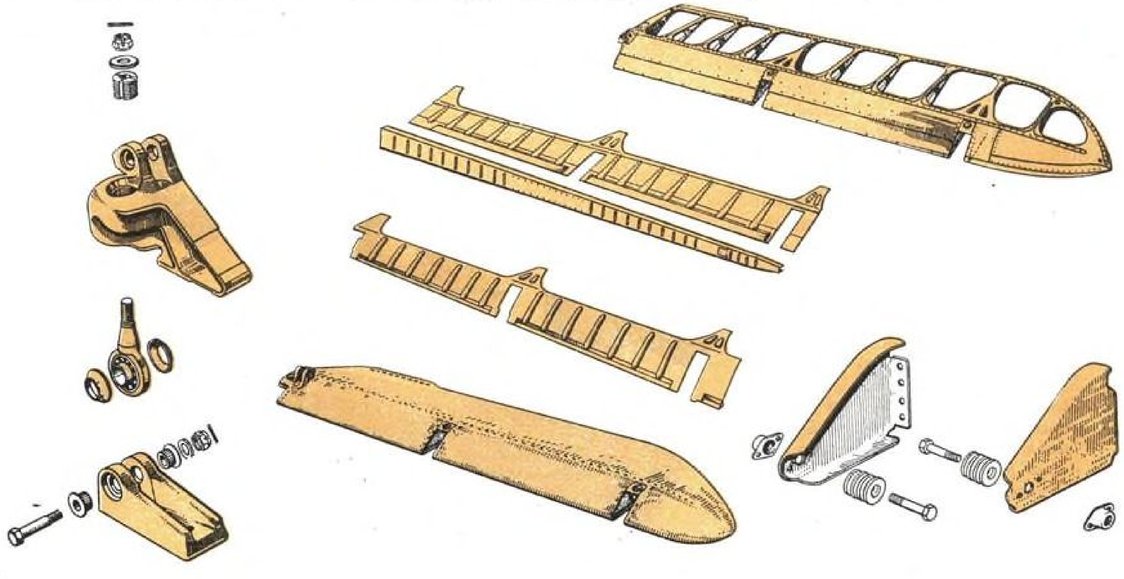


Flaps are built around metal monospar and are constructed in two halves riveted together at the middle hinge, with inclusion of actuating arm. This hinge—unlike inboard and outboard hinges—is welded to spar and carries a dial with readings from 0-60 deg. Numbers show through a hole in top skin (as illustrated in top detail sketch) so that pilot has exact reading of each flap's position at all times. Flaps are electrically operated with their individual motors connected through relay control box so that neither will get more than 3 deg. out of line with other.

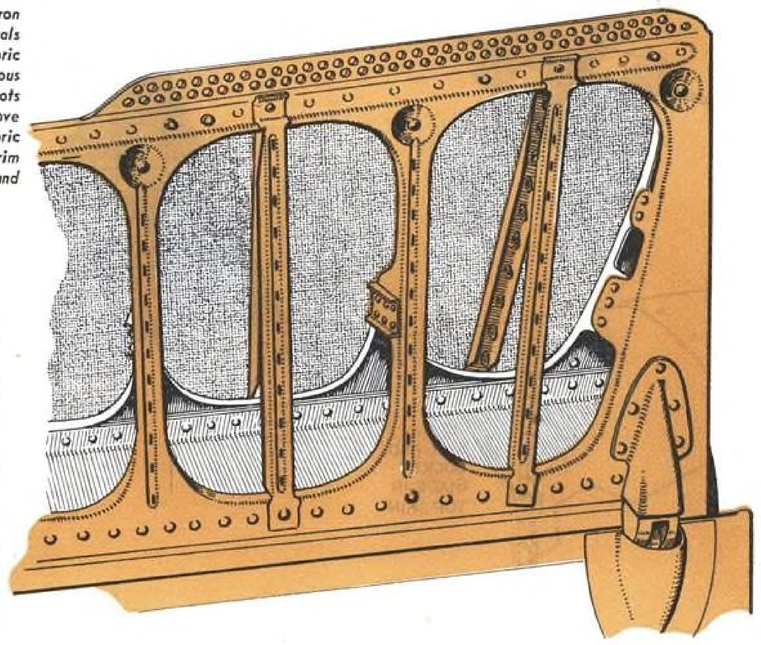


This field sketch shows detail of flap from above, with top fabric covering removed to reveal how ribs are formed from cutout sections of top face. Shown on trailing edge are two of ten rubber bumpers which absorb vibration when flap is closed up against top skin.

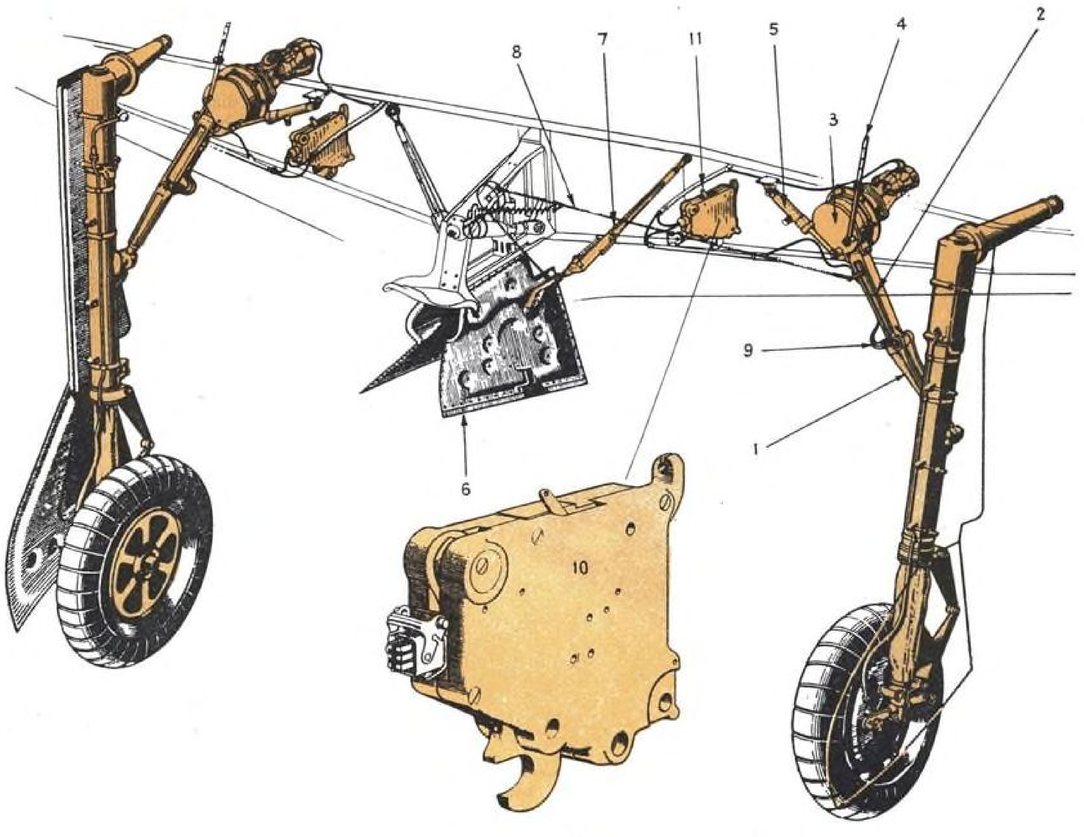
Complete details of aileron are shown below. From top to bottom: Unit without fabric covering; lower leading edge skin; single spar; upper leading edge skin; unit with fittings and fabric covering in place. At left is exploded view of inboard ball-bearing mounting and at extreme right is exploded view of outboard hinge slot ribs.



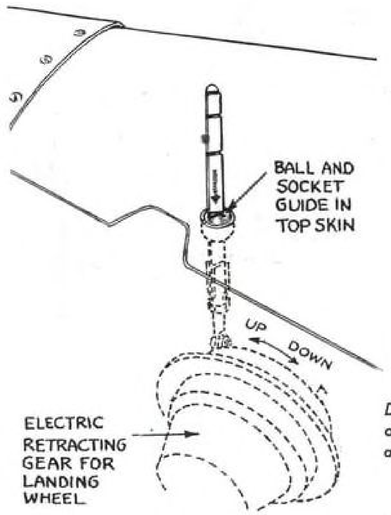
Field sketch (right) of inboard end of aileron with bottom fabric removed. Intercostals (but .012-in. thick) only serve to hold fabric which is stitched in place with continuous wire fastening poked through the slots punched in frame. These slots are in a groove so that wire will be buried beneath fabric surface. Also clearly shown is perforated trim tab, similar to those used on rudder and elevator.



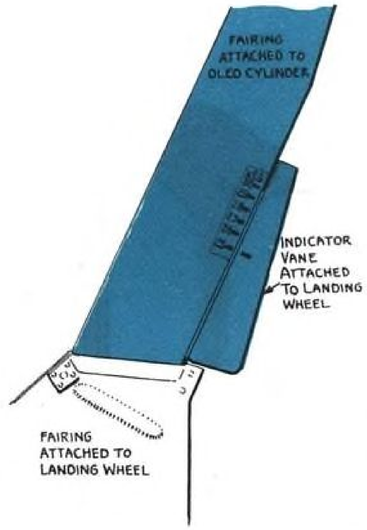
Main landing gear (below), showing how wheels are hinged from front spar. Retracting gear arms (1) and (2) are attached to electric motor-driven drum (3) to which are attached mechanical position indicator (4) and dash pot (5). Fairing (6) is pulled up into place when landing gear strikes arm (7). A steel cable (8) running from retracting gear arm in over pulley at center line straightens arm (7) to hold fairing in open position when wheels are down. Switch (9) between retracting gear arms cuts power off when wheels are down. When retracted, gear is secured by latch shown at bottom of detail sketch (10). This unit also carries switch to cut off power when wheel is latched up. A cable attaches to lever (11) to release latch in case of power failure, when wheels go down by gravity as motor is disconnected when power is off.

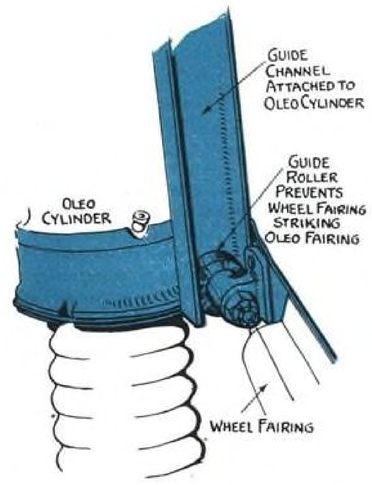




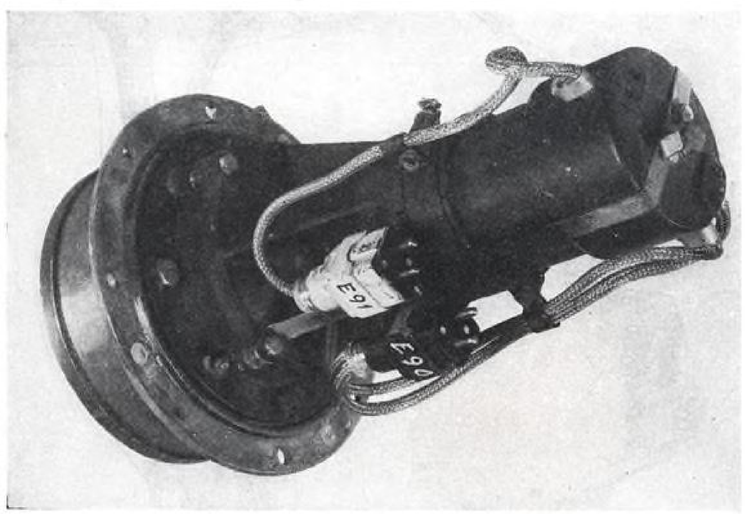


Phantom view from pilot's cockpit looking toward leading edge of wing, showing landing gear position indicator. It is entirely mechanical, like a bayonet oil gage. It slides through slotted ball in top wing skin and disappears when landing gear is fully retracted.





Detail field sketch showing pressure indicating marks on main landing gear fairing. Lower part of vane moves with wheel; upper part is attached to oleo cylinder. Scale is graduated in atmospheres, 25-30 being range.



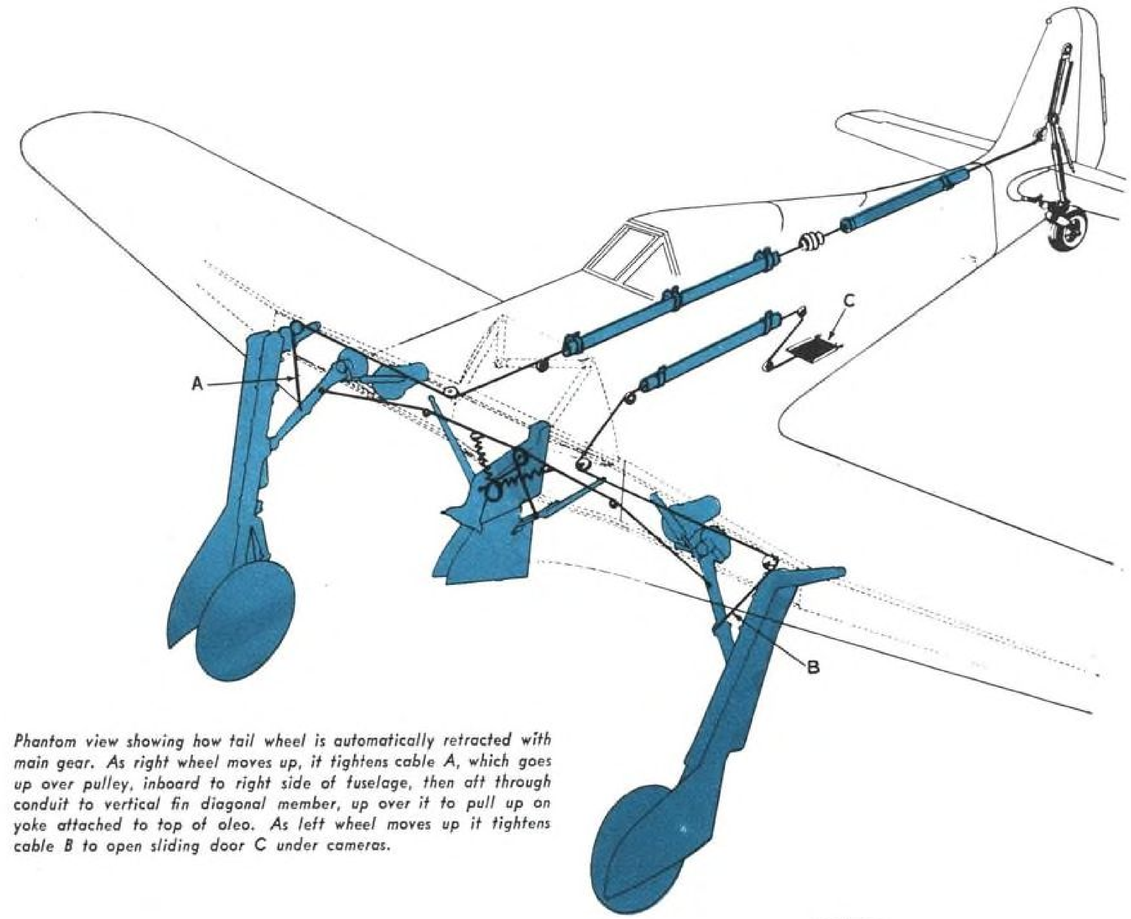
Main landing gear retracting motor and reduction gear, a unit but 14 in. long and 7 in. in dia. at ring, with bolt holes where it is attached to front spar. Motor turns up 14,000 rpm., has 3.3:1 reduction from armature shaft then safety centrifugal clutch, then 53:1 and 60:1 gearless reductions for over-all reduction of 10,494:1. One such unit is provided for each wheel.

riveted together at the leading edge, and the whole is fabric covered. With a total span of 7 ft. 10 in. each, the flaps are built up in halves, the two sections being riveted together adjacent to the middle of three ball bearing hinges. Atop the trailing edge are ten ¼-in. dia. rubber bumpers to absorb vibration between the flap and trailing edge.

Inboard and outboard hinge fittings are castings riveted to the flap spar. The mid-fitting, which also forms the flap actuating arm, is of built up welded construction. Attached to this fitting is a dial reading from 0–60 deg., visible through a hole in the top skin panel, so that the pilot can get an exact reading of each flap position.

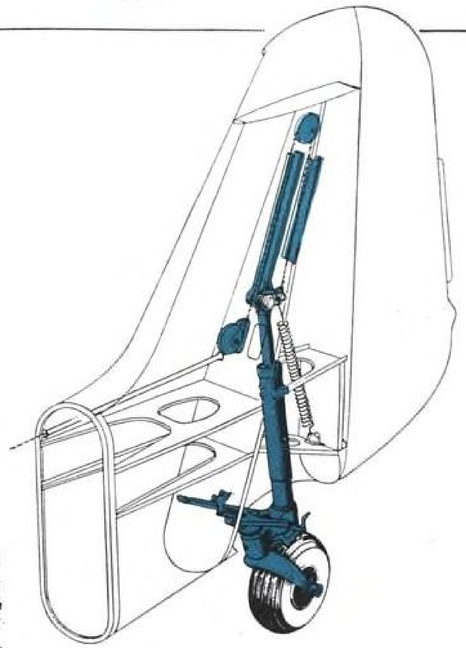
Electrically driven by gear trains through a nut to a screw jack attached to the motor mounted on the front face of the rear spar, the flaps move down 60 deg. The two motors are connected through a relay control box so that neither flap can go more than 3 deg. without stopping to wait for the other to catch up.

Fabric-covered metal Frise-type ailerons are as light in weight as they are reported to be on controls. They are built around a channel monospar with beaded vertical stiffeners to which are riveted upper and lower two-layer metal leading edge skins, the inner ones having beaded stiffeners. Aft of the spar there are 10 conventional ribs, with the familiar rounded gussets, and 10 intercostals of stamped flanged light aluminum alloy. These lightweight intercostals are provided to

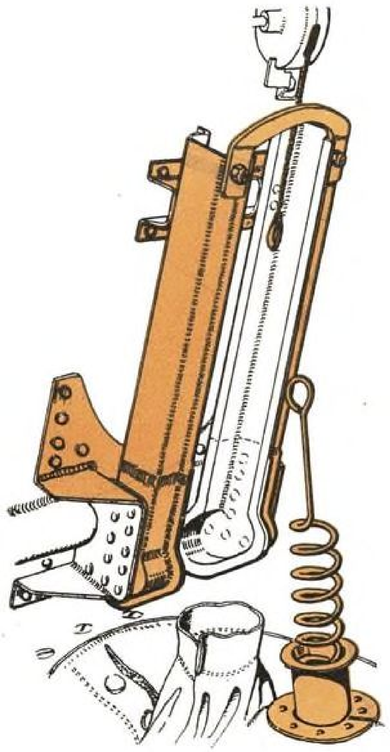


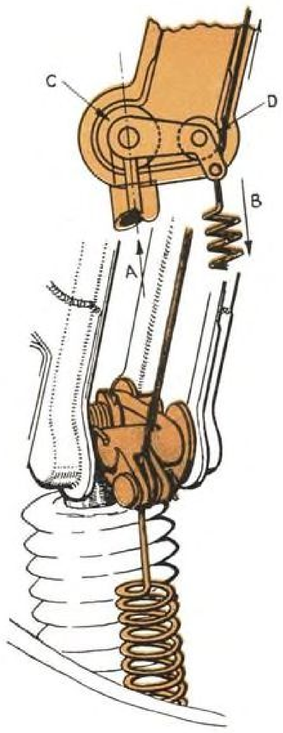
Phantom view showing how tail wheel is automatically retracted with main gear. As right wheel moves up, it tightens cable A, which goes up over pulley, inboard to right side of fuselage, then aft through conduit to vertical fin diagonal member, up over it to pull up on yoke attached to top of oleo. As left wheel moves up it tightens cable B to open sliding door C under cameras.





Here is phantom view of vertical fin, showing tail wheel assembly. Wheel fork is set in front end of figure-eight casting to give castering action, but oleo strut is in direct line with wheel hub. Loads of both front end of drag yoke and top of oleo strut are taken by diagonal member. Stabilizer goes between horizontal ribs extending aft from front bulkhead to diagonal member.

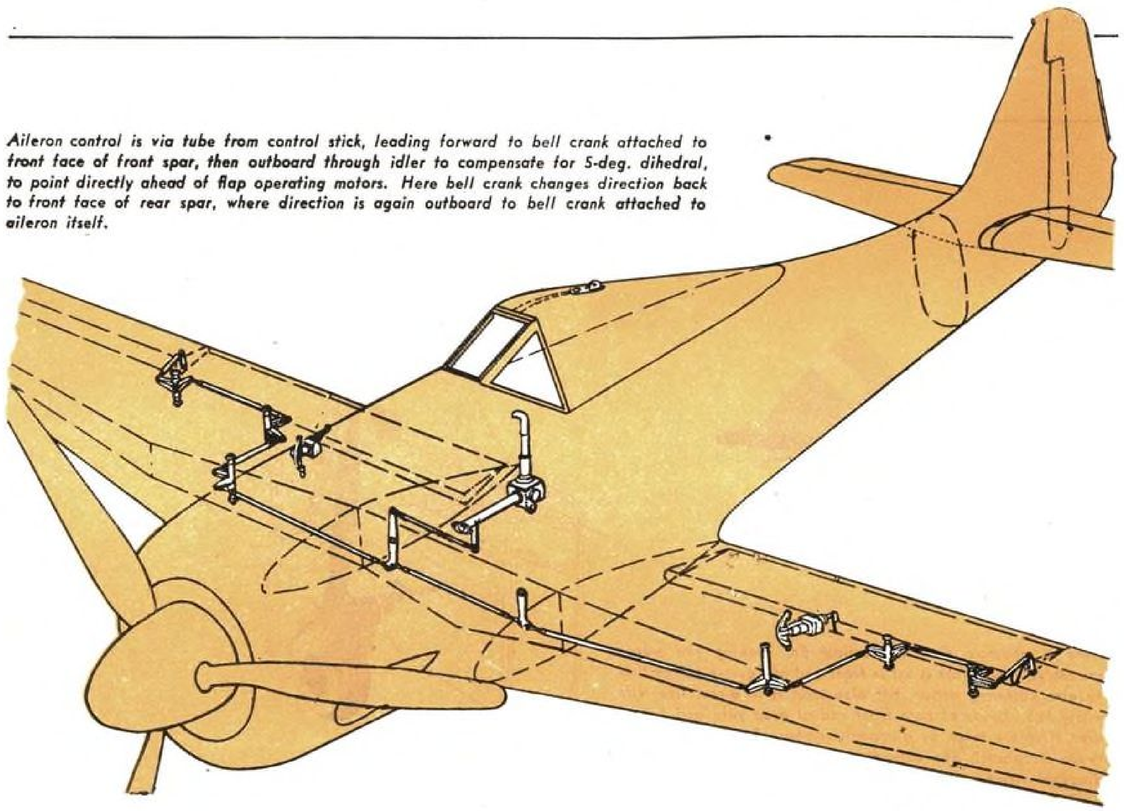




These field sketches show details of tail wheel retracting gear and roller locking device. At left is track (with oleo and lock removed) which is riveted to aft face of diagonal member of assembly. Oleo would extend up through the dust-catching fabric with bellows attached to the top. Also shown is metal tube to prevent coil spring from injuring enclosing material. Sketch at right shows gear in place and locked in down position, and in upper right method of locking is shown diagrammatically. A is direction of load thrust, B is direction of pull by coil spring. This pulls trigger roller C down into locking position, forcing large roller D—which takes landing load thrust from top of oleo—into its down position.



Aileron control is via tube from control stick, leading forward to bell crank attached to front face of front spar, then outboard through idler to compensate for 5-deg. dihedral, to point directly ahead of flap operating motors. Here bell crank changes direction back to front face of rear spar, where direction is again outboard to bell crank attached to aileron itself.



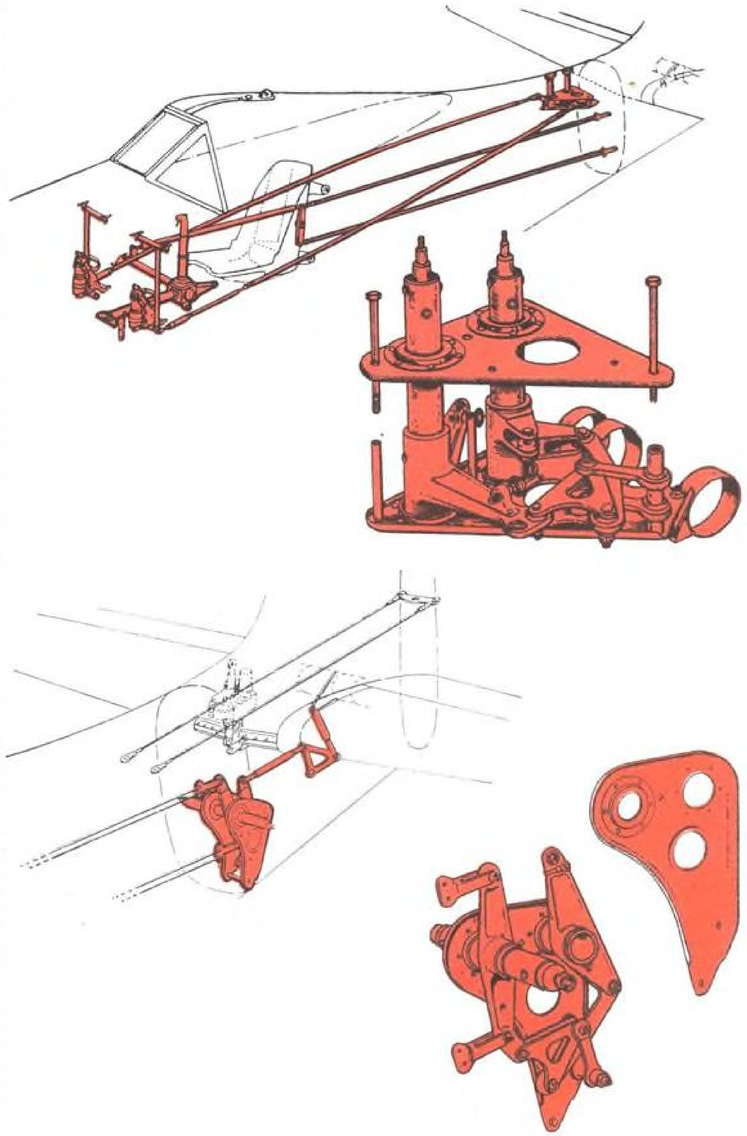
contour the fabric and allow it to be stitched down with wire.

Ailerons are mounted on three self aligning ball bearing hinges at ribs No. 1, 5, and 9. The inboard hinge at rib No. 1 is a cast aluminum fitting into the bottom of which screws a lug and ball bearing collar, running on a tapered pin assembly through the bracket attached to the rear spar. The screw bearing collar is split and the taper jambs it tight when the lock nut is tightened. This makes it possible to get perfect alignment between the hinge, bracket and wing fairing without the necessity of mating the parts in jigs. Mid and outboard fittings are cast angle brackets, with roller bearing collar screwing in from the bottom and running on a pin through the bracket in the same manner as the other hinge. In each case, curved shims between the bearing collar and bracket are utilized to eliminate side play while retaining alignment. Balance weight washers are fastened into the hinge slots with a bolt and captured nut riveted to each side rib of the slots.

On the inboard end of the right aileron is a 19¼-in-long trim tab—adjustable only on the ground—similar to those on the stabilizer and rudder.

Main landing gear is a single-strut oleo shock unit, with conventional torque scissors, attached to a forged steel tapered roller bearing spindle assembly. The front face of the mounting is flanged to bolt to the front spar. Fairing is in three sections; one attached to brackets extending up from the hub, another bolted to the oleo strut and the third hinged at the center of the fuselage. A scale painted on the two fairings attached to the landing gear tells at a glance if proper pressure —about 1,300 psi.—is being maintained in the shock strut.

Retraction is electric, with a separate unit for each wheel. The motor which turns up 14,000 rpm., is mounted back of the front spar web, with a 3.3:1 reduction from the armature shaft, then a safety centrifugal clutch, followed by two gearless reductions, one 53:1 the other 60:1, giving a total reduction of 10,494:1 in three steps in a unit 14 in. long and, at the front end, 7 in. in diameter. The last reduction stage—at the front face of the spar web—drives a 1⅜ in. thick forged steel ring to which is yoked a tapered aluminum alloy I-beam of 13¾ in. length. This in turn is jointed to another tapering beam into the lower end of which is screwed a ball and socket joint that attaches to the oleo strut. The forged ring turns outward to lower the wheels and the arms, due to their toggle action, lock the landing gear down. When turned toward the airplane center line, the joint between the I-beams or toggle arms breaks to pull the oleo and wheel up and inward.



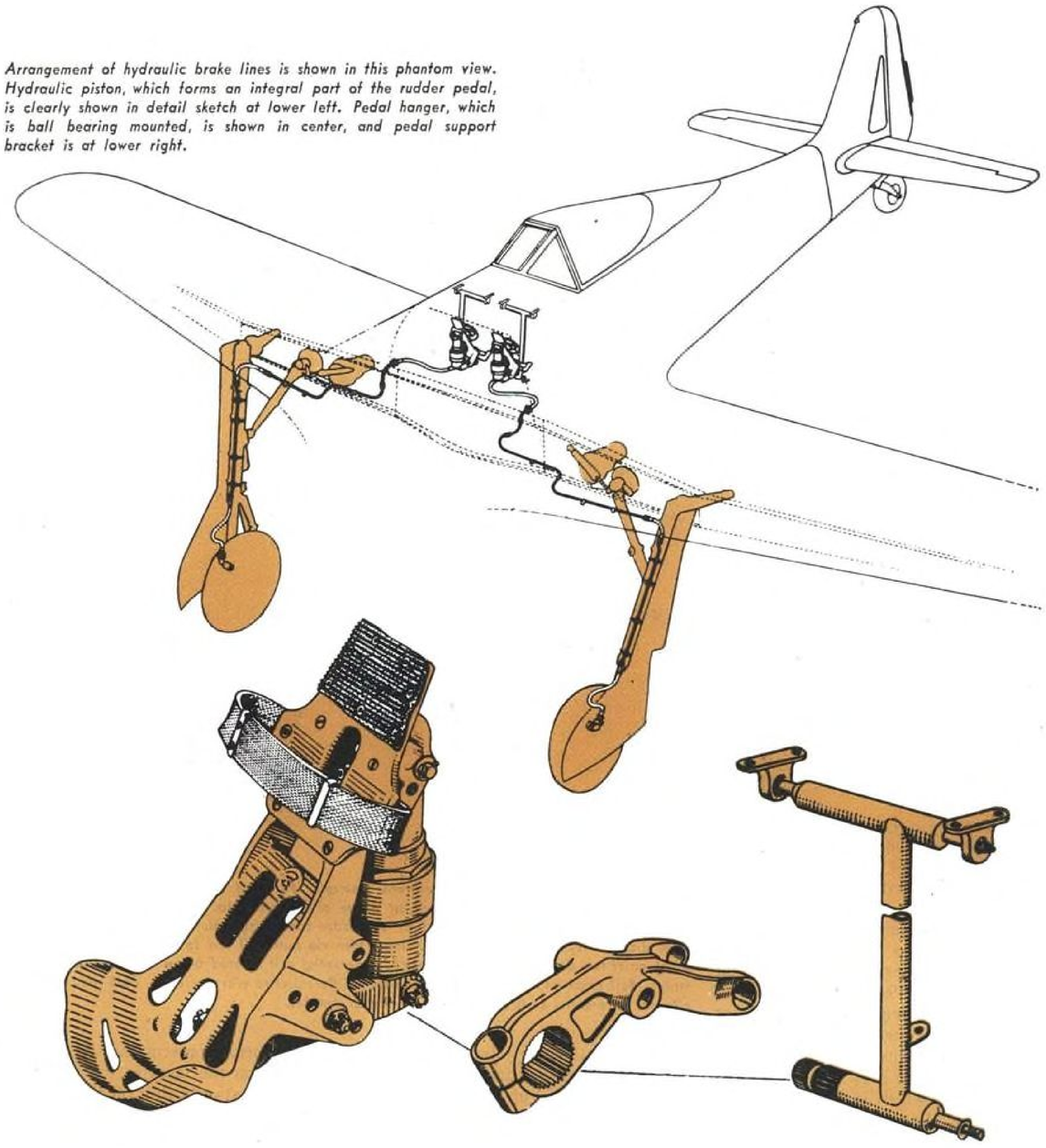
Phantom views showing rudder and elevator controls. Push-pull rods go direct from rudder pedals to differential linkage located just ahead of bulkhead No. 14 in aft fuselage. From this linkage cables go inside vertical fin to rudder connecting points. Elevator controls go from stick via tube to right side of fuselage, then via push-pull rod to bulkhead No. 8, from which point two double cables lead back to differential unit located below stabilizer adjusting motor. Bell crank and push-pull rods lead from differential to elevator horn. Both rudder and elevator differential units are shown in the detail sketches.

It is interesting to note that in down position the oleo struts have not yet reached the perpendicular, but there is no down lock on the gear. The two I-beams form a straight line when the gear is down and this straight thrust, coupled with the high reduction from the motor, appear to suffice for gear down locking.

Small metal contacts through fiber insluation on the faces at the I-beam joints automatically shut off the motor when the landing gear is full down. On the rotating member of the landing gear mechanism there is a small scaled rod which projects up through a ball joint in the top of the wing as the gear goes down so that the pilot can tell the exact position of each wheel.

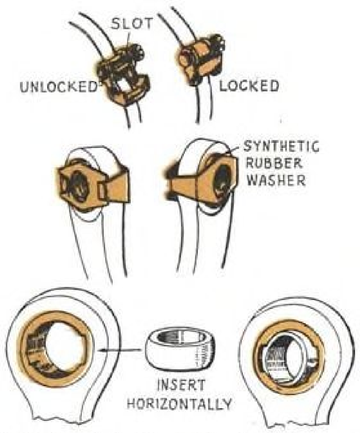
As the gear retracts, the oleo strut just above the wheel contacts a coup-

Arrangement of hydraulic brake lines is shown in this phantom view. Hydraulic piston, which forms an integral part of the rudder pedal, is clearly shown in detail sketch at lower left. Pedal hanger, which is ball bearing mounted, is shown in center, and pedal support bracket is at lower right.

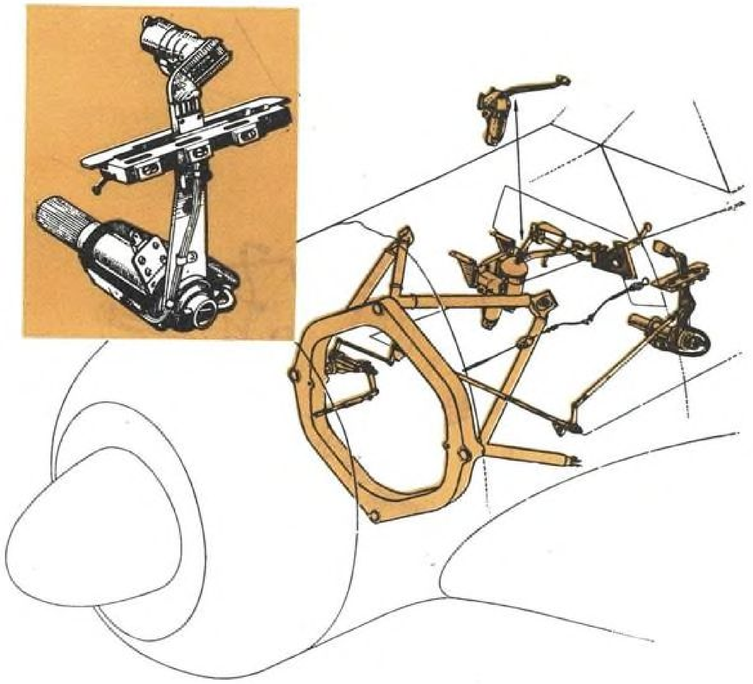


ling (set in a box-structure mounted on the front face of the front spar) which snaps into place, locks the gear in up position and automatically shuts off the retracting gear motor. The lock is held closed by an electrical latch and releases electrically when the power is turned on to lower the wheels. Unlocking can be done manually however; the pilot pulls a knob (on the left side of the instrument panel) attached to a flexible cable which, atop the center of the front spar, is yoked to similar cables leading out to each landing gear up-lock box.

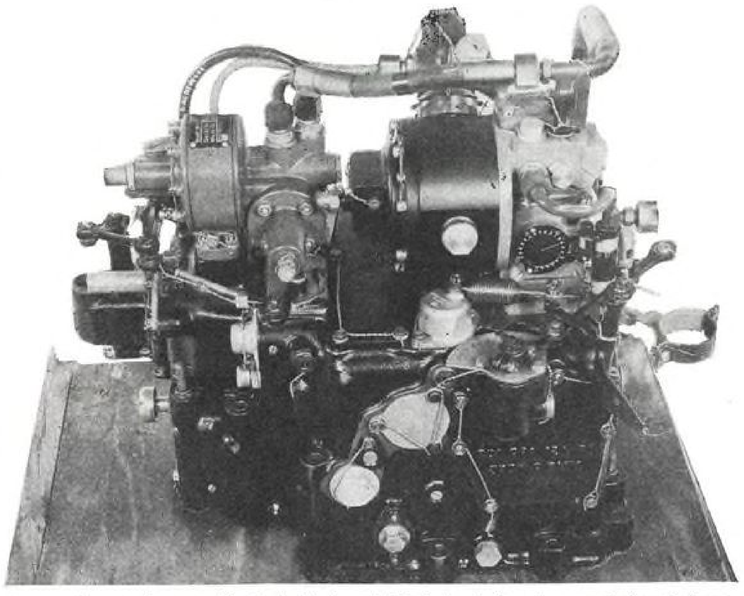
The tail wheel is retracted automatically with the main gear. At the joint of the two I-beams on the right main wheel is attached a cable that runs over a pulley set just above the gear spindle, thence inboard along the spar front to the right side of the fuselage, then over a pulley and back through the fuselage—in a conduit through the cockpit—back to a pulley on the front of the diagonal "heart" member in the fin, then up over a pulley atop it and down to a yoke set at the top of the tail wheel oleo. Thus, and it's not as Rube Goldbergian as it



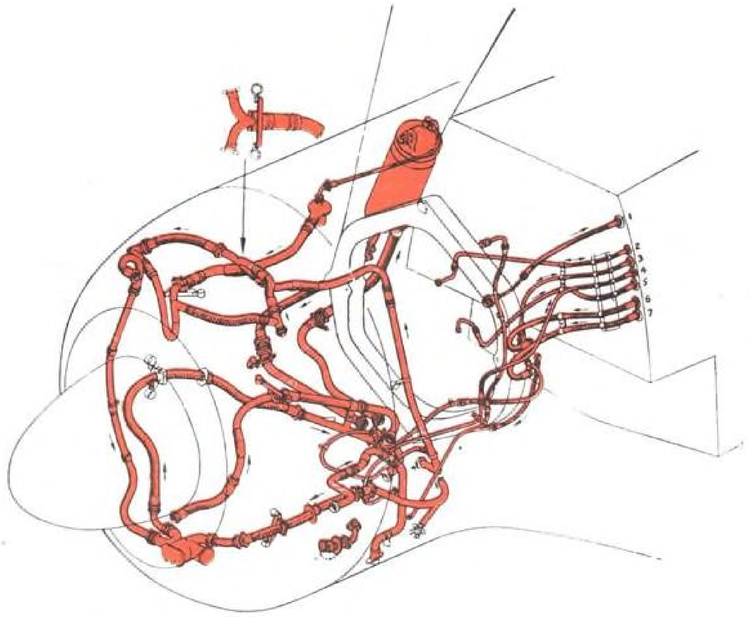
Indicative of lavish attention to design, and wide use of ball bearings, are details shown in these field sketches. At top is seen open and closed position of wind-up device on straps which hold hydraulic lines on landing gear. Note ratchet locking device. Center sketches show how ball bearings used on brackets are peined in place, then protected by felt washers and held by simple metal clamps. All elevator hinges, for example, use this type. In many places, as shown in lower sketches, ball joints are provided. A notched ball bearing race is pressed into place, then ball shaped ring is slipped in. When rotated into operating position it cannot fall out; it provides a self-aligning connection. This type unit is used on rear spar attachments, lower engine mount attachment to front spar, on all jacks, shock absorber connections and other points where stresses might be raised by fixed fittings.



Engine mount ring is attached to engine mount at four points, loads being distributed to four corners of fuselage and to bottom of front spar at center line. Also shown are throttle control linkage—leading from left to right side of craft before going forward through engine mount ring. Detail at lower right depicts throttle itself. Pulling lever back into rear slot kills engine; pushing forward and across quadrant gives double boost for short periods. Thumb switch on end of throttle handle controls propeller pitch electrically.



Here is Kommandgerat or "brain box." Located just ahead of engine mount ring, it is connected to throttle linkage. When pilot moves throttle lever this hydraulic-electric unit automatically adjusts fuel flow, fuel mixture, propeller pitch setting, ignition and, at proper altitude, cuts in second stage of supercharger. It is 16-in. high, 16-in. long, and 12-in. wide.



Group assembly showing all oil lines for power plant. All lines going through to fuselage are attached to permanent fittings installed in firewall. A tape at edge of fuselage carries number of each connection; corresponding number is on line itself on encircling tape just behind union nut.

sounds, as the main gear joint starts to move up, tension on the cable is transmitted back to the tail wheel retracting mechanism and the wheel is pulled up. A similar cable arrangement is used to pull the camera protecting door open when the landing gear is retracted. The center wheel fairings are held tightly open by a cable system when the landing gear is down. They are closed by the wheel when it is retracted.

The tail wheel itself is mounted in a steel fork which fits into the front end of a heavy steel figure-eight casting which places the center of the yoke 6 in. ahead of the wheel center to permit castering. The tail wheel drag yoke attaches to the diagonal empennage member and to this figure-eight casting just ahead of the bottom of the oleo strut, which fits into the aft portion directly over the wheel center.

At the top of the oleo strut is a yoke containing four rollers; two load carrying larger ones set on each side of the center, two smaller locking ones just aft. These rollers run in the channel member (previously mentioned in discussion of the empennage) on the aft face of the diagonal member, and are part of the yoke to which the retracting cable attaches and to which is also attached a coil spring going down and aft to the rib holding the lower rudder hinge. This spring—and gravity—pull the unit down. At the bottom of the channel the track leads forward, just enough for the larger rollers to fit into the resulting "pocket" so that loads from the tail wheel are transmitted up through the oleo directly against—and toward the front—of the diagonal rib, thus locking the wheel in down position. When tension is put on the cable from the main gear it starts the smaller rollers up the channel and they in turn pull the larger ones out of the "pocket", to unlock the gear, and then up the track.



The tail wheel moves up 20 in., and rubber pads on the axle just outside the fork fit snug against the bottom fuselage skin when it is retracted. A spring loaded "V" cam centers the wheel as soon as the load is released.

An interesting detail of the tail wheel castering unit is this: the pivot is a hollow steel forging, welded to the fork and the hollow space is utilized as a grease reservoir for lubricating the swivel surface, the grease coming out through a 3-in. long slot which also serves as the tail wheel lock.

Main landing gear tires are 700 x 175 mm. smooth contour and tail wheel tire is 350 x 135 mm., also smooth contour.

Stick-and-rudder controls are generally the conventional push-pull rod and cable type, except that the elevator and rudder controls embody differential bell cranks which give a higher control surface-to-stick or rudder ratio near neutral position, thus tending to smooth out control action at high speeds.

Rudder pedals are stirrup type with heel plates, with the hydraulic brake cylinder an integral part so that exerting toe pressure energizes the system. Distance of rudder pedals from the pilot's seat can be individually adjusted by turning a knurled knob set in the push-pull rod on each side of the cockpit aft of the pedals themselves. There are also four positions for the pedal fulcrum point. Rudder pedal units are suspended from brackets attached to fuselage bulkhead No. 2. Push-pull rods lead directly aft through the fuselage up to the differential bell crank which is suspended from the top longeron at bulkhead 13. From there cables lead aft inside the empennage skin and attach to the rudder spar, which is 4 in. wide at the middle hinge.

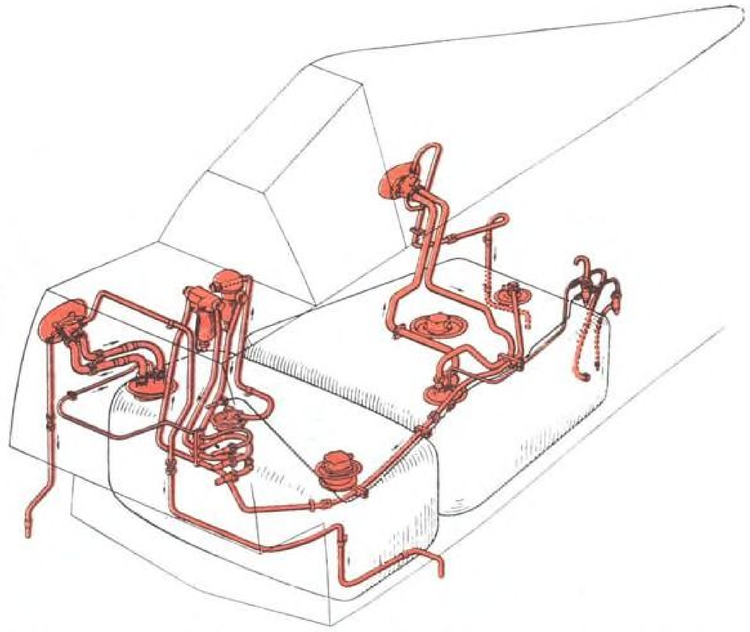
The 21¼-in long control stick is mounted in a cast base in the fuselage floor center between bulkheads 3 and 4. Elevator control is via a tube leading to the right side of the cockpit, then via single push-pull rod to just aft of the pilot's seat to a bell crank from which two double ¼-in. cables lead back to a differential bell crank mounted in bulkhead 14, where another short single push-pull rod leads back to a bell crank directly under the stabilizer leading edge and a vertical push-pull rod attached to the elevator horn on the center of the elevator spar.

Aileron control consists of a tube running forward from the control stick base and actuating a push-pull rod and bell crank set on the front face of the front spar center. From here push-pull rods extend outboard through an idler hinge to change direction corresponding to the 5-deg. dihedral to a point directly in front of the flap operating motor where a bellcrank changes direction aft to the front face of the rear spar. Here another bellcrank changes direction along the rear spar to the inboard end of the aileron where still another bell crank and push-pull rod attaches to the aileron horn. All hinges and connections are mounted on self aligning ball bearings. The bell cranks are all mounted on widely spaced ball bearings so that there is little lost motion even when the bearings get loose.

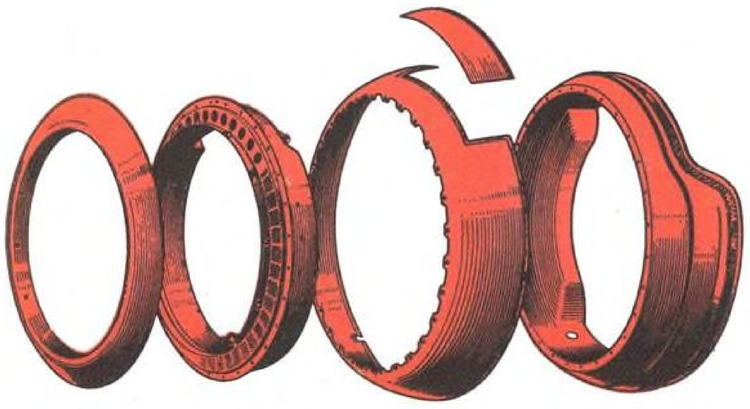
The Germans' extensive use of ball bearings is particularly evident in the Focke-Wulf 190 controls, for finely built bearing units are used not only throughout the complicated differential bell cranks, but wherever moving parts are joined and in all the electric reduction gears and motors.

Aileron stick gearing is 3.2 deg. to the inch; elevator stick gearing is 4.1 deg. to the inch; and rudder pedal gearing is 6 deg. to the inch.

Outstanding control on the craft is the throttle quadrant and its *Kommandgerat*, or "brain box". Only one lever, mounted on the left side of the cockpit is used. From it a push-pull rod leads forward and down to a bell crank attached to a rod which runs across to the right side of the fuselage to a second bell crank and push-pull rod going up and forward through the



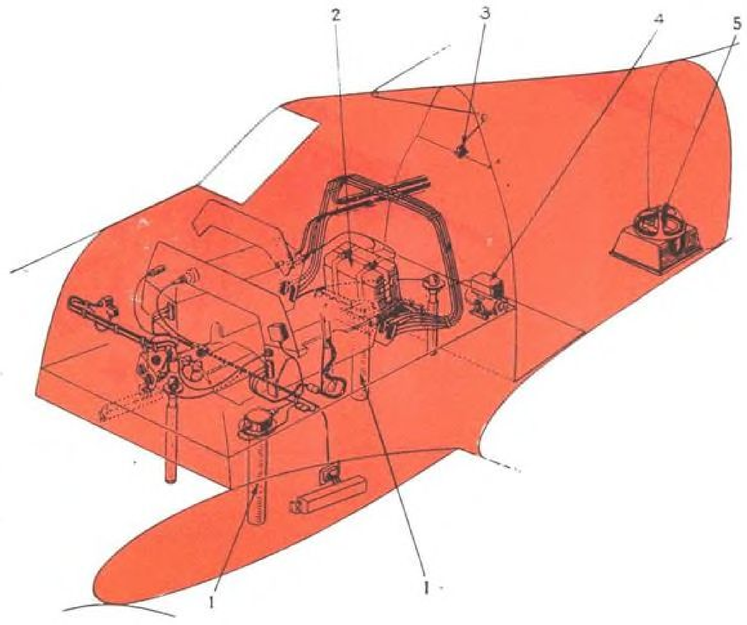
Complete fuel tank and line arrangement. Electric pumps are used in each tank and electric measuring gages are also employed. Filler openings are on right side of fuselage inside quickly detachable cover plates. Forward self-sealing tank holds 61.2 U. S. gal.; aft tank holds 76.8. Tanks are separated by rear spar tie-through member.

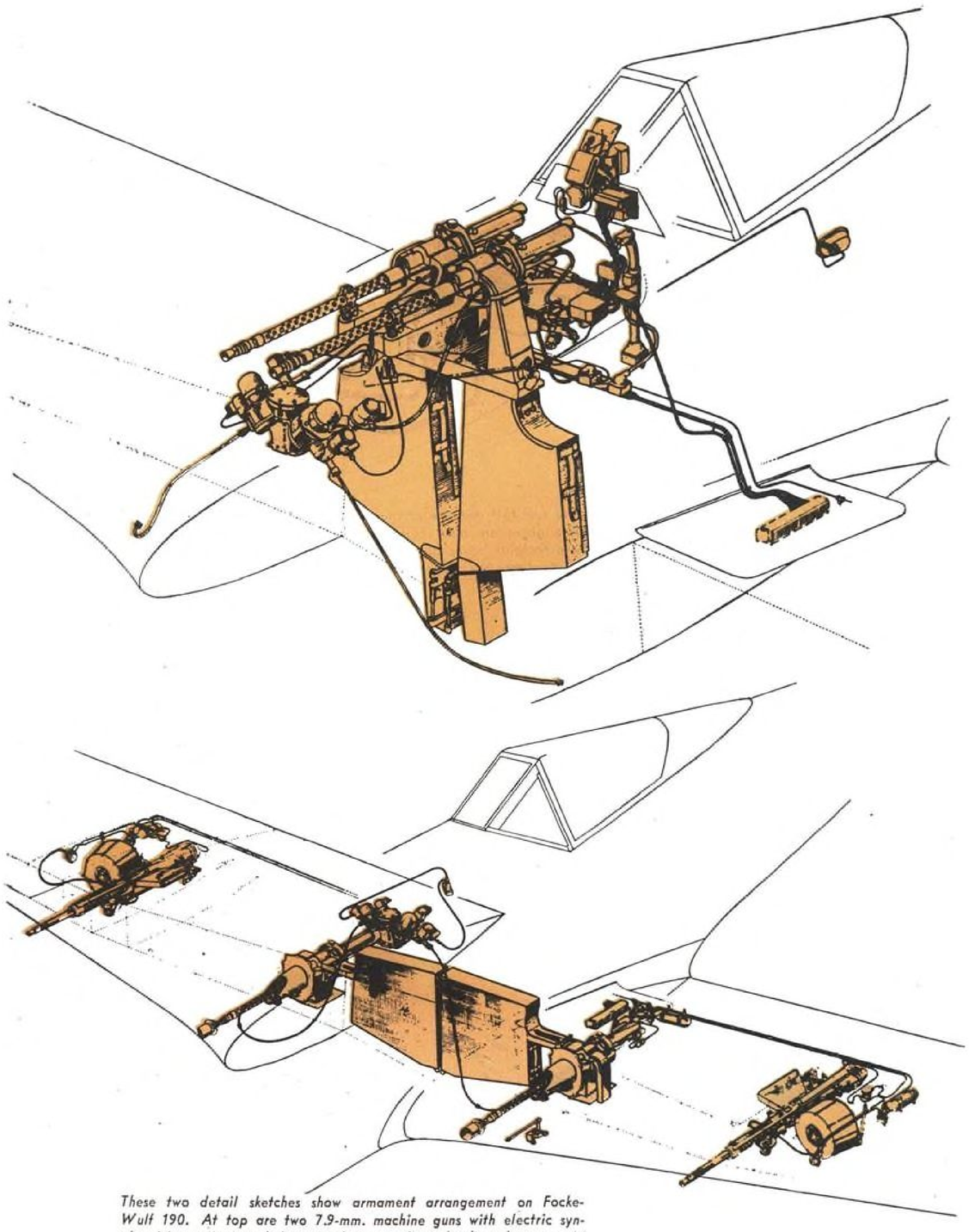


Oil cooler of FW-190 is set behind armor plate in nose of engine cowling. (Also see AVIATION for Nov. and Dec., 1942—"Design Details of the BMW 801 Engine.") Exploded view at left shows (left to right) armor plate, oil cooler, armor plate, and cowling.



This wiring diagram shows: (1) Electric fuel pumps in tanks; (2) battery; (3) radio antennae; (4) radio motor-generator; and (5) master compass which operates electric repeater head on instrument panel.





These two detail sketches show armament arrangement on Focke-Wulf 190. At top are two 7.9-mm. machine guns with electric synchronizing unit just below muzzles; two lines leading down go to inboard 20-mm. cannon, which also fire through propeller arc. Two outboard 20-mm. cannon (also shown in lower sketch) are located just outside propeller arc.



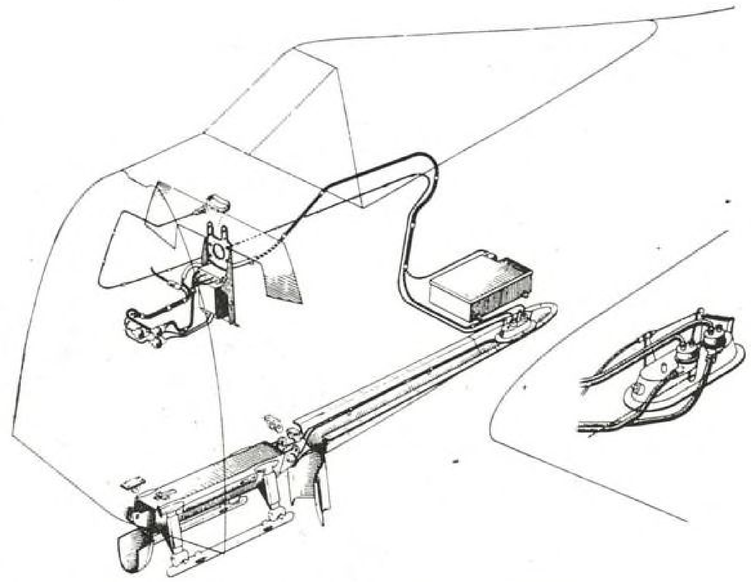
firewall to another push-pull rod-bell crank and the tube unit which takes the movement to the left again a few inches (to a point inside the engine mount ring) and another bell crank and push-pull rod which connects with the "brain box", a finely built complicated unit measuring 16 x 16 x 12 in.

As the pilot moves the throttle, and the movement is transmitted through the bell cranks and push-pull rods, the "brain box" automatically makes compensating adjustments for fuel flow, fuel mixture, propeller pitch setting, ignition, and cuts in second stage supercharger at proper altitude. If, however, the pilot desires to make a propeller pitch change without changing other settings, he may do so "manually" by pushing a rocking lever switch set in the throttle. Further details of the "brain box" cannot be revealed at this time.

Another interesting detail of the Focke-Wulf's design is the engine mount ring, a hollow tubular structure which also serves as the reservoir for the hydraulic fluid used in the "brain box". The BMW-801 engine itself was discussed in detail in AVIATION for Nov. and Dec., 1942, and thus is not included in this discussion of the craft.

All the 190's fuel supply is carried in two self-sealing tanks suspended by fabric straps in the lower fore fuselage section with the fore tank, between spars, holding 61.2 U. S. gal. and the aft tank having a capacity of 76.8 U. S. gal.

Both tanks are filled from the right side of the fuselage, the filler pipe cover plates being quickly detachable flush units. Each tank contains a sealed electric pump. Gages are all electric; the fuel warning light and pump indicator lights being arranged vertically in the center of the lower instrument panel; the fuel supply gages for each tank just to their right; and selector gage to their right. Manually-operated fuel selector valve, however, is on the left of the top instrument panel. Lines from tanks to engine go through the left side of the firewall.

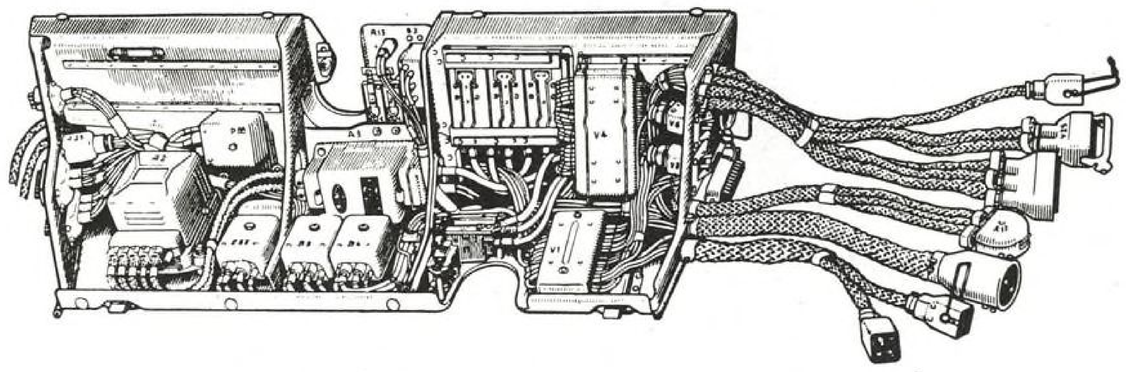


Use of FW-190 as fighter-bomber brought installation of this electrically-operated rack beneath fuselage center for carrying one 500-lb. bomb. Note long light aluminum fairing extending aft from bomb rack itself.

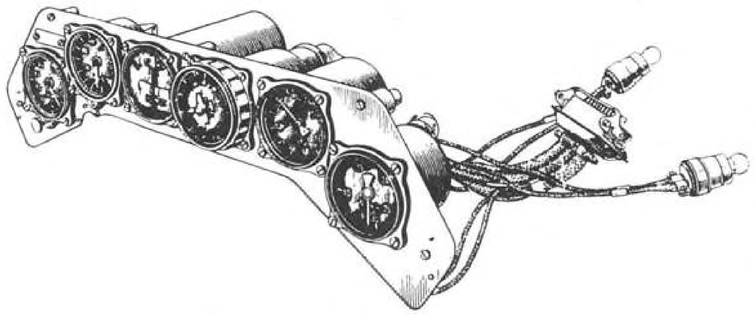
Majority of the highly complex electric system components are located to the right of the plane's centerline. On this side, for example, are the distributor, two generators, battery and main junction box with its ground supply connecting plug, this latter unit being located in the aft fuselage between bulkheads 8 and 9.

Wires leading from the removable top instrument panel—containing six flight instruments—go out through three quick disconnect plugs to the right for power or, as in the case of the dash repeater compass, to the master compass in the aft section.

Two control switch junction boxes are required, one on each side of the cockpit. That on the left contains the



Bottom view of control switch junction box located at left of pilot's seat. Note how all lines leading out at right have been grouped into seven quick-disconnect plugs, each one of which is of different shape so that wrong connections cannot be made.



Quickly detachable flight instrument panel with, left to right, altimeter, bank and turn and airspeed indicators, tachometer, compass and manifold pressure gage. Note use of quick-disconnect plugs.

throttle quadrant, propeller pitch control, ignition switch, flap and landing gear indicator lights, starter mixture control, stabilizer trim switch and indicator, flap and landing gear switches, primer pump switch and radio. It is built as a removable unit, and wires going out from its front end are led through three quick-disconnect plugs, those out the back end to the main junction box through five lines in two similar plugs.

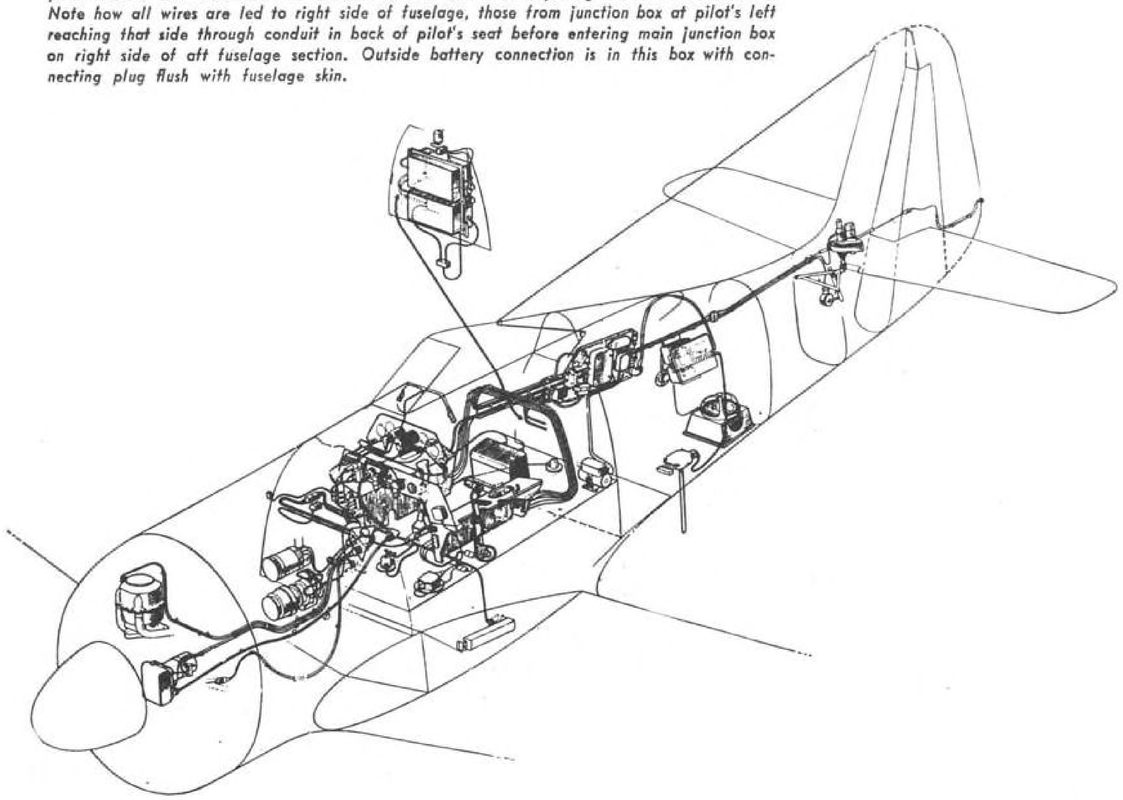
The right-hand panel contains forward and rear circuit breakers, external battery indicator, fuel booster pump switches and engine starter. Four quick-disconnect plugs are installed in the front end; seven in the rear leading to the main junction box.

The electric system is further complicated by the fact that four of the six guns—the two 7.9-mm. machine guns and the two inboard 20-mm. cannon—must be synchronized to fire through the propeller. The synchronizing units are mounted behind the engine. Electric leads from them go to each gun.

Wherever possible, wires are grouped when leading from one part of the airplane to another through generous use of quick-disconnect plugs. In general, too, the Focke-Wulf 190 follows the German practice of having wires leading from one part of the plane to another in the same location, so that mechanics working on one aircraft will not have to become completely indoctrinated before being assigned to another make or type.



Phantom view illustrates general arrangement of wiring in fuselage, extending from propeller pitch control and distributor at extreme left to stabilizer adjusting motor in vertical fin. Note how all wires are led to right side of fuselage, those from junction box at pilot's left reaching that side through conduit in back of pilot's seat before entering main junction box on right side of aft fuselage section. Outside battery connection is in this box with connecting plug flush with fuselage skin.



Bullet-Checking Plastic For Pressure-Plane Glazing

By G. M. KUETTEL, *Assistant Manager, Technical Service, Plastics Department, E. I. duPont de Nemours & Co.*

It's of cardinal importance that pressurized warcraft have transparent enclosures which will confine bullet-shattering to the smallest possible area. Here's the story of the development of a new laminate for just such installations, complete with design data and details of attachment, gunfire tests, and strength factors.

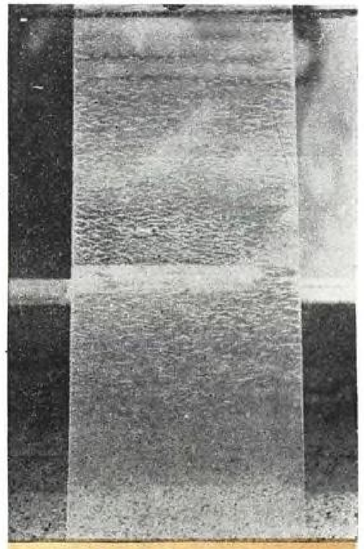


Fig. 1. Here is plastic specimen showing crazing caused by excessive stress.

DEVELOPMENT of the pressurized plane cabin has created many new problems for both designer and engineer. Progress in solving one of these problems has been the development of a new transparent plastic laminate which, when pierced by a bullet, confines shattering to a small area.

However, even this improvement in glazing brings with it the problem of positive attachment, for in pressurized military aircraft the plastic enclosures become more of a part of the structure than they were as non-structural materials in non-pressurized installations.

The nucleus of the problem of mounting plastic glazing in pressurized installations is the plastic's behavior under constant and repeated stresses. Conventional strength data are usually obtained by straining the plastic at a specified rate. In pressurized planes, however, duration of load may be for several hours, that is, for the period of pressurized flight. Relaxation will be that period of time between flights.

Under conditions of constant and repeated stress, the performance of pressurized glazing is quite different from performance under standard tests. All plastics show fatigue when subjected to stresses. Fatigue causes their failure under continuous or repeated loads at a point well below standard values, which are derived by quickly applying the load.

Unfortunately, it is impossible to predict the behavior of plastic glazing in pressurized structures, because all the characteristics which render a material resistant to fatigue are not completely known. Fatigue may evidence itself in the form of a pattern of tiny cracks called crazing. This usually results when stresses are sufficient to crack the plastic's "skin" (Fig. 1).

Cracks may also form which have their origin in incipient cracks in a rough-sawn trimline or edge, or drilled hole. Improper installation may promote cracking by setting up local stress concentrations which bring large forces to bear on limited areas of the plastic (note Fig. 2).

Other factors which influence fatigue are the magnitude of the stress load, duration of the load, the cycle employed, and temperature. At low temperatures, plastics will bear greater dead loads, or constant stress, than at high temperatures.

Relationship of Design Variables

The designer must also give careful consideration to a number of other variables which bear a close relationship in the network of pressurized plastic glazing design factors for military aircraft subject to hits by enemy gunfire. These are:

1. Manner of restraint of enclosure.
   (a) Attachment design.
      (1) Eccentricities in loading.
   (b) Bolt holes.
2. Shape of structure.
   (a) Cylindrical, spherical, flat, or compound.
3. Ratio of projected area to attachment ring length.
4. Volume of pressurized air.
5. Pressure load on glazing.
   (a) Static load and air load.
6. Temperature of glazing.
   (a) Exterior or ambient temperatures.

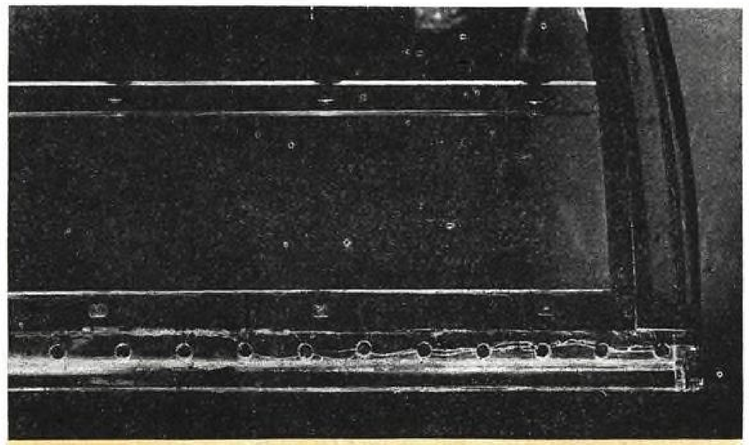


Fig. 2. Failure of pressurized semi-cylindrical plastic canopy caused by cracking due to local stress concentrations.

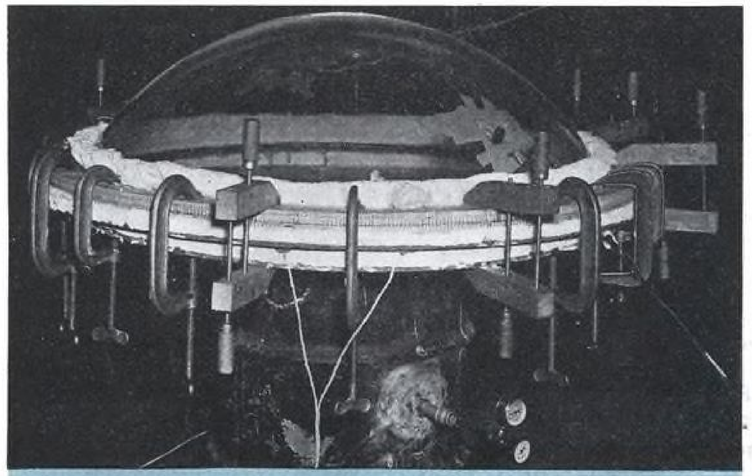


Fig. 3. Gunfire test assembly showing dome mounted on steel barrel. Thermocouples attached to inner and outer skins record inner and outer temperatures. Barrel contains heater and fan for studying effect of varying internal air and skin temperatures as related to resistance to shattering.

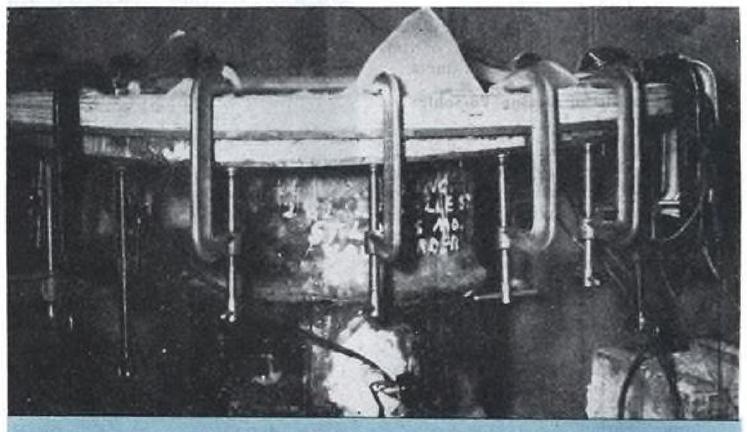


Fig. 4. Remains of ½ in. thick solid acrylic pressurized dome after .50-cal. gunfire test. Pressure differential was 5 psi., inside air temperature was +50 deg. F., and outside air temperature —49 deg. F.

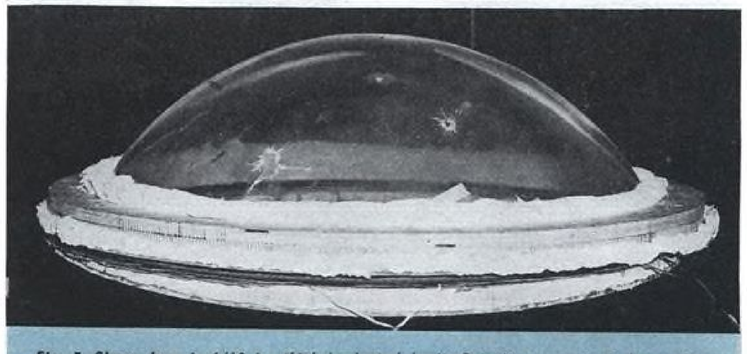


Fig. 5. Shown here is 6/10 in. thick laminated Lucite-Butacite pressurized dome after 50-cal. gunfire test. Pressure differential was 5 psi., inside air temperature was +50 deg. F., outside air temperature —41 deg. F. Note small size of entry hole and exit hole (foreground), and limited fracture lines.

(b) Interior temperature.
(c) Variation in temperature differenital caused by variation in film coefficients, due to:
(1) Air velocity.
(2) Double glazing.

7. Thickness of glazing.
(a) Influenced by depth of draw and thinning out when shaped.
8. Nature of impact.
(a) Caliber of bullet.
(b) Angle of line of fire.
(c) Tumbled versus 0-deg. yaw.
9. Condition of projectile.
(a) Jacket of bullet intact or stripped back.
(b) Fragments from other structures accompanying bullet.
(c) Flak.
(d) Explosive bullets.
10. Physical condition of glazing before impact.
(a) Previous bullet or flak holes.
(b) Patches present.
(c) Cracks or other faults in structure.

Complexity of relationships of variables encountered in designing pressurized glazing can be readily appreciated from the foregoing outline. Until more fatigue data and experience with pressurized glazed structures have been accumulated, it is practically impossible for a designer to attempt a balance of the value of such items as weight of enclosure and rupture protection.

The most advisable manner to approach such a problem is to construct a full-scale replica of the glazing, together with the proposed mount, and attach the assembly to a jig representing the portion of the plane to which it will be attached in service.

By enclosing the exterior and interior surfaces of the glazing and its attachment, or by placing the whole assembly in a cold room, the results of temperature and pressure differentials can be studied, pressure cycle tests can be conducted, and gunfire programs can be carried out.

Laminated Lucite-Butacite

To meet the requirements of shattering from the impact of a bullet or under conditions of stress, a new combination of plastics has been developed. It consists of a sandwich—made up of two layers of Lucite methyl methacrylate resin with a layer of Butacite polyvinyl butyral resin between them.

Toughness and shock-resistance of the Butacite, together with the rigidity, hardness, and weather-resistance of the Lucite, yield a laminate which, when pierced by a bullet, performs in a manner superior to a single sheet of acrylic resin. At ordinary temperatures, even under pressure, the laminated Lucite-Butacite sheeting is practically self-sealing, that is, the hole left by the passage of the bullet is small, and the shattering is not excessive.

In almost all instances, the hole is such that it may be repaired with a patch of rubber or transparent Butacite sheeting. Non-laminated acrylic structures under pressure are usually badly shattered, even when sheets of considerable thickness are used.



Fig. 6. Graph showing variation of tensile strength with temperature, with rapid loading of 0.400-in. thick laminated Lucite-Butacite (before accelerated weathering). Load application rate was about 0.3 in. per min.

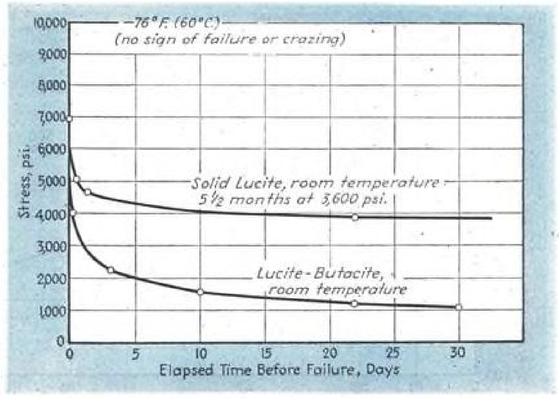


Fig. 7. Graph showing tensile strength with long time tension. Illustrated here is duration of load before failure of 0.400-in. thick laminated Lucite-Butacite stressed continuously at room temperature and at —76 deg. F.

In order to compare the laminate with similar structures in solid acrylic, a series of tests was conducted on semi-cylinders, domes, and flat glazing, at various temperatures, pressures, and manners of gunfire.

The accompanying illustrations portray the results obtained with a 50-in. dia. dome with an 18-in. draw.

Fig. 3 shows the mounting of the dome on the top of a 50-gal. steel barrel. The entire assembly was placed in a cold room. A number of thermocouples were attached to the inner and outer skins for purposes of recording inside and outside temperatures. An electric heater and fan were placed in the bottom of the barrel to permit a study of the effect of varying internal air and internal skin temperatures, as related to resistance to shattering by gunfire. The domes were pierced with .50-cal. bullets. Fig. 4 represents the results of gunfire on a dome made from ½ in. thick solid acrylic sheet. The inside air temperature was +50 deg. F, the outside air temperature —49 deg. F, and the pressure differential was 5 psi. Fig. 5 shows a dome made from laminated Lucite-Butacite sheeting 6/10 in. thick. The inside air temperature was +50 deg. F, the outside air temperature was —41 deg. F, and pressure differential was 5 psi. The exit hole is in the foreground. Smallness of size of both exit and entry holes and limited fracture lines can be seen.

Mechanical Properties

The problem of collecting mechanical data on laminated Lucite sheeting which can be used to design transparent aircraft enclosures is complicated by the fact that mechanical properties are generally determined by testing machines which employ rapid loading. Values of tensile and flexural strength, for example, cannot be used with confidence because plastics tend to cold-flow upon application of stress, and the amount of flow is not only a function of the stress duration but it is also greatly influenced by temperature.

An attempt has been made to supplement the values of tensile strength with long-time tension data and those of flexural strength with flexural creep data.

Fig. 6 shows a variation of tensile strength with temperature. The rate of

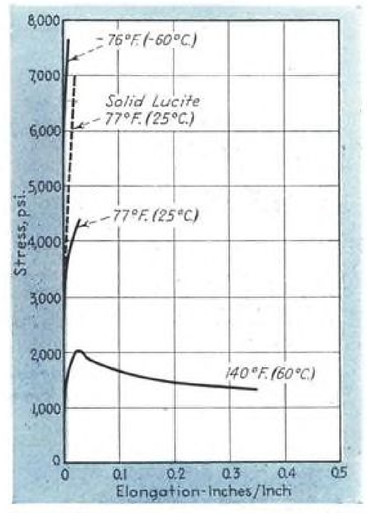


Fig. 8. Tensile stress-strain curves of 0.400-in. thick laminated Lucite-Butacite at various temperatures. Curves give approximate relationship between stress and strain at various stresses.

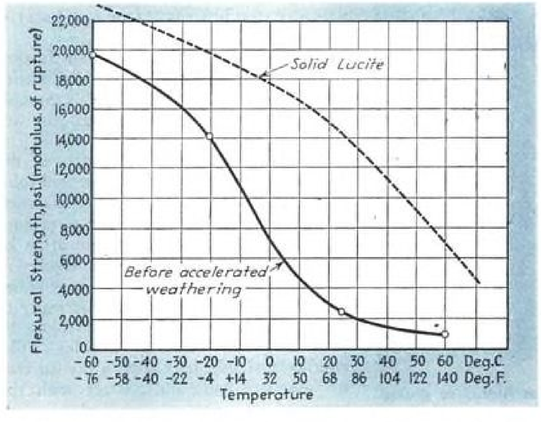


Fig. 9. Values of flexural strength with rapid loading perpendicular to laminate of 0.400-in. thick Lucite-Butacite.

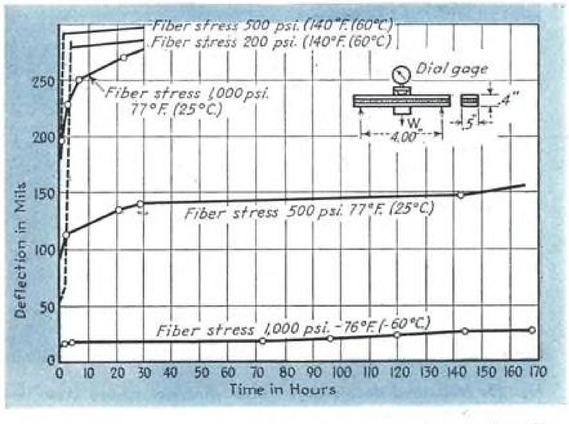


Fig. 10. Creep in flexure of 0.400-in. thick laminated Lucite-Butacite. Insert shows method of deflection measurement for graph values.

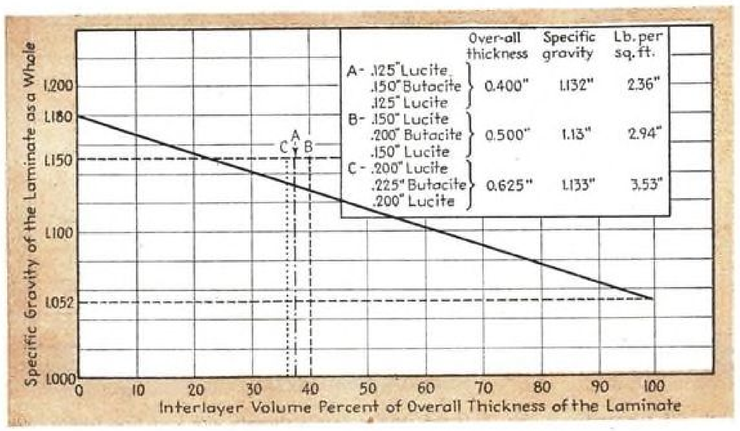


Fig. 11. Nomograph calculated for laminated Lucite-Butacite having interlayers of various thicknesses.

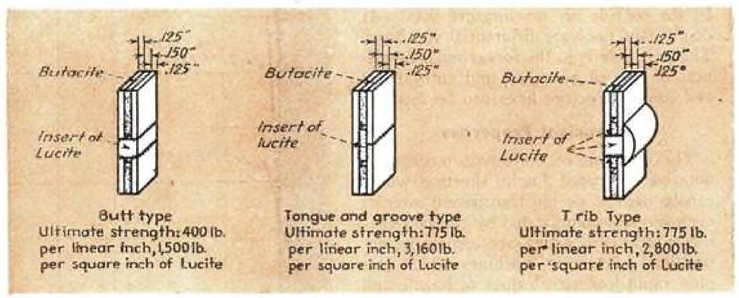


Fig. 12. Experimental joints of laminated Lucite-Butacite and corresponding breaking strengths.

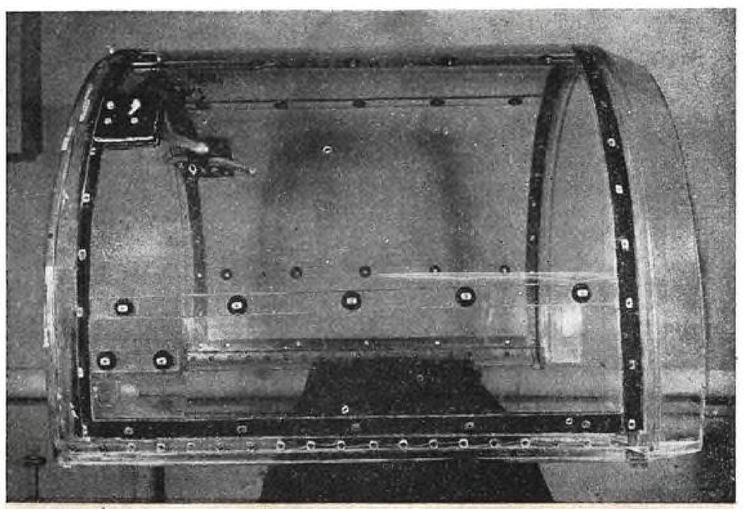


Fig. 13. Pressurized double-glazed semi-cylindrical canopy shown here was bolted to sliding track mechanism. Cyclic pressure and vibration tests caused bolt-hole-to-bolt-hole cracks. See Fig. 2 for closeup of cracks.

Table I
Impact Strength-Temperature Relationship

Temp. deg. C.	Ft.-Lb./in. of Notch—Charpy	
	Laminated Lucite	Lucite
25	4.31	0.59
12	4.13	0.59
−10	0.46	0.55
−20	0.41	0.50
−40	0.41	0.50

application of load in each case was about 0.3 in. per min. Fig. 7 shows the duration of load before failure of 0.400 in. thick laminated samples stressed continuously at both room temperature and at −76 deg. F. Long-time tension data indicate that the 0.400-in. laminate will not indefinitely withstand a tensile stress at room temperature greater than 1,000 psi. (Fatigue of thicker laminates is being studied).

Allowing the conventional safety factor of 2, the operating stress of the 0.400-in. laminate is then about 500 psi. Design based upon a fiber stress of 500 psi., however, makes no allowance for a decrease in tensile strength with a rise in temperature. For these reasons, if the 0.400-in. laminate is to be subjected to pressurization for prolonged periods of time at room temperature, fiber stresses in excess of 250 psi. should be avoided. Fig. 8 portrays tensile stress-strain curves at various temperatures. From these, an approximate relationship between stress and strain at various stresses can be obtained.

Fig. 9 shows values of flexural strength with rapid loading, and Fig. 10 shows creep in flexure. Data given in Table I shows the relationship between impact strength and temperature. The specific gravity of the laminate will vary slightly with the proportion of Lucite to Butacite employed. It has been found desirable, however, to concentrate commercially on thicknesses of 0.400, 0.500, and 0.625-in. laminates, whose weight factors are shown in Fig. 11.

From 90 to 92 percent of light in the visible range is transmitted by the laminate. When the laminations are properly made and formed (blow-forming and not vacuum-forming is recommended), the optical properties are as good as those of a similar structure made from solid acrylic sheeting.

The composition of laminated Lucite-Butacite offers a number of possibilities for making cemented joints. Sample joints with their breaking strengths are shown in Fig. 12.

It is necessary to exert care in the design and fabrication of a cemented joint which is to be placed under continuous stress. No sudden changes in curvature must be allowed, since concentration of stress caused by sharp curves results in greatly reduced strength. It is essential that the loads be applied symmetrically to both outer layers and that all joints be clear and free from air bubbles. The interlayer should be routed away so that it does not come in contact with the cemented interface.

Fabricating Information

Laminated Lucite can be handled,

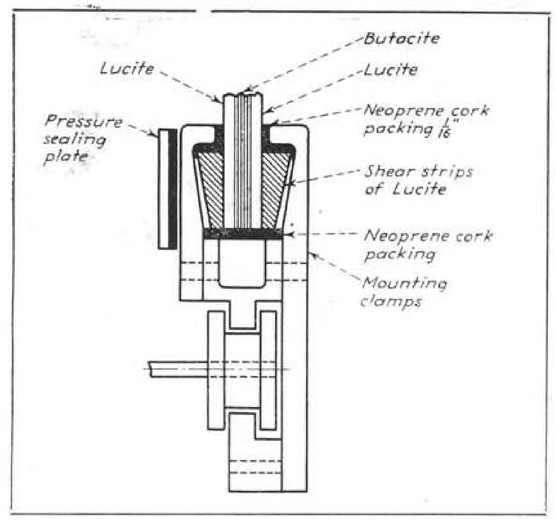


Fig. 14. Cross-sectional view of mobile mount with closure tension applied through wheel shafts.

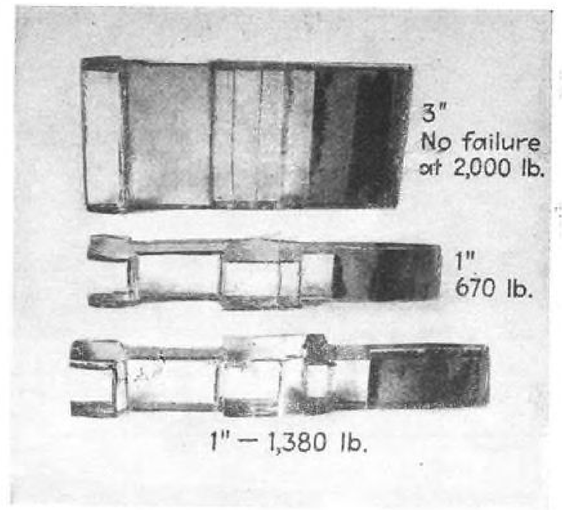


Fig. 15. Test specimens of double shear strip type of mountings. See Table II for test data.

sawed, drilled, routed, finished, and cleaned, as easily as solid Lucite.

A properly laminated sheet can be formed with the same readiness as solid acrylic sheeting, with the exception of one method. Vacuum-forming is not recommended. Excellent results are being obtained with blow-forming methods.

Temporary patches of transparent Butacite have been successfully applied to bullet-penetrated canopies. These patches permitted repressurization and withstood the shock of a second bullet. Temporary patching materials are being further developed.

Damaged glazing should be replaced at the earliest opportunity. Repairs must not be relied upon in pressurized glazing.

Methods of Attachment

One of the most frequent causes of failure of plastic glazing, especially where the glazing is part of the plane's primary structure, is faulty installation. Every effort should be made to avoid eccentricities in loading. Excessive pressure on any part of the glazing must be avoided —the total stress should be uniform over as large an area as possible. Stresses should be kept to a minimum, regardless to how favorable the operating conditions may be.

Experience gained in the development of a number of pressurized structures and their manner of installation may be of value. Trouble attended the original type of attachment employed in a pressurized double-glazed semi-cylindrical canopy (shown in Fig. 13). This attachment was made by bolting the canopy to a sliding track mechanism. Cyclic pressure and vibration tests caused cracks radiating from bolt hole to bolt hole (a closeup of cracks was shown earlier in Fig. 2). Continued pressure tests finally caused the canopy to burst.

A redesign of the attachment was then undertaken. A double shear strip type of mount was developed, replacing the bolted mounting. Fig. 14 portrays a cross-sectional view of the mobile mount with closure tension applied through the wheel shafts. Test samples of the double shear strip type of mount developed for this canopy are shown in Fig. 15. The design load called for a maximum of 200 lb. per in. of attachment length, so the breaking load of 670 lb. possessed by the double shear strip provided a reasonable margin of safety. Table II gives data for the test sections. A pressurized dome also revealed much information concerning proper types of mounts and attachments.

Table II—Test Data for Samples of Double Shear Strip Type of Mount

Sample	Width (in.)	Breaking load (lb.)	Load/in. (lb.)	Location of break
1	1	1,380	1,380	Across repair joint
2	1	670	670	In jaws
3	3	No break at 2,000	No break at 670	

As originally designed, the turret had a type of attachment in which loading set up high stresses due, for the most part, to non-tangential loading. This mounting consisted of a ribbed dome with a gussetted base ring of plastic, as shown in Fig. 16. The turret was to stand 81 lb. per in. around the attachment. Tests indicated that the original attachment was far too weak, and the turret failed when pressured to only 2–3 psi. Failure occurred at the top of the gusset. To check the strength of the attachment, sections of the turret were sawed into two 1-in. strips, two 2-in. strips, and one 3-in. strip including a section of rib.

Table III—Test Data for Samples of Ribbed Dome

Sample	Width (in.)	Breaking load (lb.)	Load/in. (lb.)	Location of break
1	1	54	54	Gusset Top
2	1	76	76	" "
3	2	122	61	" "
4	2	143	72	" "
5	3 (rib at center)	934	311	Base of rib and through gusset

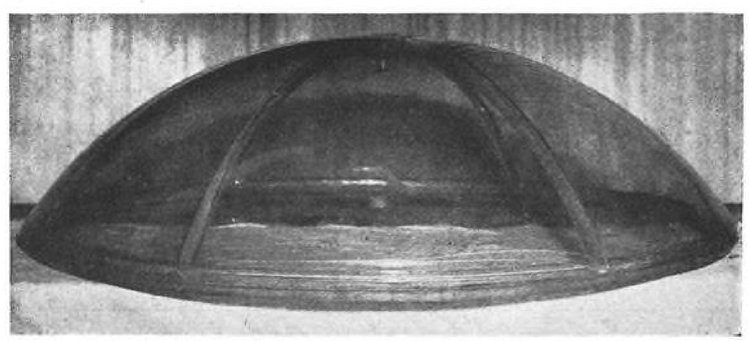


Fig. 16. Ribbed dome with gussetted base ring of plastic.

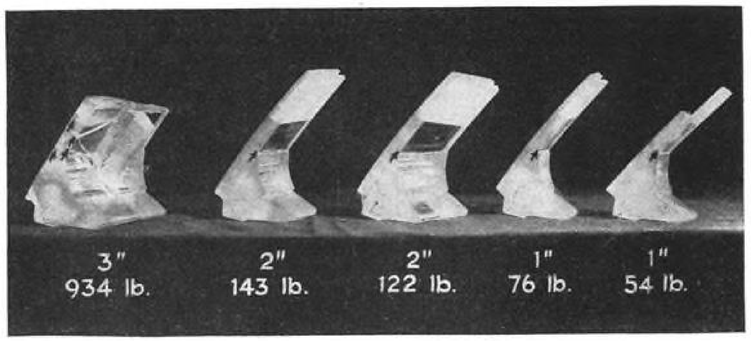


Fig. 17. Test specimens of ribbed dome. Points of failure are indicated by arrows. See Table III for test data.

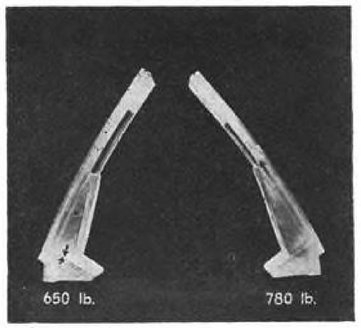


Fig. 18. Shown here are high-gussetted test specimens. Test data for specimens are given in Table IV.

Fig. 17 shows the results of testing the sections. Only in the area of the ribbed section was the strength in exces of that called for by the design load (as shown in Table III). Problem of attachment strength was solved by increasing the height of the gusset from the original $\frac{3}{4}$ in. specified in the design to one reaching several inches up the wall of the turret. Fig. 18 shows a three-quarter view of the new test sections, possessing a 2¾-in. high gusset, which yielded the test data shown in Table IV. At its best, however, this type of attachment is not recommended for pressurized structures, because the applied loads are eccentric, and the long gussets interfere with vision.

Table IV—Test Data for Samples of Ribbed Dome With Increased Gusset Height

Sample	Width (in.)	Breaking load (lb.)	Load/In. (lb.)	Location of break
1	2	780	390	Gusset top
2	2	650	325	Cemented joint (cement not fully seasoned)

In a third instance, a pressurized hemispherical dome was given a series of attachment design alterations before satisfactory operating results were obtained. At first, the dome was attached by means of bolts and nuts. Holes were drilled in the dome skirt. Failure during repeated pressurization was encountered at the bolt holes again in the form of cracks, which gradually lengthened and ultimately permitted the dome to rupture.

The dome was then redesigned to a drilled, flanged type of mount (shown in Fig. 19). Excessive fibre stresses due to flexure were created, and rupture occurred in usage. The final design eliminated the flange and substituted a double shear strip type of mount, as illustrated in Fig. 20, which permitted the load to be brought to bear tangent to the dome, thus reducing flexural stresses. Excellent results have been reported from the field with this type of mount. Rubber shear strips, replacing shear strips of rigid plastic, are also being used successfully at the present time.

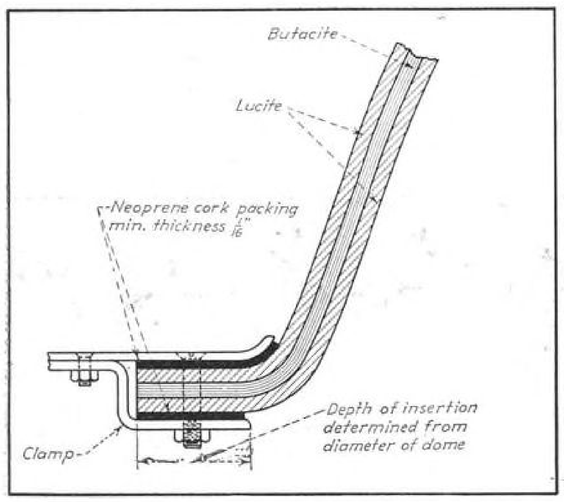
Summary

The problems involved in designing glazing for pressurized aircraft may be roughly classified into three parts:

1. Design of attachment. Eccentricities in loading must be avoided. The load should be applied equally to both faces of the plastic. Attachments should be chosen which will not necessitate breaking the surface of the plastic, as in routing or drilling.

2. Design of glazing. Careful thought must be given to the fatigue characteristics of plastics since, in pressurized planes, they become a part of the primary structure.

3. Resistance to gunfire. If it is necessary to pressurize a military plane, then it is equally important to choose a plastic material which provides the greatest insurance against rupturing when the plastic is penetrated by bullet or flak.



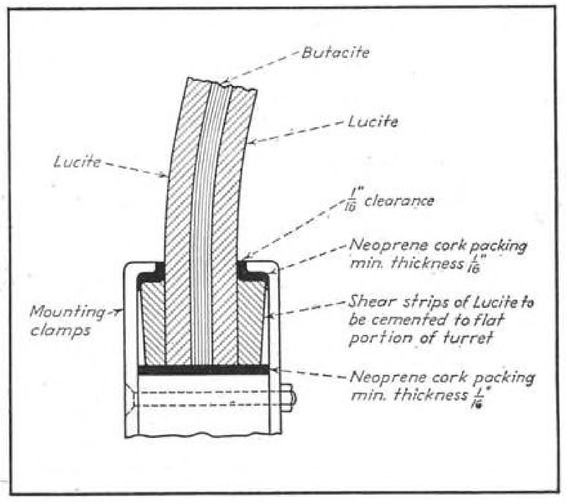


Fig. 19. Left, drilled flanged-type of dome mounting. Fig. 20. Right, double shear strip type of mount for semi-cylindrical and hemispherical glazed structures. This type mount replaced that shown in Fig. 19.

Favoring the Classical In Flying Boat Hydrostatics

By W. J. GRIFFEY, *Senior Weight Engineer, The Glenn L. Martin Co.*

Contending that traditional methods of naval architecture—rather than experimental means—prove most economical in trim, draft, and lateral stability calculations, the author "builds" an exemplary flying boat to illustrate his point.

FLYING BOATS, having a natural element in water as well as air, are subject to the same laws of flotation as ordinary boats. Because of this, it is imperative to investigate the static water characteristics of a proposed hull design in order to determine the height of watertight riveting, location of doors and hatches, and size of auxiliary floats.

Characteristics that must be considered are the displacement and trim of the hull for the necessary design conditions of loading and compartment flooding, and the lateral upsetting moment. These values may be determined by either of two means: The classical methods of naval architecture, which have been slightly altered to suit the requirements of flying boat design; and the experimental method, which necessitates building a scale model and attempting to duplicate in a trimming basin the flotation conditions that will exist on the full scale boat.

It has often been suggested that the experimental method would result in an improvement both in speed and accuracy over classical methods of calculating these values. Although experimentation has been developed to a high degree of accuracy, it is the writer's opinion that, at the present time, conventional methods of naval architecture still provide the most economical means of doing the job.

Proponents of the experimental method are inclined to exaggerate the number of waterline calculations that must be made in order to supply sufficient design information. If it were necessary to determine from 15 to 200 waterlines as claimed, then the classical method would undoubtedly find itself ill-suited to such a mass production job. However, it has been found that from 6 to 9 calculations usually satisfy design requirements.

Under these conditions an experienced person can finish a complete hydrostatic report within three weeks time, which seems barely adequate for a highly skilled technician to construct an accurate model and its precision-built accessories. Design

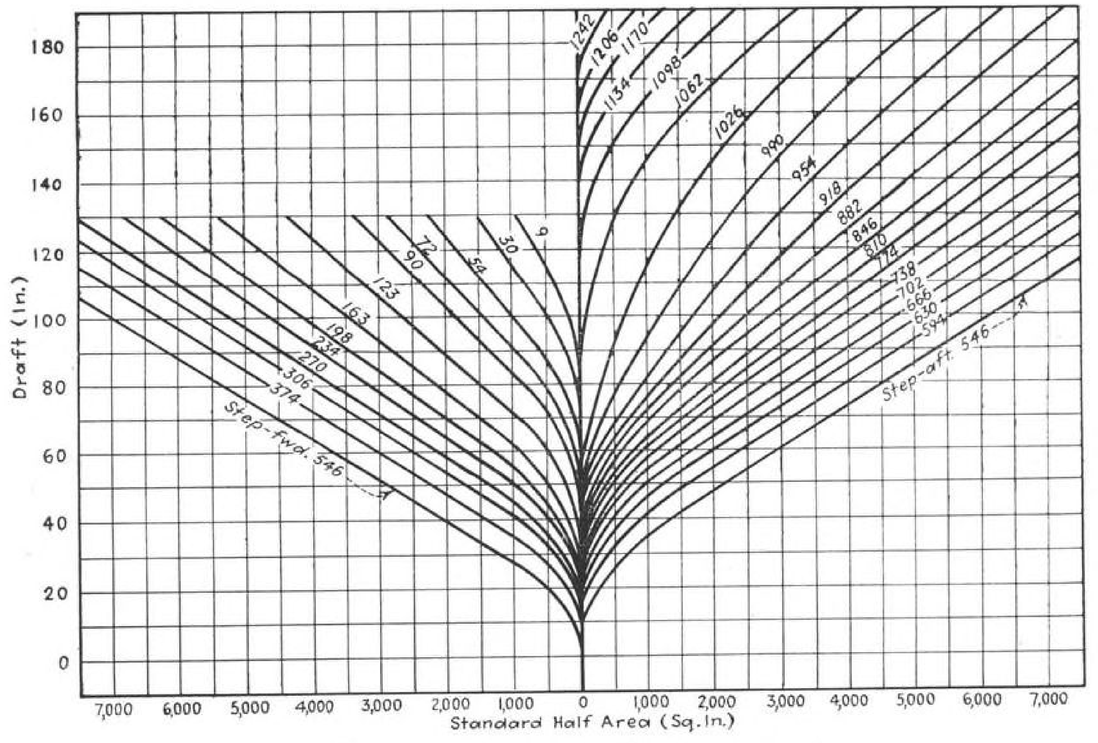


Fig. 1. Bonjean curves representing plot of sectional area against draft.

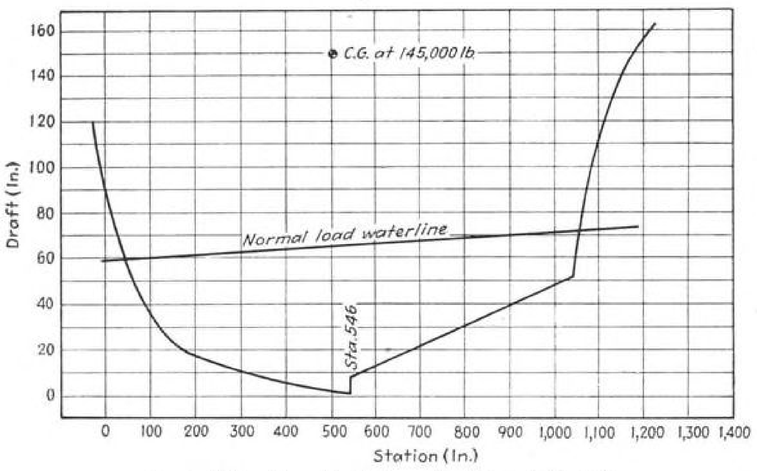


Fig. 2. Hull profile and waterline reduced to workable scale.

changes will lengthen the time required to do the job by either method, but as a rule the design is frozen before accurate flotation data is required. What changes do occur are usually minor and may affect one method more than the other, depending upon the nature of the redesign.

Claims that the experimental method provides greater accuracy than the calculated methods have still to be proven. The Martin Hydrobal, which indicates gross weight and C. G. position by draft readings near the bow and stern, respectively, was installed on two different flying boats and calibrated over a wide range of known loadings and C. G. positions. It was found that the error between the calculated waterlines and those actually obtained was so small as to be considered negligible insofar as practical application is concerned. Considering the wide margins of safety that must be allowed due to turbulent water, it does not appear wise to spend excessive time striving for hairline accuracy when, actually, it is not needed.

Whatever method is preferred, a working knowledge of the classical method is necessary, and it is hoped that the presentation here of the basic principles and steps involved in making these calculations will provide a convenient reference for those individuals desiring this information.

Navy Specifications SF-1 and SR-59, and CAA Bulletins CAR.-04 and CAM.-04 require that these calculations be made in order to determine the hydrostatic stability of all flying boats under certain conditions and limitations. For reasons of clarity the following discussion is confined to conventional flying boats with one main float and two auxiliary wing-tip floats. However, the principles involved may be adapted to any type boat.

Basic Principles of Calculation

A boat hull at rest in water will sink to a depth sufficient to displace a volume of water equal in weight to the gross weight of he ship, and it will assume an angle of trim such that the center of buoyancy (C.B.) falls on a line which passes through the center of gravity and which is perpendicular to the waterline. The boat will also assume an angle of heel, the magnitude of which depends upon the vertical location of the C.G., the shape and size of the waterplane, and the location and buoyant effect of the auxiliary float.

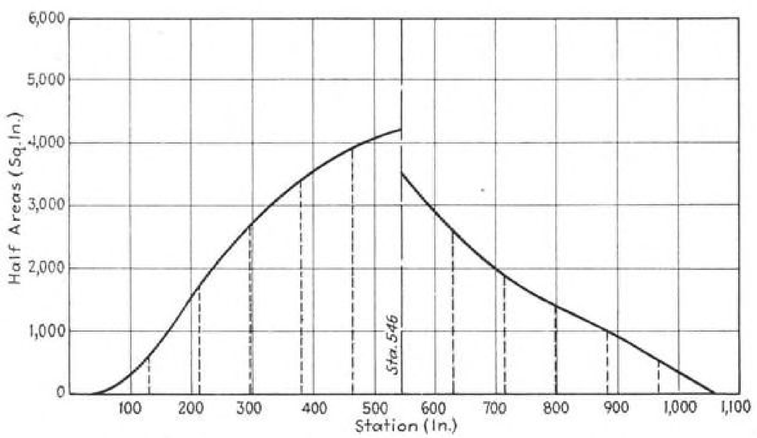


Fig. 3. Graphical representation of half-area against distance fore or aft of forward perpendicular. This curve is derived from Bonjean curves.

Determination of Draft and Trim

Calculation of draft and trim calls for approximation of a waterline and then determination of the volume and the C. B. of the water displaced. The method of making these calculations can best be shown by an illustration of the determination of the normal load waterline for a typical flying boat using the following criteria:

Gross weight ....145,000 lb.
C. G. position .....sta. 505.5, 150 in. above base line
Sea water .....64 lb./cu.ft.

The method consists of the following steps:

1. Construct a set of curves of sectional area against draft (Fig. 1) Since Simpson's rule employs half-ordinates, it is advantageous to plot only half-areas of the frames selected. For convenience, it is customary to locate the zero axis of sectional area at the center of the graph, and plot to the left of this axis the frames forward of the main step, and to the right the frames aft of the step.
2. Draw a hull profile compressed to a convenient scale (Fig. 2).
3. Assume a waterline position on the hull profile.
4. Determine each corresponding section area under the assumed waterline from the "Bonjeans," and construct a plot of half-areas against distance aft of the forward perpendicular (Fig. 3).
5. Divide each area fore and aft of the main step into an even number of sections using equally spaced ordinates, and obtain the volume and C.B. of each by Simpson's rule. If area is measured in square inches and distance aft of the forward perpendicular in inches, then—

$$\text{Volume (cu. ft.)} = \frac{2}{3} \times \frac{L}{M} \times \frac{\Sigma f(V)}{1{,}728}$$

where L = actual distance under the sectional area curve, N = number of sections into which the area under the curve has been divided, and $\Sigma f(V)$ is summation of the functions of volume as determined by Simpson's multipliers. For a state of equilibrium to exist, the total weight of the volumes of water displaced fore and aft of the step must be equal to the gross weight of the ship.

Horizontal location of the C.B. of each displaced volume with reference to some fixed point, preferably the step, may then be found by the formula:

$$\text{C. B.} = \frac{\Sigma f(M)}{\Sigma f(V)} \times \frac{L}{N}$$

where $\Sigma f(M)$ is the summation of the functions of the moment as determined by Simpson's multipliers; and the answer is expressed in inches fore or aft of the reference point. Summing up, we have the calculations as shown in Table I.

6. For all practical purposes the vertical location of the C.B. may be assumed at two-thirds the mean draft or at approximately 43.7 in. above the base line. We now have the relationship between the C.G. and the C.B. as shown in Fig. 4. If we have assumed the waterline at the correct angle to cause the C.B. to fall on a line which passes through the C.G. and which is perpendicular to the waterline, then the angle Θ must be equal to the trim angle (ϕ). From Fig. 2 we find that the difference between the bow and stern drafts is 12 in., and the total length of ship submerged is 1,016 in. Then—

$$\theta = \tan^{-1}\frac{1.2}{106.3} = \tan^{-1}.0113 =$$

0 deg., 39 min.

$$\phi = \tan^{-1}\frac{12.0}{1016} = \tan^{-1}.0118 =$$

0 deg., 41 min.

The answer is then expressed as:

Draft at step = 66 in. above base line
Trim angle = 0 deg., 41 min. down at stern

It is obvious that an exorbitant number of approximations would be necessary in order to calculate a displacement and trim angle exactly equal to those required for the conditions of equilibrium, and it is improbable that such accuracy could be attained using graphs of workable size. Past experience has shown that sufficient accuracy is obtained if the calculated displacement is within ± .25 percent of the gross weight and Θ is within ± 0 deg., 10 min. of ϕ.

This method may also be used to determine waterlines for flooded compartment conditions as well as total displacement of the hull fully submerged. In calculating flooded compartment conditions the method is identical, except that no displacement is shown under the sectional area curve at the flooded section.

Trim Change by C. G. Movement

An approximate change in trim caused by a movement of the CG. may be found by the formula:

$$Y = \frac{a \times L}{GM}$$

where Y = change in draft, bow plus stern (in.); a = distance that C.G. moves, measured parallel to normal load waterline (in); L = length of waterplane (in.); and GM = longitudinal metacentric height (in.). Since the physical characteristics of metacentric height are discussed later (under the subhead "Transverse Stability") we will demonstrate here, therefore, only the mechanics necessary to obtain such metacentric height.

Longitudinal metacentric height is determined by the moment of inertia (I_o) of the normal load water plane about a transverse axis through its centroid. The first step in calculating I_o is to construct a plan view of the normal load waterplane, plotting half breadths in feet against distance in inches aft of the forward perpendicular (Fig. 5). The area under the waterplane curve is then divided into an even number of sections using equally spaced ordinates. Our accompanying Table II is set up for the application of Simpson's rule.

Converting the length of the waterplane (L) to feet and letting N = number of ordinates, the area is—

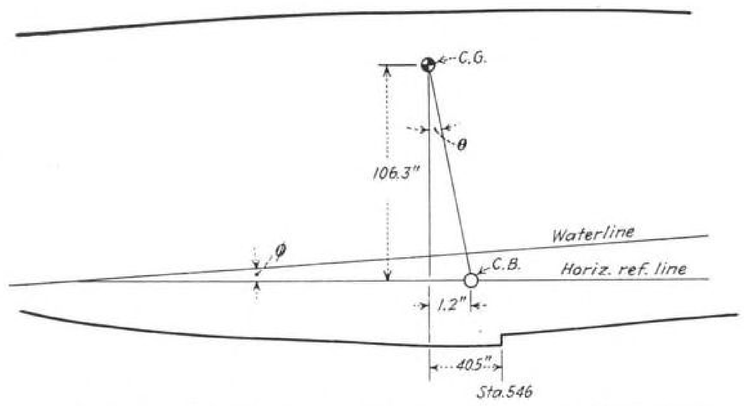


Fig. 4. Relationship between C.G. and C.B. Note that angle must be equal to trim angle.

Table I—Summary of Calculations for Volume and Center of Buoyancy.

Ord	*M*	*f(V)*	*L*	*f(M)*
0	1	0	6	0
570	4	2,280	5	11,400
1,650	2	3,300	4	13,200
2,660	4	10,640	3	31,920
3,390	2	6,780	2	13,560
3,910	4	15,640	1	15,640
4,200	1	4,200	0	0
		42,840		85,720

Forebody

$V_1 = \frac{2}{3} \times \frac{546-42}{6} \times \frac{42840}{1728} = 1388$ cu. ft.

$CB. = \frac{85720}{42840} \times \frac{546-42}{6} = 168.1$ in. fwd. of step

Ord.	*M*	*f(V)*	*L*	*f(M)*
3,480	1	3,480	0	0
2,580	4	10,320	1	10,320
1,840	2	3,680	2	7,360
1,375	4	5,500	3	16,500
950	2	1,900	4	7,600
475	4	1,900	5	9,500
0	1	0	6	0
		26,780		51,280

Afterbody

$V_2 = \frac{2}{3} \times \frac{1058-546}{6} \times \frac{26780}{1728} = 882$ cu. ft.

$CB. = \frac{51280}{26780} \times \frac{1058-546}{6} = 163.4$ in. aft of step

Ord. Ord.

Total Displacement = $(V_1 + V_2)$ 64 lb./cu. ft. = 2270 × 64 = 145280 lb.

$CB. = \frac{(1388 \times 168.1) - (882 \times 163.4)}{2{,}270} = 39.3$ in. fwd. of step

$$A = \frac{2}{3} \times \frac{L}{N} \times \Sigma f(A)$$
$$= \frac{2}{3} \times \frac{(1058-42)}{12 \times 12} \times 180.76$$
$$= 850 \text{ sq.ft.}$$

Location of the centroid of this area with respect to Ordinate No. 6. is—

$$\bar{X} = \frac{L}{N} \times \frac{\Sigma f(M) \text{ ord. } 0\text{-}6 - \Sigma f(M) \text{ ord. } 6\text{-}12}{\Sigma f(A)}$$

Table II—Calculations for the Application of Simpson's Rule

Ord. No.	Ord.	*M*	*f(A)*	*L*	*f(M)*	*L*	*f(I)*
0	0	1	0	6	0	6	0
1	2.95	4	11.80	5	59.00	5	295.00
2	5.90	2	11.80	4	47.20	4	188.80
3	6.43	4	25.72	3	77.16	3	231.48
4	6.65	2	13.30	2	26.60	2	53.20
5	6.75	4	27.00	1	27.00	1	27.00
6	6.75	2	13.50	0	236.96	0	
7	6.45	4	25.80	1	25.80	1	25.80
8	6.07	2	12.14	2	24.28	2	48.56
9	5.34	4	21.36	3	64.08	3	192.24
10	4.17	2	8.34	4	33.36	4	133.44
11	2.50	4	10.00	5	50.00	5	250.00
12	0	1	0	6	0	6	0
			180.76		197.52		1,445.52

$$= \frac{(1058-42)}{12 \times 12} \times \frac{(236.96 - 197.52)}{180.76}$$
$$= 1.54 \text{ ft. fwd. of Ord. 6.}$$

Calculation follows:

Find I about Ord. No. (6).

$$I \text{ Ord. (6)} = \frac{2}{3} \times \left(\frac{L}{N}\right)^3 \times \Sigma f(I)$$
$$= \frac{2}{3} \times \left(\frac{1058-42}{12+12}\right)^3 \times 1445.52$$
$$= 338{,}642 \text{ ft.}^4$$

Transfer this I Ord (6) to a transverse axis through the centroid; then we have—

$$I_o = I_{\text{Ord.}}(6) - A(X^2)$$
$$= 338{,}642 - (850 \times 1.54^2)$$
$$= 336{,}626 \text{ ft.}^4$$

The height of the metacenter above the C.B. is then—

$$BM = \frac{I_o}{V}$$
$$= \frac{336{,}626}{2{,}270}$$
$$= 148.3 \text{ ft. or } 1{,}779.6 \text{ in.}$$

where V = calculated displacement (Cu ft.)

Since the C.G. is 106.3 in. above the C.B. (Fig. 4), the height of the metacenter above the C.G. is—

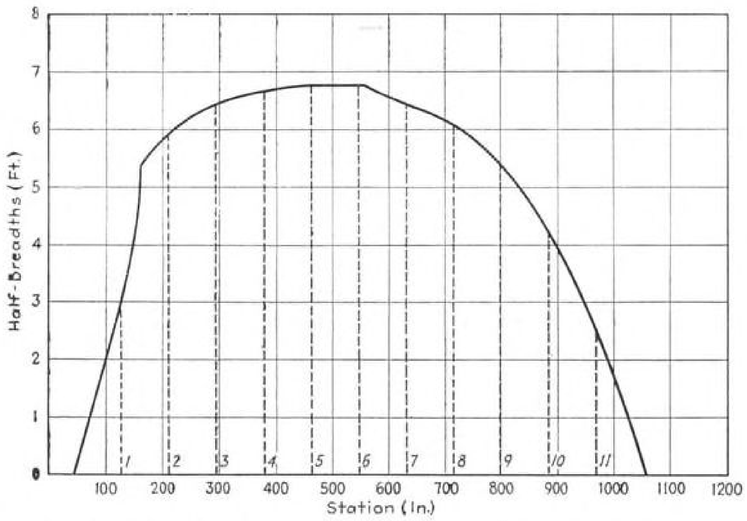


Fig. 5. Plan view of normal load waterplane. Graph shows plot of half breadths in feet against distance in inches aft of forward perpendicular.

$$GM = BM - 106.3$$
$$= 1{,}779.6 - 106.3$$
$$= 1{,}673.3 \text{ in.}$$

Total change in draft for a 1-in. movement of the G.G. is expressed by—

$$Y = \frac{a \times L}{GM}$$

$$= \frac{1 \times (1{,}058 - 42)}{1{,}673.3} \qquad (11)$$

$$= .607 \text{ in.}$$

Expressing this in change of trim angle for 1-in. movement of the C. G. we have—

$$\Delta\phi = \tan^{-1}\frac{.607}{1{,}016} = \tan^{-1} .00060 =$$

0 deg., 2 Min.

Transverse Stability

Static stability of a boat resting in water depends upon the effective height of the C.G. above the C.B. This effective height is termed either the transverse or longitudinal *metacentric height*, depending upon the direction in which stability is being considered. Because all flying boats of conventional design are laterally unstable (ignoring the affect of auxiliary floats), and the magnitude of this instability is a major factor in the design of the auxiliary float, it is necessary to determine the location of the transverse metacenter.

Fig. 6 shows the ship inclined at a small angle from the upright, causing C.B. to move from its original position B to B'. The upward force of buoyancy now acts through B' and the weight of the ship, which is equal to the buoyant force, acts vertically down through G, the C.G. If GZ is drawn perpendicular to the vertical through B', then we have a couple tending to take the ship further away from the upright. The upsetting moment of this couple is $W \times GZ$, where W = gross weight.

The point M where the vertical through

Table III—Summation of Moments of Inertia

Ord. No.	Ord.	Ord. 3	M	$f(I)$
0	0	0	1	0
1	2.95	25.67	4	102.68
2	5.90	205.38	2	410.76
3	6.43	265.85	4	1,063.40
4	6.65	294.08	2	588.16
5	6.75	307.55	4	1,230.20
6	6.75	307.55	2	615.10
7	6.45	268.34	4	1,073.36
8	6.07	223.65	2	447.30
9	5.34	152.27	4	609.08
10	4.17	72.51	2	145.02
11	2.50	15.63	4	62.52
12	0	0	1	0
			$\Sigma f(I)$ =	6,347.58

B' intersects the centerline of the ship is called the *transverse metacenter*, and the distance GM is called *transverse metacentric height* or h_e. Since for small angles M remains practically in a constant position, we may say that GZ = GM sin $\Theta = h_e$ sin Θ for angles up to 15°. Therefore the upsetting moment at any small degree of inclination is—

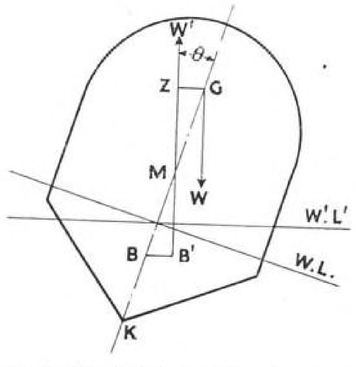


Fig. 6. Ship heeled at small angle, causing C.B. to move from B to B'.

$$W \times h_e \sin \Theta$$

It will be noted that when the metacenter occurs above the C.G., as did the longitudinal metacenter, the resultant couple will tend to right the ship, and hence the structure will be hydrostatically stable.

Transverse metacentric height is determined by the moment of inertia of the normal load waterplane about its longitudinal centerline. This is calculated by the following steps:

Determining Metacentric Height

1. From the normal load waterplane curve (Fig. 5) set up a table for the application of Simpson's rule.

If the length of the waterplane (L) is expressed in ft., I is then:

$$I = \frac{2}{3} \times \frac{L}{3N} \times \Sigma f(I)$$

$$= \frac{2}{3} \times \frac{(1{,}058 - 42)}{12 \times 3 \times 12} \times 6{,}347.58$$

$$= 9{,}947 \text{ ft.}^4$$

2. Height of the transverse metacenter above the C.B. is expressed:

$$BM = \frac{I}{V}$$

$$= \frac{9{,}947}{2{,}270}$$

$$= 4.38 \text{ ft. or } 52.6 \text{ in.}$$

3. If the hull has a compartment that is partially filled with a liquid having a free surface, then when the ship is heeled to a small angle the liquid will adjust itself to a surface parallel to the level waterline. The I of the free surface of liquid about its fore and aft centerline decreases the effect of the I of the waterplane, and therefore reduces the value of BM. In a case where there are fuel tanks in the hull, this reduction in the value of BM is given by—

$$\Delta BM = \frac{\rho I}{v} = \frac{50I}{w}$$

where ρ = fuel density (about 0.8), I = total moment of inertia of the free surfaces of fuel about their respective fore and aft centerlines, V = displacement of the ship (cu.ft.), and W = gross weight.

Fuel Tanks

The boat discussed here has one row of fuel tanks on each side of the centerline extending from Sta. 263 to 678. If l = length of tank row (ft.), and b = width of row, then—

$$I = 2\left(\frac{1}{12} \times l \times b^3\right)$$

$$= 2 \times \frac{1}{12} \times \frac{(678 - 263)}{12} \times (6.74)^3$$

$$= 1{,}764 \text{ ft.}^4$$

Reduction in BM is then—

$$\Delta BM = \frac{50^a}{W}$$

$$= \frac{50 \times 1764}{145{,}000}$$

$$= .608 \text{ ft. or } 7.3 \text{ in.}$$

The final location of the transverse metacenter above the C.B. is therefore—

$$BM' = BM - \Delta BM$$
$$= 52.6 - 7.3$$
$$= 45.2 \text{ in.}$$

4. Since the C.G. and the C.B. locations with reference to the base line or K are known, the distance of the transverse metacenter below the C. G. will be—

$$h_e = GM' = KG - (KB + BM')$$
$$= 150 - (43.7 + 45.2)$$
$$= 61.1 \text{ in. or } 5.1 \text{ ft.}$$

Fig. 7 shows the location of the auxiliary float as designed. The angle of heel necessary to submerge the float then will be—

$$\theta = \tan^{-1}\frac{77.6}{12 \times 69.6} = \tan^{-1} .09291 =$$

5 deg., 19 min.

The Bureau of Areonautics specification for transverse stability of seaplanes, SR-59C dated Feb. 20, 1942 states that for satisfactory stability the submerged displacement of each side float should be equal to, or greater than, the value given by the equation:

$$\Delta = \frac{W}{1}\left[h_e \sin\theta + \frac{0.1\,b}{(W/S)} + 0.06\sqrt[3]{W}\right]$$

where Δ = submerged displacement of the side float (lb.)
W = normal gross weight of seaplane (lb.)
l = distance between C.B. of side float and centerline of seaplane (ft.)
Θ = angle of heel required to submerge side float
b = total wing span (ft.)
S = total wing area (sq.ft.)

In this equation the first term within the brackets is due to the effective height of the C. G., the second term is due to the effect of the wind on the wing, and the third term represents a reasonable excess restoring moment based on accumulated experience. Substituting in this equation we obtain the theoretically correct submerged displacement of the side float, which is:

$$\Delta = \frac{145{,}000}{69.6}\left[(5.1 \times .0927) + \frac{0.1 \times 200}{145{,}000/3{,}686} + .06\sqrt[3]{145{,}000}\right]$$

$$= 8{,}610 \text{ lb.}$$

Side Float Displacement

Submerged displacement of the side float as designed, as well as the partial displacement at various angles of heel, can be determined by the same method used in calculating the displacement of the main float. In case the total displacement of the side float is smaller than the minimum allowed by the above equation, the question of redesign may be left to the discretion of the customer. The side float selected for this flying boat had a total displacement (Δ) of only 7,869 lb. of sea water. The customer was satisfied with the adequacy of this displacement, and redesign was considered unnecessary.

The righting factor of this float for normal load is the ratio of the righting moment of the float fully submerged to the upsetting moment at the angle of heel required to submerge it.

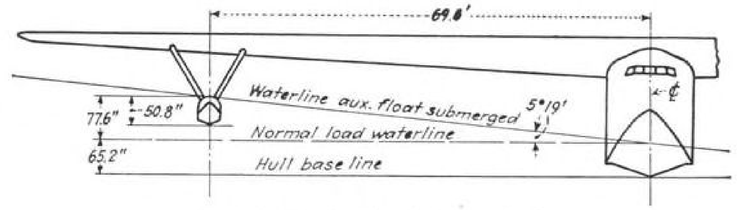


Fig. 7. Location of auxiliary float as designed.

$$RF. = \frac{\Delta' \times 1}{W \times h_e \sin\theta}$$
$$= \frac{7{,}869 \times 69.6}{145{,}000 \times 5.1 \times .0927}$$
$$= \frac{547{,}682}{68{,}500}$$
$$= 8.0$$

The side float should also be large enough to give a satisfactory righting factor for a maximum upsetting moment due to off-center loading. This off-center loading can be either the most extreme condition that can possibly exist or a condition that is limited by some loading restriction in order to prevent any excessive increase in displacement of the float. In this instance the maximum off-center loading was assumed to exist when two men were on the wing at 52.2 ft. from the centerline of the ship refueling the tank, the opposite tank being empty. The upsetting moment due to this condition is—

2 men at 400 lbs. each × 52.2 ft.	= 20,880
630 gal. fuel at 6 lb./gal. × 52.2 ft.	= 197,316
Total moment	= 218,196 ft.lb.

Adding this moment to the upsetting moment at the angle of heel required to submerge the float we have—

$$RF. = \frac{\Delta' \times 1}{(W \times h_e \sin\theta) + 218.196}$$
$$= \frac{7{,}869 \times 69.6}{(145{,}000 \times 5.1 \times .0927) + 218{,}196}$$
$$= \frac{547{,}682}{286{,}696}$$
$$= 1.9$$

If a series of displacement calculations for the side float are made at various heel angles, we can plot a curve of righting moments against angle of heel (Fig 8). The point where this curve intersects the curve of normal upsetting moments will then locate the lateral inclination at which the ship fill remain at rest, and is termed the static angle of heel.

The calculations described here correspond to standard practice in naval architecture. For further study concerning the theory and applications of these methods, the following books are recommended: *Theoretical Naval Architecture*, by Attwood and Pengelly; *Practical Principles of Naval Architecture*, by S. S. Rable; and *The Naval Construction*, by Simpson

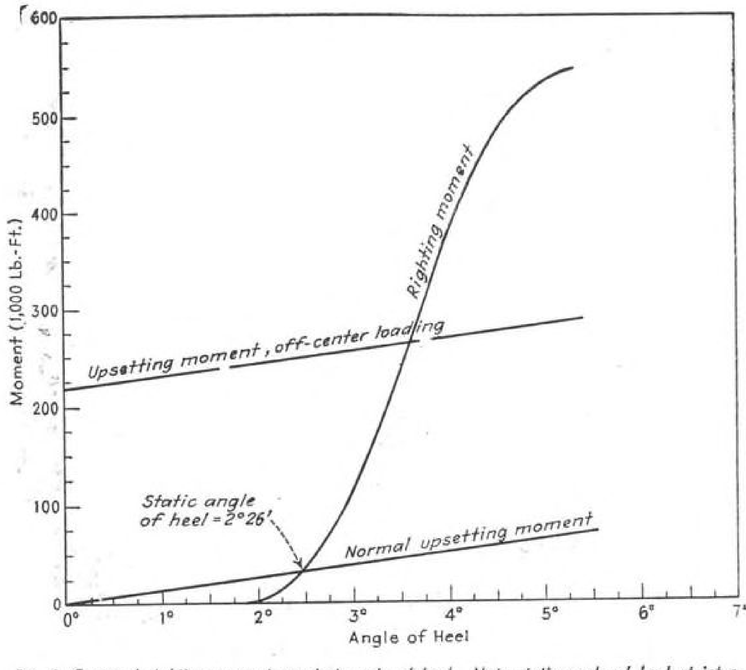


Fig. 8. Curve of righting moments against angle of heel. Note static angle of heel at intersection of righting moment and normal upsetting moment curves.

HIGH FREQUENCY A.C. "UPS" MOTOR PERFORMANCE*

PART II

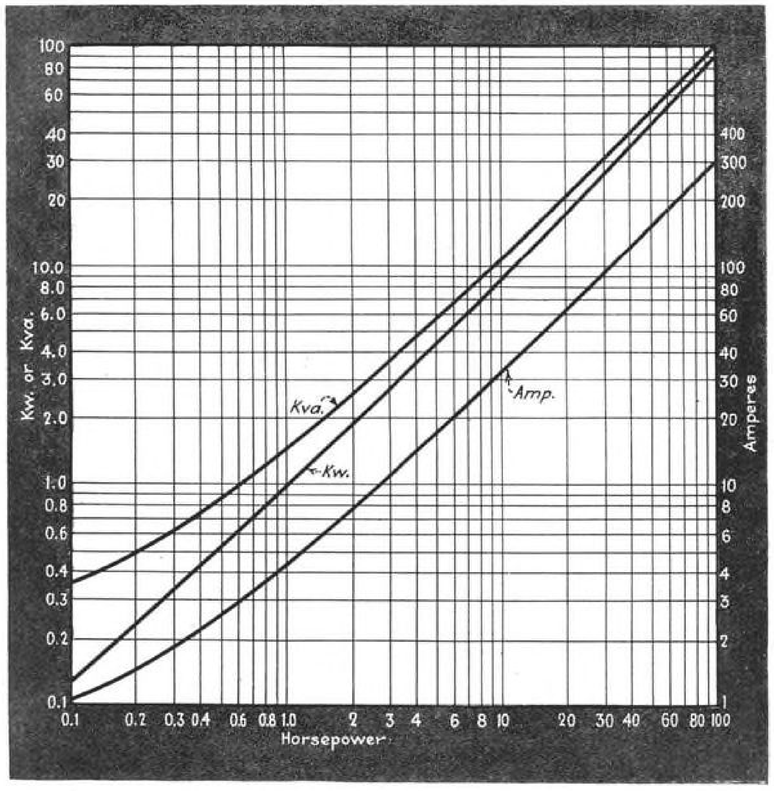
By J. D. MINER, *Westinghouse Electric & Mfg. Co.*

Increased efficiency and advantages due to weight saving are detailed in this concluding article on substitution of alternating high frequency current for direct current on aircraft.

CONSTANT-SPEED OPERATION of generators provides one definite advantage apart from constant-frequency considerations. It permits a tremendous reduction in weight, since weight of an electrical machine of given output varies almost inversely with the speed.

A machine operating at 6,000 rpm. is very much lighter than one which must develop the same output at 2,100 rpm. Although step-up gears could be provided to convert from 2,100 to 6,000 rpm., the same gears would give 23,000 rpm. at the high end of the speed range, an obviously impracticable speed for a machine of appreciable size.

A great deal of the weight of the variable-ratio drive may therefore be charged to the reduction made possible in alternator weight. Similar considerations would apply to d.c. generators, especially for sizes appreciably larger than those now in use.



Average values of full load inputs required by 400-cycle, 3-phase induction motors operating at 195v.

A speed governor must be provided to maintain the speed of the alternator at 6,000 rpm. within permissible variations, and for parallel operation it must also control torque. That is, it is necessary to establish a definite relation between speed and torque so that the governor can maintain simultaneously system frequency and alternator load.

Since alternators operating in parallel must all have the same speed, individual loads must be exactly proportional to applied torque.

Governor speed setting should therefore be responsive to the load, and errors in speed calibration will show up as an incorrect division of torques.

Obviously all governors should produce the same incremental drop in speed as alternator load increases. It has been agreed that the speed drop will be 8-percent from no-load to 150 percent load. With 400 cycles at 75 percent load, the no-load frequency will be about 417 cycles and the frequency at 150 percent load will be 384 cycles. It should be noted that 1 percent error in speed calibration will produce nearly 20 percent error in torque or load division.

An over-running clutch in the drive limits the negative torque to practically zero, so that, if one alternator should be driven faster than the no-load speeds of the others, the alternators will idle at the speed of the fast-drive alternator without requiring any great amount of power. The idling alternators will be incapable of supplying *real* power or kilowatts, although they will become synchronous motors and will supply reactive power-factor correcting power or *kilovars*, thereby aiding excitation of the machine carrying the load, thus increasing its load capacity during momentary surges.

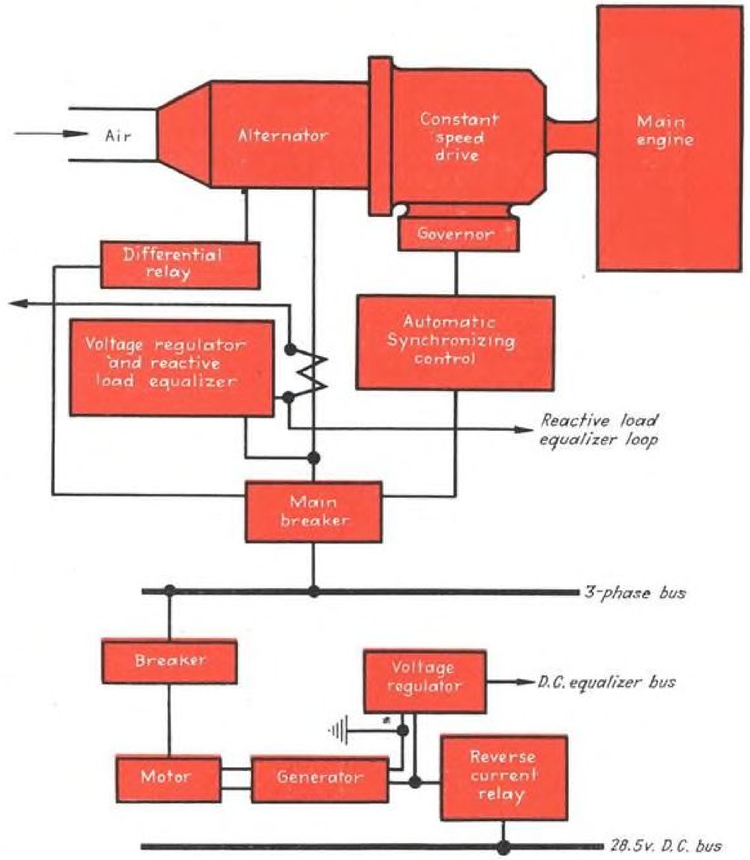
The governor should operate rapidly enough to keep the load division within permissible limits even at maximum engine acceleration. The over-running clutch will prevent major system disturbances during such acceleration, and there is little danger of damage even if the load shifts rapidly between alternators. Setting one governor permanently high so that one alternator continues to carry a heavy overload is another matter, and damage to either the drive or alternator would be certain if such a condition were to persist through malfunctioning of protective devices.

It should be apparent that a "soft" drive or one that has considerable droop with load, because of slippage or because of a torque-limiting device, greatly reduces the difficulties of governor control and materially reduces response speed necessary to prevent over-frequency and excessive torque when an engine is rapidly accelerated. Droop in the drive is momentarily added to that in the governor so that momentary torques are reduced and the governor is given time to reach a proper setting. Droop in the drive, if produced by slippage, involves power loss, whereas droop produced by the governor does not involve any such loss.

Droop in the governor is produced by a kilowatt-responsive element in the governor calibration system. Each governor responds to the load on its own alternator only, to avoid complicated interconnections. Load division may be adjusted in flight by biasing the governor calibration through electrical remote control. This adjustment will raise or lower the entire speed-torque curve but will not change its slope.

Voltage regulators on an a.c. system with paralleled alternators must accomplish two results: (1) They must control system voltage, and (2) divide reactive circulating power loads to prevent overheating of individual units or serious reductions in synchronizing torques. System voltage will be a function of total excitation, including any negative excitation or demagnetizing effects produced by low-power-factor loads. The proportion of total excitation applied to the field of any one machine determines its power factor rather than its voltage. That is, a slight change in excitation of a single alternator paralleled to a high-power bus will have much less effect on bus voltage than on distribution of circulating reactive power.

Improper adjustment of excitation with parallel alternators may lead to unnecessary overheating of some. An alternator with an abnormally weak field will pull out of synchronism easily during power surges. For these reasons, voltage regulators for use with parallel alternators will be provided with an automatic reactive-load compensating circuit which will prevent any appreciable unbalance of power factor. Because the compensating circuit is responsive only to the circulating zero-power factor component of the outputs, it can operate to redistribute excitations without changing system voltage.



Block diagram for a. c. aircraft electric system. Any number of a. c. and a. c.-to-d. c. conversion units may be connected to a. c. bus.

Alternator

Main-engine driven alternators are of eight-pole design to provide 400 cycles at 6,000 rpm. Mechanically they are required to withstand 9,000 rpm. without failure, since in the event of governor failure some types of drive will go into direct ratio with a possible maximum alternator speed of 8,100 rpm. Machines are of salient-pole rotating-field construction and resemble large machines built in miniature. Damper bars are used in pole faces to provide anti-hunting characteristics.

Excitation is provided by means of an exciter either integral with alternator or coupled to it at the end opposite the flange mounting. Heavy overload capacity is necessary to provide system stability and to supply the short-circuit current required for clearing faults rapidly to avoid loss of synchronism or motor load. The exciter is designed for a high ceiling output because momentary overload alternator capacity varies directly with excitation.

Cooling is provided by blast-tube air through axial ventilation ducts in rotor and stator.

Continuous rating is determined by effectiveness of the cooling, since inherent excitation is sufficient to maintain voltage for momentary overloads of twice the nominal rating.

The alternators, with their variable-ratio drives, represent a sizable installation, and no attempt should be made to mount them on the engines. Ventilation problems are complicated by providing engine cooling through the same main air ducts, and further by a requirement that the alternators supply at least a small output with the airplane on the ground.

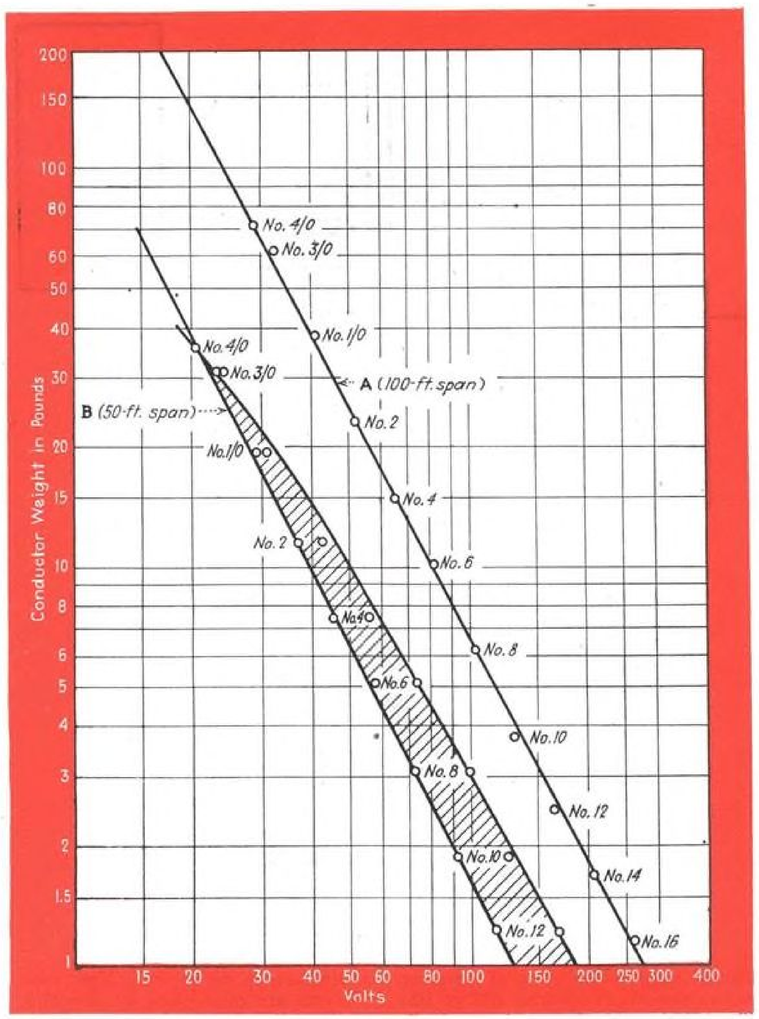
Parallel Operation

Parallel operation of several small alternators will provide maximum reliability for a system exposed to hazards of combat service. Full output is instantly available wherever required. Requirements for successful parallel operation add complications to the speed and voltage-control problems, yet these matters are but little more complex than those problems solved on the Douglas XB-19.

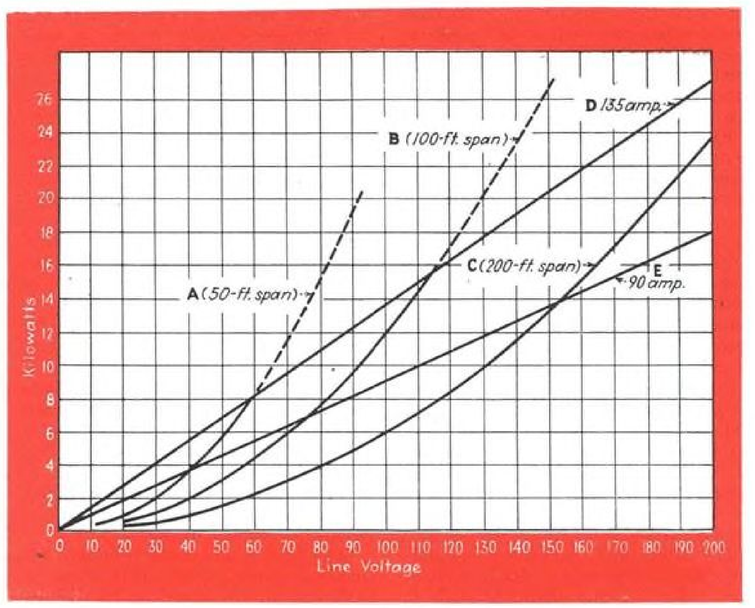
It will be necessary, however, to lay out the system so that operation can be obtained with isolated alternators and sectionalized buses so that failure of, or damage to, paralleling equipment will not render the system inoperative. Transfer breakers must be provided so that any bus may be connected to any alternators, in such fashion that loads can be shifted, as required, to avoid overloads or to compensate for combat damage.

Equipment is now being developed for automatic synchronizing. It is similar to equipment already tested on the XB-19.

* The author acknowledges the assistance of C. G. Veinott and D. W. Exner, both of the design engineering department, Lima Div., Westinghouse Electric & Mfg. Co., and of J. C. Cunningham, central station engineer of Westinghouse's East Pittsburgh Works, in offering valuable suggestions and in checking certain of the technical points covered.



Effect of voltage on conductor weight carrying 5 kw. with 3 percent regulation. These curves are based on AN-J-C-48 aircraft cable with cotton braid. Cables from different manufacturers will vary slightly in weight. Shaded area indicates extra weight required for bunched conductors to prevent overheating. Shaded area indicates extra weight required for bunched conductors to prevent overheating.



Effect of voltage on load capacity when using No. 4 cable (AN-J-C-48). Cable averages 150 ft.-lb. Thermal rating is given by D for single, and by E for multiple, conductors in open air. Regulation is 3 percent.

A dead-bus relay will allow the first alternator coming up to speed to do so independently of the synchronizing controls and to be connected to the bus. As soon as voltage is available on the bus, the automatic synchronizing equipment comes into play, and before the other alternators come in they will be automatically brought up to proper voltage and frequency, then automatically connected in proper phase relationship to the bus voltage to avoid system disturbance.

Distribution System

Various distribution systems have been proposed to meet requirements for maximum reliability under combat conditions. It is mainly in the distribution system's protective features that the new a.c. systems will differ from previous aircraft electrification conceptions. Problems approach those encountered on naval vessels, where every consideration must be given to continued operation even after severe damage by hostile fire.

Attempts have been made to provide two separately routed feeders for each vital load, but in most cases this involves too much weight penalty. Instead, each major feeder consists of 12 or 15 spaced conductors; that is, 4 or 5 for each line. Subdivision of the feeders permits a reduction in total copper, since spaced leads dissipate heat much better than a single large conductor.

Subdivision of main lines into parallel conductors makes possible fusible links or limiters for clearing faults on lines or at loads. These fusible links have an inverse time-current characteristic which provides very rapid blowing for heavy overloads and avoids blowing for light overloads of short duration. A minimum of three conductors is required; four or five are used for vital circuits so that at least two faults in any given section can be cleared without failure. It is necessary to match limiters to circuits so that faulted sections will clear without blowing or damaging adjacent limiters. Limiters in individual conductors must have a high enough rating to continue to carry the load current when one or two conductors have faulted and cleared.

Replacement of a limiter by one of incorrect rating may destroy the protec-

(Turn to page 277)

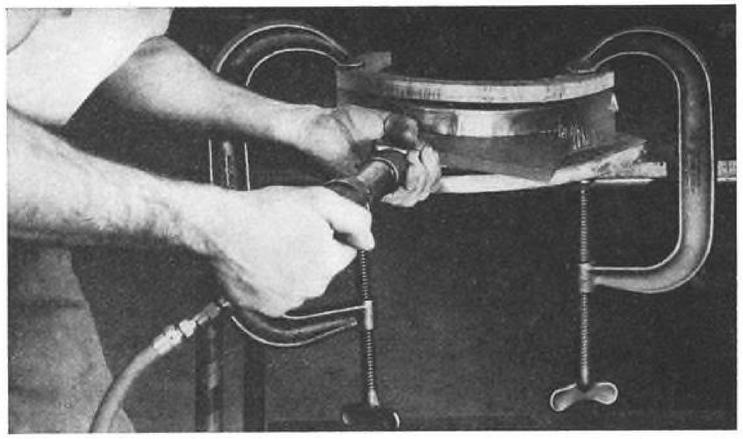
PLANT-PRACTICE HIGHLIGHTS

New Tool Devised For Shrinking Wrinkles

• Powered by compressed air and used with a riveting gun, a new forming tool for shrinking wrinkles in aluminum parts has been designed by Elmer G. Jost of the Curtiss-Wright Airplane Div., Missouri Plant. Operation of the device is stated to be easy and fast, with its performance suitable for both simple and intricate parts. In shrinking wrinkles on nose ribs and similar airplane flanges, it is reported especially efficient, saving as much as 49 percent in man-hours over hand shrinking.

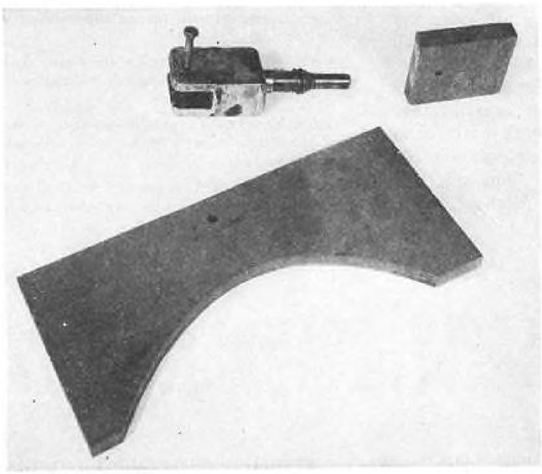
Of sturdy design, the tool has a rectangular block grooved at one end for insertion of a forming block made of red fiber, and fitted at other end is a shank to connect it to a Cleco riveting gun. The fiber block, which fits into groove, is cut to fit contour of flange being processed. A ¼-in. bolt secures block firmly in place but permits it to be readily removed.

The retainer block is made from cold rolled steel with bevelled ends. Groove is cut 1½ in. deep and ⅝ in. wide, while hole for shank is ¾ in. dia. and 1½ in. deep with a ¼ in. counterbore running from shank hole to groove. Retaining bolt is located 1 in. from bottom of opening. The shank, 4⅛ in. in length, is made of cold rolled steel, threaded at center where it enters gun. That part which fits into gun nozzle is chamfered 45 deg. for 1/16 in. Red fiber has been found to be most suitable material for use with this tool.



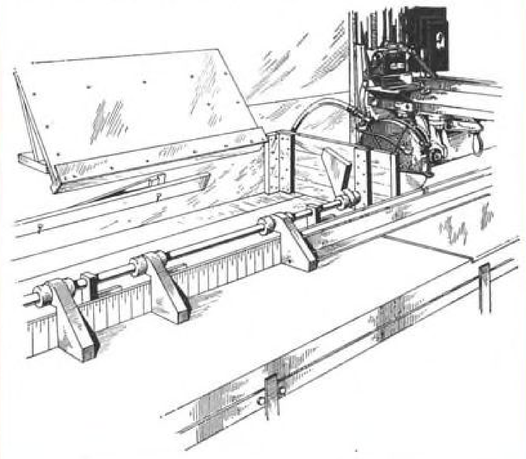
Shrinking wrinkles in aluminum with new forming tool and riveting gun. Using fiber block cut to fit contour, up to 49 percent of time is reported saved over hand work.

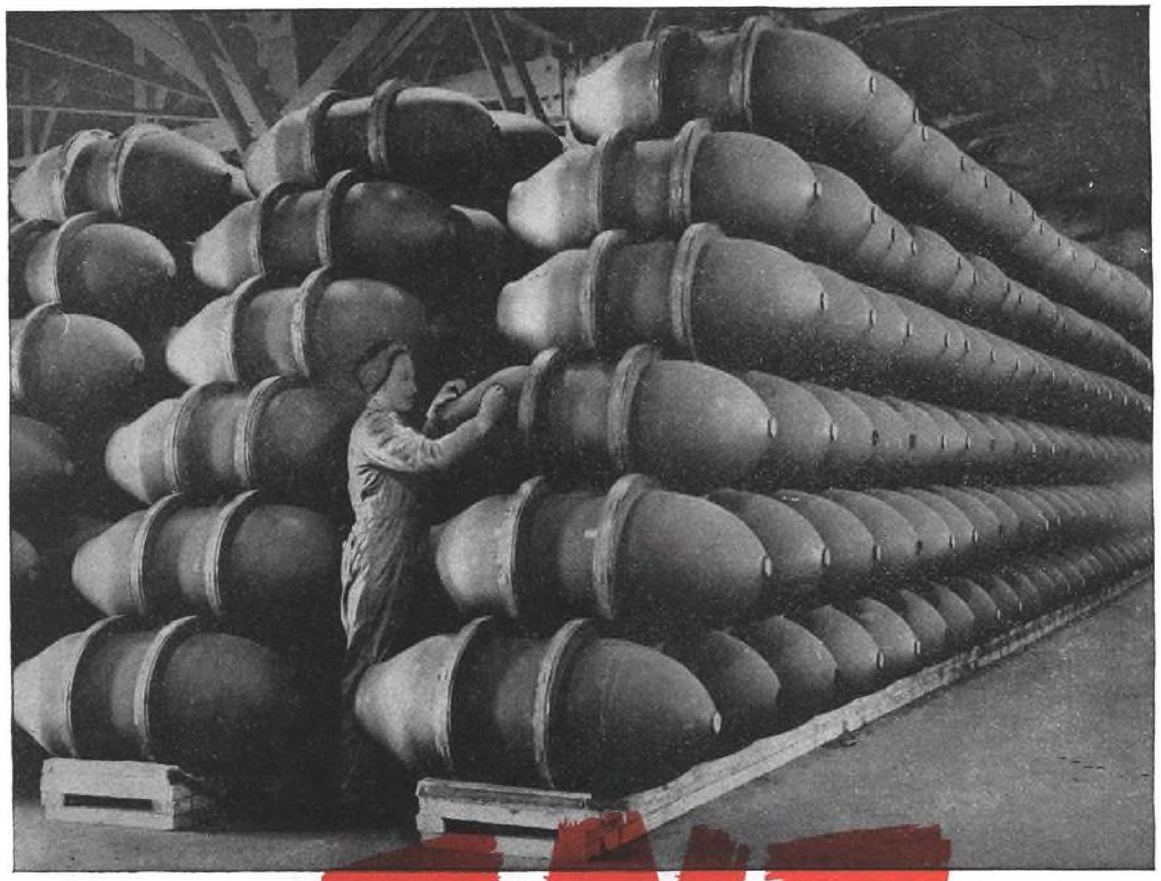
Knocking block (foreground) is red fiber cut to fit rounded contour. Rectangular fiber block is used for shrinking wrinkles on smaller parts. Metal retainer block has special shank designed to fit nozzle of riveting gun.



Gang Cut-Off Saw Stop

• This stop saved an estimated five-sixths of time formerly required for cutting lengths of material on production work. Devised by Marvin B. McCoy of Northrop Aircraft, this machine has a series of hinged adjustable stops each of which can be thrown over into position by hand when that specific length is to be sawed.





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TEXACO CUTTING, SOLUBLE AND HYDRAULIC OILS FOR FASTER MACHINING

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT — CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

HERE'S THE PRESCRIPTION TO KEEP MAGS SPARKING

A hundred miles of sparks—200,000,000 electrical impulses at nearly 20,000v.—is the normal aircraft magneto output between overhauls. Careful inspection of these reliable little units is the key to keeping them operating efficiently.

ALL THREE TYPES of Scintilla magnetos described here are single flange-mounted rotating-magnet models of anti-clockwise rotation.

Types SF9LN-2 (Fig. 1) and SF9LN-4 (Fig. 3) are 9-cyl. models, Type-2 having the breaker cam directly on the magnet shaft, while Type-4 has a compensated cam mounted on a separate shaft, driven at ½ engine speed by gears with a 4:9 ratio.

Type SF14LN-3 (Fig. 2) is the 14-cyl. model, having the camshaft driven by 4:7 ratio gears. With the exception of these differences, there are no variations in their working principles, apart from the installation of a condenser in the secondary circuit of the 14-cyl. SF14LN-3 model.

Cam lobes are ground at unequal intervals to compensate for the slight variations from equal firing intervals, due to the design of radial engines. On the magneto, the "E" gap varies for each contact point opening. The "E" gap is the angular difference between the neutral position of the magnet and its position when the contact points commence to open.

When the magneto is changed from right to left hand side of the engine, the only variations required are the use of the correct air blast cover and the radio shield having the proper outlet for the high tension cables.

The booster electrode is located so that it trails the high tension segment of the distributor finger to give a retarded spark while the engine is being started on booster. At coming-in speed, magneto automatically restores the spark timing to that required for normal running.

Before installing magneto, make sure that it has been properly checked and inspected. A complete set of special tools, available from the magneto manufacturer, is essential for best results.

Timing to the Engine

Turn crankshaft in the direction of

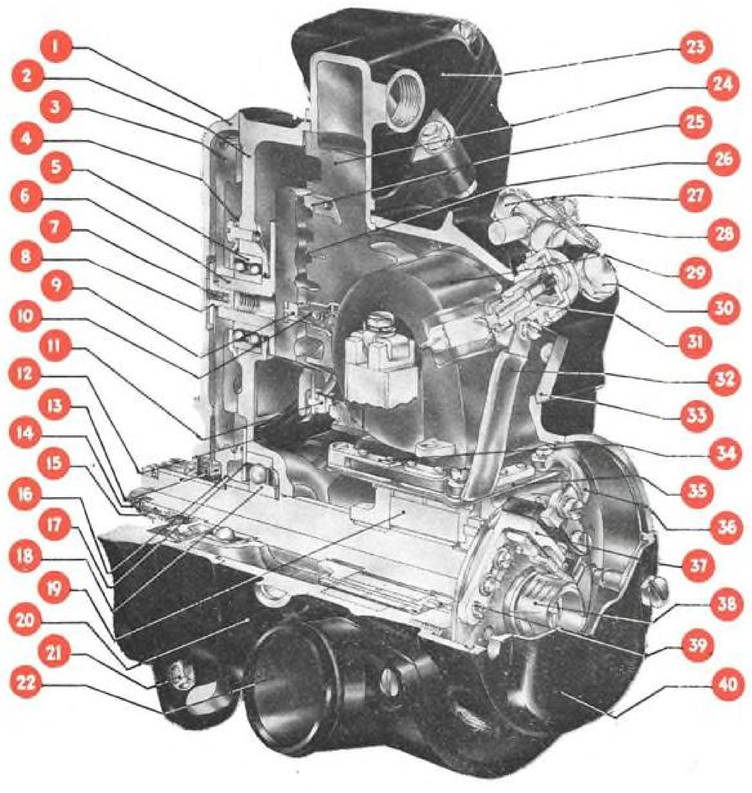


Fig. 1. Scintilla Model SF9LN-2 Magneto.

1. Mounting flange.
2. Front end plate.
3. Large distributor gear.
4. Ball bearing retainer.
5. Distributor gear axle ball bearing.
6. Distributor gear axle.
7. Static carbon brush.
8. Distributor gear securing screw.
9. Distributor finger center electrode.
10. High tension carbon brush.
11. Distributor finger high tension electrode.
12. Insulating plate.
13. Oil seal.
14. Drive shaft nut.
15. Splined drive gear.
16. Small distributor gear.
17. Ball bearing retainer.
18. Drive end ball bearing.
19. Rotating magnet.
20. Magneto housing.
21. Oil drain.
22. Air blast cover.
23. Radio shield.
24. Distributor block.
25. Distributor block electrode.
26. Booster collector ring.
27. Coil cover strap.
28. Safety pin.
29. Coil.
30. Thermocouple plug.
31. Ground terminal.
32. Coil-condenser primary condenser.
33. Coil cover.
34. Primary condenser.
35. Insulating plate.
36. Breaker-condenser primary connector.
37. Breaker contact point assembly.
38. Breaker cam.
39. Breaker adjusting eccentric screw.
40. Breaker cover.

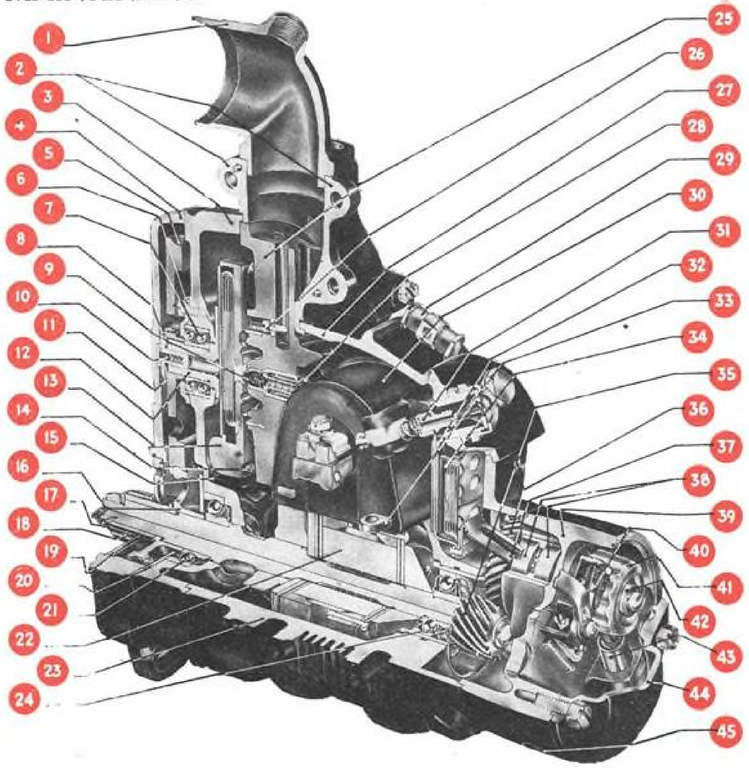


Fig. 2. Scintilla Model SF14LN-3 Magneto.

1. Radio shield cable outlet.
2. Radio shield.
3. Front end plate.
4. Mounting flange.
5. Large distributor gear.
6. Ball bearing retainer.
7. Distributor gear axle ball bearing.
8. Distributor gear securing screw.
9. High tension carbon brush.
10. Static carbon brush.
11. Ear lock washer.
12. Distributor gear axle.
13. Distributor finger.
14. High tension electrode.
15. Insulating plate.
16. Small distributor gear.
17. Drive shaft nut.
18. Splined drive gear.
19. Oil seal.
20. Bearing retainer.
21. Drive end ball bearing.
22. Rotating magnet.
23. Magneto housing.
24. Breaker end ball bearing.
25. Distributor block.
26. Cable piercing screws.
27. Coil cover.
28. High tension contact button.
29. Coil cover clamping strap.
30. Coil.
31. Ground terminal.
32. Primary condenser connector.
33. Coil grounding lug.
34. Primary condenser.
35. Small cam drive gear.
36. Large cam drive gear.
37. Primary connector.
38. Camshaft ball bearings.
39. Breaker adaptor.
40. Breaker contact assembly.
41. Breaker cam.
42. Cam adjusting ratchets.
43. Plunger oiler.
44. Breaker cover.
45. Breaker ventilator.

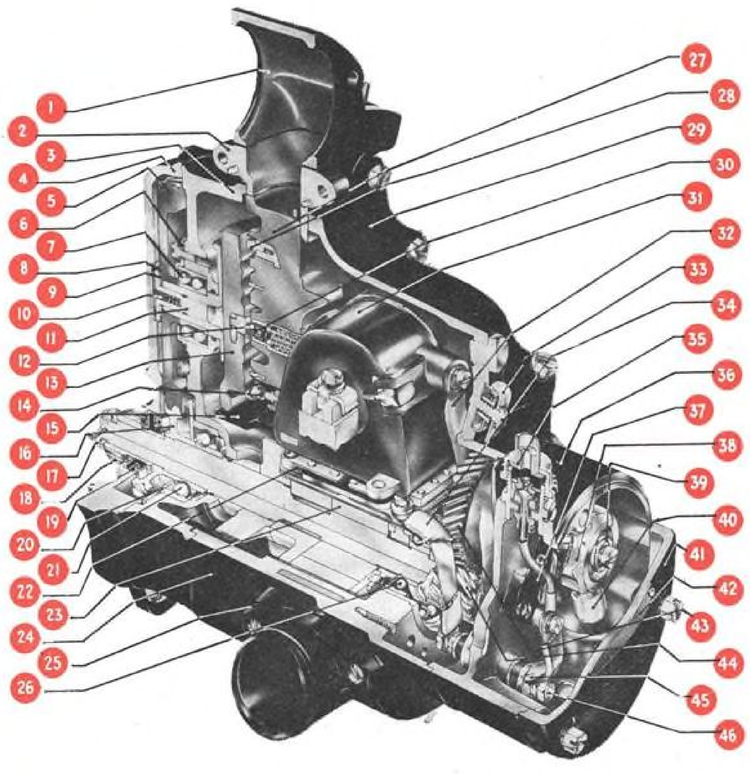


Fig. 3. Scintilla Model SF9LM-4.

1. Radio shield adaptor.
2. Radio shield.
3. Front end plate.
4. Mounting flange.
5. Large distributor gear.
6. Ball bearing retainer.
7. Distriubtor gear axle ball bearing.
8. Distributor gear securing screw.
9. Ear lock washer.
10. Static carbon brush.
11. Distributor gear axle.
12. High tension carbon brush.
13. Distributor finger.
14. Distributor finger electrode.
15. Insulating sleeve.
16. Small distributor gear.
17. Drive shaft nut.
18. Splined drive gear.
19. Oil seal.
20. Bearing retainer.
21. Drive end ball bearing.
22. Primary condenser.
23. Rotating magnet.
24. Magneto housing.
25. Airblast cover.
26. Breaker end ball bearing.
27. Distributor block.
28. Distributor block electrode.
29. Coil cover.
30. High tension contact button.
31. Coil.
32. Coil-condenser primary lead.
33. Ventilator.
34. Condenser-stud primary lead.
35. Ground terminal assembly.
36. Breaker adaptor.
37. Breaker contact assembly.
38. Breaker cam.
39. Cam adjuating ratchets.
40. Plunger oiler.
41. Breaker cover.
42. Warning plate.
43. Large cam drive gear.
44. Small cam drive gear.
45. Primary conductor.
46. Insulated stud.

normal rotation until the timing disk pointer on the engine indexes full advance firing position of No. 1 cylinder.

Remove coil cover, breaker cover, and distributor block. Turn the magneto until timing mark (A) on the distributor finger (see Service Charts Fig. 4, 5, and 6) is approximately opposite timing mark

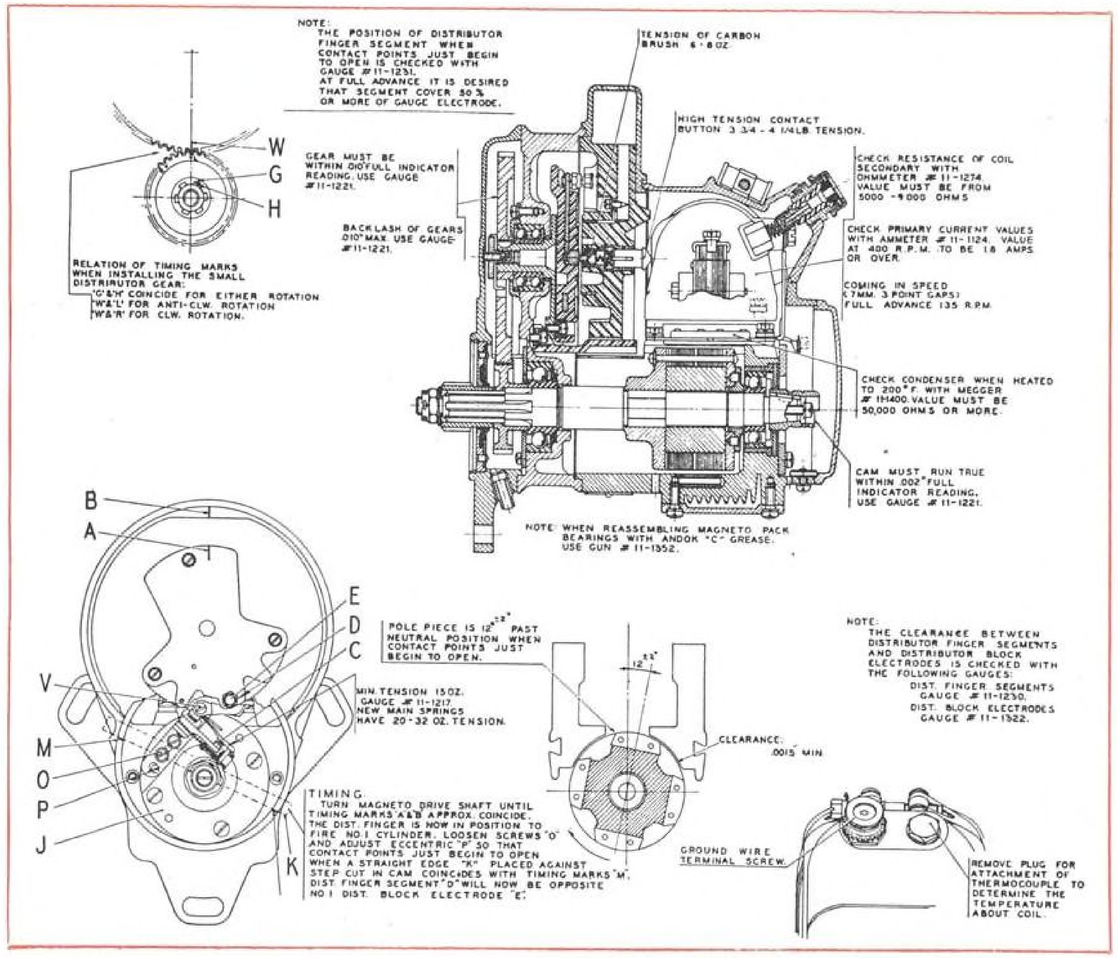


Fig. 4. Service chart give methods and clearances for adjusting magnetos. This chart, for Model SF9LN-2, specifies special tools required to do the work most efficiently.

(B) inside front and plate when straight edge (K), placed on the step cut in the cam, coincides with the timing marks (M) at end of housing. At this position, high tension electrode (D) on the distributor finger will be opposite distributor block electrode (E) for firing No. 1 cylinder. Install magneto to engine, but do not tighten the cap screws or nuts so that further adjustment cannot be made.

When exact timing is made, all adjustments must be at drive end and not by altering adjustment of contact points.

Make adjustments by turning magneto through angle permitted by slots in mounting flange, so that contact points begin to open when a straight edge (K) placed on the step of the cam coincides with the timing marks (M) at the breaker end of the housing. It may be found that timing mark (A) is not exactly opposite timing mark (B) after making the final adjustment. However, any slight variance of the distributor finger timing mark (A) will not affect the operation of the magneto, for this is merely used to locate the approximate firing position of the magneto for No. 1 cylinder.

For synchronized spark requirements, the breaker contacts on each magneto must open simultaneously. Use the timing light, or equivalent, to determine the opening of the contacts. The use of feeler strips invariably introduces a possibility of fouling the points, since oil and dirt are nearly always present. When the synchronization has been made, secure magneto firmly by tightening all cap screws or lock nuts.

For staggered spark requirements, one magneto will fire later than the other. Install and time one magneto, then turn the engine crankshaft until the piston of No. 1 cylinder is in the correct position for the staggered spark and install the other magneto.

Electrical Operation

The poles of the rotating magnet are arranged in alternate polarity (see electrical diagrams Figs. 7, 8 and 9) so that the flux can pass from a north pole through the coil core and back to a south pole. As the magnet is turned, the polarity continually changes, thereby producing flux reversals in the coil core. The number of flux reversals during one complete revolution of the magnet is equal to the number of poles on the magnet.

The flux reversals induce current in the primary winding while the contact points are closed. The flow of current in the primary winding stores energy which is released later by the opening of the contact points, thereby producing high voltage in the secondary winding.

One end of the primary winding is connected to ground. The other end is connected to the insulated contact point. When the contact points are closed, the primary current passes to ground. The condenser is connected across the contact points

The ground terminal is electrically connected to the insulated contact point. A wire is connected between the ground terminal and switch. When the switch is in the *Off* position, this provides a path to ground for the primary current, pre-

venting the production of high voltage in the secondary winding.

One end of the secondary winding is also grounded. The other terminates at the high tension insert on coil. High tension current in secondary winding is conducted to the central insert of the distributor finger by a carbon brush. From here it is conducted to the high tension segment on the distributor finger and across a small air gap to the electrodes of the distributor block. High tension cables then carry it to the sparkplugs. Booster electrode trails high tension segment on distributor finger to give a retarded spark for starting.

Wiring

Remove cable piercing screws from distributor blocks to avoid possibility of cables not being fully seated in holes.

Insert sparkplug cable for No. 1 cylinder into the hole marked No. 1 and secure it with the cable piercing screw. Place the sparkplug cable for the next cylinder to fire into hole marked No. 2, etc. Numerals on block denote serial sparking order of magneto and have no bearing on engine firing sequence. Parts of cables in the distributor block holes should be treated with powdered talc to prevent their fusing to the walls. Connect cable from booster to distributor hole marked *B*, and secure it with a cable piercing screw. Lock washer is not required beneath the head of this screw. In a magneto not used for booster starting, a lock washer is used with cable piercing screw and a Neoprene retainer is installed in the distributor block cable hole marked "B".

Before installing radio shields, connections should be checked for short or open circuits and to ascertain whether cables lead to the proper cylinders. Either a buzzer or light system or a booster magneto can be used. When using a buzzer or light, touch the distributor block electrode with one point and the sparkplug end of the cable for the proper cylinder with the other. Circuit is complete when buzzer signals or lamp lights.

If circuit is not complete, check for open circuit or wrong connection. To check for a short circuit due to faulty insulation of the cable, a booster magneto is used. High tension terminal of the booster magneto is connected to the distributor block electrode. Sparkplug end of cable is held about ¼ in. from a ground. If no spark occurs, check cable for faulty insulation.

Install radio shield to distributor block. Allow enough slack in cables to prevent extremely sharp bends. Install radio shield, distributor block, and main cover on the magneto.

Unscrew ground terminal cap and take out brass contact, rubber washer, and ground wire shielding ferrule. Slip ferrule through the terminal cap and solder ground wire shielding to it. Strip the insulation from the end of the wire for a length of $\frac{3}{16}$ in. Insert wire through rubber washer and into brass contact. Slide rubber washer back over ground wire to brass contact. File solder flush with contact surface, take up slack wire, and screw cap home, locking it with wire bail.

Inspection and Maintenance

Ball bearings and gears contain grease and do not require lubrication between overhauls.

Examine cam follower felt at routine inspection to see that it is properly lubricated. If oil appears on its surface when felt is squeezed with the fingers, do not oil; if it is dry, moisten it with aircraft engine oil SAE No. 60, or equivalent grade under AN specifications. Don't use too much oil—it will be thrown off during operation and will come between the contact points, causing pitting and burning.

Always keep breaker compartment free from excess oil.

If plunger type oiler is used, it is not necessary to remove the breaker cover to insure that the cam follower is properly lubricated. At 50 to 60 hr. intervals, remove retaining clip from oiler and push plunger once as far as it will go. Then

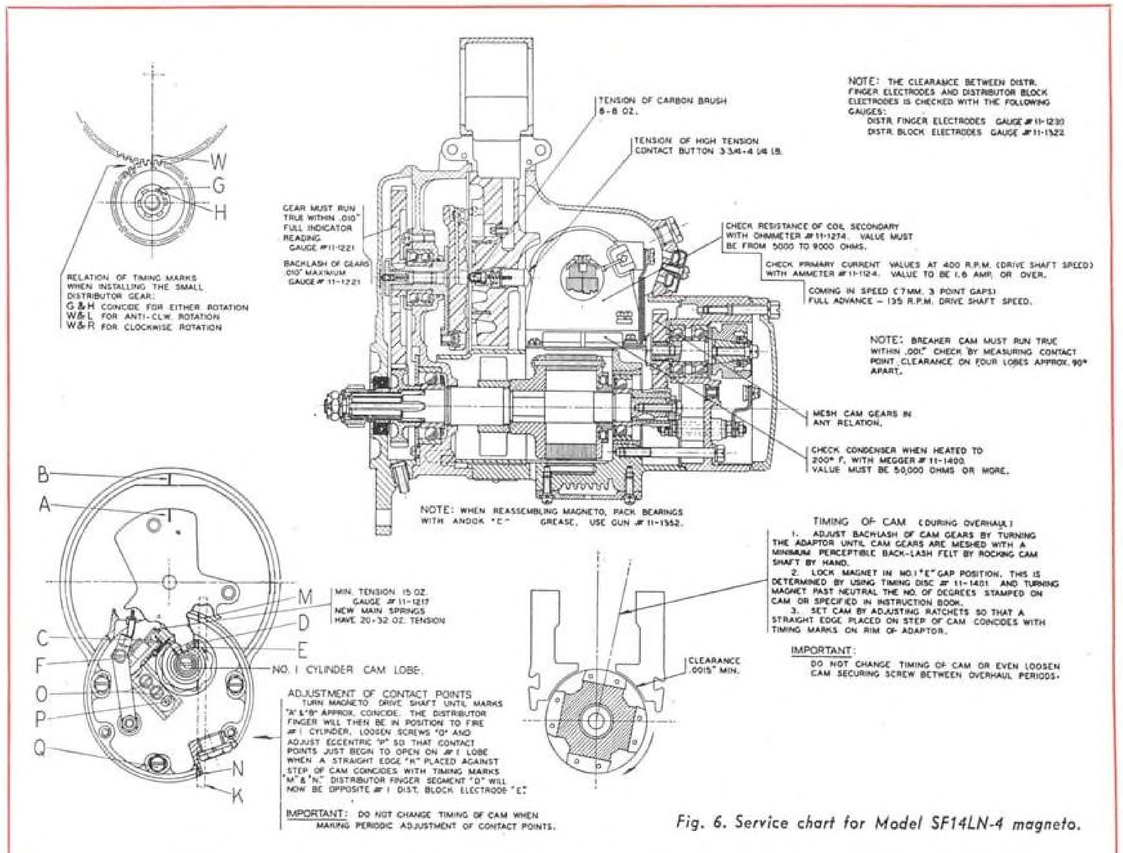


Fig. 6. Service chart for Model SF14LN-4 magneto.

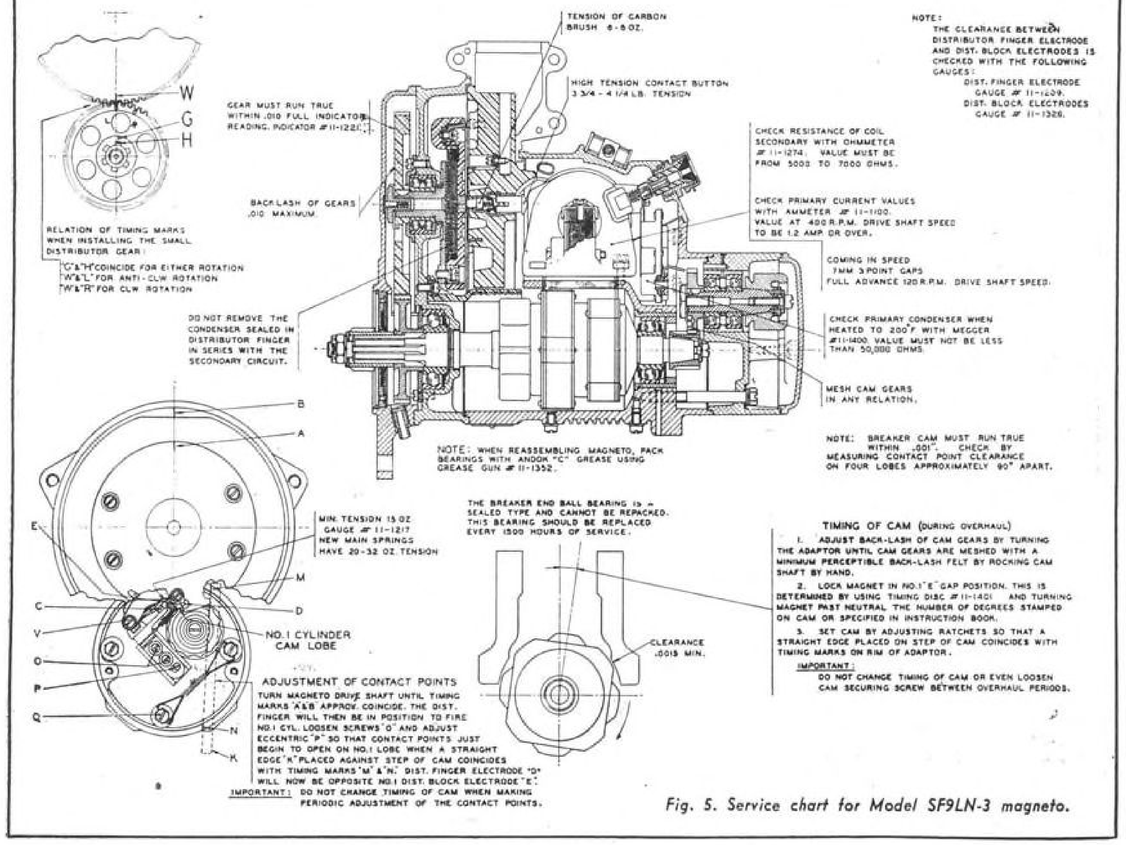


Fig. 5. Service chart for Model SF9LN-3 magneto.

replace clip. This will deposit sufficient oil on surface of cam to provide lubrication. Never push plunger when magneto is being operated, because too much oil will collect on the cam.

Breaker Contacts

At routine inspection periods, check adjustment of contact points. The contact points of pivetless breakers must always be adjusted to open at the proper position of cam in relation to timing marks and not for any fixed clearance between points.

To check adjustment, place a straight edge on step in cam. Turn crankshaft until this straight edge coincides with timing marks on breaker adaptor. At this position contact points should just begin to open on the No. 1 lobe of the cam. A permissible service tolerance (see service charts) is allowed; that is, the distance between the straight edge and the timing mark (M) located on the housing must not exceed that amount when the contact points open. If it is more, adjustment is necessary.

Should inspection show that adjustment is necessary, loosen the two screws (O) which fasten movable contact support to breaker plate. Adjust movable contact point by means of eccentric screw (P) so

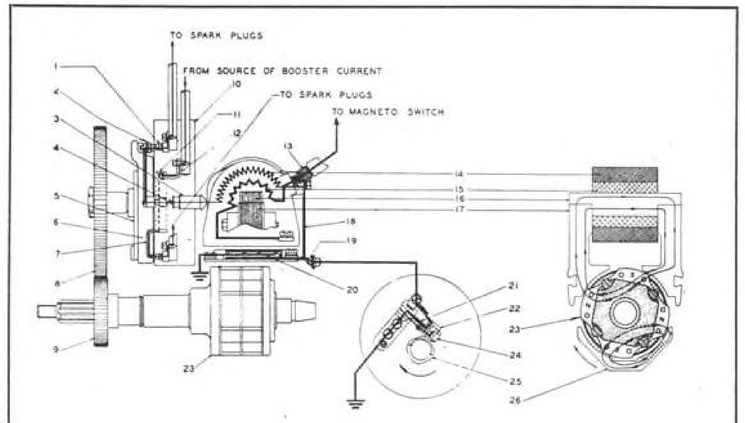


Fig. 7. Electrical diagram for Model SF9LN-2 details high and low tension circuits.

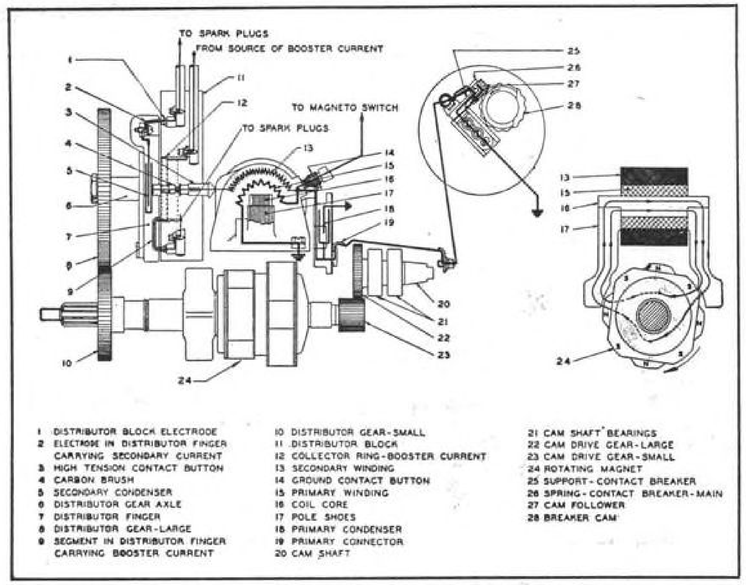


Fig. 8. Electrical diagram for Model SF14LN-3, which differs from other two models in that it has high tension condenser (5) in distributor finger.

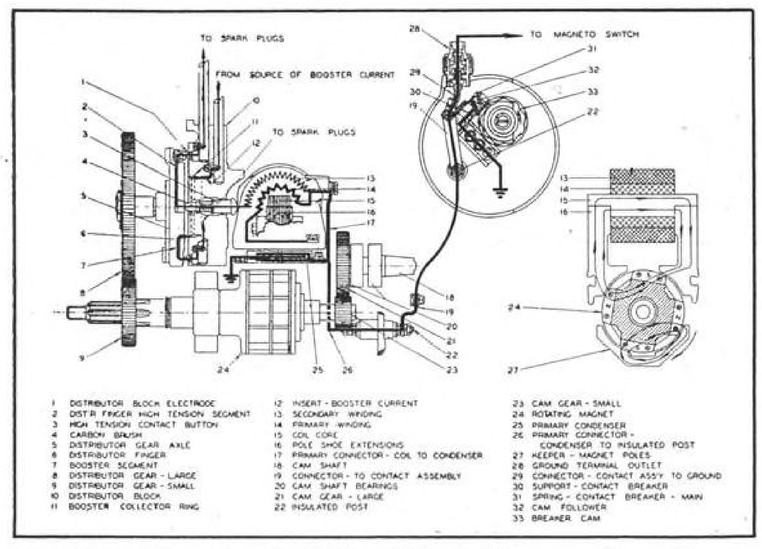


Fig. 9. Electrical diagram for Model SF9LN-4, which has nine-lobe cam gear-driven at ½ engine speed instead of four-lobe cam at 1⅛ times engine speed, as in 9-cyl. SF9LN-2 model.

that points just begin to open when straight edge (K) coincides with timing marks (M). Tighten screws (O) when setting has been made, then recheck adjustment.

When inspecting points for any reason, do not raise breaker main spring beyond a point giving $\frac{1}{16}$ in. clearance between points. Any further tension on the main spring will weaken it, causing unsatisfactory magneto performance.

If contact points are pitted or burned, do not use a common file. Points must be removed and placed in a suitable block, after which they can be smoothed and polished by a special file and stone.

Disassembly and Inspection

Disengage coil cover strap fastening screw, after removing safety pin, and take off cover. Remove ground wire terminal screw after unfastening lock ring and removing slotted nut.

Remove screws which secure radio shield to front end plate and take assembly from magneto by applying pressure toward the coil on top and bottom of assembly and then lifting upward. Loosen the screws near base of radio shields which secure distributor block. Remove screws which hold shield halves together and disengage halves.

Clean electrode surfaces in distributor block with fine emery cloth. If electrodes are worn too badly, replace with new ones. Socket wrench is used for the electrodes. Tap is used for cleaning tapped holes for electrodes in distributor block. Another tap is used for holes for the cable piercing screws. Place distributor block in radio shield assembly and check the height of each electrode with the gage. It may be found necessary to remove some material from new electrodes if installed. If so, place the distributor block so that it is held securely when machining electrodes.

Examine cable holes and remove any foreign particles. Examine distributor block to make sure it is not cracked.

Press the contact button until the tip is $\frac{1}{16}$ in. from face of distributor block. Pressure at this point should be from 3¾ to 4¼ lb. Compress brush to observe effectiveness of its spring. Brush and contact button must always move freely. Make sure that either one will come back to its original position under its own spring tension when pressed. Carbon brushes which stick or are broken may cause serious damage, because this would leave a gap in the secondary circuit. If the high tension current is allowed to jump continuously at this point, the dielectric material may burn away.

If it is found necessary to remove the contact button and carbon brush assembly, do so by placing a screwdriver under head of contact button. Pad that part of screwdriver in contact with distributor

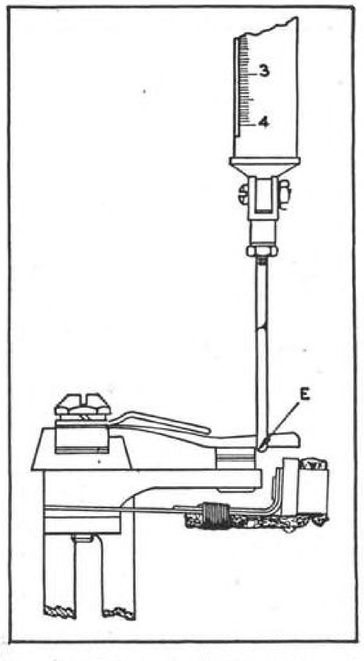


Fig. 10. Method of checking tension of breaker main spring. Gap E should not exceed 1/16 in. or spring will be permanently weakened.

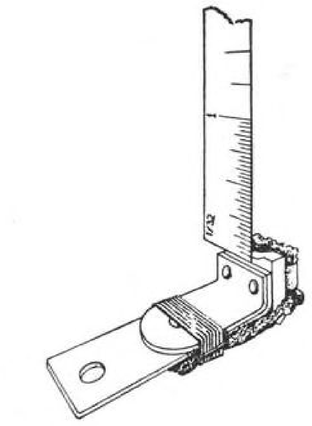


Fig. 11. Cam follower wear should be checked periodically with scale.

block. By applying a slight pressure on screwdriver, contact button can easily be removed. Carbon brush, spring, and sleeve can then be taken out.

Contact Breaker, Cam, and Adaptor Assembly

Remove breaker cover after taking out fastening screws. Take out screw which fastens primary connector to contact point assembly. Then remove the contact point assembly, after taking out securing screws, and lift out eccentric screw.

Check the main spring tension with gage (Fig. 10). When making this check, be sure that the hook of the gage is applied under the main spring adjacent to the contact point (E). If the tension of a main spring that has been operated is 15 oz. or more, it is satisfactory for further service. If it is necessary to install a new main spring its tension should be from 20 to 32 oz. Shims are used primarily to line up points squarely to obtain maximum contact surface between points. Main spring tension is decreased by the addition of shims; it is increased by their removal.

Examine contact points. If the wear seems to be excessive or if the surfaces are rough or pitted, the contact points should be cleaned and polished.

Normal operation causes a certain amount of wear on the top of the cam follower (Fig. 11). This wear is indicated by a small depression in top of cam follower where it lifts end of the main spring. The distance between the lowest point of this depression and the top of the spring on which the cam follower is riveted should be checked at each overhaul. This distance should be 1/32 in. or over. If it is less than 1/32 in., a new cam follower should be installed. The contact assembly screw (Fig. 12) must be tightened to a torque value of 15 to 20 in.-lb. as measured with the tension wrench.

Take out the cam fastening screw, washer, bushing, and two adjusting ratchets. Pull cam with puller. Remove

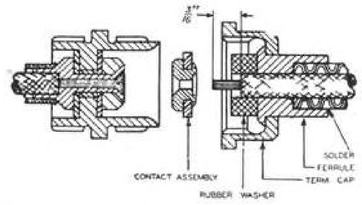


Fig. 12. Contact assembly screw, shown here, should be tightened with torque of 15 to 20 in.-lb.

screws which secure adaptor to housing and lift off adaptor assembly. Bend back ear lock washer on large cam gear securing screw and take out screw. When removing the screw, hold cam shaft with wrench. Push out cam shaft. If shaft sticks, it may be tapped out with a small brass drift applied on gear end. Full bearing nearest gear with puller. Take out spacer and tap out remaining bearing with drift.

Examine cam gears for excessive wear. Clean ball bearings and inspect for roughness or looseness. If satisfactory, repack with Andok "C" grease. Avoid excess grease.

Observe adaptor casting to see if it incorporates holes for ventilation of space between cam shaft bearings. Magnetos not having these holes should be modified to incorporate them in accordance with Scintilla service bulletin No. 89. If magneto incorporates ventilation holes, make sure they are open by blowing out with compressed air.

Coil

Remove screws and clamps which secure coil to pole shoe extensions, also the screws which secure coil to magneto housing. Take out screw which secures condenser connector to coil and lift coil from the magneto housing.

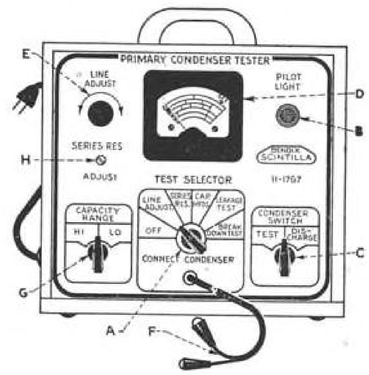
Next remove screws which secure condenser to magneto housing and take out condenser, bushings, and primary connector. Examine rubber housing of coil for cracks and make sure all inserts and screws are tight.

Inspect distributor finger and insulating plate for cracks. (In Model SF-4-LN-3 do not remove secondary condenser sealed in the distributor finger. However, make sure the condenser cover securing screws are tight). Clean the high tension segment on the distributor finger and remove the pits. If the high tension segment is burned or worn excessively, replace it with a new one.

Replace oil seal washer riveted in oil seal assembly if it is worn badly or deformed. Examine all gears for burrs or excessive wear. Clean and repack ball bearings with Andok "C" grease, using grease gun.

Magneto Housing and Rotating Magnet

Take out rotating magnet from housing, using puller. Remove small cam gear securing screw, taking out gear with puller. Remove breaker and ball bearing with puller. It is recommended that



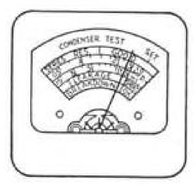


Fig. 13. Condenser tester, with enlarged view of meter dial.

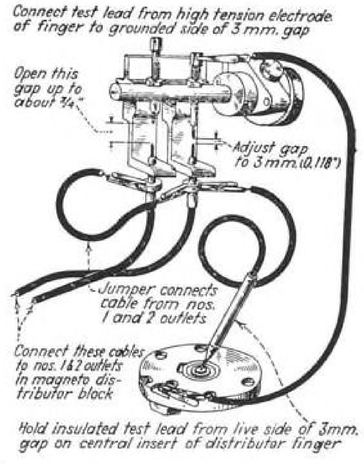


Fig. 14. Method of rigging and using test bench for high tension condenser.

this bearing be automatically replaced every 1,500 hr. of operation, or whenever inspection "by feel" discloses that it is rough, loose, or otherwise unsatisfactory.

Reassembly

Replace felt washer in front end plate back of distributor gear axle bearing and saturate with SAE 60 oil. Press drive shaft and distributor gear bearings into front end plate, using an arbor press. Secure these bearings with retainers.

Push distributor gear axle through bearing and engage with large distributor gear. Grasp gear with one hand and axle with the other. By simultaneous pushing and turning, axle can be inserted through hub. Index keyway of gear with keyway on axle. Using a light hammer,

(*Turn to page* 291)

Hot Doping Spreads Overhauls

By **RALPH HALL**, *Foreman, Paint Shop, and*
THOMAS PERRY, *Fabric Shop, American Export Airlines*

New materials and new methods in doping aircraft fabric not only save time in application but also add to durability—thus keep planes flying longer.

THOUGH HOT DOPING is among the newer methods for surface finishing aircraft fabric, sufficient progress has been made to enable the operator to know definitely beforehand just how thick the coat will be and the kind of surface which will result.

Savings in man-hours through the hot-doping process result from two main advantages over the older cold-dope method. First is the ability to apply hot dope when the atmosphere is humid, a condition which would cause blushing and the cessation of cold doping.

Second is the fact that seven coats of hot dope equal the finish obtained with nine coats of cold dope, or, if time is of the utmost importance, three or four coats may be applied to form a durable surface which will stand much hard wear before requiring reconditioning.

The above advantages, translated into terms of maintenance, mean that the doping crew can work under almost any weather conditions, day or night, and the fabric surfaces may be placed in service in very much shorter time than has heretofore been considered possible for the job.

Regarded as profit factors, the properties mentioned in the last paragraph definitely keep aircraft in service longer with shorter overhaul time and longer periods between overhauls. Extended life of materials means less replacement costs and smaller labor charges against fabric-covered portions of the airplane.

An example of the time saved: At American Export Airlines a rudder was completely doped and ready for installation in slightly less than 15 hr. This job, done by only two men, is an excellent illustration of what can be done when time is short. In addition, experience has shown that hot dope extends the life of fabric at least 50 percent.

When applying the primer coat with the old style cold dope, much time was wasted in hand brushing the dope into the surface of the material. Hot dope may be sprayed in much less time and the resulting surface is better impregnated than by the hand method. If this time saving is taken into account with the additional saving due to less frequent redoping, the added revenue from the extra service time of the airplane will be found to have more than paid for the entire hot-doping process.

Naturally, any process must have some disadvantages. In the case of hot-doping there are two—one temporary and the other more or less difficult to overcome. The temporary trouble is lack of trained and experienced personnel. Hot doping is not a difficult operation but it does require that the untrained operator work under the supervision of a man who has had previous experience. This situation will, of course, be solved as more personnel learn the work.

The other more serious disadvantage is inherent. Considerable time is lost when changing fluid in the hot-doping machine, and the only remedy at present found practical is to have two machines, so that one may be used while the other is being cleaned. This is not really a remedy but merely a way of overcoming the difficulty which still remains if a second machine is not available whenever needed.



Internal mix gun used in spraying hot dope onto fabric control surfaces.

From time to time the question has arisen regarding the effect of hot dope on frame structures due to tautening in drying. Actually, hot dope has somewhat less pull than cold dope. The reason for the incorrect notion that it would pull more than the cold variety is because hot dope tends to spray much more heavily, and so the operator, used to cold dope, will find that he has laid on an extremely heavy coat instead of the normal one. When this coat dries it naturally exerts an enormous pull on the frame, with the result that warping occurs. With an experienced operator this warping is not found in any frame capable of standing normal fabric shrinkage.

It is well to point out here that the reason for using this new dope in a hot condition is that its viscosity has to be reduced to a point where it will spray easily and form a thin coat. Dope at 100 deg. F. at the nozzle will lose much of this heat when sprayed, resulting in a higher viscosity when it strikes the fabric. This fact must be borne in mind constantly by the operator if he wishes to obtain satisfactory tautness in the finished surface. Before ribstitching, fabric may be sponged to tauten it if the operation appears necessary.

Prior to doping, the fabric should be inspected for tautness and pulled so that it does not sag between the ribs. If an additional finishing tape is added beneath the fabric under the reinforcing tape, it should be laid down with hot dope primer. In case metal strips are used as fabric retainers, the operator should wet the fabric surface with hot primer before attaching the strip. And he should take care that only the surface which will be beneath the metal is then wetted with primer.

When the entire fabric surface has been tightened and is ready for doping, it should be cleaned off with a whiskbroom and spots removed with carbon tetrachloride. Surface to be doped should be stood in approximately a vertical position.

First application is a lap coat, which should be sprayed on as thickly as possible without causing sags or runs. Lighting for this work should be from both ends of the surface at an acute angle, so that the nap of the fabric can easily be seen. This method of lighting permits a much heavier coat to be evenly applied than if the lighting were at any other angle. It is a good plan to watch the surface being sprayed, rather than the cone of dope coming from the gun.

Method for spraying hot dope is the reverse of that used with cold types. With cold dope it has been customary to spray all corners, sharp edges, and pockets first, then finish the large flat surfaces afterwards. This was done in order to eliminate, as much as possible, the dust of overspray.

With hot dope, if corners were sprayed first, the overspray would settle on the unsprayed flat surfaces and dry. Then, when these parts were sprayed, the dried dope would absorb the solvents in the primer and prevent proper penetration of the fabric. As the quality of the primer coat depends almost entirely on the amount of penetration, the above is a point to be remembered. Even a very heavy primer coat may not have the penetration of a much lighter application, if the type of nozzle, the pressure, or the temperature are not all as they should be.

It has been found that an internal mix gun gives a spray with a sharply defined cone, thus eliminating much of the overspray.

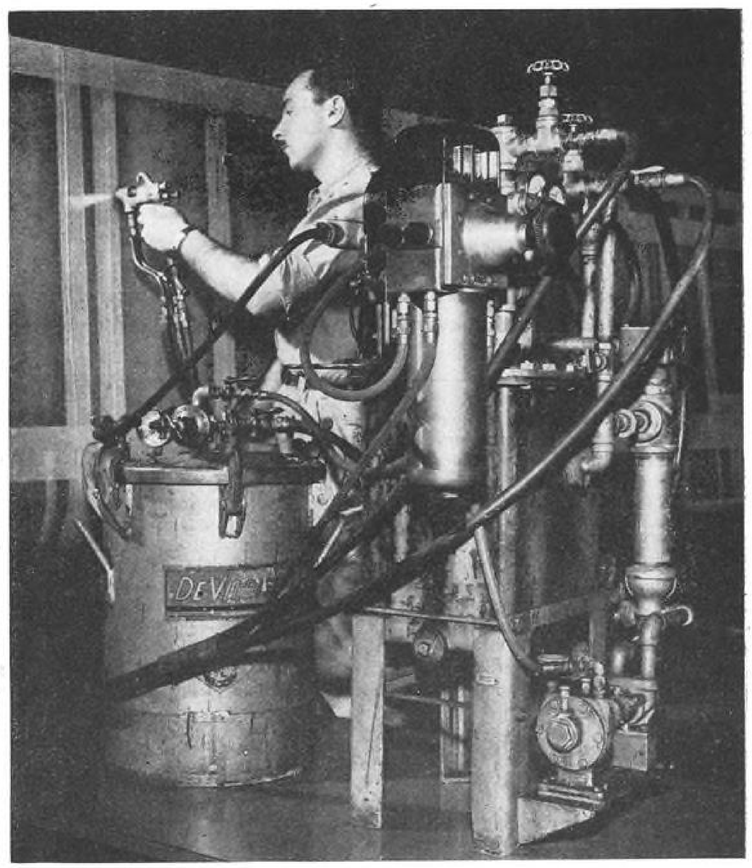
Drying will take from 1 hr. in a room having controlled heat and humidity, to 2 hr. under less advantageous conditions. The surface will be found to be very rough, due to the nap sticking up. This nap can be removed with No. 180 wet-or-dry paper, used dry. This will give a very smooth surface, but care must be taken to prevent cutting through dope or fabric at projecting points or corners. After sanding, routine is to wipe off all dust, since this will cause lumps in the next coat.

A second primer coat is now given, at right angles to the first. This is for the purpose of filling thoroughly the cut ends of the nap, which may not have been completely filled by the first coat. This second coat is not as heavy as the first because the fabric has already absorbed one coat and the excess would not be taken up but would cause runs and sags or might develop pinholes due to breathing of the fabric.

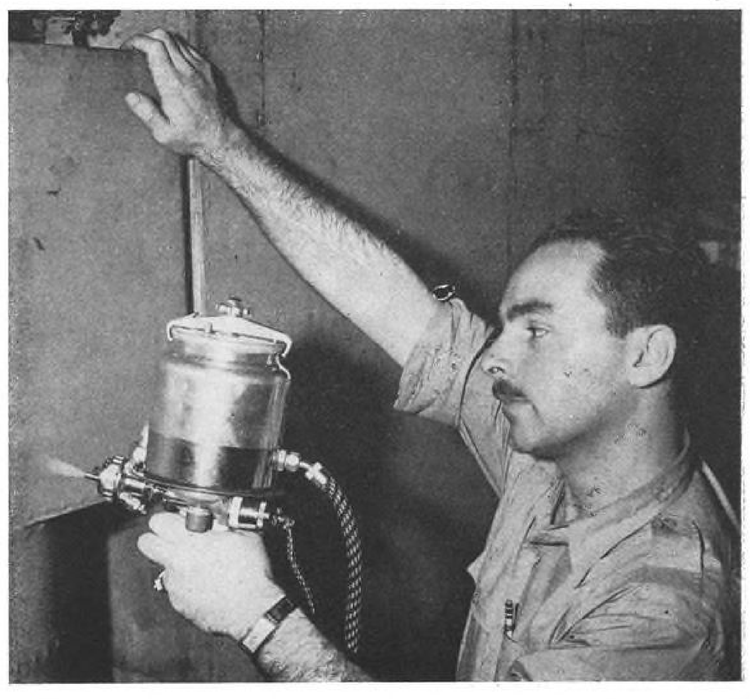
Another important reason for not laying on too heavy a second primer coat is that too thick a coating tends to work after the surface has been finished, developing cracks which eventually break out to the surface and render the repair of the whole job necessary.

Best method of applying the second coat is to spray it on just heavily enough to flow but not so heavily as to form a full body coat that would still be wet after the entire surface had been sprayed. As a test, spray a few panels and observe the results. If the newly sprayed surface is starting to dry, the spraying is satisfactory. If, however, the dope is still wet and not at all tacky, the application has been too heavy. When a newly sprayed area is quite dry to the touch and feels rough, it is a sign that it has merely been

(*Turn to page* 289)



Hot dope being applied over taped surface by DeVilbiss machine at American Export Airlines' New York base.



William Marcu, foreman of AEA's fabric and dope shop, operating Paasche gun, used where large container is not convenient.

The System for Servicing Hydraulic Unloader Valves

Here are the simple and detailed methods given by Electrol for keeping the heart of the hydraulic system pulsating throughout a long and useful life.

HYDRAULIC FLUID PRESSURE could be controlled by ordinary spring-controlled relief valves if the excess energy were not turned into heat, which would in a short time damage many parts of the system.

Owing to this condition, the unloader valve has been designed, with the two functions of maintaining accumulator pressure and also by-passing the excess fluid to the reservoir with as little loss of pressure as possible.

Electrol's unloader valve consists (Fig. 1) of a square body (1) containing three drilled and tapped main passages connected together. Fluid under pressure enters the pressure port and lifts the valve (7), normally passing out through the upper opening to the hydraulic system.

If, however, the pressure exceeds that for which the valve is set, fluid pressure will force the ball valve (29) off its seat (27) and against the opposite seat (30), allowing fluid to pass through the small diagonal port to the left hand side of the plunger (18), which then moves to the right and lifts ball valve (15) off its seat, allowing the fluid to flow freely back to the reservoir through the return port (shown in the side of the body in Fig. 2).

When pressure above valve (7) drops to a point where it can no longer hold ball (29) on its seat against the pressure of the adjustable spring (36), valve (29) is forced against its other seat by the spring (36) and pressure, which has been holding valve (15) open, is allowed to bleed to return through the upper seat (30), thus allowing spring (14) to close valve (15).

This completes one cycle of operation for the unloader valve, there usually being about one per minute during normal operation of the hydraulic system. The pressure range between cut-out and cut-in pressures is governed by the difference in areas of the two seats of valve (29) and by the pressure of the adjustable spring (36).

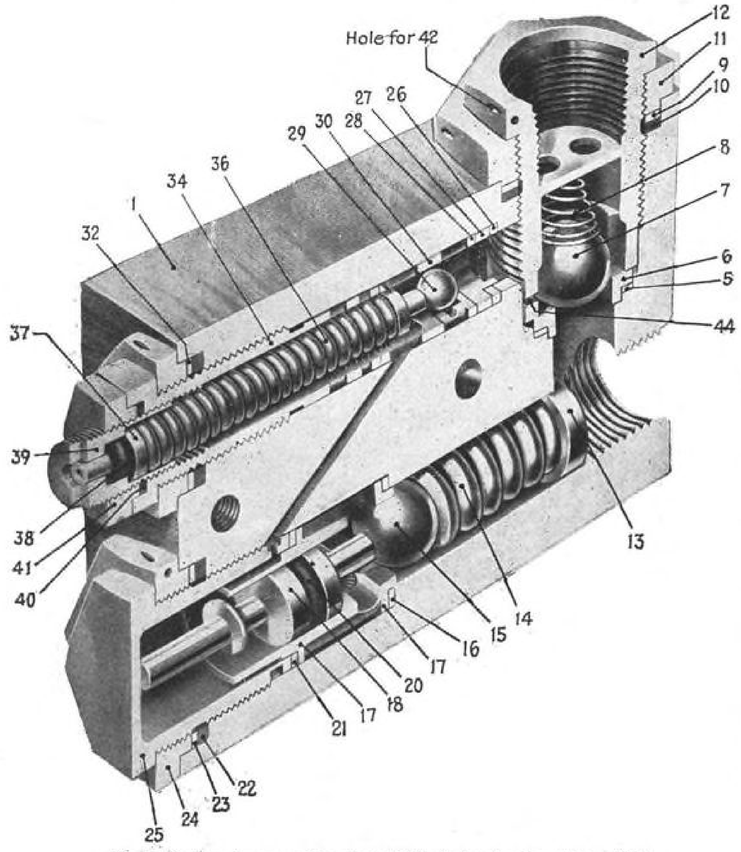


Fig. 1. Sectional perspective view of Electrol unloader valve. (All parts are identified in Fig. 2, which employs same numbers.)

Inspection

Daily: Inspect fluid for sludge or water. If any signs of these are detected, drain the system and flush it out with clean oil, using either a portable power pump or the engine-driven unit. While pumping, operate all controls and valves frequently enough to make sure that they all work perfectly. Clean all strainers thoroughly and replace packing seals and gaskets.

In this and all other work on hydraulic systems, remember that working parts must operate perfectly and without leakage under pressures up to ¾ ton per sq. in. which is always "looking for" a scratched or rough surface along which it may leak. *Using old gaskets or packing is not economy—it is asking for trouble.*

Every 25 hr.: Inspect tubing and joints for leakage, and check all nuts for tightness, marking each off on a list to make sure none have been missed. Though hydraulic systems are extremely strong and well designed, they have the same liability that all machinery has when worked to the limit—nothing can be left to luck, and "next time" is usually too late for work which should be done now.

Maintenance

When removing parts, cover all openings to exclude dirt. Protect all disassembled equipment with *clean,* dustproof covers. Coat all parts with mineral oil conforming to specification AN-VV-0-366. Parts to be placed in storage should be protected from corrosion or risk of freezing. Oil containers should be kept closed and clean, and dirt or dust should not be permitted to accumulate on their top surfaces. Containers which have accidentally become dirty should be wiped clean before opening. Accidental dirt can disrupt the action of hydraulic systems faster than any other cause.

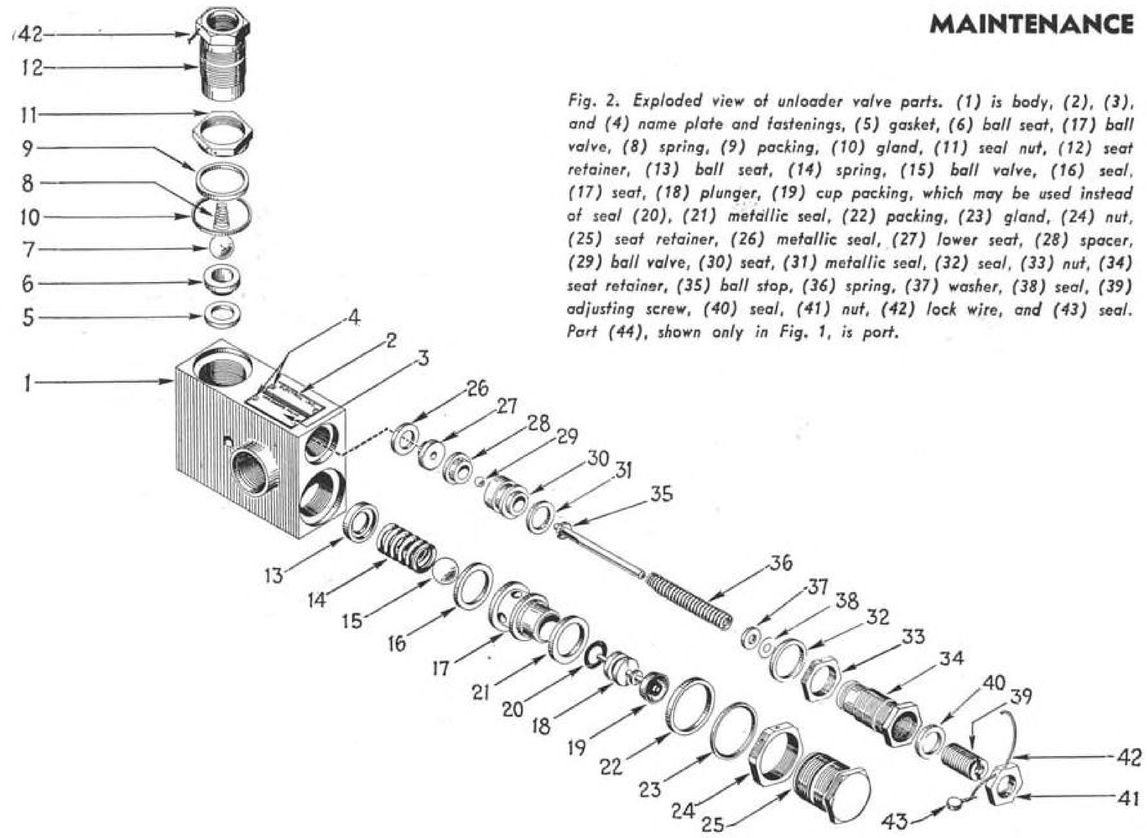


Fig. 2. Exploded view of unloader valve parts. (1) is body, (2), (3), and (4) name plate and fastenings, (5) gasket, (6) ball seat, (17) ball valve, (8) spring, (9) packing, (10) gland, (11) seal nut, (12) seat retainer, (13) ball seat, (14) spring, (15) ball valve, (16) seal, (17) seat, (18) plunger, (19) cup packing, which may be used instead of seal (20), (21) metallic seal, (22) packing, (23) gland, (24) nut, (25) seat retainer, (26) metallic seal, (27) lower seat, (28) spacer, (29) ball valve, (30) seat, (31) metallic seal, (32) seal, (33) nut, (34) seat retainer, (35) ball stop, (36) spring, (37) washer, (38) seal, (39) adjusting screw, (40) seal, (41) nut, (42) lock wire, and (43) seal. Part (44), shown only in Fig. 1, is port.

Adjust the setting of spring (36) by turning screw (39) in or out, locking it with nut (41), which should afterwards be safety-wired.

Pressure control is obtained by the above adjustment before operation of the valve. No lubrication is required.

Disassembly

Hold body in square-jawed vise between wood blocks. Then first remove hydraulic lines with an open end wrench, using another wrench on fittings to prevent strain. If not familiar with the equipment, tag each connection to facilitate reassembly later on. After tubing has been disconnected, take out screws which hold fittings to frame or brackets. Remove all seals and safety wire, and do not re-seal or safety until completely overhauled or reconditioned, for the latter operations indicate that the work on the part has been completed.

To remove spring ball check: Loosen nut (1) with 1¼-in. wrench. Unscrew seat retainer (12) with 1-in. box wrench and remove it. Take out adapted gland (10) and packing ring (9). Tip out valve, spring (8), and valve (7), then seat (6) will fall out. Remove metallic seal (5).

Differential pressure control valve is taken out by first loosening seal nut (33), with ⅞-in. wrench. With ¾-in. box wrench remove part (34). Tip out ball stop (35), with spring (36) and washer (37). Loosen nut (41) with ¾-in. wrench. Remove pressure adjusting screw (39) with special tool shown in Fig. 3. Remove nut (41) and seal (40) from pressure adjusting screw. With scriber remove ring seal (38) from inside screw. Next screw seat puller (Fig. 3) into upper seat (30) and remove from body. Take metallic seal (31) from (30). Take out ball (29) and spacer and plug assembly (28). Remove lower seat (27) with special tool (Fig. 3). Take out metallic seal (26).

Pressure valve: Loosen seal nut (24) with 1¼-in. wrench. With 1-in. box wrench, remove seat retainer (25). Take off packing (22), adapter gland (23), and nut (24) from seat retainer. Pull out and separate plunger (18) and seat (17), as noted in Fig. 4. Tip out ball (15), seat (13), and spring (14).

In disassembling the unloader valve, it is worth while to keep the parts of each separate assembly in different containers, labelled with the name of the particular group. This will save much valuable time in reassembly and may prevent mis-

Table I—Causes and Remedies of Trouble

Trouble	*Cause*	*Remedy*
Leaky packing nuts.	Loose nuts.	Tighten nuts.
	Nuts worn or damaged.	Replace with new.
	Ball stop seal damaged.	Replace with new.
Valve cuts in and out continually.	Low accumulator pressure or broken diaphragm.	Check accumulator pressure and examine diaphragm.
	Internal leaks or bypass in other units in system.	Repair leaking parts.
	Dirt under ball check.	Disassemble and clean.
Valve does not unload with 250 psi. pressure above normal.	End of pressure-adjusting screw damaged.	Smooth stem, and use proper tool in future.
	Dirt in bleed hole.	Disassemble and clean.
	Damaged unloading plunger seal.	Replace seal.
	Worn selector valve seats.	Lap seats or renew.
	Dirt in check seat.	Disassemble and clean.
Chatter or line hammer.	Air in pump or system.	Bleed pump suction. Check for air leaks. Work all parts continuously to remove air.
	Broken accumulator diaphragm.	Examine accumulator and check air pressure.

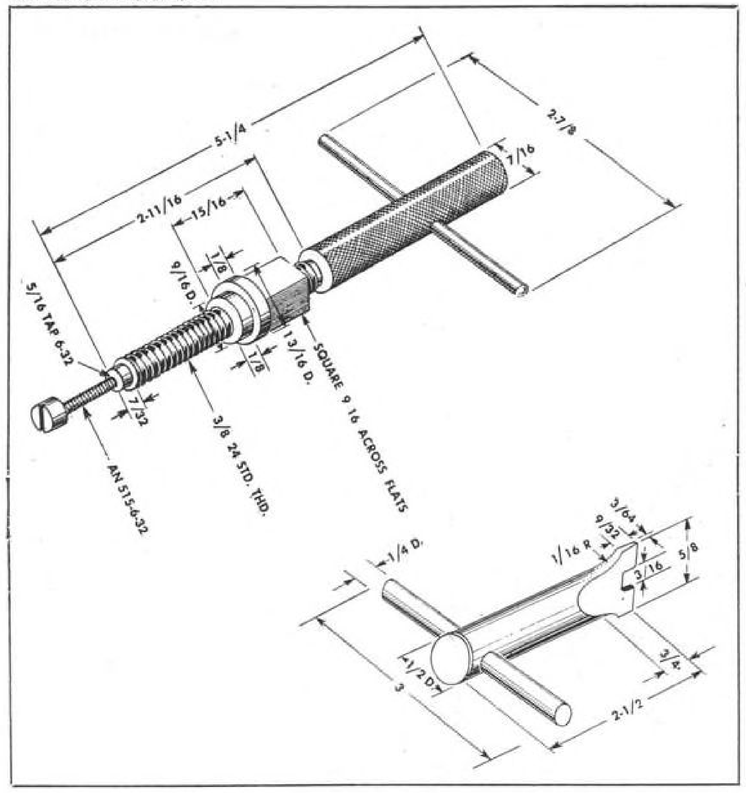


Fig. 3. Special tools required for disassembling unloader valve.

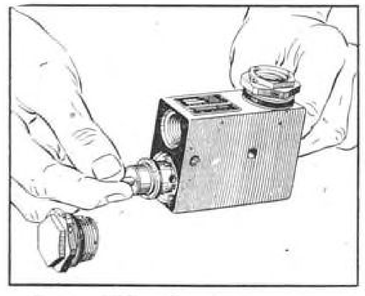


Fig. 4. Method of removing pressure valve plunger and seat.

placing of similar parts during the process.

Parts should be cleaned with the same hydraulic fluid used in the system.

After drying, all worn or damaged parts should be replaced with new ones. Replacements are not required between major overhauls unless necessary because of accident or neglect in assembly or use. Seals and packing No. (9), (19), (22), and (38) are replaced by removing the parts which hold them in place (Fig. 1) and reassembling in reverse order.

Reassembly

Steel ball check: Renew gasket (5), install ball seat (6) with ball (7) and spring (8). Assemble seal nut (11), gland (10), and packing (9) on seat retainer (12). Place in position in body with small end of spring fitting over post in seat retainer. Tighten seat retainer with 1-in. box wrench and seal nut (11) with 1¼-in. wrench. Safety wire in place.

Pressure valve: Replace seat (13), spring (14), and valve (15) in that order. Fit seal (16) on seat (17) and insert in body. Insert metallic seal (21) and plunger (18) fitted *either* with packing ring (20) or "U" cup packing (19)—*but never with both.* To insert, first dip in hydraulic fluid and turn slightly while pressing into the bore. Assemble nut (24), gland (23), and new packing (22) on seat retainer (25). Place in bore and tighten with 1-in. box wrench, afterwards using 1¼-in. wrench to tighten nut (24), which is then safetied.

Differential pressure control valve: Install metallic seal (26) in body, follow with lower seat (27), spacer and plug assembly (28), valve (29), and seat (30), fitted with metallic seal (31), in that order. Next screw nut (33) onto part (34), following with Toriod seal (32). Tighten into body, using ¾-in. box wrench for (34) and ⅝-in. wrench for the nut. Renew packing (38) inside adjusting screw. Insert ball stop (35), spring (36), and washer (37) inside (34), in that order. Then turn adjusting screw into (34), place lock nut (41) on screw, tighten with ¾-in. wrench, test, and safety-wire securely.

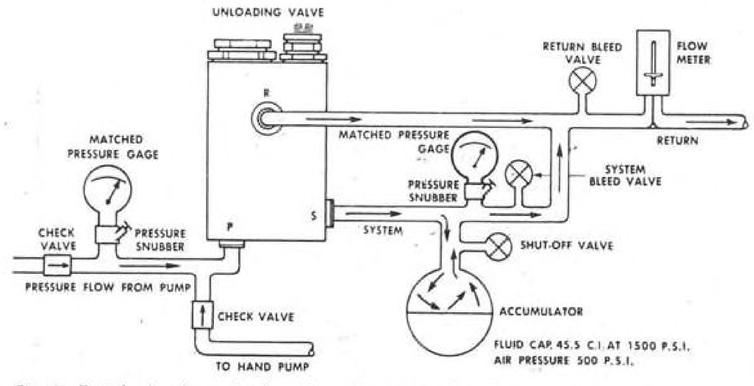


Fig. 5. Test hookup for unloader valve after overhaul or replacement of parts.

Testing

Only standard fluid of the same specification as that in the hydraulic installation should be used for testing. The setup should be as shown in Fig. 5. Temperature range should be between 90 deg. F. and 110 deg. F. Pump should deliver 5 gpm. at unloading pressure. Return bleed valve should be set to permit valve to complete 3 to 5 cycles per minute.

To test tightness of valve seat (30) and check valve seat (9), shut off system bleed valve, stop pump, and shut off accumulator. Pressure should be retained so that loading does not take place for 2 min.

After testing, leave fluid in valve to prevent seals from drying. Install shipping plugs in openings, wrap in waxed paper, and box securely.

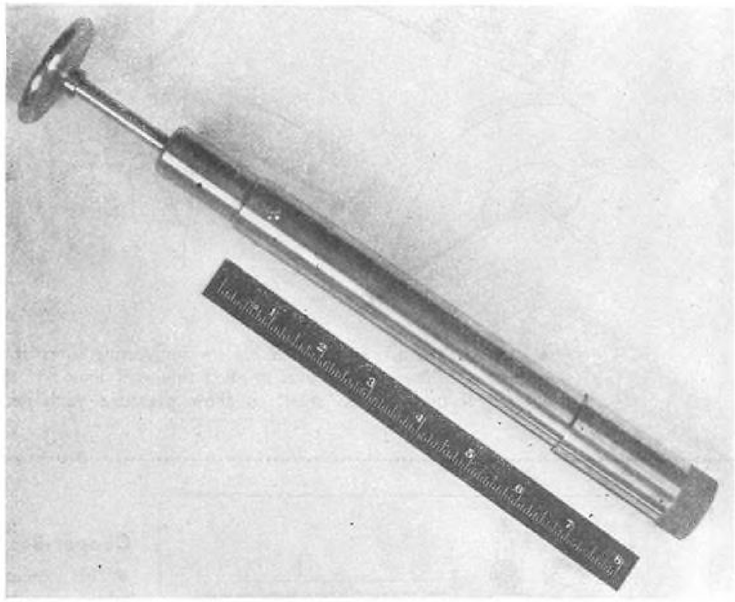
Table II—Test pressures for Electrol Unloader Valves

Type	*Operating pressures in psi.*	*Unloading pressure in psi.*
204T.....	800 ± 50	1,000 ± 50
204.....	800 ± 50	1,000 ± 50
206.....	1,250 ± 50	1,500 ± 50
220.....	1,250 ± 50	1,500 ± 50
235.....	1,000 ± 50	1,200 ± 50
253.....	900 ± 50	1,100 ± 50

Capacity per min., 5 U. S. or 4.15 Imp. gal.; line size, 1/2 in. Threads, fittings; pressure line, 3/4 — 16 AN; ports in equipment, 3/4 — 16 AN; return line 3/4 — 16 AN.

THIS FABRIC TESTER TAKES OUT THE GUESSWORK

For years, rule-of-press-with-your-thumb has been the practice in testing the strength of doped fabric—but now the CAA has a simple pocket gager which substitutes scientific forces for the old faulty "feels."



Dope-fabric tester developed by CAA for field testing of old material.

IMPORTANCE OF FABRIC CONDITION has long been recognized by the CAA, but a simple and foolproof method for testing strength had been lacking. Sought was a handy and accurate means to replace the generally unsatisfactory practice of pushing a thumb against the fabric to determine by feel and previous experience whether it was strong enough.

Since many airplanes are fabric-covered and most metal planes have fabric-covered control surfaces, regular tests are considered essential for safe operation.

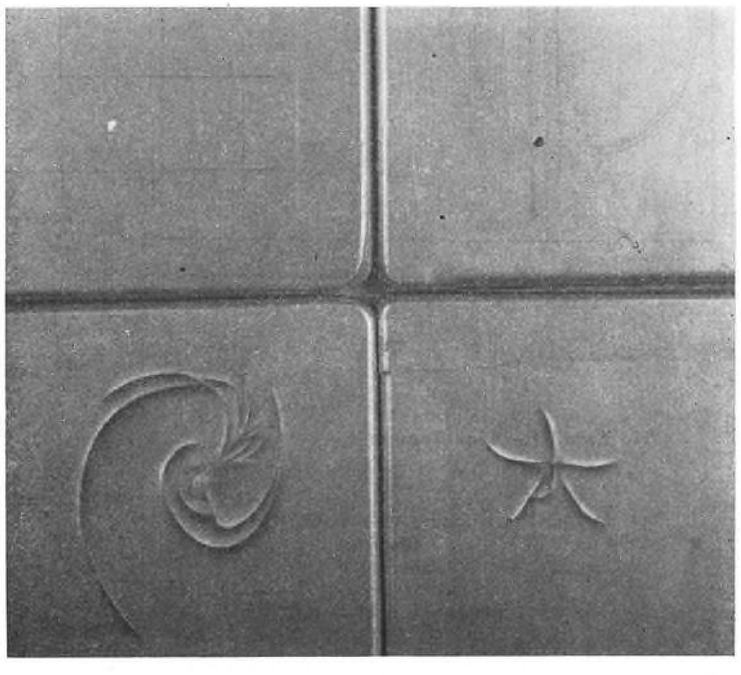
Developed by the Civil Aeronautics Administration, the new mechanical tester illustrated here operates similarly to a spring-center punch. When its disk-shaped pad is placed against the fabric and the handle is pressed down a center plunger is driven through pad against the fabric with a known force. The effect determines whether the fabric is dangerously rotten or if the dope has become brittle.

The tester can be used on fabric anywhere about a plane to check conditions locally, eliminating the necessity of cutting out pieces of fabric for testing.

In developing the device, CAA's Technical Development Division staged tests on airplane fabric in cold chambers in temperature of –40 deg. F. and in heated chambers at 160 deg. F. The National Bureau of Standards cooperated in the tests.

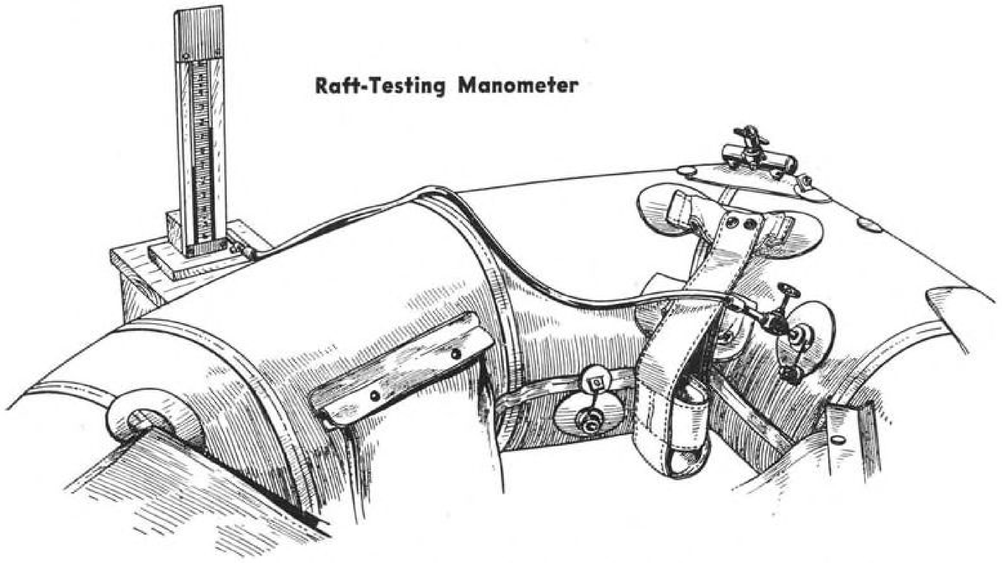
The internal spring of the new device is adjustable to various grades of fabric. The plunger makes a slight dimple in the finish of fresh, live fabric, and the mark soon disappears. Rotten fabric, even though it may be stretched taut by a fresh coat of dope, gives way before the plunger, which either makes a clean hole or produces permanent cracks in the finish around the point of contact. Aged brittle dope always cracks.

The initial instruments produced are being put in the hands of inspectors for a thorough field service test.

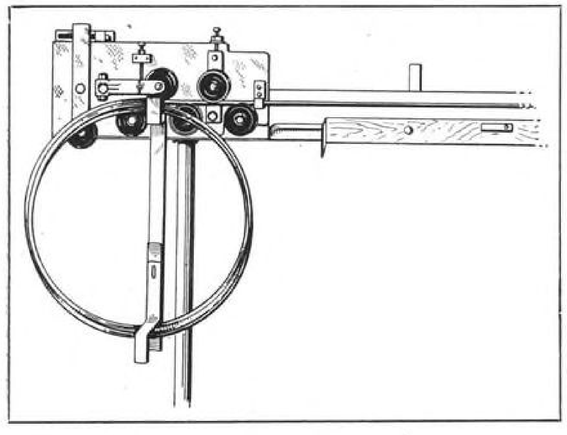


Results of using tester on old but seemingly sound fabric. Top panels show holes pierced through rotten fabric, while lower panels illustrate cracks due to brittle dope.

Raft-Testing Manometer



• Pan American uses this manometer for testing aircraft life rafts carried on overseas flights. Liquid level in glass tube will demonstrate slightest leak, even though it may be too small to show pressure variation on ordinary gage.

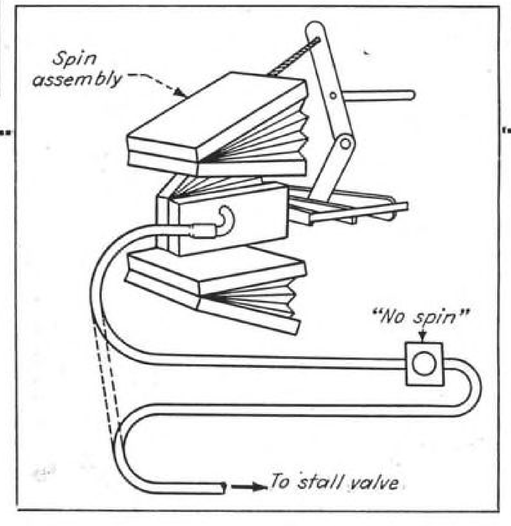


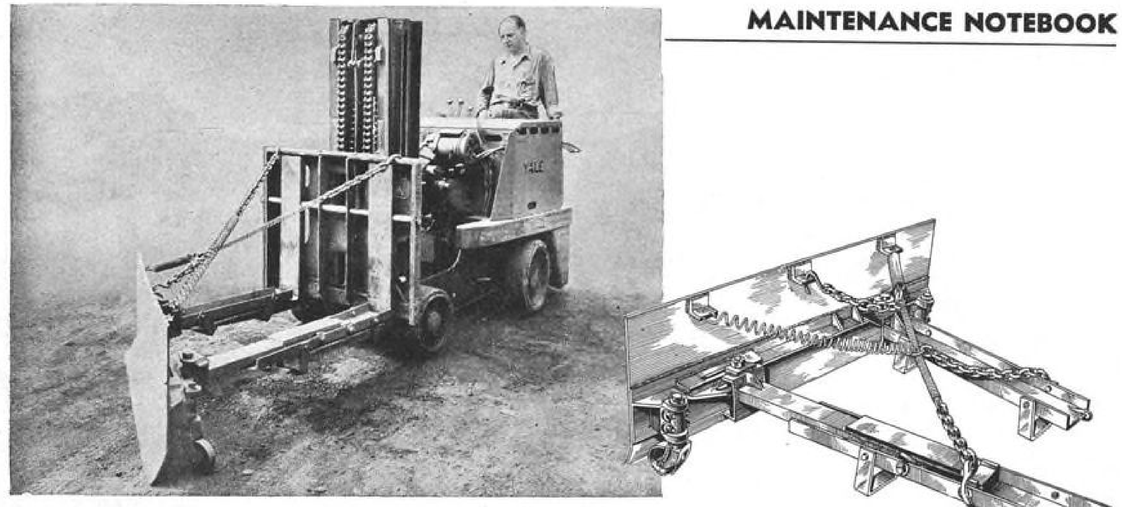
Cooper-Bessemer Tubing Straightener

• This machine for taking bends out of coiled tubing was made entirely from scrap. Constructed by Howard Kinsely and Frank Babcock of Cooper-Bessemer, the device consists of several rollers through which the tubing is pulled, following which it rests on a long table to prevent bending. Lower rollers are permanently aligned with guides, but upper ones are adjustable by screws, to permit insertion of various sizes of tubing.

"No Spin" for Link Trainer

• G. L. Cooper and M. K. Lyster of Southwest Airways, Falcon Field, Ariz., installed this device in the tube leading to the spin-trip assembly on the company's Link Trainers. By collapsing the vacuum in this tube when unlocking the trainer and until 75–80 mph. airspeed is reached, confusing initial spin is eliminated and trainer is stablized at starting.





Snowplow Made From Salvaged Material

This home-made plow attachment for truck or tractor, serves adequately to remove snow at Westinghouse. Idea was that of Tom Turner of company's meter division, and details were worked out by Ernest Hauck, works engineer.

Constructed of channel iron and boiler plate, plow has two heavy duty truck casters to serve as lead wheels and keep blade edge at proper clearance height. Expansion springs, located at yoke bolts, permit plow blade to maintain proper height regardless of pavement irregularities.

Operated by an electric truck, this plow is easily attached or removed in five minutes. All that is required is fastening of truck forks into strap iron loops, then connection of cross spring chains to upper elevating portion of truck.

Traction is provided for truck by using a set of conventional tire chains cut down to fit smaller wheels.

Converted-Ford Plane "Tuggers" Save Fuel and Taxiing Time

By using converted Model "A" Fords to tow planes around the ramp instead of taxiing them, Hawthorne School of Aeronautics, operator of AAF Primary School at Orangeburg, S. C., has been able to save 4,000 gal. of gasoline monthly and also eliminate hazards of taxiing accidents. Designer of tugs is F. M. Cullers of Dorr Field, Fla.

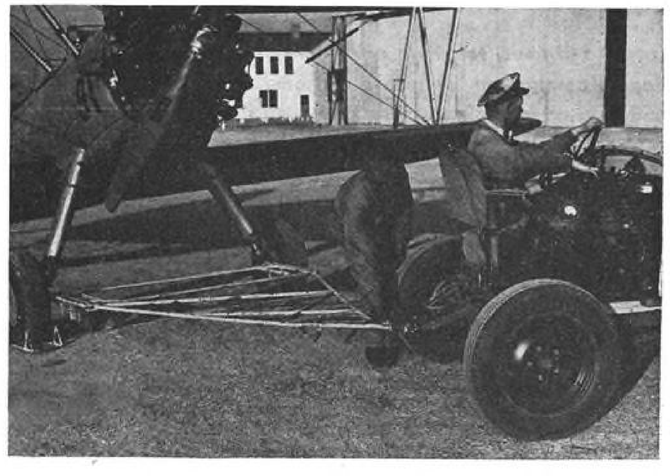
Initial tug was made from a converted 1929 Model "A" Ford truck. To enable a minimum turning radius, wheel-base was shortened to 6 ft. by cutting about 30 in. from frame and 32 in. out of middle of drive shaft. Body was removed entirely and one seat for driver was added to frame.

Additional utility is achieved by installation of a regulation AAF gas-driven generator on right side of driver to provide power to an electric energizer for inertia starters on PT-17 training planes. This power-driven energizer which is considerably faster than manpower, is needed for use in cold weather when starter sometimes must be employed several times before engine starts.

Towing mechanism is a triangular shaped truss 9 ft. long and of welded ¾-in. black iron pipe. End of tow bar which couples onto tug is equipped with two tractor springs to absorb shock of sudden starts and stops, eliminating jerks. Couplings at other end of tow bar are attached to tow rings mounted as standard equipment on axles of Boeing PT-17 trainer. All three couplings are firmly secured by safety pins slipped into place after tow is secured. Since width of PT-17 landing gears varies slightly in different models, landing gear couplings on bar are self-adjusting.

When not attached to an airplane, tow bar trails behind tug on two small wheels made from rejected PT tires and tubes.

Almost as important as saving in gasoline is saving of time in moving planes around ramp.





Rugged terrain is but one of the many problems presented in developing air transport and product markets in Latin America, the author states. Good markets can be developed, with proper planning and, in many cases, with a new approach called for by new conditions.

NEW LATIN AMERICA REQUIRES NEW THINKING

By CHARLES CARROLL

Markets — whether for transport services or products — can be developed among our neighbor nations, but changing conditions demand revised planning. Here's how and why.

EVER SINCE the words "postwar planning" became a part of our everyday conversation, the aviation industry has been told time and time again—with varying slants by politicians, economists and editorialists—that the Latin American market was just the medicine it needed for its reconversion ills.

The story usually runs something like this: Total production capacity, at war's end, will be greater than ever before. The domestic market, including even peacetime military and naval requirements, simply will not be able to absorb all that the industry will then be able to manufacture. Therefore, the industry must plan to sell abroad what it cannot sell at home. Otherwise, it is argued, part of the plant will have to be closed, some of the workers let out, and many returning servicemen denied their old jobs.

That, admittedly, is sound logic. Only full employment programs can avert another depression. Full employment can be gained only by stimulating demand or expanding the market. Domestic demand, at least in the immediate postwar years, cannot be stimulated enough to warrant full employment. Thus, the industry must look to foreign trade for its prosperity in even greater measure than it did in the years before the war when its exports accounted for nearly 27 percent of total volumes, and it must, like the nation, rely on the dollars that it earns in foreign commerce to tip the scales in its favor.

Furthermore, Latin America should prove a good market when the war is over. She will then have over $3,500,000,000 in credits in the United States. She is in the throes of a great industrial revolution. A skilled-labor middle class is being born. More money is reaching more people. Her railroad, highway and shipping services are not large enough to bear the traffic that her industrialization demands. Air transportation services must expand. Planes and plane parts will be needed.

But that, unfortunately, is not the whole story, and the story as it is being told is fraught with gravest danger. For, if Latin America is to be even a partial answer to the problem of industrial reconversion, we must reconvert our ideas on foreign trade first.

In the first place, we must understand that trade means exchange and we must realize that nations, like individual men, cannot buy from one another unless they are first free to sell. Latin America cannot buy from the United States unless the United States, in turn, buys enough from her to supply the dollars necessary to pay for her purchases in this country.

Trade can only flow in a two way street. And the economic history of the late twenties and thirties should serve as sufficient proof that the United States cannot return to the "beggar-thy-neighbor" policy which raised tariff walls so high and lowered the world's dollar supply so much that we resorted to large international loans to finance our own trade. And then—wondering why our exports had fallen so severely—we wondered also why our loans were not repaid.

Therefore, the aviation industry must play a large part in the formation of that educated enlightened public opinion without which a sound and workable foreign policy will not survive.

Moreover, there must be a clear understanding of that word "foreign" in foreign trade. We must realize that success in export comes not only in recognizing that trade flows in a two way street, but that the man in the house at the end of the block lives in the same world we do and is affected by the same influences affecting us, though his politics, economics, geography, race, language, customs, habits and traditions may differ from ours.



Full development of Latin American markets for U. S. aviation services and products will require great development of airway aids, a program which means those markets cannot spring full-blown overnight. Meteorological stations are among first essentials, and are increasing rapidly due in part to U.S. program which gave South Americans a chance to study weather forecasting here. (CIAA photo)

Above all, we must rid ourselves of the idea that foreign business will fall into our lap or come in "over the transom". The truth is that it takes just as much planning, intelligence and business acumen as domestic business; in some ways a lot more.

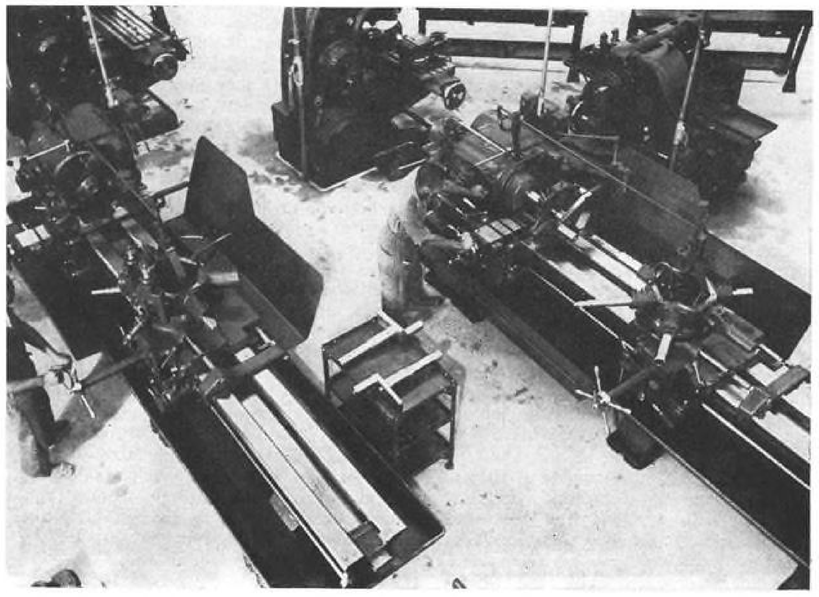
In normal times, the average businessman has to worry about the United States alone. The foreign trader, however, has to keep in touch with conditions in every country with which he trades, and in many with which he does not.

For example, the recent aviation conference in London was of deep and great significance to the aviation industry everywhere. But, to the foreign trader, it was just one more development about which he must keep himself informed—just another like the first conference of the Commissions of Inter-American Development held in New York City in May, or the International Financial and Monetary Conference held at Bretton Woods, or the recent Dumbarton Oaks conference in Washington.

For it is conferences such as these that give him a partial answer, at least, to the many questions he himself must answer before he can plan his postwar trade program. What will he have to pay for air cargo transport? How will the rate be determined? Will he be able to use American airlines exclusively in his foreign trade? If he does, will this deny to the country to which he is exporting the sale of a service upon which its income and ability to buy from him depends? What provisions are the Allied Governments making to stabilize world currencies? How will this effect his credit policy? Will the Allied peace plans of the Big Four break the world up into several large trade blocs? Or will trade continue on much the same basis as in the prewar years? And lastly—will Allied attempts at an international organization for the maintenance of a just and durable peace be sufficiently successful that the fear of war, which goads nations to self-sufficiency, may be lifted and a freer exchange of goods and services may be expected? Those are the types of questions which the exporter, regardless of the product he sells, deals with every day. And it is upon his ability to answer these questions that his success or failure, in large measure, depends.

Then, beyond these general questions

(*Turn to page* 264)



Auguring well for larger Latin American markets in the future is recent rapid increase of industrialization, such as well equipped shop shown here. Although it will take time, author says, present trend indicates birth of whole new skilled labor class—all leading to greater demand for more air transport and aviation products which can increase trade with U.S. (CIAA photo)

• *Charles Carroll, a graduate of the Institute of International Studies at Yale, and former student of international law at the University of Berlin, has traveled widely throughout both Europe and Russia. Prior to the war he made a 12,000-mile air survey of political and economic conditions in South America under the auspices of former Brazilian foreign minister Oswaldo Aranha, chairman of the 1942 Pan-American Conference which led to severance of diplomatic relations between 19 American countries and the Axis. Long a student of Latin American affairs, he has been associated with Time Magazine, the Chicago Tribune, the Brazilian Government Trade Bureau in New York, and is at present a member of the editorial department of Business Publishers International Corp.*



Three-quarter front view of new single-place Landgraf helicopter, with right rotor attached. Twin rotors are of 16 ft. dia., with 11 ft. between axes. Contra-rotating twin rotors are all-wood construction, with blades being made as separate units to fit over hollow, tapered spars.

(All photos by Erik Miller)

Landgraf Helicopter Has Unique Design Features

By WILLIAM R. NELSON, *Pacific Coast Editor, "Aviation"*

Its twin three-blade contra-rotating rotors have ailerons for altitude control; power is delivered to both rotors by unusual cable system from single gear box; and new control system eliminates foot pedals.

A NEW TYPE HELICOPTER, which the designers expect to be inherently stable, safe and easy to operate, and efficient in performance, is now undergoing tests in Los Angeles. Included among 51 claims set forth in patent applications covering it are several features which may well have profound effect on future helicopter designs.

Designed and built by the Landgraf Helicopter Co., of Los Angeles, the new craft has twin three-blade rotors which contra-rotate. The ship has no tail rotor.

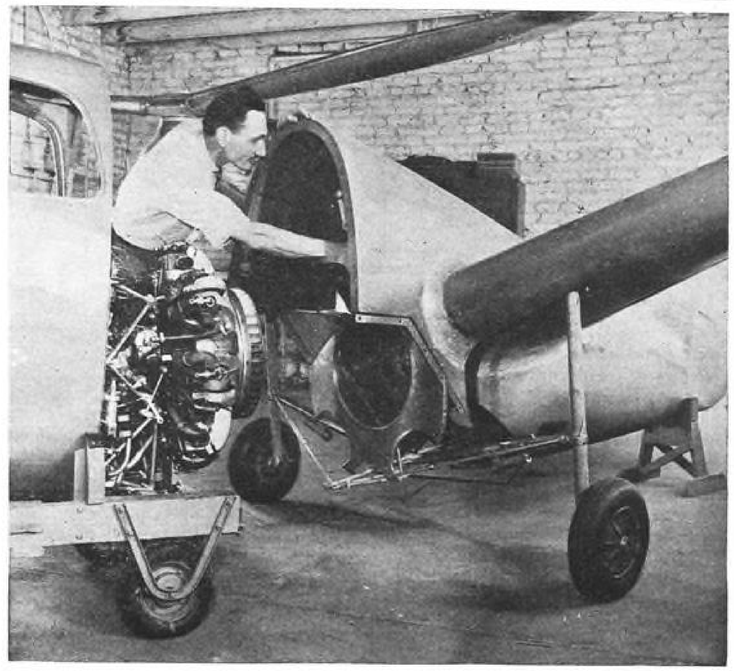
Outstanding features of the Landgraf machine include: 1. Its side-by-side rotors with non-articulating blades; 2. meshing (rather than separate) rotor disks; 3. attitude control by cycle operation of ailerons mounted near the tip of each rotor blade; 4. attainment of fore and aft stability by locating center of gravity considerably forward of the rotor axes; and 5. elimination of heavy and complicated gearing and shafting through use of a tension rod drive.

Begun more than ten years ago with a design approach almost as "radical" as some of the plane's features, the Landgraf helicopter, it is stated, was built to create, rather than meet, a customer demand. Contention: That sales of aircraft have lagged because of lack of utility rather than lack of safety or high cost.

Having isolated what he conceived to be the sales obstacles, Fred Landgraf, head of the company, next prescribed the set of "musts" an aircraft should have if it were to overcome the existing lack of interest on the part of the public. His approach was to improve the utility and convenience while retaining all of the known safety features, believing that low cost could be achieved through large volume if a highly useful aircraft could be offered.

To increase utility it was specific that the craft must be capable of landing within a short distance of the operator's *ultimate* destination. To do so it must be capable of descending and landing in small areas, even if they were surrounded by obstructions. It must take off without forward run and be capable of vertical ascent. It should then be capable of flying at very much reduced speeds in case of poor visibility. It should be maneuverable on the ground without assistance of a ground crew or other outside help, and it should be reasonably quiet.

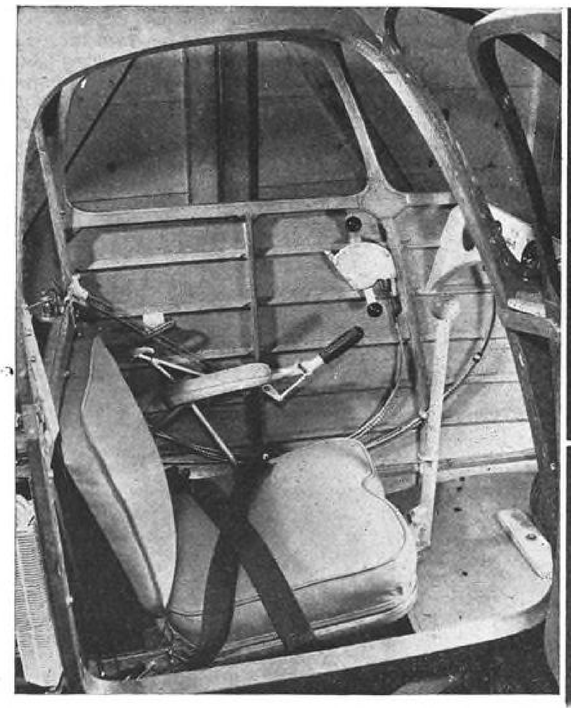
To be safe and convenient the machine must always accurately respond to the controls, at any speed, altitude, or condition of flight. Means of control, while separate and independent of each other (but synchronized and complementary in their operation) must not at any time conflict with, cross, nullify, or reverse each other in different plane attitudes. The craft's rate of descent without power should be slow enough to permit a safe vertical landing in case of engine failure. And the machine must be automatically stable about all three axes, so that it would tend to return to an even keel after any kind of disturbance.



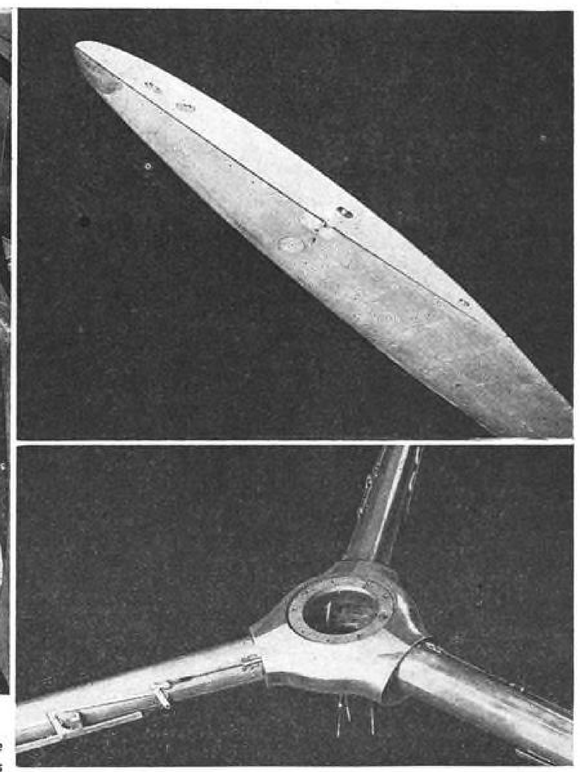
Designer Fred Landgraf makes adjustment on his radically designed helicopter. Power plant, mounted just aft of pilot's cabin, is modified 85-hp. Pobjoy with suction rather than blower fan for cooling. Full cantilever rotor booms also support main wheels of tricycle landing gear, and wheels retract into fuselage. Contra-rotating rotors eliminate need for anti-torque rotor, thus vertical stabilizer is much like that of conventional airplane, except that no rudder is employed.

Added together, Landgraf decided that his "musts" automatically eliminated all aircraft types except the helicopter. At the time the design requirements were drawn up (1934-35) no helicopter had yet been flown with any degree of success (the Focke-Wulf was not flown until 1936). Starting with known data, particularly that developed by autogiro engineers, several years of designing, building, testing, and revising of small flight models accumulated data upon which the current prototype is based.

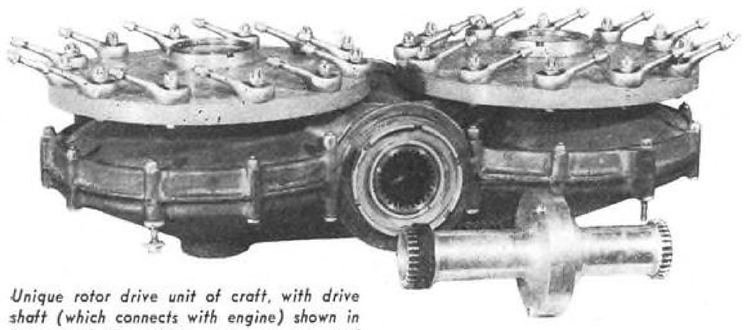
Fuselage of the Landgraf helicopter closely resembles that of standard fixed-wing designs, except that the engine com-



Close-up shows details of pilot's cabin. Pitch control lever can be seen at left of pilot's seat. Pitch of all blades in both rotors is increased as lever is raised. Handhold is of bicycle handlebar type, with additional feel and leverage provided by arm rest built as integral part of control. Throttle and spark controls are just beyond pitch control, and stick is immediately in front of seat. Landgraf control system eliminates need for foot controls, pedals being used only for wheel brakes when taxiing.



Fore, aft, and lateral control in Landgraf helicopter is achieved by spring-loaded ailerons (top) which make up about 8 percent of total blade area. Ailerons move 10 deg. each way, giving whole rotor blade pitch variation of from —12½ deg. to +12½. Lower photo shows hub, part of aileron control mechanism, and hollow, tapered rotor spars.



Unique rotor drive unit of craft, with drive shaft (which connects with engine) shown in foreground. Transmission gears are comprised of hour-glass worm gear driving two bronze worm wheels mounted on vertical splined hollow shaft extending up through top of gear box attaching to aluminum alloy driving disks (seen in position atop gear box). These are connected with driven disks at end of rotor booms by twelve carbon steel cables each.

partment is behind the pilot. It is a fully enclosed, streamlined, semi-monocoque structure of wood framing covered with $\frac{1}{16}$-in., 3-ply Oregon pine skin. It is divided just aft of the pilot's compartment by a firewall, on the rear side of which the engine mount is attached.

Rotor booms, extending out and up from the fuselage, are of full cantilever symmetrical airfoil design and are set at negative incidence that contributes to longitudinal stability because they are located aft of the C. G. They house the rotor drive and provide part of the landing gear support structure.

Among the Landgraf-conceived or Landgraf-adapted features of the new 'copter are its meshing rigid rotors with non-articulating blades contra-rotating forward over the fuselage. This type rotor made possible location of C. G. approximately 10 percent of rotor diameter ahead of the rotor axes. This forward C. G. location is called a major factor in giving the craft inherent stability. The rigid blade structure also made practical the use of a small aileron on each blade for lateral and longitudinal control.

Rigid rotor construction appears to have aerodynamic as well as structural advantages, promising lower costs of construction and probably of maintenance. Added structural weight in the spars is offset by reduced weight through elimination of blade hinges, hinge pins, dampers, stops, and extra joints and mechanism. On the test stand, operation of the rigid rotors was exceptionally smooth at all speeds.

The use of contra-rotating rotors eliminates the need for a tail rotor to offset torque. Location of the rotors less than a rotor diameter apart made it possible to design light rotor supports easily streamlined to a high degree of efficiency and yet strong enough to absorb the gyroscopic loads resulting from the use of rigid rotors.

Meshing of the rotors reduces over-all width, with a consequent reduction in structure dimensions, weights, costs, and operational space requirements. It also reduces the tip loss to a considerable degree, as air spilling from the tip of one blade decreases the inflow velocity on the succeeding blade, with a consequent increase of lift.

Rotors, having an over-all diameter of 16 ft. each, are mounted in the same plane, with an 11-ft. spacing between axes, giving the blades a 5-ft. meshing area. In flight, the disks of both rotors are permanently inclined forward 6 deg. from the horizontal axis of the fuselage. To facilitate ground handling, the rotor axes remain inclined forward when the plane is at rest on its tricycle landing gear. They are geared to turn at a constant speed of 485 rpm., instead of the 120 to 230 rpm. of most other helicopter rotors. However, their smaller diameter reduces tip speed to 400 ft. per sec., or just under the 300 mph. common in most other 'copters.

Rotor construction is of wood on the prototype. Inasmuch as airflow over the blades is in many directions, and for the most part not parallel to the ribs, every effort was made to make the blade surfaces as clean and efficient as possible.

The blade airfoil is NACA 0015, faired into an approximately oval section at the root. The 8-ft. blades, built up of Oregon pine spars and ribs, are covered with $\frac{1}{16}$-in. plywood skin. Blades are formed as separate units and fit over 6-ft. rotor spars.

These are round, hollow, tapered, and built integrally with the rotor hubs. Made of birch, they are designed to carry the bending moment at the hubs. By setting the spars at a 2 deg. coning angle, the moment due to centrifugal forces subtracts from the moment due to air loads, so that a relatively efficient structure is obtained.

Blades are attached to the spars by two long metal strips which also serve as pitch adjustment hinges. The strips can be flexed through a series of small bellcranks and rods attached to the spar, permitting a blade pitch variation from $-2\frac{1}{2}$ deg to $+12\frac{1}{2}$ deg. The blades contact the spars in such manner that when pitch is changed they roll on the spars. A set of springs attached to the pitch

(*Turn to page 299*)



Driven disks (one of which is shown here in test stand) are identical to driving disks shown on gear box. Rod ends have 23-deg. offset to give required clearance as disks rotate. Of twelve rods on each disk, six are always in tension, so maximum pull on any rod does not exceed 400 lb. at full throttle.

The B.F. Goodrich Airline of the month

DELTA AIR LINES

The first passenger air line across the "Deep South," Delta now serves a Southern and Middle Atlantic area extending from the Atlantic to Texas and as far north as Cincinnati, Ohio. Today, in addition to handling the largest volume of commercial traffic in the company's 20 year history, Delta is flying cargo, training personnel, and modifying warplanes for the U. S. Army and Navy.

Many B. F. Goodrich products fly over the Delta routes. Silvertown tires mean smoother, surer take-offs and landings; brakes equipped with B. F. Goodrich Expander Tubes give pilots excellent ground control; De-Icers add their big factor of flying safety.

To the more than 900 men and women who *are* Delta Air Lines goes this salute . . . our nomination of Delta for this month's "Airline of the Month."

In war or peace

B.F.Goodrich

FIRST IN RUBBER



New De-Icer improvements increase ice protection . . . provide longer life . . . save weight . . . cut maintenance costs!

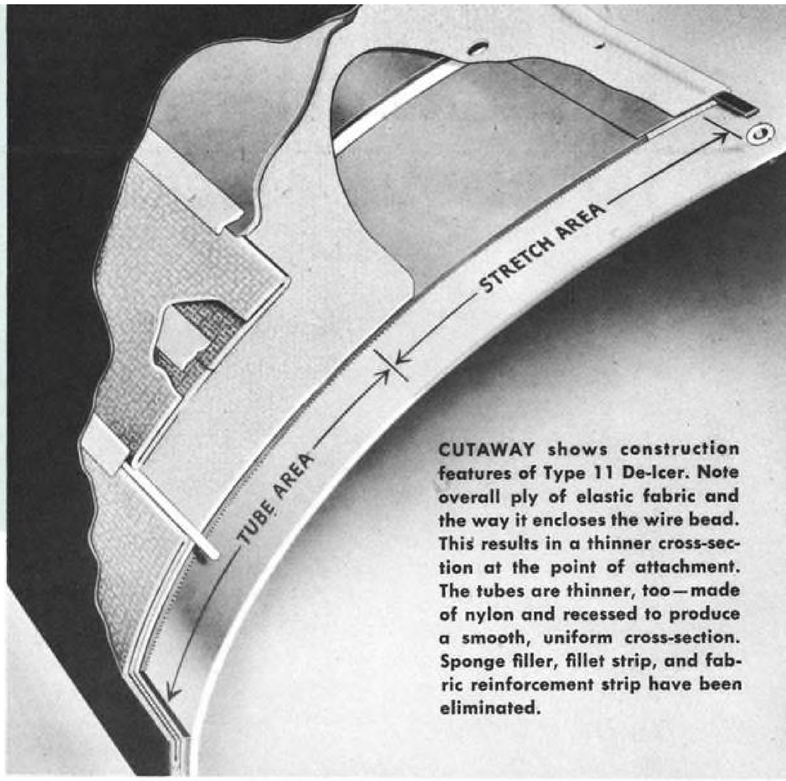
The big assignment in our De-Icer laboratories has been to cut down weight, to increase aerodynamic efficiency, and to continue improvements in ice-removal effectiveness. In the new Type 11 De-Icer, a series of refinements have been developed which add up to better performance on all these counts.

FEATURES OF THE TYPE 11 DE-ICER

- **IMPROVED TEAR RESISTANCE:** Type 11 De-Icers have an all-surface ply of special elastic fabric which resists tearing.
- **THINNER AT ATTACHMENT:** This same all-over ply encloses the wire bead at the attachment edge, which results in a thinner cross section and permits better aerodynamic smoothness at the point of attachment.
- **NYLON TUBES:** The tubes which pulsate when the De-Icer is in action are made of a highly stretchable nylon fabric, and are recessed into the De-Icer to produce a smooth, uniform cross section.
- **LIGHTER:** Elimination of reinforcement strips and sponge filler, and more effective use of rubber and fabric, reduce the weight of the De-Icer.
- **BETTER ICE REMOVAL:** Improved tube arrangements, made practical by the stronger, lighter materials, provide more efficient ice protection.

HOW THE DE-ICER WORKS

The Type 11 De-Icer works on the same principle as other standard types. It consists of a rubber sheet, containing cells or tubes, stretched and mechanically attached at its outer margins to the leading edge surface to be protected. The inflation and deflation of the cells cracks the ice so that it is carried away by the air stream.



CUTAWAY shows construction features of Type 11 De-Icer. Note overall ply of elastic fabric and the way it encloses the wire bead. This results in a thinner cross-section at the point of attachment. The tubes are thinner, too—made of nylon and recessed to produce a smooth, uniform cross-section. Sponge filler, fillet strip, and fabric reinforcement strip have been eliminated.

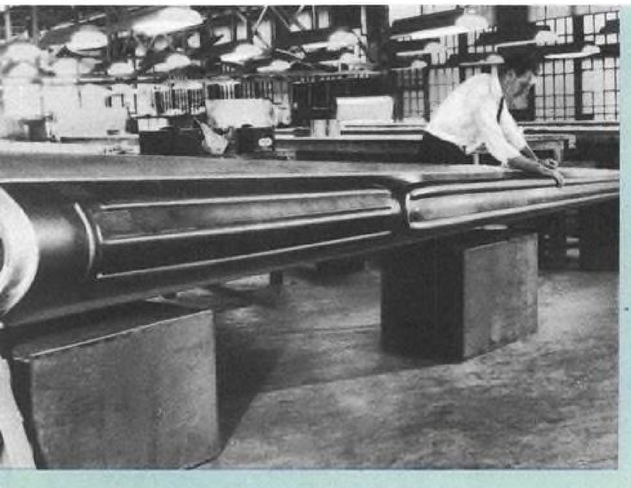
- **LONGER LIFE:** The required tension is obtained with less stretching of the De-Icer over the leading edge. That means less strain on the rubber, and longer useful life for the De-Icer.
- **NO TRAPPED AIR:** The back of the new De-Icer is ribbed, forming spanwise channels between wing-skin and De-Icer. These channels guide any trapped air to chordwise channels and then to the vent holes. They also help to keep lubricating talc spread evenly under the surface.
- **REDUCED MAINTENANCE:** Most of the features mentioned here contribute to lower maintenance requirements, so that both repair time and costs are greatly reduced.

Army Navy "E" Awards to 9 plants

- **C. A. A. APPROVED** Type 11 De-Icers have been approved by CAA and Army Air Forces. The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

ELASTIC FABRIC reinforces entire surface of Type 11 De-Icer. Special weave prevents lateral stretch. This fabric permits installation at lower tension than possible with all-rubber stretch area, increases tear-resistance, and greatly increases De-Icer life.

TEST INSTALLATION of B. F. Goodrich Type 11 De-Icer on wing section. View shows first inflation of inboard tubes and second inflation of outboard section.



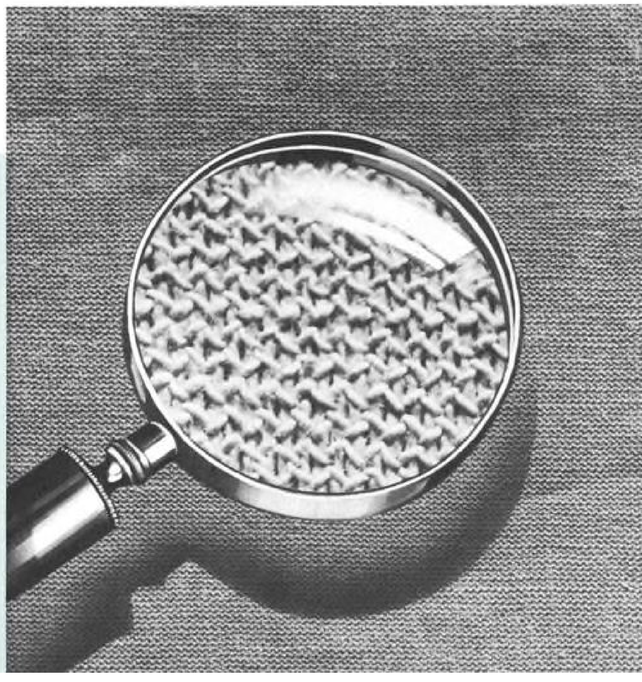
SMOOTHER SURFACE of new Type 11 De-Icer is the result of more uniform thickness. Tubes are recessed; tear-strips, sponge filler and fillets are eliminated.



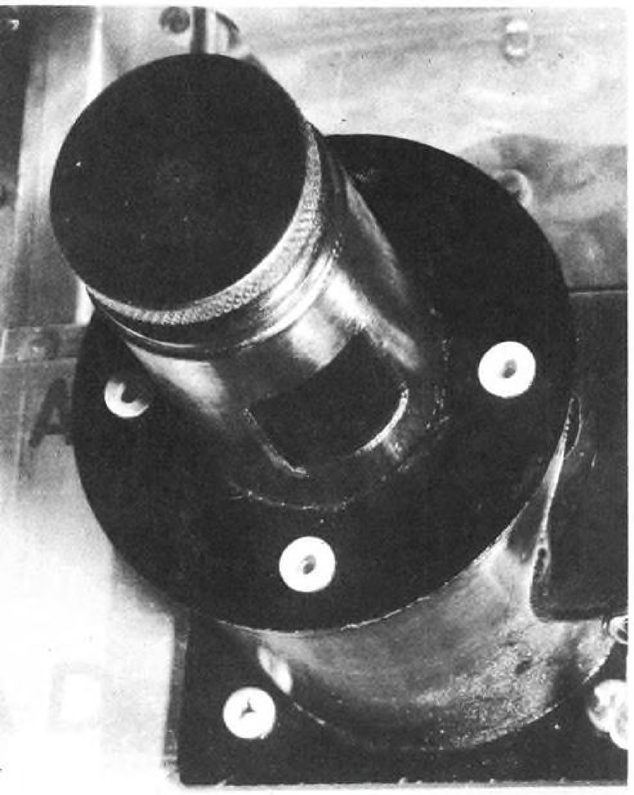
Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER



B. F. Goodrich RIVNUTS excellent for plastic assemblies like this . . .



Here's just one of many uses for these simple, dual-purpose blind fasteners

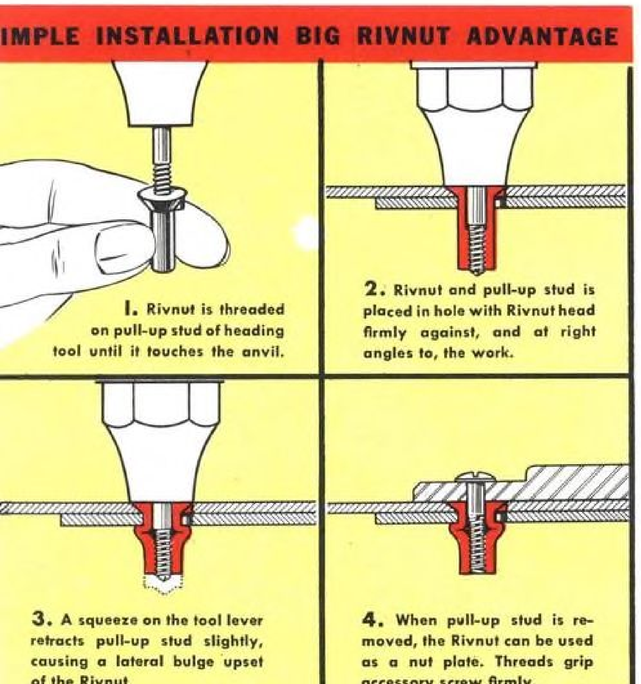
Rivnuts combine light weight with strength; simplicity of design with low cost; easy installation with efficient performance. All these qualities make them ideally suited for use as blind fasteners in this plastic ventilator assembly.

The many other advantages of B. F. Goodrich Rivnuts make their applications practically unlimited. They can be used as blind rivets, as nut plates for attachment, or both . . . in metal, plastics, or plywood. They have a wider bearing area than any other blind fastener, yet are compact and fit a smaller hole. And they're ready for use as received.

New splined aluminum Rivnuts are now available for application in plastics and wood. Brass Rivnuts are also available in standard sizes 6, 8 and 10.

Some typical applications of B. F. Goodrich Rivnuts

- Assembling cloth-covered wings, ailerons, rudders, etc.
- Fillets and fairing
- Door and window frames
- Access panels
- Flooring in airplane and on work platforms
- Wing panel closures
- Fastening bonding wires, clips, brackets, etc., for conduit
- Attachment of insulation
- Light frames
- Fastening fixtures to panel boards



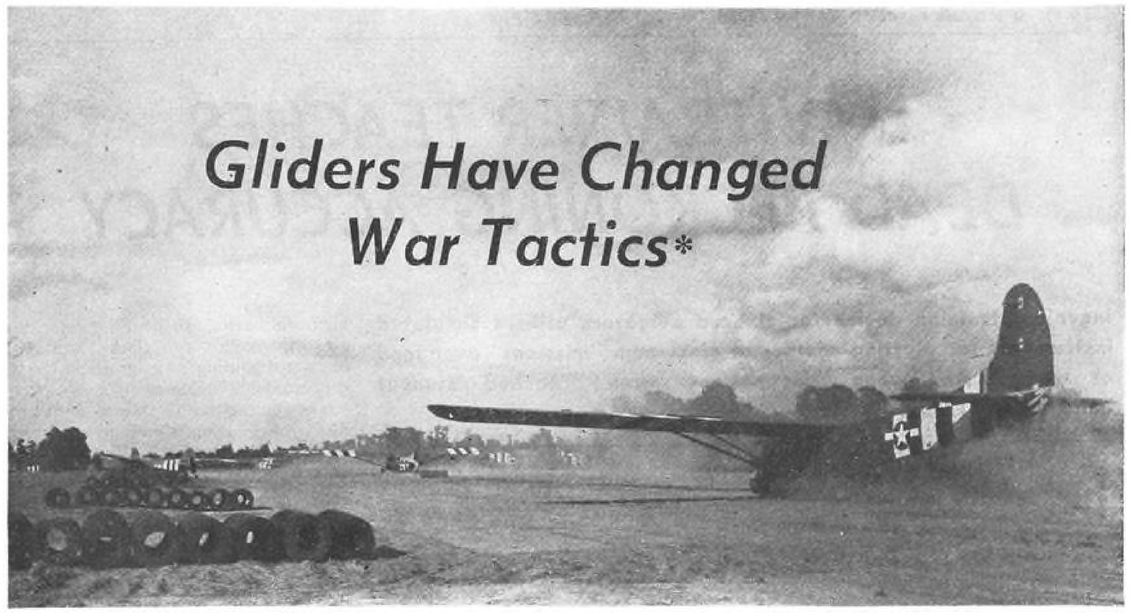
NEW FOLDER "RIVNUT DATA"

Perhaps there's a place in your operation for this unusual fastener. Write for your free copy of "Rivnut Data," which contains a complete picture story on installation, types, sizes and grip-ranges. Address The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.



B.F.Goodrich
RIVNUT
IT'S A RIVET...IT'S A NUT PLATE

Gliders Have Changed War Tactics*



In swirl of dust, gliders loaded with supplies land almost nose-to-tail on partly completed airfield in Normandy on June 15. Rolled up landing mats not yet in use are seen at left. (U. S. Signal Corps photo.)

By MAJ. ELIOT F. NOYES, AAF

Right in the enemy's backyard, engineless planes fight their own decisive battles—disrupting the foe's carefully planned campaigns.

FIRST LARGE SCALE military glider operation in history was the invasion of Crete in May, 1941. The most recent was the airborne invasion of Normandy in June of 1944. It is necessary to compare these two operations to understand what a tremendous development has occurred in slightly more than three years.

In Crete, gliders were used in conjunction with much larger numbers of paratroops, air-landed troops, and invasion forces from the sea. However, the British Navy was present in such strength that practically none of the seaborne troops were able to make shore, and the island fell to airborne assault.

Gliders were most successful in their attack on the Malemo airdrome, near which they landed in a river bed, in advance of landings by paratroops. Once the airdrome was secured, Ju-52's came in (often in crash-landings) bringing more troops, which eventually captured the island. At the time, the glider assault on Crete seemed to be on a very large scale. Landings were made by day, and not more than 40 or 50 gliders were sent against any one objective. A total of about 70 were used, each carrying about 10 men—a total of about 700 men.

By present standards, this was a small scale mission, yet, for that time it definitely was a large operation, since gliders for military use were new and untried, having appeared only in small numbers before (in Poland, Norway, and Belgium).

Airborne invasion of Normandy makes the Cretan business seem like a pretty small affair, in numbers, technique, and complexity of planning. For this was the initial assault wave of the largest overwater invasion in history. While in Crete the German DFS-230 gliders carried 10 men each, and no heavy equipment; in Normandy we used Waco-designed CG-4A's carrying 15 men and British Horsas carrying 25 men, or heavy artillery and transport vehicles. Even British Hamilcars were used, which brought in airborne tanks. And instead of 700 men, three airborne divisions were involved here, which required many hundred of gliders to transport the thousands of troops and their great quantities of supplies.

Furthermore, these troops landed at night, without lights, behind German coastal defenses to seal off the invasion beachhead on the east coast of the Normandy peninsula. This was a movement which would have been totally impossible before, and which required the most exact planning, the most careful coordination with sea and ground forces, exact timing, and the highest degree of air discipline and precision flying on the part of the glider pilots. The success of this operation is unquestionable, and its success was due to the accumulated experience of these three years.

Beyond any doubt, the glider has now been accepted as a tactical weapon of great military importance. Gliders have now been used tactically in a variety of ways, but even so this is still a new weapon. The extent of its tactical possibilities is not known—and it will not be practically discovered without further use in actual theaters. However, we can analyze the various ways in which gliders have been used tactically, and we can suggest ways in which they may be used.

In such an analysis, it is very important to keep a close eye on those characteristics of a glider which make it useful for military operations. This may sound too easy. Our military gliders were designed to carry airborne troops and equipment into combat. Their military characteristics were determined according to this primary mission. This appears very obvious, yet for the first years of our army program, discussions have raged about the CG-4A and other military gliders as though they were designed solely for cargo use, to increase the payload of a towplane.

The main point was lost in these arguments. The important fact is that the glider is a large container. As a container, it has military value when it can do a job that cannot be accomplished at all, or cannot be accomplished as efficiently, by any other means. Its most important military characteristic is its ability to land in small unprepared areas in which a transport plane cannot land, also its ability to carry larger loads of men or equipment than can be dropped by parachute.

The glider must be understood in its

(*Turn to page* 285)

* Paper read at convention of Soaring Society of America, July, 1944.

NAVITRAINER TEACHES DEAD RECKONING ACCURACY

Ingenious training device for embryo avigators utilizes simulated instruments for plotting courses of classroom "missions" over land or water. And when "destinations" aren't reached, student quickly learns why.

FAMILIARLY KNOWN as the Navitrainer, the G-1A dead reckoning teaching device—widely used at primary and secondary Army and Navy air forces instruction centers—simulates as closely as possible conditions encountered in actual flight.

It enables considerable saving in flight equipment, fuel, and man-hours which might otherwise have been spent in flying, and it also completely eliminates the factor of weather.

Developed by the AAF and engineered and produced by American Automatic Typewriter Co., the Navitrainer enables the air cadet to learn how to take drift readings, how to employ them in double drifts to find wind and ground speeds, and how to use various instruments necessary in dead reckoning.

Basically, the operation of the Navitrainer may be described as follows: The student sits in a canopy-covered car and depends entirely on the trainer's instruments for knowledge of his position. The car is mounted on a triangular frame moved over the floor by an electric motor. Direction and speed are set by the instructor.

Beneath the car and frame, and having independent movement, is a device called the Windtroducer, which serves two functions: It brings the element of wind drift into the avigator's problems and supports the chart or map on which a pencil affixed to the car traces the true course of the "plane" over the ground. The Windtroducer also is actuated by the instructor via an electric motor set.

Within the car are a simulated driftmeter, altimeter, airspeed indicator, free air thermometer, two clocks, and an illuminated plotting table on which the student makes his calculations.

The student records trainer airspeed by means of the airspeed indication as modified by temperature and altitude; then he obtains wind direction and velocity by calling for a double drift. The instructor moves the car 45 deg. to the right, then 90 deg. left, then back to the original heading, while the student observes drift through a driftmeter mounted in the car, which simulates movement over varied terrain by means of an illuminated moving film strip.

Self-contained, the driftmeter has no connection with any other unit. The instructor can set the instrument for any desired drift, and the student reads it as he would read the drift of an actual plane over the ground.

After completion of the mission, the pencil line is checked to see how far from the destination it stops and at what angle it crosses the meridians. If the angle is off, the student's log is checked to see where an error was made. Thus, the Navitrainer actually provides a more accurate method for teaching dead reckoning than does actual flight.

A new addition to the trainer consists of an azimuth ring surrounding the avigator's car to represent the observer's horizon, while a vertical ring at right angles to the horizon is used to mount a model celestial body, thus providing the student with the fundamentals for celestial avigation. This addition was made not only to prepare the student for advanced celestial avigation, but also to permit him to supplement and check his dead reckoning.

The triangular frame on which the avigator's car is mounted is electrically moved on three casters in any desired direction. The frame travels at a speed proportionate to the true airspeed of the simulated airplane and in a direction representing the plane's heading. It is impossible for the frame, itself, to change its heading, but the direction in which it travels is controlled by changing the heading of the avigation car.

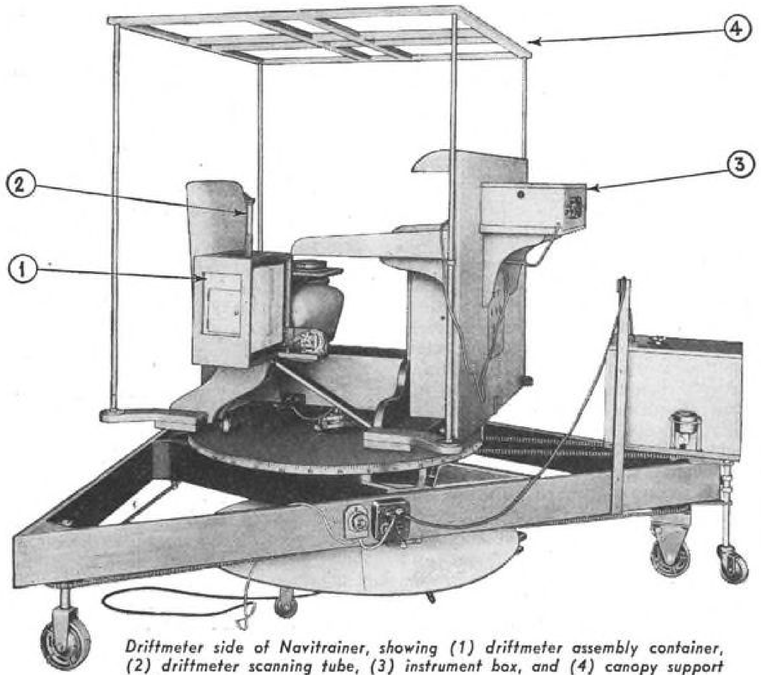
The car is supported on the frame by means of four stationary casters to permit easy turning. The electric motor, mounted on an adjustable base, transmits power to a drive shaft by means of a variable speed pulley, and its speed is geared down by a worm gear and various spur gears.

A tachometer registers the motor drive shaft speed, which is translated into miles or knots per hour for the instructor so he can, for the information of the student, set the airspeed indicator to correspond with the speed of the frame over the floor.

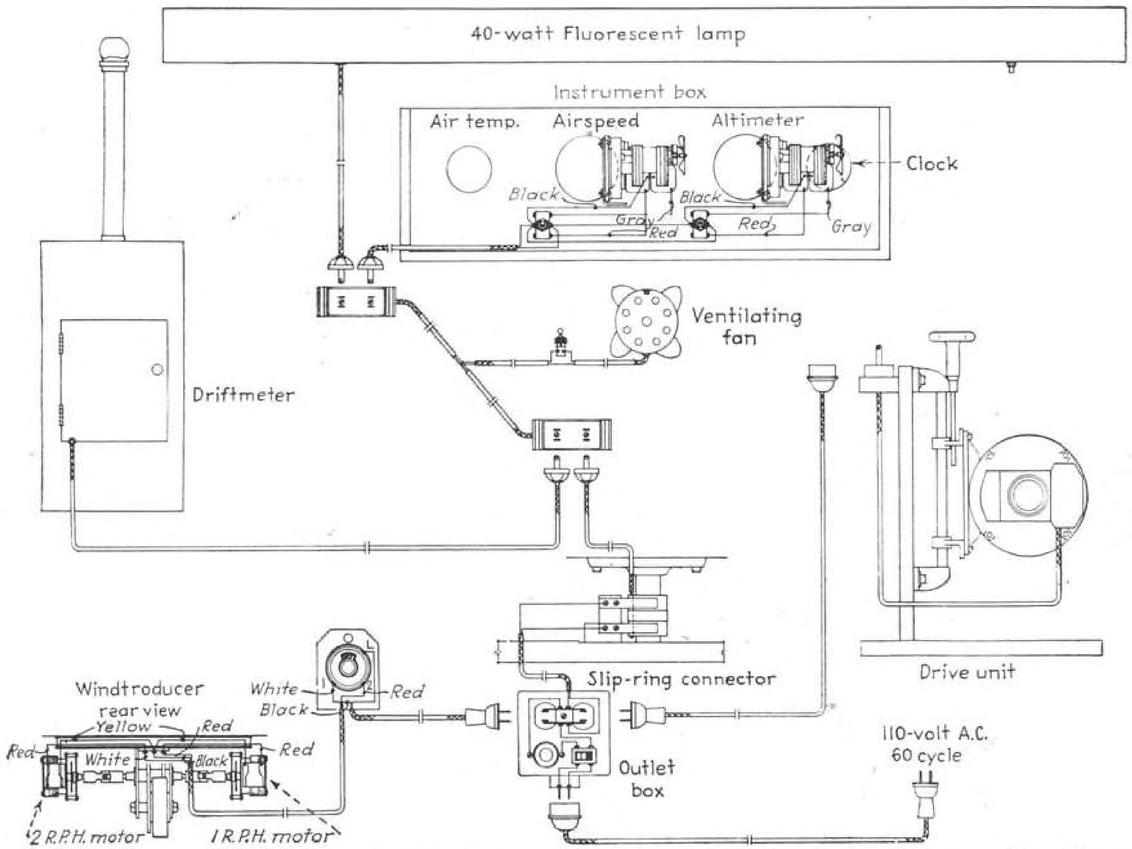
Variations in the speed of the trainer are made by changing the position of the motor on its adjustable base. When it is high on the base, the V-belt transmitting power to the drive shaft rides lower within the variable speed pulley, thus slowing the speed of the drive shaft.

The motor operates on 115v., 60-cycles, a.c. A horizontal roller chain links the main drive wheel with the two other wheels and keeps all three pointing in the same direction. Current for the trainer is brought to a terminal box on the frame where two outlets are located—one for

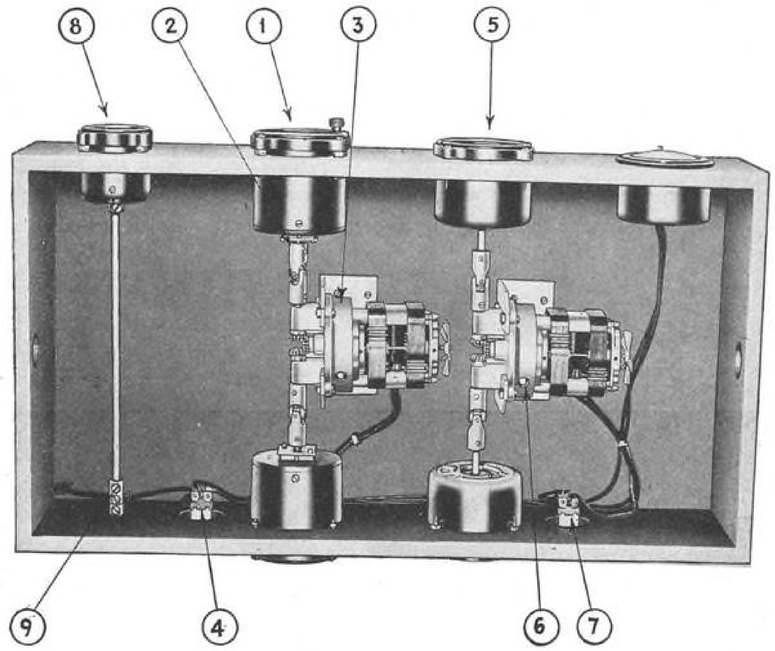
(*Turn to page* 306)



Driftmeter side of Navitrainer, showing (1) driftmeter assembly container, (2) driftmeter scanning tube, (3) instrument box, and (4) canopy support frame.



Wiring diagram of Navitrainer. Windtroducer speeds are obtained from two synchronous motors used singly or in combination and providing, via gearing, a speed of about 4 1/16 in. per hr. with right motor, 8 3/8 in. per hr. with left motor, and 14 1/16 in. per hr. in combination.



Interior of Navitrainer instrument box shows (1) altimeter, (2) flexible coupling, (3) altimeter motor, (4) altimeter switch, (5) airspeed indicator, (6) indicator motor, (7) indicator switch, (8) air temperature indicator, and (9) connecting collar.



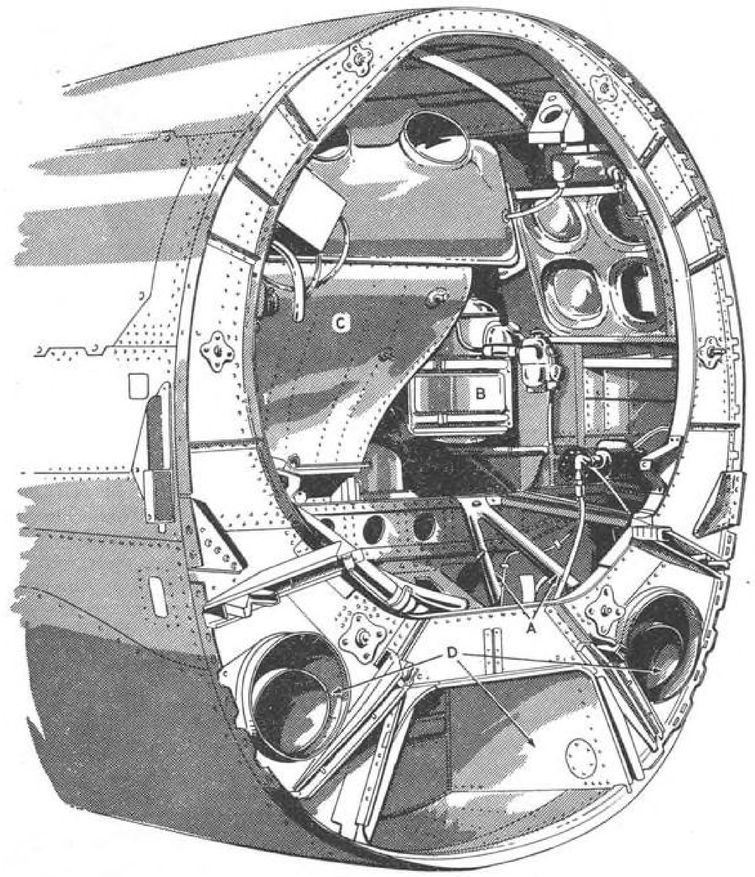
Ranging far out over enemy waters, bombing convoys, getting valuable reconnaissance information, countless Navy patrol bombers, finished with Berry Brothers' materials, are dramatically shortening Axis resistance. ¶ When the war is over, counterparts of these same famous planes, finished with the same famous finishes, will through world-wide commercial aviation, help reunite a world which war has torn apart.

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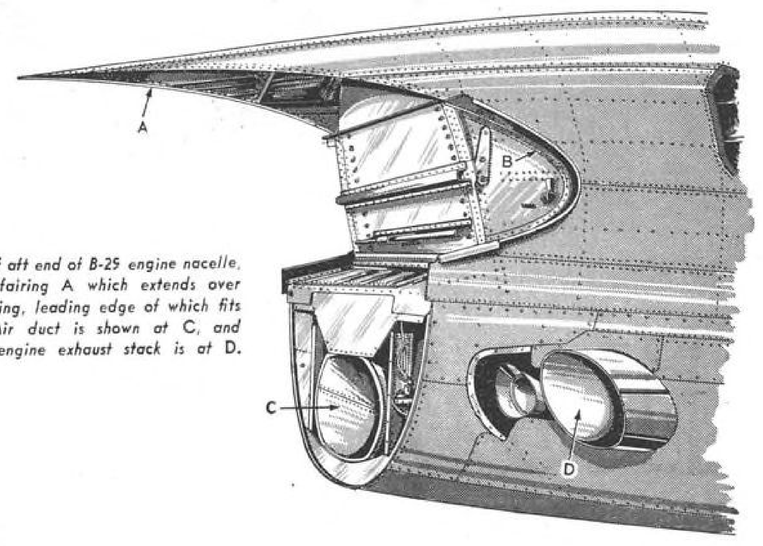
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Presenting First Sketches Of Boeing B-29 Superfortress



Engine nacelles of Boeing B-29 Superfortress — greater in diameter than fuselages of many smaller craft — are of built-up construction, including tubular members such as shown at A. Size permits installation of auxiliary units, such as those at B and C within nacelle. Air ducts leading aft are shown at D.



Details of aft end of B-29 engine nacelle, showing fairing A which extends over top of wing, leading edge of which fits at B. Air duct is shown at C, and end of engine exhaust stack is at D.



Titeflex Aerocon Conduit

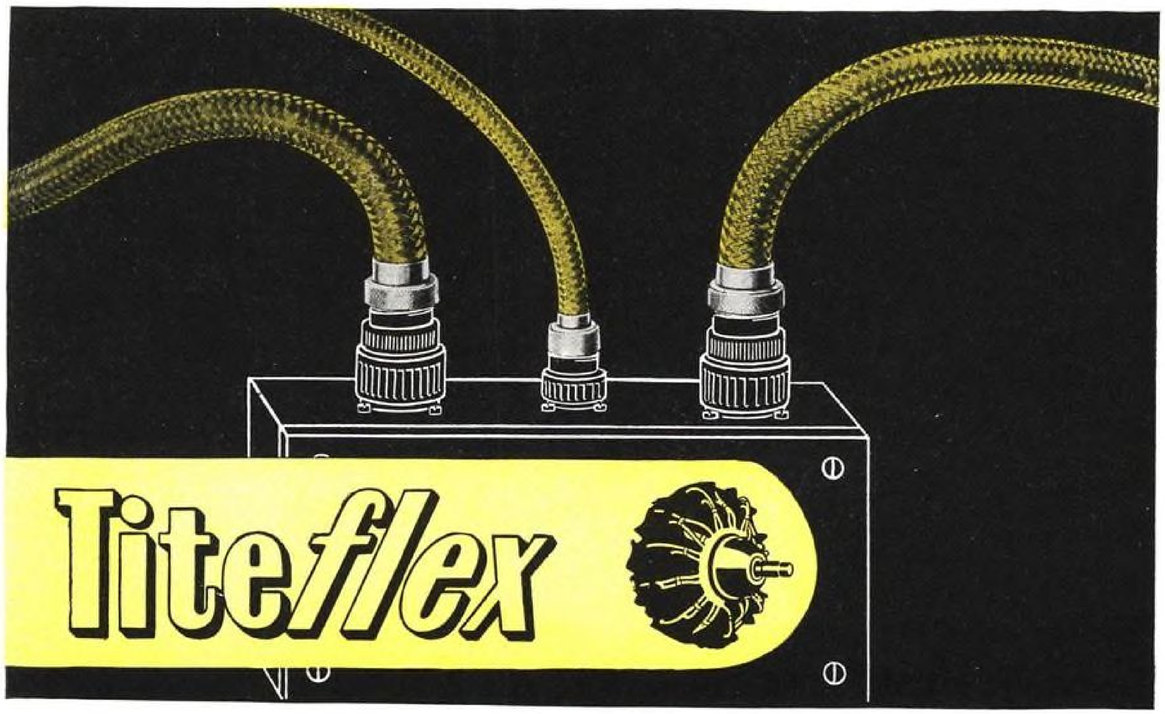
DEVELOPED for *high tension* ignition shielding AVAILABLE for *all* aircraft electrical wiring

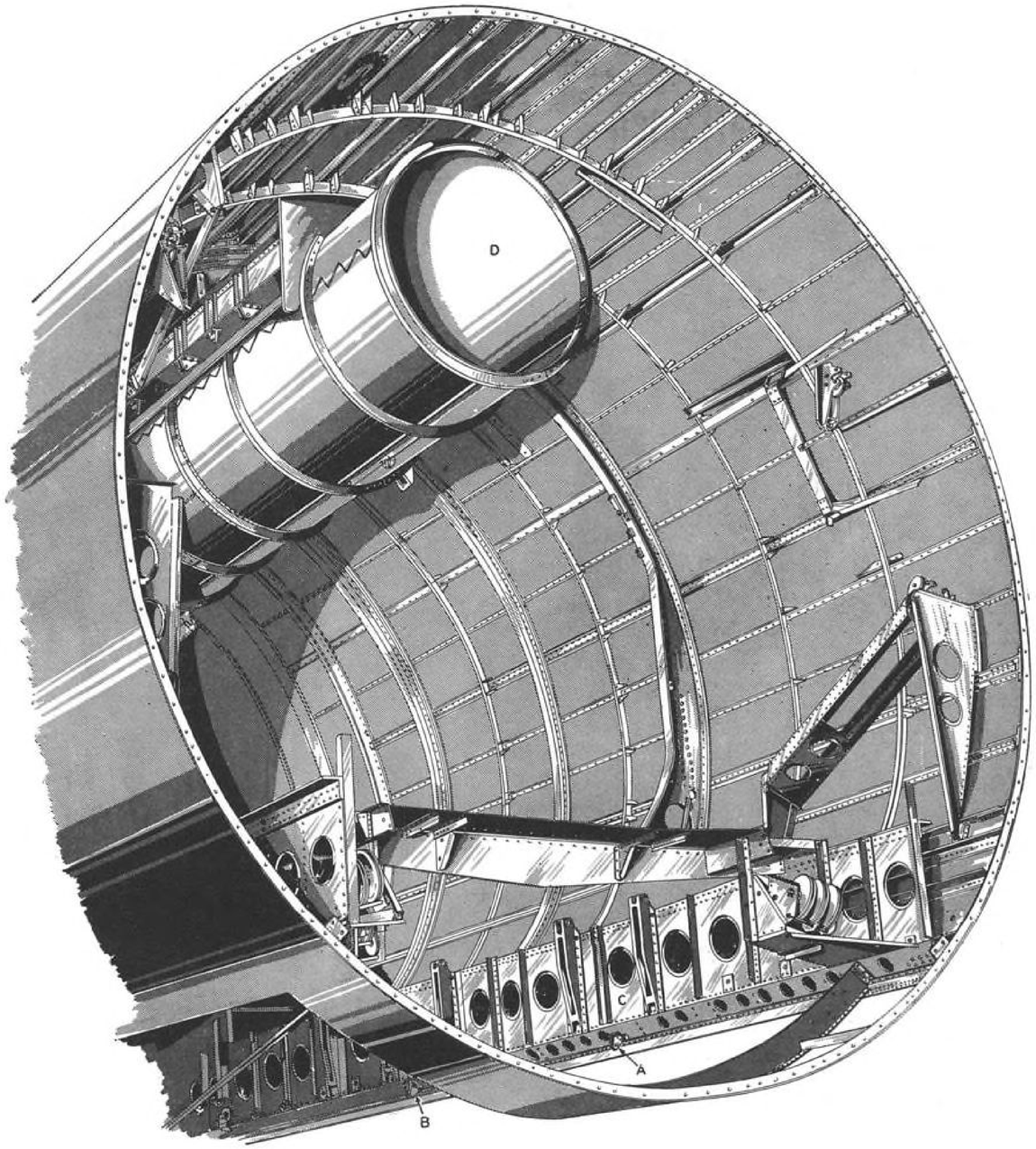
With the development of super-sensitive radio and electronic devices on aircraft, more efficient ignition shielding conduit had to be developed. It was developed — Aerocon by Titeflex — and Aerocon type conduit is now specified by both Army and Navy Air Forces for Ignition Shielding.

While the problem of interference from high-tension ignition systems has been largely overcome, noise from other electrical wiring in the plane has made itself more apparent. Titeflex Aerocon — which helped solve the problem on high-tension ignition cables — this same conduit can and should be utilized by manufacturers of air frames to dampen the interference of all electrical wiring — high or low-tension.

Titeflex Aerocon is available in all diameters for which conduit is required. The use of complete assemblies manufactured by Titeflex insures interference-free operation of radio and electronic devices on America's fighting aircraft. Titeflex engineers are prepared to cooperate with aircraft builders, and manufacturers are invited to submit their specifications.

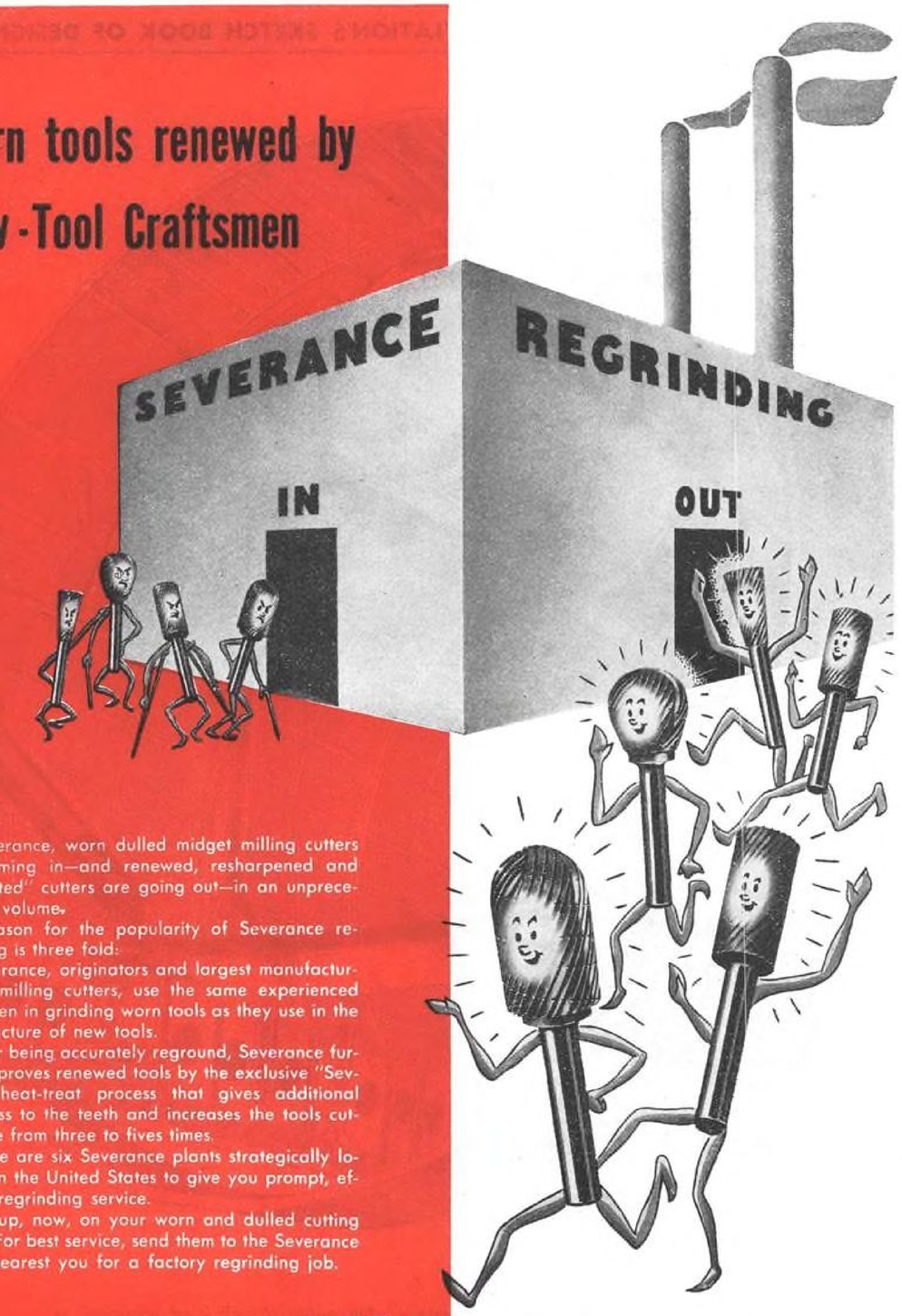
TITEFLEX, INC.
510 Frelinghuysen Avenue
Newark 5, New Jersey





Cross section of B-29 Superfortress fuselage— is 9 ft. in diameter at this point—at fore end of first of two bomb bays. Bomb bay doors attach to hinges (two of which are shown at A and B) at bottom of built-up structure C. This portion of craft is not pressurized, so tunnel D is provided for crew members to move between pressurized control cabin and gunners' compartment aft of bomb bays. Note varying sizes of frames used in this section.

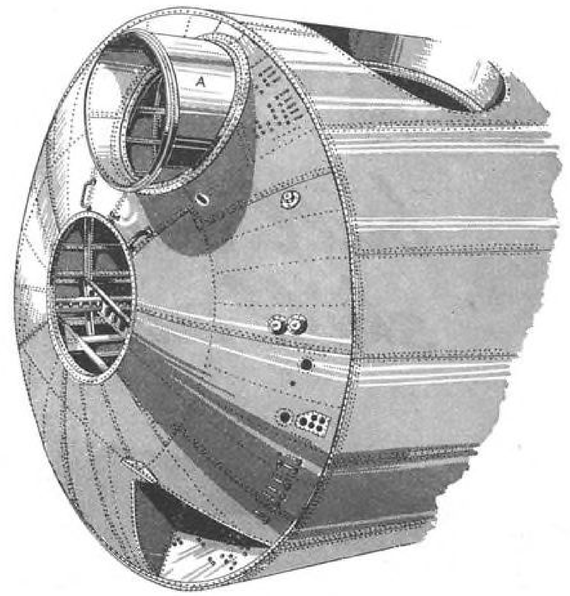
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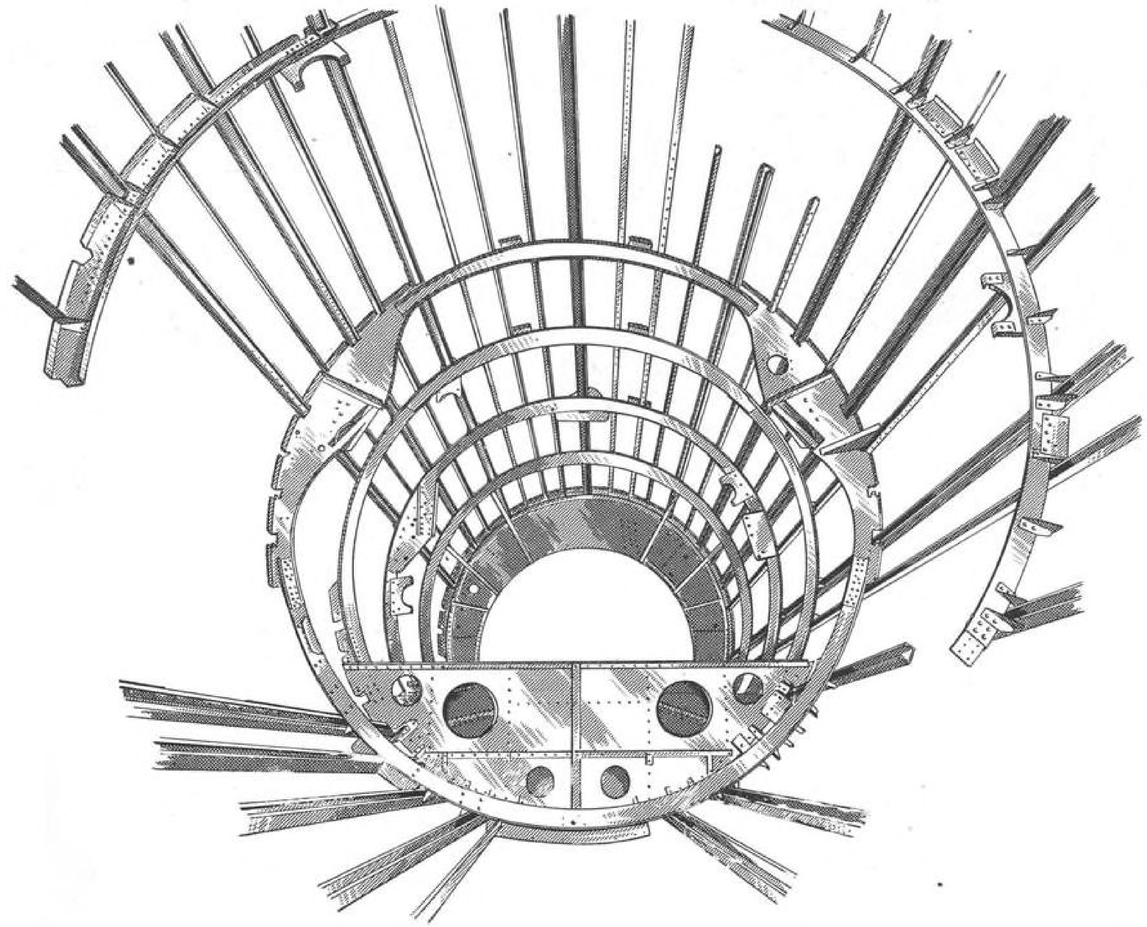
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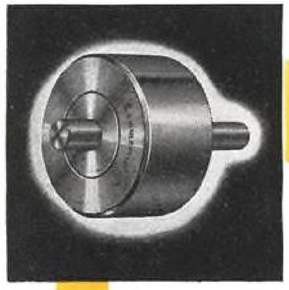
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View of aft portion of cabin control section of Boeing B-29, showing shape of bulkhead between pressurized and unpressurized sections. Note cylindrical shape of fuselage, ideal section for pressurized structures. Tunnel for passage of crew over unpressurized section—which attaches to left end of this section—is shown at A.

Skeleton view of part of B-29 Superfortress fuselage, showing circumferentials and stringers prior to installation of skin. Lighter stringers are L-shaped; heavier ones are U-shaped.





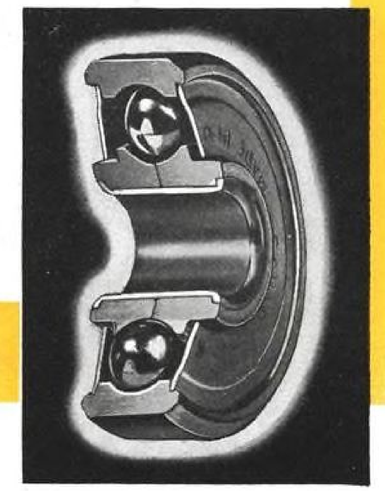
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AVIATION'S *New Regular Feature*

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NEW RIVET IS PLASTIC

An innovation in fastenings is the plastic rivet (Fig. 1) brought out by Douglas Aircraft Co. for attaching fabric to metal, wood, or plastic (as illustrated in Fig. 2), and metal to plastic sheeting. Invented by S. H. Phillips, process engineer of the company's El Segundo plant, the new rivets have been tensile-tested and indicate an average breaking load of 220 lb. for those formed from acrylic.

Applicable for use where ordinary metal rivets cannot be driven, the plastic rivet has a center-bored body and is expanded by compressed air (Fig. 3). Its weight is said to be less than metal, and it can be driven faster.

The new rivet also has a very marked "plastic memory", for it will resume its initial contour, for removal, when heated. It is reported resistant to moisture, oil, gasoline, has a high degree of impact resistance, minimum cold-flow, and can be produced in any color, indicating wide usage for attaching linings and upholstery.

A recently developed process for electroplating plastics with various metals lends even more promise to plastic rivet development and use. Electroplated plastic develops greater tensile strength, flexural strength, and dimensional stability. Experiments conducted at El Segundo indicate that plated plastic rivets can be driven as successfully as the unplated types.

The new rivets were developed from experiments with acrylic, high-temperature acrylic (Lucite HM-119), Ethocel LT, Ethocel ER, cellulose acetate butyrate 204A-H2, 204A-H3, 204A-H4, 205A-H2, 205A-H3, and 205A-H4. Although the acrylic type plastic exhibited the best all-around characteristics, the inventor believes other plastics would serve as well after a slight modification of formulas.

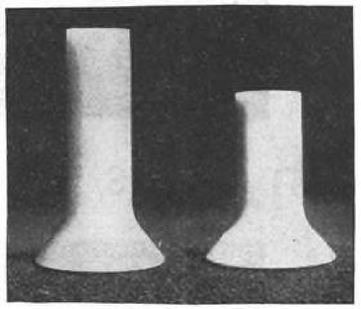


Fig. 1. These newly developed plastic rivets, stated to weigh less than metal, have favorable strength characteristics and can be made in any color.

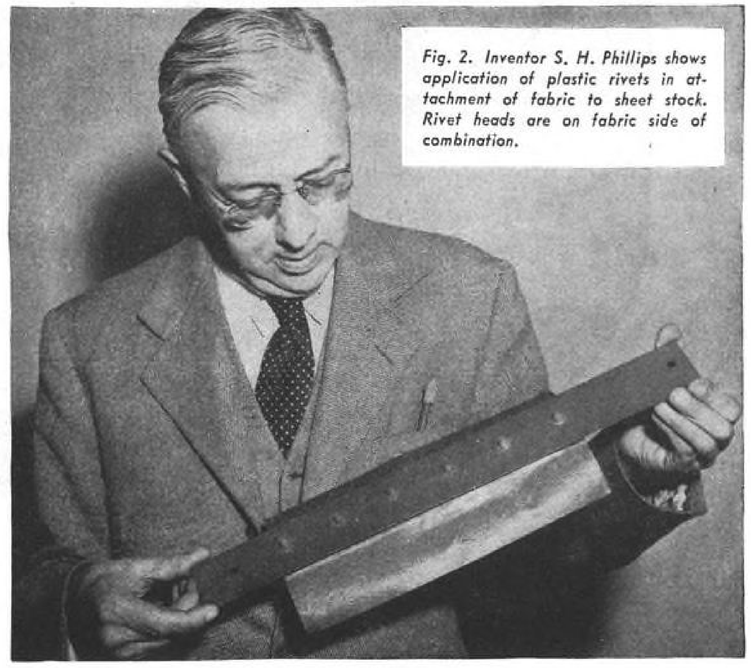
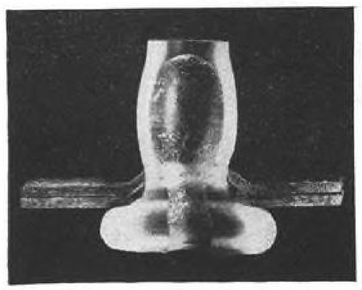
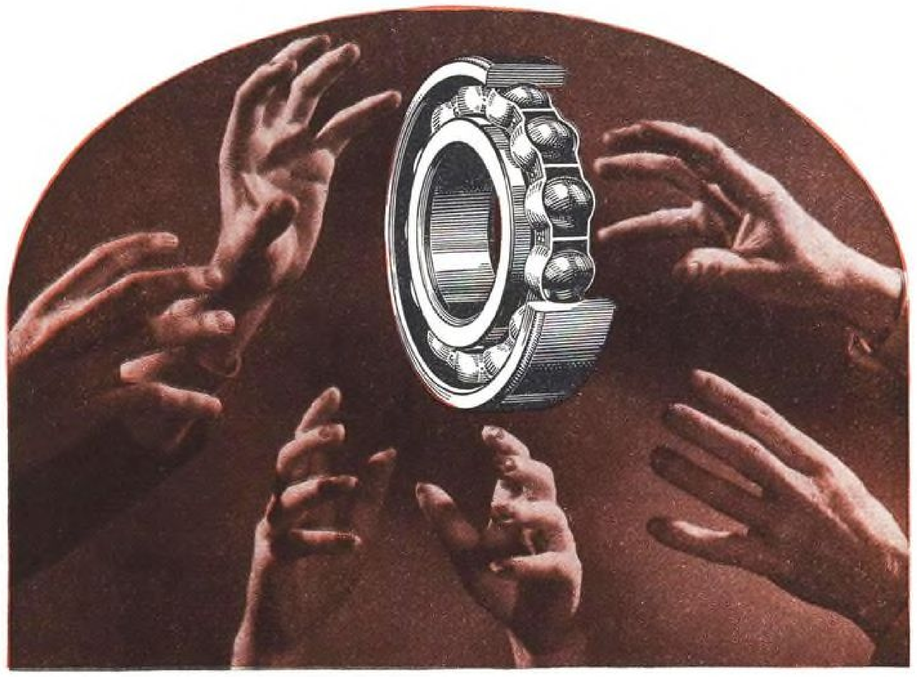


Fig. 2. Inventor S. H. Phillips shows application of plastic rivets in attachment of fabric to sheet stock. Rivet heads are on fabric side of combination.

Fig. 3. Cross-sectional view of plastic rivet after it has been driven. Note how bored body has been upset by compressed air.





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PLASTIC CRAZING AVOIDED

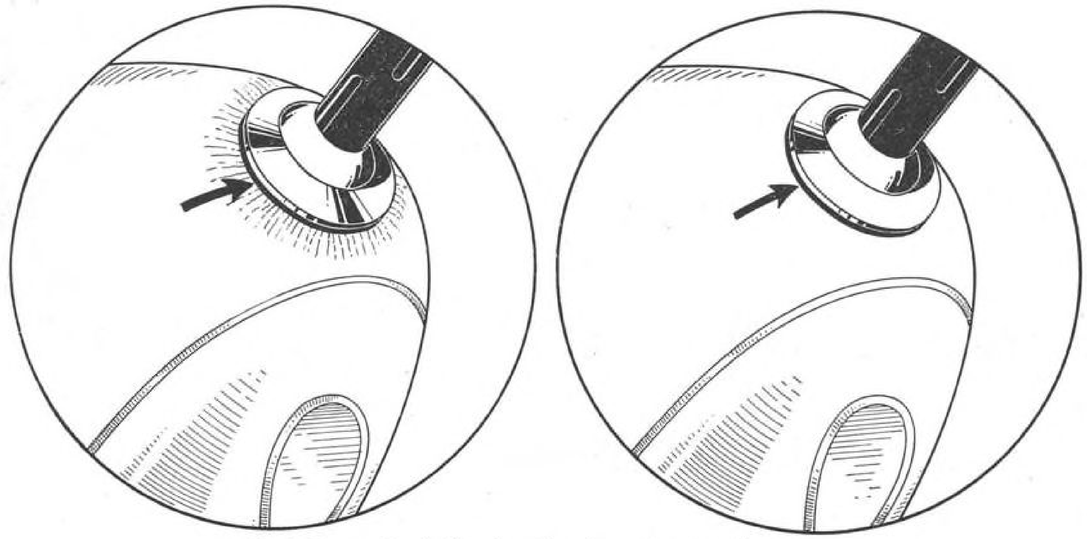


Fig. 1. Comparative sketches of acrylic resin nose turrets to illustrate crazing (left) resulting from use of gun mount gasket containing ester type plasticizer, and absence of crazing (right) when gasket of inert material is used.

LABORATORY research at Glenn L. Martin discloses that by eliminating the use of synthetic rubbers or other materials containing ester type or harmful placticizers, crazing in surfaces of formed acrylic resin nose turrets may be avoided (Fig. 1).

The crazing was traced to plasticizers of the ester type which exuded from the Buna "N" type synthetic rubber gaskets which had been substituted, as a result of procurement difficulties, for the natural rubber gaskets clamped under flexible gun mounts in turrets (Fig. 2).

Clear plastics are also crazed by cleaning fluids such as acetone, chloroform, benzine, carbon tetrachloride, lacquer thinners, and aromatic or aviation type gasoline.

Generally, crazing occurs when the acrylic resin is subjected to stress, which may occur in formed plastic sections as residual stresses caused by the forming action. Stresses may also be set up by improper matching of the curve in the plastic to the curve of the metal structure to which it is fitted, when the plastic is forced into place by attaching screws.

Another important cause of overstress is temperature change, particularly where the ends of the plastic structure are restrained; therefore, sufficient tolerance in the form of compressible material or slip should be provided.

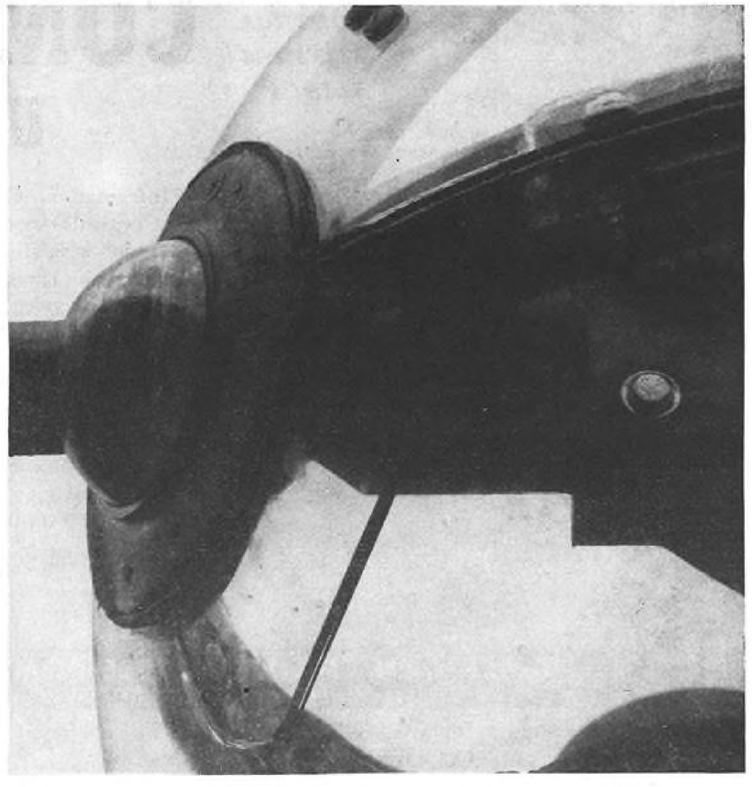
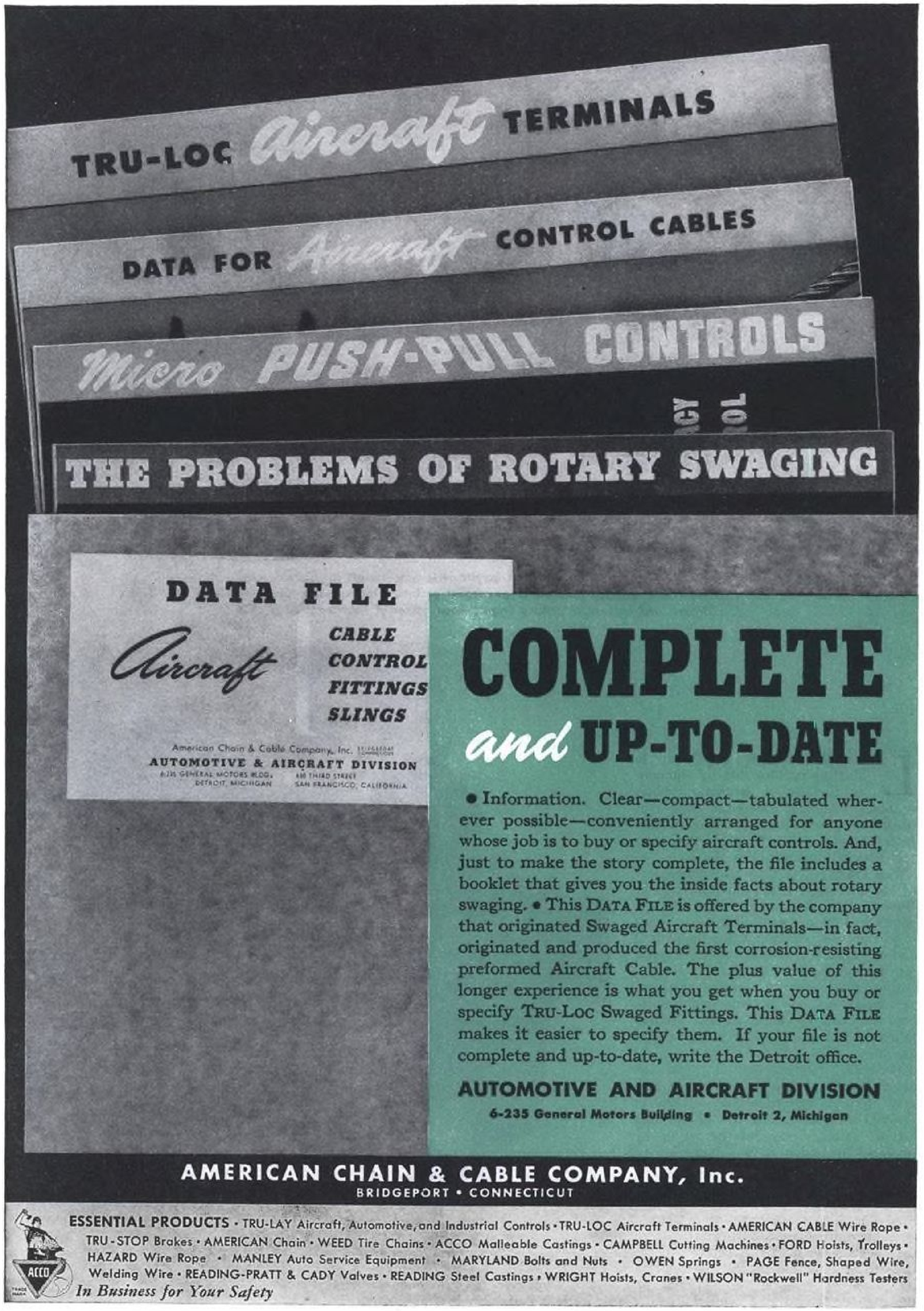


Fig. 2. Large crack in acrylic resin nose turret is result of crazing due to ester type plasticizers in synthetic rubber gasket of gun mount.





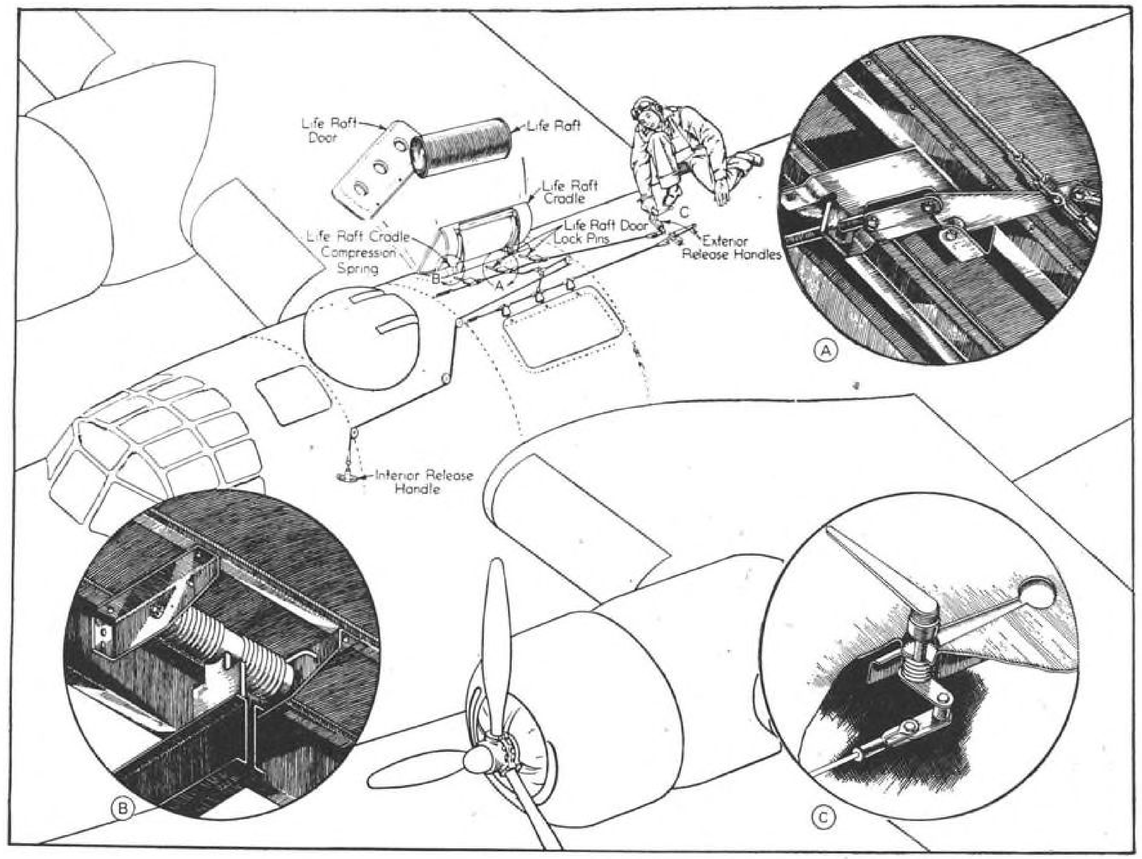
FLASH WELD USED FOR CONTROL ROD BOND

APPLICATION of flash welding (left) instead of riveting (right) in the assembly of steel rod ends to carburetor control rods on the Martin PBM-5 produced a joint in which the weld is equal in strength to the parent metal. This reduced rework, scrap, and the number of shop operations from seven to three. Required operations now consist only of flash welding, removal of excess material at weld, and proof loading.

QUICK RELEASE FOR LIFE RAFT

OPERATIONAL AND INSTALLATION details are pictured here for a simple and efficient life-raft-ejecting device developed by Consolidated Vultee Aircraft Corp. for use on Liberator B-24's. The ejecting device, provided on each side of the upper portion of the fuselage, consists of a semi-cylindrical container-cradle for a five-man raft, held in place by a door streamlined to the fuselage contour and equipped with safety locks to prevent accidental release of the raft. Control handles are installed both inside and outside the plane as shown in diagrammatic sketch below.

The control operates via cable and lock pins (detailed in insert A) to release the streamlined door and permit a compression spring (insert B) to force the container upward, throwing the raft clear. In main drawing, one ejecting device is shown being-operated by exterior release mechanism (insert C). Door of other ejecting device is shown in normal closed position.



Contract termination presents problems as tough as production once did. Definitely, the cracking of these problems will require well-manned staffs headed by key personnel. So —

Don t Put a Boy On Man-Sized Terminations

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

THE TIME HAS COME for aircraft manufacturers to put some of their *best* men to work on contract termination.

That's the view of the War Department, which is now looking with alarm at the termination records of the first half of 1944. These tabulations show that while the Army Air Forces cut the time for settling claims from 4.5 to 3 months, prime aircraft contractors were tending to take more time, their average period for filing claims showing an increase from 3.3 to 4.6 months. No wonder AAF officials shudder when they think what might happen on the day mass terminations begin.

In order to speed terminations that will be "fast, fair, and final," high-ranking AAF officers have been holding one-day forums in a number of procurement districts. Following are some of the highlights brought out in these meetings, accenting points which should be of interest to all aircraft contractors, who must prepare for the downhill pull of contract termination just as they prepared for the uphill battle of production.

The AAF, of course, continues to stress the urgency of this or that item vitally needed for the war. As Col. Edwin Rawlings of the Materiel Command's readjustment division puts it, "We constantly urge them to hurry production—and then we come to them and urge them to do the paper work involved in these claims. They ask us which we want them to do. And we have to answer, 'both'."

AAF contracts, according to Col. Rawlings, are more complex than those of any other service. In the first place the AAF deals with many new companies and, second, the answers on property disposal are not well known. The aircraft industry handles specialized materials of great cost that cannot be used for anything else but aircraft. In disposing of these surplus materials, he points out, the industry has neither adequate data nor the nucleus for a good record system.

Here are his recommendations:

1. Every company should get its records into agreement with physical inventories. The only way a contractor can put in a claim is to have his physical inventory put on a cost basis. And the prime contractor has a responsibility to see to it that his subcontractor does likewise.

2. Adjust commitments for materials and subcontract items. In other words, "get your house in order."

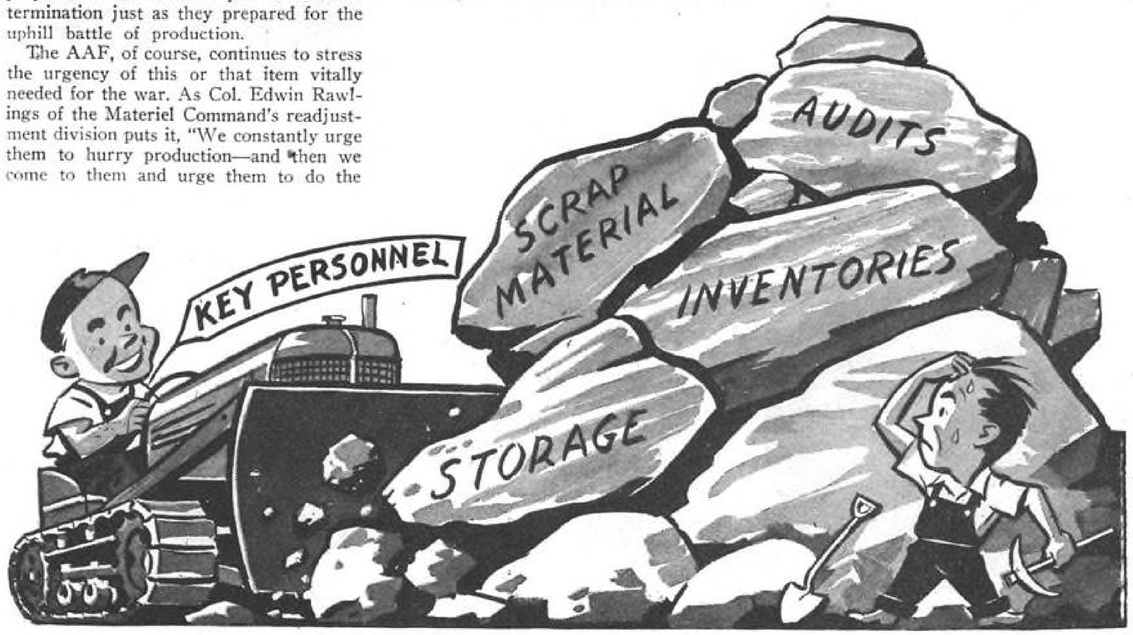
3. Set up a separate termination organization with trained personnel.

4. Pre-determine problems that will appear on termination.

It is inevitable that there will be much confusion when mass terminations come. Decisions will have to be made quickly on: First, goods in process; second, what goods to keep; and, third, storage problems. Much time can be saved if these matters are considered ahead of time.

For example, the biggest termination enigma is the question of what goods should be scrapped and what may be usable. The AAF estimates that from 80 to 95 percent of all goods in process in the aircraft industry will have to be scrapped. It may be difficult for a man in a plant to scrap pistons that are only useful for the engines for which they were designed. Nevertheless, they must

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PROVEN IN WAR — FOR PEACETIME PERFORMANCE

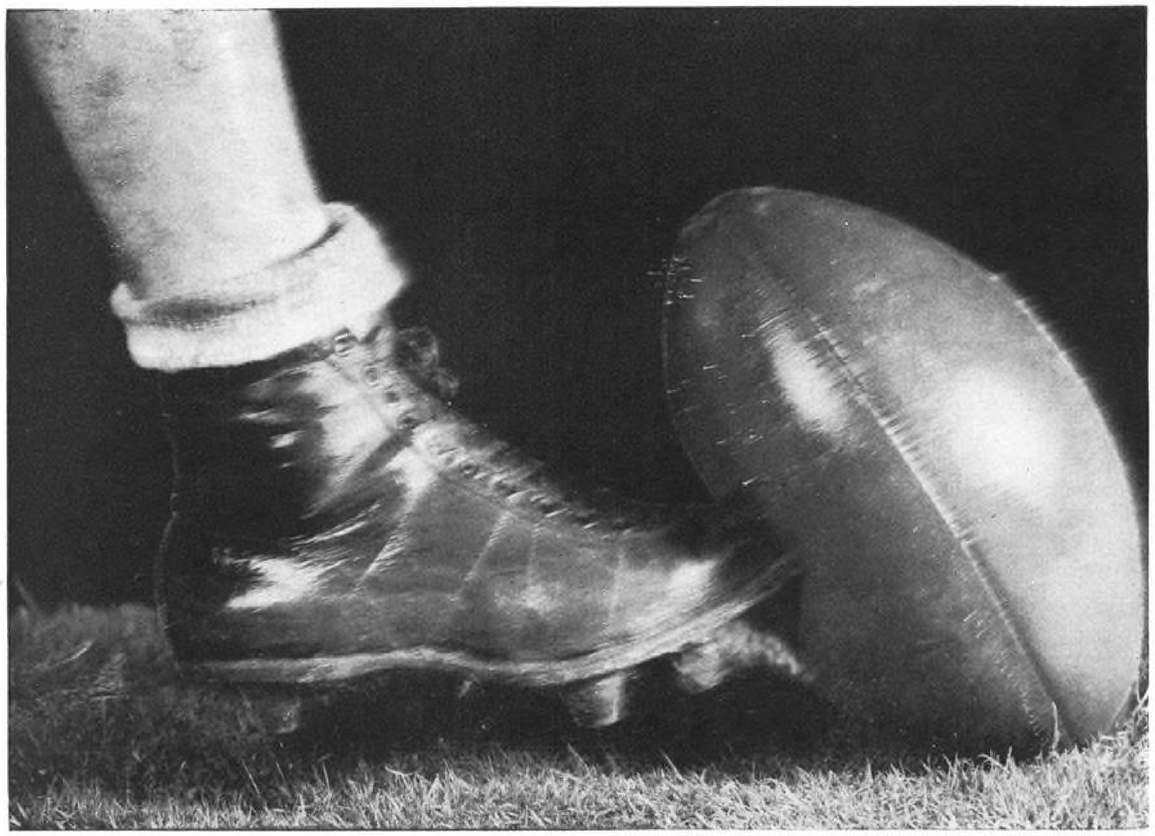
In war the Curtiss Commando has established itself as a major instrument of transportation. It has hauled personnel and supplies of all types wherever the need has been critical—often under most unfavorable flying conditions.

Evolved from an airline design, the Commando will be available for commercial operation as soon as the strategy of war permits. Its conversion into a luxury airliner or a cargo carrier will be speedy. This will help to bridge the gap between war and peace by providing jobs for the men and women who build and operate these transport airplanes. Look to the Sky, America!

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Unretouched photo of wet football being kicked; exposure, 1/10,000 of a second.

WEIGHT ADDED—NORMAL RANGE REDUCED

Chances are that kickoff won't be too successful—a soaking wet ball takes on so much weight that it just can't be kicked as far as if it were dry.

Added weight also affects plane performance. And resilient parts—gaskets, packings, seals, hose, diaphragms, accumulator bags—may take on weight by absorption of petroleum products with which they're constantly in contact. They may swell, too, reducing capacities of hose, accumulator bags and other parts.

That danger can be avoided by using parts made from Hycar. Lightweight to begin with, Hycar *stays* light because of its superb resistance to petroleum products. The twin problems of absorption and swell are licked. Look at this list. You'll see why there is no other material directly comparable to Hycar.

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Weights of Screws, Bolts, and Nuts

Machine Screws

Length	DIAMETERS										
	2	3	4	5	6	8	10	12	1–4"	5–16"	3–8"
1/8	.34	.49	.67	.90	1.18	1.81	2.73	4.00			
3/16	.42	.59	.79	1.06	1.37	2.09	3.09	4.49	6.55		
1/4	.49	.69	.91	1.22	1.56	2.38	3.45	4.97	7.20	13.46	
5/16	.57	.79	1.03	1.37	1.74	2.66	3.81	5.46	7.85	14.50	23.84
3/8	.64	.89	1.15	1.53	1.93	2.94	4.18	5.94	8.50	15.54	25.37
7/16	.72	.99	1.27	1.69	2.11	3.22	4.54	6.43	9.15	16.58	26.90
1/2	.79	1.09	1.39	1.85	2.30	3.50	4.90	6.92	9.80	17.63	28.43
9/16	.87	1.19	1.51	2.01	2.49	3.78	5.26	7.40	10.45	18.67	29.95
5/8	.94	1.29	1.63	2.17	2.67	4.06	5.63	7.89	11.10	19.71	31.48
3/4	1.09	1.49	1.87	2.49	3.05	4.63	6.35	8.86	12.40	21.79	34.54
7/8	1.24	1.69	2.11	2.80	3.42	5.19	7.08	9.83	13.70	23.87	37.59
1	1.39	1.89	2.35	3.12	3.79	5.75	7.80	10.80	15.00	25.95	40.65
1 1/8			2.59	3.44	4.16	6.31	8.53	11.77	16.30	28.03	43.71
1 1/4			2.83	3.76	4.54	6.88	9.25	12.74	17.60	30.11	46.76
1 1/2			3.31	4.39	5.28	8.00	10.70	14.69	20.20	34.28	52.87
1 3/4			3.79	5.03	6.03	9.13	12.15	16.63	22.80	38.44	58.99
2			4.27	5.65	6.77	10.25	13.60	18.57	25.40	42.60	65.10
2 1/4				6.30	7.52	11.38	15.05	20.51	28.00	46.76	71.21
2 1/2				6.93	8.26	12.50	16.50	22.46	30.60	50.93	77.32
2 3/4					9.01	13.63	17.95	24.40	33.20	55.09	83.44
3					9.75	14.75	19.40	26.34	35.80	59.25	89.55

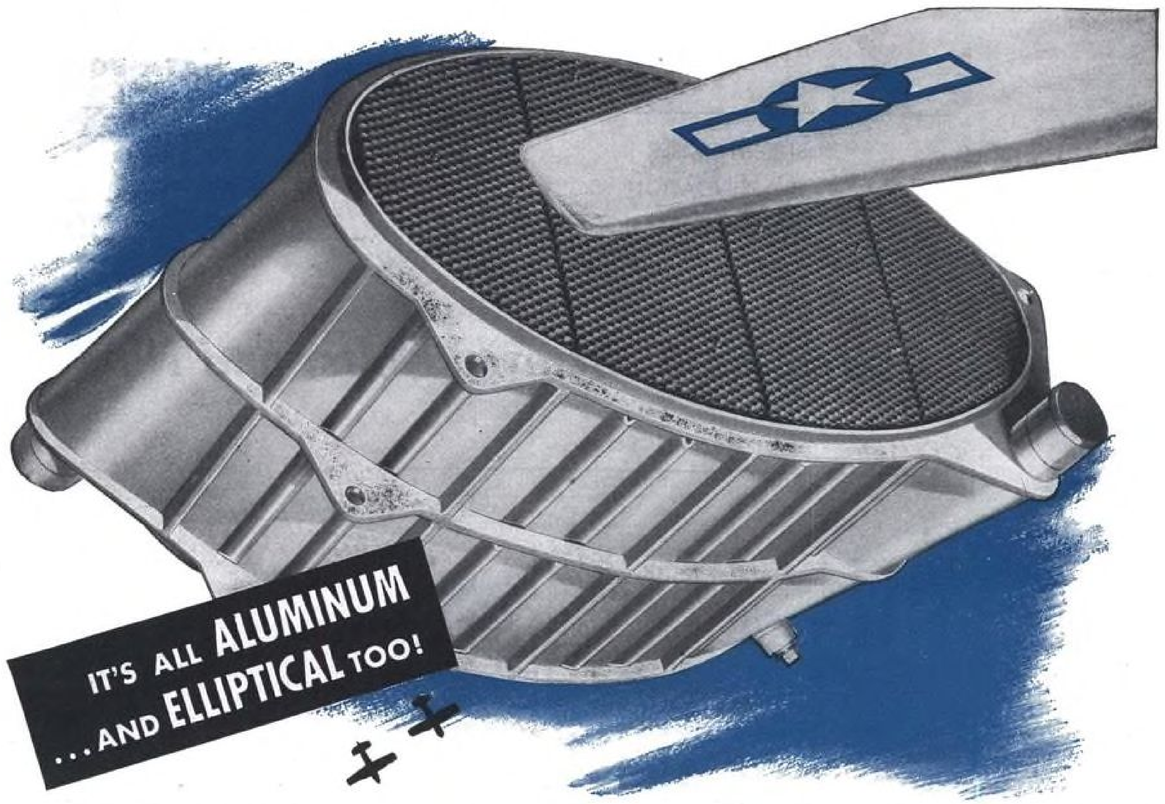
Stove Bolts

Length	DIAMETERS						
	1–8"	5–32"	3–16"	1–4"	5–16"	3–8"	1–2"
1/8	3.50	5.21					
3/16	3.66	5.49	7.09				
1/4	3.82	5.78	7.45	14.80			
5/16	3.97	6.06	7.81	15.45	29.40		
3/8	4.13	6.34	8.18	16.10	30.44	45.57	
7/16	4.29	6.62	8.54	16.75	31.48	47.10	
1/2	4.45	6.90	8.90	17.40	32.53	48.63	116.3
9/16	4.61	7.18	9.26	18.05	33.57	50.15	119.0
5/8	4.77	7.46	9.63	18.70	34.61	51.68	121.7
3/4	5.09	8.03	10.35	20.00	36.69	54.74	127.2
7/8	5.40	8.59	11.08	21.30	38.77	57.79	132.6
1	5.72	9.15	11.80	22.60	40.85	60.85	138.1
1 1/8	6.04	9.71	12.53	23.90	42.93	63.91	143.6
1 1/4	6.36	10.28	13.25	25.20	45.01	66.96	149.0
1 1/2	6.99	11.40	14.70	27.80	49.18	73.07	160.0
1 3/4	7.63	12.53	16.15	30.40	53.34	79.19	170.9
2	8.26	13.65	17.60	33.00	57.50	85.30	181.8
2 1/4	8.90	14.78	19.05	35.60	61.66	91.41	192.7
2 1/2	9.53	15.90	20.50	28.20	65.83	97.52	203.7
2 3/4		17.03	21.95	40.80	69.99	103.64	214.6
3		18.15	23.40	43.40	74.15	109.75	225.5
3 1/4		19.28	24.85	46.00	78.31	115.86	236.4
3 1/2		20.40	26.30	48.60	82.48	121.97	247.4
3 3/4			27.75	51.20	86.64	128.09	258.3
4			29.20	53.80	90.80	134.20	269.2
4 1/4			30.65	56.40	94.96	140.31	280.1
4 1/2			32.10	59.00	99.13	146.42	291.1
4 3/4			33.55	61.60	103.29	152.54	302.0
5			35.00	64.20	107.45	158.65	312.9
5 1/4			36.45	66.80	111.61	164.76	323.8
5 1/2			37.90	69.40	115.78	170.87	334.8
5 3/4			39.35	72.00	119.94	176.99	345.7
6			40.80	74.60	124.10	183.10	356.6
Weight of Square Nuts	2.60	3.40	4.00	7.60	14.90	20.20	52.7

Machine-Screw and Stove-Bolt Hexagon Nuts

Machine Screw Size	Stove Bolt Size	Width Across Flats			Thickness		
		Basic	Max.	Min.	Nominal	Max.	Min.
2		3/16	.1875	.180	1/16	.066	.057
3		3/16	.1875	.180	1/16	.066	.057
4		1/4	.2500	.241	3/32	.098	.087
5	1/8	5/16	.3125	.302	7/64	.114	.102
6		5/16	.3125	.302	7/64	.114	.102
8	5/32	11/32	.3437	.332	1/8	.130	.117
10	3/16	3/8	.3750	.362	1/8	.130	.117
12	7/32	7/16	.4375	.423	5/32	.161	.148
1/4	1/4	7/16	.4375	.423	3/16	.193	.178
5/16	5/16	9/16	.5625	.545	7/32	.225	.208
3/8	3/8	5/8	.6250	.607	1/4	.257	.239

(Courtesy Progressive Mfg. Co., Torrington, Conn.)



WHEN CLIFFORD STREAMLINES COOLANT RADIATORS FOR NEW AAF FIGHTERS . . . } **⅔X = A CENSORED WEIGHT-SAVING**

Clifford's discovery of the method of brazing aluminum tubes, having very thin walls, has revolutionized aircraft design two vital ways:

1. Now heavy-weight copper oil coolers and coolant radiators (with a weight of X) can be replaced by feather-weight aluminum without any design change. The resulting weight-saving is ⅔X. This victory over weight is now helping two famous types of USAAF fighters perform gloriously on many aerial battle fronts.

2. In addition, the greater strength of aluminum under continuous heat and pressure now enables aircraft designers to replace the traditional cylindrical radiators by models having a streamlined, elliptical cross-section. Two of these elliptical models assembled in "V" shape occupy far less space than two conventional numbers . . . offer far less air resistance . . . boost potential aircraft speeds by worth-while margins.

CLIFFORD MANUFACTURING CO.
South Boston 27, Mass.

CLIFFORD *Feather Weight* **OIL COOLERS AND COOLANT RADIATORS**

Save ⅔ The Weight ..same size and shape

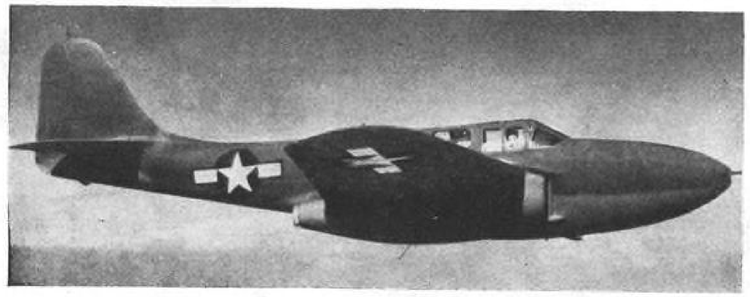
HYDRON

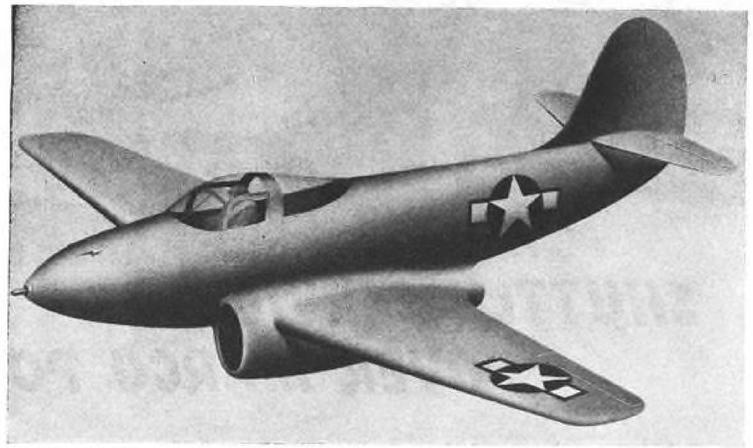
CLIFFORD'S "HYDRON" BELLOWS

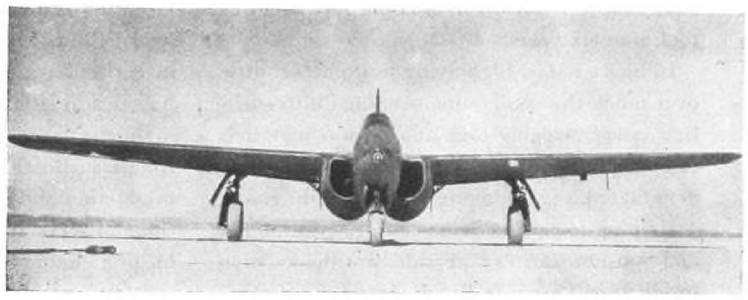
. . . INDUSTRY'S FIRST HYDRAULICALLY-FORMED BELLOWS

Bell's Jet-Propelled P-59A Airacomet

Here are first photos of Bell Aircraft's GE-jet-powered P-59A fighter . . . Comparative illustrations show striking similarity between earlier AVIATION conception (Feb. 1944 issue) and actual ship . . . British show their Gloucester jetplane.









JOHN Q. PUBLIC got his initial picture view of America's pioneer jet-propelled aircraft—the Bell Airacomet—when side and nose photos of the fighter were released late in September.

In addition, Britain's Gloucester jetplane, reported to have performed successfully against German robot bombs, likewise was revealed in a photo study.

Our top photo shows the side view of the Bell P-59A in flight. It will be immediately observed that several of the design lines which featured the Airacobra have been retained; however, the cockpit has been ranged forward for better pilot visibility, and empennage surfaces appear larger, likely for improved control in the absence of propeller blast. While retaining many of the Airacobra lines, the new Airacomet appears to be a larger craft, both in span and length.

Second illustration shows a jetplane conception which appeared in AVIATION'S article titled, " . . . And Now the Jet-Propelled Airplane," which appeared in our Feb. 1944, issue. That article was considering the probable approach of designers to the problem of developing a jet-propelled aircraft on the basis of the P-39's structure. It is readily apparent that this conception closely parallels Bell's finished product.

Third photo presents the P-59A from the front. It is seen that the jet power plants are located close to the fuselage of the aircraft, also that the fighter stands low to the ground, a long-arm undercarriage not being needed because, lacking a propeller, there is no problem of prop-clearance on this plane.

Bottom photo is of the British Gloucester, which will be noted to have its jet plant incorporated in the fuselage, as did the Italian Caproni-Campini craft, as shown in AVIATION'S Sketch Book of Design Detail for February, 1942.



SHUTTLE SERVICE OVER MARCO POLO'S TRAIL

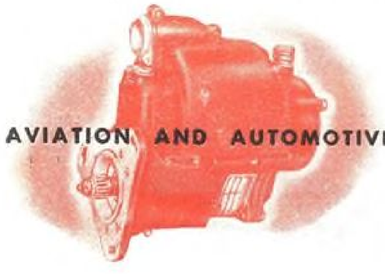
It is written that no man ever equalled Marco Polo's "speed" record in crossing Asia afoot. It took him six years.

In hours today, high-flying transports shuttle over much the same route, keeping China's life-line intact, winging tons of vital war materials to our fighting allies. Pilots fly this route, confident that plane and engine will deliver the goods.

Helping to push service ceilings even higher and non-stop ranges ever wider are the aviation products of American Bosch. Aviation magnetos perform dependably from sea level to the ceiling — in air temperatures that vary from +130° to −70° in a matter of minutes. Starting vibrators send fighters into the air faster. And new fuel injection equipment adds another plus to American plane excellence.

In the peace to come as in war today, American Bosch research, engineering counsel, production and maintenance facilities will continue to serve all branches of the internal combustion engine industry.

AMERICAN BOSCH CORPORATION
Springfield, Massachusetts



AMERICAN BOSCH

AVIATION AND AUTOMOTIVE ELECTRICAL PRODUCTS • FUEL INJECTION EQUIPMENT

Review of Patents

By A. HARRY CROWELL, *Registered Patent Lawyer*

FOLLOWING are digests of some of the more interesting recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will gladly furnish readers with free information on approximate cost and procedure in applying for patents and trademark registration. Address inquiries to him, care AVIATION, 330 W. 42nd St., New York City (18). Printed copies of any of patents listed are obtainable at a cost of 10c. each, directly from U. S. Patent Office, Washington.

Glider Towing Device assures immediate release of draft member from pair of oppositely acting locking jaws. Incorporated is spring-loaded indicator pin, cooperative with locking mechanism, which signals locked and unlocked condition.—2,350,999, filed Oct. 27, 1942, patented June 13, 1944, J. C. Beirise.

Emergency Landing Runway incorporates plurality of rollers extending above surface and arranged successively lengthwise to provide landing area affording traction for disabled plane.—2,351,002, filed Nov. 18, 1941, patented June 13, 1944, G. Burton.

Airframe Construction Process is concerned with spirally winding continuous-flanged metal channel upon mandrel and winding sheet metal strip to bridge channel. Overlapping margins of strip are electrically welded to channel flanges, using mandrel as one or electrodes, to form rigid plane body.—2,351,152, filed Aug. 23, 1940, patented June 13, 1944, H. M. Schick.

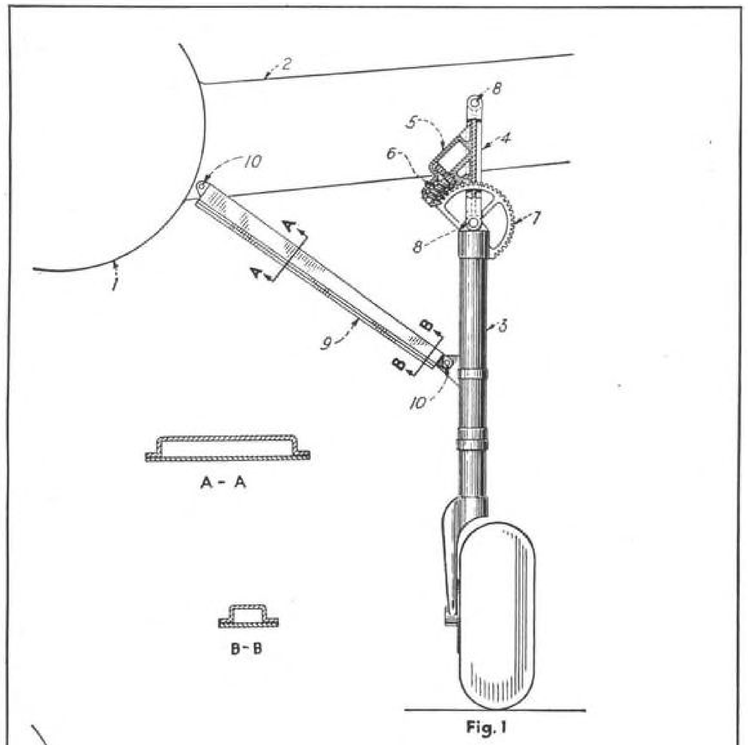


Fig. 1

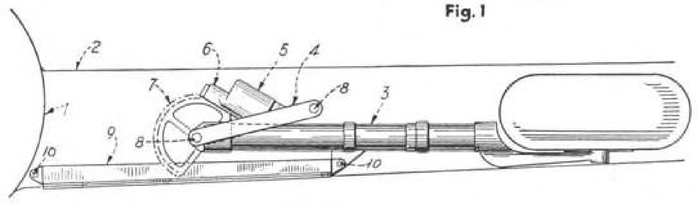


Fig 2

New Undercarriage Invention, relating to planes having relatively large-diameter propellers, has automatically self-locking gear adapted to fold while being retracted so as to reduce extent of main support strut mechanism for nesting in wing of relatively small spanwise dimension. In Fig. 1, (1) represents fuselage, (2) wing, (3) main support strut, and (4) forked link bracketed to reversible-type electric motor (5). Latter is coupled to worm gear (6) in mesh with crank-sector (7). Pivot pins (8) attach forked link to strut and wing structure. Lateral brace (9) is connected to strut and plane structure by pivot pins (10). Worm and gear arrangement (6-7) is stated to be inoperative by forces transmitted through strut-link members (3-4), and it is self-locking to provide strut-link assembly with rigid character. Fig. 2 shows landing gear mechanism in retracted position.—2,351,893, filed Nov. 27, 1941, patented June 20, 1944, P. S. Yujuico and D. B. Thurston, assignors to Brewster Aeronautical Corp.

Landing Gear Locking Means includes trolley movable into engagement with locking mechanism which comprises housing to receive trolley and trigger releaseable by spring latch to lock trolley. Special device fitted to locking mechanism is designed so latter cannot prevent landing gear from being moved to fully extended or retracted positions.—2,351,284, filed May 29, 1940, patented June 13, 1944, J. W. Overbake, assignor to the Glenn L. Martin Co.

Aircraft Ice Remover consists of parallel scraper arms on opposite sides of windshield, rotary scraper blades, and means for selectively controlling flow of antifreeze solution through arms to blade faces. Moving parts of mechanism subject to intense cold operate in bath of antifreeze, which serves as lubricant.—2,351,699, filed June 29, 1942, patented June 20, 1944, R. D. Parry and C. F. Hartman, assignors to W. W. Osborne (1/3).

Aircraft Canopy Invention includes feature of hinged entrance door located above fuselage longerons to form ceiling of canopy. Door hinge comprises fixed pins on windshield arch and semi-circular hooks on door frame. Door is actually hinged only in open position or when swinging about hinge axis, but it is free to be pulled out from outside or pushed out from inside in closed position, except for action of

(Turn to page 315)

Book Reviews

ZWENG AVIATION DICTIONARY, Compiled and Edited by Charles A. Zweng. Pan American Navigation Service, North Hollywood, Calif. 366 pages, illustrated. $6.00.

Encyclopedic dictionary of aviation terms and phrases designed for instructors, airmen, students, research workers, and writers. Subjects covered include: Aerodynamics, theory of flight, aircraft, power plant and aircraft maintenance, radio and instrument flying, air and celestial avigation, meteorology, and CAA regulations.

THE GEOGRAPHY OF WORLD AIR TRANSPORT, by J. Parker Van Zandt. The Brookings Institution, Washington, D. C. 43 pages, appendices, index. $1.

Volume is first of a series under the general title "America Faces the Air Age." This introductory work is limited to outlining the basic setting of the world air transport problem, reappraising our conventional ideas of geography and transportation economics, and delving into the fundamentals on which world air policy should be based. Succeeding volumes will deal with development aspects of global air transportation.

ESSENTIALS OF AERIAL SURVEYING AND PHOTO INTERPRETATION, by Talbert Abrams. McGraw-Hill Book Co., N. Y. 262 pages, glossary, bibliography, index. $3.

Aerial photographic mapping and reconnaissance has become of greatest war importance because it furnishes rapid means of obtaining information on enemy movements, installations, and methods of attack. This volume is designed to describe instructively the modern method of aerial photographic interpretation and mapping, also operation of photogrammetric equipment. Material is arranged in order of difficulty, the modern handbook-textbook style enabling reader to understand or to refer to elementary uses of aerial photographs before attempting more advanced uses. Noted were chapters on simplified mathematics including slide rule operation, surveying, and map types.

ARC AND ACETYLENE WELDING, by Harry Kerwin. McGraw-Hill Book Co., N. Y. 235 pages, illustrated, index. $2.50.

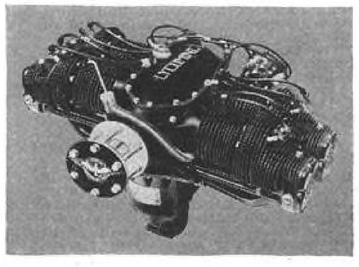
A nontechnical volume on acetylene and electric welding. Designed for students, instructors, and engineers, this work emphasizes the "110 percent" weld, reminding students they should sacrifice speed in favor of quality and accuracy to maintain this standard. Special welding techniques are stressed, for the author maintains students must master the actual manipulative technique of welding before advancing to welding of alloy metals and before studying construction and joint design as applied to welding.

What the men who fly them say—

LOG OF LYCOMING DEPENDABILITY

"100 STUDENTS, 1000 HOURS, 1 LYCOMING ENGINE..."

Harry T. Wilson, president of the Mid-South Airways Corporation and operator of Wilson Field, Memphis, Tenn., has chalked up 27 years experience in the aviation business. Back in 1917 he flew with the 193rd Squadron and has since operated his own airports and flying schools. He really knows aircraft engines — and has standardized on Lycoming 65's.



LYCOMING, MODEL O-145, developing 65 h.p. at 2550 rpm.

Weight — only 165 lbs., *7-10% less than competitive engines.*

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Williamsport, Pennsylvania

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I shipped you Saturday by Express one 65 horsepower Lycoming motor for major overhaul and modernization.

I am pleased to inform you that this motor has run 1006 hours with absolutely no repairs except its regular 20 hour inspection. Over 100 students have flown this ship, over 50 have taken solo courses on same and about 20 have taken their commercial and instructors rerating tests on it. We are very well satisfied with its performance which has prompted us to standardize on Lycoming 65's for our flying school.

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By Harry T. Wilson

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The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB POWELL, New York

T. P. Wright is Appointed CAA Administrator; World Air Policy Conference Opens Nov. 1

. . . C. E. Wilson leaves WPB and resumes his GE post . . . Air Policy Commission urged . . . Surplus planes tested at Ohio base . . . To mark 100,000 grid "addresses" . . . CAA 9th Regional Office to center at Hawaii . . . WTS sale nearly over . . . Russell directs ACCA.

Appointment by the President of T. P. Wright as Administrator of the Civil Aeronautics Administration was "an outstanding step in preparing American civil aviation to meet its heavy postwar responsibilities." Charles I. Stanton, who has been highly commended for his excellent services as Administrator through two tough years of war, resumes his former position of Deputy Administrator of the CAA.

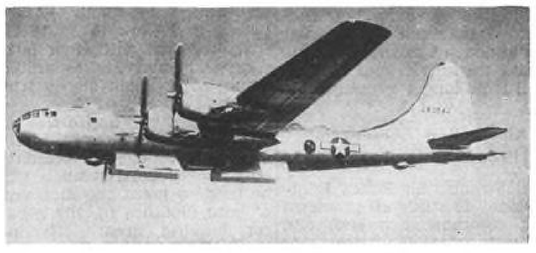
Mr. Wright, vice-president and director of engineering of the Curtiss-Wright Corp., brings to CAA a combination of experience in aviation and in government administration. He was Director of the Aircraft Resources Control Office from the time of its organization in Mar. 1943, and Recorder of the Aircraft Production Board. ARCO served as the executive agency of the board, which is now disbanded; as coordinator of production of airframes, engines, propellers; supervisory agency of the Aircraft Scheduling Unit at Dayton, Ohio; and liaison office between WPB, AAF, and Navy air forces with reference to aircraft procurement. Mr. Wright, as much if not more than any other man, helped to make reality of the President's original request for 50,000 airplanes.

Theodore Paul Wright was born in 1895; was commissioned as ensign in the U. S. Naval Flying Reserve; during World War I, became an inspector of Naval aircraft; later was appointed superintendent of Construction of Naval Aircraft for the New York District. Leaving the Navy, he became executive engineer with Curtiss Aeroplane & Motor Co., and he has spent all of his years since then in high office with the Curtiss and Wright companies.

An impressive list of famous airplanes were produced under his supervision as chief engineer, including Pulitzer and Schneider Cup Race winners, and the "Hawk," "Falcon," "Helldiver," "Shrike," "Condor". His "Tanager" won the Guggenheim Safe Aircraft Competition, and his paper, *The Tanager*, won SAE's Wright Brothers Medal.

The "Project Engineer" system of aircraft design and manufacture, developed by Mr. Wright, has since become standard practice in most major aircraft manufactories. In 1931, after the merger which created the Curtiss-Wright Corp., Mr. Wright was placed in charge of combined operations of the Curtiss Experimental Manufacturing & Research Activities at Garden City, (consolidated with the plant at Buffalo), as vice-president and general manager. In 1937, he was elected a vice-president of the parent Curtiss-Wright Corp., retaining his duties as Director of Engineering.

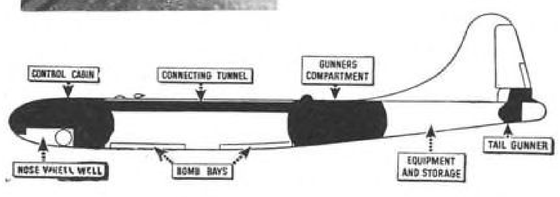
Mr. Wright is the author of many well-known documents on aviation, among them, *The Truth about the National Defense Program*, published by

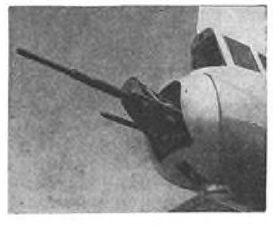




MORE SUPERFORTRESS FEATURES REVEALED

Additional details on Boeing's hard-hitting B-29 Superfortress were released during month, with graphic photos and diagrams accenting revelations. In flight shot above, remote-control gun turrets, formerly touched out of photos, are seen—top and bottom in nose, under tail and forward of dorsal fin aft, and in tip of tail. Twin bomb bays are likewise shown. Left: Closeup of top-rear twin-50 turret illustrates its fine streamlining and low profile. Behind is sighting station. Lower left: Pressurized sections of B-29 are depicted by shaded portions. Lower right: Tail has walloping 20-mm. cannon as well as two 50's. (Also see AVIATION'S Sketch Book, pages 197-201.)





Coming Up

October 19-21: The Electronic Parts & Equipment Industry Conference, Stevens Hotel, Chicago.

October 20: Air Transport Meeting, Institute of Aeronautical Sciences, Hotel Statler, Washington.

November 9-10: Fall Meeting, Institute of Aeronautical Sciences, Dayton.

November 13-14: National Association of State Aviation Officials, Annual Meeting, Oklahoma City.

November 13-14: Annual Fall Convention of Society of the Plastics Industry, Waldorf-Astoria Hotel, New York.

November 15-18: Second Annual Clinic of Domestic Aviation Planning, Oklahoma City.

December 4-6: Society of Automotive Engineers National Air Cargo Meeting, Hotel Knickerbocker, Chicago.

December 5-7: Aviation Distributors & Manufacturers Association, Second Annual meeting, Hotel Jefferson, St. Louis.

December 6-8: National Aviation Trades Association, Annual Convention, Hotel Jefferson, St. Louis, Mo.

December 17: Wright Brothers Lecture, Institute of Aeronautical Sciences, Washington.

January 8-12: Society of Automotive Engineers Annual Meeting & Engineering Display, Book-Cadillac Hotel, Detroit.

January 30-February 1: Thirteenth Annual Meeting, Institute of Aeronautical Sciences, New York.

April (date to be announced): Spring Meeting, Institute of Aeronautical Sciences, Detroit.

AVIATION in Jan. 1941, which won the Industrial Marketing Award of Merit for that year, and which was proved by later events to have been the clearest foresight analysis of air power to appear in this war.

Facing Mr. Wright as CAA chief are the problems of administering a vast new airport program which Congress is expected to authorize; administration of expanding airlines, feeder systems, fixed base operations, and the main development period of private flying still to come; cooperation in the establishment of vast American flag overseas services; and the working out of technical integration with the aviation of many foreign countries, particularly airworthiness requirements.

World Air Policy Parley Opens Nov. 1

More than 50 countries have been invited to attend the international conference scheduled to begin No. 1 in an as-yet-unnamed U. S. city. To consider world civil aviation policy, the meeting will climax earlier negotiations among spokesmen of various countries, who found numerous points of agreement as a basis for this coming major conference on postwar air routes.

Establishment of provisional world-routes, formation of an advisory council to act in the transition period following the cessation of hostilities, and determination of principles for a permanent international air body are called the prime points on the agenda.

Extent of the regulatory powers of the proposed world air organization and the question of "chosen instrument" vs. "free competition" will bring differences of opinion. Points where some agreement has already been reached concern the right of transit and non-traffic stops, application of sabotage in air traffic, control of rates, curtailment of government subsidies, the "non-exclusive" viewpoint of operating rights, and recognition of the need for uniform operating and safety standards.

The fall of Germany will open the way for numerous civil air services over Europe and Africa. That plans have developed broadly is indicated by the fact that several countries have already "filed" with our CAB for routes to the U. S.

C. E. Wilson Leaves WPB And Resumes GE Post

After two years of service as executive vice chairman of the War Production Board and as chairman of the Aircraft Production Board, Charles E. Wilson offered his resignation, which was accepted by President Roosevelt. During recent months a controversy had developed between Mr. Wilson and Donald Nelson, WPB Chairman, which finally rendered both of their positions difficult.

Mr. Wilson has resumed his former post as president of General Electric Co. Praise was accorded him from all sections of the aircraft industry for his part in the success of the warplane program. Wilson said that the program was over the hump, otherwise he would not leave it. The Aircraft Production Board was disbanded by unanimous vote of its members, who considered it no longer necessary.



YOUTH SHOWS THE WAY

W. H. Engle, chief test pilot for Fleetwings division of Kaiser Cargo, Inc., demonstrates Hiller-copter, novel-design helicopter designed and built by 19-yr. old Stanley Hiller, Berkeley, Calif., inventor. Kaiser has bought Hiller patents and given youth employment contract for further development—when Hiller returns from Army—and plans production at plant to be built in Berkeley. Contra-rotating rotors have 25-ft. length and fuselage is 12 ft. long. No anti-torque propeller is used.

Air Policy Commission Proposed in Congress

A 15-man "Air Policy Commission" to study all problems and recommend a civil and military aviation program for the United States is called for in a joint resolution offered in Congress by Sen. James E. Murray of Montana, and Rep. Jennings Randolph of West Virginia. Aim of the sponsors is to guard against the bad effects of curtailed activity in the industry when peace comes, and to make the most of American opportunities and advantages in the air.

Patterned after the Morrow Board which functioned during the Coolidge Administration, the commission would consist of representatives from the Senate, the House, executive offices of the government, from the industry, from labor, from science, and so on. It is hoped that confusion resulting from present conflicting efforts of many organizations would be resolved by establishment of the commission.

To Mark 100,000 Places With Grid "Addresses"

Grid marking of the entire country, to guide contact and lost flyers, will be started by CAA as soon as permission of the Army, requested last July 24, is granted. When war broke out, the Army ordered all marking obliterated as protection against the remote chance of invasion. The grid system adopted will consist of the names of about 100,000 places in letters 10 to 12 ft. high, together with their latitude and longitude, separated by an arrow pointing to true North.

The pilot will locate the air address of the place by reference to a standard co-ordinated map. Special symbols will be used to point the direction of, and distance to, the nearest landing area. Blanche Noyes, of CAA, is in charge of the program, which has been worked out in detail.

CAA 9th Regional Office To Center at Hawaii

As a result of increased air traffic in the Pacific area, CAA is creating a 9th Regional Office, with headquarters at Honolulu. The Territory of the Hawaiian Islands, and the Pacific Ocean area not now under the jurisdiction of the 8th (Alaska) Region, will comprise the area of the 9th Region. The standard regional equipment is being prepared for installation; a personnel complement will be assigned.

Establishment of the new oceanic region follows nearly a year of partially secret service of a CAA Traffic Control Center at Honolulu. This center manned late in 1943, has been handling traffic control for all aircraft westbound from California. Radio ranges, which overlap on the long run between California and the Hawaiian Islands, keep planes in constant radio communication with ground sources of aid.

Since the installation of the CAA center, pilots have found that what was a desperate situation in the months before is now no more than a routine problem often easily solved by the co-ordination of CAA experience with range work, electronic devices, radio voice, and all other possible aids to pilots in distress.

WTS Sale Nearly Over

Nearly 4,000 of the total 5,500 War Training Service trainer planes have been sold to bidders. Prices have come considerably below ceilings set by the OPA. Light low-powered types are by far most popular, though the heavier planes are also in demand for commercial purposes.

RPC recently announced the setting up of 30 centers throughout the country for disposal of planes declared surplus. This program does not interfere with the sales procedure of CAA-WTS. Planes weighing more than 5,000 lb. are sold by the Surplus Property Administrator. Estimates of the number of Army aircraft to be sold vary between two or three thousand and ten thousand. No combat types will be sold to the public.

Russell Directs ACCA

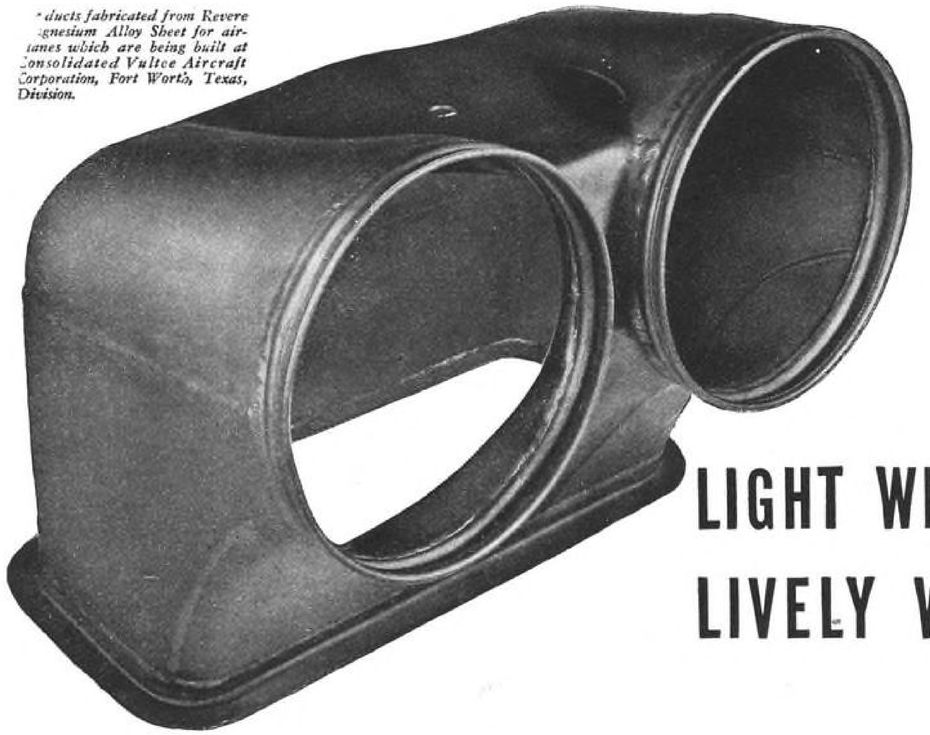
Appointment of Scott Russell as new general manager of the Aeronautical Chamber of Commerce is announced. Recently serving as general counsel for the Senate's George Committee on postwar planning, he previously was president of the Bibb Mfg. Co., cotton manufacturers, and also was U. S. District Attorney. In addition, he served as director of the American Cotton Textile Manufacturers Assn. and the Cotton Textile Inst.

John Lee will serve in consulting capacity to Mr. Russell through Coast firm of Lee & Losh.

★ SPOT CHECKING ★

Service tests on a large Army bomber of huge new 18 ft. 2 in. Curtiss Electric propellers are reported by C-W's Propeller Div., Caldwell, N. J. Ability of the blades to "efficiently harness 3,000 hp. and more in the substratosphere" is remarked by the company.

Dr. Paul R. Harrington, head of the Department of Aeronautical Engineering at Polytechnic In-



ducts fabricated from Revere gnesium Alloy Sheet for airtanes which are being built at Consolidated Vultee Aircraft Corporation, Fort Worth, Texas, Division.

LIGHT WEIGHT IS LIVELY WEIGHT!

REVERE Magnesium Alloys

DON'T be misled by the inevitable fact that thus far the use of magnesium for structural purposes has been largely confined to the airplane. As more and more of this remarkable light metal becomes available (and more is being released every day) you will find magnesium creating the new light metal age, in which a great many things that move will do so more quickly and economically and easily because magnesium is used in them.

Remember that it costs money to move anything—trucks, trailers, elevator cages, railroad cars, buses, *anything*. And it costs money to ship to, and move around a plant, the materials of which they are made. It takes effort to move such common articles as vacuum cleaners, hand tools, portable typewriters, chairs. Weight reduction will be *so* important after the war!

Revere Magnesium Alloys are available now in the form of sheet and plate, rod and bar, tubes and shapes, forgings and forging stock. The Revere Technical Advisory Service will gladly assist you in obtaining magnesium's maximum advantages... Write for your complimentary copy of the new 32-page booklet, "Revere Magnesium Alloys and the Light Metals Era."

THE FOUR REVERE MAGNESIUM ALLOYS

Working Characteristics	"M"	"FS-1"	"J-1"	"O-1"
FORMABILITY	Good	Excellent	Fair	*
STRENGTH	Good	Good	Excellent	Excellent
WELDABILITY	Excellent	Good	Excellent	Excellent
DEEP DRAW	Excellent	Good	Fair	*
FORGEACILITY	Excellent	Excellent	Excellent	Excellent
MACHINABILITY	Excellent	Excellent	Excellent	Excellent

*Heat-treatable extrusion or forging alloy

REVERE
COPPER AND BRASS INCORPORATED
MAGNESIUM—ALUMINUM DIVISION
Founded by Paul Revere in 1801
Executive Offices: 230 Park Avenue, New York 17, N.Y.



ALUMINUM'S "PORT OF EMBARKATION"—outside Reynolds' great plant at Listerhill, Ala., millions of pounds of aluminum ingots await their swift transformation into sheets for airplane wings, foil to protect supplies, hundreds of other uses. Reynolds has rolled more light-gauge aluminum than any other company.

REYNOLDS ALUMINUM:

A shortage turns into abundance...and America gets more efficient weapons

WHEN snarling Axis planes swarmed over Europe's sky, they thundered out the inescapable fact that this was to be a war of *light metals*—of aluminum.

At that time, Germany was making *three times* as much aluminum as the United States.

This was a plain warning of peril to America. Heeding it, Reynolds Aluminum went into action. On its own resources, Reynolds set up huge new aluminum plants . . . started the long fight to end a shortage of aluminum that could be disastrous for this country.

Today, the success of this struggle is apparent in one great fact of American aluminum production... output is now more than enough to fulfill minimum war needs—that is, aluminum for our growing thousands of warplanes.

The hard-won abundance of this vital metal means that aluminum can now be applied to dozens of uses where *lightness* plus *strength* will mean a more efficient weapon for airfield landing mats; gun mounts; cartridge cases; hundreds of other war uses.

"THE FUTURE THAT COUNTS MOST"

Reynolds has its plans, and its definite program for peacetime application of aluminum's magic to hundreds of new uses; but the men of Reynolds have taken to heart the words of Robert P. Patterson, Under Secretary of War . . . "The future that counts most," said Mr. Patterson recently, "is that stretch of time between this day and that day on which the last shot of this war will be fired.

"Aluminum, alone of the three controlled materials, is meeting production schedules on military requirements; but for any of us to interpret this as a signal to take it easy is an error. Our opportunities to serve our fighting men can be as inexhaustible as is our debt to them for what they do."

Reynolds intends to meet this challenge—to produce, in its 40 plants, for "the future that counts most."



WEAPON OF AIRBORNE INVASION... airfield landing mats, potent weapons of attack, are now made of tough aluminum alloys, strong enough to withstand the jounce of giant bombers.

REYNOLDS METALS CO.,
Aluminum and Parts Div., Louisville 1, Ky.

stitute, Brooklyn, N. Y., announces formation of the Long Island Aeronautical Engineering Conference as a means to consolidate research activities.

Convair is issuing to its employees a frank report titled, "We Face the Future". Aim is to build worker recognition of the great need to stay on the job.

National Aeronautic Assn. advocates taxation of aviation gasoline by state governments, with proceeds to be earmarked for aero development.

Though Higgins Aircraft, New Orleans, lost contract to make Curtiss C-46's, company still retains subcontract for C-46 wing panels.

Dominator is name chosen for Convair's huge B-32 bomber. Chairman of Board Tom Girdler is stated to have originated this designation.

Donald W. Douglas is new president of National AWPC and also heads AWPC, West Coast. Alfred Marchev, Republic head, has become v.-p. of the national body, and new AWPC West v.-p. is Harry Woodhead, prexy of Convair.

War Dept. announces Northrop "Black Widows" are now in action in both European and Pacific theatres.

At press time, Georgia Aviation Clinic was being called to order in Macon. Chief accent in statewide meeting was to be upon acquisition, use, and development of airports. Also underway at this writing was First Annual Meeting of Magnesium Assn. in New York City.

AAF has opened a helicopter school at Freeman Falls, Ind. Col. E. T. Rundquist is commanding officer.

Thirty-passenger transport featuring high-wing has been designed at Glenn L. Martin and is aimed to satisfy air patrons desire for better views of ground.

Fairchild recently successfully tested its new C-82, twin-boom tricycle-gear military cargo plane. Craft is described as "in the 50,000-lb. class, with range better than 3,500 mi." It mounts two radial engines. Aft end of fuselage opens to accommodate freight.

★ CANADIAN NOTES ★

By James Montagnes

Canadian aircraft factories delivered 12,908 aircraft, comprising 17 types, since start of war to end of June 1944, and they had orders for 5,393 more planes. Seven types are now produced. The aircraft industry has been extended capital assistance of $68,563,000 of which $15,589,000 is for aircraft overhaul. Of types now in production, deliveries were: De Havilland Aircraft of Canada, 227 of an order for 1,500 "Mosquitos," comprising 670 bombers, 773 fighter-bombers, and 57 trainers; Victory Aircraft Ltd., 81 of 600 "Lancaster" bombers; Canadian Car & Foundry, 220 of 1,030 Curtiss "Helldivers" for U. S. Navy; Fairchild Aircraft of Canada, 175 of 705 Curtiss "Helldivers;" Boeing Aircraft of Canada, 233 of 380 Catalina PBY's; Canadian Vickers, 212 of 369 Catalina PBY's; Noorduyn Aviation, 539 of 1,146 "Norseman" transports, and 2,278 of 3,120 Harvard advanced trainers; and Federal Aircraft, 742 of 1,300 Anson V twin-engine trainers. Parliamentary Committee on War Expenditures recommended that new orders should be for tranports planes, and immediate postwar planning was urged.

Canadian Fleet Air Arm is being formed. RCAF is training the personnel.

Canadian Government has established two new companies at Leaside, Ont. One company, Turbo Research, Ltd., working closely with similar organization in Britain, will design and develop jet propulsion and gas turbines for aircraft. Other is Aero Meters, Ltd., which takes over instrument plant of government-acquired Sutton-Horsley Co.

RCAF has inaugurated vocational counselling plan to give its personnel better-than-average postwar employment opportunities.

By F. H. Fullerton

Boeing Aircraft of Canada is working out arrangement with Boeing in Seattle, whereby parts for B-29's will be produced in former's Vancouver plant.

Philip G. Johnson Dies

One of the nation's most prominent leaders in the aviation industry, Philip G. Johnson, president of Boeing Aircraft Co., died in Wichita, Kan., Sept. 14, at the age of 49. His demise ends a remarkable career of achievement in organization and production activities.

Beginning with Boeing as a draftsman shortly after he graduated with an engineering degree from the University of Washington, he rapidly rose to positions of plant superintendent, production manager, and vice-president and general manager. In 1926 he became Boeing president.

Subsequently, the company entered the new field of commercial air transport. Boeing Air Transport was formed with Mr. Johnson as president. In 1931, the company was reorganized as United Aircraft & Transport Corp., one of the largest organizations of its kind. Then, following cancellation of air mail contracts in 1934, the company was subdivided into separate activities.

In 1937, Mr. Johnson aided in the organization of Trans-Canada Airlines and with the approaching aspect of world-wide conflict, returned to head Boeing in 1939. Under his guidance, Boeing delivered its renowned contribution to the war effort in a huge production of Fortresses and Superfortresses, and in Mar. 1944, even exceeded its own top-flight production records.

Mr. Johnson was a member of IAS, ASME, NAA, SAE, ACCA, and other organizations, and at various times in his career he served as president of Pacific Air Transport, Varney Air Lines, National Air Transport, and United Air Lines.



The late Philip G. Johnson

Other Obituaries

Cuthbert Hicks, RAF officer in World War I and later attached to British Air Ministry. He was national director of Amelia Earhart Foundation in 1938.

Sir William G. S. Mitchell, Air Chief Marshal and London Commandant of Air Training Corps. He entered British Army in 1906, later qualified as pilot with Royal Flying Corps, and after World War I was permanently commissioned in RAF. Subsequently, he served as Commander, School of Technical Training; Director of Training, Air Ministry; Commandant, RAF College; Commander in Chief, Middle East RAF; and Inspector General, RAF.

Frederick C. Kroeger, vice president of General Motors Corp. and manager of its Allison Div. He was formerly manager of Delco-Remy Div., Anderson, Ind. Graduated as an electrical engineer from Purdue University in 1911, he entered employment with Delco-Remy in 1913, and in World War I he was with Army Motor Transport Corps as head of electrical equipment design.

AMERICA AT WAR

Aviation's Communique No. 34

Allied aviation carried a heavy part in the task of backing the German army into its homeland. Attack planes and bombers extensively hindered the Nazi rush of troops to invasion points. Even more effectively it broke up their organization in retreat. A third result of the air attack is reduction of the enemy's strength in his border stand.

Allied destruction of enemy roads, waterways, bridges, and airfields has, of course, also obstructed the progress of the Allies own ground forces, or the enemy could have been thrust back even faster than he was.

Creation by Gen. Eisenhower of a full-size airborne Army stands as an assurance against an impasse at any German defense line. The flying Army, fully equipped with field guns, tanks, tools, and supplies, can take the overhead route to its objectives in Germany—at the risk of proportionate loss of course.

While tactical air support of Allied ground operations becomes more intense increasing air strength enables the bomber commands to continue their strategic attacks on Nazi installations at pre-invasion levels. Forces of 3,000 and more bombers are still hitting enemy oil works, aircraft plants and chemical production. It would be possible for AAF and RAF to throw perhaps 10,000 combat craft, including some long-range attack planes, at a given objective in Germany.

Far East

The Pacific theater is ready to utilize the same vast land and air forces that have been putting the knockout on the Nazis. These reinforcements, which will include also the considerable British aircraft carriers and many warships, will more than double the power now facing Japan.

Adm. Nimitz recently told the press he did not know exactly how Japan would be beaten, and he probably meant it. This enemy is much weaker in steel production than Germany was, and the 20th Air Force attacks may mortally hurt its steel supply for ships and weapons. But the Allied submarine and air attack on shipping could do the trick, too. Several officials have expressed opinion that a land invasion will be necessary.

Boeing B-29 operations against Japan are increasingly satisfactory. Some changes have been made in the ships. Most gratifying is the low rate of loss of the Superfortresses, due to armor, gunpower, speed, and altitude. Meanwhile, the Japs have developed some high quality combat planes which will be ready for the showdown battle. Indeed, all fighting characteristics of the Nip planes have been improved, especially the horsepower and performance of the engines. This equipment will give the Allies some trouble. But whether it can tackle the B-29's effectively remains to be seen.

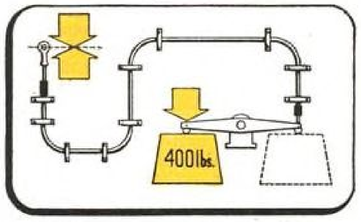
The Allied air forces in China are now superior to those of Japan, and our control of the air has crept North to include part of the Philippines, and Westward to include islands within 600 mi. of Tokyo. Bombardment of Japan from bases which can receive gasoline from tankers—instead of from cans flown over the Burma hump—may start any time. The B-17's and B-24's, as well as the B-29's and B-32's, can be brought into this action.

Dependable *all around duty assured with* Simmonds Push-Pull Controls

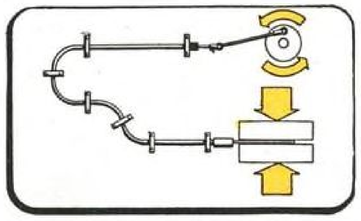


FIRST TO CARRY THE YELLOW DOT

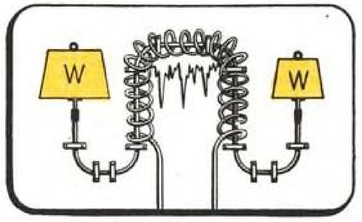
of Army Air Force Winterization acceptance for operation in extreme temperatures is the Simmonds-Corsey Push-Pull Control. Comprehensive tests with temperatures as low as minus 72°F. and as high as 160°F. prove efficient operation under wide variety of conditions.



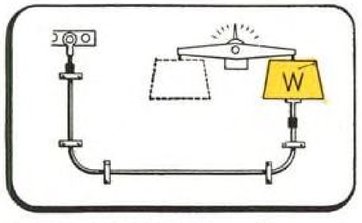
STATIC STRENGTH: *In this test Simmonds push-pull control successfully withstands tensile and compressive forces of 400 lbs. Credit simplification of design, improved linkage.*



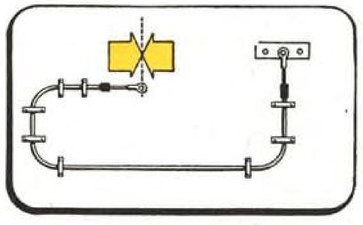
ENDURANCE: *Cycled 30,000 times under stress, as illustrated, Simmonds controls are not affected in any way, and can be expected to outlast the life of unit served.*



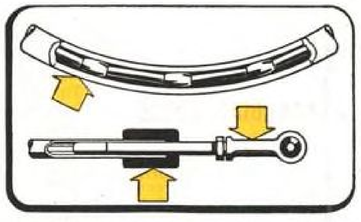
EFFICIENCY: *Input-output ratio of control is measured at various temperatures in insulated chamber. Result: average efficiencies are twice the AAF requirements.*



PRECISION CONTROL: *Motion between tension and compression is negligible. Before endurance test: average—.046"; after—.082". Simmonds are precision-built controls.*



DEFORMATION: *AAF specifications call for loads ranging from 10 to 50 lbs. Allowable average deformation is .140". Simmonds controls average only .083".*



CORROSION: *Simmonds controls meet AAF specifications for corrosion resistance with standard cadmium plated or anodized surfaces. Tube ends are rubber sealed.*

INQUIRIES concerning War Contracts or Post-War problems involving push-pull control equipment are invited. Our service engineers will furnish you gladly with analyses and recommendations. Telephone or write to your nearest Simmonds office.

SIMMONDS EQUIPMENT FLIES WITH EVERY TYPE OF ALLIED AIRCRAFT

Automatic Engine Controls — Push-Pull Controls — Spark Plugs
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Self-Aligning Rod-End Bearings — Fasteners and Clips of Specialized Design

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New York 20, New York

Branch Offices: Dayton • Washington • Hollywood • Montreal

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★ CALLING NAMES ★

Dee H. Hollowell has been elected v.-p. in charge of sales and service for aircraft div. of Continental Motors Corp.

Garrard Mountjoy becomes head of Lear, Inc., Radio Laboratories.

Renville H. McCann, procurement control manager for Republic Aviation Corp., has been loaned to AWPC, East Coast, to serve as coordinator between AAF and manufacturers in handling surplus materials.

Capt. Joseph H. Hart, Jr., Pan Am. pilot, joins Century Club on completion of his 100th crossing of Atlantic.

C. W. Perelle, Convair v.-p. in charge of manufacturing, has resigned to join Hughes Tool Co., headed by Howard Hughes. Other Convair changes: **Norton C. Sather,** manager of Miami division, takes similar post at New Orleans division, being succeeded by **L. H. Cooper,** Elizabeth City division manager; **W. A. Schiller** becomes assistant factory superintendent at Ft. Worth division; **A. E. Shelton** becomes Allentown division manager, succeeding **R. J. McMahon,** who returns to San Diego division; **W. L. (Swede) Larson** and **James L. Fetcher** become works manager and chief engineer, respectively, at Allentown.

T. W. Tinkham becomes general manager of Bendix Aviation Corp's, Eclipse Machine division at Elmira, N. Y., succeeding **William L. McGrath,** who is retiring. **E. P. Case** is appointed director of advertising and publicity for the company's Philadelphia division.

Raymond J. Cowden is named general contract manager for American Propeller Corp., Div. of Aviation Corp., and **Richard E. Posthauer** becomes manager of military contracts and service of Lycoming Div.

George A. Snodgrass, assistant factory manager at Curtiss-Columbus becomes assistant to Gen. Mgr. **J. P. Davey,** succeeding **E. J. Lyons,** who becomes industrial relations manager for C-W's airplane division, with headquarters at Buffalo. Lyons succeeds **Charles S. Mattoon,** who becomes industry member of National Airframe Panel of War Labor Board. After some months in Washington, Mattoon will open offices as consultant on industrial relations problems. **Clyde E. Smith** has become assistant manufacturing manager for Ranger Aircraft Engines Div. of Fairchild; **James F. Stengel** has been appointed director of industrial relations; and **Frank M. Begley** becomes security director.

Orrin R. Broberg, assistant manager of engineering service, aircraft and transportation division of Adel Precision Products Corp., has been granted leave of absence to join the Office of Scientific Research & Development in Washington.

E. K. Hubbard, II, has been named surplus materials officer for Pratt & Whitney Div. of United; **H. E. Carlson** assumes responsibility for sales contracts control; **Allen Dewing** becomes assistant manager, spare parts sales; and **Robert Storrs** is appointed supervisor of spare parts sales.

Roger C. Fleming, regional director for General Motors public relations at Indianapolis, becomes director of advertising and public relations for Allison Div.

Arthur Nutt, v.-p. of engineering for Wright Aeronautical, has resigned. He had been with both Wright and Curtiss for 28 yr.

G. W. Simonds, plant suggestion coordinator for all Douglas plants, has retired after 22 yr. service with the company.

TWA announces appointment of **William F. McGrath** as traffic manager of new transportation dept.; **Howard K. Morgan,** former superintendent of communications, to the post of director of engineering, to be succeeded by **Gordon A. O'Reilly; Robert I. Robinson** to sales promotion manager; and **Charles E. Hurley** as supervisor of military contracts.

THE WASHINGTON WINDSOCK



By BLAINE STUBBLEFIELD

Almost unanimous opinion is that flying bombs will be a major weapon in any future wars. Further development of them is chiefly a problem in aircraft design. There are several ways of obtaining accuracy of aim, and the range can be greatly increased. Already the air forces of this and other countries are planning research on the robots.

The air marking program approved by the CAA—to guide contact and lost flyers by means of ground "addresses" coordinated with a grid map—may be abused and confused by outdoor advertisers, unless some control is exercised. On the other hand, advertisers, with proper regulation, might assume most of the cost of the system, with advantage for all concerned.

The Stubblefield award goes to the Army. Stanley Hiller, boy builder of a new helicopter (photo on page 218), was asked by the Navy to produce additional models—but then the Army drafted him.

Great demand for trucks in Europe was partly due to lack of rail facilities, which were knocked out by Allied air forces during the time the enemy held them.

People who should know say that manufacturers in one line will not muscle into other lines of production, as often predicted. Auto men will be too busy meeting demand of cars to bother with a "smallish" airplane market. Most people who moved into aircraft were *established* in some other business—to which they will return.



ACHTUNG! ANOTHER SPITFIRE

First photo of latest in Spitfire line, Mark XIV. Powered by 12-cyl. Rolls Royce Griffon engine developing over 2,000 hp., it has new five-blade constant-speed Rotol propeller. Armament shown is battery of four 20-mm. cannon, but other installations include two 20's and two 50-cal. machine guns or two 20's and .303-cal. machine guns. Drop tank fittings beneath fuselage will take 250 or 500-lb. bomb. Increased power, two-stage supercharger and retractable tail wheel give it greatest speed and altitude of any Spitfire version. (British Combine)

George Tharratt becomes general manager of Lear Avia, of California.

H. Ainsley Highman, UAL New England executive, is named administrative supervisor on the Atlantic Seaboard, including New England; New York, and Philadelphia. **Eugene A. Raven** becomes assistant director of advertising for agency and direct mail activities, and **Lawrence E. Apitz** becomes sales control manager at Chicago for UAL.

Col. Harris B. Hull of New York and Washington, on staff of Lt. Gen. Ira Eaker, has been awarded Legion of Merit.

Col. Harry C. Short is named manager of Continental Air Lines Denver modification center, succeeding **Stanley R. Shatto,** who has returned to Continental as v.-p. in charge of maintenance and engineering.

Ernest B. Riley, assistant passenger manager for American Export Airlines, returns to American Export lines.

Leonard F. Bouman has been appointed joint representative in the U. S. for KLM and KNILM Airways.

Port of New York Authority has named **John W. Moore** traffic manager for air transport.

Capt. A. E. Wilson, PCA assistant chief pilot, has been transferred to engineering department, and he is succeeded in flight duties by **Capt. J. A. Brooks. C. A. Lupole** now takes post vacated by Capt. Brooks.

C. H. Bennum is promoted from assistant sales manager to field sales manager for Aircooled Motors Corp.; and **W. F. Burrows** has been elevated to senior project engineer.

Lt. Col. Edward C. Greene, USA (ret.), has been named medical director for American Airlines, succeeding Dr. Hodges McKnight, who has resigned because of ill health.

Brig. Gen. Charles R. Glenn, surgeon on Lt. Gen. B. K. Yount's AAF Training Command staff, becomes deputy air surgeon on staff of Gen. H. H. Arnold.

Terrell C. Drinkwater, recently resigned executive v.-p. and g. m. of Continental Air lines, has been elected a director of American Airlines, succeeding the late **Hollis R. Thompson.**

Air Marshall Sir Harold E. Whittingham, director general of medical services for the RAF, will receive John Jeffries award of Institute of Aeronautical Sciences for his contribution to aero medical research.

Willard C. Drum has been made industrial relations director for Timm Aircraft Corp.

David B. Peckham, comptroller of sales for Western Electric Co., has been appointed comptroller of manufacture, and he is succeeded in sales by **Clifford W. Smith.**

F. G. Malbeuf, former regional director of public information for American Airlines, is now assistant director of that service.

Arthur F. Cofod has been appointed assistant cargo manager of American Export Airlines. **William C. Silkie** is now station cargo manager.



Photo Courtesy Boeing Aircraft Co.

PRESSTITE Sealing Compounds

Extensively Used in Boeing's Giant B-29 Bombers

Nose sections, Plexiglas enclosures and gun turrets are sealed with Presstite No. 23212 Synthetic Glass Extruded Tape. It is also used between window pane flanges and window panes of the B-29.

Various holes and slots in the pressurized cabins, watertight compartments, and the vapor seal in the wings are sealed with Presstite Type SH-30 Thiokol Sealer. Presstite Type 11544 Brush-On Cabin Sealer seals the riveted seams in pressurized sections.

Meeting the complex sealing requirements of our vast aircraft industry is only one example of Presstite's ability to develop sealers for specific requirements. For today, on land, sea, and in the air, Presstite products are being used in ever-increasing quantities by our Armed Forces.

If your product or your manufacturing processes require sealing or coating compounds, send your requirements to *sealing specialists*. Presstite will gladly work with you and your engineers in suggesting the most effective compounds to meet your particular needs.

PRESSTITE SEALING COMPOUNDS

A Partial List of Industries for Which Presstite has successfully Developed Special Sealing Compounds:

For the Aircraft Industry:
Sealers for
Integral Fuel Tanks
Fuselage Seams
Drop-off, Expendable Fuel Tanks
Gun Turrets
Synthetic Glass
Instruments
Intercoolers
Air Ducts
Insulating Dissimilar Metals
Seaplane Floats

For the Refrigeration Industry:
Sealers for Domestic and Commercial Refrigerators
Bonding and Sealing Low Temperature Insulation in Refrigerated Rooms

For the Railroads:
Sealers for Insulating, Soundproofing and Weatherproofing of Railway Cars—Sealing Car Windows and Spot Welded Seams

For the Building Industry:
Roof Coatings, Caulking, and Waterproofing Compounds

For the Shipbuilding Industry:
Insulation Adhesive and Sealers — Rust Preventive Compounds

For the Automotive Industry:
Special Adhesives and Sealers

For the Construction Industry:
Sealers for Jointing Sewer Pipes
Sealers for Waterproofing Excavation Work

Miscellaneous:
For Glazing Greenhouse Windows
Extruded Caulking Compounds
Ammunition Paints
Plus Many Special Products for the Army and Navy

Our Engineering, Technical, and Laboratory facilities are at the service of any industry with a sealing problem.

PRESSTITE ENGINEERING CO., 3910 Chouteau Avenue, St. Louis 10, Mo.

Nazi Fall to Allow Wide Switch to Civil Craft; See 3,000 Cut in Monthly Warplane Output

. . . Personnel reduction gaged . . . August Plane Production down to 7,939 . . . It's 1,500 heavies monthly . . . Surplus-plane prices expected to drop . . . Scrapping of war craft necessary—Lovett.

"Any plant and any materials" not needed for war work shall become available for production of civilian goods when Germany quits the war, in accordance with the WPB's big cutback order. This opens the way for immediate manufacture of aircraft for scheduled, fixed base, and private operation.

A number of airplane plants, favorably located with reference to manpower, have been ready for this order for several months. Most of them will commence production with prewar designs to satisfy the urgent immediate demand for new equipment. Nearly all materials needed to build airplanes are now on the plentiful list.

A considerable cutback from the current level of about 8,000 military aircraft per month—perhaps to below 5,000 per month—upon cessation of hostilities in Europe has been the expectation of government and industry officials. Manpower, materials, and plant facilities thus made available for peace work could produce many times the number of airplanes needed for the civilian market. A large portion of plants will go back to production of goods not in the aircraft line.

Problem of reconversion and readjustment to the new era is now definitely upon the industry's doorstep.

Personnel Reduction Gaged

Maj. Gen. Oliver P. Echols, Assistant Chief of the Army Air Staff, recently told the Senate War Investigating (formerly Truman) Committee that the aircraft industry's manpower will be reduced by 294,000 workers by next July. About 20,000 employees have already been released as a result of cutbacks in Consolidated B-24's, Curtiss-Wright C-46 "Commando" transports, and Republic P-47 "Thunderbolts."

The General said that the Ford Willow Run plant's output of B-24's will be stepped back to half the present rate by December, releasing 17,000 of the 30,000 employees.

Corresponding cuts will take place in Buick engine plants and propeller plants which supply Willow Run. Stop orders soon will affect all categories of aircraft, except long range bombers. War agencies anticipate that for a while most released aircraft workers will be needed in other industries.

August Plane Production Down to 7,939

Total production of military aircraft declined from exactly 8,000 in July to 7,939 in August. This was 3.5 percent below the revised August schedule of 8,228 units. Emphasis on heavy bombers will cause the unit output to decline throughout the rest of this year—or until Germany goes down.

Many war officials and Congressmen believe the Allies already have enough aircraft in action and in process to finish the war. But no one is willing to risk any sacrifices that might result from unforeseen contingencies. And both Army and Navy are wary lest the Japs come through with unexpected air strength when the battle moves onto their home grounds. Japan's air forces have recently put into production some combat airplanes of high quality.

It's 1,500 Heavies Monthly

Some time before his resignation, Charles Wilson, chairman of the now-disbanded Aircraft Production Board, promised to reveal figures on production of heavy bombers. Just as he was about to leave Washington, Wilson got permission of the Army and Navy (which had long refused his request), and announced that about 1,500 heavies had been produced in each of the months since June.

It may be recalled that last January Wilson said the output of heavies had exceeded 1,000 for the first time: The figure was 1,300. Totals are not yet broken down into deliveries of B-29's, B-17's, B-24's, and B-32's, but the production of 29's and 32's will increase, while that of 17's and 24's will decline toward termination. More than 15,000 heavy bombers have been built, it is stated, in the past 12-mo. period.

Surplus-Plane Prices Expected to Drop

Anticipated availability of new civil airplanes is expected to push down prices for thousands of surplus warplanes to be sold by the Defense Plant Corporation, or other disposal agency to be set up by Congress. Many of the surplus planes are desirable for peace service only as fill-ins in the absence of equipment designed for specific work.

Many of them, though able to pass airworthiness inspection, are extensively worn and about ready for costly repairs. On the other hand, many are in good shape. Every purchaser is advised to have his selection checked by an expert before taking delivery.

Even though the prospect of new airplanes on sale may reduce the price of surplus planes, most observers believe that everything available, new and used, will be taken for months to come.



TWIN-ROTOR PLATT-LEPAGE DROPS ITS "X"

Word comes that AAF has now accepted Platt-LePage dual-rotor helicopter, hence craft's old designation of XR-1 has been shortened to R-1. Seen here hovering above Wright Field, ship has ample "greenhouse," making pilot visibility a feature. Helicopter's twin rotors preclude need for anti-torque prop at tail, so empennage lines of craft bear similarity to those of a conventional plane. (Press Association photo)

Scrapping of War Craft Necessary — Lovett

Large-scale realistic scrapping of surplus and obsolete military airplanes will be necessary after the war if the United States is to maintain its world leadership in air fighting, according to Robert A. Lovett, Assistant Secretary of War for Air.

Maj. Gen. Oliver P. Echols, AAF Assistant Chief of Staff, recently told the House Committee on Postwar Military Policy that 8,000 Army planes already have been declared surplus, and that "a considerable number" in addition will be so classified when the German phase of World War II is terminated.

Surplus Planes Tested At CAA Ohio Base

A flight base has been opened by CAA at Vandalia, Ohio, for airworthiness testing of various military aircraft which are now, or will be, declared surplus and sold to the public. When a type is declared surplus, one plane is marked for test and is given a 24-hr. run to determine length of takeoff, rate of climb, stability, and other characteristics which determine airworthiness.

J. D. McCutcheon, manager of the station, can recommend licensing as is, licensing with modification, or withholding of certification. Commercial versions of such planes as the Curtiss C-46, Douglas C-54, and the Lockheed C-69, which have not been certificated, will be tested by their manufacturers, and results will be acceptable by CAA for certification of surplus military units of the same design. Such airplanes probably will be among the last to be declared surplus.

At this writing, Vandalia has tested four types: North American 0-47-B, Aeronca PT-23, Navy trainer N-3-N, and Taylorcraft L-2-L. Others are in process.

★ ASSEMBLY LINES ★

The 200,000th electrically heated flying suit has been delivered to AAF by General Electric.

Northwest Airlines has received a letter of commendation from Washington for meeting production schedules at its bomber modification center.

The 7,000th B-24 "Liberator" produced by Convair has been delivered to AAF. Plane was 5,000th built at company's San Diego plant.

New Naval combat films now available for showing to war workers are "Invasion—Nazi Version" and "Return to

Guam." The former is German film of Allied invasion of France, while latter depicts amphibious assault on Guam.

WPB announces formation of Rolls Royce Prime Contractors Aluminum Castings Industry Advistory Committee. Members are A. H. Drake of Packard Motor Co. and Carl H. Richter of Continental Aviation & Engineering Corp.

ACCA has appointed following technical specialists to A.R.C. Ground Loads Subcommittee: Charles R. Strange, Douglas; J. F. McBrearty, Lockheed; Roy A. Miller, Convair; and M. S. Simms, Northrop.

Fairchild Camera & Instrument Corp. has been assigned "approved quality control" rating by AAF.

Standardization of catalog pages at 8½ in. by 10⅝ in. has been approved by Aviation Distributors & Manufacturers Assn.

United Aircraft Corp. reveals that shipments of aircraft, engines, and propellers by its four divisions are up 26 percent for first half of '44 over same period of '43.

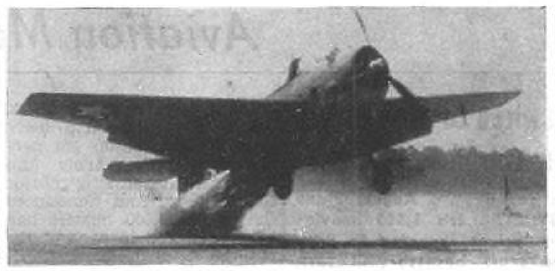
Postwar: Convair, it is said, will build aircooled aircraft-engined experimental buses for Greyhound Bus Co. as a postwar project. And Bendix is reported planning to build small home radio sets when military situation permits.

North American's Kansas City plant announces completion of 300 B-25 bombers in August.

Fourth revision of American Standard, Terminal Markings for Electrical Apparatus, has been approved by American Standards Assn.

Our $750,000,000 war-born synthetic rubber plant may pay for itself within 4 yr. of resumption of Far East rubber operations, according to James J. Newman, v.-p. of B. F. Goodrich Co.

Fisher Body has converted a 1,000,000 sq.ft. Cleveland plant for building Boeing B-29 nacelles, using over 18,000 jigs, tools, and fixtures specially designed for the work.



RED HOT TAKEOFF

Grumman TBF Avenger makes "jump" takeoff aided by power of four 330-hp. jet units, which Navy designates "jato," attached to bottom of fuselage near wing roots. Jato units permit greatly increased loads with takeoff run reduced by 33 to 60 percent. Each unit is cylinder full of solid propellant which includes oxygen in mixture so it can burn without air, and each unit has an electric spark plug for starting. (Press Association photo)

Consolidated Vultee states it delivered 29.5 percent of all heavy bombers during first half of 1944, and declares it had higher lb.-per-man-day rating than did other plants in similar line of work.

WPB will issue unrated purchase orders for 15 types of capital equipment for preparation for postwar civilian goods production, subject to military requirements.

Roxalin Flexible Finishes, Elizabeth, N. J., is permitting free licensed use of its patented aircraft fabric rot-proofing process by aircraft manufacturers supplying the Navy.

Glenn L. Martin Co., reports Brazil, is considering establishment of an aircraft plant at Goiana, State of Goias, Brazil.

★ FOR THE RECORD ★

Demco Tool Service, Inc., has been organized at 5236 San Fernando Rd., Glendale, Calif., and will represent Michigan Tool Co., Colonial Broach Co., Detroit Tap & Tool Co., Tungsten Carbide Tool Co., Colonial Bushings, and New Method Steel Stamps, all of Detroit, and Genesee Tool Co., Fenton, Mich. Demco head is R. W. Luzius.

L.G.S. Spring Clutches Corp., new Curtiss-Wright Corp. subsidiary, has acquired assets of L.G.S. Spring Clutches, Inc. E. F. Theis, will be president of new company, while also continuing as manager of C-W Propeller Div., Indianapolis.

Hufford Machine Works, Redondo Beach, Calif., has appointed Moore Machinery Co. exclusive distributor in California, Arizona, and Nevada for Hufford's hydraulic stretch-forming machine and portable hydraulic elevator.

American Standards Assn. has moved from 29 W. 39th St., N.Y.C., to Grand Central Terminal Office Bldg., 70 E. 45th St., N.Y.C.

The Hydraulic Press Mfg. Co. has established new regional and branch sales headquarters at 500 Fifth Ave., N.Y.C. Syracuse office will be discontinued. M. N. Ripley is in charge of new headquarters as sales manager for North Atlantic region. D. L. Cleveland is manager of New York branch office.

U.S.-Mengel Plywoods, subsidiary of The Mengel Co. and United States Plywood Corp., has opened new warehouse at Atlantic Coast Line Freight Warehouse Export Terminal, Jacksonville, Fla.

Northwest Air Service, formerly operated by Alan L. Blum and Walter W. Burrington, has changed ownership and management. New president is Charles H. Babb, while Joe E. Crosson is v-p. and manager, and Noel Wien is treasurer.

Aeronca Aircraft Corp., Middletown, Ohio, has retained Alden E. Calkins (516 Fifth Ave., N.Y.C.) as publicity and public relations counsel, with special Aeronca office at 350 Fifth Ave., N.Y.C.

Industrial Plants Corp. has been retained to dispose of surplus machinery and equipment at Brewster's Long Island City plants.

Kropp Forge Aviation Co. has changed name to Aviation's Forging Corp. of America. Correspondent: G. F. Wagner, 105 W. Adams St., Chicago.

Course in Airport Management & Operation will begin at University of Texas on Nov. 1, states John H. Frederick, professor of transportation and industry.

New companies: North Central Air Lines, Inc., 5951 S. Laflin St., Chicago. . . Atlantic Airlines, Inc. Principal office: Corporation Guarantee & Trust Co. of Delaware.

Williams & Tweney, Book Tower, Detroit, is new firm in industrial design field. G. H. Tweney, engineer, was formerly acting dir., Dept. of Aeronautics, University of Detroit; maintenance and flight test engineer for PAA; and consultant to manufacturers. F. C. Williams, designer, was design executive, Stout Research Div., Convair; and he previously operated own graphic arts studio.

Acme Pattern & Tool Co., Dayton, Ohio, has changed name to Acme Aluminum Alloys, Inc.

Victor Equipment Co., 844 Folsom St., San Francisco, has opened sales and service branch at 312 12th St., Oakland, Calif. E. I. Russell is branch manager.

The Quaker Chemical Products Corp., Conshohocken, Pa., announces trade name "Microcut" for its soluble cutting oil bases formerly known as Tool Kool 1, 20, etc. Designating numbers for base types are retained.

Square D Co. has opened a new plant and warehouse at 2310 Ranier Ave., Seattle, Wash. W. H. Bodle is manager.

Ergolyte Mfg. Co., Philadelphia welding equipment firm, announces purchase of Precision Mfg. Co. of Chicago, welding machine maker.

★ KNOW-HOWS ★

Baldwin Locomotive Works, Southwark Div., has developed the Montgomery-Templin compression yield point testing machine, capable of testing single, thin sheets, an advantage over old method of using multiple sheets for a single test.

For aircraft applications Glenn L. Martin Co. has devised "plastic sandwich," with high tensile plastic surfaces covering impregnated woodpulp filler. Combination reportedly saves 32 percent weight, 60 percent tooling cost, and 50 percent total cost. First use as loop antenna mount indicates material has large number of uses elsewhere.

Bendix' Friez Instrument Div. now uses human hair in humidity indicator for forecasting icing conditions on blimps. Instrument was designed at request of Navy.

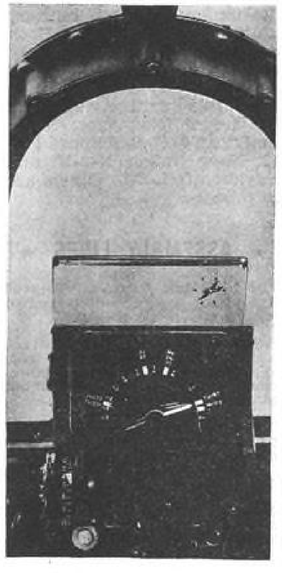
Minnesota Mining & Mfg. Co. announces light, sprayable, nonskid walkway coating, flexible between —20 and + 160 deg. F. Made of Thiokol and ground cork, surface showed negligible wear after passage of 100,000 people. Moisture absorption is reported under 3 percent in 4 hr.

Army Ordnance has devised a foolproof glider-tow-cable cutter, employing explosive charge for use when ordinary fitting is inoperative.

Firestone's new foam rubber production method produces finished cushion material directly from synthetic latex in light, medium, and firm grades. Named Foamex, product is described as of low cost, washable, oilproof, odorless, and virtually unaffected by temperature change.

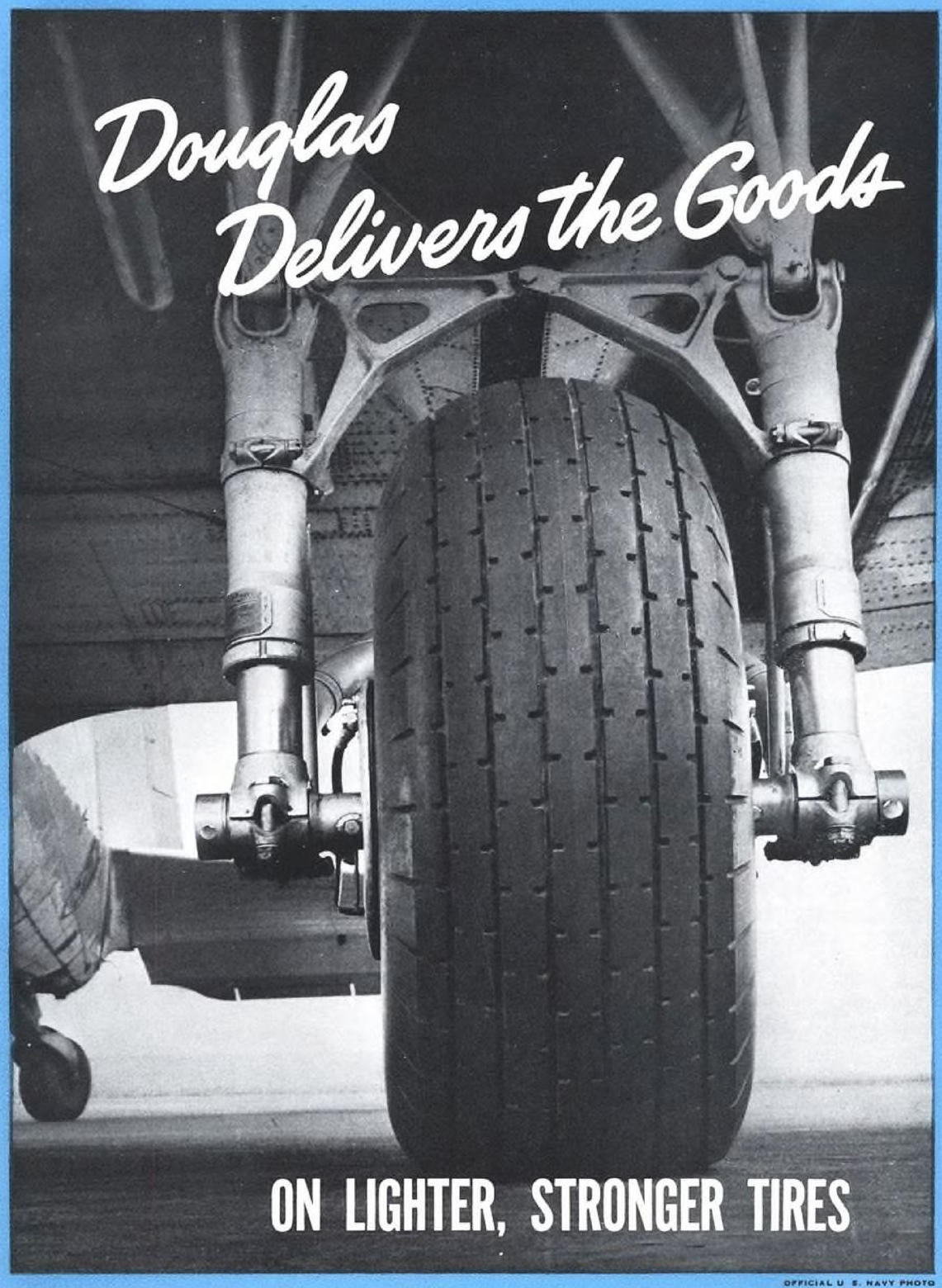
Argus, Inc., Ann Arbor, Mich., has produced special UV-101 thermo-setting optical cement for instrument and bomb-sight lens applications where the temperature range causes softening or disintegration of usual type of cementing material.

RAF SCORE-DOUBLER



Twice as many Nazi warplanes are reported kayoed by RAF skyfighters since adoption of this gyro gun sight. Pilot makes but two adjustments—type of enemy craft and range—then mechanism automatically calculates deflection. Sight is said to enable effective fire at speeds upward of 400 mph., at ranges over 400 yd., and at deflection angles once thought impractical.

A special development of Britain's Ministry of Aircraft Productions, this electrically actuated device features sighting head having glass screen (see photo) through which pilot first spots enemy craft. He then moves lever (center) to plane types, and next turns throttle-incorporated twist grip (left) for range, lining up enemy with aiming graticule (see screen) consisting of six diamonds around "bead" spot. Graticule moves on screen. It also expands or contracts by adjustment of twist grip, and in action pilot varies its diameter to fit enemy craft's wing span, as illustrated here by plane image. With deflection autocalculated, guns do rest. (British-Combine photo)

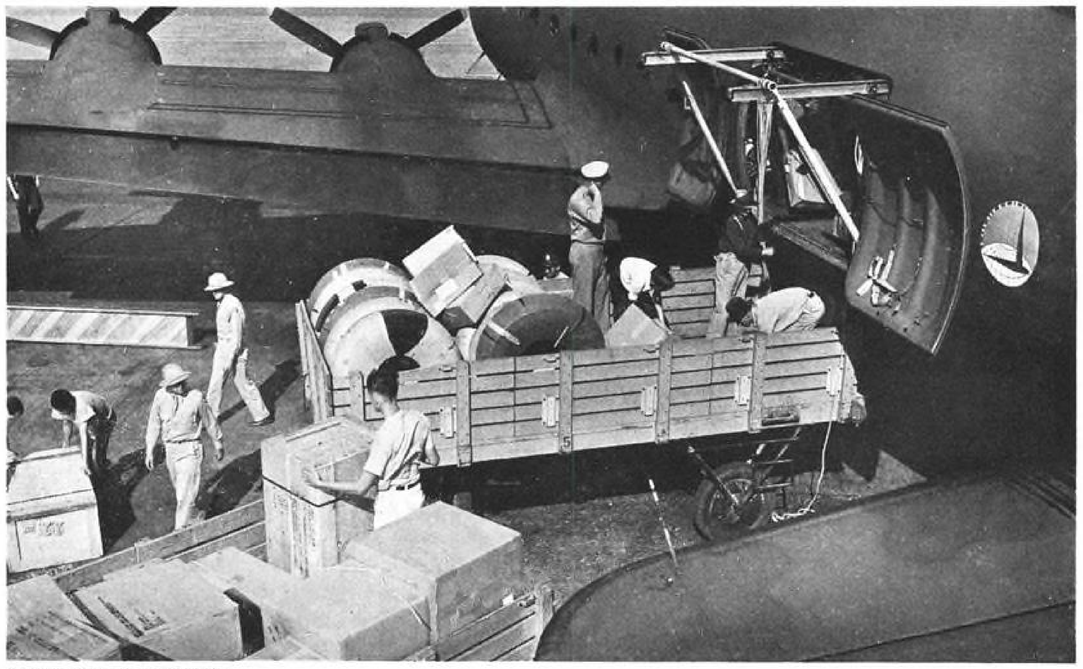


UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE
ROCKEFELLER CENTER
NEW YORK 20, N. Y.

"Box Car" Capacity

DELIVERS MORE MEN,



OFFICIAL ARMY AIR FORCE PHOTO

...AND LIGHTER, STRONGER TIRES CARRY THE LOAD

Wherever the Army Air Transport Command, Troop Carrier Command and the Navy Air Transport Service fly men and supplies, Douglas transport planes deliver the goods. The giant C-54 with its "box car" dimensions and the veteran C-47, military version of the airlines' DC-3, are transporting loads of troops and top priority materiel that give new scope to global warfare. With no change in tire size, these great planes are carrying heavier loads today than ever before...and landing them on every type of runway. Wherever Douglas transports fly, U.S. Royal Airplane tires are on the job.



OFFICIAL U. S. NAVY PHOTO

LESS THAN 48 HOURS to the South Pacific. The Army Air Transport Command and the Navy Air Transport Service flying Douglas "Skymasters", speed giant loads of men and materials to all world fronts.

ENGINEERED BY DOUGLAS

MORE SUPPLIES...ON TIME

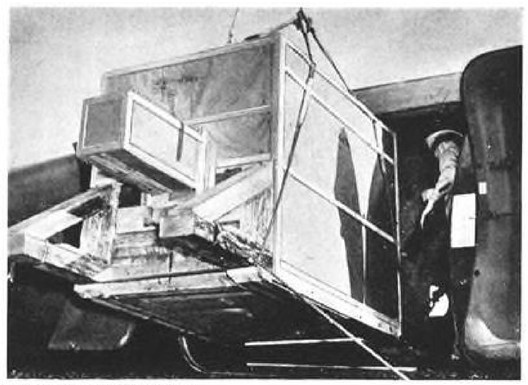
From whole airplane wings to engines, top priority cargo is loaded into Douglas "Skymasters" and rushed to the corners of the world. Built to carry 12,650 pounds of pay load 3000 miles non-stop, the "Skymaster" often loads in 20,000 pounds and more.

Every pound of extra load means more work for airplane tires on every take-off and landing. To give this extra reserve of strength, "U.S." pioneered the lighter, stronger rayon cord construction... now the standard of the Service.



OFFICIAL U. S. NAVY PHOTO

2000 HORSES ABOARD! An urgently needed airplane engine is loaded into the cavernous hatch of a Douglas "Skymaster" destined for a distant front.



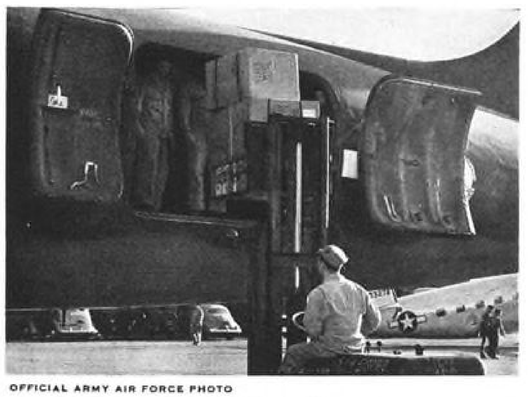
OFFICIAL U. S. NAVY PHOTO

"BOX CARS" IS RIGHT! A generator rotor weighing 8900 pounds, one of the heaviest individual items ever carried by air, starts for Panama in a Douglas "Skymaster" flown by NATS.



OFFICIAL U. S. NAVY PHOTO

HOSPITAL SHIP! The Army Air Transport Command flies wounded and sick fighting men swiftly from remote South Pacific island in Douglas "Skymasters"



OFFICIAL ARMY AIR FORCE PHOTO

"SKYMASTER" LOADS! The "box car" capacity of this Douglas "Skymaster" is being loaded with urgently needed supplies for our fighting men. Douglas delivers the goods.

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OFFICIAL U. S. NAVY PHOTO

DOUGLAS "DAUNTLESS" DELIVERS, TOO, ON U. S. ROYAL AIRPLANE TIRES

The Douglas "Dauntless" dive bomber delivers a different kind of cargo...a 1000-pound bomb. Though production of the SBD has ceased, thousands of Douglas "Dauntless" dive bombers are still in action and will go on to establish one of the most magnificent combat records ever set by one type of warplane. In the Battle of Midway, SBD's sank four Jap carriers and from Pearl Harbor over the whole Pacific area, they carried destruction to the enemy.

On the "Dauntless", on the "Skymaster" and on the C-47, lighter, stronger U.S. Royal Airplane tires contribute their part in making landings and take-offs safer under heavy wartime loads...from coral runways or from carrier decks.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 EWT Carl Van Doren and a guest star present an interlude of historical significance.

Serving Through Science . . . To Speed The Victory



This is the under-carriage of the Douglas "Dauntless" equipped with U.S. Royals. Dive bomber, fighter or transport, there is a U. S. Royal engineered for every airplane tire job.

UNITED STATES RUBBER COMPANY

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Airlines Placing Orders for 108 DC-4's, 6's AA, UAL, Panagra in Deal; EAL Weighs Buys

. . . Rate cut proposals spark competition . . . Surface lines press for air rights . . . International policy battle coming to head . . . Air imports reported . . . All-weather landings for Idlewild . . . Airmail up 52 percent.

Far-reaching move for domestic airlines' reconversion to peace operations was made last month when four lines ordered, or indicated intentions to order, a total of 108 Douglas DC-4's and DC-6's. Signing contracts with Donald Douglas were: American, for 30 DC-6's and 25 DC-4's; United, 20 DC-6's and 15 DC-4's, with 15 additional 6's to be ordered shortly; and Pan American Grace, three DC-6's. Capt. Eddie Rickenbacker, Eastern president, announced his line had under discussion a contract for unnamed number of the same types of craft, and American indicated its order would soon be upped.

At contract-signing in Wings Club, New York City, Mr. Douglas revealed that four foreign lines and other domestic operators were negotiating contracts which would raise the manufacturer's backlog of orders—including the $50,000,000 then involved—to well over $100,000,000, more than three times any previous non-military peak.

Few days later he told employees at Chicago Douglas plant, now turning out C-54's, that fall of Germany would result in no cancellations; instead demands of Pacific war would necessitate increase in output from that factory. Execution of commercial contracts, he said, would definitely not interfere with production of military craft.

Specifications on DC-4—developed from current C-54 "Skymaster"—were revealed as follows: Span, 117 ft. 6 in.; length, 93 ft. 11 in.; height, 27 ft. 6⅛ in.; gross wt., 71,300 lb.; landing gross wt., 56,500 lb.; wing loading, 48.9 lb. per sq. ft.; power loading, 12.3 lb. per bhp.; max. cruise power speed, 280 mph.; cruising speed at 60 percent, 239 mph.; stalling speed, 80 mph.; wing area, 1,457 sq. ft.; power plant, four P & W R-2,000 radials of 1,450 takeoff-hp. each. With crew of five, it is designed for 44 passengers.

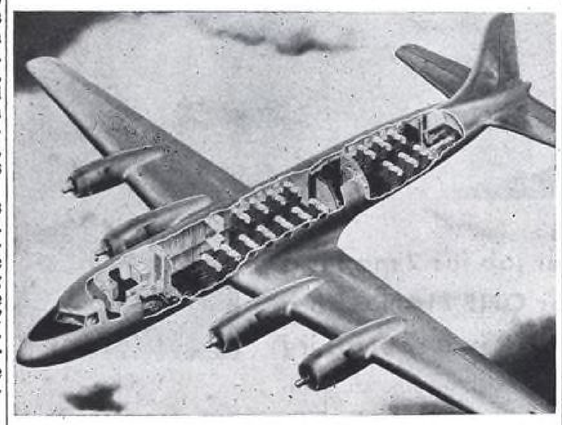
DC-6, also developed from C-54, will have span of 117 ft.; length of 100 ft.; gross wt., 80,500 lb.; cruising speed, near 300 mph.; non-stop cruising range of 2,715 mi., which can be increased to 3,540 mi.; power plant, four 2,100-hp. P & W Double Wasps. It is designed to carry 50 passengers, crew of 5, and cargo.

Rate-Cut Proposals Spark Competition

The air transport rate war is mostly a war of words so far, but the competition motive is strong and postwar fares may be brought lower than some experts estimate.

National Airlines is proposing a fare of about 5¢ per mile against Eastern's roughly 5.5¢ on East Coast runs. Rep. Carl Hinshaw, after a junket with the House Aviation Subcommittee, predicts that vacation air travel rates will come within reach of the average citizen within five years after victory. Pan American Airways promises to cut New York-Buenos Aires time from 91 hr. to 21 hr. and reduce the fare from $561 to $190. United Air Lines and Matson Navigation, both having applications on file for West Coast-Hawaii certificates, propose fares lower than those of PAA. Other Hawaiian run contenders are Hawaiian Airlines, Northwest Airlines, Ryan School of Aeronautics, and Western Air Lines.

Curtiss-Wright reports results of a survey by its researcher, Dr. D. H. Davenport, finding that air travel will increase 7-fold and air express 30-fold in five years of peace, with passenger fares down to 3.5¢ and express at 30¢ per ton mile. Rail fares have been, and probably still could be, held below 2¢ per mile.





Top: Cut-away conception of Douglas DC-6, coming commercial version of famed C-54 Skymaster. Major American lines have ordered total of 108 of this type and of DC-4, giving Douglas Aircraft backlog of more than $100,000,000, some three times greater than any previous non-military orders. With 117½-ft. span 100½-ft. length, and 28½-ft. height, DC-6 will gross 80,500 lb. A 50-passenger dayliner its top speed will be 334 mph. and cruising speed 278, with four P & W 2,100-hp. engines. Above: Signing contracts for 93 DC-4's and DC-6's, valued at more than $50,000,000. Seated (left) is W. A. Patterson, United President, about to sign order for 20 sixes and 15 fours—with 15 more sixes to come later. Beside him is Donald Douglas, while stading (left) is Eddie Rickenbacker, Eastern president, who reported contract under negotiation for similar equipment; A. N. Kemp (center) American president who signed contracts for 30 sixes and 25 fours; and (right) Harold J. Roig, Panagra president, who ordered three DC-6's. (Press Association photo)

Surface Lines Press For Air Rights

Controversy over the right of surface transportation to operate airlines is flaring up again as Congress prepares to consider new revisions of the Civil Aeronautics Act. Some airline officials fear that the powerful railroad drive for rights in the air will succeed. They accuse ground transportation of efforts to have Congress abolish the CAB, which interprets the law as prohibiting control of airlines by non-air companies.

Seven major shipping companies, including the Grace Line, Matson, Moore-McCormack, United Fruit, and others, have called upon Congress to allow them to share in postwar international air traffic.

International Policy Battle Coming to Head

Developments come slowly but steadily in the U. S. flag foreign air service picture. Both the State and Justice Departments have informed Congress of their opposition to a "monopoly" airline to represent the United States abroad. The opinions were requested in connection with Sen. Pat McCarran's bill which would establish a billion dollar overseas airline corporation in which all transport companies would be entitled to hold stock.

Again, as he did months ago, Sen. Champ Clark of the Senate Commerce Aviation Subcommittee, has asked President Roosevelt to hold up any contemplated action on certification of oversea airlines pending determination of foreign air policy by Congress. (Oversea operating permits issued by CAB must be approved by the President). The Board, however, is under strong pressure to make decisions on foreign service ap-

They're Cutting Sanding Time 83% with SKILSAW BELT SANDERS

AT DURAMOLD DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORP.



DURAMOLD Photo shows SKILSAW BELT SANDER in jig which won suggestion award for the designer, Albrecht Halbig.

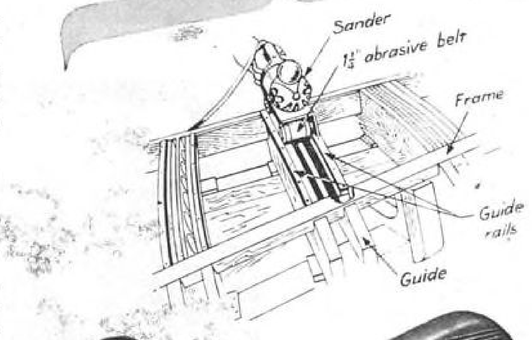
A former 3 to 4 hour job for 2 men is a ONE HOUR JOB for ONE MAN with a SKILSAW BELT SANDER in a special jig

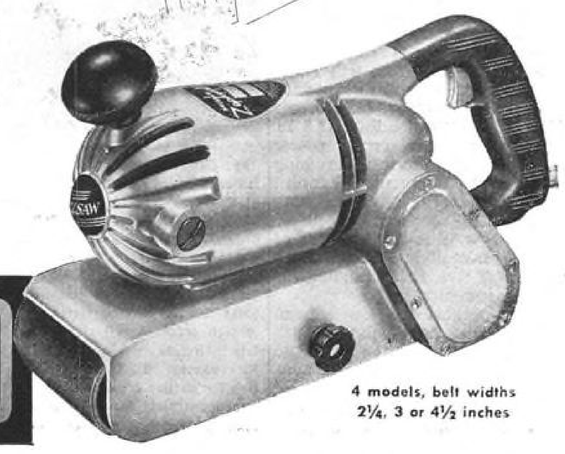
Stepping up finishing work on aircraft stabilizer frames is just one more example of how SKILSAW BELT SANDERS *do more jobs better!* In or out of a jig, on any flat and on many curved surfaces, SKILSAW BELT SANDERS do a cleaner, ripple-free finishing job faster and easier.

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plications, so that operators can make plans.

The Clark Committee also objected to CAB's policy of no limitation on volume of traffic in international agreements. This Committee's idea is that low-cost foreign flag lines could get most of the business, which largely originates in the United States.

State Department has announced that exploratory talks between the U. S. and Soviet air delegations have been completed. The two parties agreed that an international authority for civil aviation should be set up and that technical experts of the two countries should confer in the near future. Preliminary conversations are being held with Brazil, India, and Belgium. Other nations will follow. Conversations with Britain have been completed.

At press time came word that Alexander B. Royce, New York lawyer, has been named permanent chairman of the Airlines Committee for United States Air Policy representing the 17 American lines which favor "regulated competition" over postwar international air routes.

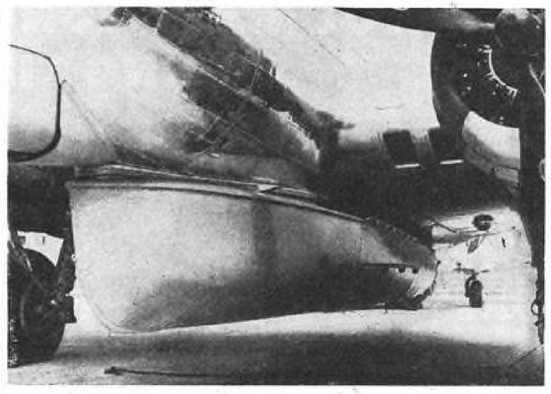
Air Imports Reported

Planes of the Army Air Transport Command, Naval Air Transport Service, and their civilian contract operators, brought more than 22,000,000 lb. of war cargo worth $79,000,000 into this country in the first half of 1944, according to the OWI. Some of the total was surface-carried over part of the transit distance. Two main routes are over the hump from China to India, and from India via Africa and the South Atlantic to the United States. Army uses Douglas C-54, C-87, and C-47 (DC-3), and Curtiss-Wright C-46 Commando. Navy uses R4DA (stripped down DC-3), PB2Y-3R (Coronado flying boat), PBM3 Martin Mariner, R5D (Navy DC-4), and RY-2 (Consolidated 4-engine land plane).

Explore "Drop" Deliveries

AAF has been making large deliveries of cargo to inaccessible places by parachute and free fall, and this experience may lead to development of this practice in postwar air commerce. Officers in charge so far favor parachue delivery over the free fall and other devices, but experiments with with all methods are continuing. One promising device is a plastic container with a single rotating wing which reduces the rate of fall.

Cargo chutes of 90 ft. dia. have been used for special jobs, but the largest chute in standard use is 48 ft. Many types of containers, of wood, fabric, and other materials, have been developed for free drop and parachute. In the later '20s, a dead-stick airplane was let down on an 80 ft. parachute.



HOW BOEING B-17 CARRIES BOAT

Close-up shows details of streamlined fitting of new portable-by-air lifeboat on Boeing B-17 mother ship. All-plywood power-driven boat is dropped to personnel stranded at sea, its fall from sky being eased by three 48-ft. chutes. Other heavy planes will likewise be equipped to take boat. It's stated that neat attachment seen here cuts Fortress speed only 8 mph. (Wide World photo)

All-Weather Landings For Idlewild

After many years of development work, the first commercial instrument landings will be made at New York's new Idlewild airport in the autumn of 1945. Glide path, marker, and localizer radio beam projection and reception have been under intensive use and experimentation during the war, and radar has been practically applied to zero weather landing problems. Mayor La Guardia promises that the 48 million dollar field, with its two-mile-long runways, will be in operation a year from now, even if temporary buildings have to be constructed. The CAA, various radio communications manufacturers, and the airlines have worked on instrument landing for a decade.

Airmail Up 52 Percent

Despite priorities on plane space, and the airmail postage rate increase, airmail volume expanded 52 percent in the fiscal year ended June 30. This rise was figured in terms of pound-miles. The data was contained in a report by the Post Office Dept. to the House Appropriations Committee, which is working on estimates for next year.

Officials said it is impossible to know how much greater the volume of mail might have been without the increase from 6 to 8¢; actually, the load ran approximately level following the increase, which was effective last Mar. 26.

Airmail executives in the P. O. believe that the airmail habit has been acquired by millions during the war, and that they will not drop it.

UAL in New York Test Of Food Transport

Having earlier flown perishable foods for a special dinner in Detroit, UAL, Wayne University, and the A & P, now jointly exploring the possibilities of air transport of food commodities, followed with a luncheon in New York City where samples of both air and rail-borne food were judged by the guests.

Harvey A. Baum, v.-p. of the A & P, and Drs. Bow and Larsen of Wayne U. expressed belief in the promise of air transport of perishable foods, and E. T. Finneran, president of N. Y. Fruit & Produce Purveyors Assn., visualized use of large freight airliners given wholly to carriage of fruits and vegetables to metropolitan centers.

Meanwhile, however, imminence of air rate cuts to a level making such business profitable is questioned in some circles.

★ CROSS COUNTRY ★

PCA has increased service over its entire system. Cities affected include Baltimore, Washington, Norfolk, Detroit, Buffalo, Pittsburgh, Youngstown, and Cleveland.

Chicago & Southern has been authorized by CAB to extend service from Memphis to Detroit.

Air Express Div., REA, reports over 15,300,000 lb. of air express handled for domestic airlines during first half of '44, an increase of 11.2 percent over same period of '43.

Continental Air Lines announces July total of 2,512,571 passenger-miles, an increase of 7 percent over June, and 12½ percent passenger revenue increase over same month. Mail pound miles for July was up 5 percent over June. Meanwhile, CAB has advised company that mail compensation for its routes has been set at 24.80c. per plane-mile, retroactive to May 1, '44. Compensation for period Aug. 15, '43 to Apr. 30, '44 was set at 45.21c. per mile.

National Airlines has filed application with CAB for trans-Atlantic routes. Proposed service is to Mediterranean area, with Miami, Jacksonville, Charleston, Washington, and New York as U. S. terminal points and Cairo as African terminal point. Additional application asks that Washington be designated as intermediate point between Philadelphia and Norfolk, also New Bern, N. C., as intermediate point between Wilmington, N. C., and Norfolk, and that Newark be co-terminal with New York. Also filed with CAB was proposal for low fares from Florida cities to Savannah, Charleston, Wilmington, Norfolk, Philadelphia, and New York. Company announced new flight from New York to New Orleans and Miami.

PAA set new high for trans-atlantic commercial air cargo by carrying over 725,000 lb. of mail and express in August. Also, three world records were made by PAA crews for over-water flight in July. Company's special license for cargo and passengers between interior Brazilian points is reported scheduled for termination Jan. 1, '45. Panair do Brazil, in which PAA has substantial interest, will probably take over local business. Latin-American Div. of PAA has reported air travel between Americas increased 22 percent, and air express 88 percent, in one year. Compania Mexicana de Aviacion, PAA affiliate, celebrates 20th anniversary.

Air Traffic Conference of America, representing all U. S. and two Canadian air carriers, has plans to provide for ticket purchasing from agents to be located at various business corners.

Western Air Lines, at this writing, was about to start passenger and mail service from Alaska and Canada to U. S. via Great Falls, Mont.

UAL has flown over 7,100,000 mi. for ATC in first half of '44. Airmail loads in July increased 79 percent over July '43. Company announced second all-cargo service from LaGuardia Field to San Francisco to handle increasing mail and express loads. UAL's exclusive cargo flights carry as much as 8½ tons—equal to about 260,000 letters—in Cargoliners (DC-3 Mainliners stripped of passenger fittings).

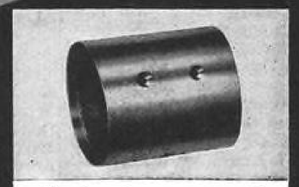
Hatching eggs can be safely shipped by plane, according to Department of Agriculture, which determined that reduced air pressure of high altitudes does not affect hatchability.

Air parcel post service is to be subject of hearings planned before end of year by Rep. Holifield.

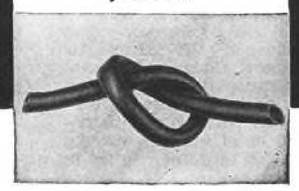
Air commuting services in metropolitan New York City area is planned by at least three companies. Metropolitan Airways, 347 Madison Ave., would operate helicopters to Westchester, Connecticut, and Long Island centers; Otto Aviation Corp., Caldwell, N. J., plans new short-flight schedules employ-

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ing conventional planes; and Pickair Seaplane Service, of Ossining, experts to fly float planes from New York City on nine-stop route along Hudson to Poughkeepsie.

Airport expansion plan by Oakland, Calif., has been adopted by city's postwar planning committee which set up additional educational, airport development, commercial aviation, private flying, and general committees to study and carry out program.

Colorado's state aeronautical commission announces proposals to be placed before next legislature to provide for state aviation advisory committee with paid director and engineering staff, also legislation for counties to finance and construct airport facilities.

Lineas Aereas Mexicanas, S. A., has received first of five Boeing 247-D's purchased after release by Army. Plane was converted at Cheyenne maintenance base of UAL, which owns controlling interest in LAMSA.

Testing idea of postwar deliveries by helicopter, William Filene's Sons recently had packages flown from warehouse in Cambridge, Mass., to company branch store in Belmont aboard 'copter produced by Aeronautical Products, Inc., of Detroit. Piloted by Charlie Whittaker, rotor craft negotiated 8-mi. run in 7 min., whereas truck time is half hour.

TACA Airways System announces interline traffic agreement with American Airlines to sell through tickets from U. S. to Central and South America via Mexico City. TACA has recently obtained 20-yr. franchise for service from San Salvador to Mexico City, and company hopes to re-establish its Guatemala service, taken over few years ago by Aerovias de Guatemala. Meantime, TACA has been granted permanent landing rights in Cuba, and company further has announced addition of two new lines to system—TACA Venezolana and TACA Colombia.

Alaska Airlines conducted special mid-summer altitude excursions in lodestar to 16,000-ft. for passengers to see midnight sun.

Survey of 200 leading insurance companies by Institute of Life Insurance reveals postwar probability of no policy limitations on flying risks.

American Airlines' Pilot-Engineer S. P. Saint has invented slide rule device which figures landing intervals of "stacked-up" planes and is reported to cut "come in" time from 12 to 4 min.

Panagra recenty celebrated second anniversary of all-cargo service to eight countries in Latin-America.

Need for accelerated ground handling to maintain speed values in air transport of cargo was emphasized at recent SAE West Coast Transportation & Maintenance Meeting, which called for greater coordination of land and air functions.

★ ALONG THE APRON ★

Don Scott Field, Ohio State University airport, is now headquarters for CAP Ohio Wing. Meanwhile U. announces school of aviation offering courses in aero engineering and air transport management.

Parks Air College, East St. Louis, Ill., has issued pamphlet outlining educational and training benefits it will offer to veterans under provisions of "G.I. Bill of Rights."

Summer just ended saw training of 9,000 Civil Air Patrol Cadets chosen from entire CAP on merit basis.

Fourteen Naval Flight Preparatory Schools are being closed in Texas, Oklahoma, New Mexico, Arkansas, and Louisiana.

AAF examining board at Chicago announces distribution of 150,000 posters and 530,000 cards and stickers in enlistment drive for 17-18 yr. olds for the Enlisted Reserve as gunners, bombardiers, navigators, and pilots. During first year, Chicago area enlisted 14,319 in this class.

Aeronautical Training Society's East St. Louis Meeting at Parks Air College endorsed President Roosevelt's suggestion for postwar military youth training. ATS President J. W. Coombs wired the White House to that effect.

George H. Scragg, White Motor Co's director of advertising and sales, has been promoted to Major, Ohio Wing, CAP, and will take charge of public relations. During World War I, Major Scragg was Chief Technical Officer, Night Bombardment Section, AEF.

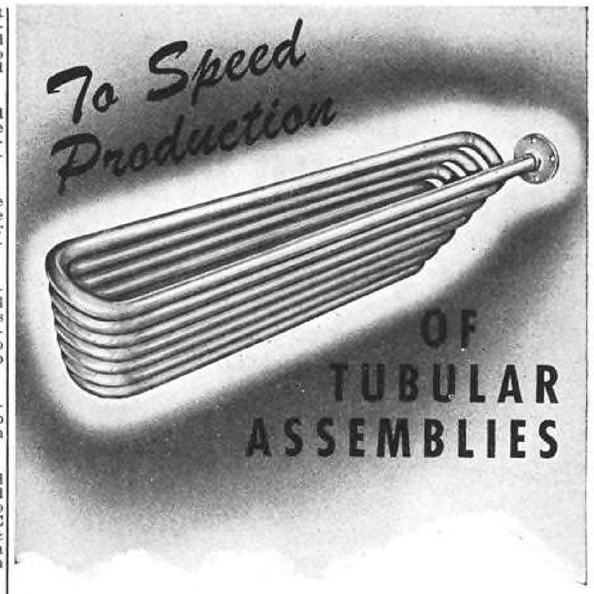
Aeronautical courses are now offered by 250 Illinois high schools, states V. A. Hines, who just closed University of Illinois summer course to train instructors.

Aero-Crafts Corp., Los Angeles, owner of Aero Industries Technical Institute, announces acquisition of American School of Aircraft Instruments and the United Flying Schools of America.



ELECTRIC EYE FLASHES RESERVATIONS

Inter-office records are now sped by United Air Lines between Oakland and San Francisco via Telefax, automatic photo-electric device developed by Western Union. Here, H. L. Garrison, UAL western division superintendent, of communications at S. F., inspects reservations report just in from across Bay. Facsimile system employs some 15 mi. of telegraph circuit. (UAL photo)



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The C. O. Jelliff Mfg. Corporation of Southport, Conn., whose strainers are illustrated, is one of the prominent weavers with long experience in nickel alloy wire cloth and strainer production. The output of Monel, Nickel and Inconel wire cloth goes today entirely for war requirements and for essential production and maintenance where the unique properties of these materials are needed.

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TYPICAL STRAINERS PRODUCED IN MONEL

1—Finger type aircraft engine oil strainer, formed from 16 mesh Monel wire cloth with brazed seams.

2—Gasoline tank screen made from 10 mesh, 0.025" diam. Monel wire.

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4 and 5—Refrigerator strainers, made from 80 mesh and 200 mesh Monel wire cloth.

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Four German Jet-Type Warplanes Identified

. . . Miles 20 was alternate for Battle of Britain . . . Nazis try Ju-88/Me-109 pick-a-back bomber.

During the past months American escort fighters have met and overcome new German jet-propelled fighters, notwithstanding their spectacular speed and rate of climb.

In all, four jet-propelled or jet-assisted planes have been reported. One of these is the Heinkel He-219 night fighter, conventionally powered but having a jet unit for extra speed to get away from Allied fighters. Another is the Heinkel He-280, infrequently spotted and of which little is known beyond the fact that it has a twin jet unit with double tail surface.

Already shot down by our fighters is the Messerschmitt Me-163, a batwing plane somewhat similar to Northop's flying wing. Powered with a single jet it is said to attain 600 mph. for short periods. Its jet operation, controlled by the pilot, is used in bursts, with the plane doubling as a glider when the jet is idle.

Fourth jetplane is the Me-262. As with the He-280, little is known about it, except that it, too, employs a double jet.

Miles 20 Was Alternate For Battle of Britain

When during the first stages of the Battle of Britain in 1940 a fighter plane shortage appeared possible and was feared by many authorities in America and predicted by the Nazis—there actually was a supplementary craft in readiness.

Designed and built in nine weeks and two days, this fighter was made available by Phillips & Powis, builder of the Miles planes. It was a Merlin-powered ship, known as the Miles 20, made of mixed wood and fabric construction, and it was developed for fast production and for this reason had a spatted, fixed undercarriage and no hydraulic system. Other unusual features were the bubble canopy, which four years later came into general use, also a fin and rudder set well forward of the horizontal tail surfaces.

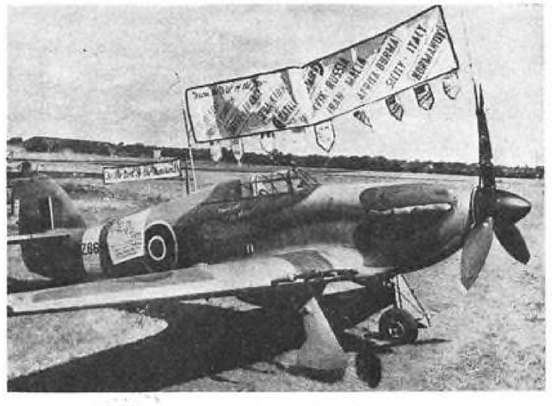
Apparently this fighter is still good enough to have its performance and specifications on the secret list, since the only details now announced cover speed (between the Hurricane's and Spitfire's performance) and give armament of eight .303 machine guns with a heavier ammunition load than was available in the other two fighters.

Nazis Try Ju-88/Me-109 Pick-a-Back Bomber

With the robot launching-platform country fairly well cut off by Allied armies, resulting in virtual stoppage of robomb attacks on Britain, the Germans switched to another aerial monstrosity or so-called "secret weapon".

This time the Nazis copied the old English Mayo Composite aircraft, using as lower component a Ju-88 with radio control and carrying about two tons of explosive in the fuselage and an Me-109 fighter with the remote control equipment as the pick-a-back unit.

Results are termed nil so far, control being imperfect; and tied together the planes are slow and easy fighter prey.



"LAST OF THE MANY"

—Is inscription on cockpit of this final Hurricane produced by Hawker Aircraft Co. And big streamer recounts triumphs won by craft—"from the first of the few to the last of the thousands,"—in 1935 Brussels Exhibition, in Battle of France, at Dunkirk, in Battle of Britain, and in campaigns of Narvik, Russia, Iran, Malta, Africa, Burma, Sicily, Italy, and Normandy. Banner laid on fuselage cites use of plane, in such forms as Fleet Air Arm fighter, fighter-bomber, catapult fighter, meteorological aircraft, single seat trainer, long range fighter, rocket fighter, etc. (British-Combine photo)

WORLDATA . . . . . By "VISTA"

This month marks the 25th anniversary of Netherlands KLM. Per past accomplishments, KLM may well take a prominent place in the world's postwar air transport, but there are problems yet to be considered, such as matters of the present London management's policies and the factors of the old management in Holland and the many employees stranded at the time of the German invasion.

Another KLM question is the reported purchase of a large number of the new Avro Tudor transports, now in limited production in England. Also in initial production in Britain are the York, Shetland, and also the Huddersfield, the latter a craft on which details are yet to be released. The Tudor, developed from the York, is stated to have performance and capacities similar to the Lockheed Constellation, with cruising speed around 300 mph. and accommodation for 68 passengers. Tudor's price is reported to be less than that of the Constellation, a factor seen influencing airlines which once bought American equipment.

It's implied from Germany that Nazi bigwigs may escape the Reich in Me-264's, one of which is said to have flown non-stop to Japan last year. But official circles doubt production on the 264. Most likely escape plane would appear to be the Heinkel 274, transport version of the He-177 four-engine twin-prop bomber, known to have an 8,000-mi. range with crew and six passengers. Meantime, a submarine is also rumored as the escape vehicle.

Spitfires may, one of these days, be providing long range cover for far-flying bombers. Long confined to fairly short hops, "Spits" have now been fitted for distance work by the AAF at Wright Field. Two of these craft went direct from assembly lines to the U.S., then were flown back within a few months by AAF test pilots after having new range built into them.

Reports have it that BOAC is planning to start regular air service between Rio de Janeiro and Buenos Aires. Permission from Argentina and Brazil is implied by a statement to the effect that inauguration only awaits the green light from the British Government.

★INTERNATIONAL BRIEFS★

Though still on the secret list, Britain's Tempest fighter has made its debut in several photos showing it in "robomb" chases. Features are very long eliptical wings and tail surfaces, also a stubby Typhoon-like nose, accounted for by use of 2,200-hp. Napier Sabre engine.

The fading Germans are said to have come up with a new high-altitude fighter to combat expected raids by Boeing B-29's. Known as the Henschel 130, it has three engines, two for driving propellers and the third to operate cabin and engine superchargers. But the three prototype craft are reported to have crashed.

De Havilland has developed a new twin-Gipsy-engined feederline plane with eight-passenger capacity to succeed the well-known Dragon series. A suitable name is now sought.

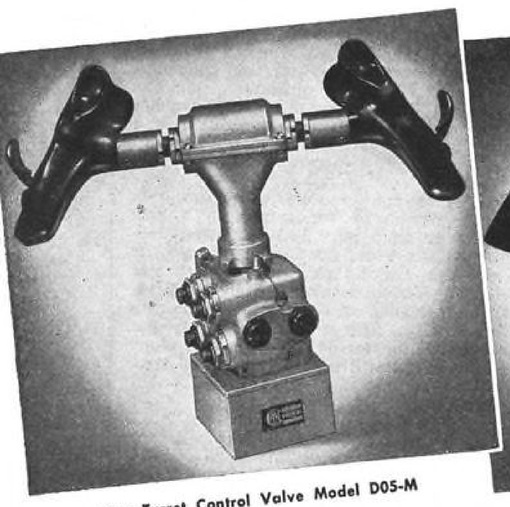
Lord Knollys of BOAC has told a London audience that trans-ocean airports would probably be served by helicopters operating from surrounding metropolitan centers. He also predicted 24-hr. service to India, 60-hr. trips to Australia, and 66-hr. service to New Zealand on superskyliners weighing more than 50 tons.

Quantas Empire Airways has been operating a 3,500-mi. airline from Australia to Ceylon for more than a year, according to recent official announcements. This route was opened as an official BOAC alternate. It was initially surveyed by Richard Archbold.

Government of Portugal has granted permission to American Export Airlines to continue service between America and that country for the period of one year.

Clarke-Aero

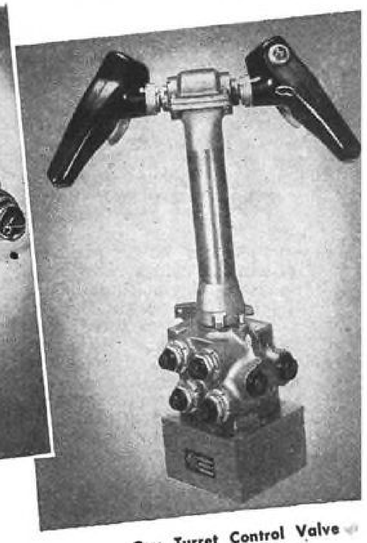
HYDRAULIC COMPONENTS FOR MILITARY AIRCRAFT



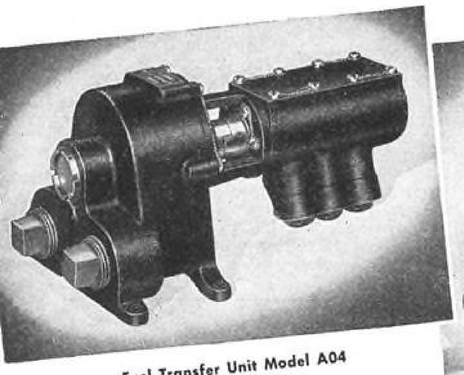
Gun Turret Control Valve Model D05-M



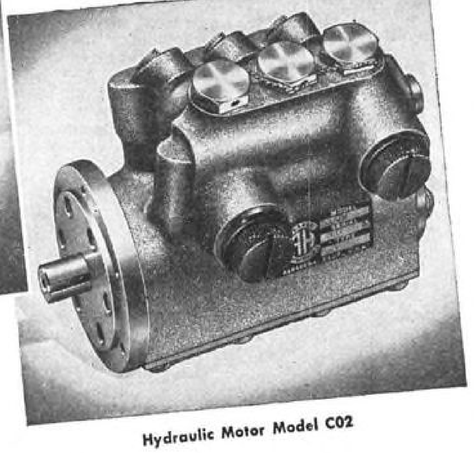
Gun Turret Control Valve Model 0404-Y2



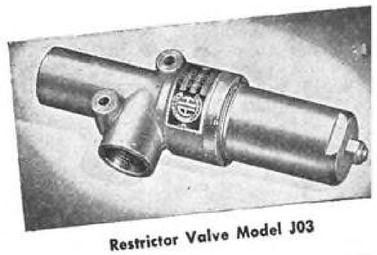
Gun Turret Control Valve Model D05-Y3



Fuel Transfer Unit Model A04



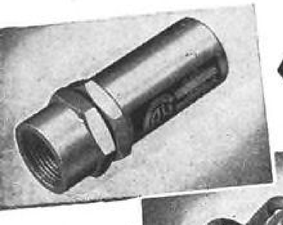
Hydraulic Motor Model C02



Restrictor Valve Model J03



Gun Elevator Cylinder Model 0601-Y1



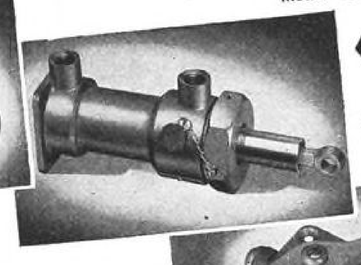
Relief Valve Model E01



Rotary Valve, Rotor Type, Model 1402-Y2



Shuttle Valve Model L02



Gill Cylinder Model F01

Rotary Valve, Split-Sleeve Type Model 1401-Y3



ARMY E NAVY

CLARKE AERO-HYDRAULICS, INC. BOX 591, PASADENA 19, CALIFORNIA

United Aircraft Corp. reports net income of $8,450,113 or $2.93 a share for the six months ended June 30, compared with $4,070,163 or $1.41 a share for the like 1943 period. Shipments were $419,925-815 against $333,798,454 a year ago. Shipments in the June quarter were $204,645,801. The company's reconversion and inventory write-off reserves now stand at $34,135,000. Loans made in connection with government emergency plant contracts are down to $1,223,500 from $37,774,000 two years ago.

Bendix Aviation Corp. reports net sales for nine months ended June 30 of $663,586,477 compared with $643,148,412 in the like previous fiscal period. Net income was $12,159,486 or $5.74 a share against $11,995,-931 or $5.67 a share. Price reduction totaled $62,305,000 for the eight months, according to Pres. Ernest R. Breech.

American Airlines reports net profits for the six months to June 3 were $2,165,035 or $3.58 a share against $2,814,915 or $4.71 a share last year. Pres. A. N. Kemp said that heavy traffic is expected to continue throughout the war period.

Fairchild Engine & Airplane Corp. reports sales of $102,-450,364 for 1943 compared with $47,800,224 in 1942. Net income was $1,827,211 or $1.75 a share against $626,744 or 60c. a share in 1942. Postwar reserves at the end of 1943 totaled $2,221,609, including $500,000 transferred from the earned surplus and an amount equal to the $919,654 postwar excess profits tax rebate accrued in 1943.

Dividends: Rohr Aircraft declared a 25c. dividend payable Sept. 11 . . . Air Associates paid a regular dividend of 20c. on Sept. 8 as well as an extra dividend of the same amount . . . Continental Motors paid a dividend of 15c. a share on Sept. 22.

Sperry Corp. reports net profits of $4,413,287 or $2.10 a share for the six months to June 30 against $4,242,813 or $2.11 a share in the like 1943 period. Shipments were 8 percent less than for the first half of 1943. A further provision of $2,500,-000 was set aside for postwar contingencies.

United Air Lines reports net profits of $2,912,797 or $1.79 a share for the six months to June 30, against $2,153,400 or $1.44 a share in the like 1943 period. Pres. W. A. Patterson pointed out that present high load factors and earnings could not be expected to continue in the postwar period.

Kellett Aircraft Corp. reports sales for the first six months of $5,572,615 against $5,394,900 in the same 1943 period, while net earnings were $100,053 against $128,087 for the first six months of 1943.

Unfilled orders: Bendix reports unfilled orders of $677,-868,000 on June 30 compared with $1,042,431,000 a year ago . . . Fairchild Engine & Airplane had unfilled orders of $156,000,000 on June 30 against $269,000,000 listed at the end of 1943.

Penn-Central Airlines reports net earnings of $114,006 or 24c. a share for the quarter ended June 30 against $107,128 or 22c. a share in the like 1943 period. Six months net income was $61,490 or 13c. a share against $119,520 or 22c. a share a year ago.

Loans: Solar Aircraft's Pres. Edmund T. Price announced amendments to the company's loan agreement with banks raising allowable annual dividends from $161,000 to $232,-000, which makes possible payment of dividends at the rate of 60c. a year, provided earnings continue at present rates. Solar's bank loans have been cut from $6,175,000 to $3,900,-000 . . . Ex-Cell-O has borrowed $6,000,000 out of its $15,-000,000 V-loan agreement with banks . . . Packard Motor Car Co. has a $30,000,000 bank credit agreement expiring Dec. 31, 1947.

Cutbacks: Stewart - Warner Corp. shows a net decrease of 28 percent in unfilled orders since the end of 1943, with the order backlog now standing at $80,000,000, according to Pres. James S. Knowlson . . . Sperry shipments in the current half year will show a further reduction in volume compared with the first half of the year, according to Pres. T. A. Morgan.

Borg-Warner Corp. reports net earnings for the six months to June 30 were $4,-091,617 or $1.75 a share against $4,665,477 in the same 1943 period.

Stewart-Warner Corp. reports net profits of $1,733,197 or 89c. a share for the first half of 1944. No report was issued for the comparative 1943 period.

Western Air Lines reports net profit for the six months to June 30 of $43,233 or 10c. a share compared with $71,767 or 17c. a share in the like 1943 period. Pres. William A. Coulter said that passenger revenues were up 57 percent in the first half this year compared with the company's first-half record in '43.

New Products: The Ex-Cell-O Corp. plans to go into production on a new line of machines as soon as equipment is available . . . American Central Mfg. Co., a subsidiary of Aviation Corp., has a contract to make peacetime "jeep" bodies for Willys-Overland Corp., according to late reports.

ADDING IT UP.....By RAY HOADLEY

Airline earnings. Although most airlines reported an anticipated decline in profits for the first six months of 1944, the important thing about these reports was the vast improvement shown in earnings for the second quarter. Not only did the lines have more equipment with which to operate but, equally impressive, they were able to report that operating costs were under better control. Some lines were able to record their first increases in flight schedules since the spring of 1942 when substantial parts of their fleets were turned over to the Army.

Future Prospects. Further gains in airline profits in the months immediately ahead should bring results for 1944 somewhat ahead of last year. Penn-Central showed July net before taxes of about $165,000 compared with $156,000 in June and $90,000 in May. American Airlines should have a fleet of 73 planes by the end of October as compared to 79 in the early part of 1942. By the end of the year all lines probably will be operating as much equipment as they did in 1941, possibly more.

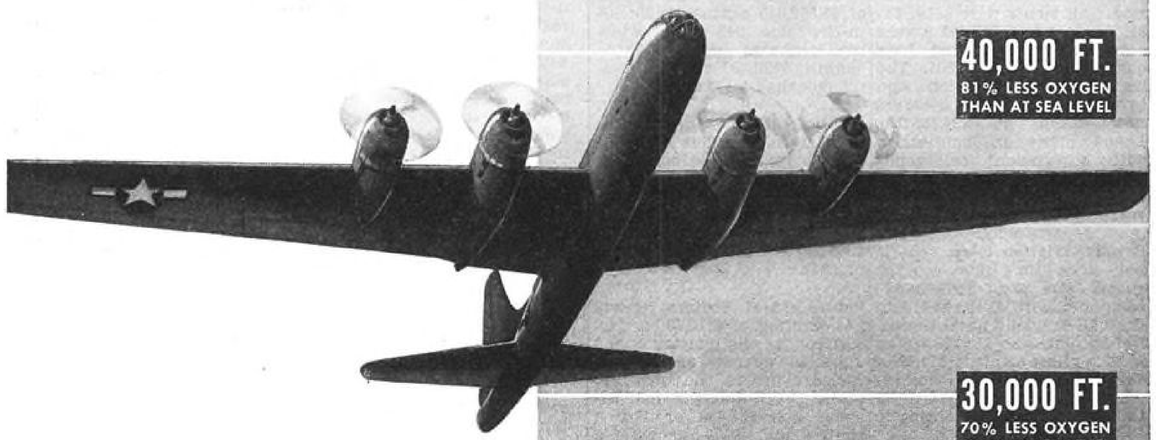
Excess profits. Ways and Means Committee of the House of Representatives has its staff of experts preparing several alternative programs of tax adjustments. Termination dates for the excess profits tax is one of the matters under consideration. Some members of the committee feel that Congress should enact a joint resolution specifying that this levy should be cut 50 percent as soon as possible after Germany's defeat and be abandoned altogether a month after the end of the war in the Pacific.

Contract Cutbacks. It apparently is an integral part of the reconversion plans of WPB and the War and Navy Departments that contract cutbacks will hit converted industries first. That would seem to mean that as plane requirements drop, production will be concentrated in the regular aircraft companies. In the case of the automobile companies, it is understood that Washington plans to accede as far as possible to their requests to free the entire facilities of a company at one time for motor car production.

State taxes. The CAB has appointed a special committee to look into the vexing matter of multiple state taxation of airline equipment. Under a resolution passed by Congress the committee has until next January to gather the facts on such tax troubles for presentation to Congress. The matter came to a head when the Supreme Court held that Minnesota could tax the entire fleet of Northwest Airlines despite the fact that six other states also tax portions of this airline's equipment.

War profits. Figures introduced by the CIO on aircraft profits before a Congressional committee recently were arranged to make it appear that stockholders and management have been vastly overpaid in relation to the wages paid employees. The Aeronautical Chamber of Commerce, in reply, pointed out that aircraft stockholders are not as well off now as they were a year before Pearl Harbor. Stockholders of the eight largest concerns, the Chamber noted, have lost 26 percent in market value of their stock from the lowest point reached in 1940. Their dividends have increased 13 percent since 1940. The net result was that stockholders lost an average of $6.62 in market value and gained $0.54c. in dividends in four years. Average weekly wages of aircraft workers, using the figures of the CIO, increased 47 percent from 1940 to 1942.

B-29 Crews Above 30,000 Feet Breathe *without oxygen masks*



AiResearch Pressurized Cabin Controls make it possible. They promise a new kind of air travel postwar

TO CARRY heavier bomb loads faster and farther than ever before, the giant Superfortress flies the substratosphere route! Away up there—30,000 feet or more—where air is much too thin to sustain life without the aid of oxygen masks.

It *was* too thin. *It isn't any more* inside the Boeing B-29 Superfortress. In its pressurized cabin, AiResearch controls constantly keep the air pressure at a safe "low altitude." And at the same time these controls maintain a comfortable flow of fresh air through the cabin.

Here men can live and breathe as at home, without oxygen masks or heavy, cumbersome clothing...without nausea or dizziness however high they fly.

AiResearch engineers worked long and closely with Boeing and the Army Air Forces to perfect the pressurized cabin. You'll hear more about this miracle of air control. A military achievement vital now, it will help make possible faster, smoother planes to speed postwar air travelers through the upper air in undreamed-of comfort. AiResearch Manufacturing Company, Los Angeles and Phoenix.

AiResearch
DIVISION OF
THE GARRETT CORPORATION

Superfortresses carry AiResearch Cabin Pressure Regulating Systems • Engine Oil Cooling Systems Engine Air Intercooling Systems • Supercharger Aftercooling Systems • Automatic Exit Flap Control Systems • Temperature Control Systems





JOHN A. COLLINGS (left) TWA's operations v.-p. has been named v.-p. heading Transportation Dept., which embraces all operating and service functions of line. Field activities of department will be decentralized through three regional offices. **JOHN B. THURSTON** (right) lawyer and public accountant, has joined line's executive staff as head of new Industrial Engineering Div. Formerly comptroller of Fram Corp., Thurston was first president of Institute of Internal Auditors, and he was editor of the first book published by that organization. (TWA photos)



GEORGE O. STAYMAN goes from post of Cincinnati City traffic manager to district traffic manager for Delta Air Lines, with territory embracing Knoxville, Tenn., and other points contiguous to Cincinnati. He joined Delta in 1941, becoming manager in Cincinnati, home town, in '43.



A. JACKSON KELLY, former Pan Am division traffic manager in London, moves to LaGuardia Field as assistant to Atlantic Div. manager. He has been with Pan Am since 1937, and, in present position he succeeds Tolbert A. Rice, who has been transferred to United Kingdom offices.



THOMAS J. DEEGAN becomes Director of Public Relations for American Airlines. Veteran newspaper and public relations counsellor, he has acted in advisory capacity to both War and Treasury Departments. Prior to appointment he was with Johnson & Johnson. (AA photo)



GEORGE C. MITCHELL now heads CAB's committee to investigate multiple taxation of airlines by states. Committee was formed after Supreme Court decision in Northwest Airlines case, in which court said law it upheld was inequitable. (Underwood & Underwood photo)



HENRY G. TARTER is named chief engineer of aircraft carburetor engineering department of Bendix Products Div. of Bendix Aviation Corp. An Oregon State College and Pennsylvania U. grad, he was test engineer for 6 yr. at Phila. Naval Aircraft Factory before joining Bendix in 1935.



RUSSELL H. LASCHE is appointed director of engineering and research for Fairchild Camera & Instrument Corp. With Fairchild companies for 15 yr., he organized aerial photo program for Colombian government and made first air map of the Caribbean and photos of Orinoco headwaters.



MERLE L. GALLAGHER (left) becomes UAL's Boston station manager as company moves to establish direct service into New England. For past 18 mo. assistant to R. L. Dobie, eastern operations v.-p., Gallagher has been with UAL since 1932, and has served in both Canadian and Australian posts. **GEORGE ESTILL** (right) becomes line's supervisor of cargo service procedure, working with operations officials analyzing cargo problems and standardizing handling procedures throughout UAL system. Previously with D&RG railroad, he has been with UAL since 1940. (UAL photos)



CAPT. JAMES YOUNG CRAIG has become chief pilot of American Export Airlines, succeeding Capt. Charles F. Blair, Jr., who returns to trans-atlantic run as flight captain. Capt. Craig is Pensacola Naval graduate. (AEA photo)



W. C. LAWRENCE, former director of development for American Airlines, has been named chief engineer of American Export Airlines, heading new department, former engineering sections of both operations and maintenance departments.



J. F. SCHIBLER (left) has been made assistant chief engineer for Taylorcraft Aviation Corp., and he will retain former duties as engineering planning supervisor. Before joining Taylorcraft, Schibler was test mill and bearing engineer with Timken Roller Bearing Co. **HAROLD J. WHITE** (center) formerly in charge of Service Department, becomes project engineer on Models B and B-12. One of the oldest Taylorcraft employees in point of service, he was one of original eight-man staff with which company began operations in 1936. A third promotion involves **DELMAR J. TOBAN** (right), formerly in charge of Shipping Department, who has been appointed manager of Taylorcraft's Service Sales Department.





Famous for LONG LIFE!

Tobe Capacitors are *built* to last. From winding to shipping, each step is under rigid inspection to maintain the high standard set by twenty years' experience.

Below is shown a Tobe RLO Type Capacitor. It is impregnated and filled with mineral oil, made with watchful care and—like all Tobe Capacitors—rated conservatively. Let us know about *your* capacitor problems.

LONG LIFE ASSURED

SPECIFICATIONS—TYPE RLO* CAPACITOR

RATINGS: 600 VDC	Single Units	.01 to 2.0 Mfd.
	Dual Units	.05 to 1.0 Mfd.
	Triple Units	.05 to 0.5 Mfd.
1,000 VDC	Single Units	.01 to 1.0 Mfd.
	Dual Units	.05 to 0.5 Mfd.
	Triple Units	0.1 and .25 Mfd.

STANDARD CAPACITANCE TOLERANCE—plus or minus 20%**
TEST VOLTAGE—twice D.C. rating
GROUND TEST—2,500 Volts D.C.
OPERATING TEMPERATURE—55° F. to 185° F.

SHUNT RESISTANCE—	.01 to 0.1 Mfd.	—20,000 Megohms
	.25 to 0.5 Mfd.	—12,000 Megohms
	1.0 Mfd.	—10,000 Megohms
	2.0 Mfd.	— 5,000 Megohms

POWER FACTOR —1,000 cycles—.002 to .005

MOUNTING HOLE CENTERS: 2⅛" except for the following capacitance values which are made in containers having 2⅝" mounting centers:

600 VDC—	Single Units	1.0 and 2.0 Mfd.
	Dual Units	0.5 and 1.0 Mfd.
	Triple Units	.25 and 0.5 Mfd.
1,000 VDC—	Single Units	0.5 and 1.0 Mfd.
	Dual Units	.25 and 0.5 Mfd.
	Triple Units	0.1 and .25 Mfd.

*Data sheets showing complete code number for units having a specific capacitance value and voltage rating available on request.
**Other tolerances available.

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

a small part in victory today

A BIG PART IN INDUSTRY TOMORROW

Photo Courtesy of Southern Pacific Lines

THE GROUP was discussing aircraft distribution, and one old die-hard allowed as to how he thought the way things were done before was all right. Seemed, said he, that the airplanes got bought without all these plans and sales programs.

Anyhow, his remarks brought forth this story—a true one:

A wealthy family operating a string of farms was eager to have a plane to use for convenience as well as the efficiency which its time-saving would bring. So they got in touch with a dealer, seeking a demonstration. But getting that demonstration was no easy matter: The dealer had a lot of other things to do and couldn't be bothered, but eventually, under considerable pressure, he made a date to fly to the home farm and give the demonstration. On the way, however, he had a bit of trouble, finally cracking up in a field about two miles from the house.

Making his way to a phone, he called the prospect and said, bluntly. "I just cracked up over on So-and-so's field; if you wanta see the plane, come on over and look at it."

Believe it or not, he was actually surprised when he didn't make a sale.

• This discussion of selling planes took us back a good many years—back to the days of what was to be the first "flivver" plane, the old Curtiss Junior. The chap who taught us to fly (he had 50 hr. when we started) was cruising in a Junior over a university town where the "light of his life" was a student. Her sorority house was rather on the edge of town, in fact the other side of the street was vacant for more than a block.

Suddenly this chap got a brilliant demonstration idea; he'd land right in the street and taxi up to the front door to call on her—thereby proving that those ships could really land on a dime and be handled easily; besides he'd get to see the lady. No sooner thought than done. He made a honey of a landing, then taxied up on the lawn, to be greeted effusively by not one gal but a whole houseful of them.

Only thing wrong with the deal was a passing motorcycle cop. He immediately took the attitude that "this guy" ought to be pinched for something, but he couldn't figure out what. No matter, he did nab the fellow, and after getting him in the hoosegow it took the city attorney all day to figure out a charge—"operating a motor vehicle within the city limits without a muffler."

Paying the fine wasn't too much of a problem, but getting the lad out of town was. City fathers finally agreed he could taxi out of town without a muffler, and he was escorted down the unpaved street by the same motorcycle cop to the city limits where, passing from city jurisdiction, he could take off. And brother, did that cop get a prop-dusting as the city line was reached!)

Sure, the deal got quite a bit of publicity—some adverse, some right good. But we never could actually trace a sale to it.

• Ah, to be one of the airbrush designers and have no worries about aerodynamics, structures, power, economics—or even common sense! They draw such very pretty pictures of truly wondrous things. Like one recent ad illustration, showing a gargantuan flying wing with integral floats. Its range, says the caption, "may be 10,000 mi., bringing world centers into a proximity measured well within a 24-hr. day." Yet it would have a machine shop and carry reserve motors.

Turn back, oh time in thy flight, we gotta whip up some new parts and change an engine.

• The complexity of modern airplanes is almost matched by the job-wanderings of some of the people in the industry. The other day, for example, a man whom we'll call Zilch was thinking of changing pastures, so he called a friend, who'd best be called Smathers, to see what could be done about joining Smathers' company.

Things were progressing fairly well, but all of a sudden Smathers called Zilch to say he was out of a job, how about *his* joining *Zilch's* company. The very next day Zilch called Smathers to ask, "Did you know Jones has left your company—just called me to see about a job." "Yeah," replied Smathers, "I fired him." At last reports Zilch was still with his original company; both Smathers and Jones were making final arrangements to join his firm.

Is there a termination expert in the house?



Why's Maguire so worried about reconversion —I've got the answer right here in my yo-yo!

KEEP POSTED ON

Products and Practices

This selected information on new publications and products 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 literature or additional data on new products described, simply fill in form below, clip it to your letterhead, and mail. There is no cost, no obligation.

ENGINEERING DATA

Self-Locking Nuts 1

Combination catalog and data book on "Esna" elastic stop nuts is offered by Elastic Stop Nut Corp., Union, N. J. Book covers hex, anchor, and clinch types, also contains data for design engineers and suggestions for applications.

Pressure-Lube Study 2

Lubrication, technical publication of the Texas Co., New York, considers "The Action of Extreme Pressure Lubricants" in August issue. Beginning with idea of E. E. Hendrick in 1869 that "body" in lubricating oil was simply another name for specific gravity, which might be obtained by addition of oxide of lead to light oils, study covers technical details of friction and application of extreme pressure lubricants.

Aircraft Control Terminals 3

Tru-Loc Aircraft Terminals is title of new booklet published by American Chain & Cable Co., Detroit. It contains descriptions and data on swaged terminals of varied types.

Stainless Steel 4

Design Data on High Tensile Stainless Steel Sheets for Structural Purposes, published by American Rolling Mill Co., Middletown, Ohio, is new handbook intended to aid designers and engineers in accurately proportioning stronger and lighter aircraft structures and components. It contains test results and discussions on "Armco" sheets in quarter, half, three-quarter, and full-hard tempers, compression and tension data, mechanical properties, and other information.

Turnbuckles 5

New methods of aircraft turnbuckle production and their results are described in booklet offered by Reliable Electric Co., Chicago.

Synthetic Resin Glue 6

Information is available on new synthetic resin glue produced by Casein Co. of America, New York, reported to set at room temperature and to be completely durable for wood joints which cannot be treated, such as in thick laminations for propellers, aircraft spars, and certain assemblies.

Plasticized "Leather" 7

Southern Friction Materials Co., Charlotte, N. C., offers bulletin on Cotton-leather, abrasion resistant plasticized cotton fabric suggested for oil-soaked clutch facings and other applications.

Rupture-Proof Plastic Glass 8

Booklet describing laminated Lucite-Butacite sheeting for transparent panels in aircraft has been published by E. I. duPont de Nemours & Co., Arlington, N. J. Described as being proof against rupture when subjected to gunfire, use of material permits quick sealing of holes, assisting in maintenance of air pressure in pressurized cabins at high altitudes.

Altitude Testing Chambers 9

Bulletin descriptive of altitude chambers made by Kold-Hold Mfg. Co., Lansing, Mich., has been issued. Chambers enable manufacturer to test products at various altitudes, temperatures, and humidities.

PRODUCTION

Heat-Treat Guide 10

Complete information on heat treatment of all Carpenter matched tool steels is given in new heat-treat guide published by Carpenter Steel Co., Reading, Pa. Guide covers type analysis, forging heat, normalizing heat, annealing treatment, hardening treatment, furnace atmosphere, and recommended drawing range, in addition to method of determining hardness for various drawing temperatures.

Refractories 11

Bulletin describing new series of basic, acid and neutral refactories designed for rapid emplacement on furnace linings by air stream and water, is offered by Basic Refractories, Cleveland.

Radiant Heat 12

The Near Infra-Red Process is booklet describing use of this radiant heat process issued by Fostoria Pressed Steel Corp., Fostoria, Ohio.

Storage Battery Welding 13

Welding with storage batteries as a battery source is described in new booklet issued by Progressive Welder Co., Detroit, titled *The How and Why of Storage Battery Welding*. Questions relating to costs, operation, maintenance, design and installation are posed and answered.

A.C. Arc Welder 14

Bulletin descriptive of basic engineering idea in continuous a.c. arc welding, covering two differently sized welders in four models each, is offered by Ergolyte Mfg. Co., Philadelphia.

Degreasing 15

Booklet *Solvent Degreasing* emphasizes fundamental practices for economical use of degreasing solvents in metal cleaning departments of industrial plants and describes typical designs of degreasers. It is offered by Detrex Corp., Detroit.

Springs 16

Reliable Spring & Wire Forms Co., Cleveland, has issued new catalog describing line of springs. Tables for figuring weight, detailed drawings of end finishes, and spring design chart are given.

MACHINERY & ACCESSORIES

Belt Drive Equipment 17

Split pulleys and bushings, shaft collars, shaft hangers and bearings, split and solid conveyor pulleys, high-torque motor pulleys, belting, and "Econ-o-matic" drives for short-center flat-belt drives, are described in new catalog issued by American Pulley Co., Philadelphia. Application and design of group drives are also discussed.

Fatigue Testing Machine 18

Bulletin on its line of vibration fatigue testing machines has just been issued by All American Tool & Mfg. Co., Chicago. Model 10HA is designed to subject parts up to 10 lb. in weight to vibrations produced horizontally in simple harmonic motion. It has range from 10 to 55 cycles ps. (600 to 3,300 pm.) which are increased and decreased automatically at uniform rate.

Hydraulic Broaching Machine 19

Bulletin descriptive of improvements in hydraulic broaching machine for small parts work has just been issued by Zagar Tool Co., Cleveland.

Cutting Tools 20

Ground thread cutting tools and hobs are described in Bulletin 644, issued by Universal Engineering Corp., Cedar Rapids, Iowa. Included are instructions to customers for ordering hobs, taps, cutters, and leaders.

Plastic Forming Tools 21

New booklet, *Tenite II Casting*, issued by Tennessee Eastman Corp., Kingsport, Tenn., describes casting of new thermoplastic material for forming tools. Product, states company, will form sheet metal into corners of die without becoming rounded, can be cast to finished size in die without scraping and polishing; is relatively unaffected by temperature changes, and may easily be made harder or softer. Finished casting is reported easily machined.

Welding Electrode 22

Bulletin B6340 from Allis-Chalmers Mfg. Co., Milwaukee, describes new line of smooth-flowing arc welding electrodes with quiet arc characteristics, both in a.c. and d.c. types.

Plastic Board 23

Physical properties of Walesite, laminated lignin plastic board used in Wales plate sets and hole punching units, is considered in Bulletin 6 issued by Wales-Strippit Corp., North Tonawanda, N. Y.

Grinder Unit 24

Bulletin No. 318, from Baldor Electric Co., St. Louis, describes new 7-in grinder, in company's 7100 Series. Grinder is reported to have 100 percent overload capacity. Feature is inclusion of pre-lubricated ball bearings.

ELECTRICAL

Pressure Switch 25

Developed for use where there is need for a small compact unit that will open or close circuit at predetermined pressure, new pressure switch made by Hawk Tool & Engineering Co., Detroit, is described in catalog sheet just issued by company.

Capacitor Catalog 26

Dry electrolytic capacitors developed by Sprague Electric Co., North Adams, Mass., are described in new catalog. Capacitors are available in various combinations of capacity and voltage ratings to suit requirements.

Welder Controls 27

Weltronic Co., Detroit, announces Bulletin WT-40-41 covering application, operation, description, specifications, and features of its full-electronic seam welder controls, improved Models 40 and 41. Both instruments are described as complete machine controls which have been incorporated into single interchangeable-panel type cabinets.

Tack Welding Control 28

Bulletin describing and giving full technical information on Wilson Type 30 special tack welding circuit control panel is available from Air Reduction Co., New York. Control is described as new and improved panel with constant potential power supply.

MANAGEMENT & EMPLOYEES

Grinding Practice Film 29

Bryant Chucking Grinder Co., Springfield, Vt., announces new film of interest to plant engineers, tool and fixture designers, grinding room foremen, and production men. Shown are correct methods of internal grinding, chucking equipment, setups, and special and standard fixtures.

Film on Welding 30

The Story of A. C. Welding is title of new all-color sound film offered by General Electric Co., Schenectady, N. Y. This motion picture tells detailed story of a.c. arc welding.

War Film 31

Brief For Invasion, listed as No. 6 of the "Why We Fight" series, is now ready for distribution by War Department's Motion Picture Branch, Industrial Services Div., New York City. Film highlights for workers the need for enormous amounts of materials in war campaigns.

Employee Safety 32

Report titled *Developing Safe Employees* has been issued by Safety Bureau of Metropolitan Life Insurance Co., New York City, to aid industry in fostering care on part of workers, both on and off job, as means to reduce accidents. Study is based on records of numerous industrial organizations. Safety through fitting right employees to right jobs is emphasized, also integration of preventive elements in training programs.

AVIATION READER'S SERVICE — OCTOBER 1944

AVIATION, 330 W. 42nd St., New York City 18

Please send me additional information according to key numbers circled.

INFORMATION TIPS:					1	2	3	4	5	6	7	8	9	10	11	12	
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32																
NEW PRODUCTS:					33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90									

NAME ..... TITLE .....

FIRM OR AFFILIATION .....

ADDRESS .....

Latest Machine Tools

Broach Sharpener 33

New broach sharpener has been developed by **Colonial Broach Co.**, Detroit, to handle virtually any broach in use. It is designed to sharpen flat, spline, and serrated types up to 7 ft. long with max. dia. of 6 in. Sliding head is of lightweight aluminum alloy and is supported and guided by full anti-friction double-row rollers. Dual-ratio micrometer hand wheel is incorporated to maintain identical steps per tooth in regrinding, and roller curtain design protects ways of machine when table is moved. Universal positioning and movement of wheel are obtained by use of vertical column, a cross slide mounted on graduated support, and a graduated wheel head mounting. Headstocks for cylindrical broach sharpening are provided, with reduction gear giving spindle speeds of 200 and 400 rpm. Tailstocks have quick-release spring-loaded centers.—AVIATION, Oct., '44.

Midget Milling Cutters 34

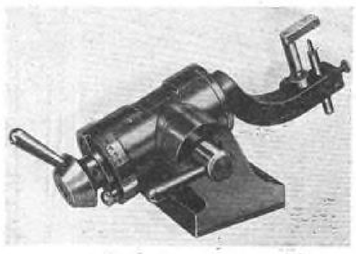
Midget milling cutters with ⅛-in. shanks are announced by **Severance Tool Industries, Saginaw**, Mich., and are available in ten standard shapes from stock, packed singly or in sets in kit box.—AVIATION, Oct., '44.

Automatic Reamer 35

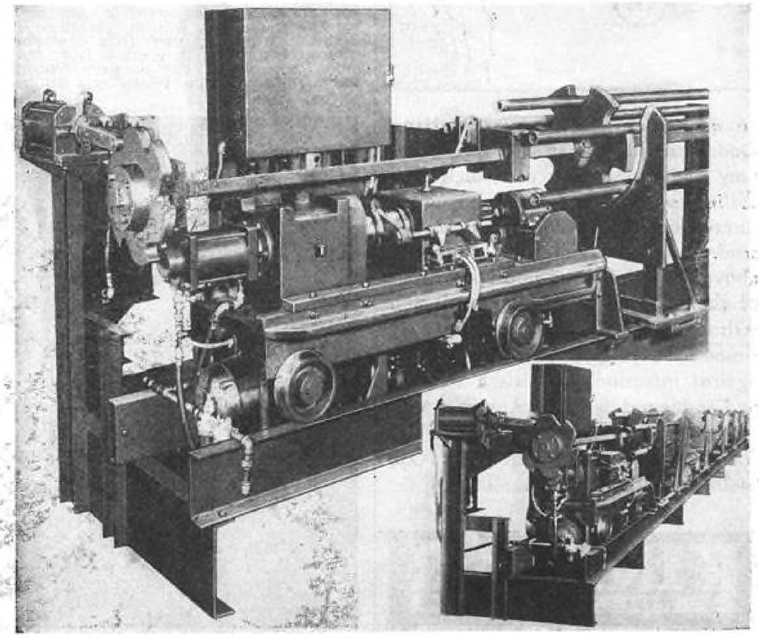
Pines Engineering Co., Aurora, Ill., is marketing new combination automatic reaming and burring profiler for handling tubes up to 6 in. o.d. and lengths from 3 to 60 ft. or longer. Head assemblies, consisting of spindles and chucks, are suspended on flanged wheels anchored to channel iron track. One car can be positioned for processing any length of tube, and tubes are fed by automatic reel mechanism, which selects tubes from storage rails regardless of diameter. Indexing mechanism, automatic self-centering chucks, and spindle advance are actuated hydraulically. Same type machine is also used for threading, flaring, burring, turning, boring, and chamfering.—AVIATION, Oct., '44.

Radius Dresser 36

U. S. Tool & Mfg. Co., Dearborn, Mich., announces new dual-purpose angle-correcting radius dresser which is designed to dress corrected radius on a wheel for grinding compound and compound-complex forms on flat form tools. Tool employs direct-reading principle. Procedure



is: (1) Swing diamond dresser arm mechanism through specified number of degrees, as indicated on scale, and lock in position. Reading is taken directly from print, and if a 20 deg. relief angle is called for, dresser is set at 20 deg.; (2) radius dresser is then put on chuck, on center line of wheel, and is dressed to radius required. For compound-complex angle, same procedure is followed, with



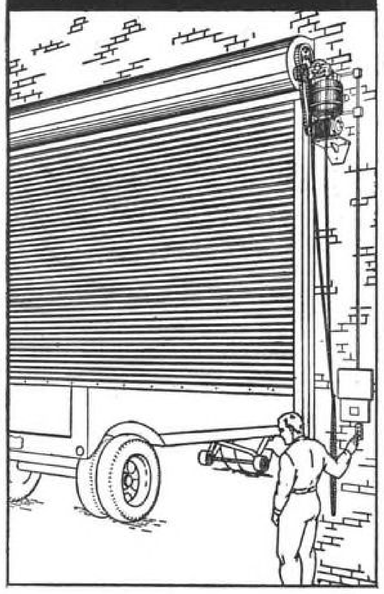
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Do you have an opening for this well-known, long experienced and highly efficient worker, who would like an opportunity to cut costs and save time and effort . . . who can stand up under long hours of hard continuous activity, and can produce excellent records of past performance? If so, get in touch at once with

KINNEAR ROLLING DOORS

CEMENT WORK—Steps, Walk



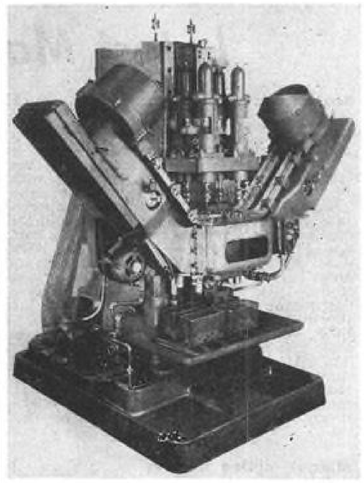
In *any* opening, Kinnear Rolling Doors provide the space-saving economy and time-saving convenience of *coiling upward action.* The rugged interlocking-steel-slat curtain opens straight upward and coils compactly above the lintel—the doors open out of the way and leave floor, wall and ceiling space clear and usable at all times. They give extra protection against intrusion, fire, wind, weather and accidental damage. Any size, with motor or manual operation. Write for details. The Kinnear Mfg. Co., 1440-60 Fields Ave., Columbus 16, O.

KINNEAR ROLLING DOORS

base of dresser being swung away from parallel bar of chuck, using upper right hand corner of base of dresser as pivot point. Angle is read directly from blueprint as before.—AVIATION. Oct.. '44.

Nut Tapping Machine.....37

Described as delivering four nuts simultaneously to four tapping stations by means of two hopper feeding mechanisms, each equipped with two adjustable chutes, new high speed automatic nut tapping machine has been developed by **Bodine Corp.**, Bridgeport, Conn. Feature emphasized by maker is lead screw precision



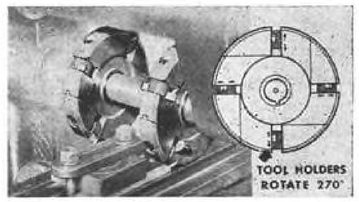
control on all four spindles, operated simultaneously by one segmental gear drive which starts taps at slow speed and reverses at double tapping speed. Threads on master screw and its spring-tensioned nut match those of tap. Screws and nuts are changed when tap pitch is changed. Two sizes may be tapped at one time. If commercial threads (classes 1 and 2) are to be tapped, lead control spindles are not required. Model 48 (illustrated) is an automatic self-contained unit for tapping any nut blank that can be hopper fed, up to ½ in.—13 threads per inch in mild steel or its equivalent.—AVIATION, Oct., '44.

Cylinder Block Processor.....38

New automatic transfer-type processing machine for cylinder blocks is announced by **The Cross Co.**, Detroit. Machine is designed to pick up work from conveyor, completely process it, eject it from machine, and re-deliver it to conveyor. Photo shows machine with only a drilling and a tapping station, but units using same principle may be had for processing intricate work requiring a multiplicity of operations.—AVIATION, Oct., '44.

Universal Fly Cutter 39

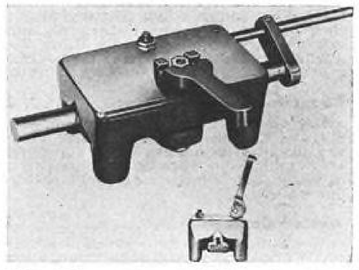
Newfield Machined Parts Co., Los Angeles, announces universal fly cutter, utilizing standard steel or carbide bits, which is designed to do the work of many



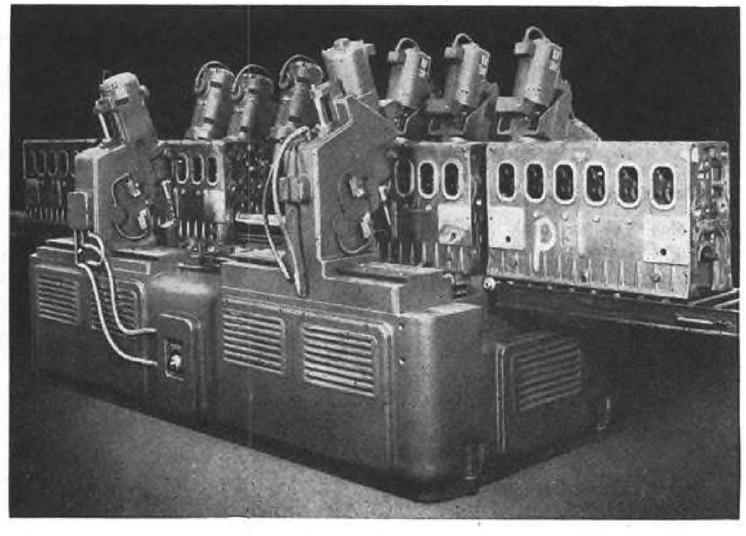
special cutters. This tool may be used for slotting, milling, boring, disk and gear cutting, and is adaptable for machining plastics and light metals as well as steel on mills and drill presses. Standard bits are inserted in holders which may be rotated 270 deg. at right angles to shaft, permitting individual adjustment for width and depth of cuts. Each bit and holder is held by a single alien screw. Complicated cuts are broken down into simple units by grinding each bit for a portion of job, each tool being adjustable to perform multiple duties. Sizes 4, 6, 8, and 10 in. are available from stock and provide bore range of 1 to 1½ in., bit capacities from 5/16 to ½ in., cut widths of ⅝ to 1 in., and four to six bit holders.—AVIATION, Oct., '44.

Drill Jig 40

For holding many sizes of small round stock, new type of drill jig called "Parlec" is offered by **Universal Tool Co.**, Inglewood, Calif. Three sizes are for handling work from ¼ to over 2 in. dia. Body is ground top and bottom with 45 deg. angle



finished in center, and clamp is ground top and bottom with 30 deg. angle finished in center.—AVIATION, Oct., '44.



PHYSICAL AND CHEMICAL PROPERTIES

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"Mr. Dag"

You get far more than just a smooth, black liquid concentrate when you use Dag colloidal graphite. A versatile group of valuable properties is also at your service. The most important of these properties are listed here. A color and a number is given to each for easy reference.

In the typical applications below, trace the record of some of these properties. You can do this simply by matching the ribbon colors against the property chart.

1 3 14 13 15



1, 3, 14, 13, 15
CITATION: "Die and punch life is increased and forgings having better finish are produced to closer tolerances with Dag colloidal graphite treated lubricants."

2 6 14 13

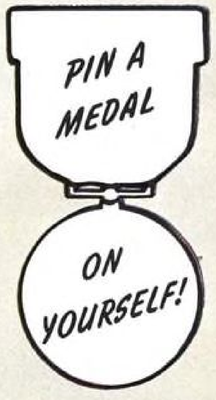


2, 6, 14, 13
CITATION: "Excellent electrical contact is obtained between copper oxide discs and adjacent metal electrodes in rectifiers when dry coatings of Dag colloidal graphite are used on the crystalline oxide surfaces."

1 2 3 14 8



1, 2, 3, 14, 8
CITATION: "Dag colloidal graphite is extensively used to impregnate asbestos packings for pumps handling chemicals and explosive fluids. It protects the packing against chemical action and provides safe, dry lubrication."



Check this list

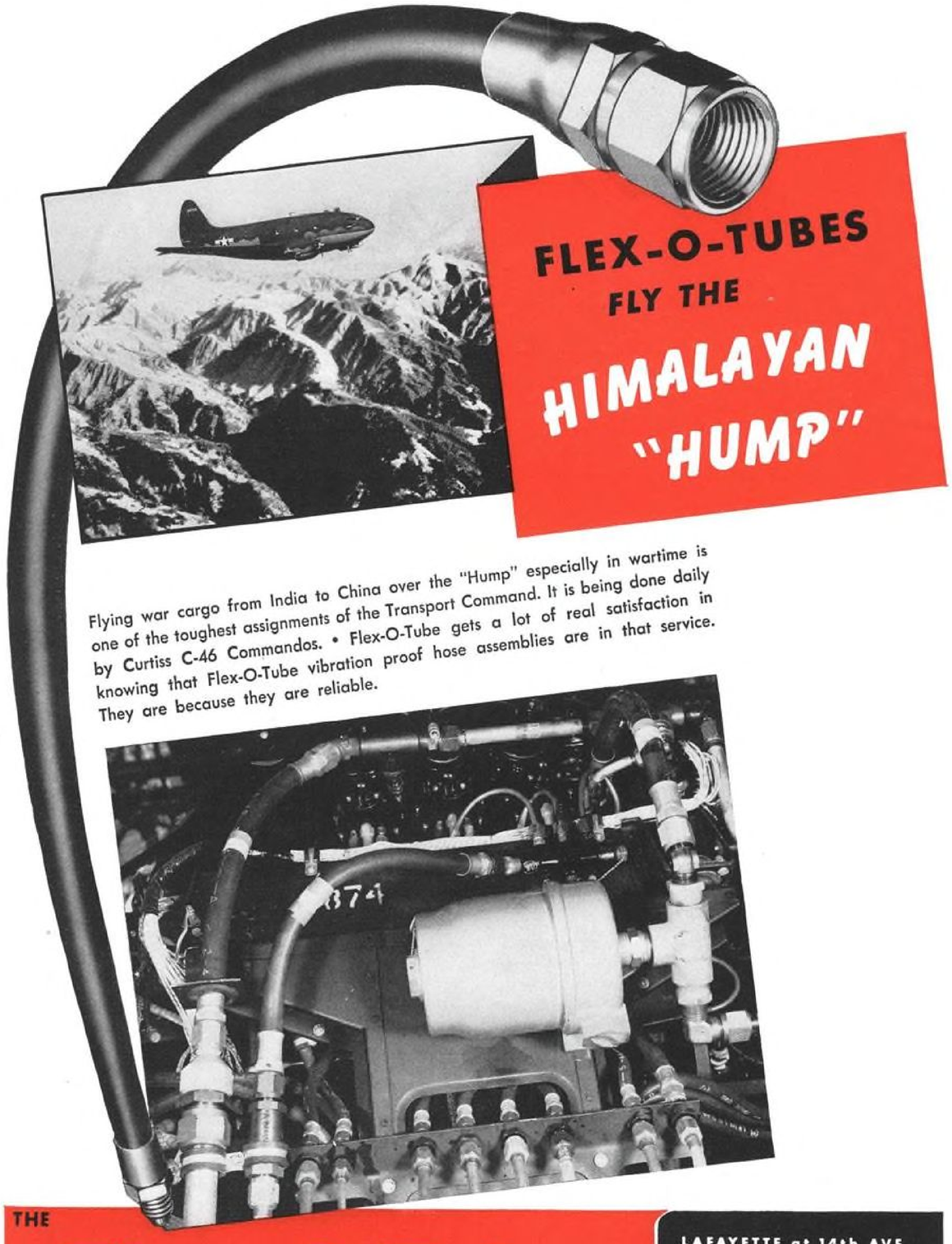
and pick out those properties which you can use. Then state your problem to us and let our engineers give you the benefit of their experience. It is quite possible that they have already studied a parallel application. You'll pin a medal on yourself for calling in Mr. Dag.

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3 Withstands Temperature Extremes
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5 Maximum Purity
6 Low Coefficient of Expansion
7 Particles Bear Like Electric Charges
8 Insoluble in Acids and Alkalies
9 Black and Opaque
10 Gas Adsorbent
11 Little Photoelectric Effect
12 Miscible with Most Fluids
13 Films Adhere Tenaciously and Dry with Sharp Edges
14 Microscopically Fine Particles. Penetrates Fine Pores
15 An Excellent Suspension



Flying war cargo from India to China over the "Hump" especially in wartime is one of the toughest assignments of the Transport Command. It is being done daily by Curtiss C-46 Commandos. • Flex-O-Tube gets a lot of real satisfaction in knowing that Flex-O-Tube vibration proof hose assemblies are in that service. They are because they are reliable.

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Center Grinder and Drill Press.....41

Portable combined center grinder and drill press weighing 165 lb. is announced by **Dalzen Tool & Mfg. Co.**, Detroit. Changeover from grinder to press is ac-



complished by lifting pin and swinging dresser in or out of position. Height is 67 in., floor space 15x21 in., and work table is 10x10 in. There is slotting for T-bolts. Standard length between centers is 39 in., with other lengths available. Capacity of drill press, which drills to center of 13 in. circle, is ½ in. Dresser is adjustable from 20 to 100 deg.—**AVIATION, Oct., '44.**

Tap Reconditioner.....42

Model DTR-3 tap reconditioner, made by **Detroit Tap & Tool Co.**, Detroit, has been redesigned with facilities for grinding full length of tap flutes in addition to machine's original functions of chamfering, spiral pointing, and spiral point polishing. Taps with 2, 3, 4, 5, or 6 flutes may be ground on one head, it is stated, and entire flute grinding and spiral pointing unit is now of sliding table type. New chamfering head employs quick-change type collet chucks for standard tap shank sizes. Spindle head is designed to accommodate interchangeably a wide range of motor types, voltages, phases, and frequencies.—**AVIATION, Oct., '44.**

Surface Grinder.....43

Designed for tool room use and light production work, model G-1 "DoAll" surface grinder has table travel of 21 in. and transverse travel of 7½ in. with vertical wheel head adjustment of 12 in., using 7 x ½ x 1¼ in. wheel. Weight is 2,200 lb. Combined hydraulic control is designed to eliminate all piping, this unit controlling five hydraulically actuated movements of machine. When un-



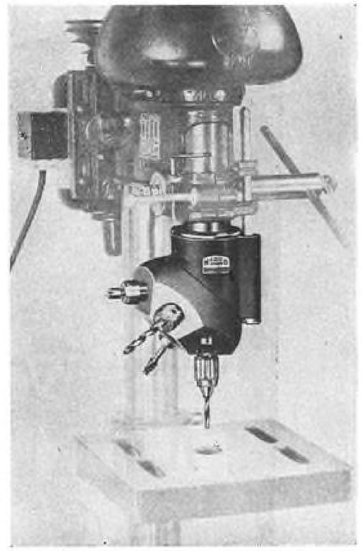
der automatic operation, cross feed screw disengages. Wheel head is raised or lowered by graduated hand wheel operating vertical adjustment screw through single gear contact. Inbuilt hydraulic oil reservoir and pump unit is rubber mounted. Lubrication is by automatic pressure. Manufacturer is **Continental Machines Co.**, Minneapolis.—**AVIATION, Oct., '44.**

Die Casting Machine.....44

Lester-Phoenix, Inc., Cleveland, announces two new high-speed, high-pressure die casting machines, one for zinc, tin, and lead alloys, and other for aluminum, brass, and magnesium alloys, each being convertible from zinc to aluminum, and from aluminum to zinc. Designed for high production of small castings, zinc machine is stated to make 400 to 500 shots per hour. Molten metal is injected by means of submerged plunger and gooseneck injection system, consisting of nitrided alloy steel cylinder, hydraulically actuated plunger with cast iron rings, and removable gooseneck and nozzle. Pressures range from 2,200 psi. for 4-lb. casting to 1,400 psi. for 6-lb. casting. Aluminum machine has cold chamber injection system, and pressures up to 20,000 lb. are available. Three automatic timers control die movement and injection cycles. Machines may be operated manually or semi-automatically. An automatic centrally-located hydraulic ejector is provided. Cold chamber for aluminum is 15 ft. 3 in. long, 4 ft. wide, 6 ft. high, and weighs 10,000 lb. Gooseneck machine is 14 ft. 3 in. long, 3 ft. 9 in. wide, 7 ft. high, and weighs 10,500 lb.—**AVIATION, Oct., '44.**

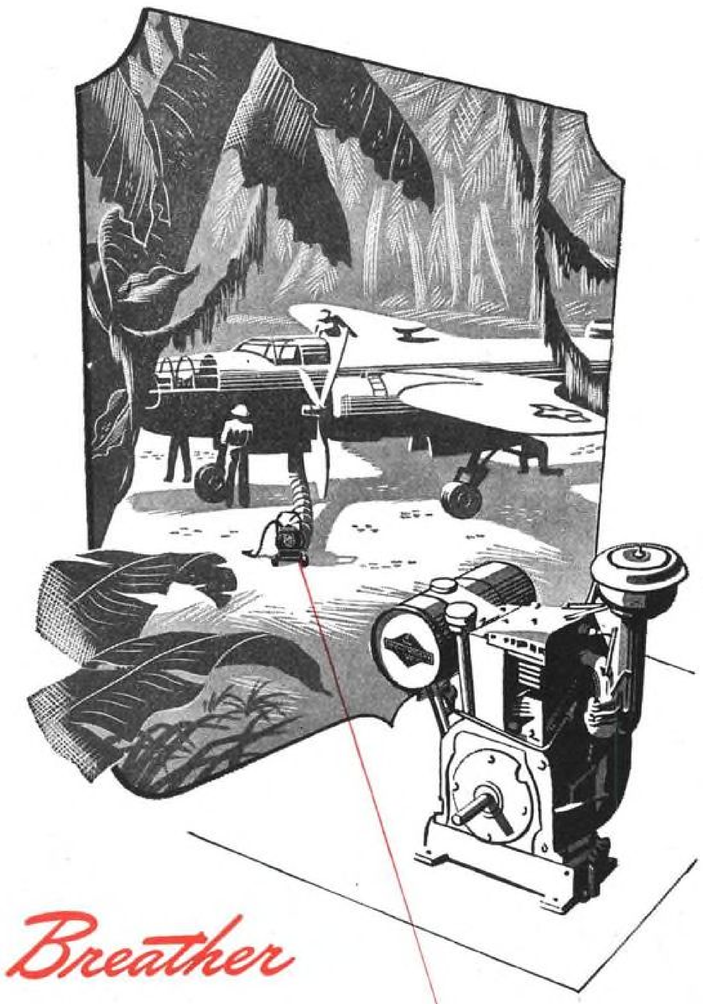
Turret Attachment.....45

"Madco" turret head, drill press turret attachment, is designed to enable single spindle drill presses to be used for multiple spindle operations. Model illustrated carries six individual spindles, taking up to ⅝-in. dia. drills. When press is equipped with reversible motor, head can also be used for tapping, reports maker, **Machine Development Co.**, New York City. Unit is attached to lower end of drill press quill by means of locked collar. Chuck is replaced by special driv-



ing mechanism, and by means of clutch, individual spindles are driven in alignment with main drill press spindle. To operate, worker raises lever and turns head to station desired, then lowers lever. Ball and detent arrangement indicates when head is in correct position, and clutch automatically engages and aligns spindle. Head comes equipped with six screw chucks furnished blank so that user may drill for his own tool applications, or with six adapters for No. 1 Jacobs chucks, or a combination of both. Also available are adapters for Nos. 2 and 3 Jacob chucks, an automatic indexing depth stop, and adapter collar for attaching head to drill press.—**AVIATION, Oct., '44.**





a Breather

FOR HOT PLANES AND MEN

Heat—140 degrees, and more—
maintenance crews in plane interiors, oven hot.
Portable ventilating units, powered by gasoline engines,
bring relief—draw hot air out, or shoot cool air in—
one more war job for dependable Briggs & Stratton
4-cycle air-cooled gasoline engines.

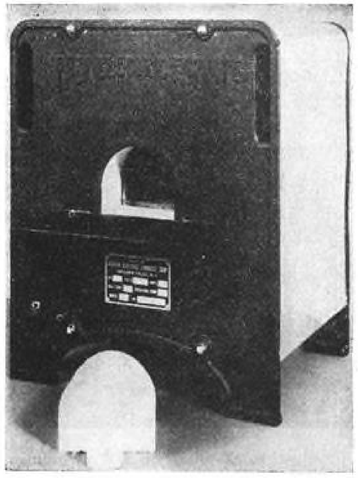
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During 25 years of *continuous* production Briggs & Stratton has built more than 2,000,000 air-cooled 4-cycle gasoline engines. We are now well started on the 3rd million. Their trouble-free performance, easy starting and economy have made Briggs & Stratton leaders in the field—"preferred power" everywhere. BRIGGS & STRATTON CORPORATION, Milwaukee 1, Wisconsin, U. S. A.

Laboratory Furnace.....46

Built for industrial laboratory uses where materials are to be heated in an oxidizing atmosphere at temperatures above those attainable with metallic elements, new laboratory furnace is announced by **Harper Electric Furnace Corp.**, Niagara Falls, N. Y. Maximum



temperature is 2,750 deg. F. and operating temperature 2,500 deg. F. Furnaces are equipped with silicon carbide muffle and are heated with Globar brand non-metallic heating elements located above and below muffle. Either plug type or counter-balanced door is available. Furnaces are made with these chamber dimensions: 2⅝ in. high x 3½ in wide x 5 in. deep, and 5½ in. high x 6 in. wide x 18 in. deep.—**AVIATION, Oct., '44.**

Six-Element Oscillograph.....47

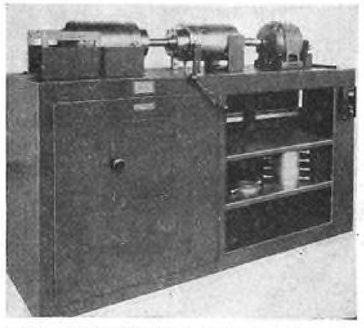
A smaller and lighter six-element oscillograph, designed by **General Electric Co.**, Schenectady, N. Y., is stated to be capable of recording simultaneously six different measurements—vibratory motion of stresses set up in such parts as struts during flight, for example, or current or voltage performance of various types of electric equipment. Characteristics of circuits are translated into beams of light, each beam registering as a thin line on photographic paper.—**AVIATION, Oct., '44.**

Carbide Tipped Tool.....48

Carboloy Co., Detroit, announces addition of new ¼-in. carbide tipped tool to its line of Style 4 and Style 7 right and left hand standard turning tools, available in grade 78 and grade 883. Tip measures 3/32 in. thick, 3/16 in. wide, by 5/16 in. long.—**AVIATION, Oct., '44.**

Fatigue Machine.....49

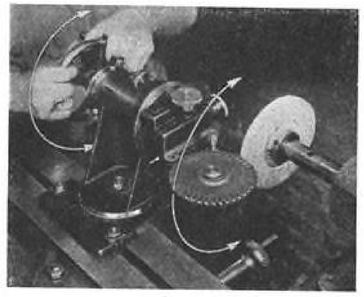
New oversize rotating beam fatigue machine, designed to help "see around corners" in testing materials, is announced by **Baldwin Locomotive Works**, Philadel-



phia. Model SF-10 has testing capacity from 0 to 10,000 in.-lb., adjustable by units of 5-in.-lb. (bending moment) by position of weight on beam. Specimen length is adjustable from 3½ to 9½ in.—**AVIATION, Oct., '44.**

Radius Grinding Fixture.....50

Designed to solve a problem in the company's shop, Model B radius grinding fixture for grinding radius cutters is now offered to the trade by **Hill Machine Co.**, Rockford, Ill. Stated to grind 180 deg. or any smaller arc, and certain angular or flat edges or surfaces, fixture has column which carries a horizontal spindle. On one end is operating hand wheel with disk and adjustable stops to limit arc of swing, and on other end is head which has two micrometer-set adjustable cross slides at right angles to each other. Slides enable positioning of cutter so that center of tooth radius coincides with centerline of fixture spindle. Outer slide carries adapter plate onto which work is clamped. On inner side of head is a graduated scale and lock plunger to secure adapter plate in the horizontal, when desired, or in upper or lower vertical position. On base there is a graduated scale, also there is an adjustable spring stop for index. Furnished are diamond dresser and gage for squaring up first tooth face. It is reported that cutter can be held so that it can be swung around center of arc of tooth profile, and fixture



is designed to fix this center point on line which is an extension of spindle axis. Each tooth of cutter is ground by rotating spindle by means of handwheel through desired arc. As each tooth is ground, table is traversed to clear wheel and cutter is indexed to next tooth. Maker states teeth can be ground at any position on face of wheel.—**AVIATION, Oct., '44.**

Hydraulic Speed Press.....51

"Corsair", new air hydraulic, gap-type speed press, made by **Studebaker Machine Co.**, Maywood, Ill., is designed to exert maximum pressure of 1¾ ton when



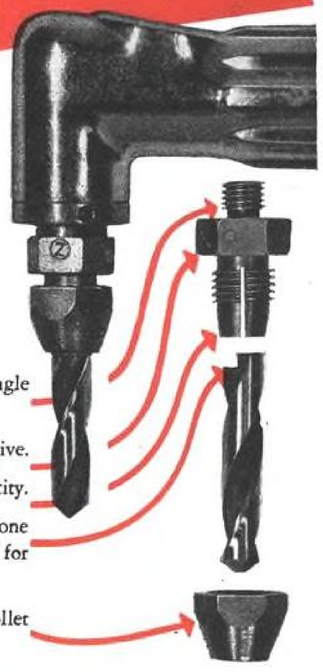
hand or foot control is pushed down, ram traveling set stroke from 1/32 to 2½ in. and delivering pre-selected pressure. When control is released, ram retracts automatically.—**AVIATION, Oct., '44.**

Corrosion-Preventive Filter.....52

Hilliard Corp., Elmira, N. Y., announces "Hilco" corrosion-preventive filter and sprayer, designed for spraying rust- and corrosion-preventives on metal surfaces, including internal mechanism of aircraft engines. Unit consists of tank, filter equipped with heaters, motor, and hose.—**AVIATION, Oct., '44.**

A Great NEW TOOL

POSITIVE DRIVE
Collet Chuck
DRILL ADAPTOR



Uses new or broken flute ends

... no threading

... no soldering

- Standard thread sizes to fit most angle drills.
- Drive pin provides positive, non-slip drive.
- Precision bored collet assures concentricity.
- Simple rough ground notch (can be done on any bench grinder) prepares drill for use . . . slides past drive pin in body.
- Lock nut has inside taper to match collet nose . . . locks smoothly and firmly.

This amazing new tool solves several drill problems: Saves time and is easy to use. Does not gall drill shank . . . increases life of drills two or three times. Nothing to wear out. Reduces costs . . . in some plants the savings on drill costs alone have paid for these adaptors *the first day!* Prices range from 95c down, depending on quantity.

Order a quantity . . . specify spindle thread and drill sizes

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ZEPHYR TOOLS

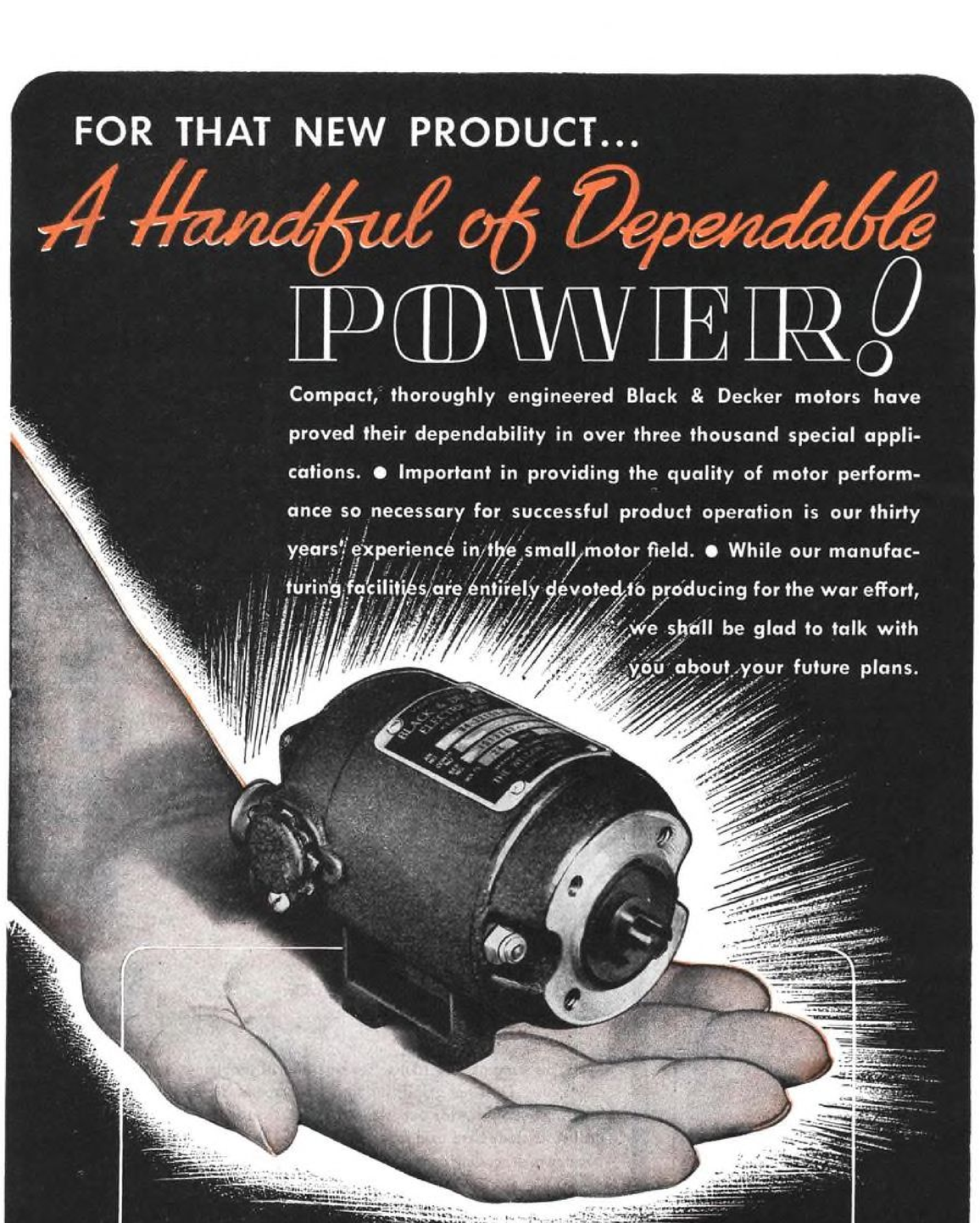
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Compact, thoroughly engineered Black & Decker motors have proved their dependability in over three thousand special applications. ● Important in providing the quality of motor performance so necessary for successful product operation is our thirty years' experience in the small motor field. ● While our manufacturing facilities are entirely devoted to producing for the war effort, we shall be glad to talk with you about your future plans.



THOROUGH ENGINEERING is the basic factor behind the successful operation of this de-icer pump motor and many other special application motors we have designed for all types of equipment.

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FRACTIONAL HORSEPOWER SPECIAL APPLICATION MOTORS

Shop Equipment & Accessories

Tubing Seals 53

"Cel-O-Seal" caps, developed by I. F. Schnier Co., San Francisco, western distributor for maker, **E. I. duPont de Nemours & Co.**, Wilmington, Del., are designed to protect aircraft tubing and



hex nuts against dirt, careless handling, and tampering. Caps are hood enclosures made of non-fibrous cellulose. Applied by hand, they shrink in drying and conform to contours. Re-opening of once-sealed tube is quickly detected.—AVIATION, Oct., '44.

Potentiometer 54

New version of company's type 58 wire-bound potentiometer or rheostat made by **Clarostat Mfg. Co.**, Brooklyn, is described as control capable of coping with extreme vibration and mechanical abuse. Metal strap on shaft face provides for two-position locating pin and grounds metal cover clinched to it. Cover, keyed in place, is dustproof. Bushing is keyed into Bakelite case. Center rail and terminal are one-piece, and there is direct connection between winding and L and R terminal lugs. There is zero hopoff at terminal and 1,500 v. breakdown insulation between winding and shaft. Ratings: Linear, 3 watts; "V" and "W" tapers, 2 watt; "L," "N," and "U" tapers, 1.5 watts. Resistance: Linear, 1 to 75,000 ohms; tapered, 10 to 50,000 ohms.—AVIATION, Oct., '44.

Solder For Aluminum 55

"EutecRod 199" is described as new free-flowing soft solder welding rod for use on aluminum and aluminum alloys. Manufacturer is **Eutectic Welding Alloys Co.**, New York. It is reported employed like the old lead-tin solders would be used on tin-plate or brass and copper; and it is stated that in long laps it makes joints of moderate strength but should be used generally as a seal. It is suitable for applications where completed joint will not be heated over 212 deg. under working conditions.—AVIATION, Oct., '44.

A.C.-D.C. Electrode 56

Designed for welding light-gage chromemoly and similar steels used in aircraft, new "Airco" No. 90-A electrode, made by **Air Reduction Co.**, New York, is reported to make better appearing deposits, and to have stronger arc action and reduced slag interference, while permitting operation at high currents without deterioration of coating at end stub. This a.c.-d.c. electrode is available in 1/16, 5/64, and 3/32-in. dia.—AVIATION, Oct., '44.

Liquid Level Gage.....57

Developed for use in bomb bay fuel tanks, new leakproof liquid level gage, made by **Rochester Mfg. Co.**, Rochester, N. Y., utilizes float which, with its "Alnico" permanent magnet, travels vertically up and down within a tube which has a spirally cut slot guiding float and causing it to turn in accordance with level of fuel. Motion of float is imparted to dial indicator by magnetic action through solid non-magnetic metal floor, which separates dial chamber from tank interior. Gages have white fluorescent or phosphorescent markings against dull black dial, or vice versa. Dial swings through 300 deg. arc, and graduations are widely spaced. Both side- and top-view dials are available.—AVIATION, Oct., '44.

Engine-Driven Fuel Pump 58

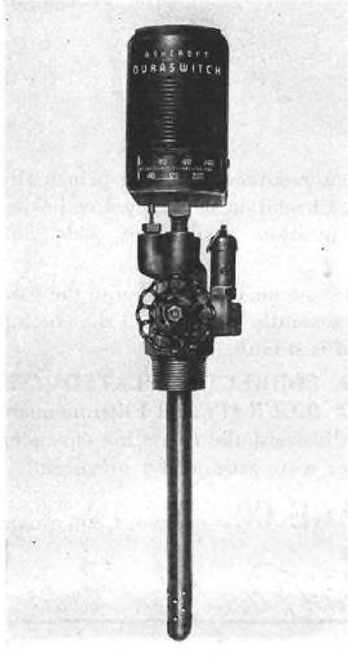
To withstand extreme temperature ranges, new lightweight, high-pressure engine driven gasoline pump is announced by **Romac Pump Co.**, Elyria, Ohio. Weighing 2¾ lb., pump is stated to deliver 400 gph. at 2,500 rpm., and it has pressure range of from 6 to 35 lb. psi.—AVIATION, Oct., '44.

Four-Way Control Valve 59

For permitting regulation of high-pressure hydraulic system with "Isodraulic" remote control system, and stated to eliminate cable controls, push-pull rods, and other mechanical controls, new remote positioning four-way control valve is announced by **Adel Precision Products Corp.**, Burbank, Calif. Unit has 16 gpm. flow, 3,000 psi, and is designed for ¾ in. lines. In combination with other units, new valve is adaptable for installations, such as wing flaps, dive brakes, and steerable nose wheels.—AVIATION, Oct., '44.

Compressor Control 60

Stated to combine seven devices for control of compressor operations into one instrument, **Manning, Maxwell & Moore**, Bridgeport, Conn., announces Ashcroft "Compressor-Trol". Designed to eliminate pipe and fittings, it is made in three sizes, ½, ¾, and 1¼ in., to cover all requirements of tank mounted compressors up to 15 hp. or 60 cu. ft. per min. Unit is equipped with "Duraswitch" with either electric or mechanical attachment for operating two-way unloading valve. Muffler on compressor discharges into tank and acts to break up discharge and disperse air in manner which is stated to insure adequate mixing with cooler gases in tank to reduce temperature and moisture content before delivery.—AVIATION, Oct., '44.



to thousandths of an inch



DIE-CUTTING of Booth felt parts is a precision job . . . often to tolerances in thousandths of an inch. Every die in the vast Booth stock is accurate. Each Booth-designed machine has its skilled operator. To the controlled qualities in Booth "prescription" felts—made to suit your individual requirements—add precision cutting. Exact duplicating of any felt part, re-ordered after a lapse of time, is considered a feat. Booth does it consistently.

THE BOOTH FELT COMPANY
482 19th Street Brooklyn, N. Y.
745 Sherman Street Chicago, Ill.

APPLICATION CHART AND SAMPLE KIT . . . Contains swatches of S.A.E. felt types, with specification tables. Write for it. (No sales follow-up.)

2073
Booth
TRADE MARK
PRECISION CUT FELT PARTS

Portable Coolant System 61

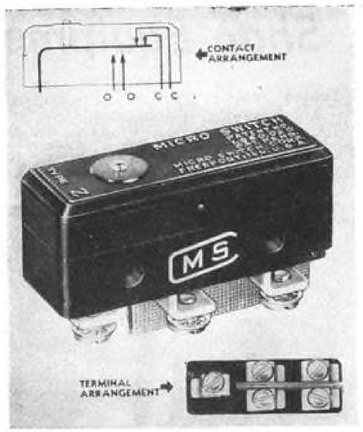
Designed for application of coolants to grinders, cut-off saws, milling machines, and such operations as fine abrasive cutting and honing, new portable coolant system is offered by **Gray-Mills Co.**, Evanston, Ill. Employed is No. 1100 centrifugal pump which has capacity of 1,200 gph. (water) at 0 head, and 360 gph. at 5 ft. head. Motor is 1/15 hp. with sealed bearings. Pump is also designed for in-built system and as a general purpose pump for sumps. Mounting bracket permits vertical or horizontal attachment, or unit may rest on its base.—AVIATION, Oct., '44.

Portable Aircraft Heater 62

Having an output of from 275,000 to 300,000 Btu. per hour, new portable, light weight aircraft heater is announced by **Harvey-Whipple, Inc.**, Springfield, Mass. Heater burns either gasoline or fuel oil, has automatic electric ignition of flame, and is operated by gasoline engine running in closeable compartment with controlled heat directed to carburetor and crankcase. Power plant is designed to be moved quickly without wrenches. Unit is enclosed in insulated jacket and balanced on rubber tired retractable wheels or on sled runners. Two 12 in. or six 6 in. ducts, which may be folded back without disconnecting, may be fitted. Generation of heat by indirect method is stated to be non-toxic.—AVIATION, Oct., '44.

Split-Contact Switches 63

Stated to simplify many complex electrical circuits, new line of split-contact micro switches made by **Micro Switch Corp.**, Freeport, Ill., enables switching operation from d.c. control to a.c. control. Two sets of contacts are mechanically interlinked but electrically isolated. Transfer action is stated to be only a matter of



a few milliseconds, and control of four isolated circuits is by pairs, eliminating use of relays. Double throw switches have two contacts on both normally open and normally closed side. Outside dimensions are same as basic single pole switch. —AVIATION, Oct., '44.

Aircraft Heater 64

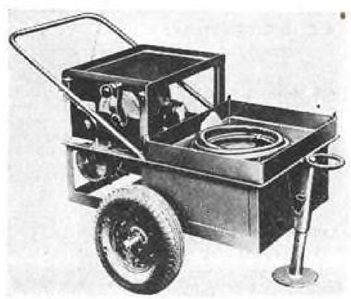
Vapor entraining system which uses a capillary vaporizing block in conjunction with pre-heated combustion air, is new process used in series SRH aircraft heaters developed by **Fluid Heat Div., Anchor Fence Post Co.**, Baltimore, Md. Flame is completely suspended to avoid oxide formations and is described as so stable that its characteristics remain the same regardless of altitude or speed. Barometric compensation permits operation up to 40,000 ft. Multiple heat exchanger compartments are designed to give flame and hot gases travel of four times the length of exchanger. Models offer capacities of 100,000 and 50,000 Btu./hr. Total weight is 24½ lb. for the former and 16 lb. 6 oz. for the latter. Dimensions are 28 x 9 in. and 27 x 7 in., respectively. Blowers are available for ground operation.—AVIATION, Oct. '44.

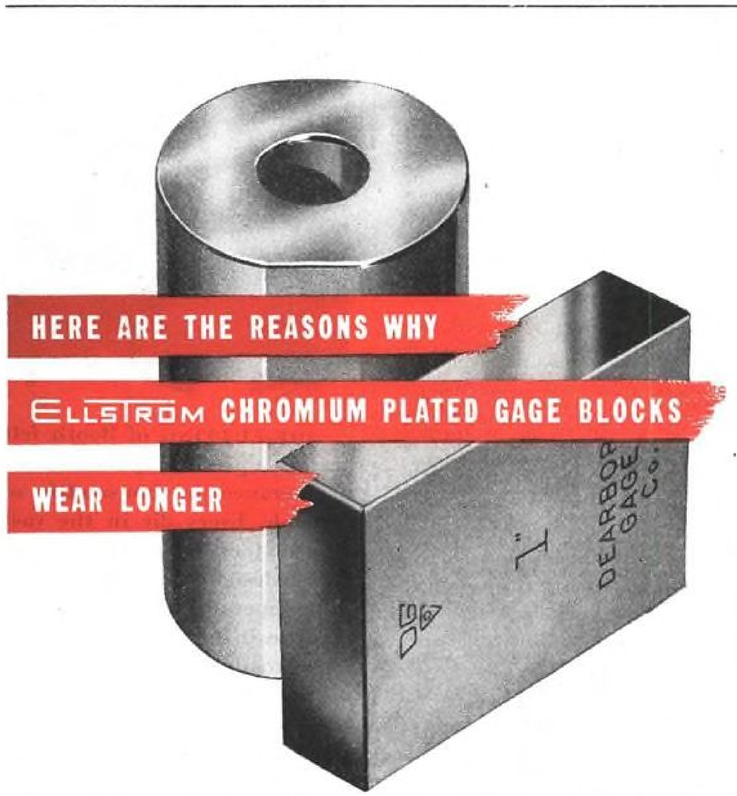
Aircraft Engine Starter 65

Hobart Bros. Co., Troy, Ohio, announces new portable aircraft engine starter and battery charger. Unit is 300 amp., 45v. d.c. flat-compound wound generator connected directly to Chrysler T-118 six-cylinder self-starting gasoline engine with battery ignition. It has separate but built-in exciter. Control panel cabinet includes ammeter with shunt, voltmeter, generator field rheostat, and disconnecting switch, and it also has two separate 150 amp. charging circuits with generator overload protection, provided with 175 amp., 250v. "Fusetron." Unit is assembled under weatherproof canopy with doors.—AVIATION, Oct., '44.

Portable Power Unit 66

Independent and portable source of power for starting aircraft engines, checking and testing radio equipment and gun turrets, and recharging installed batteries is provided in improved portable power unit made by **Pacific Airmotive**, Glendale, Calif. Unit is powered with 4-hp. gasoline engine, and 50 amp., 30 v. generator is mounted direct on crankshaft.





CHROMIUM PLATING offers excellent resistance to wear principally because of its extreme hardness. Chromium is accepted as having a value of 1000 Brinell with a No. 9 position on the Mohs scale. The diamond is No. 10.

Sometimes chromium plate does not offer adequate protection to the base metal, however, when this occurs, it is generally evident that the coating is too thin or the plating procedure itself is at fault.

BECAUSE ELLSTROM GAGES ARE **CORRECTLY PLATED** ***AND UNCONDITIONALLY GUARANTEED ACCURATE,*** **all Ellstrom-made chromium plated gage blocks successfully resist the corroding effects of moisture or acids. This means still longer wear with greater precision.**

DEARBORN GAGE CO. 22035 BEECH STREET DEARBORN, MICHIGAN

Originators of Chromium Plated Gage Blocks

Capacity is 480 amp., 1,500 watt. Power output is taken directly from two 12 v. batteries of 240 hr. each, stored power of which covers possible failure or damage to engine. Generator by-passes batteries, when desired, for battery charging. —AVIATION, Oct., '44.

Oil Heating Unit 67

To provide heat transfer oil to machines which require elevated temperatures, **Youngstown Miller Co.**, Sandusky, Ohio, has developed oil heating unit, typical model of which has 12.8 kw. of electric heaters applied externally to heating portion of tanks and capacity for 12 gal. of oil. It has three thermostats, each of which can be set to desired temperatures. Selector switch changes controlled temperature. Heated oil is circulated by rotary pump driven by ½-hp. 1,150-rpm. direct connected motor. Selector switch permits operation of pump without heat, pump with portion of heaters, or pump with all heaters. Float inside tank indicates oil level, and thermometer shows temperature. By adjustments of thermostats, any three temperatures can be pre-selected between 200 and 500 deg.—AVIATION, Oct., '44.

Direction-Indicator Compass 68

Designed for all types of passenger and cargo aircraft, new direct reading magnetic direction-indicator compass is announced by **Autoflight Corp.**, Burbank, Calif. Azimuth pointer rotates in front



of fixed dial, and course reference lines are settable. Instrument uses standard 3¼ in. luminous dial, graduated every 2 deg., and it combines short time of swing or period with low value of overswing and high lateral dynamic stability. Mechanism is immersed in compass fluid. Wide range temperature and magnetic compensation are provided within housing. Total weight is 1.1 lb.—AVIATION, Oct., '44.

New Buna N Stock 69

Los Angeles Standard Rubber, Inc., Los Angeles, has developed new Buna N resistant stock (233-5) which is reported to retain tensile strength of over 1,000 lb. psi. and elongation of over 100 percent after being subjected to aircraft engine oil at 300 F. for period of 70 hr. It is also stated to remain flexible at 40 deg. F. below zero. Stock was designed for oil seals, oil rings, and other applications requiring resistance to aromatic fuels.—AVIATION, Oct., '44.

Flameproof Glass Cloth 70

U. S. Rubber Co., New York, has developed new glass, flameproof, synthetic rubber coated cloth having several applications in aircraft, such as in sealing joints in metallic hot-air ducts of high altitude bombers and fighters. It is described as having high tensile strength, lightness and tear resistance, also to be oil-proof, gasoline-proof, grease-proof, water-proof, mildew and insect-proof. Is also used for gun-bore-aligning targets. —AVIATION, Oct., '44.



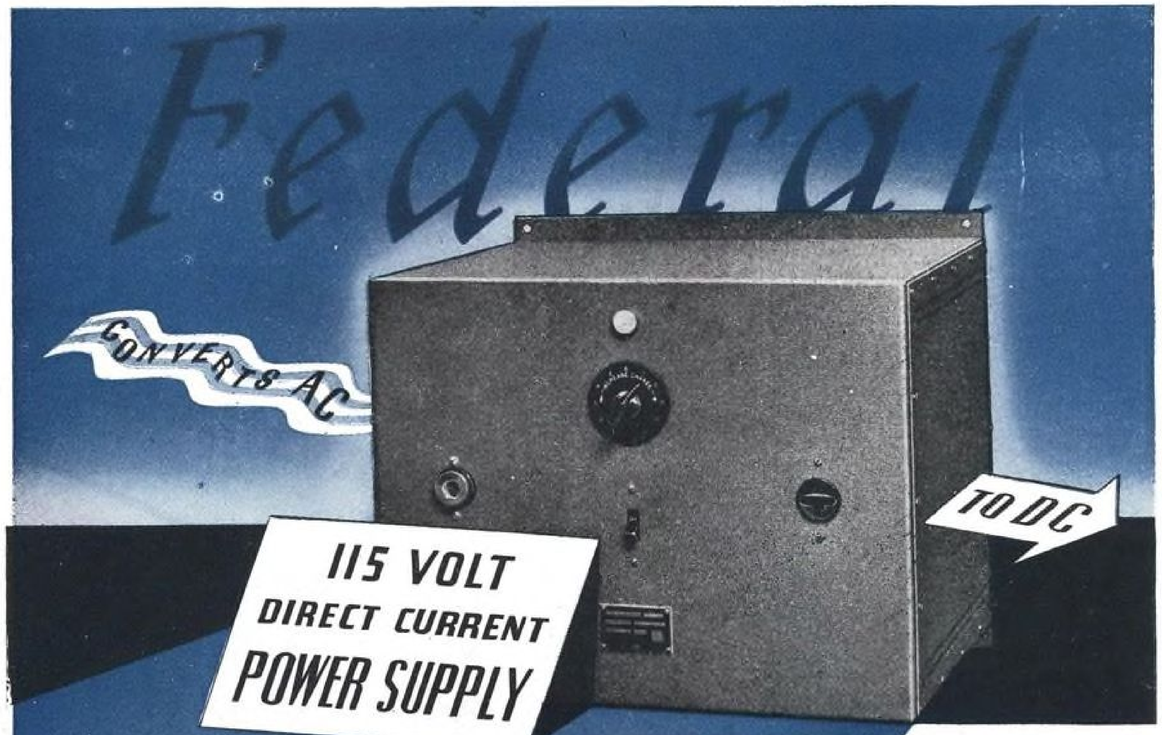
In large and small standard aircraft cases

For a third of a century the name HICKOK has been the sign of highest standard in quality. Here we illustrate but one of many aircraft instruments. This is an electrical resistance type thermometer operating on D.C. voltage in conjunction with resistance bulbs per A.N. spec. Average resistance 100 ohms. Enclosed nickel type. Calibrated for 12 or 24 volts D.C. Permits 25% change in voltage without undue error. Permanent magnet and moving coil type. Very thin construction. High torque with snappy response. Exceptional accuracy from 60° below zero C. to 100° above. Write for literature.

THE HICKOK ELECTRICAL INSTRUMENT CO.
10525 Dupont Avenue **Cleveland 3, Ohio**

THE STANDARD OF QUALITY FOR A THIRD OF A CENTURY

Federal



FEDERAL POWER EQUIPMENT—well known for long dependable life, low cost, and high efficiency . . . made in a wide range of sizes and outputs . . . for any DC need from any AC source.

- **PUBLIC UTILITIES**—for station DC bus service, floating storage batteries and operating controls.
- **CHEMICAL AND METALLURGICAL**—DC power for refining, electroplating, electro-cleaning and laboratory analysis.
- **METALWORKING**—for operating magnetic equipment such as grinders, chucks, lifts and vibrating hammers.
- **FOOD AND DRUGS**—for magnetic separators, operating packaging equipment and power supply for processing.
- **INDUSTRIAL PLANTS**—for DC motor operation, electric brakes, general testing and generator field excitation.

★



Federal's exclusive CENTER CONTACT Selenium Rectifier discs provide new protection against corrosive atmosphere, are now in Federal Power Supply equipment. FIRST IN THE FIELD . . . . STANDARD FOR INDUSTRY. *Write for Bulletins.*

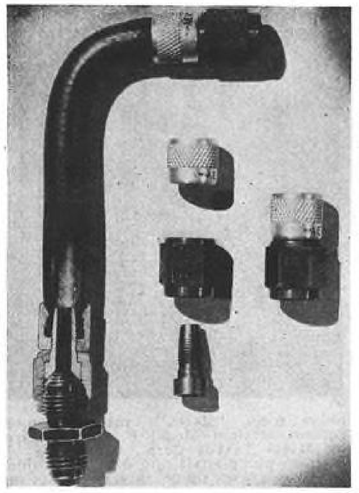
Federal Telephone and Radio Corporation

An IT&T Associate

Newark 1, N. J.

Detachable Hose Fitting 71

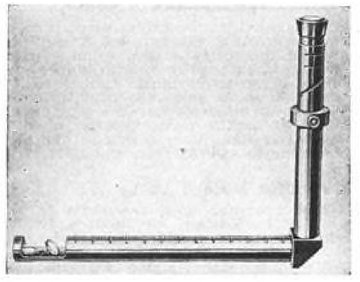
Hose fittings in detachable reusable form for use with low pressure hose are now available from Aeroquip Corp., Jack-



son, Mich. Each part of the fitting assembly is removable and replaceable without use of special tools, and making of assembly involves only screwing fitting together without regard for torque.—AVIATION, Oct., '44.

Industrial Telescopes 72

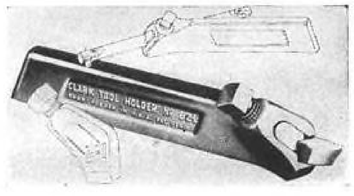
"Borescopes", industrial telescopes made by Polan Industries, Huntington, W. Va., are designed to make accessible to the eye surfaces of long bores, such as internal surfaces of bored engine shafts, tubular bodies, and hydraulic and other



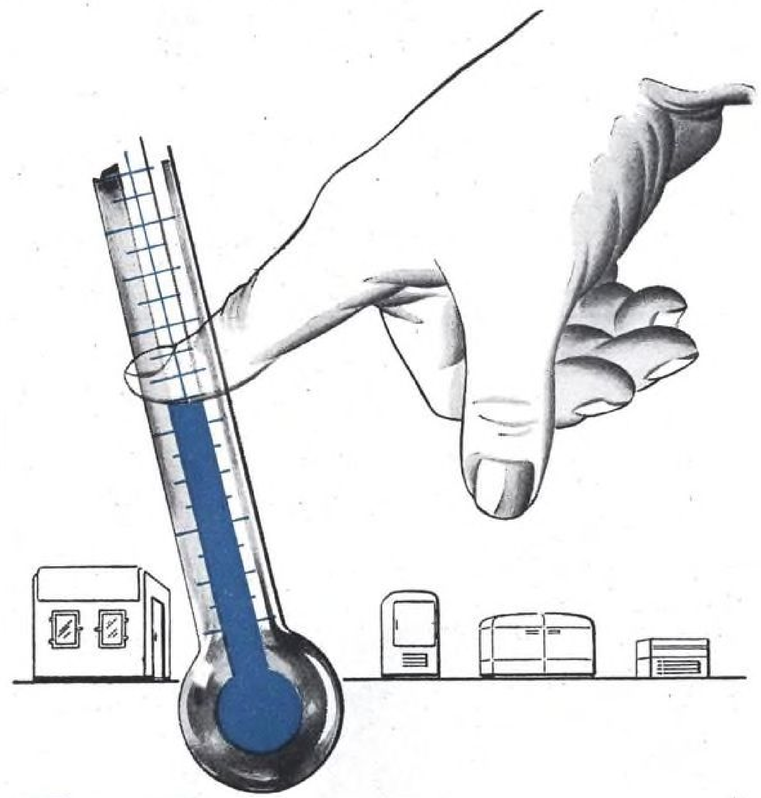
cylinders, so that minute cracks or other faults may be detected. Covering dia. range from 13/16 to 9 in., and bore length up to 30 ft., instruments are stated to combine highly corrected lens system and interior illumination. Illustration shows instrument with right-angle eye piece extension.—AVIATION, Oct., '44.

Adjustable Tool Holder 73

Robert H. Clark Co., Beverly Hills, Calif., announces new adjustable tool holder with vise grip, unit being designed to make possible use of any of four or more sizes of tool bits in same holder. Models available are 15 deg. sloping cutter channel type and the horizontal or parallel channel type in both right and left hand offset, each type being available in several shank sizes. Vise-grip jaw holds bit vertically and horizontally with pressure evenly distributed over entire holder channel.—AVIATION, Oct., '44.



INDUSTRY'S NEW SOURCE OF CONTROLLED POWER



Fluid Power DRIVES THE MERCURY DOWN

When the mercury in the thermometer rises too high, many things spoil—including tempers. But Fluid Power forces the temperature down, makes synthetic cold one of man's most useful servants.

Your electrical refrigerator is a good example of this type of Fluid Power. In a closed system of tubing, liquids change into gases and back again to liquids. Heat is extracted, carried away, then dissipated into the air.

Applications of this type of Fluid Power are expanding rapidly. Industry uses below-zero cabinets to obtain shrink fits. Home freezers may revolutionize the food storage problem. Air cooling and conditioning may eventually become standard in every home.

If you are considering product development using this type of Fluid Power, ask a Parker engineer. He is familiar with the new advances and applications in this field.

Ask a Parker Engineer about *Fluid Power*

Today, you'll find Parker-engineered Fluid Power Systems in locomotives and bombers, in ships, machine tools and chemical plants. If you need FLUID POWER for control or drive, talk the matter over with a Parker engineer. He has the kind of "know-how" you'll find most valuable. Write direct to The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio.

THE **PARKER**

APPLIANCE COMPANY

CLEVELAND • LOS ANGELES

FLUID POWER ENGINEERING

Snap Gage Spindle 74

Sheffield Corp., Dayton, Ohio, announces new type of snap gage spindle for use with "Precisionaire" instrument, offering application combining features of snap and air-flow gages. Spindle is designed for use on highly finished or soft plated parts without marring, as well as on thin-walled cylinders without collapsing them. Other uses are checking work while in machine and checking large or unwieldly parts which cannot be presented to gage. —AVIATION, Oct., '44.

Broken Drill Adapter 75

Designed for use with small drills from No. 80 to No. 60, broken drill adapter is announced by Topflight Tool Co., Towson, Md. Accurate, concentric drilling is reported to be assured through self-locking device which holds broken piece of drill firmly.—AVIATION, Oct., '44.

Metal Protective Coating 76

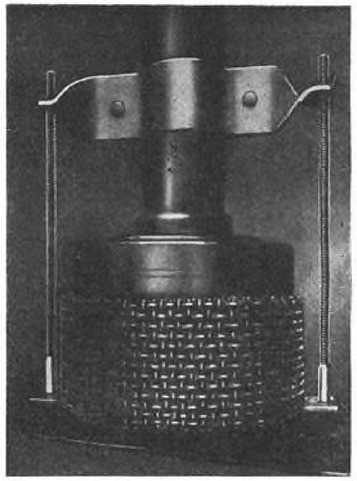
Described as perfected equipment and processing for dichromating of zinc coated steel and die cast parts, Udylite Corp., Detroit, announces new installation which is automatic in operation and stated to eliminate irregularities, largely through control of both time and temperature.—AVIATION, Oct., '44.

Fog Prevention 77

Designed to prevent fogging of aircraft instruments, aerial camera lenses, and other glass and plastic surfaces, "Anti-Fog" is announced by Merix Photo Co., Chicago.—AVIATION, Oct., '44.

Coolant Strainer 78

Designed for use over base intake of immersed centrifugal pumps in grinders, automatic screw machines, and other machine tools, "Metex" knit wire mesh coolant strainer Model F, manufactured by Metal Textile Corp., Orange, N. J., bolts to pump shaft and centers strainer, which is drawn up on threaded bolts and sealed over intake. Feet or lugs of pump base casting imbed themselves in mesh. Openings in mesh, large in relation to wire size, are designed to provide large capacity to hold chips and dirt without clogging.—AVIATION, Oct., '44.



Carbide Thread Gages 79

Three styles of carbide thread plug gages are offered by Jansson Gage Co., Detroit. Solid carbide is used for smaller sizes, while larger sizes have carbide bushing over steel body. Range of sizes is from .112 to 3 in.—AVIATION, Oct., '44.

Plastic Tape Insulator 80

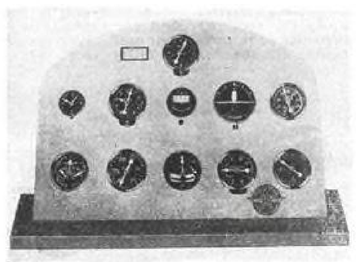
Designed for insulating wires, cables, and electrical equipment, and for splicing and for protection of equipment, wiring, and piping exposed to caustic or corrosive fumes, oil, grease or acids, "Fibron", new plastic tape is announced by Irvington Varnish & Insulator Co., Irvington, N. J. Made of Vinylite resin, tape is stated to be heat-sealing, flame resistant, and high in strength.—AVIATION, Oct., '44.

Capacitor Motor 81

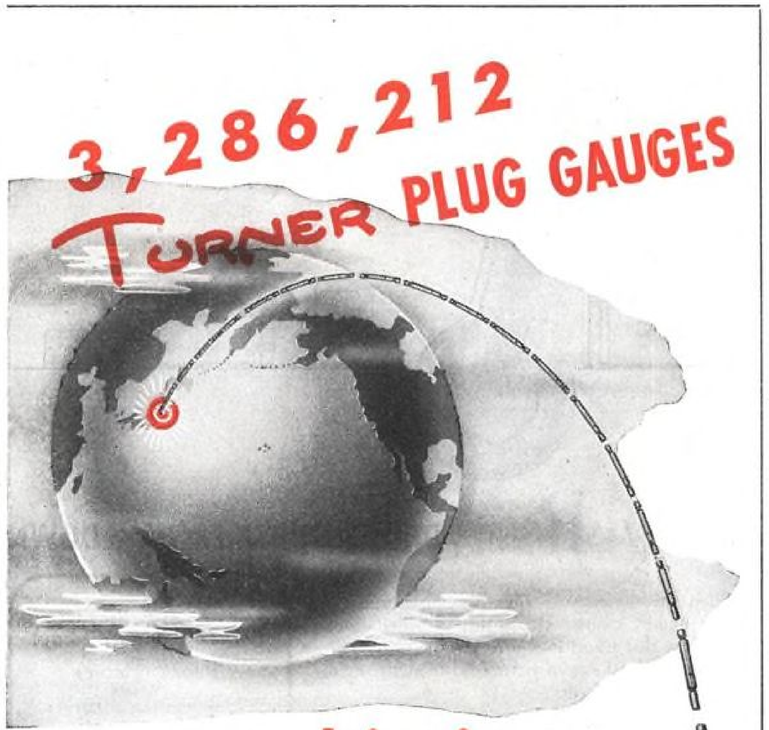
New 1/50-hp. capacitor motor is announced by Eastern Air Devices, Brooklyn, with these specifications: 60 cycles, 115 v.; single phase, 3,400 rpm.; dia., 3 5/16 in.; length 3⅛ in.; shaft dia. 5/16 in.; weight 3 lb. Motor can be supplied to deliver 1/25 hp.; can be wound for two or three phase, and can also be furnished for 400-cycle applications at higher speeds and hp.—AVIATION, Oct., '44.

Instructional Panel 82

Kollsman Instrument Div., of Square D Co., Elmhurst, N. Y., has issued new advanced instructional instrument panel for setting up sample instrument problems. Included are settable indication on gyro horizon and directional gyro in addition to that of standard instruments. Instruments are standard size, arranged as on typical panel. Made of heavy cardboard, panel is mounted on easel.—AVIATION, Oct., '44.



3,286,212 TURNER PLUG GAUGES



. . . are hitting the target!

We don't know how many plug gauges laid end to end it would require to reach Tokyo or Berlin, but we do know that we made 3,286,212 steel and chrome plug gauges to check many types of war implements that do reach our military objectives.

Yes, *precision* has become the watchword of industry during this war, and it will continue to be a factor in those industries that will be the leaders in peacetime production.

★ Remember the name Turner when you think of Precision.

TURNER BROTHERS

TURNER GAUGE GRINDING COMPANY
2625 HILTON ROAD • • • • FERNDALE, MICH.

Pipe Gage 83

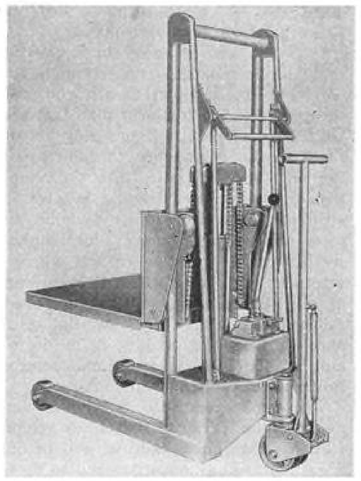
New model three-point pipe gage designed to measure quickly all sizes of pipe from ⅛ to 12 in., also all sizes of electrical conduit and metallic tubing, is announced by Three-Point Gage Co., Chicargo. Of pocket size, it consists of two pivoted steel plates with edges curved at three points for contact, together with scales to automatically register standard sizes. A third scale shows drill size for tapping. Included is inch and metric rule.—AVIATION, Oct., '44.

Side Molded Cores 84

Line of iron cores, molded by pressure from sides rather than from ends, are described by maker, Stackpole Carbon Co., St. Marys, Pa., as having advantages for permeability tuning applications at broadcast band frequencies and also for short wave frequencies, including television and frequency modulation. Density resulting from molding pressure extends, in side molded cores, evenly over entire length. AVIATION, Oct., '44.

Lift and Tiering Truck 85

Lyon-Raymond Corp., Greene, N. Y., announces new hydraulic high-lift and tiering truck combined, weighing 495 lb. Stock model has capacity of 1,000 lb.,



with platform 24 x 30 in. and raising range of 42 in. (6 in. lowered to 48 in. elevated). It can also be supplied to meet other specifications.—AVIATION, Oct., '44.

Degreasant 86

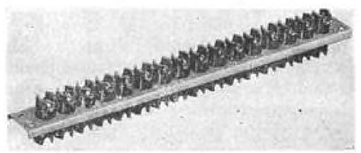
Reported to gain strength with dilution, new emulsifying degreasant developed by Gaybex Corp., Nutley, N. J., has alkaline factor of pH-7 (neutral) and flash point of 150 deg. F.—AVIATION, Oct., '44.

Torquemeter 87

Information is available on magnetic coupled torquemeter, designed to increase bomber and fighter aircraft range through more accurate determination of engine output. Maker is Westinghouse Electric & Mfg. Co., Pittsburgh.—AVIATION, Oct., '44.

Terminal Block 88

To meet demands of electronic and electrical design requiring external terminals, Curtis Development & Mfg. Co., Chicago, has devised new terminal block for sub-



panel assembly, consisting of individual "Feed-Thru" terminals molded in Bakelite and permanently held in a metal strip in any combination desired. Stock blocks

The handiest, time-saving, cost-cutting LOAD HANDLER around your place . . .



The Free-Roving Tractor-Footed

ROUSTABOUT CRANE





It does quickly all kinds of lifting, moving, loading, unloading, stacking and handling jobs, loads to 7½ tons, outdoors, indoors—hundreds of users say it prevents delays, breaks bottlenecks, saves money and manpower. It's where you want it when you want it, easy to run, low in expense. Modernly engineered and built for years of overwork—stout, ball-bearing, running-in-oil construction. For fast post-war action and low costs, write today and ask for the whole story.

THE HUGHES-KEENAN COMPANY
637 NEWMAN STREET • MANSFIELD, OHIO

ARMY-NAVY E

ROUSTABOUT CRANE

Roustabout Cranes
By Hughes-Keenan
Load-Handling Specialists Since 1904

Speed Up Assembly—with This ONE-PIECE Terminal



IT'S A FACT—you can get more production with Sherman UNI-CRIMP Solderless Terminals, because this terminal is designed to go on the wire easier and *faster*.

Installed with hand crimping pliers or any of the standard types of indenting dies, the UNI-CRIMP makes a connection that has greater mechanical strength and resistance to vibration, coupled with high conductivity.

Tongue, barrel, and insulation gripping ears are formed from a single piece of fine grain, specially rolled, pure electrolytic copper of the highest conductivity obtainable. Entire inside of barrel is serrated, to grip the full circumference of the wire.

Get the UNI-CRIMP specifications. Write for Bulletin UC-2.

H. B. Sherman Mfg. Co.
Battle Creek, Mich.

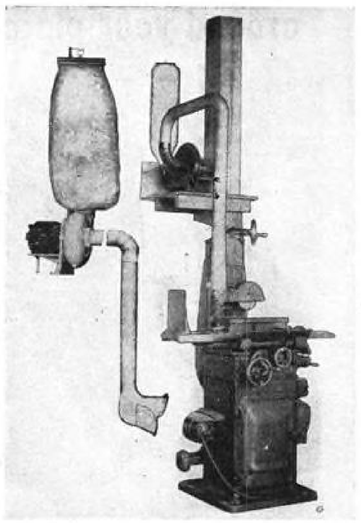
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The Sherman
UNI-CRIMP
Solderless Terminal

have any number of units from 1 to 16, but blocks can be supplied with any number of terminals. Terminals will handle circuits carrying up to 300v., 20 amp. Center to center distance between units is ⅝ in.—AVIATION, Oct., '44.

Individual Dust Collector.....89

Operating from light socket, individual suction dust collector reported to handle 600 cu. ft. fee air per minute with ¼



hp. motor at 3,500 rpm. is announced by **Leiman Bros.**, Newark, N. J. Collector stands 47 in. high with 9 in. dia. dust bag, 3 in. pipe, and elbows and dust hood. —AVIATION, Oct., '44.

Slide Rule Decimal Locator.....90

New decimal point locator and slide rule is announced by **Pickett & Eckel**, Chicago. Device is designed to determine decimal point mechanically in involved expressions, with results up to 19 places. —AVIATION, Oct., '44.

More Airports

(Continued from page 119)

square miles, number of civil aircraft registered, and number of airports in the state.

Mr. Randolph and CAA did not collaborate in the writing of his bill, nor is it sponsored by CAA. However, many provisions of his bill are in harmony with our own recommendations, and I am told that Mr. Randolph is in agreement with many of the ideas which I have publicly discussed, including the federal aid fund-matching feature. No doubt, both CAA's recommendations and the Randolph bill (HR 5024) will be changed and modified in many ways before either takes the form of legislation. The final measure will probably be a combination of proposals from many sources.

Opinion seems to be almost unanimous that non-scheduled aviation is entitled to the major share of immediate airport development. I am of that opinion. All do not agree with me but I believe we will have 300,000 civil planes within four years after the war ends, in contrast with the 25,000 we have today. At most, 3,000 of my predicted total will be large airline craft. The remaining 99 percent will be relatively small private and commercial planes.

Of the 3,000 airports in the United States, about two-thirds are Class 1 and 2, suitable for non-airline aircraft. In other words, about 1,000 fields (including those that CAA has built for war use by the air arms) are capable of handling airline traffic. Even allowing for a five-fold expansion of scheduled operations, those thousand ports will just about meet the transport needs. Our head start in transport facilities is the result of spending about $400,000,000, during the past four years, under supervision of CAA, on civil airports to serve as defense auxiliaries.

This is how we arrived at the estimate that 6,000 airports will be needed before 1950: There are in this country 6,670 communities containing 1,000 people or more. Every community, we believe, will want to make itself accessible by air. In many cases more than one, or several, of them can use the same field. On the other hand, many of the larger cities will require two or more airports. So the figure balances at about 6,000.

I do not wish to give the impression that the federal government intends to hand out free airports to all who want them. Any apportionment plan that may be finally adopted will probably require the state or community to contribute a fair portion of the cost. Nor do I imply that the government means to give instructions when and where to build airports. Every state and every local authority is free to decide when and where it wants a field, or whether it wants any at all. CAA merely offers advice and information; it may offer financial assistance, if Congress enables it to do so; and it classifies airports and enforces safety regulations in their operation.

The public has accepted the airplane as a potential personal and family vehicle. It will come into broad use, and become a big job-making industry. But to do so, it must have plentiful and convenient ground facilities. Whether or when the annual count of light planes will reach the seven figure mark, along with automobiles, no one can say. The proposed airport program will pay off on our conservative estimate of one-third to one-half a million; if the acceptance of the light plane runs into millions, that will be velvet.

On the prospect of helicopters, autogiros, and roadable planes, we run no risk. Even if the fixed wing type of plane we have now should be displaced entirely by one or more of these types, the air fields we now propose would not be enough for the long pull. There would not be room within municipal limits for helicopters and roadable types in mass use; they would need the space for service, parking, starting, and landing.

The Personal Aircraft Council of the Aeronautical Chamber of Commerce is one of the several groups which have been sketching the outlines of a future landing area program for light planes. This group is helping cities and towns to determine what type of field they need. In some cases, it is saving them from going into excessive costs for unnecessarily elaborate facilities.

A four-year plan for building 20,000 landing areas for private airplanes is proposed by the Council. The plan includes the word airparks to designate small fields. It is assumed that airparks, including recreational facilities in addition to aircraft accommodations, will have extra appeal to the taxpayers and bond-buyers. On the other hand, some experts argue that every municipality will want to match the Joneses with something called an airport. Personally, I shall be pleased if every town has a field, whatsoever they call it. Undoubtedly, a great many small air fields throughout the country will be built with private or local public funds, without any federal assistance.

All who know me or have heard me discuss the subject know that I am not in favor of flight strips when that term means runways located along highways. But I am strong for the rights of advocates of such landing areas to sell the idea if they can—and if the public is appraised of all the facts.

It seems to me that flyers will not want to go to a landing area just because it is adjacent to a highway. They will land because destination has been reached, because it is time to refuel, time to eat, or to terminate the day's run. I feel sure that those purposes can best be served by small airports having a planned relationship to the communities, to country clubs, summer resorts, places of mass employment, and so on. Of course there will be a road near by; there are roads everywhere.

Opposing argument is that private flying has always been, and will be for a long time, contact flying; that contact flyers follow highways; that small airports will not be able to support service stations for a while; and that automobile facilities can serve aviation also. They emphasize flight strips especially for cross country flying over sparsely settled regions. If these people prove to be right in the end, I shall be first to cooperate in the realization of their objectives.

I do not believe that two-way (one strip) airports are acceptable at all, except in valleys where parallel hills obstruct ground runs in more than two directions, and where the winds usually parallel the valley, or in other special circumstances. In all other locations, I believe that two or more runways should be provided for safety, even if cost limitations compel the use of sod instead of hard surface. If a one-strip field is built, the plan should allow for an addition to produce a field shaped like L, T, X or V.

Interesting proposals have been made for marking off the country in ten-mile squares for the guidance of contact and lost flyers. Further discussion develops the contention by some experienced pilots that markers on the ten-mile corners would be as hard to find, in many cases, as the pilot's destination.

One simplification of the plan is that existing longitude and latitude divisions on the United States map be reduced to smaller sections, and that the resulting co-ordinates be the basis of "air addresses" which would be prominently lettered on landmarks, such as towns; mountains; rail, river and highway junctions; gas



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Dremel Moto-Tool has AC-DC motor with shock-proof bakelite housing, oil-sealed (oil-less) bearings, and built in cooling fan. Weighs only 13 ounces—so light and compact a *girl* can handle it with ease. Dynamically balanced armature eliminates vibration and provides precision control. Moto-Tool's high speed (27,000 rpm) permits finer, faster work—conserves cutters.

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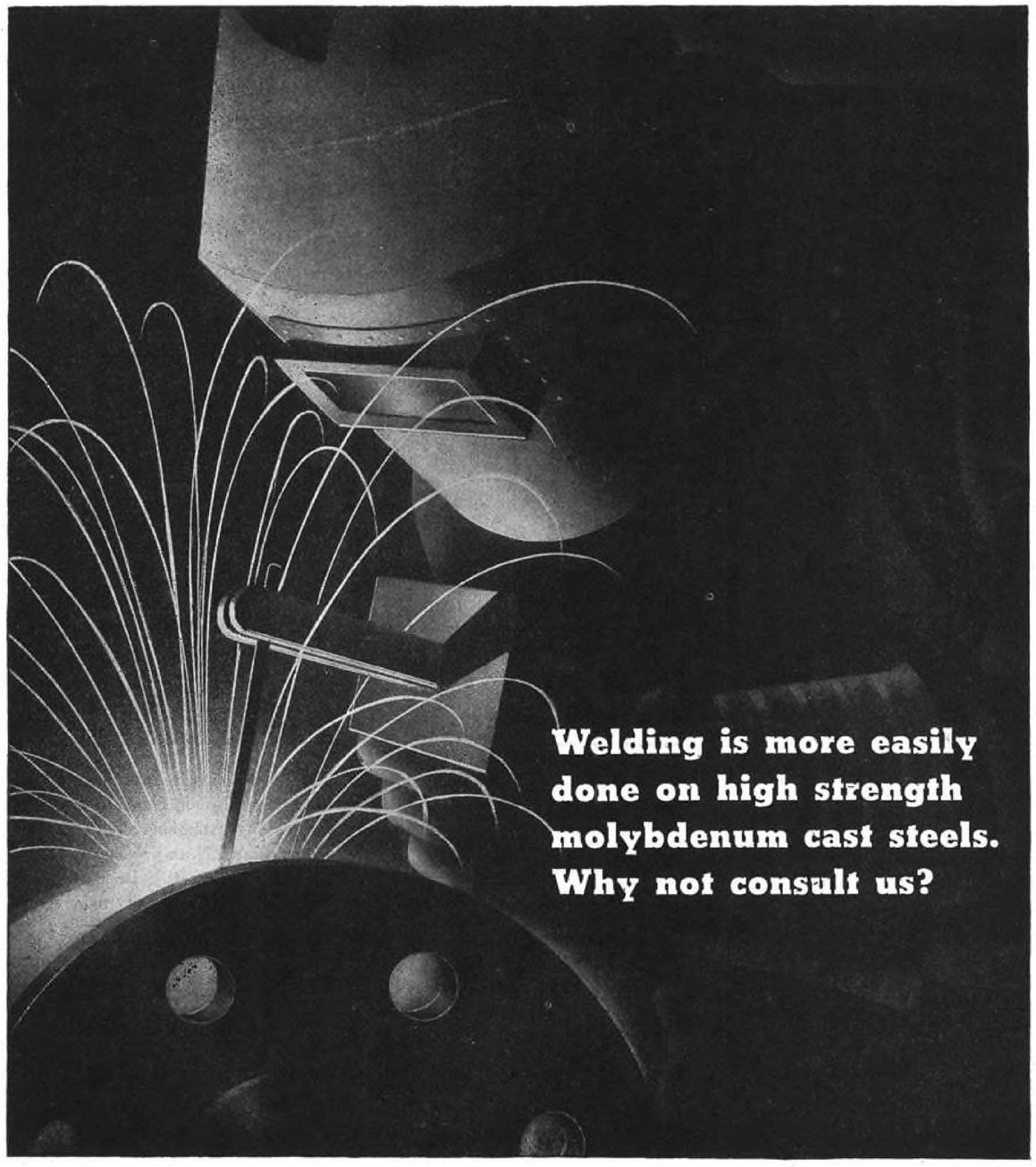
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tanks; etc.—landmarks that contact flyers have always used. The pilot would read the address, find it on his coordinated map, orient himself from the direction pointer on the ground, and soon know his location and the way to his destination. The CAA has now standardized on such a system.

I am told that the Joint Aircraft Users' Conference, sponsored by the National Aeronautic Association, and held in Washington during my absence abroad, accomplished some excellent preliminary results. Especially notable was the unexpected interest displayed in landing areas for waterplanes. Reports indicate that many airmen are in the habit of thinking landplanes, forgetting the possibilities of float planes, flying boats, and amphibians.

It is quite possible that the efficiency of small waterplanes, as well as of large flying boats, may be brought to favorable comparison with that of landplanes. A great many communities have water areas suitable for aircraft, some of them far more conveniently located, and certainly cheaper to prepare for use, than areas for landplanes. These possibilities I think should be kept in mind and constantly investigated.

Ames Laboratory

(*Continued from page* 123)

and under the same instigation, a bill, with phraseology furnished largely by Dr. Walcott, was introduced into Congress providing for the organization of a scientific body whose functions should be broadly similar to those of the English committee to which I have referred. This bill was signed by the President, Mar. 3, 1915, and the membership was announced on the second of April following.

Opening words of this bill read as follows:

"An Advisory Committee for Aeronautics is hereby established. . . ."

There followed a specification as to the membership of the Committee, which at that time was placed at twelve. Then came this statement:

". . . . and [it is] provided that it shall be the duty of the Advisory Committee for Aeronautics to supervise and direct the scientific study of the problems of flight, with a view to their practical solution and to determine the problems which should be experimentally attacked, and to discuss their solution and their application to practical questions."

This latter spesification forms what we should now, I suppose, call the "directive" of the committee. It is notable in two respects: First, it opened to the activities of the committee the entire domain of flight with all its secondary and allied problems; and furthermore, it invested the committee with the widest initiative as to the problems which should be undertaken and the manner and extent of such investigation.

Acting under this broad commission, the committee promptly held its first meeting Apr. 23, 1915 and laid the plans for a number of investigations and reports upon topics then deemed of importance in the general field of aeronautic science.

The First Annual Report of the committee was issued under date Dec. 9, 1915, and it was certainly a very respectable and creditable first effort. It actually comprised seven different reports, certain of which are in two parts, making in effect eleven documents by as many different authors with eleven different problems.

Regarding our modest beginnings, this will be indicated by the extent of our first annual allotment of funds, which amounted to the sum of $5,000. Of this amount the committee expended for all purposes during the first year the sum of $3,938.94, leaving an unexpended and unobligated balance of about $1,000. It will certainly be agreed that this was a very modest beginning—but it was a beginning from which the activities of the committee have now grown to the extent of requiring a normal annual operating budget of about $23,000,000, with three laboratories representing a total investment of the order of $65,000,000.

And now a few words about the birth pangs of our laboratory here at Moffett Field:

As early as the middle '30's indications and information received regarding the progress of the developments of aeronautic laboratories in Europe, especially in Germany, appeared to indicate that the Committee was in danger of receding from its preëminent position with respect to facilities for aeronautic research—into a position of relative inferiority.

The situation was made the subject of careful and serious study by the Committee, and shortly thereafter, in 1938, a special committee was appointed to undertake the development of long range plans, with reference to facilities supplementary to those at Langley Field and calculated to bring up the working equipment of the Committee again to a definite position of world leadership.

There were, at this time, limitations in the situation at Langley Field. It was noted—

(1) That there were no more than 8,000 hp. available at any one time, and that amount only for parts of the day.

(2) That the area was limited to 23.9 acres, with uncertainty as to further expansion.

(3) That there was a serious congestion of important work at Langley Field and an imperative need for further facilities if important studies were to be carried on.

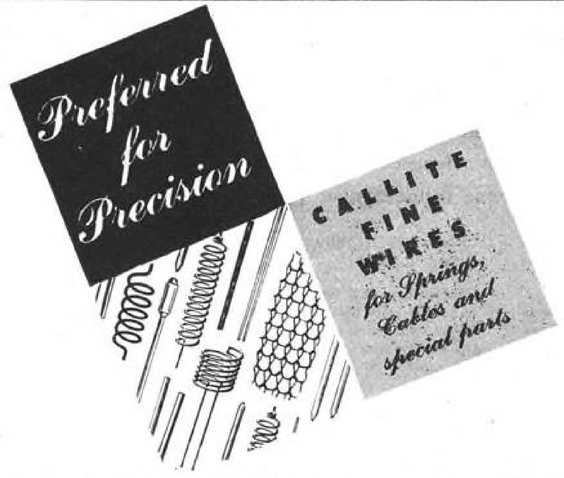
(4) That there was the hazard of having all research facilities at one place, with the possibility of loss through a single raid in time of war.

The following conditions were laid down as covering the characteristics to be sought in a new location:

(1) That the new NACA research station should be located on an Army or Navy flying field under a status similar to that of the Committee's present research station at Langley Field, Va.

(2) That the site should be located within a convenient distance of the aircraft manufacturing industry on the West Coast.

(3) That the site should have climatic conditions permitting the efficient conduct



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of flight research throughout the year.

(4) That adequate electric power at reasonable rates should be available.

(5) That the site should be near industrial centers for skilled labor and technical supplies, and that it should afford satisfactory living and working conditions for employees.

(6) That the site should preferably be located at or near sea level.

A considerable number of sites were carefully studied with reference to these various conditions, and the longer and more penetrating the study, the more inevitably the choice narrowed down to California and to Moffett Field.

But the decision that additional facilities should be provided with the selection of a preferred site did not, in itself, provide a laboratory.

For this, an approval by Congress with an appropriation of funds was required. And here the efforts of the Committee began to run into heavy weather. The committees of Congress before which hearings were held were not interested. The Congressional committeemen did not believe that a war was likely to come or that such added facilities for aeronautic research were significant or required. For the first time since its organization, the Advisory Committee for Aeronautics met with a rebuff from Congress on a major and important project.

But, like John Paul Jones, the Committee had only "just begun to fight." New approaches were made to individual influential members of the Congress, their attention was gained, and finally a bill was introduced and passed on Aug. 9, 1939 appropriating funds for making a start on the project.

Terms of this bill were such, however, as to appear to invite a re-study of the question of the site, and accordingly a second committee was appointed which again made a careful study and reappraisal of the various sites proposed, in all some 54 in number.

But the final decision was inevitable. The over-all advantages of the Moffett Field site so clearly stood forth that a confirmation of the earlier choice was reached by this second and independent committee. And then, with a site and with funds, the dirt began to fly, buildings began to appear, and equipment came streaming in, and all with the result seen today. That result is an excellent installation now in operation at Moffett Field.

New Latin America

(Continued from page 185)

which must be answered in common with all exporters, he must seek answers to the questions raised by the specific world area with which he hopes to trade.

Latin America is one continent, but 20 different countries, each one a new and entirely different market. Here is a continent where eight out of every ten people live within 250 miles of the coast; a continent with all imaginable varieties of climate, temperature, terrain and language; and a continent which, unfortunately, has changed so radically in five years that prewar statistics are, at best, a poor index of potential postwar trade.

How different it is from the United States can be readily gauged from the following true story.

The representative of a very highly respected and successful airline recently visited the New York office of a Latin American government seeking information on possible air routes. On the surface, the information requested seemed to constitute common-sense questions. So the visitor was very much surprised to be told that "where you intend to fly, man has never flown before. Topographical maps are poor and, at best, untrustworthy. Radio and meteorological stations are few and far between. Railroad and inland waterway communication is unreliable and gasoline would, in most instances, have to be flown in. Repair and service shops simply do not exist. Skilled labor is almost unobtainable. And, even if you brought in your own men, its only fair to add that the area in which you contemplate your landings is one of the unhealthiest in our nation. Furthermore, I would heartily recommend that you seek some alternate route, for, if this route proves unsuccessful, it would only be a poor advertisement for our country."

Fortunately, the representative found all this out in New York rather than "on the ground". But it is schemes such as these which, carried through, give a bad name to foreign trade.

After all, the representative was not to blame. He did not know that the Latin American interior was so sparsely populated. He probably would have been surprised to learn that the largest country in South America has only 21,000 mi. of railroad—less than one tenth the United States mileage. A citizen of the most highly-industrialized nation on earth, he doubtless did not realize that a skilled labor class is just aborning in Latin America. And chances are that it had not occurred to him that malaria, yellow fever and beri-beri were common diseases in the region in which he planned operations. He simply had not adapted his mind to a very different situation from that he would encounter at home.

Recent years, of course, have brought great change in many sections of the continent. Once almost completely dependent upon agriculture, Latin America today is providing the Allies with large percentages of their total requirements of manganese, tin, tungsten, tantalite, columbite, beryllium, platinum, quartz crystal, antimony, mercury, and countless other minerals and metals and industrial raw materials.

The Pan-American highway has been extended and improved. A great new highway has been built across the Peruvian Andes into the lush, tropical country of the Amazon. The Brazilian rubber boom, like the gold rush several centuries ago, has inspired the migration of thousands of workers from the coastal areas to the interior. Brazil's great steel plant at Volta Redonda and her new airplane engine factory; Argentina's hunt for metals and construction of new industries; and Colombia's extensive industrialization program are outstanding examples



JUST as startling new developments in electronic communications and new methods of aircraft control now enable our military planes to pierce the veil of fog, clouds and darkness, so will even greater advancements to come further increase safety in future flight.

And just as AIR-COM Products are now being depended upon to help increase the operating efficiency of our American warplanes, so will the dependability of new AIR-COM Products add safety, convenience and economy to the mass transport of freight and passengers in the "Air Age" ahead.

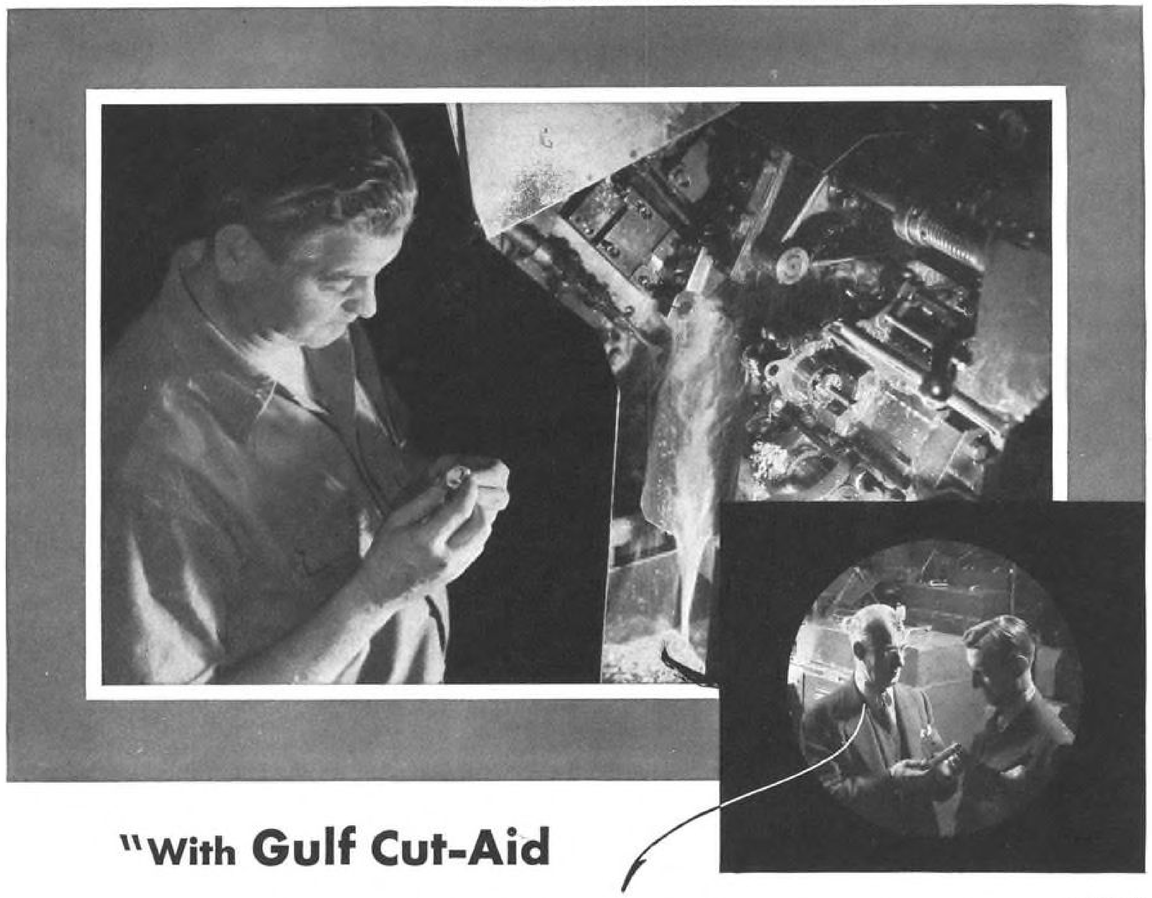
As AIR COMMUNICATIONS, Inc. continues to work for victory, our war-tested engineers are looking ahead and designing ahead. Even now AIR-COM Cooperative Engineering is available. Let us help you solve your engineering problems of the future.

★ *Designing, Engineering and Building for Victory . . . and for the Future*

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The big battery of modern screw machines in this plant produces several different types of aluminum aircraft parts with the help of Gulf Cut-Aid. In the lower photo a Gulf Service Engineer (right) is shown consulting with the plant Superintendent on machining aluminum caps.



"With Gulf Cut-Aid we increased aluminum cap production 25% —— tool life over 100%"

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GULF CUT-AID does a better job on aluminum than any other cutting fluid we've ever used," says this Superintendent. "With this outstanding new cutting oil we stepped up production of aluminum caps 25%, increased tool life well over 100%, and are getting better threads."

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BACK THE INVASION . . . BUY MORE WAR BONDS!

of a great continental trend toward economic diversification and the rise of a skilled labor class.

Floating dispensaries are traveling the rivers of the interior aiding man in his fight against disease. Meteorological stations are multiplying, thanks to a United States program which afforded young Latin Americans an opportunity to study weather forecasting in the United States. Airports are increasing; maps are improving; and night flying has been inaugurated.

However, for many years to come, Latin America will still be faced with problems of health, transportation, communications and industrialization that will be markedly different from those confronting the people of the United States. And, though the degree of this difference will be reduced with each industrial advance made on the southern continent, the business-wise exporter will reckon with these differences and make his plans accordingly.

The principal problems to confront the foreign trader, after study of these general and regional aspect of export, are the problems of the individual country for, just as we have sectional differences in America, the people of the Latin American countries have sectional differences within each of the 20 nations.

Once research has led the foreign trader to his decision on markets, he still faces the practical problems of doing business. And the first of these is the law.

Here conditions vary radically from country to country. One nation may require businesses to employ two natives to every foreigner. Others may demand three to one. Some republics prohibit the operation of foreign-owned and foreign-controlled companies, unless 40 percent of the capital stock is home-owned. Others ask up to 60 percent control. Still others may have no laws regulating the labor and management of foreign corporations. But all have company law, import and export regulations, tariffs, and income taxes.

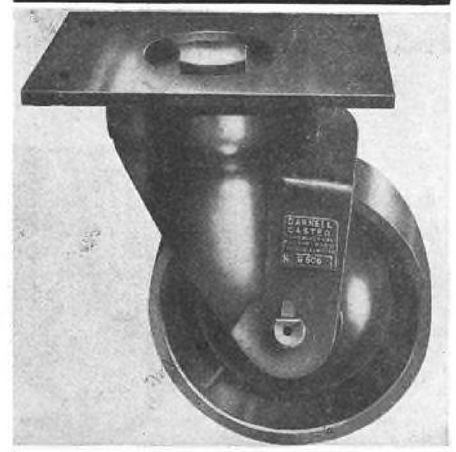
From these studies will come answers as to the best way of doing business—whether through dealers and distributors; an American subsidiary domesticated in Latin America; domestication of the parent company in Latin America; or a Latin American corporation.

Next comes advertising. This is almost indispensable to a successful export business. First, it introduces the product. Second, it assists the company in the recruitment of capable personnel. Third, it builds the prestige so necessary to good business-government relations. Fourth, as always, it informs; it instructs and it sells.

In the case of aviation, which first gained popular recognition in the war years, advertising becomes an even more necessary adjunct to sales promotion. Whether in a transport or private plane, the Latin American is only waiting to be shown where aviation—passenger or cargo—fits into his business picture; and the greater the speed, the lower the fare (or price), and the more numerous the services, the more he will want aviation to help him.

This, quite naturally, assumes an intelligent advertising policy which will not

DARNELL



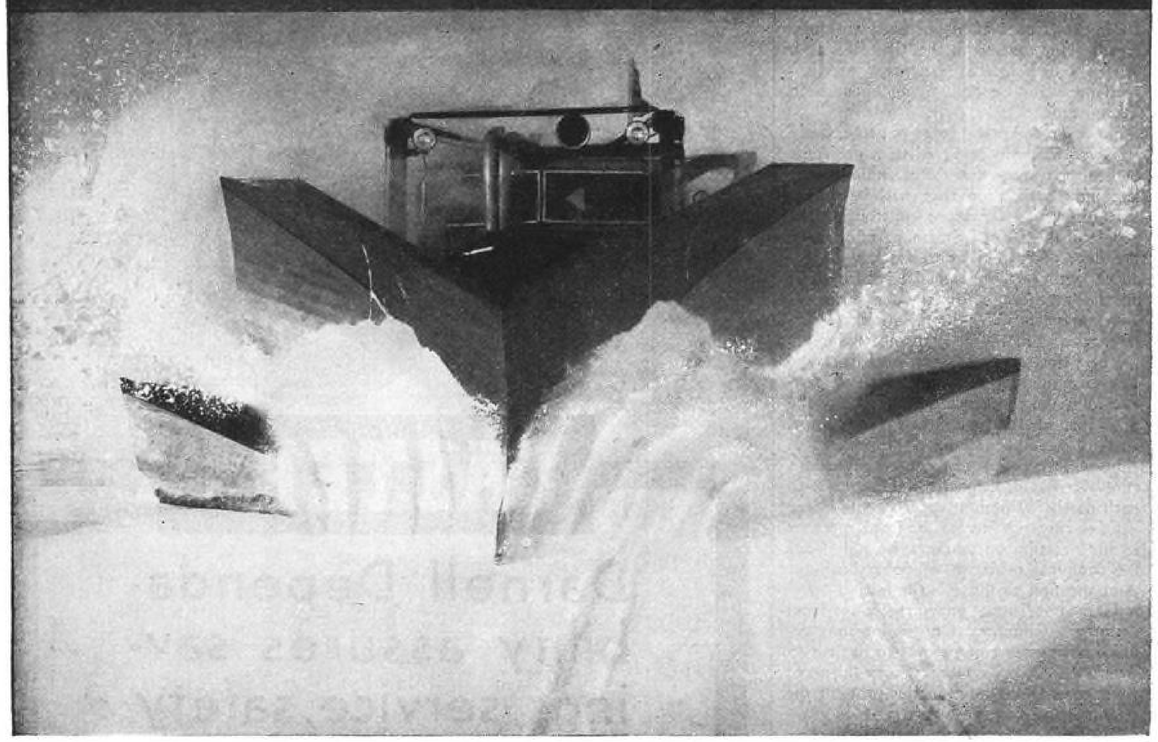
CASTERS

Darnell Dependability assures savings, service, safety, speed. A caster or wheel for every use.

You are sure to find the exact caster or wheel for your individual requirements in the Darnell line.

DARNELL CORP. LTD.
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SPEED IS WHAT YOU NEED TO KEEP RUNWAYS CLEAR!



CLEARS A 28 FT. WIDTH IN ONE RUN AT 20-30 M.P.H.

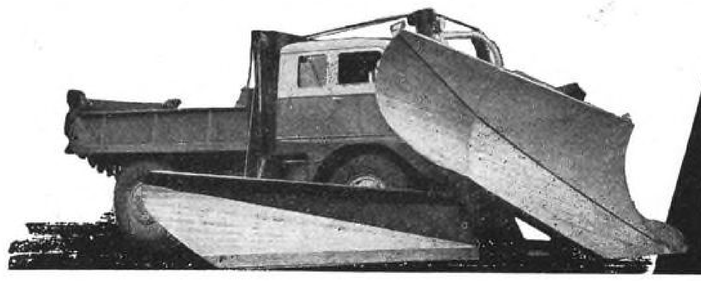
You can drastically reduce flight-hours now lost at your field after a snow storm. Clear your runways FASTER with Walter Snow Fighters. Their outstanding speed and capacity keep you ahead of any blizzard. You start flying from clean runways the moment the snow stops!

These specialized units have the highest snow-removed-per-hour record of any equipment. The Walter 250 H.P. Snow Fighter, for example, *clears a 28 ft. width in one run, at 20-30 m.p.h.!* This sustained high-speed plowing throws snow far to the side—eliminating dangerous snow banks.

Walter Snow Fighters maintain high speeds through snow because their tremendous power is translated into smooth, positive traction by the exclusive Walter Four-Point Positive Drive. Three automatic locking differentials proportion the power to each of FOUR driving wheels according to its traction at any instant. There is no wheel-spinning, side-slipping or stalling to reduce speed.

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WALTER SNOW FIGHTERS

alone use the best foreign and domestic media circulated in the local markets but will speak the language and scrupulously observe the customs, and traditions of the peoples resident in the market areas. The Latin American customer expects advertising copy and art to respect his ideas of the good and bad in life. He likes to see a beautiful woman as much as anyone, but he does not see the point of advertising heavy machinery with bathing beauties. He expects the dignity of his religion to be respected; and he is quick to accept as a slur on his pride too-great mention of the primitiveness of his country.

Many Latin Americans have lived their whole life through without once becoming conscious of a "color line". Art work which awakens that consciousness, no matter how high its purpose, is offensive. And lastly, the Latin American likes history. He knows Lincoln, Washington and Wilson; he believes he has right to expect Americans to know Bolivar, San Martin, Bonifacio and Hidalgo. He knows the Wright brothers; he expects Americans to know Santos-Dumont and Bartolomeo Gusmao, his pioneers.

The last step and certainly the most important is the choice of the men to do the job. Everything else depends upon this, for the best product will not sell itself. And in Latin America where knowledge of the language, tradition and culture of a people is just as indispensable to the salesman as knowledge of his product, nothing short of a broadminded man, willing to associate with the native as his equal can do the job.

Many aviation services and products have been sold Latin Americans because they were superior in quality to those of a competitor. Many, too, have been sold because of favorable credit terms. But, equally as many have been sold because the customer liked the salesman. And in Latin America the company and its products—whether they be transport service, planes, or parts—are judged by the salesman. In some cases, need of the product overshadows personalities but in most instances the man who shows his respect for his customer by speaking his language, observing his customs, and accepting his friends has a long start on his competitor.

All this may seem very discouraging to the man in aviation who, time and time again, has been told that foreign trade was an easy, painless cure for all the post war ills of his business. Doubtless it seems discouraging to the man who, though less illusioned, has been no more serious a planner. Perhaps, too, it robs the glowing stories of the vast postwar expansion of international air routes of a great part of their former attractiveness.

And articles upon the growth of charter and taxi services, private flying and civil aeronautics may not seem so promising. Even to the airlines operators and plane manufacturers who stand to gain so handsomely, the red tape, serious study, and cosmopolitan outlook demanded of foreign traders may appear as too heavy a demand.

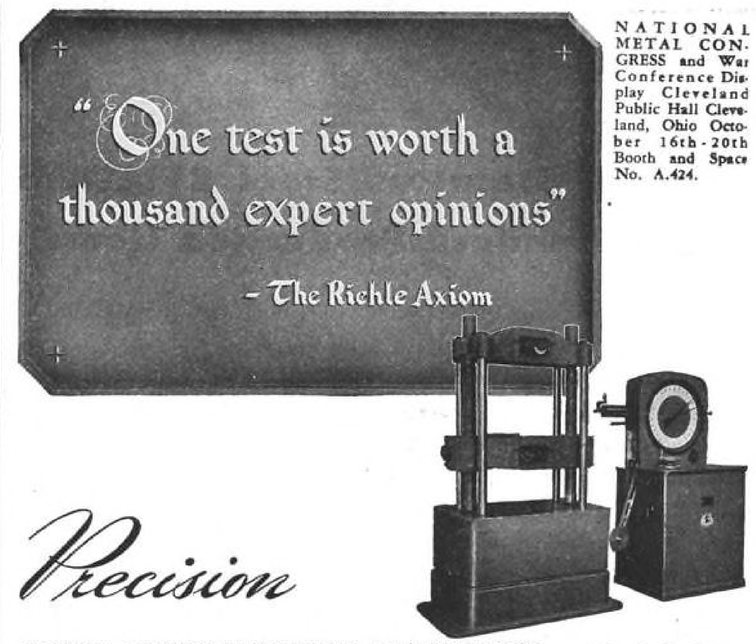
Yet, American aviation, which has made such tremendous strides in design and production, and has gained such invaluable experience in tropical flying during the present war, can make only one decision that would be consistent with its reputation for intelligent planning and farsightedness. That is to face the facts.

Europe's aviation production facilities are, in large measure, in ruins. The peacetime world will need peacetime planes and peacetime transport facilities. America is better suited than any other nation to tackle the job. And if her air lines and manufacturing units accept the challenge, they will have gone far toward solving the problems of reconversion.

Latin America is a good market. Every day it is becoming a better market, producing more that America can buy, making it possible for her to buy more from America. Her present program of industrialization is just a beginning, but it is a beginning. Just as the principal trade routes in America lie between great industrial centers such as New York and Chicago, so some day, in the not distant future, great trade routes and air lines will spring up between the United States and Latin America. They will be greater than anything we now dream possible.

Therefore, study of the realities of foreign trade with Latin America and realistic appraisal of its difficulties will avoid the bitter disappointment of high hopes suddenly collapsed and will allow the building of a trade which, however small its beginnings, will, in time, become one of the mainstays of American aviation.

Hard? Certainly. But so was it hard



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. . . . have repeatedly demonstrated the practical truth in the words, "One Test is Worth a Thousand Expert Opinions." Because they have simplified the science of testing the physical properties of materials they are widely used throughout the wartime industries today. Here Riehle Testing Machines "ferret out" material weaknesses and defects; avoid failures before they occur. This technique of progressive testing on the production line and in research laboratories saves valuable machine and man-hours. Write for descriptive literature and quotations.

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to create—almost overnight—an air force that, fighting in Africa, Europe, Asia and the Southwest Pacific brought defeat to the Axis and hope for a better, greater world to all mankind. An industry that did that can do no less to maintain full postwar employment, expand American foreign trade and assist, through trade, in maintaining the peace it has so magnificently helped to achieve.

How Will Planes Be Sold?

(*Continued from page* 125)

making the aircraft to go further and check how the distributors handled the dealers. Very few companies even outlined suggested plans for distributor-dealer-customer relationships, because most of them were too glad to see their planes roll out the doors to worry about how the individual sales had been consummated. These irregularities and weaknesses in distribution were not common to all companies, but their very existence was inherent in the distribution system then in effect.

In order to stay in business in the future, manufacturers of aircraft will have to adopt some of the proven distribution practices of other industries. With labor costs far higher, importance of keeping the unit distribution cost down is even greater. We are told that selling prices should be lower because of improved manufacturing methods and the anticipated increase in sales resulting from the tremendous new popularity of the airplane, which is interpreted as public acceptance.

After the last war, comparatively few military pilots continued to be interested in flying as a means of personal transportation. This was because the craft they had flown were not considered the safest vehicles available, and they were glad to get out of them for good. Our flyers in this war have learned that an airplane, in addition to being a bird of prey, is the best means of getting from one place to another in a hurry. Today they have learned that conventional flight incurs very little danger.

With more than two million individuals actively associated with the operation of aircraft in our own Army Air Forces, it is reasonable to assume that several hundred thousand will want to buy planes of their own at the first opportunity. But they, representing perhaps the largest immediate numerical market, cannot afford to pay high prices. High distribution costs contribute to high prices.

The percentage of commission is irrelevant. It is the actual profit in dollars and cents which interests the dealer or distributor most. Thus, if a dealer's discount is cut in half and he then sells three times as many planes, he is ahead of the game. Obviously, just cutting the commission will not bring prices down to the point where sales will soar upwards to balance out the cut. The costs of manufacturing the airframe, costs of accessories and power plant, etc., are of equal importance, but distribution costs should stay in step with them.

There is only one way to decrease distribution costs that is to draft immediately a plan or plans which will most nearly fit all the factors under the varying degrees of market development. In order to begin to formulate a plan which will have any chance of success, the old methods should be thrown out the window lock, stock, and barrel.

Prime requisite in successful distribution of consumer goods is adequate control. In planning controlled distribution, the interests of the customer are of first importance. An investigation will show that the distribution of higher priced goods is more closely controlled than that of lower priced goods—the higher the price, the more rigid the control.

Setting up various standards and making certain that they are strictly maintained for the benefit of the customer will result not only in more business for the manufacturer but also for every one engaged in the distribution. Primarily this means that standard sales and service facilities must be established at major sales outlets, with predetermined standard charges made for certain service and overhaul jobs. It means, too, that salesmen should be trained alike, also that the physical appearance of various merchandising material, such as signs and posters, should, by being similar, have public recognition value.

Much can be learned from the automobile business concerning a few of the jobs which face the aircraft manufacturer, despite the fact that the airplane and automobile are, and probably will remain, far apart in concept and purpose. The automobile business, before the war our largest industry, was very highly competitive and employed all the finest techniques in the arts of marketing, merchandising, and advertising.

Our present capacity to produce airplanes is conceded to be 'way beyond what the most optimistic demands will require in the immediate postwar period. Some experts predict that, at the very best, only 15 to 20 percent of the present combined capacity will be required, figuring tens of thousands of private-owner airplanes every year and enough larger craft to take care of military and commercial transport requirements of the nation.

This simply means that competition will be terrific. To survive it and stay in business, plane makers will be forced to take a page or two from the automobile manufacturer's book. But they must bear in mind that the essential differences between the plane and the auto will continue, that the markets are different, and that therefore the actual physical distribution cannot be expected to be parallel. But the methods and principles, to a substantial degree, can and should be similar in respect to certain phases of marketing and merchandising.

As previously mentioned, the airplane business followed a rather haphazard pattern of distribution prior to the war, partly out of necessity and partly out of "habit". The loopholes in the pattern resulted primarily from the disability (or unwillingness) of the manufacturer to consider proper control over distribution. The most aggressive concerns in merchandising were the most successful, but even

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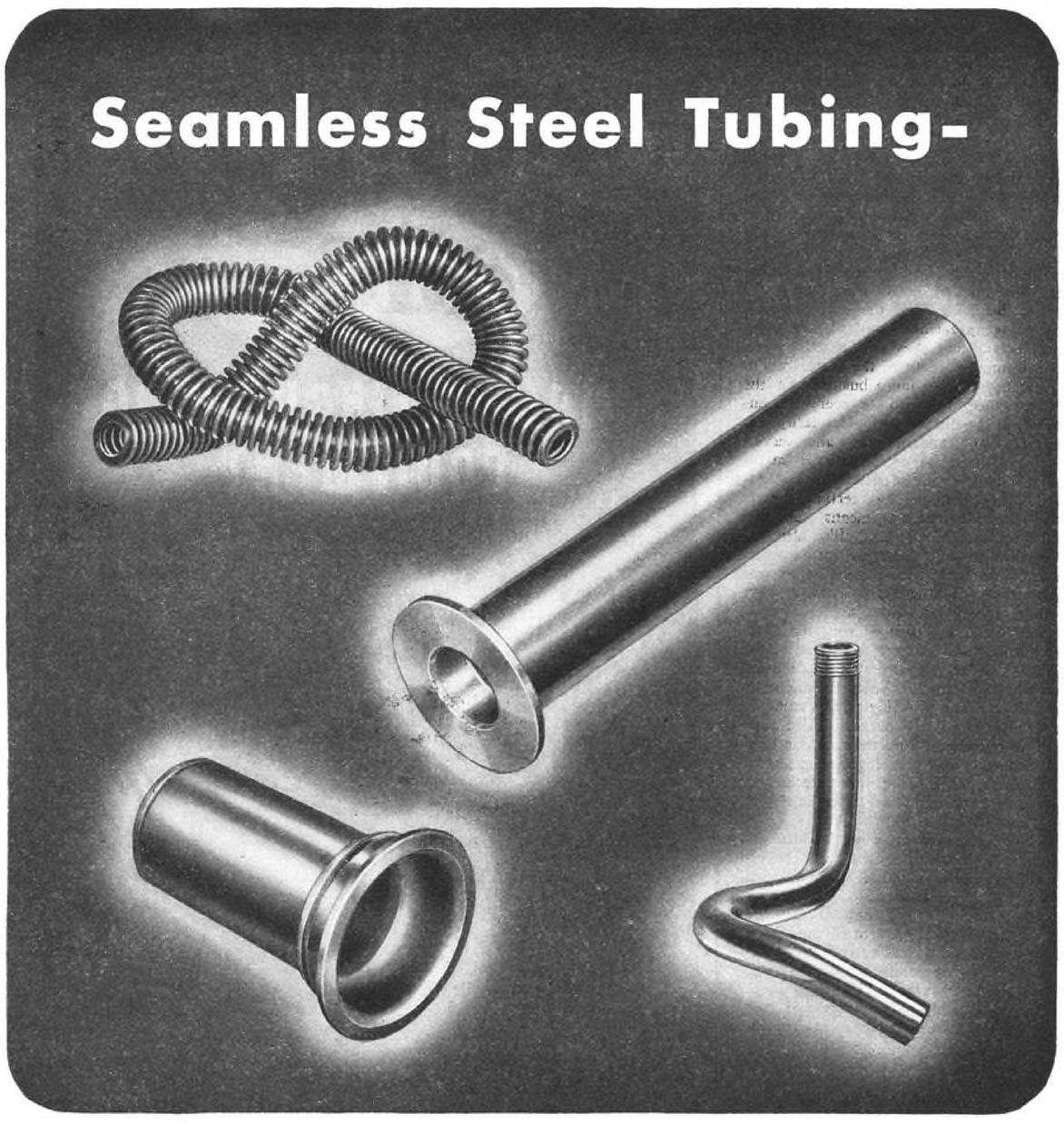
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they used but a fraction of the control over distribution which will be necessary under highly competitive conditions.

Three Plans

To learn what is considered controlled distribution, let us look at three possible basic distribution plans which might be eligible for adoption by aircraft manufacturers. None of these is given in great detail. None is ideal for *every* company. They are intended only as general methods, and each has distinct advantages all its own. They are not offered as the only methods available, but, in the opinion of the writer, they appear the most logical under the conditions which the industry may be expected to face in the decade following the war.

1. *Dealer Plan*—This is the simplest of the three from the standpoint of operations. It involves the appointment of direct factory dealers by the manufacturer's sales manager. Prior to appointment of the dealers, a very thorough market survey is made to determine sales territories and thus the correct number of dealers and their most favorable locations. It is then the sales manager's job to select the best possible dealer in each predetermined territory, bearing in mind certain general factors (which will be discussed later). Here are the mechanics of this plan: First, bring the dealer into the plant for an intensive training course in the design and construction features of the airplane which he is to sell, this to include complete maintenance procedure and the recommended repair methods.

Second, give him a complete sales course, showing him how and when to use certain sales helps and merchandising materials.

Third, school him in the company's standard accounting and general business procedures insofar as they will affect his own operations in recording deals, handling trade-ins, and financing new airplanes.

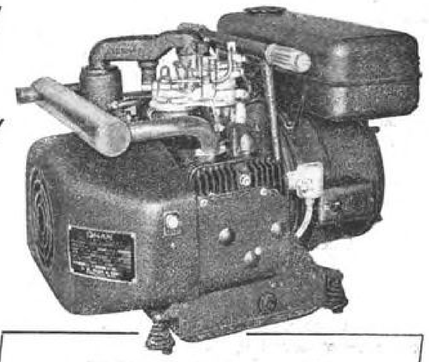
The dealer agrees on a certain quota of sales for his territory and receives a straight commission of the same percentage as all the company's other dealers. If the dealer exceeds his quota, he might be entitled to a sliding-scale bonus commission for all sales made above the quota. To keep an accurate check on the development of each dealer, the company can adopt either or both of the following courses:

First, have a field representative regularly afford the dealer any specific help which he requires to assist in the success of his business, and also have the representative make a monthly check of the individual operation and report to the factory any violation of the dealer contract.

Second, require the dealer to make weekly or monthly reports of his activities to the factory and to attend general sales meetings of all dealers, to be held periodically at the home plant. The reports could be of varying types depending upon the policies of the manufacturer, who should at all times have a very clear picture of each dealer's volume of business (sales and service), his obstacles,

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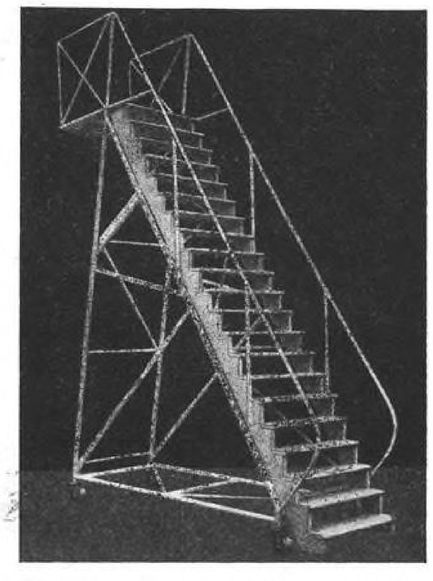
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and his failures as well as his successes.

This plan is best suited to the smaller manufacturer, provided he has the right man in the position of sales manager and can maintain at all times the complete contact required with all his dealers. From the standpoint of unified control, the plan has advantages to the large manufacturer —up to the point where the cost of its operation may make it more profitable for him to follow one of the two plans presented below.

2. *Distributor Plan*—In its conception, this plan is essentially the same as the one so widely used before the war, but here it involves a completely different technique of actual operation because of the control exercised by the manufacturer. Basic establishment on the principle of predetermined sales territories is similar to the Dealer Plan except that the territories are larger and the quotas are proportionately higher. The responsibilities of the distributor are naturally greater than those of the dealer, because he has several dealers working directly under him in preassigned sub-divisions of his over-all territory.

Contrary to past practice, the factory sales manager is responsible for the formulation of the distributor-dealer relationship policy, including the straight and bonus commission scales, which become a part of both the company-distributor contract and the distributor-dealer contract.

The distributor is required to carry sufficient airplanes and spare parts in stock to take care of the demands placed upon him by his dealers. He must assist his dealers in reselling trade-ins by making each dealer's trade-ins available to all others in his territory through a frequent listing or other such arrangement. He must maintain more complete overhaul, maintenance, and repair facilities to handle those jobs in his territory which cannot be undertaken by the more limited service facilities of the dealer.

In this plan the direct factory control over the dealer is removed and placed entirely over the distributor, who is directly responsible to the factory as is the dealer under the Dealer Plan. Furthermore, factory field representatives come into a more important role in this plan, since they must keep a check upon the distributor's relationship with his dealers at all times.

Distributors, under this method, are to receive even more complete training than that slated for the dealers under the other plan, because the distributors are responsible for the maintenance of training among their dealers. It is desirable that a factory representative conduct the training of new dealers in the distributors' territories, thus assuring uniformity and complete understanding of the factory policies and practices.

Because of the variation in individual territories and the degree of adoption of certain detailed requirements of distributors and dealers, we will not attempt to recommend a specific assignment of definite portions of the total commission. It is quite probable that, until experience proves the wisdom of a uniform program under more or less stable market conditions, the division of commission might differ from one distributor's territory to another, depending upon how much of the sales burden is shown to rest on the dealer or on the distributor. In this respect, the field representative will have much to say, but a continuous effort should be made to keep the division between dealer and distributor and the requirements of each as uniform as possible.

3. *District Sales Office Plan*—Differing from either of the first two plans but incorporating some of the best features of each, this plan has possibilities of adoption by the large concerns which wish to execute very close control over distribution. Practical where large volume sales are anticipated, it should aid in attaining volume more quickly because of the advantages which it affords customers.

The sales territories are larger than those in either of the other plans. In charge of each territory is a district sales manager, paid by the factory on a salary plus a bonus commission. Each district sales manager performs the same duties in his territory as does the sales manager in the Dealer Plan, for this district executive is responsible for making the proper sub-division within the territory and assigning qualified dealers to each.

Mechanics of the operation are based upon the establishment of branch offices and warehouses, one to a district, managed by the district manager. Thus the district man becomes, in effect, a very large distributor, except that he is a factory man and not in business for himself. He has the advantage of having the physical property under his control owned or leased by the factory. By the same token, the factory stocks him with airplanes and parts for quick delivery to his dealers. Being a factory branch, his operation may be able to render better service to dealers than some distributors under the Distributor Plan.

Necessity of separate field representatives is reduced because the district manager will perform a portion of that function himself as well as train dealers and their salesmen. The district manager is in a most favorable position to carry out his company's sales and service policies and preferred practices, thus exercising a standard control over all his dealers.

Obviously, this method involves a larger initial investment by the manufacturer than either of the other two, but it offers, through what we have termed "control", a much more complete and direct relationship between the factory and the dealer in a way which should prove of the most advantage to each. Because of having airplanes and parts always close at hand, the dealer can offer his customers what amounts to "factory service" and his salesmen can be trained quickly and efficiently in home territory and by the best means known to the manufacturer. The dealer is assured that he will always have near at hand the same assistance that would be available to him at the factory.

This plan does not intend that dealers should be "weak sisters", leaning on the district office for the solution to every problem. On the contrary, it should result in the establishment of ultimately strong dealers, because it fosters their development along sound lines. Each dealer will still be required to stock airplanes and parts and to maintain service facilities.

The district office is not to compete with dealers for service and repair business, but it should have available skilled troubleshooters to assist dealers when tough maintenance or repair problems come up. Such men would also be used to train the dealers' regular mechanics in standard maintenance, overhaul, and repair procedures.

This plan permits the factory to appreciate fully all the local problems which may be peculiar to certain territories, and thus it most nearly approaches the establishment and continuation of perfect teamwork between manufacturer and local sales agency. Because of the added expense to the manufacturer and the admitted advantages to the dealer, the latter should be able to operate at a profit with less commission than that allowed to dealers under either of the other plans. Again the amount of commission paid to dealers would depend upon cooperation afforded by the district office to dealers.

Because of the large scope of operations it is reasonable to assume that district offices and warehouses should have allocated for their maintenance a larger portion of the unit distribution cost than is received as commissions by distributors under the Distributor Plan.

Furthermore, after the initial establishment of successful dealers, the cost of operation of the district offices should go down with the reduction in training activities, and further economies might be effected by concentrating airplane and parts stocks in the hands of dealers rather than maintaining heavily stocked district warehouses. This latter point could only be clarified in the light of actual experience as the plan develops, but the fact remains that the initial cost will be higher than the operating costs, once the plan is in full swing.

Undoubtedly there are many other possible plans, such as the establishment of separate territorial sales companies, factory-owned retail outlets, and even straight sales by traveling representatives, which may be considered by aircraft manufacturers for postwar distribution. In any event, the most careful study should be given a plan before its adoption, because any major change later can be expected to produce headaches with a capital "H." Get the right plan, or the one which is felt to be the most practical under the circumstances surrounding the particular problem—and stick to it.

Here are additional considerations—

For the most part, every manufacturer still has a soft spot in his heart for his prewar dealers and distributors. Those fellows sold airplanes the hard way, and very few, if any, made any real money at it. But they sold what the factories pro-







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duced, and most of them are planning to take up where they left off.

The aircraft manufacturer who goes "high-hat" and divorces the old timers will have a tough time of it, because the private citizen in Podunk, who wants to buy an airplane, will almost always go first to the man who runs the Podunk Airport and who was more often than not an airplane dealer before the war. John Public respects the opinions of his friend the airport operator. There will be difficulty in carrying a distribution plan to succeed if such operators are side-stepped. That does not mean that every operator is a logical dealer, but most of them can be made into good dealers if they are shown how.

Service, as already implied, is as important as the initial sale. Standardized service must be available from all dealers, and charges for each type of service work must be consistent. Actually, the dealer has only begun his relationship with the customer at the time the plane is sold. If he maintains proper service facilities and always treats the customer right, the dealer is almost bound to be successful in making repeat sales and new sales to friends of earlier customers.

In his selling of service, the dealer must be just as thorough and conscientious as he is in selling airplanes. He must make himself more of a businessman than he has been in the past. He must put up a good front, keep a neat shop, and inspire confidence. If he wants to get the public to fly and buy the planes he sells, he should put one in a downtown showroom.

Last, but far from least, he should make the very best possible use of every piece of merchandising material and every merchandising idea which the factory makes available to him.

Let's all remember that the field of private aircraft will be a *competitive* one, and that it will prosper as such only if we plan now to modernize the old ways of doing things so that the customer benefits. He is the man who pays the bill. And we will always want *more* customers!

High Frequency A. C.

(Continued from page 166)

tion of a large portion of the entire system by causing limiters to open incorrect sequence.

Limiters cannot protect the system against faults occurring on buses where subdivided feeders are tied together. For this reason, it is proposed to provide vital buses with armor, which can also serve a structural function.

Limiters cannot protect the system from faults within alternators. Differential current relaying is the best protection against damage to the system or airplane from alternator faults. Relays are used which operate when the incoming and outgoing currents do not balance; lack of current balance occurs only in the event of phase-to-ground or phase-to-phase faults within the alternator. Operation of any differential relay opens the main breaker for the particular alternator and simultaneously kills excitation, shutting the machine down and avoiding danger of fire or other damage.

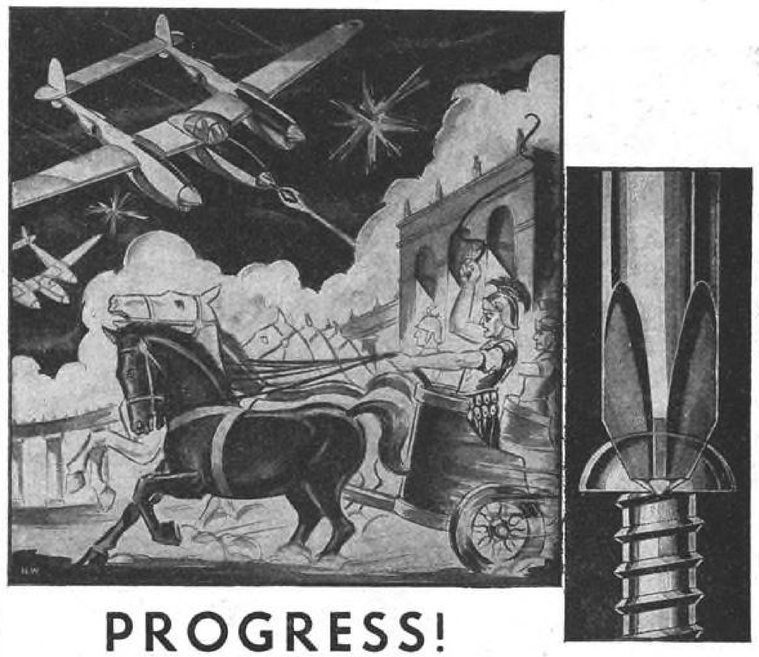
Additional protection will be provided by a thermal relay, responsive to exciter voltage, which will open the exciter field in the event of sustained operation at ceiling voltage, since such operation indicates either faults or excessive overloads.

Additional protection will also be afforded by a relay which will take the alternator off the bus if the frequency is below a predetermined value. Dangerous over-frequency will be prevented by an over-speed release in the drive.

Main and transfer breakers will be of latched-in type so that momentary voltage dips cannot cause drop out. They will be controlled from a 30v. auxiliary d.c. control circuit. Operation of d.c. control magnets is necessary to close or to open breakers. System stability demands extremely fast operation of differential relay and main breaker in the event of an alternator fault—to avoid loss of synchronism of remaining alternators and dropping of the system voltage to a point where the entire motor load cannot be restarted.

Motors and Motor Characteristics

Practically all a.c. motors will be of polyphase squirrel-cage type with three-line leads and grounded neutral. Motors will have their normal ratings at 200v. and must operate successfully at 190. All types of duty cycles will be required, and



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ratings will vary from 1/50 hp., or even less, to 20 and 25 hp. for hydraulic pump drives. A determined effort is being made to develop standard three-quarter motor dimensions so that one bearing bracket may be made integral with the driven appliance whenever this permits a reduction in space or weight.

Performance of 400-cycle induction motors is similar to that of ordinary industrial motors, except that higher speeds and lower weight per horsepower are possible. Synchronous motor speeds at 400 cycles are given in Table I. Few bearing applications are successful at speeds above 12,000 rpm. unless very special methods of lubrication are employed or the motors and loads are extremely small. The majority will be four or six pole.

Table I—Synchronous Speeds of 400-Cycle Motors

Type	*Rpm.*
2-pole	24,000
4-pole	12,000
6-pole	8,000
8-pole	6,000
10-pole	4,800
12-pole	4,000

Rectifiers and Motor-Generator Sets

A considerable amount of 30v. d.c. power will be required for equipment not converted to a.c. and for control applications such as relay magnets and motor brakes. The d.c. power may be obtained from dry-plate rectifiers or from rotating equipment. Parallel operation of at least two d.c. units on the 30v. bus is imperative to insure reliability of control circuits. Provision is made in control circuits for operation either with or without a battery across the bus.

A dry-plate rectifier is lighter than a motor-generator of comparable output but requires voltage control of power, whereas the motor-generator requires only a comparatively small field regulator so that net weights for 200-amp. units are about equal. The dry-plate rectifier has inherently poor regulation, and present requirements involve adjustment of d.c. output voltage between limits of 26 and 30v. so that a considerable range of input transformers has been proposed for controlling input voltage.

A saturable reactor is an iron-core inductance coil, the impedance of which can be changed by applying a small direct-current to a control winding. Since the impedance voltage is in quadrature time phase with the working voltage, a considerable change in impedance is required to provide the requisite voltage control. Weight can be saved by making the variable impedance a part of the transformer used to reduce the voltage from 200.

Rectifiers have little thermal overload capacity so that when a 200-amp. unit with a 2-min. 50 percent overloading rating is specified, it is necessary to provide a rectifier for practically 300 amp. continuously. It is possible to protect a saturable-reactor controlled rectifier from short-circuit damage by using the rectifier d.c. output for d.c. control winding power supply, since loss of output voltage immediately inserts maximum impedance in supply lines.

Tap-changer transformers for controlling voltage with dry-plate rectifiers are lighter than saturable reactors, but the present designs are motor-driven and slow in response. Heavy damping is required to prevent hunting during parallel operation, and changes in system voltage are corrected very slowly. Complete equipment is 10 to 15 lb. lighter than a saturable reactor unit or a motor-generator for a rating of 6 kw.

Motor-generators are considerably less efficient than rectifiers at light loads, and the light-weight high-speed units are noisy, but they have these two definite advantages: They use standard voltage regulators identical with those used with present d.c. aircraft generators, and they can supply power from stored rotational energy in the event of a momentary dip in a.c. voltage. The latter consideration will not be of much importance if a battery is used, but it may be extremely important if the battery is omitted. Motor-generators can also stand short periods of operation at extremely high temperatures; rectifiers, on the other hand, require a great deal of cooling air, since they cannot stand high temperatures and have very little thermal capacity to protect them from high temperatures caused by even short overloads.

A number of other motor-generators will also be required, particularly for the variable-voltage operation of power-driven turrets. High-power d.c. motor-generators are seriously limited in operating speed because of the difficulty in making large commutators which will withstand centrifugal stresses. This difficulty vanishes with a.c. motors, and considerable reductions in weight are possible.

The a.c. system outlined should not be compared with the latest work in d.c. systems; for proper perspective, it should be compared with early 12v. installations. The one described may well develop into a design which will be as far ahead of present ideas as a d.c. superbomber system is ahead of that using a single 15v., 15-amp. generator.

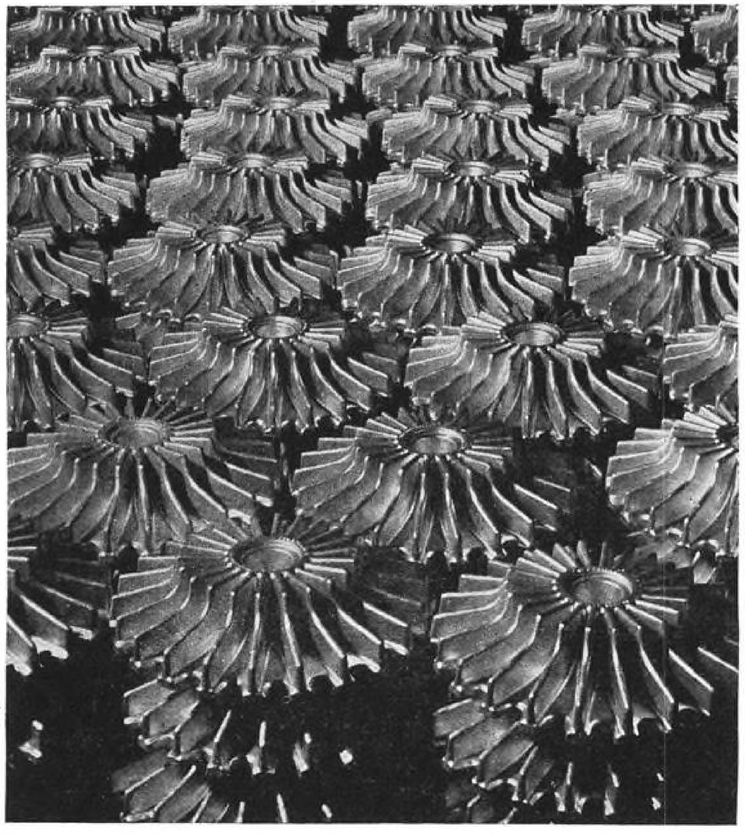
With the exception of size, most apparatus for a.c. installations will be required whether the system is designed for 150 kva. or for 500 kva., so that the relative advantages of a.c. will become greater with increased capacity.

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Surplus Plants

(*Continued from page* 117)

factory." This consisted of grouping a number of small enterprises under the single roof of a large formerly-idle building.

The advantages of the trading estate were summarized in a talk by the chairman of the North Eastern Trading Estates, Ltd., in the spring of 1939. Following is a report of what he said, as given by the Travel & Industrial Development Assn.'s bulletin:

"Tenant industrialists receive from the Estate Company service of a commercial as well as of a social nature. The Company's professional advisers and staff supply intending occupiers with free architectural and engineering advice. On raw material supplies, market for products, and sales methods, the Company has created its own research and sales staff, which can supply industrialists with such data free of charge. Apart from common services, the grouping of factories on an estate, the speaker thought, can and should lead to other less tangible advantages. Factories may be able to supply each other with their respective products, including waste products. The results of daily association are likely to lead to the exchange of ideas, to possible partnerships for limited purposes, such as sales, administration, and so on, thereby saving overhead charges, and to united efforts vis-a-vis governmental authorities, public utility undertakings, and similar bodies.

"The speaker concluded with these words, 'The Team Valley Trading Estate and the similar estates in South Wales and Scotland started as an effort to relieve unem-



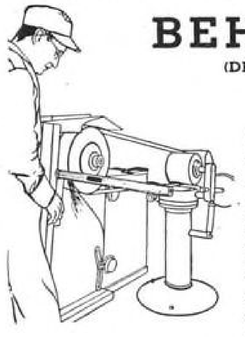
No! THEY DIDN'T USE THESE SANDING BELTS ON THE DOUGHNUTS; but they made it possible to turn out more doughnuts through the production of more machines in less time. Glance at just two examples:

"52 pieces—'A' Pipe posts. These had to be ground on the top to fit jig, as well as on the diameter for plating. It would have required 17 face wheels for this job. The material was extra tough. Only one #40 grit belt was used.

3 pieces—D 1099 Doughcan Covers. #46 grit stone wheel, 12½ minutes; #80 grit face wheel, 7½ minutes. 20 minutes to prepare for plating; 5 minutes to rehead wheel. Total time 25 minutes (8⅓ minutes per piece).

12 pieces—D 1099 Doughcan Covers were ground using the Belt Method. These castings had heavy gates on them which had to be removed. Total time 37½ minutes (3⅛ minutes per piece)."

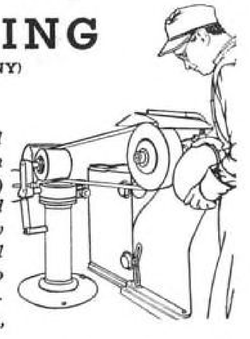
An Idler Backstand—and there are several fine makes—equipped with these outstanding abrasive cloth belts designed for this specific purpose, is not only far superior to set-up wheels, but can be adapted to purposes entirely new.



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In the U.S. Army crash boats (shown above) and landing barges built by the Owens Yacht Company of Baltimore, American Phillips Screws are used to make *speedier, stronger fastenings* . . . to get these vitally needed craft into service quicker, and to make sure they will stand up to the strenuous service required. Owens workers, using power drivers, make clean and flush fastenings right down the line, with American Phillips Screws. No fumbling starts, no crooked driving, no gouged work-surfaces, no split screw-heads. This is typical American Phillips Screw performance.



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Owens Yacht Company's peacetime pleasure craft, like their present-day war craft, will feature sturdy, ship-shape fastenings made by power-driven American Phillips Screws. In fact, the matchless speed and controlled accuracy of American Phillips fastenings will help this well-known boat builder to meet the pent-up, urgent demand for his quality product . . . and still maintain his rock-bottom cost per fastening. In fact, in all fields of peacetime production, the production advantages of American Phillips Screwdriving will continue to be just as important as they were in meeting wartime delivery schedules . . . on time and with the inspector's OK.



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ployment. They are now also an example to the world in the planned location of industry. Their success proves how much more efficient, economic and healthy industry can be made if it is divorced from residential and commercial surroundings. By granting itself good conditions of work, such as are found on the Trading Estates, industry can give society better conditions of living. The Trading Estates also prove that industrial depression and prolonged unemployment can be transformed into new hope and fresh achievement by the inventive genius and dogged enterprise of the people, and by the courage and spirit which are found not only among the wealthier and better educated, but in the humblest home. The Trading Estate movement is thus a great experiment out of which must surely arise happier relations between employer and employee, greater opportunity for all, and a better standard of living for the country.'"

How, it may well be asked, can the estate idea be applied to the United States?

What else will this country have in surplus plants but potential trading—or business—estates for the development of nest factories of all sizes? Any big modern factory, crammed with modern machine tools of all types, presents all sorts of opportunities. It only has to be divided off into rentable units—a simple job compared with the constant shifting within a plant which has gone on to meet war's needs. And the common facilities—power, light, heat, restaurants, loading docks, railroad sidings, and highway approaches —are all there. Many even have their own airfields.

Utilization of these facilities to create jobs depends upon whether the community in which they are located regards them as potential assets to be exploited, or as white elephants to add to the thousand and one problems of the postwar era.

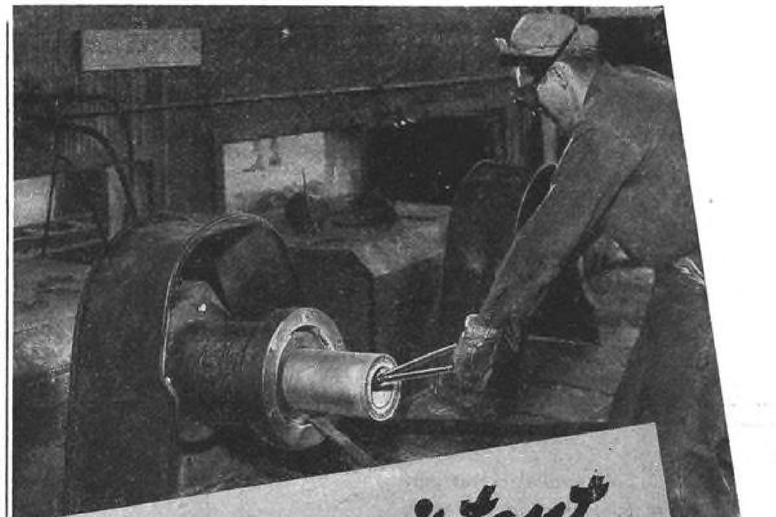
Certainly, these facilities *can* be exploited. Here is a plan, based upon the principles of the trading estate which, in the writer's opinion, holds much promise if it is sponsored actively by the leaders of communities in which big war factories will present a problem.

The first step, and one which should be taken immediately by any such group of leaders, is the formation of a private company—one preferably financed by local capital inasmuch as this is to be a project designed to benefit the entire community. It is important that it be privately owned, financed, and operated, rather than a municipal, state, or federal enterprise, as we shall see.

When the proper time comes, the company would seek to purchase from the federal government the local war plant, plus all equipment. In most cases, this probably could be done at a favorable price since, of course, every government-financed plant which the federal government can sell to private enterprise reduces its wartime obligations by that amount.

As soon as it is organized, the operating company should begin its search for tenants. Three immediate sources present themselves:

First, there are those local industries housed in antiquated buildings, operating inefficiently with obsolete equipment, and contributing to nearby slum conditions. The prospect of being able to move into modern quarters with excellent equipment



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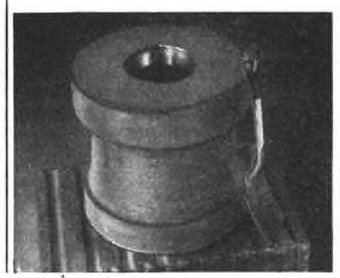
Ampco Metal, Inc.

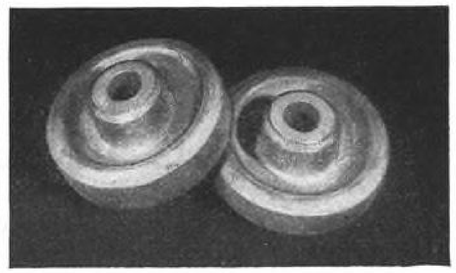
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available at a low rental should prove attractive. It might also be worthwhile for the community itself to condemn these old properties, pay the owners a fair price, remove the buildings, and convert the sites into little parks, with consequent improvement in bordering real estate.

Second, there would be enterprising local individuals, anxious to create businesses of their own but who had been deterred because of the lack of necessary capital with which to finance the original plant and equipment.

Third, there would be new industries attracted to the community.

Is such a program practical? Certainly. One of the major units in the aircraft industry had its beginnings in something like a nest factory. Back in 1925 Pratt & Whitney Aircraft Co. was formed with the aid of the Pratt & Whitney Tool Co. It started to develop and build aircraft engines with about 25 employees using 6,000 sq. ft. in part of a building owned by the Tool company. Because of its relationship to the latter, the new company had available to it equipment which was far better and more expensive than a struggling young enterprise could have afforded. From this small beginning has come today's United Aircraft Corp.

This example shows why the equipment in the war plant should be acquired when the building is purchased. For the most part, it represents the finest equipment money can buy or the human brain can devise. It should be regarded as a great asset to the community.

Obviously, when the factory is divided into individual units, much of the equipment, such as drills, turret lathes, broaches, screw machines, etc., undoubtedly will fit right in with the needs of the tenant, who can thus start off with some of the finest equipment ever built.

But there is sure to be other equipment —heat-treat, laboratories, presses, hammers—for which no one tenant would have sufficient use to warrant accepting it as part of his own unit.

In such cases, nothing would be simpler than to form little companies around such pieces of equipment—a hammer company, a testing laboratory, or what not. Initial business could come from other groups within the big plant, and from there the company could seek more volume from the outside.

Thus the tenants would have access to equipment which, otherwise, would simply be out of their financial reach. In short, the idle machinery would be converted into jobs.

No mention has been made, up to now, of the greatest asset the nation possesses in these wartime plants. That is the large pool of skilled and semi-skilled workers who have received their training during the war. It is just plain nonsense to talk of them as a potential surplus in the labor market, existence of which will mean there won't be enough work to go around.

The particularly happy thing about it is that a great percentage of these workers think—that is, they use their heads as well as their hands. Every plant in the country that has posted rewards for ideas has ample proof of this fact.

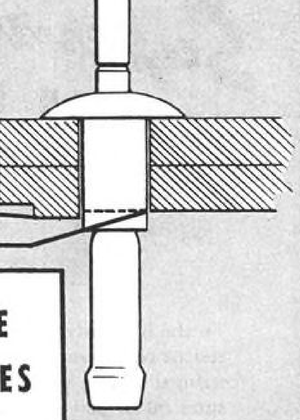
And so, a fourth, and perhaps major, source of tenants presents itself. These men are now working on the equipment for which they have been trained. With help from the estate, workers now employed in the war plant might create their own companies to operate the equipment for which they already have special training. They would then be creating their own postwar jobs.

In view of the thousands of ideas which have already poured in from the factory floor, it is reasonable to assume that there will be plenty of additional ideas to make such a venture work when the reward is ownership of one's own company.

True, some of the men will prove to be poor business men; accordingly, some of the little companies will wither away. But others will grow and prosper, to become bigger and bigger creators of jobs. That is a fundamental aspect of all business. The estate itself, however, can play a big part in advising, helping, and nursing along those beginners as they take their first steps alone. One of the biggest services the estate can render will be help in creation of markets for its tenants through advertising and marketing research.

It is for precisely that reason that the estate must be a private company operating on private, rather than government, money. Operated on a private basis, the opportunity exists to create a new class of economically sound, independent, chins-up

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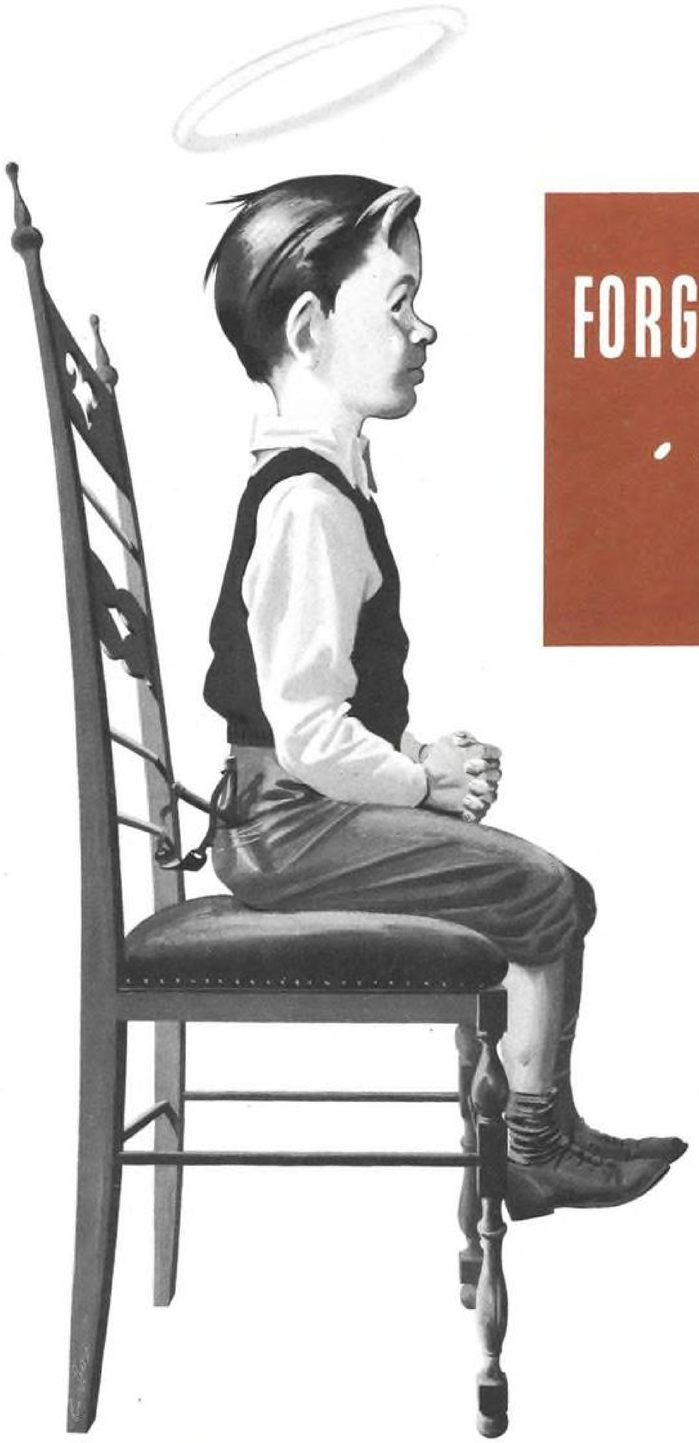
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Episode Near Luzon BY JAMES M. SESSIONS



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Forgings of aluminum and other light-metal alloys have always been considered notoriously hard to handle. Many seemed to be too difficult to be practical. Yet today, at Tube Turns, they have been "brought into line" — and are being successfully produced in remarkable volume, and with highest precision! Perhaps you have a problem in forgings for wartime production — or looming in sight for the future. In either case, why not let Tube Turns help you with it? Broad experience, ingenuity and facilities all are here at your command. Equipment such as mammoth upsetters, powerful presses and the most modern heat-treat furnaces . . . plus original techniques . . . is ready to tackle and lick any forging job, however tough! Tube Turns (Incorporated), Louisville 1, Kentucky.

TUBE TURNS *Forgings for Industry*



In the painting reproduced on the reverse side, Artist Sessions has recaptured some of the stirring action which occurred off Luzon during the Jap invasion of the Philippines.

small industrialists—creators of jobs and employers of labor, standing on their own feet, and making their way by their own efforts. It is the very sort of thing that built America strongly in the past. Operated on a public basis, with government funds, we have the specter of government subsidy on a gigantic scale softening rather than stiffening the backbone of our people.

It is for that reason, too, that the estate company should not be a non-profit enterprise. It should be expected to make profits. Its stockholders should expect and demand of its management cash dividends in addition to the benefits to the community as a whole. This pressure on management would be the surest guarantee that the estate company would be striving night and day to insure the success of the tenant companies, if only because solvent tenants alone pay rent, and the more tenants there are and the faster they grow, the more rent will be collected.

By fostering the traditional American feeling of individual independence, the business estate would provide a guarantee of jobs in the postwar world.

Gliders Change Tactics

(*Continued from page* 193)

relation to this primary mission and these other means of delivering men and supplies by air. Its many advantages over the parachute as a means of delivery are obvious. Not only does it deposit its fighting team at an exact predetermined spot, but the troops are together, ready to fight the moment they stop rolling.

Another great advantage is pointed up by an episode in Tunisia. A small force of Germans was thrusting forward to seize an area of strategical value to both sides. To forestall this, American parachutists, outnumbering the German force, were dropped—and they succeeded in taking the area. Complete surprise was effected and the mission went off exactly as planned.

However, the German force, equipped with heavy artillery, soon forced the Americans back, since the paratroops had only the smaller weapons which they had been able to jump with or drop. Had gliders been available, they might have brought to the paratroops the necessary AT guns and howitzers which would have enabled them to hold their ground.

Another aspect of the use of gliders as the sole means of performing a mission involves the pickup system. Developed by Richard duPont for the AAA mail line, pickup has been expanded so that it is now perfectly feasible to snatch a fully loaded CG-4A from almost any open area. For operations like those in Normandy, this may have little immediate tactical value other than that gliders can be quickly and easily retrieved for succeeding missions. It does, however, open up many new tactical possibilities, and it seems likely that the future use of the pickup with gliders will be increasingly important.

Keeping in mind, then, that the glider is a form of large container for delivering men or supplies, and that it can be retrieved full or empty, let us examine the various types of tactical operations for which gliders might be used.

First in importance is the airborne attack. This is exemplified by the Crete, Sicilian, and Normandy missions. It involves the use of large numbers of gliders, flying probably in darkness or half light, in an operation designed to land troops who will outflank the enemy three-dimensionally, to seize important communications points and disrupt the enemy's rear, thus making it difficult or impossible for him to bring up reserves while a coordinated attack is launched on the ground. In Normandy the airborne troops were landed well inland astride road and rail lines while the seaborne assault stormed the beaches. Such an operation is extremely complex, and many of the factors which must be considered in planning have been learned only by hard experience. Local air superiority is an absolute prerequisite, unless complete surprise can be attained.

A second and most important type of mission is the establishment of an airhead behind enemy lines—as was done in Burma by Col. Cochran's Air Commandos. The important difference between this and the Normandy invasion lies in the fact that here the airborne force comprised the entire assault. It was not merely sealing off an area where ground troops or seaborne troops would later attack. This unique and daring operation was the first





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Ray-Ban Shooting Glasses are preferred by champions.

PROTECTION OVERHEAD...

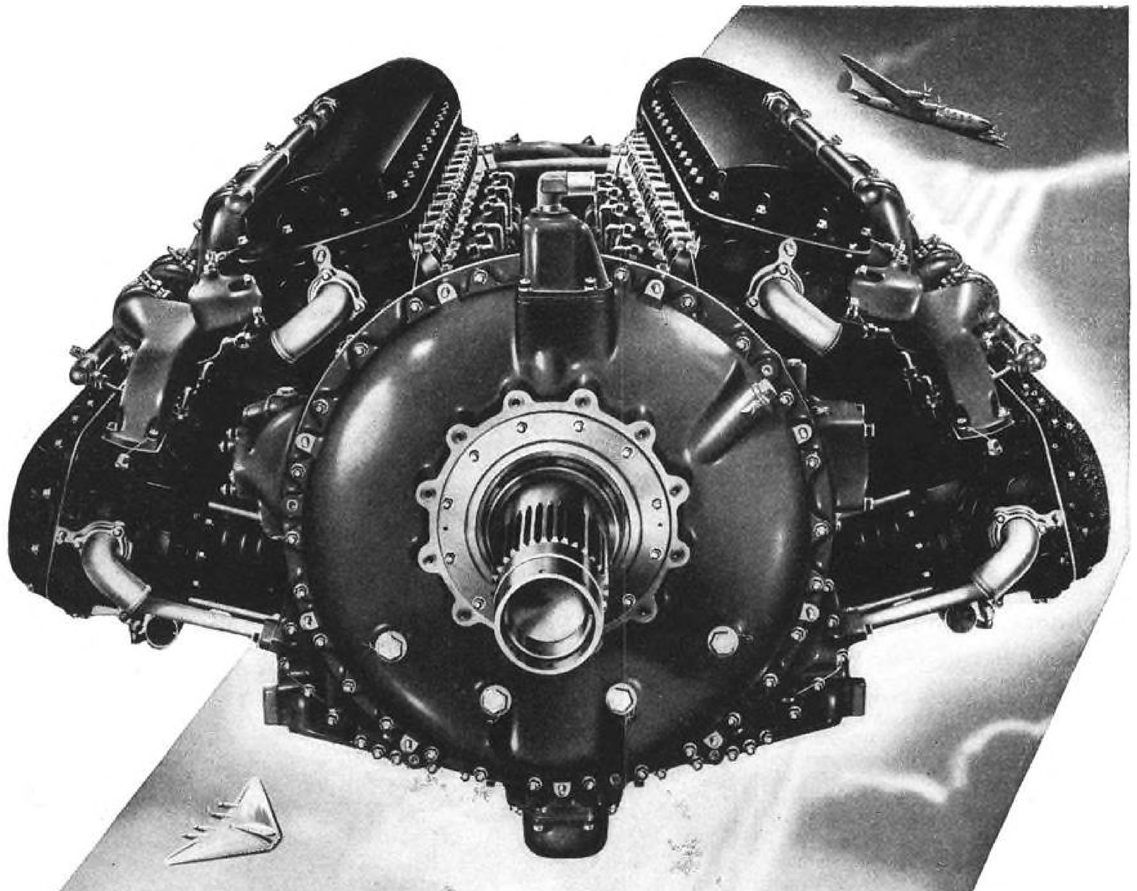
Fighting escorts protect our bombers from intercepting enemy planes. That's part of the advance planning. And comfortable, cool Ray-Ban Glasses give our flyers protection from the dazzling rays of the burning sun. That, too, is foreplanning. Long before the war, scientifically correct Ray-Ban lenses were developed to meet United States Army and Navy specifications.

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of its kind, and it proved the feasibility of such a form of warfare, particularly for this theater where a large area is sparsely held.

While seaborne assault troops are limited to two dimensions and must establish their beachhead along a coastline which may be strongly defended, the airborne attack may establish its airhead anywhere in enemy territory, and there is no way of defending surely against it, except possibly by other airborne forces.

It is apparent that the mere existence of a large airborne force as a strategic reserve is a potent threat, and the enemy may have to tie up large forces to be prepared to meet the attack of airborne divisions which may drop anywhere in his backyard. In the case of the Burma operation, the mission was run off at night, with no fighter cover; it depended on complete surprise, which was attained. This show was different from the first type in that gliders were not used to carry in the assault troops. The gliders served as containers for delivering aviation engineers and equipment to prepare an airstrip so that powered transports could then make a regular shuttle run to this spot 150 mi. deep in enemy territory, bringing in Gen. Wingate's raiders, food, ammunition, and other equipment.

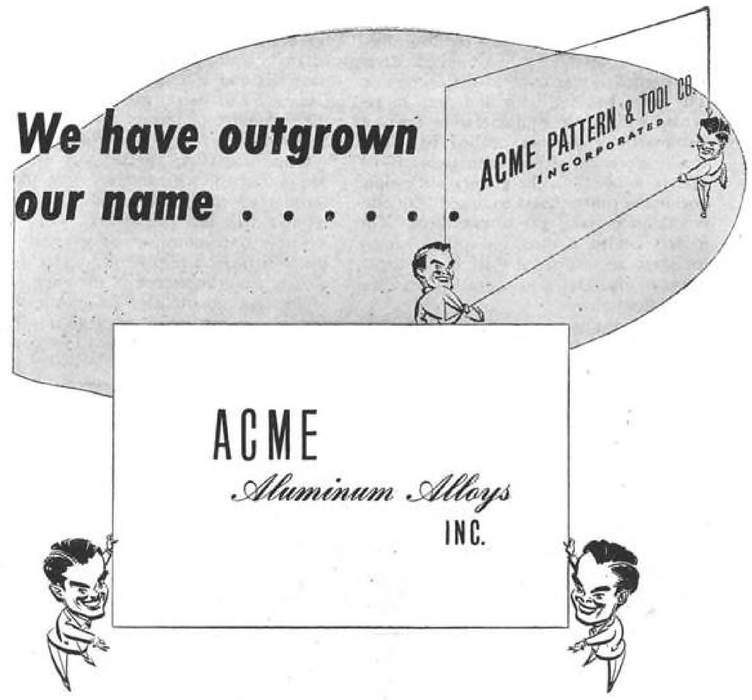
The glider landings succeeded in getting the engineers in, and the next night 65 transport planes landed, carrying the first of the Wingate forces. Within seven days a large fighting force had been delivered, including 500,000 lb. of supplies, 1,183 mules, and 175 ponies. The airstrip was not discovered by the Japs for eight days—by which time it was much to late. Here was a clear case of gliders performing a unique service. No other way of doing this same job could have been used.

Similar to this type of mission, but on a different scale, is a third type which we might call the airborne raid. This has been used with success by the Germans and ourselves. Fort Eben Emael in Belguim was captured in the early days of the war by demolition engineers who landed inside the fort in gliders.

An allied officer who was with a fighter outfit in North Africa has described to me how the Germans occasionally pulled raids with gliders. Sometimes his group would spot an enemy plane coming over the area at night. It was a question just what it was—but in any event no bombs were dropped and it went on. However, in due course a bridge would blow up, and they later would find a German glider abandoned somewhere nearby. The plane had been towing a glider which cut off and landed. Its crew did the demolition job and filtered back to their own outfits in Arab costume.

Since Crete, the Germans' use of gliders has been mainly in raid operations. You will recall that Mussolini was rescued by troops that landed from gliders, also that the surprise attack on Marshal Tito's headquarters in Yugoslavia was again largely a glider-borne force.

Our Commando outfit in Burma performed similar missions, landing small forces to blow bridges or establish road or rail blocks between Mandalay and the northern area of Burma.



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On one mission of this sort the ground forces had come up to the Chindwin River and needed to get over to the other side. The river was too wide and deep to get across with their equipment, so the Air Commando group was called in. Two C-47's were dispatched with two CG-4A gliders in tow. In the gliders were eight pneumatic rubber boats equipped with outboard motors and gas to run them. The gliders landed at dusk on a sand bar by the river and unloaded their boats, which were at once put into operation bringing the troops across.

Next morning two pickup planes were flown out to the scene, where both gliders were set up for pickup. Both were successfully snatched and flown back to their base. It was a most successful operation from start to finish, and it clearly shows the feasibility of further use of gliders in such ways.

Other operations of this sort were run off in Burma, too, and in some the returning gliders brought back useful loads of prisoners for questioning.

These operations, which were, in fact, the first tactical uses of pickup, represent a very small beginning in the exploration of its war possibilities. For one thing, there is opened up a war-cargo possibility for gliders. For while the CG-4A is undoubtedly not an efficient glider for straight cargo hauling from airport to airport, when used with pickup to service units in inaccessible areas it becomes efficient, since it is performing a job that cannot be done by any other aircraft.

In North Africa we captured German *Gotha* 242's which had landed with barrels of oil for advanced tank units which had outrun their supply lines. This becomes a rather costly mission if the glider cannot be retrieved. With pickup we could deliver additional gas and ammunition to an outfit in similar circumstances and recover the gliders, thus making it feasible to repeat the operation and keep the unit going via air supply. It would be perfectly possible to carry this form of supply to a much more advanced stage, and with definite gain in efficiency over any other system.

As an example, a theater supply system could be set up to operate in much the same way that the All American Aviation Co. runs its mail line. Assume a large sub-depot with an open field next to it but no airport. Fifty miles away is an advanced position which is not near an airstrip or airport, but which needs supplies. At the sub-depot, a CG-4A glider is loaded and prepared for pickup. From a Troop Carrier base 25 mi. away a C-47 flies over to the sub-depot, picks up the glider, and tows it to the advanced position.

As he approaches, the glider cuts loose to land. On the ground, ready for pickup, is another glider which landed the day before, and which is now loaded with wounded, prisoners, or anything else. The C-47 comes in, picks up this glider, and starts back to the sub-depot. On arrival there, the process is repeated. Under these conditions, the C-47 with normal full gas could make ten round trips from the sub-depot, delivering a possible 40,000 lb. of cargo at the advanced position and returning 40,000 lb. to the sub-depot. In this way the C-47 would be using its full time to best advantage.

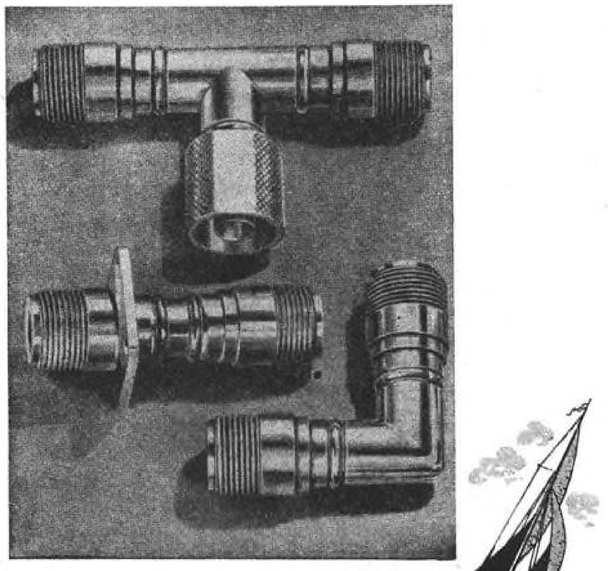
We have assumed here that there was no possibility for C-47's to land at either end of the operation. But even if there were, it would require for the C-47 about twice as much time to accomplish the same job, since it would have to spend about half its flying time on the ground being loaded and unloaded, and in landing and taking off.

Pickup and gliders are inseparable for many operations and may extend the usefulness of many other pieces of equipment in the Army and Air Forces. Special utility installations have been developed for many purposes, and since gliders and pickup ships are in almost all parts of the world, it seems likely that there will be an increasing development along these lines.

There are various types of repair shops which may be used in this way. A mobile glider repair shop is fitted in cases which are mounted on a trailer, and the whole unit is carried in a CG-4A. This glider can then be landed in a field where other gliders have been damaged, and the crew can repair them so that all may be recovered by pickup. Similarly many other types of shop—for repair of aircraft, ordnance, motor vehicles, etc.—may be carried. Such shops include a tent and power tools.

Another group of utility possibilities include the evacuation glider which carried wounded, also the various field dressing stations, which can be neatly packed for delivery by glider. There are also many units which, while not designed specifically for gliders, are readily air-carried and could be loaded quickly when desired. An example would be the standard field kitchens. Thus airborne, they would enable one glider load to serve 150 men with hot food. There are also portable radio detection stations and weather stations which can be carried with their crews to any point within flying range for special reporting missions.

Obviously, there is no limit to these possibilities, and we may soon see all sorts of service equipment provided by glider to front line outfits, such as shower units, clothing and shoe repair shops, refrigeration units, and the like.



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ASTATIC

THE ASTATIC CORPORATION
YOUNGSTOWN, OHIO

Hot Doping

(*Continued from page* 177)

"dusted" and a heavier coat should be applied over it.

When properly applied, the second coat should be ready for sanding in about 1½ hr. Method: Using No. 220 wet-or-dry, dry sand lightly. Check surface for any rough spots left from first sanding and rub them vigorously, for any rough places will be very hard to remove if another coat is sprayed over them.

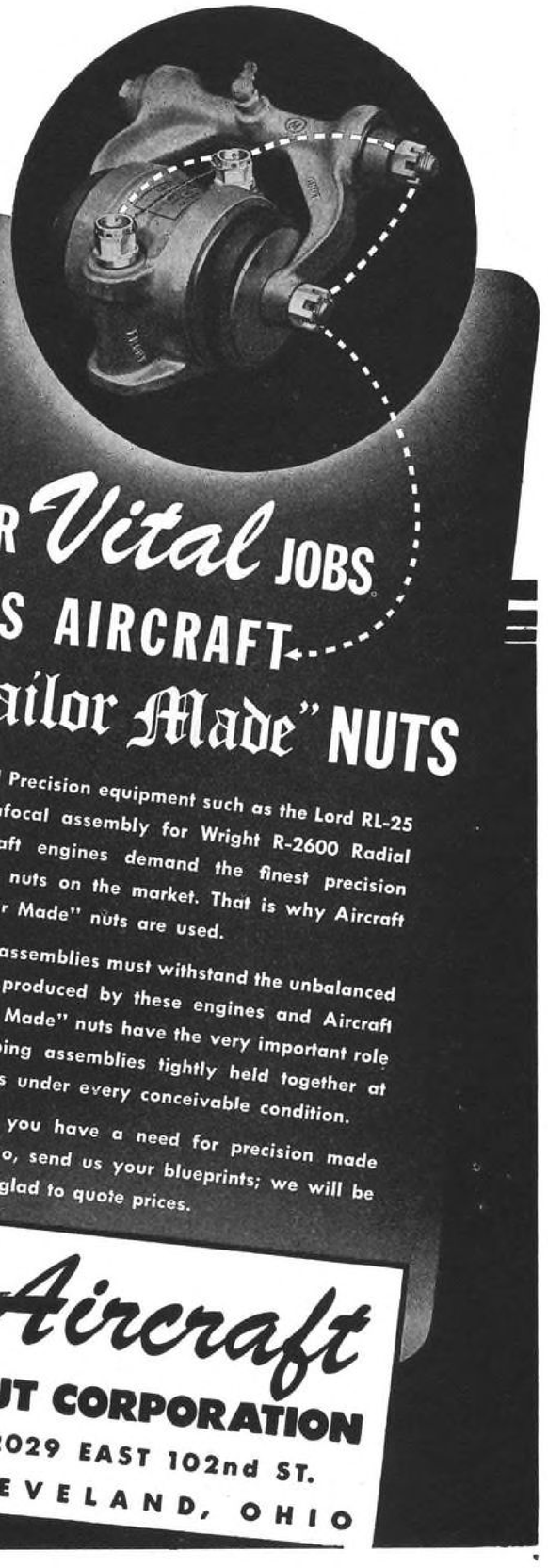
After the surface has been thoroughly smoothed it is ready for taping. Tape is laid as on any other doped surface, using regular tape adhesive or clear hot dope applied cold. Taping adhesive is excellent for taping over ribstitching, but care should be used because it is a thick liquid and has a tendency to leave a heavy deposit at the tape edges, which will later develop into cracks. This can be avoided by thinning 10 percent with hot dope thinner or by mixing half-and-half with intermediate hot dope.

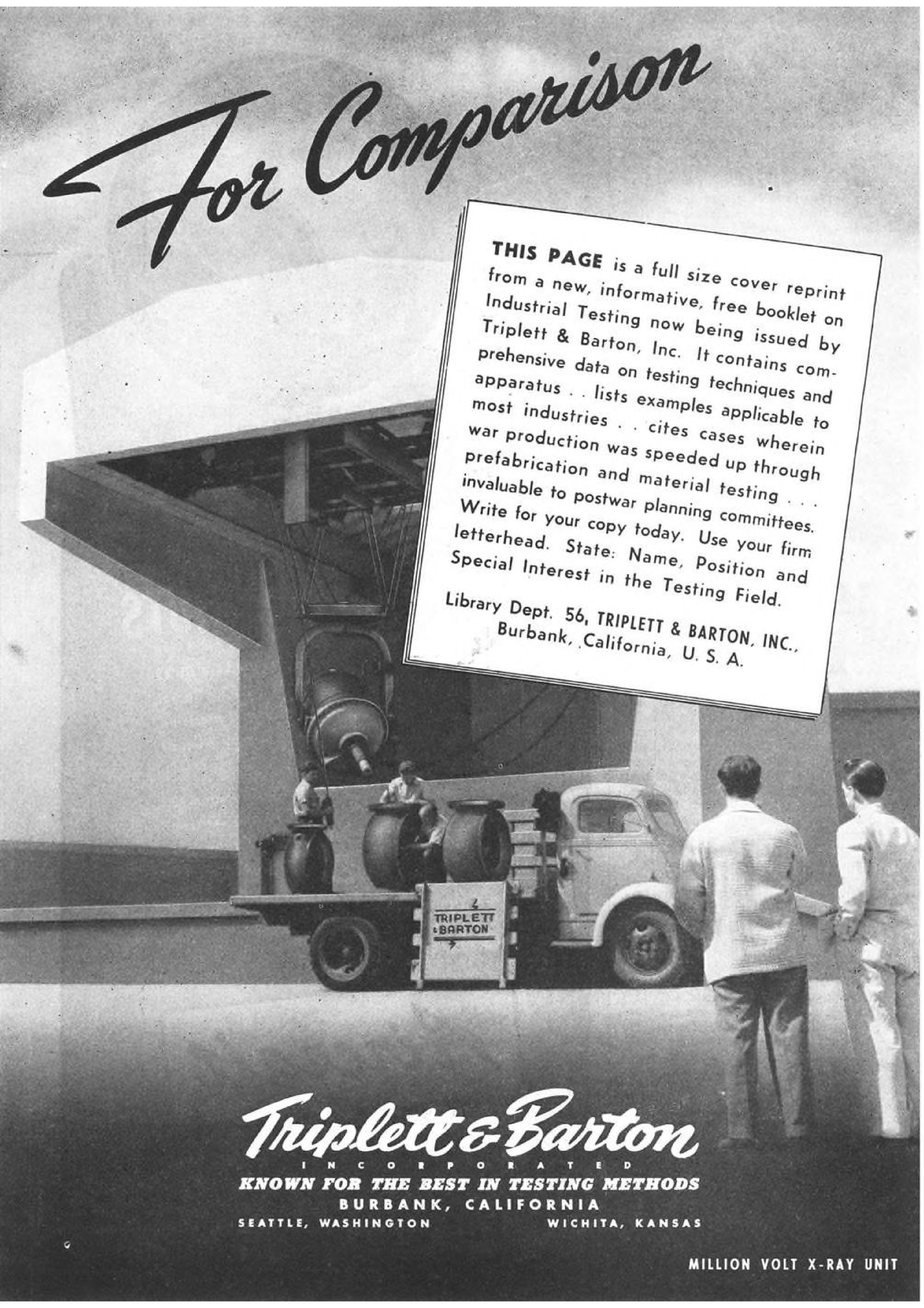
When using intermediate hot dope, brush a coat of dope over the surface to be covered and allow to dry. Then apply another coat and let it become tacky. Apply the tape and rub into the dope, afterwards giving a coat over the tape. When all taping is done, brush on two or three coats of clear intermediate hot dope to prevent bubbling when the first sprayed coat is applied. It is advisable to sand the tapes between the second and third brushed coats, or, if only two coats are given, sand between coats. However, the three coat job is much better. Dope should be thoroughly brushed on, for a wet brush coat on the tapes will surely cause bubbling.

If the fabric passes over a metal leading edge, this should be given two or three coats of brushed intermediate dope also.

When all tapes have been laid and filled, they should be given a dusting to give a good build for later sanding. This operation does not take long and is well worth the time expended.

The third coat is intermediate hot dope,





differing from the primer only in that it doesn't include the fungicide added to the latter to protect the fabric. This coat is sprayed rather lightly with only enough material to flow together. It should be dry on the surface in less than 20 min. and ready for sanding in 1½ hr. Even though this coat is sprayed very lightly, the film on the fabric will be quite heavy, due to the viscosity of the dope. This fact should be constantly borne in mind in all hot doping operations.

When thoroughly dry this coat should be sanded with No. 240 wet-or-dry sandpaper.

Fourth coat is applied after the surface has been cleaned of all dirt or residue. This is a lap coat of intermediate hot dope and should be sprayed a little heavier than the last coat to give a smooth flow. After 2½ hr. it is lightly dry sanded with No. 240 and then wiped absolutely clean.

The first color coat is next sprayed on as a full flow coat. If possible, this coat should dry overnight because it is to be thoroughly wet sanded with No. 280. A good plan is to sand until the clear dope of the previous coat is visible through the color, after which it is washed with clear water and dried.

Next, color coat is applied rather lightly, and the surface should be dry soon after being sprayed. After standing about 1½ hr., it should be lightly dry sanded with No. 320 wet-or-dry sandpaper and wiped off perfectly clean.

The seventh coat, because it is the one on which the appearance of the completed job depends, is very important. The dope is cut with 50 percent hot-dope thinner and is sprayed as a full-flow lap coat. It is the heaviest of all coats except the first primer, reason being that it flows together with the two previous color coats and results in a velvet smooth finish which can be highly polished with rubbing compound and then waxed. This method, used by American Export Airlines on its trans-Atlantic flying boats, has been found equal to any 15-coat cold-doped surface.

Wartime transport does not need this velvet finish but does require a strong, dependable covering on the control surfaces that will stand the humid tropical heat and the cold of high altitudes with a minimum of maintenance and the longest possible time between recovering periods. With hot dope, this can be done without slowing down production.

The following method is just as strong and durable as the last one, the difference being in the time spent on the surfaces and the smoothness of the finish.

First comes a cross coat of hot dope primer, the first lap being laid on heavy with the second a little on the light side. Do not spray the whole surface and then cross it, but cross each section as you finish the first lap. When dry, dry-sand with No. 180. Wipe off and tape. Only two coats of dope need be given tapes and leading edges where covered with fabric. When this is done, the second coat may be applied.

It is recommended that the tapes and leading edges be dusted before applying this second crossed coat of intermediate. Because this is a full flowcoat, edges of the tapes should be watched carefully for signs of bubbles. If any bubbles appear, they can be eliminated by dusting the spot, then rubbing quickly with the fingers. After drying, dry-sand lightly with No. 240 to remove any rough spots.

Color coat is the third and last. It is applied as a flow-coat and should not be sanded. If a fourth coat is desired, however the third coat may be smoothly sanded with No. 280 and a fourth flow-coat of color sprayed onto the surface. Either system will give a good, taut, durable cover which will stand up well under the worst climatic conditions.

From the above, it can be seen that hot doping is a great asset when time must be saved, and this operation appears to have a very promising commercial future in the postwar period.

Keep Mags Sparking

(*Continued from page* 175)

tap in Woodruff key. Use a new four ear lock washer and secure axle to gear with hexagon head screw. Tighten this screw securely, using socket wrench and gear holder. Tap prebent ear of lock washer firmly against sides of hole into which it is seated. Bend ear opposite prebent ear against side of hexagon head screw. Insert carbon brush into center of hexagon head screw.

Secure distributor finger to axle with



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its screws and lock washers. Check height of electrode of distributor finger with gage. Replace electrode if it clears *No Go* side of gage. Check new electrode after installing. If electrode hits *Go* side of gage, remove material with a file. Secure insulating plate to front end plate with screws and lock washers.

Rotating Magnet

Install breaker end bearing by placing the drive shaft end of the magnet in a sleeve. Then, using an arbor press, press bearing onto its shaft with pressing tool. Shielded end of bearing faces magnet.

Place Woodruff key in keyway on breaker end of shaft. Install small cam gear and secure with retainer, ear lock washer, and screw, making sure that retainer is engaged with keyway of gear. Tap short ear lock washer tightly into slot in retainer and lock by bending other ear against flat side of screw. Recharge the magnet with magnet charger.

Place the breaker end of the rotating magnet in a sleeve. Place insulating sleeve over drive end of shaft with flattened extension of sleeve up. Place front end plate over drive shaft end of magnet, and after extension of sleeve is centered toward the distributor gear axle in the front end plate, press front end plate into position, using pressing tool in conjunction with an arbor press.

Apply a light coating of SAE 60 oil on poles of rotating magnet. Make sure magnet is clean. Then engage front end plate and magnet assembly with magneto housing by inserting magnet as far as possible. Make sure that insulating sleeve enters straight. Place the breaker end of the housing on support and center in arbor press. Press shaft and front end plate into position over the drive gear end of the shaft.

Make sure rotating magnet turns freely and does not bind. Check clearance between pole piece and shoes in housing. Clearance must not be less than .0015 in.

Install small distributor gear. Timing mark on drive shaft spline must index with timing mark on hub of small gear over one of its splines. There are two timing marks adjacent to teeth of small gear. One is marked *R* for clockwise rotation and the other is marked *L* for anti-clockwise rotation. Index tooth marked *L* with timing mark on the tooth of large distributor gear.

Check the backlash of the distributor gears. If reading is more than .010 in., large gear should be replaced.

Apply evenly a small amount (about ½ oz.) of Keystone No. 44 grease, or equivalent, upon the teeth of the distributor gears.

Place the magneto upright on support, and install mounting flange on front and plate by tapping it into position. Insert and tighten large and small screws, not omitting lock washers.

Cam and Adaptor Assembly

Front bearing (nearest the gear) must be installed in adaptor first. Open end of bearing faces inward. Press bearing into position, using pressing tool and support with an arbor press.

Place remaining bearing on cam shaft with shielded side toward taper of shaft, and place spacer on shaft over bearing. Insert cam shaft and bearing into adaptor as far as possible; then press into position, using pressing tool against outer race and support under already installed bearing, allowing cam shaft to extend up.

Push cam gear on cam shaft, engaging splines in any relation. Shouldered side of gear faces the bearing (see service chart). Using a new four ear lockwasher, secure gear with its hexagon head screw. When tightening this screw, hold cam shaft with wrench.

Secure flexible primary lead to terminal post which extends through adaptor. Apply a small amount of keystone No. 44 grease evenly on the teeth of the cam gears.

Place adaptor in position on magneto housing having the large gear mesh in any relation with small cam gear. Make sure the flexible primary lead is in such a position that it can be secured with the condenser securing screw.

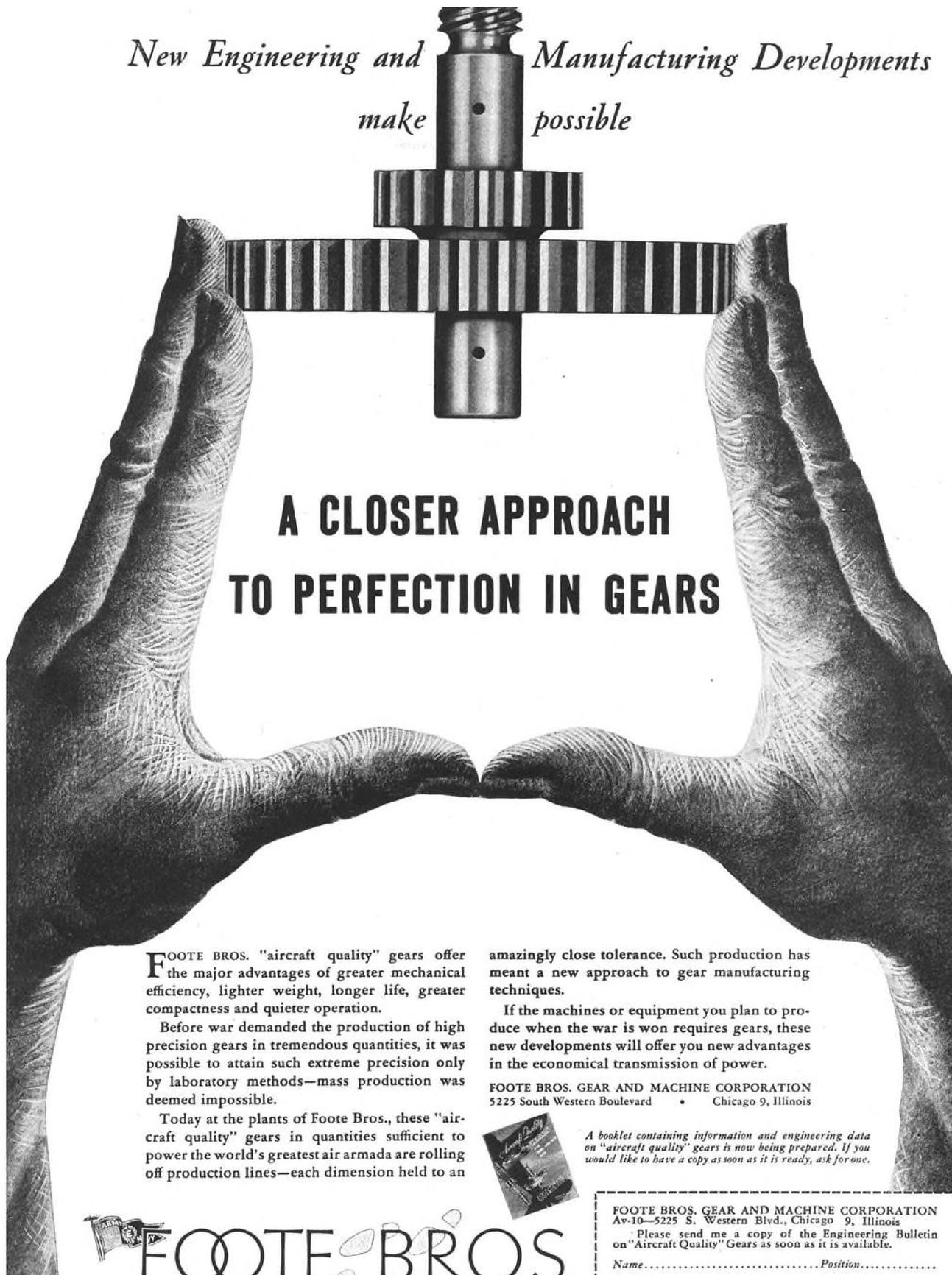
Secure adaptor with its screws (Q), plain washers, and lock washers (see service chart).

Timing of Cam

Cam gears must be set with a minimum perceptible backlash. To make this adjustment, loosen the three screws (Q)



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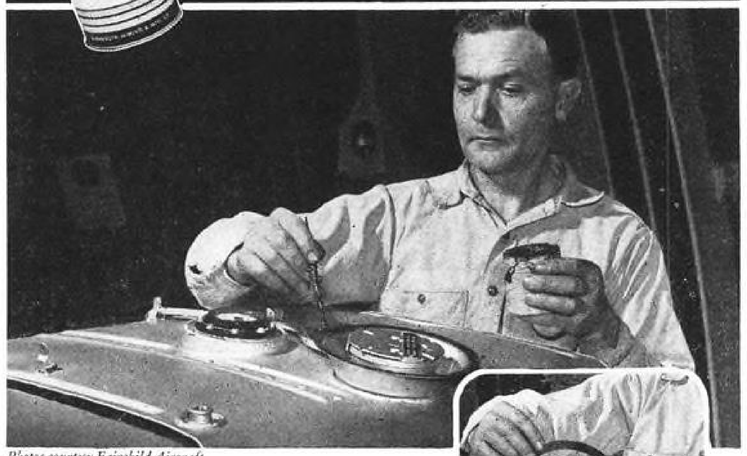
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(see service chart), turn adapter to the right until cam gears are meshed snugly with no perceptible backlash by rocking the cam shaft by hand. Tighten screws (Q). Turn magnet by hand through ten or twelve complete revolutions, while gears are meshed snugly, to remove any burrs or foreign particles on teeth of cam gears.

Loosen screws (Q) and turn adaptor to left until a small amount of backlash can be felt when rocking by hand. Then turn the adaptor just slightly to the right until a minimum backlash is obtained without having cam gears too tight, then tighten the screws (Q) securely. Check backlash at several positions of gears by turning magnet a few degrees at a time through one revolution of large gear and by rocking shaft by hand at each new position to make sure there are no tight spots and that backlash is not excessive. When correct adjustment has been obtained, tighten screws (Q) and safety bottom and right hand screws (see service chart).

Place timing disk on drive shaft and attach pointer in elongated slot in mounting flange.

When using timing disk with SF9LN-4 magnetos, it will be necessary to provide a spacing washer for use under disk to prevent locking sleeve of disk from displacing oil seal in front end plate when timing disk is locked. (Any washer having a hole diameter of approximately $\frac{3}{8}$-in. will be satisfactory).

Next, turn drive shaft in direction of normal operating rotation until timing mark (A) on the distributor finger approximately coincides with timing mark (B) on inside of front end plate (see service chart). Then turn drive shaft a few degrees in opposite direction until magnet is in netural position, when pole piece is centered and completely fills space between pole shoes on magneto housing.

When magnet is in neutral position, from which the No. 1 E gap must be measured, set the pointer over a degree marking on timing disk. Now turn the rotating magnet in direction of normal rotation to the No. 1 E gap position, which is obtained when the rotating magnet is turned past its exact neutral position the number of degrees stamped on the cam. By means of locking device on timing disk, lock rotor at the No. 1 E gap position. After it is locked, re-check degree reading to make sure that rotor did not creep when locked in position. It is very important that rotor be looked accurately at No. 1 E gap position.

See that taper of cam shaft and cam are free of all dirt which might prevent cam from seating. Also see that top adjusting ratchet fits freely over splines on end of cam shaft. Put a little grease on splines, for it is necessary to have the ratchets operate absolutely freely, otherwise there will be interference with the timing of the cam.

Place cam lightly on its tapered shaft so that it can be turned by hand. Next, mesh adjusting ratchet which has teeth on both sides with teeth in recess of cam. Teeth on one side of this ratchet will not mesh with teeth in cam recess, so make sure that correct side is used. Then place stop adjusting ratchet over splines on cam shaft so its teeth will mesh with the teeth of the intermediate ratchet. Place chamfered washer in position on top, adjusting ratchet. Then place tension spring over cam securing screw. Screw in cam screw until tension spring will just cause a clicking effect between adjusting ratchets when the cam is turned. Ratchet the cam back and forth by means of cam setting tool until straight edge on timing tool, which is represented by (K) on service chart, coincides with the timing marks (M) and (N) on the rim of the adaptor. *This setting is very important.* The ratchets located under the cam screw provide for this fine adjustment. The cam can be turned by means of the cam, setting tool one tooth forward and one back, thereby moving the cam in the anti-clockwise rotation only a fraction of a degree because of uneven number of teeth on ratchets.

Ratchets must be fully meshed when timing tool coincides with timing marks (M) and (N). If ratchets are not fully meshed when straight edge coincides with timing marks, cam may turn slightly when its securing screw is tightened, or might possibly loosen when running.

When the cam is set, remove tension spring and place lock washer over cam screw. Hold cam setting tool firmly where it coincides with timing marks (M) and (N) and tighten cam screw securely.

After tightening cam screw, disengage locking device on magnet and recheck setting of cam to make sure the straight edge coincides exactly with marks (M) and (N) when magnet is in the No. 1 E gap position.

Check eccentricity of cam to make sure there are no foreign particles or burrs on tapered surfaces. Eccentricity can be checked by measuring the contact point clearance on four lobes approximately 90 deg. apart. Eccentricity must not exceed .001 in.

Place condenser insulating plate in position between pole shoes. Secure condenser with its screws nearest the front, but do not tighten. Secure laminated primary connectors, insulating bushings and rear securing screws with their plain washers and lockwashers, making sure laminated connectors do not touch screws at any place. Connector for coil must be secured in position so that it can be connected to primary of coil.

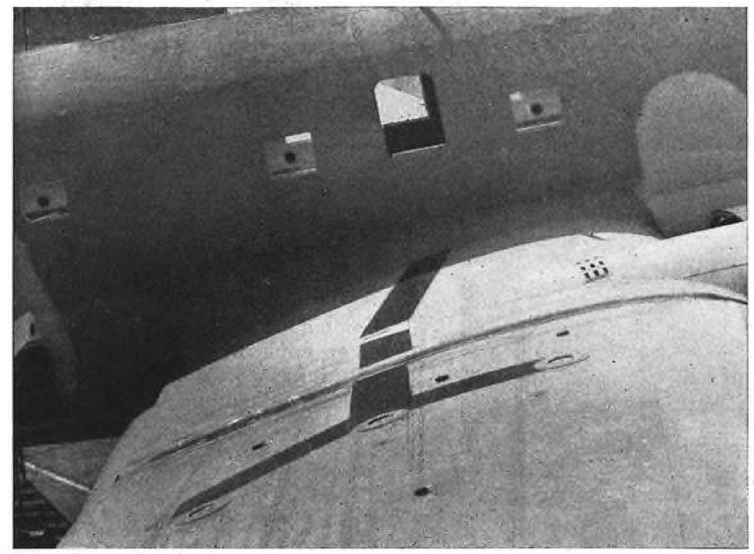
Secure coil with its fastening screws and washers. Connect flexible primary lead from condenser to coil by means of screw provided. Next, place eccentric screw in position and secure contact point assembly with its screws. Fasten primary connector with its screw F. Then fasten connector from terminal post to contact point assembly, and install ground terminal.

Adjust contact points. To do this, loosen the screws (O), as noted on service chart, and turn eccentric (P) until contact points just begin to open on No. 1 cam lobe when (K) coincides with timing marks (M) and (N). When this adjustment has been made, tighten screws (O).

After magneto is timed, check position of timing marks (A) and (B) when points just begin to open on No. 1 lobe,

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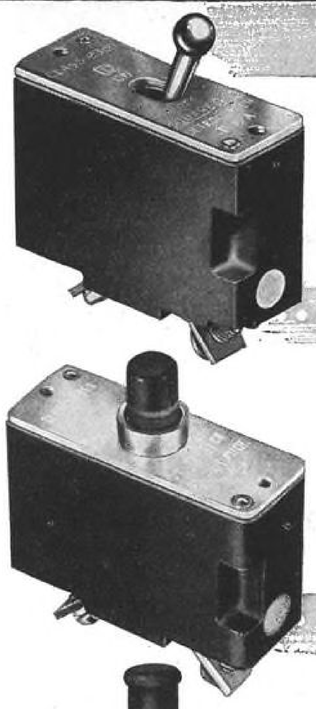
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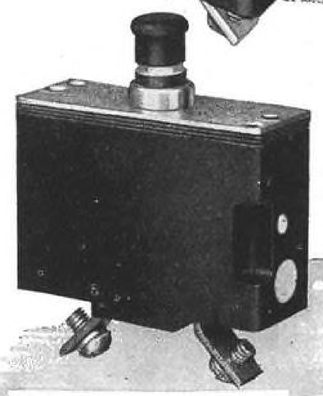


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to make sure distributor gears are meshed correctly. Timing marks (A) and (B) should approximately align.

Check timing further by placing gage on top of magneto housing adjacent to front end plate. Make sure that gage is centered between recessed edges of plate. High tension electrode on distributor finger must cover at least 50 percent of the gage when contact points just begin to open on No. 1 lobe of cam.

Observe cam follower felt to make sure it is properly lubricated. Allow the felt wick in the plunger oiler to absorb as much oil as possible. Use same oil as recommended for cam follower. Remove excess oil and install the oiler in the adaptor, being sure that it does not touch the cam, except when plunger is pushed.

Secure breaker cover in position with its screws. Then install distributor block in radio shield halves, securing it with screws near base of the shields. Fasten the halves together with the clamping screws. Depress high tension contact button, and place radio shield and distributor block assembly in position.

Install coil cover and secure it at breaker end with screws. Secure coil cover and radio shield to front end plate with six long screws. All coil cover screws should carry lockwashers.

After testing and final assembly, insert new leather plugs over ends of screws which secure the flange and front end plate to housing. The plugs may be tapped into place with a fiber drift and light hammer. Install drive coupling.

Magneto Test Procedure

Mount the magneto on test stand which incorporates an adjustable test gap panel. Connect high tension cables to spark rack set with 7-mm. gaps. Run magneto at normal speeds for two or three minutes to observe mechanical operation.

Check the coming-in or lowest speed at which the rotating magnet must be turned to produce consistant sparking at all of the gaps. The magneto should spark consistently at rpm. given in Table I. If the coming-in speed is above drive shaft speed given, check the following for the cause: Coil, contact point adjustment, distributor block electrode clearance, and magnet (which may be weak).

Run the magneto at 3,000 rpm. Observe sparks closely. If skipping occurs, test secondary condenser if used. If secondary condenser is satisfactory, check internal timing of magneto.

Check ground or switch terminal. When magneto is short-circuited through this terminal, sparks should not occur at the spark panel. Connect cable from the booster source to booster terminal on

Table I—Specifications of Scintilla Magnetos

	SF9LN-2	SF14LN-3	SF9LN-4
Mounting	flange	flange	flange
No. cylinders	9	14	9
No. magnet poles	4	8	4
Ratio, magneto/crankshaft	1½	7/8	1⅛
Ratio, magnet to camshaft	1:1	4:7	4:9
Ratio cam/engine speed	1½	½	½
Lobes on cam	4	14	9
Tolerance from mark "M" when points open, inches	1/64	1/32	1/64
Minimum coming in speed	135 rpm.	120 rpm.	135 rpm.
Secondary resistance, ohms	5,000–9,000	5,000–9,000	5,000–9,000



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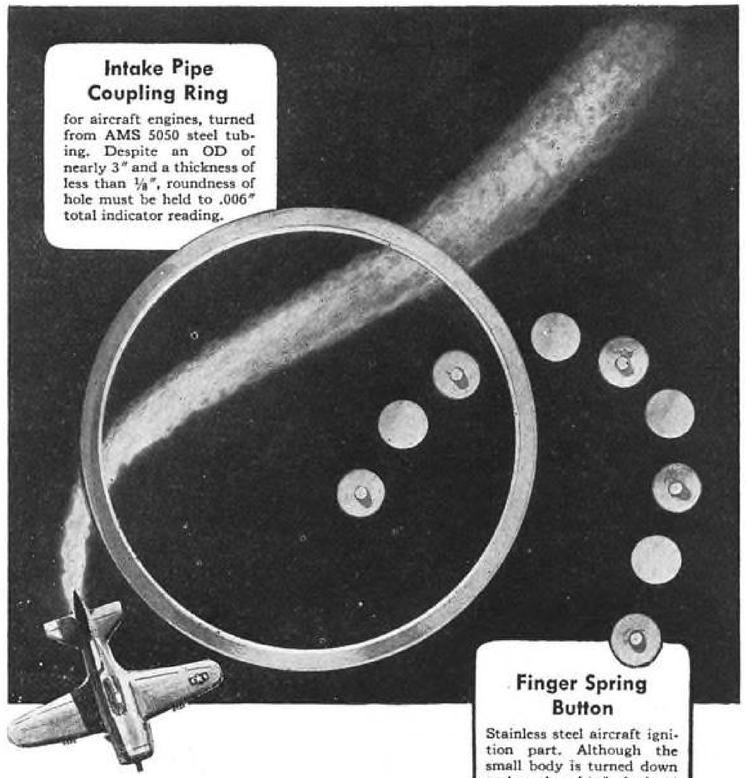
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magneto. Run magneto at 150 rpm. and make sure booster current is being distributed to spark gaps.

Rotating Magnet

The magnetic strength of the rotating magnet is checked by measuring the primary current output. Operate the magneto for about five minutes at 2,500 rpm. During this run, short-circuit the magneto through the ground or switch terminal at least 35 times. Then reduce the speed to 400 rpm. (drive shaft speed must not vary more than 10 rpm. when measuring primary current output). Hold the contact points open by hand and connect ammeter in parallel or across the contact points. The reading at 400 rpm. should be as given in Table 1. If it is below, recharge the magnet with magnet charger and make another test. If reading is still low repeat test with a new coil before rejecting the magnet.

Coil

Before installing coil check resistance of the secondary winding with ohmmeter. Reading must be from 5,000–9,000 ohms.

Final test of a coil must be actual running of magneto on test bench. Also, as heat affects insulation of the coil final test should be made at an elevated temperature by directing the reflector type heater on magneto while it is run on test bench. When temperature has reached approximately 165 deg. F., spark gaps should be increased by means of adjustable panel from 7 mm. to 9 mm. At 2000 rpm., coil must spark consistently at this temperature and spark gap. Increase gaps to 10 mm. If consistent sparking occurred with 9 mm. gap, intermittent missing with the 10 mm. gap will not be sufficient cause to reject the coil, however, if the coil does not spark consistently at the elevated temperature with 9 mm. gaps, it should not be used for further service.

Primary Circuit Condenser

Place the condenser to be tested on dry insulating material and connect the two test leads (F) of the tester (Fig. 13) to the condenser terminals. It is essential that the surface of the condenser be clean and free from oil and the connections make good contact.

Series resistance test is made by placing selector switch (A) in *Series Res.* position, (Fig. 13), then holding condenser switch (C) on *Condenser Test*. Meter reading is taken on top scale of center dial. If meter reads *Good*, series resistance is satisfactory. If meter indicates in red section of scale, resistance is excessive and condenser should not be used again.

Capacity is tested by turning selector switch (A) to *Cap. Mfds.* and capacity range switch (G) to *HI* position. Switch (C) is then held in *Condenser Test* position while reading is taken on scale *HI*. Reading should be not less than that given in Table I for primary condenser being tested.

For leakage and breakdown tests, preheat condenser in an oven to 190 deg. F., plus or minus 10 deg. Then attach test leads and place switch (A) on *Leakage Test*. Hold switch (C) in *Condenser Test* position for 30 sec. and observe position of hand on scale marked *Leakage*. If hand stops in yellow or green sections, condenser is usable, but should be rejected if hand is in red position of scale.

Switch (A) is then placed on *Breakdown Test*, and switch (C) is moved to *Condenser Test* for about 15 sec. Hand of meter should come to rest in *OK* section of scale, otherwise condenser should be rejected.

To test the secondary condenser, use a four-pole magneto having a cobalt or nickel aluminum magnet, to provide a source of high voltage. *Do not* use an *eight pole* magneto having a secondary condenser.

Mount standard magneto on test bench (Fig. 14). Adjust one spark gap to 3 mm. (.118 in.) and connect cables from distributor block cable holes No. 1 and 2 to it. Connect remaining cables to spark gap panel, using standard 7-mm. gaps.

Connect secondary condenser to be tested in shunt or parallel with 3-mm. gap. To do this, place distributor finger on bench adjacent to test stand. Provide a test lead with a clip on each end. Connect one end of test lead to ground of 3-mm. gap and clip other end to high tension segment on distributor finger. Provide another test lead and clip one end to live side of 3-mm. gap to which the Nos. 1 and 2 cables are connetced.

Run magneto at 3000 rpm. and observe spark across 3-mm. gap. Then place other end of test lead connected to live side of 3-mm. gap against central insert of distributor finger.

If there is no change in the intensity or regularity of sparking across 3-mm. gap, condenser is open and must not be used for further service.

If there is a noticeable increase in intensity of sparks across the gap, condenser is satisfactory for further service. Snappy, blue sparks occur when the condenser is functioning. These sparks, however, may be consistent or intermittent. Therefore, if any sparks of the above description occur, regardless of consistency, the condenser is satisfactory for further service.

If there is no sparking across the gap, condenser is short-circuited or punctured and must not be used. If condenser failures should occur in service, they will in most cases be caused by a short-circuit or puncture. Therefore, defective condensers will usually be determined by this test in which there is no sparking at all across the 3-mm. gap.

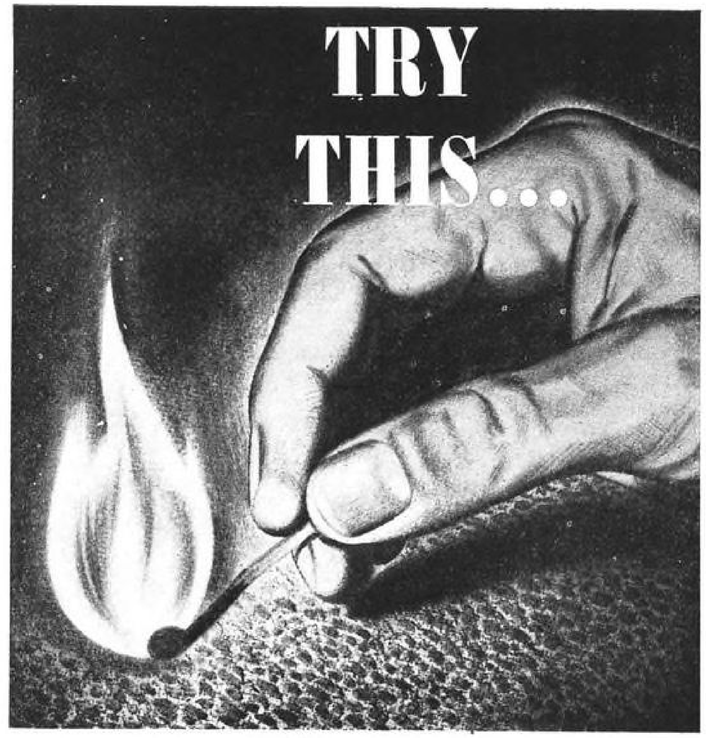
Static charges may possibly be observed arcing across 3-mm. gap when testing a punctured condenser. If it is desired to eliminate arcing from static, shorten test leads to condenser as much as possible.

Landgraf Helicopter

(*Continued from page* 188)

control arm provide automatic rotor pitch control. The spring load is held in equilibrium by centrifugal weights in the rotor blades. Rotors are bolted to flanges at the upper end of the hollow steel rotor shafts, which are rigidly mounted in ball thrust bearings.

Because of the high inertia forces involved at higher rpm. of the rotors, calcu-



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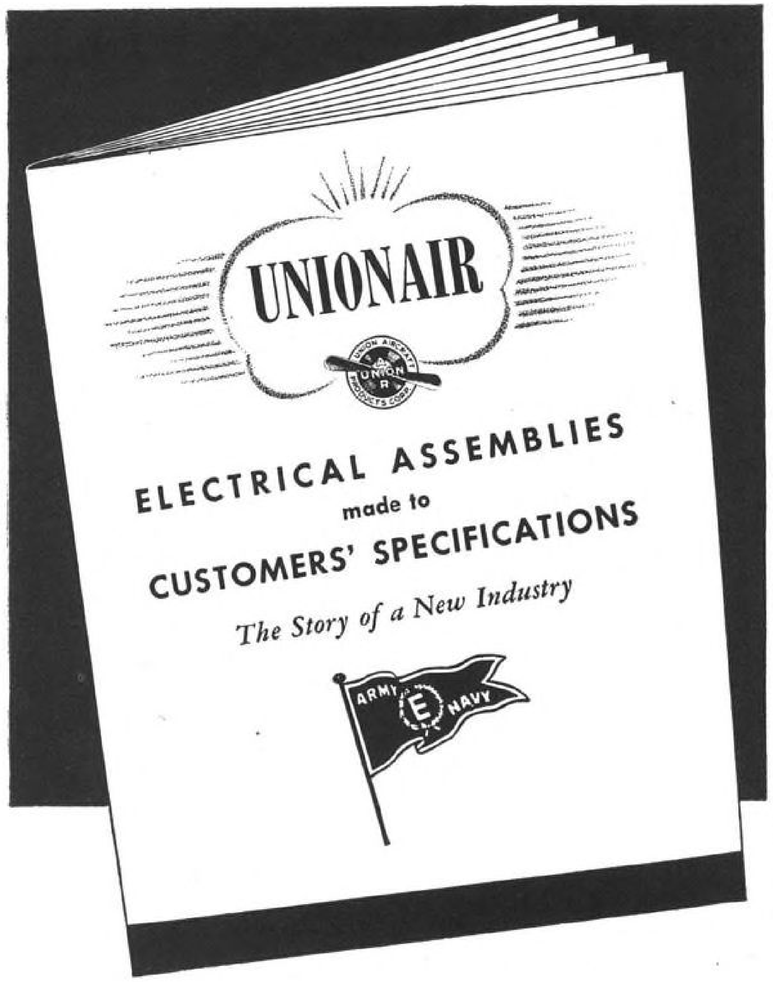
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lations indicated that it would be impractical to achieve fore, aft, and lateral control through cyclic pitch change of the entire blade. Instead, control is achieved by means of an aileron in the trailing edge of each rotor blade. Aileron area is approximately 8 percent of blade area.

The ailerons provide a small variable control force operating at a long moment arm. This force is available at any point around the circumference of the rotor disk with a measured time lag of only approximately .003 sec.

Each aileron is spring loaded, and the motion from the control cable to the aileron is transferred by a push rod mechanism which is positive in action and allows no slack in the system. A counterweight on the aileron actuating arm in the blade tip exerts sufficient centrifugal force to operate the aileron in the "up" direction, and it serves to keep the control cable taut at all times. In operation the ailerons automatically return to neutral when control tension is relaxed, and there is a definite and desirable "feel" in the controls.

This arrangement provides a positive cyclic aileron control, both laterally and longitudinally. Ailerons are arranged to operate through a maximum arc of plus to minus 10 deg. However, when it is considered that the tip speed is roughly 285 mph., the required aileron deflection for all normal maneuvers will be very small.

It is proposed to use the ailerons alone for normal turns and for longitudinal trim and attitude. The craft moves forward when the stick is moved in that direction. Hovering in a side wind or making 360-deg. turns about the craft itself as the axis can be achieved by simultaneously using the differential pitch adjustment handle and the ailerons.

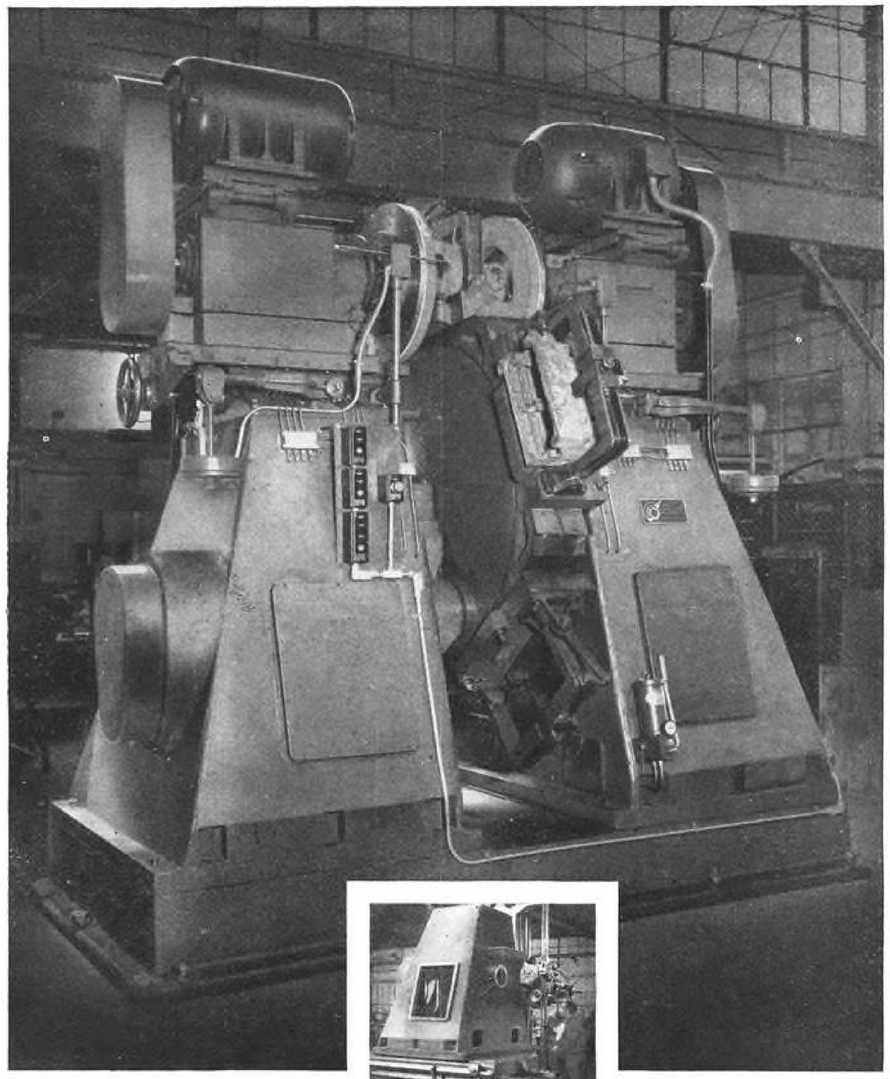
The control system is simpler than on some helicopters, partially because of elimination of the tail rotor. Except for wheel brakes, there are no foot controls. Pitch control and throttle are automatic for normal flight maneuvers, and all controls are designed to seek a normal operating position so the craft will fly "hands off".

Controls are designed for full control of linear motions—up and down, sidewise, and fore and aft; also for angular movements—roll, pitch, and yaw; and likewise to respond smoothly and instantly, but independently, so as not to interfere with each other.

Having no tail rotor, no change of control there is required each time the rotor speed or pitch is altered. The tail assembly resembles the standard vertical stabilizer assembly of a fixed-wing plane, except that there is no movable rudder.

The pitch control lever, located at the pilot's left on the cockpit wall, is so designed that pitch of all blades in both rotors is increased as the lever is raised and decreased when it is lowered. The handhold is of the bicycle handlebar grip type, and additional "feel" and leverage for sensitive and easy movement of the lever is obtained by mounting an "arm rest" type pad on top of the lever shank. This pad is so located that the pilot's forearm rests naturally on it when his





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hand is on the grip. Hinge end of the lever is roughly in line with the pilot's elbow.

Throttle and spark setting levers are directly ahead of the pitch control lever, where they are reached easily by merely sliding the left arm forward on the pad atop the pitch control lever. The throttle handle fixes a maximum position with actual control, up to the maximum selected, synchronized with the pitch control and increased or decreased as the pitch control is altered. Lateral movement of the pitch control arm provides a limited amount of differential pitch control between the two rotors.

The attitude control mechanism, supported by the rotor shafts, consists of an aluminum alloy base which is rigidly fastened inside each shaft and which supports the aileron control mast. The mast is a short, tapered steel shaft connected to the aluminum alloy base by a universal joint at the exact center of the shaft. Just above the universal the mast carries three short extensions which are 120-deg. apart and protrude through slots in the wall of the hollow rotor shafts. A small ball bearing roller is attached to each extension and rolls on a ring set in gimbals surrounding the shaft.

These gimbals are connected to the conventional control stick by means of cables. A ball joint at the top of the control mast actuates the three aileron control cables which are carried through the hollow rotor spars to the ailerons.

Power plant of the prototype is a modified seven cylinder radial Pobjoy rated at 85 hp. at 3,300 rpm. It was selected for the test craft because of its light weight, smooth torque characteristics, and small size.

Modification of the engine entailed removal of the standard reduction gear and housing and installation of a flywheel and single disk-type friction clutch which, in addition to the conventional springs, is centrifugally loaded to eliminate the possibility of slippage when full power is applied. The engine as modified is air-cooled by a suction fan built integral with the flywheel. Cylinders are jacketed, and the flywheel is inclosed in a sheet metal housing provided with an air outlet. The modification added only 2 lb. to the original dry engine weight.

The power plant, mounted in pusher position facing aft, is connected to the transmission gears by a short shaft which is splined on both ends and incorporates a multiple roller and cam-type free-wheeling unit. Sufficient clearance is provided in the involute type splines to take up any reasonable misalignment between the power plant and transmission.

Transmission gears are an hour-glass worm and two bronze worm wheels, running in SAE-140 gear oil. Worm wheels are mounted on vertical splined hollow shafts which extend through the top of the gear box to provide multiple tooth contact reversible worm drive to two power outlets and a gear reduction with a ratio of 6.8 to 1.

Two aluminum alloy "driving" disks which turn in opposite directions at 485 rpm. are splined to the worm wheel shaft extensions and run directly above the gear box housing. Two identical disks are splined to the rotor shafts which are mounted at the outboard ends of the rotor supports. The "driving" disks are connected to "driven" disks, located in parallel planes so that a line between center of the driving and driven disks would form a 23-deg. angle to the horizontal.

Each driving disk is connected to the corresponding driven disk by twelve carbon steel rods attached to the disks by bolts through sealed ball bearing rod ends. The rod ends have a 23-deg. offset and are evenly spaced around the periphery of each disk. The offset makes it possible to provide required rod clearance as the disks rotate.

Of the twelve rods on each drive, six are always in tension, with a maximum pull on any rod not exceeding 400 lb. at full throttle. This arrangement of driving and driven disks connected by rods makes it possible to turn both rotors with one set of gears and eliminates extended shafting with its weight penalties, torsional deflection, and tendency toward backlash. The whole mechanism is completely inclosed within the rotor supports.

Research for Security

(*Continued from page* 115)

This country has twice found that unpreparedness is an incitement to war, not a hindrance. The only preventive of war is superiority in weapons and counter weapons and in military, social and industrial organization. It is not necessary to maintain enormous armed forces for all time, but two things are necessary for preparedness; namely, scientific knowledge acquired through research, and the ability to produce in the required quantities all manner of weapons, equipment and supplies immediately war is threatened.

Volumes could be written on research and its organization. We believe that pure or fundamental research to add continually to our store of general knowledge is a function of Government. The specific application of this general knowledge to particular articles is best developed by private industry. Mr. J. Carlton Ward, testifying recently before a subcommittee of the United States Senate, said,

"There is a legitimate field for government activity and for private industry, in which each is by nature best adapted for its task.

1. Fundamental research not applicable to specific projects can best be fostered and accomplished in government laboratories such as those at the NACA.

2. Special application of research to particular designs or projects is the legitimate function of private industry with all of its competitive stimulus. This will avoid the mistake made by Germany, by providing a diversification of solutions not readily possible under a totalitarian or government dominated system.

3. Evaluation of the results of private industry developments can best be accomplished impartially by the Army and the Navy in their respective facilities, such as Wright Field, Elgin Field, the Naval Aircraft Factory and other Navy evalua-

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Let's Go Pioneering *Again!*



The challenge of postwar problems is stimulating to those who have pioneered before. Back in 1930 Solar challenged the method which permitted exhaust gases from airplane engines to shoot directly out through short tubes. The method was dangerous to pilots because of carbon monoxide. Night flying was hazardous because vision was obscured by a ring of fire from the exhaust. Yet the gases were thought to be too hot to handle in any other way until Solar's successful stainless steel manifold launched a new industry.

Solar has led this branch of the airplane industry for fourteen years. It will continue to make manifolds for replacement of existing equipment. But Solar is going pioneering again . . . preparing to lead in the design and manufacture of manifolds for airplanes not yet conceived . . . to develop other products for airplane designs of tomorrow.

Solar's three plants are operating at full capacity on war production, but the management is always ready to consult with aircraft and engine manufacturers about proposed equipment for postwar planes. Address "Management".

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tion centers." (Also see AVIATION for Sept., 1944, p. 108.)

The Office of Scientific Research and Development with its various committees has done a splendid job in this war and should be retained permanently. As the New York Times stated in a recent editorial, "Since there will be no time in another possible global conflict to solve urgent technical problems, it is the clear duty of Congress to preserve the existing organization of the Office of Scientific Research and Development and authorize it to continue its work on a scale commensurate with the needs of a modern fighting force."

What is a modern fighting force? The measure of modernity is dynamic, not static. Only that fighting force is modern which is continually abreast of the latest possible applications of scientific knowledge to weapons of war and the instruments and controls which direct them.

We must keep the lesson of France before us. Feeling secure behind her "impregnable" Maginot Line and with the largest air force in the world, she rolled airplanes into spacious hangars, covered the engines with grease and sat down with a sigh of complacent relief.

None but the Germans seemed to realize that with each passing day the mighty air force of France became more and more useless until at the end of the "phony war" in the spring of 1940, Germany with her dynamically modern air force proved to the world what she had known all the time; namely, that the "powerful" French air force was of no more than nuisance value. In a few short weeks the French Armeé de L'Air had ceased to exist.

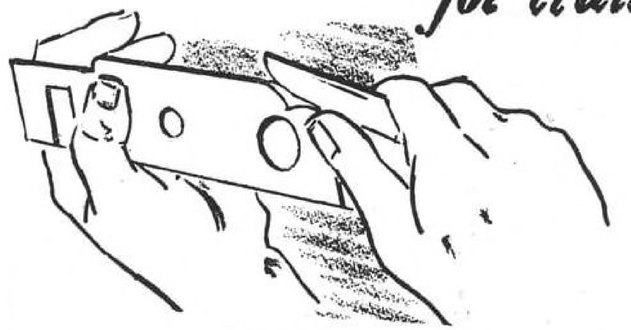
Strangely enough, the Germans made the same mistake, although their blunder was due to a fundamental misconception of British powers of resistance rather than to complacency. Expecting that Britain would fall like the ripe plums of France, Norway and the Low Countries, the German airforce was designed solely for the support of her ground armies. She had not envisioned nor did she believe in the necessity for strategic bombing against the British sources of supply, communication and government.

Such bombers as she did throw against Britain were small, poorly armed and primarily for the purpose of terrorizing the British rather than the destruction of their material means of existence. Further, Germany was so sure that she would win her lightning war within a few months that at first she made no provision to introduce into her production lines changes dictated by experience and science to keep her equipment superior to that of her enemies. Too late did she realize that frozen designs are fatal.

It has been said, "A wise man learns from the mistakes of others. A fool must learn by his own experience." We of the United States can profit both ways. We have our own mistakes as well as those of others before us. And they all point to the same conclusion. To survive, we must keep abreast or ahead of all potential enemies, and be ready to beat him to the draw of rapid production.

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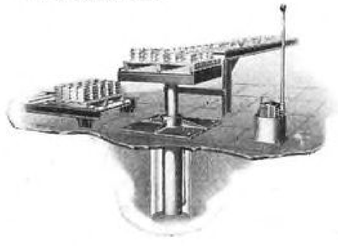


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quate service tests through operational and tactical use. Concurrently, the headaches of production which are inherent in any new article will be dissipated.

So far we have been writing only of material things. It is equally true that the quantity and quality of our personnel should be adequate to the job, for no matter how much the physical and mental powers of men are extended by weapons, instruments and controls, men adequately trained for their particular assignments will always be necessary.

We believe in the principles of compulsory military service in time of peace as well as in war. Compulsory military service is the only fair and democratic way to implement a program of national security, and is the only way by which adequate numbers of men of the types required can be procured. Further elaboration of this principle is outside the scope of this article and will be left to others.

We believe that war may be prevented through force vested in benevolent authority if that force is kept modern through research and industrial preparedness. If, however, war does come, victory will be won by that group of nations which has contributed the most to scientific research and its application to military and industrial preparedness.

To insure the security of our country, the industries—like aviation which has specialized in military equipment and has the experience, the organization and the personnel to maintain continuity of research, invention and development—all must have the incentive and the means to do so.

Navitrainer

Continued on page 195)

the drive motor and the other for the Windtroducer. A direct wire leads from the terminal to a slip ring on the axle shaft of the avigator's car so current may be brought into the car for the motors which operate the driftmeter, certain other instruments, fluorescent lamp, and a ventilating fan.

The Windtroducer has three speeds, obtained through two synchronous motors used singly or in combination to power the drive caster, providing through planetary gearing a speed of about 4 1/16 in. per hr. with one motor and 8 3/8 in. per hr. with the other motor. When used together, the motors produce a speed of about 14 1/16 in. per hr.

The direction of Windtroducer travel is controlled by setting the drive wheel mounting disk by means of three direction-setting rods, easily accessible to the instructor. The actual setting obtained is read by the instructor from a pointer on an azimuth scale. As with the triangular frame, a roller chain links the drive wheel of the Windtroducer with the shafts of its other two wheels. By means of a handle, the entire unit can be conveniently moved from place to place under the frame.

The simulated driftmeter is one of the principal devices used on the trainer. Both day and night flying can be represented in the driftmeter, which has variable lighting adjustment. Land and water are simulated to permit the student to work over both types of area. The instructor can set the drift angle by means of a scale with a setting knob—out of sight of the student—and check the student's calculations against the setting. A drift-angle scale, mounted in view of the student, is calibrated similarly to the one used by the instructor.

The airspeed indicator and the altimeter are simulated by means of small electric motors which control their readings. Motor speed is controlled by the instructor.

The airspeed indicator visible to the student and its paired instrument visible to the instructor each have a pointer mounted on a shaft connected to a reversible motor through a bevel gear arrangement and flexible coupling. A three-position toggle switch operated by the instructor permits a gradual increase or decrease in airspeed, while unchanging airspeed can be achieved by stopping the motor when the desired reading is reached.

In similar fashion, the altimeter installation consists of two paired instruments controlled by a reversible motor, which permits climb or dive rates of 500 ft. per min.

A simulated air temperature indicator, visible to the student, is manually controlled by the instructor through a dial knob. A shaft extending through the instrument box provides a reading on the student's indicator that coincides with the setting made by the instructor.

The compass is a magnetic type D-12, equipped with a lever and scale which permit setting of any desired variation so problems can be arranged which assume flights in localities other than those in which the trainer is located.

The charting pencil assembly consists of a soft pencil in a holder which is suspended, through the car axle, to the Mercator chart or map disk mounted on the Windtroducer.

The trainer, approximately 9 ft. wide by 7 ft. high, may be operated in a space as small as 14 by 17 ft. In operation, it is stationed as far as possible from large transformers or movable masses of metal which would affect the compass.

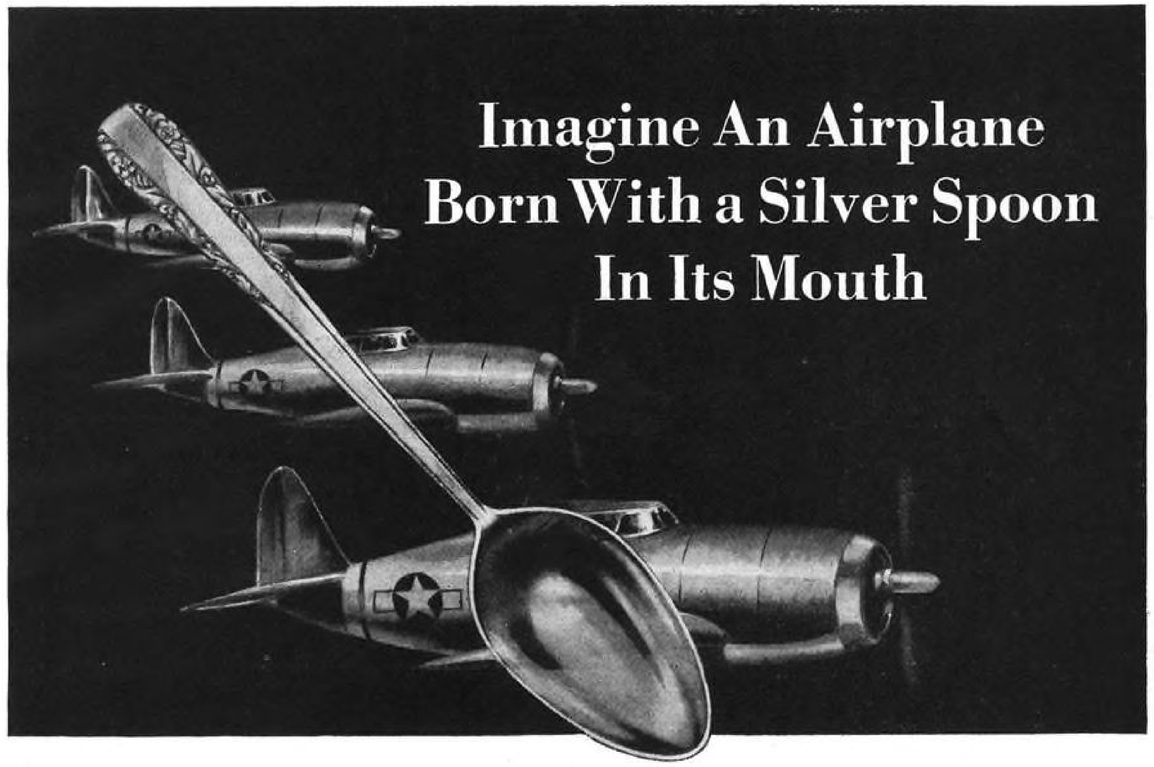
Man-Sized Terminations

(*Continued from page* 208)

be scrapped—for, come termination, there will be more than enough for the engines in service.

The government is going to try to follow the law and get its property out of plants within 60 days following termination but, privately, some AAF officials appear a bit doubtful that this can be done in all cases because of difficulties in finding storage space. In the initial period, at least, industry will have to store the goods, and it can help with this knotty stickler ahead of time by looking up and arranging storage space.

If possible inventories should be segregated in separate warehouses. And it may become necessary on termination to enter



LESS THAN TWO YEARS AGO, fighter planes powered with 2000 horsepower engines first winged their way to fame—and victorious combat. Literally, each was born "with a silver spoon in its mouth," which is to say its tough, durable engine was equipped with Mallory silver-bonded bearings.

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Although Mallory bearings are now devoted to war production, it is not too soon to consider them in connection with your future plans. Having helped to revolutionize engine performance in the aircraft industry, they are readily adaptable to the automotive, marine, railway, machine tool, rolling mill and turbine fields.

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into a storage agreement with the government. In case a contractor finds it necessary to clear the plant, he must give the government 20 days notice, plus a schedule of materials removed.

Failure to file claims, according to Col. E. S. Pillsbury, chief of the termination section of the Materiel Command, is the greatest cause of delay in settlements. It is not a question of auditing to a final penny, he explains, but it must be an audit that accountants can understand. Col. Pillsbury has a list of five recommendations to speed up termination. These are as follows:

First, set up a termination organization which includes some of the key personnel. The AAF believes that "the best men are none too good." The group should be headed by a director of terminations and include competent accountants of the executive type.

Second, make sure termination personnel know thoroughly all the rules and regulations.

Third, divide the problem into two parts—cases currently pending and plans for the coming day of mass terminations. Fourth, in the case of large companies, decentralize authority to the plants and divisions as the government is doing. It is unfair to the government if companies do not have people of like authority at the plants for government officials to deal with. Fifth, try to get along under the rules. In short, avoid searches for panacceas or rummaging to find "some different way to solve the problems."

The government has decentralized operations so that its people working on the job will be closer to the contractors and the whole job can be completed in the procurement district. More than 4,225 AAF officers have already been assigned to termination. Upon cutbacks or terminations, government officers plan an initial conference with the contractor. So far, these conferences have not been as satisfactory as they should be, AAF officials say, because the contractors' representatives have not had sufficient authority to make decisions and get things started. After claims are filed, the office review should not take more than three to five days and field audits not more than three to five weeks.

In these termination problems, the industry itself has offered some helpful aids to the harassed aircraft contractor. For example, C. H. Hummel, controller of Bendix Aviation Corp., warns that emphasis must be put on pre-planning and that the contractor should not lose valuable man-hours on insignificant items. Nor is the job done, he feels, merely on submission of claims. There should be a follow-up on government clearance and a priority schedule set up so that the contractor and the government officers are working on the same claims at the same time. Termination units, he advises, should be over-staffed rather than under-staffed.

In that connection, a survey made recently of concerns with terminated contracts revealed that termination staffs are undermanned, claims are frequently sent in with "pyramided costs," and contractors are failing to take definite action in selling to outside sources or returning to original suppliers all the raw stock or supplies shown in their inventories. It was found that, due to the pressure for quick production, many companies are underestimating the importance of the termination job and have created departments of only one or two men to handle the job. Having a staff insufficient to cope with the immensity of the job means delayed, and often improper, filing of claims.

Most contractors, when preparing claims, feel they should be allowed to add a percentage-for-handling to the cost of purchased materials. They overlook the fact that their accounting departments usually have included such costs in their overhead rate. When costs are pyramided in this way it is often necessary to re-process an entire claim.

Certain it is that there has been considerable improvement in government procedures for handling terminations since the cancellation of the Brewster contracts last spring. The government has definite power to negotiate absolute and final settlements. And, fortunately, the Comptroller General's office is authorized to step in only in case of fraud. But the AAF cannot negotiate unless the contractor puts in a claim.

Flat-Top Mastery

(*Continued from page* 122)

trol structure above the flight deck a masterpiece of compactness.

The piping and wiring problem is complicated by the need for distribution of high octane gasoline and the constant fire hazard which this involves. Not only is there danger of fire from enemy action, but operational accidents on the part of the carrier's own planes or crew are a constant source of danger. The wiring is a special problem since carriers have large high speed elevators and complicated flight deck lighting and recognition arrangements in addition to all the usual wiring required by naval vessels.

In solving some of the problems involved in building ships for a many-ocean Navy, the width of the Panama Canal must be considered. In placing the anti-aircraft guns, it is desirable to have them as far outboard and as high as possible to give them the widest possible firing arc and still keep them below the level of the flight deck and within a breadth over-all which will permit passage through the Canal's locks if the carrier must be moved from one ocean to the other.

The underwater form of the carrier is not unlike that of any fast combatant ship. The great weight of the flight deck so high above the keel and the unbalanced superstructure or island on the starboard side, however, create new problems of ballasting and stability. This same increase of topside weight requires every ingenuity to be brought into play in working out substitutions of lighter metals, plastics, etc., for the heavy shipbuilding materials usually employed in

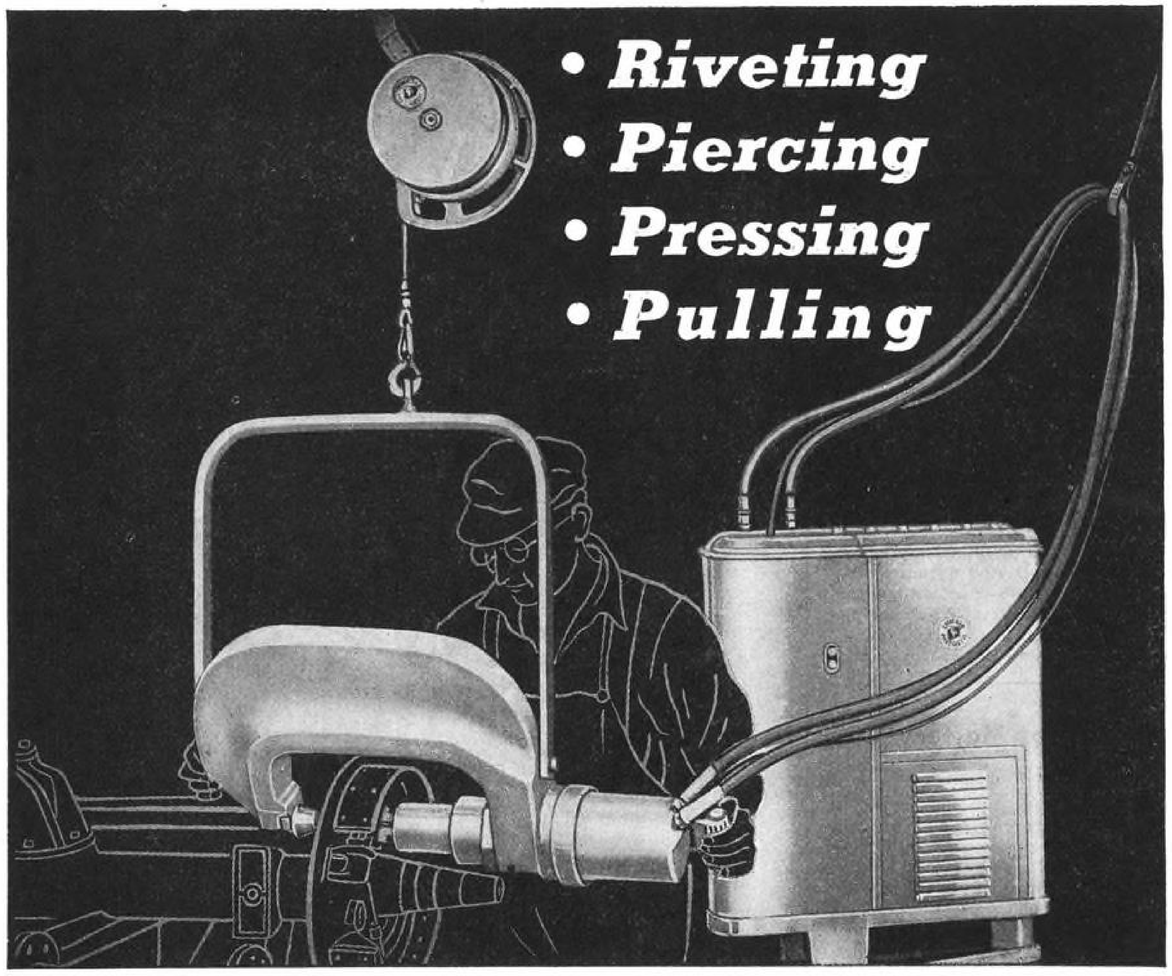


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the ship's structure and various fittings.

Improvements Increase Efficiency

Many improvements have been made and more are being made to increase the effectiveness of the carriers as fighting machines. Constant studies are being carried on, and action reports are being utilized, to increase the effectiveness of the ships and to reduce the hazards involved in bringing their maximum power to bear on the enemy.

There have been great improvements in plane handling equipment, including portable tractor-driven cranes, jeeps, and tractors for handling the planes in the hangar and on the flight deck. The installation of deck-edge elevators has accelerated the handling of planes and provides additional facilities for lifting planes and ammunition. Separate high speed elevators and hoists are provided for bombs and ammunition.

The new carriers operate with high temperature and high pressure steam in the main machinery similar to that developed in the later destroyers and subsequently used in nearly all the Navy's modern combatant ships.

Splinter protection, compartmentation, and light armor give the maximum protection that weight limits permit.

Air-conditioning is provided in ready rooms and certain other control spaces, also in the ultra-modern sick bay and dental office.

The shops for aircraft upkeep, maintenance, and repairs are extraordinarily complete and have all the modern tools to provide complete repairs for its aircraft and electronic equipment.

The number of plans required to construct a carrier is a good index of the complexity of its design. An *Essex*-class carrier requires several dozens of preliminary design plans, over a hundred contract plans and many thousands of shipyard working plans, totaling over 10,000 separate plans, as compared with only about 8,000 plans for an *Iowa*-class battleship, or about half as many for a light cruiser. This total does not take into account the thousands of plans used by the manufacturers who supply the components and innumerable items of equipment.

Construction

The vessels built as aircraft carriers from the keel up present much the same problem in construction, up to the main deck, as do any other combatant vessels. They are built on similar ways and require the same sort of cranes, fabrication equipment, and machine tools. When it comes to erecting the flight deck and outfitting, there are some additional special facilities needed, but these do not interfere with the subsequent use of the basic facilities for work on other types of vessels.

At Newport News Shipbuilding & Drydock Co., the *Essex* (CV-9)—first of the new approximately-27,000-ton class of carriers—was laid on the way previously vacated by the *USS. Hornet* (CV-8). Although the new carrier was more than 7,000 tons larger and 46 ft. longer than the *Hornet*, the ways were amply large to

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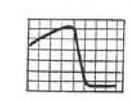
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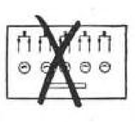
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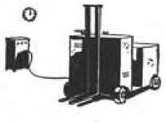
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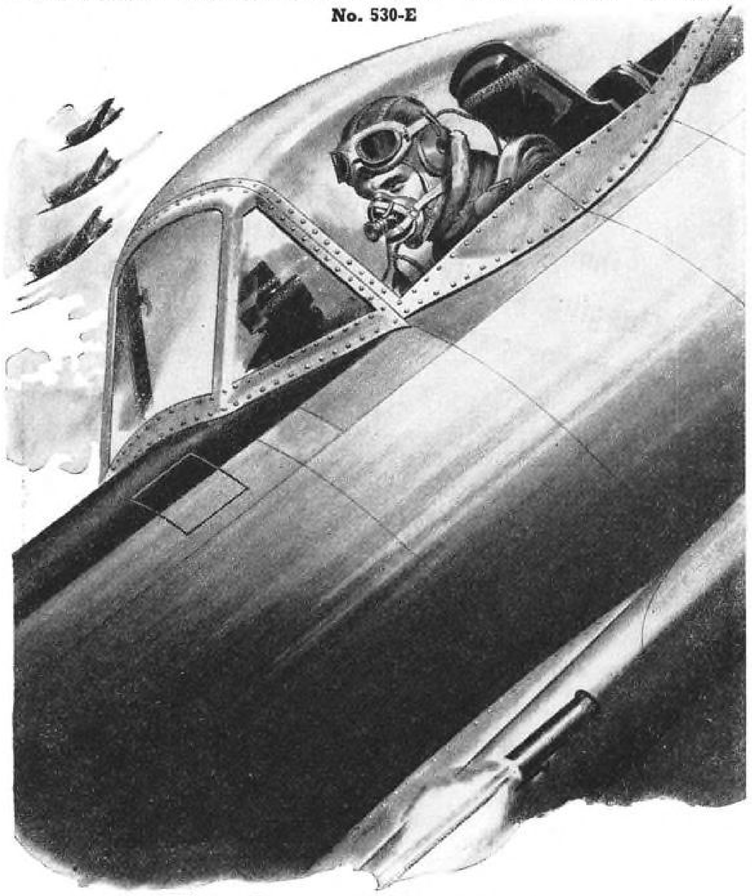
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accommodate its construction. At the same yard, the new *Yorktown* went down on a way vacated by the *Indiana*, a 35,000-ton battleship of the *South Dakota* class.

In 1940 the Navy awarded facility contracts for the construction of two building dry docks to Newport News to be used for the construction or repair of the largest size naval vessels. Immediately on the availability of these dry docks, two *Essex*-class carriers were laid down in them.

Bethlehem-Fore River had only one large shipway in service—the one on which the *Lexington* was built—when the company got its original award for carrier construction. The first carrier was laid down on the *Lexington* shipways and others were briefly delayed until two new ways, then under construction, were sufficiently far advanced to be used. The remainder of the group were built on the original way as soon as the first carrier was launched.

Had there been no manpower shortage, no shortage of materials, components, propelling machinery, and other essentials, the availability of additional building ways might have stepped up the program. Actually the completions have been just about geared to the availability of steel, turbines, gears, and the many other items where production has had to be drastically expanded.

In general, a good balance has been maintained, and in only very few instances has there been a bottleneck which has seriously slowed down the completion date. Some problems were encountered in the procurement of critical raw materials, necessitating changes in Navy specifications.

Heavier metals were substituted for aluminum wherever possible in order to release the latter material for the airplane program, and the amount of copper and nickel alloy was reduced to the absolute minimum to meet the demands for their use in the manufacture of other munitions. Actually the carrier program encountered fewer cases of delays resulting from material shortages than other programs, owing to the high priority which the carrier program enjoyed. This resulted in more favorable delivery of turbines, valves, ball bearings, pumps, electrical equipment controls, radio, etc. Delays were encountered, however, in the production of certain engine parts.

Impossible Was Achieved

In spite of all the problems, shortages, and construction difficulties encountered, the aircraft carrier program has been accomplished in a period of time which many experts had viewed as an impossibility. Within a period of 2½ yr. the Bureau has added to the four remaining prewar carriers a total of nearly 100 carriers of all types. As stated in reports issued by the Secretary of the Navy and the Commander-in-Chief, US. Fleet, these are:

Description	*Designation*	*No. completed To July 1, 1944*
Essex-class	CV9	10
Converted cruisers ...	CVL	9
Converted C-3's	CVE	51*
Converted tankers ...	CVE	4
Kaiser-built	CVE	50

* Includes 38 transferred to the United Kingdom.

This growth has been only one part of the overall growth of the Navy during this period. From a total of 4,084 vessels of all types, totaling 2,693,943 tons when war was declared, the shipbuilders of the United States, working closely with the Bureau of Ships, have designed, constructed and put into service new vessels in a never ending succession, until today we have "on hand" 5,948 naval vessels totaling 8,530,701 tons, a great many more units and more than three times the tonnage on hand on Dec. 7, 1941.

Varied Carrier Types

The aircraft carriers of the United States fleet are classified into six basic groups, as follows:

CVB (Aircraft Carriers, Large). The new 45,000-ton supercarrier will have a long flight deck which will enable it to serve as a floating base for the coming bigger and heavier planes. It has also been designed to have enough speed to insure its being able to fly its planes off and on under virtually any wind conditions.

CV (Aircraft Carriers). The *Essex*-class carriers are approximately 800 ft. long, displace over 27,000 tons, carry more than 80 aircraft, and make over 30 knots. They are armed with 5-in. anti-aircraft guns and bristle with 40-mm. quads of Chicago Pianos. The propelling machinery in one of these vessels is powerful enough to provide all the power required by a small city. In addition to the ten *Essex*-class carriers reported completed and at sea, there are more units of this type still in the process of construction.

CVL (Aircraft Carriers, Light). *Independence*-class carriers. These are converted from the 10,000-ton *Cleveland*-class cruisers. They have a flight deck over 600 ft. long, carry a good complement of planes and have high enough speed to enable them to fly their planes off when the smaller CVE's are forced to use the catapult. The rapid conversion into carriers of several of these ships, which were already under construction as cruisers, was one of the great production achievements in the early part of the war.

CVE (Aircraft Carriers, Escort). The escort carriers are of three classes:

1. CVE's built from C-3 merchant hulls. These are about 500 ft. long, carry approximately 20 planes and make the speed needed for planes to fly off and on in normal wind conditions. More than 50 of these have been completed, including 38 transferred to the British.

2. CVE's converted from *Cimarron*-class oilers. These carriers are slightly longer and faster than the C-3 conversions and can carry extra fuel for their own use and that of the accompanying destroyers and destroyer escorts. Four have been completed and more are in production at the Todd-Pacific Tacoma Yard.

3. CVE's built by the Kaiser Vancouver Yard. These were ordered as air-

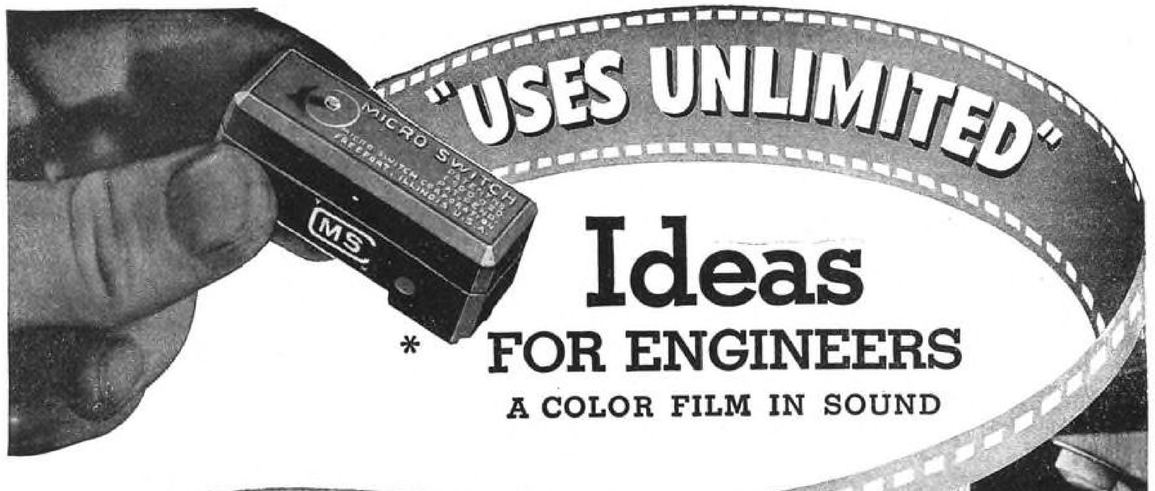


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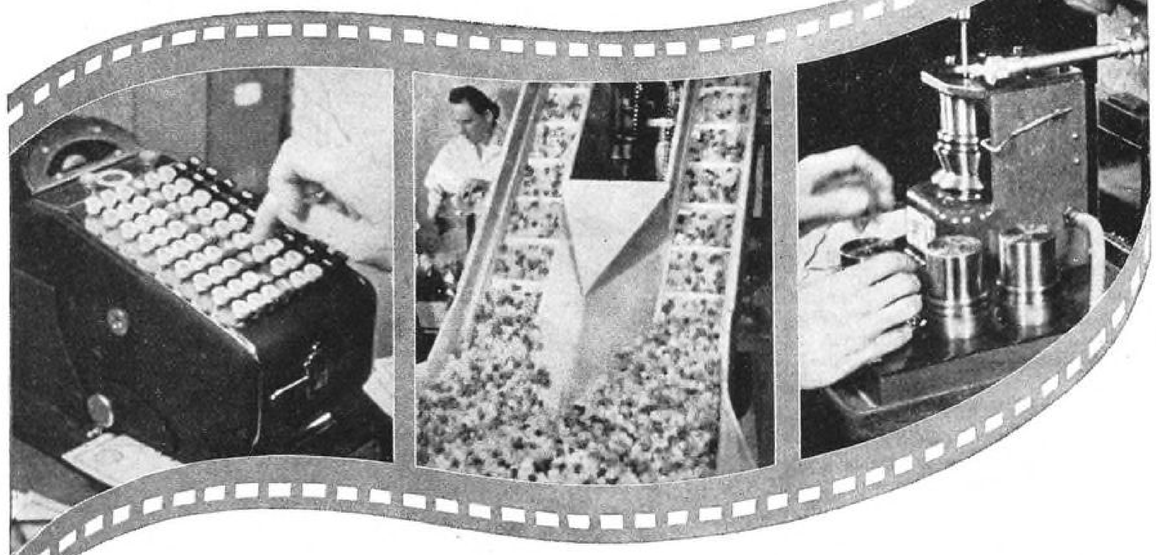
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plane transports and are about the same length as C-3's, but have somewhat finer lines, are 1,500 tons lighter and are rated at a somewhat higher speed.

Review of Patents

(*Continued from page* 215)

auxiliary latch releaseable for bail-out or to free jammed door in accidental landing.—2,351,859, filed Oct. 25, 1941, patented June 20, 1944, R. A. Kaiser, assignor to Republic Aviation Corp.

Decoy Airplane. Device is full-sized simulated plane with articulated fuselage and/or wing structure collapsible for transportation and extensible for decoy use. Construction embodies lazy-tongs type interconnections.—2,351,891, filed Nov. 16, 1942, patented June 20, 1944, J. Weisbaum.

Rotor Mechanism invention for rotor-craft employs differential pitch change for shifting lift line to maneuver craft, also means to tiltably mount rotor hub so physical axis of hub may be adjustably tilted into approximate coincidence with virtual axis of rotor and with rotor lift line in different flight conditions. Rotor hub tilts in fore and aft plane.—2,352,342, filed Nov. 2, 1940, patented June 27, 1944, H. F. Pitcairn, assignor to Autogiro Co. of America.

Parachute Invention aims to initially limit normal full-free lengths of shroud lines so that chute, when opening, does not fully spread, thus avoiding severity of shock ordinarily encountered. Shroud-shortening means yields automatically under air checking of chute to gradually increase free lengths of lines.—2,352,871, filed Mar. 24, 1942, patented July 4, 1944, G. N. Vernon.

Aircraft Airspeed Control Device consists of control member comprising flexible diaphragm subjected on one side to dynamic pressure from pitot head and opposed on other side by pump air pressure. Means operated by control member automatically adjusts control surface.—2,352,878, filed June 13, 1939, patented July 4, 1944, F. W. Meredith, assignor to S. Smith & Sons Ltd., London.



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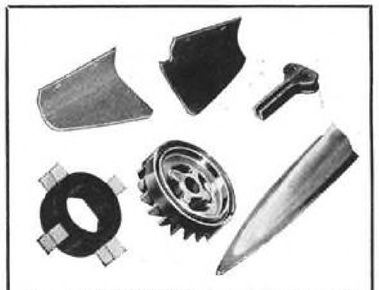
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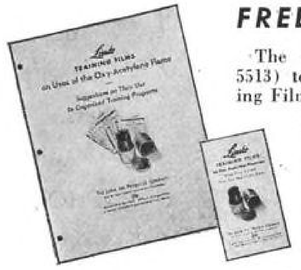
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Testing for and Fixing Leaks in Oxy-Acetylene Cutting Equipment (for oxygen and acetylene supplied from pipe lines)

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
General Office: 30 East 42nd Street, New York 17, N. Y.
Offices in Other Principal Cities
In Canada: Dominion Oxygen Company, Ltd., Toronto

. . . USEFUL AIDS FOR TEACHING OXY-ACETYLENE WELDING AND CUTTING

● You can teach the basic principles of oxy-acetylene welding and cutting easier, better, faster with the help of these new visual training aids.

Excellent for beginners—equally good for reminding "old timers" of correct practices.



FREE BOOKLETS

The small booklet (Form 5513) tells what Linde Training Films are and how to obtain them. The large booklet (Form 5366) tells how to use them and how to plan and conduct organized training programs. Send for copies—use the coupon.

The Linde Air Products Company A-10
30 East 42nd Street
New York 17, N. Y.

Please send me the following booklet(s):

☐ Linde Training Films on Oxy-Acetylene Processes (Form 5513)

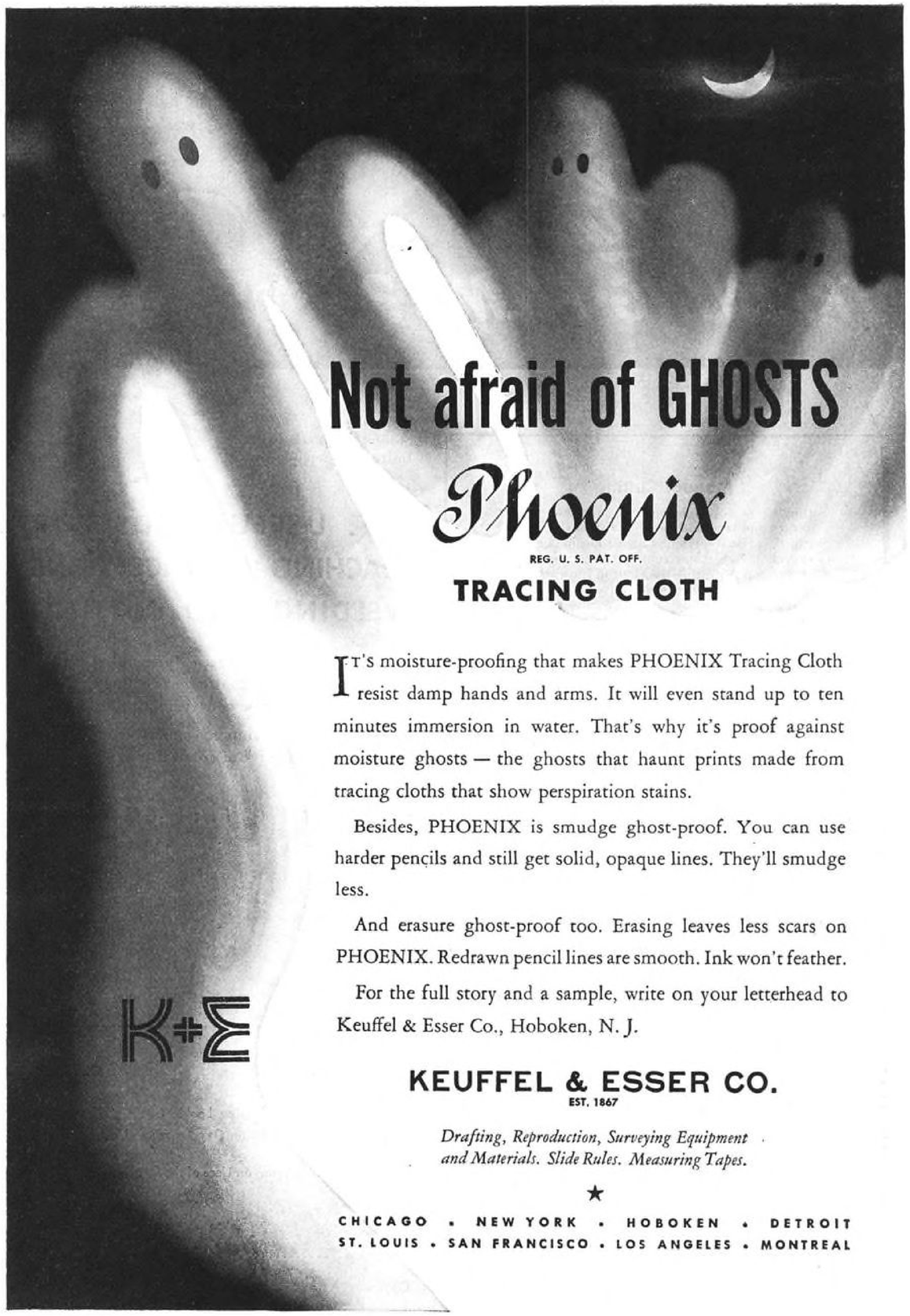
☐ Linde Training Films on Uses of the Oxy-Acetylene Flame (Form 5366)

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City ..... State .....

The word "Linde" is a trade-mark of The Linde Air Products Company



Not afraid of GHOSTS

Phoenix

REG. U. S. PAT. OFF.

TRACING CLOTH

IT'S moisture-proofing that makes PHOENIX Tracing Cloth resist damp hands and arms. It will even stand up to ten minutes immersion in water. That's why it's proof against moisture ghosts — the ghosts that haunt prints made from tracing cloths that show perspiration stains.

Besides, PHOENIX is smudge ghost-proof. You can use harder pencils and still get solid, opaque lines. They'll smudge less.

And erasure ghost-proof too. Erasing leaves less scars on PHOENIX. Redrawn pencil lines are smooth. Ink won't feather.

For the full story and a sample, write on your letterhead to Keuffel & Esser Co., Hoboken, N. J.

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Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules. Measuring Tapes.

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Precision finish of every part in Danly standard die sets makes possible Danly National Assembly. The resultant perfect fit saves you time and money through faster setups and longer, trouble-free operation.

Absolute standardization is assured.

Every Danly Die Set is individually assembled to your specification, through the Danly Plan of National Assembly to Precision Standards.

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DIE MAKERS SUPPLIES • *Welded Steel Fabrication*



"Hello dear . . . I'm flying blind over Toledo, I'll be a little late for dinner."

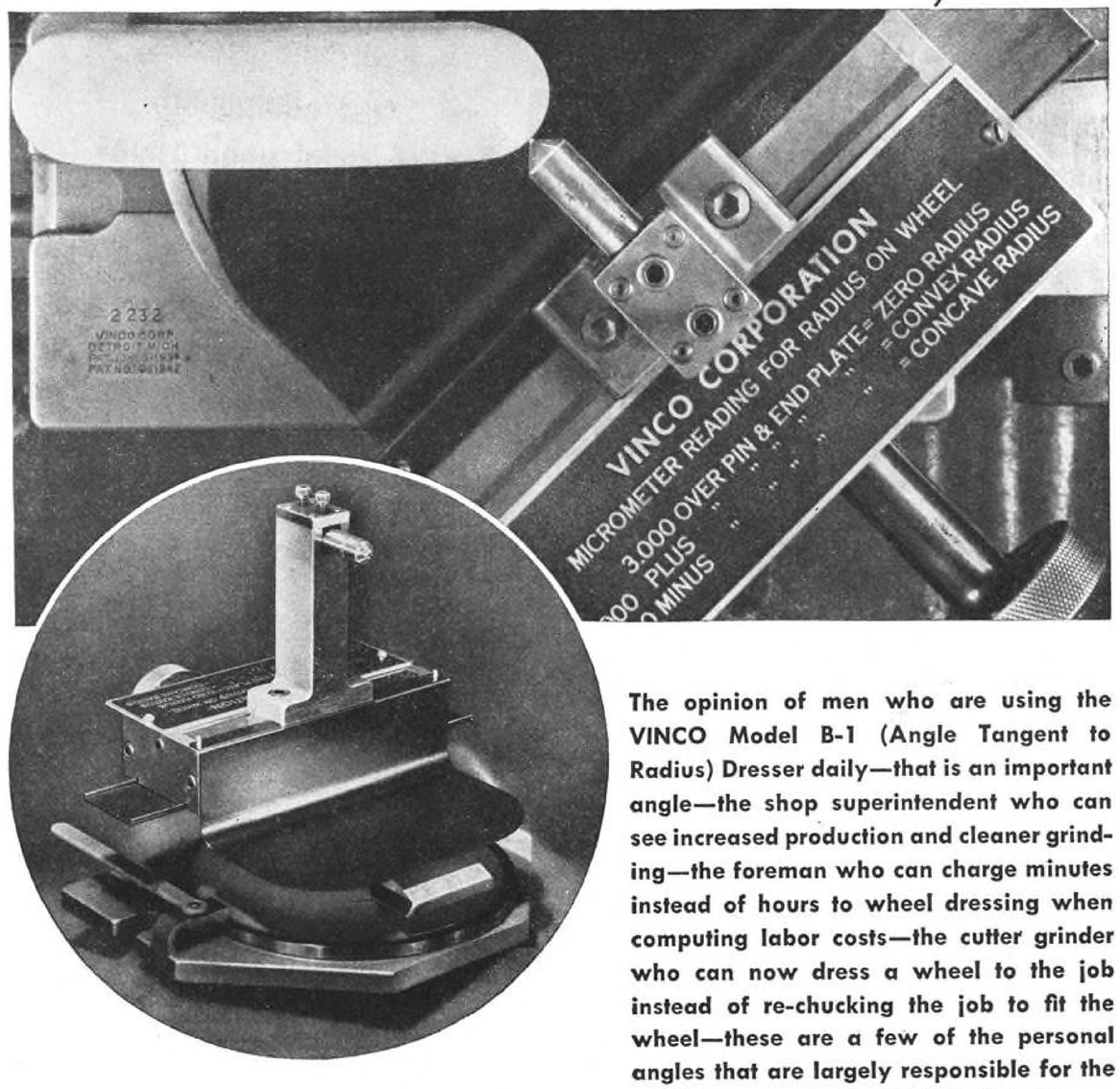
. . . . TO KEEP YOU OUT OF TROUBLE

Two way radio communications for planes and helicopters are certain to be an actual necessity in the coming air age. Some day soon you can get radio equipment built by Hallicrafters to help keep you out of trouble in the air. Hallicrafters radio telephones for use in your own plane will become a reality just as soon as the demands of war production are relaxed. To keep pace with fast breaking developments in aviation, Hallicrafters will be ready with the highest quality, most dependable equipment you can get.

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THE HALLICRAFTERS COMPANY, MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U.S.A.

THERE ARE OTHER ANGLES, TOO



Sub bases will be furnished (at slight additional cost) for most types of external and internal grinders. When ordering, specify the machine or machines on which the dresser will be used. This will enable us to advise you correctly on the type of base best suited to your specific needs.

The opinion of men who are using the VINCO Model B-1 (Angle Tangent to Radius) Dresser daily—that is an important angle—the shop superintendent who can see increased production and cleaner grinding—the foreman who can charge minutes instead of hours to wheel dressing when computing labor costs—the cutter grinder who can now dress a wheel to the job instead of re-chucking the job to fit the wheel—these are a few of the personal angles that are largely responsible for the rapid increase in the VINCO B-1 Dresser acceptance. Write us direct or consult our District Sales Offices for any further information.

VINCO CORPORATION, 8865 SCHAEFER HIGHWAY, DETROIT 27, MICH.

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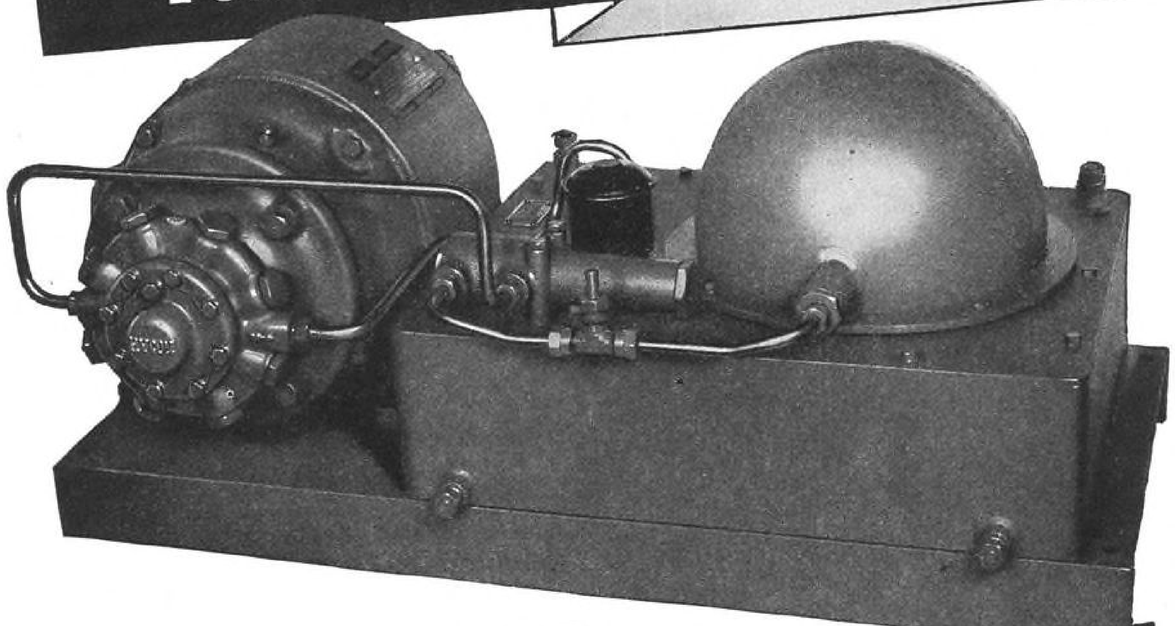
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Semi-Automatic Hydraulic Spline and Gear Grinder • Optical Master Inspection Dividing Head • Involute Checker • Angle Tangent to Radius Dresser • Index Plates • Precision Vises • Sine Bars • Straight-side Spline, Serration Spline, Involute Spline and Helical Spline Plug and Ring Gages • Thread Plugs, Rings and Setting Plug Gages • Spur and Helical Master Gears • Munition Gages • Propeller Hub Gages • Built-up and Special Gages • Gear Rolling Fixtures • Spline and Index Fixtures • Hydraulic Power, Control, Utilization and Distribution Units • Engineering, Design and Development.

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3000 p.s.i. Hydraulic Power Unit

A small compact unit for machine tools, hydraulic presses, test equipment, industrial applications



3 HP Motor
8 cylinder Pump
Unloading Valve
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Quickly and easily installed for smooth, reliable, continuous operation up to 3000 p.s.i.

Specifications and Engineering Data on Request



THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

420 Lexington Avenue, New York 17, N. Y.

75S

88,000 pounds per sq. in. tensile strength in extruded shapes, 75,000 pounds in alclad sheet—stronger than any aluminum alloy in use today—nearly two times the yield strength of ordinary structural steel and one and one-third times the tensile strength. That's Alcoa's new high strength alloy, 75S.

No untried youngster, this alloy. Alcoa's research and development divisions have spent years in testing the performance of experimental quantities. In the fall of 1943, the first commercial run was put through Alcoa mills, and production has continued at an ever-increasing pace. Already, at least eight major aircraft companies are building new experimental planes in which 75S is the principal structural material.

75S is now a standard alloy for alclad sheet and extruded shapes. Plain sheet, plate, rolled rod and bar made from 75S continue on an experimental basis, but may be obtained for certain projects.

With WPB approval, you can employ 75S in your products. Our representatives will gladly help you work it into your designs. ALUMINUM COMPANY OF AMERICA, 2182 Gulf Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

Thor BANTAM ROTARY AIR GRINDERS



A HANDFUL OF *POWER* FOR HUNDREDS OF JOBS

For All Small-Wheel Work

The new Thor "Bantam" Rotary Air Grinders are the ideal small-wheel grinders for shop, laboratory, or work bench. They handle all accessories; work in practically every material. Have the right speeds and power for grinding with abrasive wheels and points; for cutting with rotary files; routing with steel cutters; polishing with felt and soft rubber polishers; cleaning with wire brushes; and for sanding.

SMALL • LIGHT • POWERFUL

The small size and light weight of Thor "Bantam" Rotary Air Grinders provide perfect one-hand operation. They handle easily as a pencil for accuracy on precision work; yet their power and sturdy construction assure continuous and efficient performance on hard jobs.

Thor Rotary Air Grinders of the "Bantam" type are available in speeds from 7,000 to 21,000 R.P.M.; in weights from 20 ounces to 5 1/16 pounds; in lengths from 6 3/8 inches to 15 inches.



• SMALL-WHEEL GRINDING
Mounted abrasive points and wheels up to 2" diameter can be used in Thor "Bantam" type Air Grinders. Wheels are available in a wide range of sizes and grains for grinding all materials. Designed to fit the hand, the Thor "Bantams" provide perfect control, "finger-point" accuracy and dependable power for hundreds of jobs.

• CUTTING AND ENGRAVING
Because the Thor "Bantams" handle as easily as a pencil they are ideal for use with rotary files and steel cutters. Precision cutting, carving, beveling, routing and roughing in wood, plastics and metals is done rapidly and efficiently in minutes where formerly hours were required.

• POLISHING AND BUFFING
Superlative finishes on practically all materials are obtained by Thor "Bantams" when used with soft felt and soft rubber wheels. Hours of hard labor are saved and finer results are obtained with these fast, convenient tools.

• CLEANING AND SANDING
Cleaning, removing rust, and many other wire brush jobs are done faster and better with versatile Thor "Bantams."

Sanding discs and drum sanders used with Thor "Bantams" for use on wood or metal save much handwork.

Steel saws and rubber cutting discs for high speed operation with Thor "Bantams" cut light materials with lightning speed.

THOR AIR GRINDERS OFFER THESE ADVANTAGES

"Finger-Point" Accuracy—Thor "Bantam" Grinders fit perfectly in one hand . . . handle as easily as a pencil . . . provide "finger-point" accuracy.

Dependable Power—Thor one-piece rotor is perfectly balanced to revolve without vibration. Multiple blade construction insures quick action and instant starting under load.

Longer Life—Alloy-steel housings are die-cast for strength and long-lasting, continuous service.

These, and such other features as automatic lubrication, positive-lock of throttle for assured continuous operation and on some models, free rotation into any position with a swivel hose connection, are available in the *complete* line of Thor "Bantam" Type Air Grinders.



000H GRINDER — 00H GRINDER — 10 GRINDER

	000H	000	00D	00H	10-18	10-15	10-10
WHEEL (Vitrified) CAP. (Bonded)	1 1/4" x 1/2"	1 1/2" x 1/2"	1 1/2" x 1/2" 1 1/2" x 1/2"	1 1/2" x 1/2" 2" x 1/2"	1 1/2" x 1/2" 2" x 1/2"	1 1/2" x 1/2" 2 1/2" x 1/2"	2" x 1/2" 3" x 1/2"
SPEED (r.p.m.)	20,000	14,000	21,000	17,000	18,000	15,000	10,500
WEIGHT	22 ozs.	20 ozs.	3-3/16 lbs.	5-1/16 lbs.	4 1/8 lbs.	4 1/8 lbs.	4 1/8 lbs.
LENGTH	6 1/8"	6 1/8"	9 1/2"	13 3/8"	15"	15"	15"

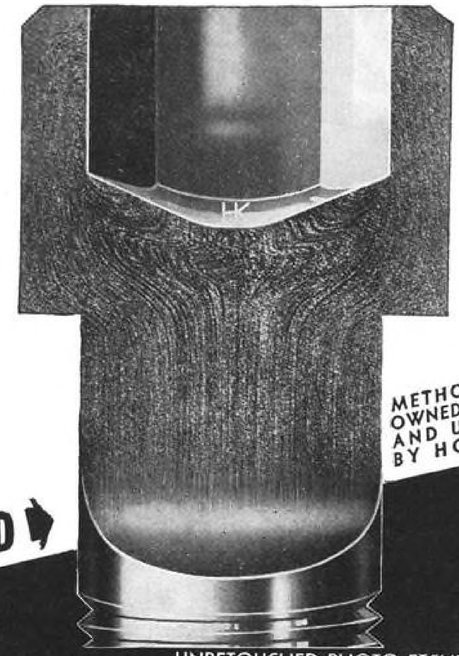
Learn today how Thor "Bantam" Air Grinders can save you time and money on hundreds of jobs. Write for Thor Catalog 52-B.

Thor Portable Pneumatic and Electric Tools
INDEPENDENT PNEUMATIC TOOL COMPANY
600 W. JACKSON BOULEVARD, CHICAGO 6, ILL.
Branches in Principal Cities

HOLO-KROME INTERNAL HEX WRENCHING BOLTS

NASC SPECIFICATIONS





METHOD PATENTED, OWNED, CONTROLLED AND USED SOLELY BY HOLO-KROME

COMPLETELY COLD FORGED

UNRETOUCHED PHOTO ETCHED CUTAWAY HOLO-KROME SOCKET HEAD CAP SCREW

Continuous FIBRES

The results of the Holo-Krome patented method of manufacturing . . . Fibres originate in the shank of the bolt and continue uninterrupted, unbroken and unsevered around the bottom of the bolt and terminate in the socket walls. The finished bolt has all the advantages of the original material plus the additional strength imparted by the Holo-Krome Completely Cold Forging process. . . . It's the Holo-Krome patented method which produces this result! Specify "HOLO-KROME".

Save
WEIGHT—SPACE—TIME



QUICK & POSITIVE TIGHTENING DUE TO INTERNAL WRENCHING

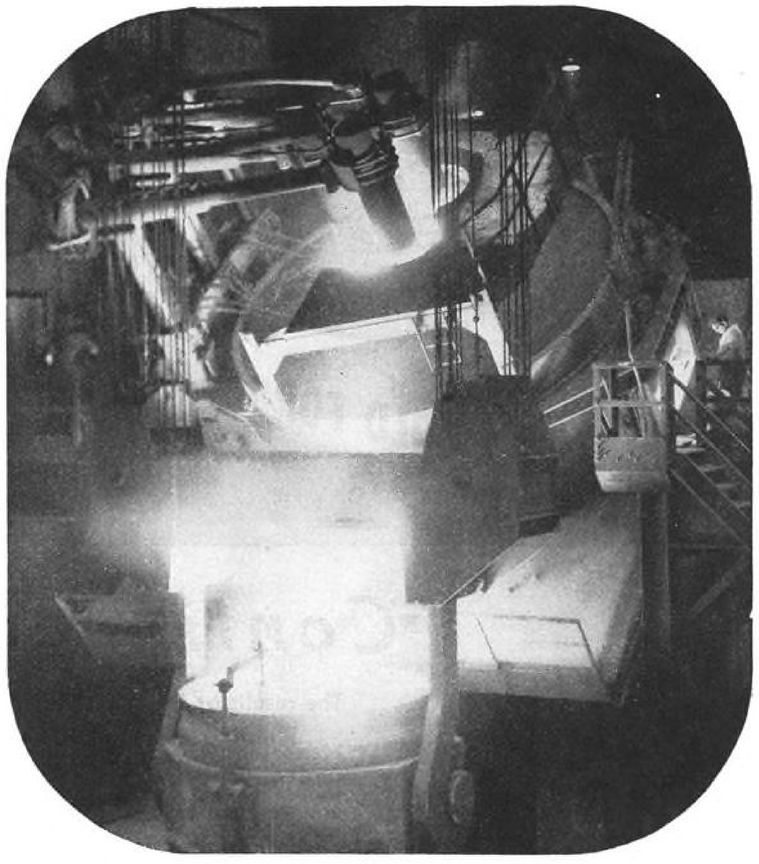
GUARANTEED UNFAILING PERFORMANCE

AIRCRAFT DIVISION

THE HOLO-KROME SCREW CORPORATION
MAIN OFFICE & PLANT
HARTFORD 10, CONNECTICUT U.S.A.

THIS ADVERTISEMENT COULD BE WRITTEN ONLY ABOUT

U·S·S Stainless Steel



No member of the U·S·S family of steels has been more highly favored than U·S·S STAINLESS. From its very beginning, highly specialized staffs have constantly perfected its characteristics, improved its performance and widened the scope of its applications.

Definitely a specialty product, U·S·S Stainless is made in plants particularly adapted for its manufacture, and is handled throughout by specially trained personnel. The equipment and facilities devoted to its exclusive manufacture are the last word in completeness and modern design.

However, this is not the complete story. For U·S·S Stainless is not confined to nor limited by the facilities or research staff of a single plant, division or company. It has at its beck and call the enormous plant facilities, the wide selections of rolls and the huge research organization of the entire United States Steel Corporation.

Because of this, U·S·S Steel produces the widest range of stainless shapes and sizes in the world—bars, sheets, plates, strip, pipe, tubing, wire and special sections—in all standard grades and specifications.

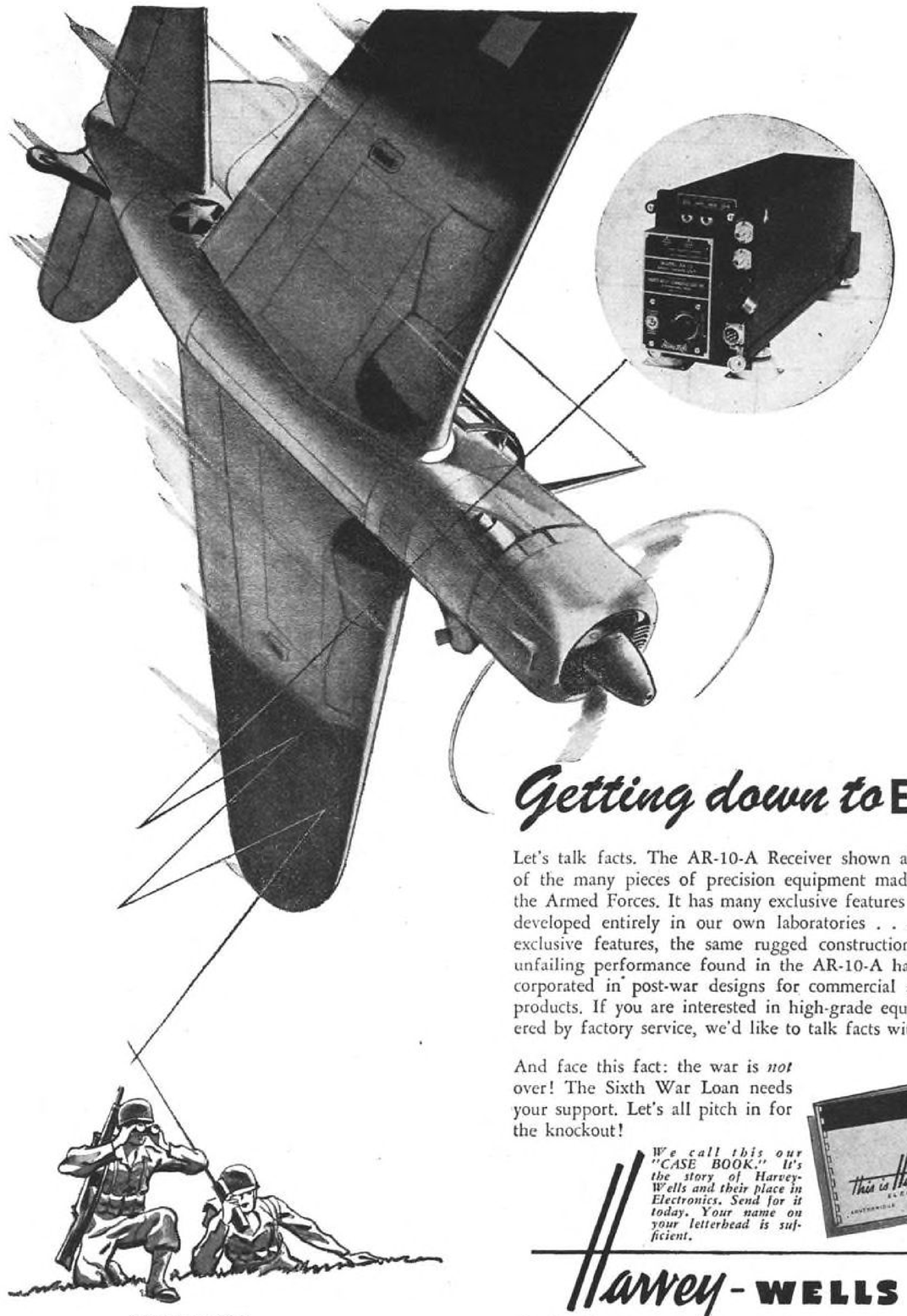
In addition, the services of the industry's largest staff of steel technicians are available to help you solve any problems involving the use of U·S·S Stainless Steel.

U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
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UNITED STATES STEEL



Getting down to EARTH

Let's talk facts. The AR-10-A Receiver shown above is one of the many pieces of precision equipment made by us for the Armed Forces. It has many exclusive features which were developed entirely in our own laboratories . . . The same exclusive features, the same rugged construction, the same unfailing performance found in the AR-10-A have been incorporated in post-war designs for commercial and civilian products. If you are interested in high-grade equipment covered by factory service, we'd like to talk facts with you now.

And face this fact: the war is *not* over! The Sixth War Loan needs your support. Let's all pitch in for the knockout!



We call this our "CASE BOOK." It's the story of Harvey-Wells and their place in Electronics. Send for it today. Your name on your letterhead is sufficient.

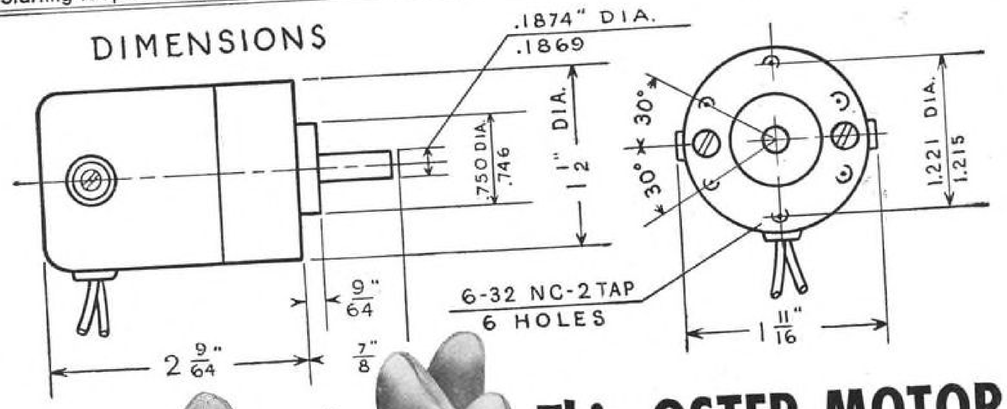
Communications
Aids to Navigation
Electronic Safety Devices

Harvey-WELLS
ELECTRONICS

HARVEY-WELLS COMMUNICATIONS, INC. SOUTHBRIDGE, MASSACHUSETTS

27 VOLT, SHUNT OR SERIES, CONTINUOUS DUTY IN 25° C. AMBIENT			
Maximum H.P.	1/300	1/400	1/650
R.P.M.	11,000	8,500	5,000
Amps. Input	.480	.450	.300
Starting torque in % of full load torque	250 min.	250 min.	250 min.

DIMENSIONS





This OSTER MOTOR

gives you maximum performance . . . with minimum requirement for weight and space

You can depend on Oster motors to live up to the world-wide reputation of pre-war Oster appliances, and to deliver results that add to the prestige of your product for war and peacetime uses. Careful engineering and precision workmanship assure you of dependable, trouble-free performance. Let us help you fit this or other Oster motors to your requirements.

M-17

FEATURES OF TYPE A-16A OSTER MOTOR

HOUSING — die cast aluminum, totally enclosed.

FINISH — black anodized.

WEIGHT — 7 ounces.

BEARINGS — high quality single shielded ball bearings, lubricated with grease suited for any specific application. Bearing housings fitted with steel inserts.

MOUNTING — standard ¾" diameter air corps rabbet.

BRUSHES—high grade metal graphite of ample size to assure unusually long brush life.

WINDINGS — available in shunt, series and split series reversible, 12 and 24 volt, intermittent and continuous duty.

TEMPERATURE RISE — 55°C. Maximum frame temperature rise at rated load.

MODIFICATIONS — special shaft extensions, mounting arrangements, leads, etc. Also furnished for operation in high ambient temperatures and high altitudes.

APPLICATIONS — operation of small blowers, switching equipment and other similar aircraft applications.

All data and ratings are approximate.

John Oster Manufacturing Co.

Department A-17 **Racine, Wisconsin**



Crash truck . . . ladies' size

Scooters, "manned" by women, rush to fires at air fields and quickly snuff out blazes with carbon dioxide gas from Kidde extinguishers. These midget fire engines are highly maneuverable, easily operated by women. And they're swift — to match the fast fire-killing effect of Kidde extinguishers.

Kidde extinguishers are used by air fields on a wide variety of mobile equipment. They're carried on full-size emergency trucks, two-wheeled trailers, jeeps, motorcycles. Kidde hand and wheeled portable extinguishers stand ready to nip smaller fires.

If you are planning fire protection for an airport—or for aircraft—Kidde's broad experience in aviation fire fighting will be valuable to you. Our engineers are at your service . . . just drop us a line!



WALTER KIDDE & COMPANY, INC., 140 CEDAR STREET, NEW YORK 6, N. Y.

Here's what the

BRUSH SURFACE ANALYZER

means to him



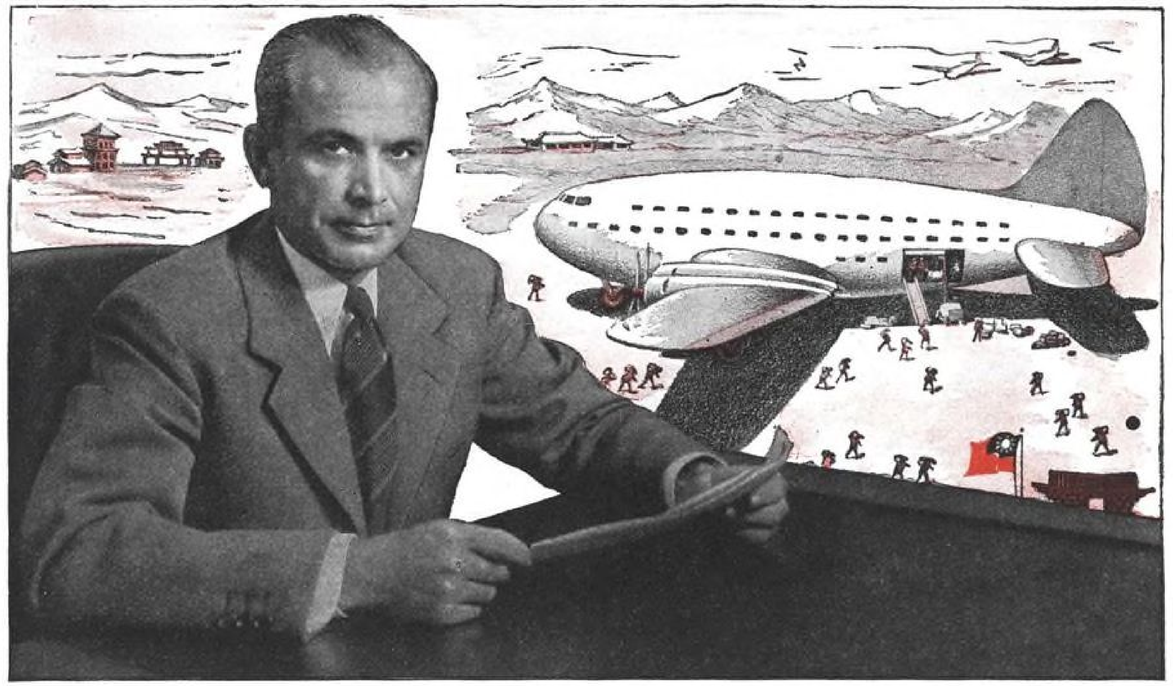
Yes, war has its good points too. War stimulates progress. Industry is called upon to deliver as never before — to produce greater quantities of finer equipment. Higher standards of quality insure our equipment of longer life, dependability and ease of operation. Surface finish is vital to fine quality. The mated surfaces of precision-built parts designed to move at high speeds are but one example of the need for microinch (.000001") smoothness. Such finishes are accurately measured and recorded for laboratory study or production-line inspection by the Brush Surface Analyzer.

Write today for a fully illustrated bulletin on what the Brush Surface Analyzer can do for you.

THE BRUSH DEVELOPMENT COMPANY

3443 PERKINS AVENUE • CLEVELAND 14, OHIO

This is the fifteenth of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME.



"Air Transport will map new frontiers for Business"

says T. CLAUDE RYAN, President of The Ryan Aeronautical Company.

"I BELIEVE *that a first-rate, world-wide air transport system is vital to American prosperity after the war.*

"If American businessmen can make many of their deliveries by air, especially to remote regions —and get there faster than foreign competition— then we shall sell millions *of new customers.*

"For instance, rival manufacturers in Moscow and Chicago may learn of lucrative business to be picked up in China; the Russian is going to have a big advantage if he can hop a plane that gives him a 24-hour head start on his competitor.

"Today, thanks to the exigencies of war, we have the finest air transport system. After the war, we'll have to guard that supremacy, or others will skim the cream of world trade. So let us maintain a web of powerful, high-speed American airlines that will radiate from American factories and deliver American products almost overnight to countries thousands of miles away.

"Thus we shall keep industry humming, more and more jobs will open up, and America will prosper."

• • •

YES, MR. RYAN, America can do it. But American passenger and cargo planes will dominate world skyways only when the projects of the aviation industry have been sold as down-to-earth practicalities—sold to that "test pilot" market of U. S. men who are ready to buy progress whenever they see it either in business or in private living.

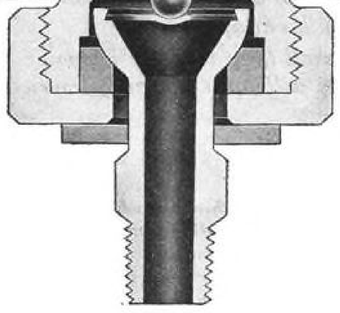
***This is the market aviation thinks of when it thinks of the more than a million TIME-reading families**—who are America's best prospects for planes and air travel—whose positions in American business make them the natural national vanguard for any programs aviation may set up—who vote TIME their favorite magazine 7 to 1 over the runner-up.*

Believing that the ideas of aviation's leaders are always of interest to the aviation industry, TIME here gives them wider circulation in the name of

AVIATION'S SILENT PARTNERS — TIME — THE READERS OF TIME

BARCO FLIES WITH THE B-29's!



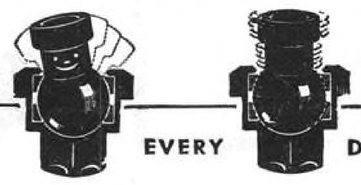


Worthy to be part of the fighting equipment on America's great Superfortress! That is the latest recognition accorded Barco Flexible Joints (winterized for all service conditions), after two years of exhaustive flying tests. Flexibility required on the brake and retracting mechanism hydraulic lines of the oleo leg on the landing gear is taken care of by Barcos. They are supplied on the oxygen re-breather system in the turrets. Barco Flexible Joints are used in various models of fighting and commercial ships...and for thirty years past have served in a wide range of American industries. Barco Manufacturing Company, Not Inc., Aircraft Products Division, 1824 Winnemac Avenue, Chicago 40, Illinois.

BARCO ***FLEXIBLE JOINTS***

Not just a swivel joint... but a combination of swivel and ball joint with rotary motion and responsive movement through every angle.

The Free Enterprise System Is the Salvation of American Business



"MOVE IN EVERY DIRECTION"



HALF THE *Weight*

It requires a piece of Formica twice the volume of a piece of light metal, such as aluminum to hold the balance level—for Formica is one of the lightest of the mechanically strong materials.

That is the fundamental reason why Formica is so often considered first as a material for airplane parts. In addition it is strong, non-corrodible and chemically inert, and for electrical and communications uses it has high insulating value, low losses at high frequencies—and those electrical properties are not undermined by moisture absorption even under very humid conditions.

These are the values of the material that have kept Formica 75 per cent on aviation production during the war.

Along with the handsome permanent finish that is possible on Formica Realwood, Formica patterns and Formica colors, these same values should gain the material a place for paneling passenger cabins, and as the cigarette-proof tops of tables used in passenger planes.

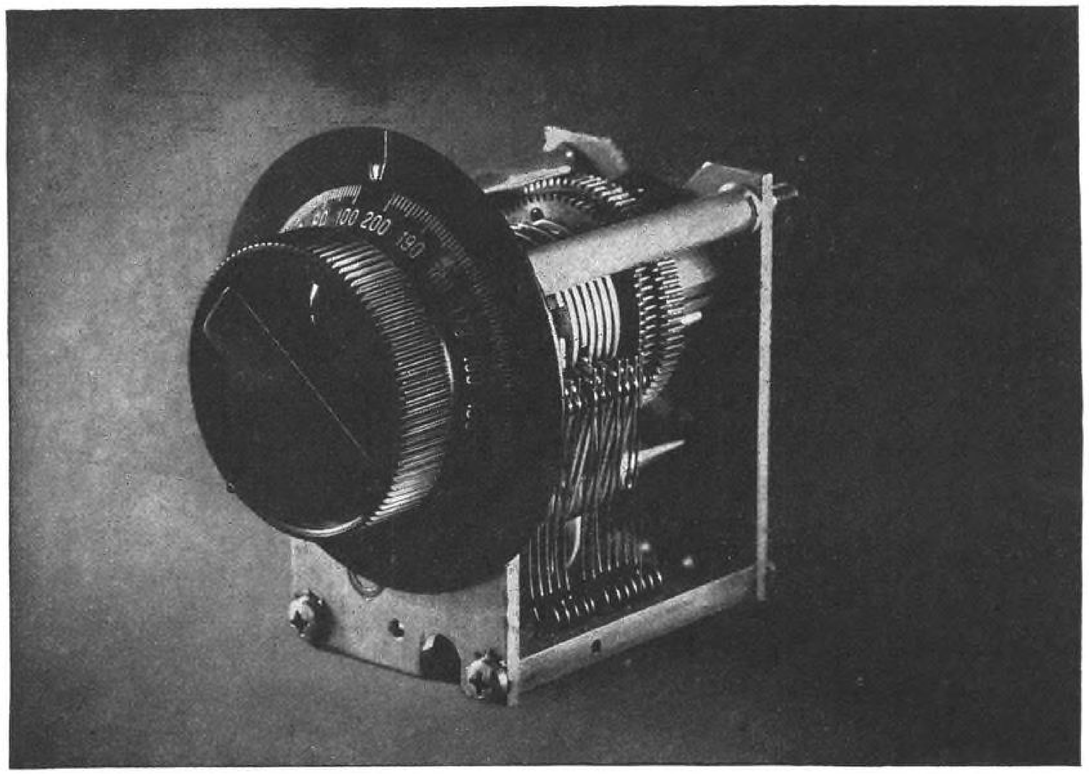
When you get to post-war designs let us tell you about these possibilities.

"The Formica Story" is a moving picture in color showing the qualities of Formica, how it is made, how it is used. It is available for meetings.

ARMY E NAVY

FORMICA

THE FORMICA INSULATION COMPANY, 4628 SPRING GROVE AVENUE, CINCINNATI 32, OHIO



COLLINS AUTOTUNE*

The Key to Precision Control

THE Autotune was conceived and engineered by Collins many years ago. It was the result of a growing dissatisfaction with slow, haphazard methods of tuning radio equipment and a persistent effort to improve them.

What is it? How does it work?

The Collins Autotune head shown above is a mechanical device for turning a control shaft and stopping it precisely at any one of several pre-determined positions.

The Collins Autotune system consists of a number of Autotune heads, all driven by a single electric motor, each quickly and simultaneously repositioning a separate and non-interrelated tuning shaft to new settings chosen in advance by the operator. At the touch of a button or flip of a dial, the Collins transmitter or receiver is thus completely and exactly tuned to the wanted channel in a matter of seconds.

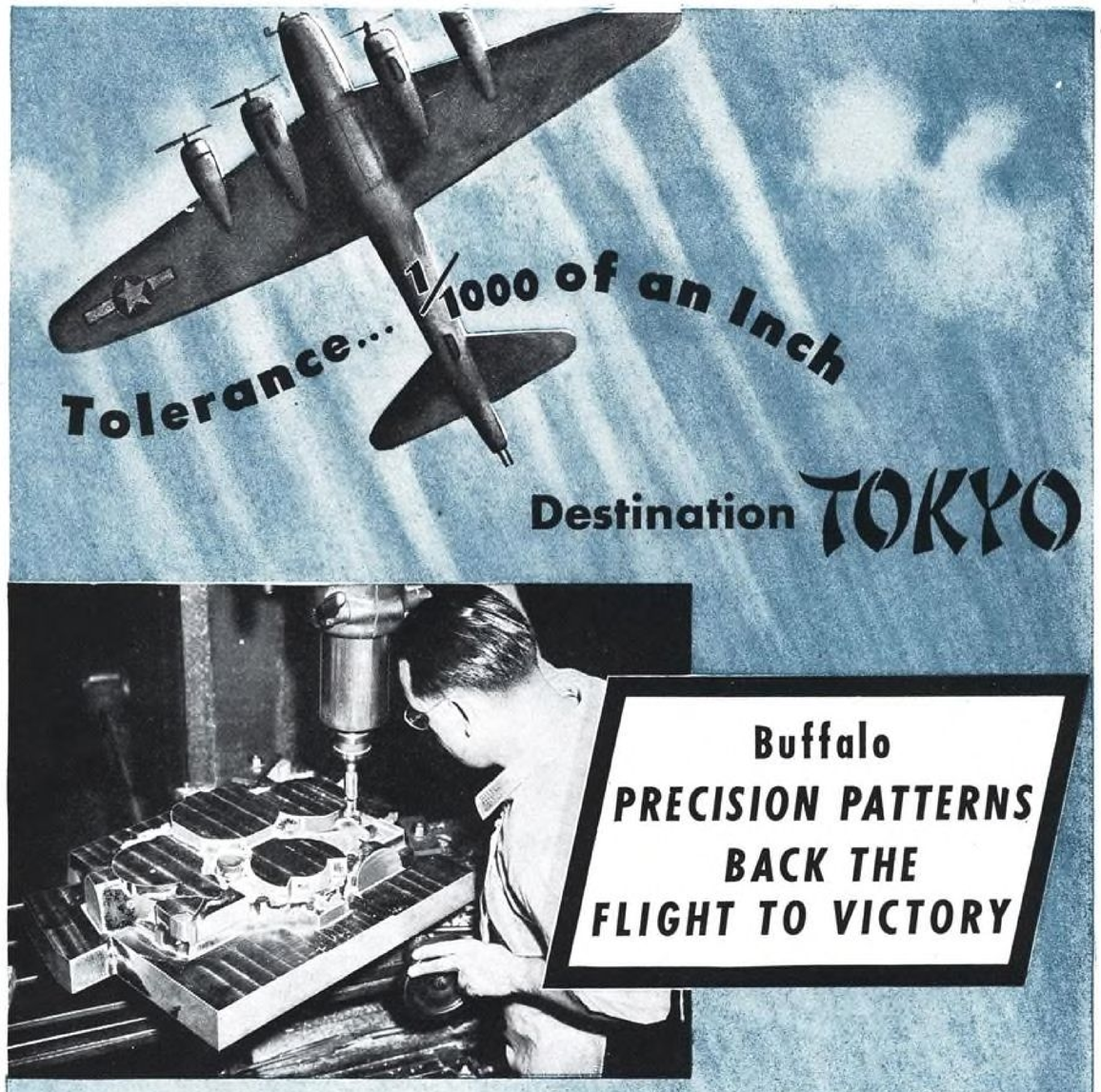
Collins communications equipment, Autotune controlled, was adopted by American Airlines, Braniff Airways, Tropical Radio Telegraph Co. and others long before the war. Reliability has been demonstrated through the years under all service conditions.

The Collins transmitter design and the Autotune have proved so advantageous to the Armed Services that military authorities have requested other large companies, in addition to Collins, to build them. The Collins Radio Company, Cedar Rapids, Iowa.

ARMY E NAVY

COLLINS

*U. S. Patents issued and pending.



Buffalo PRECISION PATTERNS BACK THE FLIGHT TO VICTORY

Precision Patterns—patterns accurate to one thousandth of an inch. It is skill of this calibre that gives America's air might its "victory punch."

Buffalo Pattern Works with its fifty years of experience in pattern making is now serving leading warplane makers by translating blue prints into precision patterns that enable speedy production of the most intricate castings—castings that meet severest specifications for close tolerances and metallurgical soundness.

Consult Buffalo on your most difficult pattern problems, present or postwar. Write or wire Dept. B.

ESTABLISHED 1893

Established 1893

BUFFALO PATTERN WORKS

830 Hertel Ave. Buffalo 16, N. Y.

"Out-Blitzing" the Nazis



ARNOLT PARTS in Armored Vehicles Help Speed the Drive to Final Victory

Smashing through the hedges and pounding down the roads of Europe, America's motorized infantry is outflanking and "out-blitzing" the best trained of Germany's armies.

Important parts for the six-wheeled armored cars, trucks, tanks and other vehicles that carry our troops to battle—are made by Arnolt craftsmen . . . Arnolt plants, equipped with the latest types of lathes, grinders, screw machines, and other tools are producing an ever increasing volume of precision-built parts for prime contractors . . . Our recently enlarged capacity permits acceptance of additional sub-contracting work. Write for a copy of "Available Facilities for the War Program" which describes Arnolt's diversified facilities in detail.

HELP SHORTEN THE WAR ★ ★ ★ BUY MORE WAR BONDS

Peacetime Builders of SEA-MITE MARINE ENGINES

★

Back the Attack BUY MORE WAR BONDS

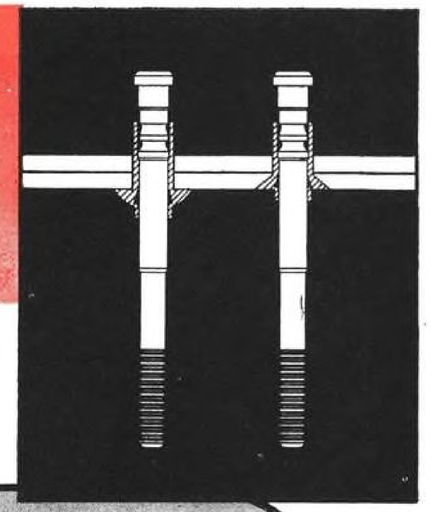
ARNOLT MOTOR COMPANY, *Warsaw, Indiana*

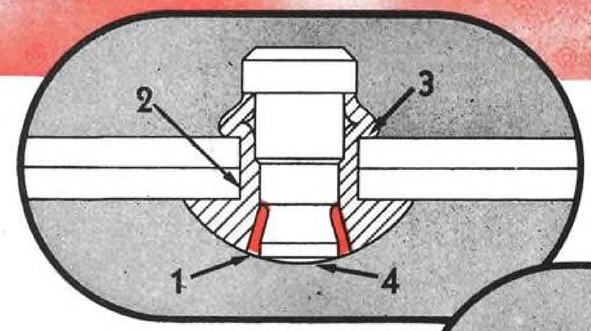
Associated with ATLAS STEEL AND TUBE COMPANY

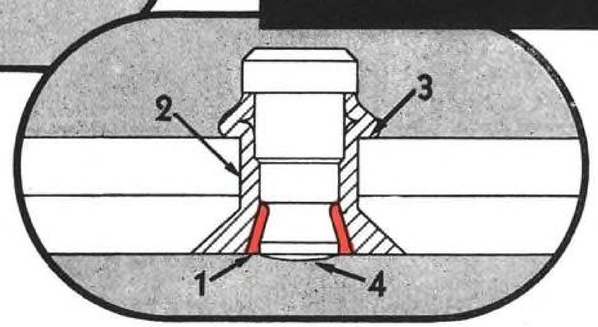
UNION TOOL COMPANY . . . . . MANCHESTER-ATLAS COMPANY

SOUTH BEND MACHINE WORKS . . . . . PERU ENGINEERING PRODUCTS

The *Only* BLIND RIVETS Offering *All* These Advantages







HUCK BLIND RIVETS, by virtue of a positive mechanical lock between the pin and sleeve accomplished during the driving operation, become the equivalent of a one-piece solid rivet with considerably greater ultimate shear strength than conventional A17ST (Type AD) or 17ST (Type D) "icebox" solid rivets. A "pull type" compressed air gun, the jaws of which automatically engage the rivet pin pull grooves, permits exceptionally simple and rapid application.

Identified by number in the illustrations above are these features:

1 The one driving operation not only fills the hole and forms the blind rivet head but also automatically extrudes the locking collar to form a conical keystone lock. This resulting positive mechanical lock between the pin and the sleeve precludes the possibility of the pin working out under any conditions of fatigue loading or vibration. With no lock other than friction, a two-piece blind rivet will, in thin sheets, become critical in tension and fail at loads very substantially lower than the allowable bearing loads of the sheets even though such bearing loads are less than the allowable rivet shear load.

2 The first part of the pin movement, prior to blind head formation, expands the sleeve to completely fill the hole. This insures joint rigidity, fatigue life, and resistance to vibration and reversal of stress loading.

3 As a result of special work hardening of the sleeve end, the sleeve upsets by forming a bulb rather than a tulip head. As the lower part of this bulb forms in the hole, completion of the bulb pulls the sheets together with great force, flattening the bulb against the sheet and thus providing surface contact between the blind head and the sheet.

4 The last part of the driving operation automatically severs the pin substantially flush with the rivet head contour. This eliminates the necessity of further trimming except where the ultimate in aerodynamics is required. This feature is also extremely important in simplifying inspection of driven rivets. COMPLETE AND THOROUGH INSPECTION CAN BE MADE SIMPLY BY VISUAL EXAMINATION OF THE ACCESSIBLE HEAD OF A HUCK BLIND RIVET. An unsatisfactory blind head resulting from the use of an improper grip length or for any other reason would be instantly detected by the resulting improper relationship of the pin break to the sleeve contour.

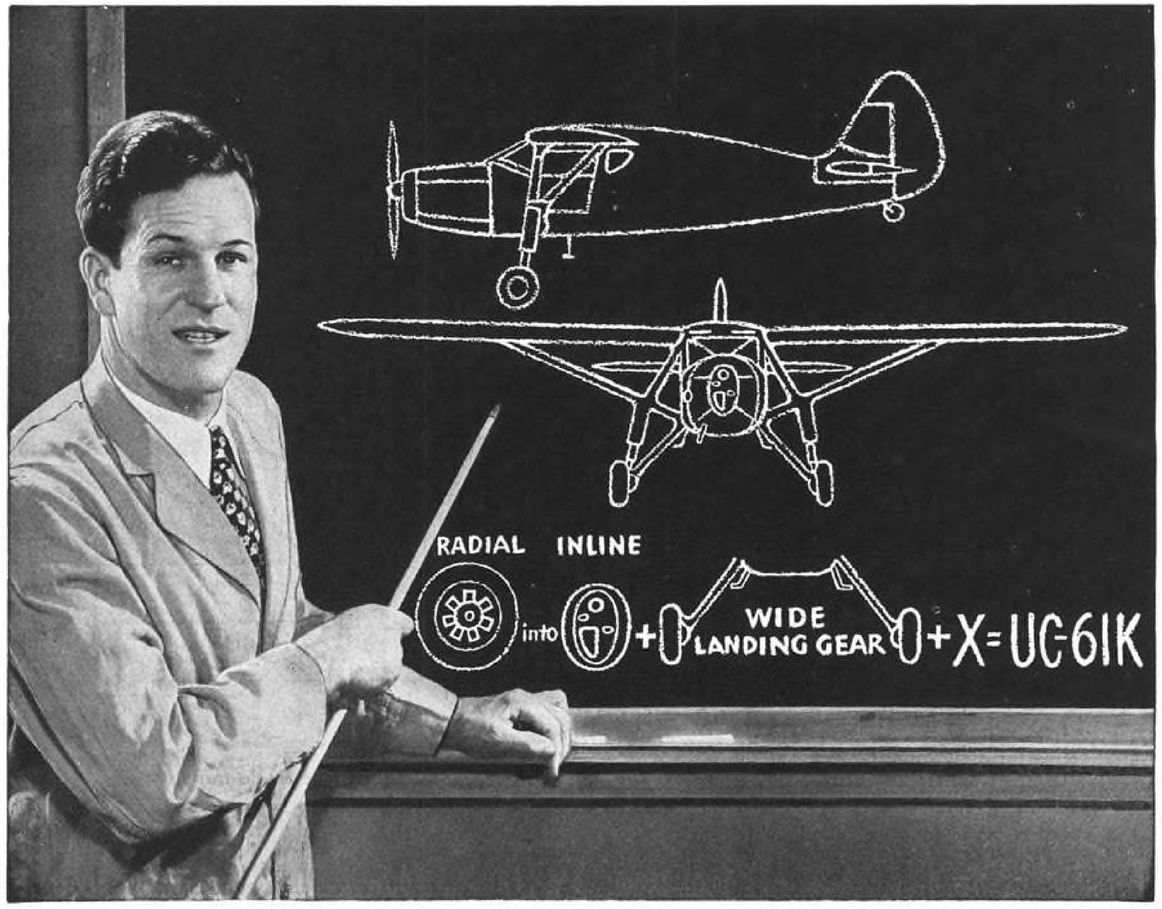
Huck Blind Rivets are now available in 1/8", 5/32" and 3/16" diameters with AN456 Brazier, 78° Modified Countersunk, and 100° Countersunk heads.

ALSO PRODUCED BY HUCK—Skirted Solid Countersunk Rivets for Coin Press Dimpling and Parts Dimpled Simultaneously . . . All Types of Solid Conventional Aircraft Rivets of Aluminum Alloys and Monel Metal.

Huck MANUFACTURING COMPANY

Specialists in Aircraft Riveting Processes

2474 BELLEVUE AVENUE • DETROIT 7, MICHIGAN



Formula for "Forwarder"

The famous Fairchild "Forwarder", designed in 1932, has been constantly revised and improved . . . and is now called the UC-61K.

Ranked before the war among the most popular four place planes—and renowned now, as always, for its stability, it is performing a vital function in many theatres of war.

The engine section has been completely changed, with the 200 hp. Ranger inverted inline replacing the 165 hp. radial. The new "K" model has a longer, more streamlined nose, which makes it look larger and, in combination with a high wing design, affords better visibility both in the air and on the ground.

The use of wide landing gear, placed well forward, and the aid of wing flaps, makes possible short landings and take offs in small, rough fields.

These and many other improvements, such as ball bearings in all control joints which reduce wear, increase maneuverability, and add to the life of the plane, contribute to the growing popularity of the UC-61K.

It may be used, for example, in advance reconnaissance of enemy gun positions during invasions. And as a utility cargo carrier where medical supplies, ammunition, or parts must be rushed to the front lines. It speeds pilots and high-ranking officials to points where they are most needed.

In the "Forwarder" our armed forces have a plane which, since it first came from the drawing boards, has always been ahead of the times, the embodiment of the Fairchild "touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

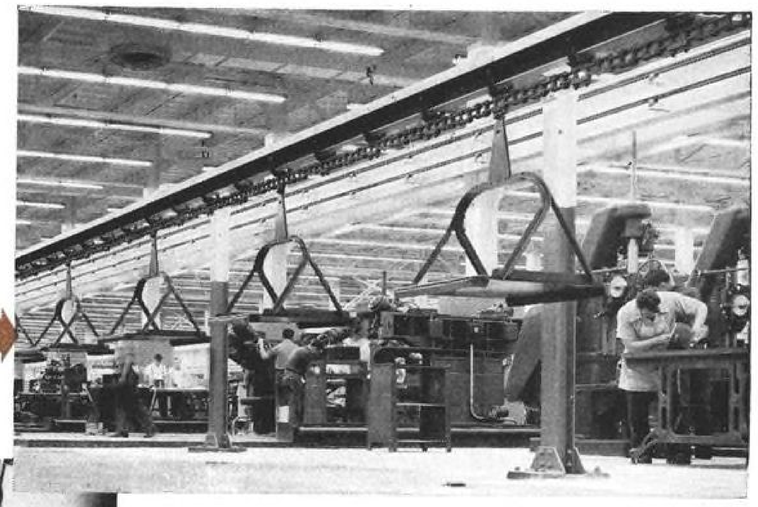
Fairchild Aircraft *Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland....Burlington, North Carolina*

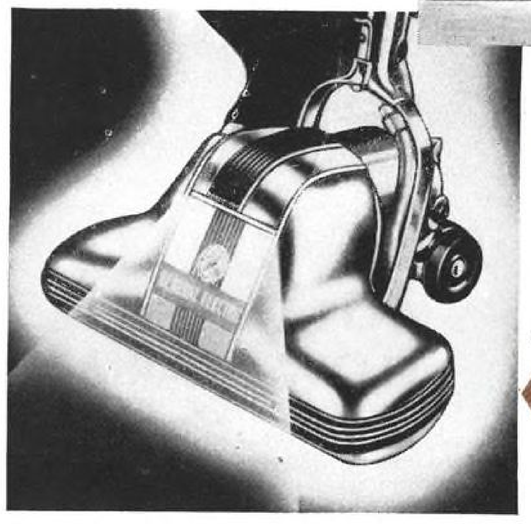


Got any Secret Postwar Weapons?

THINKING ABOUT POSTWAR COMPETITION? General Electric Lamp Engineers may be able to help you meet it . . . by showing you (1) how better lighting can improve your plant efficiency and (2) how the use of a G-E Lamp on your product can add to its sales appeal.

1. MAKE IT FASTER. Increased efficiency and lower costs will be the goal of postwar industry. That's why more and more plants are looking to G-E fluorescent lighting for faster production and lower unit production costs. Eyes can see faster, hands can work faster when lighting is improved. Quality of the work goes up, spoilage goes down. Find out what modern lighting can do for you.





2. MAKE IT SELL FASTER. Why not give your product a special, perhaps exclusive, sales advantage by building into it the right General Electric lamp? It may be a lamp for a sewing machine, a vacuum cleaner or an airplane. Or a lamp built into a calculating machine. Or a tiny indicator lamp in an electric iron, radio, range, electronic control, cordset, or in a thousand and one other products. G-E Lamp Engineers will be glad to advise you.

"TO MAKE G-E LAMPS STAY BRIGHTER LONGER"
The Constant Aim of G-E LAMP RESEARCH



IF YOU THINK G-E Lamp Engineers may be able to help you, get in touch with your nearest G-E Lamp Office or write Div. AV-J, Nela Park, Cleveland, O.

G-E MAZDA LAMPS
GENERAL ELECTRIC

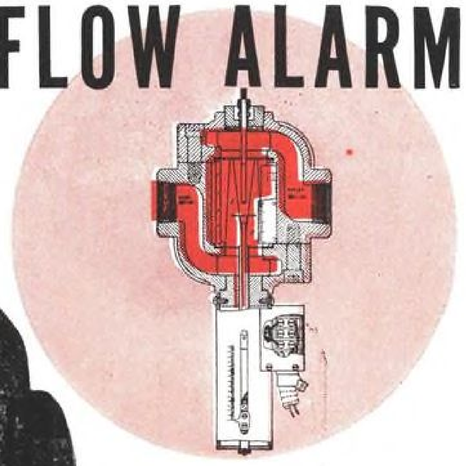
KEEP BUYING WAR BONDS—
KEEP THE WAR BONDS YOU BUY

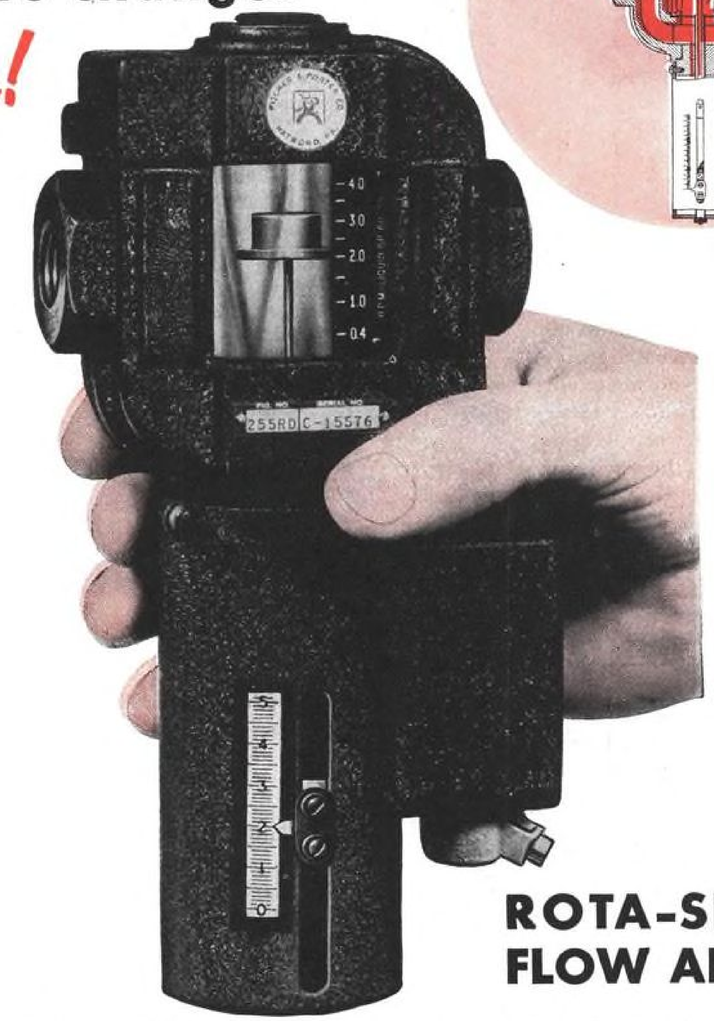
Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday, 10 p.m. EWT, NBC; "The World Today" news every weekday, 6:45 p.m. EWT, CBS

A NEW, POSITIVE FLOW ALARM

—actuated by flow rate changes

only!





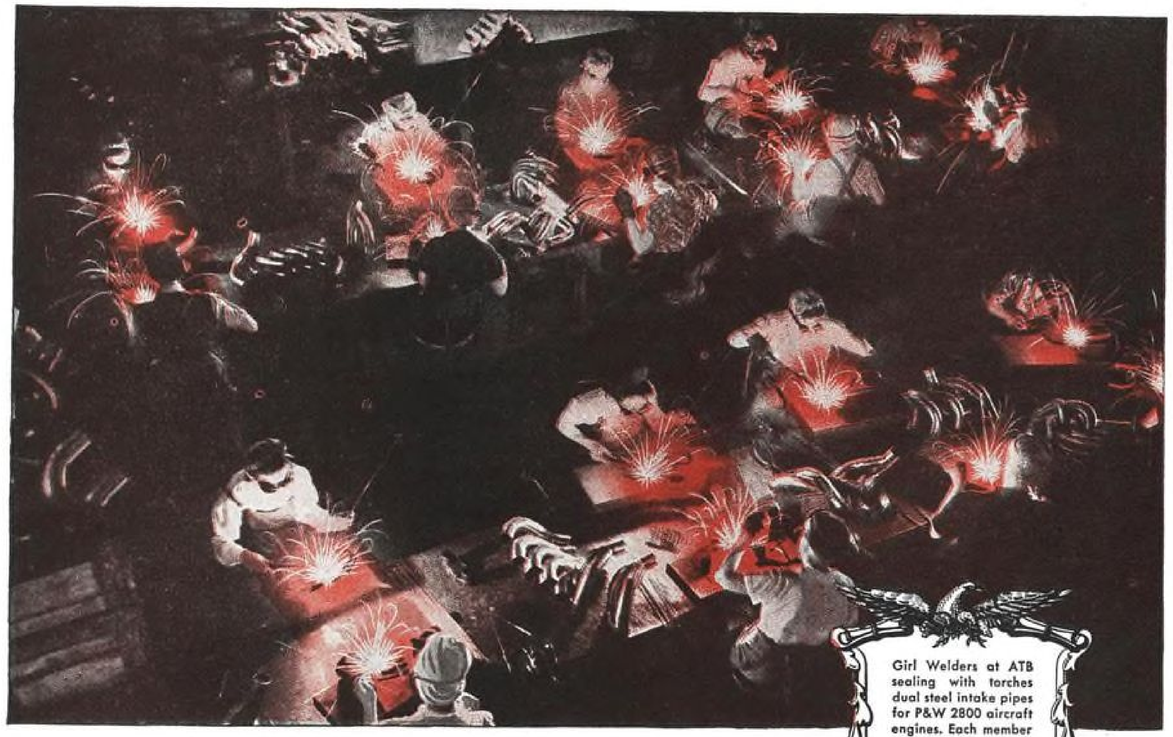
ROTA-SIGHT FLOW ALARM

When the flow rate becomes dangerously high or low the Rota-Sight Alarm will flash a red light, start or halt electrical equipment, kick solenoid valves to a new position, or set off a raucous warning horn. Furthermore it definitely indicates the actual flow rate at all times.

The Rota-Sight Alarm operates through a float which moves up and down in a precision-bore transparent metering tube, into which triangular flutes have been fashioned. As the float rises, the flow passage through these flutes increases, causing the float to assume a position in the tube in direct proportion to the amount of liquid or gas passing through the meter. Thus the float responds to flow rate changes ***only***. A magnetic extension attached to the float trips an external switch to operate the alarm circuit through a suitable relay. The switch operates ***accurately*** and ***positively*** at the flow rate for which it is set, and is readily adjustable over the entire flow range of the Rota-Sight.

This remarkable flow rate alarm is compact, inexpensive and easy to install. It is available in sizes from ¼" and up, in any metal that can be cast. It may be obtained with single alarm, or with double alarm for high and low flow protection. For inflammable or explosive fluids, the alarm fixture may be made explosion-proof. Furthermore, without the alarm attachment, the Rota-Sight is a small, low-priced flow rate meter that will indicate the true flow rate continuously. Bulletin 92-B, containing a detailed description, will be sent gladly at your request upon your Company letterhead. Write to Fischer & Porter Co., 310 County Line Road, Hatboro, Pa.

FISCHER & PORTER COMPANY



Girl Welders at ATB sealing with torches dual steel intake pipes for P&W 2800 aircraft engines. Each member of this team receives specialized training but provides her own impelling motive for Victory — a husband, brother or close one in the Air Forces.

AMERICAN Girl Welders

AS PRINCIPAL SUPPLIER of INTAKE PIPES for Pratt & Whitney, we have seen production grow from a *few hundred parts a month* to *several thousand a week*. And, we have good reason to be particularly proud of our welding jobs. Since 1910 American has played an important role in the design and fabrication of thin wall tubular parts for the automotive and aviation industries. Today American is also busy producing for Pratt & Whitney licensees, making this particular pipe en masse for both the Ford Motor Company and the Aircraft Engine Division of the Nash-Kelvinator Corporation.

New Data Book and Catalog gladly mailed on request.

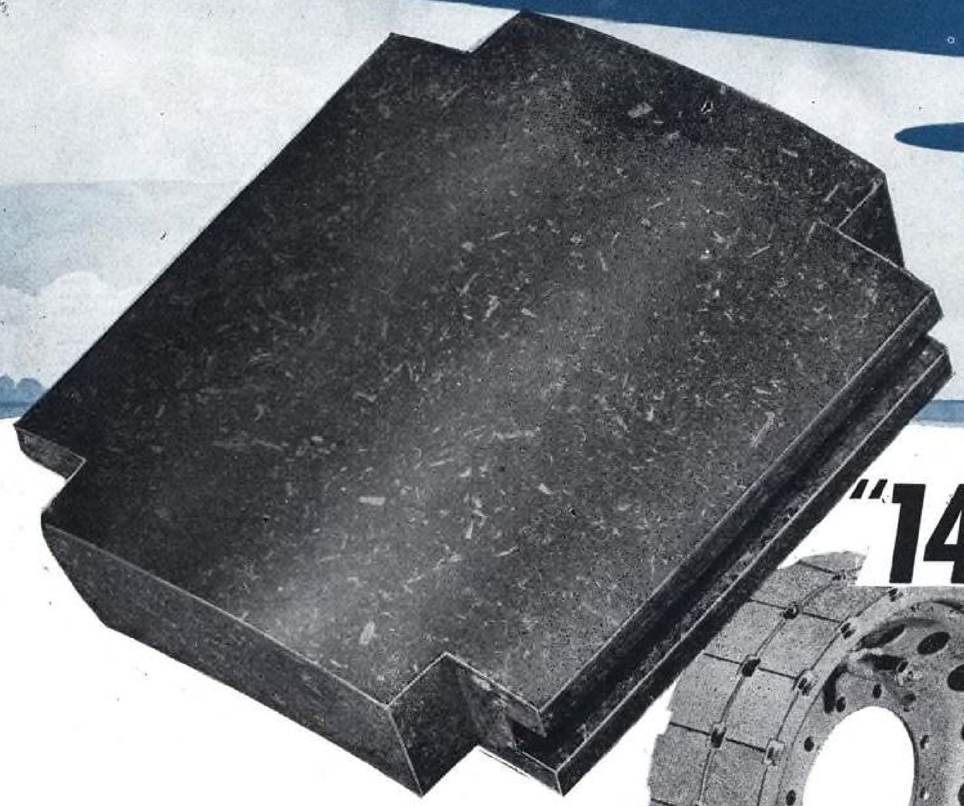


AMERICAN

AMERICAN TUBE BENDING CO., INC. 6 Lawrence Street, New Haven 11, Conn.



Boeing Flying Fortress equipped with Raybestos "1492" Brake Blocks



Raybestos "1492" Bomber Brake Block and one of the Hayes Industries Brake Assemblies

"1492" A GREAT DISCOVERY

Developed when the Army Air Force called for a superior brake lining to stop its heaviest bombers, Raybestos "1492" Brake Block met this severe test and more than 15 tons a day are now being produced.

"1492"'s unique patented process results in a product of unusual structure with a very high density, exceptional wear, temperature-resistance and stability.

The war-proven performance of this great friction discovery makes "1492" outstanding for post-war aviation and other heavy duty use.

We offer samples of "1492" specially engineered to your post-war friction requirements. And an enlarged staff of technologists is at your service for consultations.

THE RAYBESTOS DIVISION of *Raybestos-Manhattan, Inc.*, BRIDGEPORT, CONN.

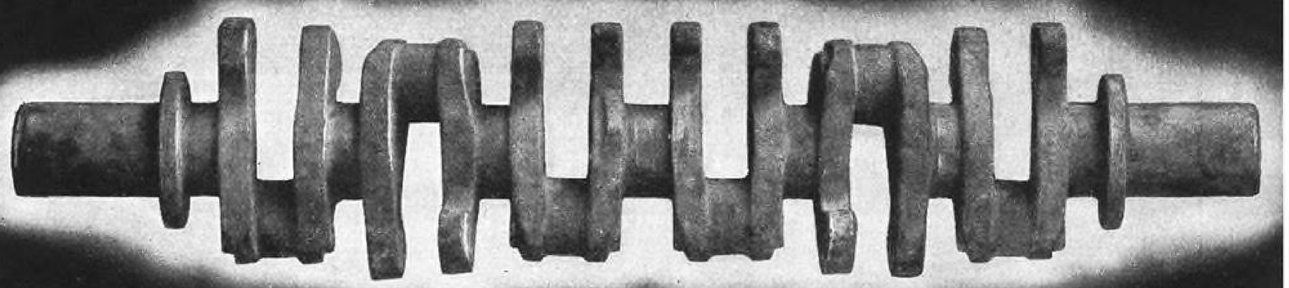
Raybestos

AMERICA'S BIGGEST SELLING BRAKE LINING

BRAKE LININGS, CLUTCH FACINGS, FAN BELTS, HOSE FOR WAR AND ESSENTIAL CIVILIAN EQUIPMENT

LADISH

QUALITY FORGINGS



THERE IS NO SUBSTITUTE FOR *Quality Control*

New forging techniques—especially in the field of heavy drop forgings—afford greater latitude in design.

Our engineers are available now for consultation on your postwar products.

DROP FORGINGS UP TO 1,800 lbs.

HAMMERED FORGINGS UP TO 10,000 lbs.

TO MARK PROGRESS

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

MILWAUKEE SUBURB

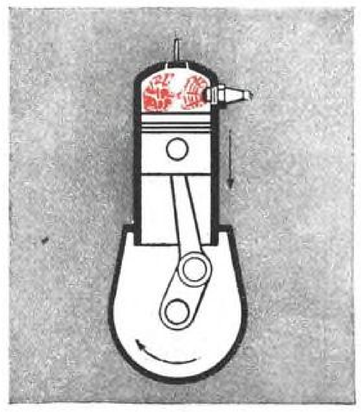
New Flight Instrument guards against fuel waste!

ECONOMY

M.I.T.-SPERRY DETONATION INDICATOR INSURES FUEL ECONOMY . . . LONGER ENGINE LIFE . . . GREATER SAFETY



1. THE ENGINES on this airplane may be detonating, but the pilot has no way of knowing. Detonation means *destructive combustion*. In your car, you can *hear* detonation. In aircraft, the noise level is too high.



2. DETONATION increases internal temperature and pressure tremendously. If continued, it damages engines, may cause failure. How is it possible to tell when detonation occurs in flight?



3. THE M.I.T.-SPERRY Detonation Indicator detects detonation *instantly*. A flashing light on the instrument panel warns pilot to change fuel mixture. Result? Greatest operating efficiency *without damage to engines*.



4. *REMARKABLE savings in fuel!* Preliminary tests show savings of 10% or more over typical airline practice. Payload can be added. Safety is increased . . . engine life prolonged . . . periods between overhaul lengthened.



Courtesy Wright Aeronautical Corp.

5. THE M.I.T.-SPERRY Detonation Indicator is installed externally—requires no piercing of cylinders. Visual signal gives instant warning of detonation. A selector switch then determines in which cylinder combustion is faulty.

6. A SPERRY *Automatic Mixture Control* may be used in conjunction with the Detonation Indicator. When detonation occurs, this device *automatically and instantly* eliminates this condition and hunts as lean a mixture as possible without sacrifice of power.

The *Detonation Indicator* is designed for use on all types of engines and aircraft. Where economy of operation is important...as it will be in postwar commercial aviation . . . this new flight instrument will stand continuous guard against wasteful conditions.

Sperry Gyroscope Company INC.

Great Neck, New York — Division of the Sperry Corporation

GYROSCOPICS · ELECTRONICS · AUTOMATIC COMPUTATION · SERVO-MECHANISMS

KLIXON Aircraft Circuit Breakers



Klixon PM Push Breakers—one of the several types of Klixon Breakers used on the Grumman Hellcat.

Make the Grade

in Jap-Busting Grumman Hellcats



Ted Kenyon, Flight Research Engineer for Grumman, and Bob Glidden, Field Engineer for Spencer, check performance of Klixon Aircraft Circuit Breakers.

Designed and built to outfly, outclimb and outshoot the best that the Nips have, Grumman Hellcats roar into battle at better than 400 miles per.

Among the many little things that help make these Hellcats the terrors of the skies are Klixon Aircraft circuit breakers that protect electrical circuits from serious damage caused by shorts and overloads.

Like the plane, there's nothing delicate about Klixon Aircraft breakers. Their simple Spencer snap-acting thermal discs automatically compensate for changes in ambient temperature and are plenty responsive to excessive amperes, yet harmless transients don't cause nuisance trip-outs. Klixon breakers are amply rugged to withstand shock, vibration, motion, altitude regardless of the position of mounting.

Klixon circuit breakers are also protecting circuits in the famous Grumman Wildcat and Avenger.

Bulletins containing sizes, dimensions, ratings and performance characteristics are available on request. Write for copies.

KLIXON

TRADE MARK REG. U.S. PAT. OFF.

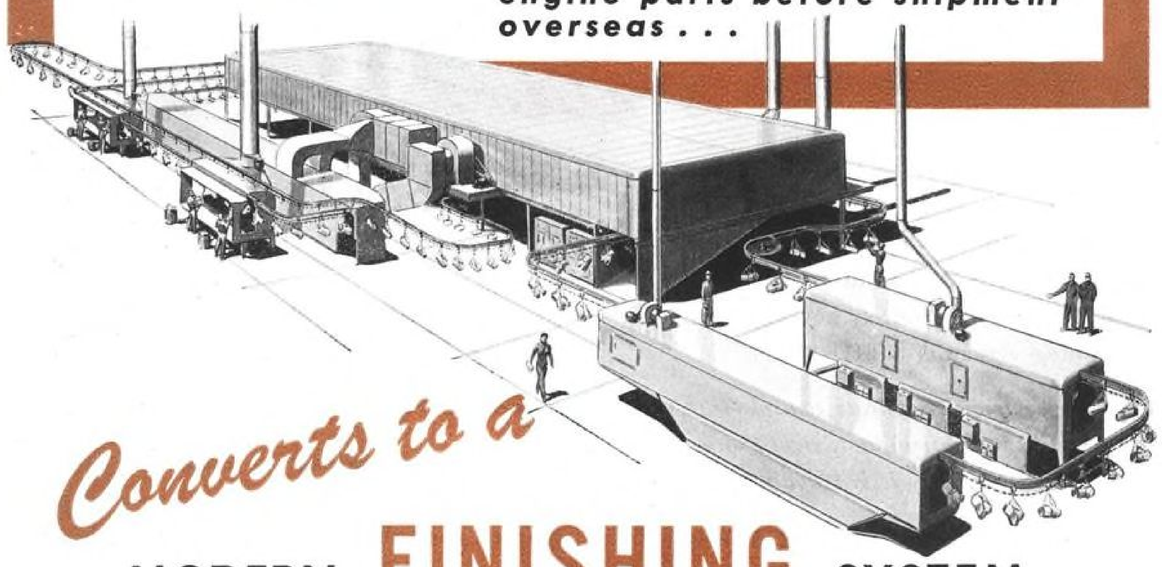
Spencer Thermostat Company, Attleboro, Massachusetts, U. S. A.

MAHON

Built-for-the-Job

CLEANING AND COATING SYSTEM

specially developed for treating engine parts before shipment overseas . . .



Converts to a

MODERN FINISHING SYSTEM

for the Coming Peacetime Operation

Many Finishing and Processing Systems—engineered by Mahon for special war production purposes—now are being revised for peacetime operation—often with only slight change and at surprisingly little expense.

The Mahon engineering staff is cooperating with numerous manufacturers on transition problems. In preparing plans for adapting present equipment to the demands of rapidly approaching civilian production they are accomplishing some highly satisfactory results. Have a Mahon representative go over your equipment with you. You will find the advice and suggestions he is prepared to offer both practical and sound. Your switchover will be made speedily and smoothly—and at a minimum cost. You will have a production line that incorporates the most recent advances in efficient and economical Finishing equipment—insuring a faster, finer output.

THE R. C. MAHON COMPANY

DETROIT 11 — CHICAGO 4

Manufacturers of Metal Cleaning Machines • Rust Proofing Machines • Hydro-Filter Spray Booths • Ovens of All Types • Filtered Air Supply Units • Hydro-Foam Dust Collectors—and Many Other Units of Special Production Equipment—including Complete Finishing Systems

PACIFIC DIVISION, BENDIX AVIATION CORPORATION

ANNOUNCES THE NEW

Geneva-loc Actuator

Pacific Division is proud to announce the development of an entirely new line of electric positioning actuators—THE GENEVA-LOC.

They offer extremely accurate control {within 1°} of any series of operations up to eight positions with each position positively locked against movement.

As the name implies, these new Actuators by Pacific Division exclusively incorporate a Geneva movement operated by a high speed motor. Positioning by switches has been completely eliminated. Five outstanding advantages result:

1. Positive control of output shaft movement which automatically locks at all stops and which is independent of motor overtravel and temperature variations.

2. No clutches, torque limiters, brakes or adjustable limit switches—eliminating major causes of trouble.

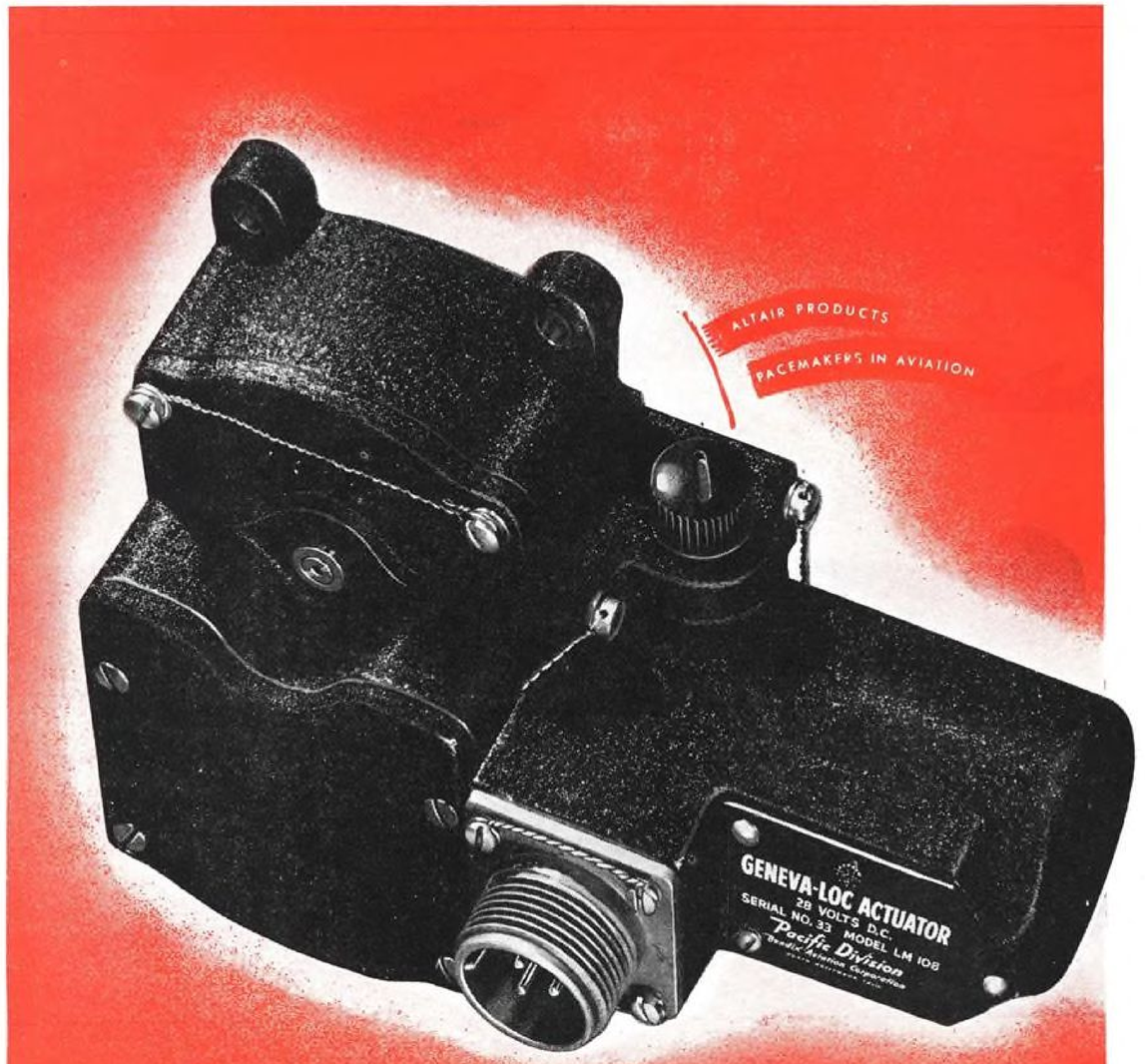
3. Motor comes up to speed under no load, then engages cam with varying ratio which develops maximum torque at breakaway positions. Thus cutout switches always operate when motor is under no load permitting maximum switch life.

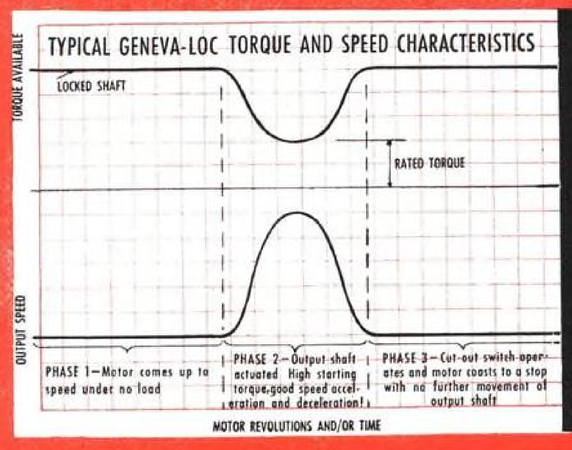
4. Design permits two to eight positions.

5. Entire unit can be disassembled and reassembled, or interchanged quickly in the field. There are no limit switches, brakes, etc., to be adjusted.

Geneva-loc Actuators are ideal for remote operation of hydraulic valves, two-speed supercharger controls, fuel selector valves (detents not necessary), spark retard, prop feathering, air duct valves or any similar installation where accurate positioning is desired. Write or wire today for the complete story on these simplified, positive actuators. Pacific Division, Bendix Aviation Corporation, 11600 Sherman Way, North Hollywood, California. Sales Engineering offices in New York City and St. Louis.

Pacific Division
BENDIX AVIATION CORPORATION
NORTH HOLLYWOOD, CALIFORNIA





No clutches.

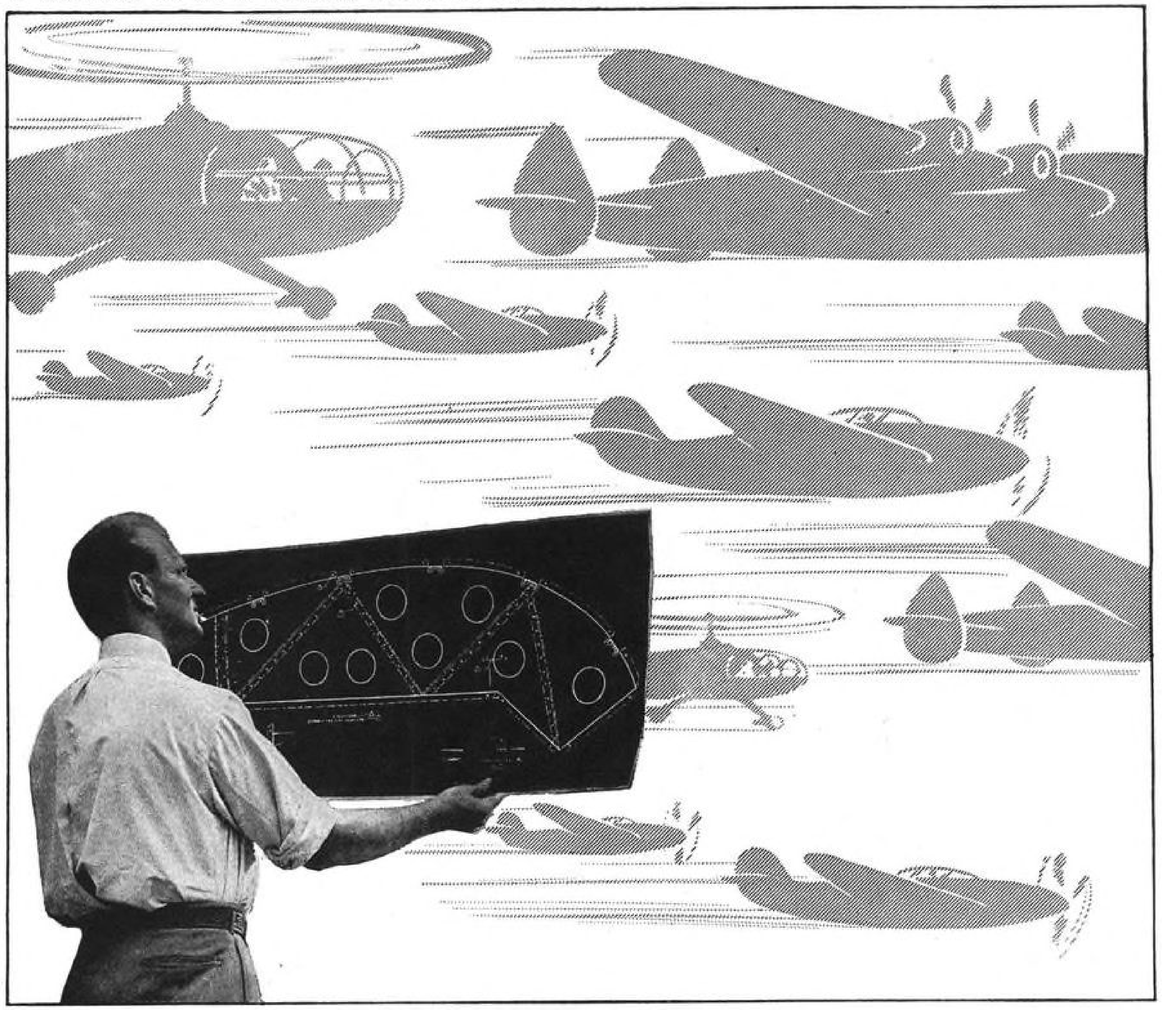
No limit switch adjustment.

Motor starts at no load.

Positive positioning of valve shaft independent of motor overtravel.

No capacitor or brake required.

© 1944, Pacific Division, Bendix Aviation Corp.



New Kellett Reproduction Method Speeds Engineering—Cuts Costs

THE thousands of drawings, layouts, templates, router block and jig patterns required for production of a single type of plane emphasize the importance of the time and cost-saving benefits of the new Kellett Loft Reproduction System.

The method, which meets the wide range of requirements for photo-reproduction, requires only one hand-made layout, which is the original drafting board item. This is made on a matte finish vinylite —a readily-available, transparent, plastic sheet, which is impervious to moisture and possesses a very low co-efficient of thermal expansion.

Once checked, the vinylite drawing is used to make photographic copies on sensitized tracing cloth for blueprints, and on steel and other sensitized materials for templates, router blocks and jigs. Right or laterally-reversed images can be obtained with maximum accuracy.

The Kellett Loft Reproduction facilities are available to other manufacturers. For full details write Loft Reproduction Dept. E, Kellett Aircraft Corporation, State Road and Landsdowne Avenue, Upper Darby (Philadelphia), Pennsylvania.

KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

Both Produce 10 Horsepower



Dow Corning HIGH TEMPERATURE VARNISH MAKES THE DIFFERENCE!

WHEREVER design limitations of electrical equipment are based on insulating temperature, you can now reduce weight by as much as 50 per cent without reduction in output. This and other long desired improvements are accomplished by utilizing the recently developed Dow Corning Silicone Varnishes. These totally new products make possible high temperature insulation of such remarkable thermal endurance that, in addition to weight reduction, the following advantages are attained:

Increased operating temperatures
Increased life under severe service conditions
Increased output

Motors of present design for use under severe service conditions of temperature and humidity may also take advantage of Dow Corning High Temperature Varnish. Dow Corning Silicone Varnished Fiberglas magnet wire, Fiberglas tapes and sleevings, and Fiberglas cloth, alone or laminated with mica, are available for use in this type of construction. We invite consultation.

Dow Corning Silicone Products Include:

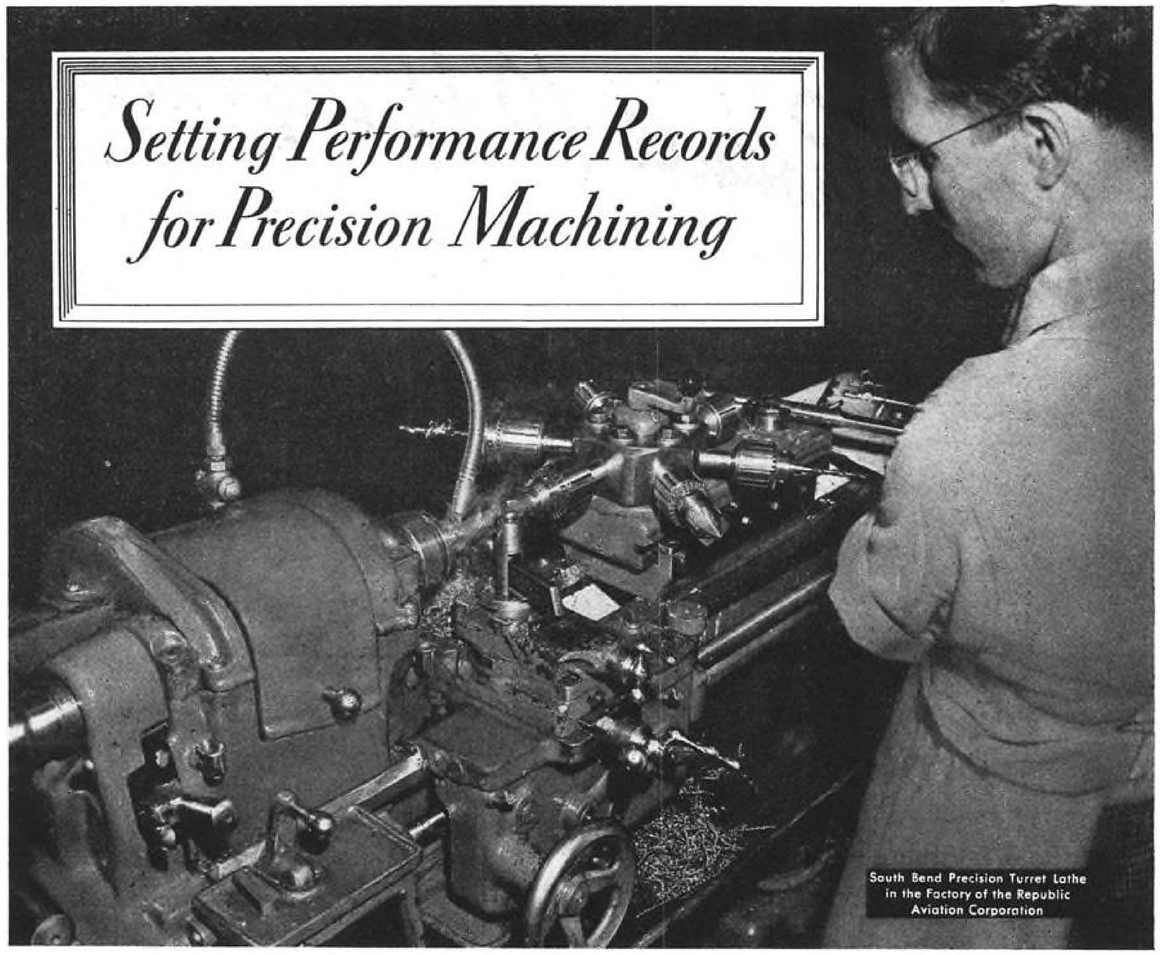
Fluids—Inert liquids, with viscosity little affected by temperature changes; for operation at sub-zero as well as elevated temperatures.

Greases—For lubrication of valves in high temperature or corrosive chemical services. Plugcock Grease—for metal valves. Stopcock Grease—for glass and ceramic valves.

DOW CORNING

DOW CORNING CORPORATION, BOX 592, MIDLAND, MICHIGAN

Setting Performance Records for Precision Machining



South Bend Precision Turret Lathe in the Factory of the Republic Aviation Corporation

High precision and close tolerances have always been the watchwords of the aviation industry. But with the war came demands for higher speeds and better performance. This meant that even closer tolerances had to be established and maintained through the greatest production schedules in history. We are proud that providing lathes to meet the exacting requirements of warplane production is one of our important assignments. Throughout the aviation industry South Bend Lathes are setting enviable performance records for precision machining.

In all metal working industries, South Bend Lathes are giving the same dependable service that they are giving in the aviation industry. Versatile and efficient, they are also used for emergency service work by the Armed Services. They travel with the Army in compact mobile machine shops. Many fighting ships of the Navy have one or more South Bend Lathes on board for making emergency repairs at sea. They are used by the Air Forces in repair bases here and overseas—sometimes even flown by plane for emergency service in remote locations.

Now, as before Pearl Harbor, our entire factory is devoted to the production of South Bend Lathes. No other product is made by us. There has been no lowering of standards because of wartime restrictions and shortages. The use of substitute materials is negligible, limited to a few non-essential parts such as name plates, paint, etc. Improvements have been accelerated. Today, South Bend Lathes are better in every way.

South Bend Engine Lathes and Toolroom Lathes are made in five sizes: 9", 10", 13", 14½", and 16" swing. Precision Turret Lathes are available in two sizes: Series 900 having 9" swing with ½" collet capacity, and Series 1000 having 10" swing with 1" collet capacity. Write for Catalog No. 100-C.

POST-WAR PRIORITY PLAN



To those who cannot qualify for a war-time priority, South Bend Lathe Works offers a practical Post-War Priority Plan. You can place your order now for any South Bend Lathe. No deposit or down payment is required. We ask only that the order be placed in good faith. When civilian production is resumed, orders will be filled in the sequence established by the numbers of the Post-War Priority Certificates. Should conditions necessitate, the order may be cancelled at any time. Write for details of this plan.

BUY WAR BONDS NOW...SAVE FOR LATHES

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 37 YEARS • SOUTH BEND 22, INDIANA



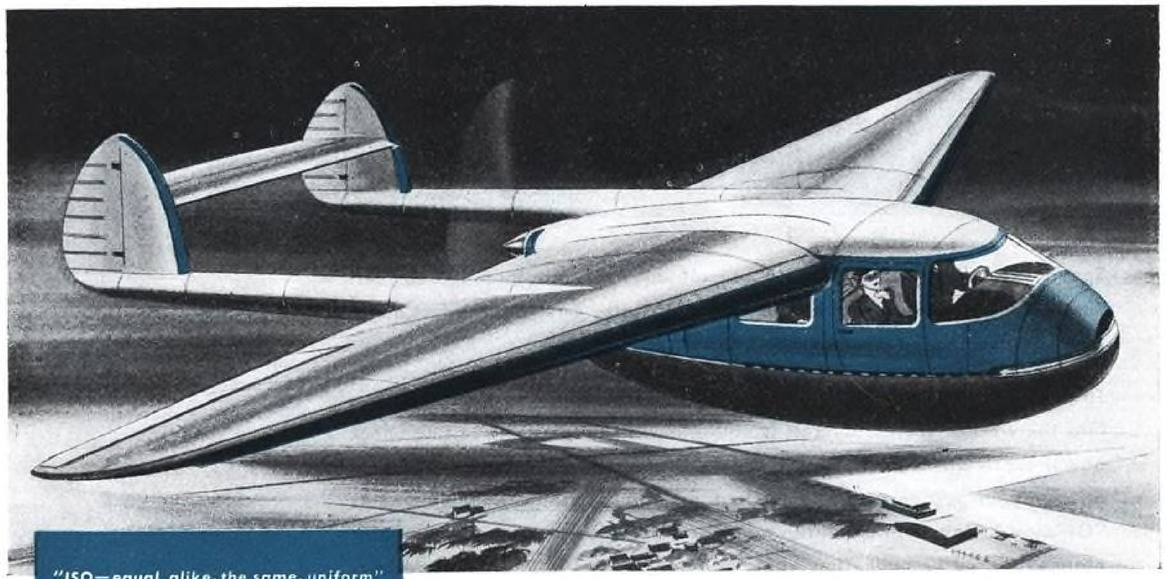
ISO-REV Constant Speed PROPELLERS

FOR UNSURPASSED EFFICIENCY

ISO-REV precision constant-speed governing at any RPM selected during flight, irrespective of power input or air speed, affords take-off at 100% of available horsepower plus optimum aerodynamic propeller efficiency and engine economy under all conditions of flight.

Today our entire energies and resources are devoted to the nation's war effort.

We feel fortunate that our contribution toward victory may also place added enjoyment and utility within reach of the plane owner of tomorrow.



"ISO—equal, alike, the same, uniform" Webster

ISO-REV CONSTANT SPEED *propellers*

AIRCRAFT SPECIALTIES DIVISION

ZIMMER-THOMSON CORPORATION

29-05 Review Avenue, Long Island City 1, New York



OFFICIAL U. S. ARMY AIR FORCES PHOTO

Near perfection of Boeing B-29 nose and tail pieces and many other vital parts is insured by G-E Industrial X-Ray inspection.

Speed exceeding 400 miles an hour—altitudes of more than 40,000 feet! That's a lot of strain on a bombing plane's vitals—one small defect might mean disaster.

To insure against such failures—to make certain each vital part that goes into the world's fastest aircraft is equal to withstanding the terrific shock and stress to which it will be subjected—U. S. plane manufacturers depend on x-ray inspection. They know that essential castings and weldments "OK'd by X-Ray" will stand the gaff—will provide our pilots with the best planes that can be built. They know that only by this reliable, non-destructive inspection method can sub-surface defects be detected—those hard-to-find flaws that might well spell misfortune.

G-E X-Ray offers a complete line of industrial x-ray units—varied types to meet every aircraft inspection need. For full information as to the unit best adapted to your needs, write or wire, today, to Department N810.

Today's Best Buy U.S. War Bonds

GENERAL ELECTRIC X-RAY CORPORATION

2012 JACKSON BLVD. CHICAGO (12), ILL., U. S. A.

BONDED with Chicago FV the Pedigreed Bond



It's the new bond that gives the ultra smooth finishes you get with Chicago Grinding Wheels—

Precision finishes undreamed of before—

Finishes so accurate that you can measure them in micro inches with a Surface Analyzer.

PERFECT FINISH INSURANCE

Whatever you have to finish—metals, alloys, plastics, wood, laminates or composition materials—you can do it better with Chicago Wheels.

Chicago Wheels have kept pace with the precision requirements of our war industries, and you can use them with confidence to finish civilian goods better in double quick time.

CHICAGO GRINDING WHEELS

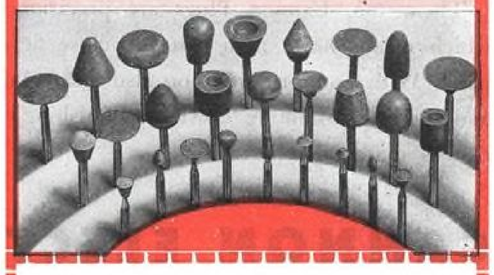
A wide range of grains and grades and—for the duration—sizes up to 3" in diameter.

CHICAGO MOUNTED WHEELS

The first made and the finest today. In a selection of bonds, abrasives and shapes to handle each job more efficiently.

TRY ONE FREE

We'll send without charge a Mounted Wheel or an FV Bond Grinding Wheel. Tell us size you'd like.



Write for Catalog listing all Chicago products and showing comparative photographs of finishes with different kinds of Wheels.

CHICAGO WHEEL & MFG. CO.

Headquarters for Mounted Wheels and Small Grinding Wheels

1101 W. Monroe St., Dept. Av. Chicago 7, Illinois

* Half a Century of Specialization has established our Reputation as the Small Wheel People of the Abrasive Industry.

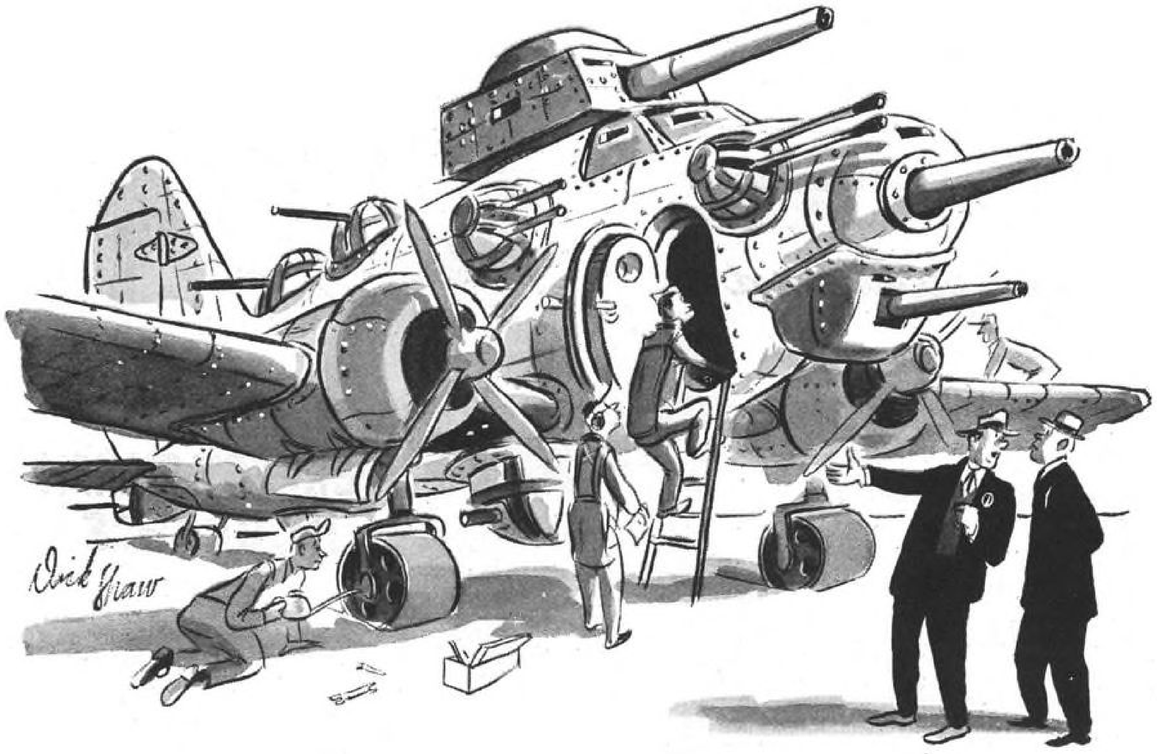
Send Catalog. Interested in AV-10

☐ Mounted Wheels. ☐ Grinding Wheels.

☐ Send Test Wheel. Size.....

Name.....

Address.....



"We saved enough weight by using Cannon Plugs to add a little more armament"

CANNON PLUGS ARE DEFINITELY ON THE LIGHT SIDE . . .

Sure Cannon Plugs do weigh a little something—but the least possible. They're engineered that way.

First off they're *designed* for aircraft use—not just adapted to it. They're strong where strength is needed. Excess weight is saved by cutting out factors that don't contribute to structural soundness.

Then, too, Cannon Plugs are precision built which means more than just the close fit of all parts. With Cannon, precision also means burring and cleaning, trimming down and finishing off all excess material.

Shells are die-cast of alloys that are tough but light. Pins and sockets machined to closest tolerances to save weight. Inserts, rings, springs, clips and clamps—each part designed to do its job exactly without waste.

The weight saved with one Cannon Plug makes little difference. But with Cannon Plugs on all the circuits a great deal is saved—actually several pounds per plane.

Speaking of weight saving, just look over the lightweight connectors in the Cannon Type AN series, built strictly to Army-Navy Specifications. A new 4th Edition Type AN Bulletin is ready for distribution. It's free for the asking. Write Dept. A-110, Cannon Electric Development Co., Los Angeles 31, Calif.



CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles 31, Calif.

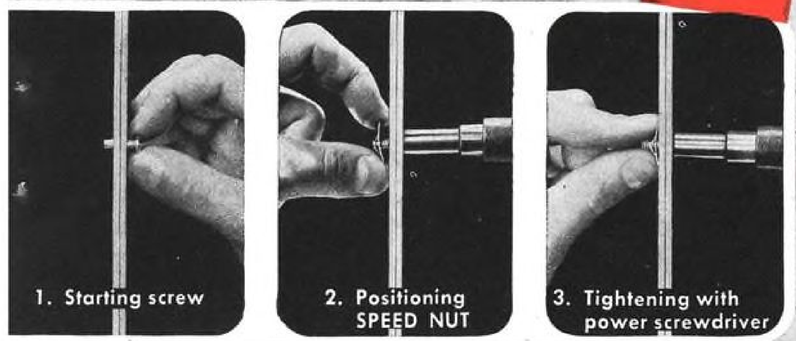
Canadian Factory and Engineering Office:
Cannon Electric Company, Limited, Toronto

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

Which is Better?



THE OLD WAY WITH 5 HAND OPERATIONS



OR THE SPEED NUT WAY WITH ONLY 3 OPERATIONS



***And* a SPEED NUT is a self-locking nut, too, that weighs less, stops vibration loosening and cuts assembly costs 40-50% . . .**

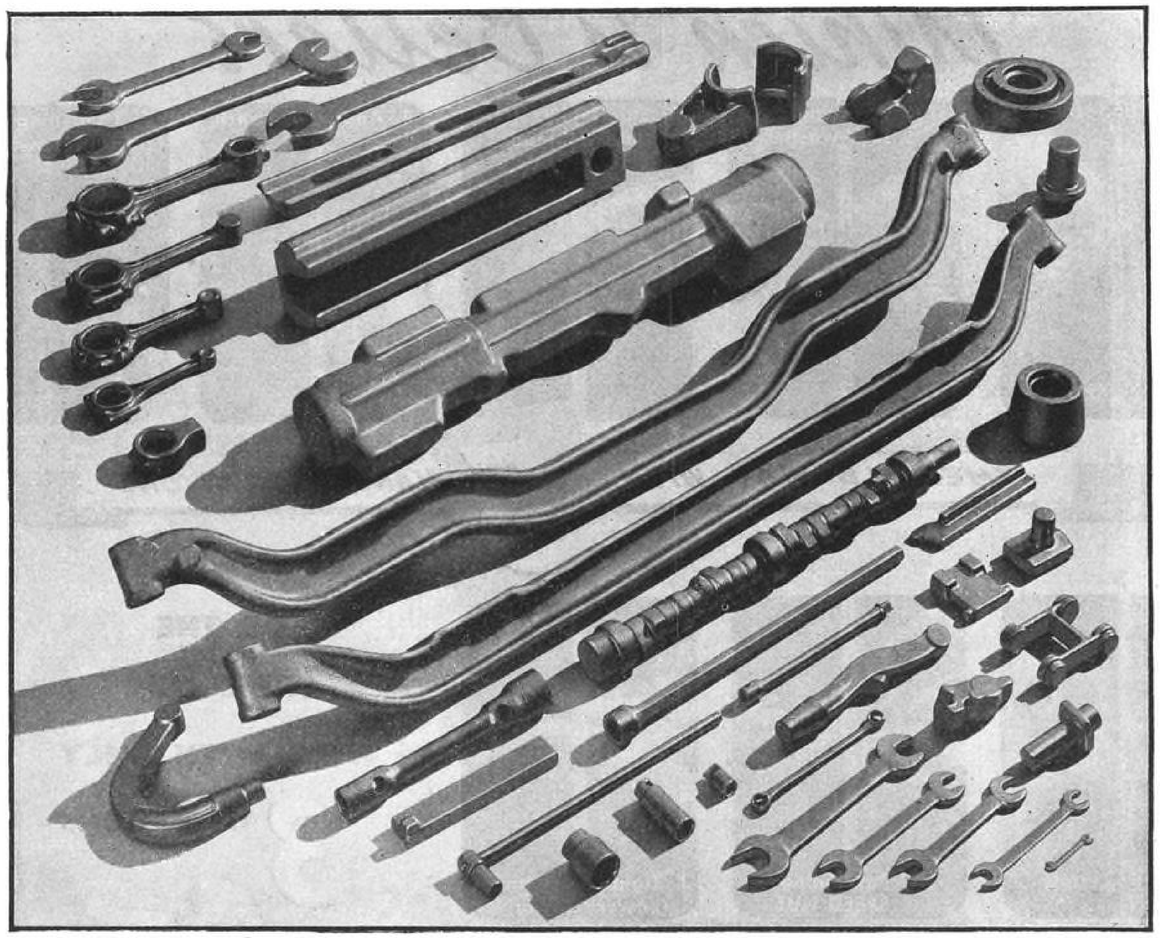
The SPEED NUT method requires only 3 hand operations as shown in photos above. And only 2 parts are needed instead of 3. Why go through 5 hand operations when only 3 are necessary? Why handle 3 parts when only 2 are required? For an eye opener on the economies of the SPEED NUT system just multiply this 40% motion-saving by the millions of fasteners you use per month. Then add to that the saving by eliminating 1/3 of the parts. Your figures will amaze you. The winning products in postwar competition will be those that are assembled faster and protected against loosening from vibration. Billions of SPEED NUTS were used before the war and on war products, too. More billions will be used on postwar products. Over 2,000 shapes and sizes. Engineers who move up faster are those who know how to make assembly lines move faster. Write for literature.

TINNERMAN PRODUCTS, INC.
2070 FULTON ROAD, CLEVELAND 13, OHIO
In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London

FASTEST THINGS IN FASTENINGS

Speed Nuts* [PATENTED]

*Trademark Reg. U. S. Patent Office



Herbrand

PRECISION FORGINGS

symbolize over 62 years of research, development and production of superior quality drop forgings

Are *you* interested in procuring drop forgings which conform to exacting specifications, and which are free from defects? If so, it will pay to remember the name Herbrand.

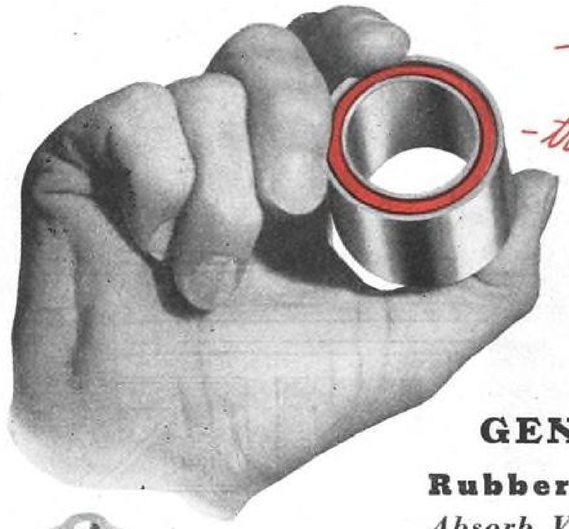
Since 1881 Herbrand has been faithfully producing quality products which reflect precise and skillful craftsmanship, and at the present time our great plants are going at top speed to produce precision forgings for war needs.

Our modern facilities include steam hammers, board hammers, upset machines, bending machines, heat treating and die making equipment. We are excellently equipped to meet any challenge for the production of quality forgings, upset or drop forged, any shape or size up to 200 lbs., as may be required for post-war production.

Today the counsel of the Herbrand engineering staff is available to help solve present war production problems, or for post-war planning . . . Your inquiries are solicited.

THE HERBRAND CORPORATION
FREMONT, OHIO

Will Your New Product Offer Improvements Like These?...



– less vibration
– less noise
– trouble-free torque bearings
– lower upkeep

GENERAL SILENTBLOC

Rubber Mountings and Bearings

Absorb Vibration... Allow Torque Action ...Correct for Misalignment



SILENTBLOC MOUNTING to control vibration from motor, cushion shock loads, isolate vibration between parts of equipment or insulate delicate instruments and controls from foreign vibration. Engineered design determines rate of deflection in any plane.

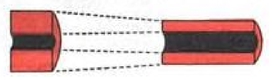


SILENTBLOC TORQUE BEARING lasts as long as the machine, never needs lubrication, makes no noise, cannot slip. Degree of torque is engineered into the bearing by experienced General designers.

YOUR customers expect improvements in your new products—and General Silentbloc can help you deliver them. These shear-type mountings, bearings and couplings are engineered to:

1. Control vibration and cushion shock-loads.
2. Give trouble-free torque action.
3. Correct for misalignment in hinges, bearings and shaft mountings.

Silentbloc are simple in construction, easy to install and practically indestructible.



Before Assembly After Assembly

They consist of an outer metal tube into which a rubber ring is inserted under pressure, with a sleeve or shaft "shot" through the ring. This patented process *elongates* and *confines* the rubber, the extreme tension giving a cohesion of rubber-to-metal which cannot rupture. The stretched rubber stays *alive* and resilient.

Silentbloc mountings and bearings can be engineered by General to solve *your* exact problem. They are made any size, to carry loads of ounces to tons. Any metal—steel, bronze, aluminum, magnesium—can be used. By variation of size and design, elongation and distortion of rubber and kind of rubber, Silentbloc can be made to give *predictable performance* under axial, radial, conical or torque loads.

Silentbloc efficiency has been proved in automotive products, aircraft, industrial machinery, home equipment, electrical products, marine equipment, and war mechanisms. To learn how it can improve your product, write now for factual booklet. The General Tire & Rubber Company, Dept. 83, Wabash, Indiana.



SILENTBLOC BEARING provides a cushion for needle or ball bearings, shaft supports in series, and hinges, which corrects for misalignment. Saves time and money in production, gives longer life and lower upkeep.

THE GENERAL TIRE & RUBBER CO.
Mechanical Products Division, Wabash, Indiana

The GENERAL SILENTBLOC
MOUNTINGS... BEARINGS
COUPLINGS

It pays to be adaptable!



After the war, Crown Zipper engineers will adapt—or if necessary, *create*—special applications to meet special needs!

A lot of old-fashioned notions were exploded when Crown Zipper engineers went into the field with our armed forces to adapt zippers to military jobs.

Crown engineers proved that zippers can be big and tough yet easy to operate, small and dainty yet virtually indestructible!

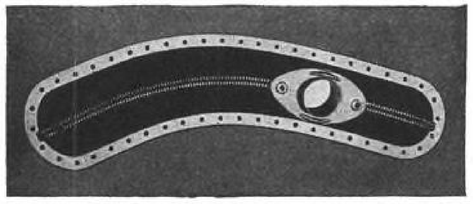
They proved zippers can be made that actually slide freely around sharpest curves!

They proved two or more sliders can be put on the *same* zipper track—to provide openings at any given point with smooth closures in both directions!

In fact, they made more big, important improvements in zipper design than anyone dreamed possible. (See complete list of Crown superiorities below.)

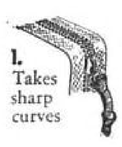
But perhaps the most important thing they proved is that zipper designs don't *have* to be "frozen"—zippers can be *adapted* to the *job!*

When *you* turn to postwar, Crown engineers will be able to show you exactly what this means in terms of longer zipper life and easier operation on aircraft equipment. Crown engineers will adapt—or, if necessary, *create*—special Crown Zippers to meet your own individual manufacturing problems!



"DOUBLE-ACTING" CROWN ZIPPER ON AIRCRAFT GUN TURRET OPENS AHEAD OF GUN OPENING, CLOSES BEHIND IT.

CROWN ZIPPERS are 5 ways better



1. Takes sharp curves



2. Die-cast for smoother action—extra strength



3. Provides opening wherever you want it



4. Won't lock open

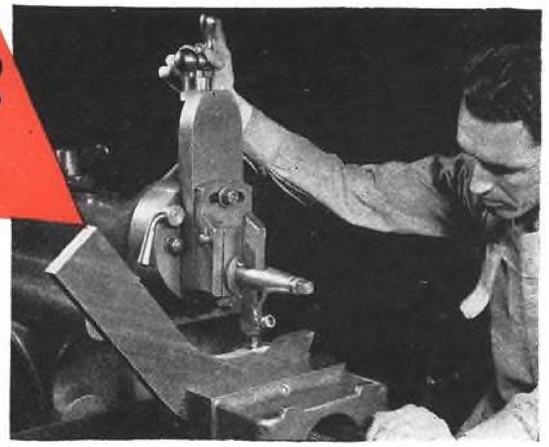


5. Resists corrosion

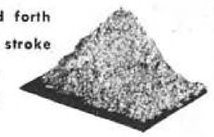
Member of the J. & P. Coats • Clark's ONT *Family*

THE SPOOL COTTON COMPANY • *745 Fifth Avenue, New York, N. Y. (Crown Fastener Division)*

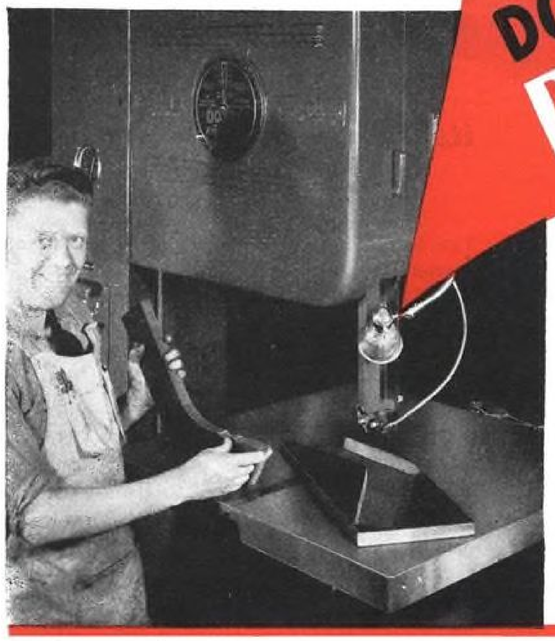
WHY TIE UP YOUR SHAPER FOR 5 HOURS?



Shaper grips the work in a vise, the cutting tool shuttles back and forth cutting on only one cycle. Each stroke makes one chip until the entire section removed is reduced to a worthless heap.



DoALL slices out the part to within .005 of the layout line, leaving the section removed in a solid, usable piece.



DO IT ON THE DoALL IN ½ HOUR

DoALL is the contour sawing machine that is doing such a grand job of (both internal and external) metal shaping, saving hundreds of man hours and thousands of pounds of valuable material. Cuts tubing, blocks, bar stock or stacked sheets.

Here's one machine tool that won't require any change-over adjusting when civilian production is given the full go-ahead signal. So, get set now with one or a battery of DoALLS.

Ask for circular EIGHT DIFFERENT JOBS, illustrating DoALL versatility.

VISIT US AT THE METAL SHOW, CLEVELAND, OCT. 16-20



DoALL

INDUSTRY'S NEW SET OF TOOLS

CONTINENTAL MACHINES, INC.

1305 S. Washington Ave. • Minneapolis 4, Minn.

Sales & Service Offices: Baltimore, Boston, Chicago, Cleveland, Denver, Detroit, Erie, Houston, Indianapolis, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Orlando, Philadelphia, Pittsburgh, Rochester, Rockford, St. Louis, San Francisco, Seattle, Toledo, Tulsa, West Hartford.

The Quick-Disconnect for small wires

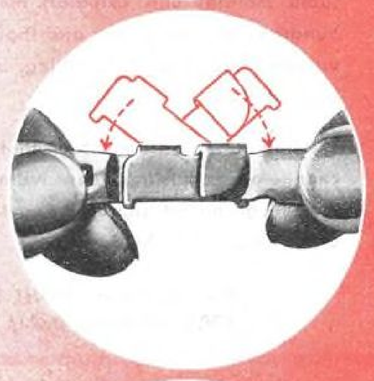
The Burndy clasp



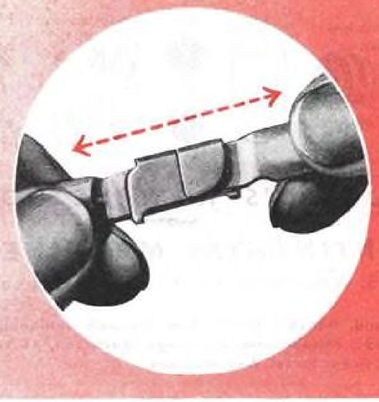
1
Lay halves together



2
Rotate to stop



3
Pull to LOCK
(simply push to disconnect)



its two identical halves LOCK TOGETHER

Two features distinguish this improved detachable connector for small wires:

1. When closed, its contact surfaces are firmly LOCKED . . . to prevent loosening from "pull" in any direction!
2. Heavy silver plating of each identical half assures "clean" contact surfaces . . . better conductivity!

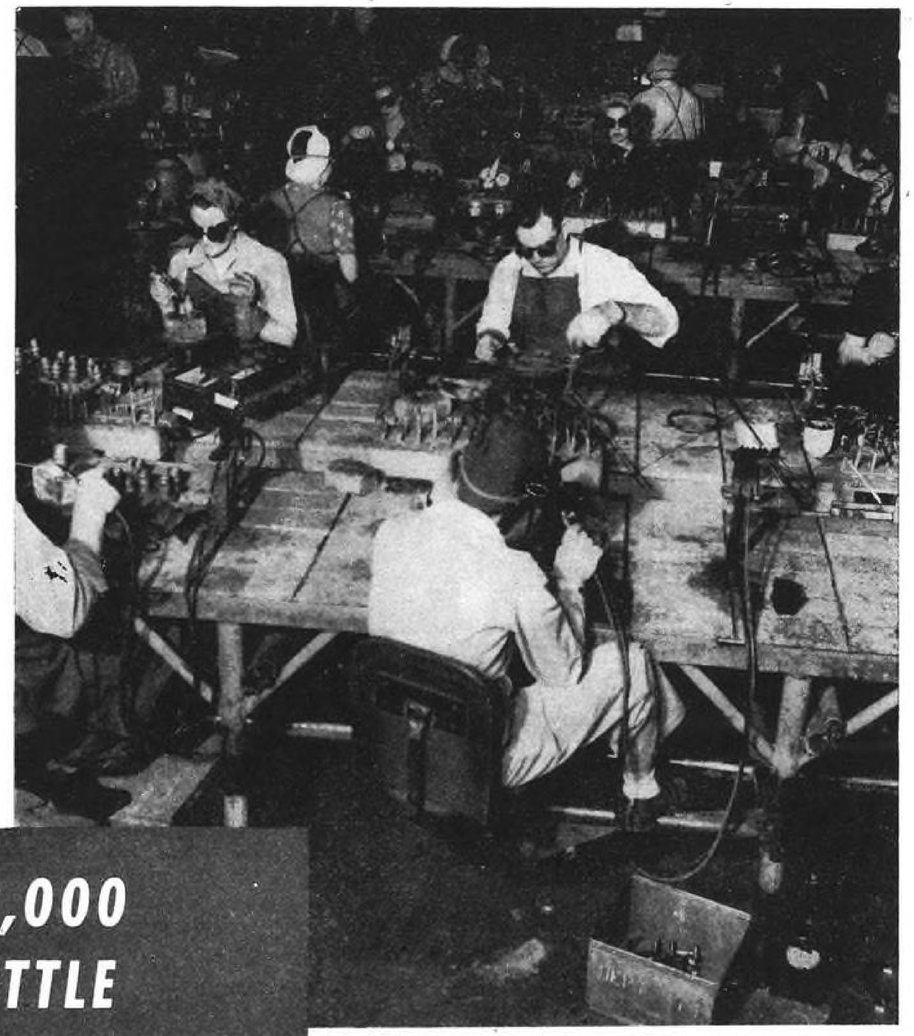
It's a "quick-action" connector, too. It *LOCKS* as it *connects* . . . and a reverse "push" and "rotation" of the two halves, instantly disconnects.

The Burndy CLASP is available for wires from No. 22 to No. 8; the halves being firmly *indented* to the conductors in the usual Burndy way. Available, too, without locking tabs. Samples gladly furnished on request. Burndy Engineering Company, 107 Bruckner Boulevard, New York 54, N. Y.

IN CANADA: Canadian Line Materials, Limited, Toronto 13

Headquarters for CONNECTORS

Burndy



10,000 LITTLE VICTOR FLAMES

Portion of the Small Parts Welding Department ... courtesy of Douglas Aircraft Company

10,000 active little VICTOR welding torch flames in the hands of 10,000 experienced men and women welders perform a vast job in the welding and brazing of the myriads of small parts and structures entering into aircraft and other vital war materiel.

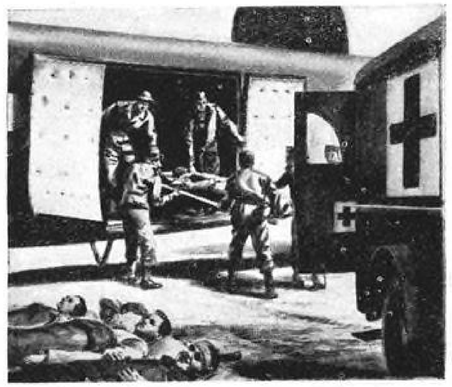
Of course, there are tens of thousands of other and larger VICTOR welding torches in operation here and abroad ...but when it comes to the intricate and dependable type of welding these small jobs demand, you too will find VICTOR welding and cutting apparatus the finest type of insurance.

VICTOR EQUIPMENT COMPANY
844 FOLSOM STREET · SAN FRANCISCO
VICTOR DISTRIBUTORS FROM COAST TO COAST

VICTOR

This advertisement is one of a series which is appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of transportation's role in the war, and its postwar opportunities and responsibilities.

Sulfa, Plasma—and Air



1. Since the start of the war, thousands of wounded Americans have been evacuated from battle zones by air. Said the Air Surgeon General's report: "The record places air evacuation in a group with the sulfa drugs and blood plasma as one of the three greatest lifesavers of modern military medicine."



2. In long-range transport planes such as the Liberator Express, no wounded American fighter is more than 60 hours' flying time from the finest hospital in the U. S. A.



3. As the hospital plane streaks across the ocean, a flight nurse gives somebody's blood – perhaps *yours* – to this wounded soldier who might otherwise never get home for the special care that will restore him to health.

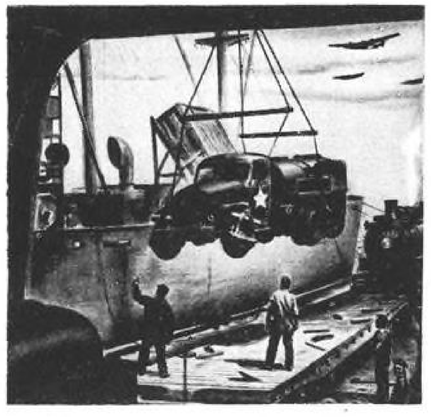


4. From many a remote combat zone, the plane is the *only* means of getting casualties back to base hospitals.

CONSOLIDATED VULTEE AIRCRAFT



5. The ambulance, hospital train, and hospital ship still transport most of our war casualties. But many a time when *minutes* can save a life, the 4-mile-a-minute speed of the flying ambulance does exactly that!



6. One reason we are winning the war is the way in which the truck, the train, the ship, and the plane are teaming up together. And the task of rebuilding the peacetime world will be a challenge which all forms of transportation must meet in the same way.

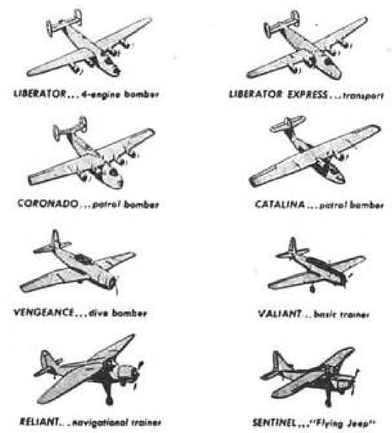
• • •

But the plane, in addition to its use as a global air transport, will have still *another* role to fulfill: a permanent postwar Air Force can well become the ever-watchful guardian of the peace we shall have won so dearly.



No spot on earth is more than 60 hours' flying time from your local airport

From "Flying Jeeps" to Leviathans of the air — *The planes shown below were all designed and developed by Consolidated Vultee. When peace comes, the company will be in a position to provide the postwar equivalent of such planes, from small, privately owned "air flivvers" to huge, transoceanic cargo-and-passenger planes.*



QUICK FACTS FOR AIR-MINDED READERS

Air Giant — The new Consolidated Vultee Model 39 transport plane – the Liberator Liner – has passed its test flights successfully. Capacity of this 4-engine transoceanic airliner: 48 passengers—or, as a sleeper, 24. Top speed: 275 m.p.h. Flying range: over 4000 miles.

Airport for Air Giants — New York City's projected airport will have runways totalling 13 miles in length, one of which will be over 2 miles long. This airport can handle 1000 plane movements per day. (Capacity of present N. Y. airport: 270 plane movements per day.)

• • •

1000-mile Shuttle Trips — The Naval Air Transport Service in the Pacific now flies 320,000 miles per week, carries over 5500 passengers monthly, reports that it "adds another stop every time the Japs lose another island."

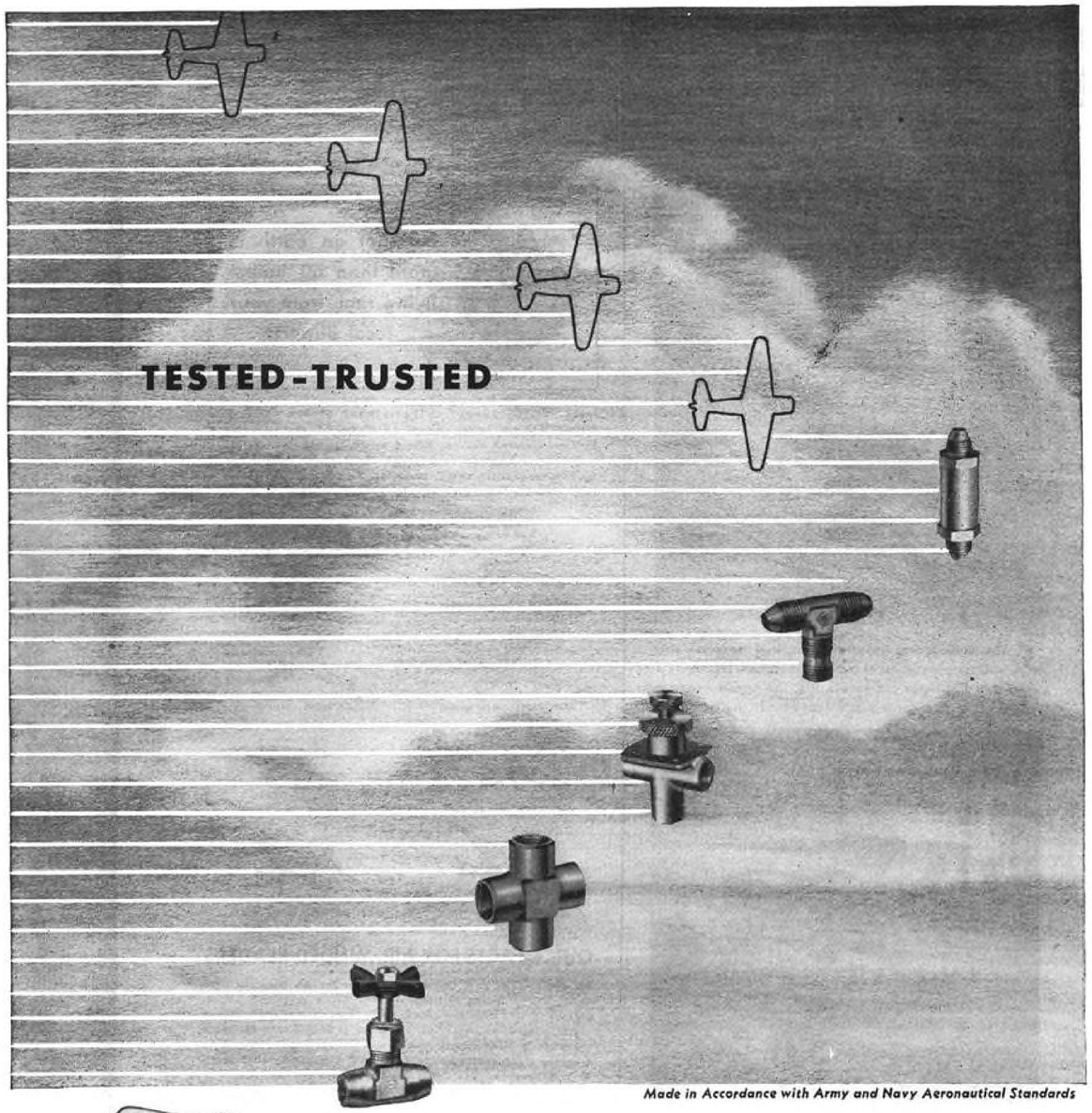
Tomorrow's Airmen: The total strength of the Army Air Forces now exceeds 2,300,000 officers and enlisted men—a vast reservoir of skilled pilots and aircraft technicians which will insure postwar America's remaining "a nation on wings."

Consolidated Vultee is the largest builder of airplanes in the world.

CORPORATION

San Diego, Calif. · Vultee Field, Calif. · Fairfield, Calif. · Tucson, Ariz. · Fort Worth, Texas · New Orleans, La. · Nashville, Tenn. · Louisville, Ky. · Wayne, Mich. · Dearborn, Mich. · Allentown, Pa. · Elizabeth City, N. C. · Miami, Fla.

Member, Aircraft War Production Council



Made in Accordance with Army and Navy Aeronautical Standards

From pilots to the smallest parts of the planes they fly, everybody and everything is tested repeatedly. This is the basis for confidence and the fact that our Air Forces can be trusted to give such a good account of themselves.

DOLE AIRCRAFT VALVES & FITTINGS

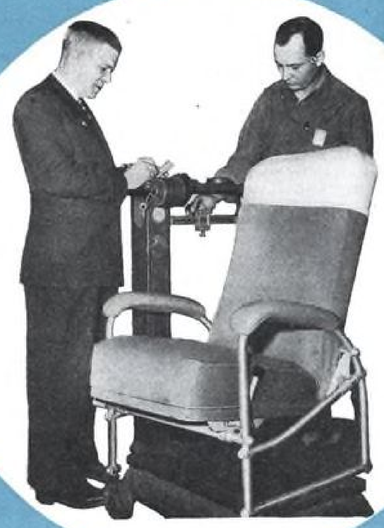
THE DOLE VALVE COMPANY • 1901-1941 Carroll Ave., Chicago 12, Illinois • LOS ANGELES • DETROIT • PHILADELPHIA

SAVE 157½ LBS



CURTISS-WRIGHT
SIKORSKY
CONSOLIDATED
BREWSTER
DOUGLAS
NORTHROP
CHRYSLER
BELL

BUDD
MARTIN
NORTH AMERICAN
BOEING
LOCKHEED
GOODYEAR
FAIRCHILD



Ed. Ratchel, Assistant Maintenance Superintendent and Don Hausen, chief mechanic, Western Air Lines, checking weight of 26 pounds of Warren McArthur passenger seat Model number 154-1E . . . 7½ pounds lighter than conventional seat.

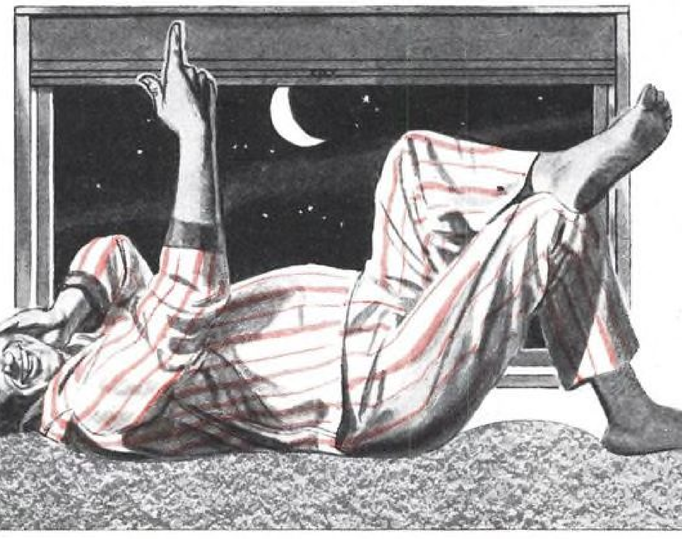
WESTERN Air Lines . . weight streamlining Douglas DC-3 for opening deluxe service . . San Francisco-Los Angeles, May 1, made greatest weight saving through installation of new Warren McArthur passenger seats. A saving of 7½ pounds per seat . . total 157½ pounds. "Save one ounce in dead weight, add one ounce to pay load", is one basic factor in Warren McArthur design.

WARREN McARTHUR CORPORATION
ONE PARK AVENUE NEW YORK CITY
DESIGNERS, ENGINEERS AND MANUFACTURERS OF AIRCRAFT AND NAVY SEATING
PILOT'S • CO-PILOT'S • NAVIGATOR'S • RADIO OPERATOR'S • REAR GUNNER'S • CAMERA OPERATOR'S • FLIGHT ENGINEER'S • NAVY PATROL STEERSMEN • BOMBARDIER • WARDROOM • OBSERVATION AND TRANSPORT SEATS



6

NOTHING TO SLEEP ON...



...IS SO RESTFUL AS FOAMEX*



That picture at the top isn't so far from the truth. It does feel like effortless floating to sleep or sit on *Foamex*.

This wonderful latex foam cradles your passengers on millions of air-breathing cells.

It molds itself to the body, supports more completely. Yet it's so deeply resilient, it lets muscles and flesh really relax.

Every one of those live *Foamex* cells acts like a little air-valve shock absorber. Every one says "No admittance" to vibration. Each one literally breathes to ventilate the mattress or seat, make it cooler, cleaner, odor-proof and damp-proof.

Every *Foamex* mattress, seat, and back is *one molded piece*, sag-proof, lump-proof — almost wear-proof. Thousands of railroad, plane and bus installations, made years ago, still serve perfectly under tough wartime use.

All the *Foamex* being made today is for the war job. When that job is done, and passengers must again be wooed instead of shooed, remember:

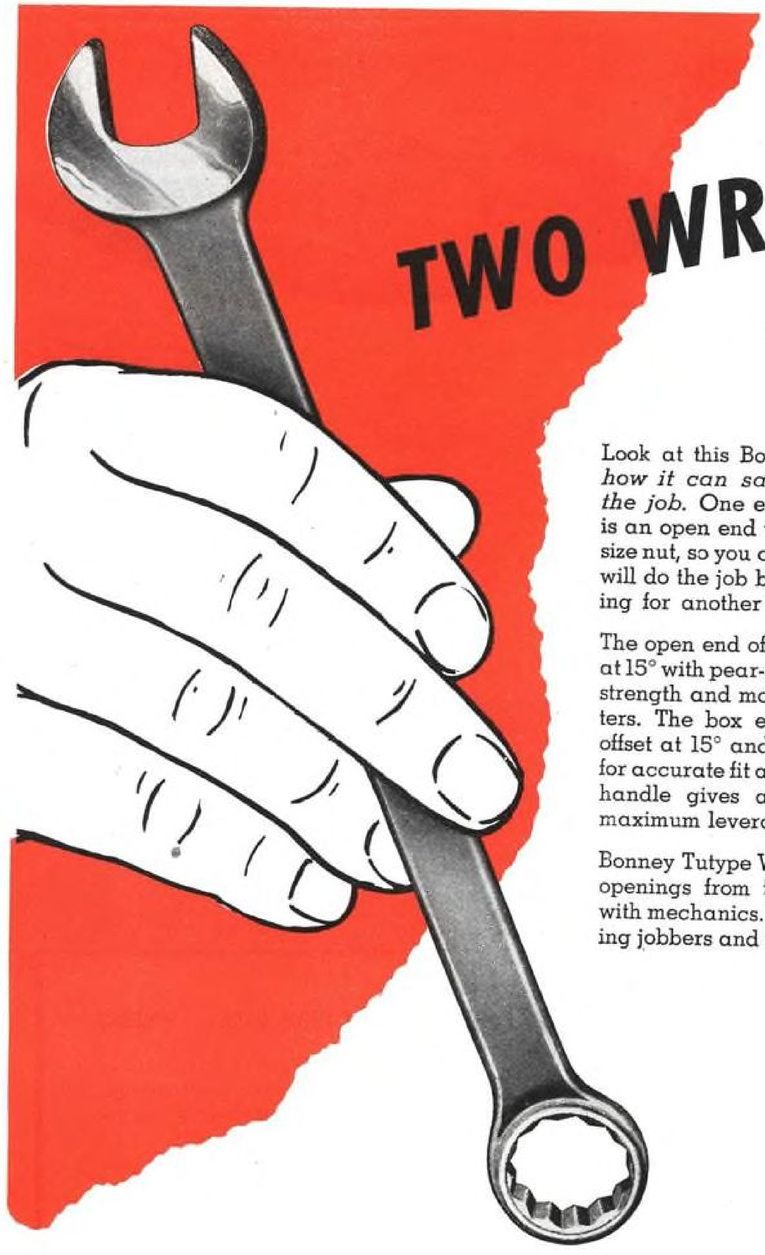
NOTHING TO SLEEP OR SIT ON IS SO RESTFUL AS FOAMEX.



*TRADEMARK

ANOTHER CONTRIBUTION TO A BETTER WAY OF LIFE by **Firestone**

LISTEN TO THE VOICE OF FIRESTONE, MONDAY EVENINGS OVER NBC.



TWO WRENCHES *In One*

Look at this Bonney Tutype Wrench and see *how it can save you time and bother on the job.* One end is a box wrench, the other is an open end wrench. Both ends fit the same size nut, so you can use whichever type opening will do the job best—without wasting time looking for another tool.

The open end of this Bonney Wrench is angled at 15° with pear-shaped head to provide greater strength and more turning room in close quarters. The box end, with thin, strong walls is offset at 15° and is pull-broached to exact size for accurate fit around the nut. The oval-shaped handle gives a firm, comfortable grip and maximum leverage.

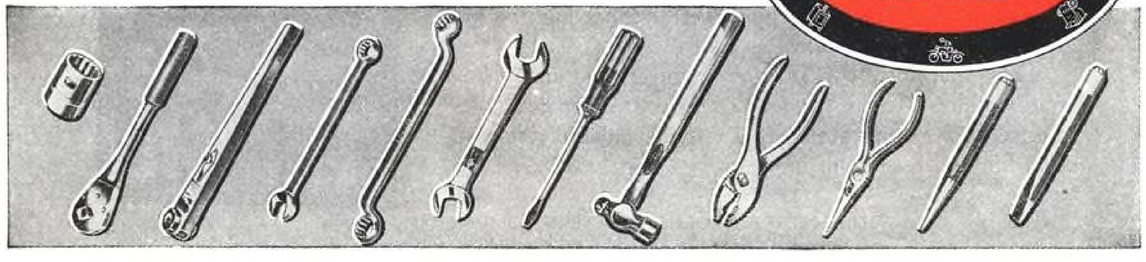
Bonney Tutype Wrenches, made in 17 sizes with openings from 5/16" to 1 5/16", are big favorites with mechanics. Bonney Tools are sold by leading jobbers and distributors from coast to coast.



BONNEY FORGE & TOOL WORKS

711 N. MEADOW ST. • ALLENTOWN, PA.

BONNEY TOOLS





History Repeats . . .

1917
1944

IT was in 1917 when America's fighter planes first went into action over France. It was in the same year —and in these same planes—that Exide Batteries first took to the air. They have been flying ever since —on voyages of discovery, on pioneering flights, in commercial service. And now—history repeats—Exide equipped military aircraft again are in action against the enemy—this time in all parts of the world.

To withstand the gruelling hardships of this destructive war, batteries, like other aircraft equipment, must have extra sturdiness, abundant power, and thorough dependability. That Exides have all these qualities, is a fact well known to aviation engineers and aircraft builders. Today, ground crews too, in every theatre of war, are learning of Exide dependability, long-life and ease of maintenance.

A LETTER FROM OVER . . . WHERE?

Every day interesting letters are received from some of the more than 1300 Exiders in the Service. A sailor, writing from one of the seven seas, says in part:

"I see where my ex-fellow-employees 'brag' that they have Exides where they are. Well, I want to 'brag' too. We also have them in the planes we fly. I hope you understand I can't tell you where I am, but you can bet Exides are here too."

ARMY NAVY

Exide
AIRCRAFT
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32, Pa.
Exide Batteries of Canada, Limited, Toronto

HOW TO KEEP 15,000 TRUCKS ON THE GO





These Elastic Stop Nuts are holding the driving flange. Even with frequent starts and stops, and the steady use the wheels of an express truck get, these nuts hold fast.

Railway Express truck bodies are completely fastened with Elastic Stop Nuts. Where other fastenings give with the sway and twist of the truck, these nuts hold tight.

Throughout the chassis, Elastic Stop Nuts are used wherever ordinary nuts loosen in service. Here they are fastening the hand-brake drum on the propeller shaft.

ON the road, trucks earn their keep. In the shop they eat their heads off.

The Railway Express Agency knows that well. And they learned one of the answers to keeping trucks on the go way back in 1927.

They use Elastic Stop Nuts — use them on a great many of their 15,000 trucks.

The reasons? These nuts increase safety and cut down mishaps. They reduce maintenance time and upkeep costs.

Elastic Stop Nuts go on like ordinary nuts. They need no auxiliary locking devices. They can be taken off and put back on time and time again and still lock. Nothing — even severe vibration — shakes them loose.

It's the elastic collar in the top that does the trick. It hugs the bolt threads tight. It cushions vibration. The nut can't shiver loose and turn.

Today billions of these nuts with the ESNA red collar are being used on our aircraft. A bomber takes as many as 50,000 in a single ship.

In the days to come there will be countless fastening problems on all kinds of products. Perhaps you have one now.

If so, we'd like to talk about it. Our engineers are at your service ready to recommend the right Elastic Stop Nut to provide a safer, surer, trouble-free fastening.

Major spots where Elastic Stop Nuts are at work on Railway Express Agency Trucks

Steering post — fasten bracket to cowl • Steering post — hold bracket to chassis • Drive shaft and universals • Master-brake cylinder to bracket • Hand-brake drum to shaft • Gas tank straps • Propeller shaft center carrier • Clutch and brake pedal brackets • Rear wheel hubs • Motor supports on cross member • Shackle bolt lock pin • Front bumper brackets • Cab bolts • Body hinges • Truck bodies — approximately 375 nuts.

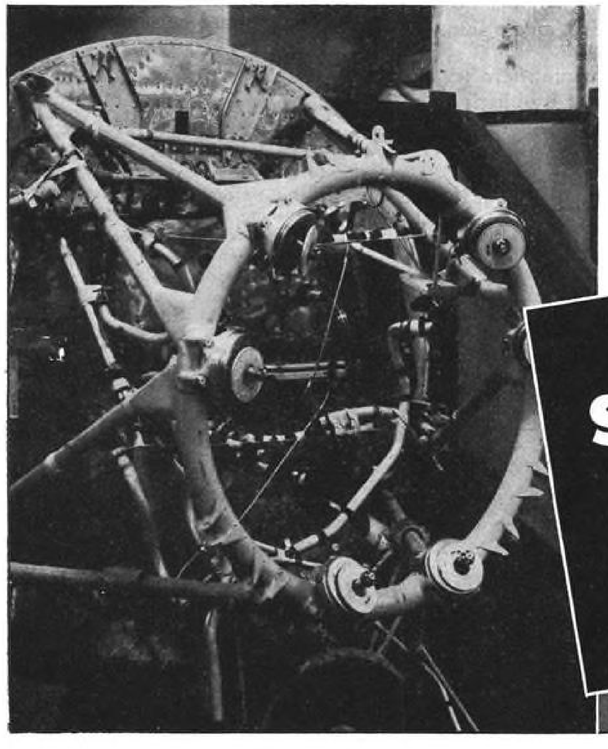


ESNA
TRADE MARK OF
ELASTIC STOP NUT CORPORATION OF AMERICA
ELASTIC STOP NUTS
Lock fast to make things last
UNION, NEW JERSEY AND LINCOLN, NEBRASKA

OVER THE "HUMP" TO CHINA with the COMMANDOS



Engine mount for Curtis Commando made of SHELBY Seamless Aircraft Tubing. Pound for pound it is the strongest type of construction known.



Seamless steel tubing pulls them up and sets them down

THE big Commandos that fly over the "Hump" to China are making history. In spite of "impossible" difficulties and enemy attacks these huge planes are keeping open the last supply line. They are freighting millions of pounds of war material into hard-pressed China through the 20,000 foot peaks of the ice-clad Himalayas. Jeeps, light artillery, spare engines, gasoline drums, ammunition and other material are being lugged over the mountains and then landed on the small, hazardous fields of China. Such service puts a terrific strain on the vital parts of the ship.

The engine mounts in particular must be absolutely dependable. There are no emergency landing fields in the Himalayas. The seamless tubes and the ring that hold the powerful engines in place are SHELBY Seamless Aircraft Tubing—the finest obtainable. These engine mounts have high resistance to vibration and fatigue and have proved so satisfactory in service that the basic design has remained practically the same since the start of the war.

When the Commandos sit down at the end of the flight, the success of the whole trip depends on the ability of the landing gear to absorb the shock of the heavily-loaded ship. Here again, SHELBY Seamless Steel Tubes are used for the tough jobs and can be depended upon to take the punishment of rough fields.

Much of the tubing for the Commandos, Flying Fortresses, Liberators and dozens of other planes is furnished by National Tube Company. No matter what type of aircraft tubing you need, National's Complete Aircraft Tube Service can furnish it.

Landing gear on the C-46 Commando. Seamless steel tubing plays an important part in bracing and taking the thrust of the main oleo strut.



SHELBY SEAMLESS *Aircraft Tubing*

WALLS WITHOUT WELDS

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL



You Still Have TIME

to enter this Popular POST-WAR "AIRCRAFT QUIZ"



THOUSANDS have already filled in and returned their answers to the Bellanca Aircraft Quiz. Perhaps there's no easier, more convenient way to register your views on post-war personal aircraft.

This is all you do. Send for the printed Aircraft Quiz, and check your answers. Later we'll mail you a digest of the score, so you can compare your preferences with those of many others who are intensely interested in peacetime flying.

You'll find the many provocative questions appearing in this Quiz worth *thinking* about! Let's take four or five questions at random, so you'll see what we mean. For example, how many engines do you want? Some say one, others prefer two! Another question is: What cruising and top speeds? Here you'll find a list of speeds beginning at 115 cruising with 130 top speed and ranging to 200 cruising with 250 top. Simply check-mark the speed *your* post-war plane should have—and if our table doesn't go high enough, just write in your speed!

Again there's the question on wing characteristics. Do you want a fixed, folding or detachable wing? And a related question—which wing style is your favorite: low-wing? mid-wing? high-wing? biplane? You'd be surprised how the vote is running on these basic features.

One of the most-discussed subjects on our popular Aircraft Quiz is the landing gear question. Here are the check-off items: Fixed streamlined? retractable? tricycle streamlined? tricycle retractable? Which do *you* prefer? Why not give some thought, now, to this and the many other points of post-war aircraft design and operation covered by this amazing Quiz? It takes no time to fill out and check your answers—and it helps you develop more definite ideas that may serve you well when the happy day comes to buy and fly your own plane!

We've been offering the Bellanca Aircraft Quiz in the magazines for several months, while proceeding with our war work, building armaments and components for victorious United Nations warcraft. Men and women have written for the Quiz from Brazil, Chile, Mexico and Canada — from New Guinea, Australia, England and almost every place where Americans carry the flag of freedom — plus thousands within the nation. Yes—there's still time to enter your name in this Quiz. Just write us—you'll get the Quiz, free of obligation, by return mail.

BELLANCA AIRCRAFT CORPORATION
Dept. S-3, New Castle, Delaware

Keep on Buying U. S. WAR BONDS



BELLANCA



TWO THINGS INDUSTRY MUST DO NOW TO MAKE HIS AMBITIONS COME TRUE

The American soldiers' ambitions must come true. In making them come true, American Industry has a tremendously important part and responsibility.

Enormous purchasing power must be maintained to make these dreams come true. We recognize in War Bonds not only their essentiality in providing the materials of war but their essentiality in contributing to the winning of the kind of a peace-time America of which every soldier dreams.

The first thing we must do is to continue with our every resource that which American Industry has been doing with such outstanding success . . . the unceasing, never-ending, all-out support of War Bond Sales.

Second, we must WORK our hardest at the job of putting our houses-in-order so that we can produce MORE GOODS . . . BETTER GOODS . . . GREATER VALUE IN GOODS and SECURE GREATER EFFICIENCY IN GETTING THEM INTO THE HANDS OF THE ULTIMATE CONSUMER.

The miracle of American War Production is an actuality. The miracle of post-war American Production is the challenge. We are confident that American Industry will be ready to meet it.

★

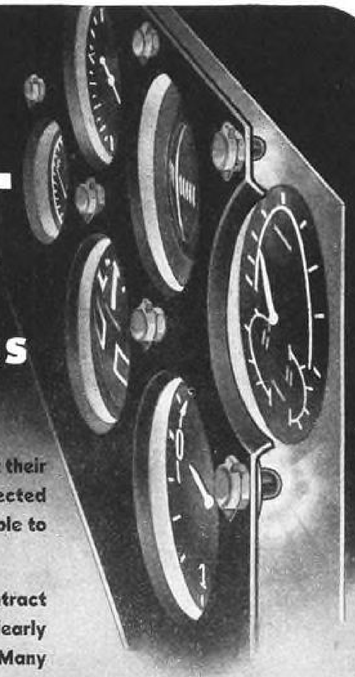
This message is published in the interests of War Bond Sales and a prosperous post-war America of Free Enterprise by Burgess-Norton Mfg. Co., the services of whose Engineering Staff, Metallurgical and Research Laboratories are available now to the manufacturers who will require piston pins, screw machine parts, heat treated and ground steel products, hydrogen copper brazing, non-precision ball bearings and related fabricated steel products.

Burgess Norton
MANUFACTURING COMPANY
40 years in GENEVA, ILLINOIS

A Part is Never Made Right unless it is Satisfactory to Our Customers

The Red
MIDGET LIGHT

THAT STOPPED NIGHT BLINDNESS





INDIRECT INSTRUMENT LIGHT No. A-2870
Units are mounted in false panel — usually two to a dial. Bulb has red plastic cover.

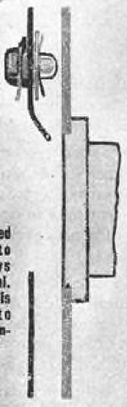
Our pilots, flying on night missions, found that their eyes were often partially blinded by glaring reflected light from the instrument board. They were unable to readily pick up objects in the outer darkness.

Nature permits the pupil of the eye to contract when exposed to light, to dilate to see more clearly in the dark—but this action is not instantaneous. Many seconds, precious to flyers, are required for the change in adaptation.

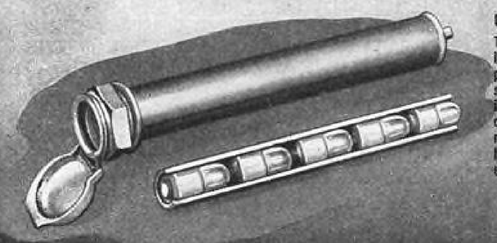
Experiments showed that red light rays, properly controlled, permit pilots to clearly observe their instruments. At the same time such light appreciably shortens time required for eyes to become adapted to outer darkness.

Grimes developed and introduced the new indirect "Red Midget Light" for instrument illumination. It is a tiny, self-contained and readily serviced unit installed in a false panel over the instrument board. Located in front and slightly above the dials, it provides a subdued red glow that may be varied to suit individual pilot preference. Instruments are plainly visible yet there is minimum objectionable glare to cause change in the dark-adapted pupil of the eye.

Another Grimes aircraft lighting innovation brings greater safety and efficiency to our air forces. In a like manner Grimes will help solve your lighting problems for post-war flying.



TYPICAL PANEL INSTALLATION
Lights are mounted in front panel to direct light rays downwardly to dial. Flanged section is deep enough to minimize objectionable reflections.



SPARE LAMP HOLDER No. A-2953
This holder containing five spare lamps, part A-2877, is installed conveniently in panel. Capped cover on light makes replacement of burned-out lamps easy and quick.

GRIMES MANUFACTURING CO.

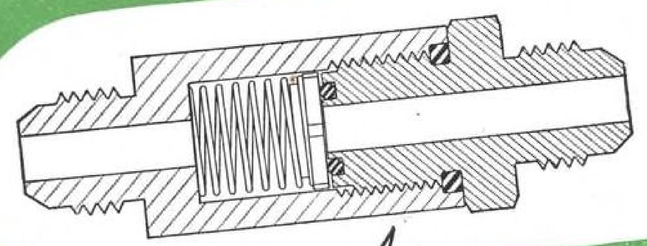
URBANA, OHIO

If it's Aircraft Lighting...

GRIMES

ARMY E NAVY

Designs and Makes it!

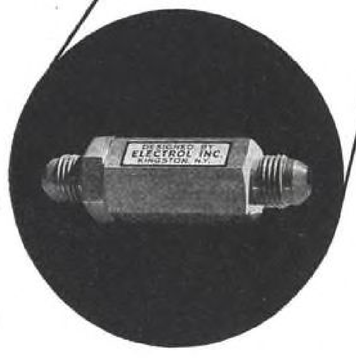


Achievement

in hydraulic design

ELECTROL'S CHECK VALVE

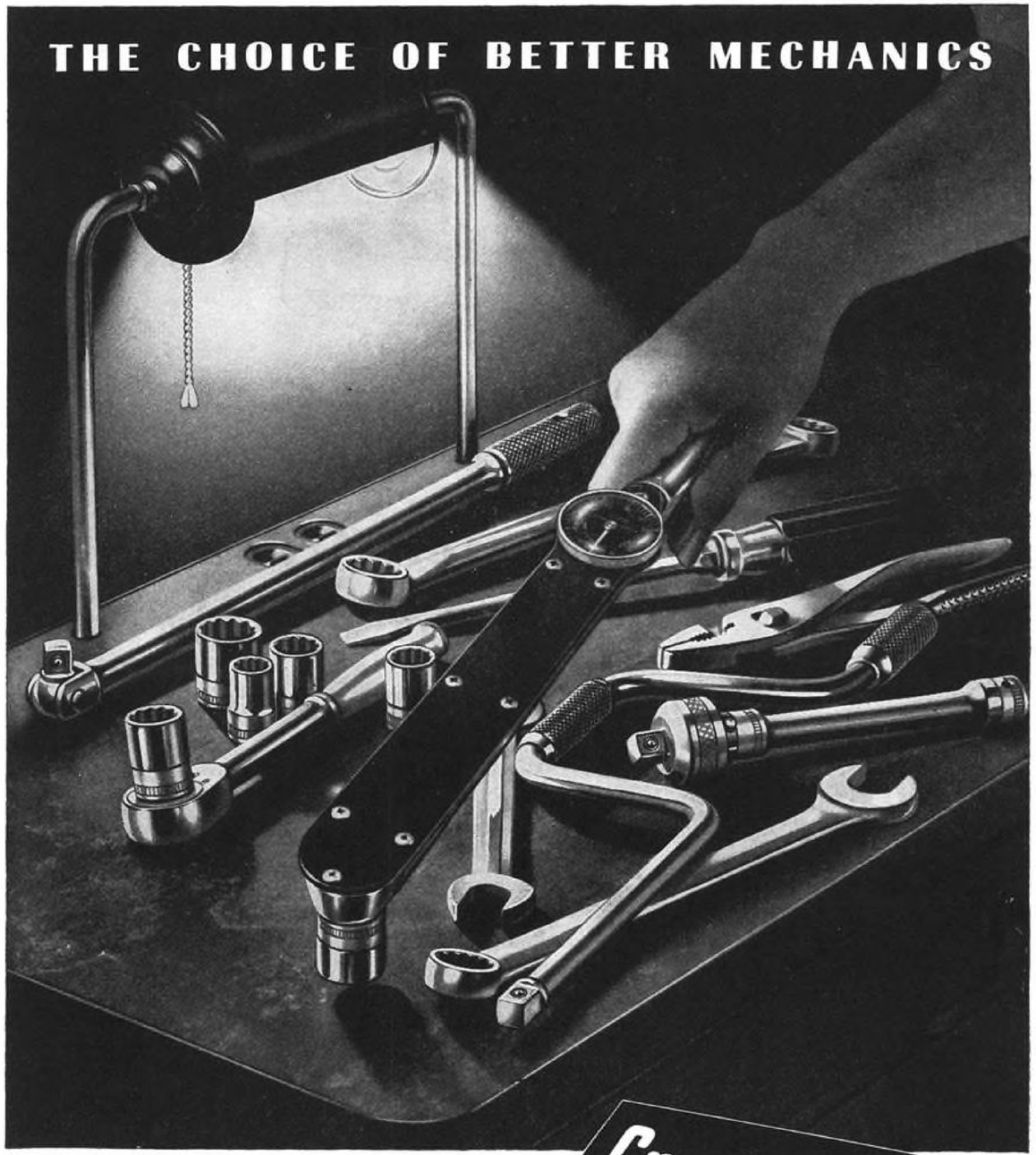
Made to conform to the Army-Navy specification No. AN 6207 . . . ELECTROL'S No. 267 Check Valve is fabricated of aluminum alloy throughout, with the exception of a small steel spring and two toroid seals. The valve comprises three aluminum pieces, two seals and one spring. Due to the flexible construction of the sealing medium, it is entirely unaffected by temperature. Since the valve contains no alloy steels, the use of heat-treating, grinding, honing and seating equipment is eliminated. These features effect substantial savings in cost. Used to check the flow of liquids, gas, air and other forms of pressure . . . Electrol's Check Valve is essential to innumerable systems. In addition to aircraft, it functions in refrigerators, oil burners, all types of Hydraulic pressure machinery, gas furnaces, heating and air conditioning equipment. Write for complete engineering data.



ELECTROL

HYDRAULIC EQUIPMENT FOR AIRCRAFT

HYDRAULICS



For Every nut turning operation there is a Snap-on wrench *engineered* to do the job better, easier, with greater accuracy and safety. Standout for *precision* is the Snap-on Torqometer shown above . . . unexcelled among tension measuring wrenches for unfailing accuracy under all conditions.

Widely used in factory assembly where accurate bolt tension is essential, Snap-on Torqometers are also the choice of better service mechanics. As you tighten the bolt, you *watch* the tension increase . . . on the easily read dial . . . and stop at exactly the pre-determined pressure.

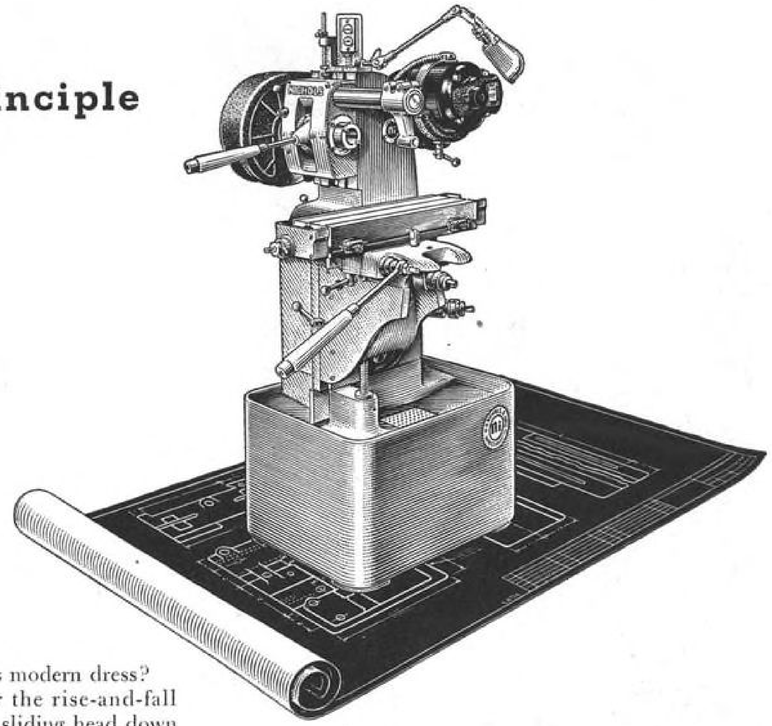
Snap-on's Torqometer series covers every tensioning requirement . . . 15 sizes ranging from zero to 30 in. lbs., up to 2000 ft. lbs. New industrial uses, such as adjusting tension on bottle capping machines, power hack saws, etc., are continually developing. Write us your tensioning problems and our engineers will gladly advise on individual requirements.

Snap-on Tools
THE CHOICE OF BETTER MECHANICS

SNAP-ON TOOLS CORPORATION, 8020-J 28th Ave., Kenosha, Wis.



How *Mass-Precision* put New Purpose into an Old Principle



Recognize this famous old miller in its modern dress?

Old-time machinists valued it for the rise-and-fall spindle which brought the cutter on a sliding head down to the work. This principle was new and basic, and the miller enjoyed many years of success. With accelerated production, however, industry demanded greater versatility, rigidity and accuracy in its machines. Operating men began to label the miller a "has-been"...until Nichols decided to *mass-precision* it.

The engineering insight of "Accurate" Nichols appraised its many advantages and foresaw its almost unlimited possibilities for the toolroom as well as the production line. Thorough redesign gave it new purpose and precision manufacture gave it the accuracy necessary to keep pace with mass-production "musts."

You'd hardly know the old miller now. The spindle is hardened and is equipped with roller or ball-bearings. Solid gibs, box-type saddle and head, counter-balanced motor drive and rapid-action rack and pinion saddle motion have been added...all merged into a compact, multi-purpose machine tool.

Today you can see it performing dozens of different high-speed machining operations on production lines and toolrooms everywhere...*to tolerances in "tenths."*

Your engineering and production problems may be far afield from machine tools, but Nichols' ability and manufacturing facilities may put *new purpose* into one of your reconversion blueprints.

Nichols-built products draw upon the most advanced manufacturing techniques and facilities, including lapping, grinding, hole locating and sizing, plus precision testing methods to affirm their accuracy.

Put your problem up to "Accurate Nichols."

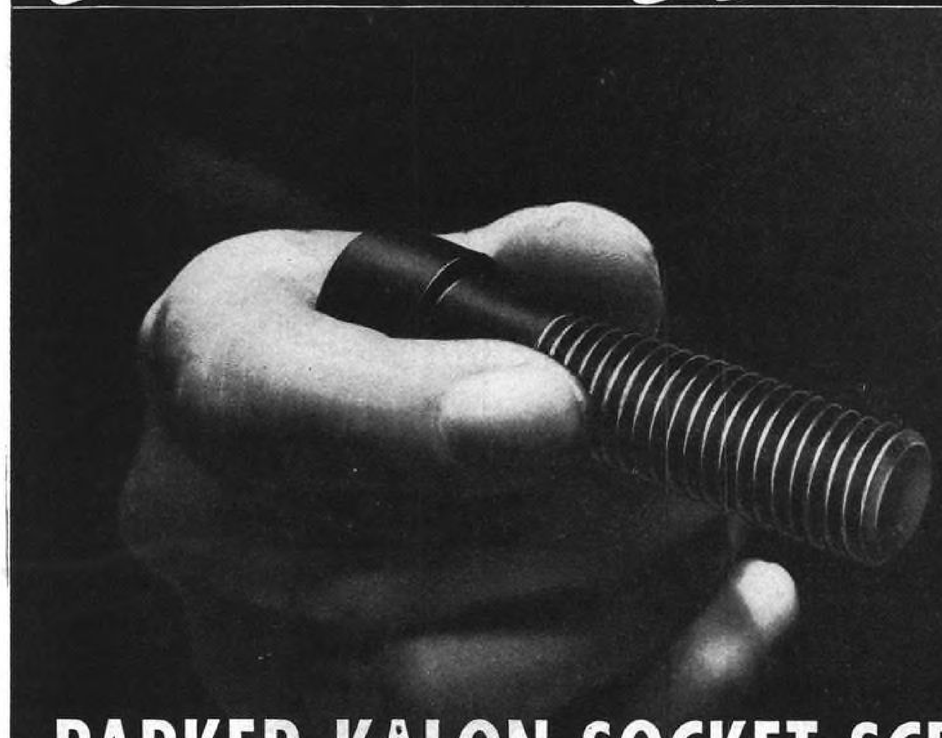
W. H. NICHOLS & SONS, 48 WOERD AVENUE, WALTHAM 54, MASS.

"Accurate" *Nichols*

PRECISION ENGINEERING AND MANUFACTURING FACILITIES FOR MASS-PRODUCTION

ni

Start RIGHT .... Seat RIGHT

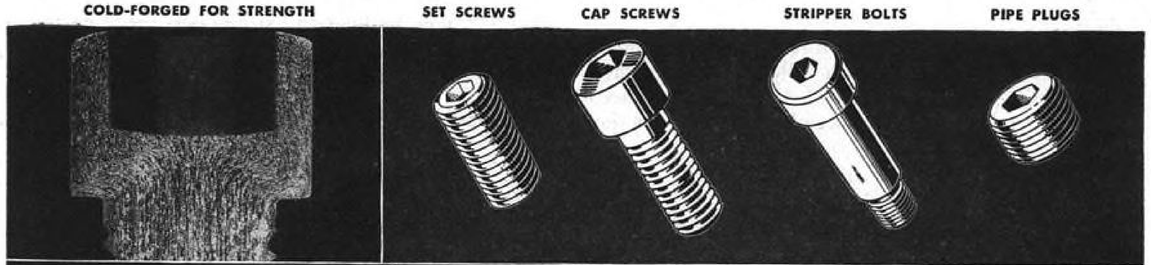


PARKER-KALON SOCKET SCREWS

Parker-Kalon's Quality-Control rules out trouble in starting and seating P-K Cold-forged Socket Screws. Threads MUST be clean cut and free of nicks and burrs. They MUST be accurately formed and true to pitch and lead. Heads MUST be concentric with the shank and the diameter held to close tolerances.

Starting when raw material enters the P-K plant, and ending only when the finished screws are packed, the P-K Quality-Control routine checks every mechanical and physical characteristic. Tests and inspections cover Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Torsion and Shear; Hardness; Head and Socket Size and Position; Thread Fit. Parker-Kalon Corp., 208 Varick St., New York 14.

COLD-FORGED FOR STRENGTH | SET SCREWS | CAP SCREWS | STRIPPER BOLTS | PIPE PLUGS



A Product of **PARKER-KALON**--*Specialists in Fastening Devices*

Wellman

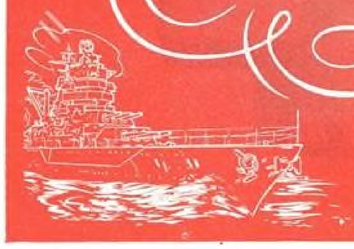
BRONZE AND ALUMINUM COMPANY

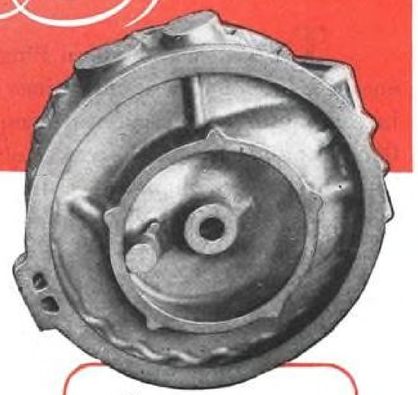
LABORATORY

WINS TWO RECOGNITIONS

1943 • 1944







Evidence of the capabilities of our laboratory personnel and quality of our equipment is contained in the following laboratory recognitions:

1. Certification for Radiography by the Air Force (this distinction won in 1943).
2. Being placed on the Navy Department's list of Approved Private Chemical Laboratories (early in 1944).

Here is further proof of the ability of our company to meet your rigid requirements.

Castings in
ALUMINUM
(Heat Treated)
MAGNESIUM
AMPCO BRONZE
BRONZE • BRASS
•
Patterns in
Metal and Wood
•
WELLMAN
Means **WELL-CAST**

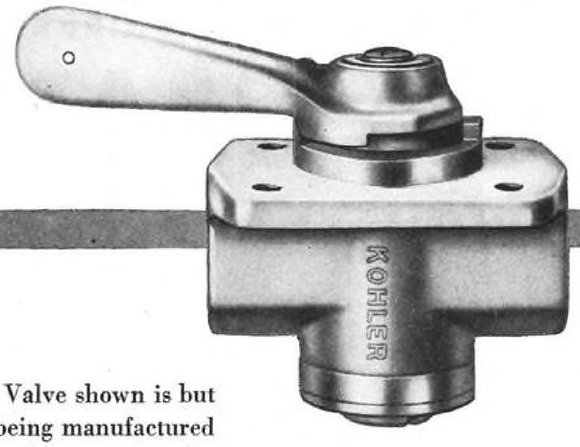
THE **WELLMAN** BRONZE & ALUMINUM COMPANY

GENERAL OFFICES:
2533 EAST 93rd STREET • CLEVELAND 4, OHIO

CASTINGS X-RAY INSPECTED

AIRCRAFT VALVES AND FITTINGS

...KOHLER MADE



THE Two-Way Flanged Plug Valve shown is but one of a line of valves and fittings being manufactured in volume for leading aircraft companies as well as for the Army and Navy Air Forces. Kohler produces the finished products without subcontracting, since complete tool-making, forging, heat-treating, machining and anodizing equipment, as well as testing and laboratory facilities, are all centered at Kohler.

Evidence of the high standard of Kohler production is found in the fact that these valves and fittings are manufactured under an Army Air Corps Class "A" quality rating which entrusts to the company full responsibility for fabricating, assembling, inspecting and delivery of products to meet all requirements.

Kohler of Kohler was founded 71 years ago, on the principle of quality-first. That principle stands today — in the manufacture of Kohler plumbing fixtures and fittings, heating equipment, electric plants . . . and *aircraft valves and fittings.*

Write to Dept. A-10 for FREE copy of a new catalog of Kohler Aircraft Valves and Fittings. Kohler Co. Established in 1873. Kohler, Wisconsin.

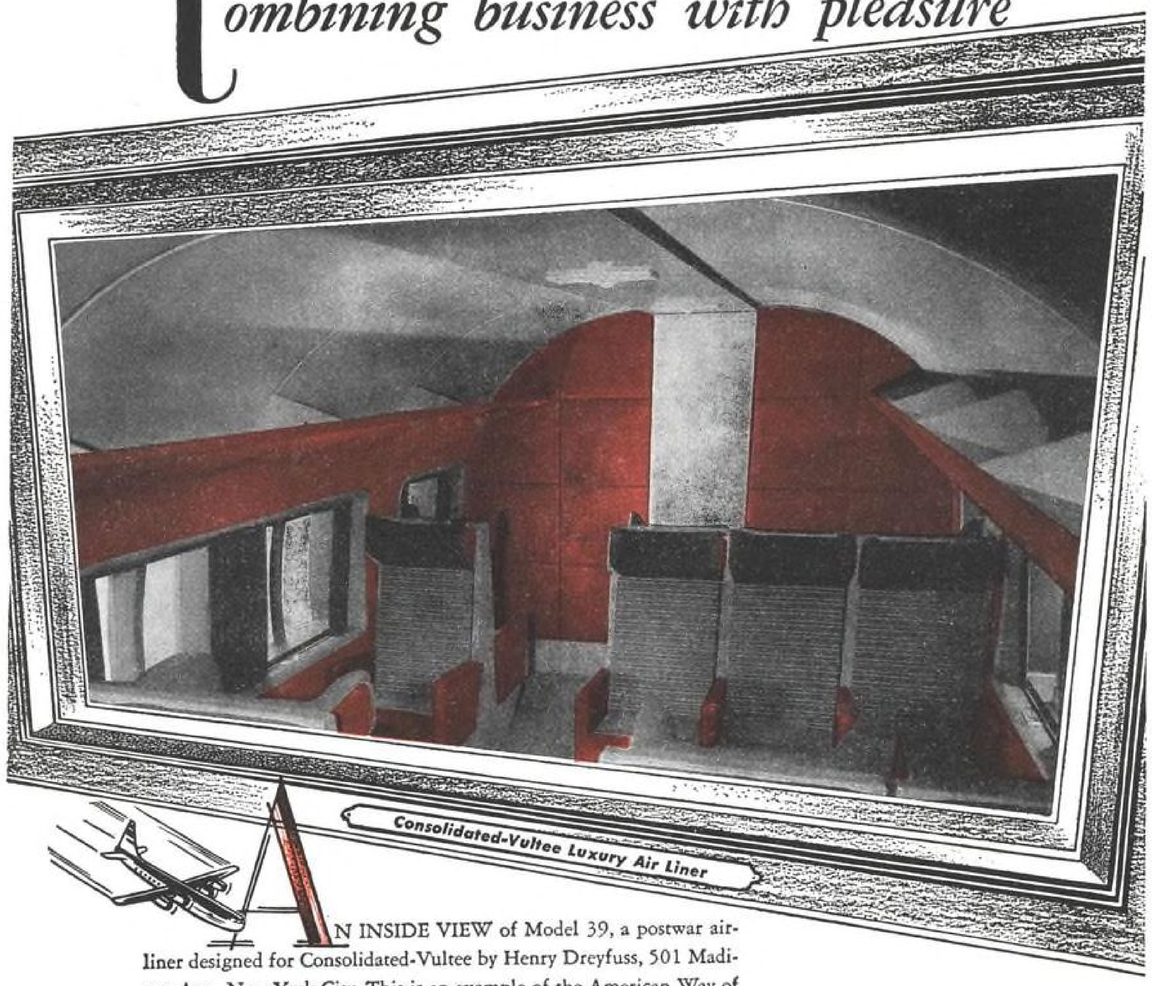


★ BUY UNITED STATES WAR BONDS ★

KOHLER of KOHLER

PLUMBING FIXTURES AND FITTINGS • HEATING EQUIPMENT • ELECTRIC PLANTS

Combining business with pleasure



Consolidated-Vultee Luxury Air Liner

AN INSIDE VIEW of Model 39, a postwar airliner designed for Consolidated-Vultee by Henry Dreyfuss, 501 Madison Ave., New York City. This is an example of the American Way of successfully combining business with pleasure. The *business:* flying people where they want to go... the *pleasure:* flying in luxurious comfort.

Lackawanna *Lite-Flite* leather, tanned especially for aircraft use, serves in this plane on arm rests, seat facings and walls. Also combining business with pleasure, it is lightweight (only 2 oz. per sq. ft.), sturdy, sound-absorbing and luxurious as only *genuine* leather can be.

Today designers and engineers are specifying Lackawanna leather for *most* of America's fighter and transport planes. Our leather experts will be glad to help you with *your* leather problems... write for samples and specifications.

DO YOU KNOW?
Lackawanna Leather is now available in *rolls.* Length: 25 yards, widths: 27" and 36". It is supplied at present only for essential purposes, but offers many advantages for post-war designers.



ARMY E NAVY

THE *Lackawanna Leather* CO.

735 GRAND AVE., HACKETTSTOWN, NEW JERSEY
Sales Offices: NEW YORK CITY... 512 FIFTH AVE. • BOSTON...354 CONGRESS STREET • CHICAGO...6748 NO. ASHLAND AVE.
Agents: **PACIFIC HIDE AND LEATHER CO.**
LOS ANGELES...716 E. WASHINGTON BLVD. • SAN FRANCISCO...50 HAWTHORNE STREET • SEATTLE....1424 10TH AVE.

Instrument LEADERSHIP
IN NAVIGATION. TOO!



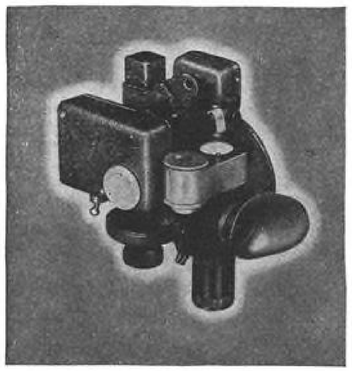
THE *Fairchild*
AERIAL SEXTANT
WITH AUTOMATIC SIGHT RECORDER

As familiar as the Fairchild aerial cameras found in the camera bays of our combat planes, is the SEXTANT used in the planes' astral dome for celestial navigation. *It's made by Fairchild, too!*

For Fairchild also is leader in the manufacture of these critical instruments . . . more of them being produced for our air services than all other types combined.

Based on designs suggested by U. S. Army Engineers, the Fairchild SEXTANT is distinguished by its extreme compactness and light weight, and its skillful "balance" for handling ease. An improved air reservoir chamber has been provided, too, the bubble now remaining "stable" during the entire sighting cycle. And recording of the consecutive sights has been made automatic, with the duration of the sighting cycle optional

Thus in SEXTANTS, too, Fairchild leadership stems from its development policy of engineering from bedrock, and supplementing *sound design* with *precise manufacture* and *craftsmanship*. Look for many of these Fairchild developments . . . optical as well as electronic . . . to find widespread industrial application when "tomorrow" comes.



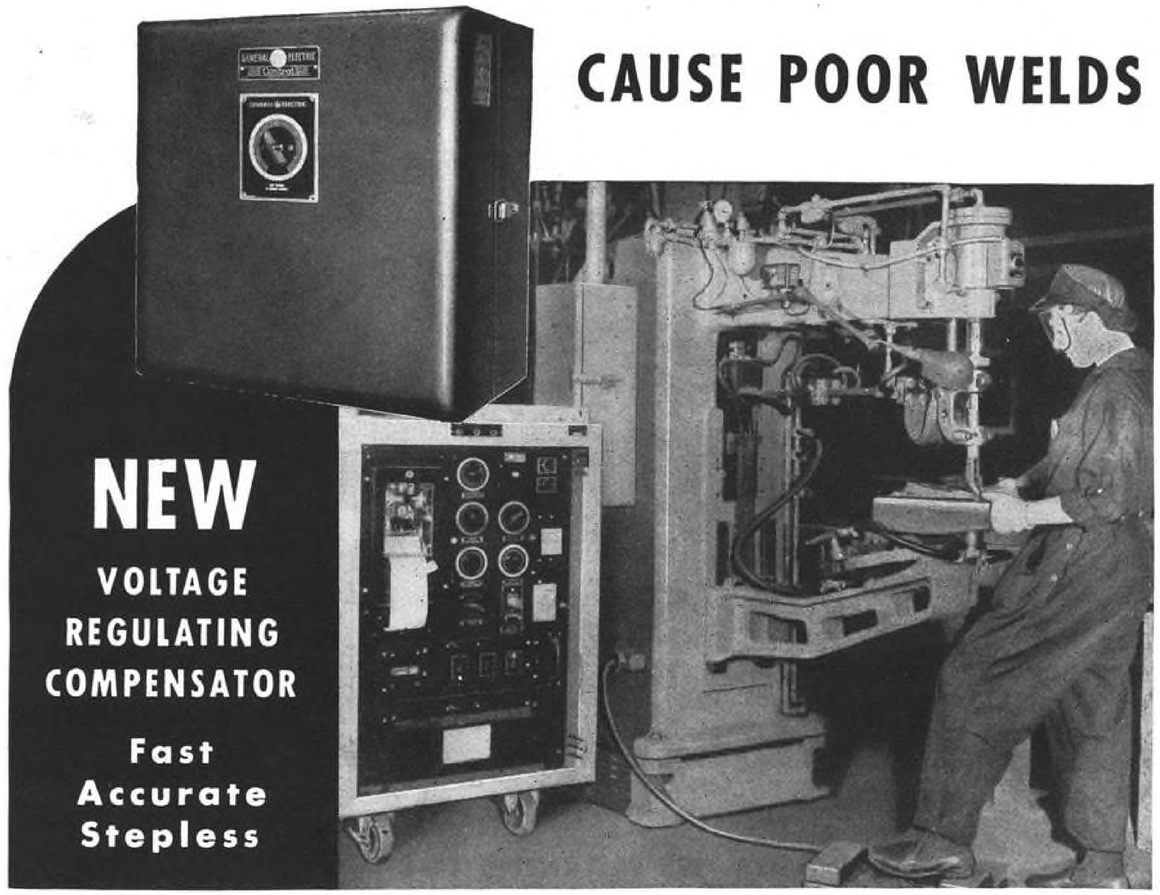
With the Fairchild A10A SEXTANT, *one* press of the trigger gives the navigator automatic interval recordings for any desired sighting cycle. Thus collimation is never disturbed by the necessity of recording each individual sight.

Fairchild CAMERA
AND INSTRUMENT CORPORATION

88-06 VAN WYCK BOULEVARD, JAMAICA 1, N. Y. • *New York Office:* 475 TENTH AVENUE, NEW YORK 18, N. Y.

THE STORY OF AERIAL PHOTOGRAPHY IS THE STORY OF FAIRCHILD CAMERAS

DON'T LET LINE-VOLTAGE VARIATIONS CAUSE POOR WELDS



NEW
VOLTAGE REGULATING COMPENSATOR
Fast Accurate Stepless

Helps insure good welds by holding the current constant

THIS electronic compensator, for use with G-E resistance-welding controls, automatically regulates weld current, holds it constant, regardless of line-voltage variations.

1. ACCURACY OF OPERATION—The weld current is held within plus or minus 2 per cent of the preselected value, for variations in line voltages of plus and minus 20 per cent.*

2. SPEED OF COMPENSATION—If there's a sudden change in line voltage, this compensator will correct for 75 per cent of the change in 1 cycle, provide 100 per-cent correction within 3 cycles.

3. RANGE OF CONTROL—Functions over the entire heat-control range of the main control circuit. This range is normally from 20 to 100 per cent for 460- to 575-volt applications, and 40 to 100 per cent for 230-volt applications.

**This allowable voltage deviation may be limited by your other electronic controls.*

Buy all the BONDS you can—and *keep all you buy*

The voltage-regulating compensator is built into the bottom of this G-E control. In the welding of airplane parts, this compensator keeps the welding current uniform when other machines "hit" the line and cause a voltage drop.

RESISTANCE-WELDING CONTROL

Want more information?

General Electric Company, Sec. E645-31
Schenectady 5, N. Y.

Please send me a copy of your bulletin (GEA-4223) which will tell me more about compensating line-voltage variations.

Name.....
Company.....
Address.....
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8960

GENERAL ELECTRIC



NICKEL AIDS THE MACHINE TOOL INDUSTRY

to KEEP 'EM WORKING!

Everyone marvels at the speed of American production for war . . .

But how many realize that much of the credit should go to machine tool designers?

They are the ones who created the *tools* for doing the job.

They're making production miracles commonplace...with the most efficient machine tools that ever whipped raw material into finished product.

And the secret? For one thing, they try to design each component part of a machine so that it outlasts the machine itself.

They know that failure of a single machine in a mass production setup might bring whole assembly lines to a stop.

So they lean heavily on Nickel alloyed materials for the critical parts of machine tools.

Over the years they have learned that Nickel contributes toughness, strength, and fatigue resistance . . . properties vitally essential to many different kinds of tool parts . . . from grinder frames to tail shafts, from gears and spindles to drill chucks and lathe beds.

In the industries which use machine tools, it's an axiom that "a little Nickel goes a long way" to keep 'em working.

Whatever *your* industry may be . . . if you want help in the selection, fabrication, and heat treatment of alloys . . . we offer you counsel and data.

New Catalog Index

New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects—from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?

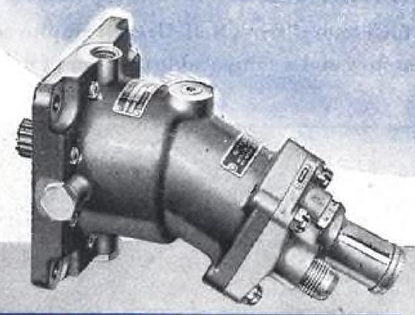


* Nickel *

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York 5, N. Y.*

ANSWERING THE QUESTION:

"Should I Use Constant Volume or Variable Volume Aircraft Pumps?"

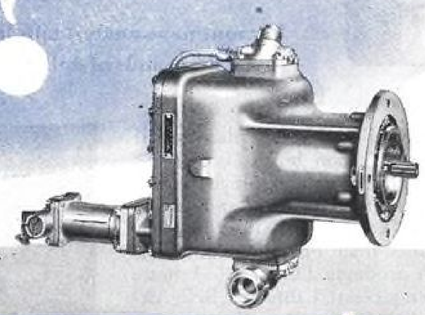


WHEN TO USE

VICKERS CONSTANT VOLUME

PISTON TYPE PUMPS

This pump requires an accumulator and unloading valve in the majority of aircraft hydraulic circuits. The fixed-stroke pistons deliver fluid continuously to the unloading valve. The unloading valve automatically opens when the accumulator has received and stored its maximum volume of fluid at system pressure; the pump then operates at no pressure by returning oil directly to reservoir. When the accumulator pressure drops to a predetermined minimum, the unloading valve automatically closes and diverts the oil to charge the accumulator. This constant volume pump is recommended when hydraulic power is required for short periods during take-off and landing . . . when operating flaps, landing gear and power brakes. It also supplies any small demand during flight . . . like cowl flap actuators. And it takes care of normal requirements while on the ground . . . including parking brakes and cargo door operation.



WHEN TO USE

VICKERS VARIABLE VOLUME

PISTON TYPE PUMPS

This pump automatically delivers the volume of fluid required by the hydraulic system. When the requirement decreases, the stroke of the pistons is automatically shortened; when more volume is needed, the piston stroke is automatically lengthened. There is no inlet restriction to cause cavitation. An excess of fluid is *never* pumped. The pump *maintains* full pressure in the system with minimum horsepower. An integral pressure control device automatically and continuously maintains the desired pressure independent of varying volume demand and of engine speed. This variable volume pump is recommended when hydraulic power is used continuously during flight . . . as for power boost flight control, gun turret drive, and cabin supercharger drive.

Vickers Engineers will gladly discuss with you the relative merits of these pumps for your individual requirements.

VICKERS
Incorporated
1462 OAKMAN BOULEVARD
DETROIT 32, MICHIGAN

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

A LITTLE WOODEN BOX that's speeding aircraft progress



By JOHN B. KENNEDY

Famous news analyst tells how "Suggestions for Victory" from Bell Aircraft employees have saved thousands of dollars of the taxpayer's money and a comparable number of manhours

"IN every Bell Aircraft plant you'll see suggestion boxes. Into these boxes Bell Aircraft employees, who think while their skilled hands are at work, last year deposited 4200 ideas to improve plant operations and Bell Aircraft products. One third of these, after being cleared through Bell Aircraft's Patent Office, have been put to work. As a result thousands of dollars have been saved in the cost of building Bell airplanes and other war weapons. Other suggestions are helping to speed Victory by saving thousands of manhours.

"Take the case of a supervisor of Intra-Plant Traffic in one Bell Aircraft plant. His plan for simplifying the operation of the conveyor system, by which workers receive material and parts, eliminated 54,561 telephone calls per week—totaling a yearly saving of $39,845, to say nothing of time.

"Instead of a telephone operator notifying the station that supplies are on the way, when the conveyor passes a certain point, it lights an electric bulb. This signal notifies the worker to be on the lookout.

"This new system is one of many production methods suggested by Bell Aircraft employees that are now in use in other Allied Aircraft plants.

"Bell Aircraft workers are making every effort to speed the day of Victory. When that time comes, you can trust this same manufacturing skill and ingenuity to bring you many things to make for a better world at peace."

★ *Buy War Bonds and Speed Victory* ★



MEMBER AIRCRAFT WAR PRODUCTION COUNCIL...EAST COAST, INC.

BELL Aircraft

PACEMAKER OF AVIATION PROGRESS

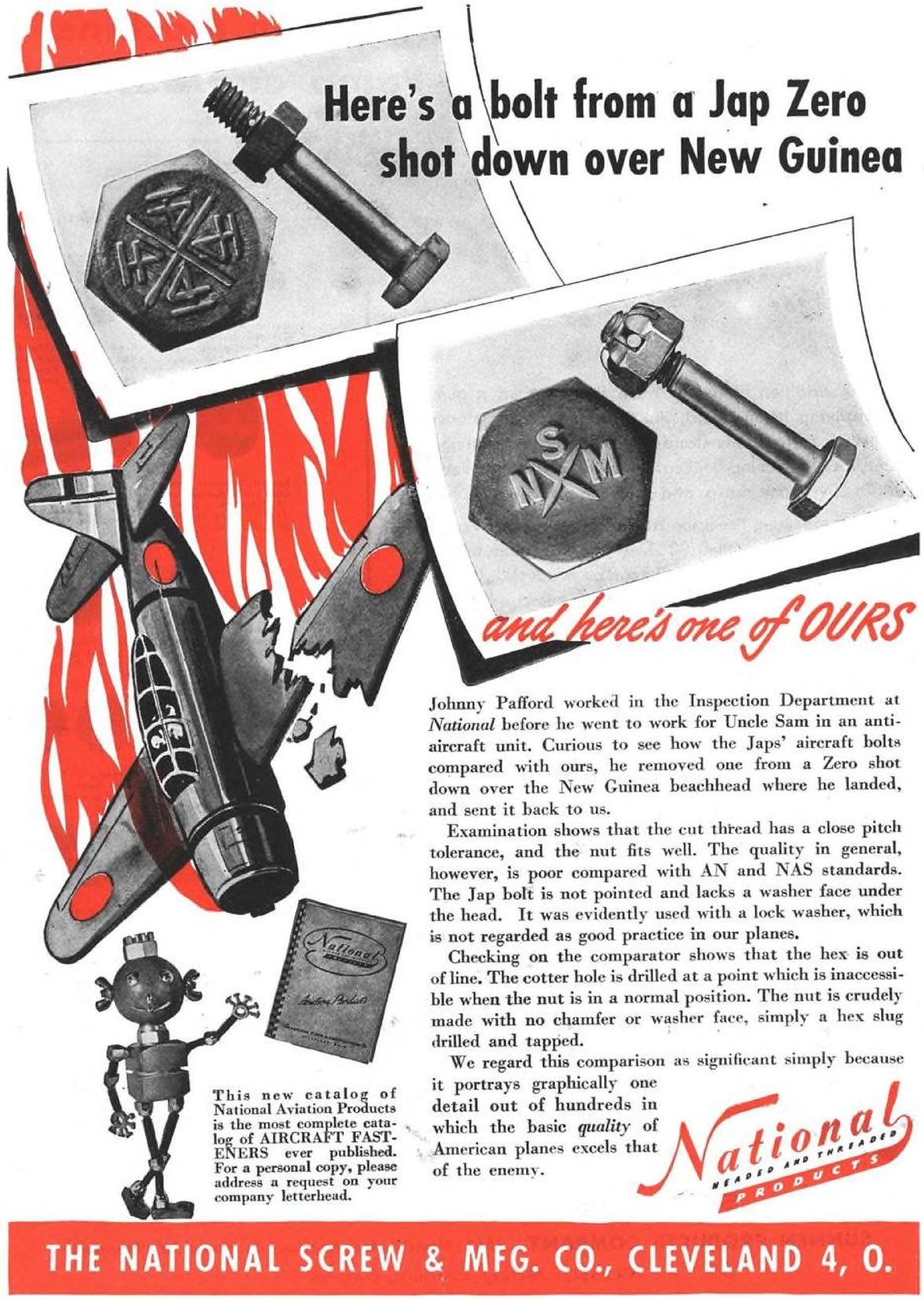
● *Bell Aircraft Corporation*

NIAGARA FRONTIER DIVISION
Buffalo and Niagara Falls, N. Y.
Airacobra (P.39) and Kingcobra (P.63)—Fighters
Airacomet—America's First Jet Propelled Plane
The Bell Helicopter

ORDNANCE DIVISION
Burlington, Vt.
Flexible Gun Mounts and other ordnance materials

GEORGIA DIVISION
Marietta, Ga.
B-29 Boeing Superfortress

Here's a bolt from a Jap Zero shot down over New Guinea



Johnny Pafford worked in the Inspection Department at *National* before he went to work for Uncle Sam in an anti-aircraft unit. Curious to see how the Japs' aircraft bolts compared with ours, he removed one from a Zero shot down over the New Guinea beachhead where he landed, and sent it back to us.

Examination shows that the cut thread has a close pitch tolerance, and the nut fits well. The quality in general, however, is poor compared with AN and NAS standards. The Jap bolt is not pointed and lacks a washer face under the head. It was evidently used with a lock washer, which is not regarded as good practice in our planes.

Checking on the comparator shows that the hex is out of line. The cotter hole is drilled at a point which is inaccessible when the nut is in a normal position. The nut is crudely made with no chamfer or washer face, simply a hex slug drilled and tapped.

We regard this comparison as significant simply because it portrays graphically one detail out of hundreds in which the basic *quality* of American planes excels that of the enemy.

This new catalog of National Aviation Products is the most complete catalog of AIRCRAFT FASTENERS ever published. For a personal copy, please address a request on your company letterhead.

National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

The Sunnen Precision Honing Machine
– with New Coolant Pump and Base –

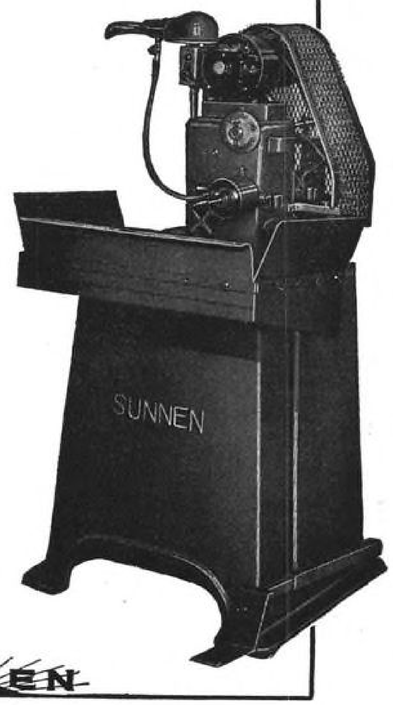
Provides GREATER HONING SPEED and ACCURACY

With the addition of a new base that contains a pump for supplying honing fluid, the Sunnen Precision Honing Machine is setting new standards of accuracy. Honing is faster, too. The honing fluid carries away all cuttings, keeps the abrasive stone sharp, and cools the part being honed.

With the Sunnen Precision Honing Machine, accuracy is guaranteed to be within .0001"— and has been held to .000025". A super-smooth finish can be produced. On certain types of metal, a finish of 2 to 3 micro inches can be obtained.

- **Hones and finishes cylinders from .185" to 2.625" in diameter**
- **Can be used in either ferrous or non-ferrous metals — plastics — ceramics, etc.**
- **Does not require skilled labor**
- **No jigs or fixtures needed**
- **Economical to operate**
- **Can be set up to operate in one minute**

Write for a free bulletin giving details about this low-cost honing machine — or ask a Sunnen engineer to show you how it can be used on your jobs.



The coveted Army-Navy "E" waves over the Sunnen plant — evidence of the important part Sunnen equipment is playing in the war effort.



SUNNEN

Typical Jobs



Aircraft Hydraulic Brake Cylinder. Honing 3 times faster than lapping — and gave a straighter hole.



Header Die. Life of header dies increased 3 to 9 times over lapping. Knock out pin breakage practically eliminated.



Aircraft Instrument Panel Control Wire Bushing. Hole .187" diameter — held to .0002", stock removal .001", sixty per hour.



Aircraft Piston Pin. Sunnen honing is twice as fast and gives a cleaner, better looking pin.



Stainless Steel Load Compensator Valve Seat. Hole is honed to .0002" limit



Aircraft Valve Tappet Roller. Honed after grinding to give 100% bearing surface.



Aircraft Carbureter Operating Valve Sleeve. Sunnen honing eliminates distortion from assembling operation.



Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour.



Roller Bearing Outer Race. Finish improved from 12 micro-inches to 2 micro-inches.



Bearing. A very small part. 2 micro-inch finish necessary.



Carbureter Idler Valve Jet. Hole is honed after reaming for smooth action.



Shell Loading Die



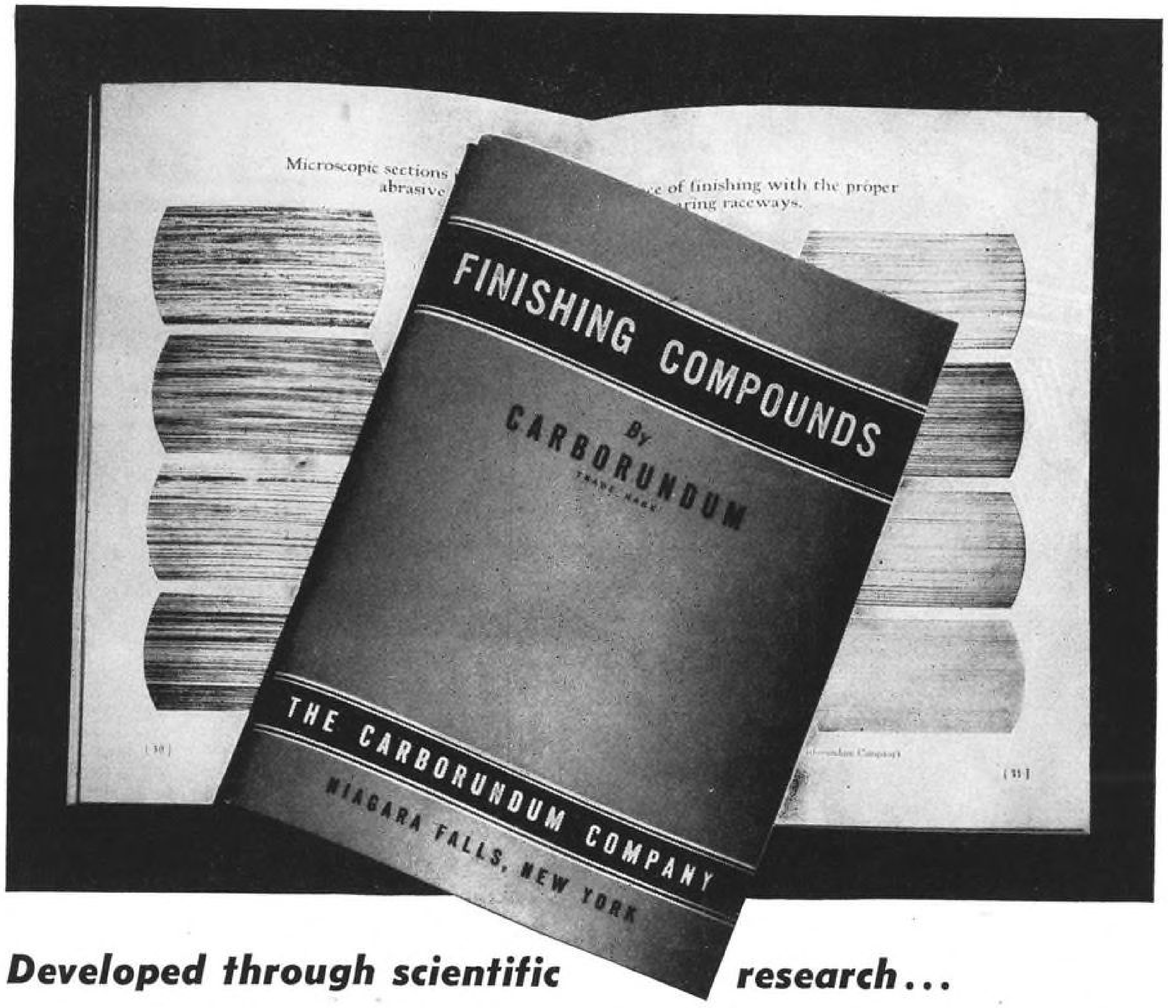
Cast Iron Valve Stem Guide. ½ to one thousandth removed — 220 pieces per hour. Better finish and straighter hole.



Hydraulic Control Bushing. Honing gives straight round hole after rough reaming.

SUNNEN PRODUCTS COMPANY, 7942 Manchester Avenue, St. Louis 17, Missouri

Canadian Factory: Chatham, Ontario



Developed through scientific research...

FINISHING COMPOUNDS BY CARBORUNDUM

There was a time when the use of lapping mixes was pretty much a hit or miss proposition. The preparation of mixes was the result of individual judgment—there were no scientific methods used in the proper compounding of abrasive grain with oil or other carrier media.

But now Carborundum research has substituted science for guess work. Today, finishing compounds by Carborundum are the result of a close scientific study of the proper combining or mixing of abrasive grain and carrier—the development of carriers for specific finishing applications—the accurate grading of abrasive grain—the correct type of abrasive.

These compounds are produced in various grades to meet all conditions. Grit ranges are from 60 down to 1,000, the extremely fine powders being produced under microscopic control.

They are made with four types of abrasives—Carborundum Brand Silicon Carbide, Aloxite Brand Aluminum Oxide, the natural abrasive garnet and the diamond.

For complete details regarding various grades—correct application and lapping procedure send coupon today for new free booklet "Finishing Compounds by Carborundum".

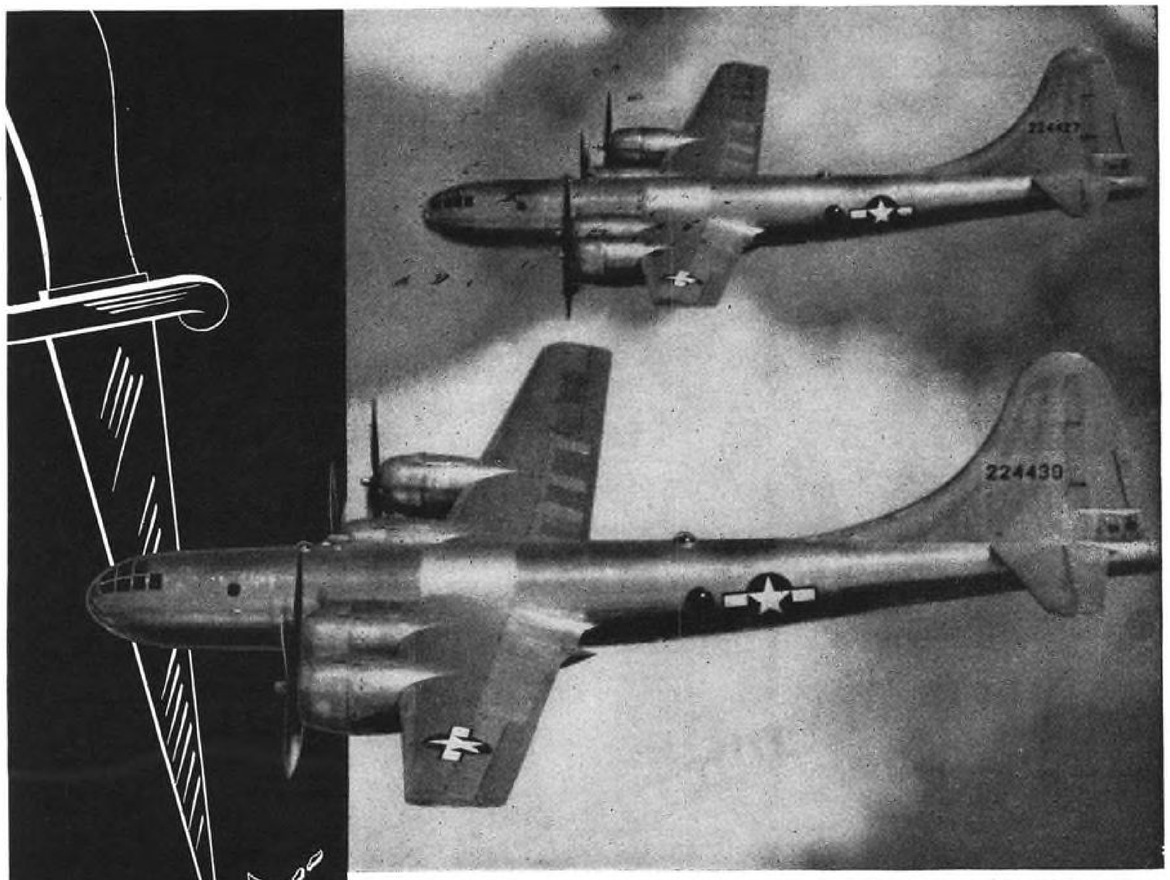
The Carborundum Company,
Niagara Falls, N. Y.

The Carborundum Company,
Niagara Falls, N. Y., Dept. A.
Please send my free copy of "Finishing Compounds by Carborundum":

Name .....
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Company .....
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(Carborundum and Aloxite are registered trade marks of and indicate manufacture by The Carborundum Company)



U. S. Army Air Force Photo of B-29 Superfortress

The great B-29 Superfortresses are Ceco equipped.

DAGGER-THRUST

where it hurts most!

There is no sneaky, knife-in-the-back quality about the fierce stabs of these massive B-29 Superfortresses at the heart of Japan. The Nips expect them . . . warning systems tell when they're coming . . . fighter planes take off to meet them and ground defenses throw up a curtain of flak. But nothing yet devised can stop these sky-giants from delivering their loads of destruction *when and where it hurts most.*

The skill and genius that designed, engineered, and produced this "blitz on wings" is American to the core. It is typically American to build the most powerful and complicated flying mechanism ever assembled . . . *and then put it into mass production.* This means that each one of the thousands of component parts must be as technically and physically perfect as man and machine can make it. And further it means ceaseless seeking for new ways to achieve still higher standards of performance, stamina, and dependability.

The CECO carburetors and fuel pumps on the Wright engines powering the B-29 — and the CECO engineers and workers here at home — are living up to these specifications.

CECO

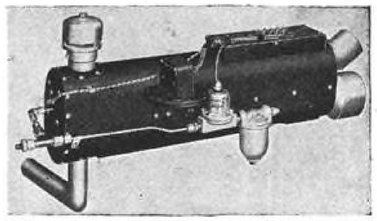
CARBURETORS
FUEL PUMPS
PROTEK-PLUGS

CHANDLER-EVANS CORPORATION
SOUTH MERIDEN, CONNECTICUT, U. S. A.

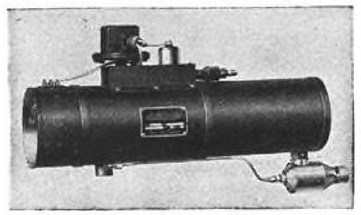
PROVED NEW COMBUSTION PROCESS FEATURED IN FLUID HEAT'S COMPLETE LINE OF AIRCRAFT HEATERS

FLUID HEAT'S NEW MODEL SRH-100 HEATER (at right)

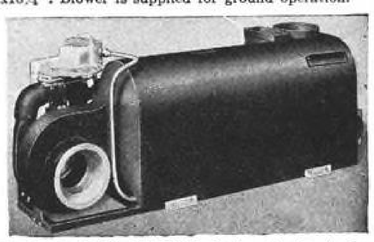
This heater has a maximum output of 100,000 BTU per hour in flight, yet weighs only 24 pounds, including all controls and accessories. Overall dimensions are 8⅛ inches diameter, 27 inches in length. Model SRH-50, not shown because it is identical in design, delivers 50,000 BTU per hour. It is 6½ inches in diameter, 20 inches long, weighs only 15 pounds 4 ounces. Both models are available with blower for ground operation. Transfer between flight and ground operation is automatically controlled.



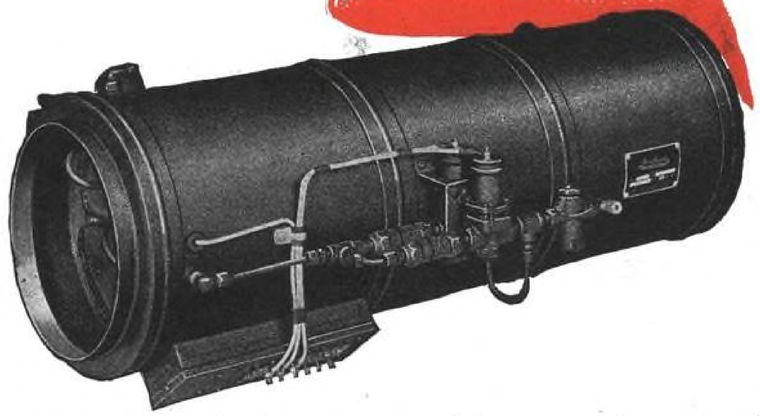
Fluid Heat's Model STH-15. Proportionally lightweight and compact, this model delivers 15,000 BTU per hour, yet weighs, with all controls and accessories, only 7 pounds. Dimensions are 3 inches by 5 inches by 18 inches. Used to de-ice windshields and heat fighter-plane cockpits. Can be supplied with blower.



Fluid Heat's Model SRH-15. Ideal for single and two-place planes, this model delivers 15,000 BTU per hour, weighs 6 lbs., 14 ozs. complete, measures 4⅜" x18¾". Blower is supplied for ground operation.



Fluid Heat's Model SGE-1. Designed primarily for the special requirements of Navy patrol bombers and transports, this light and compact model delivers 90,000 BTU per hour in flight. It performs four vital functions: Heats cabins in flight and not in flight, defrosts windshields, and pre-heats engines. Transfer between ground and flight phases is automatic.



Using a new combustion process proved by severe service on patrol bombers, a complete line of Fluid Heat Aircraft Heaters is now available for many different types and sizes of Aircraft. Compact, light, efficient, these new aircraft heaters are the result of more than two years of heat-engineering research and development by a major manufacturer of heating equipment using liquid fuel.

NEW COMBUSTION PROCESS

Fluid Heat Aircraft Heaters employ a vapor-entraining process utilizing pre-heated combustion air. This process accomplishes combustion with an unusually low pressure drop permitting operation at low ram pressures. It produces a completely suspended fire and therefore gives freedom from lead oxide formation. Flame retention is so positive that flame characteristics are the same from sea level to ceiling. All heaters are automatically compensated for constant combustion efficiency at all altitudes.

DEVELOPMENT BACKGROUND

Fluid Heat has, for sixteen years, led in the development and manufacture of automatic combustion and heat transfer equipment. Those years of heat engineering know-how are built into each light, compact, efficient Fluid Heat Aircraft Heater. You will want Fluid Heat Aircraft Heaters on planes you design, build, or equip. Write for full information on this new and proved heating achievement.

FLUID HEAT DIVISION
Anchor Post Fence Co.
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fluid heat
AIRCRAFT HEATERS

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"HERE'S THE *Hayfield* WE STARTED WITH"



NOW LOOK AT US . . . WE'RE DOING

BIG BUSINESS WITH A *Small Airport!*

"We didn't know a thing about running a profitable small airport, but Aeronca showed us! And this hayfield that my son and I picked out is now 'flying headquarters' for our town. Since he's been back, we're so busy I sold the old grocery store and moved out here to help. But we never would have made the grade without Aeronca. They sure gave us the 'know how'!" You'll hear many successful men say these things after Victory. Will *you* be one of them?

Let Aeronca show *you* how to start *now* to build a profitable post-War aviation business! Get the facts about Aeronca's new airplane *dealer program—the only complete profit-making program in the aircraft industry!* Mail the coupon—right now—to Al Bennett, Aeronca Director of Sales . . . get the real "know how" from the man who has started so many successful airport operators on the road to big money in aviation with this plan.



HERE'S YOUR POST-WAR OPPORTUNITY! Send This Coupon NOW!

The Only Light Aircraft Company to Receive the Army and Navy "E".

AERONCA AIRCRAFT CORPORATION
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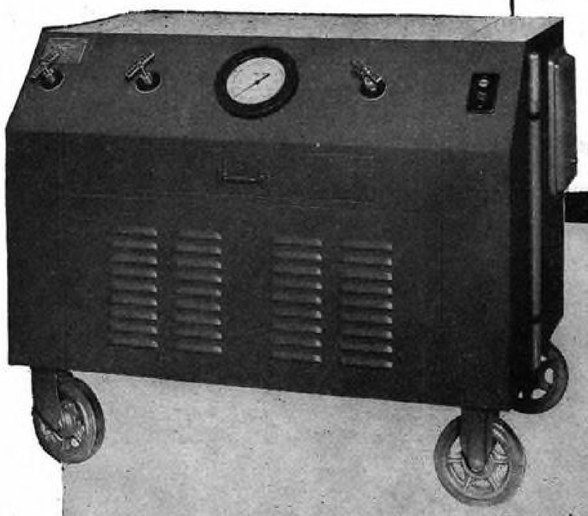
Al Bennett, *Director of Sales,*
Aeronca Aircraft Corporation, Middletown, Ohio
Send me your valuable, illustrated booklet "HOW TO MAKE SMALL AIRPORTS PAY WITH AERONCA". I enclose 10c.

Name.....

Address.....

City and State.....H-10

Greer offers a complete line of hydraulic test machines for every aircraft requirement



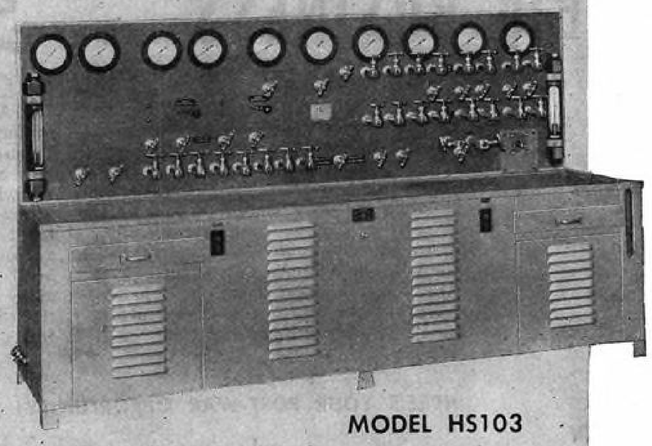
MODEL HS105

Greer UNIVERSAL HYDRAULIC TEST MACHINES

Developed specifically for testing hydraulic systems and their components. Built in a series of models, including high-pressure units, driven by electric motor or gasoline engine.

Greer PRODUCTION HYDRAULIC MACHINES

For inspection and operational testing of any single or complete line of hydraulic components, or for research and development testing. Electrically powered 7-foot and 10-foot models, including high-pressure units, are available with various combinations of equipment to meet all requirements.



MODEL HS103

For further information write or wire

GREER HYDRAULICS, INC., 39 West 60th Street, NEW YORK 23, N. Y.

Officially appointed distributors of

Government Excess

aircraft hardware & parts special accessories

Items available include **AN**

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Turnbuckles
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Tubing Fittings
Clamps & Clips
Taper Pins
Grommets
Rivets
and many others!

To curtail further accumulation of stock piles . . . and eliminate additional production of items now stored in quantity in aircraft plants . . . the U. S. Government has instituted a plan for the orderly redistribution of excess stocks.

Air Associates has been appointed an agent to aid in the disposition of aircraft hardware, parts, and special accessories. We are honored by the opportunity to serve under this plan.

Aviation supply headquarters since 1927, Air Associates is proud to offer its long experience in the field, and the facilities of its four centrally located warehouses to firms needing these fine precision materials . . . Excess stocks include all AN Standard hardware parts, all types of AN fittings, and all Standard and many special aircraft components. Items are new, unused, certified by government inspectors as "aircraft quality" . . . do not require any subsequent inspections by service branches, government contractors, or airline operators . . . are sold at the lowest prevailing market prices.

Investigate this surplus! *You perform a patriotic service by helping toward the successful fulfillment of the government's plan for liquidation of the excess—and you aid yourself by obtaining immediate delivery, without waiting for production!*

Wire your requirements to—

Air Associates, INC.

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MIDWEST . . . . . Chicago, Ill.
SOUTHWEST . . . Dallas, Texas
WEST COAST . . . Los Angeles, Calif.



Having trouble with surplus inventory?

One way to beat the excess inventory problem is to buy more of your present steel requirements from a Frasse warehouse.

By buying only what you need for immediate production, you avoid leftovers and dead stock when cancellations, cutbacks or design changes occur. Frasse stocks of cold finished bars, tubing, stainless steel, alloy, and aircraft steels and tubing are in good shape. By ordering from Frasse as you go, there's no surplus bogey to fear on cancellation day.

Why hamper your future operations with heavy, unwieldy surpluses that can be prevented? Start reducing yours today by using Frasse steel inventories instead.

Frasse MECHANICAL AND AIRCRAFT STEELS

SEAMLESS MECHANICAL AND AIRCRAFT TUBING · COLD FINISHED BARS · ALLOY STEELS
AIRCRAFT STEELS · DRILL ROD · STAINLESS STEELS AND TUBING · COLD ROLLED STRIP AND SHEETS · WELDED STEEL TUBING

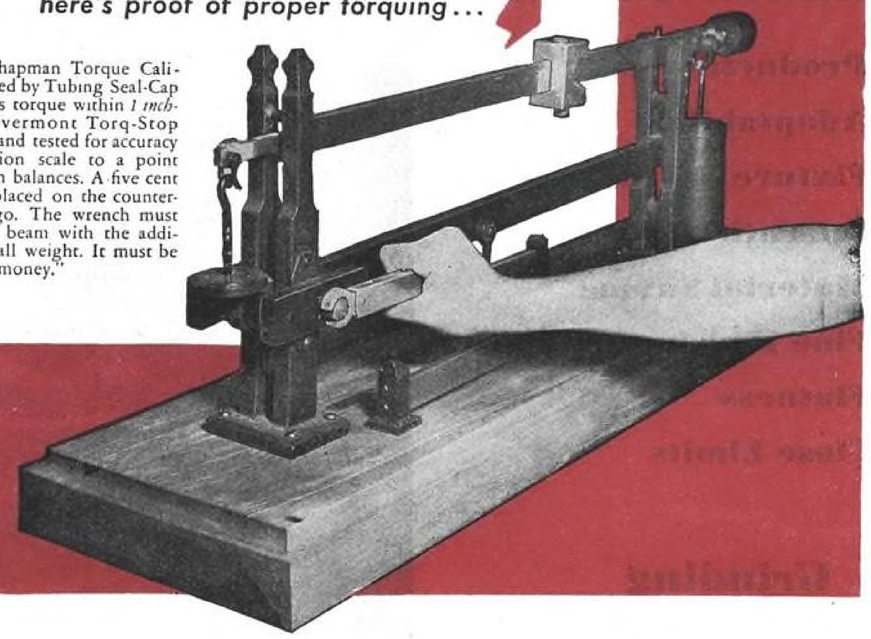
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RIGHT ON THE MONEY

here's proof of proper torquing...

Here is the Chapman Torque Calibrater distributed by Tubing Seal-Cap Inc. It measures torque within *1 inch-ounce.* Each Livermont Torq-Stop Wrench is set and tested for accuracy on this precision scale to a point where the beam balances. A five cent piece is then placed on the counterpoise as a no-go. The wrench must not break the beam with the addition of this small weight. It must be "right on the money."

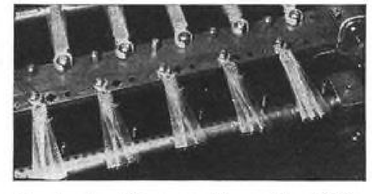


TORQUING "RIGHT ON THE MONEY"

with the world's easiest-to-use torque wrench—a recommended S.A.E. standard

Now nuts, bolts, clamps and fittings can be tightened to their safe, proper torque "right on the money" by unskilled help.

The accurate, sturdy, compact Livermont Torq-Stop Wrench is a production line tool that increases output, assures correct torquing (within 2% plus or minus). No dials, no batteries—nothing to watch. It gives an audible "click" and a definite physical sensation is transferred to operator's palm when proper torque is reached. Used by most aircraft companies and hundreds of production plants. Society of Automotive Engineers' recommended dimensions.



Tools Are Weapons—Treat 'Em Right.

10,000 OPERATIONS BEFORE FINAL APPROVAL. This is the Livermont Torq-Stop Wrench Break-In Table. Each Wrench after being set to its proper torque is operated through 10,000 consecutive cycles. When the 10,000 operations are complete the Wrench is removed and tested. It must not have varied over 2 inch-pounds during this test. It is then sealed at its proper predetermined torque for the job for which it was ordered.

Send today for 36 page illustrated Aircraft Tubing Manual.

LIVERMONT *torq-stop* WRENCH

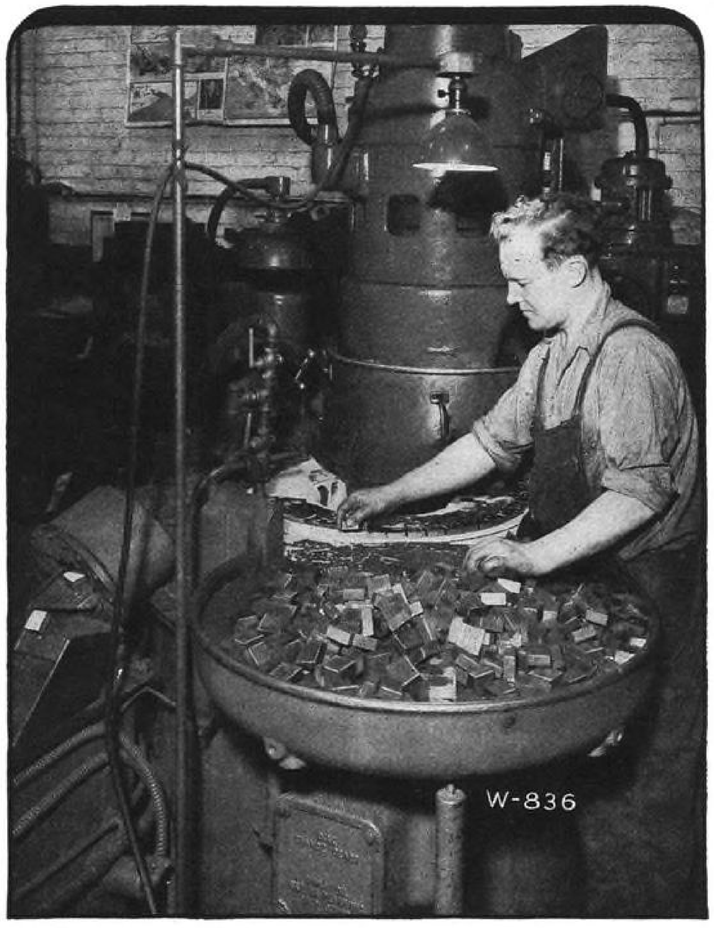
Sold by TUBING SEAL-CAP INCORPORATED
215 West 7th Street, Los Angeles 14, California
Eastern Representative: 428 New Center Building, Detroit, Michigan



"Put it on the Blanchard"

...GET THESE ADVANTAGES

Production ✓
Adaptability
Fixture Saving
Operation Saving
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Fine Finish
Flatness
Close Limits



Grinding Breech Blocks

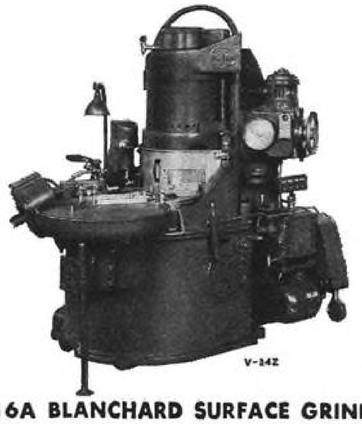
These high carbon steel breech blocks are loaded on the continuously moving 30" magnetic chuck of a No. 16A Blanchard Automatic Surface Grinder.

Each piece goes through the machine four times, a roughing and a finishing cut removing .030" stock from each surface. Production is 350 pieces (700 surfaces) per hour. The pieces are automatically unloaded and demagnetized. Size is automatically held to ±.001".

For high production and fine finish to close limits "put it on the Blanchard".



Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

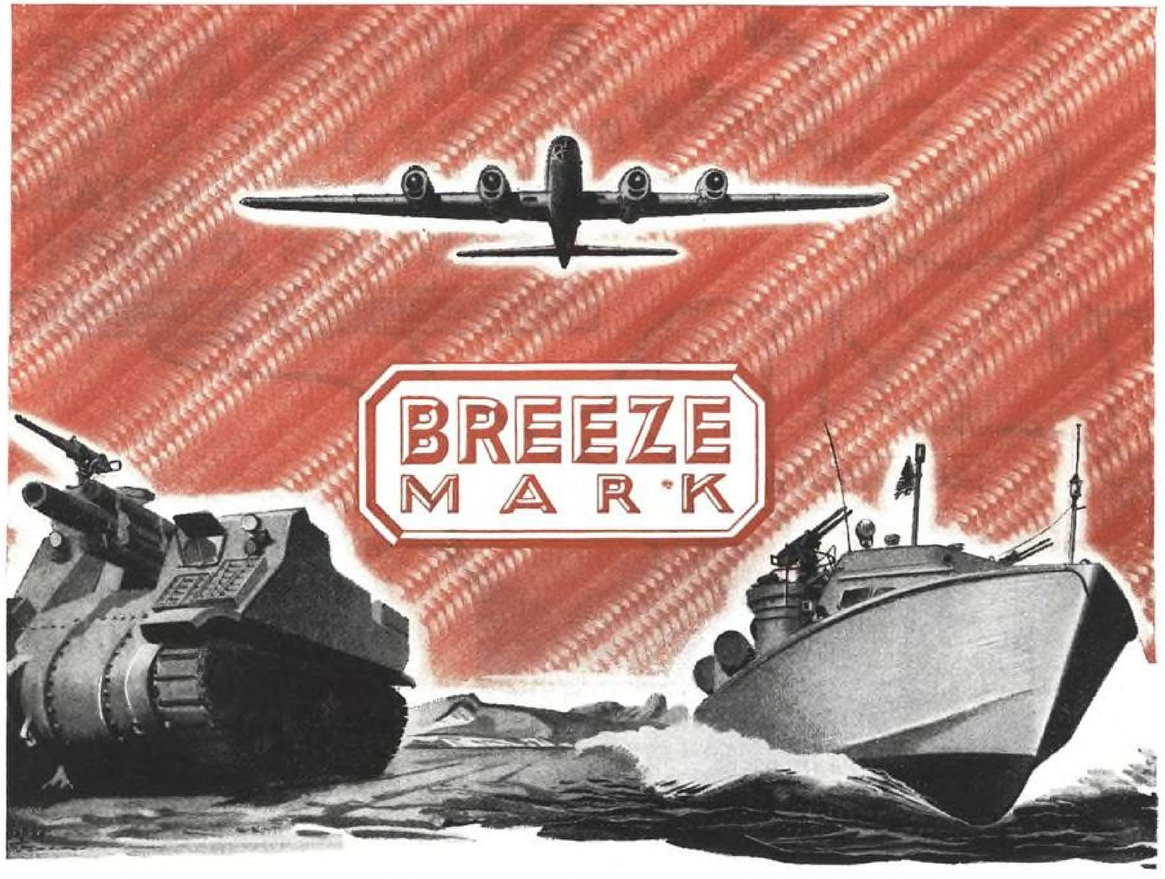


No. 16A BLANCHARD SURFACE GRINDER

BLANCHARD

The BLANCHARD MACHINE COMPANY

64 STATE STREET, CAMBRIDGE 39, MASS., U. S. A.



Mark of *Dependability* Shield of *Protection*

Breeze Radio Ignition Shielding Guards Radio Communications Against Natural and Man-made Interference

The Breeze Mark on Radio Ignition Shielding has for sixteen years been a mark of dependability, symbolizing the quality workmanship and engineering skill that has gone into every Breeze Shielding Harness. Designed for use on hundreds of different types of engines, this shielding has been developed by Breeze engineers to eliminate the radiation or absorption of high frequency interference in radio communications. In addition to this important function, durable protection is afforded to secondary wiring systems by Breeze Flexible Shielding Conduit, which guards against moisture, corrosion and abrasion.

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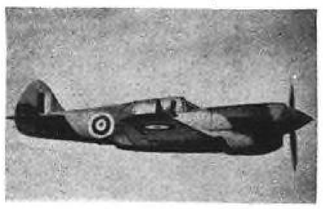
AUTOMATIC TRANSPORTATION CO.
Div. of Yale and Towne Mfg. Co.
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CHICAGO 20,
ILLINOIS



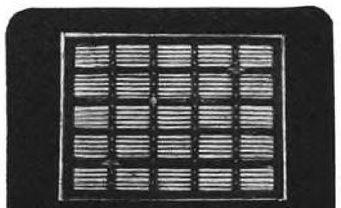


Roaring away into the darkness of the skies, tracking down with unerring accuracy the enemy intruder who dares to challenge our air-supremacy, "Cat's Eyes" finds his victim and, bringing into action the armoury of his aircraft, either forces the vain-glorious intruder to turn tail or crash to earth a shattered, burning wreck.

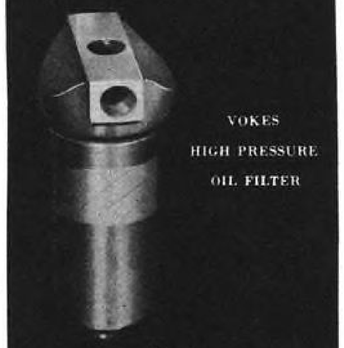




On the aircraft in which "Cat's Eyes" of the R.A.F. and his co-mates of the Dominion and American Air Forces carry out their job of work, Vokes Air and Oil Filters are fitted and have stood up to the severest test under the most gruelling conditions in all battle areas. There are many types in use. Vokes Air and Oil Filters for Aero Engines; Vokes Oil Filters for Main Circuit Filtration; Vokes Oil Filters for Gun Turrets also for Hydraulic Retractable Undercarriages. In aircraft factories Vokes Filters provide essential service for Test Bed Equipment. Vokes also manufacture Exhaust Silencers, Flame-Traps and Air Straighteners for Carburettors.



VOKES AEROVEE FILTER ELEMENT



VOKES HIGH PRESSURE OIL FILTER

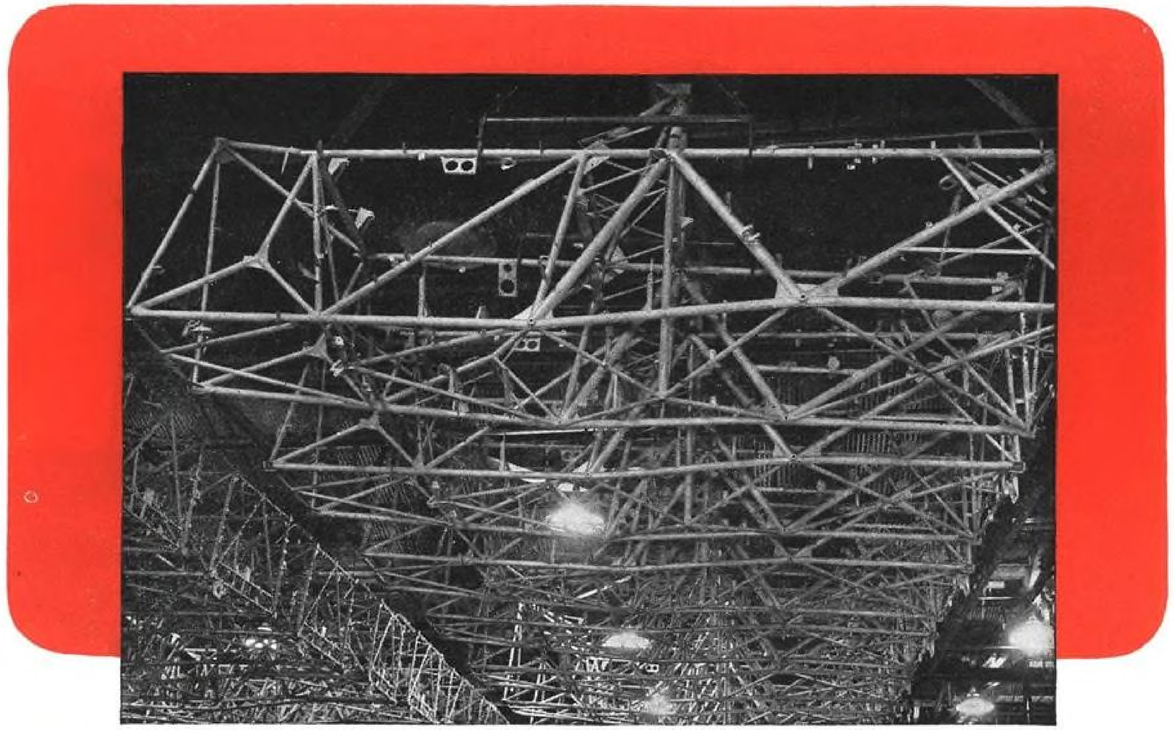
Vokes are pioneers in the science of filtration. Today Vokes Air Oil and Fuel Filters are approved and adopted by British and Dominion Governments and are fitted for Aircraft of the U.S.A. You ask "Why?" Simply because every Vokes Filter does its job thoroughly, filtering all the air and all the oil all the time. The matter of installation of these filters has a fundamental effect on their performance and we design and make the special housing and ducting to give utmost efficiency. Consult Vokes on all your filtration problems. They make every type of filter for all classes of industry.

VOKES FILTRATION & SILENCING CO. INCORPORATED, 101, PARK AVENUE, NEW YORK & VOKES (CANADA) LTD., 1123, BAY STREET, TORONTO, CANADA.

VOKES FLAME TRAP SILENCER FOR AIRCRAFT

VOKES LIMITED · LONDON · S.W.

DESIGNERS, PATENTEES AND MANUFACTURERS OF AIR, OIL AND FUEL FILTERS AND SILENCERS, CONTRACTORS TO BRITISH AND DOMINION GOVERNMENTS



ELECTRUNITE TUBING IS SOUND THROUGHOUT

—and Farrowtest Proves it!



Billions of feet of tubing produced by the ELECTRUNITE process of manufacture have been proved safe, sound, and economical in all types of mechanical, structural and pressure applications.

Now, aircraft tubing, made by the same process, is demonstrating its advantages to aircraft manufacturers. And it is being proved sound not by service alone, but by Farrowtest applied to *every length* before shipment.

Farrowtest is today's most accurate commercial method for testing tubing. It is a highly sensitive and accurate electronic test which reveals damaging imperfections—even small flaws which would be overlooked in visual inspection or ordinary testing methods.

Republic ELECTRUNITE Aircraft Tubing is easy to work and weld—because it is consistently uniform in wall thickness, diameter, concentricity and ductility—in strength, weight and smooth surface.

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SH-H-H!
DON'T SPREAD WAR INFORMATION—
IT MAY HELP THE ENEMY

Republic
ELECTRUNITE
*Reg. U. S. Pat. Off.
AIRCRAFT TUBING



WEBSTER SAYS, "Vicious Circle: A chain of circumstances constituting a situation in which the process of solving one difficulty creates a new problem involving increased difficulty..." So sorry, please, Jap know vicious circle mean Douglas SBD dive bombers.

Doak men and women are proud that part of their war assignments was the manufacture of many assemblies for this great Navy plane. When we of Doak can turn away from the vicious circle of war, our skills will be applied to products that will make your *"Family Circle"* a happier one.

DOAK *AIRCRAFT COMPANY, INC.*

TORRANCE, CALIFORNIA

WORKING AROUND THE CLOCK FOR A BRAVE NEW WORLD

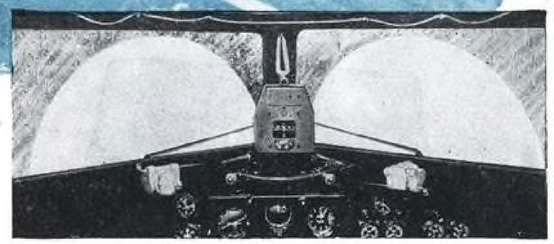
INSURE YOUR FUTURE—
INVEST IN WAR BONDS

Courtesy of Douglas Aircraft Co., Inc.

OVER OUR CITIES – OR OVER THE "HUMP"



Marquette Windshield Wipers Assure Clear Vision



Savings in *weight* and *cost* are equally important to all aircraft operators, wherever their planes are flown

Our new hydraulic wiper assemblies provide the following advantages:

MUCH LIGHTER ✓ FAR LESS EXPENSIVE ✓ EASY TO INSTALL ✓ SIMPLIFIED & COMPACT ✓

The new hydraulic motor, though of ample power, is small enough to fit in the palm of your hand. There are fewer parts, which means reduced maintenance costs and less man-hours. Also—

IT'S APPROVED ✓ IT'S IN PRODUCTION ✓

FOR EXCELLENCE

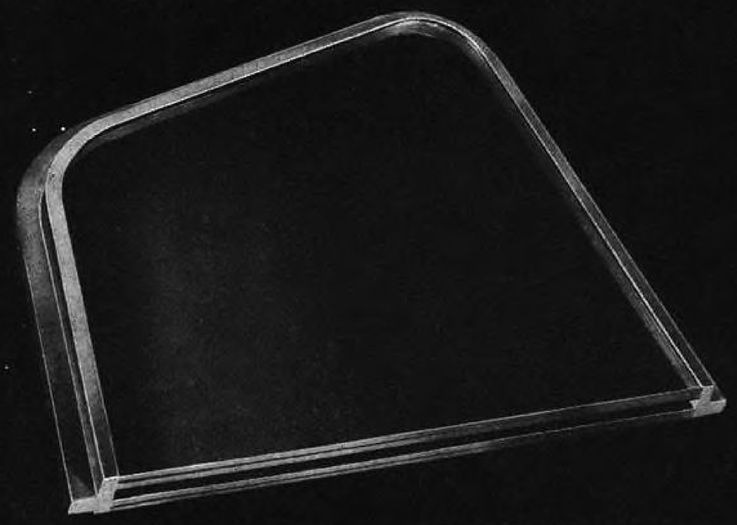
The Marquette METAL PRODUCTS CO.

CLEVELAND 10, OHIO

Manufacturers of: HYDRAULIC AND ELECTRIC WINDSHIELD WIPERS FOR AIRCRAFT
HYDRAULIC GOVERNORS FOR DIESEL ENGINES • ROLLER BEARING TEXTILE SPINDLES • FUEL OIL PUMPS
AIR COMPRESSORS • PRECISION PARTS AND ASSEMBLIES

"PITTSBURGH" DEVELOPMENTS IN AIRPLANE GLASS

Double-Glazed Units for Vision Panels





THE PROBLEM: To preserve clear vision for pilots and bombardiers on heavy bombers, by substantially reducing condensation and frost formation on the glass surfaces of vision panels.

THE SOLUTION: A Flexseal Double-Glazed Unit was developed by Pittsburgh Plate Glass Company. As shown in the cross-section above, an air space is enclosed between two panes of glass. This dead air space serves as insulation, and tends to prevent condensation or frost formation upon the glass surfaces. Being of Flexseal construction, the unit for vision panels and bombardier windows has light weight, flexibility, and freedom from framing stresses.

No manufacturer has contributed more to the rapid progress made in the field of airplane glass and glazing than Pittsburgh Plate Glass Company. The development of the Flexseal Double-Glazed Unit is but one example from an impressive list of many contributions which have been initiated by "Pittsburgh." If you would like further technical data on any aspect of airplane glass or glazing, we invite you to write us on your business letterhead. Address Pittsburgh Plate Glass Company, 2306-4 Grant Building, Pittsburgh 19, Pennsylvania.

"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

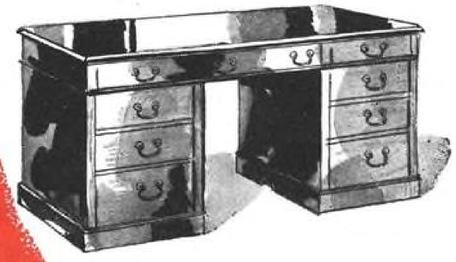


RESISTS SCRATCHES, PERSPIRATION

Nitrocellulose lacquer protects metal and other surfaces from acids, alkalies, perspiration and scratches. Easy to apply—fastest-drying finish known!

WATERPROOF AND WASHABLE

Nitrocellulose lacquer protects surfaces with a waterproof film, makes them easy to wash. Equally adaptable to fine craftsmanship or economical assembly line methods.



Improved protection *for your products*

PROTECTS FOOD, BEVERAGES



Nitrocellulose lacquer may be applied in many ways, including rollercoating. It is so flexible that articles may actually be finished first, *then formed*, as in metal covers for glass jars.

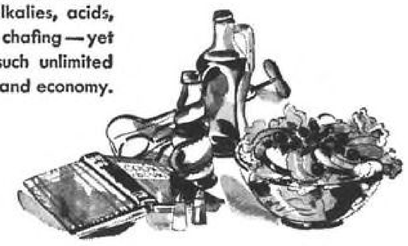


TOUGH, DURABLE, FLEXIBLE...

Flexibility makes it ideal for fabric finishes. Tough enough to stand hard outdoor use. Durable—will not crack, peel, or blister.

RESISTS OILS, ALKALIES, ACKALIES, ACIDS

No other finish can give you the same protection against oils, alkalies, acids, fingerprints, fats, stains, chafing—yet at the same time offer such unlimited color possibilities, beauty, and economy.



CL-48

HERCULES

NITROCELLULOSE

Hercules makes no finished lacquers, but supplies the base nitrocellulose from which lacquers are made. For helpful information on your finishing problem, *call your lacquer supplier*. Cellulose Products Department, Hercules Powder Company, 963 Market Street, Wilmington 99, Delaware.



THE BLACK WIDOW, with its devastating fire power, flies as a winged knight of hope . . . in a modern world threatened by the Hitleresque menace of enslavement, ignorance, fear . . . the twilight of dark ages.

Night flight over battlefronts requires great power. U. S. Super-Positive Piston Rings have ably assisted in the production of that power by meeting engineers' precise specifications. They have rendered performance possible only from rigid, unswerving adherence to exceptional quality standards. We are heartily proud of the perhaps small but definite part U. S. Super-Positive Piston Rings have played in the development of today's overwhelmingly superior air power of the United Nations.

KEEP BUYING "VICTORY BONDS" AND HOLD THEM

For Ring Conditions Favoring Peak Performance . . .
Use U. S. Super-Positives
U. S. HAMMERED PISTON RING CO., INC.
STIRLING, NEW JERSEY, U.S.A.

RIDGID

The Pipe Wrench that doesn't ask you to repair it's housing

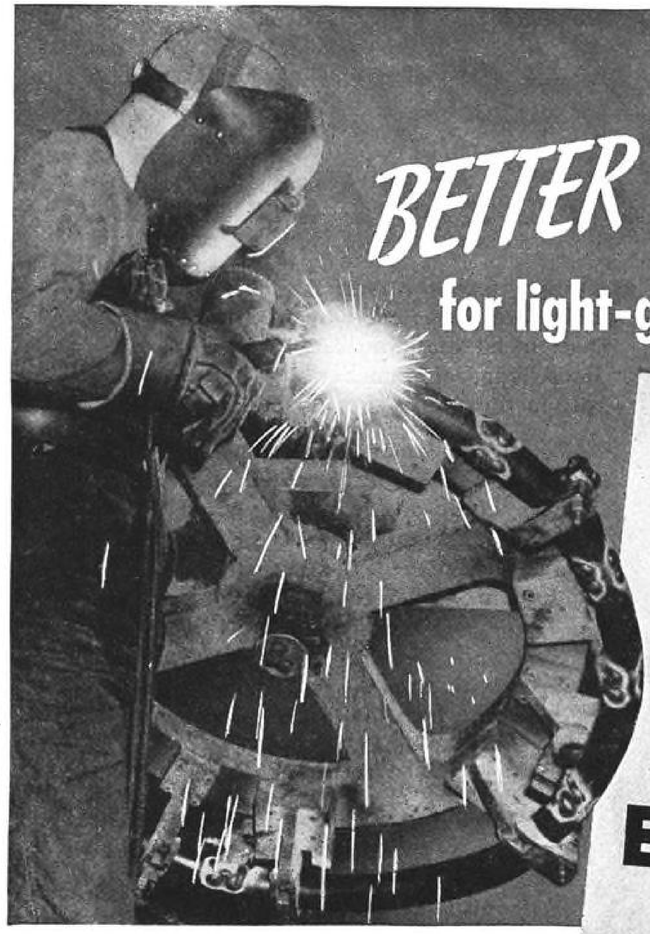


Why the RIDGID stays on the job

● The housing of the RIDGID simply won't break or warp—that guarantee assures it . . . no wrenches laid up for housing repairs or expense, fewer spare wrenches needed. Besides that you like the adjusting nut in open housing that spins easily in all sizes, 6 in. to 60 in.—the handy pipe scale on hookjaw—the comfort-grip I-beam handle. . . . Ask your Supply House for the powerful easier-work RIDGID.

THE RIDGE TOOL COMPANY, ELYRIA, OHIO





BETTER THAN EVER!

for light-gauge metal welding

The IMPROVED AIRCO No. 90-A ELECTRODE

Made in 1/16", 5/64", and 3/32" sizes

IT'S especially designed for AC or DC welding of light gauge chrome-moly and similar steels used in aircraft construction. Made to a completely new formula, the Airco No. 90-A Shielded Arc Electrode provides these four notable improvements:

1. Better appearance of deposit
2. Stronger arc action
3. Reduced arc interference
4. Ability to work at higher currents without deterioration of coating at stub end.

And that's not all! This electrode is available in all three popular aircraft welding sizes—$\frac{1}{16}$", $\frac{5}{64}$", and $\frac{3}{32}$" diameters, 9", 12" and 12" lengths respectively. It is used with AC and is also satisfactory for DC operation, straight or reversed polarity

Test specimens welded with Airco No. 90-A show tensile strengths of 80,000 to 90,000 psi. It meets the requirements of U. S. Army Air Corps Specification 10286B, Type I, Grade 2E, and conforms to A.W.S. and A.S.T.M. Specifications for Classification E 6013.

For complete details on the Airco No. 90-A, call or write any Air Reduction office. Or mail the coupon for prices and data on Airco's complete line of AC and DC electrodes.



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AIRCO
General Offices: 60 East 42nd Street, New York 17, N. Y.
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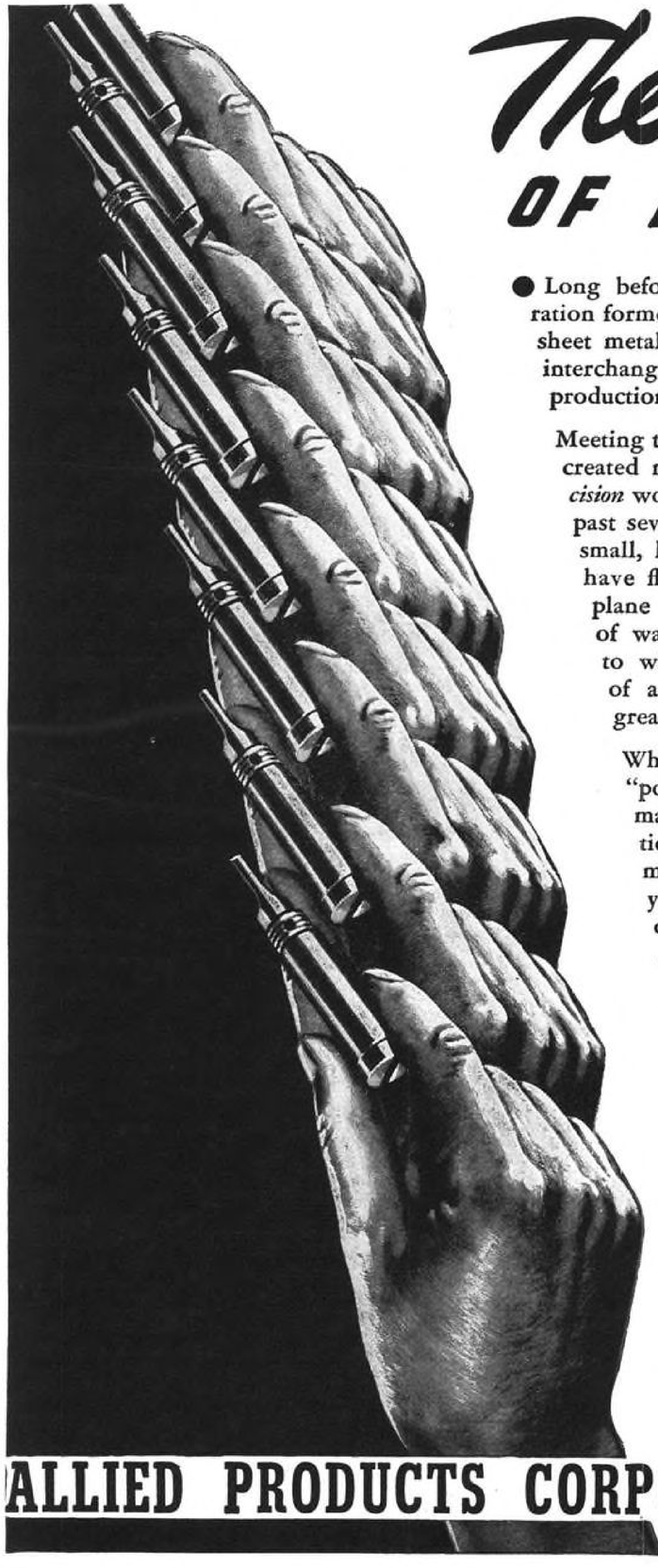
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Air Reduction Sales Co.
60 E. 42nd St., New York 17, N.Y.

Please forward by return mail copies of—.

☐ Airco Electrode Price List
☐ Electrode Consumption Calculator

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Company.....
Address.....
City..... State.....



The Habit OF PRECISION

● Long before the war, Allied Products Corporation formed the habit of precision—in building sheet metal dies, intricate jigs and fixtures, R-B interchangeable punches and dies and other vital production tools for the automotive industry.

Meeting the demands of war production, Allied created new facilities where *the habit of precision* would do the most good. Thus, for the past several years, a great variety of large and small, hardened and precision ground parts have flowed from Allied plants into airplane engines, guns and other implements of war. Some of these parts are finished to within limits of two ten-thousandths of an inch and are being produced in great volume.

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"IT'S AN ALLIED PRODUCT!" . . . Allied Products Corporation and its divisions, Richard Brothers and Victor-Peninsular, in Detroit and Hillsdale, Michigan, also make: Steam-heated plastic molds; cap screws; cold forged parts; and other special products.

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BUY MORE WAR BONDS

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Executive Offices: 4646 Lawton Avenue Detroit 8, Michigan

Sensenich Replacement Propeller List For Military Airplanes

Some Sensenich-equipped Liaison, Training and Utility Cargo airplanes originally purchased by the armed forces have already been sold to commercial operators and private flyers. There is every indication that more will be released in the near future. This list is published for the convenience of the purchasers to facilitate ordering replacement propellers.

AIRPLANE	MODEL	ENGINE MFGR.	ENGINE MODEL	HP	AAF DESIGN	SENSENICH DESIGN	NOTE
Aeronca	L3A, B, C, E, F, J	Continental	A 65	65	43K10107	72C42, 72C44	6
Aeronca	L3D	Franklin	4 AC 176 B2	65	72F42 72F44	72F42, 72F44 72F42, 72F44	7
Aeronca	L3G, H	Lycoming	O 145 B 2	65	70LY34 70LY36	70LY34, 70LY36 70LY34, 70LY36	7
Aeronca	PT-23	Continental	R 670 5	220	43K19181	90LA78	5
Boeing	PT-13 B, D, N2S-5	Lycoming	R 680 11	220	44K9705	98AA64, 98AA66	5
Boeing	PT-17, A, N2S-3	Continental	R 670 5	220	44K9705 43K19593	98AA64, 98AA66 98AA64, 98AA66	5
Cessna	UC-78	Jacobs	L 4M B	225	707-80 43K13605 44K26405	90JA81 90JA81 90JA81	5
Fairchild	PT-19A, B	Ranger	6 440 C2	180	42K15729 43K15131 43K15131A 43K26463 44K10817 44K10817M	86R61 86RA61 86RA61 86RA61 86RB61 86R61	1 5 5 5 2 1
Fairchild	PT-26	Ranger	6 440 C5	200	Same as PT-19A		
Fairchild	UC-61, A	Warner	Super Scarab	165	43K13397 43K14699	86CB69 86CA69	2 1
Fairchild	UC-61K	Ranger	6 440 C 5	200	86AB54	86AB54 86AA54	2 1
Fleet	PT-19A	Ranger	6 440 C 2	180	See Fairchild PT-19A		
Fleet	PT-23	Continental	R 670 5	220	43K19181	90LA78	5
Fleet	PT-26	Ranger	6 440 C 5	200	See Fairchild PT-19A		
Grumman	OA 14	Ranger	6 440 C 5	200	82RS72	82RS72	1
Howard	PT-23	Continental	R 670 5	220	43K19181	90LA78	5
Piper	L4, A, B, H	Continental	A 65	65	43K10107	72C42	6
Piper	L4C	Lycoming	O 145 B 2	65	70LY34	70LY34	7
Piper	L4D	Franklin	4 AC 176 B 2	65	72F42 72F44	72F42 72F42	7
Piper	L4E, F	Continental	A 75	75	70D40 70D42	70D42, 70D44 70D42, 70D44	6
Piper	L4G	Lycoming	GO 145 C3	75	78LY52	78LY52	7
Ryan	PT-22	Kinner	R 56	160	90HASP90 90HASP90M 42K12335 42K12335M 43K26215	90HA86, 90HA84 90HA86, 90HA84 90HA86, 90HA84 90HA86, 90HA84 90HA86, 90HA84 90H86, 90H84 90HB86, 90HB84	5 5 5 5 5 3 4
St. Louis	PT-23	Continental	R 670 5	220	43K19181	90LA78	5
Stinson	L5	Lycoming	O 435 1	190	85LY58 43K23447 44K15005 44K17191	85LY57 85LY57 85LYA57 85LY57	1 1 2 1
Stinson	L9A, B	Franklin	4 AC 199 E 3	90	72DF49	72DF48, 72DF49	7
Taylorcraft	L2A, B, H, M	Continental	A 65	65	43K10107	72C42, 72C44	6
Taylorcraft	L2D, F, J	Lycoming	O 145 B 2	65	70LY36 70LY38	70LY36, 70LY38 70LY36, 70LY38	7
Taylorcraft	L2E,K	Franklin	4 AC 176 B 2	65	72F42 72F44	72F42, 72F44 72F42, 72F44	7
Taylorcraft	L2G,L	Franklin	4 AC 150	50	70F45	70F45	7

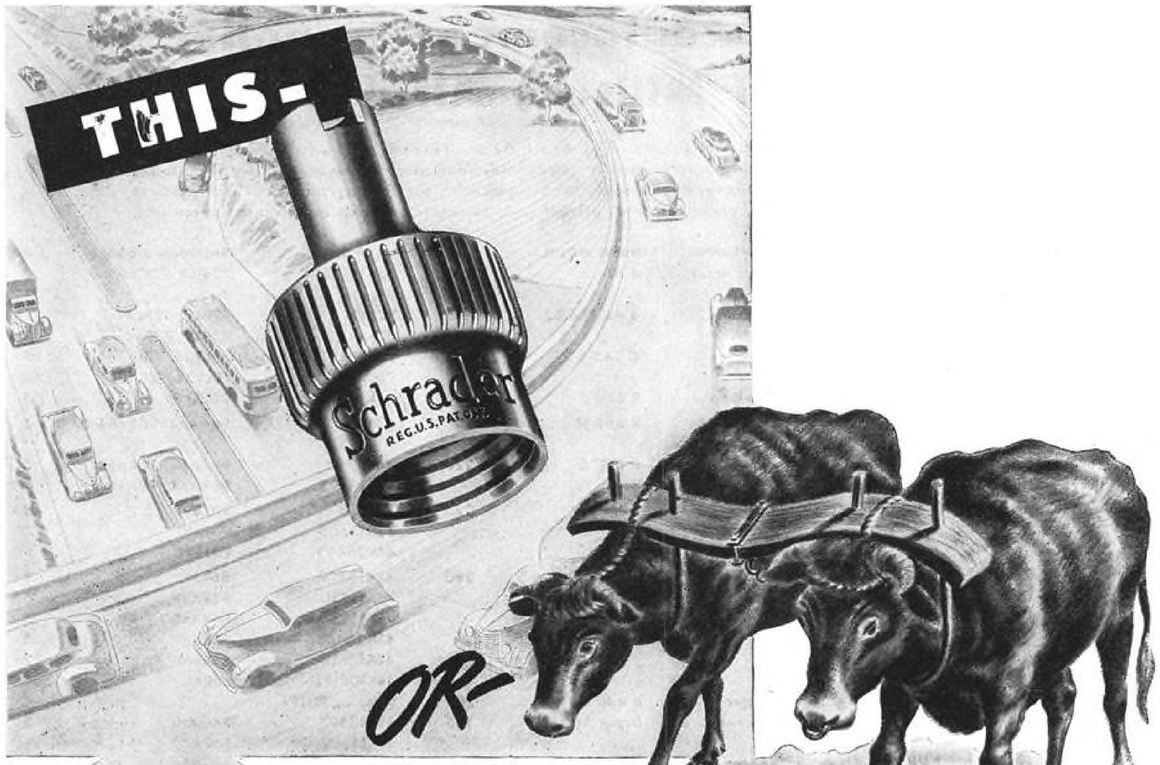
Tear out and file for ready reference (additional copies available upon request)

NOTES

1. Warner hub 20 Spline 8 Bolts (8599, 8530, 7900)
2. Warner hub 20 Spline 6 Bolts (8808 or 43D24385)
3. Kinner 20 Spline Hub (1475 or 42K14179)
4. Kinner Taper Shaft Hub
5. AN Standard 20 Spline Hub (41G2325)
6. Continental Taper Shaft Hub (3475)
7. Integral Flange

SENSENICH BROTHERS, Lancaster, Pa.—adjacent to Lancaster Municipal Airport; West Coast Branch, Glendale, Calif.

AIRCRAFT PROPELLERS SENSENICH





This Seals the Air!

All Standard Schrader Valve Caps in use today contain the specially designed sealing unit with a dome-shaped rubber washer vulcanized between two dome-shaped BRASS plates. Because of their unique construction, these caps are guaranteed airtight up to 250 lbs. pressure. This mighty midget does the work.

MR. & MRS. AMERICA

Today good tires need good care—poor tires demand it. For safety and a minimum of tire trouble, keep a watchful eye on your tires now and be sure a Schrader Cap is applied firmly to each tire valve.

What would you do if your tires wore out and you couldn't get replacements—Use oxen? Certainly not! But they would be better than nothing. So, with new tires for all admittedly remote, why not take care of your present ones? Isn't that just good sense?

What single factor ruins most tires? Underinflation. It breaks down side walls and causes a serious loss of tire mileage. Yet underinflation can easily be prevented.

What to do about it? Take air-pressure reading with an accurate gauge. Put air in when needed and seal that air in at the valve mouth with an airtight Schrader Valve Cap. Be sure there's a Schrader Cap, screwed down fingertight on every tire, including the spare.

Uncle Sam, too, realizing the importance of Standard Caps is using them on *all* pneumatic tired vehicles at home and abroad. So take care of those you have. Be sure they're on tight. And if your dealer is temporarily out of Schrader Caps, don't blame him. Try again later.

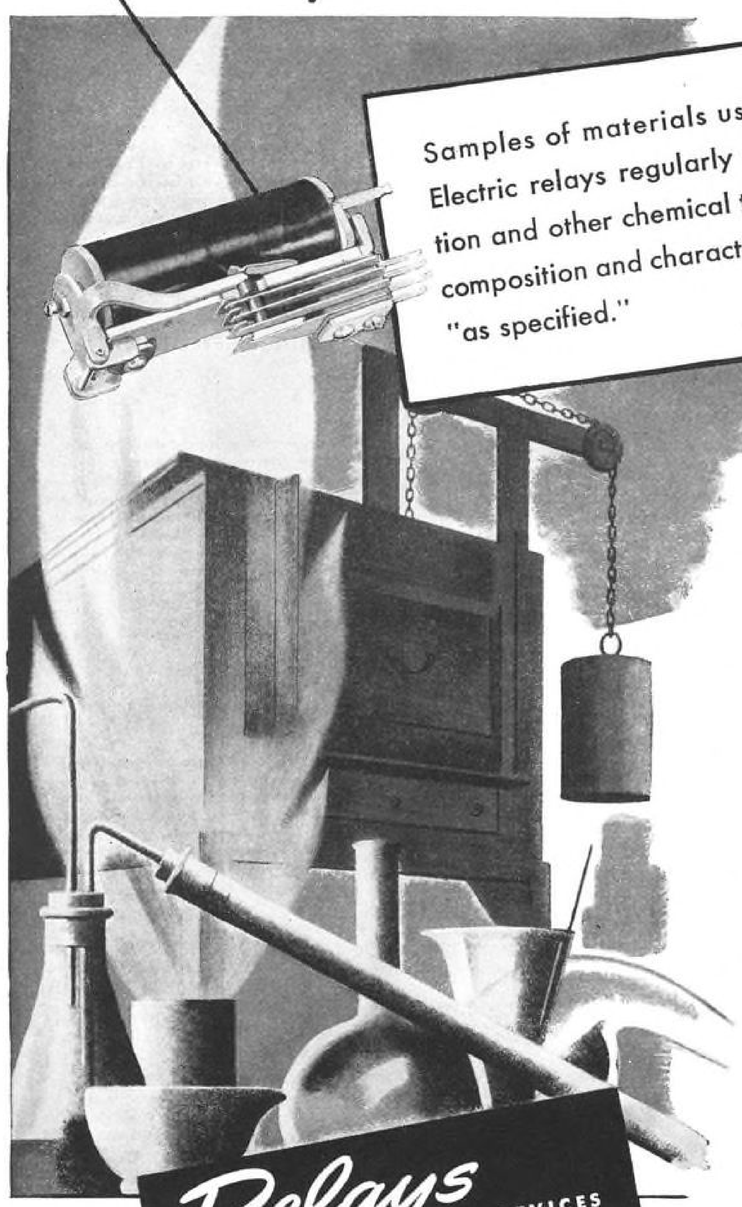


Schrader
CONTROLS THE AIR

CAPS are vital for TIRE CONSERVATION

A. SCHRADER'S SON, *Division of Scovill Manufacturing Company, Incorporated*, BROOKLYN, NEW YORK

"The Heats On" To Verify Relay Material Composition



Samples of materials used in Automatic Electric relays regularly undergo combustion and other chemical tests to insure that composition and characteristics are exactly "as specified."

It may seem a simple matter—this job of selecting the right materials for making relays; but—

Automatic Electric designers know better. They know that correct design is only the beginning—that materials must also meet exacting standards, or performance will suffer. That is why they insist that quality control must begin in the laboratory.

When you need relays, call in the Automatic Electric field engineer. He can show you how quality pays, in longer life, better performance. In the meantime, for a preview of the Automatic Electric line, write for Catalog 4071.

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Relays AND OTHER CONTROL DEVICES *by* **AUTOMATIC ELECTRIC**

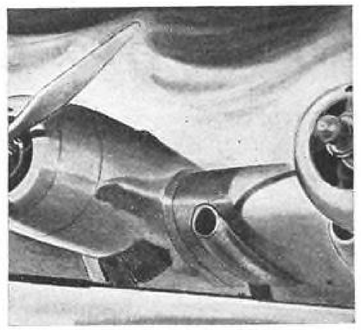
PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

LOW-PRESSURE PLASTIC LAMINATES

made with

FIBERGLAS*

offer plane builders many advantages



A new material now being used in the fabrication of air scoops, ducts and protective backing for fuel cells.

Recent developments in the field of low-pressure laminates may make possible substantial economies in the production of Postwar Aircraft. Thanks to new developments in resins, which cure with little or no pressure, and with moderate heat, large and complex parts can now be fabricated without expensive dies or costly metal-forming machinery.

For many uses, these new laminates are superior to metal. For instance: some have a greater strength-to-weight ratio than metals, together with higher impact strength. These laminates also possess dimensional stability and low moisture absorption. *Such* laminates are made with *Fiberglas Fabrics*—strong, durable cloth made from fine glass fibers twisted into yarns for weaving.

Fabricators of low-pressure laminates have done wonders in integrating the unusual qualities of Fiberglas into their finished products. For Fiberglas Fabrics, themselves, possess great tensile strength with light weight, dimensional stability and moisture resistance.

These fabricators have also been ingenious in forming unusual shapes and parts—sometimes, a combination of *several* parts. This, in turn, may provide still more production economies through the elimination of assembly operations.



Get your FREE copy of this informative book!

It contains a comprehensive report of extensive tests made by the U. S. Army Air Forces on Fiberglas-reinforced plastics. Also a brief description of their development, fabrication and applications in aircraft to date. Write today for your copy.

Owens-Corning Fiberglas Corporation, 1891 Nicholas Bldg., Toledo 1, Ohio.

In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.

OTHER AIRCRAFT USES OF FIBERGLAS



AIRCRAFT INSULATION

Fiberglas Insulation, Type XM-PF, is a lightweight, semi-rigid bat of fine glass fibers. It is firesafe and has exceptionally low moisture pick-up, even under conditions of extreme humidity. It is available in 1 lb. and 1½ lb. densities. In aircraft construction it is used for acoustical and thermal insulating purposes.



AIRCRAFT BLANKETS

Another type of Fiberglas thermal insulation, these fireproof blankets (known as Design No. 3) are made of Fiberglas Insulating Wool, Type N, faced with Fiberglas Cloth and stitched with glass thread. Available in 1½ lb. and 3 lb. densities, they are extensively used to insulate gasoline heater exhausts, heat exchanger ducts, other high temperature pipes, etc.



TAPES

Another all-glass product—woven from Fiberglas yarns. While extensively used for insulating motors, generators and other electrical equipment, many other applications have been found for these durable, incombustible tapes in aviation—such as covering of thermal insulations on hot air ducts, ties for removable insulating pads, etc.



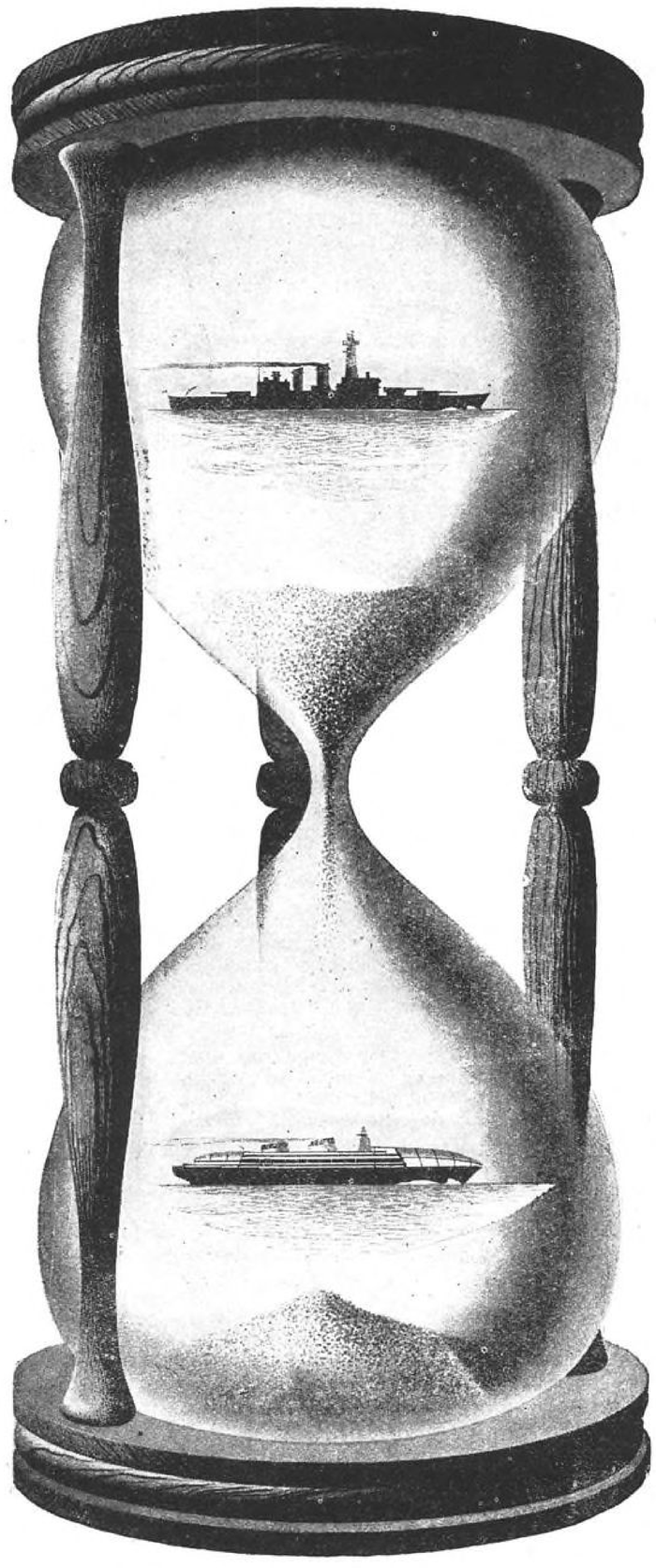
COATED FABRICS

The use of Fiberglas cloths as base fabrics for coating with natural or synthetic rubbers, vinyl compounds and other coating materials, provides a finished material having new and unusual qualities—great dimensional stability and strength under the most severe conditions of humidity, temperature and hard usage in combat. Widely used in the fabrication of gun bore sight screens, insulation covering, flexible connections, bunks, fuel cells, distillate tanks, many other items.

ARMY E NAVY

FIBERGLAS ..A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.



WILCO facilities Expanded to Meet Wartime Needs!

But Postwar Industry will be the ultimate gainer from the many new WILCO products and developments

As the Hourglass indicates . . . at the coming of peace, the skill and experience gained in the development and application of new WILCO products and techniques will mean much to automotive, electrical appliance and many other types of manufacturing customers.

Though now chiefly applied to the war effort, these new WILCO developments are destined to play as vital a role in the postwar industrial "comeback" as they are now playing in scores of wartime applications.

Thermostatic Bimetals, Electrical Contacts, and Precious Metal Bimetallic Products are such important factors in the precision performance of ships, planes, tanks, guns, and various instruments of the Army and Navy that the H. A. Wilson Company has found it necessary to enlarge its facilities and develop these important new products and techniques.

In the postwar period no company will be better equipped to meet individual requirements for Thermostatic Bimetals and Electrical Contacts on any desired scale than the H. A. Wilson Company, pioneers in this field.

WILCO PRODUCTS ARE: *Contacts*—Silver, Platinum, Tungsten, Alloys, Sintered Powder Metal. *Thermostatic Metal*—High and Low Temperature with new high temperature deflection rates. *Precious Metal Collector Rings* for rotating controls. *Silver Clad Steel. Jacketed Wire*—Silver on Steel. Copper, Invar, or other combinations requested. *Silver Clad Steel. Rolled Gold Plate.* Special Materials.

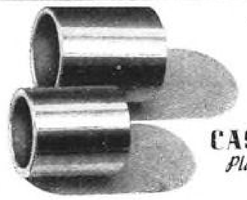
THE H. A. WILSON COMPANY
105 Chestnut Street, Newark 5, New Jersey

WILCO

Thermometals—Electrical Contacts
Precious Metal Bimetallic Products

JOHNSON BRONZE

SLEEVE TYPE BEARINGS



CAST BRONZE
Plain or graphited



SHEET BRONZE
Plain or graphited

WHICH ONE SERVES BEST ?



BRONZE ON STEEL
Plain or graphited



BRONZE and BABBITT



STEEL and BABBITT



LEDALOYL
Self-Lubricating

● There is one RIGHT bearing for every application. One that will deliver the greatest performance for the longest period of time. One that will be easiest to install and replace . . . one that will be most economical to buy.

There is one RIGHT way of making the correct selection. Call in a Johnson Engineer. Permit him to review the operating conditions. To determine the speed . . . the load . . . the shock. To check outside factors such as extreme heat . . . injurious gases or liquids . . . the presence of grit or abrasive material.

Armed with the necessary data, it becomes an easy task to make the proper recommendation. As we make ALL types of SLEEVE bearings, we hold no prejudice for any one kind. Our advice is supported by more than thirty-five years of exclusive bearing experience. Can we help you—NOW?

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620 S. MILL STREET NEW CASTLE, PA.

The MOST COMPLETE SLEEVE BEARING SERVICE in the WORLD

ENDING THE TERROR



OF LOW FLYING ENEMY AIRCRAFT





The "Water Buffalo", amphibious tank combining firepower, speed and mobility. Made by Food Machinery Corp. Uses armor plate supplied by Atkins.



The M-17 multiple-motor carriage, made by International Harvester Co. Armor plate made by Atkins. Other similar military vehicles are equipped with Atkins One-Man Crosscut Saws.

How the Same Skills Used in Making Saws for You HELP PROTECT OUR FIGHTERS

Thanks to superior weapons mounted on highly mobile vehicles and protected by superior armor plate, most of the sting of low flying aircraft, once the enemy's favorite weapon of terror, has been removed.

The manufacturer of life-saving armor plate for these and other weapons was one of the major tasks assigned to Atkins early in this war. In fact, Atkins was supplying it to the Netherland East Indies as far back as the Fall of 1939. But the special skills required in its production date back much farther. These skills are the culmination of over eight decades of extensive experience in the heat treatment and fabrication of metals.

You men in charge of metal cutting have visual proof of these skills and this experience every time you use Atkins Metal Cutting Saws... Whether these are the recently developed "Curled-Chip" Saws, the famous "Silver Steel" Blades or "A-Mol" Blades.

Citation
To Atkins Engineer
It was for development work leading to important time and material savings in the manufacture of armor plate for the M-17 Motor Carriage that Carl W. Noftke, of Atkins Engineering Department, received an Army Ordnance citation, recognizing his work as an important contribution to armament production.

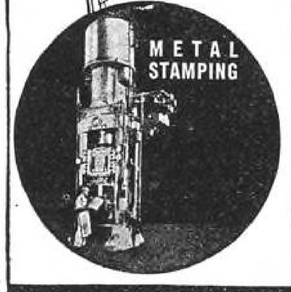
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ATKINS *Silver Steel* SAWS

METAL STAMPINGS OF QUALITY



ARMY E NAVY



The Metal Specialty Co. is completely equipped to give you efficient service in Stamping, Rolling, Coining, Forming, Drawing and Annealing in all Metals. Specialists in Hydraulic cold drawing and embossing in all metals including stainless steel. Deep drawing and embossing up to 850 tons capacity. Shells drawn up to 20"in depth. Assembling including Spot Welding and Hydrogen Brazing. Pressed Metal products to order.

A complete Plastic Injection Molding Division to fulfill your exacting requirements. Up through 18 oz. moldings.

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TRIBUTE TO THE BARNSTORMERS

Delco-Remy
Aircraft Electrical Equipment

Aviation has come a long way since men flew "by the seat of their pants," without benefit of precision instruments, radio and navigating equipment, or automatic controls. Their ships seem crude and methods primitive by today's standards, yet no one will question their skill and daring, or the contribution they made to flying. ¶ Delco-Remy electrical equipment serves today in medium and heavy bombers that are bringing the full weight of America's aircraft developments to bear on the enemy. Designed to meet military requirements, it is one of many factors that help insure the dependable performance of engines and electrical accessories for men of the Air Forces. ¶ More than half of Delco-Remy's facilities are now engaged in the manufacture of electrical units, precision parts and products for the aircraft industry. The engineering and research development that has been applied to this assignment will find a place in Delco-Remy equipment for cargo ships, air liners and private planes of the future.

ARMY E NAVY **DELCO-REMY** WAR BONDS WILL BRING THEM HOME SOONER

DIVISION, GENERAL MOTORS CORPORATION

BEYOND THE SCOPE



"Spring-life" BELLOWS

go beyond the scope of ordinary bellows applications.

Today, "Spring-life" Bellows are used in many applications by engineers who previously have said "a bellows won't do." Here are the advantages and the reasons why "Spring-life" opens a wider field of bellows application. These are the features which only "Spring-life" construction can give you.

1. CHOICE OF METALS . . . "Spring-life" construction permits the use of tinned phosphor bronze, brass, copper, beryllium copper, stainless steel, steel, Monel, Inconel and nickel silver. This gives the user a selection of metals to meet all the ordinary corrosive conditions.
2. UNLIMITED OUTSIDE DIAMETERS AND LENGTH... Cook "Spring-life" construction places no limits on the outside diameters or the length of bellows.
3. WIDE RANGE OF SENSITIVITY . . . Flexibility varies directly with the number of flanges and type and thickness of metals used. Pressure detector switches sensitive enough to actuate with a ¼" water column differential and constructed with Cook "Spring-life" Bellows.
4. CALIBRATION... Cook "Spring-life" Bellows are particularly suitable for applications requiring extreme accuracy and spring-rate, as well as zero hysteresis. "Spring-life" Bellows may be calibrated to function in direct relationship to increments of pressure, and with exacting linear travel.
5. UNIFORM MOVEMENT . . . Because Cook Bellows are made of tempered materials, they maintain a uniform movement in operation, and assure exact return to the "no load" position. Cook Bellows respond like a true spring.
6. LONGER LIFE . . . Extensive life tests have proven that Cook "Spring-life" Bellows can "take it" far and beyond any ordinary seamless type of bellows. Tests have shown that 600 million flexures cannot weaken "Spring-life" Bellows of phosphor bronze construction.

Cook Electric Company also places a staff of engineers at your service to help you solve difficult and unusual problems, supplemented by field engineers to personally contact and assist you.

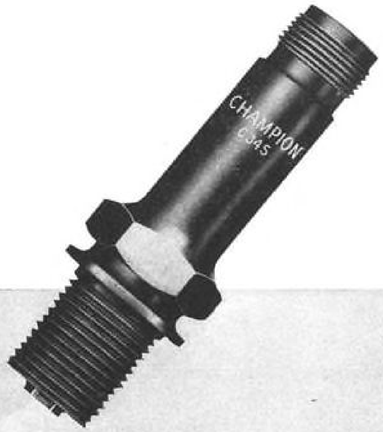
Basically, the "Spring-life" principle is a patented method of construction in which a series of diaphragms are joined alternately at their inner and outer peripheries. Each diaphragm is characterized by a flat section with radial or circumferential corrugations, and cupped inside and outside edges. All known methods of metal joining are employed in accordance with the materials used. Flexure in the assembled bellows takes place at both the inside and outside curved sections, when pressure is applied.





2700 SOUTHPORT AVENUE
CHICAGO (14) ILLINOIS

COOK ELECTRIC Company





Pan American Airways photo

Dependable ...CHAMPION SPARK PLUGS ARE ON ACTIVE DUTY!

In their far-flung operations across the face of the globe Pan American World Airways System has been a true pioneer and a model of efficiency. The record of dependable service they have compiled is unique in air transportation. Dependability is the one outstanding characteristic of Champion Spark Plugs, and Champion is indeed proud of the part its product is playing in Pan American ships. Champion Ceramic Aircraft Spark Plugs are approved by the Atlantic and Pacific Division of Pan American and are on active duty daily throughout their vast network of routes. Champion Spark Plug Company, Toledo 1, Ohio.

C26—Unshielded



INSTALL CHAMPIONS AND FLY WITH CONFIDENCE



THERE AND BACK

. . . 121 TIMES!

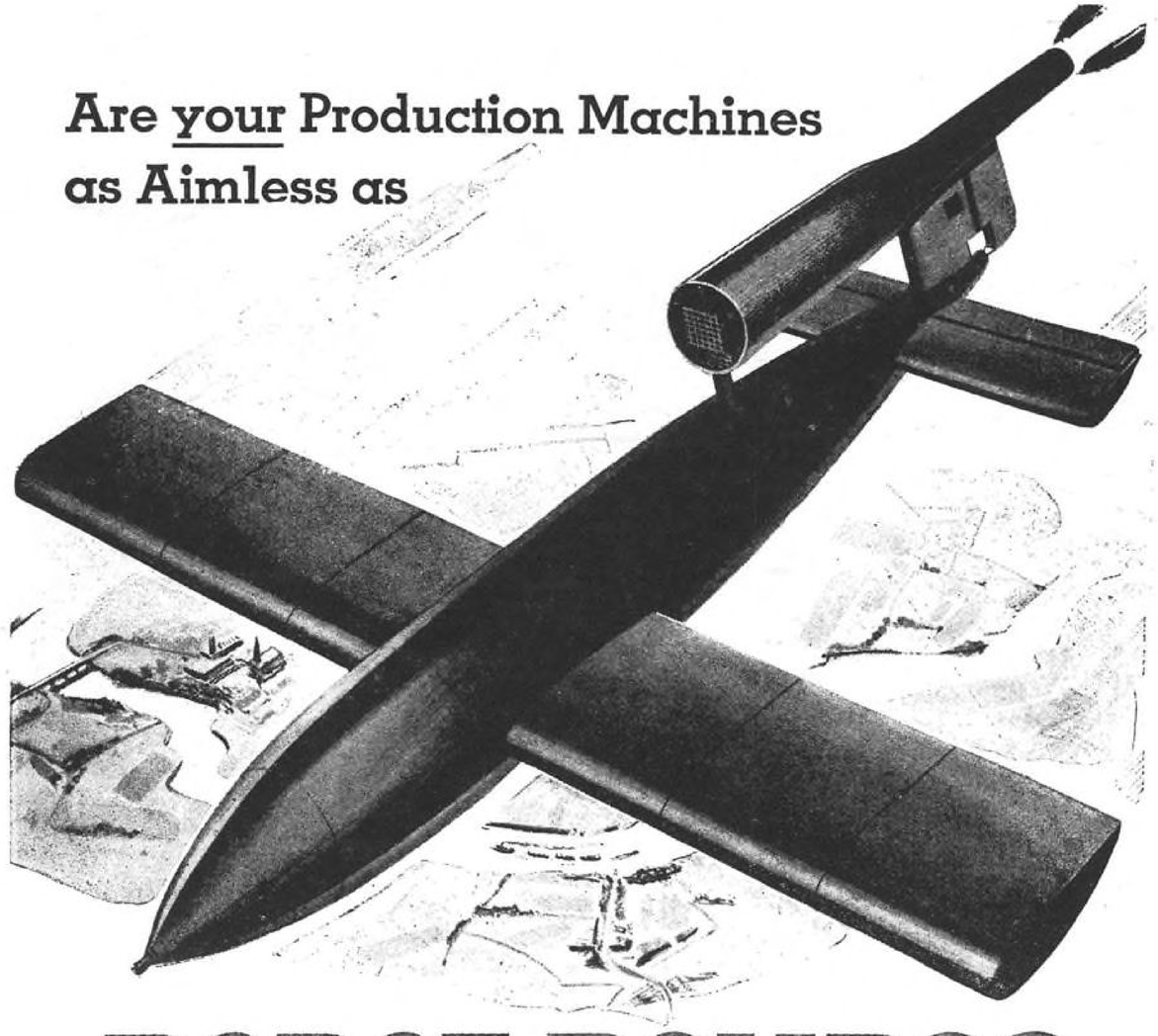
This "censored" and mutilated carburetor serial plate from "Old 59," a B-25 Mitchell medium bomber, offers mute testimony in one of the most remarkable cases of carburetor dependability on record! ¶ "Old 59" flew there and back 121 times in bombing missions over Jap objectives in China—Burma—India—without a single instance of mechanical trouble. That's what we mean when we say, "Holley Carburetors are dependable."

HOLLEY

AIRCRAFT, AUTOMOTIVE, MARINE

CARBURETORS AND ACCESSORIES

Are your Production Machines as Aimless as



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When you launch a production run, can you be sure *then* that each machine will complete its quota exactly on time, without either over-producing, or running short and delaying final assembly? Yes, you can, if each machine supplies continuous "Facts-in-Figures" on its own performance, so that your production men can spot and correct *immediately* any deviation from scheduled operating rate. And each machine can be quickly and inexpensively equipped to supply these "Facts-in-Figures" . . . with a Veeder-Root Device that will count in any terms or units required . . . turns, strokes, pieces, trips, volumes, lengths, hand-movements, light-flashes, or any other form of motion. Veeder-Root Devices are easily installed without interrupting production, and they don't add to your maintenance work. Rather, they add to your production by tightening control and ending guess-work . . . which will be just as important in peacetime as now, in wartime. Find out what these "countrollers" can do for *you*. Write to: *Veeder-Root Inc., Hartford 2, Conn.*, or *Veeder-Root of Canada, Ltd., Montreal.*



Countrol your Machines Straight to the Mark...

with the help of VEEDER-ROOT COUNTING DEVICES



It's the Laboratory Behind the Product . . . *that Guarantees Results*

TAKE the best ingredients obtainable, compound them under relentless laboratory control, toss in a pinch of "know how", add 18 years of chemical manufacturing experience—it's the recipe that produced the McAleer *tailored-to-fit-the-job* bar of composition shown above.



Rigid Laboratory Control insures *uniform* quality in *every* shipment

On your next problem involving burring, polishing, buffing of metals or finishing of plastics, let McAleer provide the answer with a *quality-controlled* composition formulated to do an exacting job, do it well and keep on doing it as long as the need exists.

Though sold by the pound, this production finishing material represents a *value far beyond purchase price* to its User. The value? Extra performance on the job, less waste, elimination of rejects, greater work output and lower operating costs.

Standards protect the manufacturer of materials which are buffed or polished; but when your compositions bear the McAleer trade mark, you get more than standards—you are protected all the way. *Use the laboratory behind the product* for results. Use McAleer.

On the Transportation Front, McAleer Rubbing Compounds, Waxes, Polishes and Cleaners help to maintain the After-Victory-Value of thousands of America's Cars, Trucks and Buses.

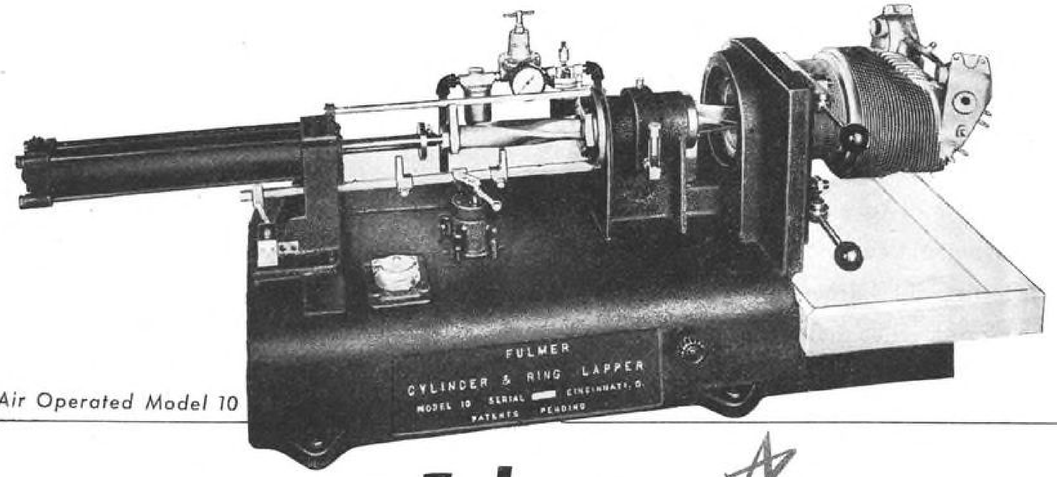
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Manufacturers of Quality-Controlled Finishing Materials, Military Aircraft Sub-assemblies and Pyrotechnics . . .

ROCHESTER, MICHIGAN

Simplifies AIRCRAFT ENGINE OVERHAULING!



Air Operated Model 10

Fulmer Piston Ring Lapper



REDUCES "BREAK-IN" TIME FROM HOURS TO MINUTES

To "break-in" piston rings in an aircraft engine requires from 6 to 24 hours of test stand operation. The Fulmer Piston Ring Lapper reduces this time to a few minutes!

10 to 25 strokes will lap in a conventional set of rings. No guesswork—you can see exactly how the rings fit the cylinders before the engine is built up. No tearing down engines because rings do not seal properly. The engine can carry full throttle right from the start, with proper control of oil.

Built by men with years of experience in manufacturing precision machine tools, the Fulmer Piston Ring Lapper is simple to operate. Flexible—will handle cylinders of all diameters encountered in aircraft engine servicing. Widely used by the Army and Navy.

Two models available: Model 10 (illustrated above) for air operation and Model 10-H for hydraulic operation.

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FULMER *PRECISION AIRCRAFT SERVICE EQUIPMENT*

ROD BORERS · HONING MACHINES · PISTON RING LAPPERS · SPECIAL MACHINERY

...FOR PEACE *Products*

TO SERVE THE EXACTING STANDARDS OF AMERICAN INDUSTRY!

Meeting Your Product Requirements

Acadia Synthetics are engineered for end use! Whether your need is for resistance to air, light, petroleum, ozone, age—or for properties that are found in natural rubber, and some that are not—Acadia has synthetics to meet these requirements in any combination! *Name the characteristics, or combination of characteristics you desire—Acadia has a synthetic compound for your product!*

Acadia engineers are prepared to help you determine the Synthetic Rubber compound best suited to your needs for products of war or of peace—without obligation on your part. *Write today for full engineering data on Acadia Synthetic Products.*



An important item in molded synthetic rubber shapes in mold design. Acadia's engineering and technical staff have the necessary "know how" to design efficient and precise molds.

ACADIA *Synthetic* **PRODUCTS**

Processors of Synthetic Rubber and Plastics • Sheets Extrusions • Molded Parts

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1 *Less Machining*
Advanced foundry technique and greater accuracy in production reduce need for machining to a minimum.

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Casting lay-out engineering, gage and checking fixture inspection and production precision, assure exact dimensions.

3 *Uniform Quality*
Strict inspection schedules and thorough laboratory control, supported by X-ray inspection and spectographic analysis, guard Permite's uniformly high quality.

The aircraft industry uses PERMITE Aluminum and Magnesium Alloy Castings because they save time and money, afford three outstanding advantages.

PERMITE means rigid adherence to your specifications. Great strength, with no excess weight . . . freedom from porosity . . . better machinability . . . perfect uniformity . . . all of which are important to you.

Let us show what PERMITE can do in meeting your casting requirements — for current production or postwar designs.

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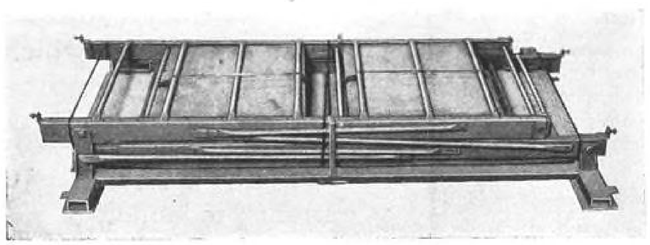
PERMITE ALUMINUM AND MAGNESIUM ALLOY CASTINGS

New! AIRBORNE SERVICE & REPAIR



"Coming in on a wing and a prayer" is plenty tough on the pilot and crew and a terrific responsibility for the mechanics who are supposed to do a top-notch repair job and get the ship into the air again. With the Airepair (Series 11) Telescopic Multipurpose Stand there is no longer any need to expect a mechanic to do the "impossible" with make-shift equipment. This new Airepair Stand is engineered and built for quick aircraft service, repair and inspection. It is far more than a ladder because it accommodates one or a half-dozen mechanics comfortably. Airepair (Series 11) can be folded and shipped by air and set up "on the spot" in a matter of minutes. Wolfe & Mann Airepair equipment is seeing service wherever a plane can land . . . at airports, military and naval flying bases, aircraft carriers and remote outposts throughout the world. Write today for further information. Please give complete details of your requirements.

The Series 11 Airepair Telescopic Multipurpose Stand Folded and Ready for Shipment by air, rail or truck.



POST WAR

If you have a new idea for a product or a piece of equipment, whether a working model or just on paper, write us about it. Our engineers are experienced in developing practical plans of production.

Wolfe & Mann

MANUFACTURING COMPANY

AIRCRAFT EQUIPMENT DIVISION

28TH AND SISSON STS. * BALTIMORE · 11 · MD.

For Safety's Sake



Fig. 1
Patents Pending.

REG. U.S. PAT. OFF.

UNBRAKO

INTERNAL WRENCHING LOCK NUTS

. . . they're thoroughly fool-proof

As the security of bolts and nuts is a vital factor in safe transportation by air it is natural that the products here illustrated and described are used by some of the largest aircraft manufacturers.

Made by a company over forty years in business, these products are the outcome of ripened experience in the production of Socket Screw Products.

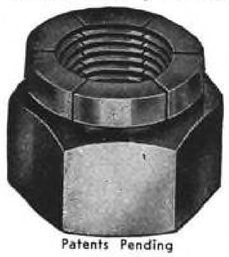
These are superior nuts for primary connections of Aircraft. The locking feature is provided by two vulcanized fibre plugs inserted through the body of the nut as shown in the horizontal sectional view, Fig. 2, and in the vertical sectional view, Fig. 3.

When the "UNBRAKO" Nut is screwed on its companion bolt the two fibre plugs contact four threads of the bolt (Fig. 3) and the resulting fibre-friction creates a firm locking of the nut that makes the connection absolutely safe.

"UNBRAKO" Internal Wrenching Nuts are specially heat treated to obtain a high Rockwell which permits them to be tightened up exceptionally hard and take a great deal of punishment. They are made in sizes No. 8 to 1 inch diameter.

"FLEXLOC" SAFETY NUTS

This lock nut is sturdy, reliable, and of one piece construction. All threads, including the locking threads do their share of carrying the load. The upper portion of the "Flexloc" has six radial slots providing an equal number of sections which do the actual locking. It is a long life nut that can be used over and over again with practically no loss of torque . . . is unaffected by temperatures. Can be made of all commercial metals. The "Flexloc" has been approved by the Army and Navy Aircraft, also by the U. S. Ordnance Dept. Sizes from No. 6 to ½" diameter.



Patents Pending

Fig. 2

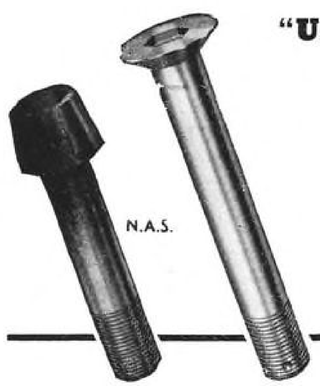


Fig. 3



Fig. 2 shows a horizontal, cross section of the "UNBRAKO" Internal Wrenching Lock Nut. Fig. 3 shows a vertical cross section.

"UNBRAKO" INTERNAL and FLUSH HEAD BOLTS



These have great strength and hardness, and are extremely accurate, fully meeting the exacting requirements of Aviation.

They are produced in our largest department, where for many years we have been making our line of famous "UNBRAKO" Socket Screw Products . . . where the equipment is most modern and the capable workers are well experienced in the manufacture of precision aircraft parts.

The internal wrenching feature of these bolts permits compactness of design — so essential in aircraft construction—economizes metal; keeps weight and cost at minimum.

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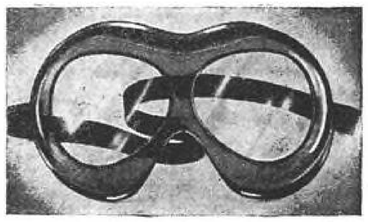
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You're Looking Through the New CESCO *Cover-Lite* Goggles

As you're looking through these new CESCO *Cover-Lite* Safety Goggles, you're practically experiencing their comfort—because when you actually have them on, you scarcely know they're there.

The combined weight of the lenses and the frame is only 96/100 of an ounce! The frame rests lightly—no pressure on the nose, brow or forehead. They're comfortably worn over prescription spectacles, too.



Cover-Lite **lenses are replaceable**

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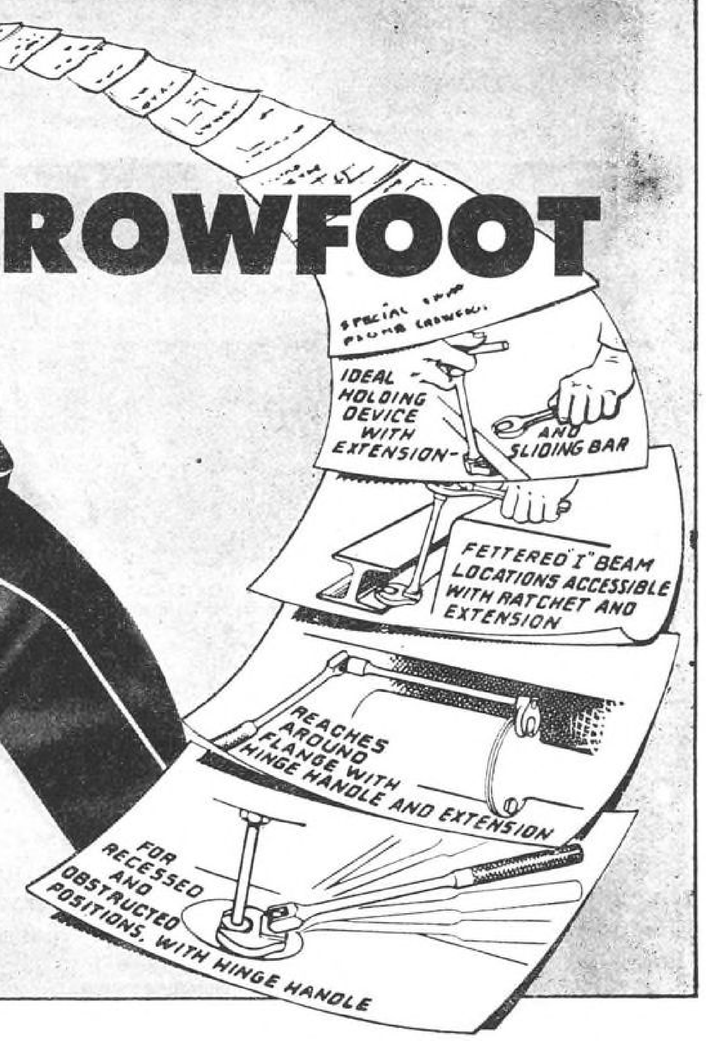
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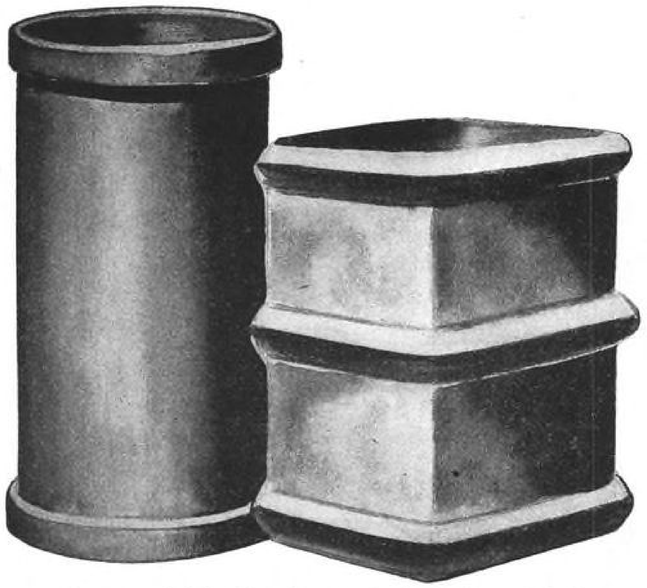
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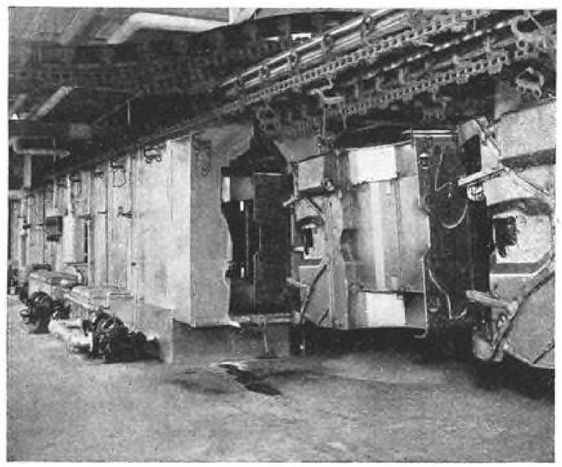
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Rust, especially during rainy, humid weather, often becomes so troublesome as to seriously interfere with the steady flow of production. Rust can disrupt the whole production line and cause serious bottlenecks unless steps are taken to prevent or remove it during fabrication. With ACP Deoxidines rust removal becomes a simple matter of routine.

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There are types of Deoxidine adapted for use in large, continuous, mechanized production in power spray washers that remove both rust and oil. Other types are adapted to immersion processes that may be mechanized or manually operated to suit production needs. There are still other types for hand wiping processes to remove occasional light rust that otherwise would require slower and more laborious mechanical operations.

These and other Deoxidines not only clean the metal—removing rust and destroying or inhibiting rust producers—they also properly condition it for painting.

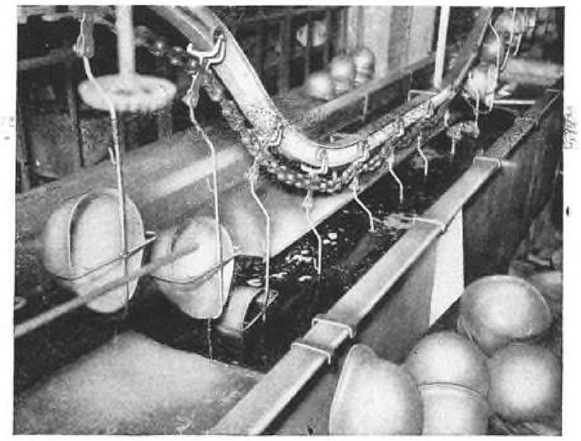


A—Spray types of Deoxidine are adapted to the cleaning and processing of large surfaces in quantity production.

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Peroline, a combined chemical and oil, not only provides a thin oil coating, effective in retarding rust, but it is unique in that it removes blushes of rust and marks from sweaty hands and destroys visible or invisible chemicals that would develop rust under conventional preventive coatings. While the amount of rust removal with Peroline is limited, its ability to remove thin coatings will often eliminate a separate cleaning or salvaging operation.

Today, Deoxidine, Peroline and other ACP Chemicals are aiding in the production of many war



B—An immersion type of Deoxidine is well suited to the rapid cleaning of helmets with mechanized equipment.

essentials. They are aiding in salvaging various items which, due to improper cleaning or lack of proper protection, have become rusted during fabrication and storage. They are helping to insure satisfactory finishes and are minimizing rejections in the production of many vital war supplies including Shells, Rockets, Ammunition Containers, Automotive Equipment (jeeps, tanks, trucks, etc.), Marine Equipment, Aircraft and Aircraft Parts, Signal Corps Equipment and hundreds of miscellaneous components.

Further information on rust removal or prevention and Service Data Sheets on Deoxidine and Peroline may be obtained by addressing the American Chemical Paint Company, Ambler Penna.

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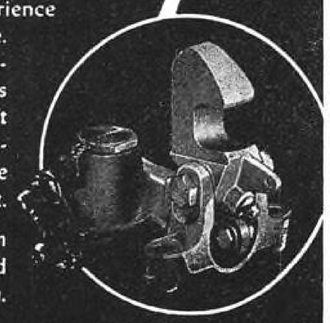
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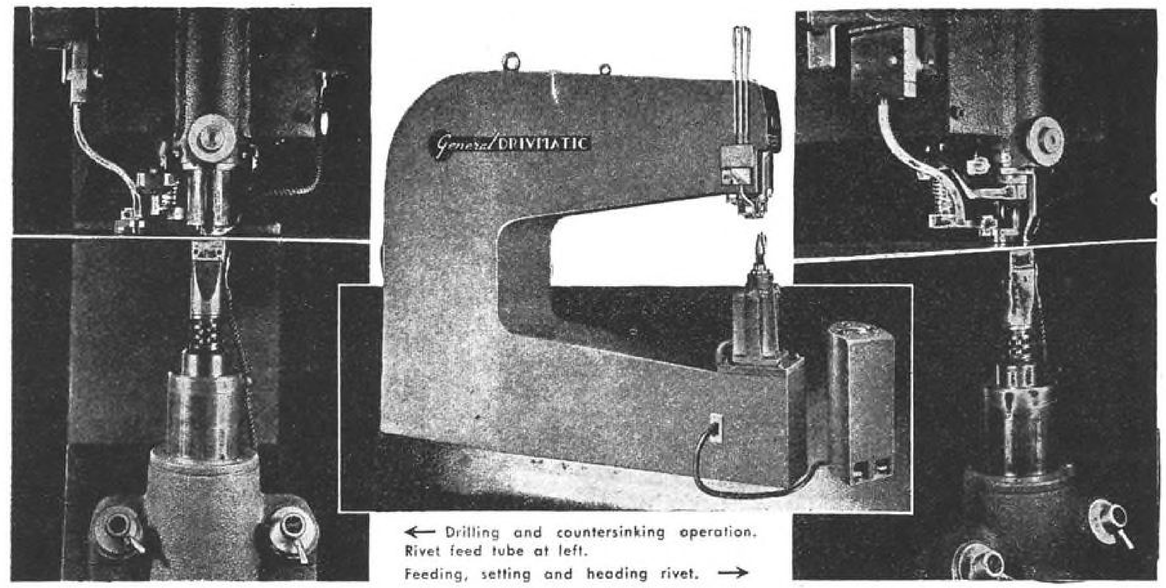
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Feeding, setting and heading rivet. →

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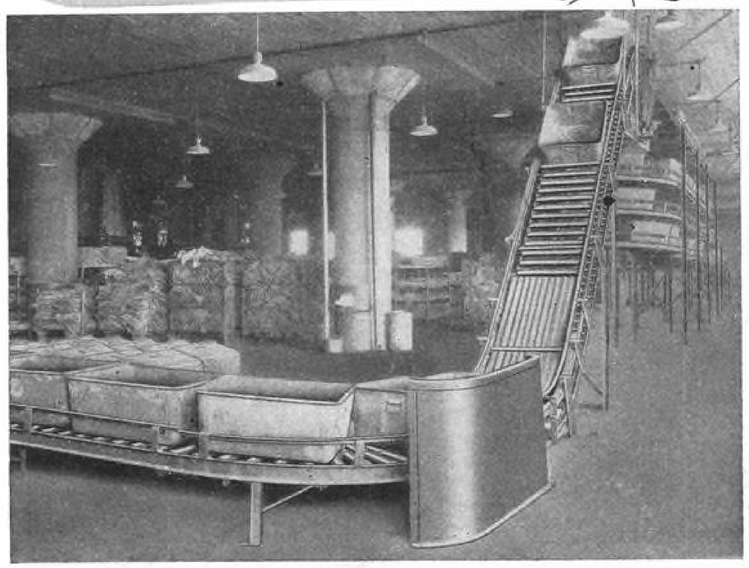
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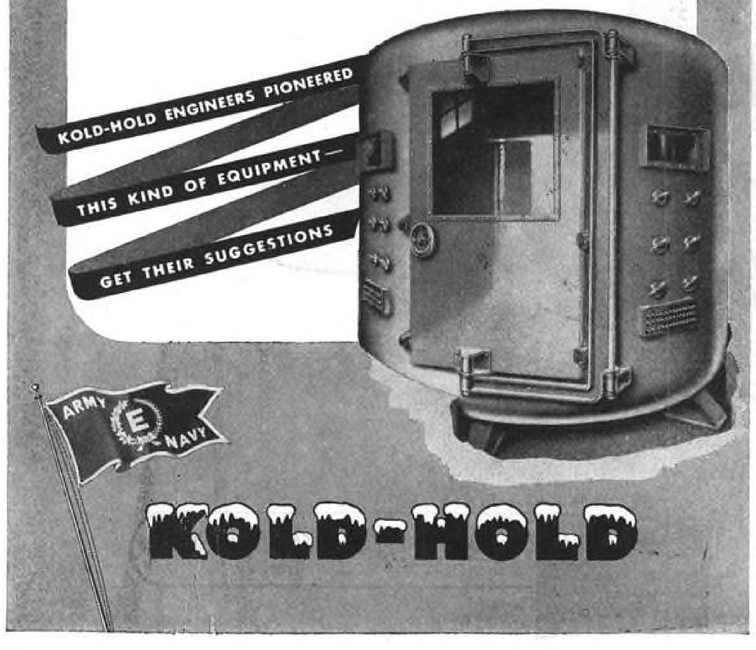
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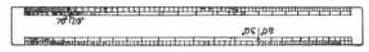
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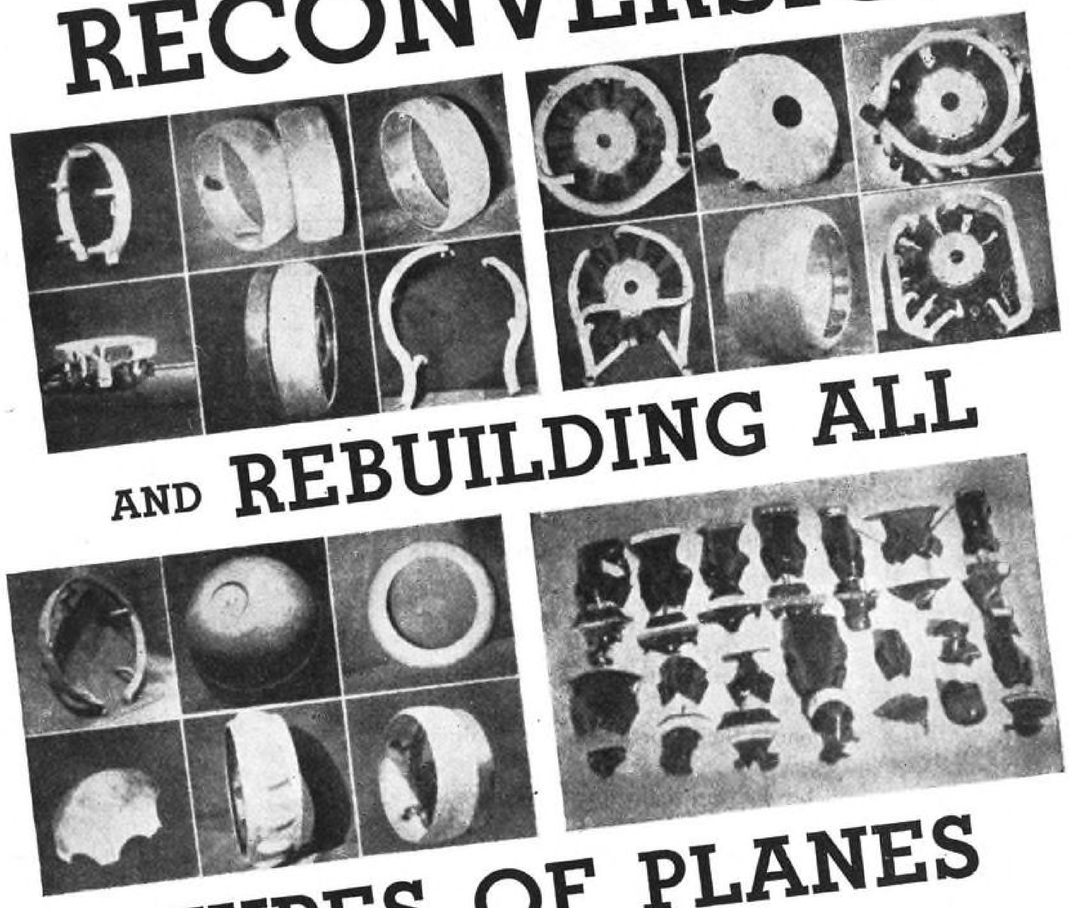


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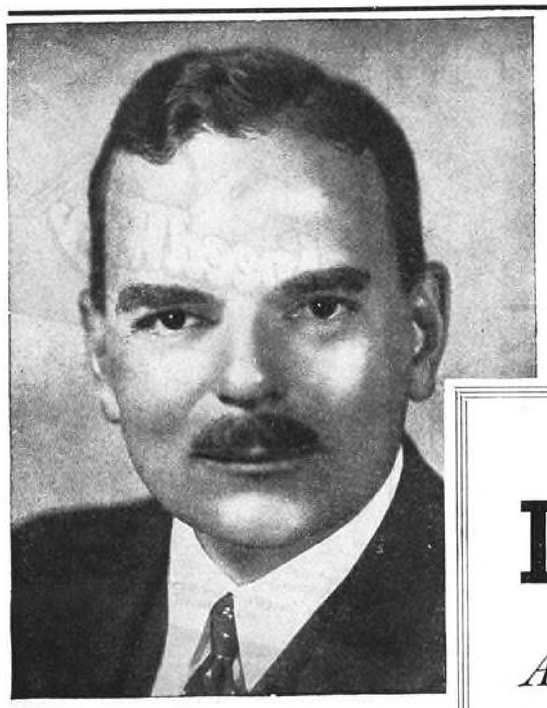
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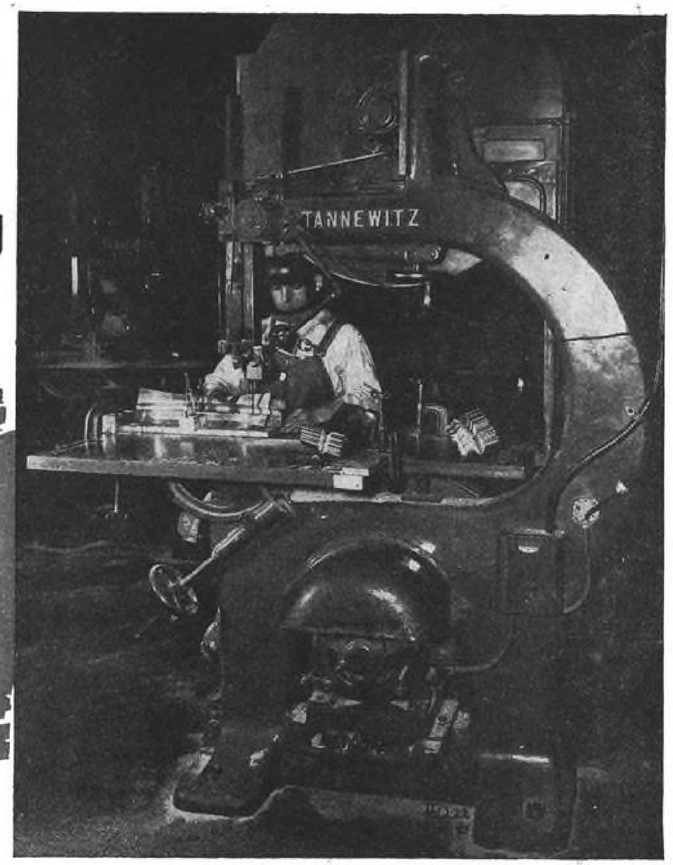


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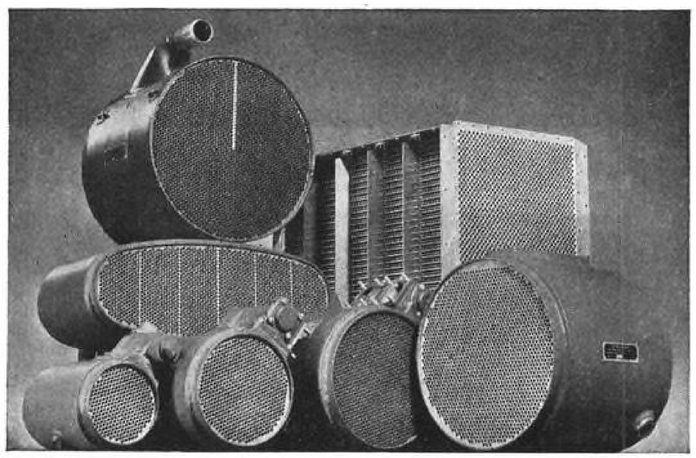


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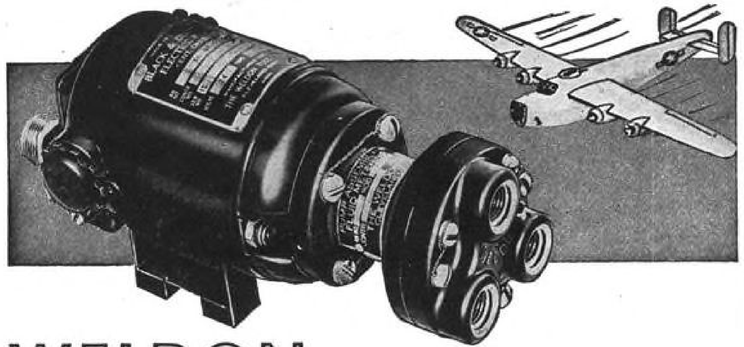
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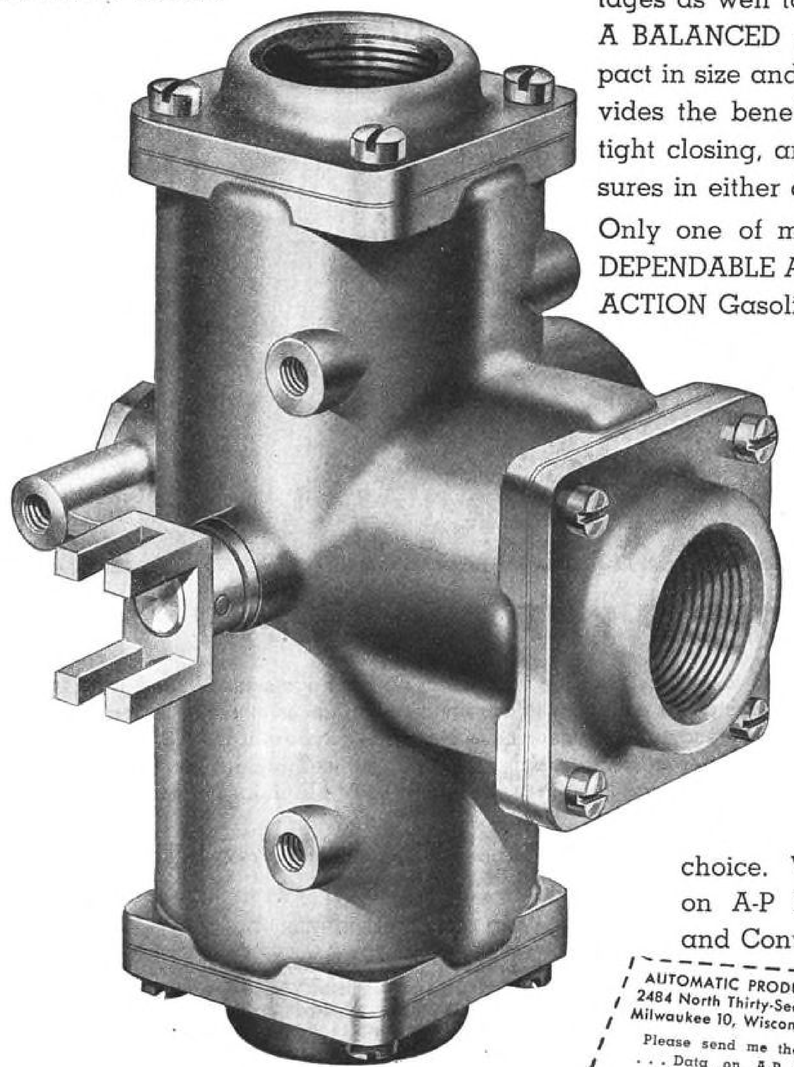
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PLAN YOUR PLANT DRIVE NOW!

Good organization will be needed to sell the 6th. The task of raising the huge sum required will be the most difficult ever asked of Industry. As each new military success brings us closer to Victory, the public naturally will feel that the urgency of war financing is lessened—whereas it isn't. So organize now to prevent a letdown on the home-front from causing a letdown on the fighting front. Build your plant's payroll campaign around this fighting 8-Point Plan. You don't have to wait for the official Drive to start—swing into action NOW!

1 **BOND COMMITTEE**—Appoint a 6th War Loan Bond Committee from labor, management and each representative group of the firm.

2 **TEAM CAPTAINS**—Select a team captain, for each 10 workers, from men and women on the payroll—but not in a supervisory capacity. Returned veterans make most effective captains.

3 **QUOTA**—Set a quota for each department and each employee.

4 **MEETING OF CAPTAINS**—Give a powerful presentation of the importance of the work assigned to them. Instruct them in sales procedure. Have them carefully study the Treasury Booklet, *Getting the Order.*

5 **ASSIGNMENTS**—Assign responsibilities for:
- (a) *Music, speeches and announcements of the opening rally.*
- (b) *Pre-drive letter to employees from management and labor.*
- (c) *Competitive progress boards.*
- (d) *Meeting schedules, etc.*

6 **CARD FOR EACH WORKER**—Dignify each personal approach with a pledge, order, or authorization card made out in the name of each worker. Provide for a cash purchase or installment pledge. Instruct each captain to put a pencil notation on the card to indicate the subscription he expects to solicit from each worker.

7 **RESOLICITATION**—People don't mind being asked to buy more than once. Resolicit each employee toward the end of the drive in a fast mop-up campaign. Call upon your State Payroll Chairman; he's ready with a fully detailed plan—NOW!

8 **ADVERTISE THE DRIVE**—Use all possible space in the regular media you employ to tell the War Bond story.

The Treasury Department acknowledges with appreciation the publication of this message by

AVIATION

This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council

AIRCRAFT TURNBUCKLES to meet "AN" STANDARDS

Precision made by new production methods, resulting in substantial savings in critical material and machine time.

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Built For Heavy Production Service



ONE of a COMPLETE LINE

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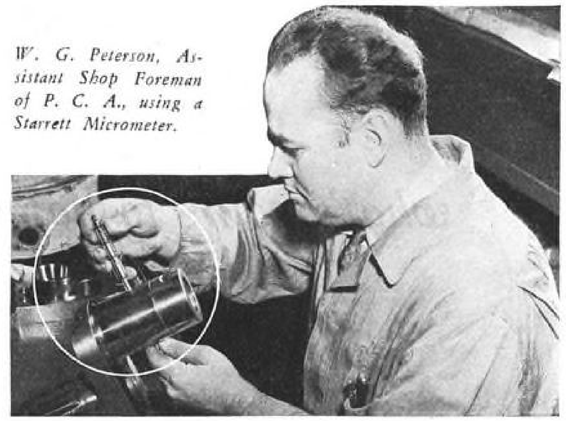
ASK FOR BULLETIN 319

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Battery Chargers
Fast Battery Chargers
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Now, with Two Service Stars

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Precision Tools . . . Dial Indicators . . . Ground Flat Stock Hacksaws . . . Metal Cutting Bandsaws . . . Steel Tapes



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what's going to happen in Aviation?

Will we go back to the handful of military planes we had in 1940?

Can we conduct tomorrow's air commerce with less than 500 transport planes operating in and from the U.S.?

The average speed of our fastest trains is 50 miles-per-hour, of our fastest ocean liners just over 30. The average speed of our newest airliners is over 250 mph. and steadily increasing. Will U.S. industry and the American public pass up that one?

Shall we expect the driving force and flying enthusiasm of three million, keen, ambitious and progressive young military airmen to evaporate without effect on peacetime aviation progress?

There was a day when we couldn't sell automobiles because we didn't have the good roads, and there was no point to building roads because we hadn't the automobiles. If that hurdle had stopped us, a five-billion dollar industry would never have been developed.

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What do you think?



Aviation's future is not speculative. The only speculation lies in *how soon* the industry will reach the full maturity of its inherent utility and of its rich commercial possibilities.

Foresighted U.S. businesses are laying their groundwork now. Through the advertising pages of *Aviation, Air Transport* and *Aviation News* today the aviation names of tomorrow are being built.

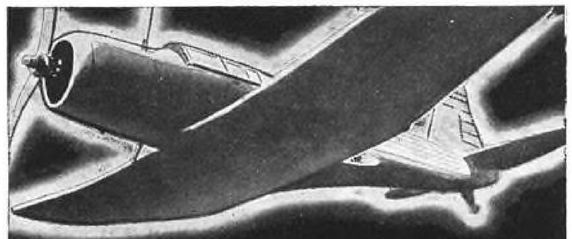
Aviation (America's oldest) serves the industry's basic needs for administrative, technical and business information. *Air Transport* serves the specialized needs of America's swiftest-growing public carrier.

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Together, these three magazines offer intensive coverage among all buying interests of the aviation industry—the key men who build planes, who operate them, who maintain them, and the men who will sell and service our planes and equipment in the period just ahead.

Now ready for marketing-minded executives—a new comprehensive analysis of postwar distribution potentials in aviation. Request your copy of "Here Are Your Markets" reprinted from the series in May, June and July *Aviation*.

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How to make them
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How to operate it

Here is the opportunity for non-technical men to become trained quickly and effectively for work in the field of photogrammetry. In a simple, 1-2-3 method of illustration never before applied to this essential field, this important new book clearly describes present-day methods of aerial photography and map-making and the operation of modern photogrammetric equipment. This material is presented in a step-by-step, handbook manner especially adaptable for quick reference and self-study.

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It covers:

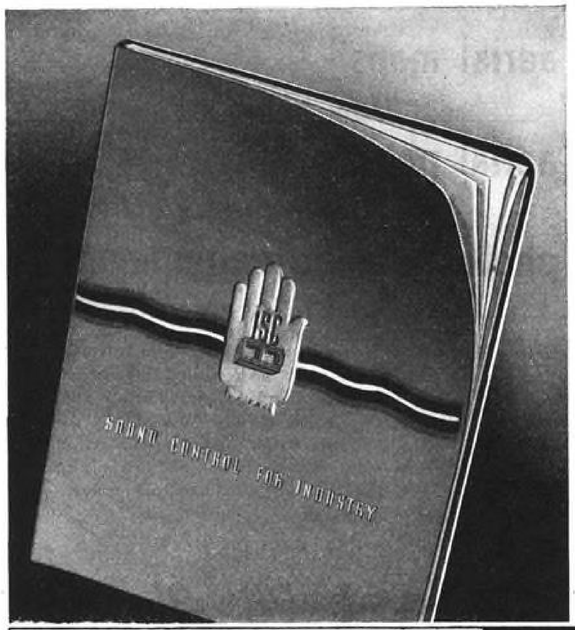
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ENGINEERS AND CONTRACTORS FOR SOUND INSULATIONS

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IN WAR AND IN PEACE

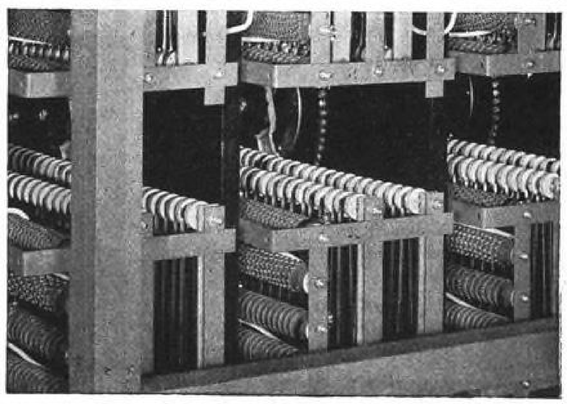
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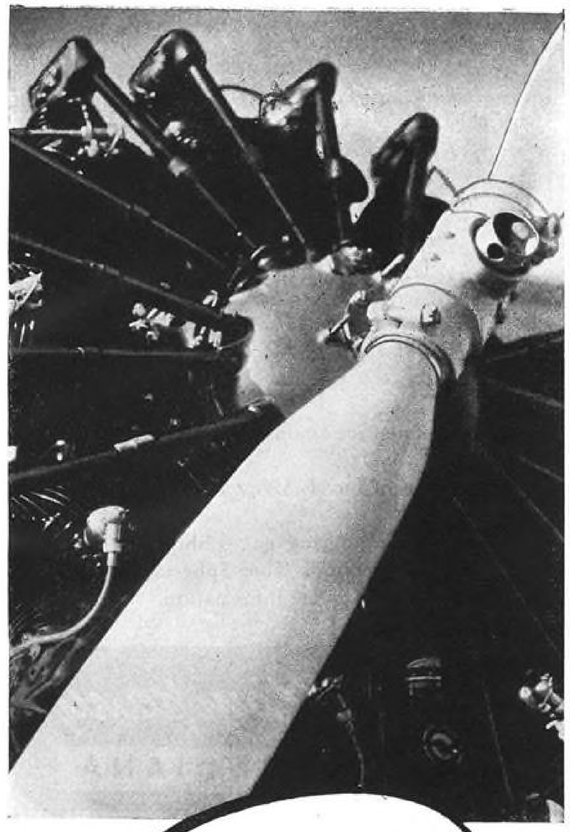
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"Say, ... today isn't any too soon—I'm going to get in touch with the LINEAR Engineers—I'll benefit from their consultation and recommendations, and when the grand rush starts, I won't be left holding the empty bag."

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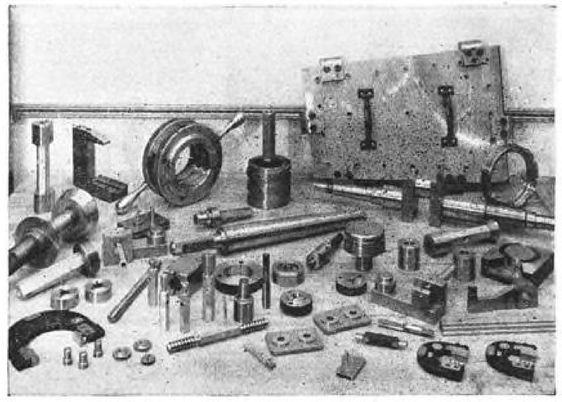
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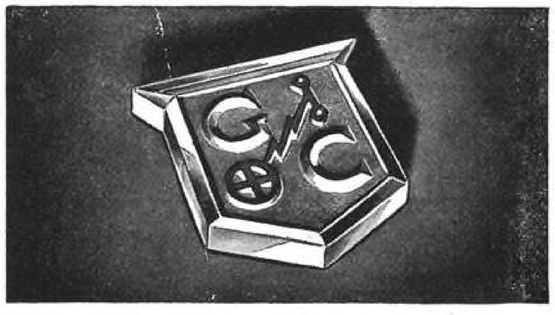
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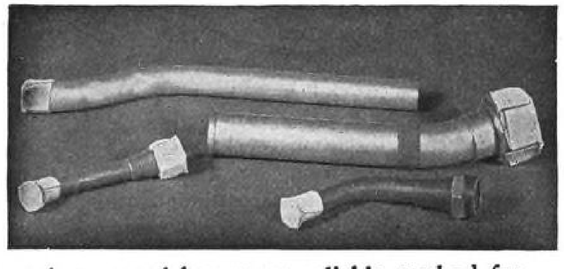
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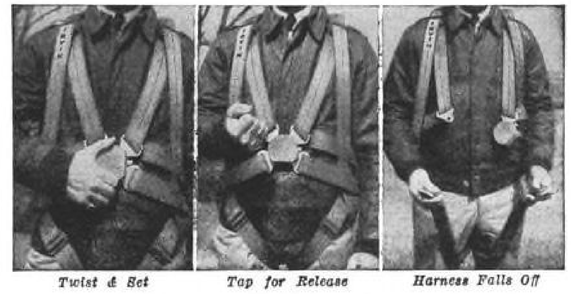


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UNITED NATIONS' FLYERS *are using it for* SAFER LANDINGS

A one-hand turn and a tap on the single frontal disk instantly releases the harness . . . leaving the flyer entirely free. Accidental release is impossible before disk is "set" for action.

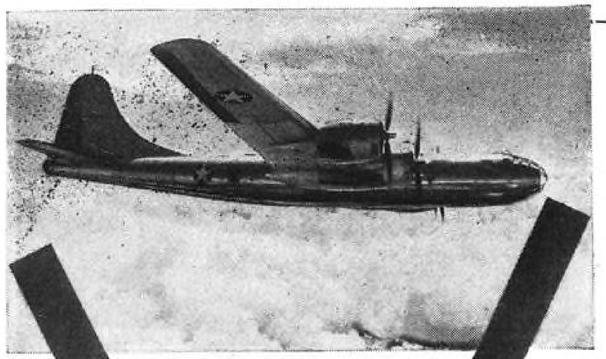
All United Nations' Air Forces for years have used IRVIN as standard equipment . . . and now the Irvin "Single-Release" harness is acknowledged as superior for all landings. IRVIN, as always, leads in Safety.

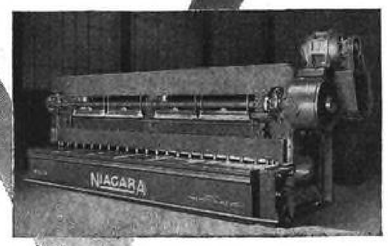


Twist & Set — *Tap for Release* — *Harness Falls Off*

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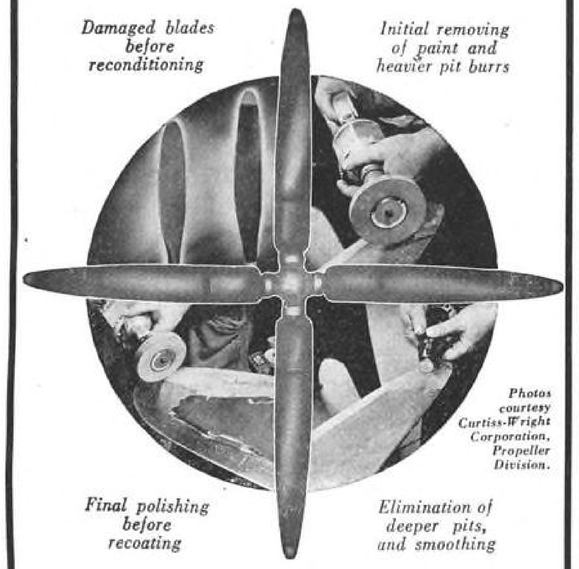
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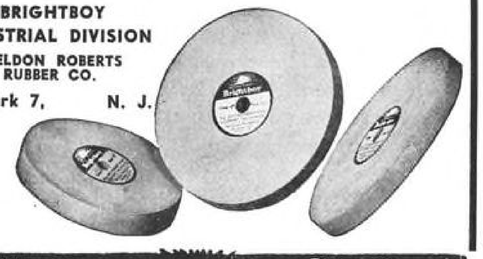
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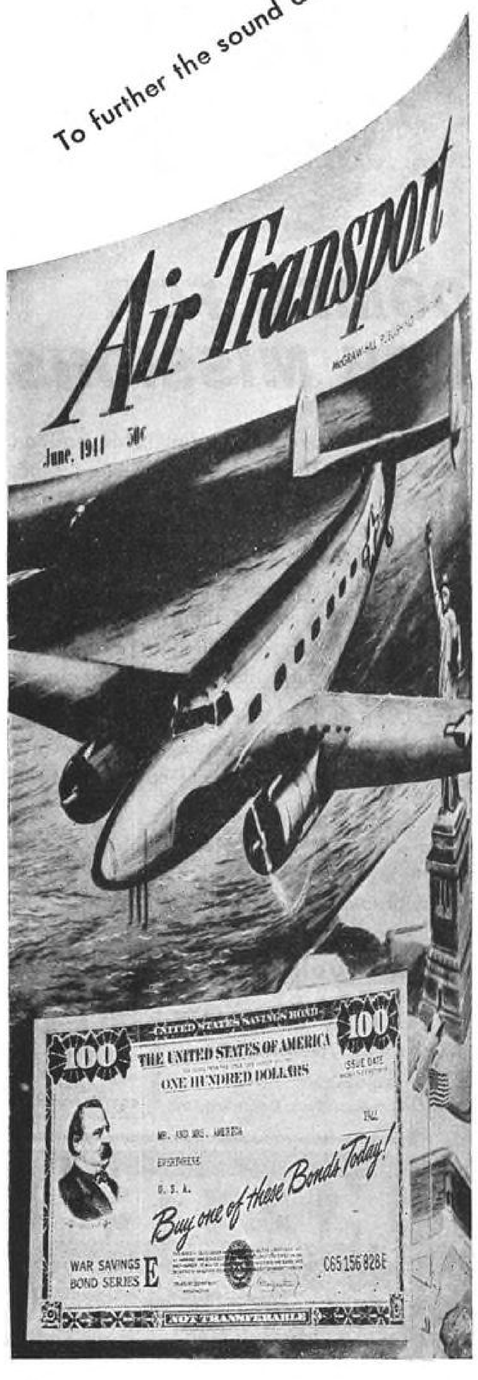
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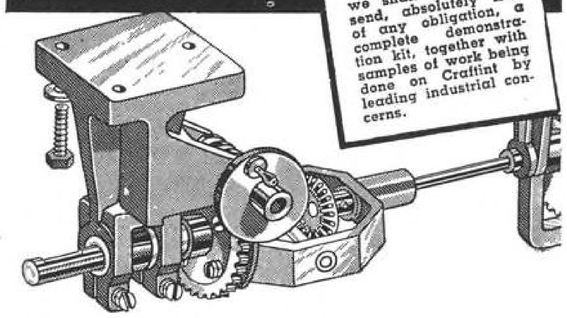
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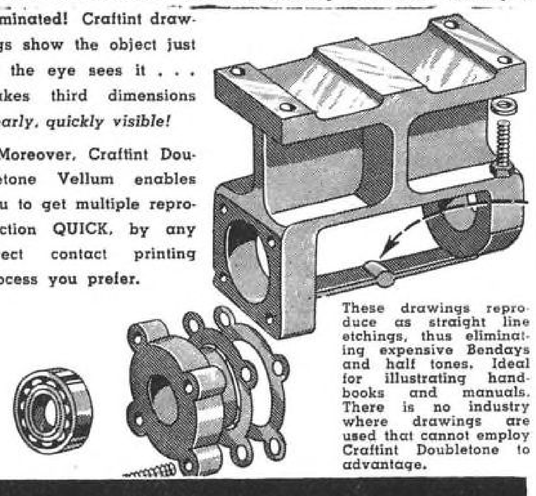
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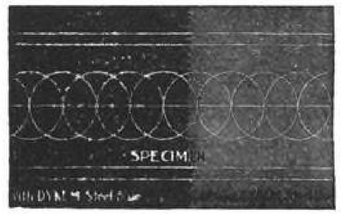
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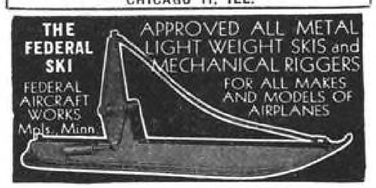
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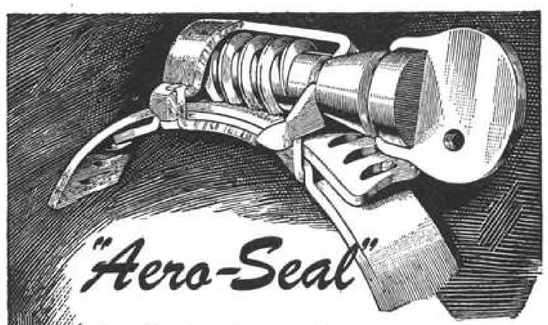


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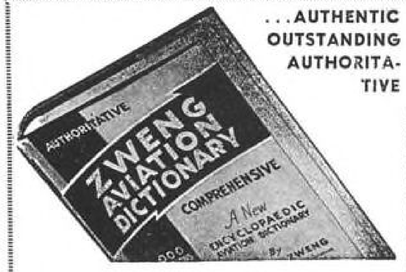
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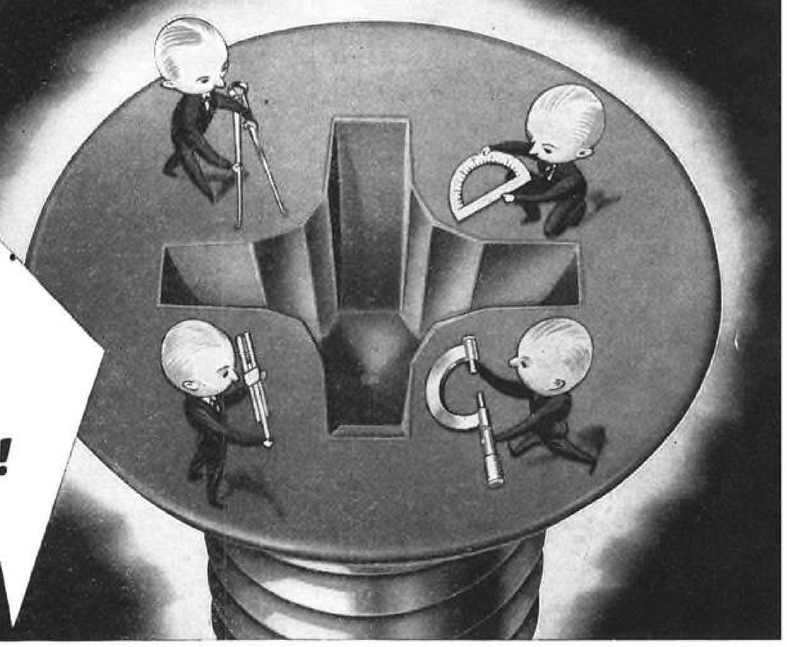
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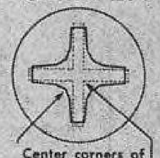
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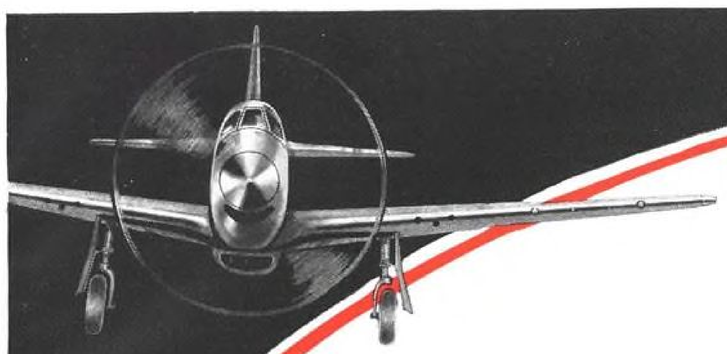
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Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.

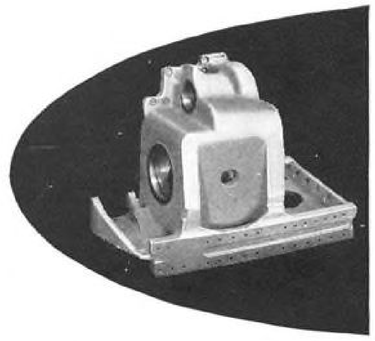


IN THE P-51 MUSTANG:

Magnesium saves weight in the world's fastest fighter

There are several reasons why the North American P-51 Mustang is the fastest of all fighters . . . why it has such a broad range . . . and a ceiling of more than 7½ miles: ingenuity of design; precise accuracy of parts; skill of assembly; and the thorough testing and wise selection of materials.

One of these materials is magnesium. Durable, strong Dowmetal Magnesium Alloys, the lightest of all structural metals, contribute substantially to the performance of the P-51, just as they make possible greater speeds and efficiencies in other types of aircraft.



One of many magnesium parts in the P-51 is this 45-pound main landing gear pivot, cast in permanent mold by Century Metalcraft Corporation, Los Angeles.

Dowmetal Magnesium Alloys are being utilized in ever-increasing volume in many branches of industry . . . wherever metal is to be put in motion . . . in transportation . . . in the moving parts of machinery . . . in hand- and power-operated equipment, tools and appliances. To help you put magnesium to work, Dow maintains complete shop, mill and foundry facilities for the fabrication of parts and assemblies, in large, small or experimental lots. And Dow offers, too, the benefits of experience and knowledge afforded solely by magnesium's pioneer producer and fabricator.

DOWMETAL *magnesium*

THE METAL OF MOTION

DOWMETAL

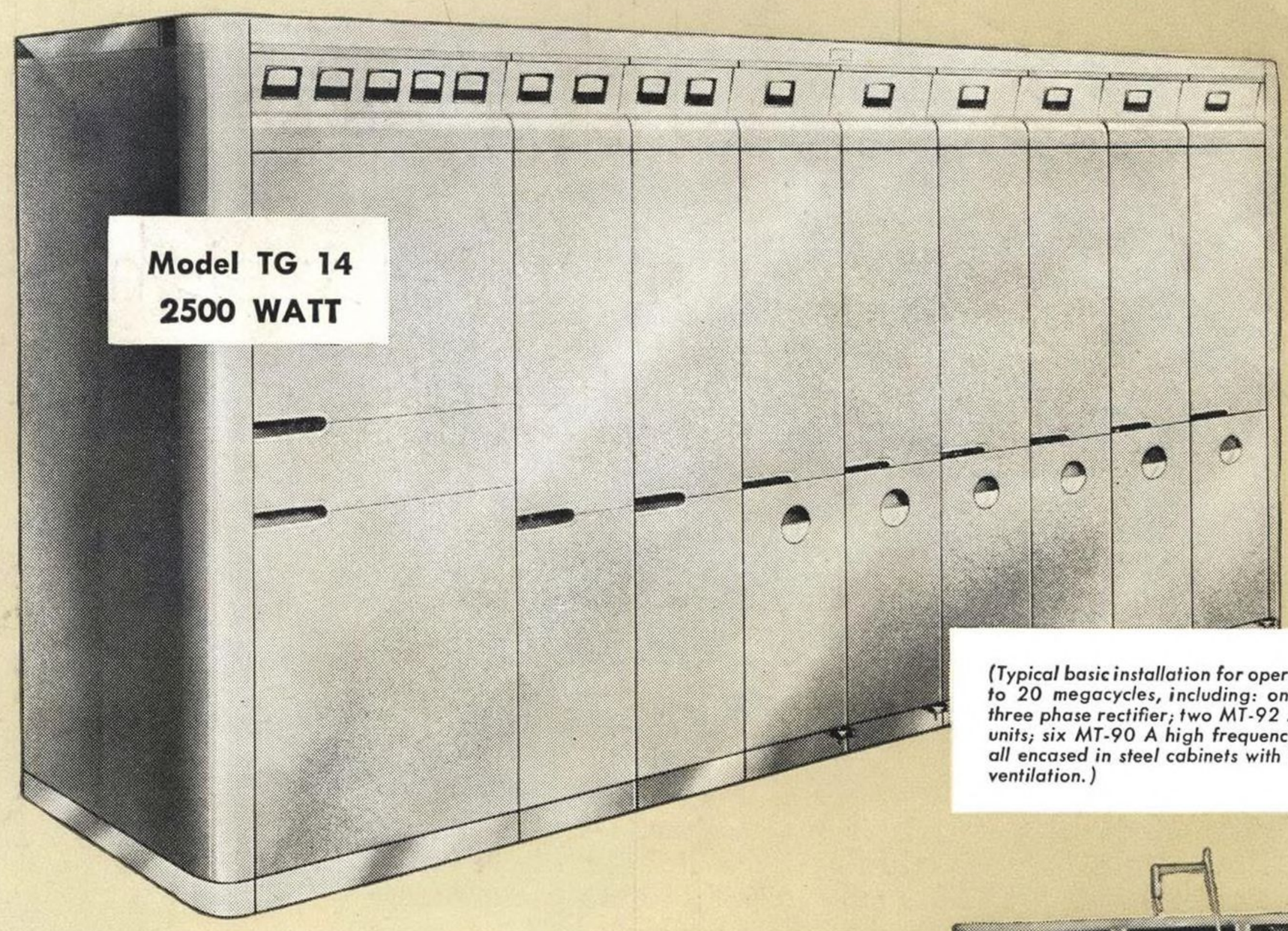
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IN AIRLINE GROUND STATION EQUIPMENT



(Typical basic installation for operation on 2.5 to 20 megacycles, including: one MP-36 A three phase rectifier; two MT-92 A modulator units; six MT-90 A high frequency RF units—all encased in steel cabinets with forced draft ventilation.)



The MS-97 Remote Control Unit, built to individual requirements, provides a method of installing control equipment in a manner which will place all the equipment in locations readily accessible to the operator. The compact low structure of this unit permits it to be installed in such a way that the operator may have a full unobstructed view in all directions.

Great Flexibility . . . Exceptional Sturdiness . . . Complete Tropicalization

Bendix Radio*—center of radio research and production for the aviation industry—has now turned its broad experience and extensive facilities to the production of the finest of ground station equipment—and here is one result: a new, unit-type installation providing an unlimited number of operating channels in the frequency range of 200-425 kc. and 2.5 to 20 mc. . . . with sufficient power supply capacity to permit simultaneous operation of 2 radio telephone, 1 radio telephone and 2 telegraph, or 3 telegraph channels . . . and designed to allow quick installation of additional RF channels as traffic loads increase.

Constructed to the quality requirements which have made the products of Bendix Radio the Standard of the Aviation Industry, this equipment has hermetically sealed transformers for tropical use, and is studded throughout with other features to assure peak performance under all conditions. As a further guarantee of reliability, *special attention has been given to adequate overload protection,* and *improved electrical design assures the effective reduction of Harmonic Radiation to a minimum.*

Information as to dimensions, weight, construction, electrical characteristics and easy-service features will be sent promptly on request.

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