DECEMBER 1943
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AVIATION

The Oldest American Aeronautical Magazine

IN THIS ISSUE

POST WAR PLANE MARKETS
— A down to earth analysis of what we may expect in post war markets for commercial and personal planes.

★

COMMERCIAL FUTURE OF HELICOPTERS
— Engineering — not ballyhoo — will determine the helicopter's utility.

★

MANUFACTURING AND MAINTENANCE JOIN HANDS
— How Douglas provides for a pooling of knowledge with operators for mutual benefit.

★

SIGHTED WRECK, REPAIRED SAME
— AAF mobile repair units roam the English countryside repairing forced-down aircraft.

★

MAINTAINING SUB KILLERS
— First published article on blimp maintenance — a vital force in our spectacular anti-submarine success.

★

APPLIED ENGINEERING IN AIRLINE MAINTENANCE
— How well integrated engineering and maintenance departments work together to produce superior operating results.

★

COMBAT MAINTENANCE TRAINING
— Air Forces finishing school trains maintenance teams under combat conditions.

★

RCAF MAINTENANCE
— Competitive system spurs maintenance crews to greater speed and efficiency in the RCAF.

★

BUSH MAINTENANCE
— Canadian Pacific operates everything from trunk line to charter service and its maintenance problems are unique.

★

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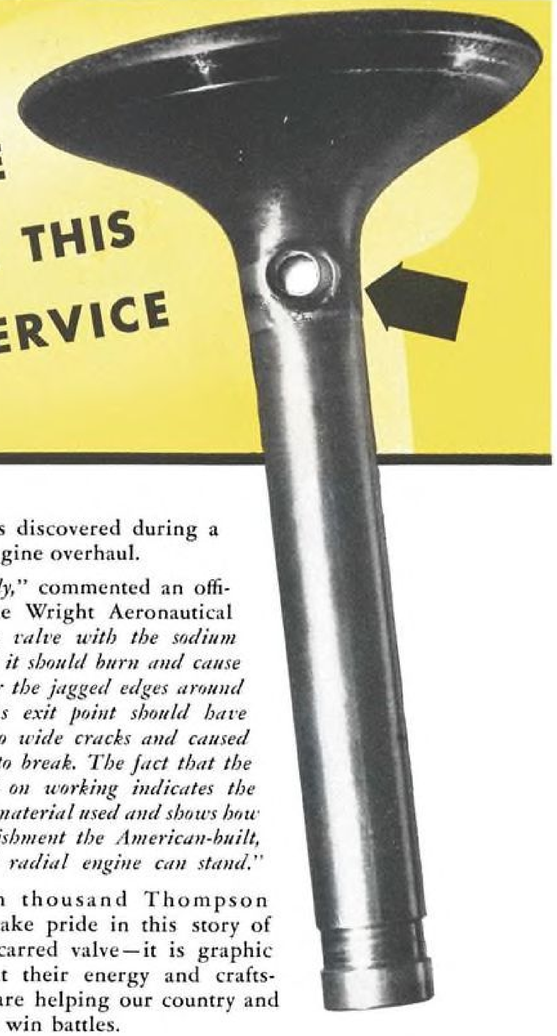
3 GREAT FIGHTERS

The Army's P-47 Republic Thunderbolt, the Navy's F4U Vought Corsair, and the Navy's F6F Grumman Hellcat are all built around the 2,000 horsepower Double Wasp, supercharged in two stages for altitude combat.

The turbo supercharger in the Thunderbolt and the engine driven two-stage two-speed supercharger in the Corsair and Hellcat give these fighters exceptional performance at extremely high altitudes with reserves of dependable Pratt & Whitney power.

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

A JAP BULLET HOLE COULDN'T KNOCK THIS VALVE OUT OF SERVICE



THIS Thompson sodium-cooled aircraft valve was pierced by a 25-caliber Jap machine gun bullet during a battle of British and Jap pilots on a far Eastern front.

The sodium, which is the coolant for the valve, drained from valve head and stem, through the bullet hole, and was blown through the engine exhaust.

The tough metal held intact; had the valve head broken off, it would have wrecked the engine, and perhaps cost a lost plane or the life of a brave young pilot.

But the Thompson valve, without the sodium coolant and with weakened stem, carried on for 110 more flying hours (approximately 30,000 air miles) before its condition was discovered during a routine engine overhaul.

"*Ordinarily,*" commented an official of the Wright Aeronautical Corp., "*a valve with the sodium shot out of it should burn and cause trouble. Or the jagged edges around the bullet's exit point should have spread into wide cracks and caused the valve to break. The fact that the valve kept on working indicates the quality of material used and shows how much punishment the American-built, air-cooled radial engine can stand.*"

Nineteen thousand Thompson workers take pride in this story of a battle-scarred valve—it is graphic proof that their energy and craftsmanship are helping our country and our allies win battles.



Curtiss "Mohawk"

• *It was in this type of fighter plane that a Thompson valve took a Jap bullet through the neck. Nine sodium-filled exhaust valves, and other Thompson parts go into the 1200 h.p. Wright Cyclone engine which powers this American-built pursuit ship. Many "Mohawks" are used by Britain's Royal Air Force in the Orient.*

Thompson Products

Helping You Keep America's Cars Rolling.

Beating Production Schedules on Vital Parts for Military Engines—Aircraft and Automotive.



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December, 1943

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Target Range for Light Rays...



DESIGNING the optical system for a modern sextant, octant, driftmeter or bombsight... is a complex mathematical undertaking. Computing the numerous lenses alone is the work of months and often years! Proof of the computation lies in "shooting" light rays through prototype lenses to targets set at exactly prescribed angles.

For this work, Pioneer has built the unique optical bench sketched. Through its use, each optical element is tested and corrected for aberrations or faults.

The ingenuity exemplified by the development of this original equipment, along with advanced engineering design and precision manufacture, contributes importantly to the superior performance of Pioneer* Instruments now serving on every fighting front. Eclipse-Pioneer Division, Teterboro, New Jersey.

PIONEER LENSES AND PRISMS are designed and precision-manufactured as integral parts of Pioneer Optical Instruments . . . important members of "The Invisible Crew" now speeding from more than 30 Bendix plants to every battle front.

THE INVISIBLE CREW — Precision Equipment by Bendix Aviation Corporation

PIONEER INSTRUMENTS

*TRADE MARK OF BENDIX AVIATION CORPORATION

Briefing for October

The postwar plane market has been envisioned in terms ranging from super-gloomy to super-glowing. Most estimates are offhand and decidedly off-base. Let's be Practical About Postwar Plane Markets, Page 114, is a hardheaded analysis of aircraft requirements based on a realistic appraisal of aviation facilities and aircraft capabilities.

Thorough engineering generally precedes thorough sales activity of a truly useful product. This applies to helicopters—but with the 'copter it appears that the cart is being put before the horse. There are many engineering problems ahead. The answer to What is the Helicopter's True Commercial Future? depends on a proper balance and sequence between these factors. See Page 116.

Properly coordinated, the "know how" of plane manufacturer and operator is bound to result in better airplanes and better operations. Douglas has made full provision for this merger of ideas through its service department, and the results are spectacular. How this service organization is set up and how it functions is described on Page 120.

AAF mobile repair units roam the English countryside on "missions" involving the repair of forced-down bombers and fighters returning from combat missions. See Page 124 for complete details on how the "mobiles" work.

The first article ever published on maintenance and repair of Navy blimps begins on Page 128. This unique story is illustrated with some of the finest photographs we have seen in a long while, and the maintenance procedures are described in detail.

A very considerable portion of the activities of airline engineering departments involves teamwork with the maintenance department. How superior operating results are obtained from this liaison at American Airlines is described in detail (Page 136).

At the AAF's School of Applied Tactics in Orlando, Fla., maintenance men prepare for overseas assignments by servicing aircraft under simulated combat conditions. The conditions under which they train are related in our Page 138 feature.

Ingenious tool design and logical arrangement of facilities have resulted in a daily saving of 40 to 50 man-hours at the Jacksonville Naval Air Station. For sketches and description of these tools, turn to Page 142.



The airlines have always maintained an enviable reputation for reliability, and this year they have achieved the impossible by keeping up their excellent record despite manpower and equipment shortages. On top of all this, the Army moved in and the airlines took over this additional maintenance. Announcement of AVIATION'S annual Maintenance Award is made on Page 118.

Curtiss Propeller overseas service men either make their battle-damaged airscrews useful again, or junk them. But it's seldom the latter, as our revealing "how they fix 'em" article proves (Page 144).

There is plenty of incentive incorporated in the RCAF system of maintenance—through an established competitive spirit among the crews (Page 148). Covered are the system and results.

When the war suddenly sent *Ranger* engines all over the world, there was a brand new service problem to lick. Our article (Page 151) relates the successful way the company met this problem.

With a frozen pond for a hangar deck and clouds for a roof, CPA services the planes of its "bush" lines. The elasticity of the system meets all emergencies (Page 154).

In Watch Your Tires (Page 156), a manufacturer explains why even good rubber may survive only two landings and tells what to do about it.

George W. Brady of the Curtiss-Wright Propeller Division believes the time to test engine horsepower is when it is flying, and he proves his point (Page 179).

When cowl flap trouble developed at Continental Air Lines, Messrs. Durham and Peters got busy. Their very effective method of overcoming the difficulties is described on Page 147.

Smooth flying often is made difficult if not impossible by slackness or creeping in the control system. Now, however, a new cable has been developed to curb this trouble. For details, see the article on Page 189.

How the small businessman may survive both the war and peace is set forth in the timely article, Don't Sell the Fixed Base Operator Short (Page 226).

Down the Years in AVIATION'S Log

25 Yr. Ago (1918)—L-W-F fighter biplane carrying seven machine guns and four bombs climbs to 10,000 ft ceiling in 7½ min. . . . NC-1 flies from N. Y. to Anacostia with 15 passengers. . . . Handley-Page plane carries 40 passengers in England, doubling previous record. . . . Government reserves large tract of airplane spruce in Alaska. . . . Boeing installs 4 ft. wind tunnel with 9 ft. propeller at U. of W. . . . Navy requests funds for four Zeppelin-type airships at $1,500,000 each. . . . Army offers P.O. 100 *Liberty*-engined DH-4's for airmail use.

15 Yr. Ago (1928)—N. Y. Dock Commissioner announces that work will soon start on Floyd Bennett Field . . . Braniff Air Lines, operating between Tulsa and Oklahoma City, announces that operations will be extended into Texas after Jan. 1. . . . Mercedes-Benz puts out 12-cyl. 1,000-hp. engine. . . . Persia (Iran) permits airlines to fly across country. . . . Rep. Kelly (Pa.) offers joint House resolution favoring aviation reciprocity with foreign countries. . . . Louisville manufacturer ships three planeloads of cigarettes to N.Y. by airmail for $2,600 postage.

10 Yr. Ago (1933)—Department of Commerce investigates possibility of $700 plane. . . . Mayor of Newark, N. J., asks government to take over city airport. . . . Fourteen Soviet engineers start training course at Wright factory. . . . Lt. Comdr. T. G. W. Settle, USN, and Maj. Chester L. Fordney, MC, ascend 61,237 ft. in a free balloon, breaking record. . . . PAA and Imperial Airways discuss N.Y.-Bermuda route. . . . Marine Corps Squadron 7M wins Herbert Schiff Trophy by flying 3,517 hr. without accident.

Teamwork Made America First in the Air!



THE urgency of creating our great Allied air armadas required a production capacity many times that of America's aviation industry. So it invited thousands of manufacturers in many fields to "team up" in the vast program of making America *first* in the air.

Kollsman joined in this effort by "schooling" over a score of manufacturers in the difficult techniques of building complete Kollsman aircraft instruments.

Kollsman immediately threw open its facilities to the engineers of coöperating plants. Step by step, Kollsman engineers revealed to them in minute detail the intricate techniques of mass-producing these vital precision products. And then they frequently went into those plants and helped work out production . . . and kept at it until the last "bug" was ironed out.

It isn't easy to build instruments that meet Kollsman specifications. But our "team" is doing just that . . . and in ever-increasing volume. While this work goes forward, Kollsman is busy at the task of developing aircraft instruments to meet new flight problems.

THE KOLLSMAN 50,000 FT. SENSITIVE ALTIMETER *is so ingeniously geared that a diaphragm expansion of only three-sixteenths of an inch sends the pointer around the dial 50 times! Capable of measuring altitude to within a few feet, its essential parts are finished to within two ten-thousandths of an inch.*



KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA



TEAMWORK!

In this war it's teamwork that counts. We see it everywhere—the Navy cooperating with the Army—Air Force pilots softening enemy defenses for the Infantry—civilians in all kinds of work pulling together on the home front.

The Piper Cub "Grasshopper" plane, too, is teaming-up with many branches of the Service. For example, it works with the Artillery—acting as an aerial observation post. When necessary, the observer sends firing corrections to the battery by radio and the guns drop shells directly on the target. It's this kind of teamwork that is bringing Victory nearer every day.

And when Victory comes, Piper will again serve peacetime America. Then, you can own a smart new Piper Cub plane—a team-mate that will carry you on your business and vacation trips with ease, pleasure, safety and economy.



FREE BOOKLET ON HOW TO FLY. Send today for your copy of "You, Too, Can Fly!" If you also want the full-color Piper catalog, enclose 10c in stamps or coin for postage-handling. Piper Aircraft Corporation, Dept. A123, Lock Haven, Penna.

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

PIPER *Cub*

Points the Way to Wings for All Americans

Trail Blazing in the Skies

1925



THE LARGEST COMMERCIAL NON-RIGID AIRSHIP FLEET in the world was built and flown by Goodyear in the interval between World Wars I and II. Beginning with the launching of the airship Pilgrim in 1925, no less than twelve airships have flown the Goodyear flag from eight operational bases, located from coast to coast. These ships flew a total of 4,000,000 miles without a single mishap, providing a great increase of knowledge regarding air structure, meteorology and airship engineering that has been of inestimable value to the nation in wartime lighter-than-air operations.

1943



THE LARGEST NON-RIGID AIRSHIP EVER BUILT is the new M-1, recently completed by Goodyear Aircraft for the United States Navy. Approximately 50% larger than the Goodyear-built airships now so effectively protecting America's coastal sea lanes, the M-1's wider cruising range and greater bomb-load capacity make it a more effective member of the anti-submarine team. Distinctive feature of the M-1 is its three-unit, articulated control cabin that distributes its weight over a larger area of the envelope — a novel application developed by Goodyear Aircraft out of its long experience in lighter-than-air design.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

1. *By constructing subassemblies to manufacturers' specifications.*
2. *By designing parts for all types of airplanes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or engineering problem.*
5. *By building complete airplanes and airships.*

Back the attack with WAR BONDS



WHAT'S NEW IN RUBBER FOR AMERICAN AIRCRAFT

Yes—A TRULY NON-FLOWERING FUEL CELL!



Early in the war it became evident that bullet-puncture-sealing linings in fuel cells were not enough. The flowering of the metal shell when hit by heavy-caliber ammunition prevented the sealing action of the liner—jagged fingers of metal held the puncture open. Goodyear's answer was to develop fuel-cell shells of Plioform—a tough plastic compound that neither flowers nor tears when shot through.

This new type of shell—combined with the aromatic-fuel-resistant, bullet-puncture-sealing lining for which Goodyear received the Presidential Award of Production Merit—now insures the highest type of protection for American warplanes. Plioform fuel cells are now being produced in many sizes for both fighters and bombers.

Plioform, Chemigum (pronounced Kem-e-gum), Airwheel—T.M.'s The Goodyear Tire & Rubber Company



HOSE THAT SAVES PILOTS

Fragment- and bullet-puncture-sealing fuel hose—made from Chemigum, Goodyear's synthetic rubber—protects the vital gasoline from fuel tanks to engines. Thus the hazards from fire and forced landings are greatly lessened.



AIRWHEELS FOR SOFT GROUND

For year-round use on unpaved fields the Goodyear Airwheel—the world's lowest-pressure airplane tire—is still your best bet for safe take-offs and landings under all ground conditions.



NOW—MOTOR CUSHIONS FOR TRAINERS

Flexible engine mounts for training planes have been developed by Goodyear—with the same high efficiency that characterizes Goodyear's mounts for larger engines.

In addition, Goodyear is producing thousands of engine mounts of other standard designs for military aircraft.

BRING YOUR RUBBER PROBLEMS TO HEADQUARTERS



With a background of more than 30 years' experience in developing tires, tubes, wheels, brakes and other aircraft accessories, Goodyear engineers are ready to help you work out any problem involving such products, particularly those made of rubber—either natural or synthetic. Address: Goodyear Aeronautics Dept., Akron 16, Ohio or Los Angeles 54, California.

BUY WAR BONDS to Speed Victory

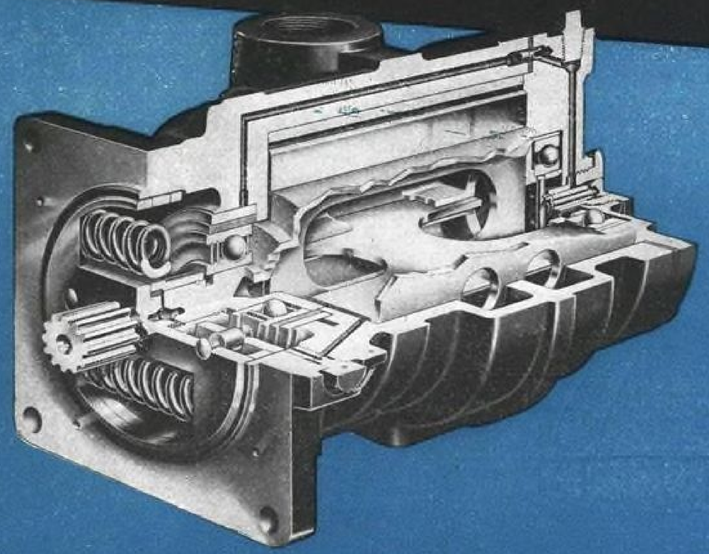
GOODYEAR

THE GREATEST NAME IN RUBBER

AERONAUTICAL RUBBER GOODS · TIRES · TUBES · WHEELS · BRAKES

AIRCRAFT SUCTION AND AIR PRESSURE SYSTEMS

Suction for Navigating Instruments . . . Air Pressure for De-Icer Systems



Sectional view of type 610-2 Engine Driven Air Pump conforming to AAF specifications for B-8A Suction and Air Pressure Systems. Newly designed precision oil metering mechanism, nitri-cast iron pump liner and interlocking through-type blades assure dependable operation and efficient long life.

Design Check Chart for Aircraft Suction and Pressure Systems Conforming to AAF Specifications

APPLICATION

✓ Designed for installation on standard aircraft Engine Vacuum Pump Drive Pads, Eclipse* Engine Driven Vane Type Air Pumps in conjunction with integrated suction and pressure safety valves, oil separators, and air filters provide a dependable source of controlled suction for gyroscopically operated flight instruments, and air pressure for inflatable wing and tail surface De-Icers.

PERFORMANCE

Sea level ratings of the three basic Eclipse Suction and Air Pressure Systems are as follows:

- ✓ B-8A, 15 CFM at 2,250 †RPM, 4" Hg. suction, 16" Hg. Pressure.
- ✓ B-11A, 4½ CFM at 1,500 †RPM, 4" Hg. suction, 1" Hg. Pressure.
- ✓ H-1, 30 CFM at 2,250 †RPM, 6" Hg. suction, 16" Hg. Pressure.

†Pump shaft RPM.

DESIGN

✓ Nitri-cast iron Pump Liner and improved through-type interlocking vanes assure dependable operation and long service life.

✓ Light weight, inherently balanced, precision machined rotor of furnace brazed steel segments assures smooth operation at high speeds.

✓ Precision built, removable oil metering mechanism provides proper lubrication under all operating conditions.

✓ Removable flexible drive coupling provides torsional flexibility and incorporates a shear section for protection in event of overload.

✓ Die-cast housings of integrated components provide compactness and light weight.

THE INVISIBLE CREW — Precision Equipment by Bendix Aviation Corporation

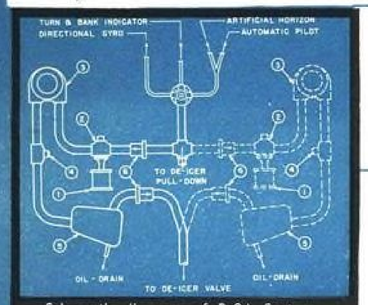
*TRADE MARK OF BENDIX AVIATION CORPORATION

Eclipse AVIATION ACCESSORIES

ECLIPSE-PIONEER DIVISION • Teterboro, New Jersey

SPECIFICATION CHART

ECLIPSE SUCTION-AIR PRESSURE SYSTEMS AND COMPONENTS



Schematic diagram of B-8A System.
SOLID LINE: SINGLE ENGINE INSTALLATION.
DOTTED LINE: ADDITIONAL EQUIPMENT PER ENGINE FOR MULTI-ENGINE INSTALLATIONS.

1. AIR FILTER
2. SUCTION RELIEF VALVE
3. AIR PUMP
4. PRESSURE SAFETY VALVE
5. OIL SEPARATOR
6. CHECK VALVE



Suction Relief Valve—maintains suction constant within the predetermined setting.



Pressure Safety Valve—limits air pressure to a predetermined maximum, preventing damage from excess air pressure.



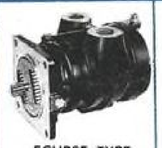
Oil Separator—removes excess oil vapor from the system.



Air Filter—removes destructive foreign matter from air entering the Suction Relief Valve.



Throttling Valve (used exclusively on H-1 systems)—maintains constant suction for instrument operation unloads air pump when pressure differential between pressurized cabin and atmosphere is sufficient to operate instruments.

	 ECLIPSE TYPE 610-2 ENGINE DRIVEN AIR PUMP	 ECLIPSE TYPE 692-2 ENGINE DRIVEN AIR PUMP	 ECLIPSE TYPE 764-6 ENGINE DRIVEN AIR PUMP
ECLIPSE SYSTEM TYPE NO.	616-6	657-11	1248-1
MILITARY DESIGNATION (AAF)	B-8A	B-11A	H-1
MINIMUM RATED CAPACITY (SEA LEVEL)	15 CFM AT 2,250 RPM—4" Hg. SUCTION—16" Hg. PRESSURE.	4.5 CFM AT 1,500 RPM—4" Hg. SUCTION—1" Hg. PRESSURE.	30 CFM AT 2,250 RPM—6" Hg. SUCTION—16" Hg. PRESSURE.
PUMP (ENGINE DRIVEN AIR)			
ECLIPSE TYPE NO.	610-2	692-2	764-6
MAXIMUM PRESSURE DIFFERENTIAL	24" Hg.	10" Hg.	24" Hg.
SUCTION (MAXIMUM)	7½" Hg.	7½" Hg.	7½" Hg.
PRESSURE (MAXIMUM)	18" Hg.	5" Hg.	18" Hg.
DRIVE SPLINE	12 TOOTH	12 TOOTH	12 TOOTH
SHEAR SECTION (IN. LBS.)	1250-1500	700-800	1250-1500
FLANGE	SQUARE	SQUARE	SQUARE
PILOT DIAMETER	3¼"	1½"	3¼"
BOLT CIRCLE DIAMETER	5"	2.651	5"
MTG. HOLES	4-11/32" DIA.	4-11/32" DIA.	4-5/16" DIA.
PORT SIZE	¾" NPT	⅜" NPT	1" NPT
SPEED RANGE	1500-4500 RPM	1500-4500 RPM	1500-4500 RPM
OIL CONSUMPTION (MAX.)	180 CC/HR	100 CC/HR	200 CC/HR
WEIGHT (LBS.)	9.50	4.25	11.00
SUCTION RELIEF VALVE			
ECLIPSE TYPE NO.	613-5	691-5	*Not used in H-1 Systems*
SETTING	4-7½" Hg.	4-7½" Hg.	
PORT SIZE	1" TUBE	⅜" NPT	
WEIGHT (LBS.)	.70	.53	
PRESSURE SAFETY VALVE			
ECLIPSE TYPE NO.	612-4	*Not used in B-11A Systems*	1246-1
SETTING	22-24" Hg.		18-20" Hg.
PORT SIZE	1" TUBE		1¼" TUBE
WEIGHT (LBS.)	.32		.53
OIL SEPARATOR			
ECLIPSE TYPE NO.	606-4	690-1	606-5
PORT SIZE	1" TUBE	½" TUBE	1¼" TUBE
OIL DRAIN SIZE	½" TUBE	½" TUBE	½" TUBE
WEIGHT (LBS.)	1.25	.22	1.25
AIR FILTER			
ECLIPSE TYPE NO.	1075-3	1075-2	*Not used in H-1 Systems*
SPOUT SIZE	1" TUBE	¾" TUBE	
WEIGHT (LBS.)	.55	.55	
THROTTLING UNLOADING VALVE			
ECLIPSE TYPE NO.	*Not used in B-8A Systems*	*Not used in B-11A Systems*	1247-1-A
SETTING			4-7½" Hg.
PORT SIZE			¾ & 1¼" HOSE

Additional copies of this Specification Chart available on written request.

GET READY FOR '44!

Post-war planning will largely depend on the records you keep today. Those records *must* be kept accurate . . . *and immediately available* at all times! As records grow . . . and *how* they do in these war times . . . *they must be housed properly!*

No longer need your file operators struggle along with inadequate, makeshift filing equipment! Their speed and accuracy can now be greatly increased by the addition of a few new GUARDSMAN wood files.

Yes, *now!* . . . for GUARDSMAN cabinets are ready for *immediate delivery* . . . without priority! Not just in four or five styles but in *every type* and size . . . and they look exactly like steel cabinets. We have on hand *the world's most complete* line of wood filing cabinets . . . priced *right* to provide amazingly low cost per filing inch!

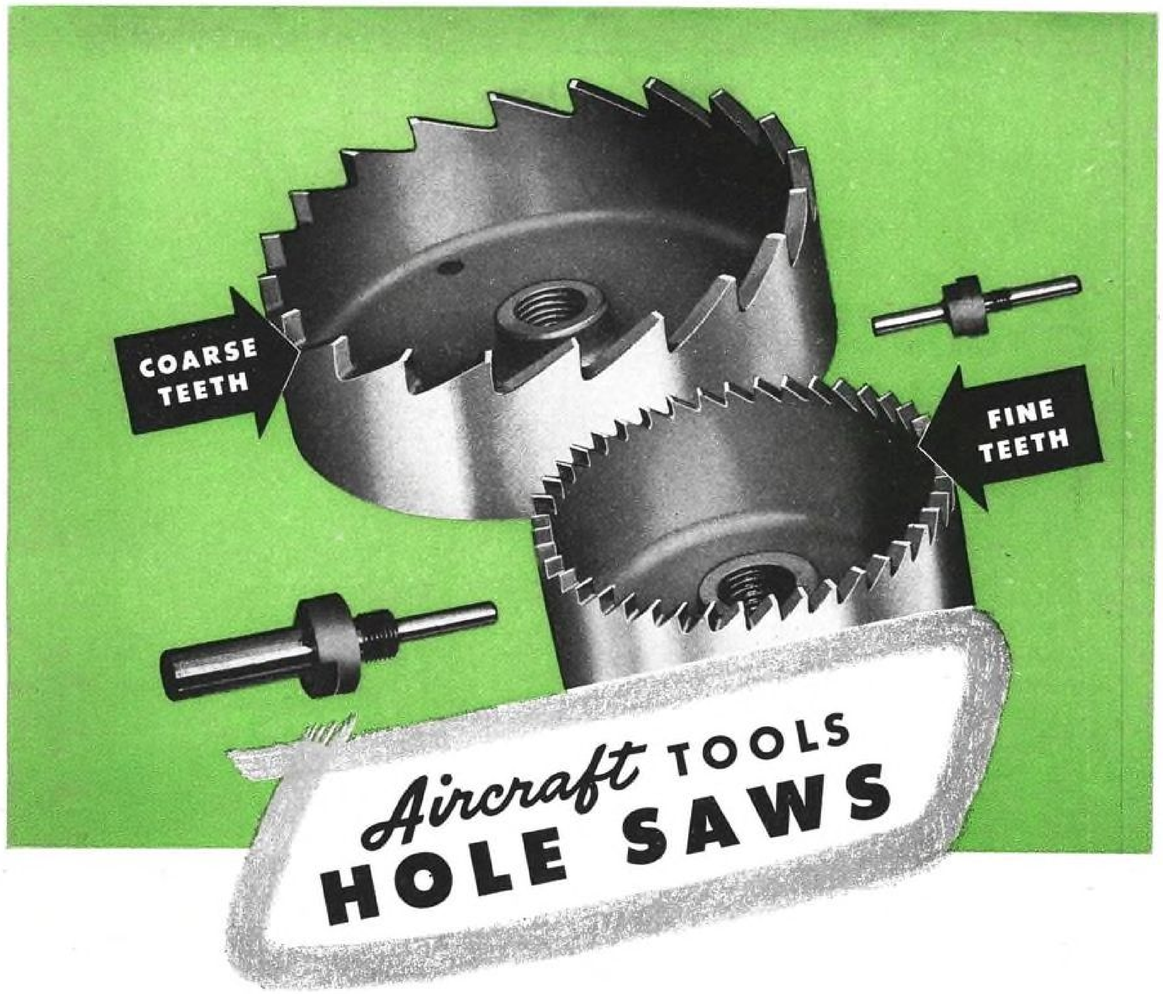
The GUARDSMAN is not a "substitute for the duration"! Ingenious construction details have made this a product of skilled craftsmanship . . . built for many years of trouble-free performance. Small wonder that hundreds of business concerns have chosen GUARDSMAN after exhaustive *competitive* tests.

Call our nearest branch office today and tell them when you'd like your files delivered. Or, if you prefer fuller information, write for your free copy of "Filing Equipment in Wood"—a complete description of GUARDSMAN in every style.



IMMEDIATE DELIVERY of GUARDSMAN Filing Cabinets

REMINGTON RAND
BUFFALO 3, NEW YORK



FOR ALL TYPES OF AIRCRAFT MATERIALS
In Sizes from 3/8" to 4"

Aircraft Tools' coarse tooth saws for stainless steel and other ferrous metals, and fine tooth saws for dural and other non-ferrous materials, have both inside and outside diameters ground with ½° clearance to insure free cutting through thin skins and corrugations. These hole saws last longer because they are made from solid, high-speed steel with wall thickness great enough to dissipate heat.

Complete Repair Service for all types of Aircraft Tools. Prompt Attention by Experienced Craftsmen!

All Wanted Sizes Carried in Stock for PROMPT DELIVERY



Please write on company letterhead for Aircraft Tools Catalog.

Aircraft TOOLS, INC.
Dallas 2, Texas · Los Angeles 1, California · Detroit 2, Michigan

*REG. U. S. PATENT OFFICE

FOREIGN REPRESENTATIVES: The A. R. Williams Machine Co., Ltd., Toronto, Hamilton and Vancouver, Canada ★ The Canadian Fairbanks-Morse Co., Montreal, Canada ★ Reginald M. Levy, Melbourne, Australia ★ Morris Black & Matheson, Ltd., Aukland, New Zealand Emilio Staub & Cia. Ltd., Sao Paulo and Rio de Janeiro, Brazil, S. A. ★ W. A. Ramsey, Ltd., Honolulu, Hawaii



Winging to Victory

With Our Fighting Aircraft

ACTUAL SIZE



No. 1041 — 9/16"
No. 1099 — 1"

This modern Auburn plant produces Auburn Spark Plugs and Precision Parts for aircraft engines. From this plant Auburn Ceramic Spark Plug Connectors "take off" to become a vital part of our Bombers, Fighters and Transport Planes — to maintain constant contact between ignition cables and spark plugs.

On every far-flung battle front Auburn Connectors make the *CONTACT* that really "keeps 'em flying!"

Auburn Ceramics do not carbonize, carbon-track or absorb moisture. Two sizes serve all requirements.

Write us for information

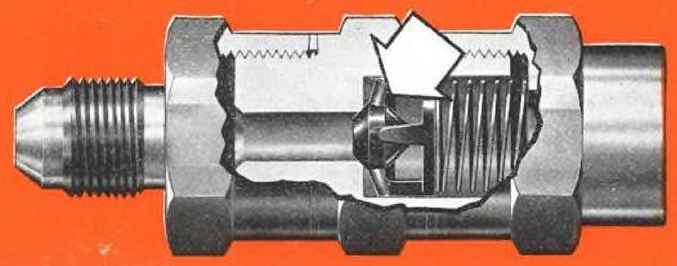
AIRCRAFT DIVISION—AUBURN SPARK PLUG COMPANY, Inc.
1180 Raymond Blvd. Newark 2, N. J.



Since 1910 manufacturers of Auburn Spark Plugs for cars, trucks, busses, tractors, etc.

AUBURN SPARK PLUG COMPANY, Inc.
MAIN OFFICE and FACTORY, AUBURN, N. Y.

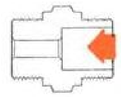
Now A.S.P. Check Valve with Protected Valve Seat



Vibration Proof—High-Flow—16% Lighter



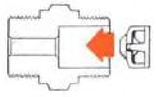
Exclusive A.S.P. Features



Protected Valve Seat:
The A.S.P. Valve seat, is an integral part of the valve body, safely below the surface. Always protected during storing and handling.



Flutterless Poppet:
The A.S.P. phenolic poppet causes minimum pressure drop—does not flutter. Small tear-drop cone in poppet streamlines the flow—reduces resistance. Tests to 50,000 reciprocations at 275° F. developed no breakdown or distortion.



Fool-Proof Assembly:
The body of the A.S.P. Check Valve is constructed so that the phenolic poppet can be installed only *one* way—the *right* way. Poppet chamber is machined in body in such a way that it is impossible to place the poppet improperly. Poppet will fit *only* in the outlet.

Up goes efficiency. Down comes inventory. Here are TWELVE valves in ONE. This new A.S.P. Check Valve operates efficiently in any position, is unaffected by variable pressure, vibration, altitude. Yet it's 16% lighter and has 100% to 300% greater fluid flow than ball check valves!

Tool crib inventory can be greatly reduced because *one* A.S.P. Valve body, with two of four types of adaptors, produces every standard combination of AN, AAF, Internal and External Pipe connections.

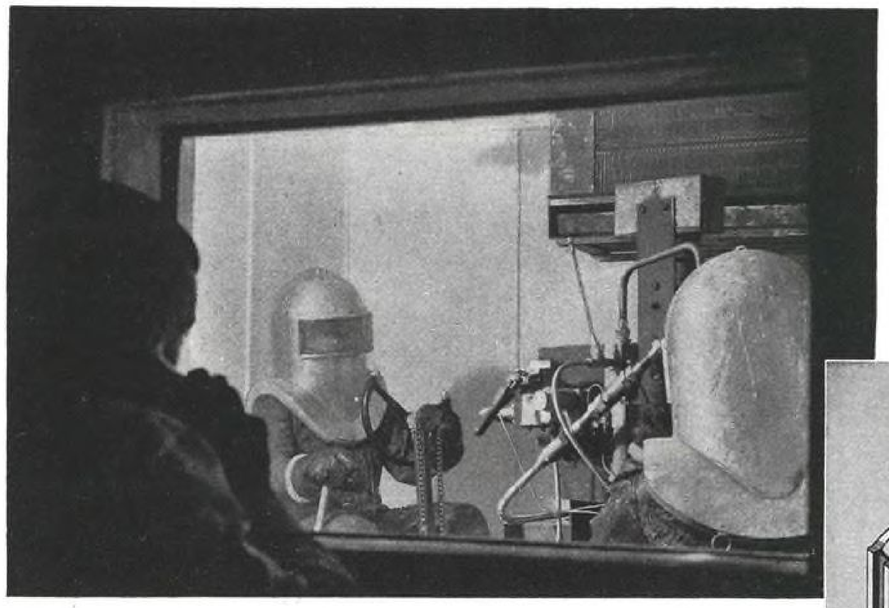
New design eliminates possibility of mis-assembly. Poppet will fit-in only the *right* way. Valve seat is in body, can't be marred during storing and handling.

AMERICAN SCREW PRODUCTS

7000 AVALON BOULEVARD • LOS ANGELES • CALIFORNIA

Another **L·O·F WARTIME CONTRIBUTION**

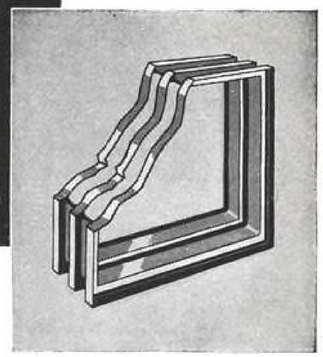
Glass for Testing Chambers



Stratosphere conditions are simulated, left, in the big Douglas Aircraft Company's test chamber while observers check proceedings through a Libbey·Owens·Ford Thermopane window.

★

Below: Cross-section of L·O·F Thermopane which is used in many wartime installations because of its extremely high insulating efficiency.



Glass Sandwich Helps Test Plane Equipment at Sub-zero

Because the dizzy heights of the stratosphere do strange things to both flyers and machines, the aviation industry untiringly tests both behavior and performance of man and metal . . . seeking facts that will enable medical science to make super-flyers . . . searching for new materials and new equipment which will give new performance levels for both men and planes.

This is one little-heard-of phase of wartime work in which Libbey·Owens·Ford is engaged—the manufacture of multi-paned Thermopane glass insulating units. Developed by Libbey·Owens·Ford. Thermopane is an air-conditioned glass sandwich—a unit of two, three or more lights of glass separated by ¼ or ½-inch dehydrated air space, and completely sealed at the edges by a patented air-tight metal seal. So effective are its insulating properties that clear visibility is provided, even when the temperature on one side is as low as 75 degrees below zero and 75 degrees above on the other.

Thermopane—now concentrated in wartime production—will become an important factor in peacetime production of dozens of products and structures. From the L·O·F Research and Engineering Laboratories have come many other and similarly important developments for both wartime and peacetime use. At all times, we welcome the opportunity to cooperate with aircraft and allied manufacturers in supplying technical assistance. Libbey·Owens·Ford Glass Company, 74123 Nicholas Building, Toledo 3, Ohio.

LIBBEY·OWENS·FORD
A GREAT NAME IN *Glass*

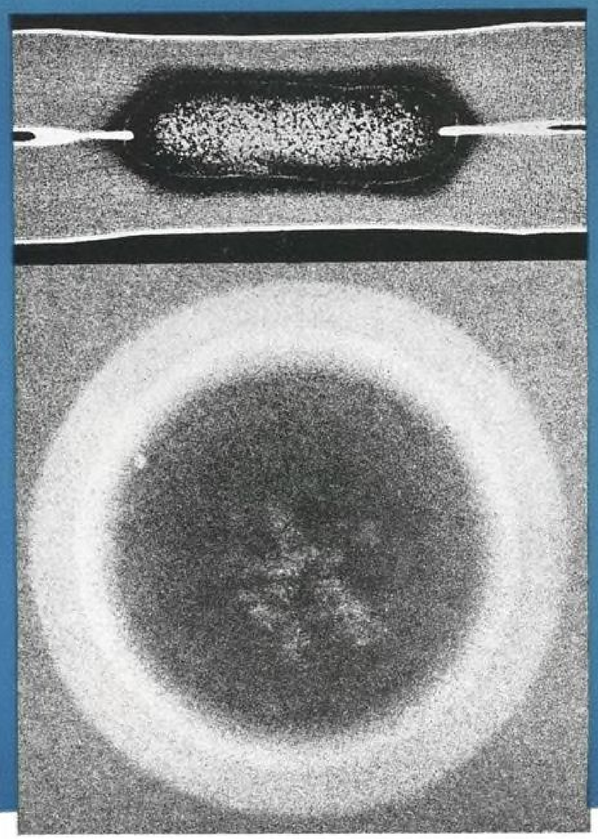
THE POWER TO SINK A SUB



will also serve your peacetime pleasure
. . . and the air commerce of the world



How good is that *Spot Weld?*



Above: Micrograph of cross section of spot welded Alclad 24S-T sheet. 10X. Below: Radiograph of the same weld, enlarged to diameter equal to the above.

Metallographic examination tells you how good a spot weld you've made, but it destroys the sample. Radiographic inspection is nondestructive. Employ both methods, therefore, to establish good welding procedures. Then use occasional radiographic inspection to check production.

Size of the weld nugget, shape, soundness and freedom from cracking are the characteristics which have the most influence on the performance of a spot weld. Radiographs can be made so that they disclose these details.

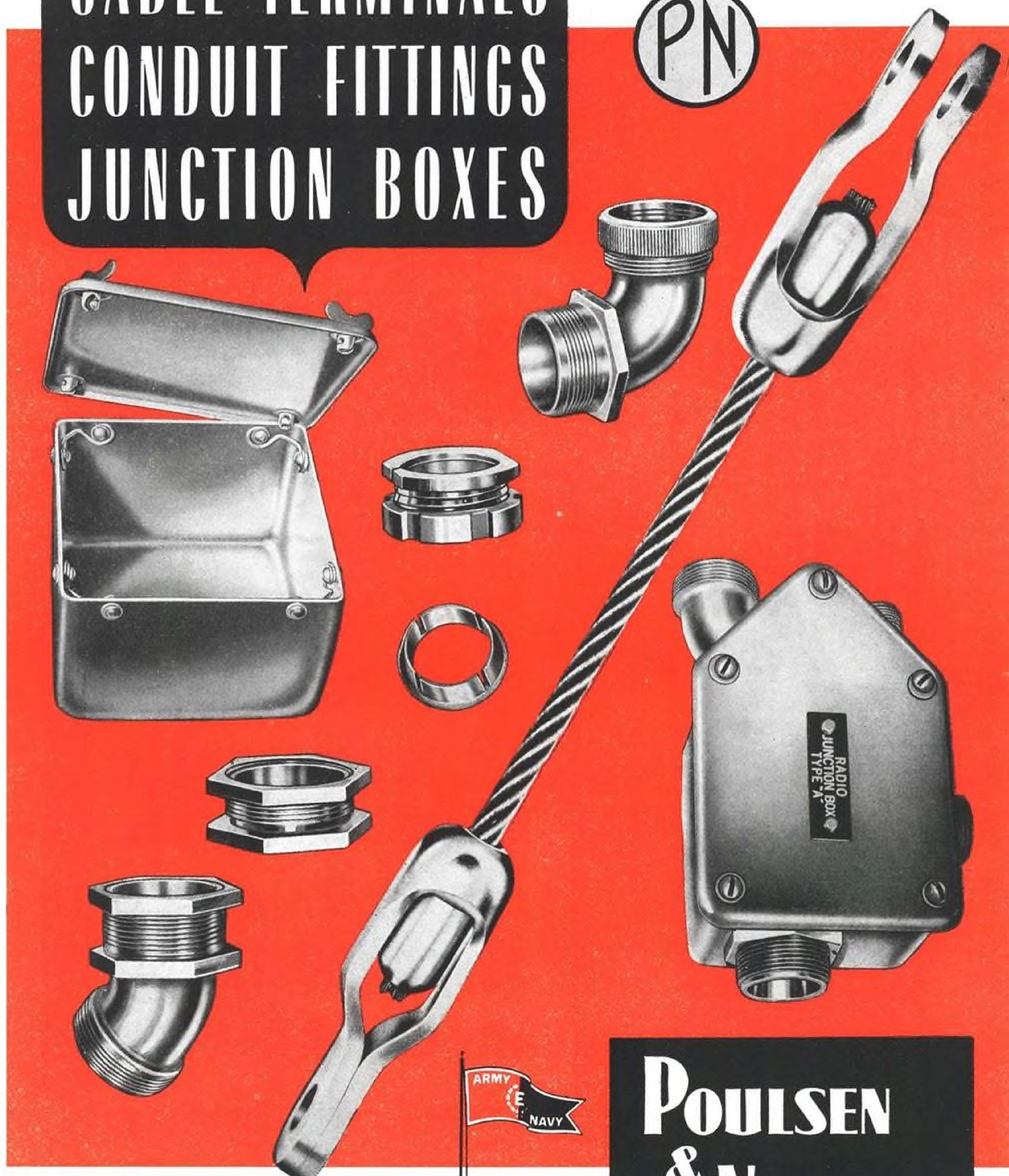
Techniques for producing good resolution in radiographs have been developed at Aluminum Research Laboratories. Information on these practices is offered by Alcoa to all fabricators of aluminum alloys to enable them to improve their products.

Send for the paper, "Correlation of Metallographic and Radiographic Examinations of Spot Welds in Aluminum Alloys." It describes methods used and results obtained. Write Aluminum Company of America, 2182 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

CABLE TERMINALS
CONDUIT FITTINGS
JUNCTION BOXES

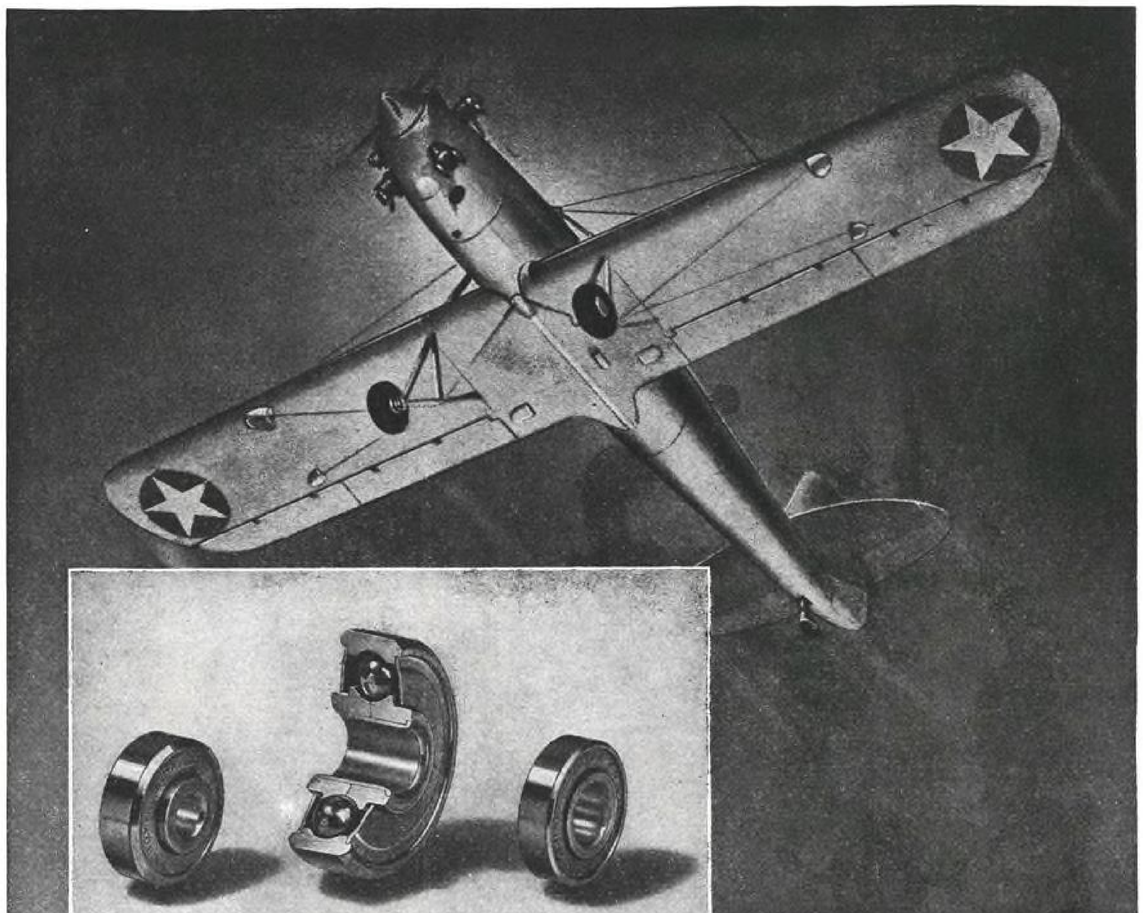
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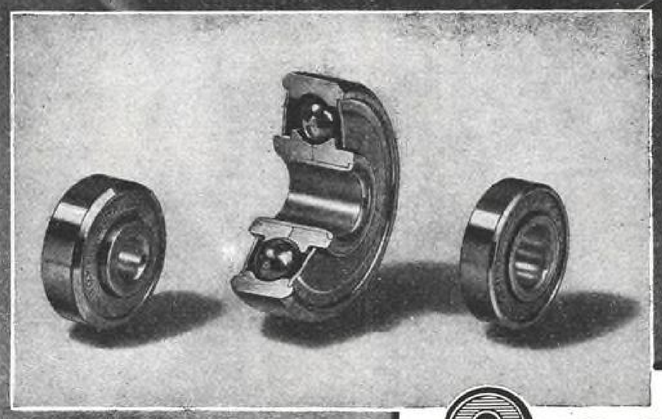


ARMY E NAVY

ESTABLISHED 1922

POULSEN & NARDON, INC.
LOS ANGELES 11, CALIFORNIA





THESE FINE BALL BEARINGS HAVE
LONG BEEN NOTED
FOR
PRECISION PERFORMANCE

•

TODAY, WE ARE MAKING THEM
IN
EVER-INCREASING QUANTITIES
FOR
FIGHTING PLANES

•

TRAINING PLANES

•

MILITARY TRANSPORTS

•

SCHATZ

Precision

AIRCRAFT BALL BEARINGS

THE SCHATZ MANUFACTURING CO.
U. S. A.

REPRESENTATIVES LOCATED AT
Detroit: 2640 Book Tower • Chicago: 902 S. Wabash Ave.
Cleveland: 402 Swetland Bldg. • Los Angeles: 5410 Wilshire Blvd.



Engines start instantly in sub-zero weather

. . . *thanks to this new* Martin lubrication system

WHEN radio warns of approaching enemies instant starting is required . . . and instant starting in sub-zero weather is now possible on U. S. planes, through Martin's newly-developed cold-weather lubrication system. Vital to victory today, this new device holds great promise as a means of starting automobiles, trucks or tractors on bitter-cold mornings. Here's how it works.

Without the Martin Method

Oil for an airplane engine is kept in a tank, not in the crankcase. A compartment within the tank lets some of the oil warm up faster than the rest so that it gets to the proper running temperature quicker. An oil cooler between the engine and tank keeps the oil from getting too hot. Pilots, landing in cold weather, press a button which introduces gasoline into the oil so that when they start the motors later the cold oil will be thin and permit a quick take-off. However this gasoline often evaporates from the hot engine, the oil is not thinned properly and when the engine is started, the oil cooler is blown up by the thick oil being forced into it. Result—disaster.

With the Martin Method

To meet this problem, Martin engineers devised the new lubricating system which:

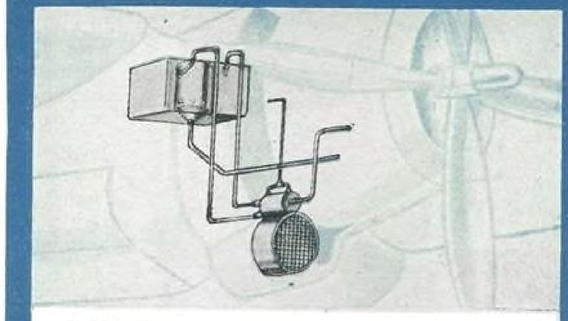
1. Injects the diluent into the oil after it has passed through the engine. This prevents the hot engine from evaporating the diluent leaving the system filled with thinned oil.
2. The new system utilizes a by-pass to prevent cold, hard oil from blowing up the oil cooler.
3. The Martin system permits dilution with dual return lines to the oil tank, one line leading to the warm-up compartment, the other to the main section of the tank.
4. With the Martin system, the diluted oil is returned to the warm-up compartment, thus avoiding dilution of all the oil in the tank.

Result—mission accomplished!

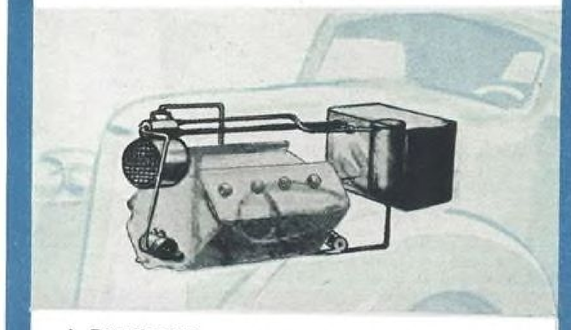
Proved in action, on Martin and other planes, the new Martin lubrication system has solved a major problem of global warfare—has brought added safety and efficiency to U. S. aircraft—and has opened new vistas for peacetime industry. In war or in peace, keep your eye on the Martin star.

THE GLENN L. MARTIN COMPANY, BALTIMORE, MD.
THE GLENN L. MARTIN-NEBRASKA COMPANY—OMAHA

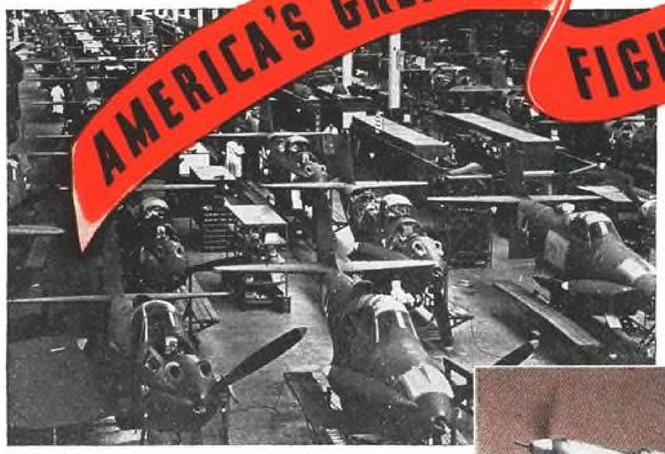
Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909



★ **TODAY,** the new Martin lubrication system is saving precious material and even more precious lives, in addition to giving our planes still another advantage over enemy types.



★ **TOMORROW,** the Martin method will mean much, not only to commercial airlines, but also to manufacturers and owners of trucks, tractors, buses and private automobiles.



AMERICA'S GREATEST FIGHTER PLANES



Snap-ons help build 'em . . .

Bell Airacobra Assembly Line

"Cannon on Wings" . . . Airacobras in Flight



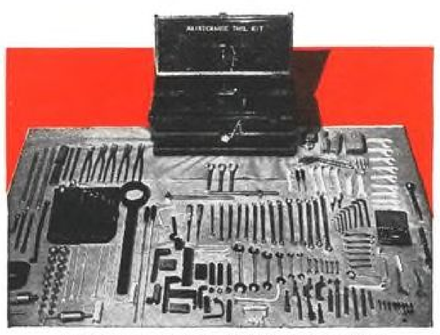
—and Snap-ons help keep 'em flying!



In every inch and every ounce, our sleek and deadly fighter planes were developed to outmatch the finest the enemy can offer . . . in speed, battle-worthiness and devastating fire power! Then followed the miracles of production-in-volume . . . to the everlasting credit of America's aviation industry!

Snap-ons help build them! To speed countless operations on production and assembly lines, Snap-ons are standard tool equipment. In "tight" places and difficult applications, where working space is highly restricted, the superior flexibility, strength and powerful leverage of Snap-ons save priceless minutes, promote better workmanship.

And Snap-ons help keep 'em flying! Efficient maintenance on far-flung battle fronts calls for extensive kits of tools identical with those used "on the line". At depots, hangars and bases around the world, Snap-on tools are on the job!



AIRACOBRA MAINTENANCE TOOL KIT

The above maintenance kit, (together with a more extensive workshop kit), is distributed by Bell Aircraft Corporation to its depots throughout the world. Snap-on offers full cooperation to manufacturers in assembling complete sets for both production and servicing. Such kits are based on standard tool units, and completed with special tools designed or adapted to fit specific applications.



SNAP-ON TOOLS CORPORATION • 8020-M 28th Avenue, Kenosha, Wisconsin

Battery of Type "D" Mult-Au-Matics in a large airplane engine plant, machining cylinder barrels.



PRODUCTION "Line of Battle"

Two urgent demands, from this all-out war, have brought into being many batteries of Bullard Mult-Au-Matics like the one shown here: The demand for production in overwhelming volume. And, no less important, the demand for the uncompromising accuracy which gives to airplane engines their fighting edge.

Since Mult-Au-Matic production is continuous production . . . since accuracy that meets fine-tolerance standards is built into its sturdy construction . . . and since the Mult-Au-Matic delivers both these essentials at marked savings of man-power and floorspace, the Mult-Au-Matic is the natural choice for scores of urgent war jobs.

* * * * * * * * * * *

And when peace is won—a little time for retooling, and they'll contribute this same volume-with-precision to important new tasks.

THE BULLARD COMPANY

BRIDGEPORT 2, CONNECTICUT

This advertisement is one of a series which will appear in national magazines and newspapers this year as Consolidated's contribution toward a clearer public understanding of "aviation geography."



Snowplows in the sky

ONLY A YEAR OR SO AGO, air-minded men used to talk about hauling tons of freight by air — someday.

Today they are doing it.

The great planes of the Air Transport Command are flying the global skyways with tons of *everything* our world-based fighting men need so badly — even snowplows for blizzard-locked Alaskan airports, and complete gasoline trucks, cut in half for shipment and welded together again at their destination.

Cargoes flown, with destinations and flying time, have included medical supplies to North Africa, *27 hours* — bomb fuses to Britain, *17 hours* — aircraft engines to China, *37 hours* — blood plasma to Australia, *35 hours* — ammunition to India, *43 hours* — mail to Iceland, *13 hours* — precision tools to Russia, *24 hours*.

The whole story of the magnificent job these airmen are doing cannot be told until after the war. To tell it now — even if we could — would endanger the lives of men and reveal military strategy.

Today these trans-oceanic fliers are making schedules — not headlines. It's a routine job to them — flying each high-priority cargo to the spot where it will do *us* good and the Axis harm.

Often that spot is halfway around the world.

But to Air Transport Command pilots, *no spot on earth is more than 60 hours' flying time* from the military airports "somewhere in the U.S.A." from which they operate.

On their timetables these pilots clock off the Atlantic and the broad Pacific like locomotive engineers. One Liberator Express was in the air only 33 hours and 27 minutes from the time it left Australia until it came down in California. Another flew from Newfoundland to Britain in 372 minutes. And a pilot on the New York-Lisbon run recently made 12 crossings in 13 days.

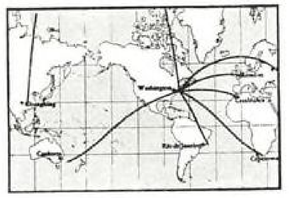
So it's too late, now, to wonder when the Air Age will come. *It's already here.*

CONSOLIDATED VULTEE AIRCRAFT

And it's still too early for rash speculation about what the postwar years of the Air Age will be like. Our job today is to win the war so that there will *be* a postwar world worth living in.

But the impact of air supremacy in winning this global war points more clearly, every day, to this fact:

When Victory has been won, air power, in the hands of the freedom-loving nations of this 60-hour-wide world, can well become "the strong right arm of peace."



MERCATOR PROJECTION

***Our old maps** do not always give us a true picture of the new "aviation" geography. If a Liberator Express pilot tried to chart a Washington-Chungking "great-circle" route on a Mercator projection* (above), *he would find that it disappeared off the top of the map!*



AZIMUTHAL EQUIDISTANT PROJECTION CENTERED ON WASH. D. C.

***Maps like this** enable us to show great-circle airline routes from Washington to any spot on the globe as a straight line. Such a map can be drawn so that it is centered on your home town or any city.*

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, Calif. • Vultee Field, Calif.
Fort Worth, Texas • New Orleans, La.
Nashville, Tenn. • Wayne, Mich.
Allentown, Pa. • Tucson, Ariz.
Elizabeth City, N.C. • Louisville, Ky.
Dearborn, Mich. • Miami, Fla.

Member, Aircraft War Production Council

QUICK FACTS FOR AIR-MINDED READERS

10 planes an hour — *It is estimated that U. S. aircraft manufacturers are now turning out planes at a rate of about 1 plane every 6 minutes, around the clock, every day of the month.*

• • •

The danger of ice formations on airplane wings has been completely overcome, according to a statement by TOM M. GIRDLER, Chairman of the Board, Consolidated Vultee Aircraft Corp. This feat is accomplished by a new thermal anti-icer, pioneered by the N.A.C.A. and perfected by Consolidated Vultee. Hot exhaust gases now are used to keep all leading edges of the plane at a temperature well above freezing when icing conditions are encountered.

• • •

Teamwork for Victory — Consolidated Vultee was the first to build multi-ton bombers in volume production on a moving assembly line. To help maintain Allied air supremacy, the Consolidated-designed Liberator bomber is also being built by Ford, Douglas, and North American.

• • •

To speed production, more than 10,000 subcontractors and suppliers, in cities all over the U. S., are working to provide subassemblies, parts, and materials for the planes being built in the Consolidated Vultee plants.

• • •

Tomorrow's fledglings—Elementary aeronautics is now being taught to students in more than 14,000 American high schools.



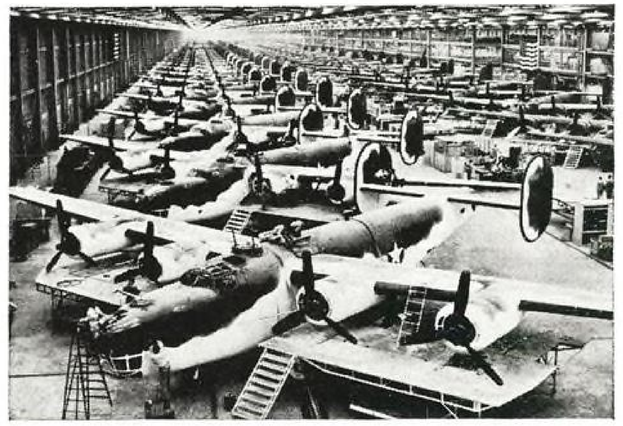
***"Gone today, here tomorrow!"** — This 33-ton, 4-engine Coronado, under way for the take-off, has a range of over 3500 miles — can remain aloft a whole day at a time. Designed and built by Consolidated Vultee, this giant Navy patrol bomber is also in service as a cargo transport plane.*

• • •

Note to plane spotters—This is the new insignia for U. S. Army planes. The change provides visibility at 60% greater range, and overcomes confusion between our former insignia and the insignia used by Axis planes.

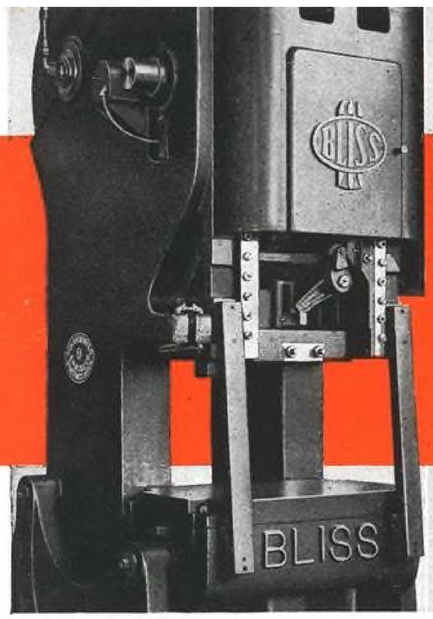


No spot on earth is more than 60 hours' flying time from your local airport



In their war paint — *Before Liberator bombers go to war, they are camouflaged and fitted with special equipment for the combat area where they will be operating.* Above: *White-bellied Liberators move down an assembly line in a modification plant.*

LIBERATOR (4-engine bomber) — CORONADO, CATALINA, (patrol bombers) — LIBERATOR EXPRESS (transport) — VALIANT (basic trainer) — VENGEANCE (dive bomber) — SENTINEL ("Flying Jeep") — RELIANT (navigational trainer)



Inclinable Press
Overhanging Single Action



One Point Press
Overhanging Single Action



Two Point Press
Overhanging Single Action



One Point Press
Straight Side Single Action



Two Point Press
Straight Side Single Action



Four Point Press
Straight Side Single Action

modern design = smooth enclosures

The enclosure of working parts is for obvious reasons, a highly desirable feature in a machine tool. Its real value however is measured by the performance it is intended to protect and preserve. With this in mind Bliss engineers designed enclosed machines that combine smooth appearance, safety and longer life with the high quality performance inherent in the older open type.

Bed areas, strokes and die space of the open models have been retained on the Enclosed Presses so that existing dies and tools can be used. A complete line of Enclosed Presses is available in all types illustrated.

ADVANTAGES OF ENCLOSED PRESSES

- *Unusually effective lubrication*
- *Reduction of torsional strain of the shaft*
- *Removal of exposed brackets*
- *Less floor space required*
- *Quiet smooth action*
- *All adjustments easily accessible*

Sales Offices:
BROOKLYN, N. Y. • TOLEDO, OHIO • CLEVELAND, OHIO • DETROIT, MICHIGAN • ROCHESTER, N. Y.
PHILADELPHIA, PA. • BOSTON, MASS. • NEW HAVEN, CONN.

Plants:
BROOKLYN, N. Y. • TOLEDO, OHIO • HASTINGS, MICHIGAN • CLEVELAND, OHIO • SALEM, OHIO

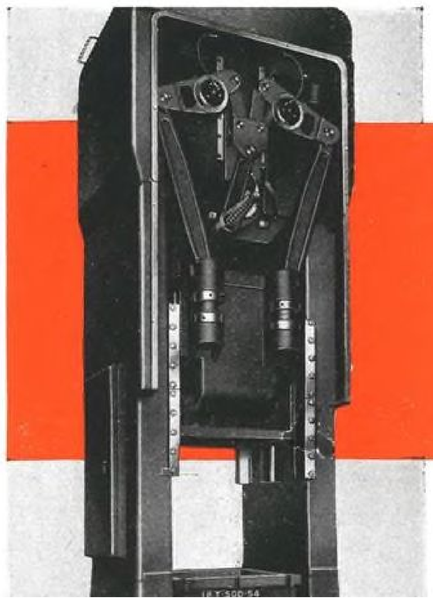
E. W. BLISS COMPANY
53RD STREET AND 2ND AVENUE • BROOKLYN 32, NEW YORK
DEPT. 12



Four Point Eccentric Press
Straight Side Single Action

MARQUETTE · BLISS · TOLEDO · CONSOLIDATED
BLISS BUILT

One Point Press *(Covers off)*
Straight Side Double Action

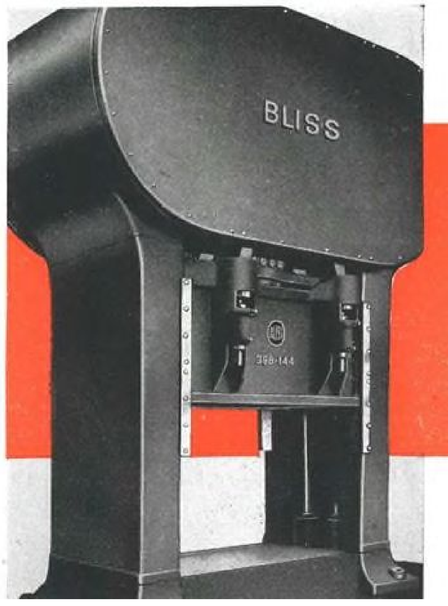


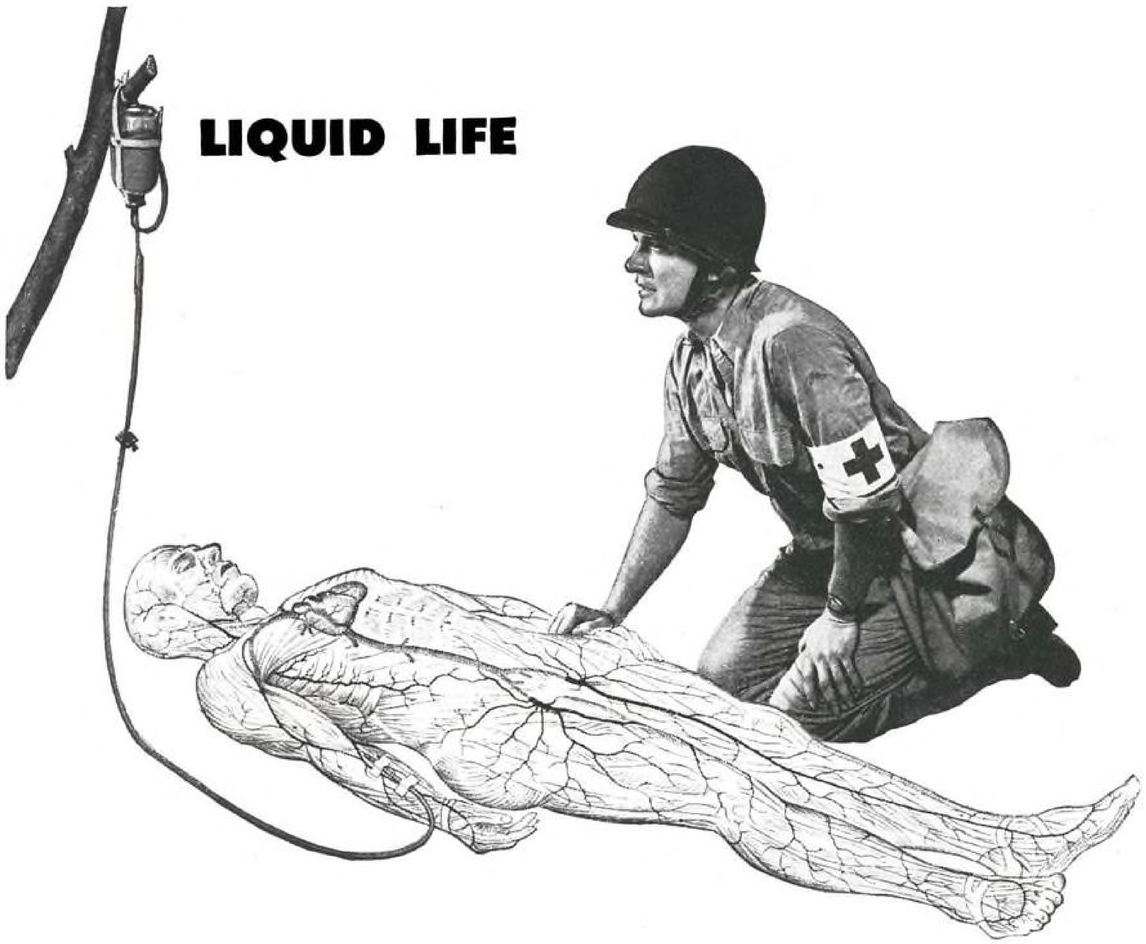


Two Point Press
Straight Side Double Action

MARQUETTE · BLISS · TOLEDO · CONSOLIDATED
BLISS BUILT

Four Point Press
Straight Side Triple Action





LIQUID LIFE

Not bullets, but *surgical shock*, has killed many a soldier in the wars of the past.

Shock is a breakdown of the blood circulatory system. Blood vessels contract. Circulation slows down, almost stops. If shock is too severe, death results.

Today, when a soldier is wounded, blood *plasma* is injected into his circulatory system. The plasma acts as a sort of pump primer . . . fills up the collapsed veins and arteries . . . starts the system working again. By thus counteracting shock, plasma saves lives and reduces suffering.

The whole blood you give at a Red Cross blood donor station goes through much processing before it gets to the front as plasma. At many points throughout the processing accurately-controlled *refrigeration* must be used.

To provide this refrigeration, General Electric has developed dependable refrigerating equipment that is more efficient, more compact and more flexible—to meet difficult war conditions.

This is only one of the many ways General Electric Refrigeration and Air Conditioning are helping to make a better world.

☆ BUY WAR BONDS ☆

General Electric Company, Air Conditioning and Commercial Refrigeration Divisions, Section 4312, Bloomfield, New Jersey.

Industrial Refrigeration by

GENERAL ELECTRIC

Hear the General Electric Radio Programs: The "HOUR OF CHARM," Sunday 10 P. M., E W T, N B C . . . "THE WORLD TODAY" News, Every Weekday 6:45 P. M., E W T, C B S

For your highest skill—

HI-DENSITY LEAD

The basis of *more opaque tracings* and *sharper, clearer blueprints*— and the exclusive advantage of **MICROTOMIC "VAN DYKE" DRAWING PENCILS**

The superior qualities of HI-DENSITY leads are best measured by the HI-DENSITY LINE they produce:

1 *Uniformly opaque, and more sharply white when blueprinted.*

2 *Dense color without thickness of lead deposit— and less smudging.*

3 *Drawn without pressing into the paper—and easier to erase.*

4 *Always uniform—because scientific manufacture produces ever-accurate* **MICROTOMIC** *grading.*

5 *Stronger points and notably longer wear.*

MAIL THIS COUPON

EBERHARD FABER PENCIL CO.
37 Greenpoint Ave., Brooklyn, N. Y.

Please send me for testing purposes, FREE, a ____ degree HI-DENSITY MICROTOMIC "VAN DYKE" Drawing Pencil.

Name _____

Position _____

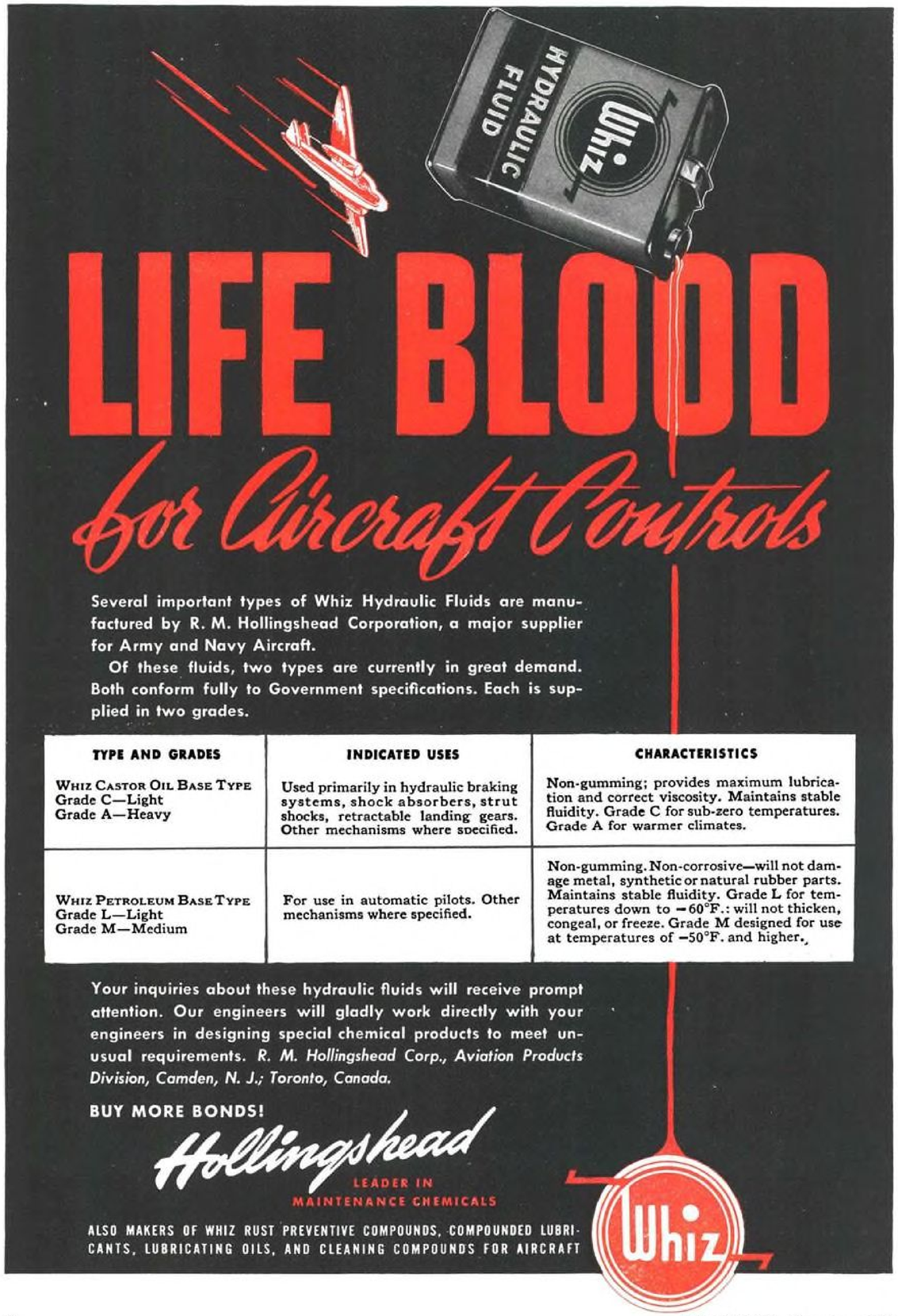
Address _____

_____

Microtomic **VAN DYKE** *Drawing Pencils*

"VAN DYKE" EBERHARD FABER. U.S.A. 3H
MICROTOMIC GRAPHITE

THE EBERHARD FABER DRAWING PENCIL WITH THE MICROTOMIC LEAD . . . 18 DEGREES . . . AND 6 DEGREES ALSO WITH CHISEL POINTS



LIFE BLOOD
for Aircraft Controls

Several important types of Whiz Hydraulic Fluids are manufactured by R. M. Hollingshead Corporation, a major supplier for Army and Navy Aircraft.

Of these fluids, two types are currently in great demand. Both conform fully to Government specifications. Each is supplied in two grades.

TYPE AND GRADES	INDICATED USES	CHARACTERISTICS
WHIZ CASTOR OIL BASE TYPE Grade C—Light Grade A—Heavy	Used primarily in hydraulic braking systems, shock absorbers, strut shocks, retractable landing gears. Other mechanisms where specified.	Non-gumming; provides maximum lubrication and correct viscosity. Maintains stable fluidity. Grade C for sub-zero temperatures. Grade A for warmer climates.
WHIZ PETROLEUM BASE TYPE Grade L—Light Grade M—Medium	For use in automatic pilots. Other mechanisms where specified.	Non-gumming. Non-corrosive—will not damage metal, synthetic or natural rubber parts. Maintains stable fluidity. Grade L for temperatures down to −60°F.: will not thicken, congeal, or freeze. Grade M designed for use at temperatures of −50°F. and higher.

Your inquiries about these hydraulic fluids will receive prompt attention. Our engineers will gladly work directly with your engineers in designing special chemical products to meet unusual requirements. *R. M. Hollingshead Corp., Aviation Products Division, Camden, N. J.; Toronto, Canada.*

BUY MORE BONDS!

Hollingshead
LEADER IN MAINTENANCE CHEMICALS

ALSO MAKERS OF WHIZ RUST PREVENTIVE COMPOUNDS, COMPOUNDED LUBRICANTS, LUBRICATING OILS, AND CLEANING COMPOUNDS FOR AIRCRAFT

Whiz



What happens when a Shadow meets an RCA Electron Tube

JUST by itself, it's hard enough to measure to an accuracy of 1/10,000 of an inch. But on a production line, where tens of thousands of wires have to measure up to this accuracy, it's next to impossible—unless you want to spend more time measuring than producing.

However, with a simple electronic device, built around an RCA Electron Tube, thousands of small lead wires for radio tubes are now being checked for such accuracy at the rate of 5 to 8 a minute!

How is it done? Like this . . .

The wire passes before a light. As it does, it casts an enlarged shadow on a sensitive phototube whose output is measured on a meter. If the wire is 1/10,000 of an inch off, the difference is recorded on the meter and the offending wire can be rejected. If desired, the wire can be rotated to measure out-of-roundness.

This is electronics—the so-called "dream science of tomorrow"—in action *today* at RCA. While the device described here is not for sale by RCA, engineers at RCA will be glad to recommend electron tubes around which *your* engineers can design equipment to do any number of jobs better, faster or more economically through electronics.

Remember—the magic brain of all electronic equipment is a Tube . . . and RCA is the fountain-head of modern tube development. For a fascinating booklet entitled "Electrons in Action at RCA," write Room 457, RCA Victor Division, RADIO CORPORATION OF AMERICA, Camden, N. J.

TUNE IN "WHAT'S NEW?"

RCA's great new show, Saturday nights, 7 to 8, Eastern War Time, Blue Network.

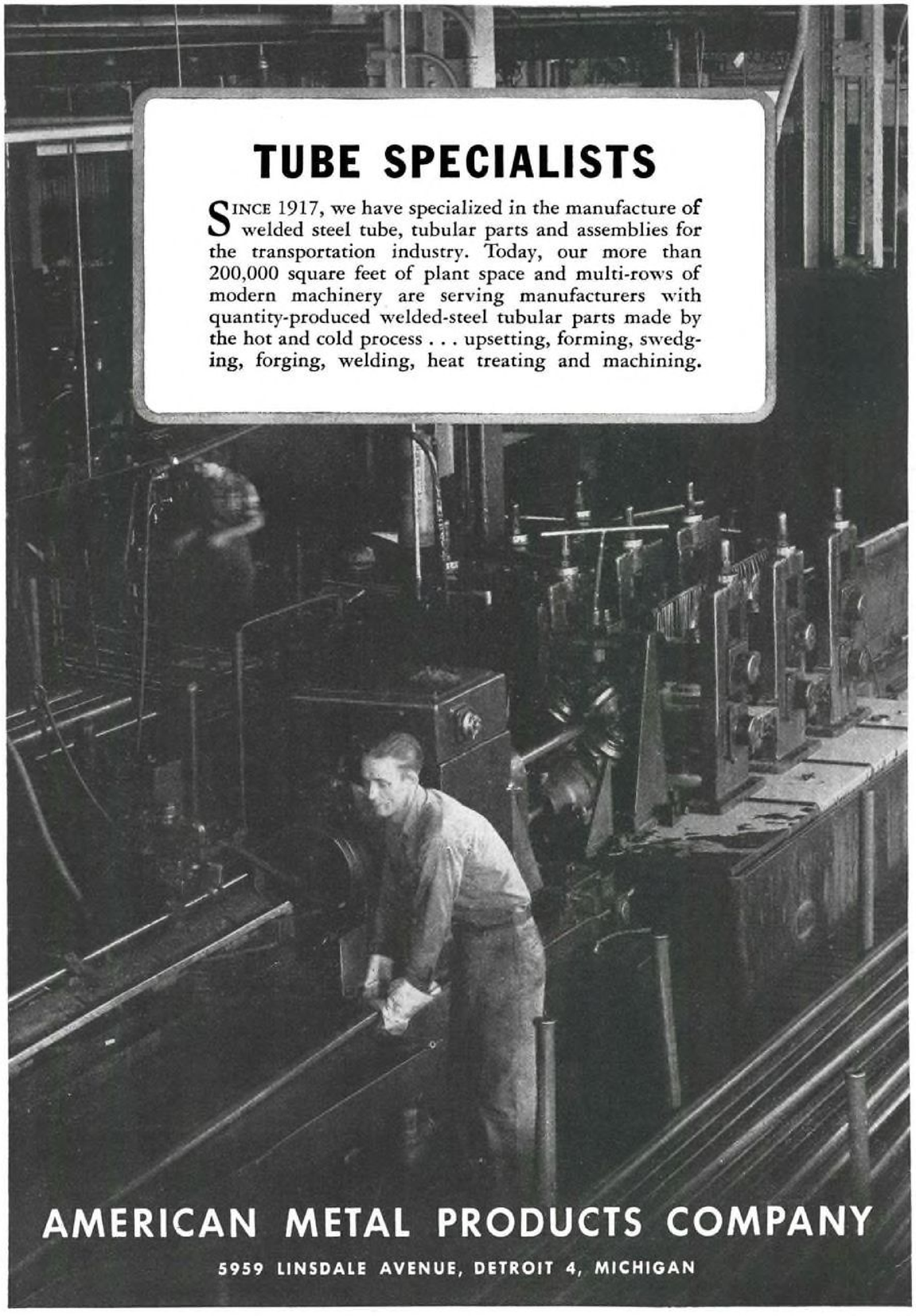


This machine, while used at RCA to measure the diameter of tungsten wires by an electronic method, embodies a basic principle for measuring any critical dimension of any component that can be made to cast a shadow directly proportional to the dimension to be checked.

ASK ABOUT... RCA INDUSTRIAL MUSIC SERVICE

RCA

RADIO CORPORATION OF AMERICA



TUBE SPECIALISTS

SINCE 1917, we have specialized in the manufacture of welded steel tube, tubular parts and assemblies for the transportation industry. Today, our more than 200,000 square feet of plant space and multi-rows of modern machinery are serving manufacturers with quantity-produced welded-steel tubular parts made by the hot and cold process . . . upsetting, forming, swedging, forging, welding, heat treating and machining.

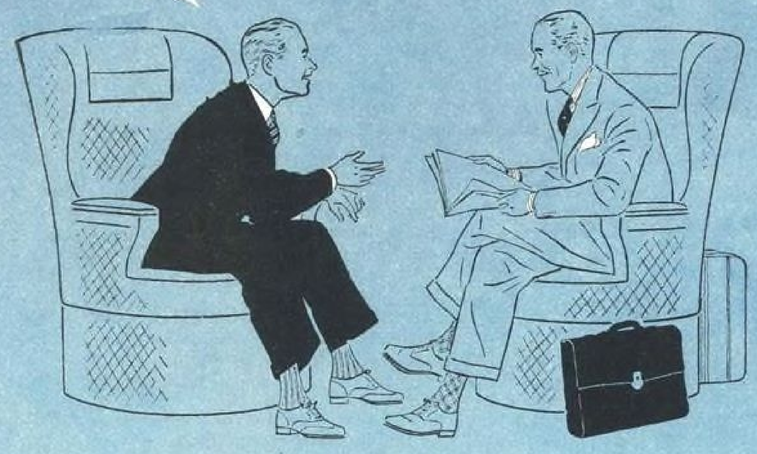
AMERICAN METAL PRODUCTS COMPANY

5959 LINSDALE AVENUE, DETROIT 4, MICHIGAN

Rumors you *can* circulate!

THOSE ARE MARVELOUS GLIDERS **GENERAL AIRCRAFT** BUILDS FOR THE ARMY AIR FORCE.

YOU CAN SAY THAT AGAIN! BUT HAVE YOU HEARD ABOUT **GENERAL AIRCRAFT'S** TWO NEW **SKYFARERS?** IN SAFETY AND SPEED THEY WILL REVOLUTIONIZE POST-WAR PRIVATE FLYING. ONE IS ROADABLE, TOO*



★To hear more about it, write to...
The General Aircraft Corporation, Long Island City (5) N. Y.

Licensors to the industry of two-control airplanes under patents to Weick and to Koppen

BE FIRST ON THE

POST-WAR PRIORITY LIST FOR SOUTH BEND LATHES





South Bend Engine Lathes and Toolroom Lathes are made in five sizes: 9", 10", 13", 14½", and 16" swings, with bed lengths from 3' to 12'. The Turret Lathes are made with 9" and 10" swings. They are fully illustrated and described in Catalog No. 100-C.

Post-war employment and prosperity depend upon quick resumption of normal peace time civilian activities, production, and services. To furnish lathes first to those who will be ready to use them (but cannot qualify for a war-time priority) South Bend Lathe Works now offers a practical post-war priority plan.

To take advantage of this plan, place an order now for the lathes you want. No down payment, no deposit is required. Should conditions necessitate, you may cancel the order at any time. All we ask is that it be placed in good faith.

When your order is received, we will issue a numbered Post-war Priority Certificate. As soon as materials and manpower are released for civilian production, South Bend Lathes will be shipped in accordance with the Priority Certificates. Certificate holders will receive the first South Bend Lathes to be thus released, up to 80% of our production. The remaining 20% will be reserved for returning service men who may need lathes.

All standard South Bend Lathes, embodying the improvements developed in meeting exacting war production needs, will be available. No revolutionary models or design changes are to be expected. There will be no price increase—unless material or labor costs, or other conditions beyond our control, require it.

Here is a practical first step in putting your post-war plans into action. Send for Catalog No. 100-C and full information on this plan. Choose the lathes that meet your needs... place an order now, and be sure of earliest possible delivery.



Buy War Bonds Now...Save for Lathes

SOUTH BEND LATHE WORKS

SOUTH BEND 22, INDIANA **LATHE BUILDERS FOR 37 YEARS**



The farm boy, physically hardy, mentally alert, motor wise, brought up with foot on throttle and tools for playthings—makes a pilot such as other nations can never match.

And the engineers who design his car, truck, tractor and stationary motors also create airplanes that have no equals.

We at Sealed Power (craftsman, engineers, executives) are proud of contributing motor parts worthy of the engines that help to grow and harvest our food, that transport 130 million Americans to and from work, that move munitions, and that do so much toward winning our war.

SEALED POWER CORPORATION
MUSKEGON, MICHIGAN
WINDSOR, ONTARIO

PISTON RINGS—PISTONS—CYLINDER SLEEVES

Is Reconditioning Tools One of Your Problems?



The carbide tipped tools for example

—where your grinding wheel and your grinding technique both are highly important.

There is a Norton booklet that covers the subject entitled "Grinding Carbide Tipped Tools."

It specifies which type of Norton Diamond Wheels should be used for each kind of grinding.

It has a chapter on the uses of Norton Metal Bonded Diamond Wheels; another on Norton Resinoid Bonded Diamond Wheels, and a third chapter tells you where Crystolon (silicon carbide) grinding wheels should have a part in reconditioning carbide tipped tools.

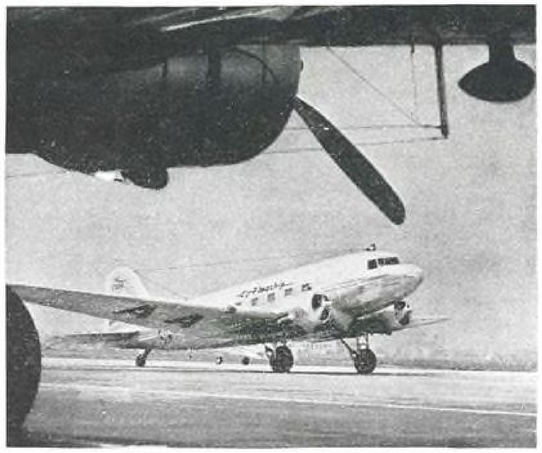
The book is sent free

Norton Company • Worcester 6, Mass.

Behr-Manning, Troy, N. Y., is a Norton Division

NORTON ABRASIVES

All of American's Prints Are Ozalid Whiteprints



At American Airlines they speak of "the *whiteprint* of things to come." Here . . . print production is one hundred percent Ozalid—no blueprints.

They're making Ozalid whiteprints of their engineering and isometric drawings, weather reports, flight analyses, and office forms.

What's most important, they're saving time, labor, and materials.

WILL OZALID HELP YOU ALSO?

If your drafting output has reached the point where it would be more economical to do your own printmaking . . . by all means investigate the savings possible with an Ozalid whiteprint machine.

If you have already installed expensive blueprinting equipment . . . you can add a Dry Developing unit, which when used with your present Printer, will provide all the advantages of Ozalid printmaking.

ONLY OZALID GIVES YOU THIS VERSATILITY

With Ozalid you're not limited to one-color reproductions. You can make prints having blue, black, or maroon lines on a white background. This allows you to assign identifying colors to different departments, to distinguish checked from unchecked prints, etc.

With Ozalid you can use cut sheets as well as roll stock. By ordering sheets cut to the size of your tracings, you can completely eliminate trimming waste.

With Ozalid you can use a wide selection of foils and transparent materials—an impossibility with other methods. You can employ these to reclaim the details of soiled or worn tracings . . . to make composite prints . . . and duplicate originals to be used instead of the original tracings in subsequent print production.

All Ozalid Prints are produced in the same manner. Dry Development eliminates variations in production.

These Ozalid features will give you a "head start" in production.

PHOTOGRAPHS—COURTESY OF AMERICAN AIRLINES

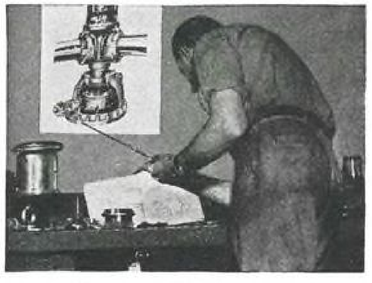


1 An Ozalid machine is clean, compact, and may be installed in a corner of the drafting room. Any inexperienced person can operate it. *ALL* prints are produced in the *same* continuous operation which incorporates *Exposure* and *Dry Development.*

No baths, driers, or plumbing connections.



2 When making design changes, it's never necessary for the draftsman to redraw any lines which remain the same. Ozalid saves valuable time. Make a "duplicate original" of the tracing. Then, delete the obsolete sections with Ozalid Correction Fluid — and draw in the new design. It's that easy!



3 Ozalid whiteprints of engineering and isometric drawings enable even inexperienced workers to grasp production details quickly. They are easier to read and check than blueprints and are preferred in the shop and field. Pencil or ink notations can be recognized immediately.

WRITE FOR CATALOG AND SAMPLES OF OZALID WHITEPRINTS

OZALID PRODUCTS DIVISION

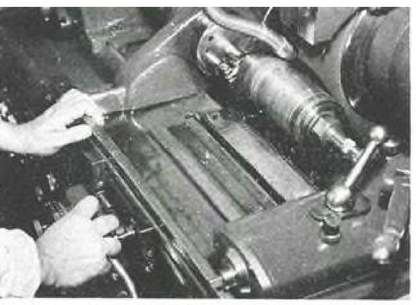
GENERAL ANILINE AND FILM CORPORATION

JOHNSON CITY, N. Y.

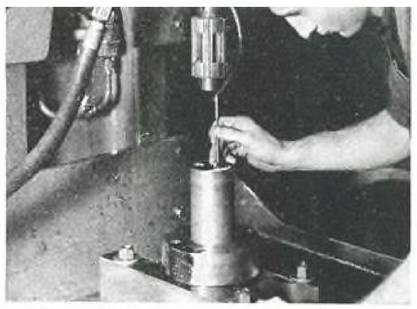
OZALID IN CANADA—HUGHES OWENS CO., LTD., MONTREAL

P.S. Some More Ozalid Users:

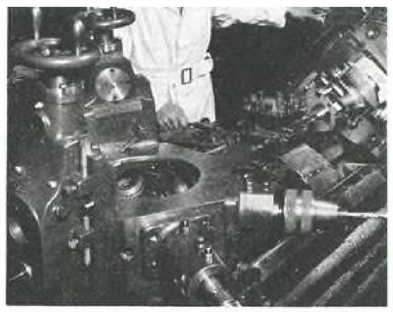
1. Pratt & Whitney Aircraft Division
2. United States Rubber Company
3. Bethlehem Steel Company
4. Emerson Radio & Phonograph Corp.
5. Ford Motor Company
6. Cramp Shipbuilding Company
7. International Business Machines Corp.
8. Edward G. Budd Manufacturing Co.
9. North American Aviation, Inc.
10. Boeing Aircraft Company



Threads on cylinders and other parts are precision ground, assuring absolute accuracy and uniformity.



Wear and leakage are greatly reduced by honing interior of hydraulic cylinder to mirror smoothness.

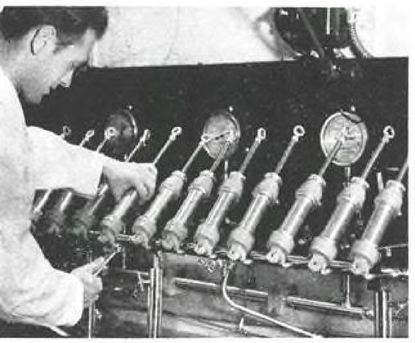


Turret lathes complete various operations in sequence to insure absolute uniformity.

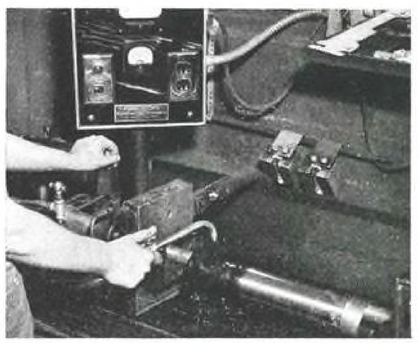
Interstate

— ANOTHER NAME FOR PRECISION

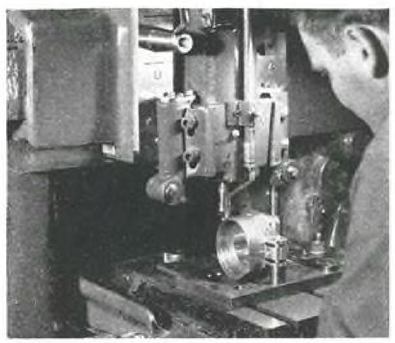
INTERSTATE AIRCRAFT AND ENGINEERING CORPORATION • EL SEGUNDO, CALIFORNIA



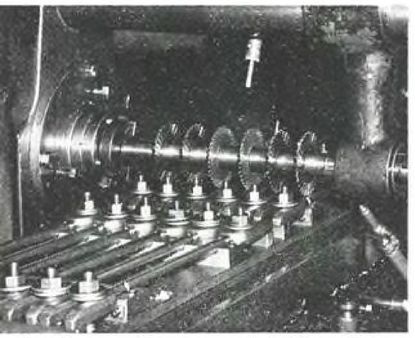
This multiple tester saves valuable time in testing hydraulic cylinders and increases overall efficiency.



The danger of hidden imperfections is avoided by the magnetic testing of materials in inspection.



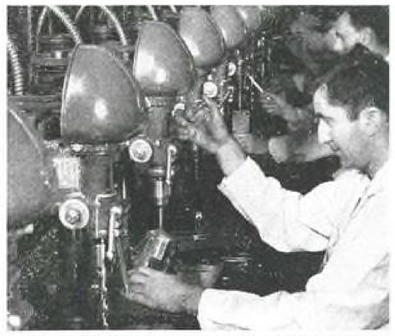
Perfect alignment is obtained in this drilling operation by tooling with greatest accuracy.



Machine operations are conducted in multiple wherever possible to conserve time and cut costs.



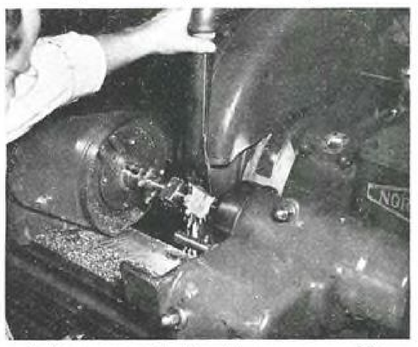
Jigs and dies are precision-built to obtain utmost accuracy in machined parts for finished production.



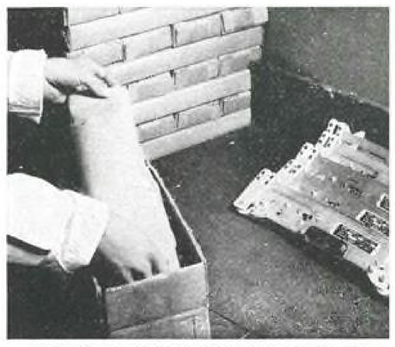
Rows of drill presses provide for rapid production by standardizing operations in correct sequence.



Every part that goes into a complete assembly is thoroughly checked and inspected for hardness.



Parts are ground to close tolerances on precision grinders for faultless performance.



Mechanisms are wrapped and cartoned for protection against damage and corrosion.

S*porty says:

see ADEL *for quick service*

● Plants in Burbank, California, and Huntington, West Virginia, will give you *immediate deliveries* of ADEL line support clips and blocks. They're the *standard* of the industry because ADEL pioneered in this field, designed, refined, simplified and improved . . . not for months but for *years*. Tested on every battle front, used by every major U. S. and Canadian aircraft company. Over 150 million now in service. 12,000 production types and sizes for all aircraft to save you money in simplicity of installation, long life, ease of maintenance, low cost upkeep.

Ask our nearest engineering service office for free catalog with authoritative information about the correct support for electric conduits, fuel, oil, instrument, and hydraulic lines. And if you hear claims that other line supports are "just as good" as ADEL'S, please bear in mind that it is always a safe bet to use what others *try* to imitate.

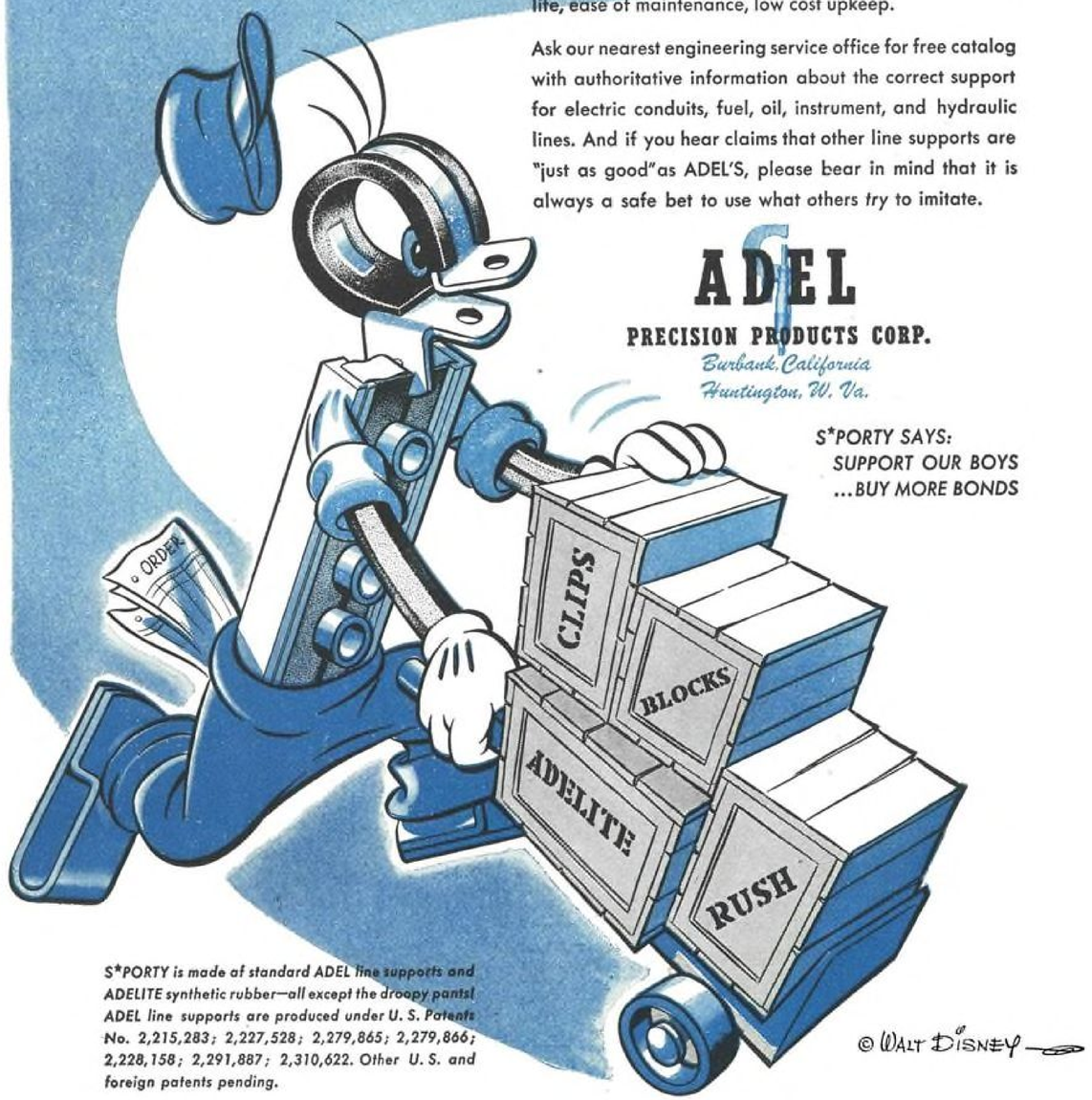
ADEL

PRECISION PRODUCTS CORP.

Burbank, California

Huntington, W. Va.

*S*PORTY SAYS:*
SUPPORT OUR BOYS
...BUY MORE BONDS



*S*PORTY is made of standard ADEL line supports and ADELITE synthetic rubber—all except the droopy pants! ADEL line supports are produced under U. S. Patents No. 2,215,283; 2,227,528; 2,279,865; 2,279,866; 2,228,158; 2,291,887; 2,310,622. Other U. S. and foreign patents pending.*

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421 Mutual Home Building, DAYTON, OHIO • 1444 Washington, HUNTINGTON, W. VA. • 303 Wareham Building, HAGERSTOWN, MD. • 302 Bay Street, TORONTO, ONTARIO

Copyright 1943, Adel Precision Products Corp.

Here too, Champion Spark Plugs are proving their dependability



You've got to have the full power of all the horsepower that's packed into an engine when you take off—particularly from an aircraft carrier. A little thing like a spark plug becomes enormously important in situations like this.

Not many months ago, spark plugs were a limiting factor in some of our most advanced high-output aircraft engines. Champion, meantime, had perfected an entirely new ceramic spark plug. It was tested and put in service. Since that day the production of Champions for our air forces—Army, Navy and Marine Corps—has continued to accelerate unabated. The coveted Army-Navy "E" award has recently been granted to Champion, through the U. S. Army Air Forces, in recognition of this achievement.

Characteristic advantages of Champion Ceramic insulation are:

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "shorts".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.



KEEP 'EM FLYING

BUY WAR BONDS AND STAMPS

DEPENDABLE

CHAMPION SPARK PLUGS



ONE REASON for America's highly successful precision bombing is the Automatic Pilot, developed and manufactured by Minneapolis-Honeywell. Until recently, details of this super-sensitive electronically controlled instrument were secret, but it can now be said that the M-H Automatic Pilot not only accurately directs the ship, but on bombing runs actually holds the plane on a designated course over the target, providing a stable platform from which bombs are released.

The Automatic Pilot is but one of a number of aids to aviation which Minneapolis-Honeywell Engineers have developed and are producing, and which are in daily use in every war theater.

When the time comes, Minneapolis-Honeywell will be ready for peacetime aeronautical problems. We therefore invite your future control problems on the basis that we have proved both our engineering and our manufacturing ability and can obviously help you with your future plans . . . Minneapolis-Honeywell Regulator Co., Aeronautical Division, 2792 Fourth Avenue S., Minneapolis 8, Minnesota.

MINNEAPOLIS-HONEYWELL

AERONAUTICAL INSTRUMENTS

AERONAUTICAL DIVISION MH

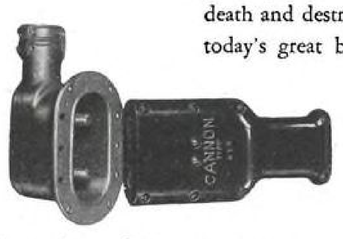


FROM BOMBS TO BROCCOLI...

In this war of many fronts, half-ton block busters are lifted by winch and motor into the yawning bellies of giant bombers . . . to spread death and destruction on our axis enemies. But today's great bombers, destruction bent, may seem puny in the light of tomorrow's aircraft, pursuing peacetime missions.

Great loads . . . entire boxcars in fact, may be the given load of aircraft in future peacetime years. And whether it's a carload of broccoli from California, a boxcar of bananas from the Tropics or pineapples from Hawaii . . . the energy expended in loading, lifting and also in flying will unquestionably be dependent in part on electrical circuits.

And wherever electrical circuits are involved, there you will more than likely find Cannon Connectors. For Cannon Connectors are used wherever electrical connections must be made quickly and with absolute certainty . . . in planes, tanks, communications, motion picture studios and hundreds of other civilian and military uses.



The two Cannon battery connectors above are a part of the complete line as shown in Cannon's latest Battery Connector Bulletin. Write today on your business letterhead for a copy.

BUY U. S. WAR BONDS AND STAMPS

ARMY E NAVY

CANNON ELECTRIC

Cannon Electric Development Company, Los Angeles, California

Canadian Factory and Engineering Office: Cannon Electric Company, Limited, Toronto

REPRESENTATIVES IN PRINCIPAL CITIES — CONSULT YOUR LOCAL TELEPHONE BOOK

TRAINING

Designed for Your Career and Future in Aviation



The high standing of CURTISS-WRIGHT TECHNICAL INSTITUTE is indicated by Mr. Donald Douglas, President of the great Douglas Aircraft Company, in choosing this school for his own son's training. In addition, this school was selected to train Army Air Force mechanics by our government in 1939, long before the war.

Today opportunities in Aviation are great. They will be greater after the war. STOP . . . THINK . . . REASON IT OUT FOR YOURSELF. Men with necessary knowledge and skill must maintain America's great Air Fleet.

CURTISS-WRIGHT TECHNICAL INSTITUTE offers you intensive and specialized training in Aeronautical Engineering and Master Aviation Mechanics which will give you this knowledge and skill.

The purpose of Curtiss-Wright Technical Institute training is to provide you with the highest standard of training, of superior value to yourself. That is why these courses have been specially . . .

DESIGNED . . . to provide high calibre training so you will be qualified to meet the exacting demands of the Aircraft Industry, C. A. A. and the Army Air Forces.

DESIGNED . . . to provide you with the basic foundation for leadership and responsibility in the industry.

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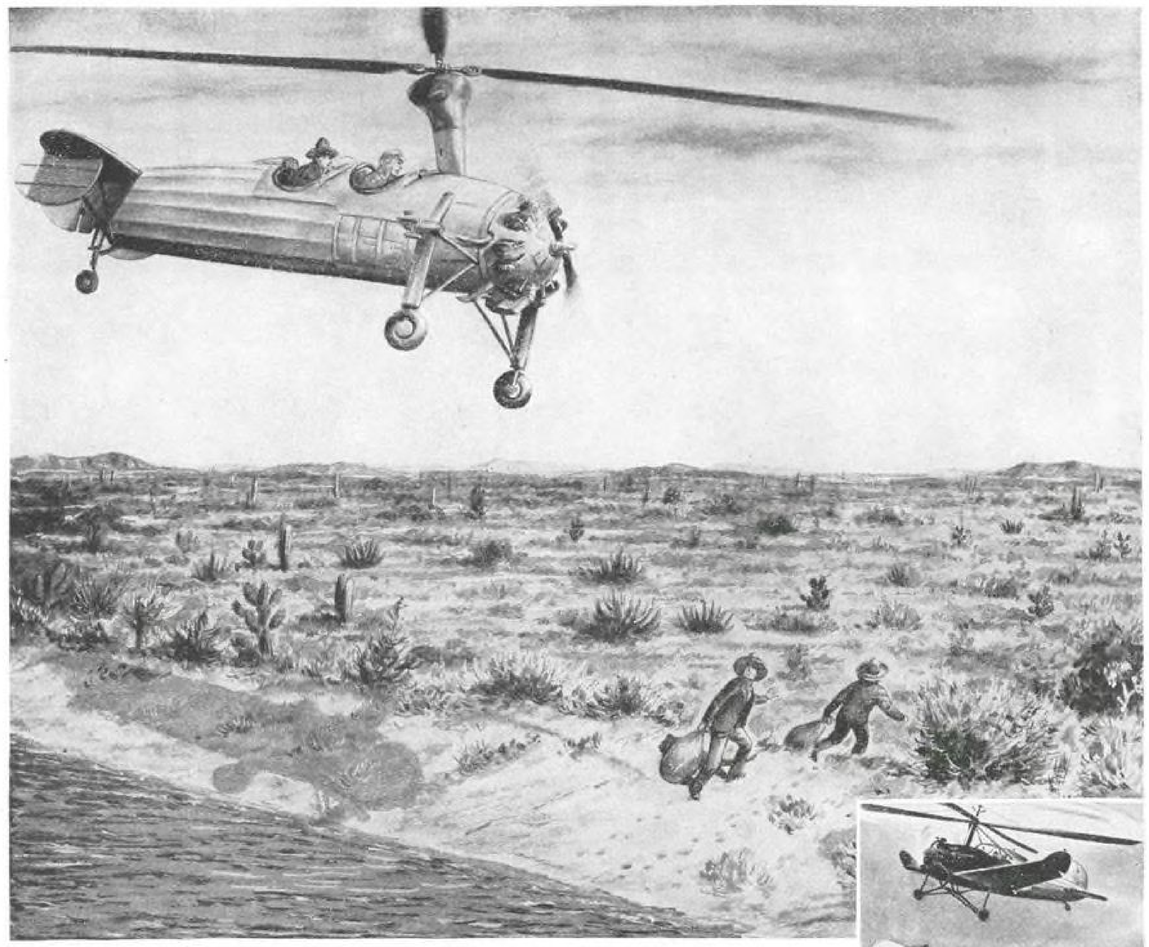
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For almost three years Kelletts have been used on border patrol, covering up to 400 miles a day. A two-man team in a Kellett patrols a larget area more thoroughly than many men and much valuable equipment could do in any other way.



A Kellett rotary wing ship accompanied Admiral Byrd on his voyage to the South Pole.



Eastern Air Line's Kellett flew mail for a full year from Philadelphia's Post Office roof.



Kellett looks forward enthusiastically to a future of expanding service to the nation.

PIONEERING NEVER STOPS ...not even for war!

Researching—engineering—and the commercial production of rotary wing aircraft have been Kellett's prime activities for over fourteen years. Tremendous strides have been made—and our work goes on, with efforts redoubled. Today, Kelletts are "earmarked" for the U.S.A.A.F. We can't give you the details now, but keep Kellett rotary wing aircraft in mind when you think of the future.

While we're cooperating with the Army in speeding the development of rotary wing aircraft, we're also supplying vital parts for many of our nation's best bombers and fighters . . . important work that requires highest skill and aircraft manufacturing "know how."

Kellett is looking forward to the time when this skill and experience can be turned to peacetime benefits . . . to provide you with Kelletts to cut time and costs in patrolling electric power lines, oil pipe lines, in transporting mail and passengers, dusting crops, and for other services to industry, commerce, forestry and agriculture. Kellett Aircraft Corporation, Upper Darby (Philadelphia), Pennsylvania.

K E L L E T T

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

Helping Build Better Planes!



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Fast! Speeds assembly work. Only 3 parts, spring unit, stud and cross pin. Locks with about ¼ turn. Just one special tool needed for installation.

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Leveling Lubeck

WITH ELECTRICAL EFFICIENCY

That's the Briete Strasse below. Once a busy street in Lubeck, Germany.

More Americans are passing over . . . leaving behind impressive reminders that "he who lives by the sword, shall die by the sword!"

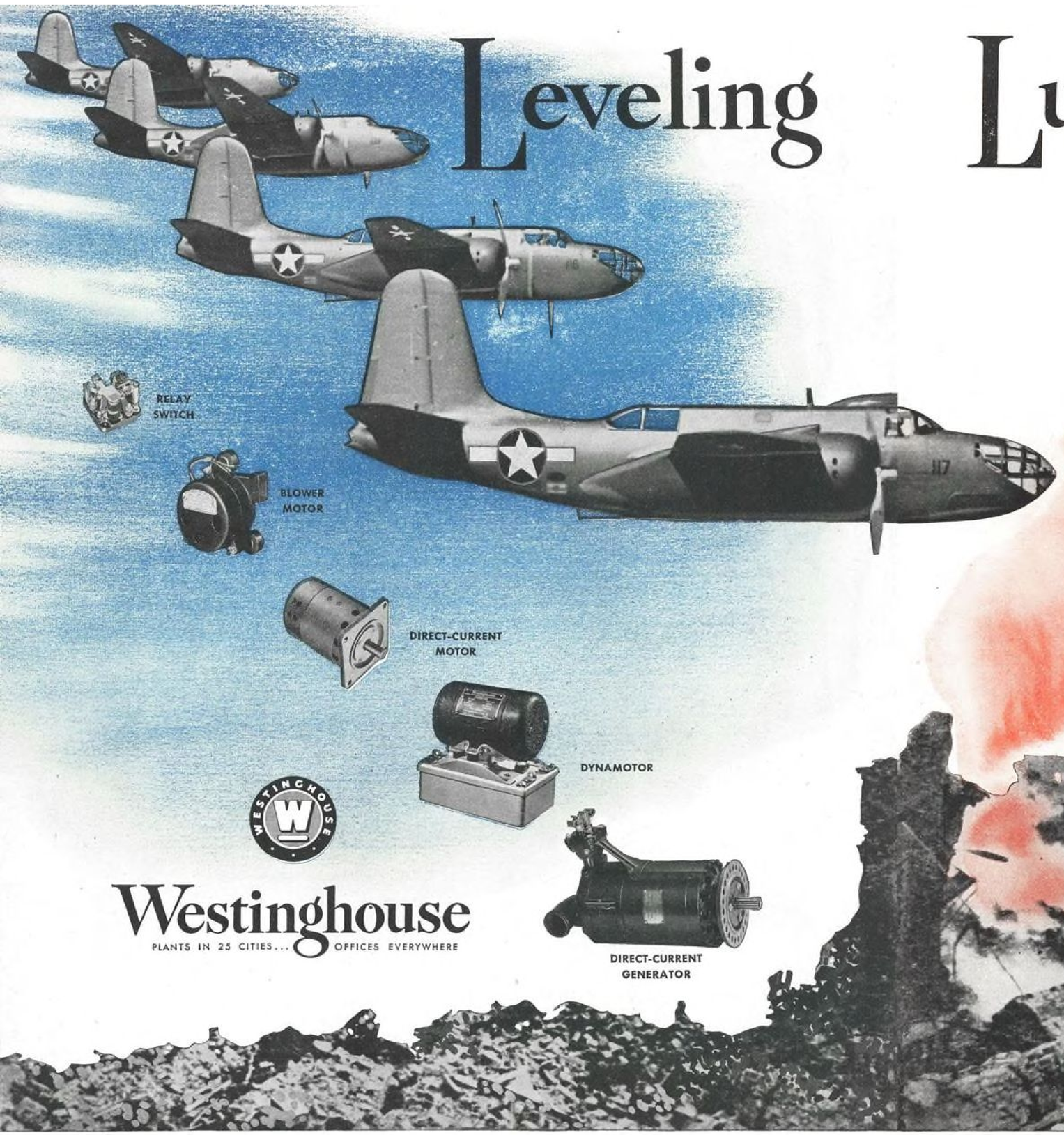
Our "persuasive" Americans make their calls in "Havocs"—the well-named Douglas A-20 Army attack bombers shown at left. With the aid of the latest developments from America's electrical laboratories, these and other great allied warplanes are leveling Lubeck and the rest of industrial Germany.

Holding our planes true on the bomb-run, and guiding them safely home are a whole host of Westinghouse products. These provide electrical power and control for such applications as wing flaps, trim tabs, fuel pumps, engine cowl actuators, landing gear and bomb doors.

On these vital electrical units, the fighting efficiency of the plane, its safety, and the pilot's life may well depend. Westinghouse builds them to operate dependably under all extremes of temperature, humidity and altitude, and under the severest flying conditions.

For help on electrical equipment for aircraft, consult Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania, Dept. 7-N.

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RELAY SWITCHES — cut the generator into the line as soon as the generator voltage rises high enough to carry the system's load.

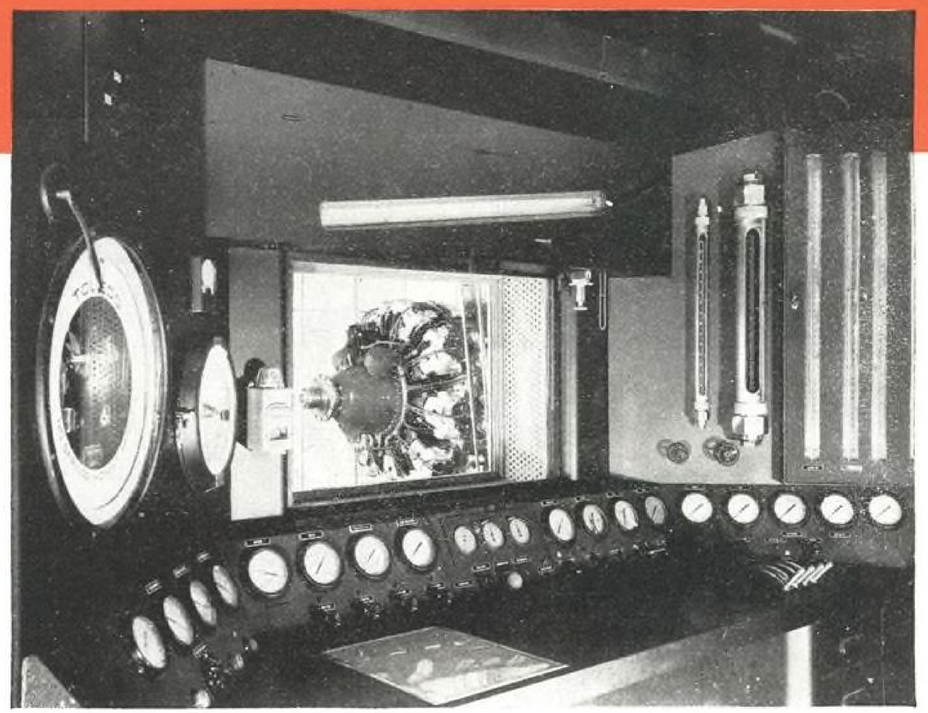
BLOWER MOTORS — maintain uniform temperatures in radio and electronic devices; defrosting and spot heating throughout the plane.

DYNAMOTORS — virtually direct-current transformers—provide higher voltage for operating radio and other electronic devices.

SPECIAL DIRECT-CURRENT MOTORS — perform many vital jobs—operating blowers, bomb bay doors, cowl flap actuators, fuel pumps. These motors are available in a complete line. They are built in standard sizes and ratings.

DIRECT-CURRENT GENERATORS — main engine driven to provide the large amount of power required by modern electrical equipment on multi-engined planes.

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IN this modernly equipped test room Meriam Manometers contribute to the efficient testing of aircraft engines by the speedy, accurate measurement of pressures, vacuums and differential pressures.

The Meriam inclinometer, directly above the cell window, measures air flow to the engine.

The inclinometer and all of the manometers are provided with fluorescent lighting for utmost comfort and visibility in reading. Speed, accuracy, convenience distinguish the equipment—all typically Meriam features.

If you have a measurement or test problem, let's discuss it.

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MERIAM—THE INSTRUMENT PEOPLE



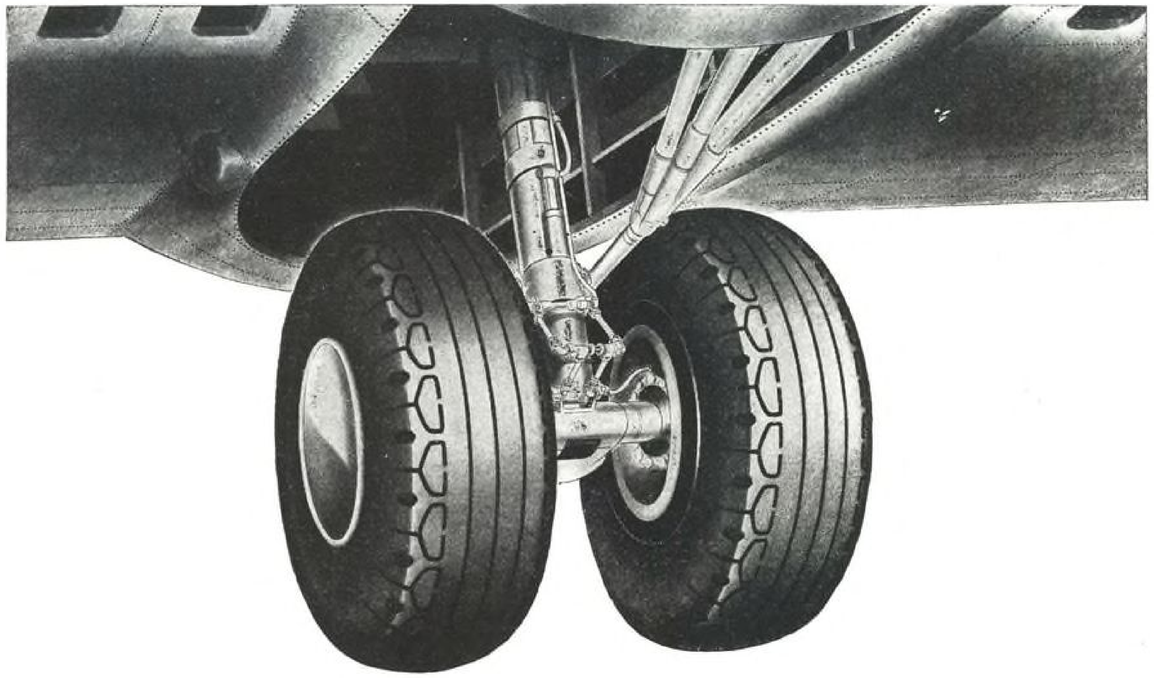
Specializing in . . . Aircraft Parts Production

At their new plant in New Britain, Connecticut, Fenn Aircraft Division is specializing in production manufacture of aircraft and aircraft engine subassemblies and parts.

Sub-contracting of subassemblies and parts is now a well established principle of airplane manufacture. Since the start of the war, well aware of this trend, The Fenn Manufacturing Company has organized to perform a specialized, highly coordinated service to the aircraft industry.

Skilled in working with all kinds of ferrous and non-ferrous alloys, adequately equipped and tooled for production manufacturing to precise tolerances, and headed by a capable management and engineering staff, Fenn Aircraft assures for the Aviation industry, now and after the war, a dependable source for subcontract work.

Fenn Aircraft NEW BRITAIN CONNECTICUT
DIVISION OF FENN MANUFACTURING COMPANY
MANUFACTURERS OF AIRCRAFT SUBASSEMBLIES AND PARTS



SWIVEL-JOINTS

THAT GIVE AND TAKE!

For over 30 years . . . in nearly every American Industry . . . Barco Flexible Joints have been specified for oil, steam, air, gasoline, hydraulic—and other fluids, gases, and liquids . . . wherever a flexible conveyor is required. When expansion or contraction is a factor, where intermittent vibration and folding must be considered, experience has proved Barco the most satisfactory fluid conveyor possible.



Barco Flexible Joints are "winterized" at —70° and are the only flexible joints . . . recognized as such . . . in the aviation field. Specified and built into landing carriages . . . they provide flexibility as well as swivel action to eliminate tubing strains caused by misalignment and landing shocks. Original costs are low; maintenance costs are practically "nil". For additional information and for help on flexible joint problems, write to our Engineering Sales Department.

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"How about using plastics?" Sooner or later, it comes up in 'most every production conference. . . . As founder of the plastics industry and as producer of the complete range of Lumarith and other plastics, we can help you very directly. We invite you to consult us on present and future problems in plastics. Celanese Celluloid Corporation, THE FIRST NAME IN PLASTICS, 180 Madison Avenue, New York City 16, a division of Celanese Corporation of America.

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Special green and red Lumarith for blind flying equipment. To the student-pilot, wearing Polaroid goggles with red Lumarith lenses, the green windshield looks black while the flying instructor sees clearly.

Starlight (*transparent blue*) Lumarith protects coastwise shipping from glare yet window shoppers can see merchandise.

Red transparent Lumarith over light bulbs of instrument dials aids night pilots on the sea and in the air. No impairment of their night vision.





You can design to more readily available standard sizes and shapes and provide quick maintenance without sacrifice of bearing performance when you specify Bunting Bronze Standardized Bearings, completely machined and finished, ready for application in machine tools, electric motors, industrial machinery and equipment of all kinds. Available in many different sizes, Bunting Bronze Bars are machined I.D., O.D. and Ends. Solid Bars are centered. Ask your wholesaler. Write for catalog giving complete specification data. The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in Principal Cities.

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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, and 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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EXTERNAL TYPE
NATIONAL AIRCRAFT
STANDARD
51



U. S. Patent
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WALDES

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RETAINING RING

SCORE ONE FOR THE SUB-BUSTER

Navy Pilot Proves Sub-Sinking Abilities of Vega's New PV-1

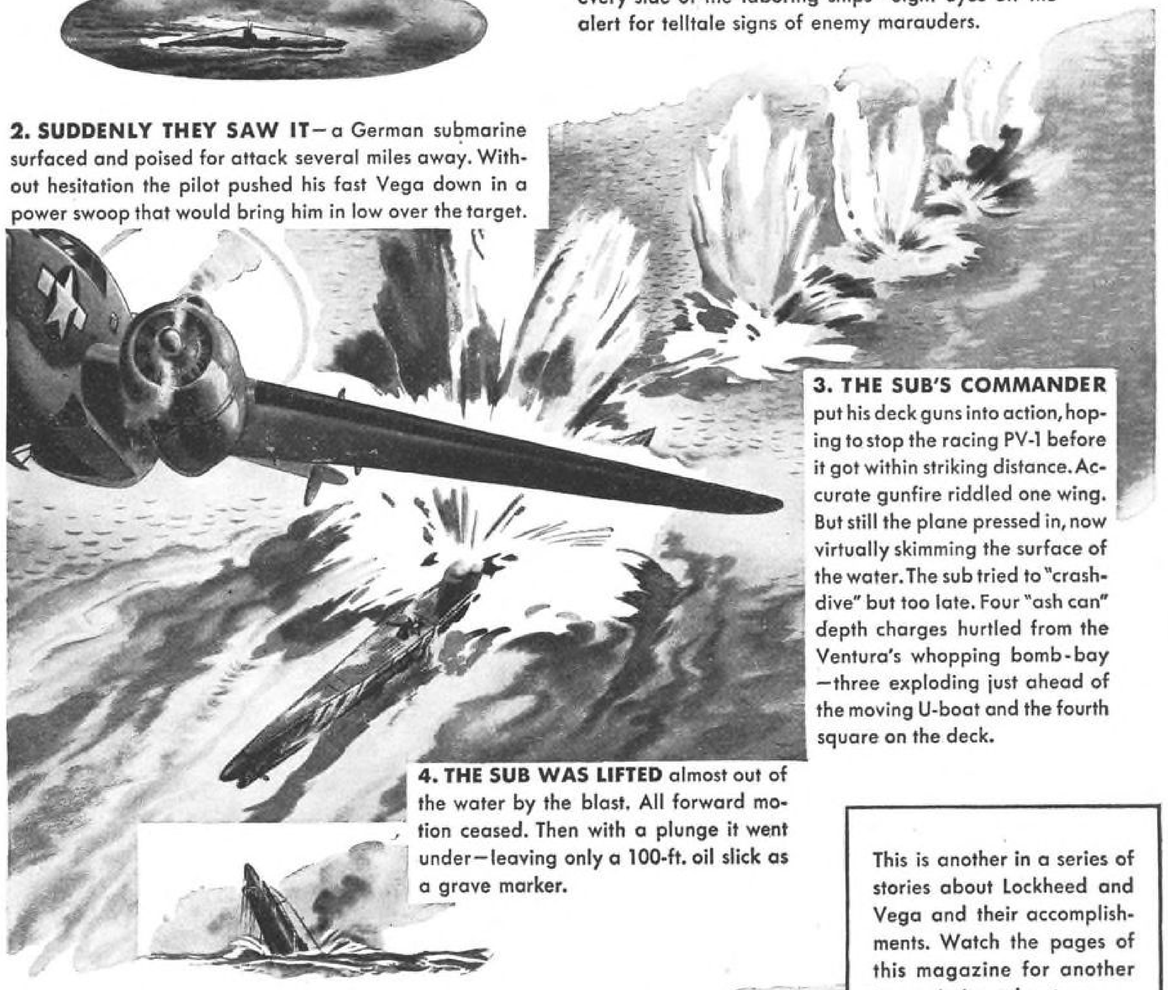


The PV-1 is the first land-based bomber built for the U. S. Navy. It's a nautical version of the Vega Ventura—a deep-bellied sea rover with extra range for long patrols, reserve speed to pounce on a sub before it can crash-dive, and wallop enough to blast it out of commission. Here's the story of the Navy Ventura's first kill.



1. IT STARTED out as a "routine patrol!" The Navy crew and their plane were to guard a slow-moving Allied convoy against enemy torpedoes. On regular pattern flights they scanned the tossing water on every side of the laboring ships—eight eyes on the alert for telltale signs of enemy marauders.

2. SUDDENLY THEY SAW IT—a German submarine surfaced and poised for attack several miles away. Without hesitation the pilot pushed his fast Vega down in a power swoop that would bring him in low over the target.



3. THE SUB'S COMMANDER put his deck guns into action, hoping to stop the racing PV-1 before it got within striking distance. Accurate gunfire riddled one wing. But still the plane pressed in, now virtually skimming the surface of the water. The sub tried to "crash-dive" but too late. Four "ash can" depth charges hurtled from the Ventura's whopping bomb-bay—three exploding just ahead of the moving U-boat and the fourth square on the deck.

4. THE SUB WAS LIFTED almost out of the water by the blast. All forward motion ceased. Then with a plunge it went under—leaving only a 100-ft. oil slick as a grave marker.

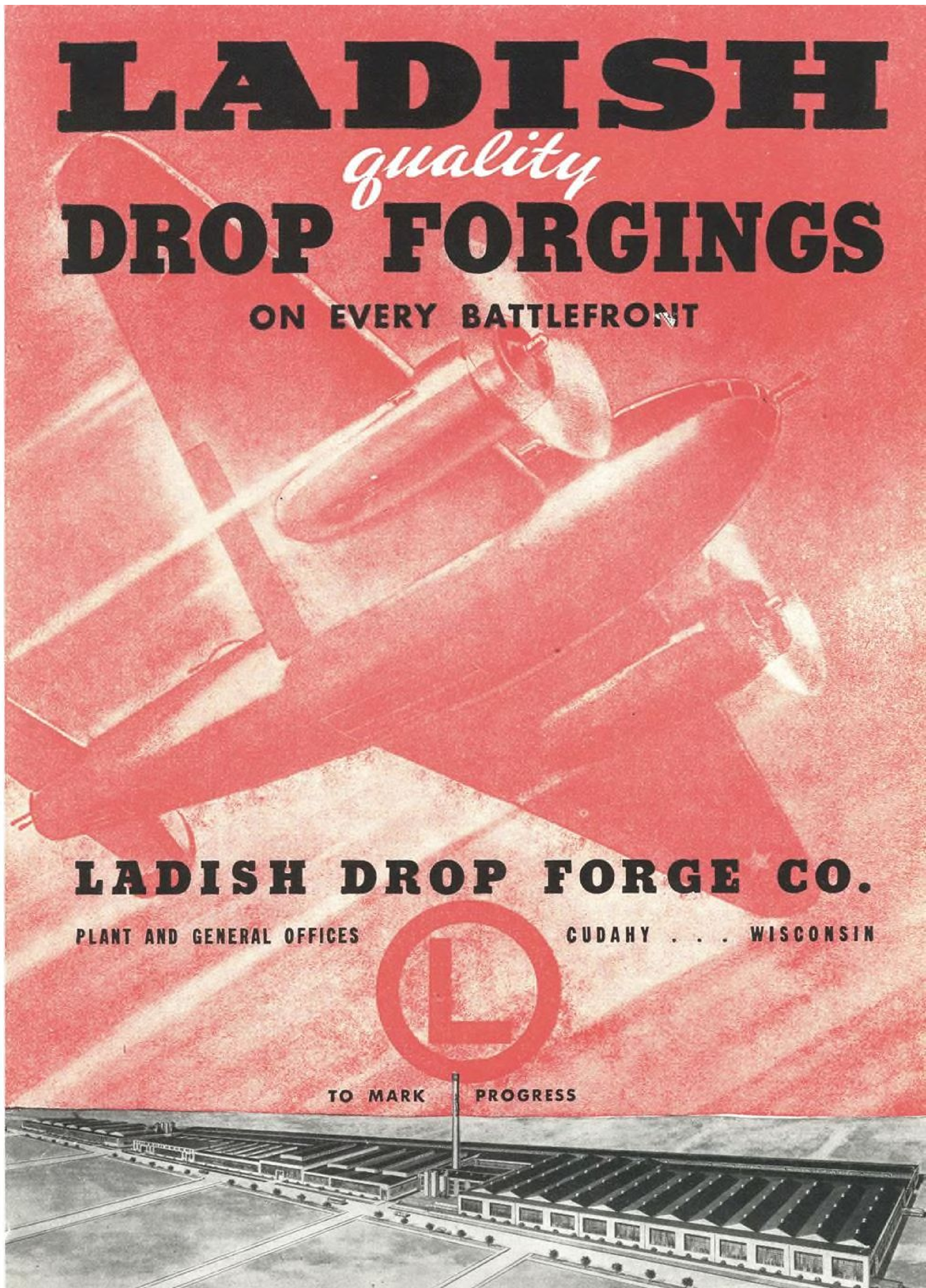
5. "GALLANT—cool—well-executed action," said the Navy of the Ventura's crew. In their hands a dependable airplane had proved itself. Now, with scores of other heroic Navy crews at the controls, rugged PV-1's are in constant service in the United Nations' battle to keep open the supply lanes of the world.



This is another in a series of stories about Lockheed and Vega and their accomplishments. Watch the pages of this magazine for another true aviation adventure.

Vega
AIRCRAFT CORPORATION
A subsidiary of Lockheed Aircraft Corporation, Burbank, California

LADISH
quality
DROP FORGINGS
ON EVERY BATTLEFRONT



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PLANT AND GENERAL OFFICES CUDAHY . . . WISCONSIN

TO MARK PROGRESS



How to walk away from a crack-up!

FIRE used to be a frequent—and disastrous—result of a crash landing of a combat plane. But now the Kidde Impact Actuator, set off by the jolt of the crash itself, can automatically turn on all fire-extinguishing apparatus, shut off the ignition. It can disconnect fuel lines and do other jobs controlled by a switch or valve. It's rugged enough to be unaffected by normal shocks and vibrations, yet so sensitive it flashes into action in the critical instant between safety and catastrophe.

The Impact Actuator is an invention of the Kidde engineers. It's one of the many contributions by Walter Kidde & Company to safer flying. If you have a job for the Impact Actuator drop us a line. Our Research and Development Department can help you work out details of the application.

Kidde

WALTER KIDDE & COMPANY, INC., 1216 MAIN STREET, BELLEVILLE, N. J.



Simmonds-Hobson Automatic Engine Controls For Greater Efficiency and Engine Protection

COMBAT calls for split-second action. In the heat of battle at constantly changing speeds and altitudes, the warplane pilot has little time for careful adjustment of his engine controls. Modern engines can "take it," but at a sacrifice of their service life.

A welcome engineering advance toward more freedom for the pilot, and safer, more efficient engine operation, is the Simmonds-Hobson Automatic Engine Control—a "third hand" for the pilot. Units now in production for the United Nations' fighting aircraft provide automatic control of manifold pressure and mixture, maintaining a selected setting through varied maneuvers and altitudes. More advanced designs now under way will extend automatic control to propeller governor, spark, and other functions.

"Simmonds Equipment Flies With Every Type of Allied Aircraft"

- ★Automatic Engine Controls
- ★Push-Pull Controls
- ★Hydraulic Accumulators
- ★Equipment and Components for Hydraulic Systems
- ★Chronometric Radiosondes
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SIMMONDS AEROCESSORIES INC.

10 ROCKEFELLER PLAZA, NEW YORK, N. Y. ● 6253 HOLLYWOOD BOULEVARD, HOLLYWOOD, CALIFORNIA

Silenced...the sparks in Sparks' Ears

Yes . . . sparks had to be banished from Sparks' ears, for today radio communication is by voice. Voice communication from crew member to crew member. From pilot to pilot. From squadron leader to squadron leader. From Air General to every one of 9,000 airmen aloft in a 1,000 plane formation.

• Spark signals from the high tension ignition systems of aircraft would completely blot out radio voices. The ignition cables must be completely shielded—electrically and mechanically. Titeflex flexible metallic tubing is doing that job.

• Titeflex Radio Shielded Ignition Harnesses in aircraft perform on the front of the engine directly in a wind stream of over 300 miles per hour. It *vibrates* in mid-air under the full military power of a 2000 hp engine running at 2700 rpm. Rain lashes it in torrents—at tornado force.

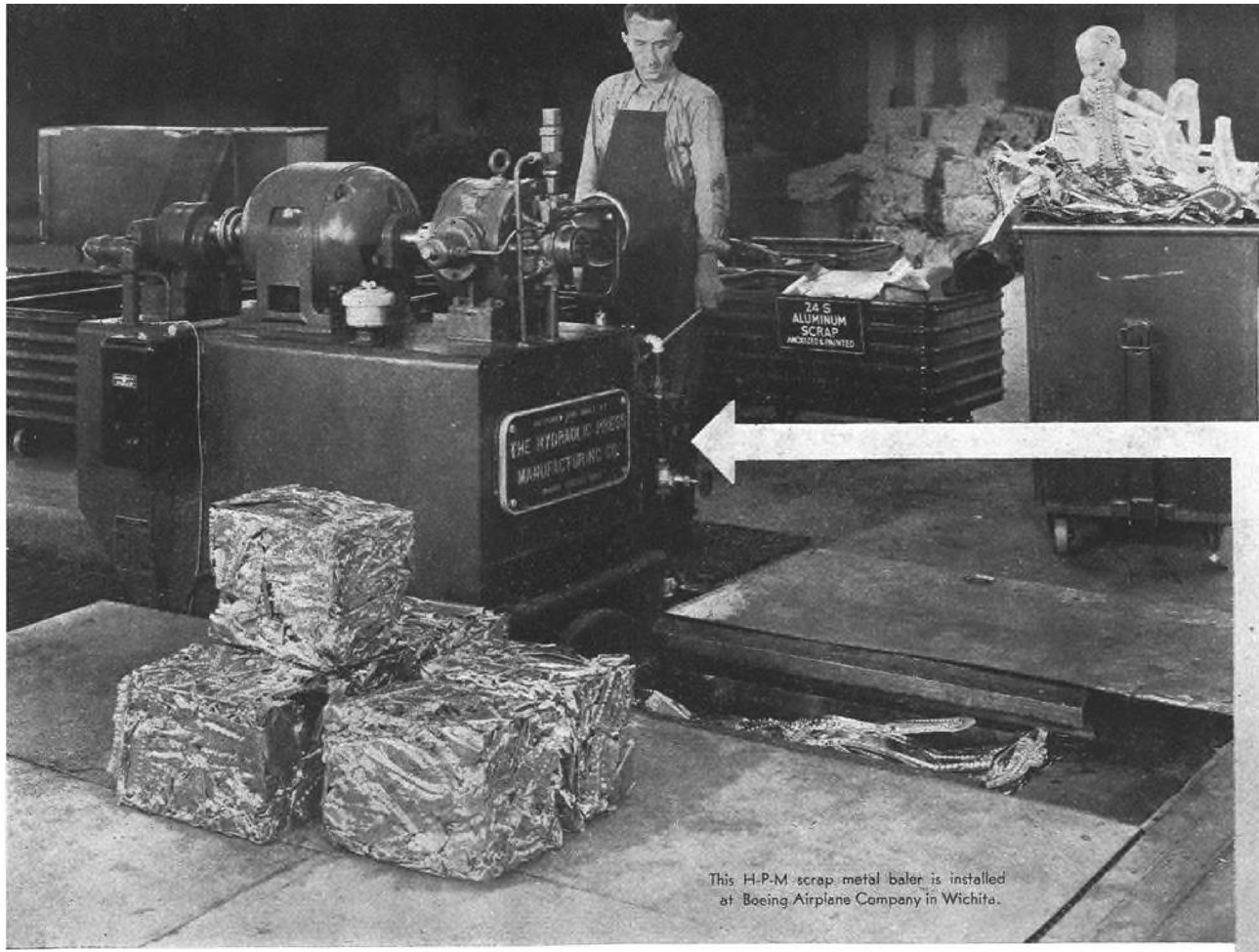
• Yet, Titeflex remains *tight* enough to shield a current of electricity at voltages up to *10,000*. And all this at substratosphere temperatures of 50° F. below, outside the tubing. And 300° F. above, at the spark plug end!

• Could any use-test be more convincing—whether the problem be the movement of oil, gasoline, acid, gas, water, steam, or electricity?

• Ask our application engineers to tell you more about Titeflex not only for wartime applications but also for postwar use.

TITEFLEX METAL HOSE COMPANY
510 Frelinghuysen Ave., Newark, N. J.





This H-P-M scrap metal baler is installed at Boeing Airplane Company in Wichita.

Bale your scrap metal with an H-P-M baler . . . . a compact unit, designed to efficiently handle your diversified scrap. An H-P-M baler will increase the value of your scrap, and at the same time permit easier and faster handling. Request a proposal today.

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The dependable long life H-P-M HYDRO-POWER Radial Pump powers every H-P-M Hydraulic Press

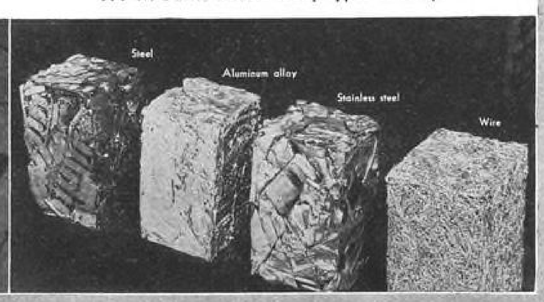


No Salvage Department Is Complete Without An HPM SCRAP METAL BALER

A pneumatic ejector removes the bale from the box.

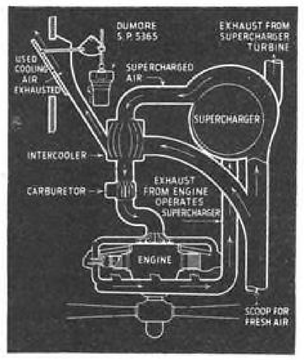


H-P-M Balers handle many types of scrap.





THE HEAT OFF!

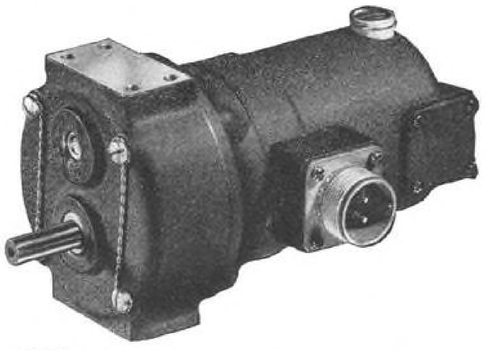


"ALL our planes returned to base!"—that this phrase appears more and more frequently in reports of bombing raids by the A. A. F., is due to perfection of the precision bombing technique, the skill and daring of our bombing crews, and to the improved protection from enemy interceptors provided by the high-flying P-47 Thunderbolts! Many elements combine to give these ships their climbing speed and high operating ceiling, most important being the super-charged engine. But this very feature introduces another problem, in that the high temperature of the air compressed by the turbo-supercharger tends to cause pre-ignition and knock, with serious loss of power. To offset this danger, the intercooler removes the excess heat from the engine intake air before it goes to the carburetor. The current of cooling air is controlled by opening or closing a door in the air-passage, located in the rear part of the fuselage.

"DOORMAN" FOR THE INTERCOOLER!

Operating the intercooler door, as required by varying conditions of speed, height and temperature, is the vital function of this Dumore Aeromotor, SP5365. To minimize overtravel and resultant jamming of the door, a magnetic brake was added to the original model, increasing its overall length only 5/8", though 3/4" was allowed by the plane builder. This motor is conditioned to operate efficiently under temperatures ranging from below zero to 165° F. and in the rarefied atmosphere of 40,000 feet altitude, necessitating special provisions for lubrication and special brushes.

In the aerial battlefields today, and on world skyways of the future, Dumore Aeromotors will power the many accessories that insure safety, operating ease and comfort. Dumore engineers welcome your inquiries and offer their aid and suggestions in your application of Dumore Aeromotors.



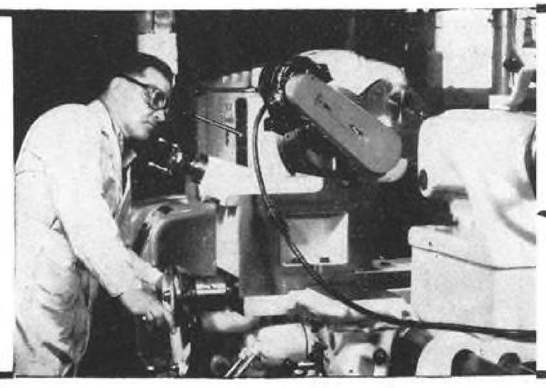
FOR EXTRA POWER HOURS — **Dumore** — *Headquarters for Fractional Horsepower Motors*

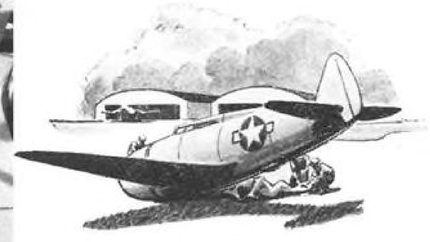
Dumore

PRECISION GRINDERS

FOR BETTER
MAINTENANCE AND REPAIR

Dumore Precision Grinder grinding crankshaft of P & W engine at U. A. L. central maintenance base, Cheyenne, Wyoming.





"IT TAKES TOOLS, TOO"

From flyers to G. H. Q., the combat forces are unstinting in their praise of the ground crews, the men who by long hours of labor, skill amounting to genius, and sometimes through sheer determination, keep the planes fit to fly and fight. But these men themselves are the first to admit that the utmost skill and determination are of slight avail in servicing modern planes and especially the engines, without precision tools. In many an Air Corps repair depot, Dumore grinders are delivering the same ten-thousandth-inch accuracy that is expected of them in the factory back home! Mounted on lathe, miller, shaper or any available machine base, these precision tools are capable of any grinding operation, external or internal to a depth of 24 inches, at speeds up to 42,500 r. p. m.! Consult your industrial distributor, or write for complete catalog to

THE DUMORE COMPANY, RACINE, WISCONSIN

A fifth freedom

Many think of the air simply as a thrilling new dimension for man to explore. Actually, it is far more. For here is a great new freedom for man—freedom to move at will, straight as an arrow, from any point on the Earth's surface to any other, unhindered by mountain, city or sea—freedom to range far and wide, as a bird, through the clear and illimitable reaches of the sky.

The all-out effort of all citizens must be concentrated on War until the Axis slave-masters are crushed, if we are to enjoy any freedom. Today Jacobs employees are devoting their utmost to this vital objective—producing engines by the thousands for the United Nations.

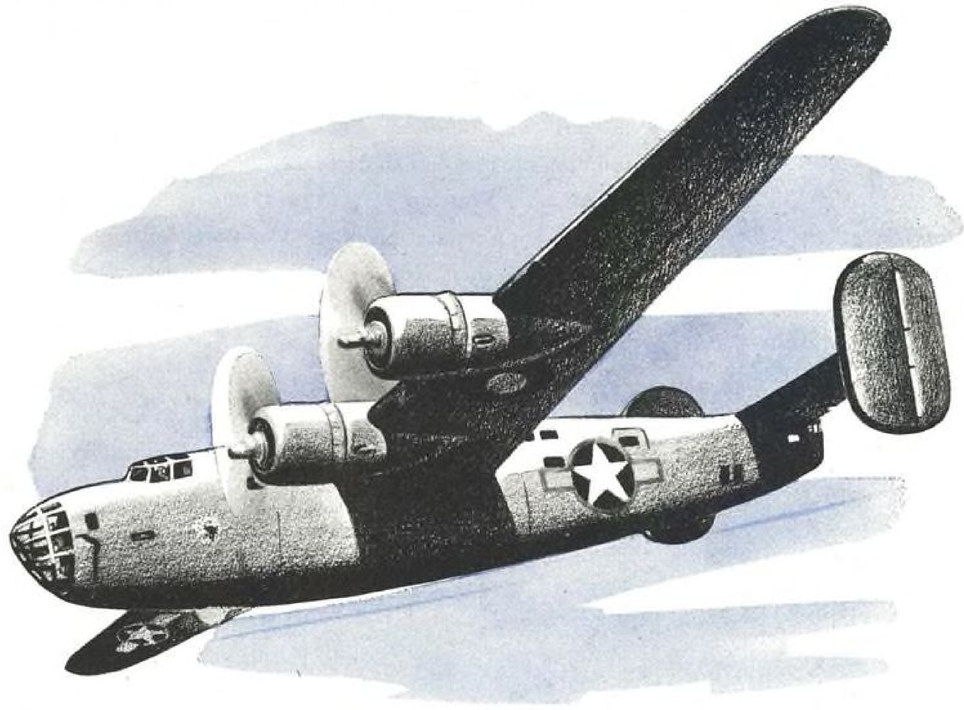
After this War is won, the technical developments created by Jacobs engineers and wrought by skilled Jacobs workmen into sturdy, long-lived engines will enable you to use this new freedom of flight with utmost confidence and enjoyment.

JACOBS AIRCRAFT Engines

POTTSTOWN • PENNSYLVANIA • U. S. A.



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WILCOX ELECTRIC COMPANY

Manufacturers of Radio Equipment

14th & Chestnut ☆ Kansas City, Mo.

Our Liberators are winging global routes, chartered and uncharted, in the fight to make all men free. Wherever military or civilian planes fly, Wilcox Radio equipment is helping maintain dependable communications.

Dependable Power for Blower Applications

. . . Oster Type C-2B Motor (1/100 H. P.) stands up in severe ambient temperatures

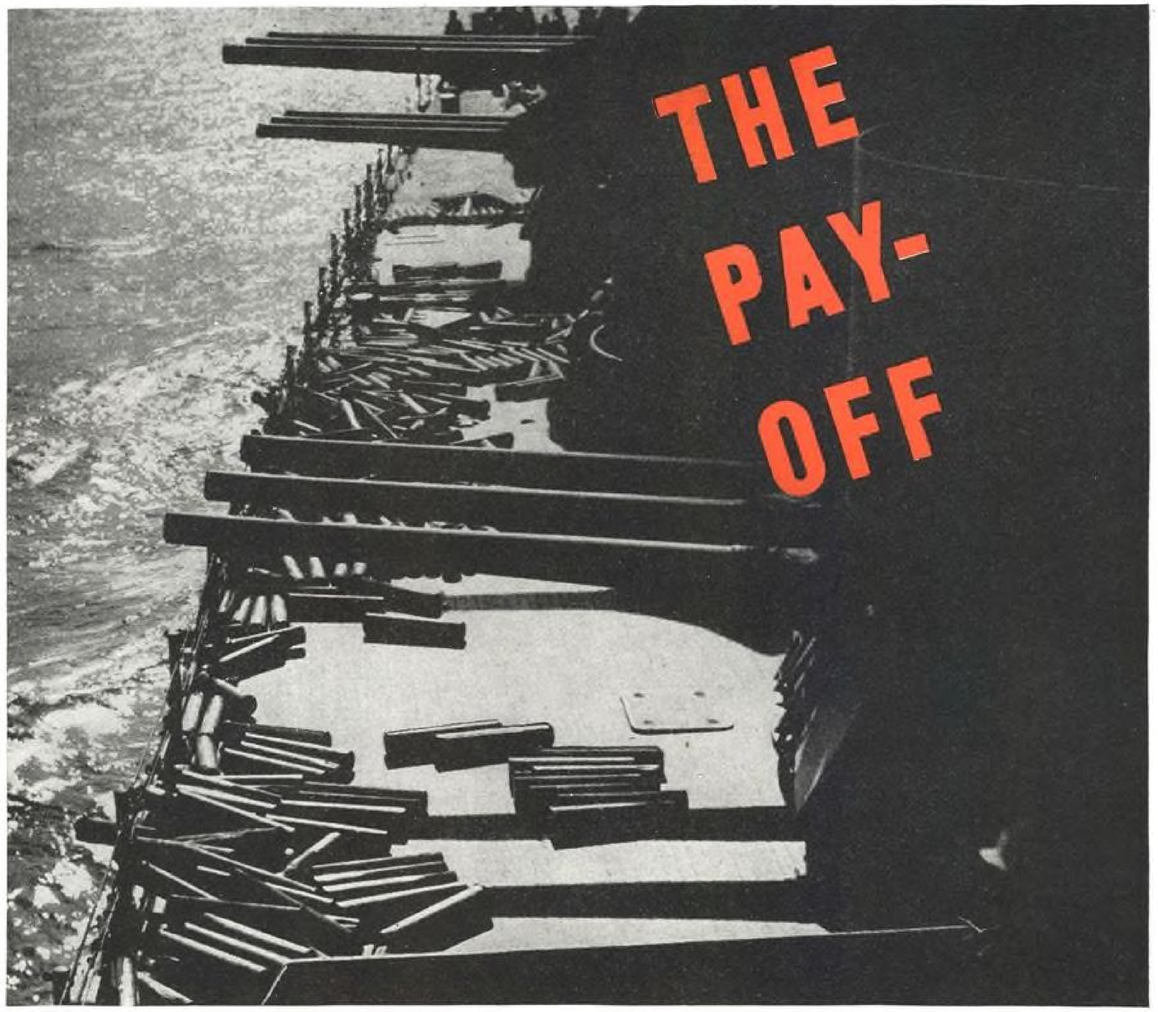
This specialized motor, developed for vitally important war-time applications, operates satisfactorily in a 90° ambient, for continuous duty. It is quality-built by the Oster organization, which for 15 years has been building fractional horsepower motors for use exclusively as original equipment on Oster motor-driven appliances. Ball-bearing equipped; built in an aluminum die-cast housing; 6, 12, 24, or 115 volts DC, 115 volts AC . . . 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 your own reputation for selecting sources wisely. Let us help you fit this or other Oster motors to your requirements.

M-13

John Oster Mfg. Co.

Department A-13 **Racine, Wisconsin**





THE RESULT of America's assembly line paying off on the firing line. At sea, on land, in the air, our Country's mighty fighting powers stem directly from her unmatched manufacturing ability.

In the high-speed machining of shells, guns, tanks, planes, ships, *Texaco Cutting Coolants* are playing a vitally important part.

Texaco Cutting Oils permit higher speeds and feeds, assure greater output. They lubricate the tools, and by carrying away heat, prevent chip welding, improve surface finish and lengthen tool life.

A Texaco Engineer specializing in cutting coolants is at your service through more than 2300 Texaco distributing points in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.*

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

★ *More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.*

★ *More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.*

★ *More revenue airline miles in the U. S are flown with Texaco than with any other brand.*

TEXACO **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



. . . To speed refueling at Airfields

Pit-to-plane means faster refueling . . . faster yet with Buckeye equipment. Helping to speed the flow of vital gasoline from these airfield "drinking fountains" to thirsty aircraft, Buckeye valves and fittings perform more efficiently because of specialized design, perfected by applied knowledge of actual working conditions.

Buckeye engineers have designed these valves and fittings to do specific jobs, from the swing gate valve at the inlet to the refueling nozzle at the plane tank opening. That's why, on numerous airfields, from our own home front to war-torn battle fronts, where split-seconds count, you'll find Buckeye time-tested refueling equipment on the job.

For utmost time-saving operation, it will pay you to take advantage of Buckeye's experience. For complete information, write Buckeye Iron and Brass Works, Dayton, Ohio.

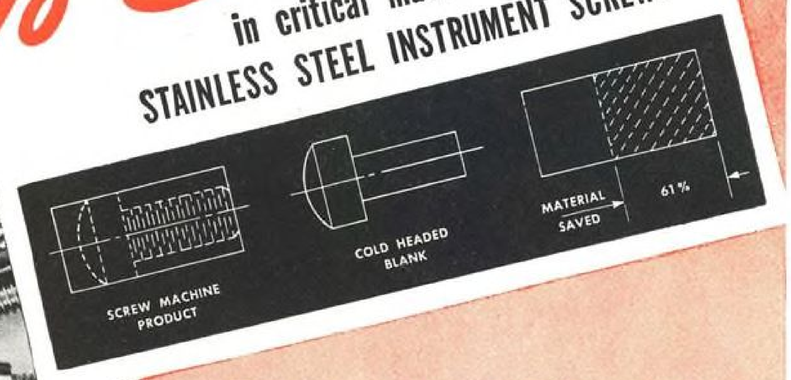
Buckeye

QUALITY VALVES AND FITTINGS
For Airfield Ground Service



61% SAVING

in critical material for STAINLESS STEEL INSTRUMENT SCREWS



Here is a typical example of the methods "National" has devised to save time, materials, man power and machines.

Formerly, instrument screws were made milled from bar, with cut threads. They are precision parts, full machine finished, with class 3 threads, a closer tolerance than that of commercial screws.

"National" developed a method of manufacture from wire of smaller diameter . . . upsetting the head, machining the blank on noncritical equipment and rolling the thread.

This effected a saving of 61 per cent in stainless steel containing highly critical chrome and nickel, and released a large number of automatic screw machines vitally needed for other purposes.

More than 55 instrument manufacturers have been highly satisfied with the quality of these screws and the savings effected.

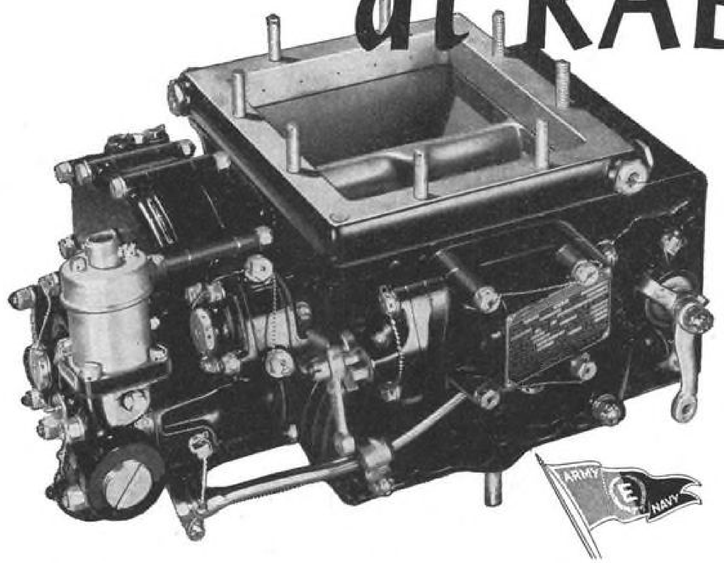
This booklet contains 15 brief stories of important savings on bolts, nuts and special parts. Send for a copy of "SAVINGS."



National
HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND, O.

There and Back... at RABAUL



Holley Aviation Carburetors were there...on Mitchell B-25's...combining mechanical dependability with high human courage, skill and daring

HOLLEY

AVIATION CARBURETORS

HOLLEY CARBURETOR COMPANY • DETROIT, MICHIGAN



Upstairs Entrance to Hitler's Fortress

Hitler built himself a European Fortress.

Without airpower, it might have been invulnerable for many, many years. But thanks to airpower, thanks in good measure to the American aircraft industry and the U. S. Army Air Forces, we were invading Hitler's Fortress from the sky a year and more ago.

Allied bombers and fighters roar through the vulnerable upstairs entrance from bases in Britain, Africa, Sicily, Russia...

A single fighter plane of the Red Air Forces has thirty-one little stars painted on its fuselage. Each star represents a German plane shot down. Each Nazi plane destroyed makes it that much easier for our airpower to pour through the upstairs entrance. Thirty-one kills may or may not be a record for a single fighter plane. It's a record we're proud of—because that plane was a cannon bearing Bell Airacobra.

There'll be an "upstairs entrance" to a better world of peaceful travel and commerce. It will take greatly advanced planes, designed for specific jobs. We're used to breaking with precedent in the design and construction of aircraft. We'll welcome new, peacetime assignments. © Bell Aircraft Corporation, Buffalo and Niagara Falls, New York.

BELL *Aircraft*

AIRACOBRAS for victory—future planes for peace

BUY WAR BONDS AND SPEED VICTORY



VAN SCOZZA

TO A NEW WORLD OF FLIGHT

The advent of huge numbers of giant troop and cargo ships of the air—with their capacity for swift movement of men, arms and supplies—is altering the entire strategy of war.

Today they serve to hasten the war's end—but in the world of tomorrow they will blaze new airways of global commerce.

In the forefront of this significant development is Curtiss-Wright, builders of the world's largest twin-engined transport, the Curtiss Commando.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION
BUFFALO • COLUMBUS • ST. LOUIS • LOUISVILLE

Member: Aircraft War Production Council, East Coast, Inc.

CURTISS *Commandos* FOR CARGO AND COMMERCE



"Let's see... how do these metals compare?"

Selecting the metal with the right combination of properties for a particular job is easier with the new Inco Bulletin ..."Properties of Some Metals and Alloys"

No. This booklet won't solve any complex technical problems. It isn't intended for that.

But it *does* provide a handy, quick comparison of 108 metals and alloys, compiled in easy-to-read chart form from recent information supplied by the metal producers.

Approximate composition, tensile strength, yield strength, elongation, Brinell hardness, density, specific gravity, melting point, specific heat, thermal expansion coefficient, thermal conductivity, electrical resistivity, and tensile and torsional moduli of elasticity are all listed.

You'll find it a convenience and a time-saver. Use the coupon below, or a postcard, for a complimentary copy or copies.

★ ★ **INCO NICKEL ALLOYS** ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
Sheet...Strip...Rod...Tubing...Wire...Castings

Data on
108 Metals and Alloys

Monel (wrought and cast)
"R" Monel, "K" Monel
"H" Monel, "S" Monel
Nickel (pure, wrought and cast)
"D" Nickel, "Z" Nickel
Inconel (wrought and cast)
Hastelloy A, B, C, D
Illium G, R
Alcoa 2S, 3S, 17S, 52S, 53S
Alclad 24S
Alcoa 13, 43, 195, 214, 220
Copper
Red Brass (wrought and cast)
Yellow Brass (high brass)
Naval Brass (Tobin bronze)
Admiralty Brass
Muntz Metal
Manganese Bronze
Silicon Bronze
Phosphor Bronze 5%
Aluminum Bronze
Beryllium Copper
Nickel Bronze (cast)
Nickel Silver 20% (cast)
Nickel Silver 18% (wrought), 13% (cast), 10% (wrought)
Ambrac 20%
Cupro-Nickel 70-30, 55-45
Tin
Chemical Lead
Antimonial Lead
Tellurium Lead
Soft Solder 50-50, 60-40
Zinc
Zilloy 15, 40
Dow Metal E, H, R, X
Silver (pure)
R-T Silver Brazing Alloy
Easy-Flo Silver Brazing Alloy
Gold (pure)
Platinum (pure and commercial)
Iridium-Platinum 10%
Rhodium-Platinum 10%
Palladium (commercial and hard)
Tantalum
Iron (wrought, ingot and cast)
Ni-Tensyliron
Ni-Resist (standard and copper-free)
Ni-Hard, low carbon, high carbon
Carbon Steel (SAE 1020)
Cast Carbon Steel
Cast Alloy Steel
Stainless Steel 304, 309, 310, 316, 321, 347, 325, 410, 420, 430, 446, 312, 330
Cast 18 Cr 8 Ni Steel
Cast 18 Cr 8 Ni 3 Mo. Steel
Invar
Cast 28 Cr 10 Ni Alloy
Cast 35 Ni 15 Cr Alloy
60 Ni 15 Cr Alloy (wrought and cast)
80 Ni 20 Cr Alloy
Iron Silicon Alloy
Durichlor
Durimet



MAIL THIS COUPON TODAY

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Please send me_____copies of "Properties of Some Metals and Alloys."

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*Company*_____

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*Address*_____

*City*_____ *P. O. Zone*_____ *State*_____



Delco-Remy Aircraft Electrical Equipment

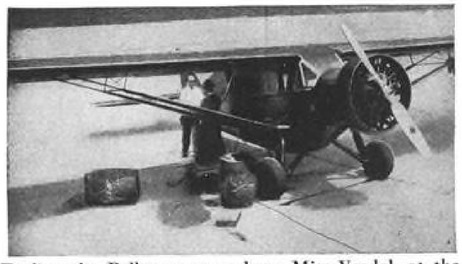
They'll bring back more than battle honors, these men who are spanning the boundaries of nations between breakfast and lunch. With their return will come a new conception of the world's size, a new release from the limitations of space, and a new appreciation of aviation's place in postwar living. In bombers, fighters and transport planes, Delco-Remy electrical equipment is serving these men who serve America. When the war is won, Delco-Remy equipment will be a feature of convenience and dependability in private and commercial planes. More than half of Delco-Remy's facilities are now engaged in supplying aircraft electrical units, precision parts and products for the aircraft industry.

ARMY E NAVY

DELCO-REMY

WAR BONDS WILL BRING THEM HOME SOONER

DIVISION, GENERAL MOTORS CORPORATION



Fueling the Bellanca monoplane, Miss Veedol, at the start of the round-the-world flight of Clyde Pangborn and Hugh Herndon, Jr. They took off from Tokyo October 4, 1931, en route to the U. S. A. non-stop.



Perfect end of a perfect flight! Having dropped their landing gear at sea to gain speed, Pangborn and Herndon are pictured about to land at Wenatchee, Wash. They flew 4,558 miles non-stop in 41 hours.

NO JAP EVER "HOPPED" THE PACIFIC

Tojo thought that treachery would take the place of skill, but he was wrong. There's no substitute for aeronautical pioneering ability! The Japanese never have caught up with the performance record of the 1931 American plane which took off from Japan and flew non-stop to the United States twelve long years ago.

In fact, no other airplane has ever duplicated that Pacific flight in the long-distance Bellanca cabin monoplane, Miss Veedol. But today thousands of American flyers are sweeping the Pacific north and south, east and west. They are flying many types of rugged American-built aircraft. They are matching the inspiring intrepidity of the men who flew that glorious assault on the enemy's homeland in the Army Air Forces B-25s shown in this photo of the U. S. S. Hornet.



Official U. S. Navy Photo



The AT-21-BL gunnery crew trainer, in production at Bellanca Aircraft Corporation for the United States Army Air Forces.

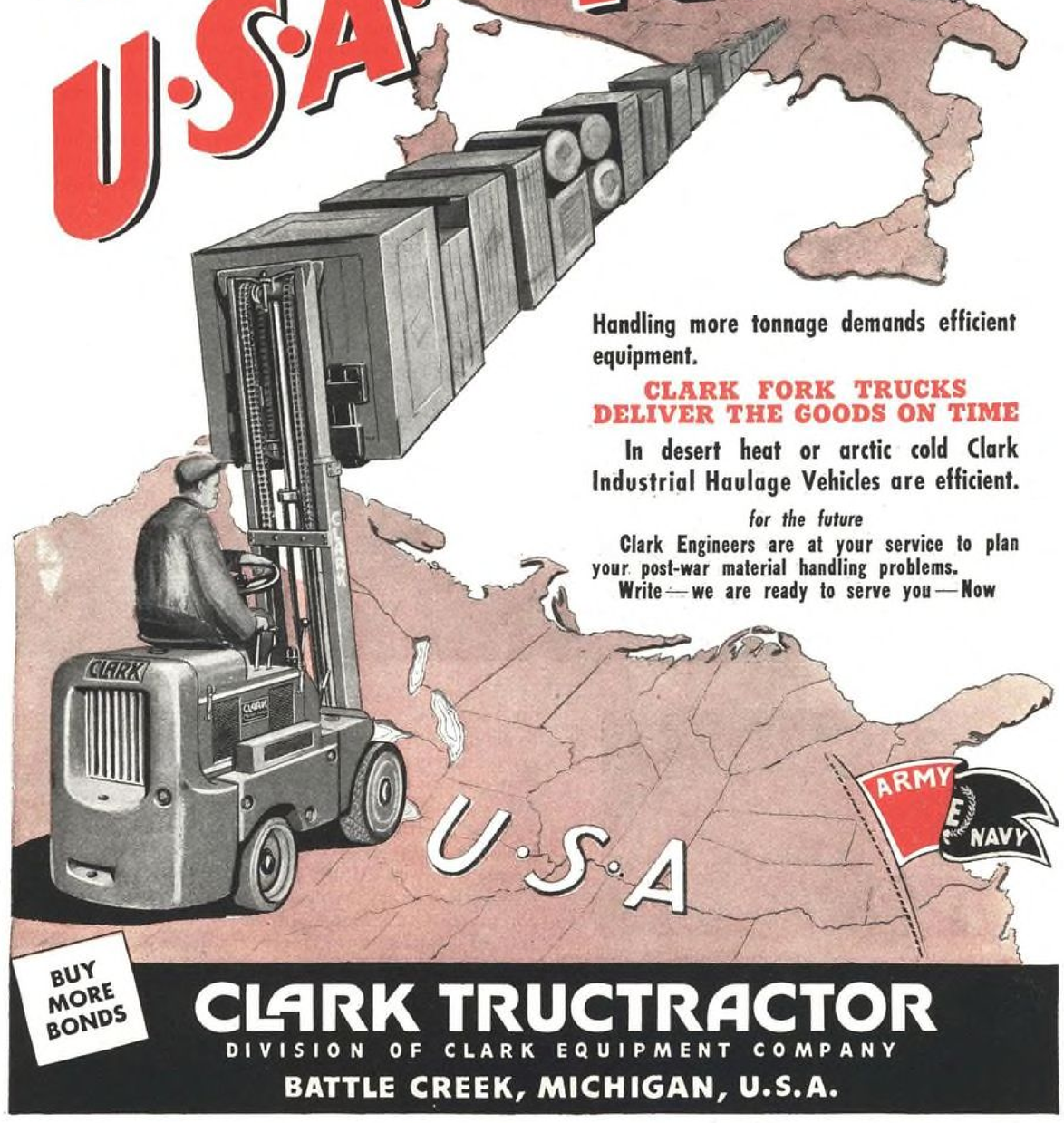
First to link Japan and America by air non-stop, Bellanca today contributes to the crushing of Japanese military power. Many of the United States warplanes, roaring to Victory, carry armament equipment and aircraft components precision-built at the Bellanca plant, where the AT-21-BL gunnery crew trainer is in production.

KEEP ON BUYING U. S. WAR BONDS

BELLANCA AIRCRAFT CORPORATION

NEW CASTLE, DELAWARE

CLARK FORK TRUCKS MOVE SUPPLIES from the U·S·A. to ITALY



Handling more tonnage demands efficient equipment.

CLARK FORK TRUCKS DELIVER THE GOODS ON TIME

In desert heat or arctic cold Clark Industrial Haulage Vehicles are efficient.

for the future

Clark Engineers are at your service to plan your post-war material handling problems. Write—we are ready to serve you—Now

BUY MORE BONDS

CLARK TRUCTRACTOR

DIVISION OF CLARK EQUIPMENT COMPANY

BATTLE CREEK, MICHIGAN, U.S.A.



NOT too little NOR too late!

The ever-increasing number of Allied bombers that are winging their way over enemy territory are hastening the day of final Victory.

General Riveters are playing an important role in getting those bombers off the production line and over their targets in record-smashing time and numbers. For new developments in *General* Riveting Equipment bring to the riveting of bomber wing skins, spars, fins, rudders and other heavy sub-assemblies the same high speed and saving in manpower which the riveting of lighter sections has enjoyed for some time.

Give some thought to the possibilities of multiple riveting NOW and in your post-war planning. Write or wire for catalog of *General* Riveting Equipment.

GENERAL ENGINEERING CO.

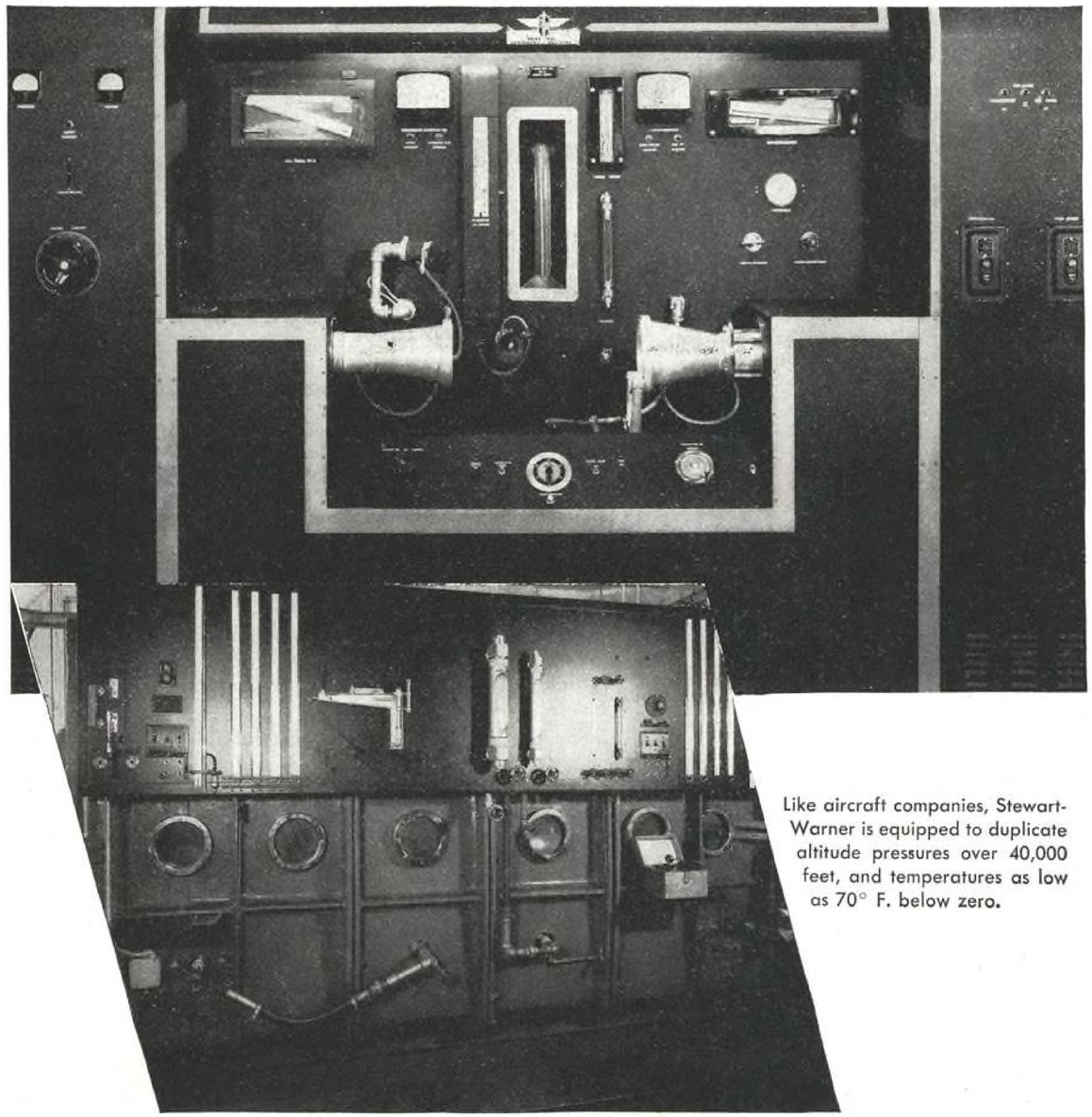
785 HERTEL AVE., BUFFALO 7, NEW YORK

"Performance Testing" OF EVERY SOUTH WIND HEATER

Is Your Assurance of "HEAT TO COUNT ON"



Every South Wind is individually performance-tested before shipment. On test board below, performance of the 50,000 Btu/hr. model 906A can be quickly and thoroughly tested.



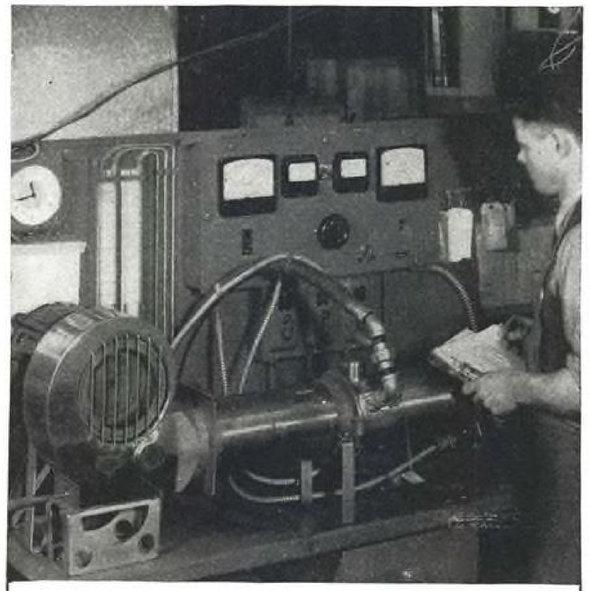
Like aircraft companies, Stewart-Warner is equipped to duplicate altitude pressures over 40,000 feet, and temperatures as low as 70° F. below zero.

STEWART-WARNER has a unique advantage in the field of aircraft heating . . . a head start of years in ferreting out previously unknown requirements for heater operation under actual service conditions.

And fortunately, we were equipped to profit from these lessons. Thus the thousands of South Wind Heaters now streaming to every fighting front are not "bright ideas," but practical, proven developments in the aircraft heating field.

No company outside the aircraft industry itself has developed such complete equipment for proving heater performance under practical operating conditions, from the first stages of development to shipment of the finished product.

The production testing panel shown at the left is a typical example, used to certify every Model 906A South Wind coming off the production line. Here, in a few moments, vital performance factors can be measured—heat output, efficiency, ventilating and combustion air pressure drop, ease of starting, and operation of accessory controls.



From the completion of the first hand-made sample of a new model, practical service conditions are used as a guide to checking performance.

Thus "heat you can count on" is not an accident with South Winds. Before it leaves the factory, the performance of every heater has been checked and proved.

ARMY E NAVY

South Wind Heaters

REG. U. S. PAT. OFF.

HEATER DIVISION, STEWART-WARNER CORPORATION, CHICAGO, ILLINOIS

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

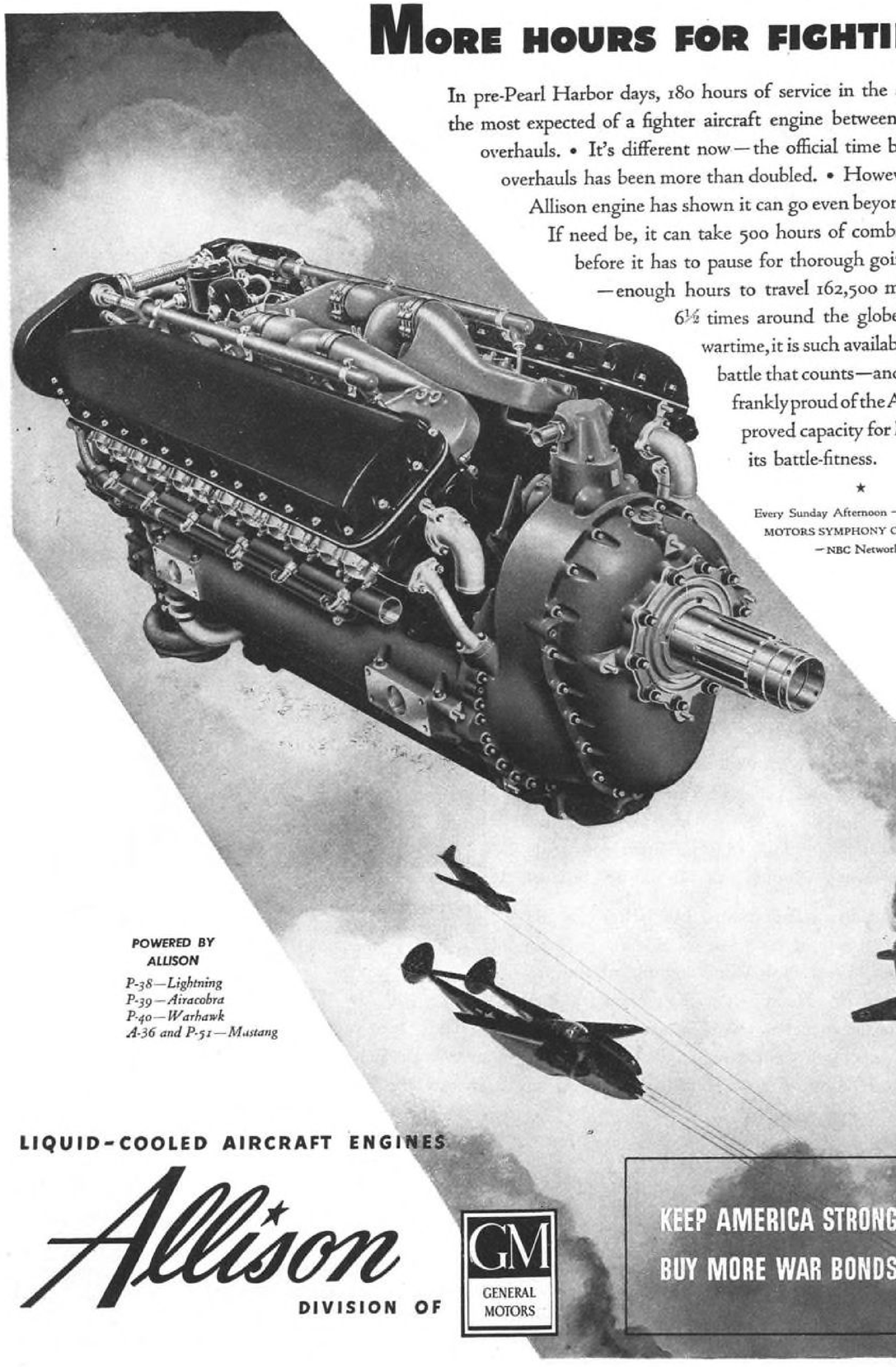
Another Product of STEWART WARNER

MORE HOURS FOR FIGHTING

In pre-Pearl Harbor days, 180 hours of service in the air was the most expected of a fighter aircraft engine between major overhauls. • It's different now—the official time between overhauls has been more than doubled. • However, the Allison engine has shown it can go even beyond that. If need be, it can take 500 hours of combat duty before it has to pause for thorough going-over—enough hours to travel 162,500 miles, or 6½ times around the globe! • In wartime, it is such availability for battle that counts—and we are frankly proud of the Allison's proved capacity for keeping its battle-fitness.

★

Every Sunday Afternoon — GENERAL MOTORS SYMPHONY OF THE AIR — NBC Network



POWERED BY ALLISON

P-38—Lightning
P-39—Airacobra
P-40—Warhawk
A-36 and P-51—Mustang

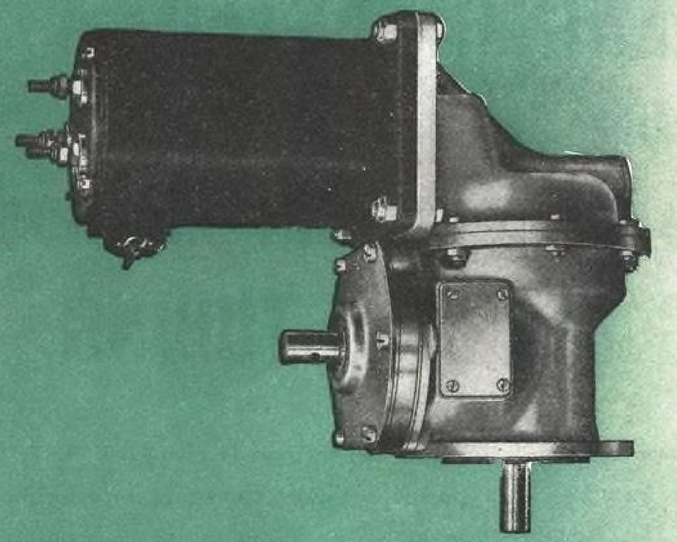
LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF GM GENERAL MOTORS

KEEP AMERICA STRONG
BUY MORE WAR BONDS

PACIFIC ACTUATORS



YOURS FOR LESS BELLY LANDINGS

Tucked up within the inside engine nacelles of Vega-built Flying Fortresses are two small but mighty Pacific Actuators. These little torque shaft type gear motors with multiple gear reduction extend and retract the heavy landing gear. Each actuator weighs but twenty-three pounds, yet develops 1050 inch pounds torque and will raise or lower the landing gear in the short space of twenty seconds. Secondary control through the gear box is provided for hand-crank in the event of damage to the electrical system.

Pacific Actuators are taking over the heavy mechanical operations of modern flight. They open and close doors, operate wing flaps, hoist bombs and cargo and perform dozens of other jobs on American planes now building and about to be built. Let our engineering staff work with you on any power problem you have in aircraft control.



Model E-1198 Pacific Actuator FOR LANDING GEAR OPERATION

ELECTRIC MOTORS BY GENERAL ELECTRIC

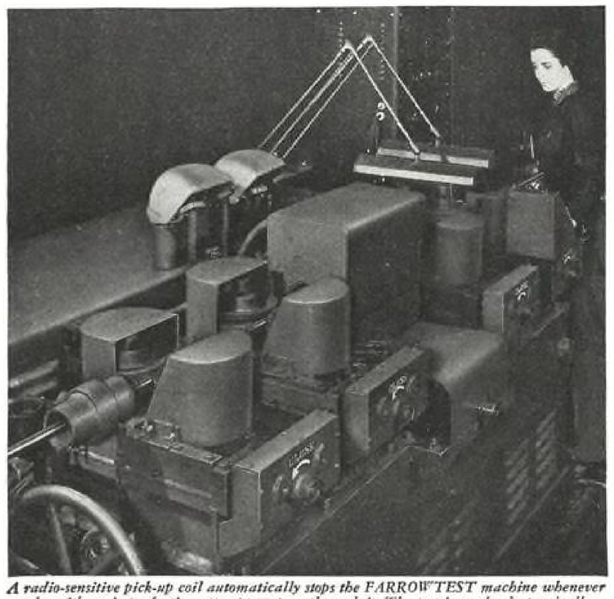
PACIFIC GEAR WORKS DIVISION

WESTERN GEAR WORKS

COMMERCIAL OFFICES AT: 11181 LONG BEACH BLVD., LYNWOOD, CALIF.

PLANTS: SEATTLE, LYNWOOD, VERNON, SAN FRANCISCO

EVERY LENGTH TESTED
by the
Most Accurate Commercial Method For TESTING FERROUS TUBING

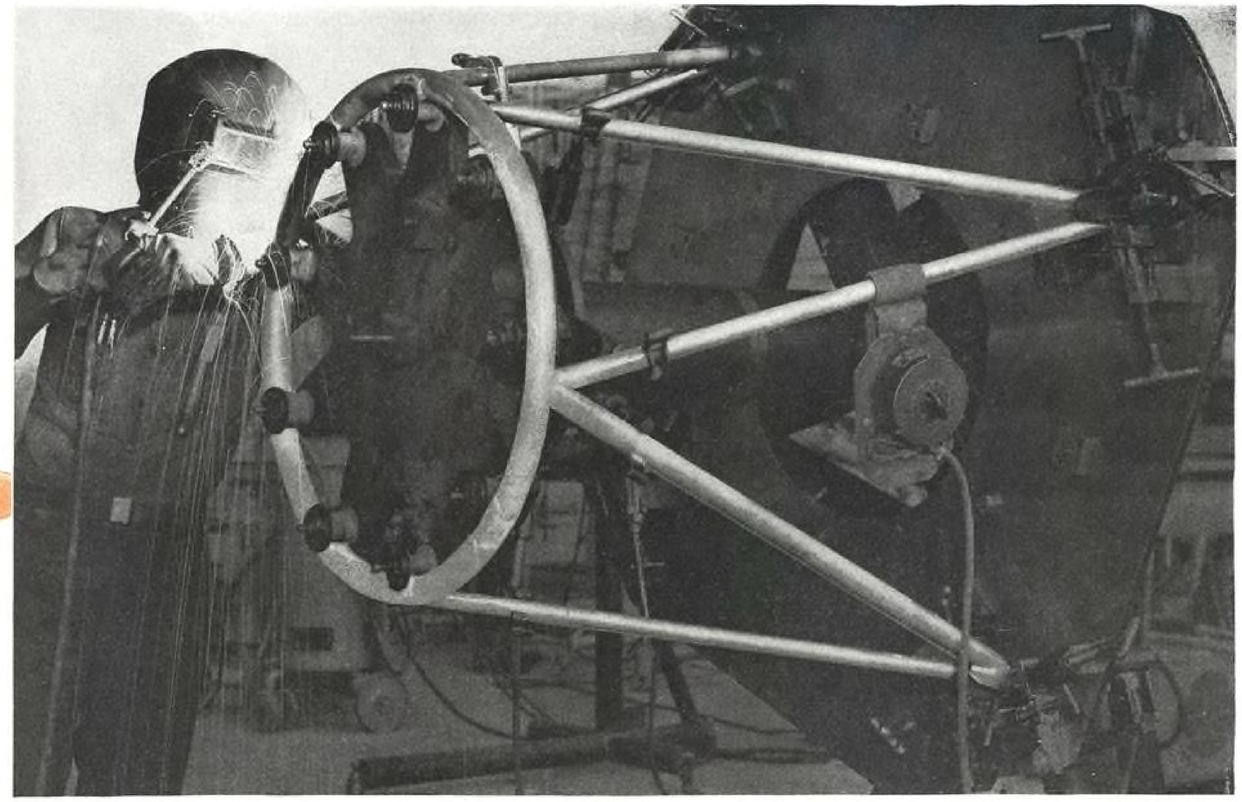


A radio-sensitive pick-up coil automatically stops the FARROWTEST machine whenever a tube with an imperfection attempts to pass through it. The test is made electronically—without necessity for relying upon the judgment of the operator.

—and that method is FARROWTEST. It positively locates damaging imperfections in tubing by the means of electronics—even small flaws which would slip by under visual inspection or when tested by ordinary methods.

Because of its high sensitivity and accuracy, FARROWTEST now is recognized as the most thorough commercial test of its type. As such, it provides assurance that tubing passed by it is the most perfect tubing commercially available.

Every length of Republic ELECTRUNITE Aircraft Tubing is subjected to FARROWTEST before shipment—to protect plane manufacturers against faults during fabrication—to protect pilots and crews against failure during flight.



Because of its consistent uniformity, each length of ELECTRUNITE Tubing may be fabricated with the same facility as every other length.

ELECTRUNITE Tubing also offers aircraft manufacturers the advantages in fabrication and in performance provided by its consistent uniformity of wall thickness, diameter, concentricity, strength, weight, ductility, hardness, weldability and fine surface.

It meets specification standards of the U. S. Army Air Corps; Bureau of Aeronautics, U. S. Navy; and the Civil Aeronautics Administration. It is made in standard sizes from both carbon and alloy steels. Write for complete data.

REPUBLIC STEEL CORPORATION
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Republic
ELECTRUNITE
REG. U.S. PAT. OFF.

REPUBLIC STEEL CORPORATION, STEEL AND TUBES DIVISION, IS THE ONLY PRODUCER OF ELECTRUNITE TUBING

REPUBLIC STEEL — PRODUCTION FOR VICTORY

AIRCRAFT TUBING



OUTREACHING
means
OUTPUNCHING

• The longest streak of lightning in the world is flashing through the skies! Super-range Lightning P-38 fighter planes team up with heavy bombers to deal knockout blows at distant targets.

On the production front smoothly-operating teams of Rohr production fighters work 'round the clock to help Lockheed put more and more of these outreaching P-38's on the wing. They use their skills to add new punch behind the challenge of increased production. They work to save the lives which will be spared by quicker victory.

ROHR
AIRCRAFT
CORPORATION

HELPING TO WRITE THE STORY OF TOMORROW

CHULA VISTA, CALIFORNIA



Winning his second
DISTINGUISHED SERVICE MEDAL



The man who has given part of his own body to his country, returns. Returns not to relax in glory and pension, but to do a job on the production front that may spare the life of his buddy still overseas.

He may have earned his first Distinguished Service Medal by routing a band of Japs at Gaudalcanal, wiping out a machine gun nest in North Africa or winning a dog fight with three or four Messerschmitts lone handed.

Today he is back with one arm and a body wound that can never be erased. Look at him now, quietly doing his war production job with diligence and without fanfare.

There are thousands of young men like this who deserve special recognition for they are earning a SECOND Distinguished Service Medal. We are proud of them.

Romec joins with other producers of fighting equipment in a special salute to these men who fight equally hard on the production front to help shorten the war.

★ ***Buy More War Bonds*** ★

ROMEC PUMP CO. • Manufacturers of Aircraft Pumps and Accessories • **ELYRIA, OHIO, U. S. A.**



© 1943, The Studebaker Corporation

The Connells of South Bend are traveling...

They've left the job of building Flying Fortress engines at Studebaker to their Dad

GEORGE CONNELL is in the Marine Corps. His brother Francis is in the Navy. Both are in the air service.

Only a little while ago they were one of numerous family groups in the Studebaker factories—headed by a father who has seen active service as a Studebaker man for over 28 years.

War has separated many of the famous father-and-son teams that have long made fine craftsmanship one of the great traditions of Studebaker's home community.

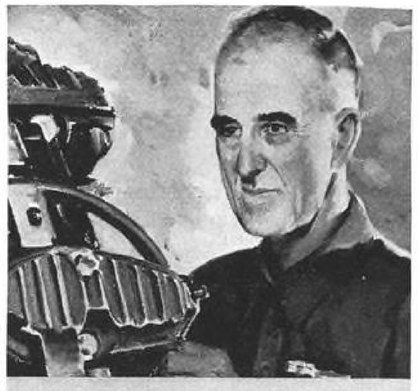
But steadily, off to the fighting fronts, from the Studebaker factories, move ever-increasing quantities of Wright Cyclone engines for the mighty Boeing Flying Fortress—tens upon tens of thousands of big multiple-drive military trucks—as well as other vital war matériel.

It's reassuring to every Studebaker man—on the production line or the firing line—to know that each shipment Studebaker makes today is helping to hasten the dawn of a safe, new tomorrow. After victory comes, still finer Studebaker motor cars and motor trucks than ever will be built for civilian use.

BUY U. S. WAR BONDS

STUDEBAKER

Builder of Wright Cyclone engines for the Boeing Flying Fortress, big multiple-drive military trucks and other vital war matériel



On his Studebaker job over 28 years

Charles R. Connell began his Studebaker career before either of his air-crew sons were born. From early boyhood, their ambition was to follow in their father's footsteps in the Studebaker plants. That has been a typical family experience in Studebaker's home community for over 91 years.

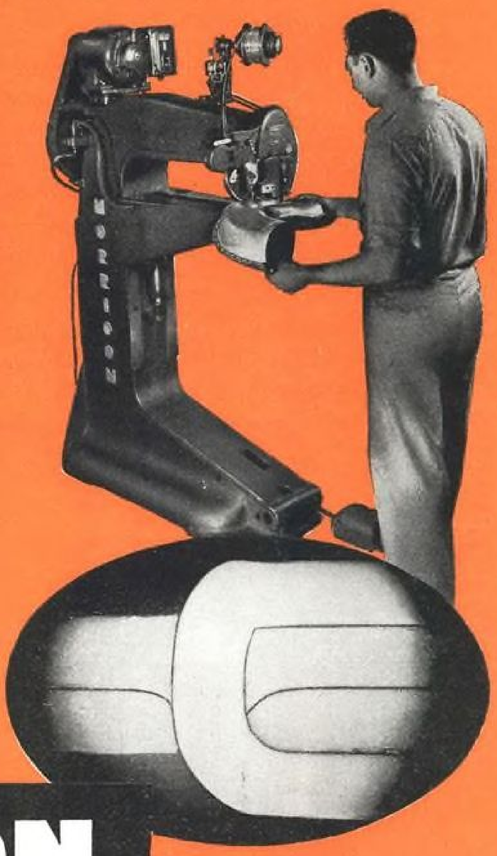
MORRISON

WIRE STITCHING

Approved for secondary structures and non-structural assembly by U. S. Government

FOR THE FACTS

This fabrication method has been thoroughly tested by one of America's leading aircraft laboratories and an official report prepared. For information, write for Bulletin No. 5.



MORRISON STITCHERS

PRODUCTS OF THE SEYBOLD DIVISION
HARRIS-SEYBOLD-POTTER COMPANY
DAYTON F7, OHIO

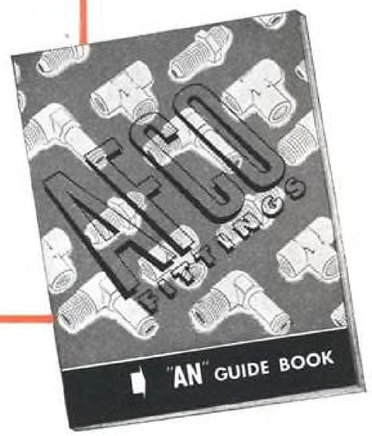
Actual photograph, magnified ten times, of cross section of stitch driven through two sheets of 24ST .040 Aluminum.

An easier way to check and specify "AN" fittings

Somewhere, there's a man who has had his headaches trying to locate certain "AN" specification sheets when they were needed in a hurry. Perhaps he even has found himself in a muddle when he let memory decide that the tee he wanted was Number So-and-So, or that the thread of that elbow was such-and-such a size.

That is the man who will appreciate the new engineering guide book of fittings . . . more than eighty pages of cross sections and engineering data which make it easier to check and specify "AN" fittings . . . condensed for simple, speedy reference. There's a handy wall chart which goes along with the book, too . . . providing a split-second identification method right at desk-side, drafting table or workbench.

Somewhere, there's a man who will want this helpful data immediately. He will write today for the AFCO Fittings "AN" Guide Book and Wall Chart . . . prepared and distributed by the world's largest manufacturer engaged exclusively in production of "AN" tube, pipe and hose fittings



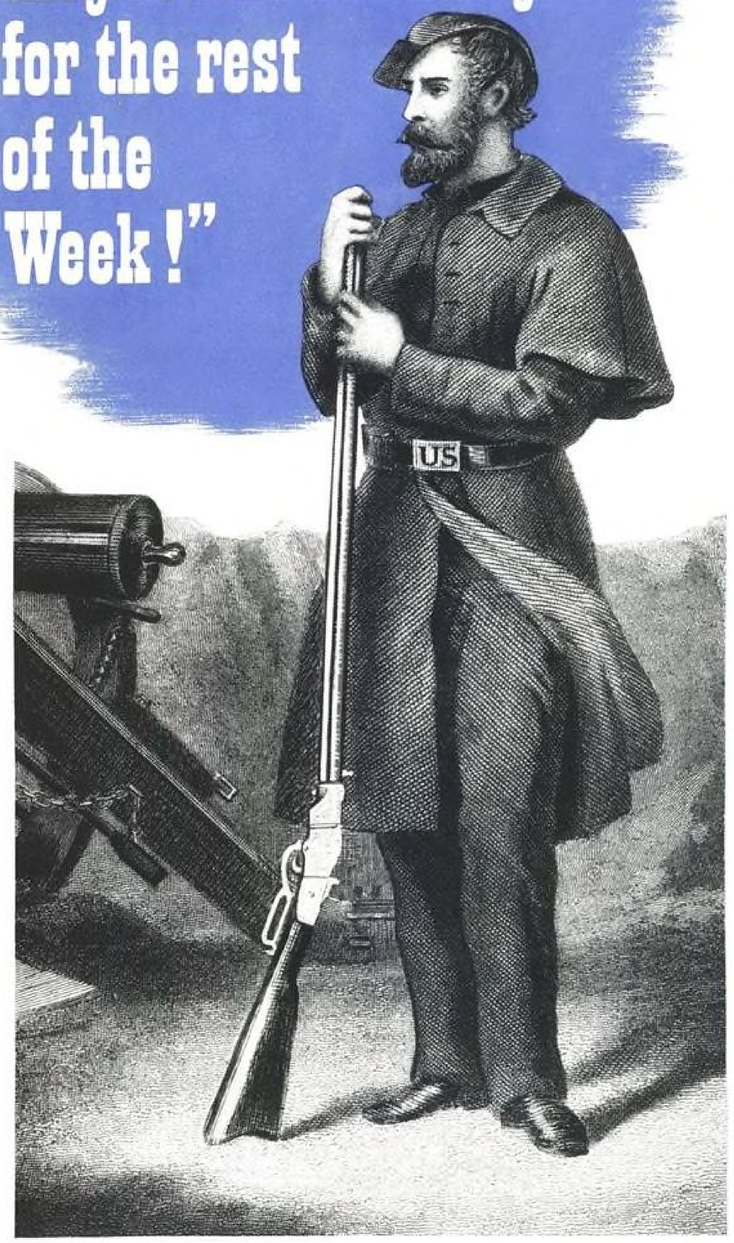
AFCO *Fittings*

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

"That Yankee gun they load on Sunday for the rest of the Week!"



These cynical and war-weary words were a Confederate soldier's description of a famous weapon of the Civil War. It was the Henry Rifle — a Yankee answer to a national emergency, back in the days of muzzle-loaders.

Benjamin Tyler Henry, the gun's inventor, was considered one of the greatest gunsmiths of the 19th century, and he helped to found the fame of Jones & Lamson in the early days of American industry . . . while the gun, in turn, commenced the fame of a great American company as the first of the world-famous line of Winchester Repeating Rifles.

* * *

It was on a Sunday that America looked up from the tragedy of Pearl Harbor and asked her industries for a Yankee gun — Today, Jones & Lamson machine tools and engineering are again helping to produce many Yankee guns such as this world has never seen before.

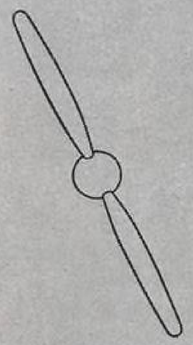
And after the war is over, our engineers and service men will play an equally important part in helping industry to convert to peacetime production . . . when new companies and products will once more stem from the men and the machines of America's oldest machine tool company. Call upon Jones & Lamson, now!

Universal Turret Lathes . Fay Automatic Lathes . Automatic Thread Grinders . Optical Comparators . Automatic Opening Threading Dies

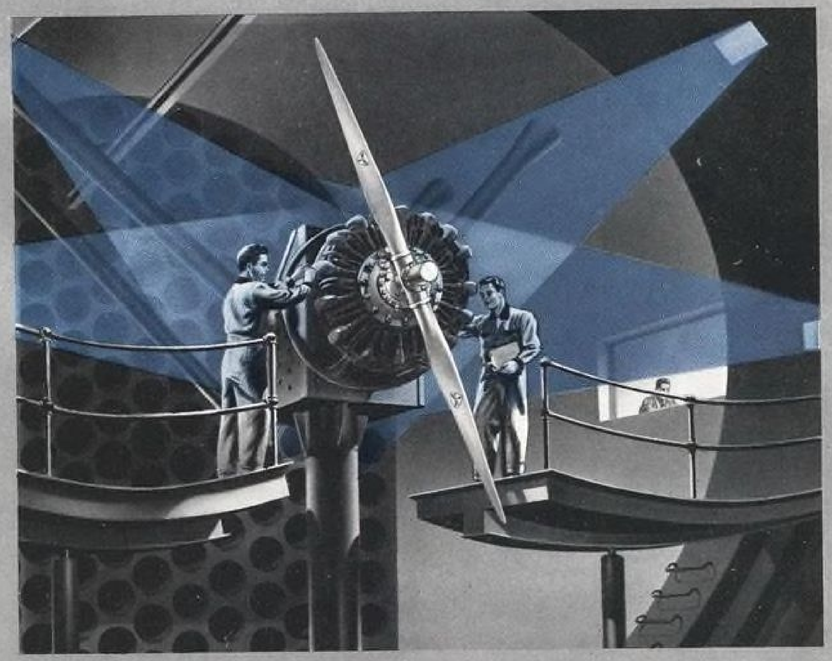
JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT, U.S.A.

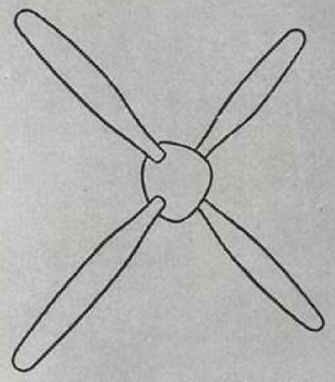
Profit-producing Machine Tools

You, too, will fly behind these "battle-tested" AEROPROPS



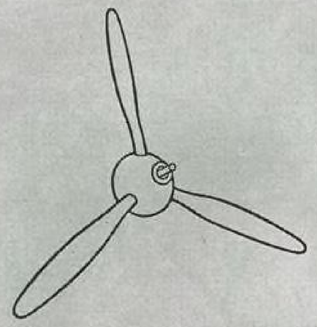
1. The TWO-BLADE AEROPROP is shown on the test stand with blades in full-feathered position. This Aeroprop, embodying all Aeroproducts engineering principles, is specially designed for lower-powered airplanes.





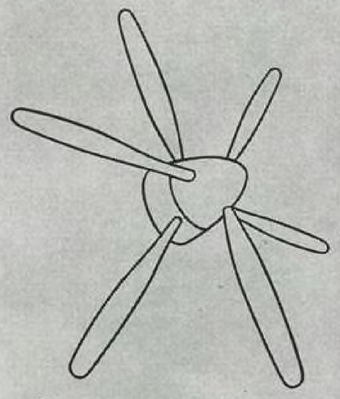
3. The FOUR-BLADE AEROPROP, like its three-blade partner, is versatile, operating either with or without a cannon in its hollow hub. Like all Aeroprops, its pitch action is fully automatic, with the power for pitch changes self-contained in the compact propeller assembly.



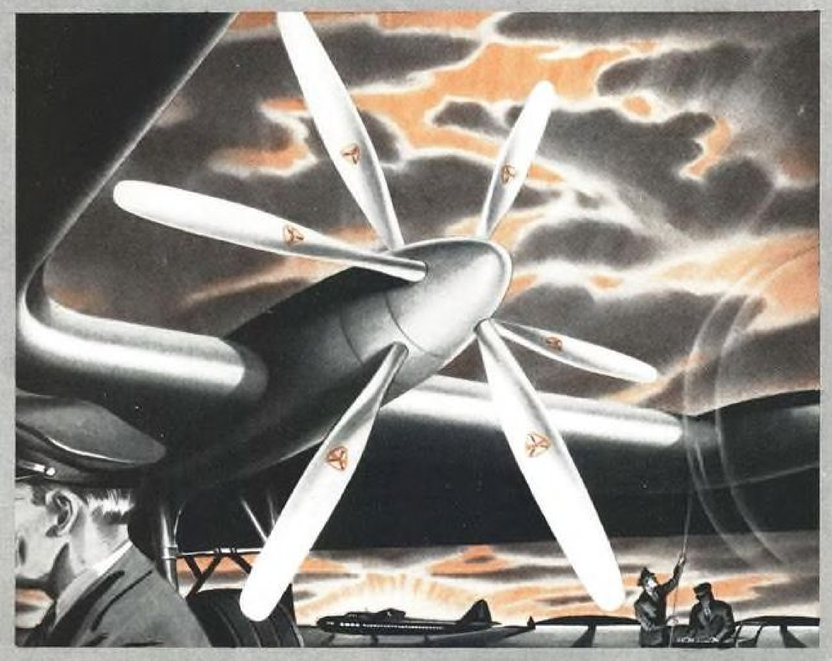


2. The THREE-BLADE AEROPROP is a veteran of many battles. Pilots of many Allied nations have flown it and have praised its flight performance, simplicity, and strength.





4. The SIX-BLADE DUAL ROTATION AEROPROP, which is built for specific military use, is destined for equally big jobs when peace is won. This giant propeller embodies the same simplicity of design that is the basic engineering principle of all Aeroprops.



YOU'LL take to the air when this war is won. Perhaps you'll fly behind the two, three and four-blade Aeroprops, designed for service today on many of America's war-planes. Or, perhaps you'll speed through the stratosphere in majestic sky-liners, their mighty engines harnessed by six-blade Dual Rotation Aeroprops. In either case, you will fly in ships whose safety, speed and performance will be enhanced by the advantages of *battle-tested* AEROPROPS.

Aeroproducts Propellers are light, strong, simplified—each a merit of great value. Their pitch action is automatic—swift and precise. Their compact, unit-construction simplifies installation and servicing operations, whether used on radial or liquid-cooled engines. These qualities, now contributing to America's military power, will ride the sky-ways with you in the age of peacetime flight.

* * *

Enlarged lithographs of these four illustrations, suitable for framing, will be sent without charge upon request. Write Department PR, Aeroproducts Division, General Motors Corporation, Dayton, Ohio.

AEROPROP

AEROPRODUCTS DIVISION

GENERAL MOTORS CORPORATION

GM ARMS FOR VICTORY

BACK THE ATTACK — WITH WAR BONDS!



MISSION *In the Rain*

Days of careful preparation—split seconds over the target. Planned results must be accomplished even in rain and sleet . . . the Marquette Bombardier Wiper helps the bombardier keep his date.

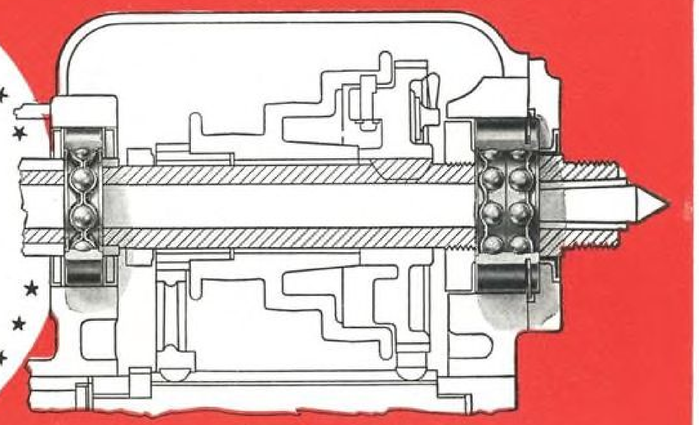
The **Marquette**

METAL PRODUCTS COMPANY
Cleveland 10, Ohio

SUSTAINED *Spindle Accuracy!*
A FINER FEATURE OF LOGAN LATHES*

***Brief* SPECIFICATIONS**

- Swing over bed 10½"
- Bed length 43⅛"
- Spindle hole 25/32"
- Precision ground ways: 2 prismatic "V" ways: 2 flat ways
- 12 spindle speeds—30 to 1450 per minute





Logan

A NAME TO REMEMBER WHEN YOU THINK OF LATHES

Precision, Pre-Loaded Ball Bearing Headstock is Standard Equipment on All Models

Your purchase of a lathe is an investment. To be profitable, it should be a *long term* investment in speedy, accurate production. It will be if the lathe is a Logan, because Logan engineering designed it that way . . . throughout! For example, to assure sustained accuracy of the spindle, the headstock is equipped with special New Departure Ball Bearings. These bearings, of extreme precision, are pre-loaded so that the pressure of the cutting tool . . . either radial or thrust . . . causes a minimum deflection of the spindle. In addition to "pre-loading" . . . these ball bearings are grease sealed . . . requiring no lubrication and no adjustment for their entire life. Moreover, the higher operating speed of the Logan Lathe, due to its ball bearing spindle mounting, enables a shop to take every advantage of modern, high speed cutting methods. Production is increased and unit costs reduced.

Write for catalog sheets so that you can compare before you buy.

LOGAN ENGINEERING COMPANY
CHICAGO 30, ILLINOIS

*This advertisement is one of a series describing the finer features of Logan Lathes . . . Look for the next of the series

PORUS ★ KROME *

isn't just talk!



Official U. S Navy photograph.

U.S.S. Sailfish—formerly the U.S.S. Squalus which was salvaged after sinking off Portsmouth, N.H., in 1939—the first U. S. submarine equipped with PORUS-KROME cylinders, reclaimed from the original engines.

Reason No. 1 for anyone using PORUS-KROME is to get more hours out of engines. You might then expect that, if PORUS-KROME *proved* to keep engines running longer, it would certainly be used in submarine engine cylinders which *must* endure long runs.

It is.

This Van der Horst development, fully protected by patents covering the process of applying PORUS-KROME, was originated and successfully established in Europe before the war. Through Van der Horst's American plants and licensees it is now setting records . . . in marine, aircraft and tank engines . . . that make its postwar place secure with American engine builders and users.

Let Van der Horst engineers show you how PORUS-KROME can improve the performance of your wartime products now and of your peacetime products tomorrow. Write for information.

*PORUS-KROME is hard chromium having controlled porosity and smoothness. It is applied with precision to internal combustion engine cylinder bores and other bearing surfaces to reduce wear, corrosion and scuffing and to lengthen engine life.

VAN DER HORST TRADE MARK

PORUS ★ KROME

Multiplies Engine Life

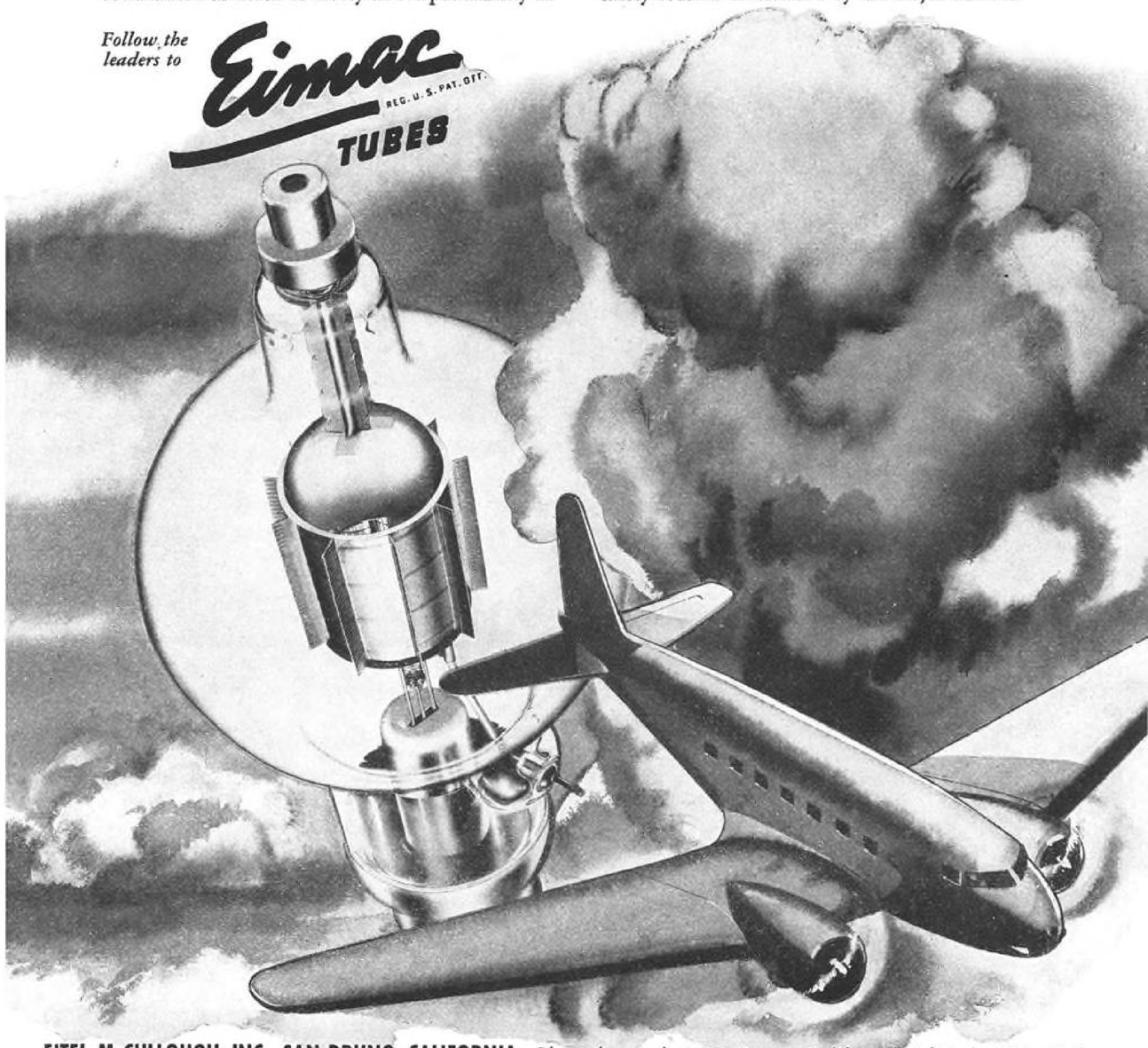
VAN DER HORST CORPORATION OF AMERICA CLEVELAND, O. OLEAN, N. Y.

With the pilot of every Air Transport plane you'll find...RADIO



Locomotive, Motor-car, Airplane—these things alone are not sufficient in themselves to create a dependable transportation system. The simple fact that man can fly in an airplane does not necessarily provide safe air transportation. The auxiliary equipment and sciences have provided the "missing links" in man's great conquest of the air. The science of electronics—which is another way of saying Electron Vacuum Tube—has for example contributed as much to safety and dependability in air transportation as the skill and craftsmanship in designing the airplane itself. Instrument landing devices, cross-country beacons, communications and today other now secret electronic equipment rank in importance with motor, fuselage and wings. Eimac electron vacuum tubes are first choice in the air transport industry. They have long, successful experience in this field and their dependable performance has contributed much to the enviable safety records established by the major airlines.

Follow the leaders to **Eimac** REG. U. S. PAT. OFF. **TUBES**



EITEL-McCULLOUGH, INC., SAN BRUNO, CALIFORNIA • Plants located at San Bruno, Calif. and Salt Lake City, Utah

Export Agents: FRAZAR & HANSEN • 301 Clay Street • San Francisco, California, U.S.A.

747

DRAW UP A CHAIR

(figuratively speaking)



...Scott engineers want to mull over your fabricated parts problem

Scott engineering consultation service has grown naturally out of practical origins:—the need among general aircraft producers for *specialized* assistance in the design and development of special fabricated parts to meet general design specifications.

Scott engineers offer this service *today*—invite you to use it.

Is greater lightness a requisite...higher ultimate and yield strengths... better shock-resistance...the elimination of heat treatment...faster ageing...as well as other practical improvements in physical properties?

Scott engineers may have the answer for you in fabricated parts of "Scott-Cast 40-E" Aluminum-Alloy. "Scott-Cast 40-E" Aluminum-Alloy has made many eminent contributions to aircraft quality and performance. It is now being used on structural parts for fighter aircraft, meeting Army-Navy Aeronautical Specifications AN-A-17. Engineering data available. Meanwhile—our engineering staff awaits your inquiry.

Scott

AVIATION CORPORATION

Lancaster, N. Y., U. S. A.

ESTABLISHED 1932

DESIGNERS AND MANUFACTURERS OF SPECIAL EQUIPMENT FOR THE AIRCRAFT INDUSTRY

"SCOTT-CAST 40-E" ALUMINUM-ALLOY CASTINGS FOR YOUR POST WAR AIRPLANE



Sir Henry Morgan

ADMIRAL OF THE BUCCANEERS: 1628-1688

Magnificent Marauder of the Spanish Main . . .
Pirate, Patron of the Arts of War . . .
Henry Morgan loved fighting for the sheer love of fighting.
How he would have prized such superb weapons as
the Brewster CORSAIR and BUCCANEER.



BREWSTER BUCCANEER NAVY DIVE BOMBERS AND CORSAIR FIGHTERS

SAVE 1 OZ. SAVE $7



NORTH AMERICAN
BELL
CONSOLIDATED
BREWSTER
BOEING
DOUGLAS
GOODYEAR
HUDSON
CURTISS-WRIGHT
VEGA
VOUGHT-SIKORSKY
NORTHROP
MARTIN
LOCKHEED
FAIRCHILD
CHRYSLER

WARREN McARTHUR



WARREN McARTHUR MODEL NUMBER 243 PILOT SEAT FOR NORTH AMERICAN P-51 "MUSTANG"

OPERATORS of air lines working on a write off of five years have calculated that the saving of an ounce in weight is worth $7. Say the weight of the plane empty is 50,000 pounds, its average pay load 30,000 pounds. It carries this load 1,000,000 miles during its lifetime. At an estimated cost of 22.4 cents per ton mile that plane will earn $3,360,000. If the plane itself weighed one ounce less — or 49,999 15/16 pounds it could carry one more ounce of pay load. That ounce will earn $7.

The realization of this vital factor has been one of the most important aims of the Warren McArthur Corporation in designing, engineering, and manufacturing scientific seating equipment from aluminum and magnesium.

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

Hallicrafters has the honor of being the first exclusive radio manufacturer to receive the Army-Navy Award for the third time.



hallicrafters

The world's largest exclusive Manufacturer of Short Wave Radio Communications Equipment.



"Peace On Earth..."

These words will not always be as empty as they may sound this Christmas! One day they will again assume their full significance. And with that day will come all those fruits of peace for which the world now yearns. And just as the 4-plant facilities of The Weatherhead Company helped American industry build products like the car, the airplane and the refrigerator in the past, in tomorrow's world we will be fully prepared to help you build your post-war products.

Look Ahead with

Weatherhead

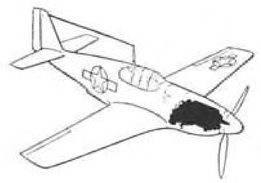
THE WEATHERHEAD COMPANY, CLEVELAND, OHIO

Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

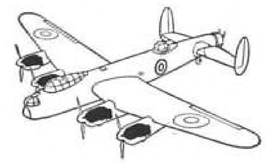
Plants: Cleveland, Columbia City, Ind., Los Angeles
Canada—St. Thomas, Ontario

Did you know this family secret?

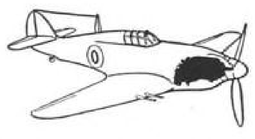
The fighting weapons shown here range from four-motor bombers to the amazing PT boats. Yet all of them have one important thing in common —they are powered with precision-built engines by Packard.



High flying Mustang! Mustang pilots now have two more miles of sky to fight in—a deadly fighter has been made even more deadly—thanks to the new Packard-built Rolls-Royce engine with its 2-speed, 2-stage super-charger. Performance at lower levels has been stepped up as well.



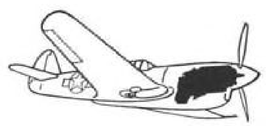
"To Berlin—with the compliments of Coventry" might well have been scrawled on the block-busters dropped by England's multi-ton Lancasters. These four-motored giants put Packard-built Rolls-Royce engines to the acid test on their long-range sweeps over German targets.



"Can opener" is the name given the Hurricane—armed with 40 mm. guns—for its spectacular tank-busting feats in North Africa. Many a Packard-built Rolls-Royce engine has helped to write the fighting log of this deadly British fighter.



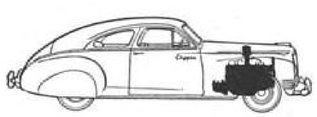
Too fast to catch! Swift deHavilland Mosquito bombers rely on pure speed to complete their missions unscathed. With two Packard-built Rolls-Royce engines to supply their power, these long-range streaks are giving the Luftwaffe plenty of headaches.



Back in "coffin corner" went Rommel's Axis divisions as U. S. Warhawks helped to pound them relentlessly. Packard workers heard the news with cheers, for they build the Rolls-Royce engines that power these planes.



"Streamline pile-drivers loaded with dynamite!" That's what men in Uncle Sam's famed mosquito fleet call their PT boats. The hit-and-run PT's, powered by Packard super-marine engines, are making a terrific dent in Axis tonnage.



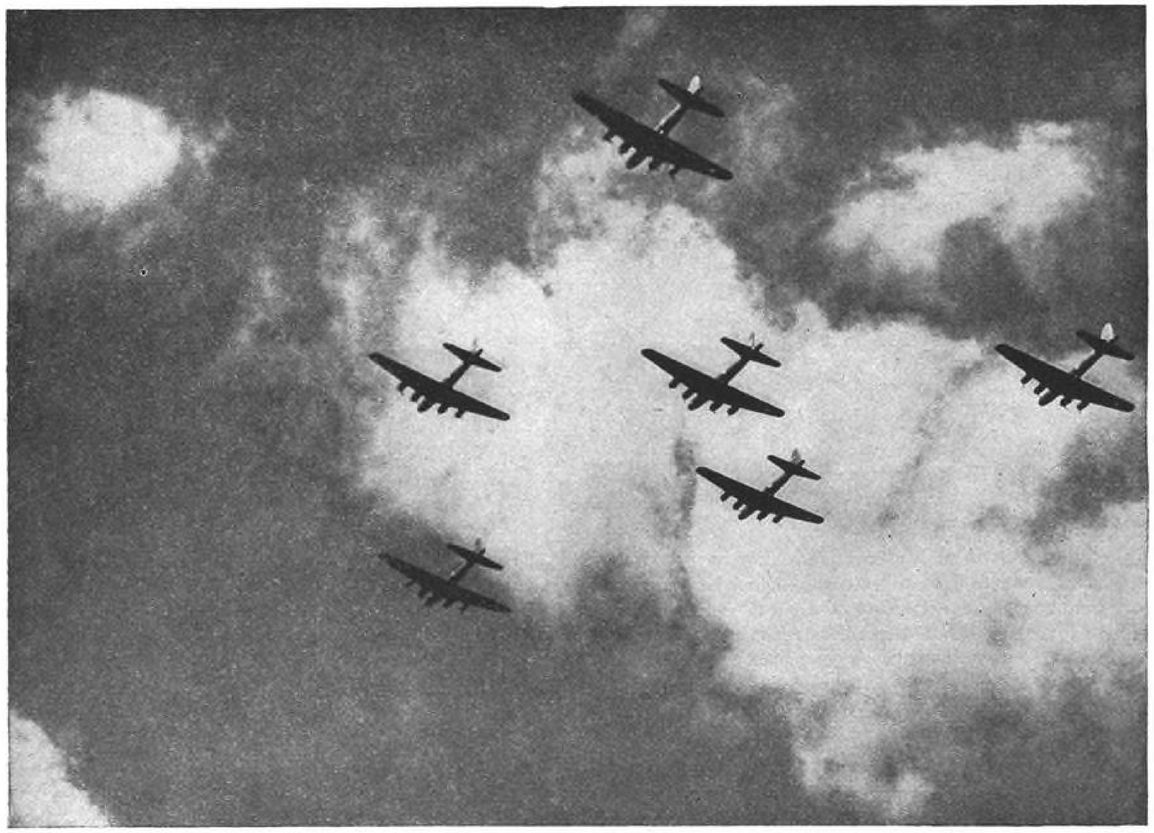
Duration durability. Packard Clipper quality counts double today, for Packard craftsmen are now building fighting engines instead of cars—acquiring precision skills that will mean even finer post-war Packards. Meanwhile, Packard dealers have ample parts and a special "car health" plan to keep your car up to par.

PACKARD

Precision-built Power

•

ASK THE MAN WHO OWNS ONE



SO THAT AMERICAN EYES MAY SEE ONLY AMERICAN PLANES IN AMERICAN SKIES...

Flying into the winds of the world—into blue and gray skies of day, and star-beaconed or storm-blackened skies of night . . . you of the Army and Navy Air Forces, blasting an evil foe into defeat, carry your people's hopes and prayers.

Whether in mortal combat—or patrolling the cloud ramparts of the enemy frontiers; whether in training or on transport runs along endless sky trails . . . you aloft, and you of the ground forces that keep 'em flying, joined with your comrades of land and sea, take your nation's salute.

Here in your own homeland, your people look to the Heavens—not in terror at the enemy's approach—but to thank God for you.

HAYES INDUSTRIES, INC. JACKSON, MICHIGAN

Representatives: { Eastern: J. Henry Reisner, Hagerstown, Md. / Western: Airsupply Co., 5959 W. 3rd St., Los Angeles



HAYES
AIRCRAFT
WHEELS AND BRAKES

On the Boeing Flying Fortresses you see above, as on Consolidated Liberators—on all American 4-engine bombers—the wheels and famed Expander Tube brakes are "Hayes." On fighting and training planes, Army and Navy—on transports and commercial airliners—Hayes wheels and brakes are doing a 'round the clock job, around the world.



DON'T WAIT UNTIL THE WAR IS WON..

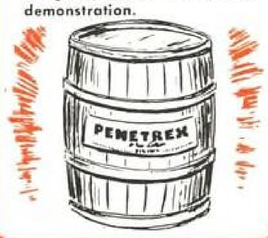
Learn About These New Compounds Perfected for Aviation Cleaning Problems

NOW!

MAC DERMID Incorporated compounds are different — they are individually formulated for special cleaning requirements; for every type of cleaning room equipment; for every metal and alloy used in modern production . . . *This specialization saves time, material and man-power—takes the guesswork out of vital war production.*

PENETREX
FOR CLEANING FLOORS

Something new has been added to our PENETREX FLOOR CLEANERS that make them the most amazingly simple to use but effective floor compounds we have ever offered. Now you can use PENETREX with every type of mop or scrubber for every type of floor and do a faster, better cleaning job and save money in the bargain. Write for actual demonstration.



Write for Free Demonstration or Data Sheets

A MAC DERMID Incorporated representative, located in principle cities, will be pleased to show you the many new, faster acting, harder hitting METEX *aero* COMPOUNDS developed for your cleaning room requirements; help you determine the most positive way to secure a chemically and metallurgically clean product . . . or, if you prefer, we will mail you Data Sheets explaining our special *aero* compounds.

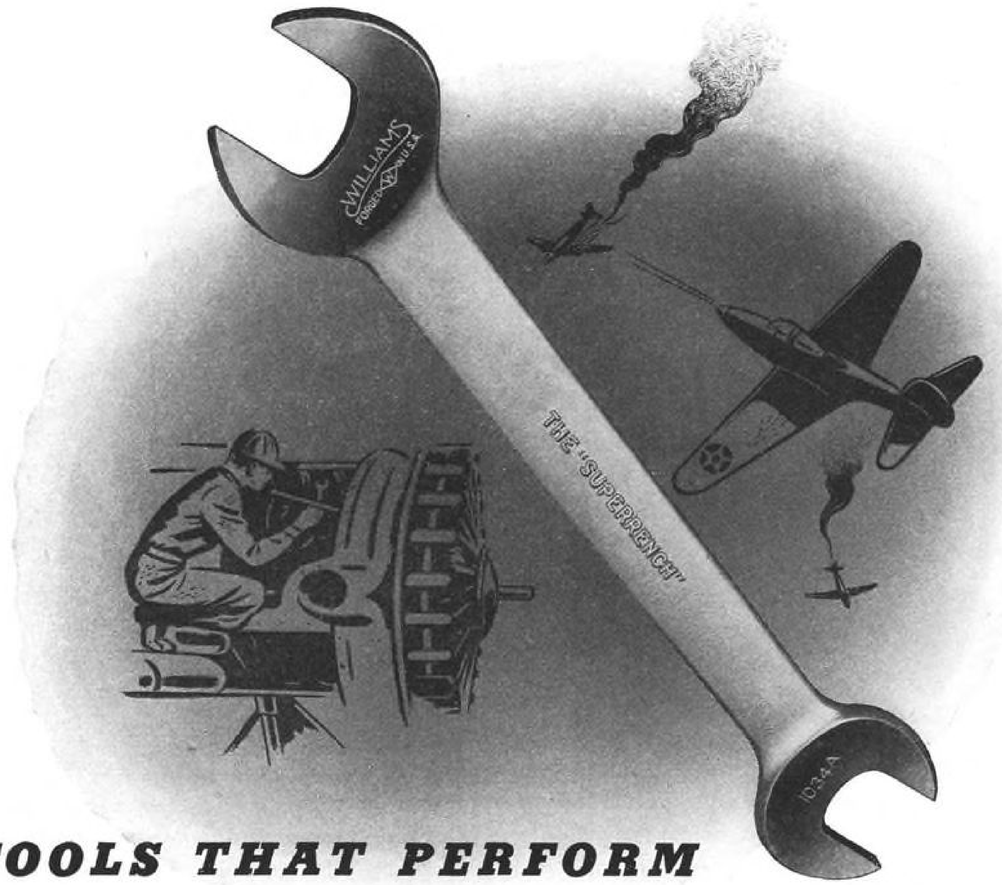
Special Compounds for Aviation Cleaning Problems

Manufactured by

MAC DERMID
INCORPORATED
WATERBURY 88, CONNECTICUT

WRITE ONE OF THESE SERVICE ORGANIZATIONS FOR FREE DEMONSTRATION

NEW YORK	DETROIT	CHICAGO	LOS ANGELES	CLEVELAND	ST. LOUIS	TORONTO—CAN.
Udylite Corp. (L. I. City)	Udylite Corp. Wagner Bro.	Udylite Corp. Geo. A. Stutz Mfg. Co.	Nobs Chemical Co.	Udylite Corp. McGean Chem. Co.	LaSalco, Incorporated	Clark Industrial Supplies Co.



TOOLS THAT PERFORM

WHERE heretofore one piece of armament was produced, thousands are now made. It's a miracle Nation—mechanized, motorized and hard hitting. In every phase of this great war effort, dependable tools are essential. Tools that challenge and lick the toughest manufacturing and maintenance jobs. Men who have Williams' Tools value them and use them wisely, for they know replacements are hard to get. With intelligent handling they will last until peacetime. A booklet of helpful suggestions, "How To Select and Use Wrenches" will be sent on request.

J. H. WILLIAMS & CO., BUFFALO, NEW YORK

WILLIAMS
SUPERIOR DROP-FORGED TOOLS

DROP-FORGINGS & DROP-FORGED TOOLS

TODAY.. IT'S WAR PRODUCTION TO SUPPLY THE DEMANDS OF THE ARMED FORCES

HANSEN
AIR HOSE COUPLINGS

● Whether it's production to meet war demands or economical production to meet after the war competition plus "on the minute" deliveries, you need Hansen Push-Tite air hose couplings. They're ***faster, easier*** to operate and ***leakproof,*** affording an air savings alone amounting to considerable in dollars and cents . . . ***Rugged*** enough to stand plenty of rough usage without tying up operations for repairs. ***Simple*** and easy to operate, no twisting, turning or locking. Merely push plug into socket—it's connected and locked, air is automatically turned on. Easy pull on outside sleeve, it is disconnected, plug is ejected and air is automatically turned off. No leakage, no wastage of air. Hansen air hose couplings can be used on air, oil or grease lines. « « « « «



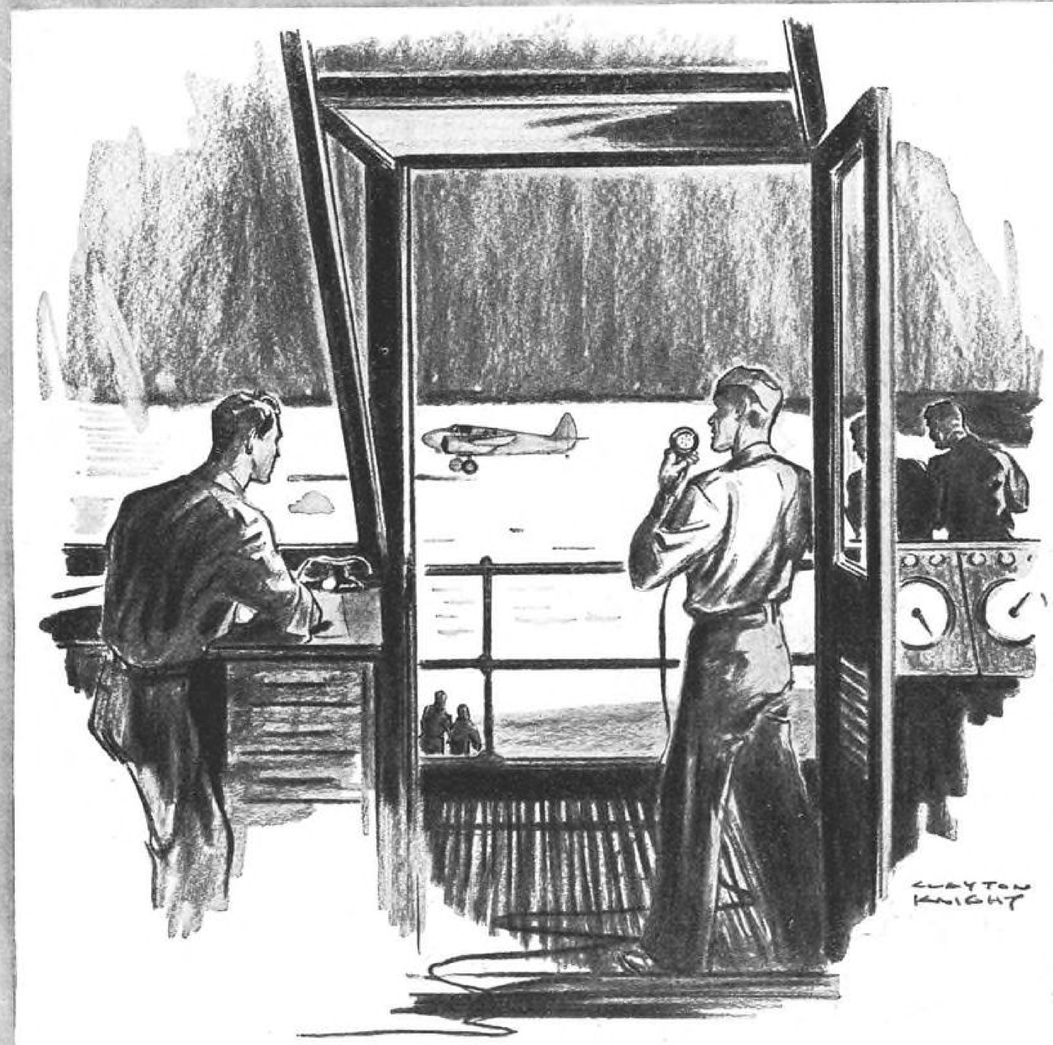
TOMORROW.. IT'S COMPETITIVE PRODUCTION TO SUPPLY THE DEMANDS OF WE THE PEOPLE

THE HANSEN MFG. CO.

1786 EAST 27TH STREET • CLEVELAND, OHIO

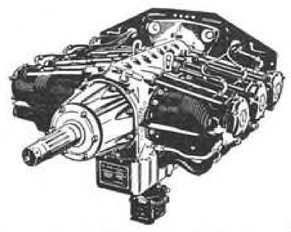
Send for FREE CATALOG

Makin' the Grade... A LYCOMING FEATURE



THAT FIRST NIGHT LANDING!...

No. 6 of a series sketched from life by Clayton Knight



Lycoming Model GO-435 six cylinder opposed geared engine rated from 210 to 220 horsepower used in primary trainer planes and in other special equipment.

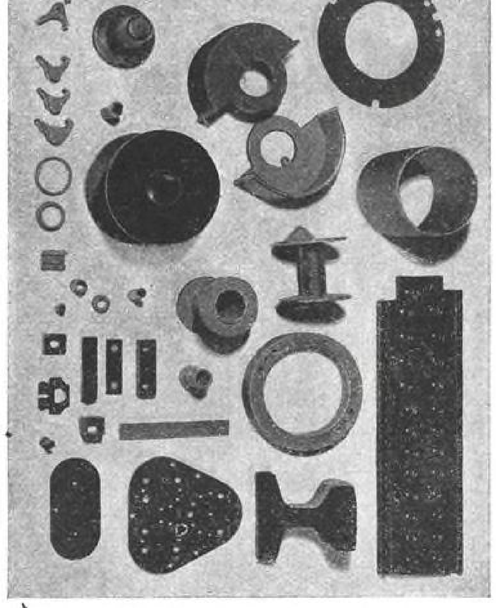
MAKERS OF AVCO PRODUCTS

Chances are you didn't think much about your Lycoming engine when you made that first night landing. That's as it should be. We aim to build them so dependable that you can forget you have one in your plane and can concentrate on learning how to become the world's best pilot.

LYCOMING
AIRCRAFT ENGINES

LYCOMING DIVISION — THE AVIATION CORPORATION, WILLIAMSPORT, PA.





When a parachutist takes his final exam both his diploma and his life depend on the fitness of his rip cord.

Lives also frequently depend upon the fitness of inconspicuous radio and electrical parts of Formica laminated plastic used in war equipment — such parts as insulating spools, insulating spacers, breaker arms, radio tube socket bases, terminal strips, rheostat cores and other insulating parts.

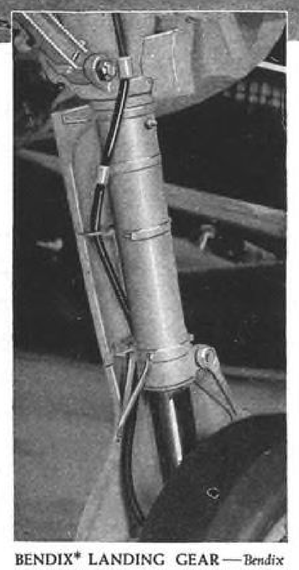
Formica combines lightness with strength, dimensional stability, and resistance to change through chemical action. It has a low power factor, low dielectric loss. There is a wide variety of grades each of which emphasizes some one of the many valuable properties of material for special purposes.

ARMY E NAVY
FORMICA

THE FORMICA INSULATION COMPANY

4628 SPRING GROVE AVENUE • CINCINNATI, OHIO





BENDIX* LANDING GEAR—*Bendix Pneudraulic Shock Struts, Bendix Airplane Wheels, Airplane Brakes, Hydraulic Master Cylinders, Pilot Seats and Power Brake Valves are important members of "The Invisible Crew" of precision equipment which more than 30 Bendix plants are speeding to world battle fronts.*

Bendix* Pneudraulic* Struts
Protect Plane and Pilot!

Whether it is the deck of a flat-top or a front line jungle clearing, the Navy's new Grumman "Hellcat" fighter plane can land safely because of Bendix-Pneudraulic Struts. These precision-built "land legs" combine maximum strength with light weight. They (not the plane) take the shock of the first contact of the wheels with the ground. Their hydraulic cylinders cushion the impact and help to make the "Hellcat" one of the "sweetest planes to handle" the Navy airmen have had.

Bendix* Landing Gear is outstanding for its rugged strength, precision and simplicity which makes its advantages readily available to all types of aircraft.

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THE INVISIBLE CREW
Precision Equipment by
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BENDIX PRODUCTS DIVISION
BENDIX AVIATION CORPORATION
SOUTH BEND, INDIANA

Free Enterprise

THE OPPORTUNITY AND OBLIGATION TO COMPETE

WE can be prosperous beyond our dreams—all of us—workers, farmers, and business men—but one of the prerequisites is the self-discipline of accepting competition for ourselves as well as others.

* * *

Free enterprise does not imply the freedom to use any or all means to make a profit. It does not mean the right to monopolize. *It means the opportunity and obligation to compete.*

Competition requires *independence of action, free access to the market,* and *no large degree of control over the price* by any buyer or seller. In general, the larger the number of sellers and the more easily buyers can shift from one seller to another, the higher will be the degree of competition (and vice versa for buyers).

But let us not get too academic or go off the deep end. We cannot have perfect competition. We cannot subdivide businesses and labor unions into tiny units to make a multitude of buyers and sellers in each market; we cannot reduce our rich variety of products to a few rigidly standardized items; we cannot educate people to judge quality precisely; we cannot eliminate the costs of bridging space between buyers and sellers. On the other hand, have we gone as far as is practical and desirable in these directions?

We cannot even have a system of highly "sensitive" prices, that is, prices which fluctuate immediately in response to every minor change in demand and supply. This would occur in the dream world of competition-to-the-nth-degree. It cannot occur in the real world, or even in the ideal world of competition best suited to physical facts and human qualities. The economies of large-scale enterprise, the need for adapting products to human wants, the costs of transportation and the costs of issuing and acquiring market information put severe limits on price sensitivity.

Economists tell us that if prices were extremely sensitive, business booms and depressions would be much less severe—provided our stock of money remained fairly constant. But with the somewhat limited degree of sensitivity which is practicable in the economy, price and wage changes cannot prevent severe declines in business activity. *We cannot count on competition alone to cure depressions.* We must look mainly to other kinds of measures to prevent mass unemployment of men and machines.

If we cannot have prices which fluctuate with every small change in demand and supply conditions, we can work toward—and achieve, if we really want it—a system in which prices and wages are at least roughly responsive to long-run changes in demand and supply, a system in which most markets are not dominated by individual businesses, groups of businesses, labor unions, or farm organizations, and in which prices and wages are maintained at levels consistent with free access to markets and to jobs.

In any kind of an economic system there must be some means of determining prices, wages, and profits, and of bringing labor and capital into employment in the industry and place where they are most needed. There are two ways to do this: by administrative fiat or by the impersonal processes of the market. The first of these is typical of the totalitarian state; it frequently involves destruction of individual freedom or fumbling mismanagement. During the war all of us have had some experience with patronizing and paternalistic treatment by the state; we have found out what it means to be pushed around by bureaucrats; and we have discovered that the political determination of prices, wages, and profits leads to chaos when self-interest supersedes the fine fever of patriotism—as it eventually does. I do not mean to imply that we can do without controls over prices, production, and distribution in time of war; but I do suggest that we can learn something from their operation. Even with a united national purpose these controls work badly when human abilities are inadequate for the superhuman task, when personal or departmental jealousies crop up among officials, and when pressure groups try to prey on the rest of the public. Every day more Americans are beginning to understand why our forefathers feared the caprice and tyranny of power.

The impersonal processes of the market in determining prices and wages and in allocating productive resources will, in normal times, save us from the fumbling of bureaucrats and from the Babel of confusion, un-

certainty, and annoyance produced by their regulations. But these market processes will not save us from paying toll to those who monopolize and restrict entry to markets or jobs.

If we want an economy in which we are free to try out new ideas, develop new products, and introduce more efficient methods of production, if we want an economy in which there are great opportunities for men of imagination, inventiveness and energy, if we want an economy wide open to progress, then we must have a free field and fair competition for all comers—without collusion as to prices, markets, or production. This is the only basis on which we have a right to demand freedom from governmental regulation for ourselves and on which we can combat monopolistic tendencies in other quarters.

Let us stand squarely for the principles of the anti-trust laws and against all collusion and combination in restraint of trade. Let us insist that the government review with a critical eye every combination and consolidation which might restrict competition. Let us face frankly the problems of economic power arising out of price leadership and encourage every honest effort to find means to deal with them. Let us not shrink from questions as to whether some great aggregations of plants are too large for efficiency, free entry into the industry, and a free price. While we resist the efforts of the Department of Justice to extend the anti-trust laws by far-fetched and distorted interpretation, and while we fight every attempt to use them as a tool of persecution, let us cooperate in sincere efforts to modernize these laws and extend them by specific legislation to monopolistic practices they cannot now reach. I do not have a simple formula for this, but I believe we must try to find one.

We can then, better face the problem of the growing monopoly in labor which is threatening to make the free enterprise system unworkable. Today labor is going through a stage of empire building reminiscent in some ways of a similar stage in business three-quarters of a century ago. Witness the same buccaneering spirit, the same concentration on selfish interests, and the same disregard for the public welfare. Business leaders learned the hard way that the public will eventually rise up against those who prey upon them. Will our labor leaders be wiser? The right to collective bargaining to protect the weak position of the individual employee is one thing—but the grant of unlimited monopoly privilege to combine into a private government which can dictate its own terms to businesses, industries, communities, and even to the government itself, and which can start a wage-price spiral such as to hinder the war effort and make full prosperity impossible in time of peace is something quite different. We need to find a middle way which will prevent employers from exploiting employees but which does not sow the dragon's teeth. The exercise of arbitrary power by labor threatens not only business, but also all workers outside the unions and all those dependent on pensions and savings for their existence, and ultimately, of course, the well being of union workers themselves.

The idea that the labor problem can be solved if great, powerful organizations of employers will sit down with great, powerful organizations of labor is a delusion. If our experience in the N.R.A. and in the war teaches us anything, it is that the best that can be expected in the long run from such a situation is an armed truce with intermittent civil war. And every truce would be a monopolistic arrangement to take advantage of those not members of the great organized groups. Business and labor unions, whenever confronted with postwar readjustments that are unfavorable to them will be sorely tempted to protect their own special interests at the expense of the public. There will be efforts on the part of businesses, abetted by labor unions, to limit productive capacity, to raise tariffs, to obtain subsidies, and to maintain prices at artificially high levels. The unions will oppose labor saving changes and will seek higher wages even in areas and industries of surplus labor. Already demands are emerging for direct joint action by business, labor, and agriculture to solve the transition problems of special concern to them. While these groups should have every opportunity to register their own self-interest, we cannot entrust our fate to decisions made by pressure groups. If experience is any guide, such coalitions will be almost certain to restrict opportunities for progress and expansion, to exploit the public, and ultimately to injure even the businesses, workers, and farmers included in them. We cannot afford a postwar N.R.A. Resort to temporary government regulation in the transition from war to peace may, however, be necessary in cases of great hardship.

We can be prosperous beyond our dreams—all of us—workers, farmers, and business men—but one of the prerequisites is the self-discipline of accepting competition for ourselves as well as others.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

'44 "Musts" for '54 Markets

As 1943—40th anniversary of Kitty Hawk—draws to a close and we are able to see the top of the plateau in the production curve that lies not far ahead, it is a good time to take steps to by-pass the poorhouse on the other side of the hill.

One obvious way of judging the future is by the past, but if we did that in the case of aviation, the future would be dark. On the other hand, to listen to the pleasant fancies of the "million plane" boys is only visionary hoping. Somewhere in between—and nearer to the lower limits—is the best place to begin our range-finding of the future.

Such a practical beginning will be found in the survey of the postwar aviation market starting on page 114. It represents more than a year of work on the part of the author and considerable collaboration by the editors of AVIATION. It is not the last word, but the first word on the subject, and it will be modified many times as conditions change and new thinking follows accordingly.

Our survey leaves us with an industry that does *not* compete with food or steel, but represents a very respectable volume of business. But surveys only measure business, they do not *create* it. Business is created by demand, and demand must be created by merchandising perspiration.

Surveys do, however, indicate ways and means. Whether the postwar volume is greater or less than our estimate depends directly on the strength of our sales effort. In recent years our salesmen have had too many opportunities to grow soft. In general, our sales effort is in a dangerously weakened condition. Steps can and must be taken to remedy this situation.

Here are some things that can be done to create a brighter future:

Let's realize that the war we are fighting will *not* end wars. It is being fought to preserve a philosophy of life which may be threatened again and again if we don't do something to secure it after victory. With the ever-increasing range of aircraft, our next attack could blast Detroit as easily as Pearl Harbor.

SOON THERE WILL BE more than 5 million people in aircraft manufacturing and in the air services. With their dependents, they represent a considerable voting bloc. This group should know how important it is for us to possess the most powerful and up-to-date air force in the world. It is the duty of each of them to exert every possible influence toward the establishment of that air force, first for the preservation of peace, second for the preservation of the aviation industry as an instrumentality of peace. If reasonable productive capacity is maintained and continuous research and design development encouraged by adequate "seed money" we will have gone a long way toward world security, and would-be world conquerors will think more than twice before attacking.

The wartime contributions of the Civil Air Patrol have proved the value of an aeronautical home guard, and government subsidy of personal flying and flight training must be continued in some form akin to that of the Civilian Pilot Training Program. Only by such an arrangement can it be possible for youth in moderate circumstances to receive flight training at a sufficiently early age. A subsidy to provide large numbers of small landing areas throughout the country would bring benefits in work and sale of materials to many parts of the nation not readily reached by any other means. Even more important than subsidy is sensible government regulation. Education will do more to prevent accidents than stifling legislation.

BUT PERSONAL PLANE BUILDERS should not sit back and wait for the aid of government. First they should apply wartime production short cuts to their manufacturing and pass along the savings to the purchaser. This goes for the producers of parts and accessories as well. The plane makers should build their sales and service organizations now, attracting the best distributors and dealers and locating them in strategic centers. Fixed base operators should lay plans now for greatly increased recreational facilities at their airports, patterning them along the lines of inexpensive boat clubs (see "More Fun at the Airport," page 38, Nov. 1940 AVIATION).

Moreover, plans should also be made now for a nation-wide fly-it-yourself service to utilize surplus planes and provide returning service pilots with an opportunity to do some flying for pleasure and business. Future aircraft shows must be planned to prove that flying is for families and not fanatical daredevils. The Army and Navy Air Forces can furnish all the necessary thrills, incidentally showing the taxpayer what he is getting for his money.

Scheduled and non-scheduled operators must work toward higher efficiency and pass the savings on to the consumer in lower fares. Merchandising will play an important part in the future of air transportation as well as in manufacturing. Development of lower fare second-class services, time-payment vacation travel, and similar ideas, will do much to attract passengers who pay fares out of their own pockets rather than on expense accounts.

These are but a few of the things we must be planning in 1944. We will have much more to say about them in the months to come. We must act now so that aviation—the victor in the war—will not become the vagrant of the peace.

Leslie E. Neville

EDITOR



Swiftly growing carrier force portends powerful blows reaching closer and closer to Jap homeland. Air power arm of carrier forces, too, rapidly gains more strength with addition of Grumman F6F *Hellcats*, such as this one—which features long range droppable gas tank—shown aboard unnamed carrier "somewhere in the Pacific." (Official U. S. Navy-International photo.)

Captured Italian air bases—such as this one already used by omnipresent P-40's and C-47's—pave way for bombing of Germany from south as well as from English bases. Good southern weather will not only make possible shuttle runs, but will also give additional alternate landing places for bombers operating from run's northern end during inclement weather. (International News photo.)

America at War

New 15th Air Force begins pounding Germany from south, opening way for shuttle-run schedules between England and Italy . . . Boeing B-29 nears "final test" . . . More people bet production will top 9,000 by year end.

FROM NOW ON through the winter, Germany will be subjected to new air attacks in the form of: 1. strong missions of the newly-formed 15th Air Force from Africa and Italy, which will take advantage of the fair weather which settles down about the last of November; 2. shuttle runs by both AAF and RAF between Britain and Mediterranean bases, terminating at the end that offers the best landing conditions; 3. attacks by 1,000-plane missions from both British and American forces, subjecting the enemy to potential 2,000-plane blows at the same time; 4. attacks by the Boeing B-29's, which may begin at any time, reaching any points in German-held Europe with still heavier loads of explosives; and maybe, 5. assaults by American and/or British air forces, flying from bases on Russia's Eastern front.

In one recent month, U. S. and British planes based in Britain dropped 20,000 tons of bombs on Axis Europe. Bombers and their escorts destroyed or damaged 1,387 German planes. U. S. 8th Air Force B-17's and B-24's accounted for nearly all of them—1,261—since they operate in the daytime. The heavies and the mediums unloaded 5,533 tons of the bombs. But the Royal Air Force, mostly engaged in area bombing at night, put down the major portion of the total—14,060 tons.

One of the first things Lt. Gen. Carl A. Spaatz did when he was appointed commander in chief of the American air forces in the Mediterranean was to send a heavy mission of bombers over the Messerschmitt plant at Neustadt in South Vienna. This first attack by the 15th resulted in "severe damage" to the enemy. Our losses were not disclosed. Before that, the RAF had given Leipzig its first large-scale bombing of the war. This was a notable achievement, because the city, Germany's third important industrial center, is over 500 mi. from English bases—a long distance for British night bombers.

The 8th Air Force's greatest invasion of Germany at this writing was its attack on the vital ball and roller bearing plants at Schweinfurt. The loss was 60 planes and 593 crewmen, but it would have taken many times that loss of material and men to hit the Reich such a heavy blow any other way. Indeed at this time it could not be done any other way. Nevertheless, both Gen. H. H. Arnold, AAF chief, and the President felt that the public should know why the mission was sent against such odds, and they explained it in press conferences.

The AAF based in England has lost, during the past six mo., about 6,000 crewmen and nearly 600 heavy bombers, not counting escort fighters. Secretary of War Henry L. Stimson says that losses of the British and American forces operating against Europe average less than 5 percent of total planes engaged. This is a low figure—especially low for belligerents whose aircraft production is already large and increasing every month.

The percentage of German losses is not known, but it must be greater than the Reich can afford. In one AAF *Fortress* attack, on Muenster, an important German rail center, 102 Nazi fighters were brought down. Bomber gunners got 81 of them and the accompanying Republic P-47 *Thunderbolts* took the rest. This was part of a three-day rampage by the *Fortresses* in which

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Let's Be Practical About Postwar Plane Markets

By E. E. LOTHROP, *Market Analyst, Sperry Gyroscope Co.*
as told to
JOHN FOSTER, JR., *Associate Editor, "Aviation"*

Realistic analyses of aircraft requirements show sharp disagreements with visionary prophets whose crystal balls show plane-filled skies.

THE FLOOD OF FORECASTS visualizing tens or hundreds of thousands of aircraft cramming the postwar "wild blue yonder" represents a definite threat rather than a help to the aviation industry.

Such prophesies—many made by people not even in the business—give a falsely optimistic picture of the industry's employment and profit-making potentialities, and this kind of preview simply doesn't stand up when viewed with a coldly analytical eye to facts.

More than a year's concentrated study, including constant checks and rechecks with manufacturers, airlines, independent fact-finding groups and government officials, leads to the inevitable conclusion that, while the aviation industry will be considerably larger than it was before the war, its markets will not be great enough to keep it anywhere near its present position as the world's No. 1 industry.

This present study appraises two markets: The first identified as V-2, covering a period of two years after the cessation of hostilities (including those with Japan) and embodying the climax of the transition period; and second, the V-5 market, covering the five years after final victory. The V-5 market will thus overlap the V-2 period.

Analysis of the study shows that the V-2 market will require just about 37,700 aircraft of all types, or less than four months' production at today's rates. By far the greatest majority of these craft may be expected to be military planes, for it is a near-unanimous opinion that the United Nations will have to maintain some sort of international police force. Military authorities generally agree that the United States' share of this force will approximate 20,500 planes which, with spares, will have a total value of $2,785,400,000.

Such a force, measured according to current and projected strategy, would include "a minimum of 7,000 heavy, medium, and scout bombers with a total value of $1,285,400,000. Next highest, from the dollar value standpoint, would be 5,000 long-range fighters with estimated value of $565,000,000. And half that number of transports—2,500—would represent a value of $562,500,000. While a higher percentage of transports are required today, military men believe that about 10 percent of the total number of planes would prove adequate to maintain a police force-type operation. Training plane requirements are estimated at 6,000 units, with valuation of $192,500,000, figures arrived at being on the basis of both peace and wartime experience.

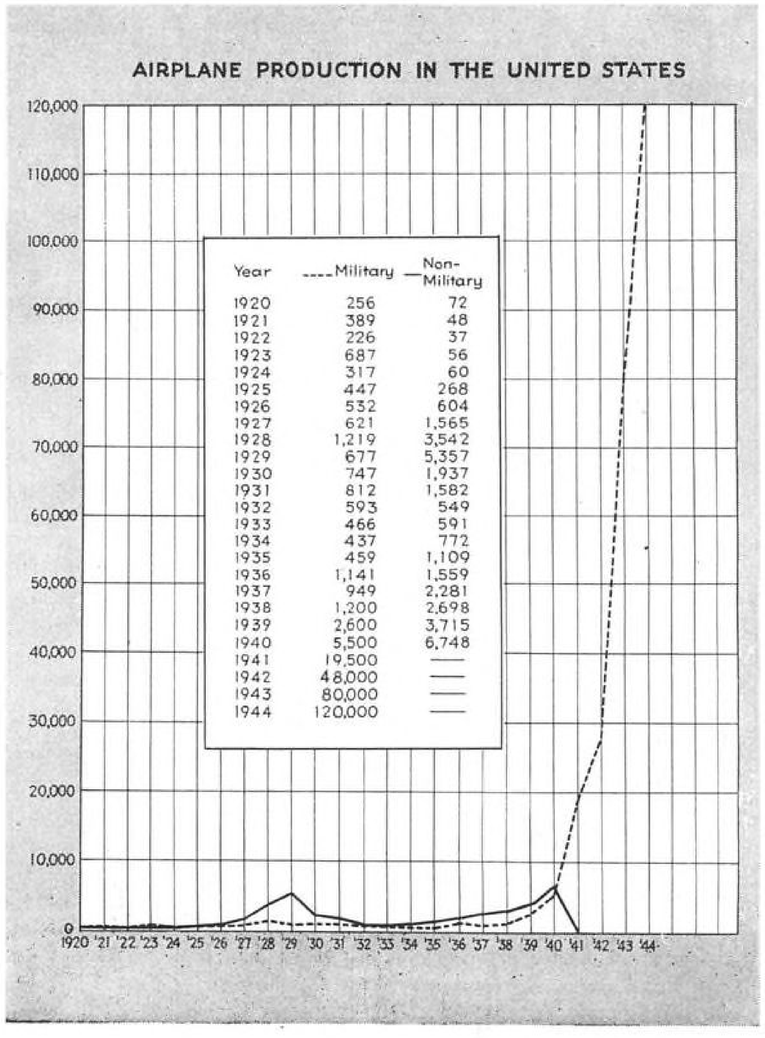
Obviously, we will have a great many more than 20,500 planes available from all military sources when hostilities cease, the day the police force must be ready. Thus, the 20,500 total will not have to be built, so that this figure becomes the absolute maximum for the V-2 military market. Replacements, based on normal peacetime attrition rates, are calculated at 6,000 planes per year for the entire force.

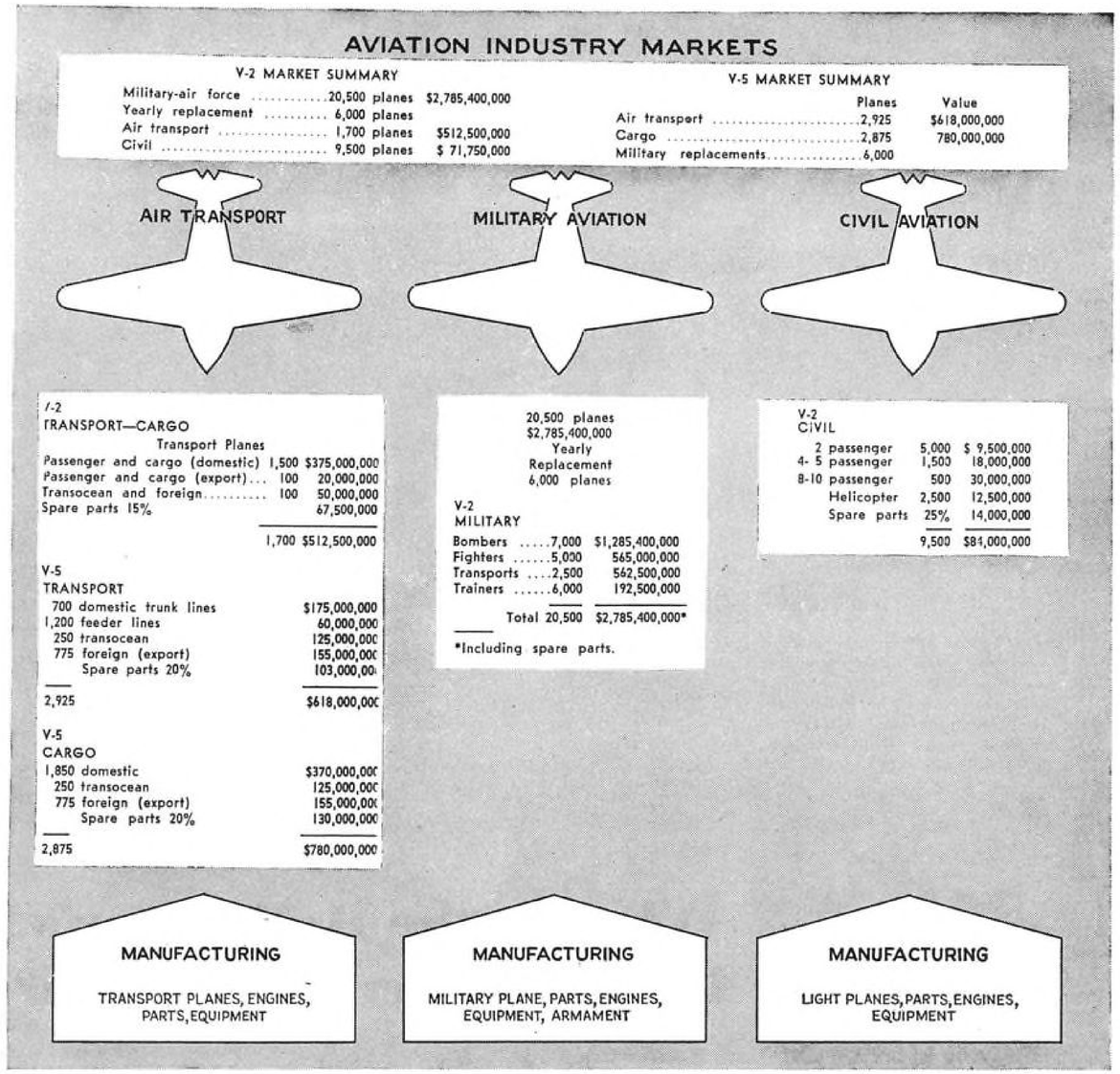
The ultimate military market will depend on five principal factors: First, length and severity of the war and, as a related factor, the number of planes surviving hostilities; second, decisiveness of the victory and the terms of the peace to follow; third, the role of the United States in international policing; fourth, new developments in military craft and the resulting obsolescence rate for existing craft; and fifth, public and congressional reaction toward continued military spending.

Even though there be a reaction against this spending, it is obvious that we will need thousands of planes in our American air forces for self protection, for training new pilots and, just as important, for research. The fallacy of building but a few hundred planes each peacetime year for military purposes has been demonstrated, but the final makeup and size of our standing air force must await the peace and the ensuing public and Congressional reaction to spending.

Due to the fact that the U. S. will have a great many more than 20,500 military planes available, the belief exists in some quarters that a large por-

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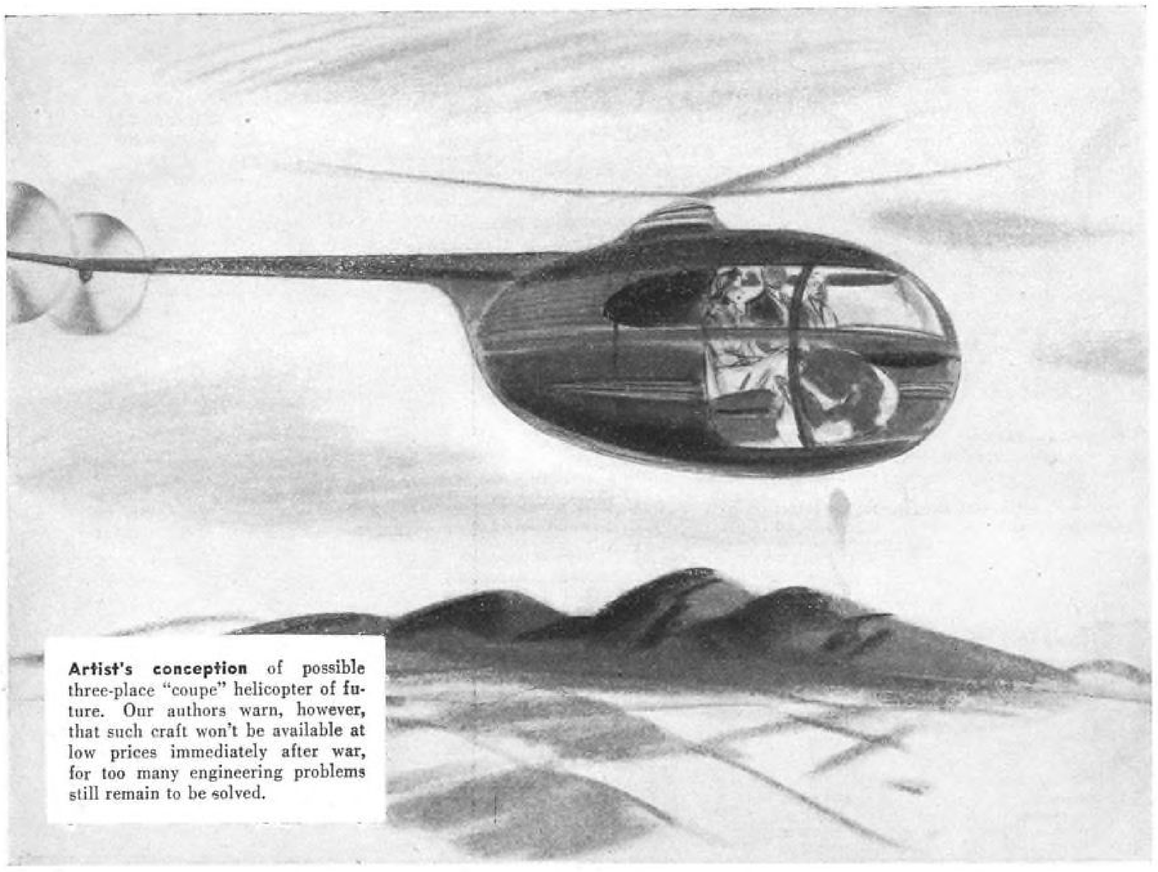


• It would be a pleasant pastime for the aviation industry to bask in the glow of its glorious achievements. Its record of accomplishments during the past three years would certainly justify some resting upon laurels.

But unfortunately we cannot stop for rest. We must look ahead toward the next phase in our development. We must face the cold reality that we will not continue to be the world's largest industry. And with the cooperation of government, we must plan an orderly withdrawal to our proper place in the industrial hierarchy.

First step is to make a realistic quantitative analysis of the probable postwar aircraft markets, and the accompanying article, based on many months of work and study, embodies such an appraisal. Of course, the authors recognize clearly that certain assumptions must be made to provide a base for deductions and that the postwar formula still contains many unknown factors, chief among which is the nature of national and international air policy.

But somewhere a start had to be made—and here it is. Meanwhile, the pages of AVIATION are open for constructive criticism and discussion of this highly important subject.



Artist's conception of possible three-place "coupe" helicopter of future. Our authors warn, however, that such craft won't be available at low prices immediately after war, for too many engineering problems still remain to be solved.

What Is the Helicopter's True Commercial Future?

By **AGNEW E. LARSEN**, *President, and*
JOSEPH S. PECKER, *Chairman of the Board, RotaWings, Inc.*

How this promising craft is engineered—not how it is ballyhooed—will determine the real answer to this big question. There are still many problems ahead. And overselling may undermine the road to their solution unless there is concerted action by the industry.

THE AMERICAN PUBLIC, engineers, aeronautical and otherwise, and practically every type of manufacturer are notably conscious today of the helicopter.

This is so in spite of the fact that there have been but few helicopters manufactured, and these mainly for military purposes. No matter, helicopters are discussed on the radio, in Sunday supplements, magazines, newspaper notices, and in advertisements with a familiarity suggesting that these flying machines are an accomplished product of American industry.

Certainly, this is a very interesting phenomena which bears further examination. It appears that the recent successes of a military helicopter have electrified the public. They have apparently crystalized the dream of the average individual of a safe type of flying machine that could be used for both business and pleasure. This is, furthermore, a confirmation of the opinion held by many engineers and manufacturers that the "rotamobile of the air" is a flying machine that would prove a "natural" for postwar investment and development.

Such widespread interest in the commercial aspects of the helicopter in the coming peace, simultaneous with its introduction as a military machine, points to the birth of a new billion dollar industry.

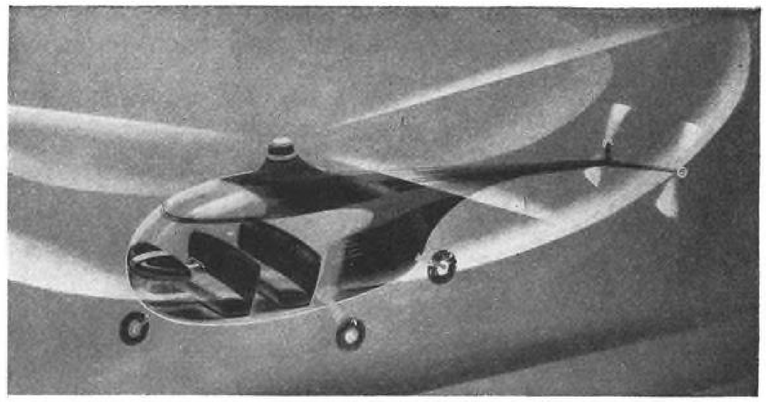
To those of us who have pioneered in the rotating wing industry, it is evident that we have reached an important turning point in the evolution of this art. Therefore it is imperative to review all of the facts that may contribute or retard this budding new industry.

Development of rotating wing aircraft had been somewhat spotty during the first 15 yr. of the fixed wing airplane's remarkable growth. But in 1923 a new and most fertile mind became applied to the many intricate problems. Our reference is to Juan de la Cierva, whose autogyro development literally cracked the "hard shell of the nut" and revealed an entirely new approach to this age-old problem. With persistent experimentation and tenacious application to each of the manifold problems, he produced in rapid order the many stages of the autogyro's phenomenal development—

1. The first successful single-rotor flying machine.
2. The first quantity manufacture of rotary wing aircraft.
3. The first direct control.
4. The first roadable "gyro".
5. The first "jump"-take-off autogyro.

To Harold Pitcairn, the Kelletts, and those associated with them goes the credit of having applied American ingenuity in perfecting the many elements that were finally crystalized into the last word in rotary wing aircraft, namely, the roadable "jump"-take-off autogyro.

Thus, with the solution of the fundamentals, the advance of the helicopter lay bare and ready. With the newly encouraged upsurge all over the world —featuring developments by D'ascania in Italy, Asboth in England, Breguet in France, Florine in Belgium, and Focke in Germany—the time was ripe for the world to have what it had long awaited.



Conception of multi-place helicopter embodying controls of vastly greater simplicity than are available at present stage of rotary wing development. Note twin anti-torque rotors.

To Igor Sikorsky here in America goes the credit for having seen clearly, chosen wisely, and assembled correctly the many elements which went into rendering to the American public an example of this "personalized flying machine".

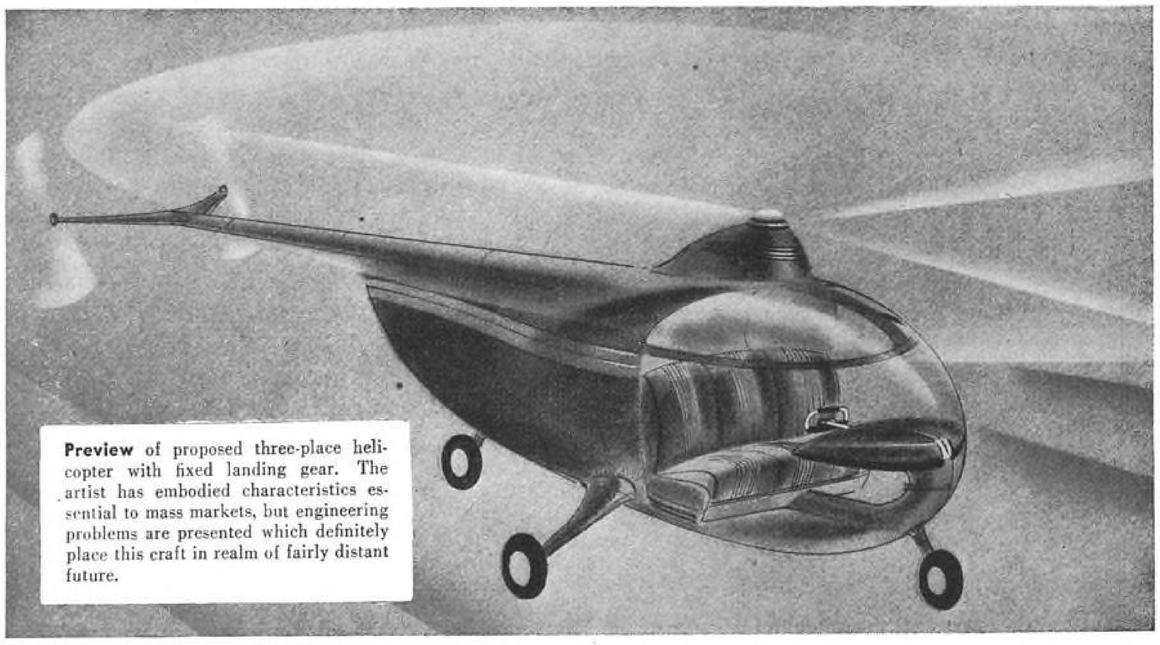
Since the inception of Sikorsky's helicopter, the attendent publicity in newsreels and newspapers has been in a great measure overselling. The "imagineering" of the public is now far in advance of the practical development made by the engineers associated with rotary wing progress. But it must be stated bluntly that there will *not* be available to the public a flood of helicopters at $1,500 each the moment peace is declared. The helicopter of today does not possess the elements that would make it possible for an untrained person to fly. All helicopters developed today of any practical note are for military purposes. Others in the proc-

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• In these days of premature enthusiasm about the helicopter, it is fitting that we present the realistic views of two pioneers in rotary wing aircraft development in America.

Both authors were associated with Harold Pitcairn during his early work in the development of the designs of the late Juan de la Cierva, hence they have vivid recollections of the unfortunate consequences when the public accepted the autogyro before it was technically adanced to the point where it was ready for the public. Their desire to avoid a similar mistake in the development of the helicopter is in full accord with the thinking of the editors of AVIATION.

Since that time the authors have been prominently identified with rotary wing aircraft design and construction. Their new organization, RotaWings, Inc., is dedicated to the solution of the many problems associated with the design and manufacture of all types of these aircraft.



Preview of proposed three-place helicopter with fixed landing gear. The artist has embodied characteristics essential to mass markets, but engineering problems are presented which definitely place this craft in realm of fairly distant future.

AVIATION'S

Maintenance Award For 1943

★

For nearly a decade AVIATION *has made an annual award to one or two airlines in recognition of outstanding maintenance performance.*

Purpose of this Award is to encourage more efficient maintenance procedures and to give due recognition to the men on whom so much of air transport's record and progress depends.

It is impossible to find greater esprit de corps and pride of workmanship than that contained in airline maintenance. But there is never too much incentive for these men, hence they have heartily welcomed the spirit in which the Award has been given.

Now, the incentive of winning the greatest test of this country's history — and the world's, for that matter — transcends anything we may propose. War calls for the most that men can give. To win a war calls for even more. It is precisely that which is being given by our maintenance men, and if anything else can be asked of them, it must be asked only in the name of speedier victory.

But recognition of the maintenance achievement is ours to give. Let there be full meaning attached to this citation.

The ability to transport is the ability to fight. We are winning this bitterest of struggles by the simple expedient of "gittin' thar fustest with the mostest". The very crux of transport operations — whether it be by air, land or sea — is maintenance. In an important sense, therefore, the work of the maintenance men can mean the difference between victory and defeat, and the magnitude of their effort is to be measured by our present opportunity for victory.

But aviation is our specific field, and all must know our pride in the achievements of its operations. We point to aviation maintenance as the foundation stone of the war effort, because it is needed for war, and of peaceful enterprise because it will have the most profound influence on our lives as we shall live them.

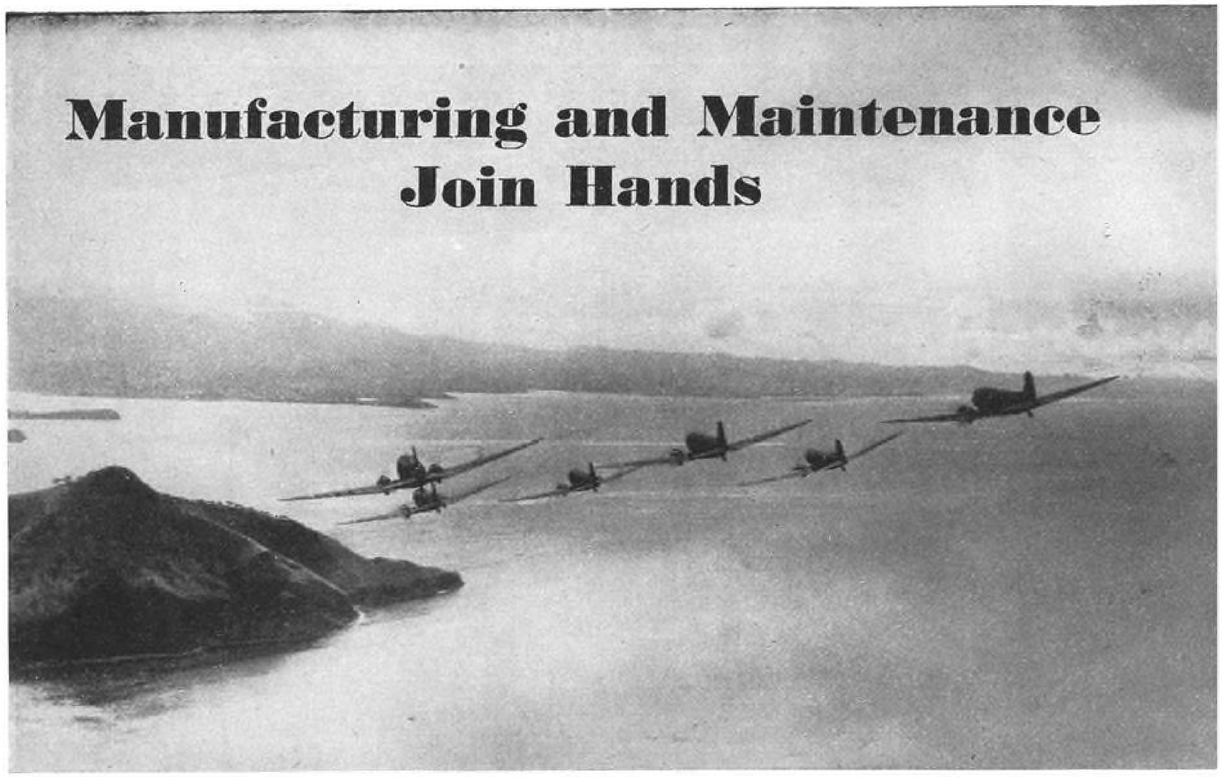
In the instance of total mobilization of resources for a common purpose, the air services of the Army and Navy are closely allied with the airlines. All three are "operations", and recognition of maintenance achievement encompasses them as sum total.

There is no one airline or branch of service that has not shared in this magnificent contribution. AVIATION *is therefore presenting its 1943 Award to the maintenance organizations of all airlines in the United States and Canada, as well as to the service commands of the Army Air Forces and Navy Bureau of Aeronautics.*



ALASKA STAR AIRLINES
ALL AMERICAN AVIATION
AMERICAN AIRLINES
AMERICAN EXPORT AIRLINES
BRANIFF AIRWAYS
CANADIAN PACIFIC AIR LINES
CHICAGO AND SOUTHERN AIR LINES
COLONIAL AIRLINES
CONTINENTAL AIR LINES
DELTA AIR LINES
EASTERN AIR LINES
INLAND AIR LINES
MID-CONTINENT AIRLINES
NATIONAL AIRLINES
NORTHEAST AIRLINES
NORTHWEST AIRLINES
PAN AMERICAN AIRWAYS
PENNSYLVANIA-CENTRAL AIRLINES
TRANS-CANADA AIR LINES
TRANSCONTINENTAL AND WESTERN AIR
UNITED AIR LINES
WESTERN AIR LINES
U.S. ARMY AIR FORCES
U.S. NAVY BUREAU OF AERONAUTICS

Manufacturing and Maintenance Join Hands



Army transports over South Pacific. They can only operate efficiently when carefully maintained. (AAF photo.)

By DONALD S. SPRAGUE, *Service Manager, Douglas Aircraft Co.*

"Divide and conquer" is one way. But "combine and conquer" is another, as Douglas quickly proved by uniting the two vital funds of "how to do it" knowledge—that of the men who maintain planes and that of the men who make them.



Service manuals give complete data on repair work such as this job requires.

SINCE ITS INCEPTION over seven years ago, the service department at Douglas has grown from a small group of half a dozen engineering and maintenance men to the present staff of well over a hundred. And the job has grown, too. It's now the big task of coordinating the service problems arising from the operation of thousands of Douglas airplanes.

During this comparatively brief period of expansion, the scope and organization have likewise undergone a radical change, but the aims have remained the same—to furnish the technical data, information, and material assistance without which continued operation and maintenance of the airplanes would in many cases prove difficult.

For a true understanding of these changes, one must keep in mind the basic functions of a service department. These include preparing and furnishing technical data to military and commercial operators; issuing instructions for, and supervising the salvage and repair of the damaged aircraft; analyzing reports from operators on failures and malfunctioning of parts of the airplane; initiating suitable corrective action to eliminate such troubles; supervising modifications on delivered airplanes; consulting engineers with regard to problems which arise during operation of airplanes; assisting in the solution of these problems through redesign on future models; and, finally, providing through field service representatives assistance to both military and commercial operators in this country and abroad.

In the early days when the number of airplanes in service was relatively small, a maintenance or operations problem was referred back to the small group which then comprised the service department, and the matter was handled on an individual basis. However, the number of airplanes increased. Moreover, various problems and difficulties began to recur. So the necessity for coordination and standardization became apparent.

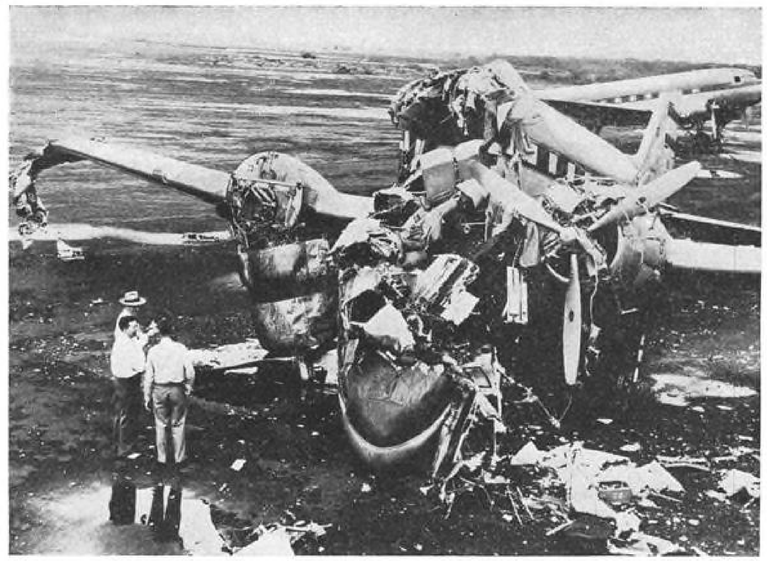
The calls for technical data (these had formerly been worked out on an individual basis) attained a frequency necessitating standardized manuals to which operators could refer when making a change or from which they could obtain technical data without getting in touch with the manufacturer's service department. It was for this reason that the now familiar *DC-3 and DST Typical Repair Manual* was prepared by service department personnel in conjunction with engineering. This manual represents a synthesis of requests received from operators for drawings, stress analyses, and typical repairs encountered in operation of the planes.

As an example of the steps, such as given in this manual, leading to the preparation of drawings and stress analyses for an outer wing handhole, it was first necessary to study the requests received from operators for the location of inspection handholes along the outer wing. Then load factors and allowable stresses throughout the affected area were determined by consulting with the stress group in engineering, after which drawings were made showing the location and dimensions of the requested handhole.

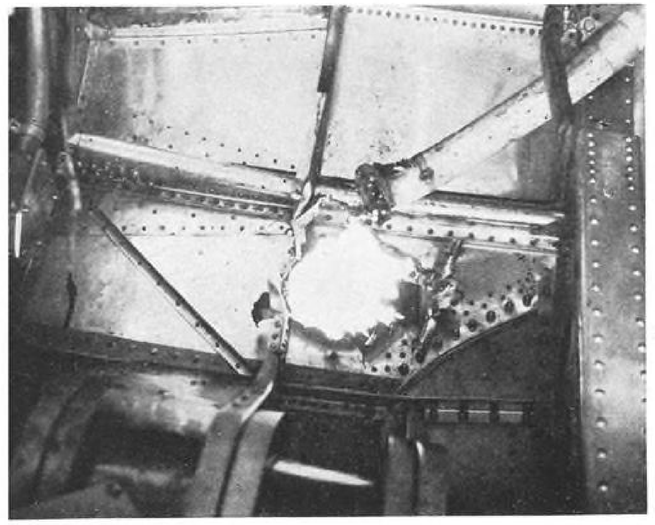
Modifications and repairs described in the manual are the result of many service contacts with operators, and the time consequently saved through publication of a reference work of this type has been to the advantage of all concerned.

In addition to the *DC-3 and DST Typical Repair Manual*, we have assisted in the compilation of data for repair manuals on our cargo and combat type airplanes. Furnished with each airplane, these describe in detail the methods and materials to be used in repairing damage incurred in combat areas or at bases far removed from the facilities offered by large repair depots. These manuals differ from the *Typical Repair Manual* in that they are prepared to be used in the field rather than by airline engineering groups. For this reason, repair procedures and methods are explained at great length with the idea of furnishing required information, drawings, and photographs so that even relatively inexperienced mechanics can effect the needed repairs without engineering assistance.

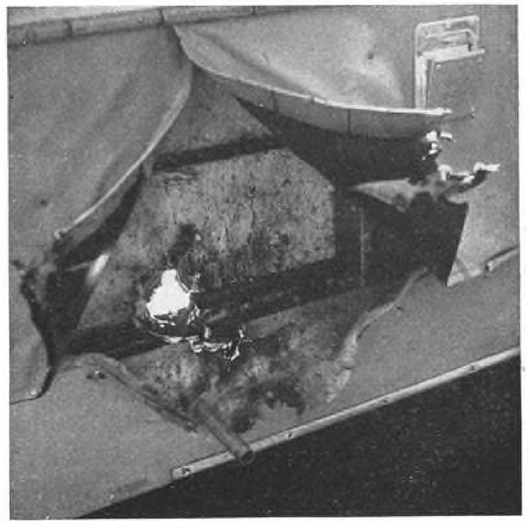
That these manuals have proven of real help to operating organizations is evinced by the numerous reports of on-



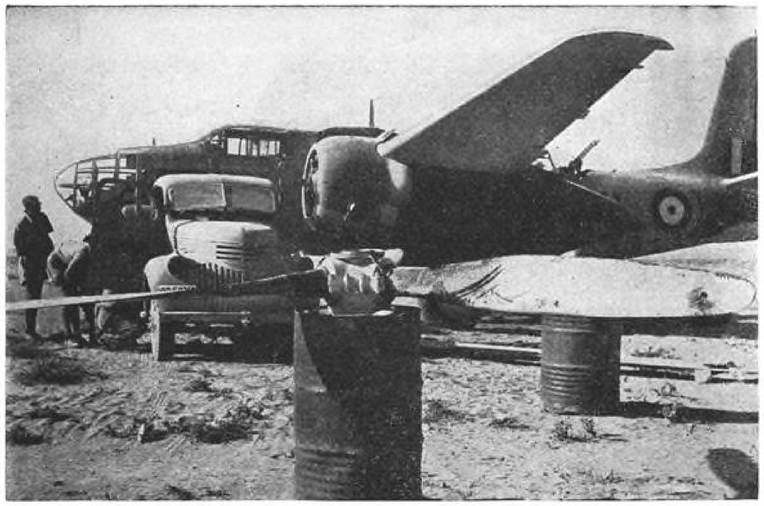
A Douglas service crew rebuilt this airliner thousands of miles from the factory.



In repairing shell holes, engineering information is needed for safe proportioning of work.



Here, a shell battered out the frame as well as the skin and insulation.



One aileron gone, prop blade shot up. Yes, plenty of work for the repair crew of this *Boston* bomber.

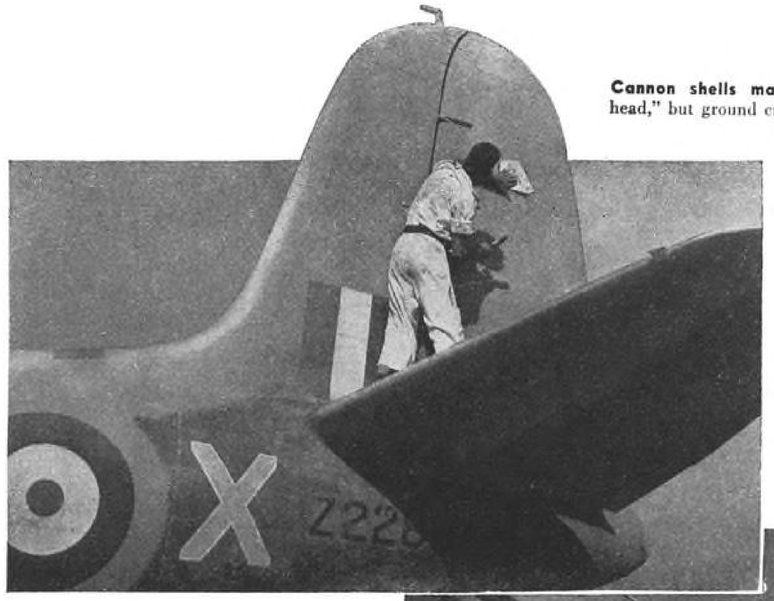
the-scene repairs made with the assistance of the contained data. One such report told of an instance in which an RAF pilot, making an emergency landing in a sandstorm at a field "somewhere in Africa," folded up the nose gear on his DB-7 light bomber when he skidded off the runway. Damage was found to be not too severe, and it was therefore decided to make a temporary repair so that the plane could be flown to a major depot. A study of the drawings of the nose wheel tunnel structure contained in the specific DB-7 repair manual provided sufficient information to start the repair, and with the help of some angle iron, bolts, hand tools, and ingenuity, the nose wheel was soon locked in the down position and reinforced sufficiently to allow the airplane to be flown safely away.

For a service department to be of maximum assistance to its operators at the present time, the dissemination of such technical data is of prime importance. This is why we have supplemented our repair and operational manuals by publication of a monthly magazine, *Douglas Service*, through which we hope to reach the large number of maintenance personnel, both military and commercial, who ordinarily would not have access to the so-called technical publications but who are nevertheless actively engaged in maintaining and operating our airplanes at bases in all parts of the world.

Through this magazine, we intend to convey the latest service changes, maintenance hints and procedures, and other data not ordinarily found in the technical orders but which are vital to the proper servicing and operation of our planes. Due to unforeseen conditions encountered through actual operation, procedures as outlined in a maintenance manual or technical order may have to be drastically altered almost "over night," and to keep field personnel informed as to these changes, we feel that a periodic publication of this nature is requisite.

Naturally, since other plants are manufacturing our equipment, close coordination between the various service branches is required, hence *Douglas Service* contains a summary of the latest items reported by these branches on the particular type airplane manufactured by each. In this way, it is felt that no matter what type of airplane is being maintained at any base, there will always be a section of the magazine devoted to that particular model. Such a publication is symptomatic of the widespread growth of service activities, and it points up the consequent necessity for some means of prompt and accurate dissemination of technical data to new operators and maintenance personnel.

Whereas in the early days of the service department we had a small group which handled any matters pertaining to maintenance and operation, it has been found expedient as the organization has expanded to assign specialists to investigate the problems involving particular components. Thus, we have a small group of highly trained men with engineering backgrounds who specialize on problems involving repair and salvage. Others are engaged in the elimination of service troubles occurring in the systems



Cannon shells make "holes as big as your head," but ground crews patch them in a hurry.

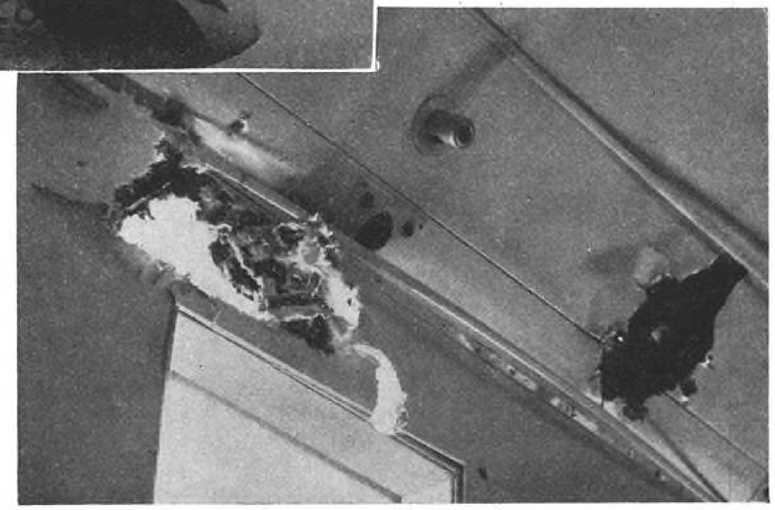
of the airplane, such as hydraulic, electrical, armament, and power plant. Because these men are specialists, problems are referred directly to them for corrective action, thus eliminating much lost motion. These men are in position to analyze the source of trouble quickly, and accordingly either to instigate design changes or to approach directly operators in the field with suggestions for improved maintenance.

Importance of such specialists in influencing future design can hardly be over-emphasized. A man who is thoroughly familiar with the operating experience gained on a system over a period of time can furnish the engineering staff with much information of decided assistance in redesigning to eliminate recurrent service difficulties and excess maintenance on future models.

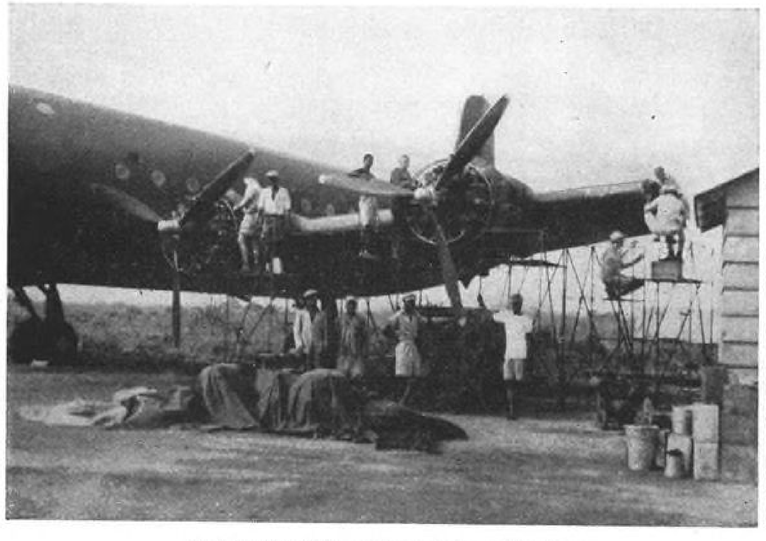
It is definitely felt that through the increased specialization by members of a service department, the service and assistance given the various operators can be materially increased.

Coincident with the growth and specialization of office personnel has been the increase of the field service staff, which is providing an invaluable source of on-the-scene instruction and assistance to both military and commercial operators. Formerly, when an operator

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Both shells and bullets were stopped by this airliner at Pearl Harbor. Another tricky repair job.



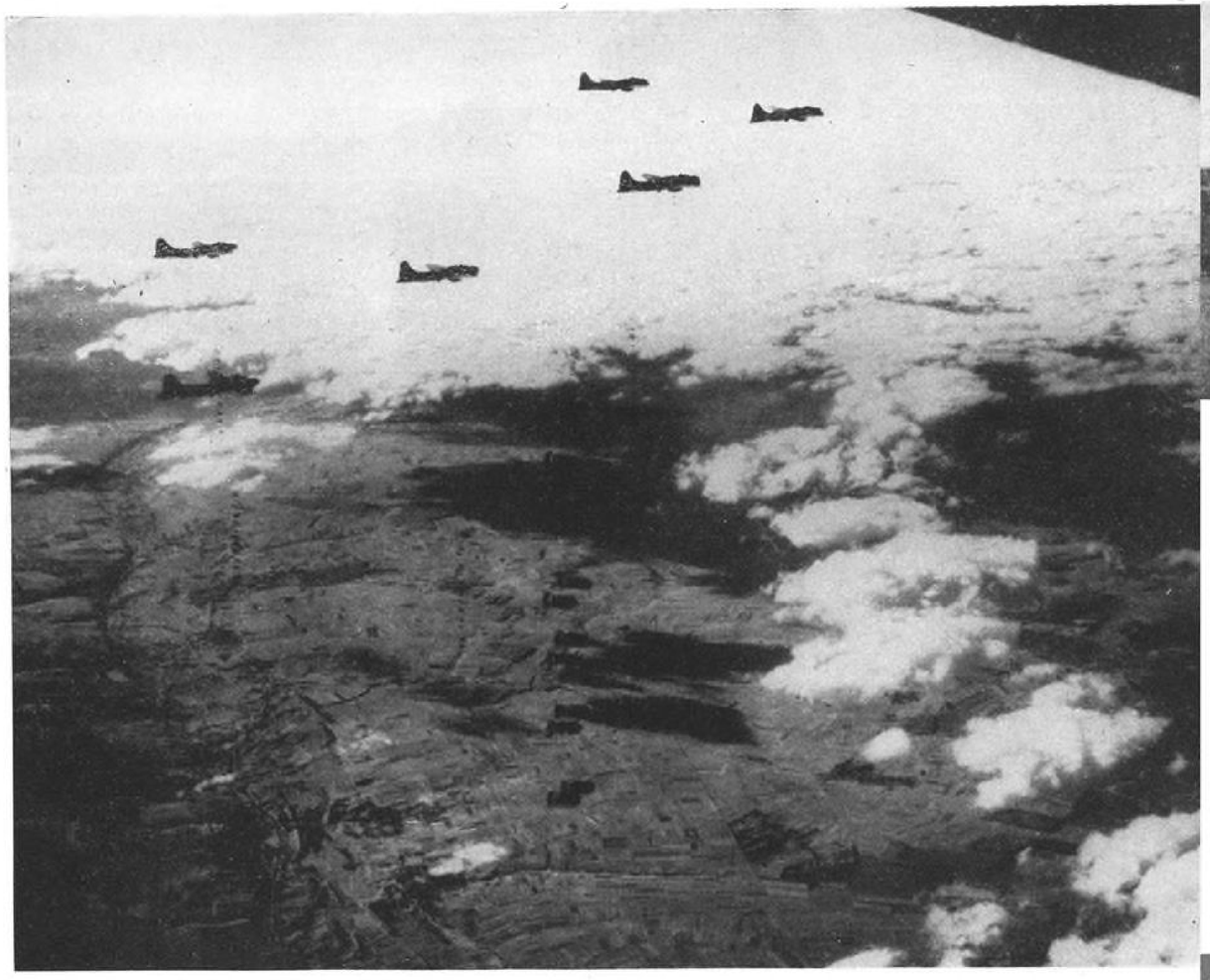
On jobs like this, engineers help maintenance men—and gain a lot of information themselves.



A servicing scene in North Africa. These men pass on their "know how" to others.



'Chutists clear ground for airborne troops. Later, maintenance men will have plenty of shot-up planes to repair. (USASC photo.)



Action shot of Amiens-Glissy raid in which B-17 "Tough S——" received near-fatal wounds described by Author Cave. It was just a few moments after this "bombs away" snap was taken that Focke-Wulf 190 collided with *Fortress*. (International photo.)

"Sighted Wreck, Repaired Same"

By **MYLES V. CAVE**, *"Aviation's" British Correspondent*

How mobile service units of 8th Air Force Service Command roam England fixing damaged aircraft which "didn't quite make it."

CONTINUATION by the 8th Air Force of its day bombing activities has vindicated Gen. Ira C. Eaker's theory—i.e., through greater bombing accuracy a smaller gross bomb tonnage can effect damage equal to that of a night "saturation" raid. At the same time, bombing by day supplements the vicious RAF onslaughts and puts the air offensive on a 24-hr. basis.

But day bombing inevitably means a heavy toll of shot-up aircraft which soon become a growing liability if repairs are unable to keep step. In fact, speed of repair is a critical factor in maintaining the pace needed to crush the Nazis surely and quickly.

The mobile service unit, pioneered and developed in the European theater by Maj. Gen. Henry J. F. Miller, commanding the 8th Air Force Service Command, is providing the answer to this important requirement. It is simply a highly developed process of taking the repair shop to the wrecked plane—instead of the former time-and-trouble method of taking the plane to the repair depot.

Partly responsible for the recent buildup of AAF bomber strength in the European theater, this mobile service has been so successful that the number of units is being multiplied many times over to meet increasing requirements. In fact, the units are now organized under a sub-command known as Advance Air Service, with Col. Charles M. Steinmetz serving as commander at headquarters. Assignment of the repair



A *Flying Fortress*, badly damaged after raising hell over Naziland, makes emergency landing in English field. Mobile service units arrive to completely repair plane for return to base under its own power. This method puts ship back in service much quicker than former system of dismantling and hauling it back to an established depot for repairs.

units to various jobs is handled by a central control board which makes a preliminary investigation of the damaged planes. If it is decided that the ship is repairable, then a mobile service unit moves in; otherwise all usable material and parts are salvaged.

Control headquarters maintains direct liaison with operational commands and with an advance air depot in the immediate vicinity of each combat wing. All advance depots provide complete maintenance, repair, and service facilities for the type of plane in service in their respective wings. Mobile units are allocated to all advance depots and, in addition, there are "floater" units attached to headquarters to cover remote



One of eight huge trucks of a mobile service unit which now travels over Britain repairing damaged bombers and fighters. If plane is so badly wrecked that mobile units can't put it into flying condition, it's ready for salvage or junk heap.



Mobile service units are completely equipped for anything. Working in this shop-on-wheels are, left to right, Staff Sgt. G. L. Wintersole of Portsmouth, Ohio; John Bakalian of Paterson, N. J., a Lockheed Overseas Corp. technician; and Sgt. Reimers of Wellows, Calif. A repair crew of a mobile unit consists of around 19 men.



All tools and equipment are packed compactly. Each mobile unit of Eighth Air Force Service Command carries a nearly complete line of accessories and spare parts.

regions when the need arises. When there are no specific jobs for these travelling units, they are kept at airfields repairing damaged planes. Being mobile, they quickly can be diverted from one squadron to another to meet urgent demands for extra service.

A typical example of how the mobile service unit swings into action is contained in the story of a *Flying Fortress*, named "Tough S——," which played a star role during a mission to Amiens-Glissy, a very heavily defended French target.

Flying in their customary tight formation, the *Fortresses* had just unloaded on their objective and were wheeling around at better than 200 mph., observing results, when Tough S——, one of the outside planes, fired at an FW-190 which was making a climbing turn. The shooting of one of our gunners—2nd Lt. Robert C. Black—was deadly, probably killing the German pilot. This caused the 190 to continue in its turn, and it whammed into the starboard wing of the Tough S——, leaving one of its 20 mm. cannon burled deep in the Yankee's wing.

The Focke-Wulf then skidded over the top of the wing surface, putting out the No. 3 engine, bending up the waist gun position like a pretzel, and finally gouging a big hole in the stabilizer fin.

It is safe to reckon that the Focke-Wulf was making some 380 mph. Thus the combined impact rate would be around 600 mph., and because of the FW's bulk that's a lot worse than the direct hit of a large caliber anti-aircraft shell.

The *Fort's* wing was torn, twisted, and crimped so that not even Boeing's most optimistic aerodynamics expert would have believed the B-17 had a chance. Logical continuation was an unsteady, steep angle dive to the nearest piece of earth. The outboard engine was running rough . . . the inboard one was dead . . . all flying controls were sprung out of line, making maintenance of flying stability a superman job for the pilot . . . and other damage was considerable.

Despite all this, Pilot Edwin R. Manchester, of Wilmington, Del., opened up his remaining engines and set a course for home, instructing his crew to send out flare signals calling escorting P-47's to handle six more FW-190's which were now doing all they knew how to make Tough S—— and her crew permanent casualties.

And thus the *Fort* came back to England—not as a lone straggler but still a very definite member of the original family. Throughout, the pilot's feats of strength and skill and the efforts of his crew equalled the amazing stamina of the B-17.

When finally the English coastline appeared, Tough S—— started losing height. The crew decided it was asking too much to make their home airfield, so the pilot selected a potato field and belly-flopped the B-17 as gently as possible. Site of the landing was one of those small English fields which checkerboard the island and which rarely offer more than a few acres, necessitating a belly landing even if the landing gear were working. Damage was so extensive that the B-17 seemed a sure thing for repair at the main depot located over 200 mi. away. Nevertheless, the central control board's technicians figured a mobile service unit *could* handle the project, and it gave appropriate instructions.

The control board's inspectors arrived at the location ahead of the service unit to make a complete damage report and an inventory of spares to be procured. All this is tricky work. A thorough job is required because inexpert knowledge delays the arrival of spares, replacements, and material. And if some damage is overlooked there's more delay.

Soon a number of vast trucks, resembling a miniature Atlantic convoy, was trundling down the road. Finally this caravan plowed through the surrounding hedge, and with no respect for the farmers' "Dig for Victory" potatoes, took up their positions around Tough S——. Immediately the crew prepared to start repairs.

A complete mobile service unit consists of the following eight vehicles—

1. Large truck and trailer equipped as machine shop with the following tool equipment: Lodge & Shipley toolmaker's lathe, Doall multi-purpose saw, Landis heavy duty universal grinder, Pratt & Whitney universal mill, oxy-acetylene welding plant, tool and cutter grinder, and air compressor unit. Sheet metal tools include beating blocks, a comprehensive supply of small tools, a fitting bench with vises, etc. The truck also carries an electric generating plant to serve the machine tools plus other requirements of the whole camp.

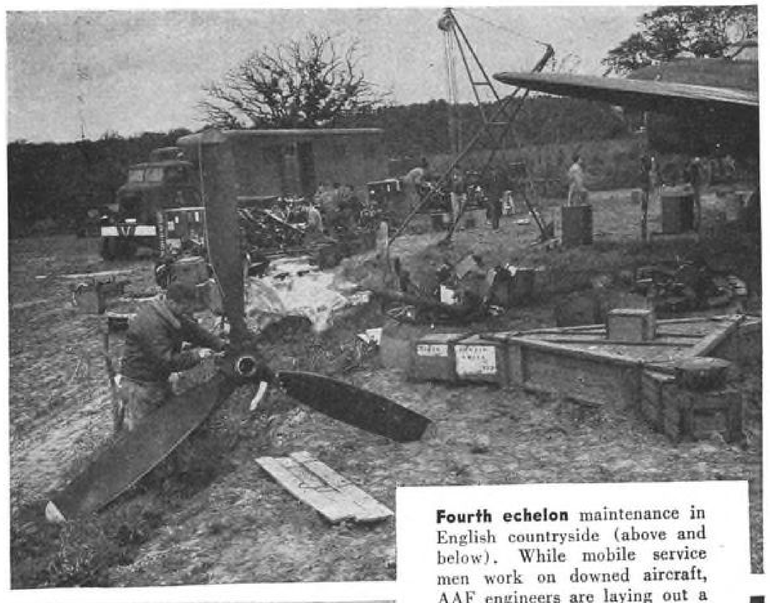
2. Large truck and trailer of similar design fitted out as a store for bar and sheet material, small parts, tools, etc.

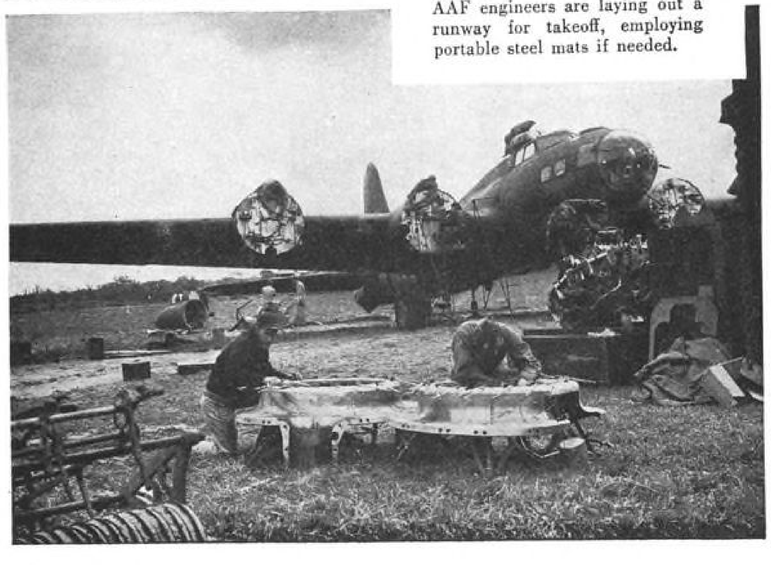
3. Large truck and trailer fitted out with a kitchen and a "bedroom" providing bunks for the 19 men who make up the personnel of the unit (13 U. S. soldiers and 6 experts of Lockheed Overseas Corp.). If hotel accommodation is available, nearby it is used in preference to the bunks.

4. Two jeeps for collecting necessary material and contacting nearby airfields.

5. One 2½-ton truck for hauling heavy material and transporting personnel.

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Fourth echelon maintenance in English countryside (above and below). While mobile service men work on downed aircraft, AAF engineers are laying out a runway for takeoff, employing portable steel mats if needed.



Interior of parts trailer of a mobile service unit. Here are stored spare parts needed to put damaged planes into flying shape. Units have a "pipe line" from supply depot, which keeps replenishing required parts.



Time out for chow. The mobile service unit has complete feeding facilities, its mess rivaling best in service. A sleeping van is also included in unit, with accommodations equivalent to those in any fixed barracks.



Welcome sight to mobile service crews is American Red Cross Clubmobile which stops to serve doughnuts and coffee to hard-working mechanics and technicians.



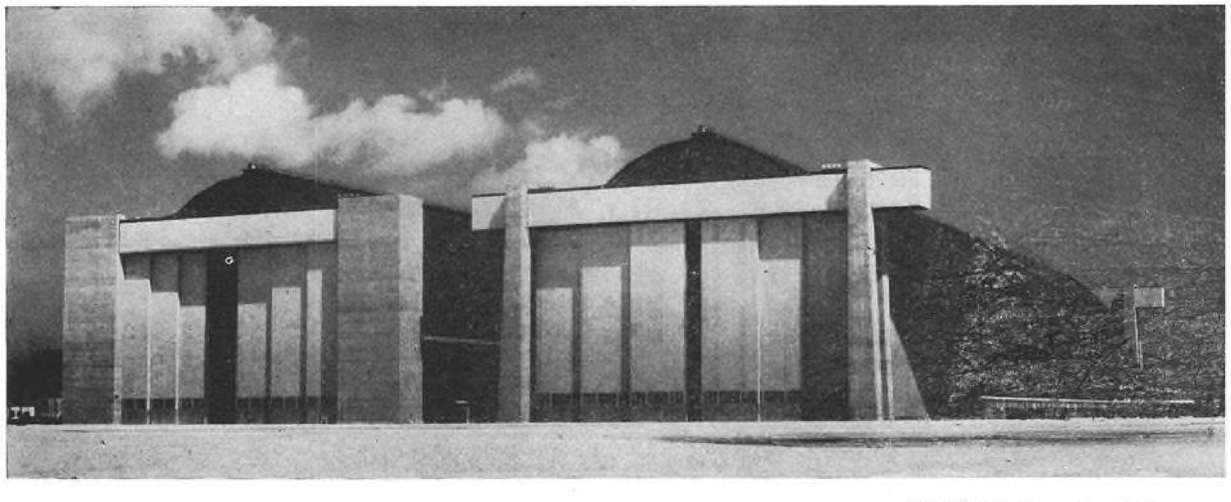
Repairs completed, *Fortress* is taxied across field to temporary runway laid out by Army engineers. Plane will fly back to its base for check flights before being recommissioned.

Maintaining Sub Killers

By LT. COMDR. ROBERT E. HUSE, USNR
Asst. Assembly & Repair Officer, Naval Air Station, Richmond, Fla.



Below: Two of three huge hangars at Richmond Naval Air Station where complete maintenance and overhaul facilities are established for blimps operating in Southeastern United States area. (Official U. S. Navy photos.)



FIRST ARTICLE EVER PUBLISHED ON MAINTENANCE AND REPAIR OF OUR NAVY'S BLIMPS

These craft, key weapons in the successful fight against the submarine menace, are writing one of the truly great stories of the war.

GRACEFUL AND IMPRESSIVE, the great silver airships of the U. S. Navy soar overhead. They are doing their part in winning the battle against the Axis submarines, they are effecting rescues both at sea and on land, and they are carrying out special missions and assignments in connection with their duties as parts and parcels of the United States Fleets.

Day in and day out, and night in and night out, the big helium-filled blimps, with their heroic crews, lift into the skies, unheralded and unsung. Blimps are credited with having performed invaluable services in convoy work; these airships are held in high regard by the Navy and by their companions of the airlanes, the heavier-than-air units.

Complex and interesting is the behind-the-scenes picture of the blimps—the problems of assembly and repair—their overhaul, upkeep, and servicing. Just as there must be at least ten men behind every heavier-than-air pilot, there must be as many, if not more, behind every pilot who flies a blimp. "A & R", the lighter-than-air assembly and repair department, is a closely knit, highly efficient, expertly staffed organization, which has been laboring 24 hr. a day—even as the airships themselves patrolled the skies—to "keep 'em up."

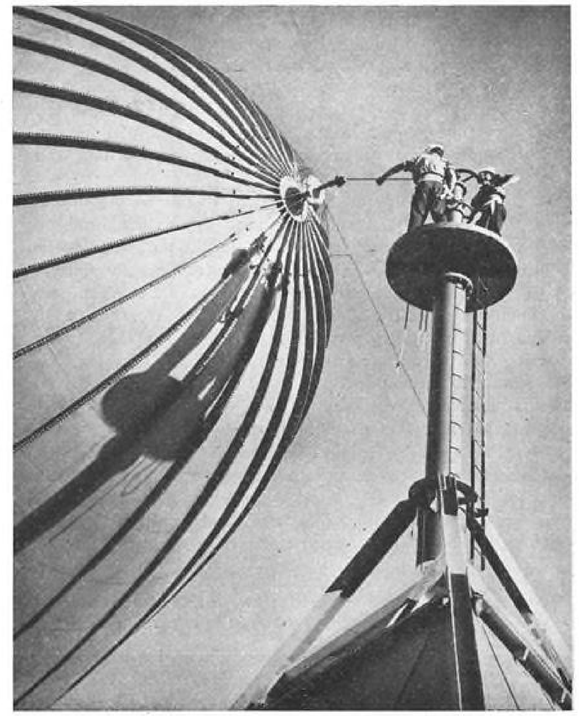
Typical is the A & R Department at the Navy's big new overhaul and operation base at Richmond, Fla. In mid-September, 1942, the Naval Air Station at Richmond was officially commissioned. It was a Naval Air Station in name only, since the 2,100 acres of scrub pine were just another spot in the edge of the Everglades. A landing mat and two runways were hacked out of the wilderness, and the mat was surfaced with easily obtainable coral rock. Even before this was completed, the first airship was ferried in from Lakehurst, N. J. The newly commissioned squadron began operating, making the most of the makeshift facilities available.

In the early days of the station, airships were "masted out" at all times when not actually flying. Handicapped by lack of regular shop facilities, expedient and novel methods were employed to accomplish upkeep and maintenance work while the airships were riding unsheltered to their masts.

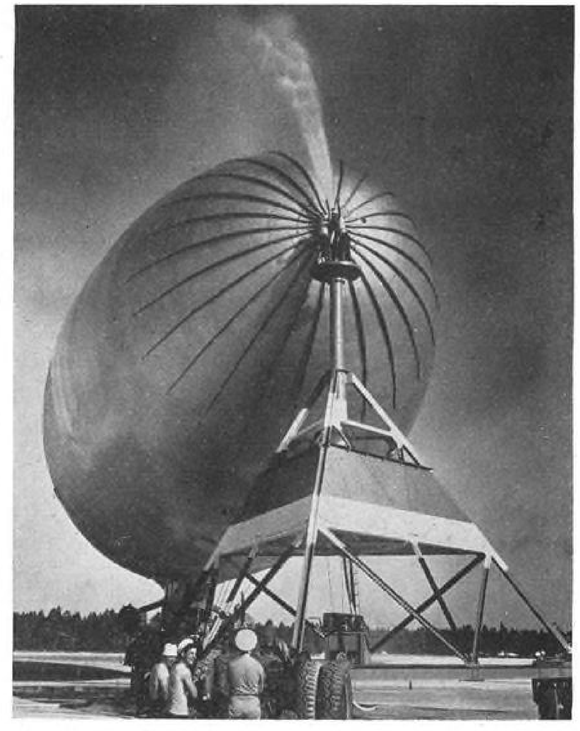
A mast watch officer and two enlisted men stayed with each ship, adjusting pressure and ballast as the helium in the large envelopes reacted to the constantly changing atmospheric conditions caused by sunshine, rain, and fluctuating barometric pressures and air temperatures. One of the huge tripod masts was fitted with a bunk-room in which the mast watchers, while immediately available for a call, took turns catching forty winks between watches.

With the squadron thus established and operating, work

This initial detailed revelation of blimp maintenance was written under the direction of Rear Adm. Charles E. Rosendahl, USN, Chief L.T.A. Training Command; Capt. Chas. J. Maguire, USN; Capt. Frank L. Warden, USN, C. O. NAS, Richmond; and Lt. Comdr. J. H. Greenwald, USNR, A & R Officer, NAS, Richmond.



Life-belted crewmen steer nose of a blimp to mooring mast. A line, running down through mast to a winch, is attached to permanent cable secured to blimp's nose. Winch is operated by an electric motor, and airship is drawn to lock at top of mast.



An Atlantic Fleet "K" ship, moored without protection from tropical sun, is "wet down" by a hose arrangement attached to portable mooring mast.

was begun on the first of the three immense wooden hangars to be built. The end was many months away, but the skeleton of a department had been created. An A & R officer was ordered to the station, and a staff of officers, enlisted men, and civilian specialists arrived to form the nucleus of the repair force being assembled. Shops were outlined, equipment ordered, and all of the intricacies of the overhaul and repair of the K-ships were analyzed.

The spirit of "can do" was instilled from the beginning. As the one and only function of the department was to "keep 'em flying," innumerable emergency repairs had to be accomplished at any hour required. Routine engine changes had never before been effected without the protection and convenience of a hangar, but ten Pratt & Whitney 1340 AN-2 aircraft engines weighing close to 1,000 lb. were changed while ships were masted outside.

At first, one engine job per night was all that could be done. But, saying "can do," a unique outside work stand was constructed. With this stand attached to the ship itself, it was finally possible to remove and replace both engines of an airship, run them in, and have the ship ready for a 0500 takeoff (a 5 a.m. flight). Almost every type of emergency repair was handled—including damaged landing wheels, broken tail wheels, and scraped tail fins—in addition to the regular routine checks by the organized and trained lighter-than-air specialists of the night check crews.

In June, 1943, the structure of the No. 1 Hangar, A & R's home, was completed. Then hangar operations were begun, although machinery and shop equipment were far from complete. The personnel problem was a difficult one. Although every man assigned to A & R possessed an attitude of willingness, interest, and enthusiasm, the majority lacked previous experience or training in airship work. However, this newly formed green crew "turned to" with a will for accomplishment, gaining in experience as interim overhaul of K-ships was begun.

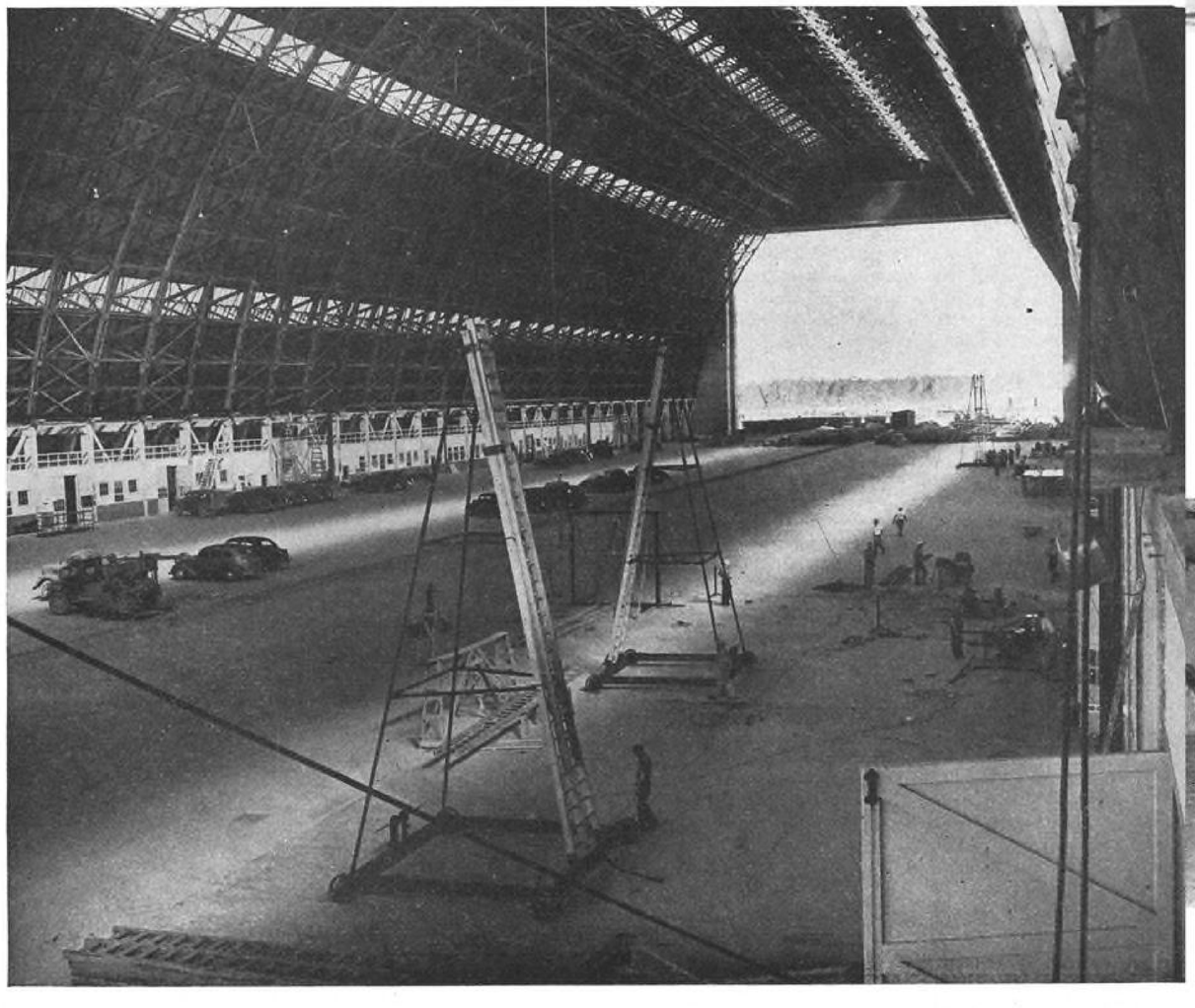
Interim overhauls, scheduled after approximately 1,000 hr. of flight time, require 10 to 14 days to accomplish. As work began, groups of Navy and civilian specialists literally swarmed over all parts of the ship.

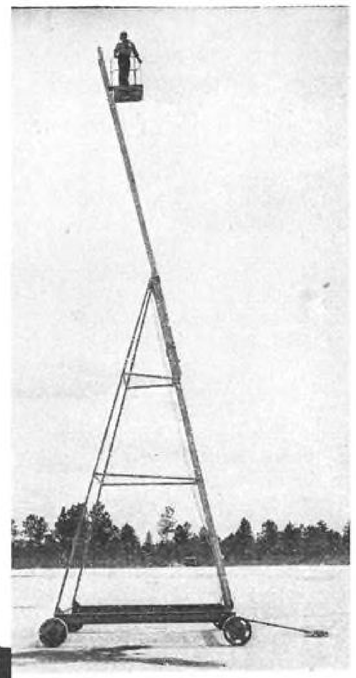
Almost all removable gear is taken from the ship and removed to shops for re-conditioning and repair. Radio, special equipment, life jackets and rafts, instruments, major and minor controls, chairs, engines, and accessories, fuel tanks and gages—all are taken to shops having cognizance over them.

The envelope is plumb-bobbed to determine its alignment and whether or not any distortion has taken place. If any misalignment is noted, fins are reset to attain the proper flying characteristics. "High-men" work up in boatswains' chairs rigged to the 180-ft. overhead of the hangar. They inspect the top of the envelopes, minutely noting any defects or unusual wear as well as re-tensioning all fin brace wires. A nose crew removes and reconditions the long slender nose battens, and riggers and cable men disassemble the nose mooring assembly.

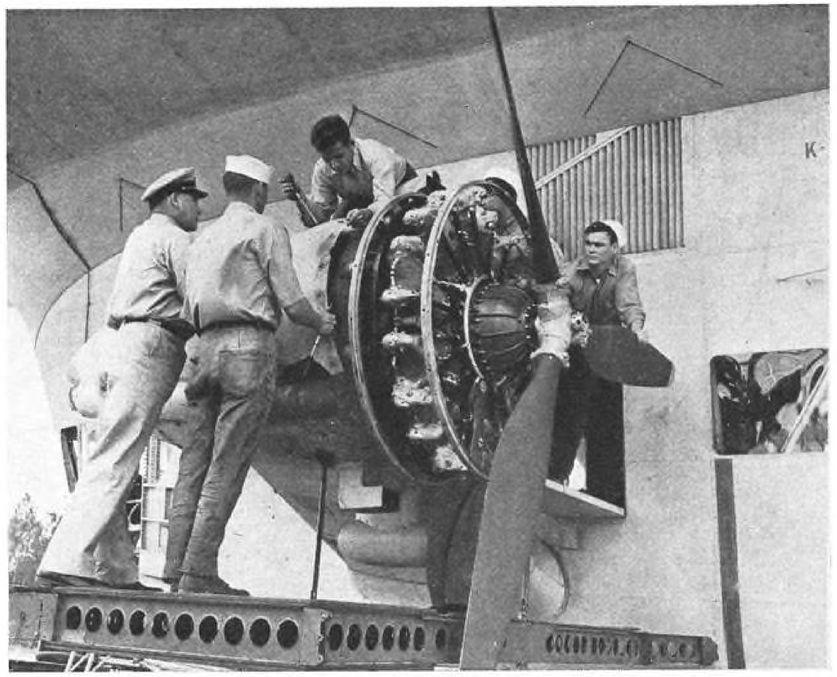
Bit by bit, the airship is completely torn down, and all but the car and bag itself is sent to one or more of the 20 shops that are part of A & R. After necessary checking and servicing, the various parts are returned to the ship

View inside partially completed hangar at Richmond station. Shown in foreground are service ladders constructed by A & R personnel.





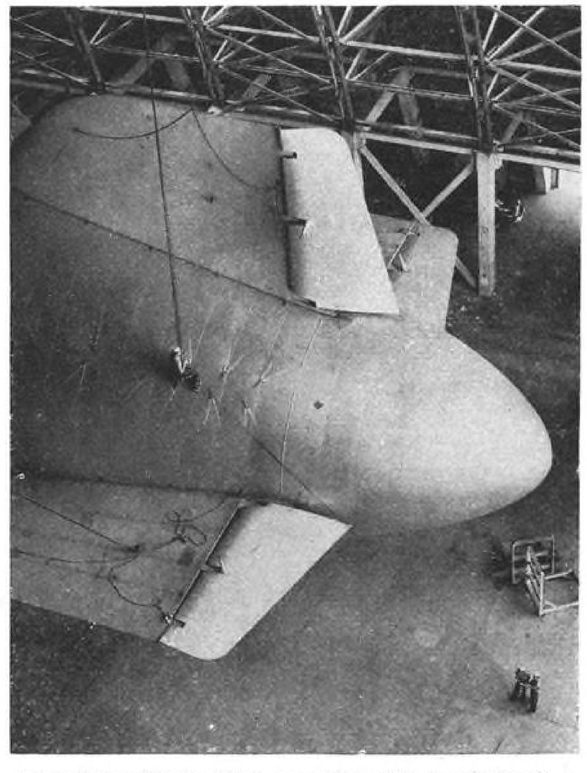
Richmond A & R (Assembly and Repair) engineers fabricated ladders, such as one shown here, out of odds and ends of non-critical materials.



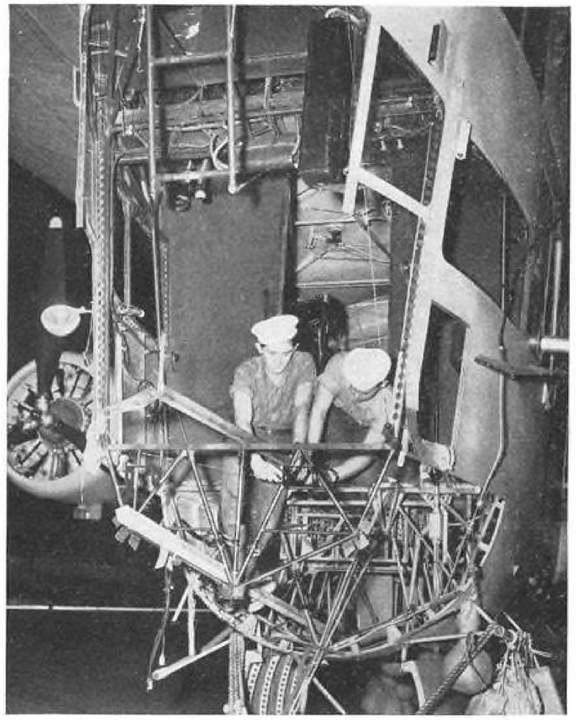
For first time repair crews at Richmond changed blimp engines out in open, with blimp attached to portable mooring mast. Note well-constructed work platform slung from engine nacelle and attached to car. Mechanic (extreme right) is standing on platform which swings out from side of car for servicing engine while in flight.



A blimp landing wheel is "pulled" under guidance of a chief aviation machinist mate. Bearing full weight of huge airship, wheels require careful checking and inspection.



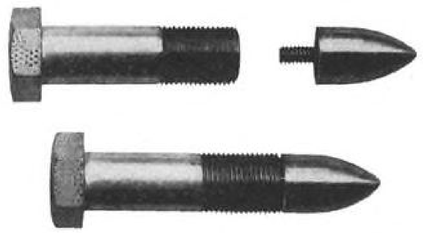
Inspecting a K-type blimp. Inspecting sailor is swinging in a bosun's chair some 150 ft. above hangar deck. He is held steady and maneuvered by his mates far below.



A & R members effect emergency repairs on damaged nose of a blimp car.

and reconstruction is begun. When painting and Plexiglas work is completed, the various parts of the ship are re-assembled and the finished product takes form. Finally, after completion of all the required work, the dock trials of the ship are begun. Valves are tested for proper calibration, engines are run in, fuel, oil, and electrical systems are checked. Then expert inspectors finally pronounce the ship ready for a test flight.

Although "lighter-than-air" is the designation for the large patrol blimps, supported by the static lift of the helium gas, actually they are usually flown initially heavy. Consequently, they must take off and sustain themselves in flight



Special purpose bolt developed by Richmond A & R technicians to take care of not-quite-aligning bolt holes. Complete bolt is driven through joining members, bullet-like guiding tip is unscrewed, and bolt is secured with a nut in regular manner.

aided by the dynamic lift gained from their forward motion and airspeed. For this reason, the ship is ballasted with sand so it is about 1,500 lb. heavy for its test hop. In the dim light of early morning, the test crew climbs aboard and the ship is undocked from the hangar by a ground handling party of 40 to 60 men.

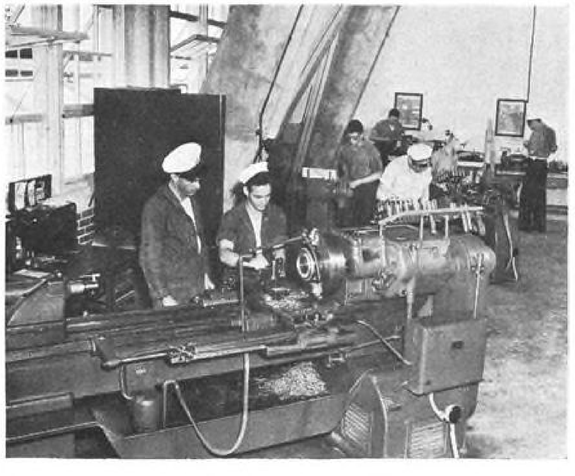
After being spotted for the maximum length of field for the takeoff, the nose mooring pendant is released from the mast, the mast is hauled away, and the ship weighed-off. All lines slack, and with the car untouched, the trim of the ship is determined—nose heavy, tail heavy, or in trim. After the proper trim is obtained, the pilot clears his engines and signals to the ground handling officer for takeoff. Held into the wind by two short lines, the huge ship gradually picks up speed, and after a 500 to 1,000-ft. run it is airborne.

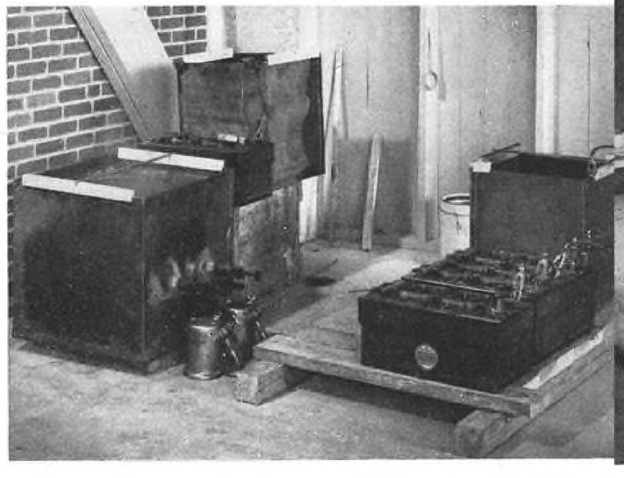
Once in the air, the real tests begin. Rate of climb and descent at various engine speeds are tried to assure the strength and stability of the huge ship. Then speed trials are run: The amount of elevator needed to fly at constant altitude is noted for each speed range. Radio, special equipment, life jackets and raft, bomb releases, and machine guns are tested.

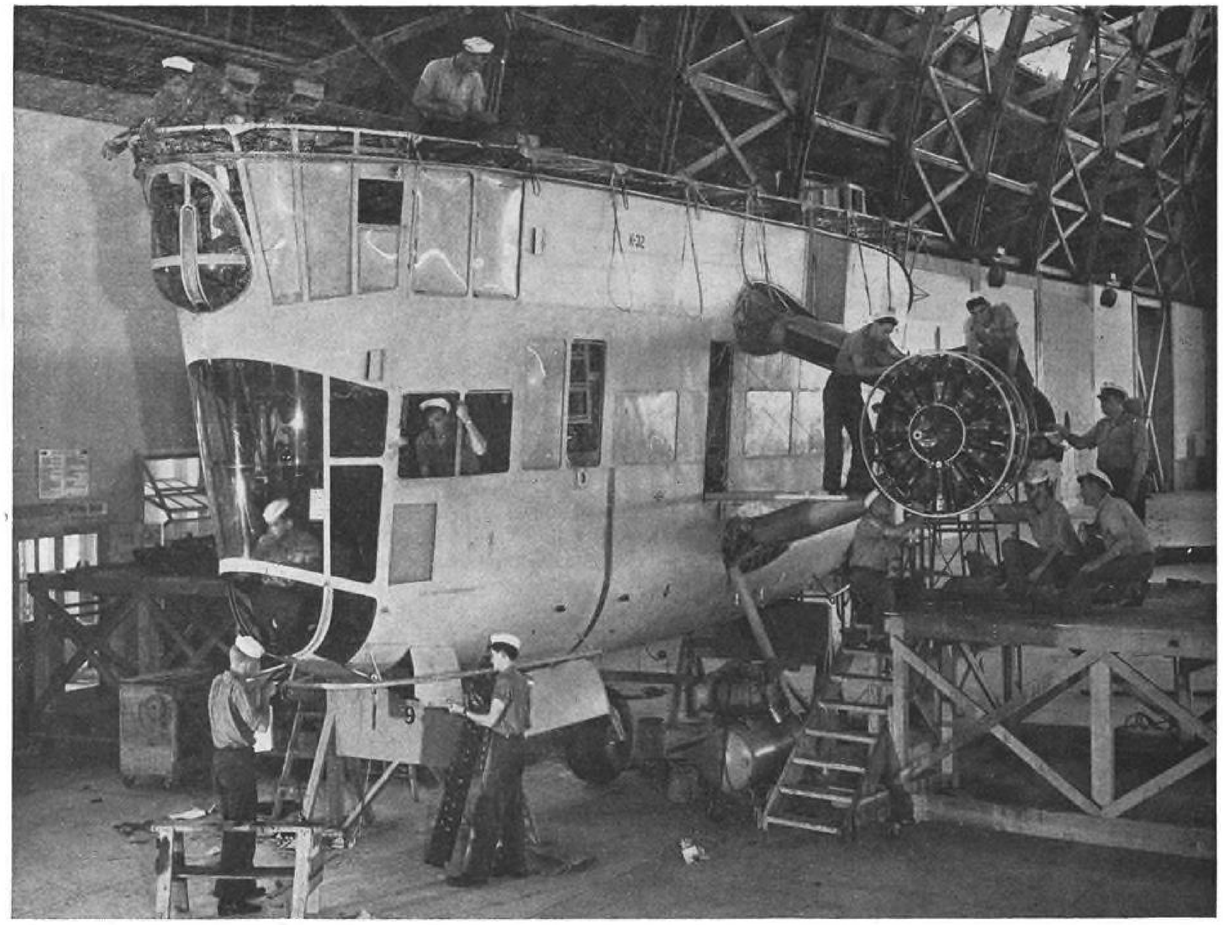
Next, the sand ballast is dumped out and the flight characteristics are carefully noted for all conditions, from the original degree of heaviness to equilibrium. Finally, with the ship in equilibrium and engines throttled all the way back, the trim of the ship is noted.

With all of this data assembled, the ship is flown back to the base and nosed down for a landing. With almost

There is all kinds of equipment to do job. Seen are late-model engine lathe in machine shop at Richmond, and improvised electro-plating set-up using batteries for current, and two blow torches for cadmium and chrome plating and anodizing.

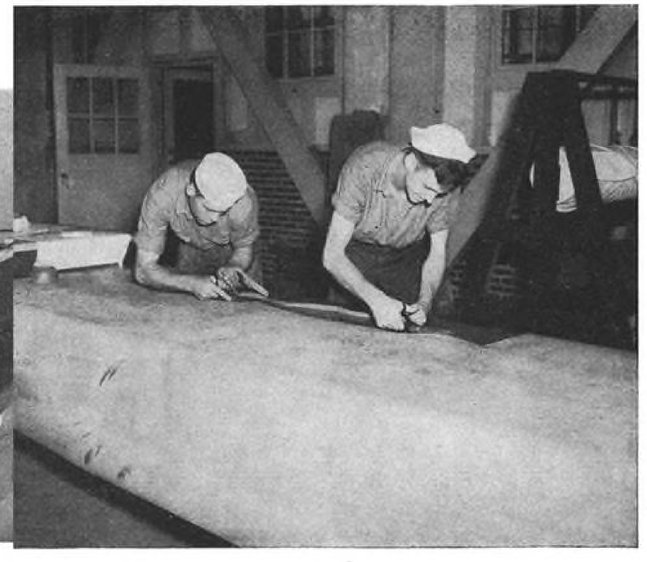




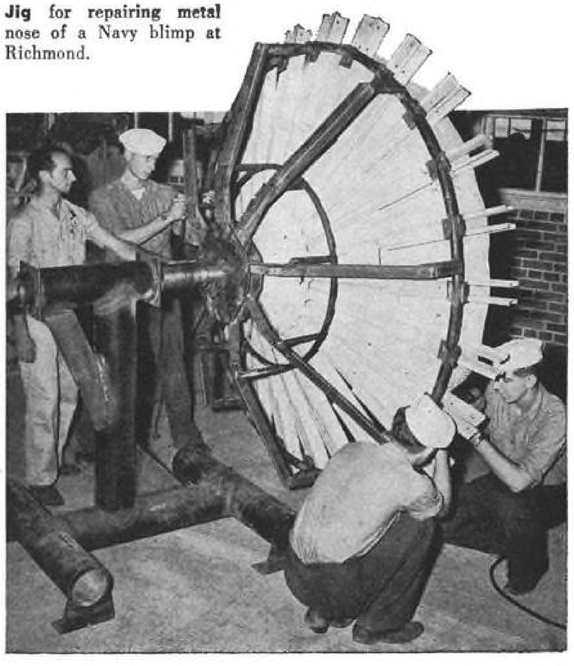


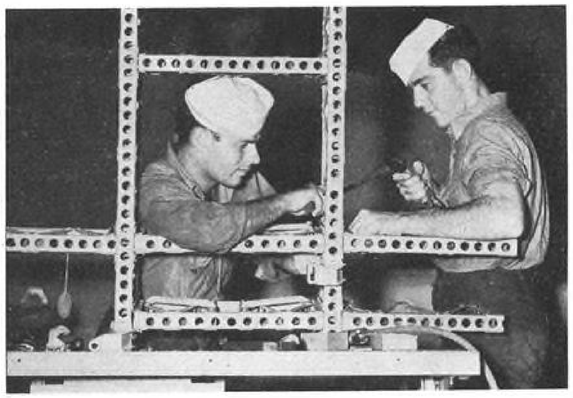
A blimp's car, detached from bag, undergoes a complete overhaul along with ship's engines.

Fabric repair shop is one of most important in line of shops at Richmond. Sailors and civilians work together in cutting and fitting fabric, fabricating sandbags and other items connected with blimp operation and maintenance.

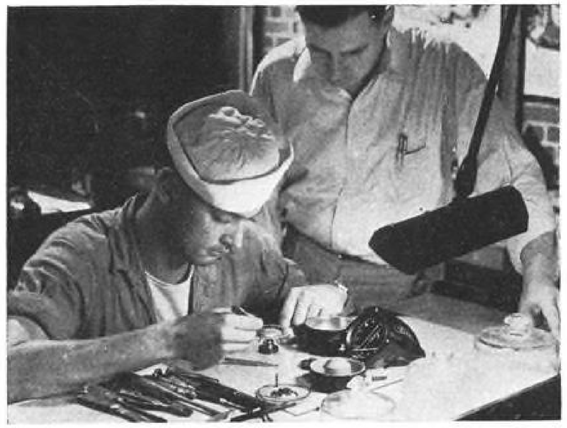


Jig for repairing metal nose of a Navy blimp at Richmond.





Aviation metalsmiths repairing framework of a blimp's car.



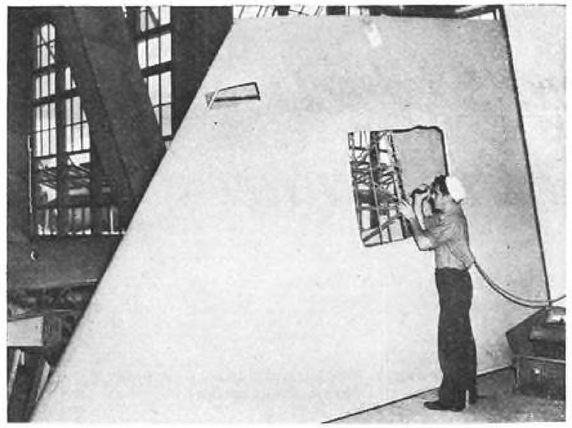
Expert craftsmen repair and service all instruments at Richmond.



Checking balance of propellers used by Navy blimps.

no forward speed, the ship hovers over the field, and the "long lines" are dropped to the ground handling party. The ship is hauled down, masted, then re-docked.

Once docked, the final touching-up is begun. Data collected on the test flight is analyzed—and the production superintendent, overhaul superintendent, and test pilot are informed as to changes or improvements to be made. Readjustment of control surfaces, re-tensioning of suspensions, or perhaps minor adjustments of controls or instruments, are decided upon and made. The ship is then fueled and turned over to the fly-away crew, perhaps to go to a closeby station or perhaps to make a series of long hops to a remote advance base. It may not be inside of a hangar again for months.

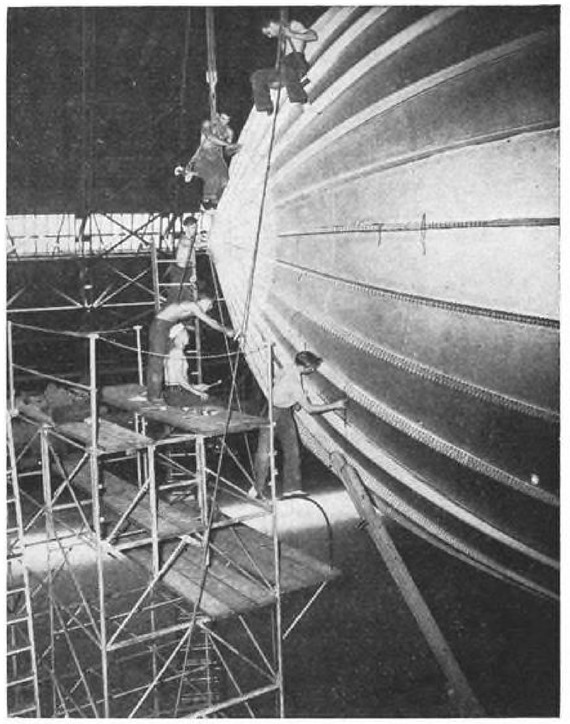


This sailor is making repairs on tail fin of a Navy blimp after a portion of fabric covering has been cut away to reach metal.

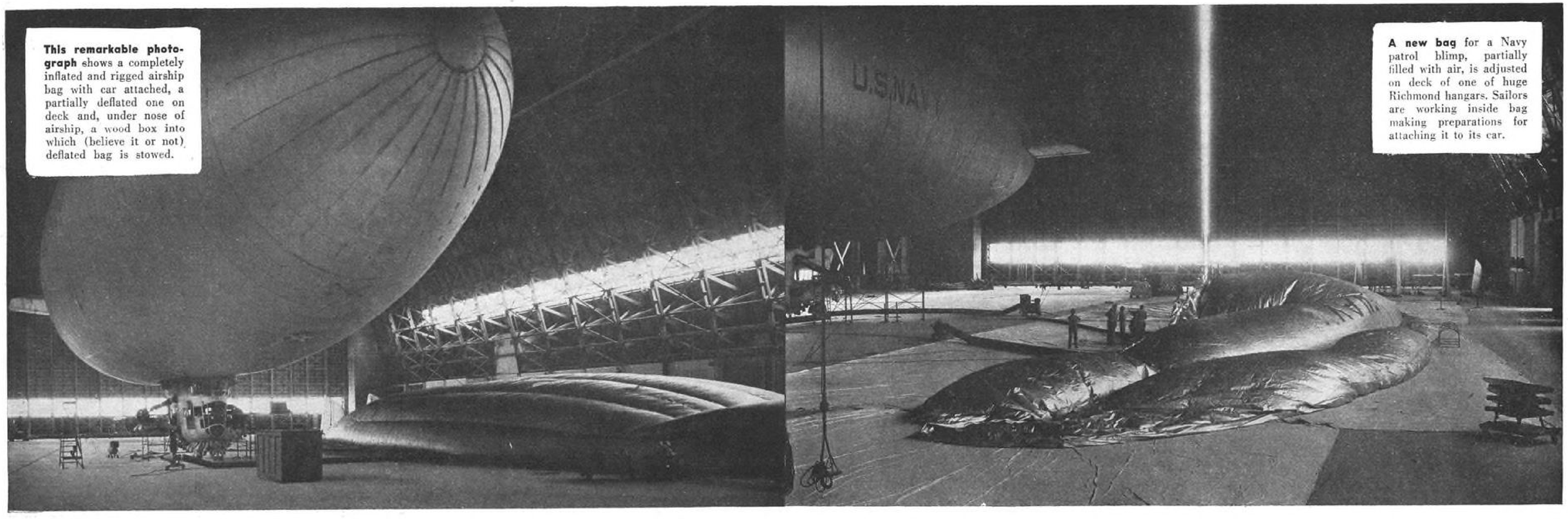
With the establishing of headquarters squadrons (blimphedrons), A & R is becoming more concerned with major overhauls, emergency repairs, and the manufacture of repair parts and changes, both for their own department and for hedrons.

Major overhauls, undertaken after approximately 3,000 hr. of flight time, consist of a complete renovation of the whole ship, including removal of the envelope and installation of a new or reconditioned one. The preliminary work consists of laying out a 300x100-ft. ground cloth on the deck. The ship is then spotted over the ground cloth on the deck

(*Turn to page* 321)



High up on rigging constructed at Richmond, A & R crews work on nose of a blimp. Here they are securing wood former stays which radiate symmetrically from metal nose piece.



This remarkable photograph shows a completely inflated and rigged airship bag with car attached, a partially deflated one on deck and, under nose of airship, a wood box into which (believe it or not) deflated bag is stowed.

A new bag for a Navy patrol blimp, partially filled with air, is adjusted on deck of one of huge Richmond hangars. Sailors are working inside bag making preparations for attaching it to its car.

Engineering Aspects Of Airline Maintenance

By DAVID NORTH,
Engineering Dep't. American Airlines

Indispensable factor in successful operation of airlines is cooperation between engineering and maintenance departments. Described is the AA way of effecting this service.

A MODERN AIRLINE cannot function without a maintenance department; nor can an airline maintenance organization keep up with modern technical developments without engineering facilities. It is the purpose of the author to show how cooperation between maintenance, with its eyes on today, and engineering, looking towards tomorrow, can combine to give highest service and efficiency.

Both maintenance and engineering are primarily service organizations in a successful airline. One has the duty of providing the operating branch with airplanes—when and how it wants them. The other has the duty of providing maintenance with the technical data needed to accomplish that service goal. It can, then, be said that maintenance work is 75 percent action and 25 percent analysis, while engineering work is 75 percent thought and 25 percent action. Essentially, maintenance is the doer, engineering the thinker, and both are successful only to the extent that they provide genuine service.

What Should Maintenance Expect From Engineering?

This is a prime question. First, maintenance can expect to get the facts, analyses, opinions, and constructive answers to any of the questions that arise in the maintaining of aircraft and their accessories. If an answer has not been found, a reasonable investigation is in order within the scope of the engineering department concerned. If the answer is not obtainable, the department should provide service at least by referring to the manufacturer of the item or to the proper higher authority, thereby providing maintenance with the facts as soon as available.

It is the responsibility of engineering to provide up-to-date information on new developments in the industry, weeding out those ideas that are unsound and presenting those that are truly progressive in the form most suitable for practical application. New ideas are the basic business of an engineering department, whereas they are only a by-product of a maintenance department's duties.

Not only has engineering the duty of providing information and procedures upon request, but also it has the privilege of making independent surveys of problems which, in its opinion, are not being successfully combatted. Improvements resulting in weight savings, lower costs, higher efficiency, use of less critical materials, and time saving fall within this category. Often an alert engineering organization will discover a solution to a problem even before it is recognized as one.

And in all cases, maintenance has the right to expect that information issued by engineering will be in writing or drawings prepared so that they present practical ideas in terms readily understandable by those who act upon them. This is accomplished by a system of engineering releases, accompanied by drawings when necessary. These engineering releases are definite commitments by the department and can only be modified or cancelled by subsequent engineering releases.

Typical example of work flow between maintenance and engineering.

MAINTENANCE

8-22-43 *Buffalo*—Maintenance service report indicates that DC-3 was delayed 33 min. because left propeller dome leaked oil. To lessen delay, equipment was changed.

8-27-43 *New York*—Maintenance service report indicates that DC-3 was delayed 39 min. because left propeller dome was found to be leaking oil prior to engine run-up. Ship was brought into hangar to install new propeller valve gasket and rework propeller dome seal.

9-14-43 Maintenance investigator received copies of above service reports and others indicating similar trouble and ordered a survey of past six months' troubles with leaking propeller domes. Findings:

Mar. 1	June 4
Apr. 1	July 6
May 0	Aug. 18

This summary indicates that the situation is growing serious. He therefore notifies director of maintenance of his findings.

9-15-43 Director of maintenance informs his department to be on the lookout for this malady and requests that attention be given to finding a solution. Maintenance issues a "request for engineering service" to engineering, assigning the project a high priority and at the same time concentrating on studying the symptoms of the problem.

ENGINEERING

9-16-43 Chief engineer receives the "request for engineering service" and assigns the project to the power plant engineer giving the job a job order number and highest priority.

ENGINEERING & MAINTENANCE

9-17-43 The project engineer in charge of power plant begins a study of the problem and a review of the past history of the case. His investigation naturally leads him to discuss the problem with the maintenance men who are most closely associated with the trouble. The maintenance men in the engine overhaul department propose what they believe is the solution to the difficulty—an aluminum spacer to be used in conjunction with the standard propeller dome seal. The engineer approves the principle of the idea and it is decided to give it a service test. Since it is a departure from standard practice, the engineer contacts the Civil Aeronautics Authority for approval and after approval is received, he writes an engineering release calling for a service test of the new type propeller dome seal on a limited number of DC-3 airplanes.

MAINTENANCE

9-24-43 Maintenance receives the release authorizing a service test and makes the required number of installations. During the test period, maintenance keeps close watch of the progress of tests and writes a summary of the results for the benefit of the project engineer.

ENGINEERING

10-24-43 Since the results of the service tests are favorable, the project engineer writes a new engineering release authorizing the use of the new technique on all DC-3 propellers.

MAINTENANCE

11-14-43 The maintenance investigator continues his analysis of the problem and finds from service reports that the frequency of occurrence of propeller dome oil leaks has fallen off from 18 in August to 8 in September which trend indicates that as soon as all propellers are converted, the problem is solved.

What Can Engineering Expect From Maintenance?

On the other side of the picture, engineering has the right to expect strict observance of the specifications and procedures it has issued, even down to the minutest details. If the plans as specified do not work, the engineer must be promptly informed.

This is especially true on trial installations of a design. If discrepancies, even minor ones, are not reported, they soon develop a condition where the engineer is thinking about one thing and the mechanic is doing another. A state of affairs such as this often will proceed smoothly for quite a period—until the spell is broken by either the mechanic or the engineer being shifted to another job. Then the newcomer, in trying to follow the uncorrected plans, finds himself in the middle of a confusing muddle.

Mechanics and their supervisors have golden opportunities to discover improved methods by experience. Their eyes must always be open for short-cuts, time-saving devices, labor-saving methods, and means of prolonging the service life of equipment. When they discover these improvements, they are expected to keep their engineering department informed. Only with this cooperation can the engineer keep his designs and specifications in line with practice.

A suggestion system consisting of an attractive form and a system of numbered stubs to avoid the use of names in judging the merits of a new plan is a convenient and equitable method of gathering ideas from the rank and file of employees. With this system it is also possible to reward the originators of truly inventive ideas without the risk of showing favoritism. New methods and techniques discovered by maintenance supervisors should also be promptly transmitted to engineering by means of correspondence or requests for engineering action so as to help the engineering department keep informed of existing conditions.

It cannot be emphasized too often that the actions of maintenance in following the plans and specifications of its engineering body must be executed with precision and strict attention to detail. Half-hearted observance of rules of procedure have no place in a well managed maintenance organization. The quality of workmanship can best be controlled by adequate and intelligent inspection.

In every instance, the airworthiness of the *design* is the responsibility of maintenance. A good engineering department expects that a good design will be translated by the maintenance department into a good installation resulting in an airworthy airplane. Furthermore, it can expect that the airplane will be maintained in such a way as to stay airworthy.

AMERICAN AIRLINER, INC. AMAIR E1 REV.-B-1-43-1M-C — B/P REQUIRED

ENGINEERING DEPARTMENT
RECOMMENDED ENGINEERING CHANGE OR PROCESS SPECIFICATION

MAINT. DEPT. EQUIP. CHGE. NO. ____
DATE RELEASED TO FIELD ____
EXECUTED INVENTORY REQ. FORM ____

DATE OCTOBER 25, 1943
ENG. RELEASE NO. DC3-1948-01:00
SUPPLEMENTS
**SUPERSEDES RELEASE NO.

PRINTED IN U.S.A.	THIS COPY TO:	COPY CHGE. TO:	DRWG ETC. TO:
ENG. DEPT. FILE		X	
ENG. DEPT. SUSPENSE			
VICE PRES. OPERATION			
OPERATIONS DEPT. ATT:		X	
MAINTENANCE DEPT. ATT:		XX	8 SETS
MAINTENANCE DEPT. ATT:			
COMMUNICATIONS DEPT. ATT:			
STATIONS DEPT. ATT:			
PASSENGER SERVICE DEPT ATT:			
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EDITOR-OPERATING EQUIPT. MANUALS		X	

Service Test	X	Installation Check	
Production		Cancellation or Correction	
Drawing Revision		Process Specif.	
Approved Repair		Confirmation	
Seasonal Change		Period Parts Repl.	
Standardization		Interchangeable Parts	
Removal		Factory Std. Starting	
PRIORITY RUSH		Time of O'Haul	C-46
CAA 18-1 Required		License	

REQUESTED TO BE MADE ON: AIRPLANE COMPANY NOS. OR OTHER EQUIPMENT MANUFACTURERS SERIAL NOS.
ONE DC-3 AIRPLANE ONLY

CLASSIFICATION: DEICER SYSTEM — SUB CLASSIFICATION: WING SURFACES

CHANGE: INSTALL FOR SERVICE TEST ONE SET OF WING DEICER BOOTS USING IMPROVED INSTALLATION METHOD AS OUTLINED IN ATTACHED INSTRUCTIONS

REASON—REMARKS: TO REDUCE TIME AND LABOR OF INSTALLATION, AND TO INCREASE SERVICE LIFE

PERIOD OF TEST: ONE ENGINE OVERHAUL PERIOD

INFORMATION TO MAINTENANCE AND STOCK CONTROL ON DISPOSITION OF PRESENT INSTALLED PARTS, PARTS ON ORDER, STOCK, AFFECTED BY ABOVE ENGINEERING CHANGE: ALSO NEW PARTS PLANNING & PROCUREMENT.

BY SPECIAL ARRANGEMENT, SERVICE TEST PARTS WILL BE RECEIVED FROM MANUFACTURER ADDRESSED TO PROJECT ENGINEER DIRECT

MANUFACTURE AND INSTALLATION TO BE SUPERVISED BY: ENGINEERING DEPT.
REQUESTED BY: MAINTENANCE DEPARTMENT; DATE
ESTIMATED WEIGHT CHANGE: + NONE LBS. / — LBS.
ESTIMATED COST—SPECIAL INSTALLATION . . . $ UNKNOWN
ESTIMATED COST—PRODUCTION INSTALLATION $ (ABOVE FIGURES FOR 1 AIRPLANE—ENGINE—)
AUTH. NO. DATE OF APP.
APPROVED: CHIEF ENGINEER ENG. DEPT.
APPROVED: DIRECTOR OF MAINTENANCE DEPT.

DRAWINGS, SKETCHES, REPORTS, SPECIFICATIONS APPLYING (ARE) (ARE NOT) ATTACHED. REFERENCE TO PERTINENT CORRESPONDENCE OR MANUFACTURER'S SERVICE BULLETIN REGARDING ABOVE ENGINEERING CHANGE OR PROCESS SPECIFICATION NOTED BELOW.
CDS-1066 INSTALLATION DRAWING
3 PAGES OF INSTALLATION INSTRUCTIONS

(FOR ENGINEERING DEPARTMENT USE ONLY) CIVIL AERONAUTICS APP: DATE 10-22-43 MANUFACTURER'S APP: DATE 10-22-43

MAINTENANCE TO CONTACT PROJECT ENGINEER WHEN JOB IS ABOUT TO BE STARTED

*THIS IS TO ADVISE YOU OF CHANGES AND/OR TESTS BEING CONTEMPLATED OR MADE ON EQUIPMENT OF YOUR MANUFACTURE OR DISTRIBUTION. FURTHER DETAILS, AND/OR DRAWINGS WILL BE SUPPLIED ON REQUEST.
**A SUPERSEDING RELEASE CANCELS THE PREVIOUS RELEASE UNLESS OTHERWISE INDICATED. ENG. REL. NO. ____

Form used for recommending changes in engineering or processes.

Maintenance and Engineering Liaison

To achieve that close cooperation required between the designer and the mechanic, an intermediary is required who knows a lot about both maintenance and engineering. This function is usually filled by a liaison engineer. Since in an airline, maintenance works around the clock every day in the week, while engineering works most productively on a 40 to 48 hr. week, the job of liaison engineer is further complicated, two or three shifts often being needed to give adequate coverage.

In brief, the duty of liaison engineers is to use their brains as well as their feet to see that information coming off the drafting board is translated into correct construction by the workman on the job. The liaison engineers are charged with the responsibility of picking up and straightening out the little misunderstandings between maintenance and engineering that usually arise with a new design or procedure.

The "Route" Of an Idea

Next, let us observe the routing of a new aeronautical idea from conception to completion. Let us look at the work flow chart of a technical improvement in the method of attaching rubber de-ieer boots to the wings of a DC-3 air-

(*Turn to page* 344)

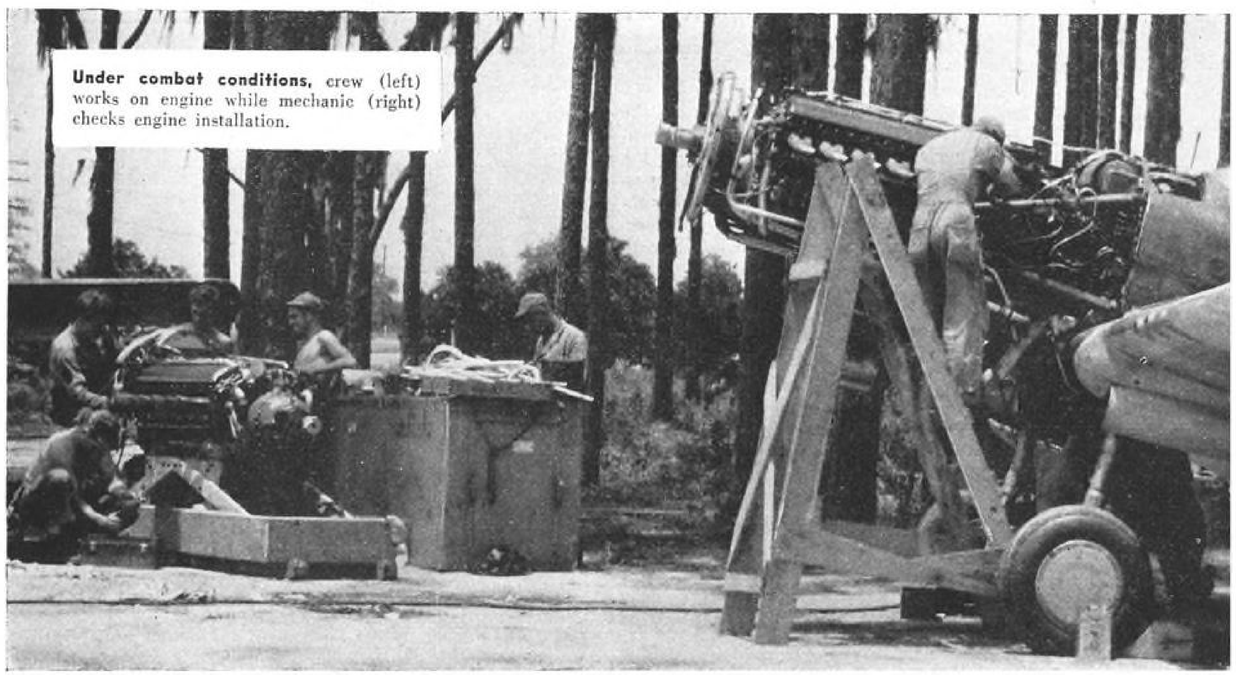
They're Trained to

Fix It Under Fire



Built like circus "big top" this 120-ft. wide portable hangar houses largest bombers. It can be erected in six hours. (All photos by AAF.)

Work under realistic combat conditions is accented at AAFSATS' "graduate" school in the art of putting planes back on the battle line. Here, crewmen get a double-tough "fighting" curriculum—one which trains them to fight through on any maintenance job and to fight off any enemy aiming to stop them.



Under combat conditions, crew (left) works on engine while mechanic (right) checks engine installation.

BATTLE-HARDENED VETERANS are carefully training mechanics at the Army Air Forces School of Applied Tactics, where simulated combat conditions modify peacetime methods of maintenance.

There is no dividing line between the work of different echelons under combat conditions. During action, fourth echelon, which usually does only heavy overhaul and rebuilding, may do line servicing and inspection, which is supposed to be first echelon work. Similarly, first and second echelon do not hesitate to do overhaul and rebuilding if it is required and they have the facilities. Indeed, they quite frequently handle tasks on the practical premise that they possess the ingenuity for the work, despite lack of the equipment which normally would be considered essential. As it is customary in the field to use the nearest repair unit, AAFSAT mechanics don't worry about which echelon is supposed to do the work—they just do it.

With only natural protection (trees and brush) or improvised camouflage, mechanics complete jobs which formerly called for equipped hangars.

Living in tents and huts and under constant threat of simulated air attacks —as would be the situation overseas— these men develop the resourcefulness which is absolutely necessary for keeping AAF planes in the air.

(*Turn page for more photos*)



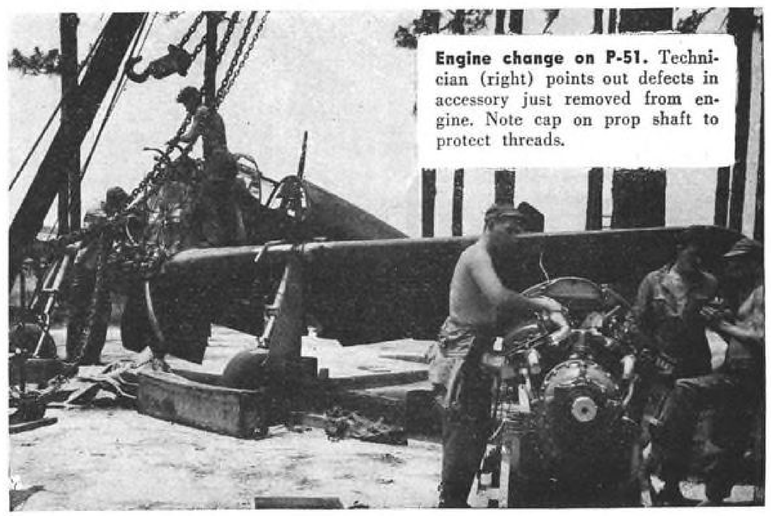
With mobile tool unit alongside, mechanics complete engine change on P-40. Note light sheet-metal platform braced for stiffness.



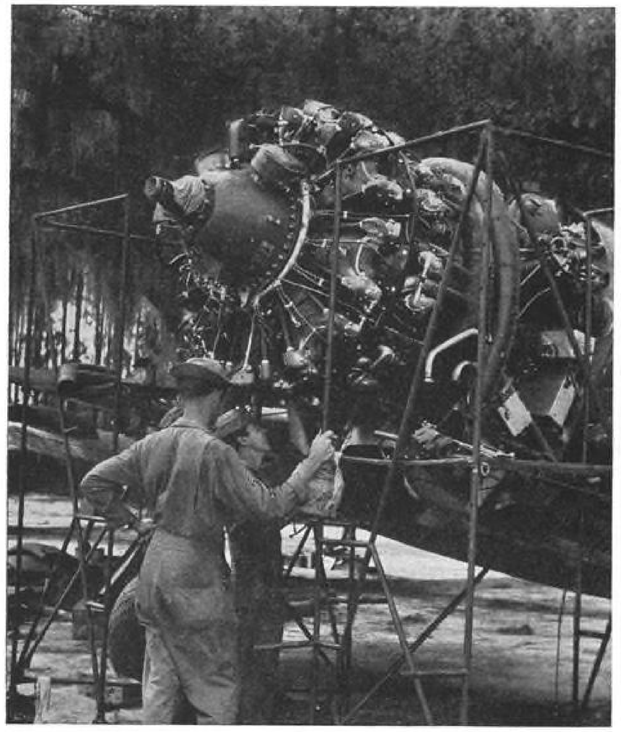


Mobile repair units have complete electrically-operated shop equipment. Provided are current and compressed air for hand tools and supply of small parts.

First echelon maintenance is minor work done by pilot, in emergency, or by ground crew. Included are engine adjustments, testing of equipment, and small repairs.



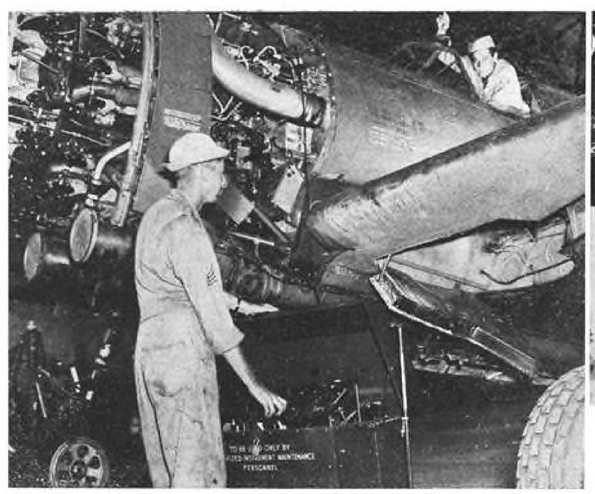
Engine change on P-51. Technician (right) points out defects in accessory just removed from engine. Note cap on prop shaft to protect threads.



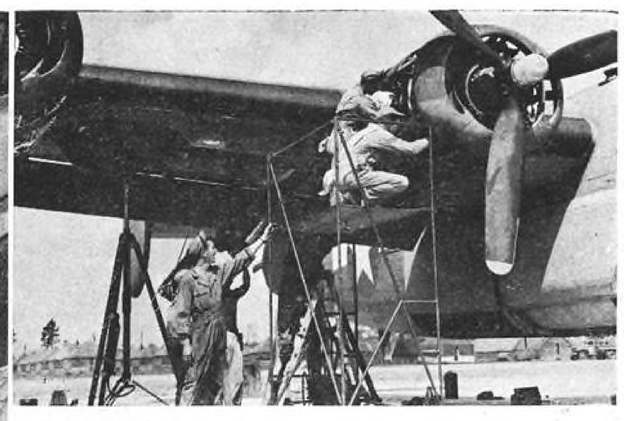
In open spot hidden by trees, crew chief and mechanics do second echelon maintenance on P-47. Protection of prop shaft by cloth shows careful attention to details.



When they need things they make them. Mechanic stands on ladder built from old packing cases. Tools and cans are placed out of danger near wheels.

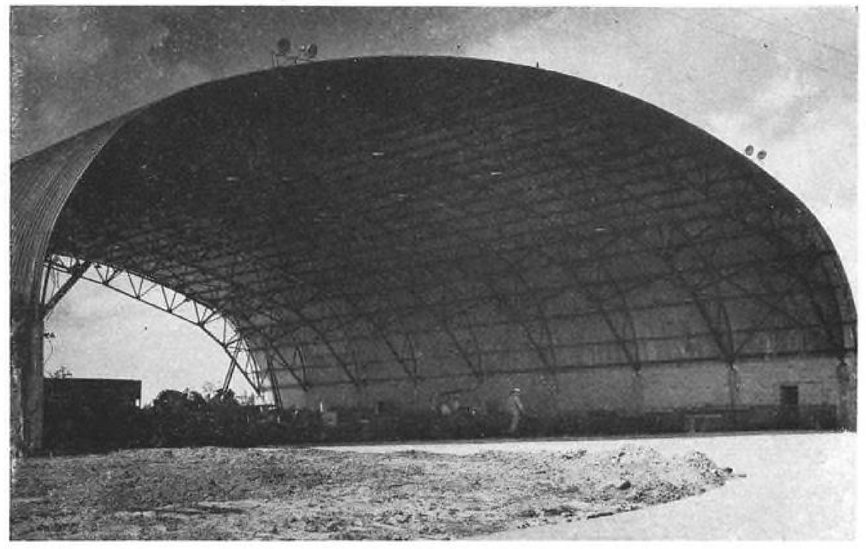


Inspection of electrical equipment on operating airplanes is first and second echelon work. Here crew checks plane instrument board with portable test panel.

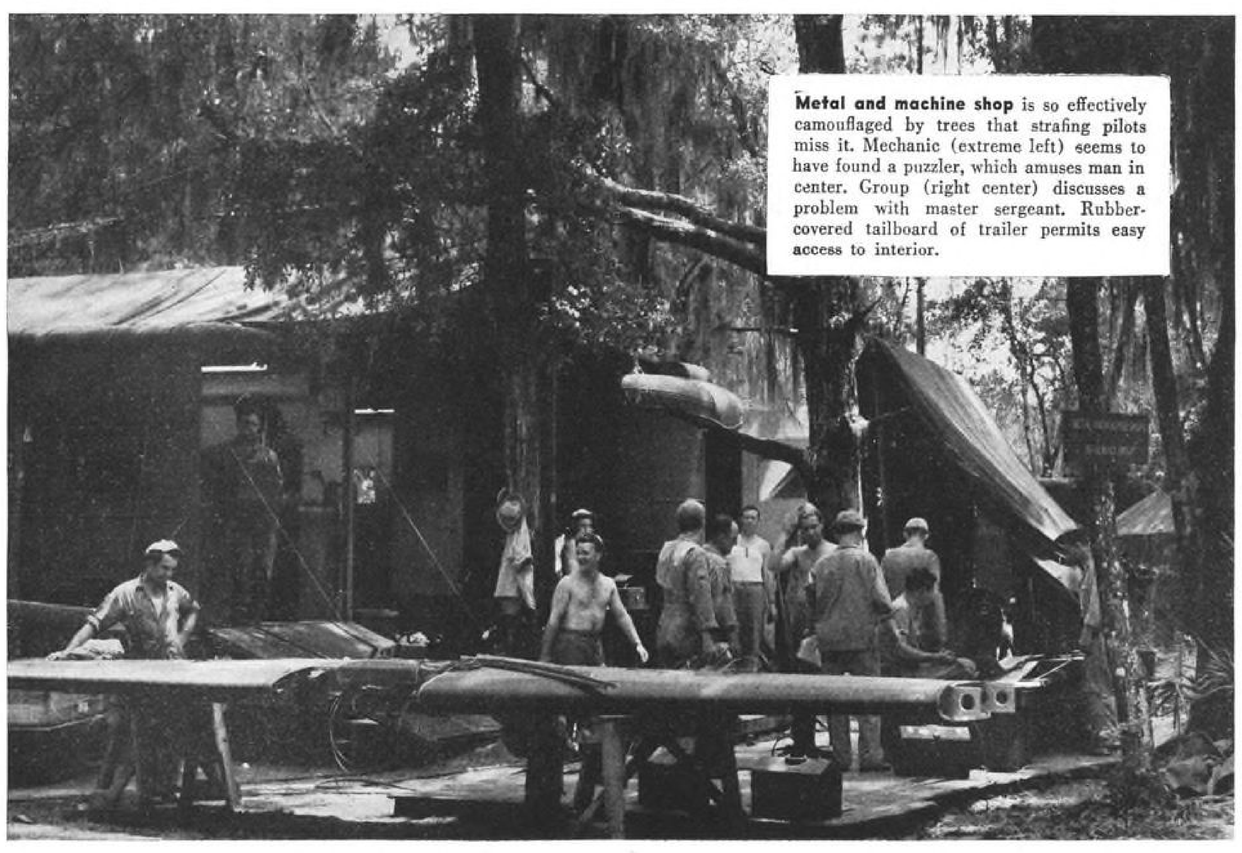


Finishing a fourth echelon rebuild of *Liberator* bomber. Landing gear and engines are being installed. Even this heavy work is done outdoors under combat conditions.

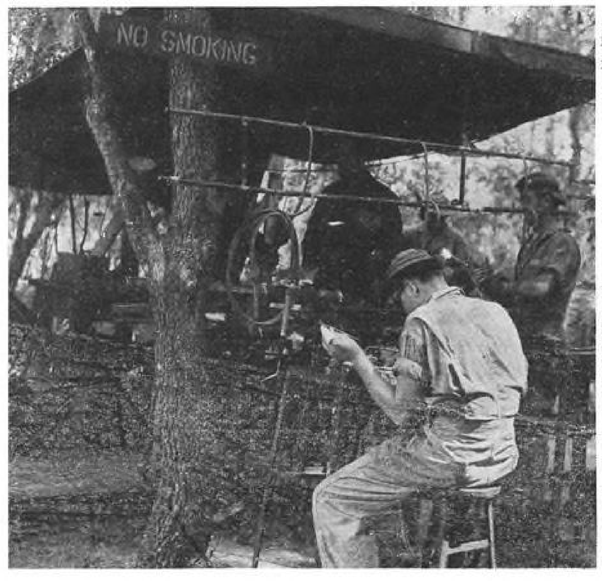
AAFSAT sectional hangar. Prefabricated in sections and marked to simplify assembly, these hangars can be rapidly taken down and erected elsewhere. In permanent installations, stone foundations, as shown, may be used.



Camouflaged by Spanish moss, canvas roof and board floor make efficient portable welding shop. Gas pipe manifold is nailed on tree as protection against mud in wet weather.

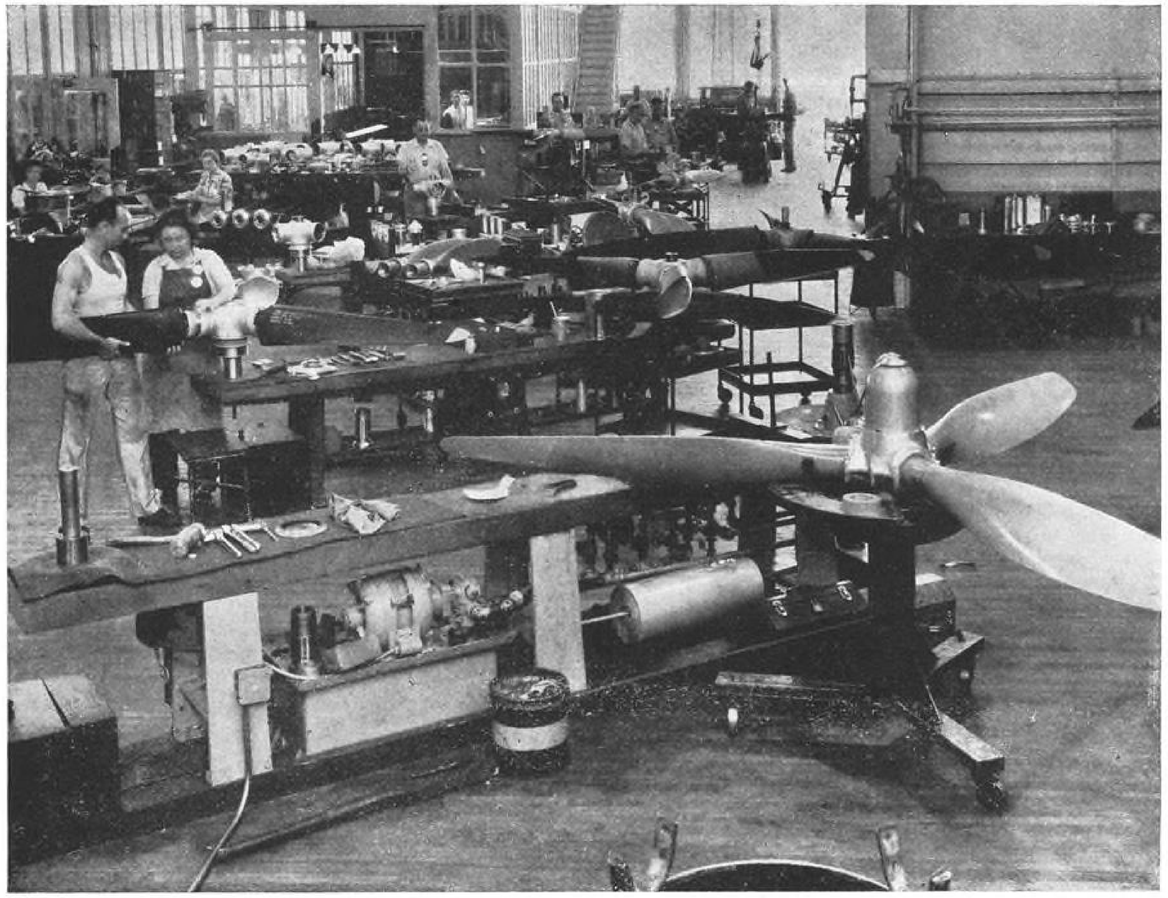


Metal and machine shop is so effectively camouflaged by trees that strafing pilots miss it. Mechanic (extreme left) seems to have found a puzzler, which amuses man in center. Group (right center) discusses a problem with master sergeant. Rubber-covered tailboard of trailer permits easy access to interior.



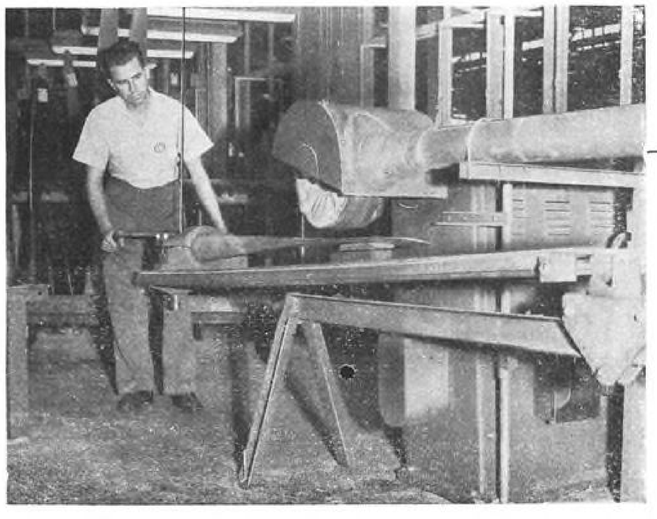
Attack—in this case by AAFSAT fighters—changes mechanics into defenders. Tools are dropped, submachine guns grabbed, and men dive into foxholes, ready for action. In five seconds no live targets will be visible.





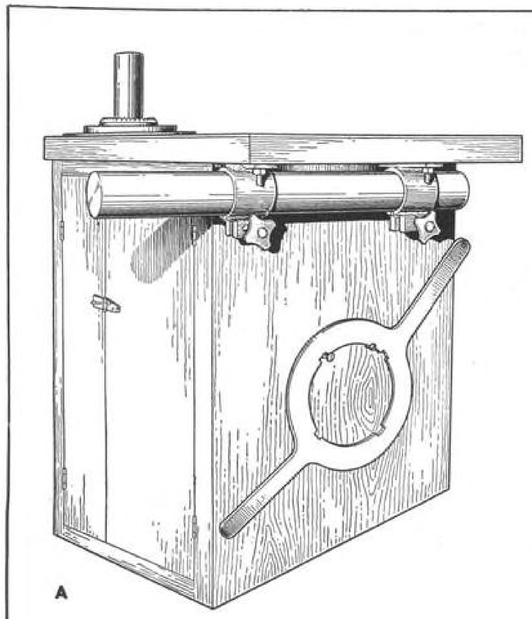
Propeller shop at Jacksonville NAS. To prevent abrasive dust from settling on equipment in main shop, a separate enclosed room, (seen at rear) was set up for buffing operations.

Navy Ingenuity in Propeller Maintenance

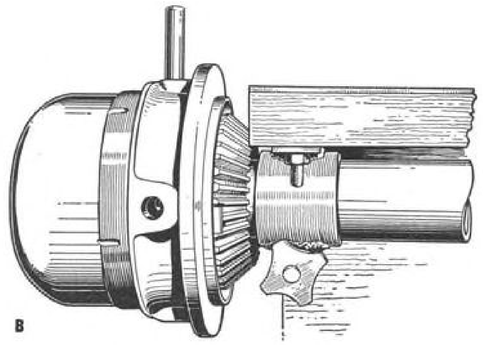


A saving of 40 to 50 man-hours daily is the result of efficient arrangement of facilities and creative tool design in the Jacksonville Naval Air Station propeller shop.

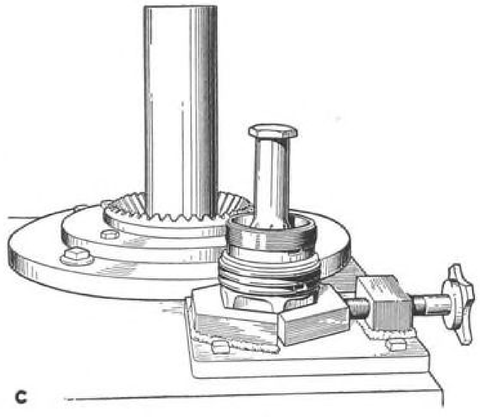
Special buffing machine, designed largely by Lt. Murray Aitken, A. & R. officer, is one of principal time savers at Jacksonville. Blade is laid out and clamped to hand-controlled bar. Wire in front of operator runs to weights slung from a pulley to take load off operator. End of bar is fixed to trolley which runs along raised track shown below.



A

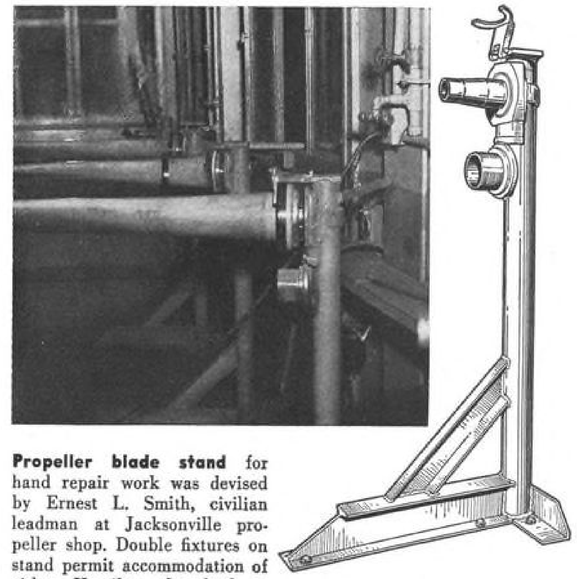


B

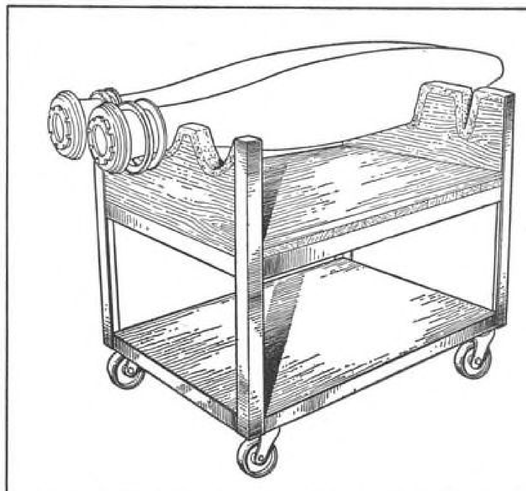


C

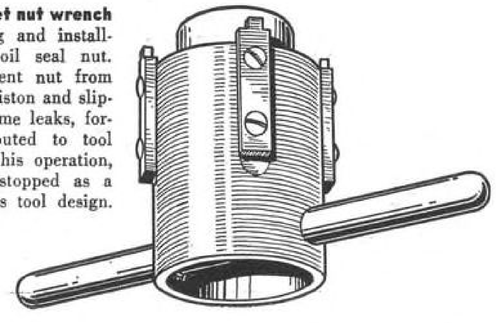
Propeller mechanism work stand consists of cabinet for tools and various holding fixtures for dome parts. Sketch *A* shows general arrangement of stand and details of holding fixture for propeller cam and piston assembly. Sketch *B* is close-up of cam and piston assembly mounted on fixture. Sketch *C* shows dome and valve holding fixtures mounted on top of stand.



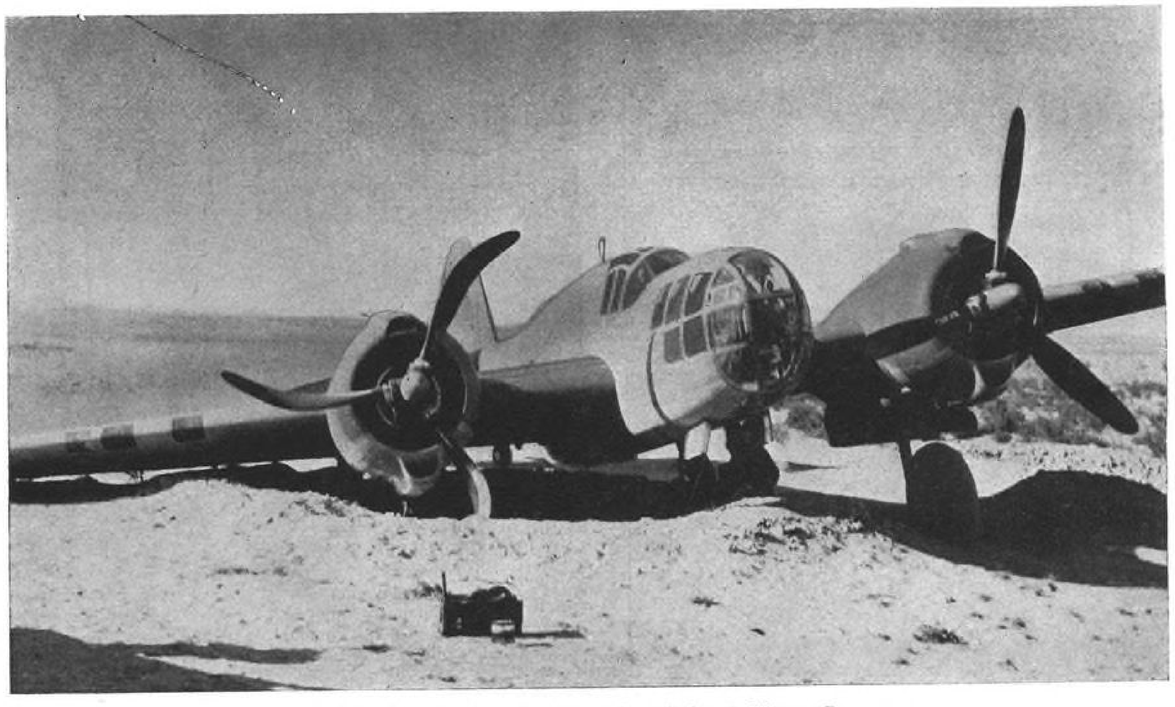
Propeller blade stand for hand repair work was devised by Ernest L. Smith, civilian leadman at Jacksonville propeller shop. Double fixtures on stand permit accommodation of either Hamilton Standard or Curtiss Electric propellers. Photo above shows blades mounted on work stands in buffing room.



Propeller blade cart designed by E. R. Smith at Jacksonville Naval Air Station. Shelves hold dome parts.

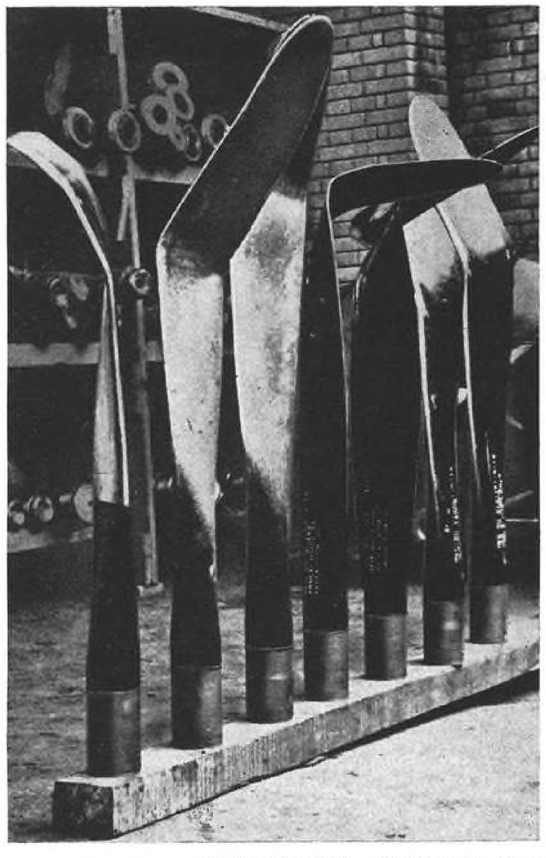


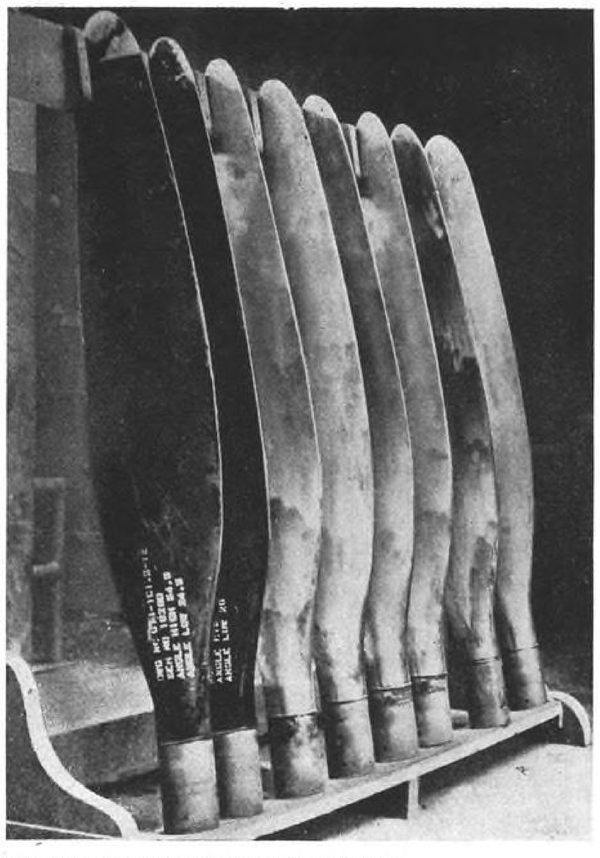
Piston gasket nut wrench for removing and installing piston oil seal nut. Guides prevent nut from cocking in piston and slipping off. Dome leaks, formerly attributed to tool damage in this operation, have been stopped as a result of this tool design.



Bent starboard prop on Martin A-30 cracked up in Western Desert exemplifies propeller repair tasks handled by Curtiss servicemen.

They Never Say "It Can't Be Done"





Battle casualties. Though now askew (left) these airscrews will again be serviceable after straightening. Right: Here they are back in shape—ready to return to action.

"Send it back to the factory" is an unknown language at those overseas bases where Curtiss-Wright—and many other—field service men work with the armed forces. They either make things work or junk them—mostly they make them work.

THIRTY-FIVE propeller service men must be spread out pretty thinly to cover all the fighting fronts. In fact, many newspapers have more than this number of correspondents. But even so Curtiss-Wright propellers are being repaired and kept serviceable by just this many mechanic-instructors, whose work in cannibalizing, overhauling, and repairing propellers has won high praise from both AAF staff officers and flying personnel.

As is the case with all civilian maintenance men overseas, the work of these 35 men is divided into three phases: Repairing damaged equipment; servicing that which is usable, whether new or reclaimed; and teaching enlisted men and native civilians correct methods of doing this work when their instructors are absent.

To accomplish this successfully the serviceman must be more than merely a skilled mechanic. He has to be capable of obtaining, by diplomacy, the help and materials he would otherwise have trouble in acquiring; he must without arousing antagonism, correct faulty methods of working, for his success depends greatly upon the cooperation of others; and it is essential that he possess the enviable quality of inspiring loyalty and enthusiasm in those with whom he comes in contact. In other words, he must be quite a man.

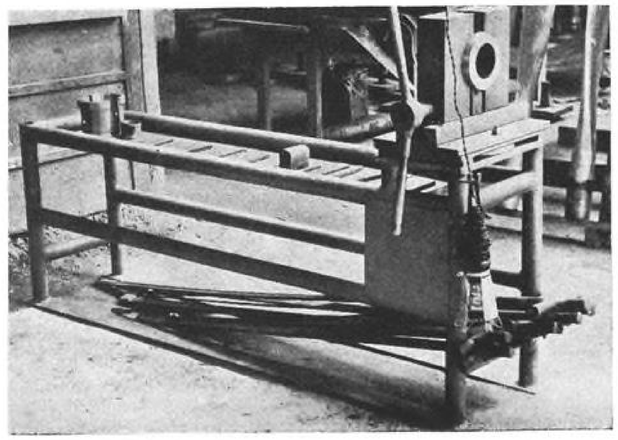
Apart from the purely professional side of his character, the field serviceman requires physical and moral courage in a considerable degree. Take this instance: In Libya, Norman Myers and a companion were thrown from their truck and injured when it was wrecked by a land mine. And on other occasions they had to take hurried shelter when strafed by German planes. Incidentally, these servicemen are quite hard to convince that the *Stuka* is "outmoded." For actual experience with an enemy aircraft is more impressive than cold data discounting its comparative performance.

Primary duty of the propeller servicemen, apart from staying alive and in one piece, is to maintain and repair propellers and to instruct ground crews how to "carry on"

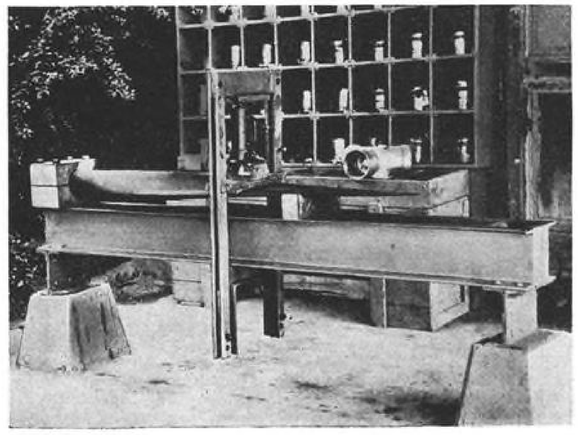


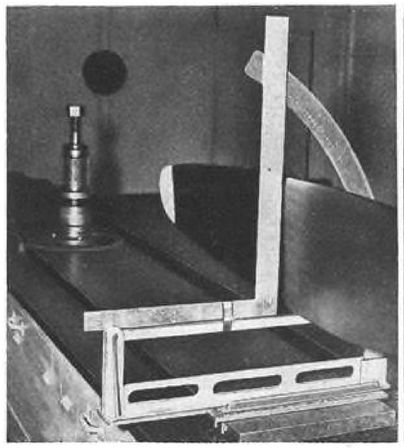
In England, propeller man has plenty of work to do on bent blades.

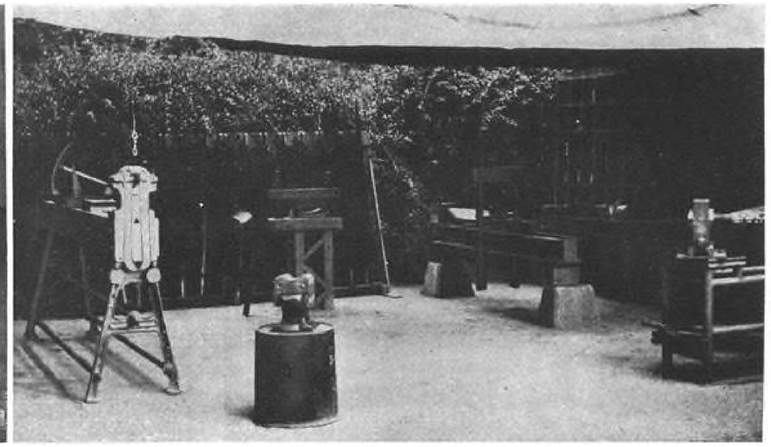
A lot of junk—changed into a machine by a lot of brains. Prop blade straightener made from whatever was handy.



This screw jack was put to work straightening blades in Egypt. Note packing-case workbench at rear.







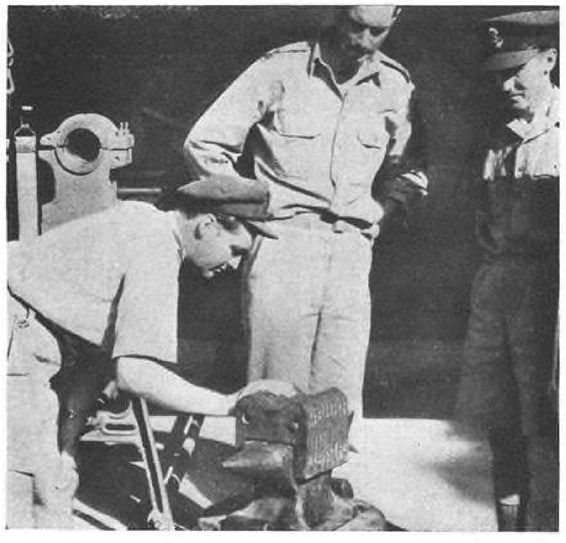
Study in contrasts. Left: PAA propeller repair set-up in Miami. Nice workbench when you can get it. (PAA photo.) Right: Back again in Egypt. Compare protractor (left) with one in last picture. Not so neat—but it does the job.

under combat conditions. To do this, they have followed the air forces into battle in China, Russia, the Aleutians, Great Britain, Italy, the South Pacific, and everywhere else that airplanes are used. In addition to their propeller work they are often called upon to help in repairing the power plant, landing gear, or some other essential equipment of a shot-up plane.

One of the qualities each man must possess is the ability to decide, on the spur of the moment, whether a damaged propeller is worth repairing or is to be relegated to the junk heap. This applies not only to complete assemblies but also to the component parts, which are often more difficult to replace than complete propellers.

Operating through the local air forces commander, the company's representatives set up repair shops and acquaint military personnel with the 'whys and wherefores' of the Curtiss electrically controlled, hollow steel blade propellers.

Constantly faced by apparently insurmountable odds, and often, through changing combat conditions, equipped only with the barest necessities in tools and equipment, these trouble shooters accomplish what has often been considered impossible. Their repair shops frequently consist only of four poles covered with material salvaged from wrecked planes or roofed with grass, native style. The repair equipment, particularly in remote areas, is devised from anything.



RAF officer (right) marvels at highly practical equipment which Servicemen Powell (left) and McRea (center) have conjured from **scrap metal to speed repair work at Egyptian base.**

As an example Serviceman McRea, working in India, had a lot of propeller blades to straighten. So he rummaged around and collected a miscellaneous lot of I-beams and tubular sections from a wrecked bomber and made a blade straightener which, as he said in his report, "worked like a charm."

These men have all had considerable experience in this country before going overseas and also have completed the course of instruction in the company's service school, one of the most comprehensive of its kind. Consequently, when they go to foreign lands they are acquainted with the latest improvements in the product they are servicing, hence know exactly what to do under any circumstances.

After arriving abroad, they are kept informed by the company on all changes in design, so that they will be prepared to handle new equipment as soon as it is delivered to the armed forces. In addition, men in the field return home after a year has elapsed to take a refresher course to bring them up to date on the latest equipment or changes.

Since the field servicemen's duty includes the work of keeping the home office informed regarding performance of equipment, they send back reports. Sometimes, these cover rather more than mechanical details, not for lack of technical matter about which to write, but because the work and personal experiences are so completely interwoven that they cannot be separated. George J. Wallis, somewhere in India or thereabouts, opened his report with the words: "No, I haven't been captured—yet." Another man explained that his work was becoming harder "because it is being done under most difficult conditions." He explained: "Practically all the work is done at night because alerts and weather keep us ducking. Then, at night we are kept on our toes by hungry panthers snooping round our tents and workshop."

Kenneth Stryker, who followed the U. S. Forces into Sicily, wrote that "the men here are constantly on the move. We never know, from day to day, where we will be next."

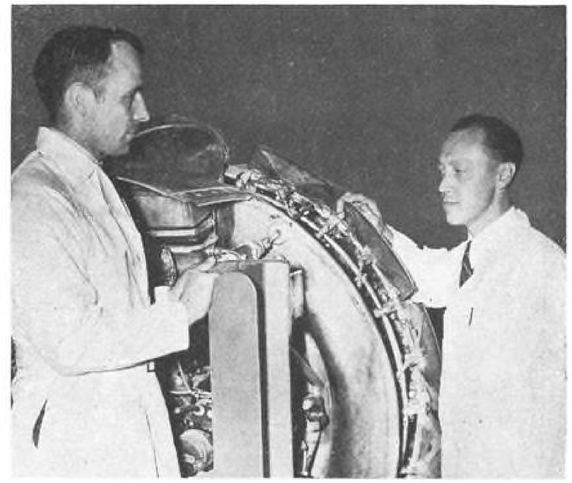
Experiencing the rigors of war and climate, these men whose names probably never will get into dispatches or citations, are doing more than most to bring the war to a close —by keeping the planes of the AAF in the best possible mechanical condition.

Continental Improves Cowl Flaps

Edwin L. Durham and Earl G. Peters of Continental Air Lines' repair base at Denver perfected alterations to the engine cowl flaps of the company's Lockheed *Lodestars*. This system differs from the original operation of the flaps, which was by an electric motor through a flexible drive shaft and gear box. Under favorable conditions, the motor and shaft were operating at peak capacity. But at any other time, running for more than a few hours without trouble was impossible.

The new hydraulic system provides the necessary power to actuate the flaps under all conditions. The hydraulic control valve in this system enables the pilot to trail the flaps, which is ideal in certain cases of airspeed versus engine head temperatures.

Another source of trouble was the tendency to form flats on the point where the flap-actuating tube was supported by two small aluminum rollers. As these rollers were not preloaded, the vibration soon produced flat spots on their surfaces, after which operation was difficult, if not impossible. By using spring-loaded fiber blocks in place of one of the rollers, this difficulty has been eliminated and with it the noise caused by the excessive clearance.



The men who did the job—Durham (left) and Peters (right).

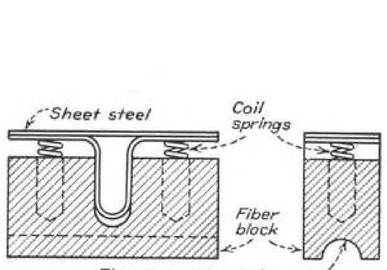
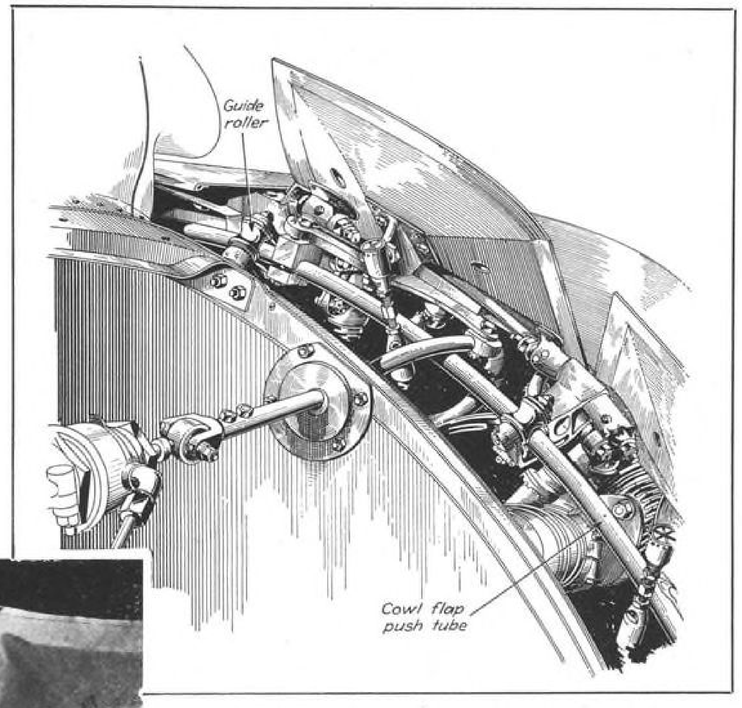
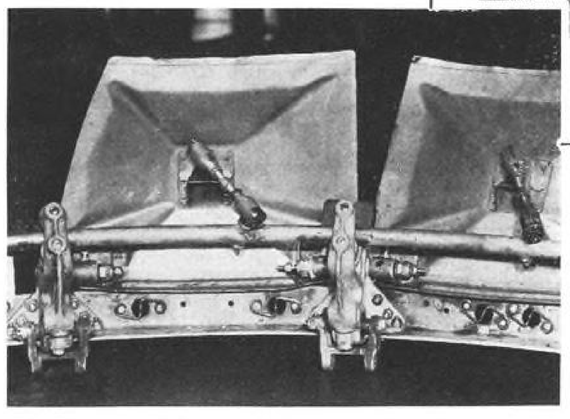


Diagram of fiber block which replaced roller in later models.



Cowl flap mechanism fitted with hydraulic cylinder.



Spring-mounted fiber block which stopped vibration, preventing wear on flap-actuating tube.



Tool and store room on ground floor of shack in center floor of RCAF hangar.

Crew Competition Speeds Maintenance

By **JAMES MONTAGNES,**
"Aviation's" Canadian Correspondent

"Secret weapon" of the RCAF is fast, efficient maintenance, with smallest possible percentage of planes grounded for the least possible time.



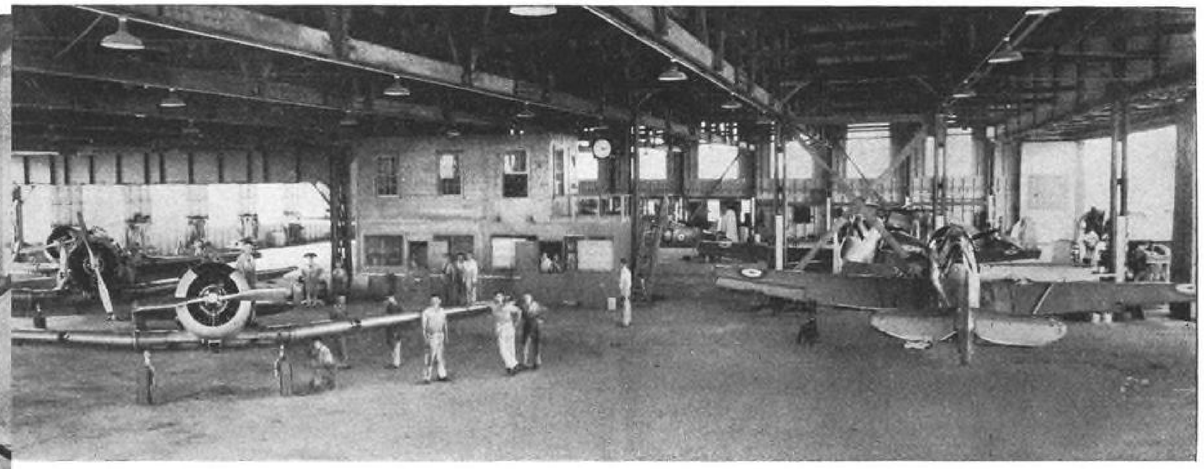
Circular log-book desk. Girls sit in center and data is handed in from outside.

EFFICIENT MAINTENANCE, sparked by the incentive of time off for fast-working crews, is keeping close to 87 percent of all training and combat aircraft in the air at Royal Canadian Air Force stations throughout Canada. Weekly reports from all stations in Canada enables RCAF headquarters at Ottawa to keep an accurate check on the number of serviceable aircraft and allows for the sending of technical investigators to stations dropping below the high percentage set by other stations.

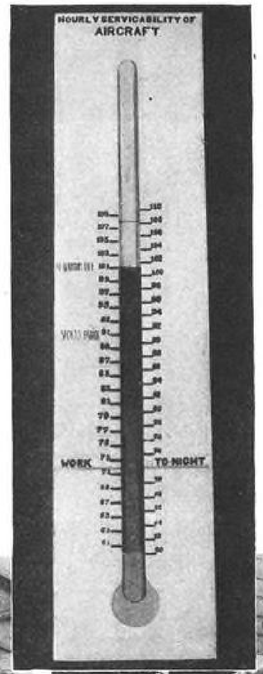
The features of this maintenance method—features which go a long way in keeping so many RCAF aircraft serviceable at all times—were largely developed at Uplands Station, Ottawa, under Wing Comdr. S. A. Greene of the Directorate of Repair & Maintenance. As each new idea worked out successfully at Uplands it was included in the RCAF maintenance set-up and standardized at all stations.

One of the first moves towards efficiency was the location of all stores and control operations in the center of the hangar. At each maintenance depot there is now a two-story shack centered in the hangar, with stores and tool departments on the ground floor, and records and controls upstairs. On this second floor there is also a public address system with which any maintenance crew member can be quickly summoned, saving much running around.

Here also is the maintenance record of all aircraft on the station. Aircraft log books being bulky and heavy, it was always a big chore to take down the books from wall racks



RCAF maintenance hangar with control and stores shack in center. Aircraft routing is counter-clockwise, starting from right.

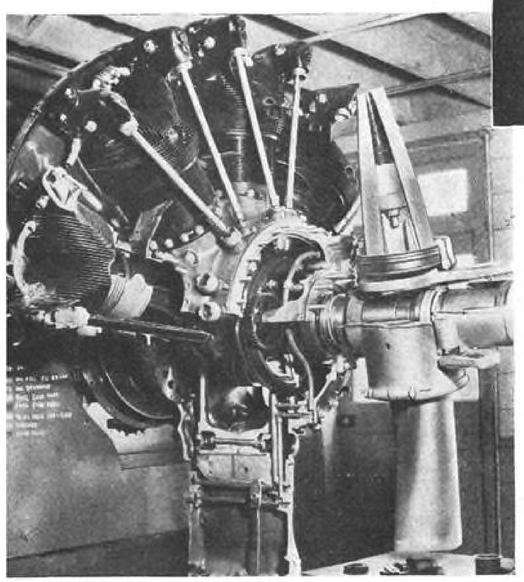


Red marker on this "thermometer" is moved hourly to show number of aircraft to be serviced before time off is given to crews.

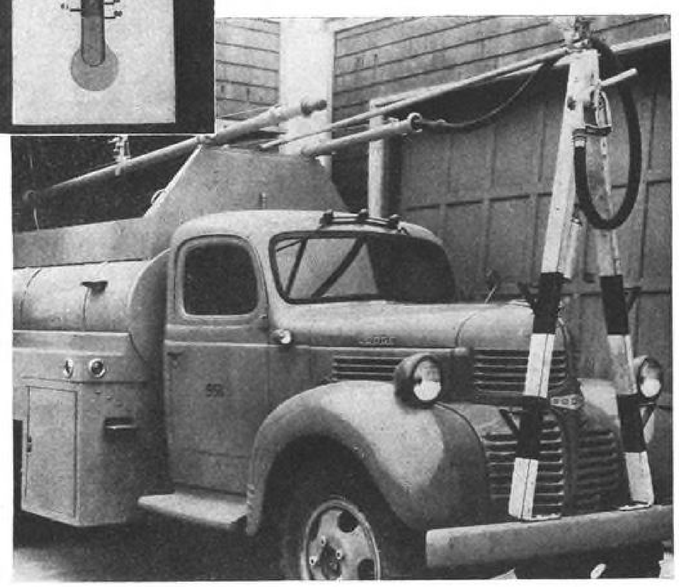
to make the necessary numerous entries each day the aircraft was in for repairs. To overcome this, a circular desk was devised with special compartments where each log book stands upright. Four girls of the Women's Division, RCAF, are seated inside the circular desk. Each one simply reaches for the required book in her section of the desk, pulls it out, lays it flat on the table directly in front of her chair, makes the necessary entries, and files the book back in its slot. The desk makes for efficient and quick handling of all necessary bookkeeping entries. It is one of the many "gadgets" now standardized in the maintenance shops.

Aircraft arriving for repair and overhaul come in the right hand section of the hangar and are routed counter-clockwise, at all times being within view of the maintenance control room. When aircraft come into the hangar, a dummy clock high up in the hangar is pushed 3½ hr. ahead, scheduling the time when the "next move of the aircraft" is made and thus reminding the maintenance crews that minor checks are to be finished within that period. As stated, there is an incentive for fast work on the job—the reward of time off.

A big "thermometer" showing hourly serviceability of all aircraft is hung at one end of the hangar so that it can be readily seen by all workers. On it, the total number of aircraft at a station are indicated in degrees. At a height comparable to the freezing point, the thermometer is marked, "Work Tonight", for if the number of serviceable aircraft does



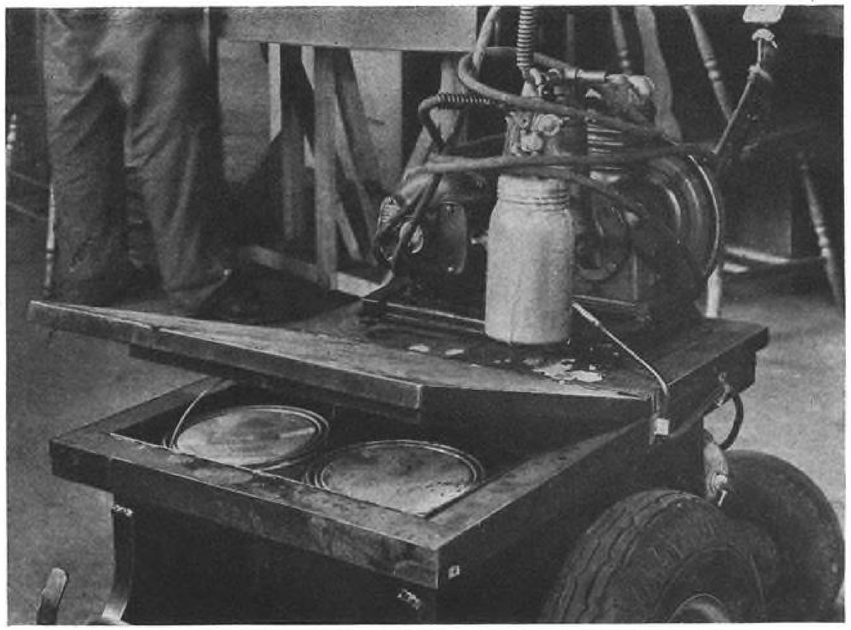
Sectionalized engine for crew instruction.



Ladder on fuel-truck front saves wing wear from feet of fueling crew.



Simple extinguisher truck speeds fire fighting.



Dope-spray truck carries two five-gallon supply cans.

not come up to this mark, all maintenance men must work that evening.

High up the thermometer a line reads, "Sports Parade." When crew performance reaches this point, a sports afternoon is the reward of the crews. Moreover, an "Afternoon Off" is tagged near the top of the device, and when serviceability of aircraft soars to this mark, the crews are granted time off. The red canvas strip representing the "mercury" is adjusted hourly.

The maintenance system at these RCAF stations is based on the principle that manpower should be concentrated on a few planes to get them into service rapidly. As many men as possible (without getting into each other's way) are put on each aircraft, thus cutting down the work time required. Under this plan fewer aircraft are in the unserviceable category at any one time.

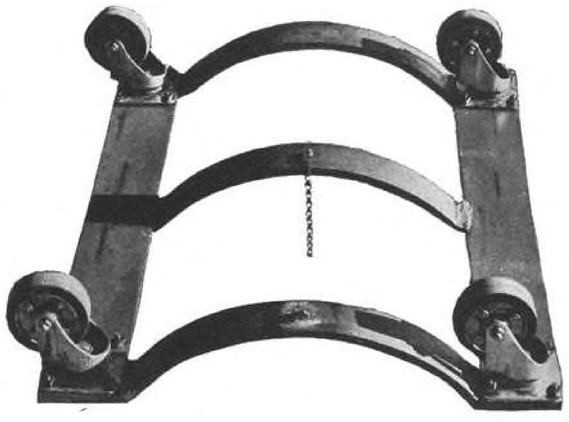
Each job is rated for the maximum time it should take, and each mechanic notes how long it took him. When he is finished he has no reason to appear to be working. Instead, he lists his name on the control board as "not working" and awaits another assignment. Guesswork as to whether or not a man is working has been eliminated by this plan.

Each crew consists of a corporal and three mechanics one of whom in many cases is just out of training school. The corporal works closely with his men, checking their work and signing for it. In charge of three such crews is a sergeant, who re-checks the signed work and then signs for it. Final check is given by a flight-sergeant, who signs for the overhauled or repaired aircraft before turning it over to flying personnel for further checking.

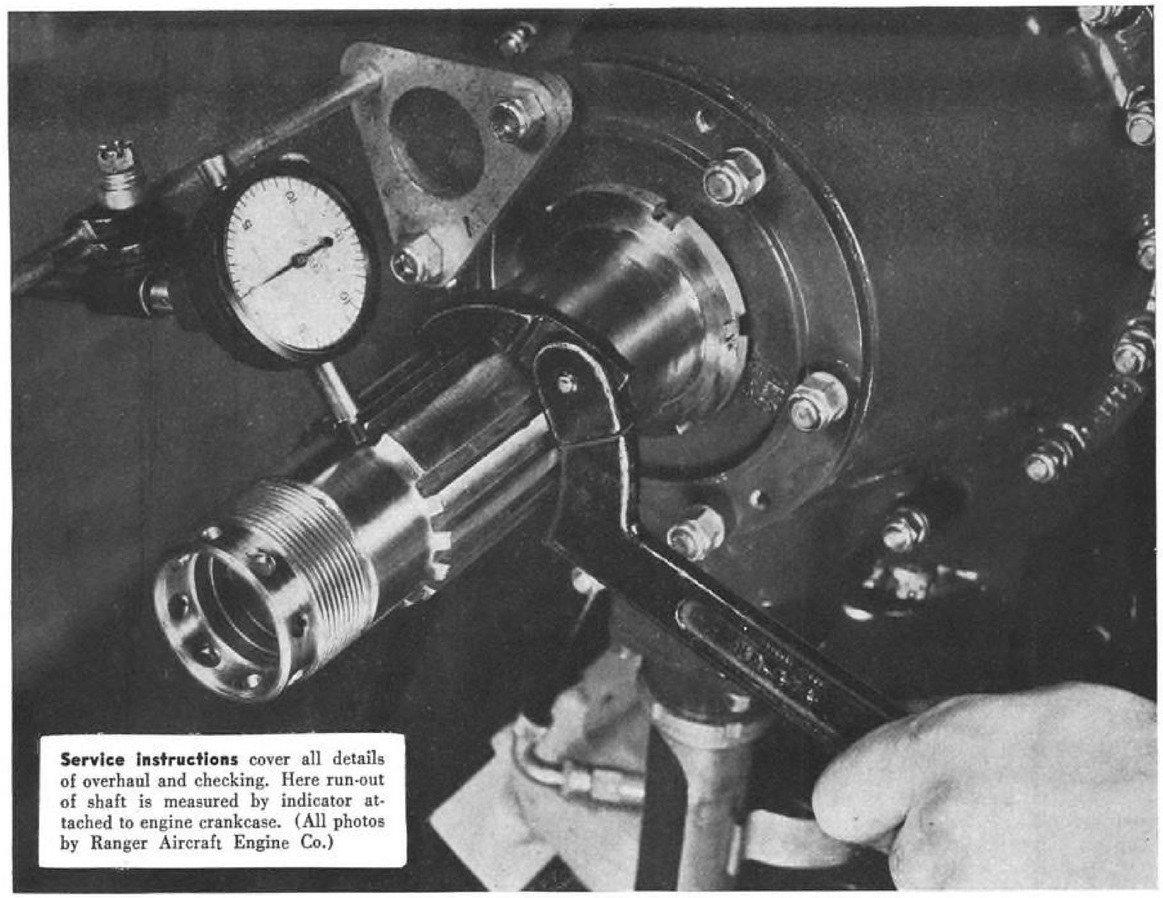
(*Turn to page* 311)



Labor saving truck for transferring fuel.



Bottom of fuel-drum truck, showing ground chain.



Service instructions cover all details of overhaul and checking. Here run-out of shaft is measured by indicator attached to engine crankcase. (All photos by Ranger Aircraft Engine Co.)

Ranger Service From Policy to Performance

By PAUL E. BATTILANA, *Service Manager, Ranger Aircraft Engine Div., Fairchild Engine & Airplane Co.*

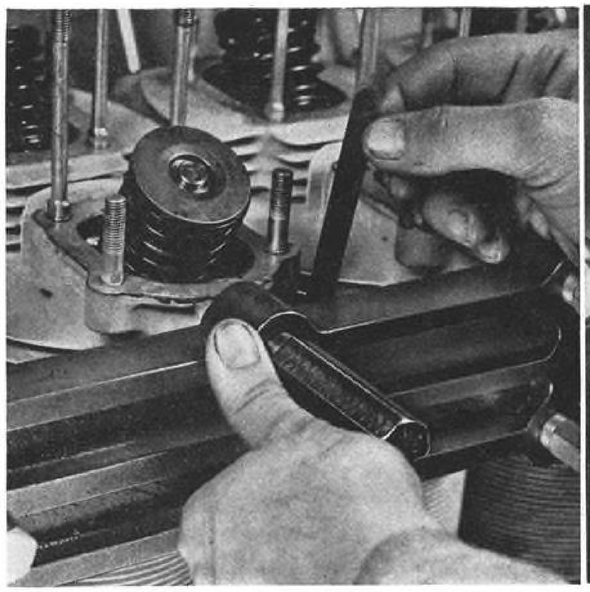
Field service on aircraft power plants is more complicated than most engine users realize. Company cooperation with the customer is primary. Revealed here are the whys and hows of that cooperation.

THE BEST ENGINES built today require special handling, for they are complex mechanisms. Further, at the present time these aircraft engines are being maintained and serviced by military and civilian personnel who, for the most part, are new to the industry and at best have only a recently acquired knowledge of such high output power plants and their proper care.

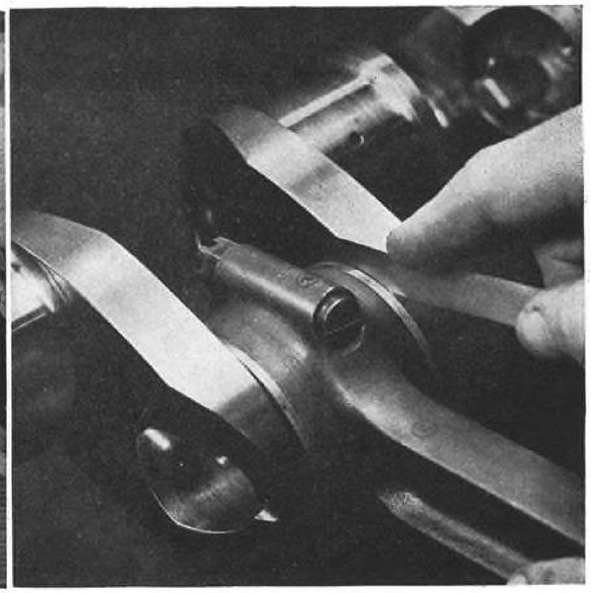
But the fact that there is enough "know how" instilled in the minds of the country's engine mechanics is proven by the excellent performance of American-built engines in all climates and in all corners of the earth.

Such performance would not be possible without proper servicing. And in this connection, it is evident that the service departments of American manufacturers, together with those divisions of the armed forces which perform a similar function, are responsible for the success of this vast undertaking.

Any customer procuring an aircraft engine, whether he represents a military or commercial organization or is an individual buyer, must necessarily look to the manufacturer for operating and maintenance instructions, overhaul information, and special tools, plus answers to all the questions which, inevitably, present themselves if he is to obtain the full value of his investment. These are the problems of a service division, whose activity to see that the



Another example of servicing instructions—lining up cylinders by means of special gage.



Gaging of end play of connecting rod on crank is simplified by service instructions.

owner is getting full value offers a yardstick of the manufacturer's integrity. Here, then, is the hidden value purchased as part of the engine.

There are no hard and fast rules, as is the case in the terms of a power plant guarantee, but the resultant customer satisfaction is a sound basis for future sales. Looking after the customers' interests and ascertaining that the product is properly understood and cared for has always been the aim of Ranger's service division.

The aforementioned, though simply stated, indicates that there is a lot more to service work than meets the eye. And this is largely true. But in this company's case, the burden is lightened by having an easily maintained, straightforward designed engine requiring a minimum of attention. This is offset to some extent by the arrangement and type of cylinders—in-line, inverted, and air-cooled. These are features which, although advantageous, require some education of the owner to convince him that there is actually nothing about it which requires any special handling.

For efficiency, the service division has found it necessary to break down its work into six departments, each of which is responsible for a separate function. Operations, however, are closely interrelated, and there is frequent conferring on the problems. Thus, the departments do not become autonomous. They are, in fact, responsible to the service management on an equal basis, and the head of each is an expert in his own line.

The publications department prepares all instructional and technical matter issued to the field. Instruction books, performance data, catalogs, and overhaul manuals must be prepared on each new model engine before the product reaches the customer. In the case of military engines, all data must meet the requirements set forth by the service which will operate the equipment.

More latitude is allowed in the preparation of data for commercial consumption, for it is felt that such publications miss the goal when they are flat and uninteresting. When such information is too formal and lacking in appeal, the reader soon finds it "bogs him down," and he decides either to finish it later or merely to use it as a reference. With a bit of dressing up and a good job of illustrating, cold hard facts may be read much easier. It is interesting to note that 2,000 photographs were taken to illustrate the text of a recently published overhaul manual, all this in addition to the art work required to dress up the pages and clarify the more complex matters.

The service tool department is called upon to design and standardize all tools, kits, special jigs, and fixtures for maintenance and overhaul work. In the event of improvements which may be incorporated in engines in the field, this department takes an active part in presentation of the modification to insure that the work may be accomplished with a minimum outlay of special equipment.



Removing cylinders without damaging pistons is another example of correct service methods given by a service manual.

Despite its ominous name, the failed-parts department does basic service division work. All complaints and information received from customers, either directly or through the far reaching activity of the field service department, are carefully evaluated and recorded, for the principal return on the manufacturer's investment in service personnel is the field experience gained. Failures are analyzed for underlying causes, and the condensed data is forwarded to the engineering division for consolidation into improvements in new or existing models.

Claims for credit on the return of damaged parts are studied and the recommendations for adjustment are forwarded to the accounting division. This work requires careful consideration inasmuch as equitable settlements are absolutely necessary and the extent of responsibility of the manufacturer, in cases where faulty operation may be a factor, is frequently quite obscure.

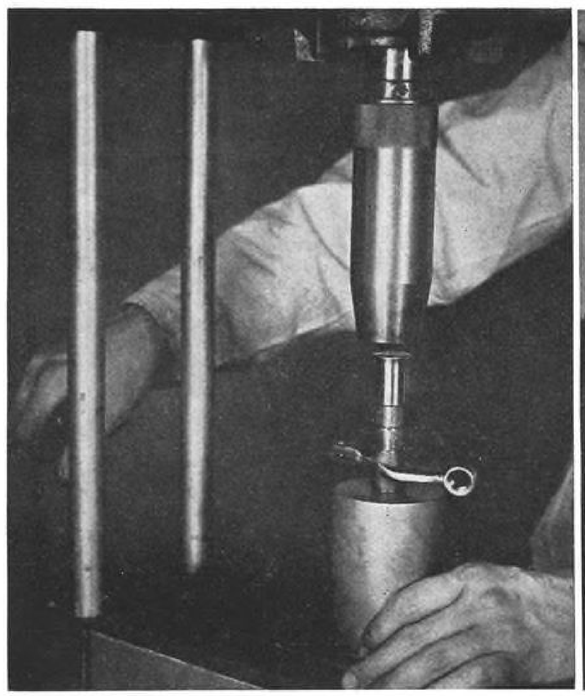
The service school has been set up to instruct both company and military personnel in the care and operation of our products. Here, the course of instruction is condensed but thorough. Students attend lectures and classes in which instructors make liberal use of cinematics, charts, actual engines, and accessories. Courses in assembly, disassembly, maintenance, and trouble-shooting follow theory and fundamentals, and the program, in the case of field service trainees, is wound up with actual work in the service division's overhaul shop.

Instruction given in the service school should not be construed as a complete technical education, since it is designed as a conditioning operation for personnel with a strong technical background.

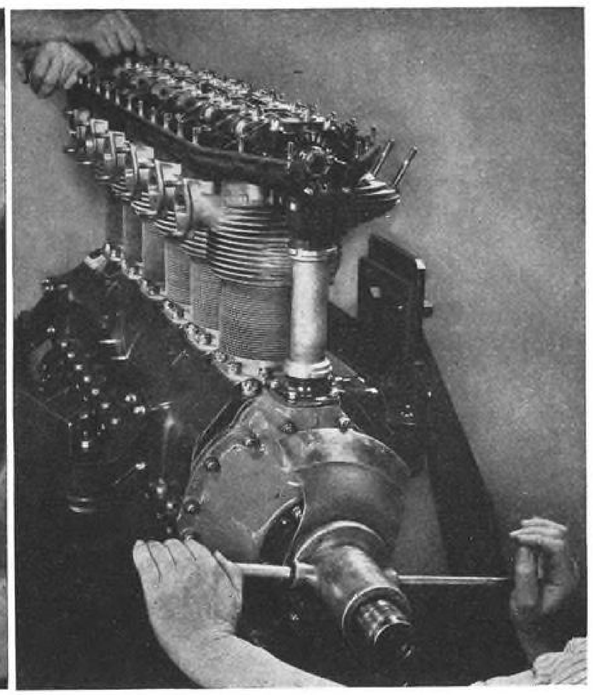
The service overhaul shop is housed in its own modern hangar, adjacent to the main plant. Its ramp and taxiway make it accessible to aircraft visiting the factory for engine repairs or adjustments. This department does all factory overhaul work and supplements its own machine shop by drawing on the factory for special operations involving use of heavy machinery and test facilities. In fact, much overhaul subassembly reconditioning is performed on the machines which originally manufactured the parts. In this way, it is possible to recondition an engine and return it to service with the knowledge that it will perform as new equipment. Furthermore, at overhaul all applicable modifications and improvements are automatically incorporated.

The above departments are more or less obscure behind the factory wall, hence the layman knows little of their activities. On the other hand, the field service department, with its representatives in many countries and climates, is perhaps uppermost in a person's mind when he thinks of the service division's responsibilities. This department, of necessity, has in its employ a relatively

(*Turn to page* 348)

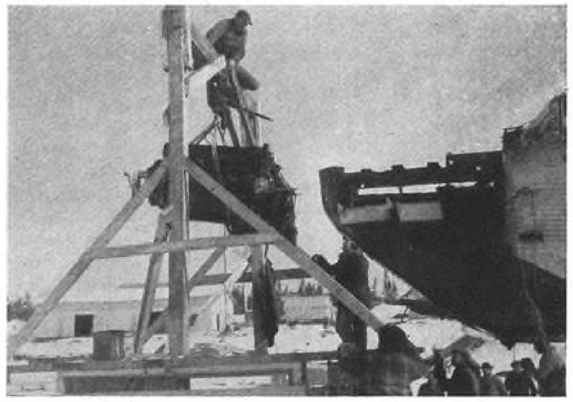


Typical illustration in service manual giving instructions for replacing bushing.

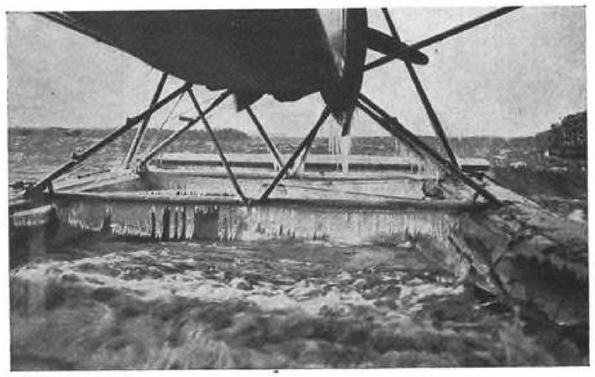


This Ranger service manual illustration depicts method of timing engine.

Airline Maintenance "In the Bush"



Wearing mackinaws and ankle deep in snow, CPA mechanics install a 920 hp. Rolls Royce *Buzzard* in a Junkers, which can carry a 3-ton load.



Pontoons present a de-icing problem rarely considered by the engineers. This is routine trouble every spring and fall.

Trying conditions are every day routine with Western Canada's pioneering lines, which frequently must handle maintenance and repairs "right out under the big shed." This story details the practical 4-period inspection system which keeps CPA ships in tune.

OPERATING virtually all north-south air routes in Canada over a varied terrain with a great many types of aircraft, Canadian Pacific Air Lines has maintenance problems which differ greatly from those of most commercial transport operators.

Operations range from mainline routes, such as the Vancouver-Whitehorse, Yukon, run with Lockheeds to "bush" runs into northern Ontario with Fairchild or Junkers aircraft. Maintenance and overhaul routines depend in a large measure on facilities available, especially in winter months. Further complication is the fact that these aircraft use pontoons in summer and skis in winter, except on the inter-city prairie runs and on the Yukon route where new airfields are available.

On its mainline runs, CPA is developing a system of regular inspections. It is also endeavoring to establish this system on bush lines, but the variety of aircraft used is causing some difficulties. On the mainline routes there is an en route flight check, with no work done on the engines unless the pilot reports something in need of attention. This No. 1 check includes an engine ground test, inspection of gasoline tanks for leaks, refilling of anti-icer tanks, inspection of propeller blades, visual inspection of the cowling, checking of the oxygen supply, cleaning of the lavatory facilities, and if there is time, cleaning of the windows and cabin.

The No. 2 check—every 8 to 12 hr. of flying time—consists of a thorough engine, propeller, and aircraft inspection, as well as an engine ground test. The No. 3 check is made after 50 hr., but if conditions necessitate, it may be postponed to 60 hr. (but no longer). This No. 3 check is more thorough than the No. 2.

Finally, there is the No. 4 check after 200 hr. (but which may be postponed to 210 hr.). This requires a very careful power plant inspection, with 26 items on the list, including cowling, checking of feathering operation of propellers with sump plugs removed, replacing spark plugs, inspection of magneto contact breakers, all accessories, exhaust stack, and similar details. There are also 70 items on the aircraft inspection list for this check, including the removal and inspection of wheels and brakes, emergency exit, opening of inspection doors and inspection of controls, checking of the hydraulic system, and tightness of the airframe, as well as the various instrument, radio, electrical, and oxygen installations.

Pre-flight inspection on the ice is part of the day's work. Portable work platforms are usually oil drums.



CPA has standardized airplane and engine report sheets for these four checks on its mainline runs using Lockheed equipment, and it hopes to do the same for its other equipment, which includes Barkley-Grow, Beechcraft, Bellanca, Boeing, Fairchild, Junkers, Curtiss, American, Travel Air, Noorduyn, deHavilland, Stinson, and Waco planes—various models, some 77 aircraft in all.

Similarly the company has a large variety of engines, including Pratt & Whitney, Wright, Jacobs, Lycoming, Rolls Royce, and deHavilland—a total of 217. This plainly shows the difficulties involved in the company's standardizing of maintenance procedure on lines operating throughout northern Canada, from the Atlantic to the Pacific, and to points north of the Arctic Circle.

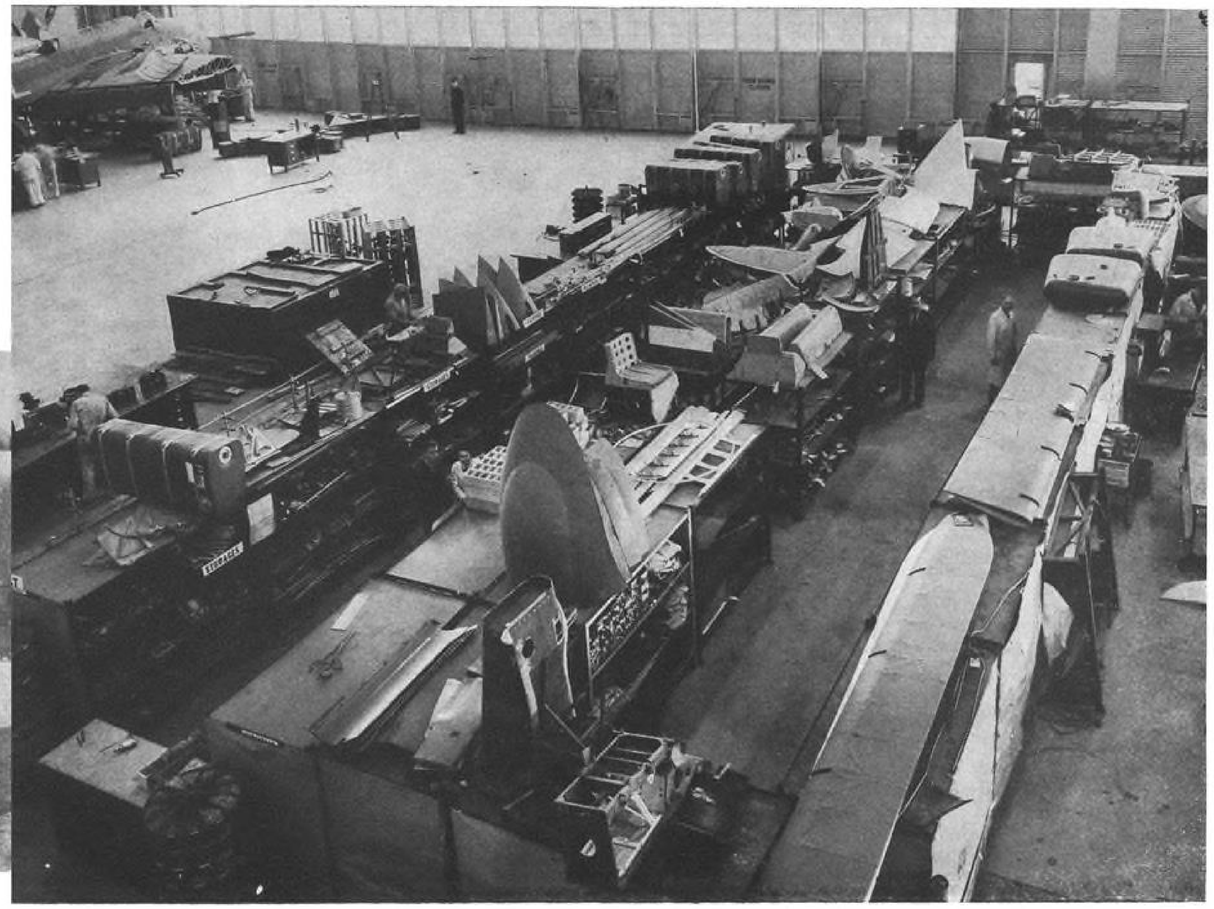
Typical of these bush maintenance operations is that of the CPA Central Division headquartered at Winnipeg, which operates throughout northern Manitoba, northwestern Ontario, and northeastern Saskatchewan. Four separate airlines operated these runs before CPA consolidated them. These facilities still carry the marks of the former owners; they were only taken over in 1942.

The chief maintenance engineer of this division periodically visits the various bases and reports to the CPA superintendent of maintenance at Winnipeg. Forms developed for use in this district include a general maintenance report listing work done on each aircraft and engine, an acceptance release from the pilot taking over from the test or ferrying pilot, an engine failure report, and an engine overhaul report. Each aircraft carries a complaint book to give the operations and maintenance personnel details of what work is necessary.

Inspections are made daily before flight, from 25 to 30 hr. of flying time, again after 50 to 60 hr., and between 180 to 200 hr. Oil changes must be made every 70–80 hr., except on oil diluted engine installations, where it is only necessary to add fresh oil to keep the oil level in the tank normal. Spark plug changes take place every 50–60 hr. Oil strainers must be removed at least once every 25 hr. A new or an overhauled engine always has a major check after 20–30 hr. of operation. The propeller, after servicing, is checked for tightness on completion of first flight.

(*Turn to page* 315)

Vancouver, the West Coast base, has complete supplies and up-to-date shops and hangars.





Airplane tire deteriorated by direct sunlight.



Disastrous tire wear can be avoided. By following these methods of tire inspection and maintenance, you'll quickly put the finger on rough usage, improper storage, oil and heat damage, and "unbalance" repairing*

ANALYSIS OF DAMAGE to tires shows that in a large number of cases their useful life depends not so much on the number of landings made as on the care given them by the ground crew and the handling of the plane by the pilot when taxiing.

Many tires lose a large percentage of their strength and wear resisting qualities because of improper storage. Oil, heat, and bright sunlight can be harder on your rubber than heavy operational use of it. Tires should be stored in their original wrappings. They should not, however, be stacked one above the other, since this method, though saving space, causes the lower tires to become badly distorted through sustaining an inordinate weight. Balance is of paramount importance in airplane tires, and any change of shape may "set", causing the tire to assume the same position when installed and resulting in the same portion of the tread always making the initial contact with the ground. This continual wear on one place will quickly cut down the life of the tire, though most of its surface will still be in good condition.

Tubes which have been removed from their cartons will keep best when slightly inflated and placed inside their casings. Dirt should be excluded by keeping the valve cap on the tube at all times.

Before mounting, wheels should be examined for burrs which might damage the tires or tubes. Balance marks on tubes should be carefully located at the red dot on the casing. In event there is no balance mark on the tube, the valve should be lined up with the red dot. Unbalance in tires, in addition to causing wear, also results in severe vibration when landing and taking off.

No lubricants should be used between the tire and wheel since this practice tends to cause slippage between these parts. A small amount of tire talc may be used to prevent the tube from sticking to the casing. Because there is a tendency to wrinkling in these large tubes, they should be inflated to seat the tire beads properly, then completely deflated and reinflated to the correct pressure. This is necessary to remove wrinkles and prevent pinching of the tube. In dismounting tubes, always remove the valve cap and core to make sure no pressure remains. Obviously, bruised or burred tools should never be used, either for dismounting or for replacing tires. Hence, mechanics should be warned against "tossing the tools around."

Since wear is governed to a large extent by the air pressure, correct pressure should be checked on a regular schedule, preferably two or three times a week. Newly mounted tires should be checked daily for several days, for frequently air is trapped between the tube and casing, causing a false reading on the gage. As this air slowly seeps out, the tube expands, causing a considerable drop in pressure. Keeping the valve cap screwed down finger-tight at all times will prevent leakage from the tube at this point, even if the valve core is defective.

Cuts in the sidewalls or treads, exposing the fabric, are sufficient cause for immediately removing a tire. Minor scratches do not affect the safety of the tire and may be left for attention when the tire is removed at the regular time. Tires showing any bulging or unusual distortion should be taken from service at once.

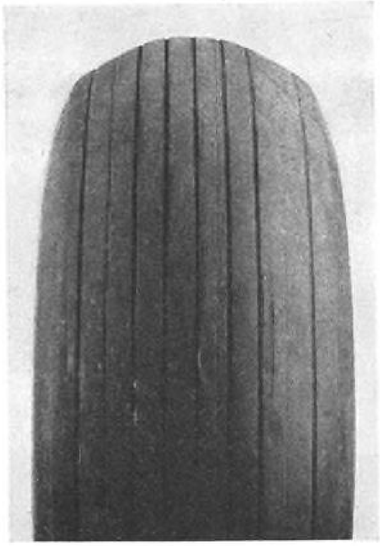
Normal inspection routing should include removal of tires after 150 to 175 normal landings. The outside of the casing should be carefully inspected for damage and the interior checked for penetration by dirt, nails, or glass. Tubes have a tendency to thin out from brake drum heat and should be carefully examined for this defect.

The type of repair material which can be used on the tires is governed to a great extent by the fact that such additions at any one point threaten to cause unbalance. However, where through holes are less than ½ in. dia., rivet repairs are indicated, for they affect weight the least and generally outlast the tire itself. Reinforcement by adding fabric is not usual practice for reasons of unbalance given above.

Tires should be removed from service for retreading before the fabric is exposed. Wear of more than two plies of fabric prevents a tire from being retreaded safely, and in









Bead damage caused by improper use of tools.

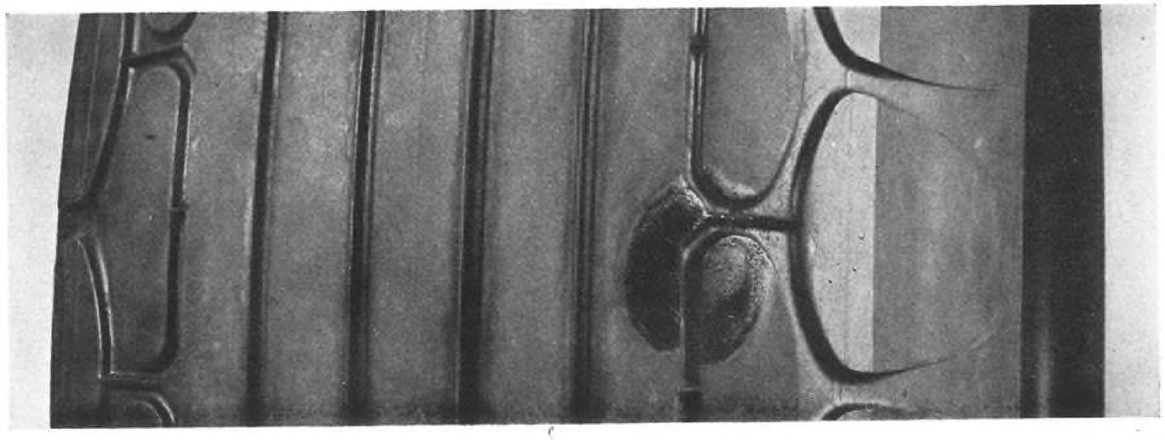


Center wear caused by overinflation.

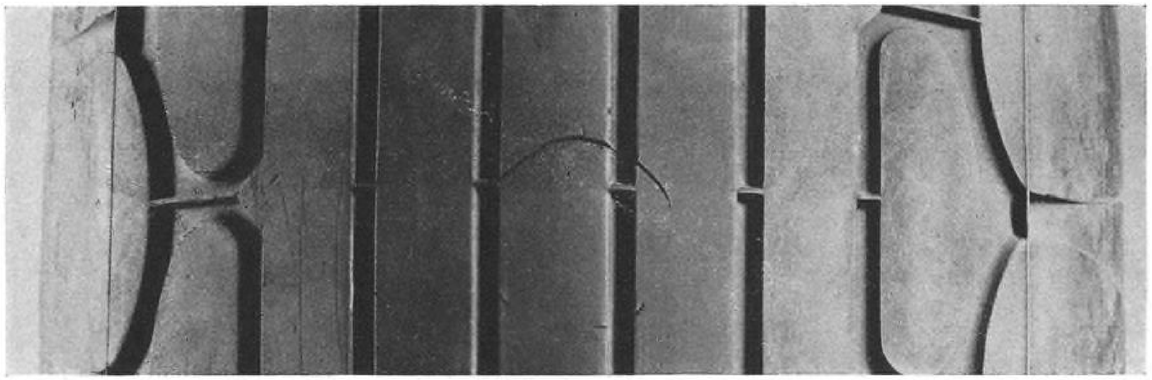


Edge wear caused by underinflation.

Spot repair on outside of tire.



* Photos courtesy B. F. Goodrich Co., Akron.



Result of leaving cans, etc., on runway.



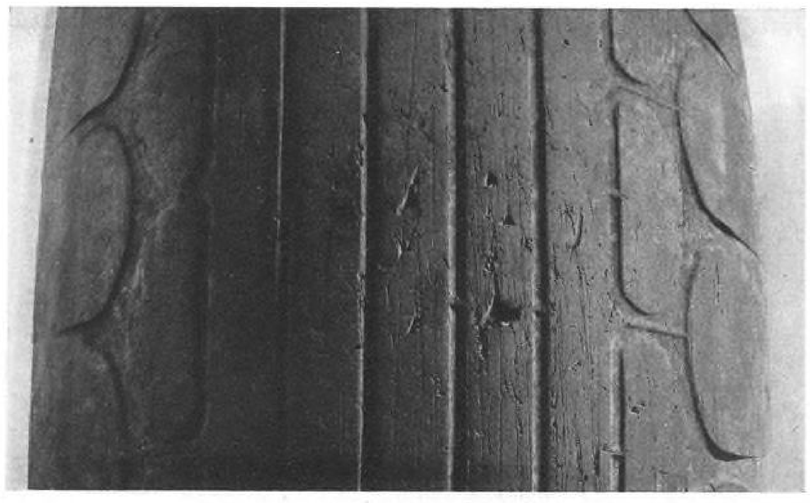
Locked brake melted rubber on this tread.

the case of tires having less than eight plies retreading is not recommended if any damage to the fabric is present. Under normal conditions, tires should be retreaded when not more than 80 percent of the possible tread wear has occurred. It is false economy to expose the fabric through wear before retreading.

Flat spots caused by improper use are good reasons for retreading the entire surface of the tire to prevent unbalance from the adding of repair material at one point only. Many flat spots are started when tires are left exposed to oil drip during servicing of the engine or hydraulic equipment. At these times they should be protected by canvas covers and should then be carefully inspected.

Ground operation or taxiing is a major cause of tire damage. Pivoting on tires exposes the rubber and fabric to an intense twisting stress and often causes small pieces of foreign matter on the ground to be forced into the tread at a time when any scratches or cuts are pulled wide open by the rotary motion of the tire on the surface.

Tire manufacturers recommend that turns should not be sharper than a 25 ft. radius for the inside wheel. Occasionally a pilot may find it necessary to pivot sharply to prevent over-running the field—a practice which has been known to wear through a new tread in two landings, in addition endangering the airplane.



Deep cuts should be repaired immediately.

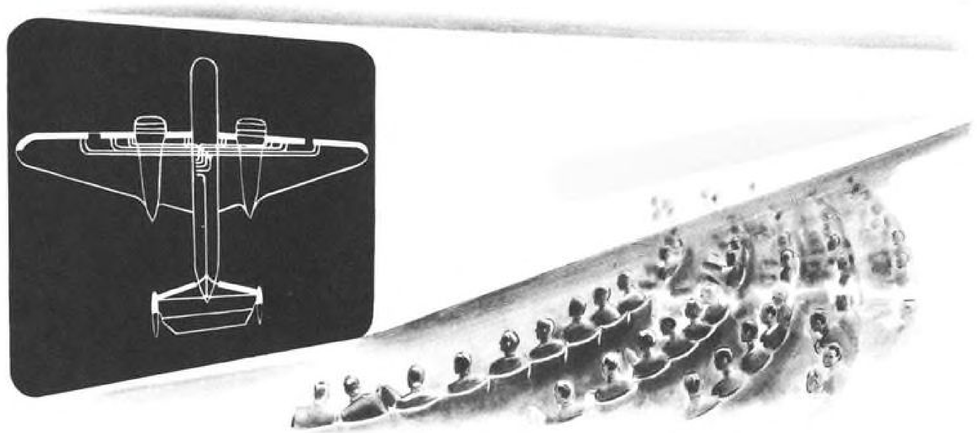


Retread time. Tread still covers fabric.



B. F. GOODRICH TRAINING FILMS FOR THE *Aviation industry*





NOW AVAILABLE FREE . . . NEW 16-MM. SOUND MOVIE, "AIRCRAFT DE-ICERS"

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PART I "Ice Formation and De-Icer Operation"—23 minutes

This section deals with the various types of icing conditions encountered and the three basic types of ice formation. Typical working De-Icer sections are shown and described in detail.

PART II "Inspection and Maintenance of De-Icers"—24 minutes

This section presents the maintenance and operation story clearly and concisely. The facts on repair and inspection procedures portrayed are bound to be reflected in greater service and efficiency from your De-Icer equipment.

PART III "Removal and Storage of De-Icers"—12 minutes

Though shorter than the other sections, Part III is vitally important. It shows the proper removal and storage procedure carefully and interestingly, step by step. All personnel connected with this phase of De-Icer servicing can get valuable aid from this film.

PART IV "Installing De-Icers"—28 minutes

In this section, the De-Icer installation story is told in complete detail with clear motion pictures and easy-to-understand comment on every step. Showing this section will give your men the know-how needed to install De-Icers quickly and efficiently.

Prints of any or all parts of this film are available for Army and Navy Training Centers, schools, airlines, and aircraft manufacturers. The films are loaned without charge, but because of the limited number of prints available, the loan period must be restricted to two weeks, unless unusual circumstances warrant an extension.

All civilian requests should be filed with The B. F. Goodrich Company, Akron, Ohio. See order form at right. Army and Navy Air Corps requests should be filed as indicated under "Note" in order form.

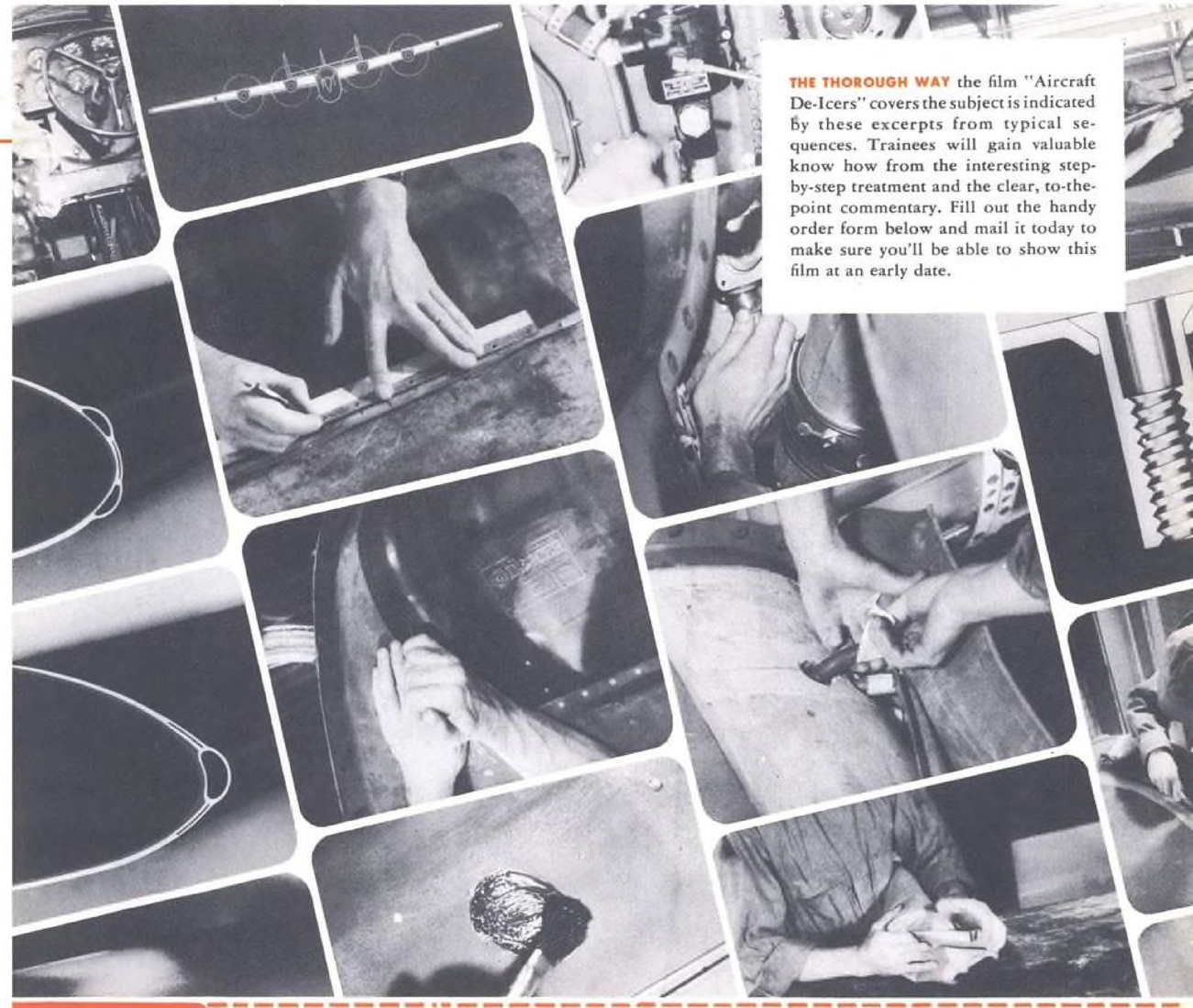
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THE THOROUGH WAY the film "Aircraft De-Icers" covers the subject is indicated by these excerpts from typical sequences. Trainees will gain valuable know how from the interesting step-by-step treatment and the clear, to-the-point commentary. Fill out the handy order form below and mail it today to make sure you'll be able to show this film at an early date.

USE THIS EASY ORDER FORM

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Akron, Ohio

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GENTLEMEN: Please send me the following part/parts of the 16-mm. sound film "Aircraft De-Icers" for showing on the date indicated below. I understand this film will be loaned free of charge for a two-week period.

PART 1 ☐ PART 2 ☐ PART 3 ☐ PART 4 ☐

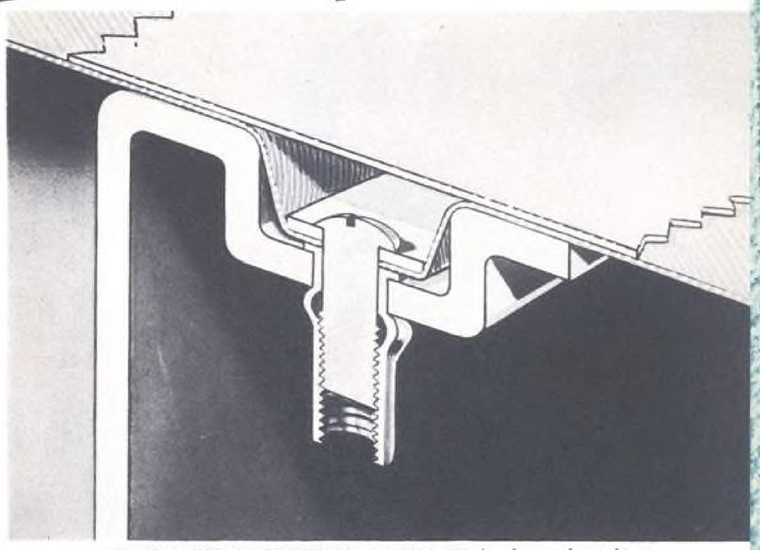
FOR SHOWING (GIVE DATE) 1ST CHOICE _____ 2ND CHOICE _____

_____
(ORGANIZATION) (YOUR NAME)

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(STREET ADDRESS) (CITY) (STATE)

Here's the secret of FASTER "BLIND" FASTENING





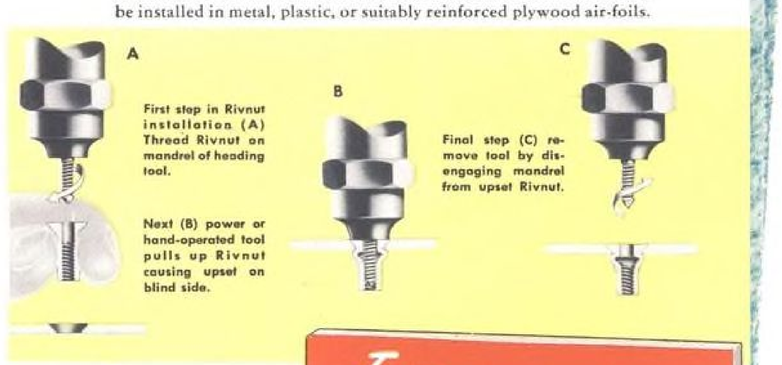
TYPICAL USE OF RIVNUT AS A NUTPLATE is shown here in a cloth-covered control surface assembly. B. F. Goodrich Rivnuts can be installed in metal, plastic, or suitably reinforced plywood air-foils.

USE DUAL-PURPOSE B.F.GOODRICH RIVNUTS AS BLIND RIVETS OR NUTPLATES OR BOTH!

If you use "blind" fastening in any fabricating operation, chances are you can use B. F. Goodrich Rivnuts to great advantage. These internally threaded tubular rivets can be pulled up while working entirely from one side. A bulge or head is formed on the under side of the work which is large enough to resist being pulled through the skin even under heavy load.

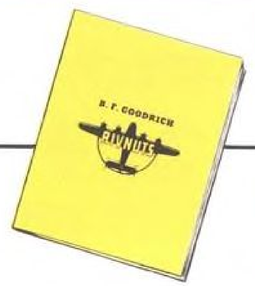
LOOK AT ALL THESE FEATURES

The Rivnut is the only one-piece blind rivet that can be used as a nut plate after installation. It is light in weight, low in cost, simple to install. Rivnuts may be inserted in a smaller hole in the skin due to their compact design. When upset, they fill the hole in the skin and have a spring effect under load. In addition, Rivnuts have a wider bearing area than any other blind fastener. Three screw sizes and a complete range of grip lengths make them ideally suited to many uses in secondary and, in some cases, primary structure.



RIVNUTS AVAILABLE NOW FOR PROMPT DELIVERY!

Facilities for manufacturing Rivnuts have been greatly expanded to accommodate the growing needs of aeronautical and allied manufacturers. This added capacity should make it possible for us to fill all normal orders promptly.



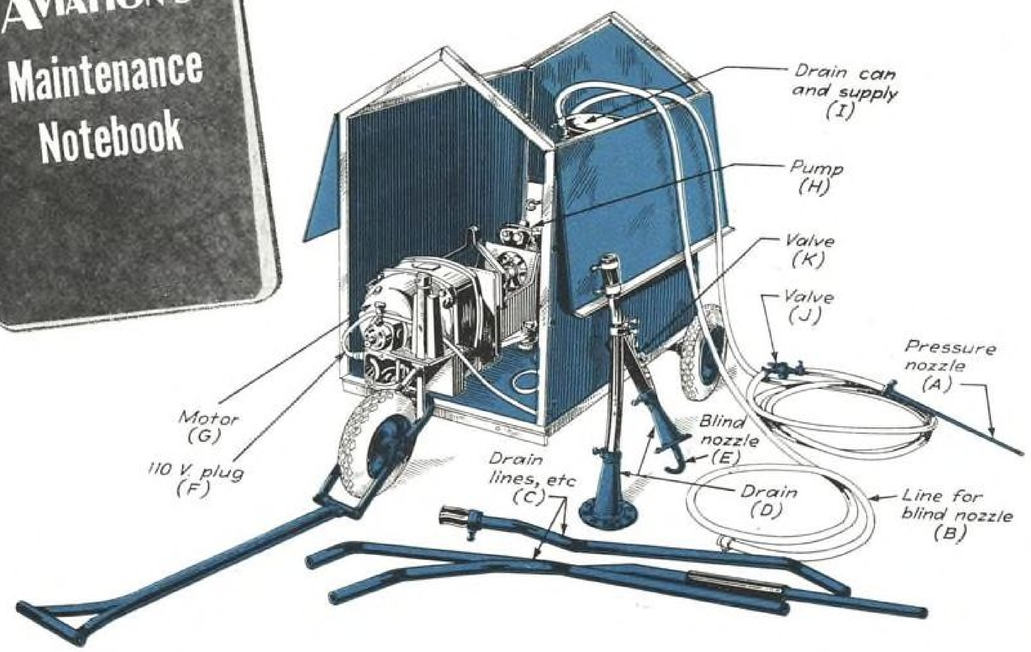
FOR FREE BOOKLET *containing data on Rivnut types, sizes, grip ranges, strength and weight, write today (on letterhead, please) to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

In war or peace

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FIRST IN RUBBER

AVIATION'S Maintenance Notebook



Portable Oil Tank Cleaner



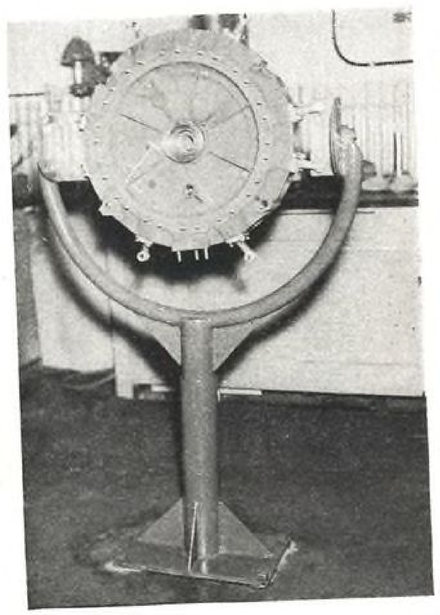
• Braniff Airways' Line Service Crew Chief Carmack Miles built this cleaning unit from salvaged parts. It has turned out to be a valuable piece of equipment. By old system, using compressed air with oleum, 15 gal. of liquid was required for cleaning an oil tank, whereas by using this cleaner the 8-gal. tank of oleum will last almost indefinitely. Though oleum is comparatively cheap, this amounts to a considerable saving over a year. In addition, cleaning time is saved because interior of nacelle is kept clean. Actual cleaning time for a tank has been cut from several hours to about 30 min.

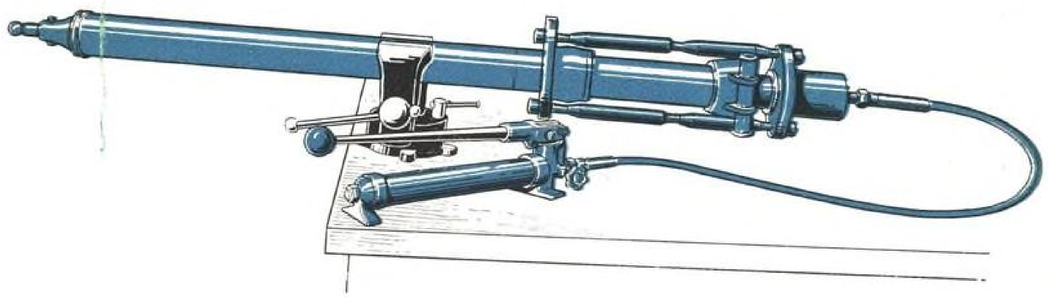
Oleum is circulated by pump *H* driven by 110-v. motor *G*. The liquid is directed into tank through filler opening by nozzle *A*. By maneuvering nozzle, entire inside can be cleaned quickly. Oleum flow is controlled by valve *J*. Nozzle *E*, which protrudes into bottom of oil tank through lower drain holes, can be turned through 360 deg. for reaching blind corners. Flow through *B* is controlled by valve *K*. Oleum and tank deposits drain through drain line *D* back into supply tank *K*, where liquid is recirculated after sediment has been separated by baffles.



Braniff Rear Section Stand

• To permit more convenient working conditions on engine rear sections, Braniff shopmen devised and built this telescopic-base swiveling stand which allows work to be placed in most advantageous position both as regards light and working angle.



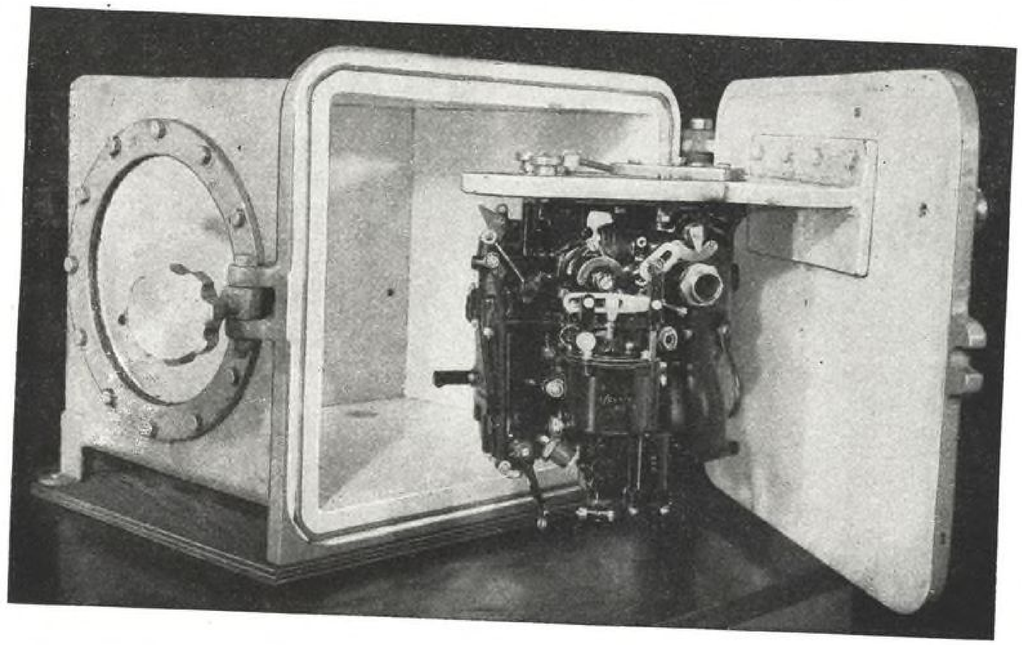


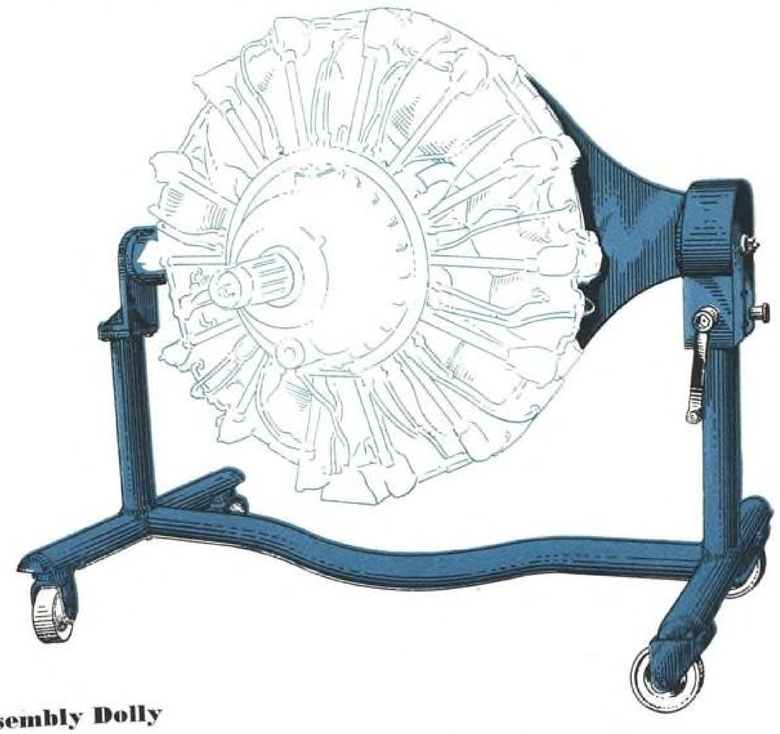
Braniff Pulls Bearings The Easy Way

• For removing tail wheel post bearings on DC-3's, Machinist Lonnie Reedy of Braniff Airways designed and built this hydraulic puller. Not only does this manually operated machine save time and work but its use leaves the parts in better mechanical condition than formerly.

Altitude Chamber

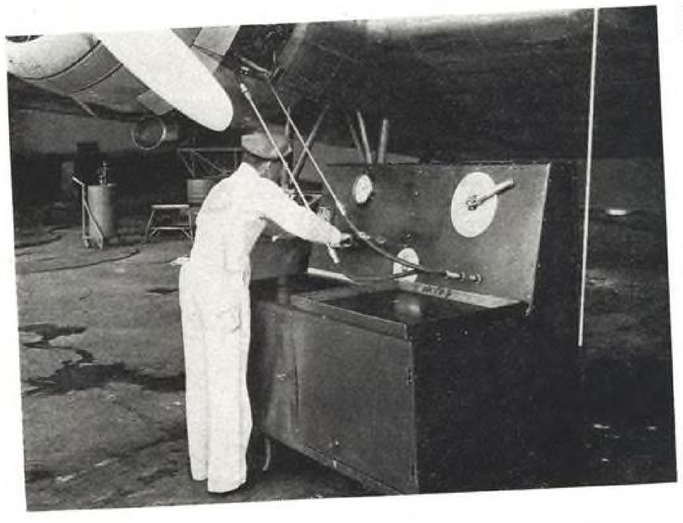
• Carburetor is installed on open door without necessity of reaching into chamber to make connections. Door is then closed and vacuum pump evacuates chamber to simulate any altitude up to 50,000 ft. Operation of parts can be observed through window at left. This equipment has greatly reduced time required in making adjustments. Built and used by Aircraft Repair, Ltd., Edmonton, Alta.





TCA Assembly Dolly

• Having its tilting angle controlled by gears and locked with a pin—shown at right—this assembly dolly, built from scrap, was made at company's Winnipeg shops.



Hydraulic Test Unit

• Chicago & Southern built this hydraulic unit for hangar testing of airplane systems. By making two union connections, entire hydraulic mechanism of plane can be tested accurately.

American Airlines Builds Cylinder Lap From Scrap

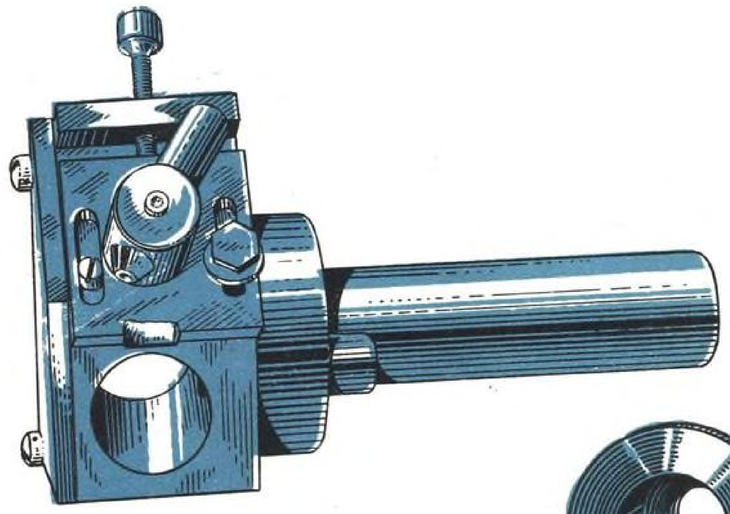
• Cylinders which have been in use for some time are not smooth, nor are they smooth even after they have been reground in overhaul. Lapping insures smoothness of lubrication. Lewis H. Trainor's machine is an original model not duplicated in any airline hangar, though several shops have small, bench models.

The cylinder lapping machine, built from material which was available in the machine shop, is a stand about 12 ft. high and 4 ft. wide. Suspended from a crosspiece is a 3-ft. piece of ordinary 2-in. tubing which is moved up and down by a valve. The valve, incidentally, was salvaged from a four-way landing gear selector valve. Attached to bottom of tubing is a removable, round piece of metal. This is main section of tool—part which actually does lapping of cylinder.

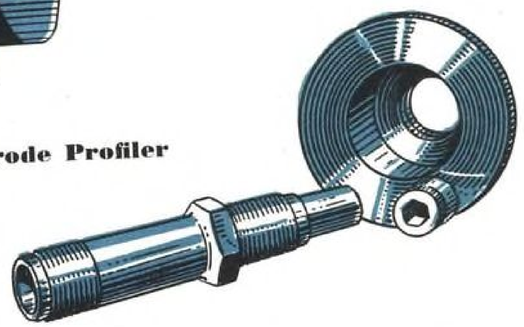
After a cylinder has been thoroughly inspected for flaws, it is sent to lapping machine for finishing. Cylinder is fixed to stand, switch turned on, and round lapper moves up and down inside cylinder, giving cylinder wall a highly polished, smooth surface. This round piece may be removed, and a different tool head installed for lapping of different sized cylinders.

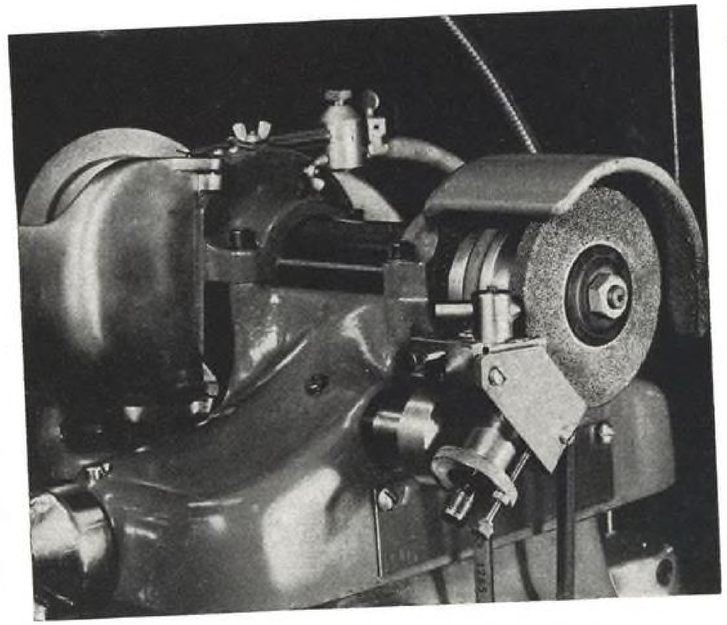
Lapping operation takes about three minutes, and though this makes standard maintenance work on a cylinder three minutes longer than formerly, lapping is an improvement in maintenance methods, giving added strength and durability to a vital, delicate aircraft part.



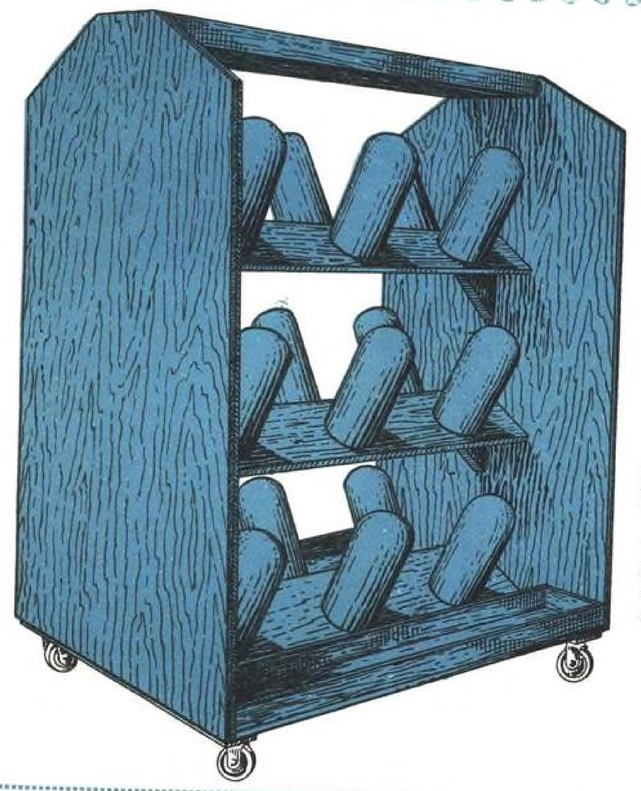


Sparkplug Electrode Profiler





• Continental Air Lines designed and built this electrode profiler for use on a valve grinder when servicing sparkplugs. Depth of cut is regulated by small knurled-head screw at side of retainer. Attachment fits into hole for handrest and is prevented from turning by pin which fits into face of grinder base casting.

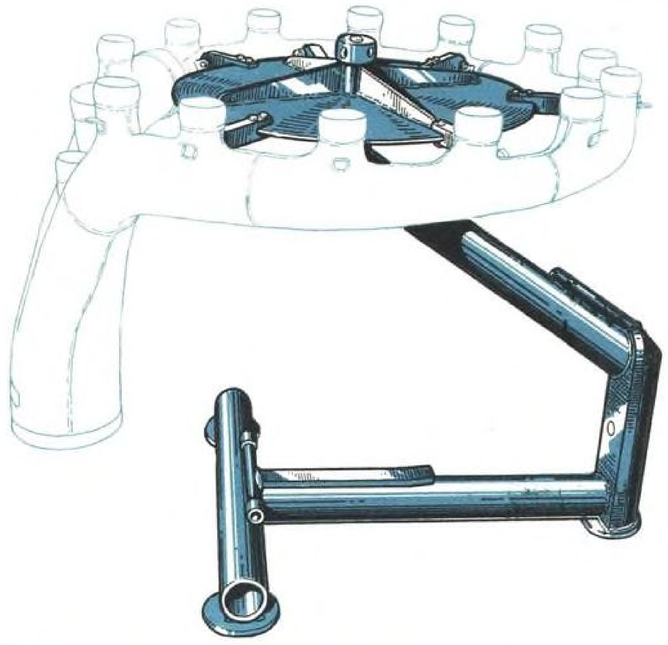


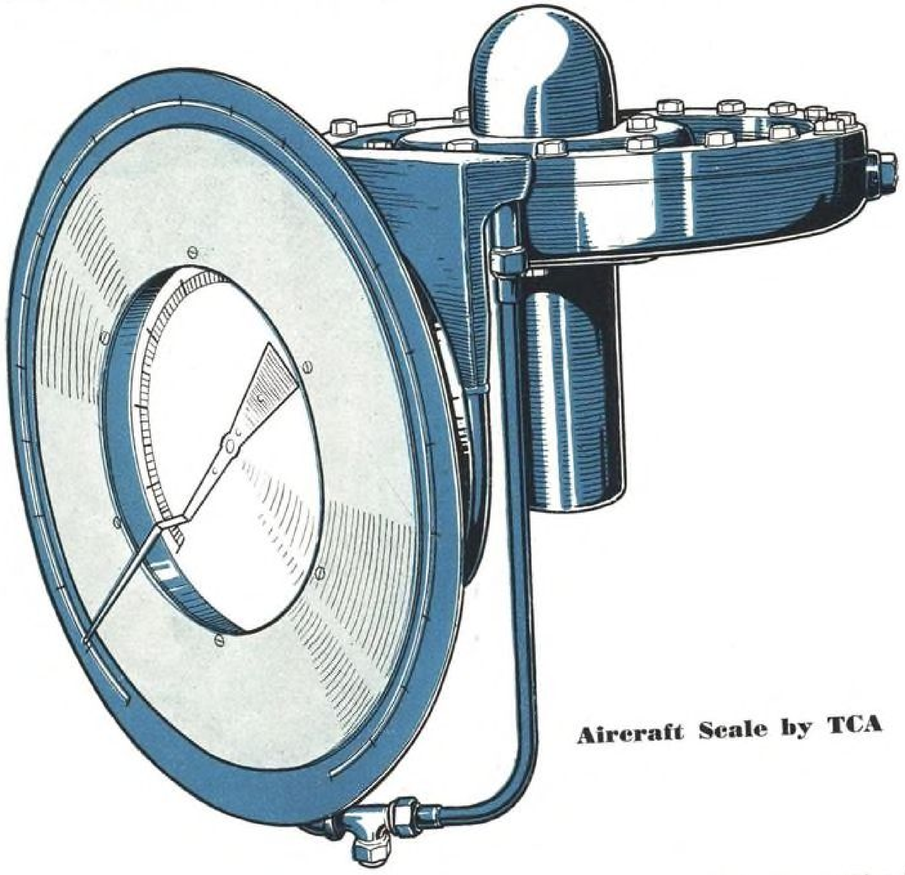
Braniff Uses Wood To Save Metal

• Braniff Airways uses this all wood cylinder assembly storage stand, saving space and critical materials.

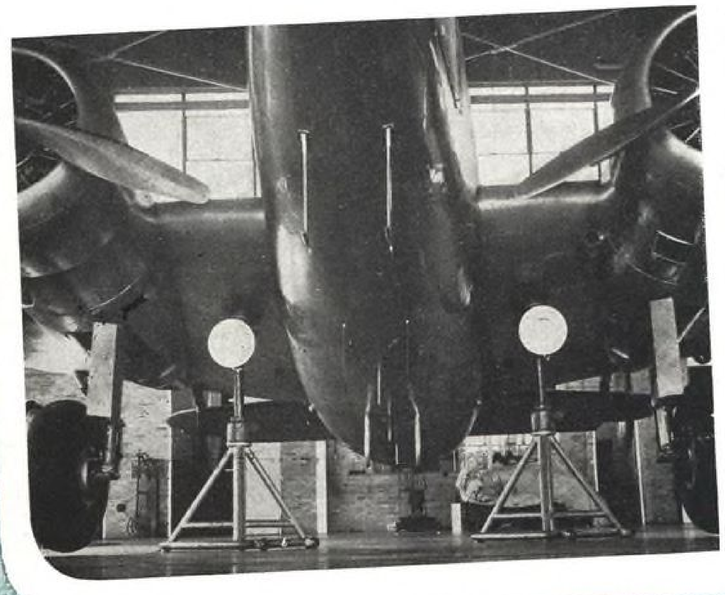
Collector-Ring Jig Used by TCA

• Designed and built at Trans-Canada Air Lines' Winnipeg base, this stand provides rigid support and gives easy access to exhaust collector rings to be built up or repaired. Turntable can be rotated and locked. Maintenance problem with this type of ring is the excessive wear in flexible ball joints, found to be due to rotation of ball from vibration. New joint, with finger which allows flexibility but prevents turning of joint, is being designed by TCA.





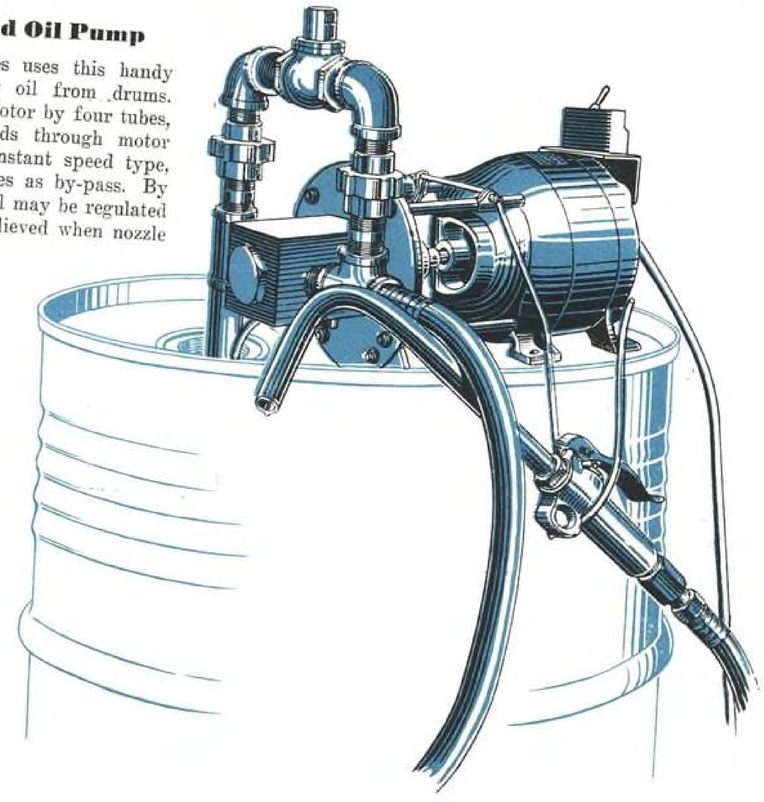
Aircraft Scale by TCA



• Hydraulic weighing head to be placed on jacks under aircraft incorporates an oil pressure chamber made of strong copper corrugated sheet diaphragm with boss bolted on to bear weight. Filler plug is at right. Oil line transmits oil pressure to gauge. One of these is put under each wing as plane is jacked up. A third scale under tail completes the process. Unit designed by C. H. Wilson, machine shop foreman, TCA base, Winnipeg.

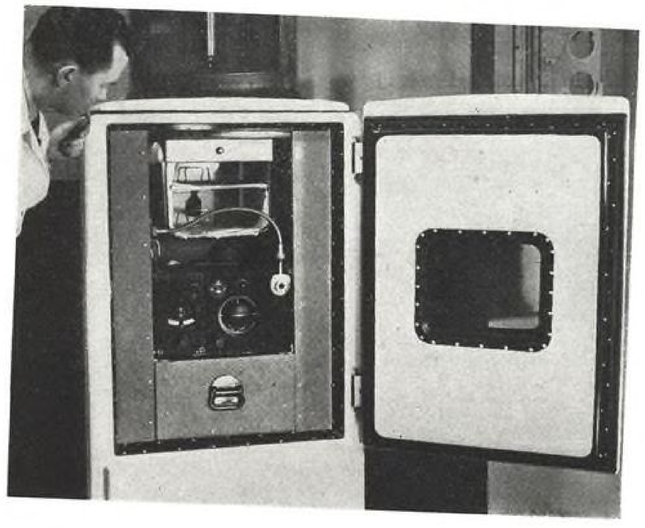
Portable Fuel and Oil Pump

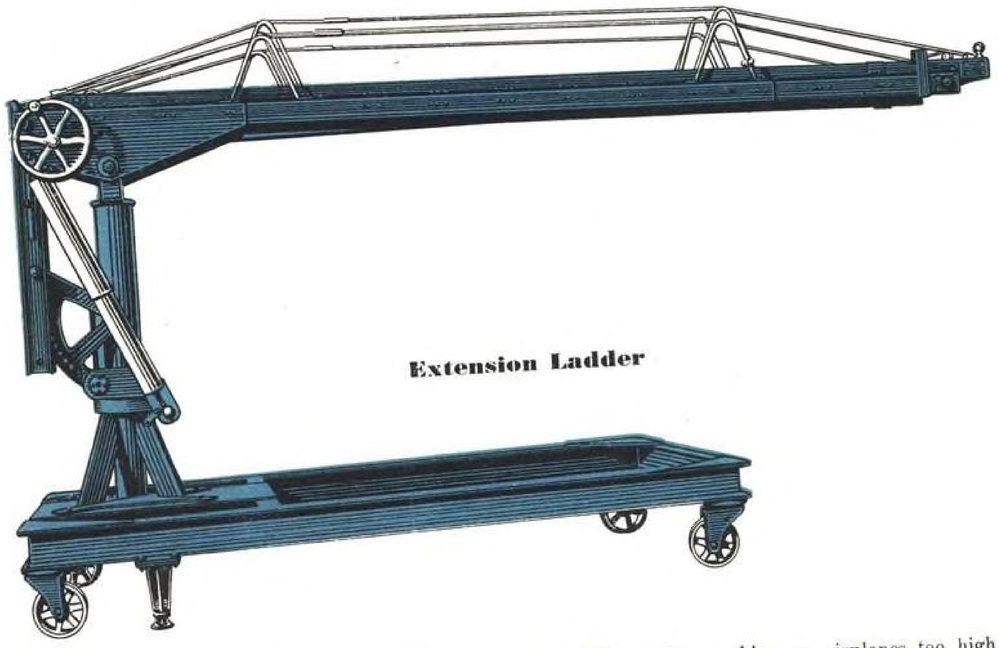
• Continental Air Lines uses this handy pump for transferring oil from drums. Pump is bracketed to motor by four tubes, slid over extension studs through motor body. As motor is constant speed type, valve above pump serves as by-pass. By opening valve, flow of oil may be regulated and pressure on hose relieved when nozzle valve is closed.



Instrument Ice Box

• United Air Lines has installed a vacuum pump and extra electric motor in the base of a household refrigerator for instrument testing under sub-zero conditions at high altitude pressures. Beneath shelf on which instruments are tested there is a drawer for dry ice and another above it. To prevent observation window from icing up, it is made double, with a 2-in. air space. Temperatures as low as 90 below zero have been obtained with instruments not requiring air flow, 35 below zero when air flow is required.

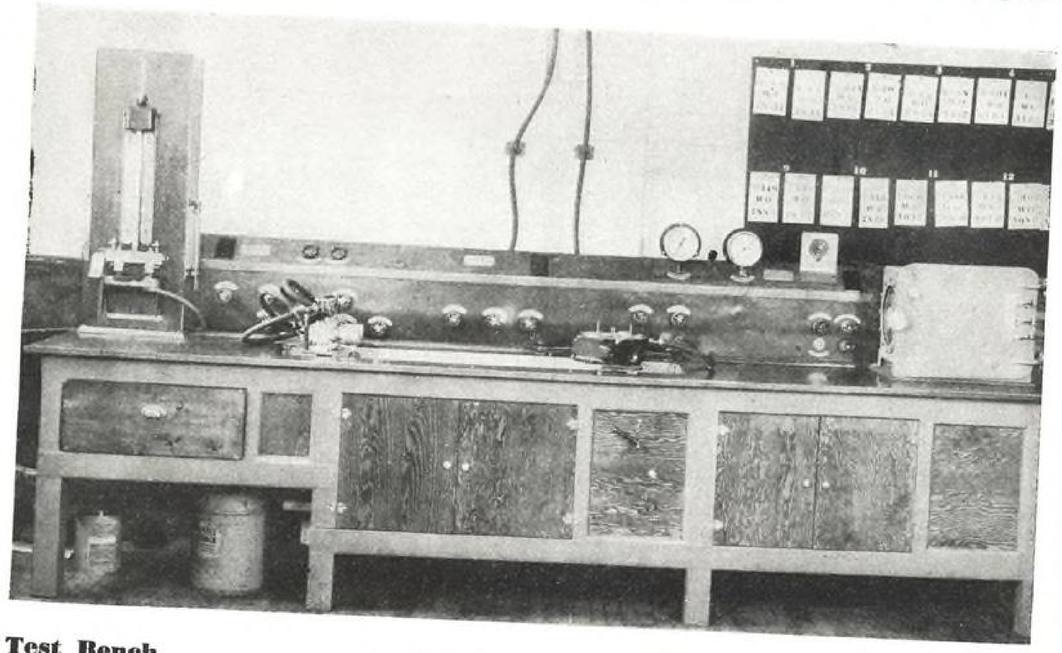




Extension Ladder



• For working on airplanes too high for ordinary stepladders, Pan American designed and built this extension ladder with a reach of 26 ft. It was intended particularly for working on the C-54 but doubtless found many other uses. Inverted screw jacks are used beneath the frames to prevent movement when working.

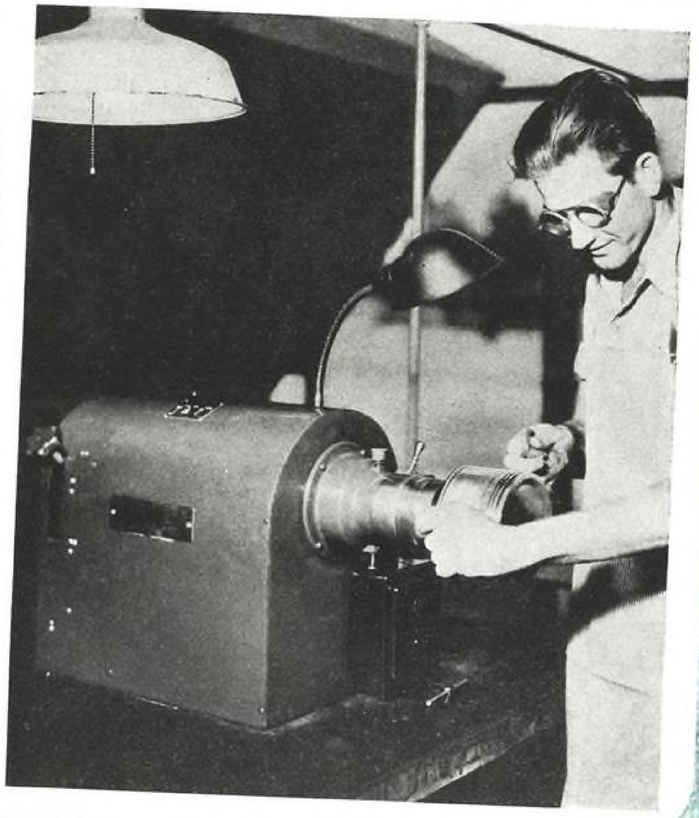


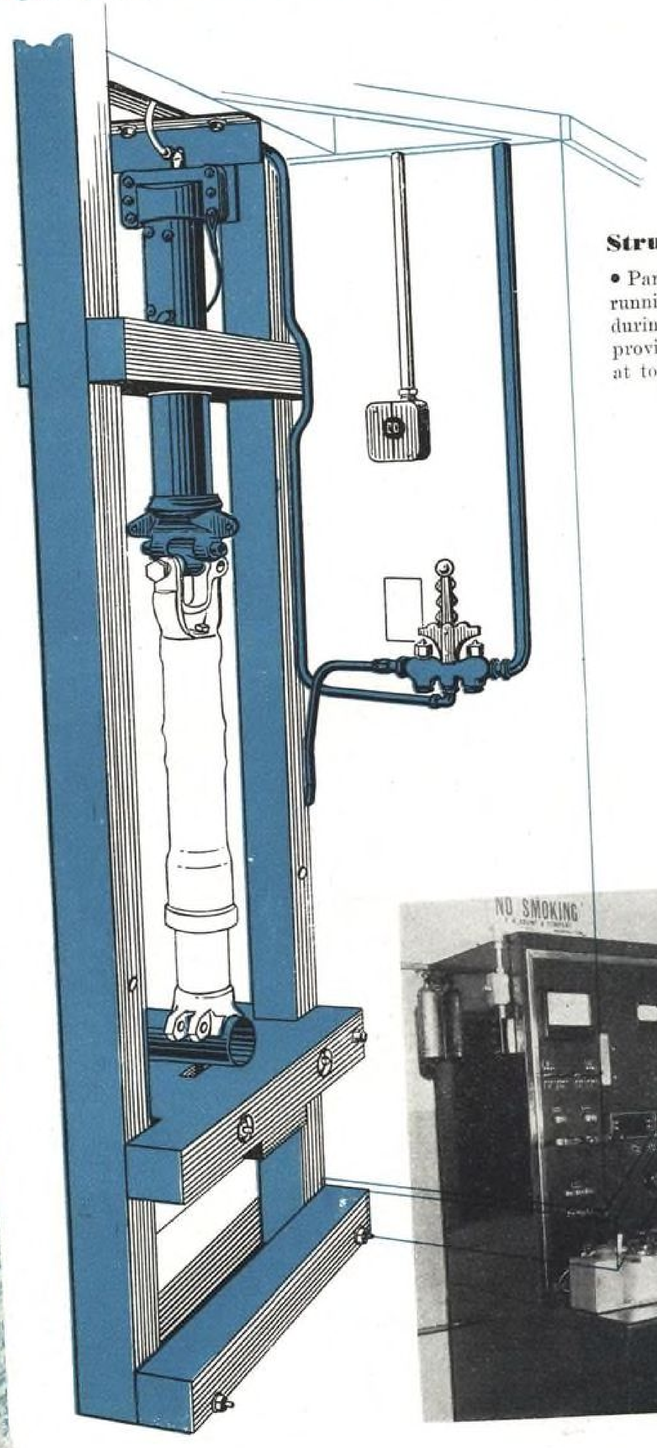
Test Bench For Carburetors And Fuel Pumps

• Aircraft Repair, Ltd., Edmonton, Alta., designed and built this bench. At left is double flowmeter for calibrating carburetor jets. Next is mounting for run-in of fuel pumps. In center carburetors are checked for float level and needle operation. At right is altitude chamber. Vacuum pumps, fuel pumps, drain tanks, etc., are in space below bench.

Piston Cleaner

• Eastern Air Lines cleans pistons by using a variable speed machine equipped with quick-acting chuck.



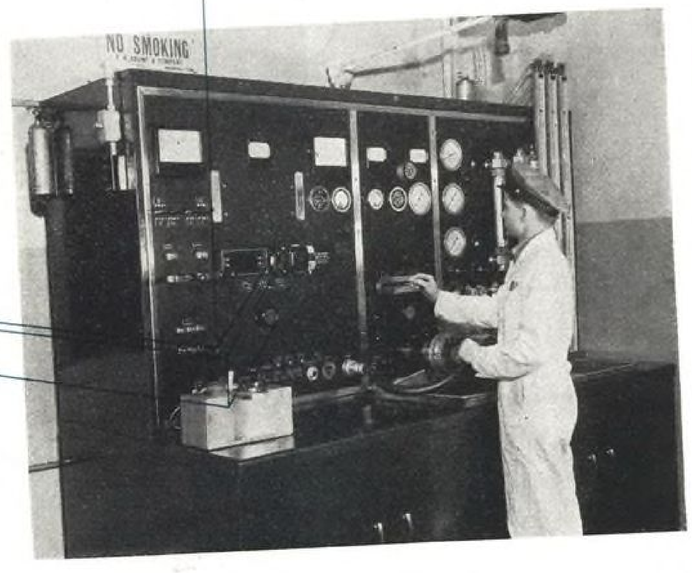


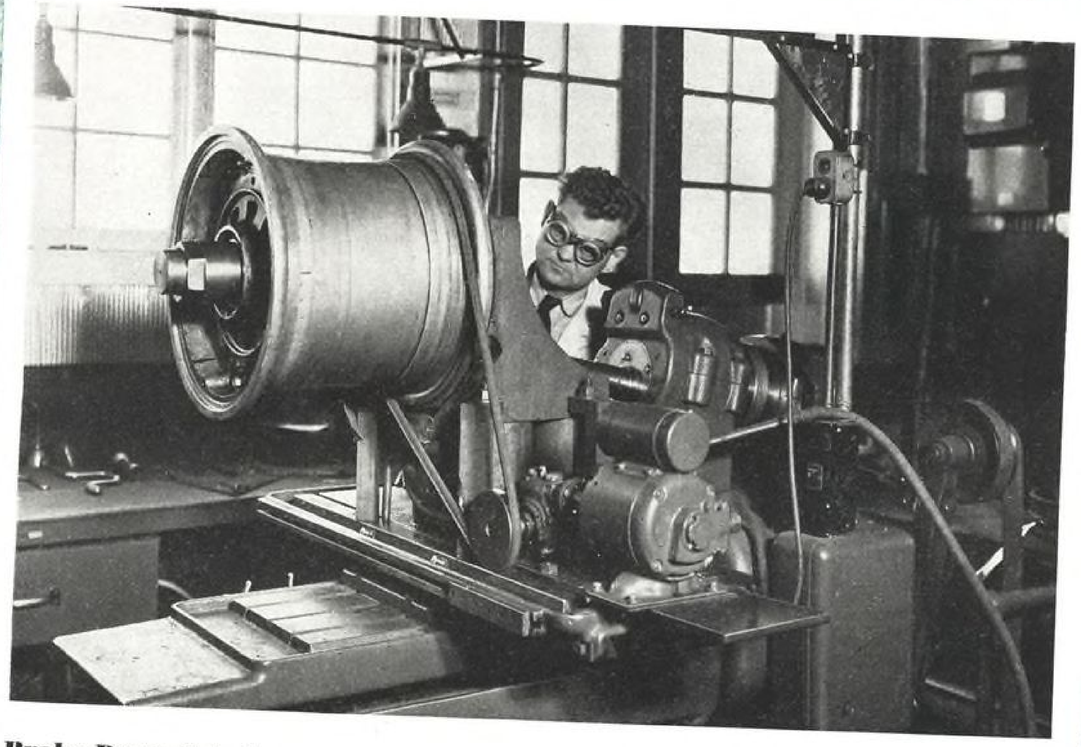
Strut Running-In Device

• Pan American uses this gadget for running in oleo struts to prevent leakage during operation. The valve at right provides pressure to operating cylinder at top.

Chicago & Southern's Engine Accessory Testing Bench

• Center section of panel is for control of a 5 hp. variable speed motor which is mounted directly behind control panel with shaft projecting through. On this is a mounting fixture with various adapters for accessories to be tested. Left section of panel handles all electrical accessories, such as generators, control position mechanisms, etc. Right section takes care of pressure and vacuum pumps.





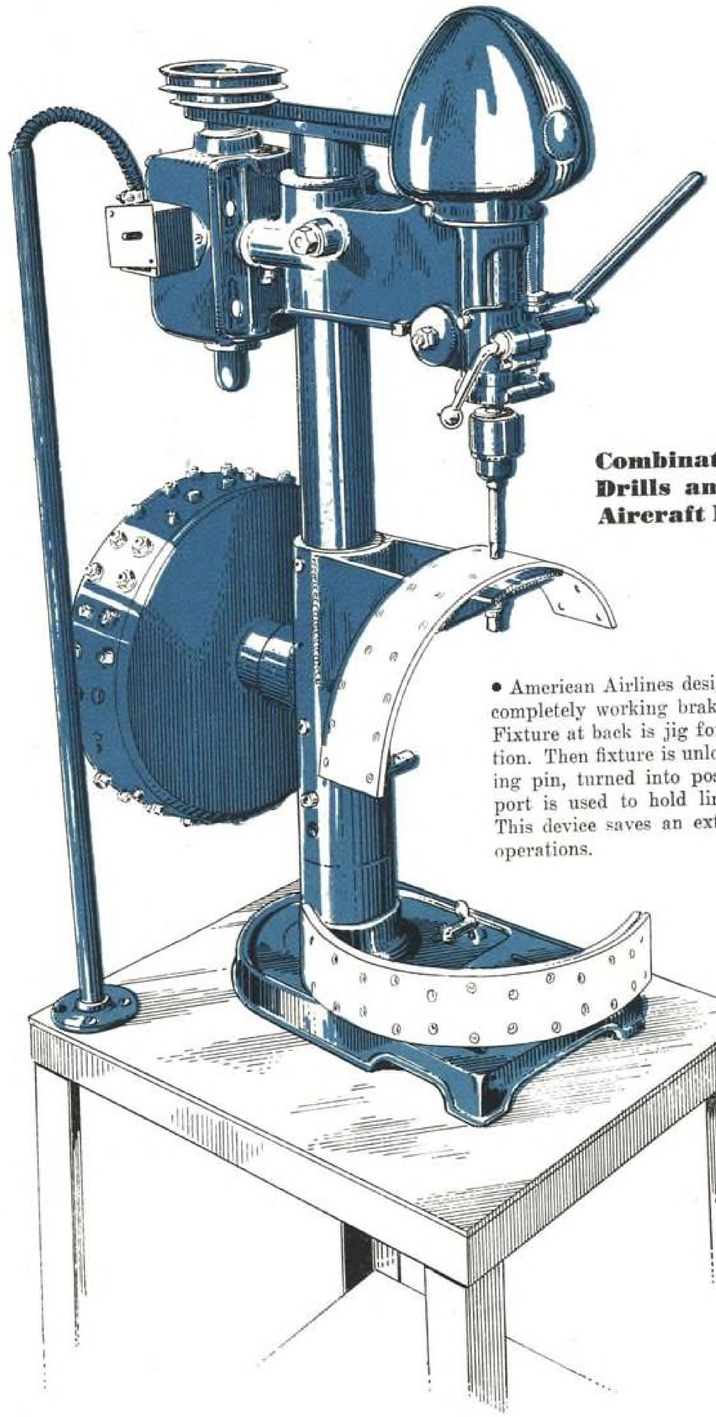
Brake Drum Grinder

• This Heald cylinder grinder has been revamped by United Air Lines for grinding brake drums at its central maintenance base at Cheyenne. The table traverse is automatic and the feed is manual. The original power application to the moving carriage is used. All parts for the conversion were salvage parts. They included a spindle for holding the 1700 by 16 wheel, an angle plate, four blocks for holding the angle plate, a small motor-driven reducer for turning the wheel, a plate for mounting the motor and reducer, two wedges for raising the spindle to get the grinding wheel into the bolt heads on the 1700 by 16 wheel, and a belt pulley for the spindle drive. The conversion was designed by United's engineering staff at the Cheyenne maintenance base.

Instrument Repair Platform

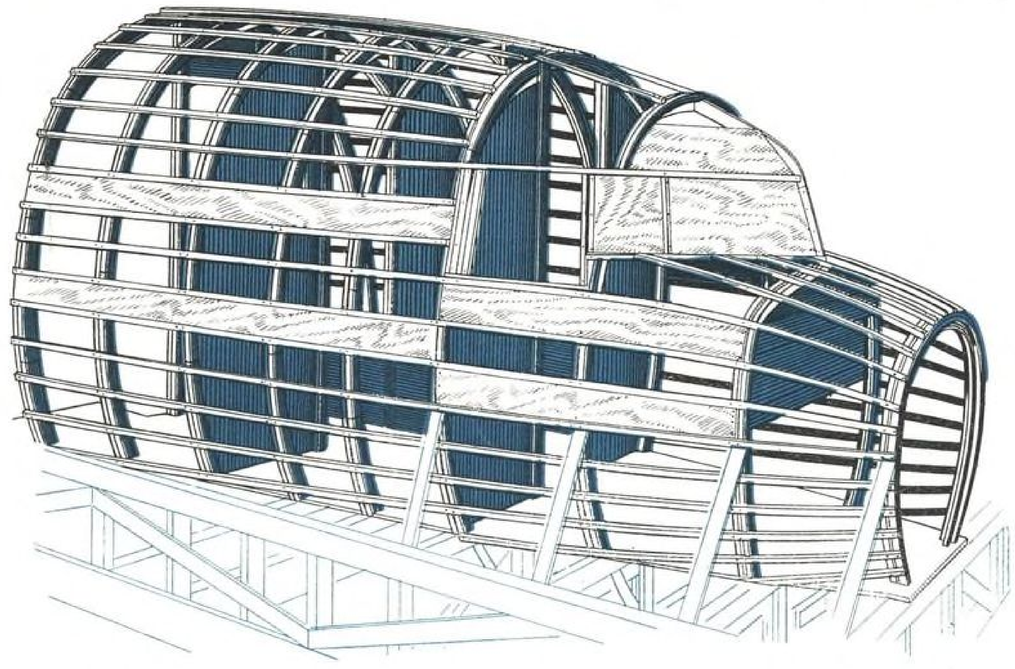
• United Air Lines use a mezzanine platform for servicing instruments on *Mainliners* at Cheyenne, Wyo. A slot in platform directly in line with overhead track permits moving of parts past platform. Instrument repair shop is at back of balcony obviating need for climbing up and down when working on instruments in nose or pilot's instrument board.





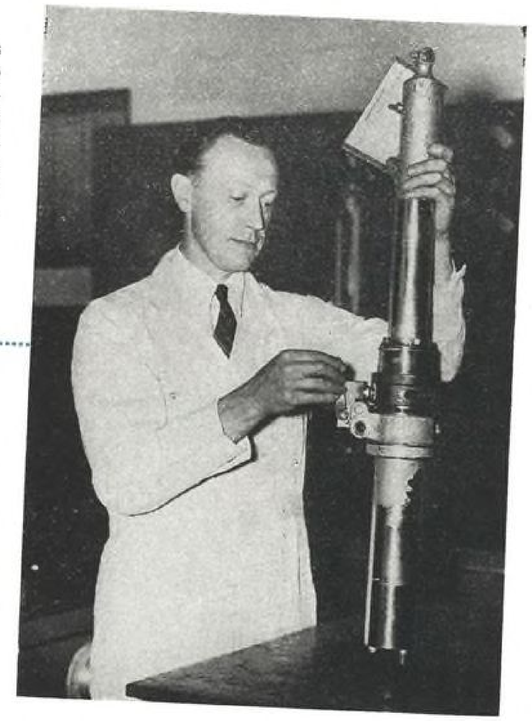
Combination Attachment Drills and Counterbores Aircraft Brake Linings

• American Airlines designed and built this fixture for completely working brake linings on a single machine. Fixture at back is jig for drilling lining in first operation. Then fixture is unlocked on center post by removing pin, turned into position shown and curved support is used to hold lining while it is counterbored. This device saves an extra machine and two handling operations.



Wood Radio-Work Mockup

• This wood mockup of a DC-3 cockpit enables Pan American Airways' radio shop at Miami to plan new radio installations and alterations without tying up aircraft on the ground. Technicians plan and install their work in this mockup and then transfer the completed work to the plane itself. By this means the plane is available for operations until the crew is ready for actual installation work.



"Lodestar" Tailwheel Lock

• Earl G. Peters, crew chief for Continental Air Lines received $50 award for this invention which enables the lock to be renewed by replacing a small part instead of the entire cylinder. Saving much valuable time, this device permits the company to make replacements in its own shop instead of waiting for them to come from the factory.

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Flight Testing With a Thrust Meter*

By GEORGE W. BRADY,
Curtiss-Wright Corp. Propeller Div.

Method precisely gages engine and propeller performance in air, and calculations on ground provide coordinated check.

THREE PRINCIPAL ITEMS must be known in order to obtain shaft thrust efficiency: Shaft thrust, shaft horsepower, and airplane velocity. These factors are then used in the formula—

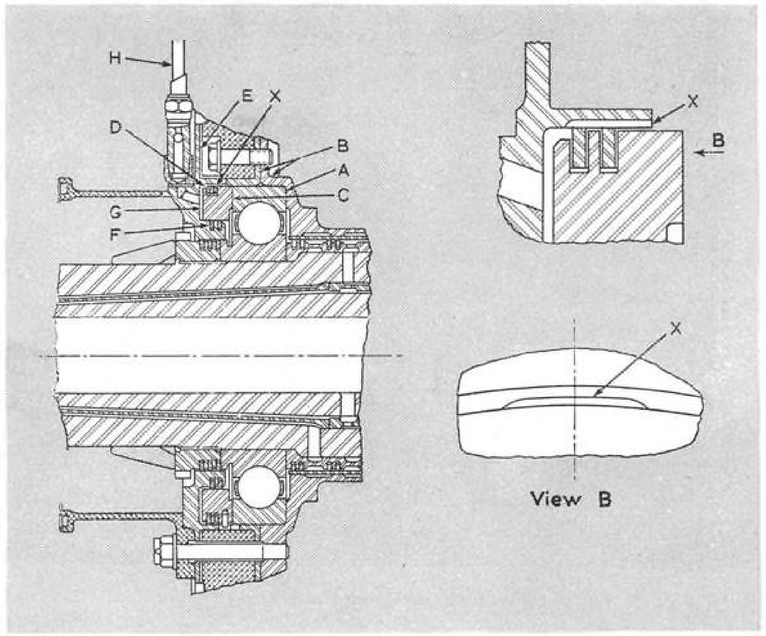
$$\eta_a = \frac{\text{Shaft thrust} \times \text{Airplane velocity}}{\text{Engine power}} = \frac{T_s \times V}{P}$$

Since horsepower is readily measured by torquemeters and airplane velocity is easily obtained, the instrumentation problem becomes simply one of developing a suitable thrust meter. Hub design in controllable pitch propellers precludes the incorporation of a meter in that mechanism, and determination of tensile stress in the shaft is excluded through lack of measurement space; hence, the method of measuring the end thrust on the movable propeller shaft bearing was decided upon as the only feasible system.

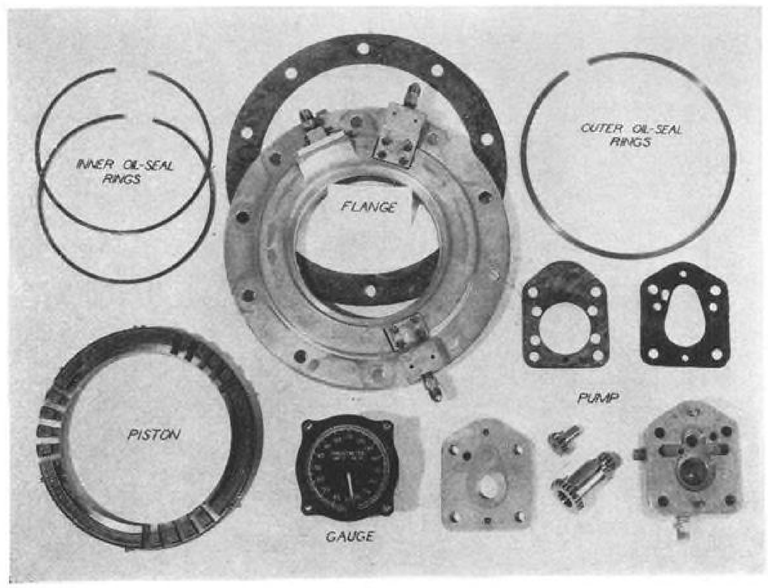
A hydraulic piston with variable-area orifice was adopted as most satisfactory. Referring to the accompanying sectional drawing, the outer race of thrust bearing *A* is given a clearance of .004 to .006 in. to permit it to slide freely. Housing *E* replaces the usual cover and is fitted with annular piston *C* which bears against outer race of thrust bearing. Rings *D* and *F* seal cylindrical space *G* between piston and housing into which oil can be pumped. Six orifices *X* in the housing allow the piston to find a position where oil pressure through duct *H* just balances thrust. Then by multiplying psi. by piston area, thrust may be computed.

Oil is supplied by positive displacement gear pump, and pressure readings are taken by a gage reading 30–180 psi., which allows thrust measurements up to 2,500 lb. Oil lines are electrically heated to prevent congealing. Since practice has shown that corrections were required in gage readings, a laboratory calibration rig was constructed and used for this purpose.

The Navy loaned an F2A-2 airplane for flight tests. This plane was equipped with a Wright R-1820 engine with .667 gear ratio. Because erratic readings were obtained in first tests, it was found necessary to use a ground calibration rig for application of a measured thrust while the engine was running. During tests it was found advisable to make corrections for each engine used because of the construction of the propeller shafts. It will be noticed that the oil pressure acts on the internal taper of the shaft, causing thrust. The oil also acquires additional centrifugal pressure in passing out-

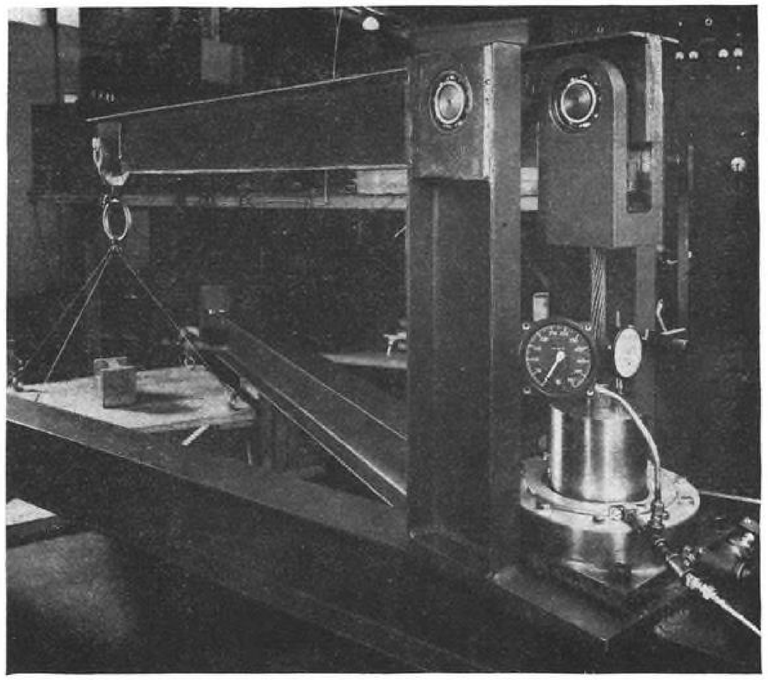


Section through engine nose with thrust meter installed.



Detail components of thrust meter.

* Abstract of paper presented at SAE National Engineering & Production Meeting, Los Angeles, Sept. 30, 1943.



Laboratory test rig for thrust meter.

ward through passages in the shaft. Both of these factors must be allowed for.

Another possible cause of error might have been the deflection of the engine reduction gears, causing a fore and aft load. But careful checking showed no noticeable effect of this sort.

Typical procedure in correcting readings for true shaft thrust is as follows:

1. Correct observed thrust meter for gage calibration.

2. Using pressure from (1), obtain indicated thrust from thrust meter calibration.

3. Correct observed intershaft pressure for gage calibration.

4 Read correction to intershaft pressure for centrifugal boost for observed engine speed.

5. Calculate thrust on propeller shaft due to oil pressure effect by multiplying effective area by difference between (3) and (4).

6 Calculate component along propeller shaft axis and propeller shaft weight, using observed inclination of shaft from horizontal.

7. Calculate corrected shaft thrust as (2) minus (5) plus (6).

Flight tests were to be made at speeds between 150 and 400 mph., and the level flight speed of the airplane was 310 mph., so it was necessary to make tests while diving. For this purpose a photo-observer was used which made simultaneous recordings of all instruments. Accuracy of readings was believed to be within 20 lb. for thrust, approximately 1 percent for speed, rpm., and hp., and within comparable limits for other readings. The only non-standard instruments were the pitch indicator and gyro-inclinometer. The inclinometer was a modification of a Sperry directional gyro mounted on its side to give inclination from horizontal of shaft axis to enable the weight component along this axis to be calculated.

The pitch indicator was specially developed to give blade angle. The transmitter on the propeller gives an impulse for each fraction of a degree pitch change and the indicator escapement counts the number of change increments in each direction, thus providing an index of the movement of the blade.

TABLE I—Range of V/nD and EHTS*

R.P.M.	2,100	2,400	2,700
B.h.p.	850	850	850
Altitude	14,000	14,000	14,000
B.m.e.p.	176	154	137
C_p	.239	.159	.112
V/nD for			
V = 160	1.007	.880	.782
V = 200	1.26	1.10	.978
V = 250	1.57	1.374	1.22
V = 300	1.89	1.65	1.465
V = 350	2.20	1.924	1.710
V = 400	2.52	2.20	1.955
nD	732	839	941
EHTS* for			
V = 160	810	918	1,024
V = 200	831	937	1,039
V = 250	862	963	1,060
V = 300	902	996	1,091
V = 350	945	1,035	1,129
V = 400	991	1,080	1,166

*Effective Helical Tip Speed.

TABLE II—Calculated Efficiency

Velocity — T.A.S.	160	220	300	400
Altitude — Ft.	14,000	14,000	14,000	14,000
B.h.p.	850	850	850	850
R.p.m.— engine	2,400	2,400	2,400	2,400
R.p.m.— propeller	1,600	1,600	1,600	1,600
C_p	.1594	.1594	.1594	.1594
V/nD	0.880	1.208	1.650	2.200
ηChart — percent	78.5	86.0	88.5	89.0
ϵdeg.	9.2	5.5	2.5	−0.2
F_N	1.255	1.132	1.051	1.00
FB	.961	.961	.961	.961
F_T	.902	.969	.987	.964
η — percent	68.1	80.1	84.0	82.4
$\Delta\eta$ (Interf.)	−1.0	−1.0	−1.0	−1.0
η_P — percent	67.1	79.1	83.0	81.4

TABLE III — Correction for Apparent Thrust and Efficiency

a) $f_2 = 0.25$				
Velocity — T.A.S.	160	220	300	400
η_a — percent	81.0	91.0	96.5	94.8
$f_\Delta T_B$	.935	.935	.935	.935
$f_\Delta D_S$	.971	.978	.982	.986
η_P — percent	73.6	83.3	88.6	87.4
b) $f_2 = 0.50$				
Velocity — T.A.S.	160	220	300	400
η_a — percent	81.0	91.0	96.5	94.8
$f_\Delta T_B$	.875	.875	.875	.875
$f_\Delta D_S$	.971	.978	.982	.986
η_P — percent	68.9	77.9	82.9	81.9

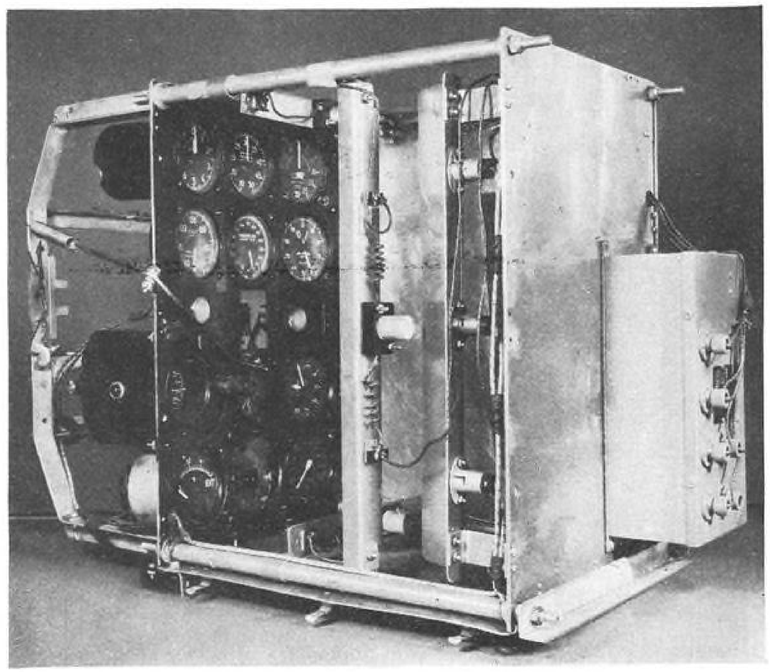
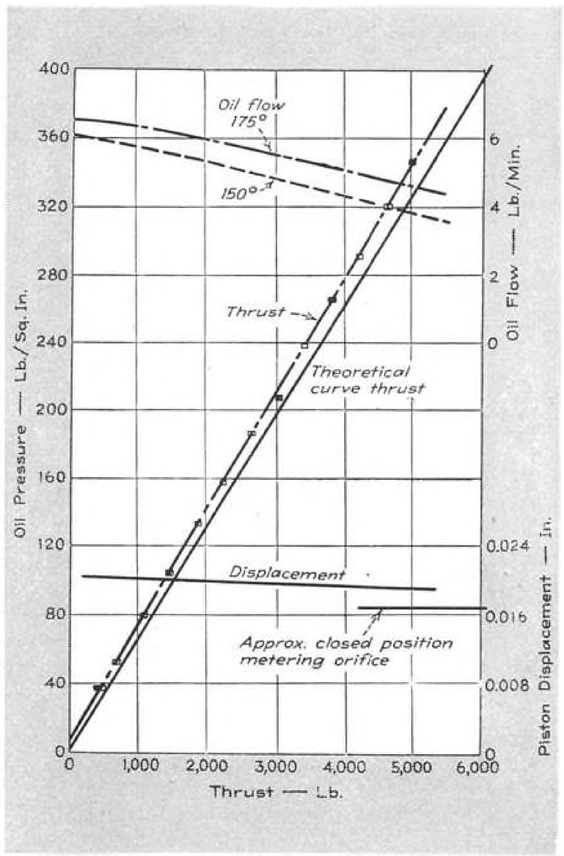
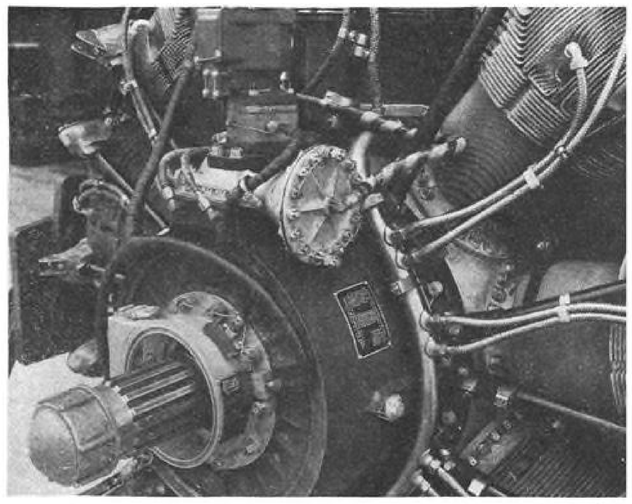


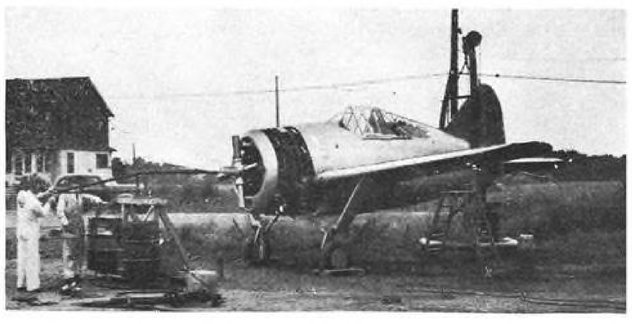
Photo-observer panel used in tests.



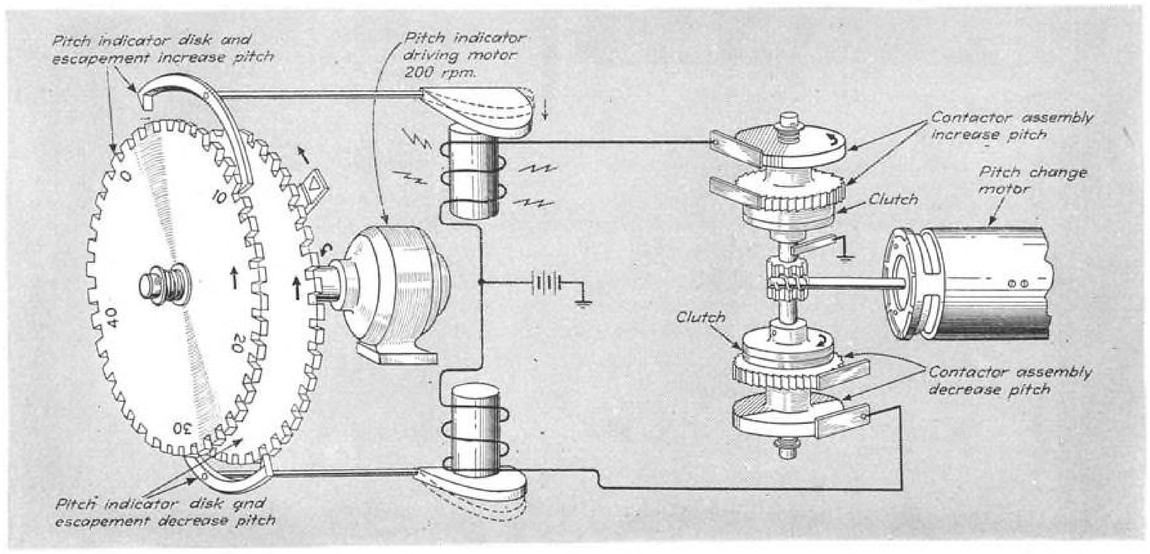
Calibration of thrust meter by laboratory test rig.



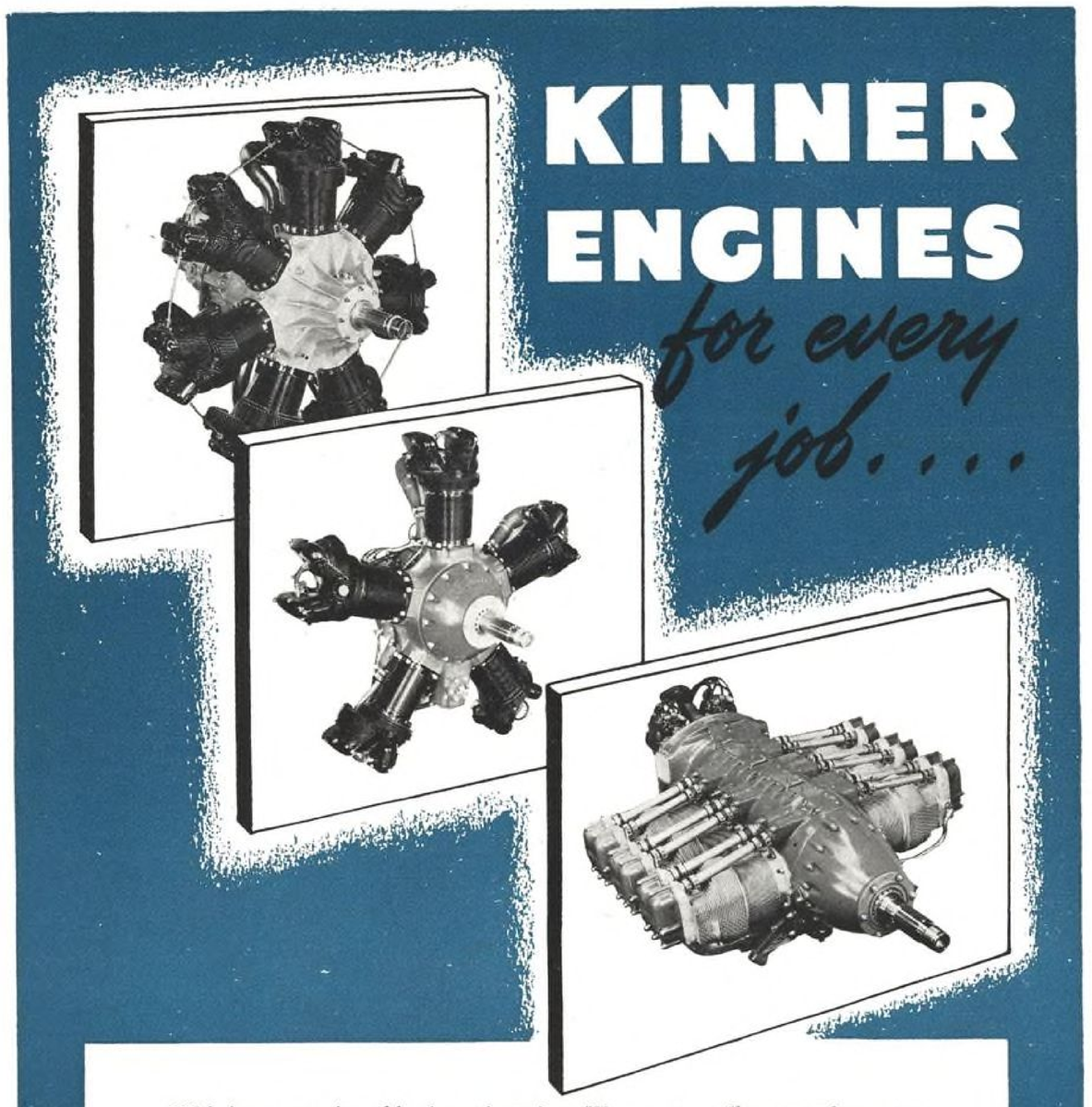
Close-up of thrust and torque meters installed on engine.



Test rig used for calibrating thrust meter on airplane.



Schematic drawing of pitch indicator.



With its new series of horizontal engines Kinner now offers manufacturers a type of engine for every power requirement from 100 to 500 horsepower.

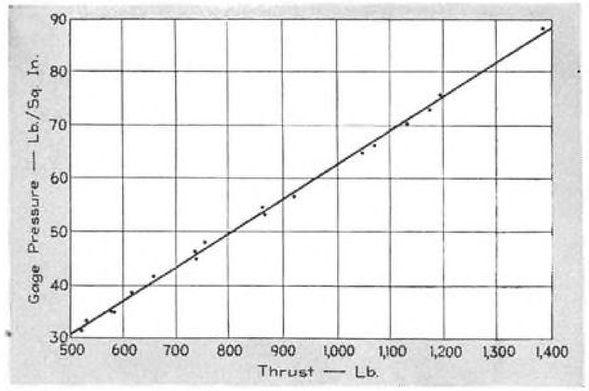
The famous Kinner 5-cylinder radial engines which are being extensively used for military training are available from 100 to 175 H. P. The 7-cylinder radials, including supercharged models, range from 350 to 420 H. P.

The revolutionary new horizontal series—incorporating many new-to-aviation developments combined with better cooling and new installation techniques are available in a wide horsepower range.

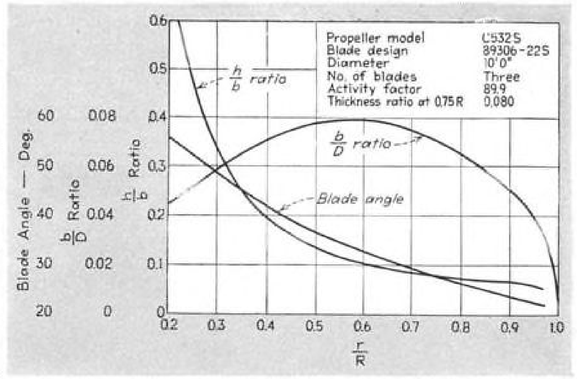
Manufacturers interested in any of these engines are invited to write for complete data and specifications.

KINNER MOTORS, INC. Glendale 4, California

BUY WAR BONDS AND STAMPS



Calibration of thrust meter on airplane with running engine.



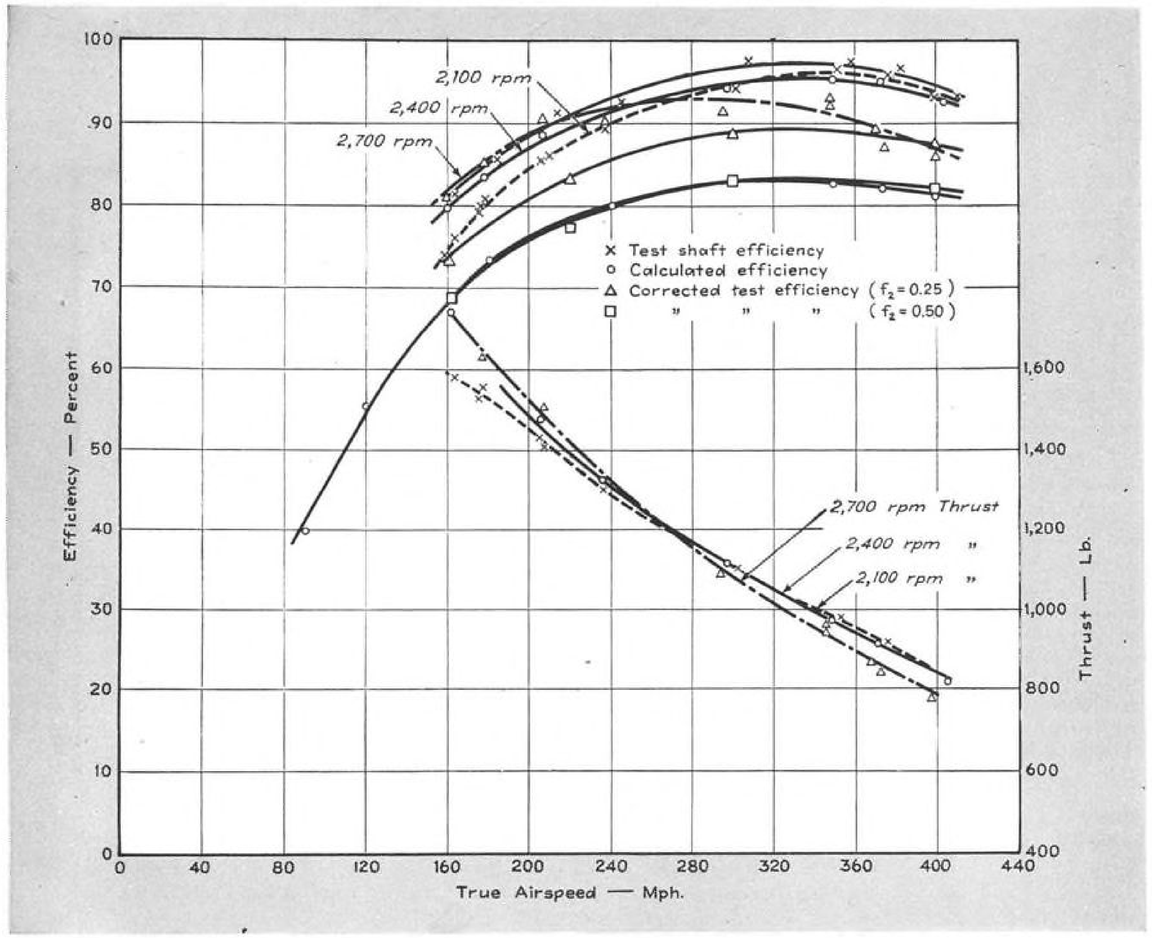
Characteristics of blades used in tests.

In flight the procedure is to adjust power and rpm. to specified conditions after locating desired density altitude. After a steady condition is reached, photo-observer is started and operated automatically for 3 min. Frequency of operation is four frames in 5 sec.

Climb tests were made so that specified power and rpm. conditions were reached at specified altitude and airspeed by starting the climb 2,000 ft. below desired altitude and making all adjustments so that desired b.m.e.p. was obtained at specified altitude. Without changing settings, the airplane was climbed to 1,500 ft. above this altitude, with photo-observer operating continuously.

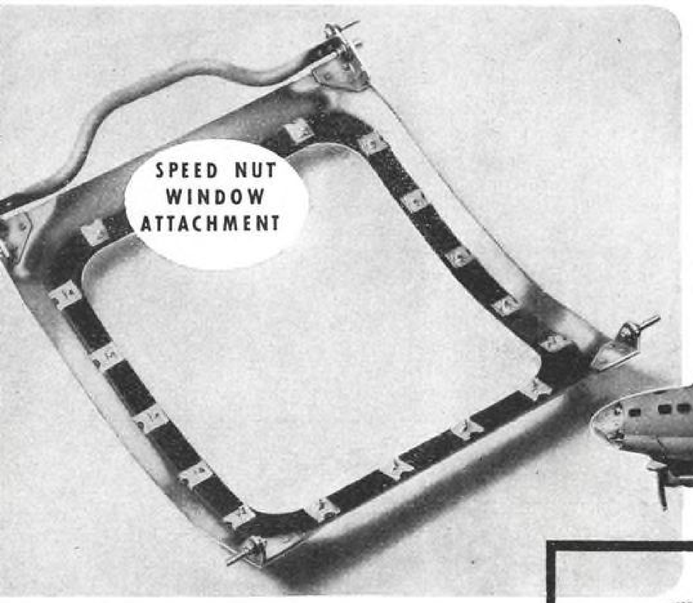
Tests above maximum level flight speed are made by diving. Required

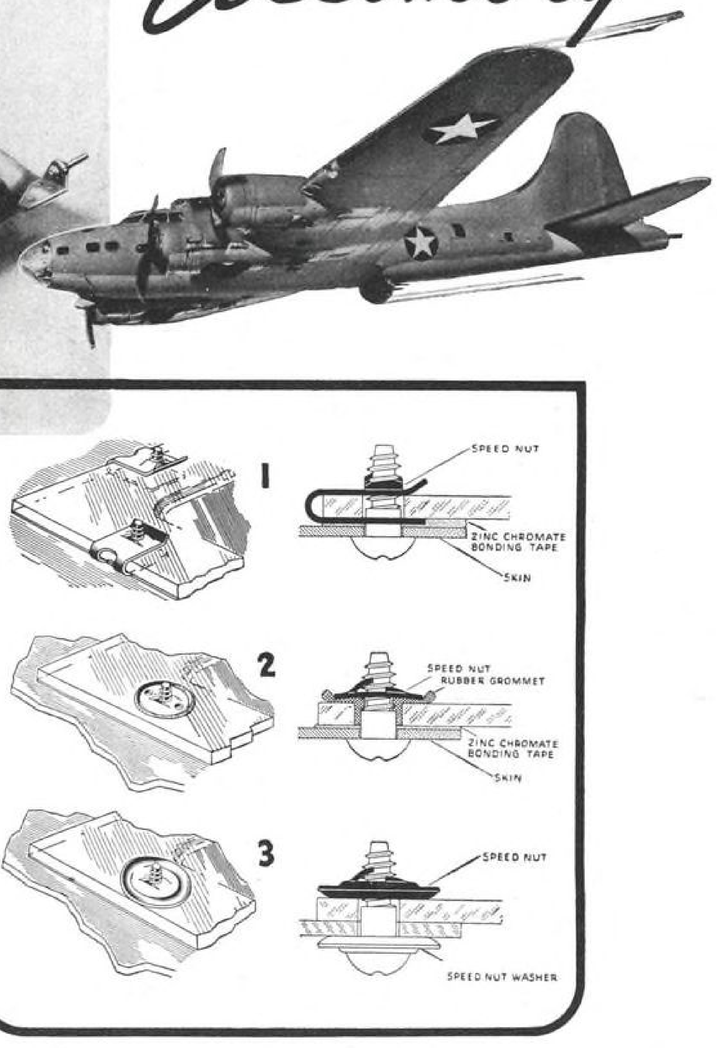
(*Turn to page* 303)



Flight test results: Variation of shaft thrust and efficiency with airspeed. Comparison of propulsive efficiencies determined by test and calculated for 2,400 rpm.

Speed Nuts IMPROVE Plastic Window Assembly





SPEED NUTS answer the problem of attaching plastic windows without danger of fracturing. They provide a spring-tension grip that frees the assembly from dead-tight fastening pressure. They also hold the plastic firmly in locked position under vibration and permit expansion and contraction of the plastic without damage. Washers are not needed as the wide bearing surface of the SPEED NUT spreads the load over a greater area and away from the screw hole. These SPEED NUTS are also applied faster—saving many manhour's time and reduce the net weight of the assembly.

In the first case illustrated, a "U" type Speed Nut snaps over plastic edges in self-retaining position. A round type Speed Nut is used in the second installation with rubber grommets in larger screw holes for additional cushion and seal. In the third method, where 2 pieces of plastic overlap, a cup-shaped Speed Nut is used with a mated Speed Nut washer—both formed to extend the load farther from the screw hole.

In writing for samples kindly give engineering details.



TINNERMAN PRODUCTS INC., 2070 Fulton Road, Cleveland, Ohio

IN CANADA: Wallace Barnes Co., Ltd., Hamilton, Ontario • IN ENGLAND: Simmonds Aerocessories, Ltd., London

THE FASTEST THING IN FASTENINGS!



Suppose He Could Watch You Cashing That War Bond...

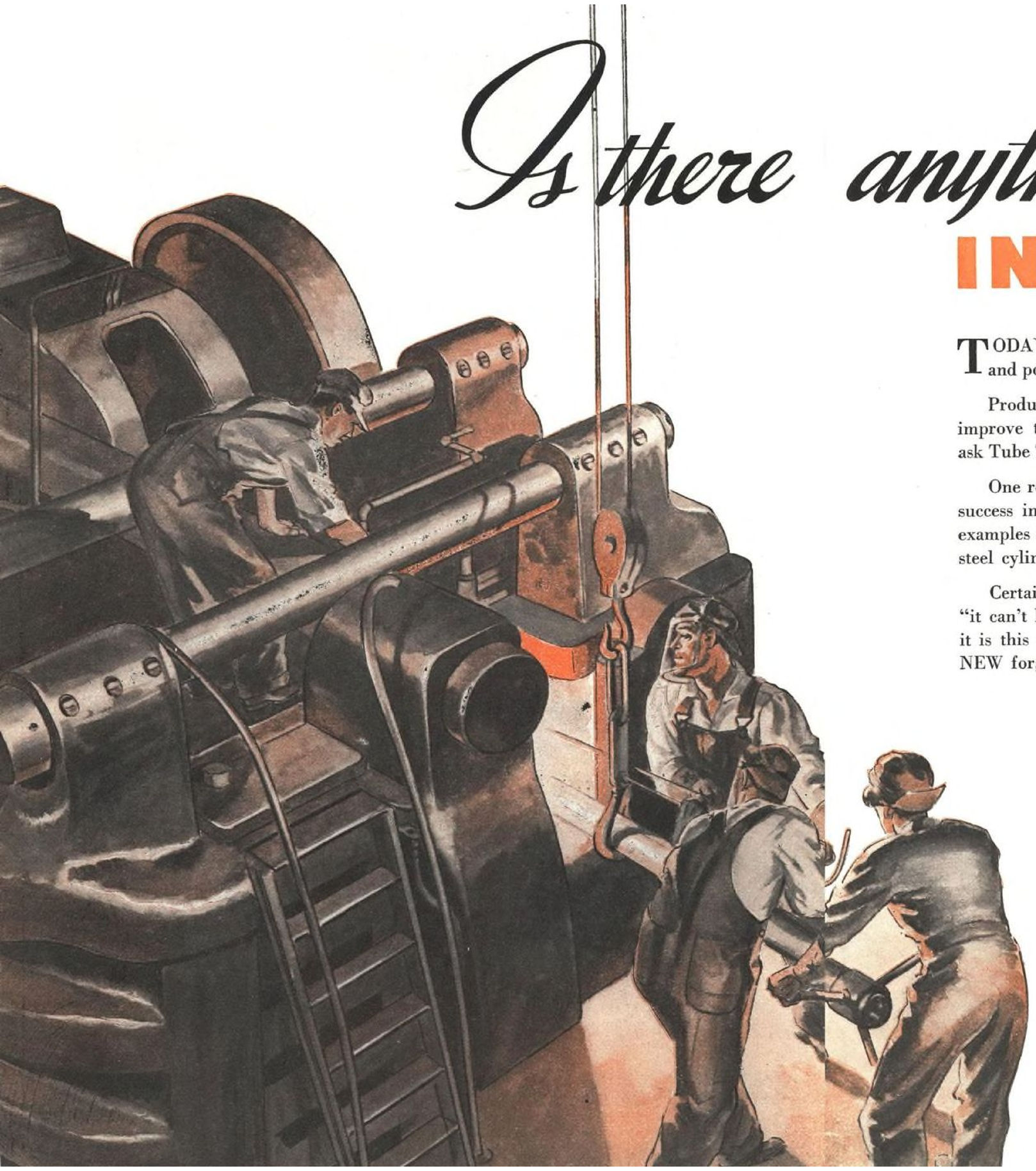
So you want that thing . . . that little extra comfort or pleasure. You couldn't afford it before. But now, you say, it's only one less bond to keep out of those you buy regularly . . . So what? If only the boy who fell, attacking that hill, could come back to answer you. Think of what he gave *for you* and all the rest of us. Want to know something else? Soldiers buy Bonds, too! Some of them give their lives and lend their money besides. Surely you can buy *extra* War Bonds — and *hang on to them!*

ARMY E NAVY

SOLAR

EXHAUST SYSTEMS

SOLAR AIRCRAFT COMPANY ★ SAN DIEGO 12, CALIFORNIA



Is there anything new IN FORGINGS?



TODAY scores of the more complicated and exacting parts of war and post-war products are being re-examined for forging possibilities.

Production and military men are asking each other: "Would *forging* improve this part and speed its production?" Both groups frequently ask Tube Turns: "*Can* it be forged?"

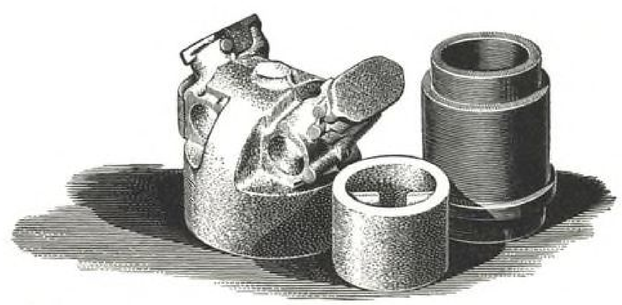
One reason is that Tube Turns has demonstrated unusual ability and success in solving tough forging and heat treating problems. Topnotch examples are Tube Turns' aluminum cylinder head, aluminum piston and steel cylinder barrel forgings for aircraft engines.

Certainly this originality and aggressiveness . . . this refusal to say "it can't be done" . . . is *one* thing that is *new* in forging. And, in turn, it is this kind of *thinking* and *doing* that will make possible unlimited NEW forgings for industry—both now and after victory!

TUBE TURNS (Inc.), LOUISVILLE, KY.

TUBE TURNS

Forgings for Industry



At Tube Turns, huge upsetters like the one at the left forge steel cylinder barrels and aluminum cylinder heads with uncanny speed and accuracy. Aluminum pistons are forged on mechanical presses.



THE GRUMMAN HELLCAT, scrappy Navy fighter, offers a new combination of climb, twist, punch and speed. Photo courtesy Grumman Aircraft Engineering Corporation.

OSTUCO contributes to the extra power in its "pounce"

With greater maneuverability, armor, firepower and all-around toughness, America's newest naval planes are giving an encouraging account of themselves. But because these larger, heavier planes travel faster and turn sharper, more is demanded from the materials of which they are built. ℂ In OSTUCO seamless steel tubing, plane manufacturers find the properties and precision required for such parts as shaft front torque, support assembly, valve assembly, piston, engine mount and wing assembly. ℂ This keeping pace with rapid-fire developments now is the best background we know for transforming mock-ups into advanced peace-time transportation.

THE OHIO SEAMLESS TUBE COMPANY

SHELBY OSTUCO OHIO

MANUFACTURERS OF SEAMLESS AND ELECTRIC-WELD STEEL TUBING

Victory reminders: Buy more bonds and stamps • Get in the scrap • Be on the job every day • Write to t[illegible]en in service

Flexible Cable Control Eliminates Backlash

Both push and pull are transmitted by this cable, and it also will operate over gears and round hairpin turns.

In at least one particular there is a similarity between an aircraft in flight and the human body in motion. Both are intricate mechanisms dependent upon coordinated control of the various members which make up the whole.

If we proceed with this analogy it might be logical to regard the pilot as the brain of the aircraft and the controls as the nerve system. If they are so considered, their importance is emphasized to a degree commensurate with the vital functions which they perform.

Controls have been made the subject of study and engineering development. But although they have been improved considerably, unfortunately they have not yet attained that state of perfection which the aircraft engineer may regard as satisfactory. Indeed, they are one of his most irritating problems and must be classed as a "necessary evil."

Generally speaking the flying controls which operate the elevators, rudder, and ailerons fall into a class which is separate from the controls for power plant and propellers. There are several factors of prime importance which make the problem of the latter an intricate one, and this problem becomes even more complicated when the controls are installed in multi-engined aircraft.

Factors which must be considered in studying the problem of power plant and propeller controls are:

1. *Positive Action.* Operation must be positive and unfailing under all flight conditions irrespective of temperature, icing, vibration, and relative movement of various parts of the airframe throughout which the control operates. This factor becomes more important as higher altitudes (and lower temperatures) are reached and as the flexibility of engine mountings and of the various members of the air frame is increased.

2. *Back Lash.* Lost motion, or backlash, must be negligible, otherwise it is difficult or impossible to obtain precise adjustment by means of the control. This factor, always of importance, becomes more critical in multi-engined aircraft, in which it is necessary to synchronize the speed of two or more engines and the pitch of each propeller.

3. *Flexibility.* The control must be sufficiently flexible to absorb vibration and relative movement between the control and remote ends. If such movement is not absorbed by the control but is transmitted, it will cause involuntary operation of the controlled unit.

4. *Stress Loads.* The control should not transmit stress loads to the airframe. As the necessary number of controls increases, this becomes of greater importance and directly affects design and ultimate weight of the aircraft.

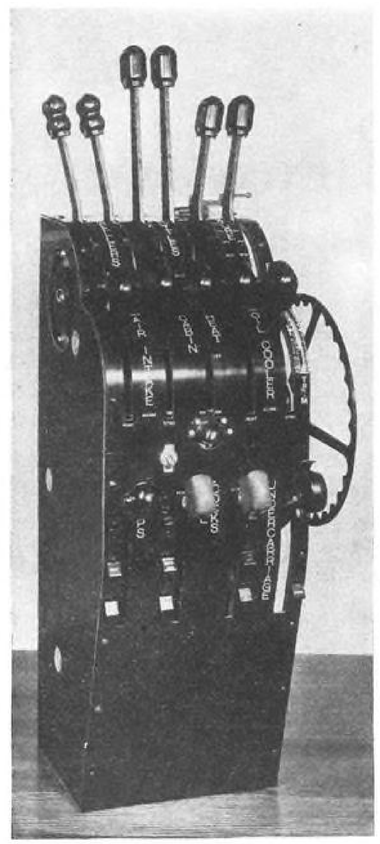
5. *Simplicity.* It is necessary to provide for trouble-free service and long life with a minimum of maintenance. The controls should be of simple design, easily adapted to any application. They should be easy to install and repair without special tools or equipment. The controls should be made up of interchangeable standard parts, otherwise a serious problem of spares arises.

6. *Weight* becomes increasingly important as lower weight-power ratios are sought and as the necessary number of controls increases. The controls should be as light as possible.

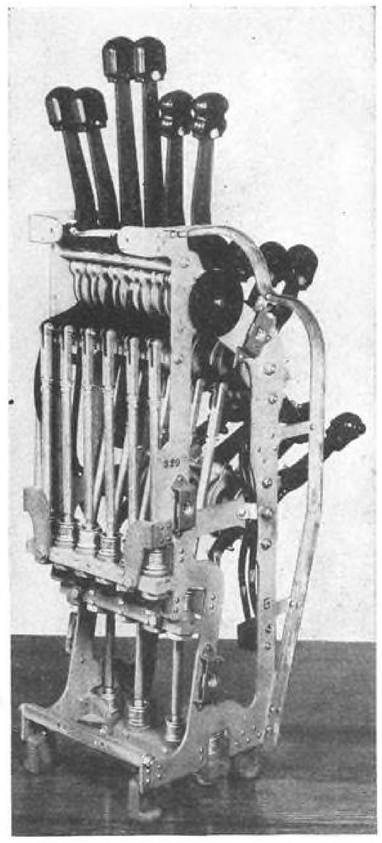
7. *Efficiency.* The control must be efficient. It must operate accurately and satisfactorily in the particular application in which it is used. Efficiency, however, is a relative requirement rather than absolute one, and it differs with each application.

Mechanical controls for power plants and propellers find favor because they are the most positive and dependable. There are three distinct types of mechanical controls, and in some applications different types are combined within one control. Fundamentally, however, each of these types should receive separate consideration in the light of the requirements which have been suggested.

8. *Rigid Rod Controls.* The push rod, in simple applications where the length of the control is short and angular travel is limited to 70 deg., is generally the best control available. It is decidedly



Teleflex centralization of controls operable by either pilot or co-pilot.



Rear view of 16-control unit. It is 22 in. high and takes 8x10 in. floor space.



BACKING THEM UP WITH
Dependable **MOTORS**

Providing the utmost in *motor performance* to the men of our airforces, whose great skill and valor have carried us well on the way to ultimate Victory ... this responsibility has emphasized the importance of our high production standards.

Rigid adherence to these standards of thorough engineering, exacting manufacture and careful inspection provides the high degree of *motor dependability* so vital for today's task ... so essential for tomorrow's opportunities.

THE BLACK & DECKER ELECTRIC COMPANY
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THOROUGH ENGINEERING is the basic factor behind the successful operation of this aircraft fuel pump motor and many other special application motors we have designed for all types of equipment.

SPECIAL APPLICATION ★ FRACTIONAL HORSEPOWER

positive, has no backlash, is exceedingly simple and efficient, and is comparatively light. It is, of course, inflexible and cannot be used satisfactorily if there is substantial relative movement between the control and remote ends. In its most simple form it transmits stress loads to the mountings at the control and remote ends only.

If a rigid rod control must operate through a change of direction of more than a few degrees, it is necessary to introduce a bell crank which must be supported on a pivot, which itself must be supported. The lever of the bell crank is, of course, at its peak operation in only one position, and it is generally conceded that the satisfactory maximum of angular movement is 70 deg. If a control must operate through a total length of 20 ft. and change direction five times, it is necessary to introduce a minimum of five bell cranks, each of which would require three pivoted connections, or a total of 15 in all. Each of such connections detracts from the positive action of the control and permits lost motion, however slight. The very essence of the best features of this type of control depends upon its rigidity, and therefore it is not well adapted to applications in which there is relative movement between the control and remote ends, such as is found in aircraft whose power plants are flexibly mounted or the airframe of which is flexible.

Each bell crank must be supported by the airframe, and the structural member, or members, called upon to furnish this support must therefore withstand, in addition to the load of its primary function, the total load which may be placed upon the control in question. If there are several controls and the load is substantial, this may become an important factor. The control should have a long life and require comparatively little maintenance, but it must be designed to a nicety and therefore presents an engineering problem.

The weight of such a control is excessive. If a straight run is unsupported the rod (or tube) must be substantial and strong or it must be supported to prevent bending. The efficiency is relatively good, but because of the engineering involved and special parts required in a complicated system the cost is high.

9. *Cable Controls.* The conventional cable control consisting of a tension cable in a closed circuit cannot be compared favorably with the push-rod control in the most simple applications, but in those which are more complicated it eliminates some of the objections to the push-rod, while retaining others. Even in long runs containing several changes of direction it is positive when operating under pre-determined tension, free of backlash, and quite efficient (power input-output).

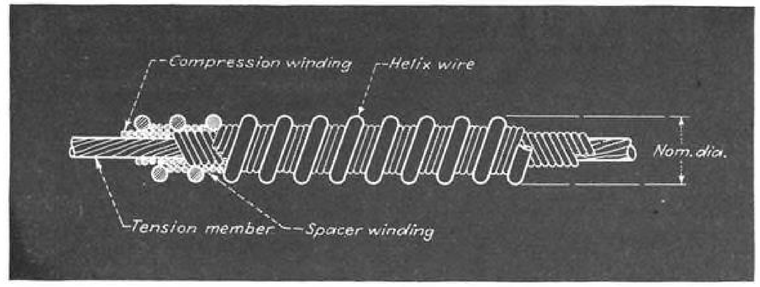


Diagram of Teleflex cable.

Unfortunately its satisfactory operation depends on tension in the control. This changes with temperature. And such a control, which operates very well when tuned in the hangar, may be "heavy" and stiff in operation at high altitudes because of increased tension resulting from contraction of the cable at low temperature. The cable is stretched under such conditions, and the controls become sloppy and loose and subject to backlash at lower altitudes and higher temperatures. Because controls of this type are set up under tension stress, loads upon the airframe result; and since it is necessary to mount two pulleys or blocks at eash point where a change of direction is necessary it is subject to greater objection from the standpoint of stress than a rigid control.

This type of control requires frequent adjustment and continual inspection. but it should have relatively long life. The design presents many problems, and installation is relatively difficult. It is lighter than a push-rod control, but it is quite expensive, not because of the cost of its component parts but because of the designing involved. Perhaps the most serious defect is a tendency for the control to creep. This follows because of unequal tension between the outgoing and return lines. After each movement of the control there will be greater tension on one side of the control than on the other, and when it is subjected to vibration or movement there is a tendency for this to equalize, which moves the controlled unit.

10. *Flexible Mechanical Controls.* In this field there are many ingenious devices which have been more or less highly developed. The basic principle involved, however, is common to all of them, and each consists fundamentally of a tube or conduit through which extends a simple or compound movable element, usually a wire or cable. As a matter of pure theory all such controls are unsatisfactory because backlash is necessarily present and efficiency (input-output) is low because of friction. It is surprising to find on examination that many of these controls are quite satisfactory despite their theoretical limitations. In many cases, backlash has been overcome to such an extent that in this

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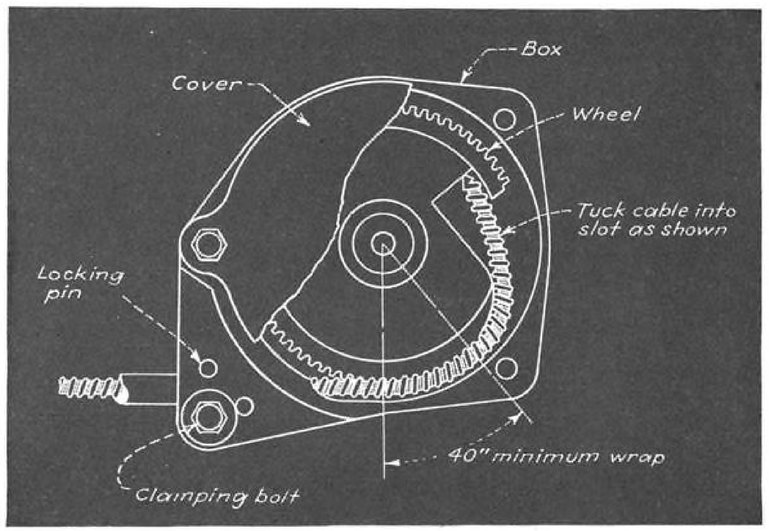


Diagram of box used to convert straight line to rotary motion with Teleflex cable.

Autopilot Gives Instant Control

By EDWARD E. THORP

Demands for greater accuracy in bombing brought development of this device which reacts faster than any pilot. Foreseen, too, is its broad use as a flight-smoother on airliners in the coming peace.

IT REQUIRES a tenth of a second for a normal man to react to an outside stimulus. In that time a bomber flies 50 ft. Thus, when an outside disturbance—wind, rough air, clouds, or enemy gunfire—throws a combat plane off its target, the loss of a second in recovering its position often results in a bomb missing its objective by several hundred feet.

But today, sensitive mechanisms which react faster and operate more accurately than the human system have been installed in bombers to take control when flight accuracy is of the greatest importance.

Minneapolis - Honeywell Regulator Co. has designed and is producing for the AAF the Autopilot control which commences to counteract the effects of any deviation from the set course as soon as it is measurable and long before human perceptions could notice that anything was amiss.

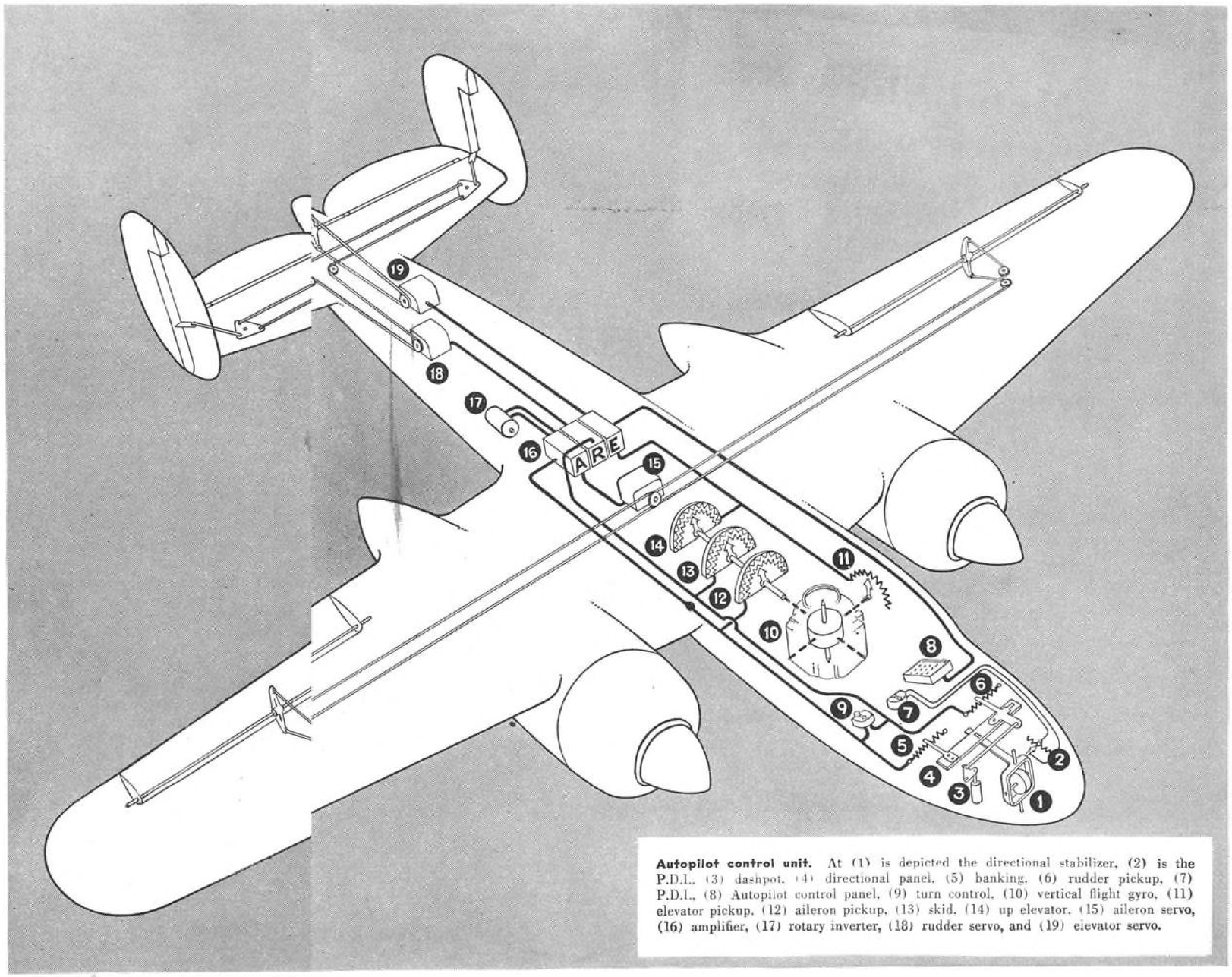
The action depends upon two gyro controls, one of which handles the horizontal or directional motion while the other controls vertical movement of the airplane Gyroscopic sensitivity is such that the slightest movement of the airplane causes instantaneous reaction on the controls, with the result that correction commences at the instant of disturbance.

Referring to the accompanying diagram, flight direction is controlled by directional gyro (1) which operates both the P. D. I. (2) and directional panel (4). The directional panel carries two arm wipers, one for banking (5) and the other for rudder (6), latter being pivoted on directional panel (4). The opposite end of rudder pickup (6) is attached by means of a link to dashpot (3), which — within limits — prevents sudden skids from too greatly affecting the plane's position, by accelerating the action of rudder pickup (6) and then gradually permitting its return to normal position.

The turn control (7) regulates the relative motion of rudder and ailerons in banking or turning, but if the pilot wishes to set the controls for banking at a certain angle he sets the large knob on the upper left hand corner of control panel (8). This board has an ingenious combination of lights so interlocked that they flash when any control is not coordinated with the rest but which do not shine if all controls are correct in their relative setting.

Rotary inverter (17) supplies current for operating the system. The servo motors, of which there are three—one each for elevators, rudder, and ailerons—obtain their power from the ship's supply. These motors not only move the control surfaces to positions corresponding to that of the related wiper operated by the gyros, but they also remain locked in position until further impulses are transmitted to them by their electrical controls. Current is amplified by electronic amplifier (16) consisting of three parts, *A* for ailerons, *R* for the rudder, *E* for the elevators.

The servo motors are placed close to the parts they operate, a system which has many advantages. If the airplane is struck by shell fire, there is little likelihood that small, flexible wiring between the amplifier and servo motor would be damaged, whereas mechanical controls from the cockpit to the wings and tail surfaces are always in danger of being severed. In such event the ship can be flown safely home with the Minneapolis-Honeywell electronic Autopilot.



Autopilot control unit. At (1) is depicted the directional stabilizer, (2) is the P.D.I., (3) dashpot, (4) directional panel, (5) banking, (6) rudder pickup, (7) P.D.I., (8) Autopilot control panel, (9) turn control, (10) vertical flight gyro, (11) elevator pickup, (12) aileron pickup, (13) skid, (14) up elevator, (15) aileron servo, (16) amplifier, (17) rotary inverter, (18) rudder servo, and (19) elevator servo.

Tilting of the plane by rough air or shell fire causes gyro (10) to turn on its fore and aft axis, rotating the wiper of aileron control (12), which causes a corresponding change in the position of servo motor (15) and the ailerons it operates, returning the wings to horizontal position. Should the airplane deviate from course because of wings being tilted from horizontal, a corrective signal will be introduced from gyro (1) to return the ship to its set course. Levelling is done by gyro (10) and the various motors it controls. As the plane returns to the course and position it originally occupied, the gyros move back to the relative positions previous to the disturbance, eliminating as they move the correcting control which is now no longer necessary.

If the nose of the plane were to drop, directional flight gyro (10) would commence to act at the same instant as the beginning of deviation from the original line of flight. Consequently, the elevators would be operated to return the airplane to level flight, the entire operation of levelling being continuous and simultaneous with the motion requiring correction.

Because of this feature, not only is the correction made in time to prevent some of the out-of-line motion, thereby restoring the plane to level flight position as soon as possible, but because of the action of the controls taking place simultaneously with the disturbance, there is comparatively little deviation before returning to the line of flight.

Metal Show Forecasts New Horizons

By HERBERT CHASE

Rapidly improving and sometimes radical techniques, coupled with completely new alloys, presage vast changes in both design and production of aircraft.

NO TWO VISITORS to the recent Chicago War Conference Display, and to the meetings held simultaneously, seem to have taken home quite the same impressions. Yet those who looked below the surface saw uncounted indications of new departures having considerable portent for the aircraft industry.

Emphasized was the fact that new alloys are ready for the market, new treatments are being developed, and hundreds of new possibilities are being investigated. Today, all metal producers have augmented capacity, and they are preparing for intensive competition in postwar markets.

Light metals, of special significance to aircraft engineers and manufacturers, are not remaining static. Reynolds Metals Co., for example, displayed samples of two new alloys, one of which is primarily for clad sheet stock and is said to offer important advantages over 24-S, including improved formability in annealed condition and a yield strength nearly 50 percent greater. In its heat-treated form, 68,000 psi. tensile strength, 60,000 psi. yield strength, and 10 percent elongation are typical. The second alloy, suited for forging and extrusion, has still higher strength. Neither alloy had been approved for general use by Army or Navy at the time of display, but this approval is anticipated.

The Aluminum Co. announced no new alloys, but it is understood to have some available. These include some having zinc content—already in the hands of certain fabricators—and one alloy, at least, suitable for forging. Data on these were not offered for publication, but some important physicals are said to be superior to those attained in the conventional high strength aluminum alloys, though fabrication is said to be somewhat less favorable.

Aluminum casting alloys are receiving their share of attention, and there is active interest in the use of castings where they have not been favored before. This is made possible in part by better casting technique and by the more general availability of improved testing equipment, notably of the X-ray type. Die castings which, until recently, have not been approved for structural application can now be used in some cases for structural uses, provided they are made in certified plants using approved methods and equipment and manned by competent personnel.

New High-Silicon Alloys

WPB committee studying die castings (which it prefers to call pressure mold castings) is working with new alloys high in silicon, containing some magnesium and understood to have properties superior to other alloys in common use. Cold chamber machines having a controlled injection rate are employed for making the approved pressure mold castings. The product is one in which low cost is subordinate to quality, but it still takes advantage of the economy of die casting.

Only one producer of primary magnesium, the American Magnesium Corp., had space in the exhibit without offering new products, but L. B. Grant of Dow Chemical Co. spoke in behalf of magnesium at one engineering session. His remarks made it clear that the preponderant use is still in the form of castings produced chiefly in sand molds. There are now upward of 100 fabricators, chiefly of castings, but some sheet is being converted into aircraft parts, such as seats and ammunition boxes, and forging facilities are being extended.

The government is advocating wider use of magnesium and, as is well known, has a large stake in its production. So large a stockpile is anticipated that the present prediction is for little production for several years after the war unless stocks are frozen or kept off the market. At present there is a definite effort to increase the use of magnesium forgings by substituting them for aluminum forgings, especially for aircraft use. One prominent aircraft company, for example, is reported converting some 250 aluminum forgings to M-alloy magnesium forgings, but this firm has experienced difficulty in finding producers with both equipment and experience to produce the forgings, even though facilities are being expanded for the purpose.

Revere Copper & Brass Corp., which has recently built a rolling mill for producing magnesium alloy sheet stock, indicates that its capacity is double the total already existing for magnesium sheet. The same company is also preparing to produce magnesium forgings. This departure of a company formerly dealing chiefly in copper-base alloys, to include production of magnesium in wrought forms, indicates a healthy interest in magnesium as well as an apparent belief in a broadening future for its use.

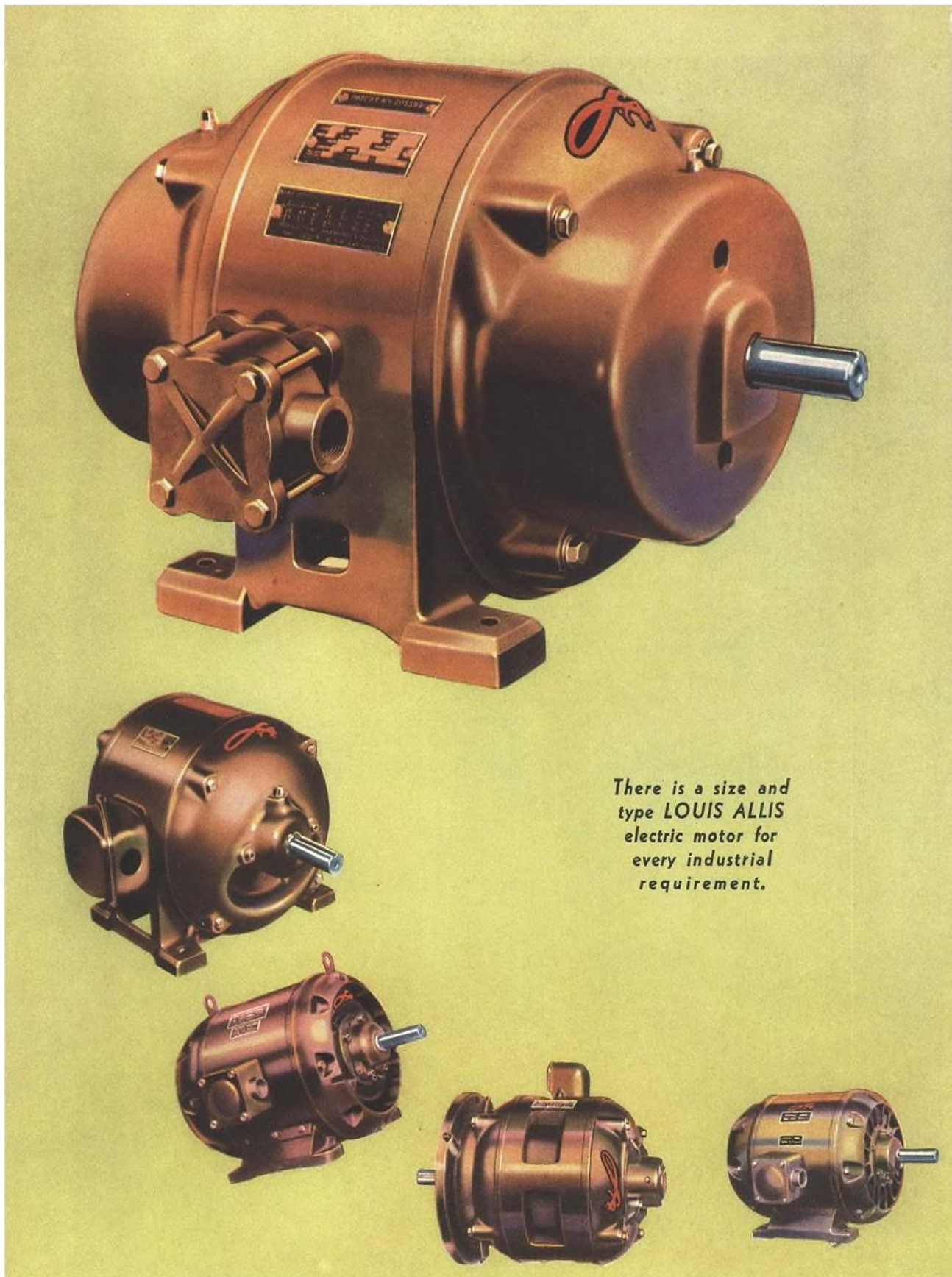
Some reports indicate that the Germans have learned to make better use of magnesium alloys than have been made to date in Allied countries. If and when the German technique becomes known, or a similar or better technique is developed here, there seems little doubt that wider use of magnesium alloys will take place where the economies of their use (including the benefits of light weight) are well founded.

Ampco Metals had a good display of its aluminum bronze products made in quantity by centrifugal casting for the aircraft industry, though these are not new. Most producers of brass, bronze, and copper products appear to have concentrated chiefly on production problems. If they have new developments of significance to the aircraft industry, especially for postwar use, these escaped the writer's notice.

Much the same can be said of zinc-bearing alloys other than brass. The chief ones are for die castings and for sand-cast dies used to shape sheet metal parts. None of these are new, but their utility has been well established. The New Jersey Zinc Co.'s exhibit centered around die castings and included an excellent film on the die casting process in a portion of which the Link trainer was featured.

Of course, zinc alloys are used chiefly

(*Turn to page* 316)



Speaking of Electric Motors—

The day of trying to use a standard motor for a special job is about over.

Machinery designers, and production managers have learned that it is much more efficient and economical to obtain a motor with exactly the electrical and mechanical characteristics required to perform a specific job than it is to try to doctor up a standard "shelf" motor to do the job.

Speed and horsepower are no longer the major measuring stick of motor requirements — they are merely incidental to the many other characteristics available in electric motors today.

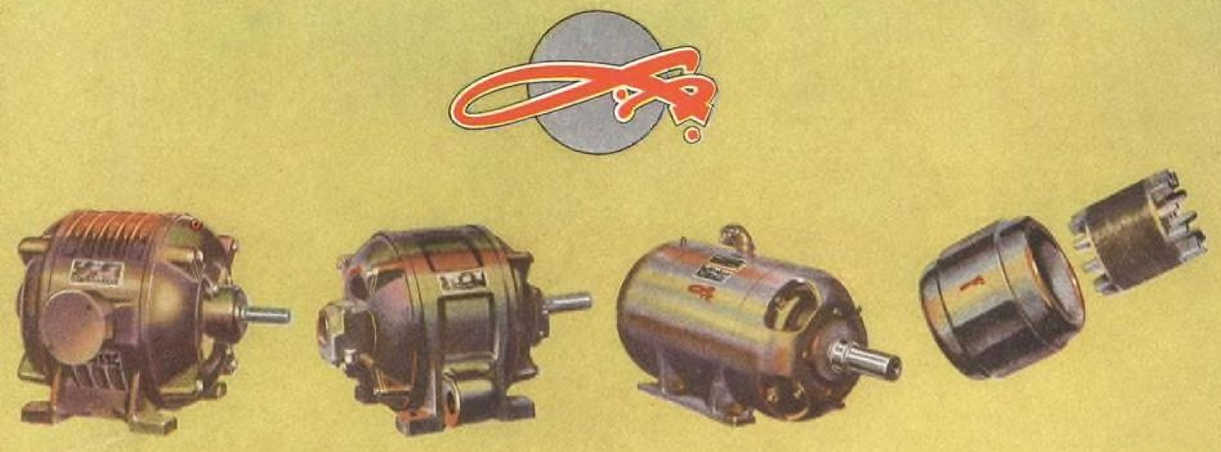
For over forty years we have been developing special motors for special jobs — our engineering department has a wealth of experience along this line —

Right now special Louis Allis motors are serving a major important role in helping your boy and mine win this war — to help bring him back home — safely — and as quickly as possible.

As soon as Uncle Sam does not so urgently need all of our facilities — your electric motor problems and requirements will receive our most prompt and careful attention in every way.

But right now — let's WIN this war!

THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.



Conflicting Reports Confuse Aviation Investors

By H. L. FEDERMAN

Consistent selling of aircrafts and the meager, scattered support of airlines present curious anomaly in "war baby" stock sphere.

WITH THE MARKET definitely peace-conscious despite repeated warnings by military leaders, investors are having a severe case of the jitters. When this happens, it is natural to anticipate renewed selling in the aircrafts—an industry indelibly labeled as a "war baby" in the public mind. Heavy selling did hit the airplane manufacturing shares. But there was also considerable liquidation of airline shares, a "peace" group if there ever was one.

Declines were rather uniformly distributed among the two aviation groups for the week which culminated with the day of the market's sharpest break of the year, Nov. 8. For example, losses registered since Oct. 30 and through Nov. 8 were as follows: Douglas $13.50, American Airlines $5, Boeing $1.62, Eastern $2.50, United Aircraft $2.75, and United Air Lines $4.12. These declines are in terms of dollars per share; percentage-wise they are even more significant.

This anomaly, on the surface, appears confusing. Close analysis, however, can dispel the seemingly contradictory trends.

At present, emotion dominates the market. This will most likely continue over the immediate term. Attention will be largely directed towards war bulletins and possible peace feelers. For the time being, underlying economic conditions, financial factors, and earnings of aviation companies may be expected to receive scant attention by the majority of investors.

A far broader view as to what war has meant to aviation equities and how these shares have reacted with the first tangible straw of victory, is vividly shown by analysis of stock group movements, as revealed by the market record from Pearl Harbor to late Oct. 1943. It shows that, from the very beginning, investors resolutely turned their backs on the aircrafts, with the result that the group, with a drop of about 18 percent, experienced the greatest decline among all other securities in the marketplace. Airline shares, on the other hand, were among the leading beneficiaries, gaining about 41 percent.

Surprisingly enough, while the aircraft industry pioneered and developed the weapon that is proving to be the decisive factor in winning the war, the material gains have gone to other industrial groups participating in the airplane building program. For instance, the automobile shares rose more than 60 percent after Dec. 7, 1941. And the rubber equities skyrocketed more than 100 percent during the same period. As the market reflects profitability and future trend possibilities, these movements show how little the airplane group has directly benefited from war.

When Mussolini was kicked out on July 25, the market was jolted into thinking of an early peace and has never been the same since. The aircrafts declined but not as much as the air transports. Why? Simply because the former had taken their beating for more than a year and a half and ample discounting of the future had taken place. The airlines, however, showed increasing evidence of outdistancing their future prospects, and realization is rapidly spreading that the group will not be without its problems in the postwar world.

It is also an interesting observation that not one of the 30 stock groups in the entire Barron's averages showed any price appreciation since July. Can peace be bad for American industry? Not at all. The conclusion of hostilities means the coming of many problems and unknowns: Reconversion, adaptation to changed conditions, and many attendant uncertainties. It is during such periods that investors tend to become cautious and are inclined to take careful look-sees. As a result, the market follows a nervous course until such time as clear-cut trends again become discernible.

Investment trusts were, at one time, favorably disposed toward certain aviation securities and were a source of considerable market support. For more than a year, however, fund managers have been liquidating these equities (as shown in Wanted: A Haven for Aviation Securities, p. 183 Sept. AVIATION). As a result, instead of being a sustaining influence, trust funds have added their weight to the downward pressure on aviation prices as they continue to move away from these issues. This is again substantiated by an examination of investment portfolios as of Sept. 30, 1943. This time 30 general trusts are examined, providing a substantial coverage of the field and representing one

(*Turn to page* 335)

TABLE I—COMBINED AVIATION HOLDINGS

(30 Major Investment Trusts As of Sept. 30, 1943)

	No. of Trusts Holding	Total Shares Held
Air Transport		
American	9	20,400
Eastern	7	21,300
Northwest	1	16,000
Pan American	12	122,800
Penn-Central	2	3,400
TWA	1	3,500
United	9	72,000
Aircraft Manufacturers		
Aviation Corp	2	43,275
Bendix	3	31,500
Curtiss-Wright "A"	2	30,300
Lockheed	2	2,000
Martin	1	1,000
North American	1	24,000
Sperry	3	5,000
United Aircraft	4	17,900

TABLE II—NATIONAL AVIATION CORP.

(Aviation Portfolio Changes Dec. 31, 1942—Sept. 30, 1943)

	Total Shares Held		
Air Transport	Dec. 31, 1942	Sept. 30, 1943	Shares Sold
American	2,800	1,700	1,100
Braniff	a19,500	12,200	7,300
Chicago & Southern b	15,450	10,450	5,000
Eastern	5,800	4,500	1,300
Mid-Continent	17,000	17,000	none
Northwest	15,000	11,500	3,500
Pan American	10,000	7,500	2,500
Penn-Central	17,300	10,800	6,500
Penn-Central, pfd	4,200	3,600	600
TWA	9,000	5,600	3,400
United	14,000	8,300	5,700
Aircraft Manufacturers			
Bell	29,500	22,700	6,800
Bendix	5,000	5,000	none
Boeing	17,500	16,600	900
Cessna	6,000	none	6,000
Curtiss-Wright	25,000	none	25,000
Curtiss-Wright "A"	20,000	20,000	none
Douglas	7,000	7,900	c900
Grumman	10,000	2,900	7,100
Lockheed	20,000	19,400	600
United Aircraft	18,500	17,500	1,000
United Aircraft, pfd	1,600	2,100	c500
Thompson Products	5,000	5,000	none
Continental Av. & Eng.	20,000	none	20,000

Note: Not shown above are holdings in Consolidated Vultee. The merger early this year tends to distort any comparison. As of Sept. 30, 1943, 17,100 shares of common and 10,000 preferred were owned. On Dec. 31, 1942, 19,200 shares of Consolidated and 4,000 shares common and 1,400 preferred of Vultee were owned.

a Braniff holdings adjusted for 50 percent stock dividend.

b Chicago & Southern common and voting trust certificates combined.

c Shares purchased.

TABLE III—BARRON'S STOCK AVERAGES

	Aircraft Manufacturing	Air Transport	50 Stocks
Nov. 4, 1943	*27.80	34.91	78
Oct. 28, 1943	28.82	37.38	80
Oct. 21, 1943	29.08	35.56	80
Oct. 14, 1943	28.35	35.50	79
Oct. 7, 1943	28.40	34.38	78
Nov. 6, 1942	30.90	25.09	67

* New low for year.

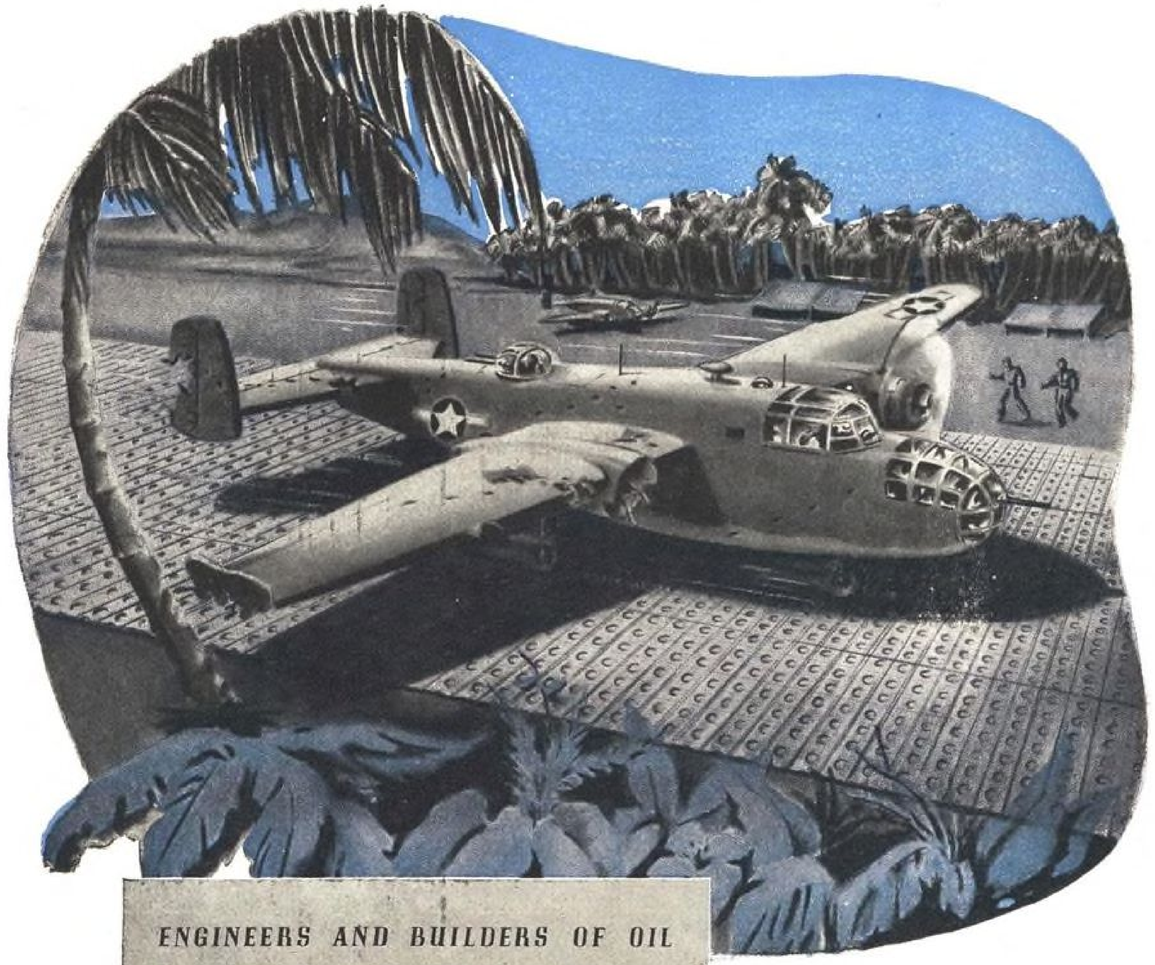
"DO THOSE JAPS *Get Burned Up!*"

"They throw everything they have at us, and our planes don't fall apart—it sure burns them up!"

From all over the world comes reports like the above telling of the remarkable stability and toughness of American planes. In spite of everything the enemy can do, a surprising number of them go right on to complete their missions . . . and then come back after having absorbed murderous punishment.

American planes can take it as well as dish it out. That means that every part and all accessory equipment must have extra durability, reliability and stamina. We are proud of the fact that Vickers Hydraulic Equipment is used on a majority of American combat planes.

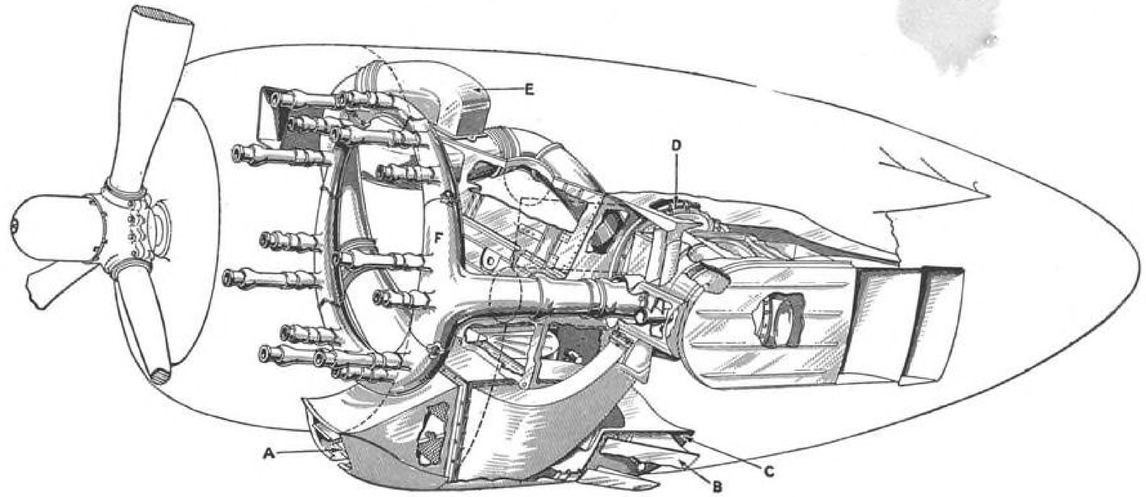
VICKERS *Incorporated*
1462 OAKMAN BLVD. • DETROIT 32, MICHIGAN

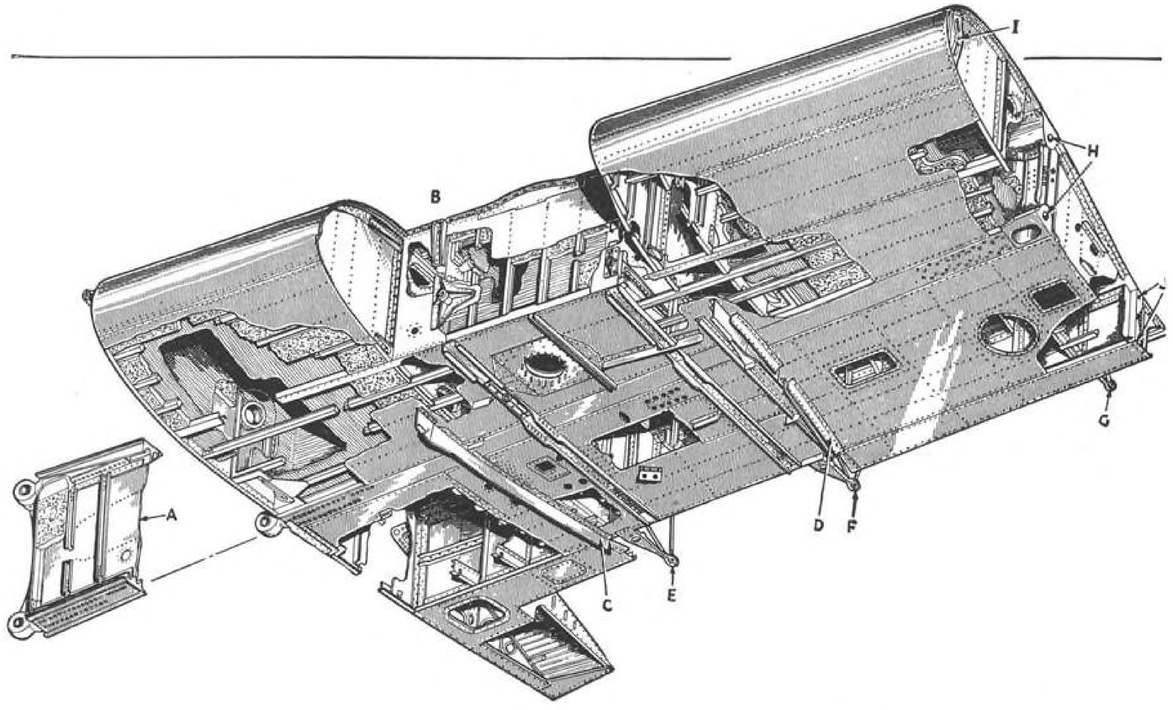


ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

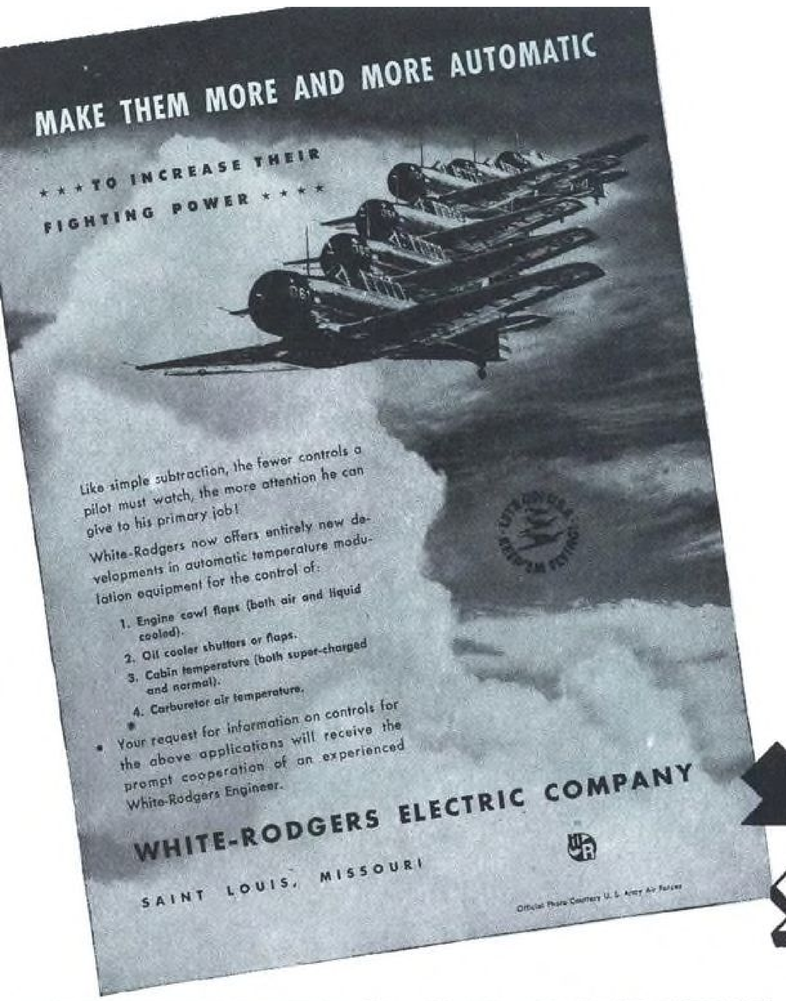
SKETCH BOOK OF DESIGN DETAIL

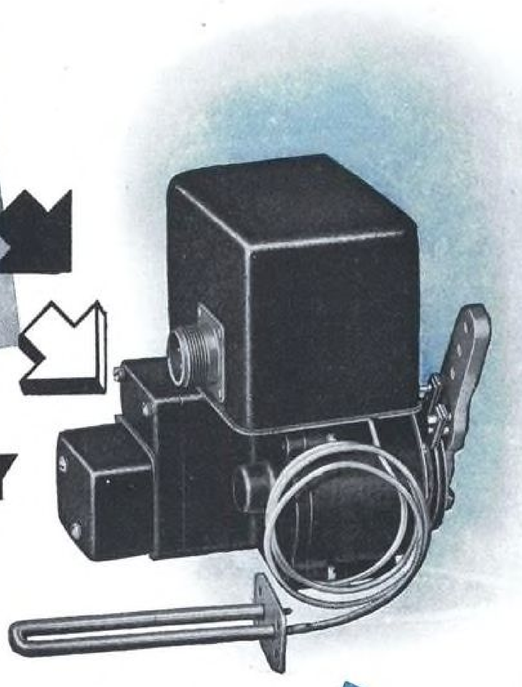
Phantom view showing turbo supercharger installation in Douglas A-20. Intercooler entrance is at *A*; intercooler door assembly at *B* for exhaust at *C*. Supercharger itself is at *D*, with power plant air induction system installation at *E* and exhaust collector ring at *F*.





Cut-away view shows details of Douglas A-20 inner wing panel construction, with inboard attachment fittings in separate detail sketch at *A*. Cutback portion of wing leading edge at *B* is to accommodate engine nacelle, with strips *C* and *D* forming top of engine nacelle fairing. Flap hinge brackets are shown at *E*, *F* and *G*. Tension bolt fittings for outer wing panel at main spar are at *H*, with leading edge shear web connection at *I* and rear shear web connection at *J*. Note extensive use of access holes.





One of the many types of automatic safety controls manufactured for the constantly increasing demands of our armed forces.

SENTINELS OF SAFETY

PROTECT PLANE AND CREW

White-Rodgers motorized temperature controls automatically prevent excessively high or low temperature conditions that spell danger to a plane and its busy crew.

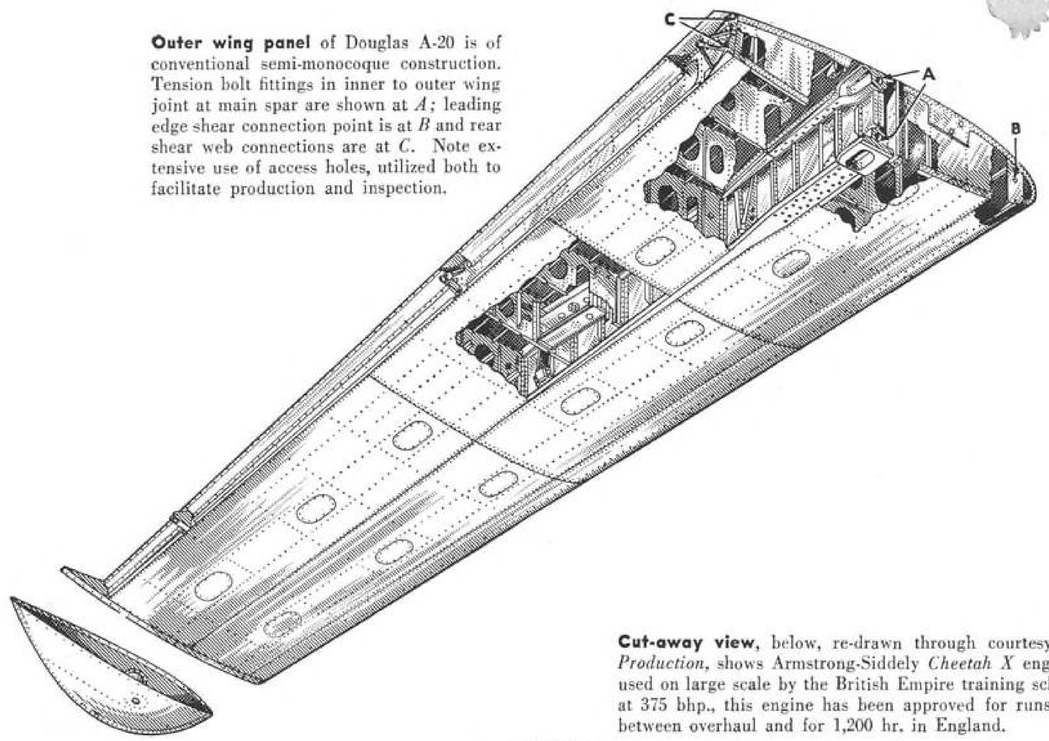
Equipped with sensitive element applicable to air duct or liquid immersion, length of capillary and the White-Rodgers motor assembly can be varied in design to fit specific applications.

Engineering data will be furnished to manufacturers upon request.

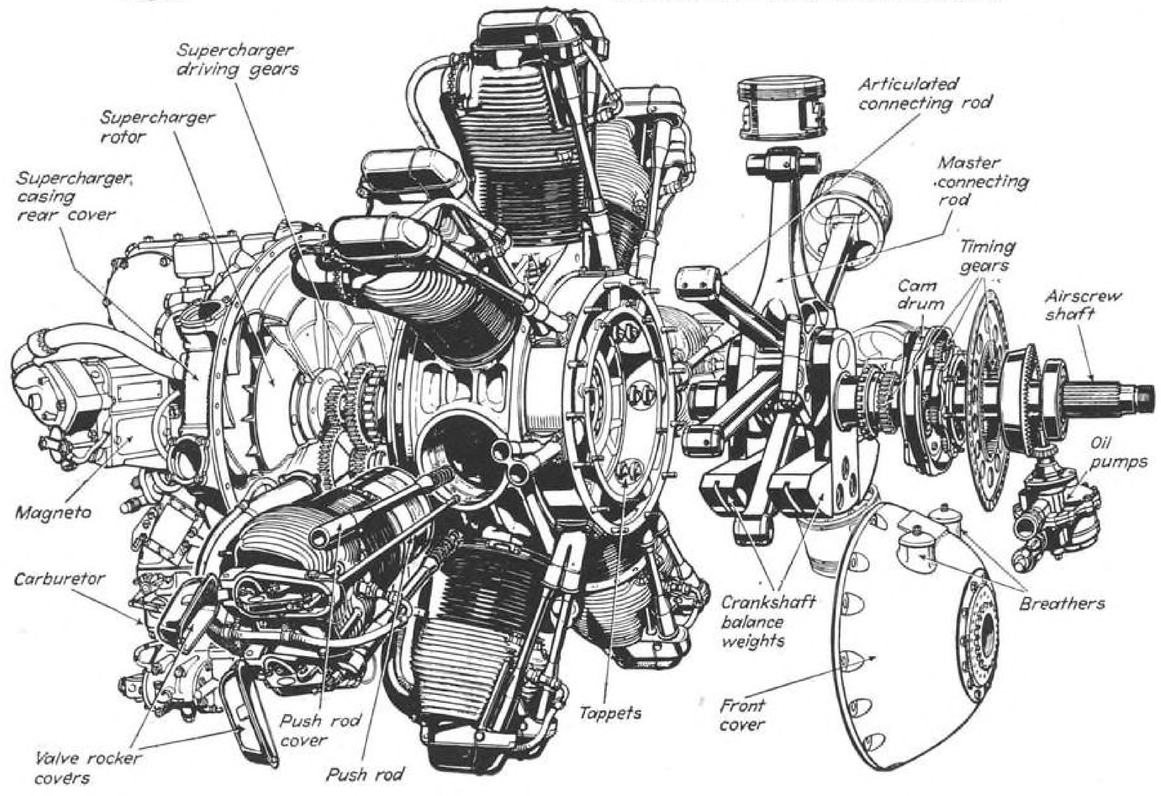
WHITE-RODGERS ELECTRIC CO.

SAINT LOUIS, MO.

Outer wing panel of Douglas A-20 is of conventional semi-monocoque construction. Tension bolt fittings in inner to outer wing joint at main spar are shown at *A*; leading edge shear connection point is at *B* and rear shear web connections are at *C*. Note extensive use of access holes, utilized both to facilitate production and inspection.



Cut-away view, below, re-drawn through courtesy of *Aircraft Production*, shows Armstrong-Siddely *Cheetah X* engine, which is used on large scale by the British Empire training scheme. Rated at 375 bhp., this engine has been approved for runs of 1,400 hr. between overhaul and for 1,200 hr. in England.

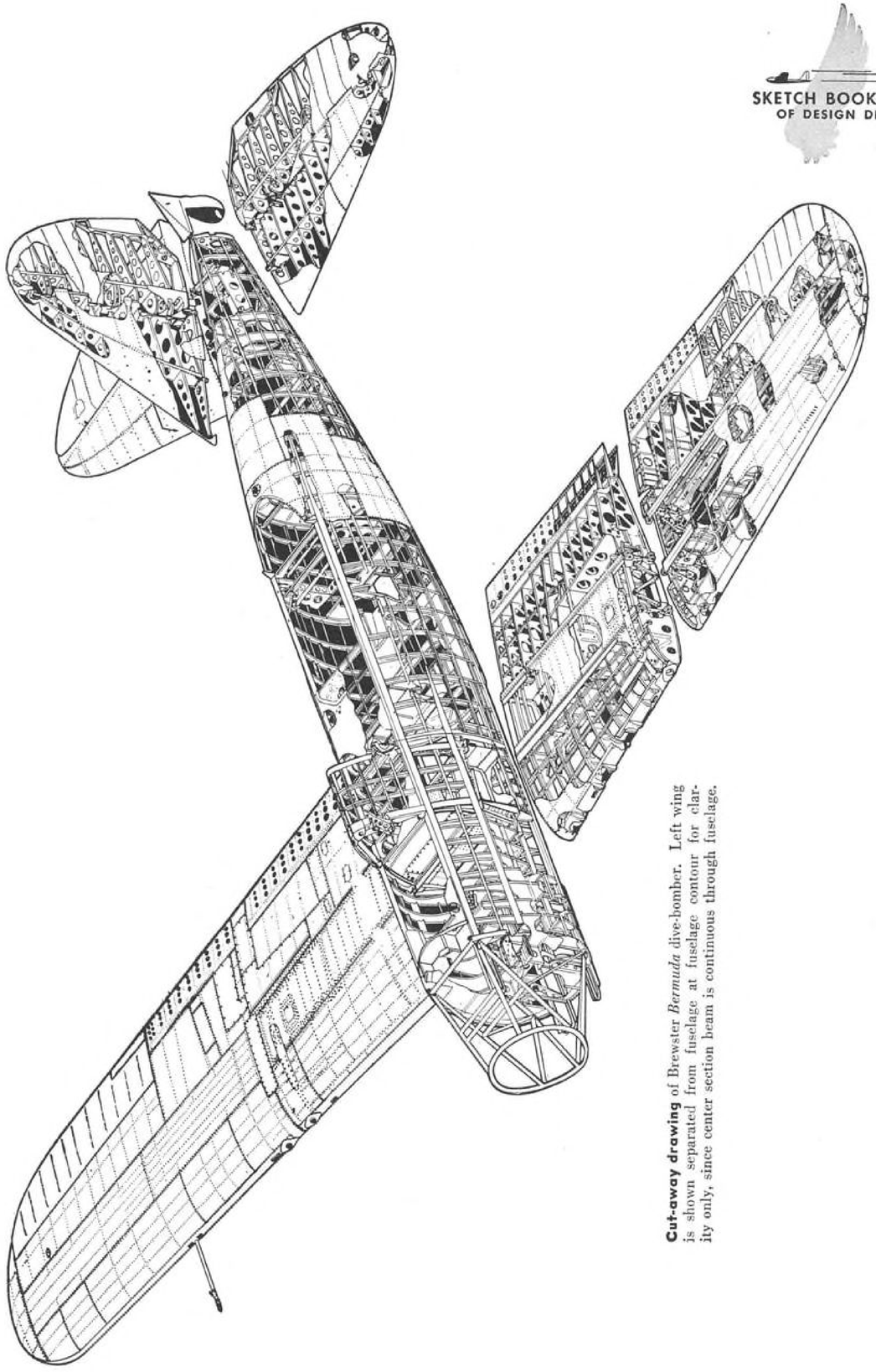


Maytag Hydraulics are easy to install

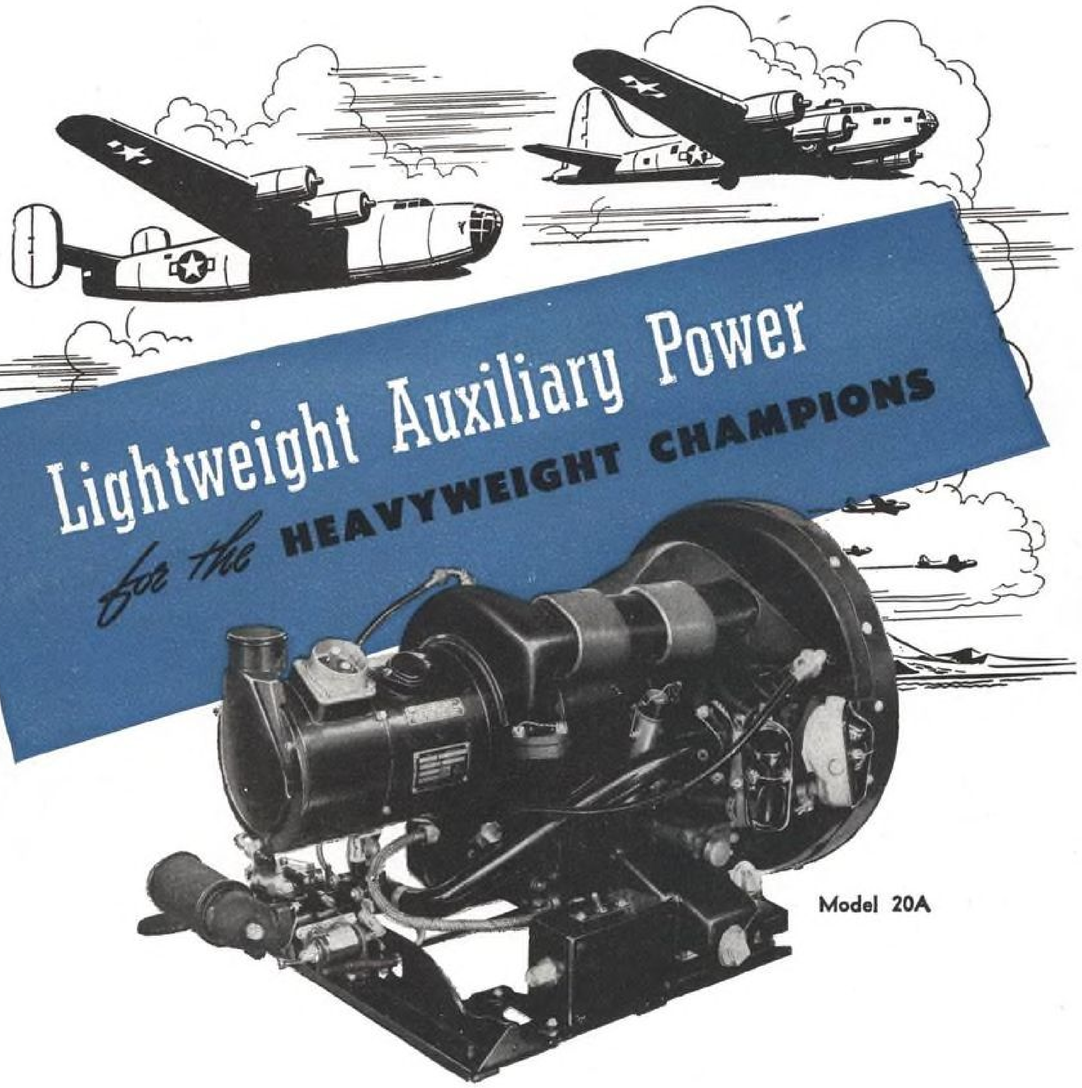


FOR MANY YEARS the world's leading manufacturer of domestic clothes washers, The Maytag Company, Newton, Iowa, is now devoting all of its efforts and facilities to the manufacture of a full line of Hydraulics of exclusive design... together with Eclipse electrical retracting units... and many types of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

Maytag



Cut-away drawing of Brewster *Bermuda* dive-bomber. Left wing is shown separated from fuselage at fuselage contour for clarity only, since center section beam is continuous through fuselage.



Lightweight Auxiliary Power *for the* HEAVYWEIGHT CHAMPIONS

Model 20A

Other Lawrance Models:

In addition to the unit shown above, there is a Lawrance Auxiliary Power Plant to meet every Auxiliary Power need. Ranging in size from 2 to 5 cylinders, and in output from 5 to 15 KW, these Auxiliaries are in service today with our fighting forces of land, sea, and air. Write TODAY for illustrated folder.

120 POUNDS—The Lawrance Model 20A, engineered to save vital space and weight, combines power and performance in a 120 pound unit only 30 inches long, 21 inches wide, and 17 inches high.

7½ KW—A continuous power rating of 5 KW, plus a 7½ KW overload rating, is an outstanding feature of the Model 20A. Vibration-free performance is insured by the high operating RPM of the 15 horsepower, two-cylinder engine.

DEPENDABLE—The Model 20A, now in service with the famous Boeing Flying Fortresses and Consolidated Liberators, supplies a steady and dependable flow of electric power to operate gun turrets, radio, bomb hoists, main engine starters and other vital equipment.

LAWRANCE POWER

Lawrance AUXILIARY POWER PLANTS

LAWRANCE ENGINEERING AND RESEARCH CORPORATION • LINDEN, NEW JERSEY, U. S. A.



Unbeatable!

THE low ratio of American aircraft losses to Axis planes downed, proves the overwhelming superiority of American pilots, crews, planes and maintenance forces.

It's been planned that way, of course. American inventive genius has designed planes that have proved their superiority. Manufacturing skill has produced them in huge quantities at a speed thought impossible a year or two ago.

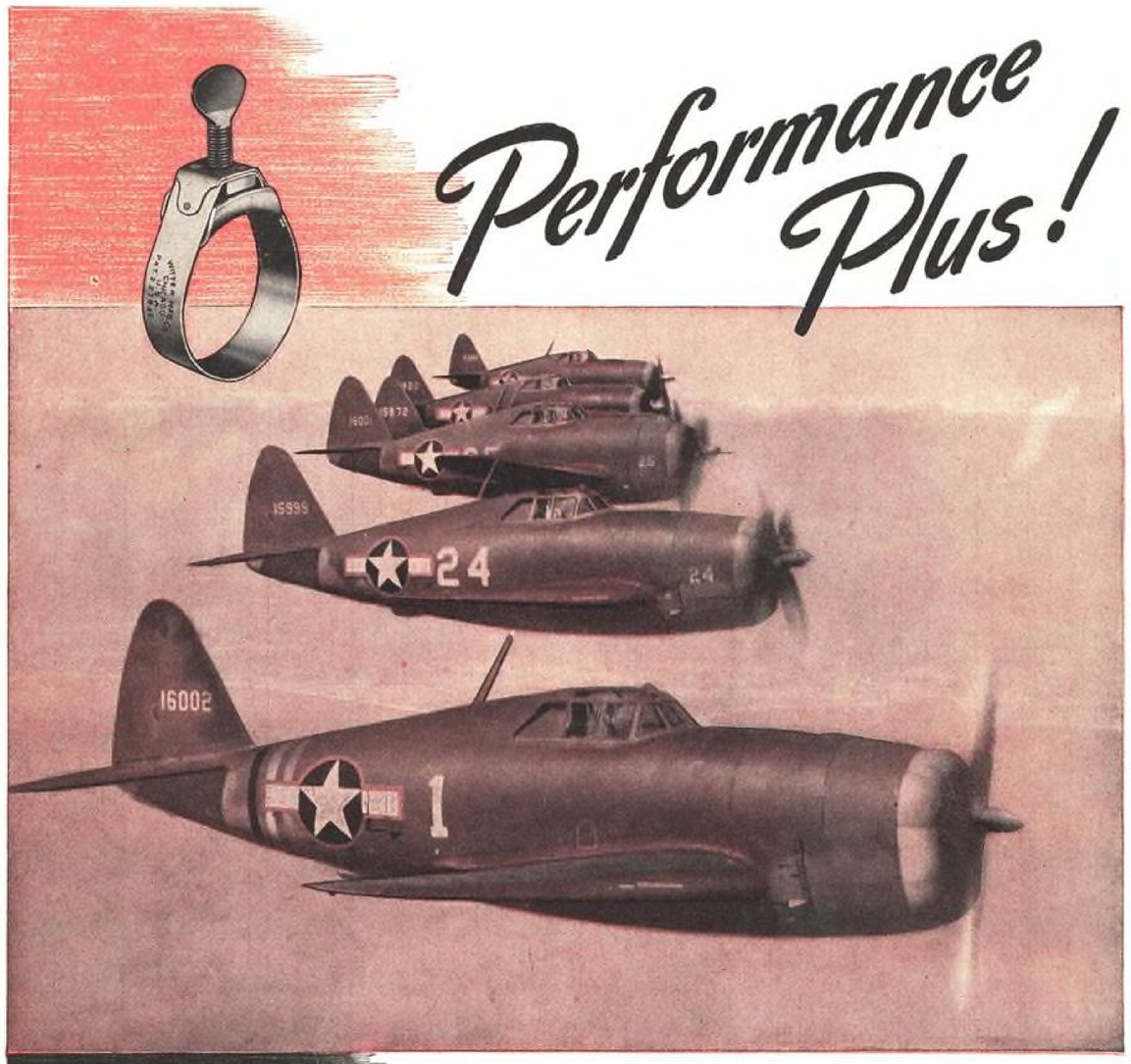
Pilots and crews have been carefully selected, thoroughly trained. Ground crews have received intensive instruction, passed rigid examinations on maintenance. Small wonder that the American Air Forces have proved their mettle in battle.

In back of all this, BONNEY TOOLS have been and are playing an important part. You'll find them in the individual tool kits of thousands of aircraft workers—on the production lines of leading aircraft, engine and instrument manufacturers—in the kits of original equipment supplied with every engine shipped by leading aircraft engine manufacturers. They've been selected because their quality has been proved through the years—quality that has gained them the reputation "the finest that money can buy."

It's an unbeatable combination—outstanding design, mass production, skilled pilots and crews, expert ground service and BONNEY TOOLS.

BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.

Star Awarded July 10, 1943



REPUBLIC
P-47 THUNDERBOLTS
are equipped with
WITTEK *AVIATION*
HOSE CLAMPS

On the offensive—with new weapons for allied victory—P-47 Thunderbolts! These fast firing heavily armored high altitude fighters are equipped with Wittek Aviation Hose Clamps. Today, as in the past, Wittek Aviation Hose Clamps, known as the standard of the industry, are being used by the nation's leading military aircraft and engine builders. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago 23, Illinois.

ARMY E NAVY

Back The Attack—Buy War Bonds

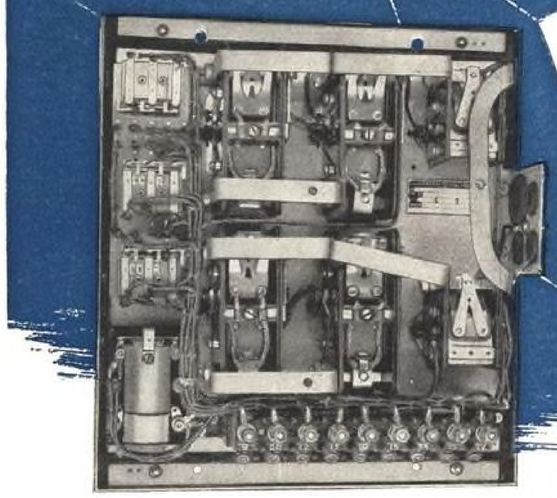
WITTEK Aviation HOSE CLAMPS

Association Standards For Copper and Brass

The Association has listed 38 copper base alloys commonly ordered in large quantities. Specifying of these alloys will simplify preparation of engineering specifications. Figures are standard specification numbers of American Ass'n. for Testing Materials.

NAME	COMPOSITION Percent	FORMS GENERALLY AVAILABLE *Indicated by (√) or by reference to nearest applicable A. S. T. M. Specifications*				
	Commercial Limits	Flat Rolled Products	Rod and Drawn Bar	Shapes	Wire	Tube
COPPERS						
Electrolytic tough pitch copper	Cu 99.90 min.	B152 Type A	B124 #12 B133	B124 #12 B133	B1 B2 B3	
Phosphorized copper	Cu 99.90 min.					B42, B68 B75, B88 B111
PLAIN BRASSES—NON-LEADED						
Gilding metal	Cu 93.5 –96.5 Zn Remainder	B36 #1				
Commercial bronze	Cu 89.0 –92.0 Zn Remainder	B36 #2 B130			B134 #2	√
Red brass	Cu 83.0 –86 0 Zn Remainder	B36 #3			B134 #3	B43 B111
Low brass	Cu 78.5 –81 5 Zn Remainder	B36 #4			B134 #4	B135 #1
70/30 Brass	Cu 68.5 –71 5 Zn Remainder	B36 #6 B19			B134 #6	B14 B135 #2
High brass	Cu 63.0 –67.5 Zn Remainder	B36 #8			B134 #7	
Muntz metal	Cu 59.0 –63.0 Zn Remainder	√	B124 #1			B111 B135 #5
LEADED BRASSES						
Leaded commercial bronze	Cu 87.5 –90.5 Pb 1.25– 2.25 Zn Remainder		B140 Type B			
Low-leaded tube brass	Cu 65 0 –69.0 Pb 0.30– 0.80 Zn Remainder					B135 #3
High-leaded tube brass	Cu 65.0 –69 0 Pb 1.25– 2.00 Zn Remainder					B135 #4
Light-leaded brass	Cu 63.5 –67.5 Pb 0.15– 0.35 Zn Remainder	√				
Low-leaded brass	Cu 62.5 –66.5 Pb 0.30– 0.70 Zn Remainder	√				
Medium-leaded brass	Cu 62.5 –66.5 Pb 0.75– 1.25 Zn Remainder	√				
High-leaded brass	Cu 60.5 –64.5 Pb 1.25– 2.25 Zn Remainder	B121 #4				
Extra-high-leaded brass	Cu 60.0 –64.0 Pb 2.00– 3.00 Zn Remainder	√				
Free-cutting brass	Cu 60.0 –63.0 Pb 2.50– 3.75 Zn Remainder		B16	√		
Leaded muntz metal	Cu 58.0 –62.0 Pb 0.35– 0.90 Zn Remainder	B171				
Free cutting muntz metal	Cu 59.0 –62.0 Pb 0.90– 1.40 Zn Remainder					√

G.E. Announces



PACKAGED CONTROL SYSTEMS FOR AIRCRAFT

AIRCRAFT CONTROL

Reversing control for:

Nose wheels
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Bomb doors
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Turret retractors
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Nonreversing control for:

Hydraulic system pumps
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Engine starters
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Factory-designed and -assembled for light weight and easy installation

You tell us the type motor you are using, the purpose for which it is to be used—we'll design the circuit, select the proper devices, assemble, wire, and test them as a unit, and deliver a complete control system to you, ready for installation. All the individual devices, such as relays, contactors, and switches, required for control of an electric motor are co-ordinated and compactly assembled in lightweight enclosures.

You get these advantages:

1. From our wide variety of aircraft control devices we can select those best suited to the job—often making one device do the work of two—with the greatest saving of weight and space.

2. Wiring, test, and assembly are completed at the G-E factory. Responsibility for the complete control system rests with one manufacturer.

3. Circuits are designed by G-E engineers who have had years of experience in the design as well as application of control equipment.

Next time you need aircraft control equipment, before you order individual devices, contact our nearest office and ask for more details on G-E packaged control. *General Electric Company, Schenectady, N.Y.*

The best investment in the world is in this country's future—BUY WAR BONDS

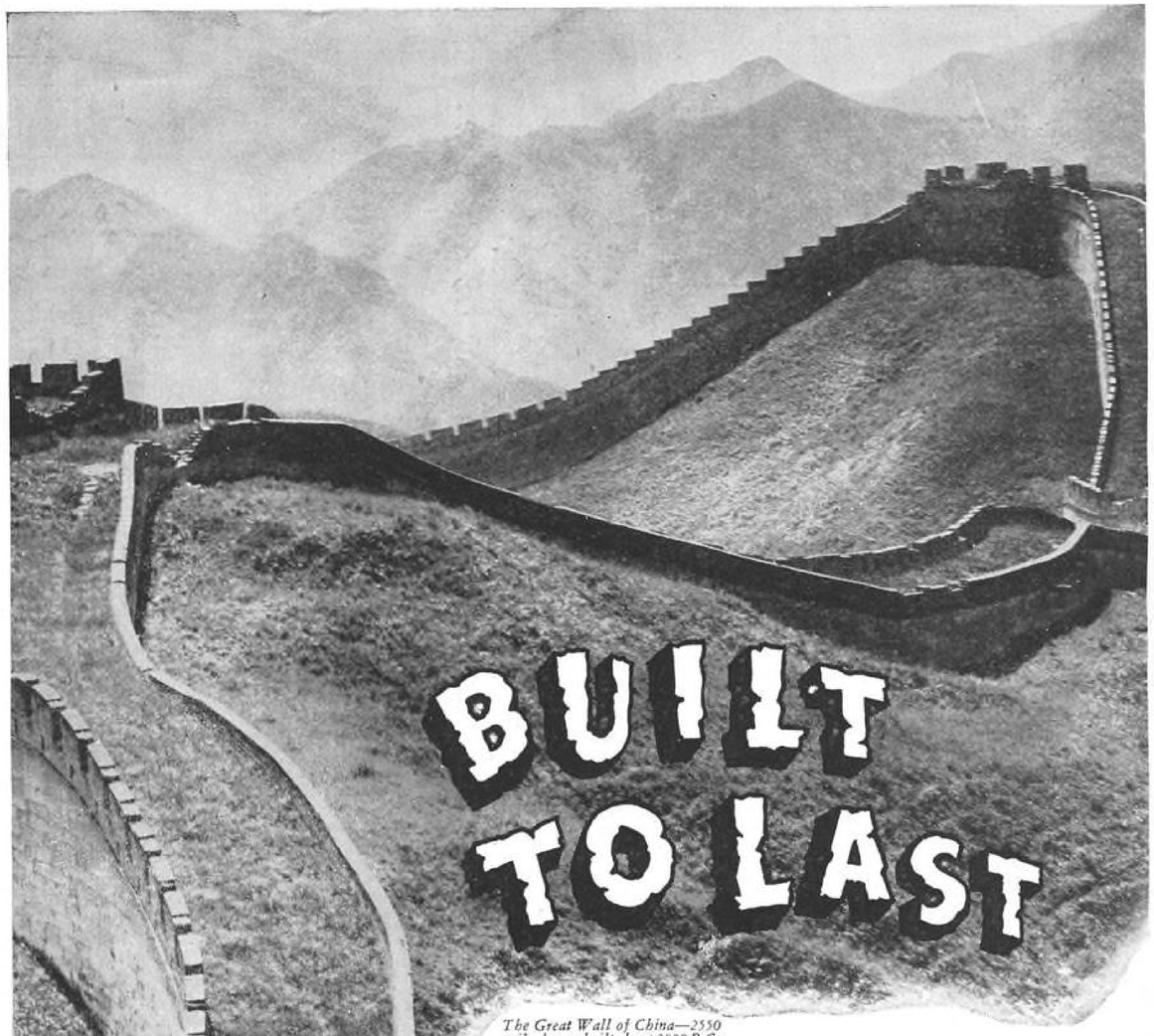
GENERAL ELECTRIC

8F6-92-8940

NAME	COMPOSITION Percent	FORMS GENERALLY AVAILABLE *Indicated by (√) or by reference to nearest applicable A. S. T. M. Specifications*				
	Commercial Limits	Flat Rolled Products	Rod and Drawn Bar	Shapes	Wire	Tube
LEADED BRASSES (continued)						
Forging brass	Cu 58.5 –62.0 Pb 1.50– 2.50 Zn Remainder		B124 #2			
Architectural bronze	Cu 55 0 –60.0 Pb 2.00– 3.75 Zn Remainder			√		
TIN AND ALUMINUM BRASSES						
Admiralty	Cu 70.0 –73.0 Sn 0.90– 1.20 Zn Remainder					B111 Types A, B, C & D
Naval brass	Cu 59.0 –62.0 Sn 0 50– 1.00 Zn Remainder	B171	B21 GradeA B124 #3			
Leaded naval brass	Cu 59.0 –62.0 Sn 0.50– 1.00 Pb 1.25– 2.25 Zn Remainder		B21 Grade C			
Manganese bronze	Cu 57.0 –60.0 Sn 0.50– 1.50 Fe 0.80– 2.00 Mn 0 50 max. Zn Remainder		B124 #4 B138 TypeA			
Aluminum brass	Cu 76.0 –79.0 Al 1.75– 2.50 Zn Remainder					B111 Types A, B, C & D
PHOSPHOR BRONZES						
Phosphor bronze—Grade A	Cu Remainder Sn 3.50– 5.80 P 0.03– 0.35	B103 Grade A	B139 Grade A		B159 Grade A	√
Phosphor bronze—Grade C	Cu Remainder Sn 7.00– 9.00 P 0.03– 0.35	B103 Grade C	B139 Grade C		B159 Grade C	
Phosphor bronze—Grade D	Cu Remainder Sn 9.00–11.0 P 0.03– 0.25	B103 Grade D			B159 Grade D	
Phosphor bronze—Grade E-1	Cu Remainder Sn 1.50– 2.00 P Trace				√	
Phosphor bronze—Grade E-2	Cu Remainder Sn 1.00– 1.50 P Trace	√			√	
CUPRO-NICKEL and NICKEL SILVERS						
Cupro-nickel	Cu Remainder Ni 29.0 –33.0	B122 #5 B171				B111 (70–30)
Nickel silver alloy A	Cu 63.0 –66.5 Ni 17.0 –19.5 Zn Remainder	B122 #2	B151 Alloy A		B151 Alloy A	
Nickel silver alloy B	Cu 53.5 –56.5 Ni 17.0 –19.5 Zn Remainder	B122 #4	B151 Alloy B		B151 Alloy B	
SILICON BRONZES (Copper-silicon alloys)						
Silicon bronze—Type A	Cu 94.8 min. Si 2.75– 3.50	B96 TypeA B97 TypeA	B98 Type A		B99 Type A	√
Silicon bronze—Type B	Cu 96 0 min. Si 0.75– 2.00	B97 Type B	B98 Type B		B99 Type B	√
Silicon bronze—Type D	Cu 94.0 min. Si 2.75– 3.50 Pb 0.20– 0.80		B98 Type D			

The alloys listed hereon are standard in the sense that over a period of years they have been the ones most commonly ordered in large quantities by consumers.

In addition to these alloys, there are many special and proprietary alloys which can be and are produced by the mills for various uses, including such types of alloys as aluminum bronze, cadmium bronzes, beryllium coppers, aluminum-tin bronzes, aluminum-silicon bronzes, silicon bronzes, copper-chromium alloys, etc.



The Great Wall of China—2550 miles long—built about 3000 B.C.

THROUGHOUT EVERY STEP of manufacture, long life is built into Tobe Capacitors. And before manufacture begins, Tobe engineers have shown great ingenuity in pioneering new and advanced designs. The original capacitor with hold-down bracket (Tobe OM-601) is shown below. It has many outstanding advantages over certain other types and shapes of capacitors. This new capacitor is strong, compact and space-saving and the new hold-down bracket permits the use of either inverted or upright terminals, with wiring underneath or on top of chassis. Write us about your capacitor problems. They will have the best efforts of Tobe engineers.

LONG LIFE ASSURED



This new separate mounting is stronger and helps prevent leaks caused by breaks in can. This outstanding Tobe design takes the minimum amount of space.

SPECIFICATIONS
TOBE OM-601 CAPACITORS

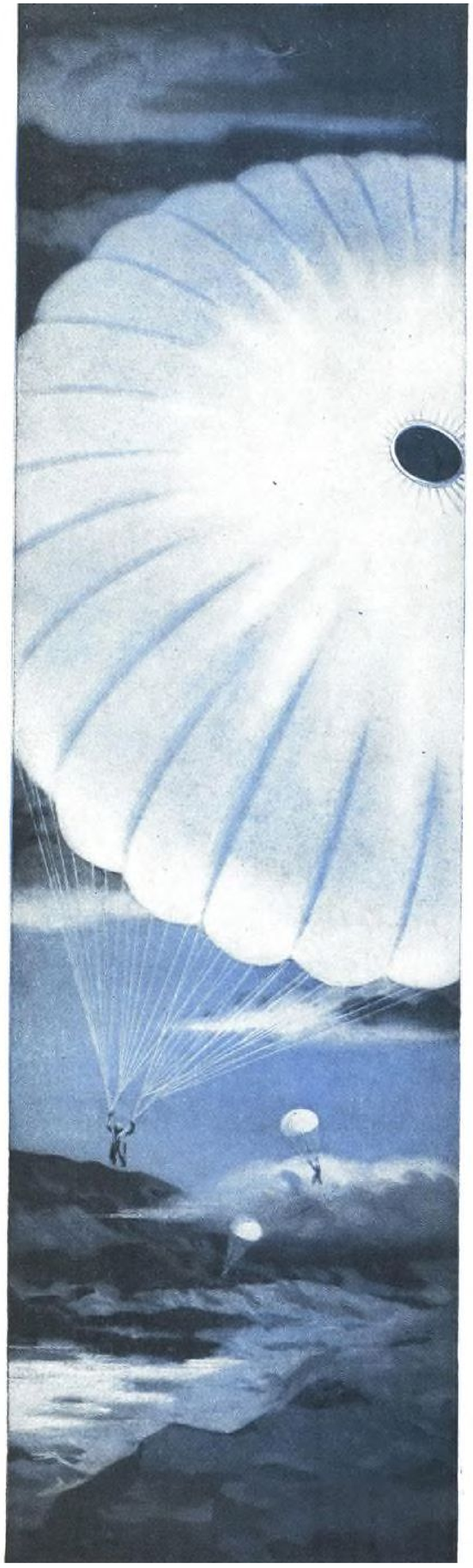
TYPE	OM
RATINGS	.05 to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
STANDARD CAPACITY TOLERANCE	. . . 10%
TEST VOLTAGE	. . . Twice D.C. rating
GROUND TEST	. . . 2,500 Volts, D.C.
OPERATING TEMPERATURE	55° F to 185° F
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms. .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms.
POWER FACTOR	At 1,000 cycles—.002 to .005
CONTAINER SIZE	Width 5/8", length 15/16", ht. 2 1/4"
MOUNTING HOLE CENTERS	1 1/2"

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

A small part in victory today

A BIG PART IN INDUSTRY TOMORROW

ONE MILE DOWN TO CHRISTMAS



Out we go at around five thousand . . . I never thought my Christmas tree would be a 'chute!

Here I am, though . . . on this Holy Night . . . drifting down to earth . . . to finish this job.

Time's short . . . and you know, as I look down below . . . I say a silent prayer . . . whisper it to the air.

Now . . . I'm coming down . . . coming down all *safe* and *sound!* coming down . . . to make "Peace on Earth . . . Good Will to Men!" a living reality.

And next year . . . Back to a Christmas tree that's green . . . decorated with tinsel and ornaments . . . standing in a room that's quiet and serene . . . where a fire on the hearth glows warm and friendly. Back home! Back to my freedom!

Back to my own little mansion . . . back to the ones I love!

And, Sky Soldier, to bring you back safely, we are working day and night. To you . . . and all like you . . . to your loved ones, too . . . we send our grateful Christmas greetings! ☆ ☆ ☆ ☆

SWITLIK SAFE-T-CHUTES

Air Power is winning the war . . . The more Bonds you buy . . . the more hours they fly!

SWITLIK PARACHUTE COMPANY
Trenton, New Jersey

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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.

Steerable Tail Wheel, of caster type, is designed to be steered by means of rudder controls. Mechanism is automatically disengaged upon takeoff so rudder controls may be more easily moved.—2,329,823, filed Mar. 25, 1940, patented Sept. 21, 1943, E. A. Camburn, assignor to Lake State Products, Inc.

Airfoil With Capped Ribs. Patent is for rib-and-fabric type airfoil. Here, ribs are jointed-in solidly with a cap piece extending around periphery of airfoil.—2,329,962, filed Aug. 9, 1941, patented Sept. 21, 1943, G. A. Weingartner, assigner to Bell Aircraft Corp.

Re Wing Leading Edges. Invention here is for a prefabricated wing in which leading edge element of multi-part wing is attached to rest of wing with special bolting arrangement to eliminate necessity of access holes through skin.—2,330,185, filed Dec. 5, 1940, patented Sept. 21, 1943, R. W. Palmer, assignor to Vultree Aircraft, Inc.

Multi-Rotor Aircraft. This design is for helicopter in which a pair of opposed rotors are mounted on ends of laterally extending spars and with a third rotor mounted on fuselage with its plane of rotation slightly higher than that of the pair of rotors. Center rotor overlaps half of lower rotors, and combined effect is one of a rotor with a greatly increased radius.—2,330,204, filed Sept. 15, 1941, patented Sept. 28, 1943, H. S. Campbell, assigned to Autogiro Co. of America.

Metal Covering for Airfoils incorporates a sheet to reinforce wing covering. This sheet is stamped into a waffle-like appearance, with centers of depressions cut out to reduce weight. Sheet is then welded to surface covering between depressions.—2,330,219, filed Aug. 13, 1940, patented Sept. 28, 1943, P. H. Kemmer. Freely licensed to government.

"Anti-Flapping" Rotor. Invention concerns rotor arrangement in a helicopter in which blades are universally mounted so they may have a cyclically controlled pitch varied according to rotational position of rotor blade, aim being to eliminate "flapping".—2,330,842, filed May 27, 1940, patented Oct. 5, 1943, C. G. Pullin, assigned to Autogiro Co. of America.

Treating of Aircraft Fabrics and products thereof. Method to prevent mildew contemplates use of copper naphthenate mixed into a doping solution. Fabric is attached to a structural framework of an aircraft, and thereafter water and a mildew-proofing agent is applied to fabric to shrink it. When fabric has shrunk and dried, a protective coating is applied.—2,330,998, filed Oct. 24, 1941, patented Oct. 5, 1943, L. Roon, assigned to Roxalin Flexible Finishes, Inc.

Balanced Control Surface. Improvement concerns a sealing membrane for open portion on trailing edge of wing adjacent to flap mounting, membrane consisting of two separate members formed into continuous sleeve extending across complete wing edge. Sleeve is inflated by a tube leading to forward edges of wing, where it has an open mouth forwardly directed.—2,331,047, filed Oct. 9, 1942, patented Oct. 5, 1943, G. S. Schairer, assigned to Boeing Aircraft Co.

Steerable Undercarriage aims to permit gear to be retracted into much smaller area. It is so mounted that wheel member may be swung so as to lie flat in retracted position.—2,331,082, filed June 30, 1941, patented Oct. 5, 1943, H. H. Smith, assigned to Dowty Equipment, Ltd.

Emergency Exit Catapult. This invention is for a pilot-ejecting device for a fighter ship which has become disabled. Principle is to use airfoil-shaped member which when released on forward edge, will fold back pulling pilot from seat to toss him out past all obstructions on ship.—2,331,309, filed Nov. 24, 1941, patented Oct. 12, 1943, L. E. Curriston, freely licensed to government.

Chute-Carrying Garment has parachute-carrying arrangement provided in place of usual chute pack. Provided is pocket in back covered with pair of flaps which are loosened when chute is to be used.—2,331,727, filed July 18, 1941, patented Oct. 12, 1943, J. R. C. Quilter and J. Gregory.

Launching Dollies. Invention relates to airplane takeoff devices adapted to travel with plane until flying speed is attained and then be released. There are two forms, one for water use, other for land. Waterborn device is self-propelled.—2,331,837, filed Sept. 6, 1939, patented Oct. 12, 1943, F. W. King.

Shock-Absorbing Ski Mounting. Arrangement is designed to maintain skis parallel to fuselage at all points of compression of shock absorber. This is accomplished by use of a parallel link mounting for skis and for shock absorber, with shock absorber replacing one of links.—2,332,021, filed May 22, 1941, patented Oct. 19, 1943, H. H. Smith, assignor to Dowty Equipment, Ltd.

New Friction-Reducing Coating, for exterior surfaces of an airplane, is intended to improve speed and performance of craft. Coating comprises mixture of nitrocellulose, castor oil, ortho toluene, ethyl sulfonamid, finely powdered graphite, and ethyl acetate.—2,332,196, filed Oct. 4, 1940, patented Oct. 19, 1943, J. Bjorksten.

"No-Break" Retractable Gear. Construction of this undercarriage is so links need not be "broken" to fold into retracting position. Fore and aft shift in weight during retraction is reported so slight that trim of ship is not appreciably changed.—2,332,453, filed July 15, 1941, patented Oct. 19, 1943, E. S. Martin, assignor to North American Aviation.

Aerodynamic Brake arrangement comprises series of tooth-like members adapted to be thrust simultaneously into airstream both above and below wing surface to increase drag on wing without imposing additional twisting stresses.—2,332,465, filed Aug. 23, 1939, patented Oct. 19, 1943, J. G. Lee and R. B. Beisel, assignors to United Aircraft Corp.

FIG. 1

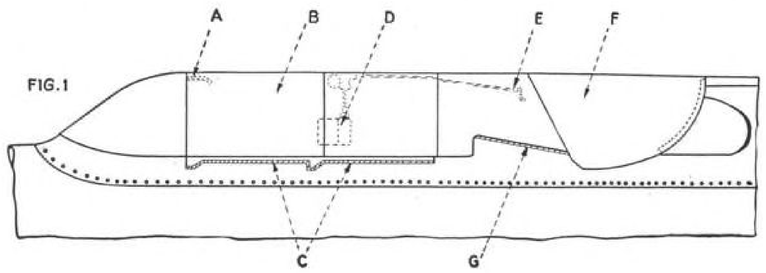


FIG. 2

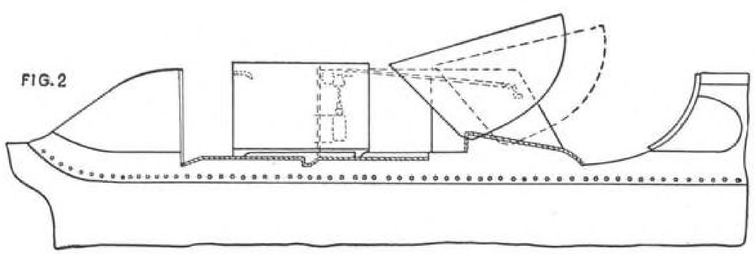
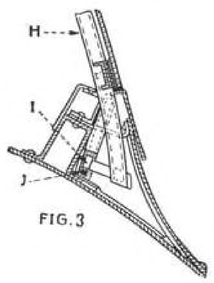
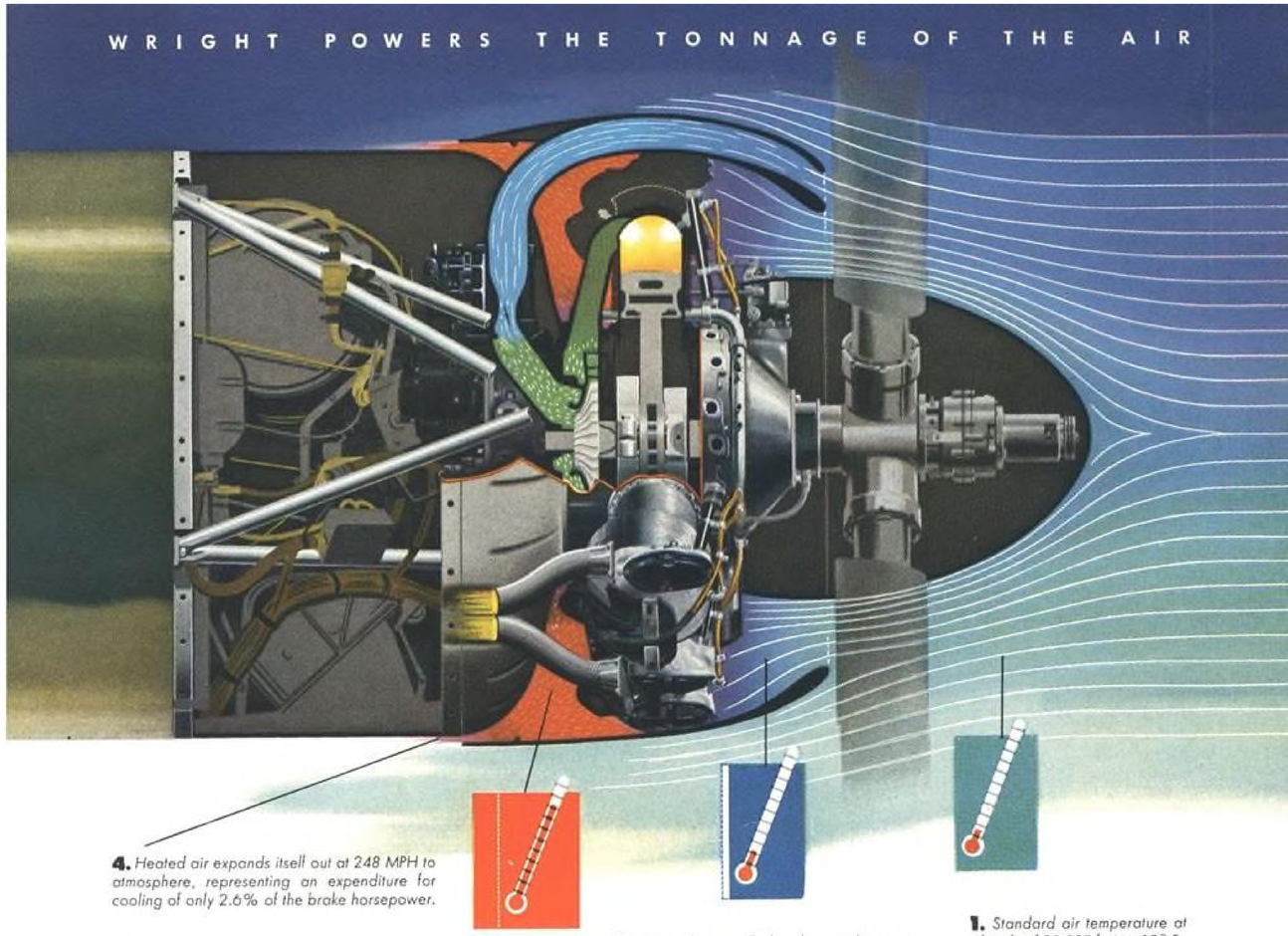


FIG. 3



Prime purpose of warplane cockpit cover design (illustrated left) is to achieve flush-closing of "greenhouse," thus doing away with stepped or irregular features which in former telescoping enclosures have induced drag. In this form, all cover units are of same cross-section size. With handle *A* (Fig. 1) pilot slides back his cockpit cover *B* over special track *C* built to lift, expand, and guide it over fixed enclosure immediately aft. In like fashion, motor *D* (operated by pilot) or manual crank *E* (used by gunner) brings gunner's cockpit cover *F* forward on track *G*. Fig. 2 shows pilot's cover in half-open position and gunner's cover fully open. When former is fully open, latter is partially open, as depicted in dotted lines. Note that gunner's cover swings up to act as wind screen. Fig. 3 shows detailed transverse section of tracking arrangement. Seen at *H* is edge portion of cover, while *I* is roller unit, and *J* is track. Patent, filed Dec. 30, 1939 and granted Oct. 19, 1943, is No. 2,332,158. It went to Harry S. Magill and Ernest G. Bruce, who have assigned it to Vultee Aircraft, Inc.

WRIGHT POWERS THE TONNAGE OF THE AIR



4. *Heated air expands itself out at 248 MPH to atmosphere, representing an expenditure for cooling of only 2.6% of the brake horsepower.*

3. *In enclosure behind engine, pressure drops to 7.23 lbs./sq.in., even though temperature is raised to 150° F. One pound now occupies 31.0 cu. ft.*

2. *In rated power flight, plane picks up air at 300 MPH. Impact compresses air to 7.49 lbs./sq.in., raises temperature 16°. One pound of air now compressed to occupy 22.8 cu. ft.*

1. *Standard air temperature at altitude of 20,000 ft. is —12° F.; standard air pressure is 6.75 lbs./sq.in. One pound of air occupies a volume of 24.5 cu. ft.*

A Direct Approach to Cooling

All aircraft engines are cooled by air, whether the air passes through a radiator containing intermediate coolant, or passes directly across finned cylinders. Wright Aeronautical has produced both types of engines, and in developing the history-making Cyclone series has advanced the science of direct air cooling to the point where Cyclones produce more power per unit of space and weight than any other powerplant of any type.

Years ago, air cooled engines were mounted in the open, without cowling. While this provided effective cooling under most operating conditions, the resultant drag exacted a high toll from the power available for thrust. Present-day engine powers and aircraft speeds have depended in large measure on two simultaneous developments — increased cylinder finning and scientific cowling.

With each increase in the number and depth of cylinder cooling fins, engine powers have gone up. In ten years, the rating of the Cyclone 9 has been raised 80% without increase in displacement. The latest development in cylinder design, incorporating a forged head with machined fins, permits as much as 15% increase in Cyclone power without adding to the size or weight. Better heat conductivity of the forged metal, plus extra-deep fins, make Cyclones with these new cylinders the easiest of all engines to cool.

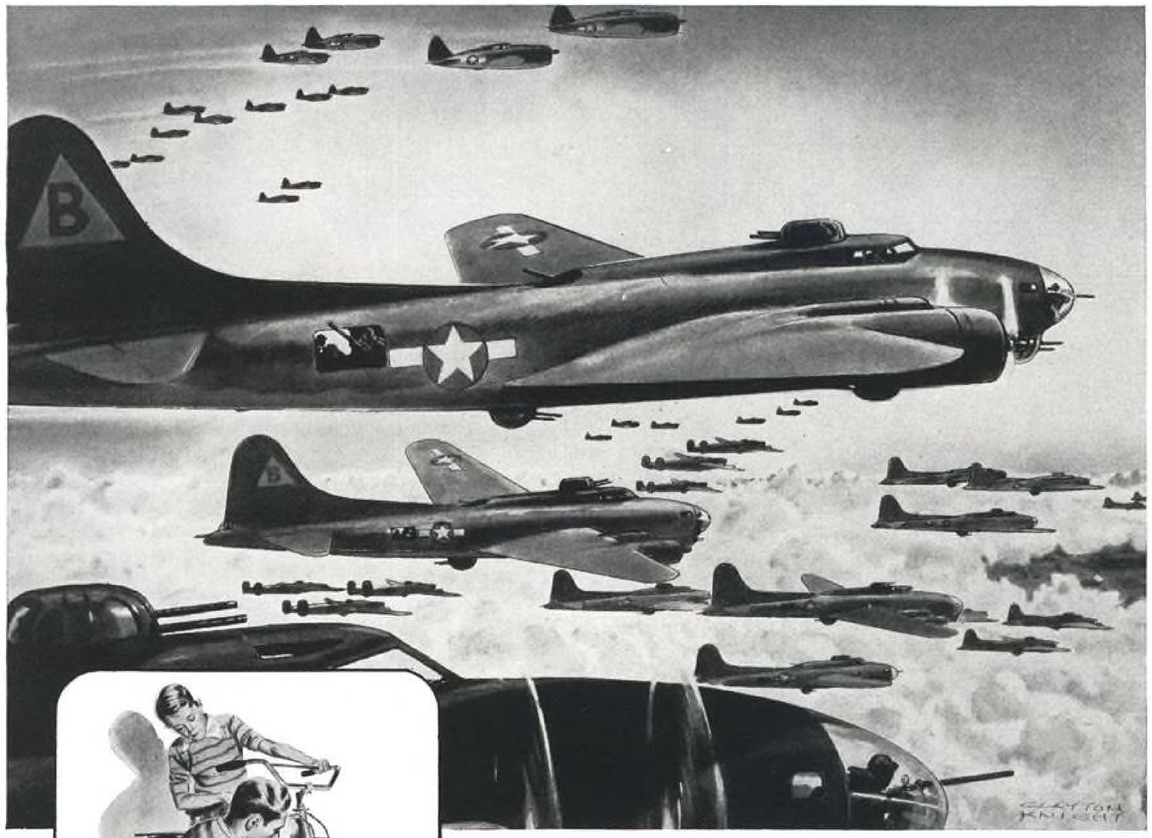
Engine cowling, meanwhile, has been refined to the point where it serves as a pump to supply cooling air to the engine and control its return to the slip-stream. In cooling an engine, still air is picked up and swept along momentarily at plane speed, then returned to surrounding air. Unless it is ejected at approximately the speed with which the plane picked it up, the forward velocity which it retains represents a serious loss of energy. The reduced cooling effort required by the Cyclone engine permits reduction of this cooling drag to negligible values in high speed flight, as shown in the illustration above.

Direct air cooling, which requires a minimum of installation weight and few moving parts, is a feature which has long established the Cyclone as an economical source of power. The marked pay load advantage and ease of maintenance means additional revenue dollars for the operator.

★ ★ ★

Wright Cyclones pay their way.

Cyclones and Whirlwinds · Light · Compact · Powerful **WRIGHT** *Aircraft Engines*





Boots Will Eliminate This Chore After Victory

Often Bill's bike shakes and shimmys so badly that he can't ride it safely. Normal vibration loosens wheel nuts—probably every other nut too—so Dad has to get a wrench and tighten up the whole bike. But after the war, Bill will ride safer and Dad will be spared many a tightening-up session, because well-made bikes will wear Boots Self-Locking Nuts. Even severe vibration can't shake Boots Nuts loose. For safety's sake and to eliminate repairs caused by vibration-loosed connections, you will insist on products protected with Boots Self-Locking Nuts.

They Fly With Their Boots On—Farther

Boots All-Metal Self-Locking Nuts are lighter than any other similar fastenings. On a single Liberator or Flying Fortress they save up to 80 pounds. That's enough to enable one of these 4-engine giants to take along extra gallons of gasoline—or 200 additional rounds of .50 caliber machine gun ammunition. A little extra range or a few more bullets may be just what's needed to get a bomber home from a 2,000 mile raid over enemy territory.

In case you're wondering whether nuts as light as Boots can "take it," there is plenty of evidence to prove just how tough they really are. They withstand the corrosive action of oil, salt water and chemicals. No amount of plane vibration can loosen their grip. Boots Nuts can be used over and over again—literally "outlast the plane." In fact, today these nuts are worn by every type of U.S. aircraft. Yes, Boots Nuts meet the exacting specifications of all government aviation agencies.

BOOTS

Self-Locking Nuts For Application In All Industries





BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN, CONNECTICUT

CRUISE CONTROL For Flying Efficiency

Part V . . . Time and Fuel Requirements

By **DIXON SPEAS**, *Asst. to Vice-Pres., Engineering,*
JERE T. FARAH, *Chief Flight Analyst,*
SANFORD HINTON, *Flight Analyst,*
American Airlines

AIR TRANSPORT

Methods of determining flight time and fuel requirements under varying weather conditions.

FLIGHT PLANNING consists of several very important steps. First, and most important, is determination of the type of cruise control which will be used. The various factors affecting this choice are discussed elsewhere in this series. The second step consists of determining the time and fuel required, while the third phase is the determination of the amount of reserve fuel to be carried during the planned flight.

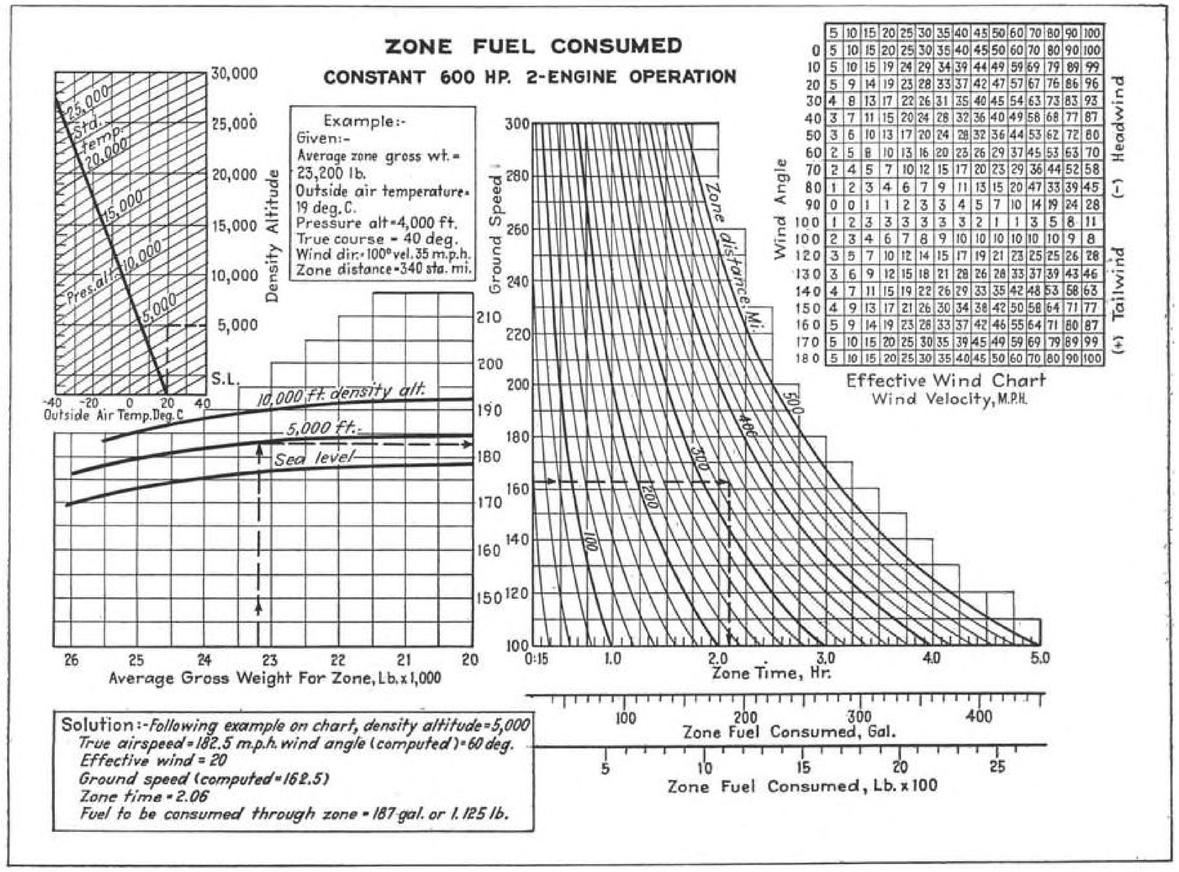
In establishing the amount of fuel and the time requirements for any flight, several phases are considered, as follows:

1. Taxi, run-up, and takeoff
2. Climb
3. Cruise
4. Descent
5. Reserve

The taxi, run-up, and takeoff operation is variable and does not lend itself to an accurate analysis.

If the airplane has been warmed up and checked by a mechanic, allowances should be made in determining the fuel load. Often, however, the tanks are filled or topped off after this check, or the engines are warm if it is an intermediate stop, in which case no allowance need be made for warm-up and run-up. A reasonable figure for twin engines of about 1,100 hp. is 5 to 10 gal., but this is highly variable, depending on the outside air temperature, which affects the time of warm-up, the priming, etc. A four-engine airplane will take approximately twice as much as two engines, and four engines having turbosuperchargers, which require running at takeoff power during the ground check, will require approxi-

Fig. 1. Zone fuel consumption and effective wind charts.



Wind Angle	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100
0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100
10	5	10	15	19	24	29	34	39	44	49	59	69	79	89	99
20	5	9	14	19	23	28	33	37	42	47	57	67	76	86	96
30	4	8	13	17	22	26	31	35	40	45	54	63	73	83	93
40	3	7	11	15	20	24	28	32	36	40	49	58	68	77	87
50	3	6	10	13	17	20	24	28	32	36	44	53	62	72	80
60	2	5	8	10	13	16	20	23	26	29	37	45	53	63	70
70	2	4	5	7	10	12	15	17	20	23	29	36	44	52	58
80	1	2	3	4	6	7	9	11	13	15	20	47	33	39	45
90	0	0	1	1	2	3	3	4	5	7	10	14	19	24	28
100	1	2	3	3	3	3	3	3	2	1	1	3	5	8	11
100	2	3	4	6	7	8	9	10	10	10	10	10	10	9	8
120	3	5	7	10	12	14	15	17	19	21	23	25	25	26	28
130	3	6	9	12	15	18	21	28	26	28	33	37	39	43	46
140	4	7	11	15	19	22	26	29	33	35	42	48	53	58	63
150	4	9	13	17	21	26	30	34	38	42	50	56	64	71	77
160	5	9	14	19	23	28	33	37	42	46	55	64	71	80	87
170	5	10	15	20	25	30	35	39	45	49	59	69	79	89	99
180	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100

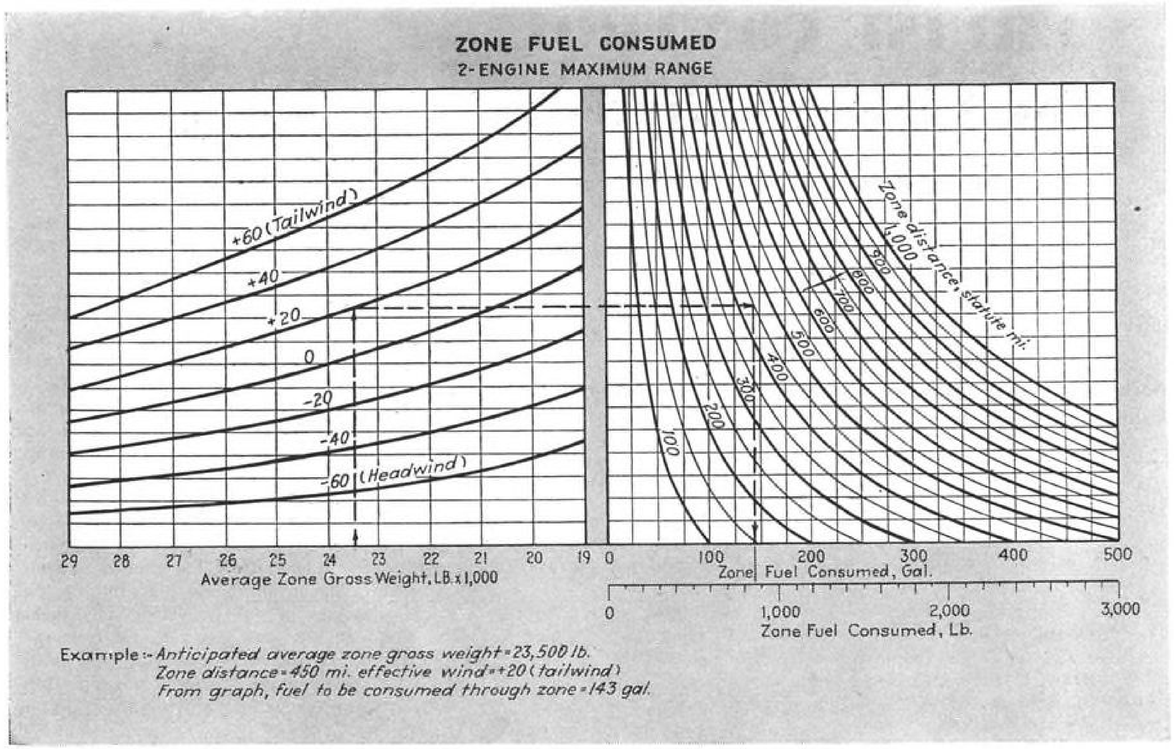


Fig. 2. Chart giving effect of wind on fuel consumption.

mately 20 gal. Engines of higher horsepower require fuel directly in proportion to their power.

Fuel for taxiing is a function of the size of the field and is therefore a rather indefinite factor. A fair fuel estimate is 5 to 10 gal.

The run-up before takeoff is influenced by the horsepower and number of engines and whether or not the airplane has turbosuperchargers. A twin-engine airplane as described above will require about 5 gal., four engines will require twice this amount, and an airplane with turbosuperchargers will require about 12 to 15 gal.

The takeoff lasts about one minute and requires approximately 2 gal. per 1,000 hp. Thus two 1,100 hp. engines require 4.4 gal., which for purposes of flight planning would be 5 gal.

With the above factors in mind, a flat figure is usually determined as an allowance for ground operation and takeoff. For a DC-3's scheduled operation (engines warm) 10 gal. is allowed for ground operation and takeoff. The time for taxiing and run-up is about six minutes for a twin-engine airplane and nine minutes for a four-engine plane.

Because of the higher power, rich mixtures, and slower airspeeds encountered during the climb, both more fuel and time are required than would be the case in level flight for the same distance.

It is convenient in flight planning to compute the fuel and time required to cover a given distance and then add the extra amounts resulting from the climb. For a DC-3 the extra requirements are as shown in Table I.

If a flight plan were to be made using 600 hp., cruising at 10,000 ft. and with an effective headwind of 20 mph., using the above table, 19 gal. and three min. would be added over and above the fuel and time requirements necessary for a level cruising flight.

Such a table would be computed as follows: Assume a climb to 10,000 ft. with an effective headwind of 20 mph., level flight cruising to be at 600 hp., the climb to be made at 650 hp.

Assume a fuel consumption at 600 hp. with cruising mixtures to be 90 gal. per hour and at 650 hp. with climbing mixtures to be 130 gal. per hour. The climb to 10,000 ft. is to be made at 120 mph. instrument air speed, with a rate of climb of 650 ft. per minute. Cruising speed at 600 hp.—10,000 ft., 25,000 lb. gross wt.—is determined from the cruising power chart to be 188 mph. true airspeed.

$$\text{Time to climb} = \frac{\text{altitude}}{\text{rate of climb}} = \frac{10{,}000}{650} = 15.4 \text{ min.}$$

With average true airspeed in climb at 120 mph., instrument airspeed is 133 mph. (from cruising power chart or calculator, taking into account installation error of 4 mph.)

$$\text{Ground speed} = 133 - 20 = 113 \text{ mph.}$$

$$\text{Distance traveled} = 113 \times \frac{15.4}{60} = 28.5 \text{ mi. in climb.}$$

$$\text{Fuel in climb} = 130 \text{ gal. per hour} \times \frac{15.4}{60} = 33.5 \text{ gal.}$$

If the same distance had been traveled in level flight at 188 mph. true airspeed, 168 mph. ground speed, and 90 gal. per hour:

$$\text{Time required} = \frac{28.5}{168} \times 60 = 10.2 \text{ min.}$$

$$\text{Fuel required} = \frac{90 \text{ gal./hr.}}{60} \times 10.2 = 15.3 \text{ gal.}$$

Difference in time = time to climb minus level flight time = 15.4 − 10.2 = 3.2 min.

Difference in fuel = fuel for climb minus level flight fuel = 33.5 − 15.3 = 18.2 gal.

Determination of the amount of time and fuel required for the "level flight" portion, or the "cruising" requirement, is of course of primary importance because of the major proportion of the fuel load which the "cruise" constitutes.

Procedure for such determination of fuel and time required in the cruise will be discussed in two ways: First, considering the basic methods of analysis of factors affecting these quantities; second, the devices such as charts, graphs, computers, etc., which are designed to facilitate a rapid, accurate estimate of these requirements.

Several quantities are required to be known for the analysis: Flight length, engine power to be used, fuel consumption at various powers, cruising altitude or altitudes, effective wind at those altitudes, and speed-power relationships of the airplane.

Flight length is ordinarily quite accurately known from airway or route maps. For flight planning, particularly on trips of great length, it is desirable to divide the total mileage into several short legs of approximately equal length, usually 200-400 mi. Each of these legs is then treated separately, and the time and fuel required for each leg, or "zone", is computed individually.

Choice of engine power to be used was discussed in previous articles of this series. The power control type will, of course, be either of constant power or of varying power such as is used in attaining maximum range. Constant power offers simplicity of flight planning, since the rate of fuel consumption will remain constant. When the power is to be varied, the changing fuel consumption per hour adds a slight complication to the problem. In either case it is necessary to have an accurate knowledge of the fuel consumption for each power to be used.

If no figures are available, a reasonable specific fuel consumption should be assumed; for cruising powers (below the cruising power limit) a "specific" of 0.45 lb. hp.-hr. can be assumed with lean mixtures. Thus, if 600 hp. is to be used for the flight, or a portion thereof, the engine can reasonably be expected to consume $600 \times 0.45 = 270$ lb. of fuel per hour, or 45 gal. per hour at a fuel weight of 6 lb.-gal. This consumption is, of course, per engine, and it must be multiplied by the number of operative engines.

Next problem is to determine the ground speed which will be maintained through each leg or zone of the flight. This, in the case of constant power operation, will be determined by density altitude, airplane weight, and effective winds encountered.

Effective wind is found by trigonometrical analysis of the airspeed-wind-speed triangle. This is accomplished more easily by using one of several available avigational computers, or from a chart such as is shown in Fig. 1. The effective wind is found by knowing the wind angle, or angle between the true course and the wind direction, and the wind velocity. At the intersection of the wind angle column (60 deg. in example) and wind velocity column (35 mph.), read the effective wind −20 mph. (headwind).

In the case of maximum range cruise control, the instrument airspeed is given for each gross weight of the airplane, in which case it is necessary to determine the power required to obtain that airspeed. Power changes, due to gross weight decrease through fuel consumption, are made at intervals of the airplane's decreasing weight.

For these speed-power-weight-altitude relationships, the cruising horsepower chart, as described in a previous article of this series, is used. The ground speed to be expected in each zone will be determined by the true airspeed minus headwind or plus tailwind.

Summarizing the basic method of time and fuel requirement analysis, the procedure is as follows: Determine true airspeed for the zone from a chart of speed-power relationship, such as the cruising horsepower chart, using the known values of altitude, average zone gross weight, horsepower (if known)[1], and instrument airspeed (if known)[2].

Add effective wind for zone, if tailwind, to true airspeed. Or subtract effective headwind, as the case may be, to determine ground speed.

Obtaining Zone Time

Divide zone length by the ground speed, to obtain the time required for that zone. The foregoing procedure is repeated for each zone.

Fuel consumed through the zone is obtained by multiplying zone time hours by the fuel consumption (gal.-hr.) to obtain the zone fuel consumed, or fuel to be used in flying through the zone. This, too, is repeated for each zone. The time and fuel required for the entire flight will then be the total of all zone times and zone fuel consumed.

Amount of time and effort involved in making an analysis of cruising flight time and fuel required in the manner described above is, to say the least, excessive, particularly when several altitudes are considered. Therefore it becomes desirable in routine operation to eliminate as many of the steps as possible through the use of pre-calculated charts and graphs. Many types of flight planning charts have been devised and successfully used for that purpose. Several in current use are described below.

Fig. 1 illustrates a chart designed for use with a constant power type cruise control (600 hp.). To determine the time and fuel required in cruising level flight through a given zone, it is necessary to know the average airplane gross weight for the zone, the cruising altitude, the effective zone wind, and the zone distance. In the example of Fig. 1., the gross weight is 23,200 lb., assumed pressure altitude 4,000 ft., air temperature at that altitude 20 deg. C., zone distance 340 mi. Cruising density altitude is to be determined from the standard atmosphere chart (see example in upper left corner of Fig. 1), as discussed previously in this series, or by following the examples shown.

Locating the zone gross weight (23,200 lb.) on the horizontal scale at the left of the chart, proceed vertically upward to the line of cruising density altitude (5,000 ft.), then right horizontally to read the true airspeed of 182.5 mph. Subtract the effective headwind of 20 mph. and enter the ground speed scale at 162.5 mph., then go to the right until the zone distance of 340 mi. is intersected. Vertically below this point, the time and fuel required for the subject zone may be read (2 hr. 6 min. and 187 gal. of gas). It must be remembered that these types of pre-calculated charts are based on the fundamental speed-power characteristics of the airplane and therefore must be calculated for each specific type of airplane flown.

Fig. 2 shows a similar type of chart based upon maximum range operation. It will be noted that the zone time is not given by this chart, since it is not possible to include this scale because of the fact that though the miles per gallon remain substantially constant with altitude (assuming constant specific fuel consumption and propulsive efficiency) the true air speed varies as altitude changes for a given instrument airspeed.

(*Turn to page* 324)

[1] As in constant power operation.
[2] As in maximum range operation.

TABLE I — Fuel and Time Allowances for Climb, DC-3 Typical Airplane

	Fuel allowance—gal. Cruising power per engine				Time allowance—min. Wind mph.						
Altitude	500hp.	550hp.	600hp.	650hp.	−60	−40	−20	0	+20	+40	+60
2,000.....	4	4	4	4	1	1	1	1			
4,000.....	8	8	8	7	1	1	1	1	1	1	1
6,000.....	12	12	11	11	2	2	2	2	1	1	1
8,000.....	17	16	15	15	3	3	3	2	2	2	2
10,000.....	21	20	18	18	4	3	3	3	2	2	2
12,000.....	26	25	22	22	5	4	4	3	3	3	3
14,000.....	31	30	27	26	6	5	5	4	4	3	3
16,000.....	37	35	33	31	7	6	6	5	5	4	4
18,000.....	44	41	39	37	9	8	7	6	6	5	5
20,000.....	52	48	46	44	10	8	7	7	6	6	5

P-51 Mustang

STANDAIR FUEL TANK ...provides Extra Range

The P-47 Thunderbolt and the P-51 Mustang—champions in dishing out destruction—now are flying higher and farther, equipped with Standair Fuel Tank Pressure Control Valves insuring a positive flow of fuel from wing tanks, belly tanks, or regular supply tanks. In addition, Standair manufactures other instruments engineered for the job—matching the high standards of precision established by the U. S. Army Air Forces and leading aircraft manufacturers. Write or wire for specifications.



WAR BONDS put these fighters in the air. Keep them fighting with MORE BONDS!

P-47 Thunderbolt

PRESSURE CONTROL VALVE for these American Fighters

FUEL TANK PRESSURE CONTROL VALVE

Model FAZ



Designed to eliminate the boiling of fuel at high altitudes, by pressurizing the fuel tank. It is equipped to automatically provide for varying atmospheric conditions existing in fuel systems. Operating pressure is derived from exhaust of supply pump. Systems can be pressurized starting at any predetermined altitude at pressure required.

Weight 1 lb. 2 oz.
4 ¼ in. x 5 in.
overall dimensions.

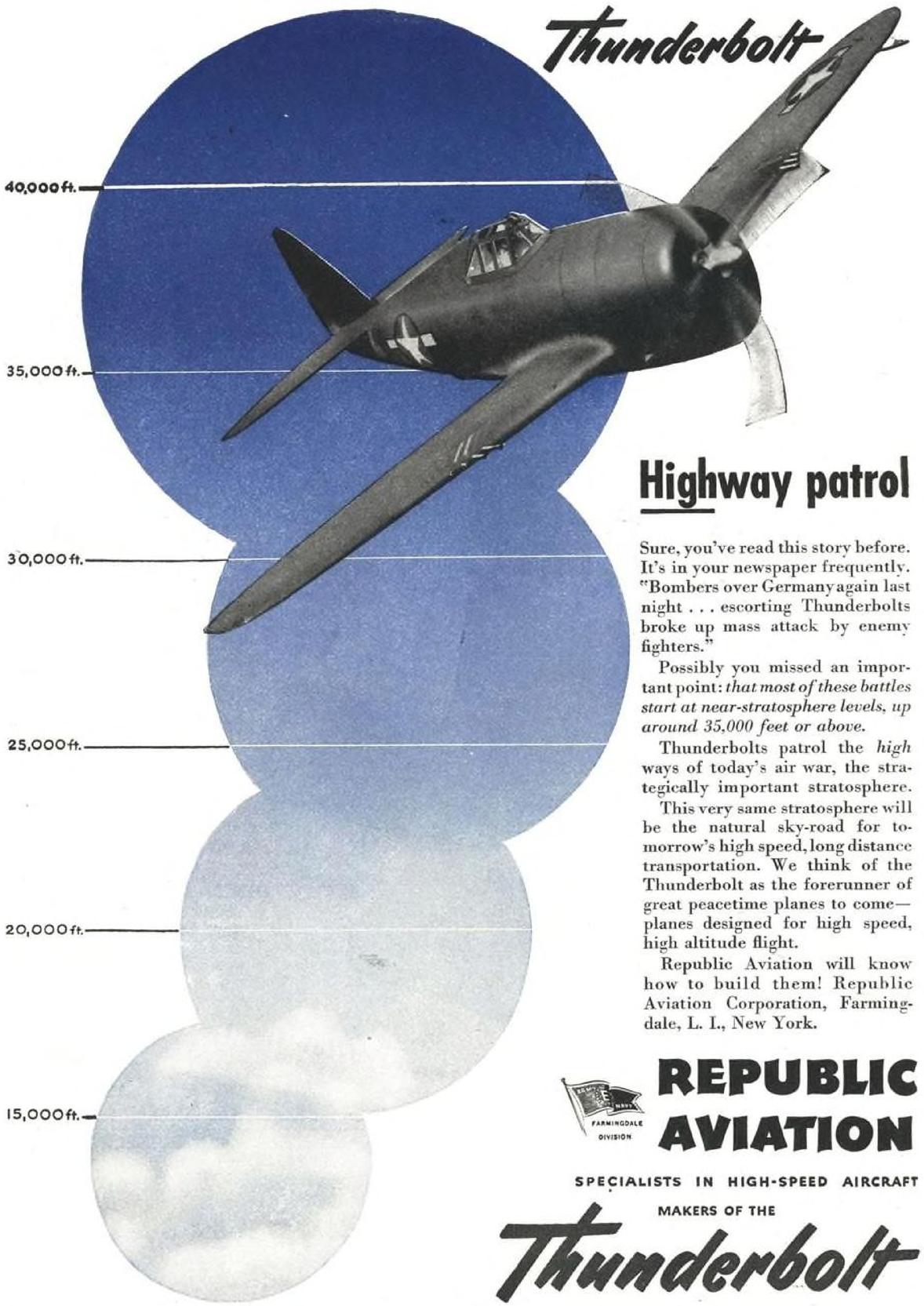
"STANDARD Products—Standard for the Industry"

STANDAIR

STANDARD AIRCRAFT PRODUCTS, INC.

DAYTON, OHIO

SALES OFFICES:
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Hartwell Aviation Supply Co., 3417 Crenshaw Blvd., Los Angeles, Calif.
Hartwell Aviation Supply Co., Huron Building, Kansas City, Kansas
Hartwell Aviation Supply Co., 608 North St. Paul St., Dallas, Texas



Highway patrol

Sure, you've read this story before. It's in your newspaper frequently. "Bombers over Germany again last night . . . escorting Thunderbolts broke up mass attack by enemy fighters."

Possibly you missed an important point: *that most of these battles start at near-stratosphere levels, up around 35,000 feet or above.*

Thunderbolts patrol the *high* ways of today's air war, the strategically important stratosphere.

This very same stratosphere will be the natural sky-road for tomorrow's high speed, long distance transportation. We think of the Thunderbolt as the forerunner of great peacetime planes to come—planes designed for high speed, high altitude flight.

Republic Aviation will know how to build them! Republic Aviation Corporation, Farmingdale, L. I., New York.

FARMINGDALE DIVISION

REPUBLIC AVIATION

SPECIALISTS IN HIGH-SPEED AIRCRAFT

MAKERS OF THE

Thunderbolt

How Gunners Learn to Wing 'Em



Future fighter pilots and bomber gunners first practice "bead work," then get the knack of nailing moving targets with BB and skeet guns, finally polish their precision on real m.g.'s in the air.

BUILDING THE AAF
PART V

THE YOUTHS WHO YESTERDAY were plugging squirrels in Oklahoma, ducks in Louisiana—or even an odd tin can on a fence in some city or town—are today drawing the same fine beads with AAF fixed and flexible machine guns in every theater of action.

It's a long way from a .22 rifle in the woods to a .50 cal. m.g. in a *Flying Fortress.* But experience with a rifle often adds up to facility with a machine gun—particularly under the AAF's system of training.

For instance, they're mighty proud down at Eglin Field, Fla., that the staunchest admirers of the instruction courses in fixed gunnery are the pilots who've been in action.

"Nothing's any good unless it's good in combat," says blond, mustached Capt. A. E. Hemming, Jr., youthful director of the training.

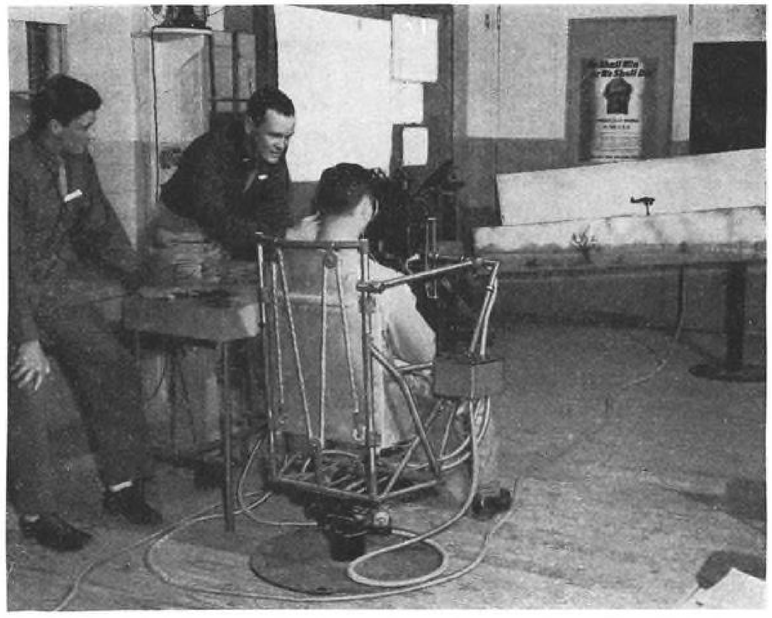
The gunnery men who established the AAF's first fixed gunnery school at Eglin have been ever-conscious of the need for close contact with ideas and techniques developed in action. Numerous innovations in firing the fixed guns mounted in the wings of fighters and medium bombers were developed by tireless study and experiment at Eglin. But others were transmitted from the war zones.

"After all," Capt. Hemming says, "There's no point in sending a plane up if its pilot can't shoot straight. We're trying to teach pilots to shoot like they'll have to in combat, so we're always on the lookout for the pertinent lessons picked up by our wide-awake fighters when they were mixing it with *Zeros* and *Messerschmitts.* Right now we know we have the world's most effective fixed gunnery training—but we're trying to improve it all the time".

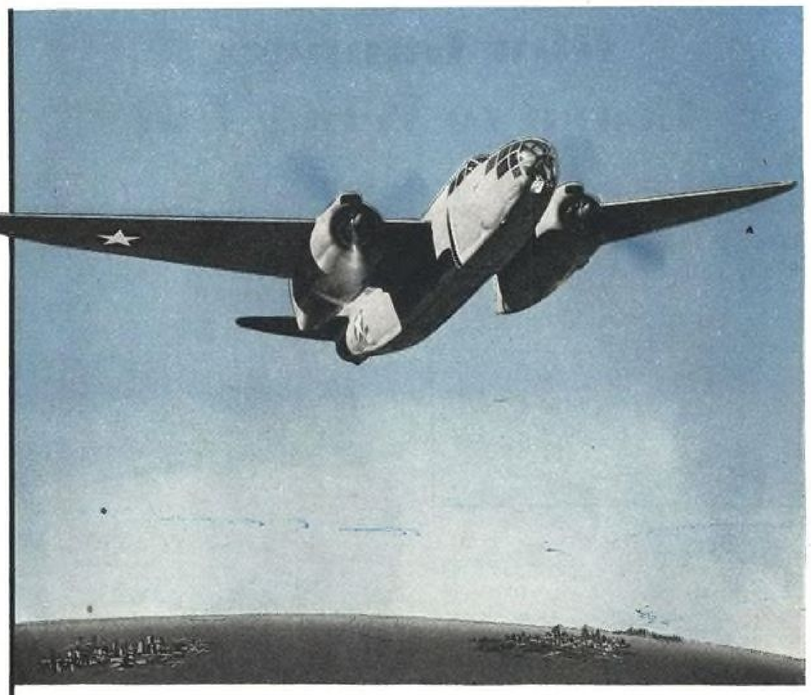
Eglin, which is also a proving ground, is surrounded by seven self-sufficient auxiliary fields. Each has broad, long



Skeet shooting teaches fixed and flexible gunnery students importance of "leading" target.



Range estimation—from a regulation plane seat, cadet takes sights on model plane and judges its distance.



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
SEALING COMPOUNDS

VISION UNLIMITED!

Presstite Sealing Compounds are playing an important part in America's production of military and naval aircraft. Yet it was the vision of our research and engineering staffs, aided by years of previous industrial experience, that enabled Presstite to meet the emergency demands of the aircraft industry in time of war.

From sealers used by the refrigeration and construction industries, by the railroads, and in many other fields, Presstite engineers developed special sealing compounds that today speed the assembly and contribute to the safety and efficiency of America's air armada.

Not only are Presstite sealers being used to seal aircraft fuel tanks, fuselage seams, gun turrets, seaplane floats, pressurized cabins, and other vital parts and devices, but we are producing many special compounds for the U. S. Ordnance Department, the Engineers Corps, and the U. S. Navy.

"*Ceiling Unlimited*" is the pilot's signal that the far horizons of the sky are visible in every direction. "*Vision Unlimited*" is symbolic of the continuing forward progress of Presstite engineering and research.

Today, and in tomorrow's post-war era, the vision unlimited of the Presstite organization stands ready to serve American industry wherever the most effective sealing compounds are required. We'll gladly work with you and your engineers, if you'll send us your detailed requirements.

PRESSTITE ENGINEERING COMPANY, 3910 Chouteau Avenue, St. Louis, Missouri

runways, photo laboratory, post exchange, mess halls, and operations and administrative set-ups. The skies are filled from early until late with North American AT-6 trainers in which cadets fire on tow targets.

Most of the cadets are in the latter stages of advanced flight training. They have come to Eglin from the various single-engine schools within the Southeast Training Center.

The shooting course lasts approximately eleven days. Each cadet contingent arrives with its own airplanes and instructors. When they report, students are novices at a deadly game—but when they leave they are equipped to join in with military aviation's finest aerial hunters.

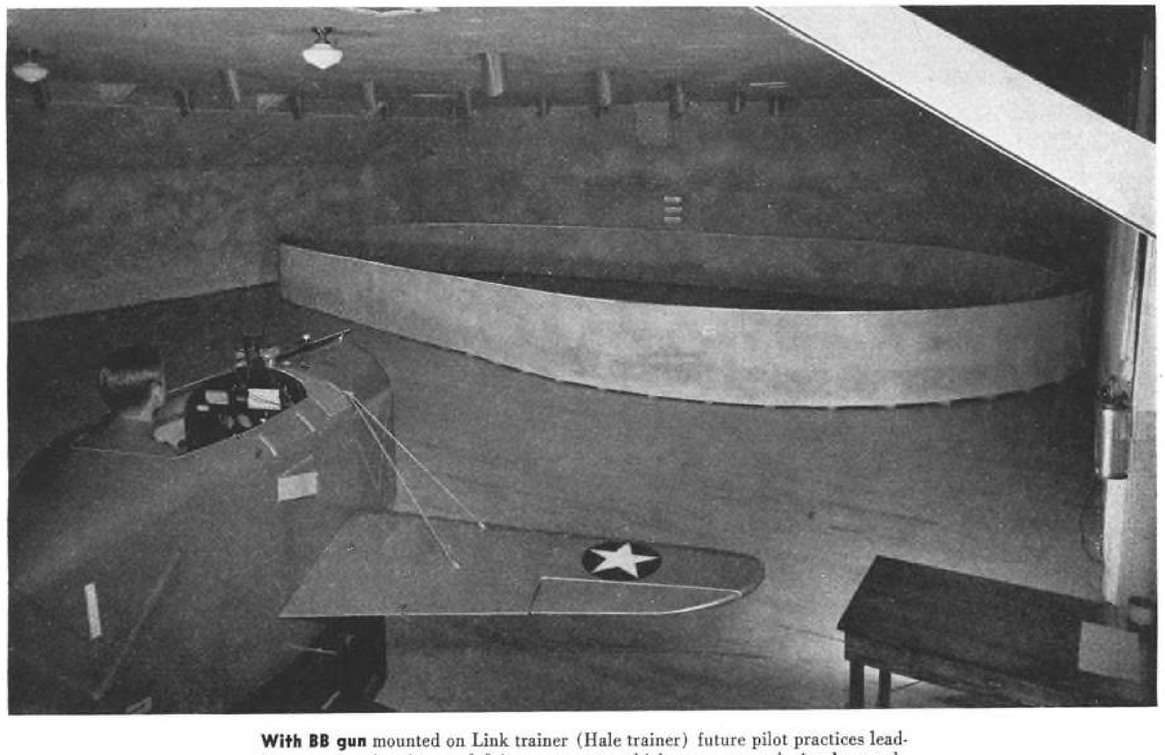
Theory and Practice

For five days after reporting to Eglin, cadets are occupied principally with ground school studies of theory and machine gun and sight maintenance and operation. During the six days they spend at one of the auxiliary fields, their time is filled with nothing but gunnery. First with an instructor and then alone, they take to the skies with loaded guns and head for a designated range. With five other planes in the range traffic pattern, they wheel and dive through 180-deg. attacks. Five or six runs on the towed target are made on each practice round aloft—the number depending on the amount of ammunition expended on each run. The target, a wire mesh rectangle 4x20 ft., is towed at 120 mph. while the attacking AT-6 comes in at approximately 160.

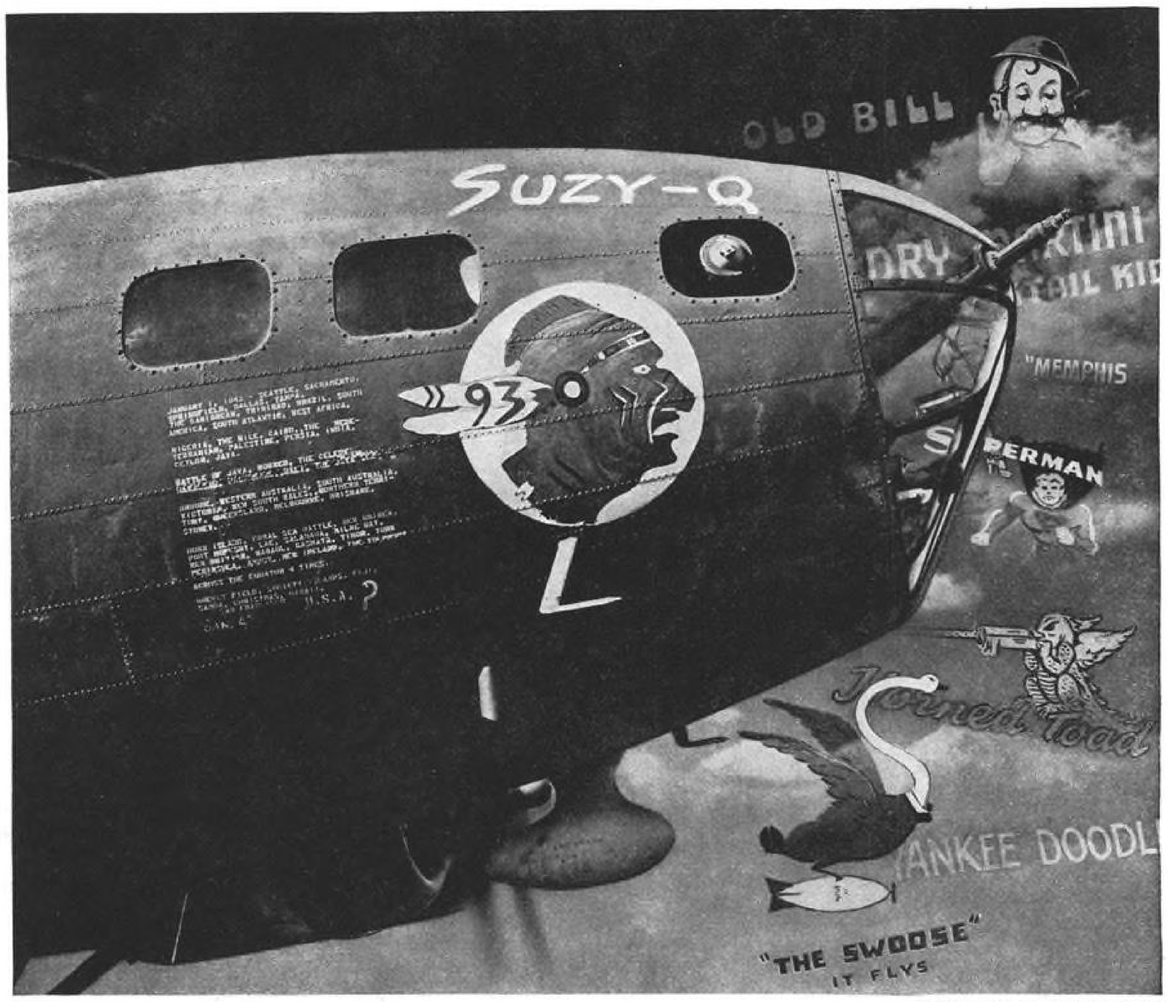
According to Lt. G. P. Charpie, operations officer at Auxiliary Field No. 2, the new student's most frequent error is to begin firing when he is still out of range, usually at 500 yd. Approximately 150 is the correct distance, giving the pilot time to fire a burst and then wing



Knowing how to knock down a gun and identify its parts is insurance for man who may have to make emergency repairs under fire.



With BB gun mounted on Link trainer (Hale trainer) future pilot practices leading, range estimation, and firing at targets which move around circular track.



Back the Attack — with War Bonds

Affection

As you read story after story about Boeing Flying Fortresses,* one thing is apt to impress you above all else . . . *and that is the deep-rooted affection which Fortress crews have for the sturdy ships which bring them back to their bases, time and again, from fierce battles with the enemy forces.*

Consider the case of the Fortress which fought off half a hundred Nazis for twenty minutes and then limped home with her left wing severely damaged, her inboard engine dead, and more than 2000 bullet holes in her tough hide. At the height of the action the skipper told his crew they could jump. "Sorry, sir," they called back over the interphone, "we're too busy shooting down Focke-Wulfs."

Or this, by another pilot: "We were traveling between 400 and 450 miles an hour. According to the slide rules, there was no chance of our pulling out of the dive. But we were goners if we didn't try. There were tearing noises; the bombs were crashing through the bottom. Then the Fortress came up level, and the wings were still with us! She's a great ship, and you know what I mean when I say GREAT!"

Back of stories like these, and the plane that inspires them, there *must* be designing and engineering and manufacturing skills of high degree. The Boeing engineering staff numbers over 3000 and includes men with experience in more than 25 distinct fields . . . structural, electrical, hydraulic, acoustical, metallurgical and many others.

Boeing products have consistently met or exceeded all claims made for them. True today, it will likewise be true tomorrow . . . if it's "Built by Boeing" it's bound to be good.

DESIGNERS OF THE FLYING FORTRESS • THE STRATOLINER • PAN AMERICAN CLIPPERS **BOEING**

*THE TERMS "FLYING FORTRESS" AND "STRATOLINER" ARE REGISTERED BOEING TRADE-MARKS



Over Gulf of Mexico, student aims at towed target with .30 cal. machine gun specially rigged in back pit of North American AT-6.



Proper distance between eye and sight of flexible gun for correct shooting is measured off with a string.

away before colliding with the target. A target-and-plane mix-up is not unusual, but no injuries or crashes have resulted from such tangles.

When class in the skies is over, the tow plane flies low over the landing area and drops its target. Later, the score for each cadet may be determined by the color fringing the bullet holes in the target, since ammunition in each plane is colored differently. When firing at targets on the ground, the cadet may gage his accuracy by the dirt he kicks up.

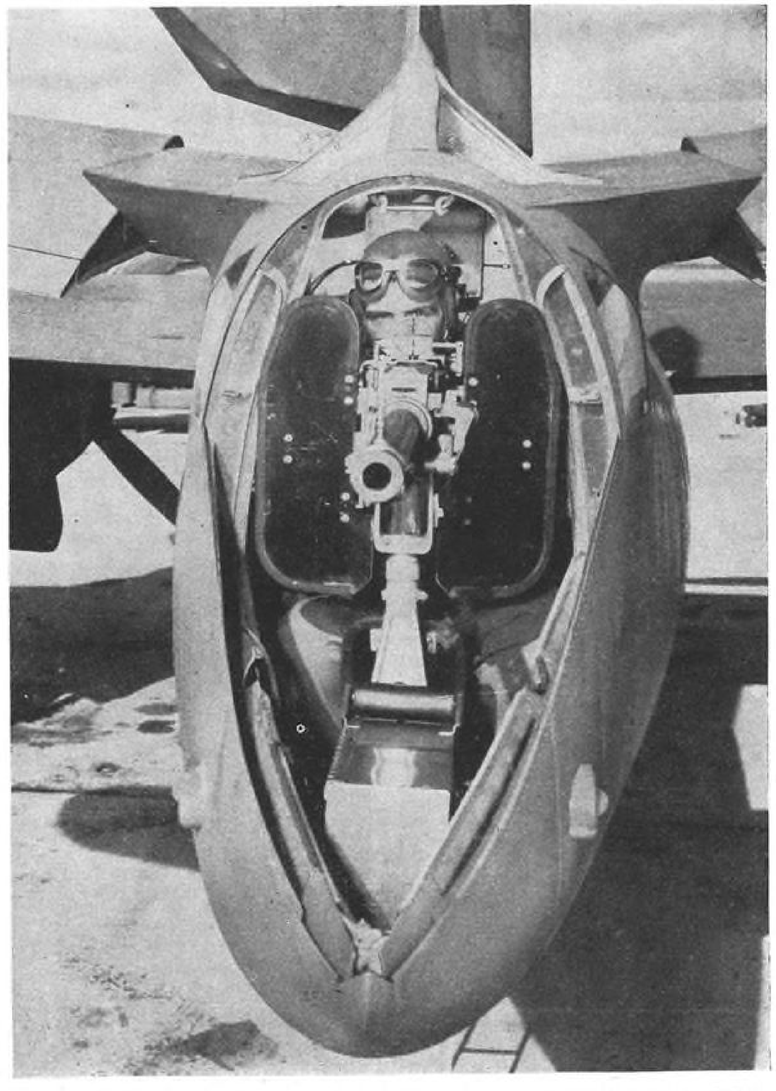
Faults in range estimation (the cadets get a thorough course in that at Eglin) and in judging relative lines of flight, in timing, and in "leading" are the most frequent errors encountered in training. However, when the cadet has fired a minimum of 1,300 rounds of ammunition for the course (and usually as many as 2,300 rounds) he has perfected the knack of spraying lead where he wants it.

The gunnery school officially began operations in 1941. Then cadets had an average of less than 1 percent of hits at the completion of their course. "Since that time, profiting from countless trial-and-error experiences and experiments," says Capt. Hemming, "we have perfected what we believe to be a significant efficiency of instruction."

(*Turn to page* 304)

ACCIDENTS DROP

Among the nearly 100,000 pilots being trained yearly by the AAF, the accident rate has dropped since Nov., 1942, although time spent in the air has nearly doubled, totaling 2,338,476 hr. this September. Percentage of present mishaps is not announced, but the number per thousand hours in the air has decreased from .045 in 1931 to .037 in 1942.



In B-26 tail turret student gunner takes sample aim before taking off for practice flight.

Don't Sell the Fixed Base Operator Short

. . . just because there's no war contract in his pocket. The adaptable "baseman" who knows the business isn't licked that easily. What's more, he can make money and project a future—as this case shows.

CAN FIXED BASE OPERATORS survive today without government contracts? Decidedly. In fact they can do better than that: They can make moderate profits and prepare themselves for continued—even expanded—operations after the Big Fuss is over.

To maintain such a position does, however, require adaptability, a lot of plain hard work, and a full share of the courage which any fixed base operator must have at any time. For excellent example, consider the operation provided by General Airmotive Corp. (at Cleveland Municipal Airport) whose experience offers some significant "hows" to other operators, many of whom face curtailment of flight training programs.

General Airmotive, organized in 1934 as a sales and service organization, immediately acquired a franchise for distribution of Wright engines, a franchise still held. The line was soon broadened to include Scintilla magnetos, Stromberg carburetors, BG, Bendix and Champion spark plugs, Eclipse starters, American Hammered piston rings, Packard Electric cable products, and, later, Lycoming engines and Sensenich Propellers.

Today, General Airmotive holds Government Certificate No. 272 for overhaul of composite and metal aircraft, engines, and metal and wood propellers. As a result of its steady expansion of facilities and services for private owners in the Great Lakes region, it boasts the most complete airplane and engine overhaul base between New York and Chicago.

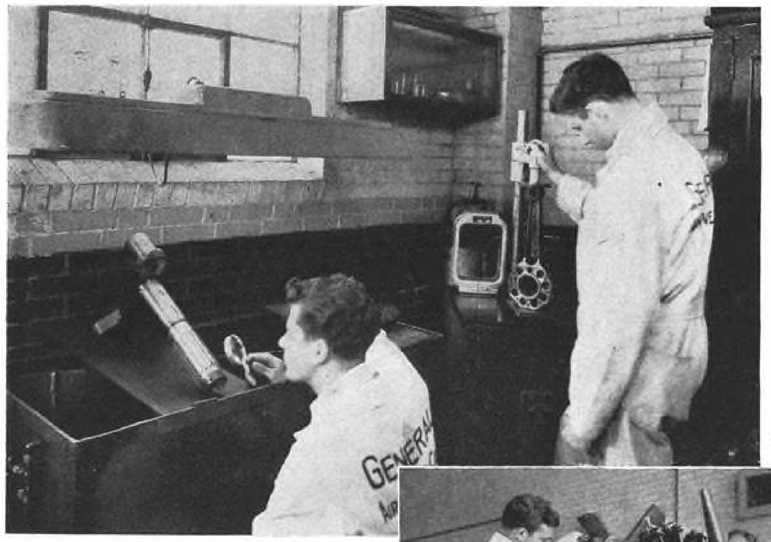
It has always been a policy—almost a fetish—of Airmotive's Pres. J. W. Borton to maintain the largest possible inventory of the complete line. This policy has stood the firm in good stead throughout its career, first because it gave the organization a reputation for ability to supply other operators with the parts they needed precisely when they were needed and, more recently, for ability to supply customers when all other sources had failed.

Not long ago, for instance, a Toledo manufacturing company which needed a special type of rivet in an emergency sent a plane to pick up the order. Other cases: Two Akron rubber companies that ran short of necessary cable and elastic nuts found them at Airmotive; a Cleveland aircraft plant which needed a timing disk located it at GAC; and a Cleveland aeronautical research laboratory was able to borrow special equipment that was necessary for an important experiment.

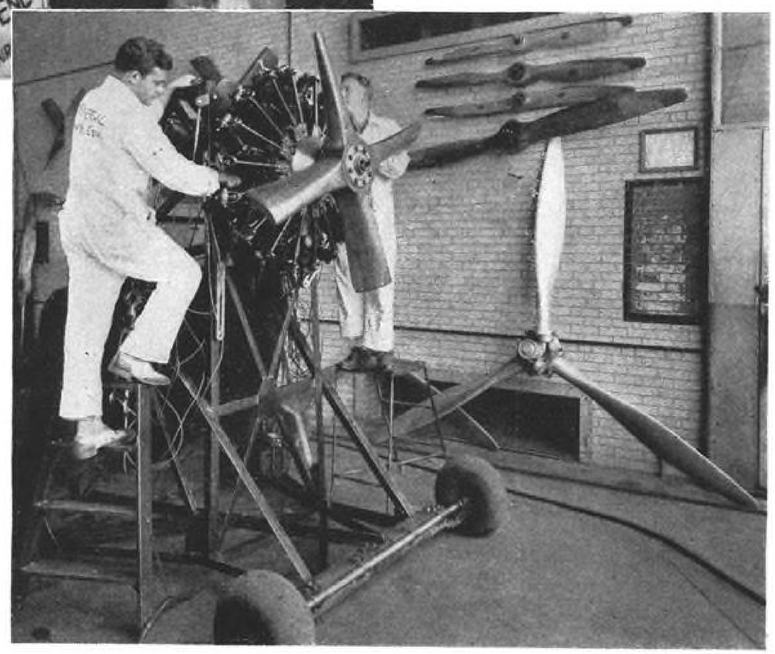
This type of operation has also given the firm a more or less official reputation as a jobber so that, if conditions in the future should warrant any change in this direction, they can easily be made, the "spade work" already having been done.

In keeping with the idea of large inventories and a wide range of products

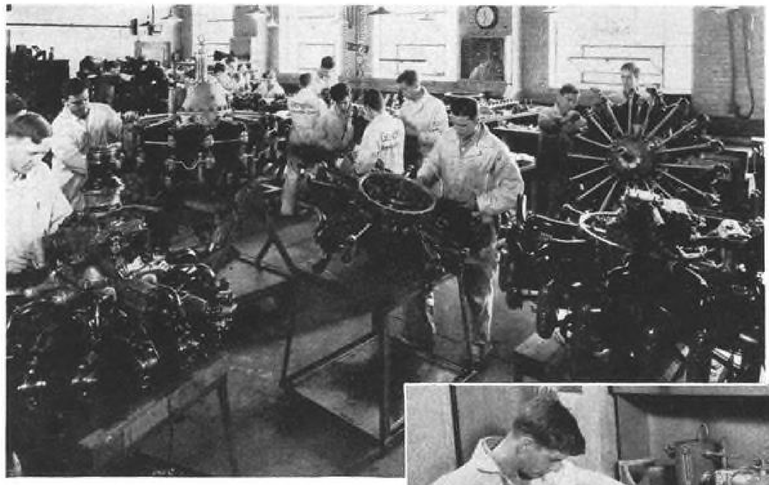
(*Turn to page* 299)



Success of General Airmotive's fixed base operations without government contracts has been due in large measure to wide line of products for sale coupled with ability to render specialized as well as general overhaul and maintenance service. Specialized service, in turn, has been greatly aided by addition of most modern equipment possible, such as this Magnaflux unit, first to go in operation in the firm's territory.

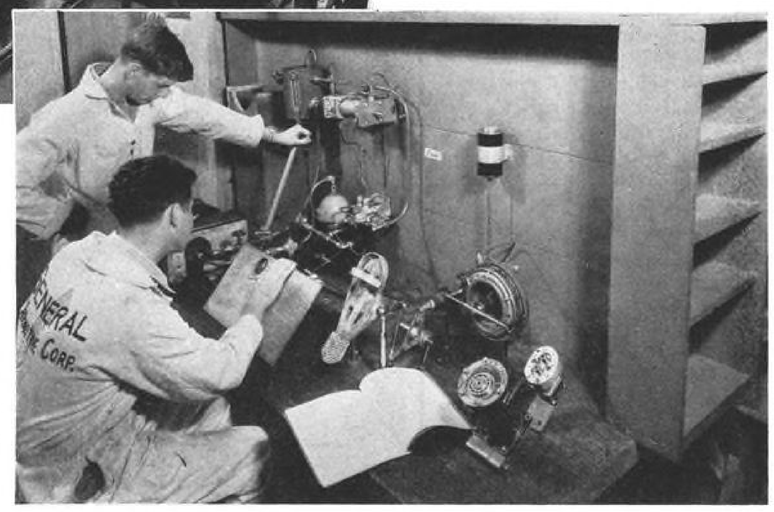


Engines coming from government-approved overhaul shop get run-ins on adjustable stand designed and built by GAC personnel. Wide variety of engine sizes and types can be handled through use of adjustable slot attaching points.

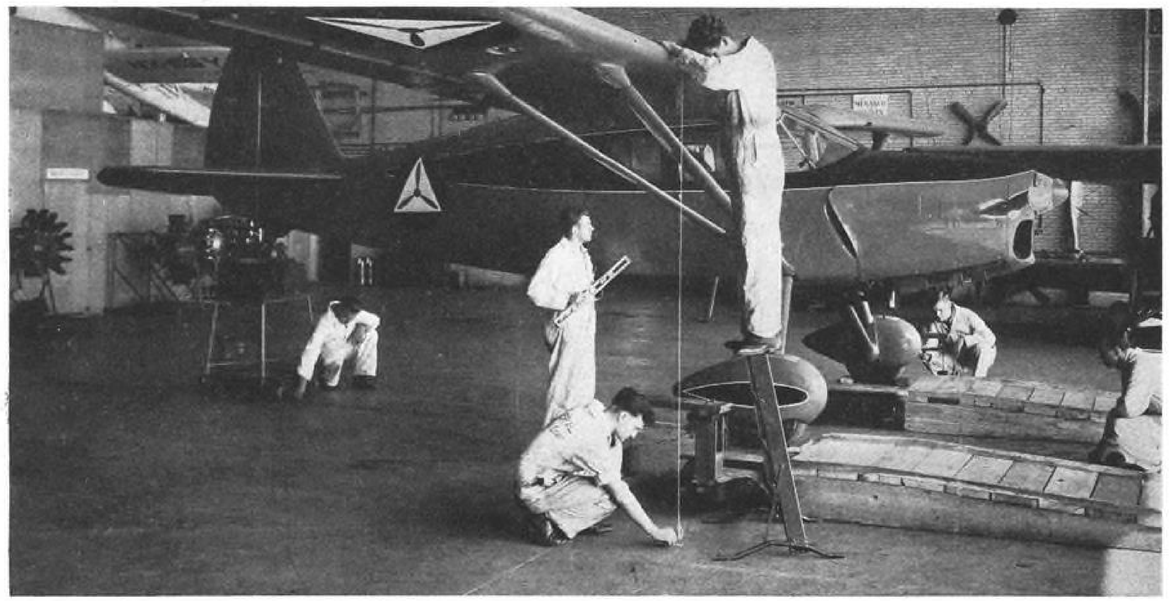


Students in company school spend 20 percent of time in classroom; remaining 80 percent in practical work on company-owned engines, ranging from 40 to 1,000 hp. GAC employees are selected from students, so some of these men may later service engines sold by firm, which is broadening line to be handled in postwar era.

CIVIL OPERATION AND TRAINING



Students study hydraulic theory and practice on test equipment built in GAC shops. More than 500 graduates and former students of school are in armed forces, and record shows 98 percent of graduates have passed CAA license examinations. Company's postwar emphasis will again be on sales and service of engines and accessories.



CAP Fairchild gets final check at GAC before taking to air after overhaul based on "airline standards for private aircraft owner." Company did service work for airlines early in its career; same may be done for feeder lines in postwar period.

WHY IS

Tego Resin Film

THE STANDARD AIRCRAFT PLYWOOD ADHESIVE?

THE introduction of TEGO Resin Film in 1935 changed entirely the concepts of aircraft designers and engineers concerning the qualities and uses of plywood in airplanes.

A phenol formaldehyde resin adhesive supplied in sheet form, TEGO made possible plywood having such improved service characteristics that TEGO-BONDED plywood became overnight an important structural material. In addition to giving unexcelled durability, TEGO Resin Film made plywood boil-proof, water-proof, weather-proof and fungus-proof. TEGO also revolutionized the manufacture of plywood—made possible the development of mass production methods.

That is why today TEGO Resin Film is the accepted standard in the manufacture of plywood not only for airplanes and airplane subassemblies but for PT boats, landing barges, Army truck bodies and prefabricated houses.



When interleaved with veneers of fine woods, then hot pressed, TEGO Resin Film forms panels which meet rigid Army and Navy Specifications for aeronautical plywood.

The Complete Line of Resin Adhesives

TEGO RESIN FILM, for hot-pressed plywood, produces the most durable plywood known, fully meet the requirements of Army-Navy Aeronautical Specification AN-NN-P-511-B.

AMBERLITE PR-14 is widely employed for rubber bag molded plywood filling the need for a powdered phenolic resin adhesive which possesses extreme water resistance and durability.

UFORMITE CB-551, a pioneer cold-setting urea formaldehyde resin complies in all respects with Army-Navy Aeronautical Specification AN-G-8, has proved an ideal bonding agent in assembling plywood aircraft sections.

UFORMITE 430 AND UFORMITE 500, for either hot-pressed or cold-setting plywood, give remarkably strong bond at relatively low cost.

THE RESINOUS PRODUCTS & CHEMICAL COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

On Patrol

• Airplane fabric and tape have been listed by WPB on first quarter 1944 repair parts applications, and distributors are being designated. Civil Air Patrol National Headquarters is informed that procedure is also being evolved for distribution of parachutes and parts.

• While CAP 2nd Air Force Courier completed 97 percent of its flights during the summer, headquarters warns that attempts to maintain such records in winter weather are foolish and may be fatal. "Unless it's a life-or-death mission—and few are as important as that—a flight with weather stacked against it is one to cancel. For a half-skilled pilot in an old klunker of a ship to give a look at the sky and take off over the hills is not heroism. It's just damned foolishness."

• St. Louis Women's Advertising Club has given the local squadron two Piper *Cubs* and an *Aeronca* for training members and cadets, who will have to pay only half the usual fees.

• Capt. Frank I. Adams is new communications officer at New York CAP headquarters.

• Otherwise qualified applicants who have been citizens of this country or the Philippines not less than ten years are now eligible for membership. Birth in Axis countries no longer excludes persons naturalized at least ten years.

• Practice hand grenades have been used by CAP flyers to scare ducks which have been desecrating California rice fields. When the ducks take wing, planes fly above them and shoo them to Wildlife Service feeding areas. Since the ducks can do 60 mph., flyers must keep on the *qui vive*.

• Indiana state guardsmen, returned from maneuvers with CAP, report that the pilots' good aim with flour bags resulted in hits on marching columns, trucks, and—alas—a cook tent.

Along the Apron

• Women graduates of the Ferry Command are now being taught to fly and maintain Boeing *Flying Fortresses*. The first 17 grads are practicing in Ohio.

• Thirty-one schools were used by Goodyear Aircraft to train new workers in a three-year expansion from 300 to 35,000. Percentage of women, already large, is expected to increase.

• More than 100 instructors and staff members of Embry-Riddle School of Aviation have left for Brazil to establish a school for training technical specialists. Following six-months' study, native students will be assigned positions by the Brazilian Air ministry for which the school is being run. By Christmas, 500 candidates are expected to be in training.

• Meanwhile, nearly all Brazilians who were studying in this country under the Inter-American Aviation Training Program (sponsored by CAA, AAF, and five other American organizations) have already been called home for military service. All but 11 of 351 students from other countries have graduated from four technical courses. Of 106 remaining here, 92 are engaged in aviation work. Out of another 259 pilot trainees, 168 have graduated. This is an average comparable to that established by American cadets.

• Summary of teaching courses, desirable curricula, and extent of present courses has been prepared by CAA in bulletin, *Education for the Air Age*. It points out that "ultimate adjustment of schools involves a clear recognition of the dual nature of the problem: The immediate effects of swift transportation, and the adjustments in society to be worked out over a longer period."

• "The breast-stroke, punctuated with preliminary splashings at the beginning of each stroke, will cut a path through the flames," explains AAF Flight Control Command in booklet, *Swimming Through Fire*. "Keep your mouth close to the water and duck your head every third or fourth stroke."

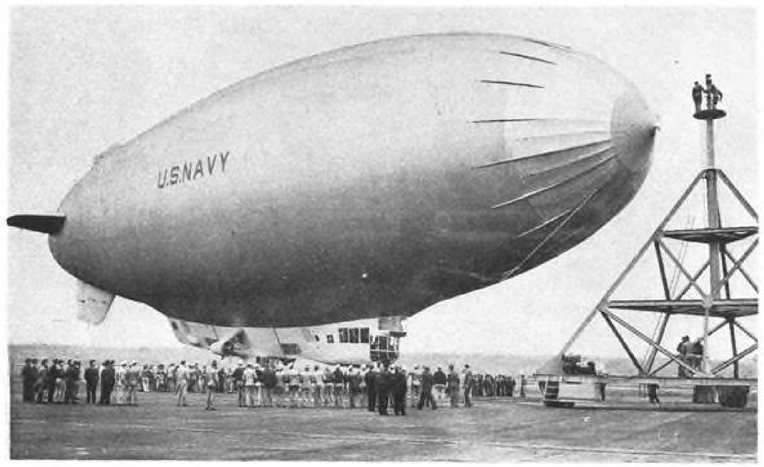
• New Courses: University of California Extension Div., "Work Simplification and Time Study", also training in avigation; Columbia University School of Engineering, advanced studies in various subjects for practicing engineers; Massachusetts Dept. of Education, pre-induction courses in aviation mathematics and camouflage, plus others in engines, structures and rigging, instruments, meteorology, and avigation.

CIVIL OPERATION AND TRAINING



FLYING SERVICE MAN

At controls of his 4-place Cessna, Edward M. Goemans, president of Transit Bus Sales, Milwaukee, covers territory from Lake Michigan to Denver in which he is a distributor for Ford buses. Occasionally he makes special flights with replacement parts for buses which are "down" on road.



M-1, newest and largest non-rigid airship built for Navy by Goodyear Aircraft Corp., begins test flight at Akron, Ohio. Half again as large as present anti-submarine patrol blimps, M-1 has greater cruising range and bomb-carrying capacity as well as additional gun mountings.

FLYING EQUIPMENT

Goodyear M-1 Blimp Begins Test Flights

Featuring novel three-section control car, new craft has 50 percent greater capacity and more range than predecessors.

UNDERGOING TEST FLIGHTS is the new M-1 "super-blimp" of 650,000 cu. ft. gas capacity. Built by Goodyear Aircraft Corp., it brings to four the number of types now being operated by the Navy.

Although the M-1's 290-ft. length is only some 40 ft. longer than the K-ships now being used on coastal patrol work, it has 50 percent greater helium capacity, which gives a substantial increase in cruising range and load. While no performance figures have been released by the Navy, the M-1 is reported to be faster than the K-type blimp.

Principal difference between the two craft is in the operating car. In the M-1 the car is three times as long as that in the older blimp. This new car is built in three connecting units which are integrated by universal joints to allow freedom of motion in coordination with the flexible gas envelope. A blister for machine gun mounting and wider observation is attached to the bottom of the mid-section of the car, on which are also mounted outriggers carrying two Pratt & Whitney *Wasps*. The M-1 craft is even larger than the Army's semi-rigid RS-1 built in 1924. Its 650,000 cu. ft. gas capacity compares with other Navy blimps as follows: L-type trainers, 123,000 cu. ft.; G-type trainers, 196,000; and K-type coastal patrol and escort ships, 425,000 cu. ft.

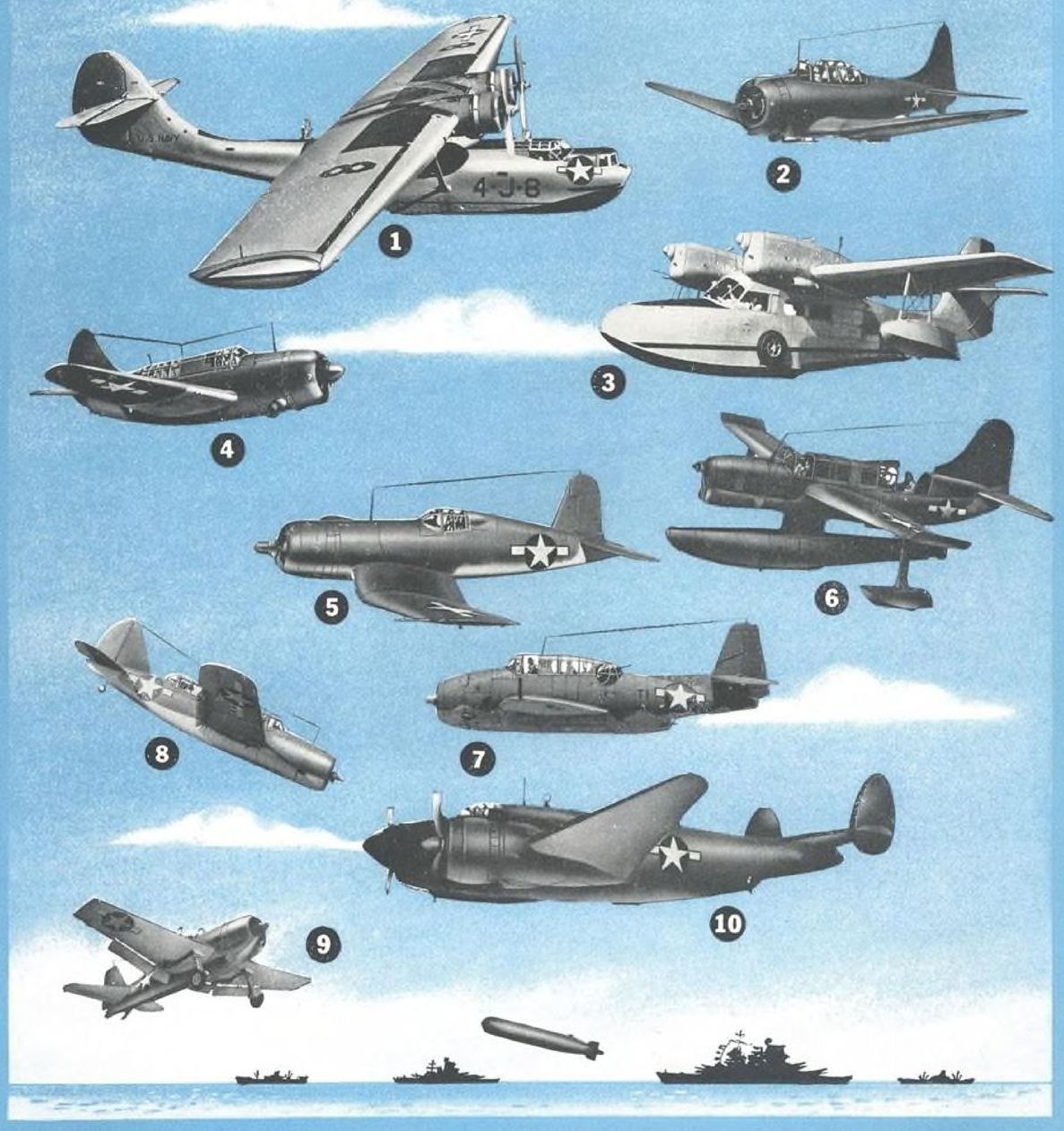


"TEEPEE AIRACOBRA" MAKES DEBUT



Bell TP-39 *Airacobra* (the "T" stands for two-place) developed for transition training. While not the first modification to provide instructor's seat in fighter craft, "Teepee" differs in that full extra set of controls and simplified instrument panel are included. Since engine is located just aft of pilot's cabin, extra seat had to be placed forward, which required removal of 37 mm. cannon, fuselage machine guns, and cowling. To maintain directional stability with extended cabin, dorsal fin was enlarged and small auxiliary fin was attached to fuselage bottom. Trainer model is interchangeable with production P-39, which can be transformed to trainer by installation of special kit of parts which can be made up and shipped anywhere. Photo at left shows special insignia developed for TP version.

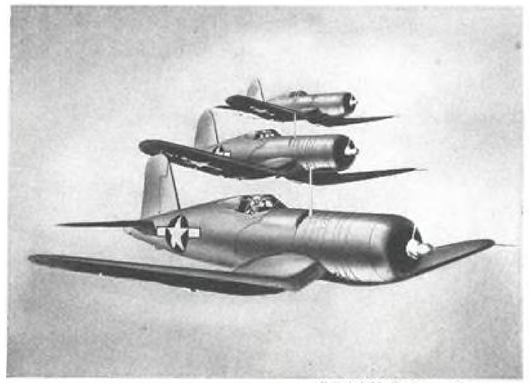
THE NAVY NEEDED LIGHTER, STRONGER TIRES...



UNITED STATES RUBBER COMPANY

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.

Heavier, Faster Navy Planes Demanded Lighter, Stronger Tires



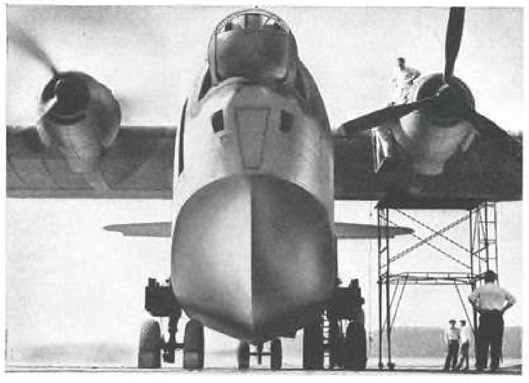
Official U S Navy Photograph

FIVE AND A HALF TONS of speed and fighting power hit a carrier's deck when the Vought Corsair lands. Tires have to take the "sock" of flight deck landing with minimum rebound, stand the high brake temperature of fast stops and track straight without dangerous skidding.



Official U S Navy Photograph

THE WHOLE WORLD IS HOME to the Consolidated Catalina. It roves the sea and land, may come down for a landing on sandy beaches, jungle landing strips, steel mats or concrete runways. Every ounce of weight counts. With cruising range of over 4000 miles, the tires of this giant amphibian must be light and strong.



FLYING BOATS NEED TIRES, TOO! At their bases, the big Navy flying boats must be beached for service and maintenance. Tires for beaching gear must be able to carry their great weight—are equipped with special valves so the gear can be applied under water.



"U. S." FIELD AIRPLANE TIRE ENGINEERS spend much of their time not only working with makers of Navy planes but also at Navy flying bases helping to work out tire problems wherever they are found. Airplane tire conservation and maintenance is an important part of their job.

Every Navy plane, from fast shipboard fighter to long-range patrol bomber has its own specialized tire problems. With weight of armor, fuel and ammunition load, speed, range and fire-power greatly increased, tires have to shoulder greater and greater loads. And every ounce of weight must mean more fighting power. The Navy needed lighter, stronger tires for its heavier, faster planes. This is the story of how those tires were built.

1230 SIXTH AVENUE **UNITED STATES**



From cotton to rayon to nylon has been the history of development of tires for military aircraft as airplane speeds and loads have been increased. "U. S." airplane tire engineers pioneered the rayon cord tire that cut down over-all weight and bulk without losing an ounce of the strength needed to support the increased load. Today rayon cord tires are the standard of the Service.

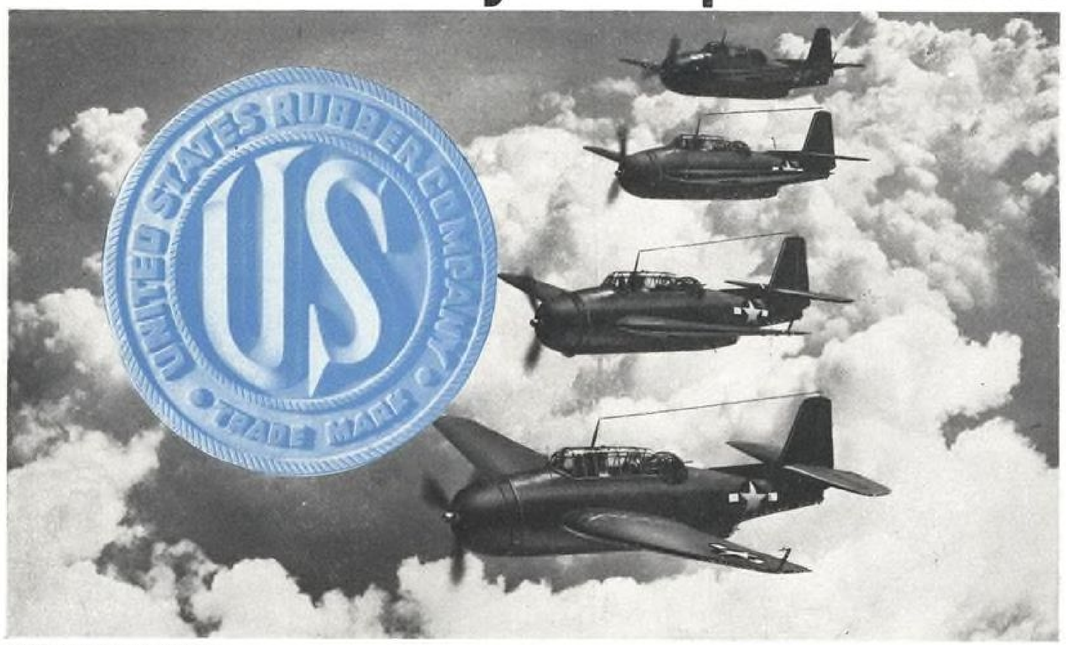
But tires of even greater strength and reduced weight were needed especially for heavy bombers. Over-all size could not be increased. Again it was a problem for the airplane tire engineers. Drawing on their experience with rayon cords, they developed a new tire built with nylon. Weight was reduced 16% from cotton cord tires and strength increased 64%! Today these giant Nylons are serving on Navy planes under the toughest landing and take-off conditions...they point the way to even stronger, lighter, better tires for the war planes and the peace planes of the future.

THE SHIPS ON THE COVER AND THE TIRE SIZES THEY USE

PLANE	MAIN WHEEL TIRE SIZE	TAIL WHEEL TIRE SIZE	PLANE	MAIN WHEEL TIRE SIZE	TAIL WHEEL TIRE SIZE
1 Consolidated "Catalina" PBY Amphibian—Scout Bomber	47" 10-ply Smooth Contour	30.00 Smooth Contour	6 Curtiss "Seagull" SO-3C Scout Observation Seaplane & Landplane	26x6 8-ply High Pressure	8.50 Solid or Channel
2 Douglas "Dauntless" SBD Scout Dive-Bomber	30x7 8-ply High Pressure	6x3½ Solid or Channel	7 Grumman "Avenger" TBF Torpedo Bomber	34x9 8-ply High Pressure	10x4 Solid or Channel Tread
3 Grumman J47 Coast Guard Amphibian	32x6 8-ply High Pressure	12.50 6-ply Smooth Contour	8 Brewster "Buccaneer" SB-2A Dive-Bomber	32x8 10-ply High Pressure	8½x4 Solid or Channel
4 Curtiss "Helldiver" Scout Dive-Bomber	Not Released	Not Released	9 Grumman "Hellcat" F6F Navy Fighter	Not Released	Not Released
5 Vought "Corsair" F4U Navy Fighter	32x8 8-ply High Pressure	8½x4 Solid or Channel	10 Vega "Ventura" Patrol Bomber	16.00-16 10-ply Low Pressure	18.00 6-ply Smooth Contour

RUBBER COMPANY ROCKEFELLER CENTER, NEW YORK 20

NAVY FLIERS "Hit the Deck" on these U. S. Royal Airplane Tires



Official U. S. Navy Photograph







Carrier-based planes must have tires that can take the toughest kind of service. They must absorb the shock of deck landings and hold the plane under control with minimum bounce. They must give sure traction on the carrier's deck or on the rough landing strip of an island outpost. U.S. Royal Airplane Tires are "hitting the decks" day after day... and coming back for more. Whatever your airplane tire requirements may be, there is a U.S. Royal Airplane Tire, with the new Static Conducting Construction, built to do the job.

UNITED STATES RUBBER COMPANY

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Products & Practices

INFORMATION TIPS

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 invaluable 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

Pipe, Tube Bending 1

Copper & Brass Research Assn., New York City, has issued 80-page illustrated book on methods of hot and cold bending of copper and alloy pipes and tubes including use of mandrels and such fillers as sand, resin, salt, and low-temperature melting alloys. Other information given includes unit weights of tubes of different alloys and various diameters, wall thickness, and shapes and data on chemical and physical properties.

Lathes 2

Engineering data book, prepared by Foster Div., International Machine Tool Corp., Elkhart, Ind., contains descriptions and specifications of standard and special tools for company's turret and platen lathes. Drawings and dimensions are provided for mechanics and engineers engaged in parts production.

Slide Chart 3

Elemoto Sales Co., Teaneck, N. J., issues folder picturing and describing its slide chart for obtaining standard dimensions from 0 to 1¾ in. for coarse and fine threads, for standard pipe threads, and for converting from millimeters to inches.

Metal Finishing 4

Folders and technical data sheets from American Chemical Paint Co., Ambler, Pa., picture and describe uses and method of applying company's "deoxidine" for preparing metal surfaces for painting, "kemick" paint for hot surfaces such as engine parts, "lithoform" for making paint adhere to galvanized and other zinc surfaces, and "rodine" for more efficient pickling of steel.

Hydraulic Fittings 5

Engineering drawings, part and tube numbers, dimensions and thread sizes of hydraulic fittings in AAF, AN, and NAF series are compiled in ring-bound booklet issued by American Screw Products, Los Angeles.

Steel Welding 6

Striking colored illustrations and photographs are contained in booklet titled *Welding Stainless Steels*, which covers effects of heat, metallic arc, atomic hydrogen, oxygen-acetylene, and electric resistance welding, and general information on welding pluramelt steels. It is distributed by Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Tooling Service 7

Complete aircraft tooling service, which its staff of 300 has supplied for production of new models by several manufacturers, is described in bulletin by Atlas Tool & Designing Co., Philadelphia. Services offered cover executive and engineering consultation, production engineering design and blue printing, manufacture of tools, dies, jigs, and special machinery, with follow-through supervision.

NE Steels 8

Components, characteristics, and specifications of National Emergency Steels are given in tables, illustrations, and text in booklet prepared by Republic Steel Corp., Cleveland.

Pulleys 9

Blueprints, photos, and engineering information on the use of its pulleys in various types of machine drives are contained in bulletin issued by Speedmaster Co., Des Plaines, Ill.

Plywood Specifications 10

Government Specifications for Plywood and Adhesives, available through Resinous Products & Chemical Co., Philadelphia, gives adhesives requirements, test procedure, and adhesives recommended in 27 specifications classified under the basic specifications of cold-setting resin glue, plywood and veneer (aircraft flat panel), hardwood and eastern red cedar plywood, and Douglas fir plywood.

Die Designing 11

Reprint of engineering article on *Factors to be Considered When Designing Die-Castings* is being distributed by New Jersey Zinc Co., New York City. It presents an analysis of suitable materials and suggestions on their fabrication.

PRODUCTION

Welding Hints 12

Current issue of *Oxy-Acetylene Tips*, published by Linde Air Products Co., New York City, contains articles on saving welding rod stubs, preventing worker injuries and avoiding fatigue, prolonging life of cutting regulators, and tabulations of recommendations for gas welding of various metals.

Lignum-Vitae 13

Examples of wartime uses of lignum-vitae in industry are given in bulletin from Lignum-Vitae Products Corp., Jersey City, N. J.

Glues 14

Use of waterproof glues in aircraft construction and descriptions of binders made by I. F. Laucks, Inc., Seattle, to meet government specifications are listed in illustrated brochure which also contains a section on wood preservatives.

Hardening, Pressing 15

Hydraulic Machinery, Inc., Detroit, has compiled in bulletins SM 843 and PT 845 information and illustrations of its equipment for flame hardening, hydraulic press

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NEW PRODUCTS:														
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INFORMATION TIPS

work, molding, bending, broaching, two-way drilling, piercing, and spot facing.

Hose Couplers 16

Features of "Snap-Tite" hose couplers reported by Snap-Tite Coupler Co., Erie, Pa., are threadless connection that can be made with a twist of the wrist, swivel ball bearing to prevent kinks, and packing designed for various types of service. Specifications of models provided for steam, air, water, oil, and grease lines are listed in folder.

Small Parts 17

Its facilities for producing small parts and accessories for aircraft—among them clips and clamps, manual control assemblies, fork and rod ends, and small stampings—are described in booklet issued by Hyland Machine Co., Dayton, Ohio.

Tubing 18

Aircraft Tubing Manual shows various fittings manufactured by Tubing Seal-Cap, Inc., Los Angeles, describes types of tubing and fittings in use, how to obtain proper torque, and a list of points to be remembered in installing tubing.

Weld Shop Fire Reduction 19

Preventing Welding and Cutting Fires, pocket-size booklet prepared by International Acetylene Assn., New York City, gives foremen and operators practical information on causes and reduction of fires.

Greases 20

What Makes a Grease, booklet offered by Sun Oil Co., Philadelphia, discusses standards for judging types of greases, factors which should control selection, and types manufactured and consulting service offered by company.

MACHINERY & ACCESSORIES

Grinding Wheels 21

Tool and cutter and surfacing recommendations for various wheels and grinding materials produced by Bay State Abrasive Products Co., Westboro, Mass., are given in illustrated folder published by company.

Abrasives 22

Minnesota Mining & Mfg. Co., St. Paul, issues manual, *3-M Abrasive Specialty Items*, picturing its line of shapes and forms for grinding and finishing metals.

Handling Equipment 23

Circular No 134 presents line of hydraulic lift, pallet, die handling, hoisting, and sheet handling trucks, hydraulic hand- and foot-operated pumps, and aircraft production and servicing equipment manufactured by Lyon-Raymond Corp., Greene, N. Y.

Portable Cleaners 24

Broadside prepared by L & R Mfg. Co., Newark, N. J., illustrates portable machine for cleaning, rinsing, polishing, and drying small precision parts.

Anti-Corrosion Wrapper 25

"Induwrap," material for wrapping highly finished steel and other metal parts consists of four plys: Kraft paper, sheet of cellulose acetate to retain protective oil film, a binder (to unite the inner material to the outer layers), and a 30-lb. neutral sulphate kraft sheet which inhibits corrosion. Sulphate sheet is slightly corrugated to give channels through which moisture may evaporate. It is made by Angier Corp., Framingham, Mass.

Alloy Tools 26

Catalog No. 227 on "Tantung" tools—trade name for non-ferrous cast alloy for metal cutting between grades now obtained with high speed steel and cemented carbides—lists sizes available and prices on solid tool bits, cut-off and milling cutter blades, shell and solid end mills, and boring and form tools. Also given by manufacturer, Vascoloy-Ramet Corp., North Chicago, are performance and screw machine data and information on grinding and brazing.

Agitators 27

Pictures, prices, and descriptions of various types of air-motor agitators for mixing liquids, such as engine oils, are contained in bulletin, *Pneumix in Action*, prepared by Eclipse Air Brush Co., Newark, N. J.

Record Reproduction 28

Copying of office and shop records, engineering diagrams, and blue prints is said to be possible without need of darkroom, camera, or focusing with machine developed by Hunter Electro-Copyist, Inc., Syracuse, N. Y. Various models of reproducers, with specifications and accessories, are shown in bulletin prepared by the company.

Rotameters 29

Catalog section 13-D, offered by Fischer & Porter Co., Hatboro, Pa., shows new rotameter instrument panels for testing and control in flow rate instruments and other models for low-capacity service.

Work Light 30

Designed by Diehl Mfg. Co., Somerville, N. J., new work light for use in inspection, assembly, sorting, and precision machine work has blue-tinted lens and 6-8 v. bulb connected to regular voltage circuit through a transformer. Applications and other features are shown in bulletin No. 2031 from company.

Testers 31

Described and illustrated in 48-page catalog prepared by Televiso Products, Chicago, are various models of test apparatus to check aircraft gyros, vibration, and electric and mechanical laboratory and production work

Die Set 32

Improved "link pivot" to absorb stresses on its aligning spring has been added to self-balancing die set manufactured by Leslie Welding Co., Chicago. Engineering drawings and text in folder show its uses and principles of operation.

Precision Cutting 33

Picture story in booklet prepared by The Doall Co., Des Plaines, Ill., shows war production jobs on which its various machines for precision band sawing, band filing, and polishing have been used.

Wrench Catalog 34

Glossary of terms for new workers is contained in catalog No. 243 of Blackhawk Mfg. Co., Millwaukee. It also gives list of wrenches now available and suggestions of types for particular production jobs.

Precisioning Equipment 35

New edition of Catalog No. 836, Challenge Machinery Co., Grand Haven, Mich., contains illustrations, descriptions, and specifications of company's equipment for precision work, including layout surface plates, reading, checking, and turn tables, work benches, bench and lapping plates, straight edges, angle irons and plates, solid and box parallels, and V-blocks.

Parts Finishing Machines 36

Machine tools for drilling, reaming, chamfering and other production operations on various parts of aircraft engines, are pictured and described in Vol. 18, No. 4 of *Tool Tips*, bulletin issued by Ex-Cell-O Corp, Detroit.

Cleaners 37

Various types and sizes of machines for cleaning, pickling, and washing metal parts, chip processing, tumbling, and burnishing are shown in 32-page catalog distributed by Howard Engineering & Mfg. Co., Cincinnati.

Diamond Tools 38

Wheels, saw blades, core bits, and other diamond-pointed tools marketed by Champion Diamond Co, New York City, are pictured in folder which gives their specifications and prices.

Identification Printers 39

York Electric and Machine Co, York, Pa., has prepared two folders showing the features and operating principles of its hot stamp printer for marking wire from No. 0 to No. 22 and of its scotch tape marker. Identification printing type is easily changed in both machines, and the hot stamp model can be adjusted to mark on from 3 to 12 in. centers.

Micrometers 40

Readings to 1/10,000 in. are reported possible on micrometers up to 3-in. capacity. Bulletin showing models in Reed 800 series has been issued by George Scherr Co, New York City.

Finishing Machinery 41

Bulletin No. 401 has been prepared by Hammond Machinery Builders, Kalamazoo, Mich., to show engine and machine parts which can be automatically deburred, brushed, polished, or buffed on several models of its machines. Table of specifications gives capacities of six and eight work-spindle models.

AIRCRAFT ACCESSORIES

Brake Servicing 42

Barrett Equipment Co., St. Louis, has prepared folder showing details of its model B-117 machine for servicing brake shoes and adjusting them to drum size.

Insignia 43

Bulletin prepared by Di-Noc Mfg. Co., Cleveland, deals with its prefabricated film insignia for aircraft identification and the marking of operating instructions on various controls. Given is brief resume of specifications and method of applying the insignia, which are said to stand bending over ⅛ in. rod without fracturing.

Starters 44

Installation and advantages of light weight kick type starters for use on small planes are given in folder from McDowell Mfg. Co., Pittsburgh.

To Curb Fires 45

Use of carbon dioxide as a fire extinguisher in aircraft is illustrated in current edition of *High Pressure*, publication of Walter Kidde & Co., New York City.

ELECTRICAL

Motors 46

Material on power issued by General Electric Co., Schenectady, N. Y., includes *Motor Fitness Manual*, 40-page booklet of engineering suggestions on efficient installation and maintenance of factory motors, and the "Motorule," a cardboard, slide rule type calculator for determining horsepower required for various metal cutting operations.

Circuit Tester 47

For testing circuits in all types of electronic equipment, new unit capable of checking one circuit per second on resistances as low as .001 ohms is described in folder from Communication Measurements Laboratory, New York City

X-Ray Inspection 48

Features of small, enclosed X-ray machine for inspecting small parts and assemblies, light alloy castings, plastics, and rubber products are listed in folder distributed by North American Philips Co., New York City

MANAGEMENT & EMPLOYEES

Copper Mills 49

To aid manufacturers in placing orders for copper and brass products, Aircraft Scheduling Unit, Wright Field, has issued list of 71 mills from which these materials may be obtained.

Pensions, Bonuses 50

Chase National Bank, New York City, has prepared 92-page analysis of pension, bonus, and profit-sharing plans.

Woman Worker Safeguards 51

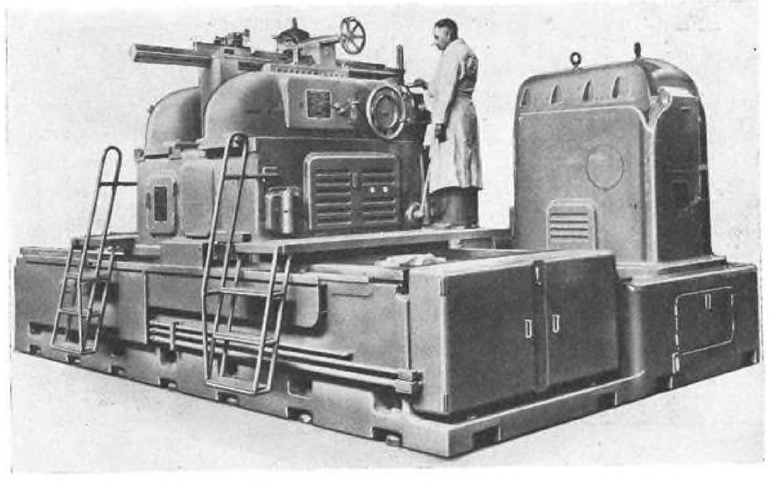
Review of methods for making women employees safety-conscious — including movies, lectures, posters, and attractive uniforms—is given in *Safeguarding the Woman Employee*, a report compiled by Policyholders Service Bureau, Metropolitan Life Insurance Co., New York City.

Latest Machine Tools

NEW PRODUCTS

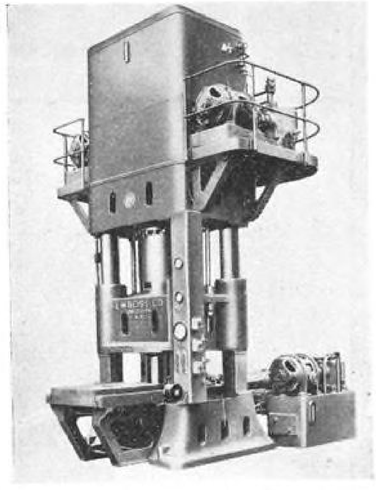
Gear Shaver 52

Announced as largest of type, machine designed for rotary crossed-axes gear shaving has maximum range from headstock spindle of 110½ in. and stands nearly 11 ft. high on a base 20x12 ft. 11 in. Its capacity is from 24 to 96 in. pitch dia. and up to 97 in. o.d. Vernier scale on cutter head and sine bar permit settings of any desired angle and accurate duplication on subsequent work. Cutting tool is driven by the work gear which can be checked without being removed from machine. Work gear (not shown in photo) is mounted on journal bearings and adjustable pedestals; its size, linear pitch, wobble, eccentricity, and pitch diameter can be determined by the chucking head. Headstock and cutter head are self-contained units, each with its own motor. Pre-selector controls amount of feed of cutter head slide across face of work gear and cutting cycle can be automatically or manually controlled. Pressure lubrication is supplied to all parts, and lubricant reservoirs have sight gages. Control stations on both sides of machine have master stops, saddle feed selectors, coolant and headstock controls, and forward and reverse regulators. Lights indicate when saddle is in feed and in which direction. At base of work headstock, says manufacturer, **National Broach and Machine Co.**, Detroit, is third control station with master stop and button to jog work spindle.—AVIATION, *Dec.*, '43

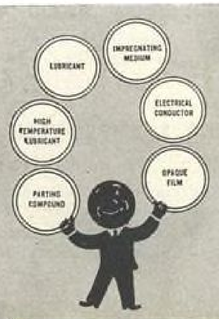


Forging Press 53

Hydraulic forging press of 1,000 ton capacity with 35-ton ejector and sliding die table has four controls for main



slide: 1. semi-automatic through one cycle; 2. full automatic until stop button is pressed; 3. jogging; and 4. inch-



"LET'S GET ON WITH THE WAR"
these free booklets will help . . .

Mr. DAG

These 5 free booklets on dag colloidal graphite can help you in more ways than one. Each covers a different use or group of uses for dag products in industry. If you haven't used dag colloidal graphite or don't know all these uses meet Mr. dag today by writing for one or more of the booklets. Just clip the coupon.



ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY

Lists 10 advantages of adding **dag** colloidal graphite to liquid lubricants for these operations and tells why with photographs, charts, and simple, non-technical text.

BULLETIN No. 421

PARTING COMPOUNDS



Tells how **dag** dispersions prevent objectionable freezing, rusting or sticking together of metals and other materials. Cites use on screw threads, lamp bulbs, aviation and driving equipment; also in glass, rubber and foundry industries.

BULLETIN No. 422



HIGH TEMPERATURE LUBRICATION

How **dag** colloidal graphite takes over when the going gets too hot for conventional liquid lubricants. Gives examples in forging, oven conveyors, kiln cars, bottle and die casting machines, etc.

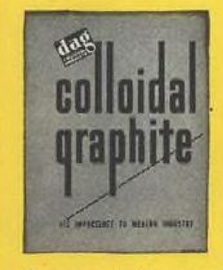
BULLETIN No. 423

"dag" COLLOIDAL GRAPHITE FOR IMPREGNATION AND SURFACE COATING



of textiles, asbestos, felt, abrasives, porous metals, paper, wood, etc. to impart lubrication properties, electrical conductivity, opacity, color, or other desirable qualities.

BULLETIN No. 431



GENERAL BOOKLET

The story of **dag** colloidal graphite. 12 pages fully illustrated. Gives the how and why of colloidalization, explains the various liquid carriers and suggests dozens of places where **dag** dispersions can speed up production.

BULLETIN No. 430

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION
Port Huron, Michigan

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No. 421 ☐ NAME_____
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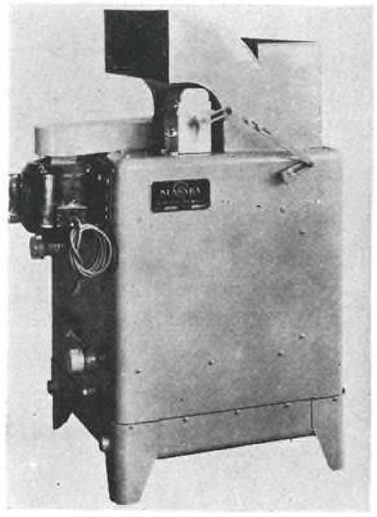
(Lubricants containing **dag** colloidal graphite are available from major oil companies.) Dept. H.

"dag" is the registered trademark of Acheson Colloids Corporation

ing. Separate pump works die slide and ejector. **E. W. Bliss Co.**, Brooklyn, N. Y., reports that 150 hp. pump gives quick advance speed of 750 in./min., pressing 37 in./min., and return 725 in./min. (units with faster speeds are available). Models are manufactured in capacity to 1,500 tons. Interlocked electrical circuits permit press, die, slide, and ejector to operate only at proper time, according to the company.—AVIATION, *Dec.*, '43.

Air Cooler 54

To produce cooler and thus dryer compressed air which will reduce water damage to pneumatic equipment, **Niagara Blower Co.**, New York City, has devised after-cooler operating on evaporation principle. Coils containing compressed air are cooled by a fan which blows through a water spray. Designed to produce compressed air with 50 to 75 percent less water at temperatures from 10 to 25 deg. lower than usual, machine, it is reported by manufacturer, can also be used with gases.—AVIATION, *Dec.*, '43.



● Announcements of new machine tools, shop equipment, and accessories are invited for inclusion in these columns. In writing, emphasis upon aviation industry applications of newly-marketed items is desirable, and wherever possible, glossy-print photos should be enclosed for illustration. Manufacturers should address New Products Editor, AVIATION, 330 W. 42nd St., New York City.

LIGHT
CLOSE TO THE WORK



Better lighting is a "must" in industry today—a means of attaining smoother, faster production after every other production aid has added its push.

BullDog Universal Trol-E-Duct makes possible that better lighting—brings the light right to the work—makes it easy to move or rearrange lights, or entire lighting systems, at any time and without interfering with production.

UNIVERSAL Trol-E-Duct

POWER
CLOSE TO THE TOOL



Don't waste valuable production time while workers look for power outlets for portable tools. Don't risk accidents due to tripping over long cords, or shorting tangled cables.

Bring the power right to the job with BullDog Industrial Trol-E-Duct — the system that not only furnishes mobile power, but also support, for portable tools.

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MANUFACTURERS OF a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Breakers and BUStribution SYSTEMS.

● ● ●

You SAVE What You SPEND for WAR BONDS

BullDog Universal Trol-E-Duct *for light*, and Industrial Trol-E-Duct *for mobile power*, are both furnished in standardized, interchangeable sections. Both are completely salvable, suitable for quick removal to a new department or to a new plant.

Ask for complete illustrated bulletins Nos. 425 and 407, describing these two time and money saving, production speeding, BullDog systems.



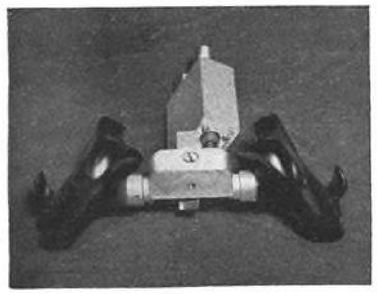
FLEETWINGS BUILDS A PLACE IN TOMORROW

Fleetwings, whose products are everywhere contributing to victory, is busy on a full time job. In part, the invincibility of the Flying Fortress; the sting of the Douglas Havoc and the speed of the Vought Corsair are attributable to Fleetwings' airminded production. For Fleetwings is concerned, right now. with the manufacture of tail assemblies, flaps, wings, rudders, hydraulic valves, etc. for these and other fighting aircraft. The many years of pioneering, experimentation and development have fitted Fleetwings for this work . . . provided, also, a background of leadership in the aviation industry . . . assured Fleetwings of a dominant role in the air story to be written after the war.

Plant No 1

FLEETWINGS
Division of Kaiser Cargo, Inc.
BRISTOL • PENNSYLVANIA

FLEETWINGS
pioneers with parts and hydraulic equipment



Fleetwings B2 J2 Gun Turret Valve

PRODUCTION SHORTCUT A special tool for spinning a radius on aluminum tubing ends has been developed by an alert Fleetwinger. With it, tubing can be fed continuously through the lathe shaft, turret-cut to length and spun to a more perfect radius with a special ball-bearing spinning tool-wheel. The operation eliminates several time-consuming operations including separate chucking of pre-cut tube ends.

FLEETWINGS HYDRAULIC ACTUATING CYLINDER There are many applications for this versatile plane part. Its most common use is the operating of wing flaps. The cylinder is designed with O ring packing and a piston scraper ring. These prevent leakage and remove foreign matter from the piston surface respectively. Bosses are threaded to latest A N specifications. The cylinder will actuate at all temperature extremes and has an operating pressure of fifteen hundred psi.

THE ARROW, Fleetwings' pocket-size monthly magazine, is filled with "plane" talk for airminded people. Rather than just a house organ for Fleetwings employes, the ARROW is fast becoming a goodwill ambassador for the workers it represents. In any one issue, you can find enough news and production hints to reward you handsomely for the time you spend in writing for your copy. Send your request on your company stationery to: THE ARROW, Fleetwings, Division of Kaiser Cargo, Inc., Bristol, Pa.



FLEETWINGS
Division of Kaiser Cargo, Inc.
BRISTOL • PENNSYLVANIA

Shop Equipment and Accessories

NEW PRODUCTS

Hand Riveter 55

R. Decat, Elmhurst, L. I., N. Y., announces light-weight cast aluminum hand riveter weighing 3¾ lb. which will upset 1,200 rivets per hr. Rivets employed are reported to withstand 100 lb. pressure,



to have positive side expansion of .030 in. to fill holes drilled as much as .005 oversize, and to have passed vibration tests of 100,000,000 cycles in temperature range of −20 deg. C. to +80 deg. C. Rivets are contained in mandrel in barrel. Turning crank, connected through cam and gear, exerts 1,000 lb. pressure.—AVIATION, *Dec.*, '43.

Map-Globe 56

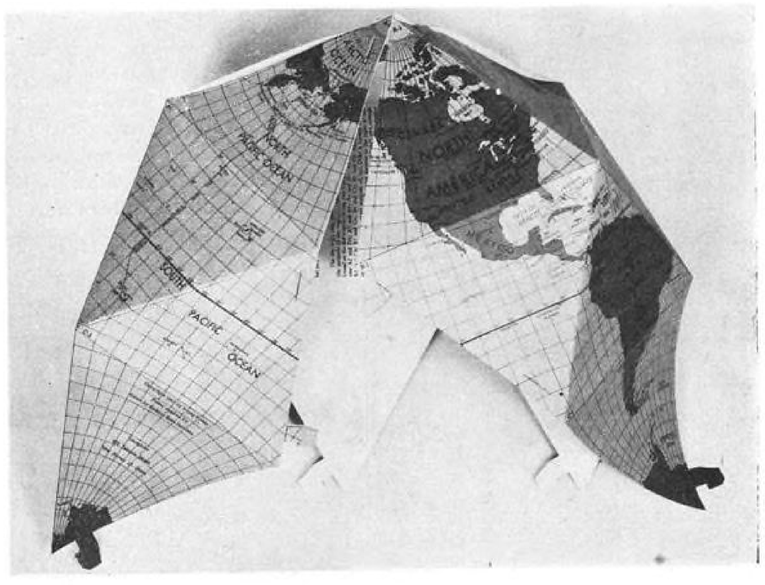
World map which can be folded into globe with minimum geographical distortion has been devised by Prof. Irving Fisher of Yale and is being sold by **Likaglobe**, New Haven, Conn. It is available for flat use and for folding into 20-sided globe. Large size is available in two-colors with markings of principal places.—AVIATION, *Dec.*, '43.

Service Stand 57

Aircraft service stand, adjustable from 13 to 20 ft., has capacity of 1,500 lb., double acting hand pump, and



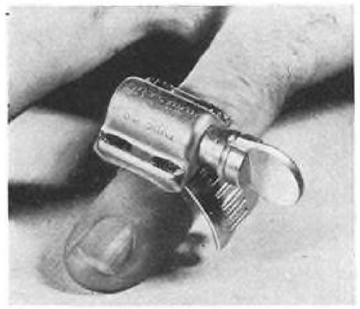
tubular steel base which can be knocked down for shipping. Stand rolls on four casters of 8 in. dia. and is leveled and



steadied when in position by four screws and floor pads. It occupies floor space 10x14 ft., says maker, **Pacific Engineering Corp.**, Los Angeles, and weighs about 1,275 lb.—AVIATION, *Dec.*, '43.

Hose Clamps 58

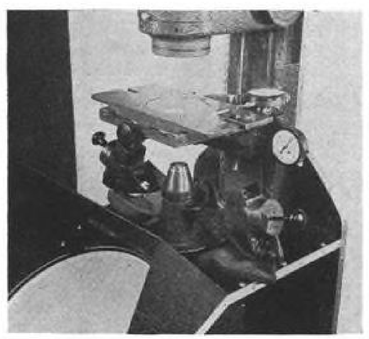
Two new model hose clamps added to line of **Aircraft Standard Parts Co.**, Rockford, Ill., increase to 16 company's line for aircraft hose sizes from ¼ in. to 4 in. i.d. Take-up mechanism con-



sists of spring-steel strip perforated to fit into worm gear. Thumb screw can tighten larger sizes as much as 1 in. dia. Worm gear arrangement eliminates need for lock wire and is reported to withstand considerable vibration.—AVIATION, *Dec.*, '43.

Optical Comparator 59

Larger coordinate stage for greater mechanical capacity and larger faces on dial indicators are features of model P2-14 optical comparator being marketed by **Portman Machine Tool Co.**, New Rochelle, N. Y. Magnification lenses are available in strengths of 10X, 31¼X, 50X, 62½X, and 100X. Blower cools lamp assembly which includes larger con-



denser lens and adjustment for beam. Image screen is 14½ in. dia., weight about 400 lb., height 60 in., and floor space occupied 24x30 in.—AVIATION, *Dec.*, '43.

Clip Assembler..... 60

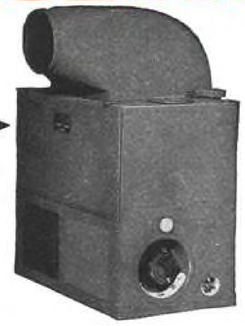
Tool for assembling pipe, conduit, and tube support clips is reported by **Adel**



MODEL UHX—10,000 BTU

HUNTER HEATERS MIGHT SOLVE YOUR PROBLEM

MODEL UH2—25,000 BTU



MODEL UH3—40,000 BTU



Burn any type of gasoline—from truck fuel to 100 octane!

Uses for Hunter Universal Gasoline Heaters are too widespread and varied to list completely, and are multiplied daily by the imagination and ingenuity of men who build, buy or command equipment for the service or supply of our armed forces, or essential civilian activities.

We build a variety of small, powerful units, each with a range of applications to which it is especially suited. YOUR heating problem may be one of these, or it may be one on which Hunter heating engineers can assist you in applying the extremely flexible basic units of Hunter Heaters to do exactly the job you need done. In either event, we shall be glad to furnish further information specific to your particular interests.

BULLETIN HB-3 ON REQUEST

HUNTER AND COMPANY

Aircraft Equipment

1550 E. 17th St.

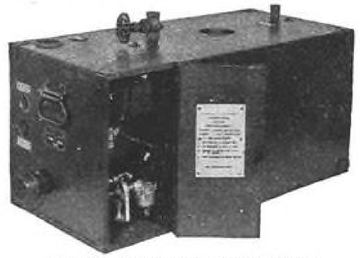
CLEVELAND • OHIO

HUNTER HEATERS MADE FOR RAPID WATER HEATING

Automatic Gasoline Burning Models Designed for Mobile Service Units

CLEVELAND, OHIO—A gasoline burning water heater that will supply water at high temperature, and that is capable of automatically maintaining a continuous supply, has been perfected by Hunter and Company of this city, makers of Hunter Universal Gasoline space heaters.

Two models are at present available. One is a portable unit with a ten-gallon pressure tank that is suitable for connection to any permanent or emergency water supply. It is completely automatic. The other is a five-gallon unit with a gravity type tank, designed to heat small quantities of water in a hurry. This heater is meant to be permanently installed in any kind of mobile service unit where there is frequent need for hot water. It fastens to a wall, and may be filled through an opening in the top, or connected to a hand pump or to a pressure water system.



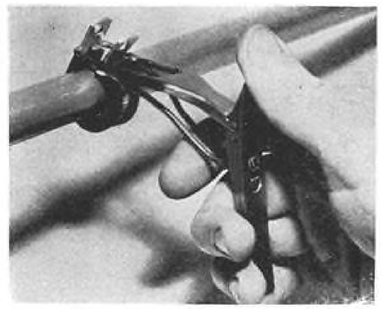
Hunter Automatic Water Heater

In both models, the heating element is a Hunter Universal Gasoline Burner, with "Sealed in Steel" flame, adapted as an immersion unit. The steel tube burner, with its terrific heating capacity, is immersed deep in the liquid to be heated. Unusual results are obtained in speed of heating and flexibility of automatic control. The same principle has been used by Hunter in special applications in storage or shipping tanks to protect oil or other fluids against cold.

These advantages, combined with the fact that the Hunter burner operates on any kind of gasoline, from truck fuel to highest octane, give Hunter Water Heaters an almost unlimited range of usefulness in mobile photographic, laboratory or hospital units, in field service units of all kinds . . . anywhere it is desirable to have an extremely simple and effective means to supply hot water.

More complete details about Hunter Water Heaters and their application may be obtained from Hunter and Company, 1550 E. 17th St., Cleveland, Ohio.

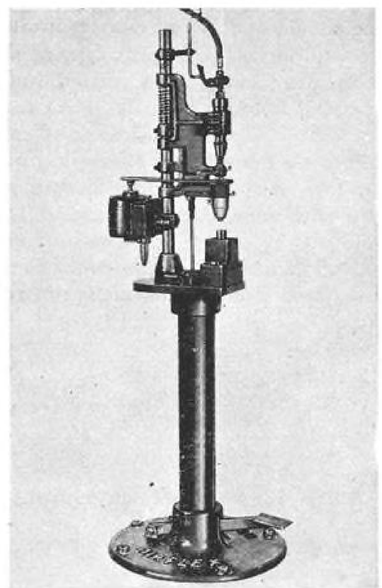
(Advertisement)



Precision Products Corp., Burbank, Calif. Time saving, states company, is feature, with fatigue and possibility of finger injuries said to be reduced. Handle of tool is in two parts, joined at a fulcrum. Under handle is a formed wire which is placed over clip, pincer fashion, when handle is jack-knifed. A pull straightens out handle and draws sides of clip together. This assembler may be used on clips from any direction —front, back, above, or below.—AVIATION, *Dec.*, '43.

Riveter 61

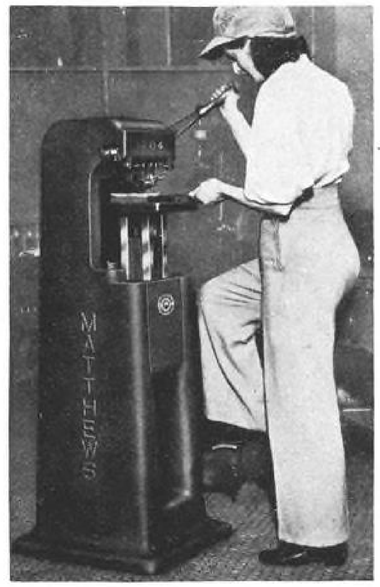
Advance pressure pad, consisting of spring and pilot which precede peening tool to hold assembly rigid against rivet set, is feature of late model riveters manufactured by **Airflex Equipment Co.**, Detroit. Machine can make round, oval, and flat head rivets, peens, shafts, pins, and studs, and furl or swage shoulder bushings and light tubes to sheet metal or plasties. Air-operated peening tool delivers strokes of ¼ in. max. Air, supplying force and frequency to blows, is controlled by petcock. Rotation is by ⅛ hp. motor with push button switch. Frame travel is approximately 2 in.,



frame adjustment on post 4 in. Models are manufactured with capacities of 5/32, ¼, and ⅜ in.—AVIATION, *Dec.*, '43.

Marker 62

Codes and other identification marks can be stamped with this machine on various shapes and sizes up to 6 in. dia. or thickness. Solid roller dies are used on flat parts and can be interchanged with flat dies for round parts. Fixture on machine table holds part which is then raised by depressing foot pedal; pulling down handle moves die across part. Specifications, as given by



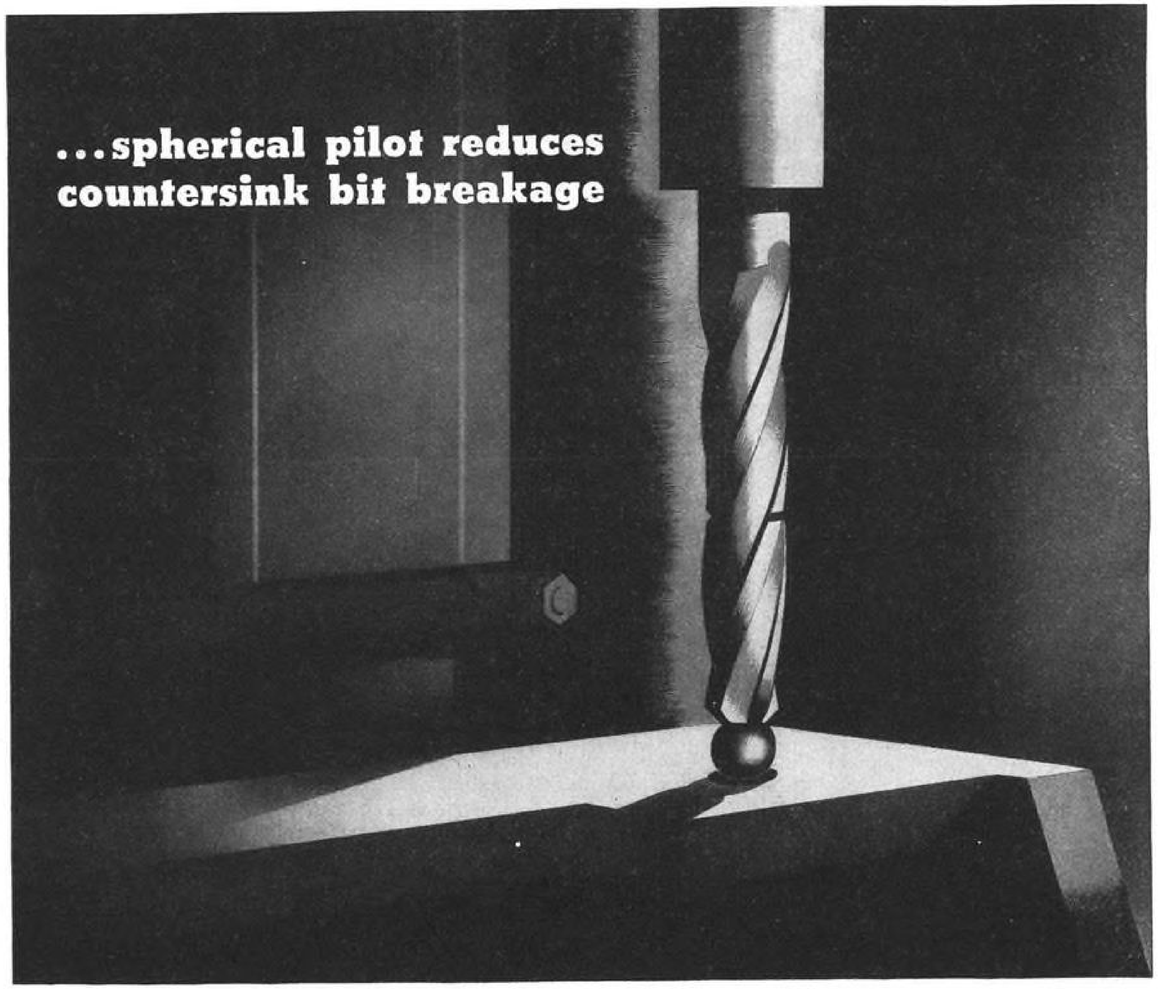
maker, **Jas. H. Matthews & Co.**, Pittsburgh: Die stroke, round parts 3½ in., flat parts 4½ in.; table rise 7 in.; table size 9x8 in.; throat from center of die to front of uprights 3½ in.; opening between uprights 8 in.; height of table from floor 43 in. max., 36 in. min.; floor space occupied 19x20 in.; overall height 52 in.; weight 500 lb.—AVIATION, *Dec.*, '43.

Check Valve..... 63

Hydraulic check valve introduced by **Electrol, Inc.**, Kingston, N. Y., is made in three screw machine-finished parts. None of them contain any hardened steel, thus conserving materials, reducing cost, and eliminating grinding and honing.—AVIATION, *Dec.*, '43.

Seam Welder 64

Assemblies mounted in fixtures and parts too big for machines can be seam-welded, it is reported by **Progressive Welder Co.**, Detroit, with air-operated portable machine capable of holding



Information supplied by an Industrial Publication

Tool breakage—even in what was once considered "normal amounts" is something to be avoided by any means today. Replacement supplies are hard to get, and the possibility of tool shortages is too serious to permit temporizing.

In many cases breakage can probably be considerably reduced by educating operators in the proper use of cutting tools. In some instances, redesign of the tool may be the remedy.

Redesign was the solution in the case of countersink drill bits used in an aircraft factory. Bits having cylindrical pilots often broke when the center line of the bit was at an angle with that of the drilled hole. Run out in the spindle could easily cause such deflection.

The remedy suggested by an employee consisted of equipping bits with a spherical, or ball shaped, pilot. Such a pilot has the effect of making bits self aligning. Deflection through a relatively wide angle cannot concentrate enough stress at the neck of the pilot to cause breakage, because the end of the bit is not rigidly held.

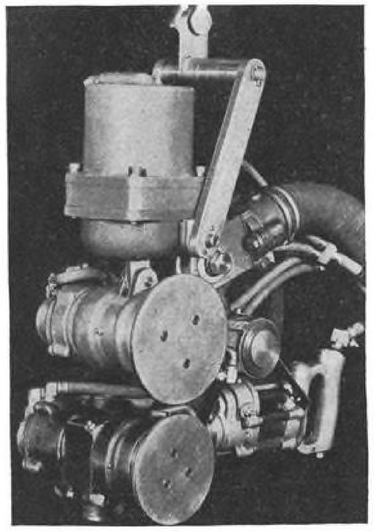
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

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Climax Mo-lyb-den-um Company
500 Fifth Avenue • New York City

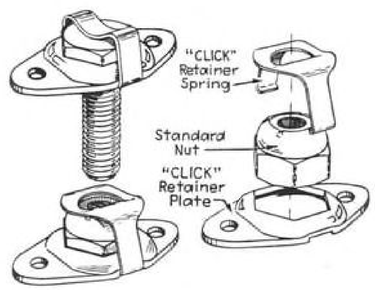
MOLY



material, including stainless steels, to 20 gage 2 in. thick. Universal suspension permits gun to be moved in practically any horizontal or vertical direction. At constant speed, air motor, regulated by governor, is rated at 2 hp. and consumes 42 cu. ft. under load. Using standard rolls or wheels, production speed is 48 to 52 in. per min. When air pressure, a maximum of 1,400 psi. obtained from 4½ in. dia. cylinder on 90 lb. line, reaches pre-set value lower wheel begins to move and timer starts welding process. Relaxing button control causes solenoid to release air in cylinder, and welding is stopped. Water cooling, 5 gpm., is supplied to transformer, cable, jumper, bushings, and interior of wheels. Transformer is rated at 100 kva. on 440 v., 60 cycles. Heat is regulated by six-stage dial, and speeds higher and lower than standard 48 to 52 in. rate are obtainable through spur gears and double worm drive. Throat depth of gun is 3 in.—AVIATION, *Dec.*, '43.

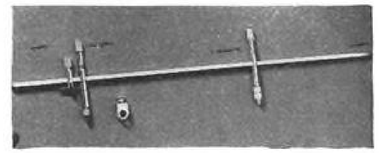
Retainer **65**

Nut and bolt retainer is announced by **Kaynar Mfg. Co.**, Los Angeles, under trade name Click. Of simple design, retainer plate and spring, (cadmium plated and tempered spring steel) are installed by spot welding or riveting at any stage of manufacture. Attaching dimensions are held to .002 in., eliminating line drilling of assemblies and allowing prefabrication of holes. For use with blind nuts, fasteners can be quickly adapted without effecting structural design. This retainer is interchangeable with present types of anchor fittings.—AVIATION, *Dec.*, '43.



Beam Compass **66**

Micrometer adjustment at pivot point of beam compass permits measurement to be set to approximately .001 in., according to **Mark Specialty Co.**, Rochester, N. Y. Pivot pin, a phonograph needle, is retained at specified projection by nut. Standard led pencil chuck will also hold steel point for marking metal. Bar can be supplied in lengths of 18-, 24-, and 36-in. or longer.—AVIATION, *Dec.*, '43.





You can't have spring quality and service without it!

PROPER BALANCE, timing and coordination between skilled employees, modern equipment and methods, and rigid production control are responsible for Accurate quality and service—to give you the springs and wireforms you want... *when you want them.*

From the specification stage through the precision manufacturing operations and the steps of testing and inspection, the Accurate organization works in smooth, production-building balance. Accurate engineers, too, are specially trained to work hand-in-hand with your own engineers to produce the precise springs or wireforms for the job, thus eliminating waste motion, saving time, trouble and headaches.

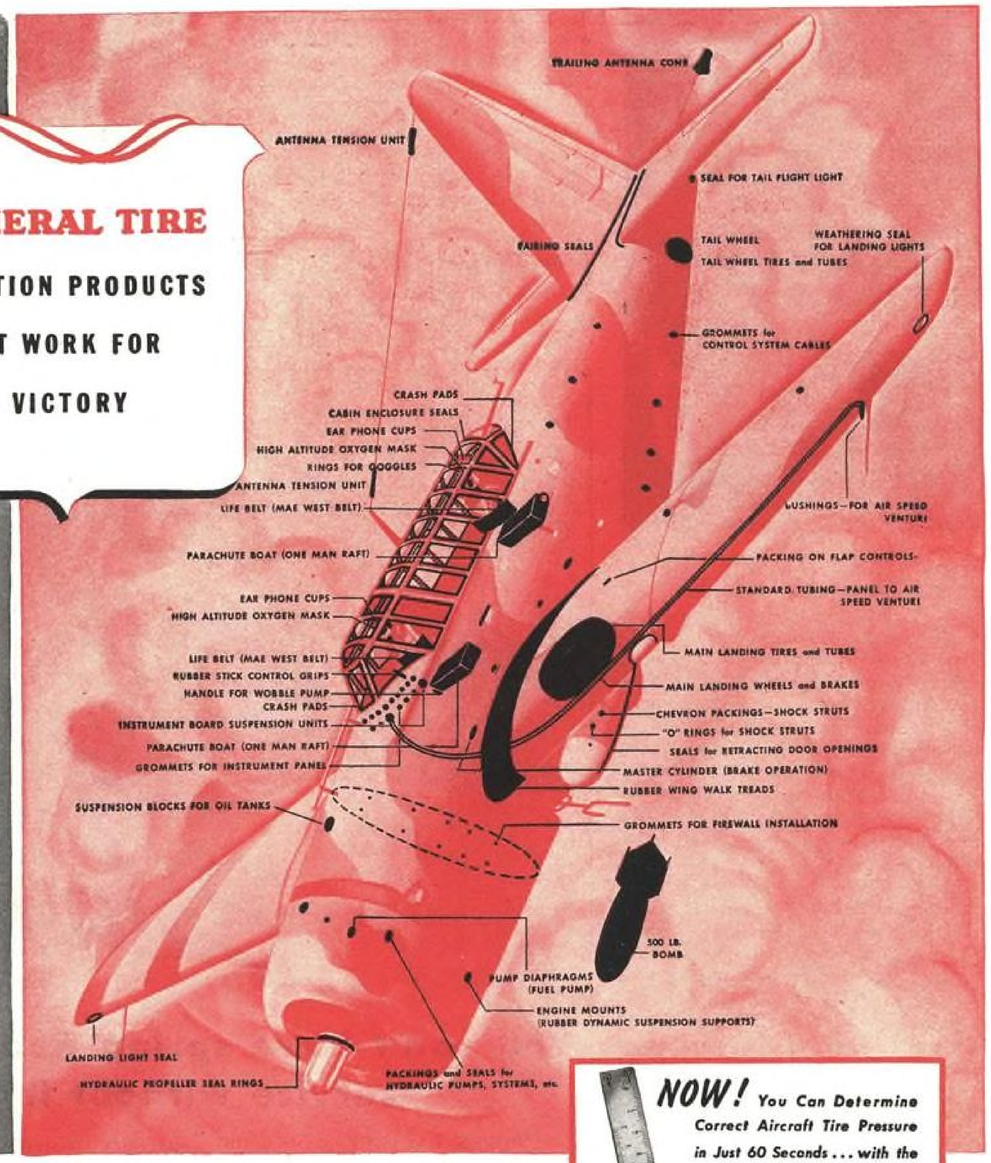
We know you will like the friendly cooperation and product quality which you will find at Accurate. When you have spring and wireform problems, bring them to us.

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SPRINGS ★ WIRE FORMS ★ STAMPINGS

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AVIATION PRODUCTS AT WORK FOR VICTORY



★ Not until the war is over . . . not until it can all be told . . . will the tremendous part being played by miscellaneous rubber aircraft parts be fully known. But they're there! The General Tire & Rubber Company alone makes *hundreds* of parts . . . gaskets, grommets, brake boots, pump diaphragms . . . *anything molded or extruded, synthetic or natural!*

And every item produced is a specialty. There are no "stock items." Your inquiry gets immediate attention . . . is the signal for a corps of trained engineers to swing into action . . . to produce for you the most efficient, economical and effective performance of that part! *So, special "problem" or otherwise . . . write, wire or call General today!*

"Extruded or molded . . . synthetic or natural . . . General can make it!"

NOW! *You Can Determine Correct Aircraft Tire Pressure in Just 60 Seconds . . . with the* **GENERAL DEFLECT-O-GAUGE**



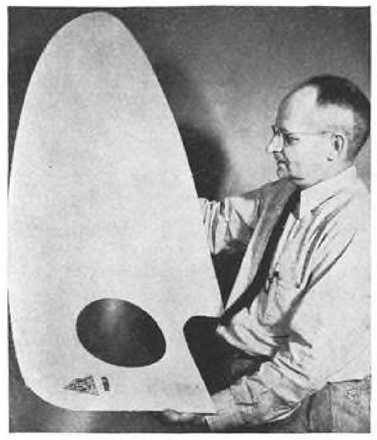
No graphs, charts, scales or air pressure gauges necessary . . . simply use the General Deflect-O-Gauge and air hose! Write for free instruction folder—Address: Aviation Division, The General Tire & Rubber Company, Akron, O.

The GENERAL AIRPLANE TIRE

THE GENERAL TIRE & RUBBER CO. • AVIATION DIVISION • AKRON, OHIO

Plastic Tank Holder 67

U. S. Rubber Co., New York City, announces that a plastic-board it has developed is being used to support self-



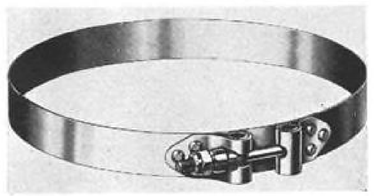
sealing gas tanks and in construction of de-icer fluid tanks. Material is stated to break clean when hit by bullets, weighs half as much as aluminum, has weight strength ratio comparable to other metal alloys, is a non-conductor of electricity, and can be used over wide temperature range. Board, as indicated in photo, can be cut in various shapes.—AVIATION, *Dec.*, '43.

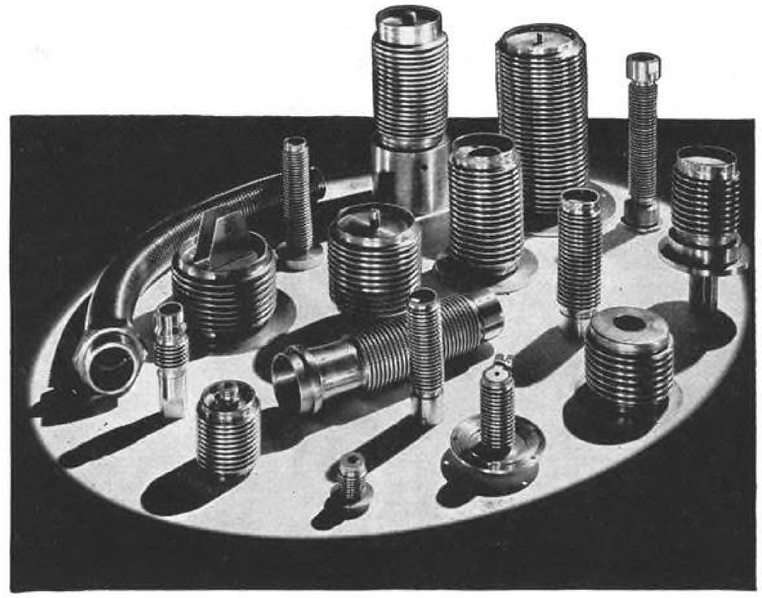
Plastic Cement 68

Offered by **Arpin Products Co.**, Orange, N. J., is No. 1 cement for use with Plexiglas and Lucite. Initial bonding strength is stated to make product specifically suited for repair work.—AVIATION, *Dec.*, '43.

Clamps 69

Aluminum alloy clamp, with ends wrapped over cross-bar anchors, combines maximum strength with extremely light weight. Announced by **Marman Products Co.**, Inglewood, Calif., new clamp is said to save 50 percent in weight and to distribute all loads evenly. The 5½ in. size (illustrated) has yield strength of 600 lb. and weighs 1 oz. Models were designed for aircraft use in ventilation, carburetor intake, supercharger, intercooler, and similar installations. They are available from 2 in. i.d. up and in wide range of special shapes.—AVIATION, *Dec.*, '43.





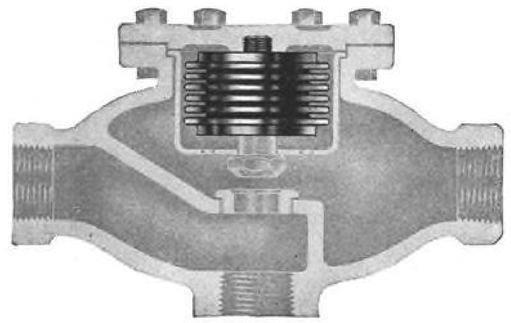
CMH

Stainless Steel Bellows

Wherever stainless steel's corrosion resistant qualities and temperature values are required in bellows service, CMH unimetal **circular seam welded** assemblies are filling that need.

No Solder or Flux Required

Long lengths of CMH Bellows are standard production; strength is further enhanced with **multiple ply** assemblies when needed.



Ask for engineering recommendations on specific applications.

CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Illinois

The glue that starts a new "Age of Wood"



THIS is the glue that makes possible assembly and joint gluing just as durable as the finest hot-press plywood bonds.

Because Cascophen LT-67 is an *alkaline,* warm-setting phenol-resin glue, it develops and maintains the full strength of the wood under all conditions of exposure, including prolonged high temperatures.

Cascophen LT-67 is available today—for wood war-products. Available after the war for better wood products of every type.

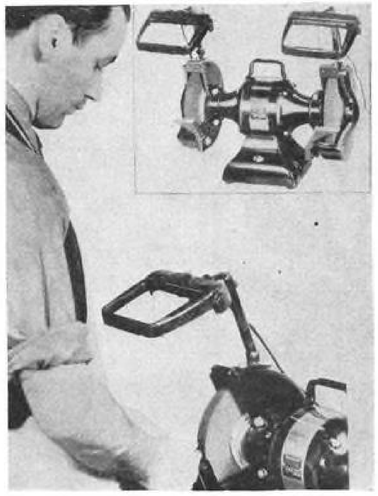


● For a complete description of Cascophen LT-67, write for the 8-page Technical Bulletin No. 104a . . . Address: Casein Company of America, Dept. A-12, 350 Madison Ave., New York 17, N. Y.
(A Division of The Borden Company)

CASCO•CASCAMITE
(casein) (urea-resin)
CASCOPHEN
(phenol-resin)
Aircraft Glues
to meet all aircraft specifications

Grinder Shield 70

Boyer-Campbell Co., Detroit, announces new grinder shield with shatter-proof glass and frame made of high impact resisting plastic. Bayonet-type



light is set flush with frame and controlled by push button switch.—AVIATION, *Dec.*, '43.

Starter Tester 71

New starter test stand is announced by **Airplane Mfg. Co. Supply Corp.**, North Hollywood, Calif., for right or left direction, S.A.E. 5, 6, and 7 in. aircraft starters. Known as the Amseo, it provides a single mounting plate to accommodate all listed types and sizes. Tests are obtained by torque action of starter, transmitted through a two-way arm to a double-action hydraulic cylinder which, in turn, registers in foot pounds on a maximum limit hand pressure gage. Standard gage furnished with tester allows readings up to 2,800 ft.-lb. on most starters. An ammeter, mounted on instrument panel, checks starter motor "draw" during flywheel energizing. All necessary switches, including selector for 12 or 24 v. operation, are part of panel equipment. Functionally designed cabinet is 38x36x28 in. Wiring and moving parts are fully enclosed; ball-bearing casters permit easy movement. Instrument panel is slanted for convenient reading and accessibility of switches. Either battery or rectifier models are available, battery model containing a charger and "tell-tale" signal light.—AVIATION, *Dec.*, '43.



Measuring Gage 72

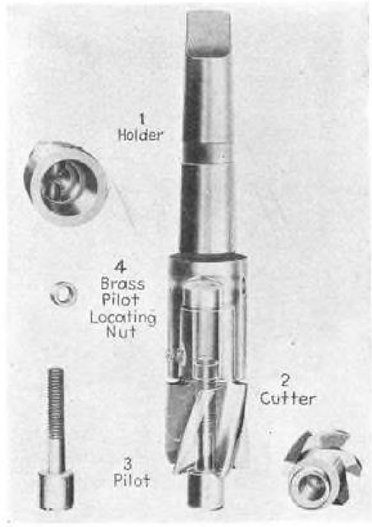
Sheffield Corp., Dayton, Ohio, provides on new instrument for internal and external measuring an electric gage, developed in collaboration with Westinghouse, with range of .0012 in. and graduated in 50 millionths (.000050). Magnification of gage head is 2,500 to 1. Push buttons raise gaging arms electrically. They are suitable for measuring diameters or internal dimensions from ¾ to 12 in. and explore holes 3 in. deep. As an external comparator, machine can check rounds, straights, and



tapers with maximum dimension of 12 in. It was designed for measuring working ring, snap, and length gages.—AVIATION, *Dec.*, '43.

Counterborer 73

Production of a range of sizes of counterbore drives is underway by **Moreland Tool Co.**, Detroit. Specific design, in which driving member fits into spherical off-center hole in holder, aims to equalize torque between driving member and holder. Possibility of shearing is also reduced. Due to length of pilot screw which holds cutter, cutter itself can be sharpened more than two-thirds



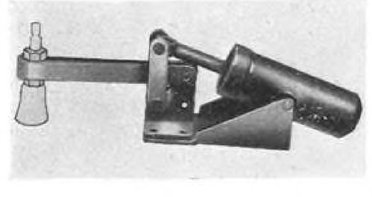
away before replacement. Four sizes of holders are made with straight or tapered shanks for cutters up to 3 in. dia.—AVIATION, *Dec.*, '43.

Rev Counter..... 74

Direct 1:1 drive with precision steel gears and Veeder-Root counter are used in light (8 oz.) device for recording number of revolutions turned on shafts when making rotary coil turns, recording vertical and horizontal stabilizer adjustments, or other operations in which shafts must be revolved a predetermined number of times. Standard model records up to ten turns in increments as low as 1/10. Others are available with ranges of 100 and 1,000 in right and left directions from **Barker & Williamson**, Upper Darby, Pa.—AVIATION, *Dec.*, '43.

Toggle Activator.. 75

New device is designed to relieve workers of job of walking around large parts or assemblies to set toggle clamps. Air-operated unit loosens or tightens clamps simultaneously from one control point. Air at 40 to 150 psi. fed to a cylinder moves arm which locks or loosens toggle. When locked, this acutuator maintains 325 psi. at end of clamping bar. Bar swings 90 deg. Device, which weighs 1¾ lb., is being manufactured by **Airop, Inc.**, Dearborn, Mich.—AVIATION, *Dec.*, '43.



3 NEW "ANGLES"
DIE CAST BODY
BALL BEARING SPINDLE

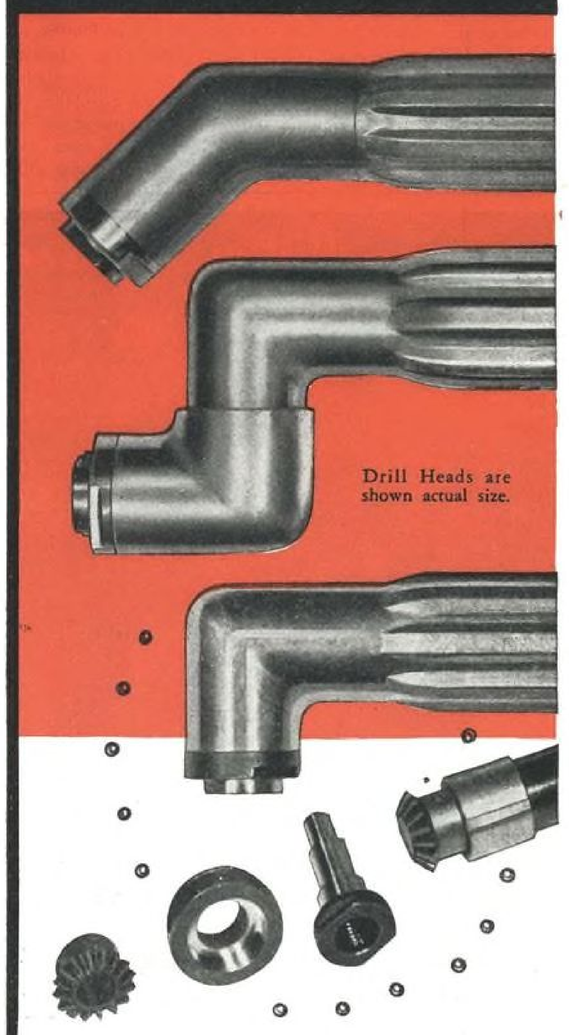
New nibbed die cast body

Operates in any position throughout 360°

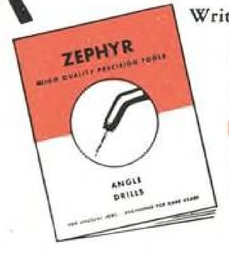
All three have new ball bearing mounted spindle

All parts are precision made

Write for our latest catalog of full line of aircraft tools



These new Zephyr angle head drills provide the last word in design . . . give better service over longer periods. Improved features include: Combination radial-thrust ball bearing mounted spindle; oilite bearings for drive shaft and spindle pilot; oversize drive shaft; die cast housing; all parts heat treated and completely interchangeable. Zephyr Tools are used in major aircraft plants in all parts of the country. Order a quantity now for actual test in your plant.



Write, on your letterhead, for our catalog.

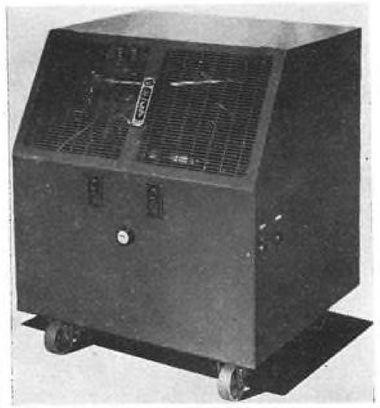
ZEPHYR
High Quality Precision Tools
ZEPHYR MANUFACTURING COMPANY
Factory and Head Office:
201 Hindry Ave., Inglewood, California
Write for address of nearest branch office or dealer representative.

Tool Alloy..... 76

Designed to fill gap between high-speed steels and tungsten carbide, tool alloy for machine work is composed of cast tungsten-chromium-cobalt alloy. With exception of manganese steel and chilled iron, it is designed to machine all materials, being particularly suitable for chromium and nickel alloys and stainless steel. Production rates, with about same depth cut as high-speed steels, is reported one-quarter to one-half faster. It is called Speedaloy by **Tungsten Alloy Mfg. Co.**, Newark, N. J.—AVIATION, *Dec.*, '43.

Fluid Refrigerator..... 77

Requiring no water connections and ready to plug into power supply, new self-contained, portable cooler has been designed for use with metal cutting coolants, hydraulic and quenching oils, spot welders, and for settling and screening out chips. Dimensions are 28½x33x44 in., and 1 hp. compressor is rated at 11,800 Btu. Optional centrifugal or gear pump, operated by ½ hp. motor, are rated at 3,000 gph. at 7 lb. pressure and 180 gph. at 50 lb. pressure, respectively. Coolant tank has 25-gal. capacity and settling and filtering screens. Baffle



plates are provided for removing chips collected. Maker, **Gray-Mills Co.**, Chicago, calls this machine Model 400.—AVIATION, *Dec.*, '43.

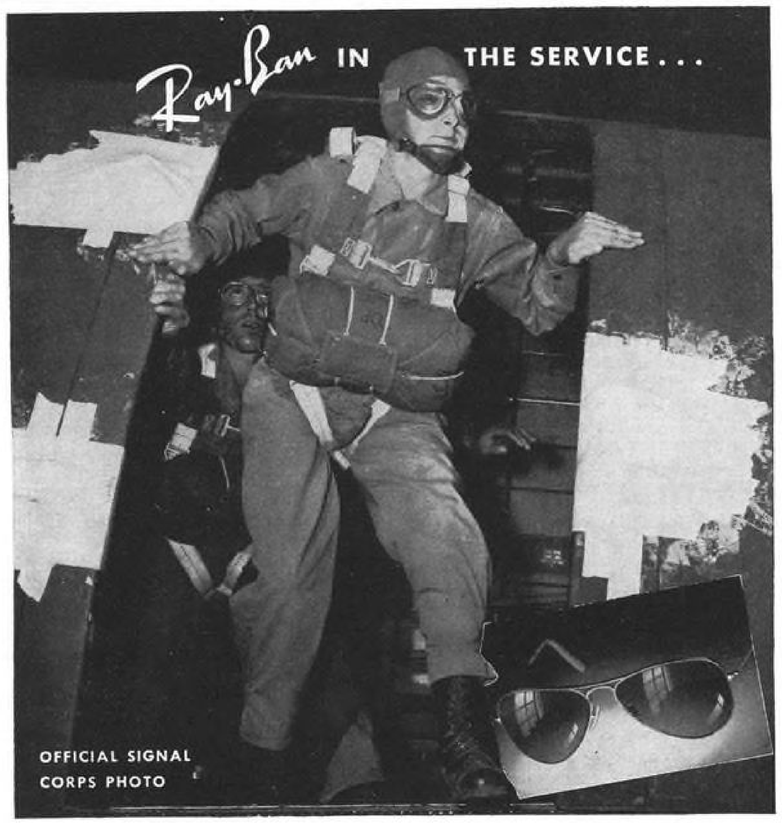
Duplicator..... 78

Dupligraph is name given new machine for duplicating contours of irregular surfaces, such as propellers, and for obtaining concave readings on forming dies without need for forming templates. Shape of object is obtained by means of stylus and pentagraph which can mark either transparent paper or metal. It is made by **Inter-Lakes Engineering Co.**, Detroit.—AVIATION, *Dec.*, '43.

Carbide Blocks..... 79

Practically non-magnetic, cemented carbide gage blocks, estimated to last many times longer than steel, are furnished in two grades of accuracy, .000004 and .000008 in., by **Lincoln Park Tool & Gage Co.**, Lincoln Park, Mich. Set of 14 blocks includes these sizes .050 in., .100, .05005, .0501, .0502, .0503, .0504, .0505, .0506, .0507, .0508, .0509 They complement standard build-up 81-piece sets.—AVIATION, *Dec.*, '43.





20/20 VISION . . . HE STILL NEEDS Ray-Bans

Poised for his leap into space, this paratrooper knows the full comfort Ray-Ban sun glasses give keen eyes.

With eyes protected against the blinding dazzle of the desert sun, he quickly sees a safe landing spot and works his parachute toward it. Hours spent on blistering desert sands do not burn his eyes—behind their cool, comfortable Ray-Ban lenses.

That's why Ray-Ban sun glasses are sold out to the Army and Navy today—why Ray-Ban lenses are available to civilians *only on prescription.*

BAUSCH & LOMB
OPTICAL CO. ROCHESTER, N. Y.
ESTABLISHED 1853

AN AMERICAN SCIENTIFIC INSTITUTION PRODUCING OPTICAL GLASS AND INSTRUMENTS FOR MILITARY USE, EDUCATION, RESEARCH, INDUSTRY AND EYESIGHT CORRECTION



Same Shape in 1943000



THE AVIATION INDUSTRY
OK's* SYNTHANE *for:

LIGHT WEIGHT with Strength
LIGHT WEIGHT with Corrosion Resistance
LIGHT WEIGHT with High Dielectric Strength
LIGHT WEIGHT with Ease of Machining

ANDROMEDA NEBULA will look the same eons from now. No man-made material, Synthane or any other, approaches such permanence. With respect to temperature, however, Synthane does change very little in shape. High temperatures do not soften it, low temperatures do not make it brittle. Over a range from −67° F to +158° F, changes in temperature do produce changes in other properties of Synthane, such as mechanical and electrical characteristics, water absorption, corrosion resistance, and hardness. But since these changes are moderate Synthane is amply satisfactory for most aircraft applications. For information on the effects of temperature changes upon Synthane, turn to the back of this sheet.

SYNTHANE CORPORATION, OAKS, PENNSYLVANIA

Materials to remember, specify and use for Aircraft Parts

SHEETS • RODS • TUBES • FABRICATED PARTS **SYNTHANE** MOLDED-LAMINATED • MOLDED-MACERATED

SYNTHANE *vs.* TEMPERATURE CHANGES

Changes in Shape

Among the many properties of laminated plastics, one of those most desired by aircraft engineers—aside from light weight—is resistance to change in shape with a change in temperature over a range of − 67° to + 158° F.

Synthane has a low coefficient of thermal expansion, .00002 cm. per cm. per degree C. (.000011 inch per inch per degree F.).

This low coefficient of expansion is, of course, desirable in numerous applications such as pulleys, rollers, panels, antennae mounts, and close fitting machined parts . . . wherever dimensional accuracy must be maintained. It is important in non-structural parts—insulation for radio and electrical devices; for example, in high frequency coils where accuracy of diameter is necessary to hold inductance values to close limits.

Another point about Synthane worth remembering is that its coefficient of expansion corresponds closely with aluminum and aluminum alloys so that wherever Synthane is constrained by attachment to these metals, there is little or no tendency to set up internal stresses with changes in temperature.

In addition to retaining its shape, Synthane retains to a practical degree other desirable characteristics, notably resistance to corrosion, mechanical strength and dielectric properties.

Effects of Higher Temperatures

Various grades of Synthane have been tested under three time-temperature sets of conditions—exposures of 10 months at 250° F., 48 days at 320° F., and 24 hours at 400° F.* From these tests the following general conclusions may be drawn:

TENSILE STRENGTH is reduced by exposure to heat but may be held within reasonable limits by the use of glass fabric base (GLF) or asbestos fabric base (AA) grades or through the use of the following melamine resin grades, GLMF (glass fabric), XKM (hard kraft paper) or LM cotton fabric base.

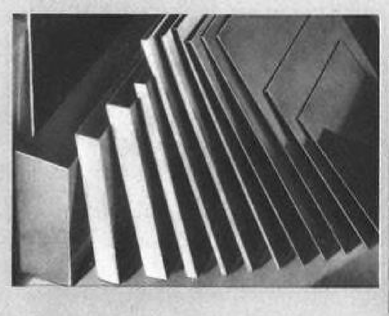
WATER ABSORPTION—In other tests tensile, flexural and compressive strengths were observed to decrease from 10 to 25% at temperatures of + 150° to + 175° F., but to increase a similar amount at temperatures from − 50° to − 75° F. Impact strength, on the other hand, was found to increase from 20 to 40% at + 150° to + 175° F. and decrease a similar amount from − 50° to − 70° F.

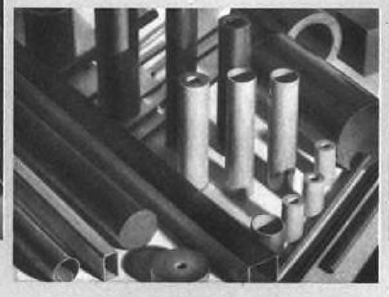
The 24-hour water absorption of Synthane is not affected by heat treatment except after long periods of exposure. The long temperature cycle (10 months at 250° F.) would substantially increase water absorption in the fabric base grades although we know of no such continuous exposure conditions in aircraft practice.

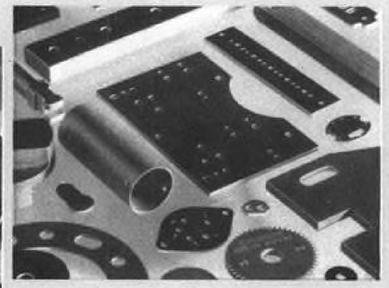
HARDNESS of fabric grades decreases slightly with heat treatment, whereas paper base grades usually become harder.

DIELECTRIC STRENGTH is virtually unaffected by any of the time-temperature conditions noted.

*Exposure to 400° F. made only after special heat treatment.







PLAN YOUR PRESENT AND FUTURE PRODUCTS WITH SYNTHANE TECHNICAL PLASTICS

SYNTHANE

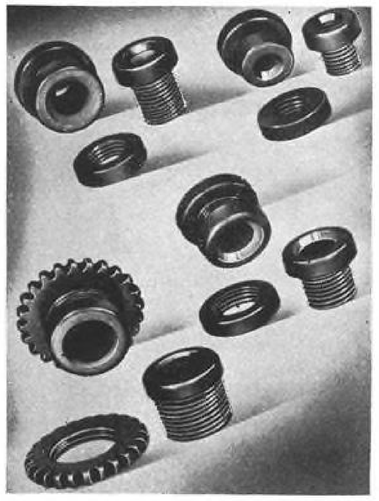
SHEETS-RODS-TUBES-FABRICATED PARTS-MOLDED-LAMINATED-MOLDED-MACERATED

SYNTHANE CORPORATION, OAKS, PENNA.

REPRESENTATIVES IN ALL PRINCIPAL CITIES

Plastic Grommets 80

Creative Plastics Corp., Brooklyn, N. Y., has put on market four standard sizes of all-phenolic plastic grommets

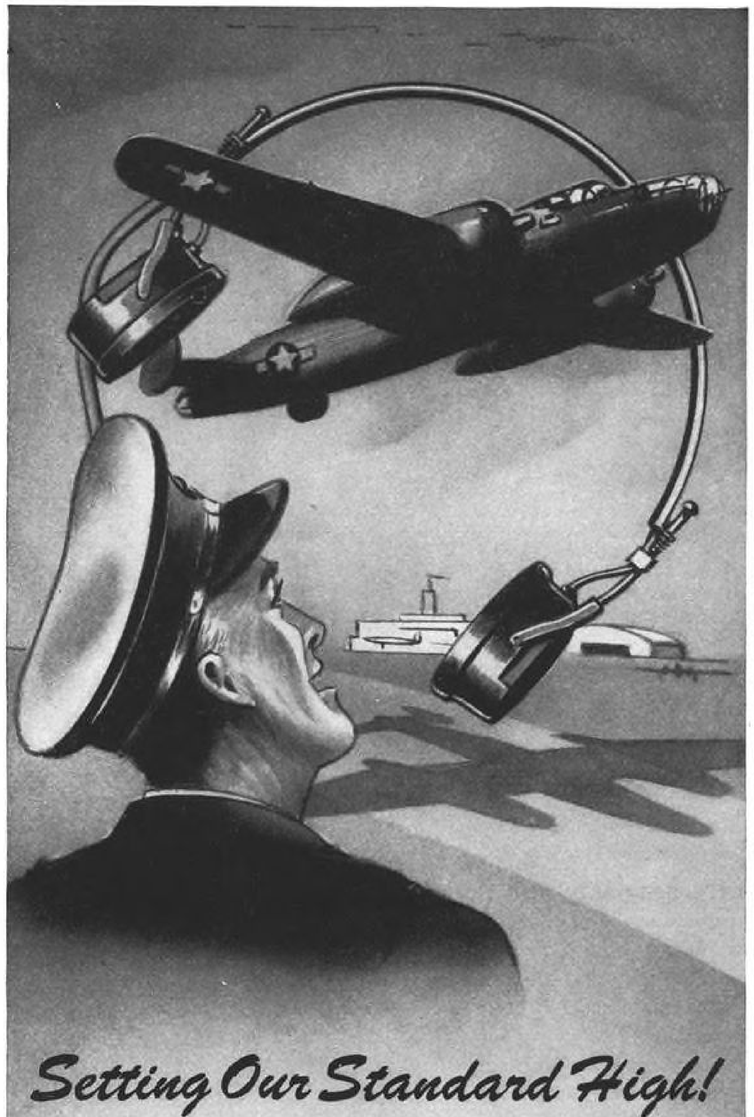


for radio, motor, and electronics equipment. Holes are concentric and corners chamfered. Threads are lubricated and unit entirely matte finished.—AVIATION, *Dec.*, '43.

Rectifier 81

Rating of new line of rectifiers found useful for aircraft engine starting and testing of radio and electronic equipment is from 65 to 500 amp. at 6, 12, 24, 36, and 48 v. in various models; power output is 4,500 w. Fractional horsepower ventilating fan motor is only moving part in portable cabinet weighing 206 lb. and measuring 16x16x29 in. Current, says **W. L. Maxon Corp.**, New York City, is supplied by self-healing magnesium-copper-sulphide rectifying stacks. — AVIATION, *Dec.*, '43.





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We live in an age of routine miracles—gigantically planned to meet the supreme challenge of wartime necessity. Permoflux Dynamic Headphones have cast their outline in the progress of communications—have attained a performance standard of unmatched efficiency and complete dependability. The horizons of tomorrow will spotlight the Permoflux developments of today!

Buy **WAR BONDS** *For Victory!*

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CORPORATION

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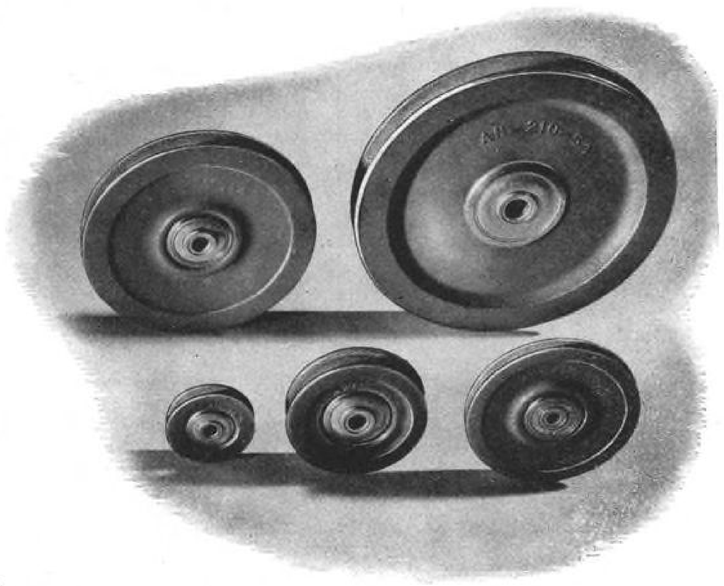
PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

INSUROK

Precision Plastics and NICE Bearings



TEAMWORK DOES IT!



NICE BEARINGS AND INSUROK have teamed up for the duration.

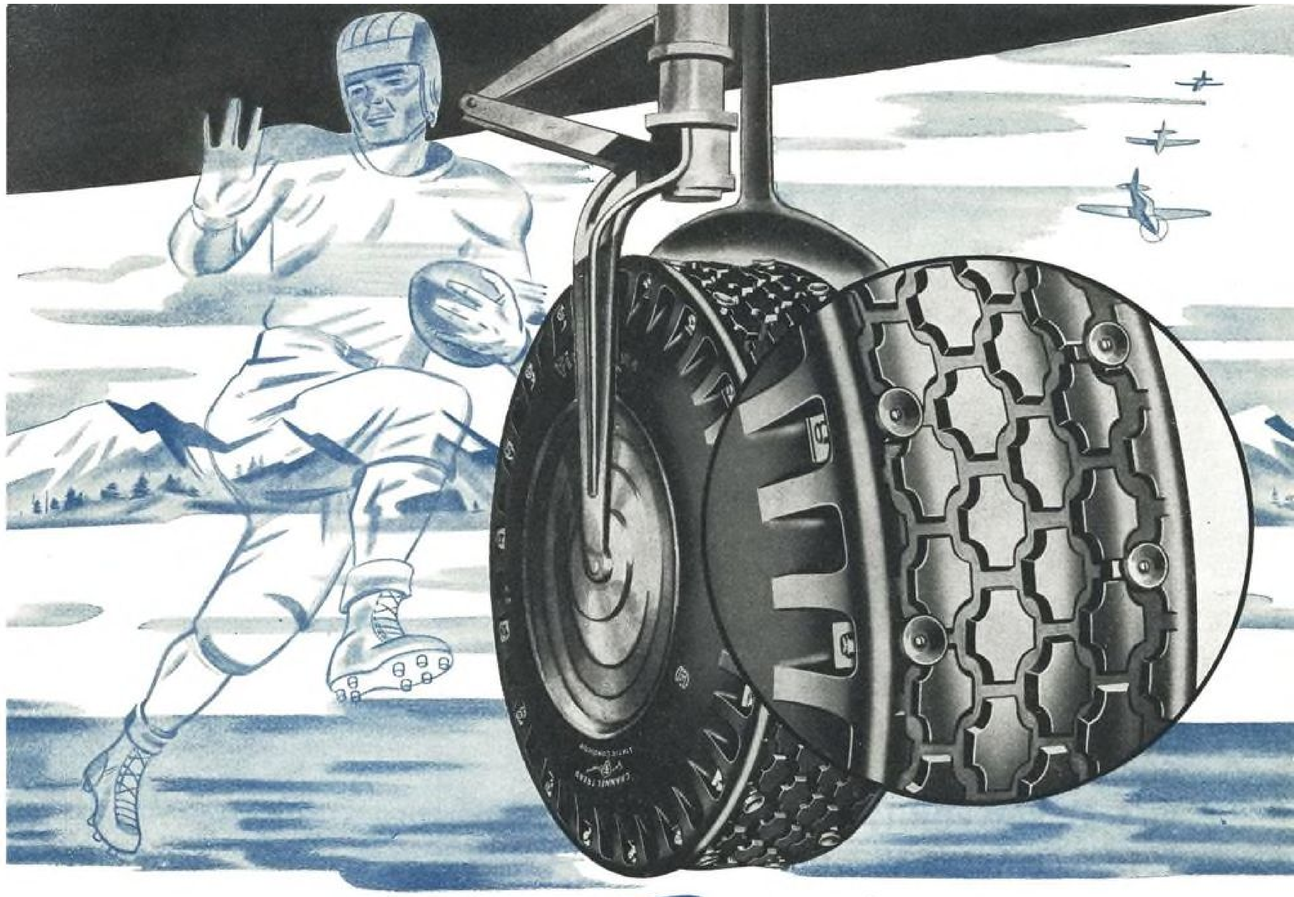
There are no individual aces in this war. On the fighting front, flyers pair up for mutual benefit—protect each other in combat.

In making vital parts for aircraft, too, teaming up is essential. NICE Ball Bearings and INSUROK, for example, are working together to supply pulleys for some of our fastest fighters.

NICE Aircraft Bearings, because of their flawless precision manufacture, and INSUROK, because of its light weight, strength, and machinability to extremely close tolerances, are giving reliable, dependable service in combat . . . hastening Victory over the Axis.

The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
DETROIT OFFICE: 4-252 G. M. BUILDING, DETROIT 2, MICHIGAN NEW YORK OFFICE: 75 WEST STREET, NEW YORK 6, N. Y.



CLEATS FOR FROZEN FIELDS

HERE'S another outstanding Firestone contribution to flying safety — the Firestone CLEATED Channel Tread Tire! Already widely acclaimed for making possible landings and take-offs on soft, muddy fields, the Firestone Channel Tread Tire now adds to its accomplishments safety in high speed landings on dangerous, icy surfaces. Sturdy, built-in, steel disks with sharp facings dig in and take hold immediately on impact of landing to provide positive traction on the smoothest ice.

Of added importance, these skid-preventing cleats may be inserted or removed in a matter of minutes. Tests under the most severe operating conditions prove definitely that the Firestone Cleated Channel Tread Tire provides performance superior to any other ice tire.

This is only one of a long list of Firestone contributions to aviation. And whether your problem is one of development, design or volume production — whether your requirements are made of rubber, metal or plastic — a Firestone engineering representative is available on request.

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

Firestone

AIRCRAFT COMPANY

SHIP BY AIR

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GOULD FACTORY-BACKED SERVICE AT KEY POINTS AVOIDS COSTLY DELAYS, MAKES QUICK REPAIRS POSSIBLE



• Speed is the essence of today's production efforts. This has added new strains on men and equipment. In hurrying to make delivery dates machines are forced to new highs, with the result that breakdowns and accidents do occur. Storage batteries are no exception to this rule.

Realizing the need for quick repairs Gould has created a special factory-backed service at key points throughout the United States. Through the completeness of Gould equipment, and the know-how of the eight Gould factories, injured batteries will again be on the firing line as good as new, with a minimum of delay.

Specify GOULD Batteries

Designed especially for aircraft service. Supplied either wet and charged, or dry charged. Engineers are invited to consult us for design or other special services. Write Gould at Depew, N. Y.

GOULD STORAGE BATTERY CORPORATION, DEPEW, NEW YORK

Builders of industrial batteries for every application. Sales and service offices in principal cities of the U.S.A.

Factories at Depew, N. Y., North Bergen, N. J., Dallas, Atlanta, Chicago, St. Paul, Leavenworth, Los Angeles

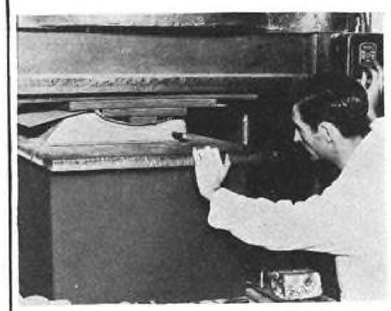
FOR EXCELLENCE IN STORAGE BATTERY PRODUCTION AT DEPEW PLANT

GOULD

Since 1898 THE BATTERY PICKED BY ENGINEERS

Forming Sheets 82

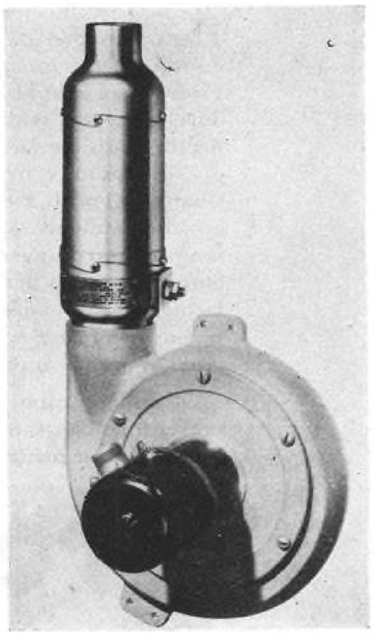
Announcement is made by **Los Angeles Standard Rubber Co.**, of new X-84 rubber stock forming sheets that give increased service is hot magnesium form-



ing. Sheets are reported to have been in service for 200 cycles, or five to ten times number possible with former stocks. Reports indicating excellent service in steam to 325 deg. F. for extended periods are also on file. X-84 is resistant to tearing and smudging when used in magnesium hot press forming.—AVIATION, *Dec.*, '43.

Heater 83

Capable of delivering between 600 and 6,000 Btu. per hr. for defrosting aircraft windows and warming instruments and compartments, new heater has element wound on ceramic core and two-piece aluminum shell. Blower or ram duct circulates air. Heater operates on 24-28 v. d.c. circuit. It is manufactured by **Avia Products Co.**, Los Angeles.—AVIATION, *Dec.*, '43.





LOOK INSIDE WITH W X-RAY

This radiograph shows a blowhole in an aircraft casting . . . a typical example of how x-ray reveals subsurface defects.

SIMPLIFY QUALITY CONTROL with easy-to-analyze x-ray inspection

Quality control of castings and weldments is easy; fast and absolute with x-ray inspection.

For example, suppose you have a casting that must be perfected before large scale pourings are practical. All you have to do to perfect quality is make small test casts—x-ray them—and you have an easy-to-analyze picture that shows up such variables as temperature of pour, location of gates and risers, ramming and shrinking.

Once perfected, an occasional x-ray is all that is necessary to maintain quality control—for there is no need for routine examination of every piece. Workmen learn quickly and pictorially the advantages and disadvantages of each modification in metal working procedures. And you make each test of quality absolutely—nondestructively.

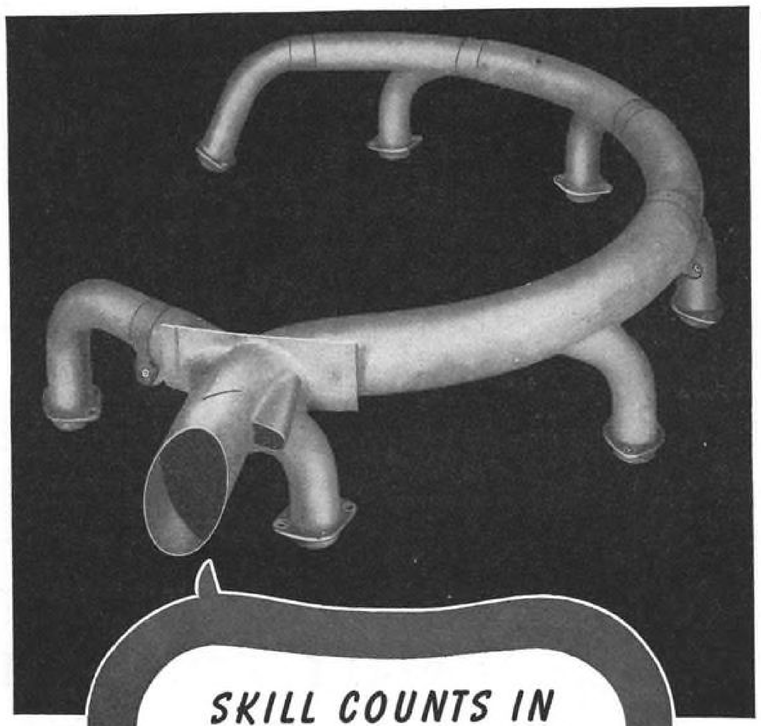
Above all, you have pictorial proof for your customers that your products meet their established standards. No arguments—no renegotiations—no excuses.

X-ray is at work on hundreds of war jobs—saving machine and man-hours, conserving critical materials, speeding production, controlling quality and helping train workers. For more information, write for B-3159. It's a simplified booklet that shows you how and where x-ray can be used in industry. J-02024

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PLANTS IN 25 CITIES... OFFICES EVERYWHERE



SKILL COUNTS IN AIRCRAFT WELDING

★ Kay Products Company occupies a unique position in the aircraft industry. Organized more than five years ago for the sole purpose of serving the Army Air Forces and leading airplane manufacturing companies, it has developed men and facilities for the production of aircraft parts and assemblies. Welding technique, particularly, has been carried to a high degree—and through recent increases in facilities and personnel, *we now offer the welding experience of this company to a limited number of new customers.*

KAY PRODUCTS COMPANY

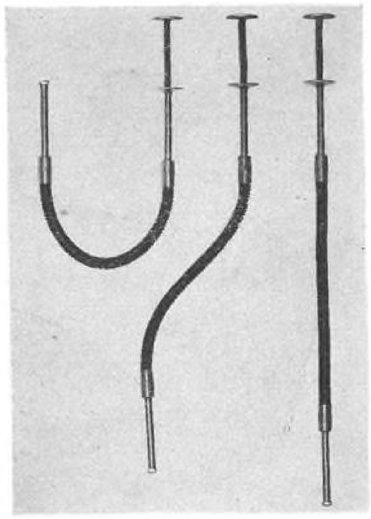
4825 CABOT STREET, DETROIT, MICHIGAN

DIVISION OF TYLER FIXTURE CORP., NILES, MICH.

AIRCRAFT WELDING

Holder, Retriever 84

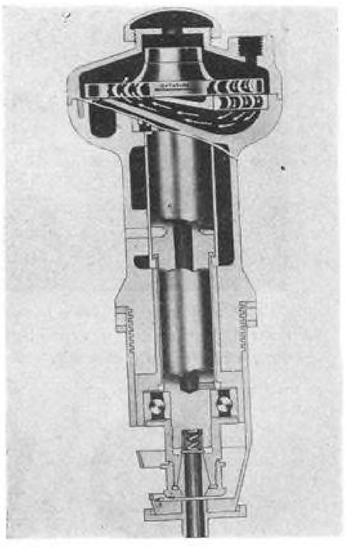
Pressing down button on end of this 18-in. flexible shaft opens claws at other end for picking up small parts or setting



screws in inaccessible places. Manufactured by **New Britain Machine Co.**, New Britain, Conn.—AVIATION, *Dec.*, '43.

Air Turbine 85

Data on air motor developed for its own products is being released to other manufacturers by **Onsrud Machine Works**, Chicago. Patented, solid milled rotor operates on impulse reaction principle with air feed-back system. It has bucket impeller blades. Company has used this type motor in power range of 1/6 to 3 hp. at speeds from 15,000 to 100,000 rpm.—AVIATION, *Dec.*, '43.



Gas Dispenser 86

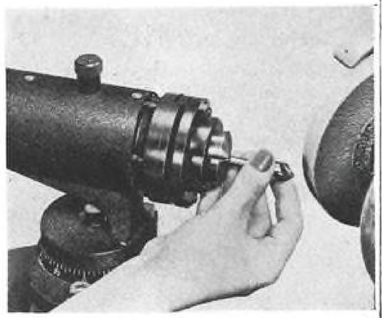
New six-barrel, four-wheel, portable oil and gasoline dispensing unit for in-the-field servicing of aircraft is announced by **Harman Equipment Co.**, Los Angeles, Calif. It will handle gaso-



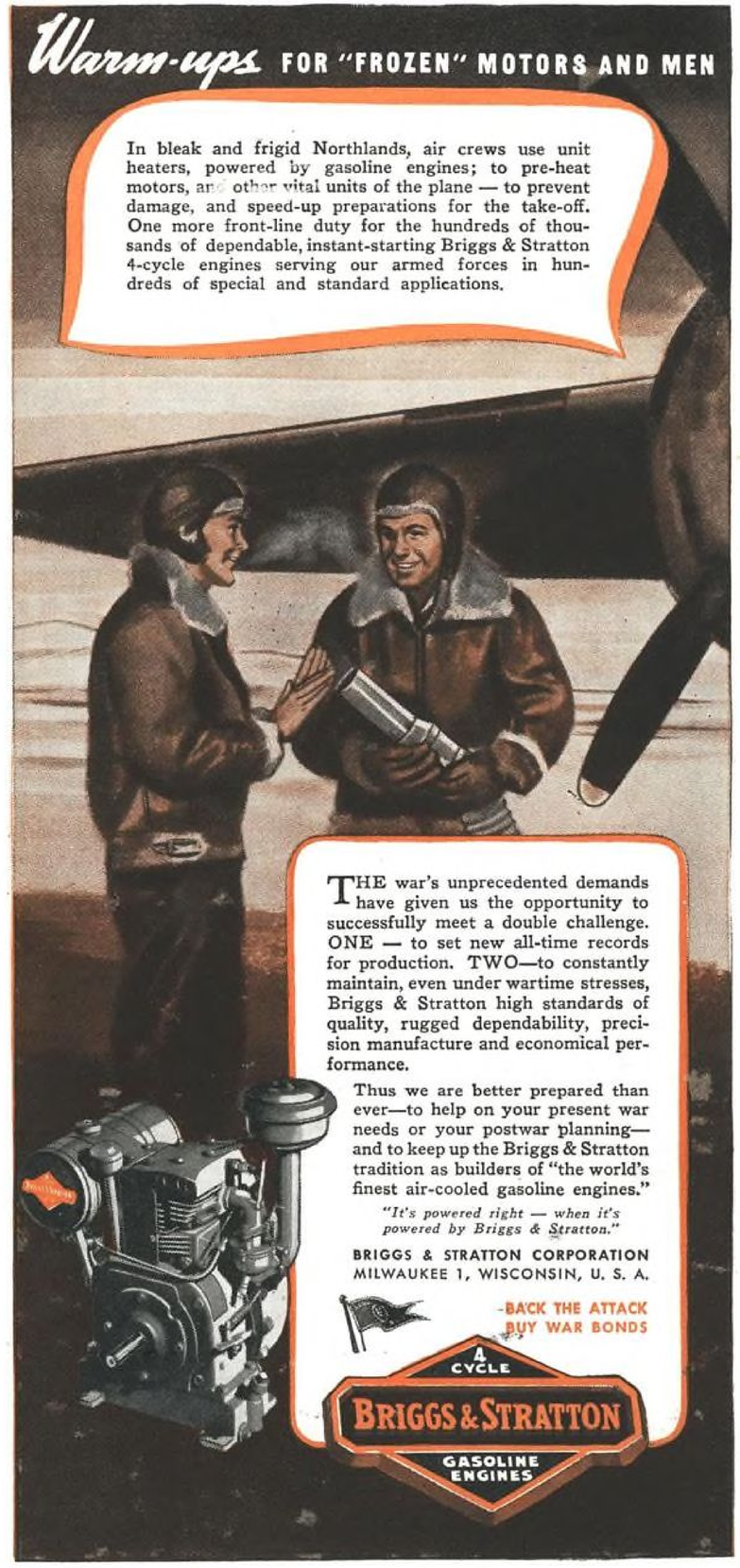
line, diesel, and other light fuels at maximum pump capacity of 15 gpm. at all prevailing atmospheric temperatures. Frame is welded into a single, rigid unit mounted on automotive type disk wheels with heavy roller bearings and pneumatic tires. Hinged tractor hitches at both ends permit four-wheel steering and extra short turning. Low trainer beds enable one man to load or unload drums. Pump and meter units are demountable and powered by electric motors or gasoline engines. A double-swing, flexible suction arm assembly reaches all barrel openings. Electric heating elements are available as extra equipment. Classed as Series 1000, unit is known as Harmeco Lube-A-Plane.—AVIATION, *Dec.*, '43.

Relief Grinders 87

Manufacture of I-G-C countersink relief grinders is announced by newly formed **Accurate Machine Products Co.**, Los Angeles. New fixture fits any standard grinding machine and will take work from 1/16 to 1 in.-dia., handling countersinks of all types, center drills, and either right- or left-hand pilot drills. Main housing is cast iron which supports a hardened and ground spindle on two large bearing surfaces requiring only



periodic oiling. Cam is hardened tool steel with steel adjustment pins.—AVIATION, *Dec.*, '43.



Wire Dies 88

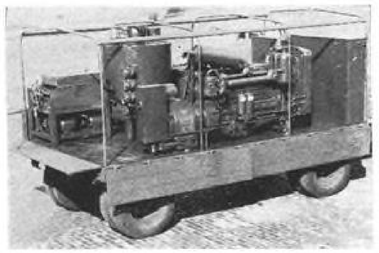
Round-hole cored dies for producing fine wire are being stocked by **Carboloy Co.**, Detroit, in sizes from .004 to .007 in. thus eliminating need for piercing by user. Dies have standard R-2 Carboloy nibs and casing sizes of 1 in. or 1½x9/16 in.—AVIATION, *Dec.*, '43.

Wire Coloring 89

Colored chemical coatings, which dry in about 1 min., are announced by **Sterling Varnish Co.**, Haysville, Pa., for identifying electric wires. Wires are drawn through coloring, a varnish known as S-184, or dipped in it.—AVIATION, *Dec.*, '43.

Oil Reclaimer 90

Portable oil reclaimer being used in battle theaters has standard unit built by **Youngstown-Miller Co.**, Sandusky, Ohio, diesel generating set, clean oil storage tank, and waterproof bins for filter papers and refinery earth used in cleaning process. Oil is pumped from drums on ground into heating unit from



which thermostat releases it into transfer tank. From here it is forced by compressed air through two-stage filter and thence to receiving drums. Used oils are said to be restored to substantially their original values of fire, flash, viscosity, color, and neutralization number.—AVIATION, *Dec.*, '43.

Temperature Indicator 91

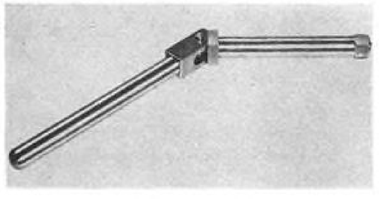
Moisture-sealed mercury thermostat tube is activating part in new temperature indicator. It measures to 1 deg. F. when threaded into cylinder head or coolant or oil line. Thermometer is connected to two indicator lights; when temperature is normal, green one glows. When temperature goes above normal, red light flashes; and at dangerous heat, red stays lighted. Available ranges for oil, Prestone, or other liquids or gases are —60 to +500 deg. F. Maker is **Vapor Car Heating Co.**, Chicago.—AVIATION, *Dec.*, '43.

Boring Tools 92

Solid round blanks that user once had to grind himself are now being supplied ready finished in two models: 27SR with side cutting edge angle 30 deg., and cutting edge 38 deg. for 30 deg. boring bar; and 29SR with side and end angles of 45 and 53 deg. for 45 deg. boring bar. Tolerances on diameter are given as + .000 and — .001 in., on other dimensions as + .000 and + .005 in. Sizes furnished in each style by **Kennametal, Inc.**, Latrobe, Pa., are 3/32, 1/8, 5/32, 3/16, and 1/4 in.—AVIATION, *Dec.*, '43.

Key Setter 93

Machine steel key setting tool for aircraft assembly is obtainable in three sizes, No. 6, 8, and 10. It has cam mechanism, and when lever is opened tool advances and makes keyway.—AVIATION, *Dec.*, '43.







master patterns STAY SHARP on this metal

More and better warplanes every month is no easy assignment for aircraft manufacturers. Yet the job is being done, thanks to faster production methods from the drawing board to the assembly line.

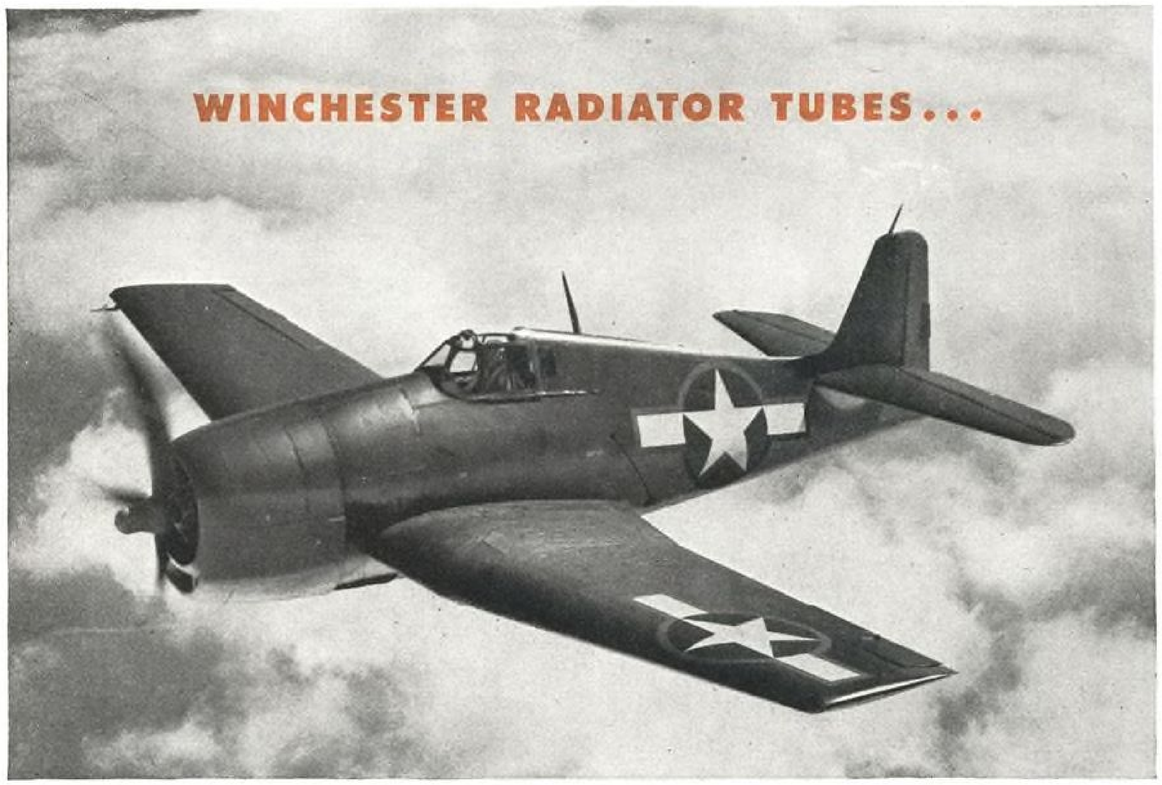
Template-reproduction (once drawn by hand) is a good example. Many designers are specifying ARMCO Galvanized PAINTGRIP sheets for their master patterns. Copies are made in a few minutes by the photo-loft or the electrolytic processes. Valuable time is saved and hundreds of designers are released for other important work.

ARMCO PAINTGRIP sheets are used for master templates because scribed lines won't flake or fade. This mill-bonderized metal takes and holds paint indefinitely. Lines stay sharp in copy after copy, leaving no chance for errors. And PAINTGRIP sheets are smooth, flat and easy to work.

Do you want these advantages of ARMCO PAINTGRIP for *your* master template work? For complete information about PAINTGRIP, write to The American Rolling Mill Co., 2631 Curtis Street, Middletown, Ohio.

GALVANIZED PAINTGRIP • ARMCO • IRON OR STEEL

THE AMERICAN ROLLING MILL COMPANY



HELP KEEP "HELLCATS" COOL FOR HOT PILOTS

The newest Navy fighter, the "Hellcat", is a direct descendant of the Wildcat,—also a famous Grumman fighter. Reports say the Hellcat flies straight and true, has dazzling rate of climb, plenty of speed and lots of high-altitude performance—qualities that "hot" (ace) pilots demand.

Helping the Hellcat range farther than any Navy fighter has ranged before, Winchester Cartridge Core Radiator Tubes in its vital oil-cooling system bring to the Hellcat . . . protection from corrosion, high-efficiency cooling and the sturdiness to stand up under the extreme cold of super altitudes.

Made of pure copper, with walls only 6/1000ths of an inch thick, Winchester Radiator Tubes, thanks to Winchester's COLD copper-extrusion process, are seamless and so assembled that *their entire outer surface is cooling area.*

WINCHESTER RADIATOR TUBES RESIST CORROSION . . . DEFY BURSTING. Pure copper, Winchester Cartridge Core Tubes will not corrode under regular operating conditions. And they won't burst from freezing, because the coolant flows on the *outside* of the tubes. If freezing should compress a tube, causing a "set" and so restricting air flow, passing a rod through it restores it to normal shape.

IF WOUNDED THEY QUICKLY FLY AGAIN. Pictures below show how to replace Winchester Cartridge Core Tubes should they be punctured in action or by accident. They explain, too, why millions of Winchester Cartridge Core Tubes are used to keep planes, and tanks in constant action.

HARDER JOBS WANTED FOR THESE SENSATIONAL TUBES

No war baby, Winchester Cartridge Core Tubes have 25 years of service behind their performance. They offer these spectacular features:

- Of pure copper, thus corrosion-proof.
- Seamless,—safe against leaks.
- Coolant on *outside*—no damage from freezing.
- 1,728 cartridge core tubes per square foot.
- Avoid waste space in radiator assembly—minimum of solder.
- Permit tailoring radiator, to fit any dimension or design.
- Provide up to 25% greater cooling per square foot.

WINCHESTER REPEATING ARMS COMPANY
New Haven, Connecticut
Division of WESTERN CARTRIDGE COMPANY

WINCHESTER
TRADE MARK REG. U. S. PAT. OFF.
"On Guard for America Since 1866"





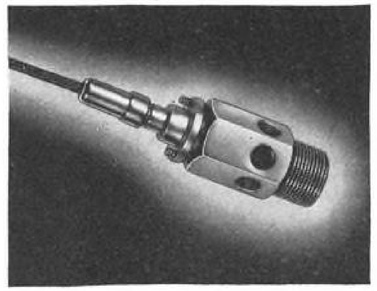
If out of your engineering knowledge, experience, research and skill you are contemplating a new fighting machine for Uncle Sam . . . are dreaming up a startling new post-war automobile, or similar product, write Desk C Radiator Division, Winchester Repeating Arms Company, New Haven, Connecticut.

COPR., 1943, WINCHESTER REPEATING ARMS CO., DIV. OF WESTERN CARTRIDGE CO.

RIFLES • SHOTGUNS • CARTRIDGES • SHOTSHELLS • CARTRIDGE CORE RADIATOR TUBES • FLASHLIGHTS • BATTERIES

Pick-Up 94

Ordinary socket wrench is reported sufficient to install and remove new type pick-up from aircraft engines. It has



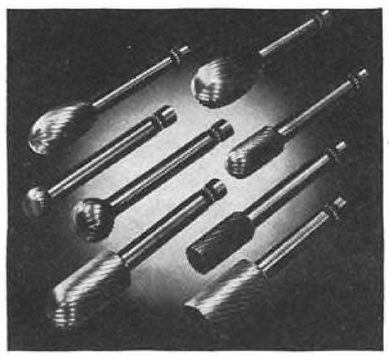
been designed for analyzing detonation and compression conditions and for actuating cathode ray oscillographs when rating fuels. Special coil impregnation has been made to withstand operating temperatures of 350 deg. F. Bayonet socket connects cable to pickup, and two set-screws are used in place of usual hexagonal nut attachment. Unit is in production by **Electro Products Laboratories**, Chicago, under designation No. 3000B.—AVIATION, *Dec.*, '43.

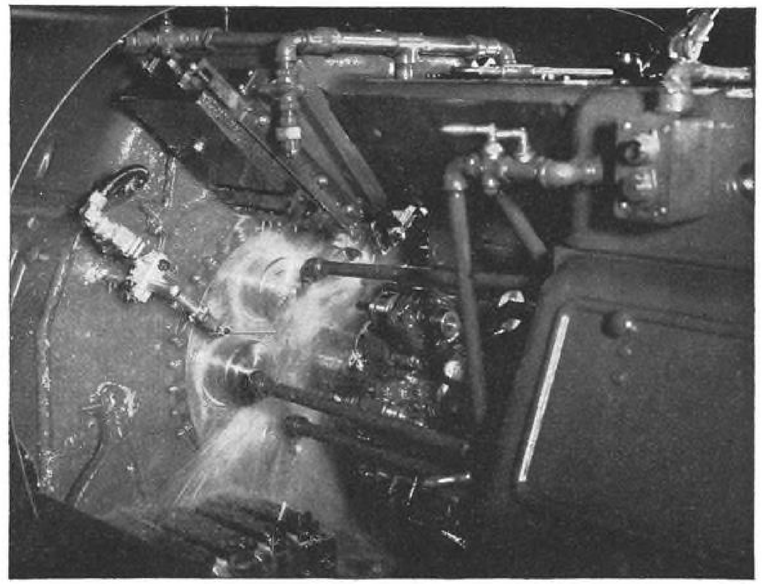
Pay-Offer 95

Wood and fiber calculator devised by **Berger-Brickner Co.**, Los Angeles, Calif., figures pay for straight and overtime of more than 40 hr. in one operation or as separate items. Rate is 40c. to $1.74 with ½c. spread and time range up to 80 hr. with 6- and 15-min. divisions.—AVIATION, *Dec.*, '43.

Rotary Files 96

Three new shapes have been added to original line of ball-end type cemented carbide rotary files produced by **Carbur, Inc.**, Lincoln Park, Mich. Each shape is furnished in two sizes. With cutting teeth ground from the solid, these files, it is said, can be run faster and longer. They also reduce burring time, states maker, and need replacement less frequently.—AVIATION, *Dec.*, '43.



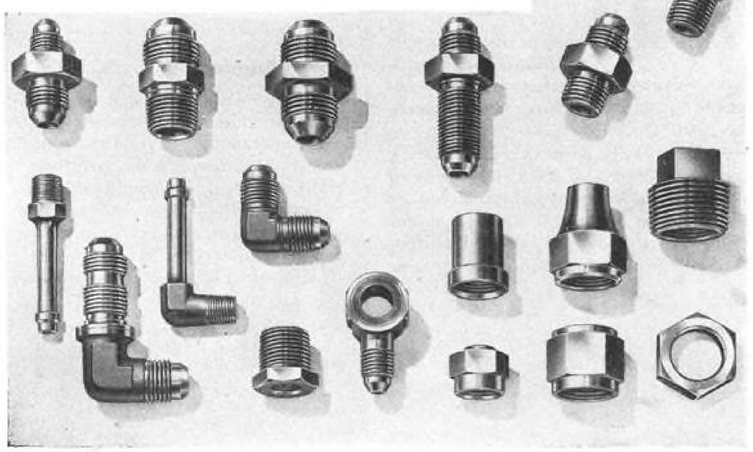


The "Know-How" and the Equipment to produce "AN" Standard Fittings

For well over 60 years Grinnell has been producing fittings for tubing and pipe in sizes from ⅛" to 24" diameter.

This "Know-How", plus up-to-the-minute production equipment, means the ability to turn out *precision* "AN" fittings in war-demand quantities.

We may be able to help you cut down assembly delays. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island.



GRINNELL
WHENEVER PIPING IS INVOLVED

Plants, Branch Warehouses and Sales Offices in Principal Cities.



...with X-RAY

—the modern way to study the internal effects of heat



For example, women welding trainees could not understand how varying degrees of heat affected welds ...classroom discussion only confused them more. Welds made at different current settings were x-rayed. Heat effects were visually revealed... easily understood... training greatly accelerated. This is but one of hundreds of everyday jobs that can be done faster, better and for less money with Westinghouse X-ray—the modern versatile production tool. J-02021

More dope? See page 257

Westinghouse X-RAY

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Vibration Tester 97

For recording vibrations in aircraft testing and on motors and generators, device developed by **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, can be



laid on object being tested or juxtaposed to it by a prod. Vibrations from 60 to 15,000 cycles per min. are recorded on a celluloid tape. Weight of tester is 8½ lb.—AVIATION, *Dec.*, '43.

Crate Sealer 98

Wishnick-Tumpeer, Inc., New York City, is marketing substance to be used as a sealer in shipping cases which often shrink and open up in transit. The material, called Witco Mastic No. 224, can be applied with rake, trowl, or spray gun. It is a dry, semi-hard material said not to become particularly brittle at low temperatures or flow excessively up to 130 deg. F.—AVIATION, *Dec.*, '43.

Cargo Loader 99

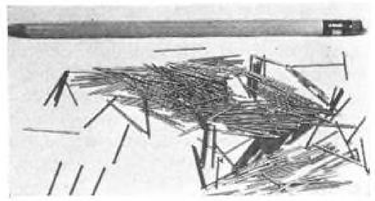
Scissor lift is activated by twin hydraulic cylinders in new truck for loading cargo planes. Cylinders, controlled from either cab or body, lift body vertically to maximum height of 10 ft. or any intermediate level. Lowered height is 4½ ft. Normal payload is 5,000 lb., maximum 8,000 lb. It has been built by **Heil Co.**, Milwaukee, to operate in



temperature range of −50 deg. F., to + 160.—AVIATION, *Dec.*, '43.

Tungsten Alloy 100

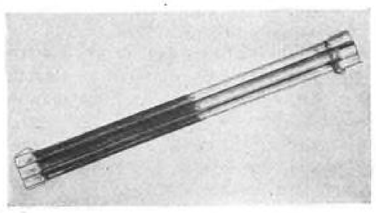
For use in instrument bearing pivots, needle valves, etc., new alloy of tungsten chromium, and cobalt has been developed by **Haynes Stellite Co.**, a unit of Union Carbide & Carbon Corp., New York City. It is cast close to desired size and finished by grinding and lapping. Properties reported: Tensile strength approximately 65,000 psi., Rockwell hardness C-60 to C-62, low coefficient of friction, susceptibility to high polish, and resistance to corrosion from atmosphere and water solutions of salts, alkalis, and acids. Non-magnetic, it has proven useful in compasses and can be brazed or welded to other base



metals and steel. Illustration shows comparative size of pins of this material centerless ground for instrument pivots and pivot tips.—AVIATION, *Dec.*, '43.

Cooler Cleaner 101

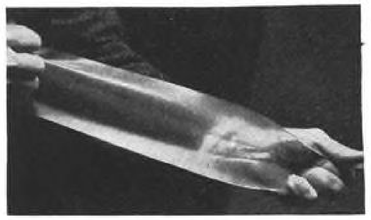
Right portion of aircraft oil cooler tubes in photo was soaked 15 min. in cleaning solution No. 786, rinsed in tap water, and air-dried. Use of this cleaner is reported to eliminate need for steam,



soda, or acid. It is simply circulated through tubes at room temperature for an hour following flushing with Stoddard solvent. Cleaning time is thus cut, according to **Magnus Chemical Co.**, Garwood, N. J.—AVIATION, *Dec.*, '43.

Plastic Material 102

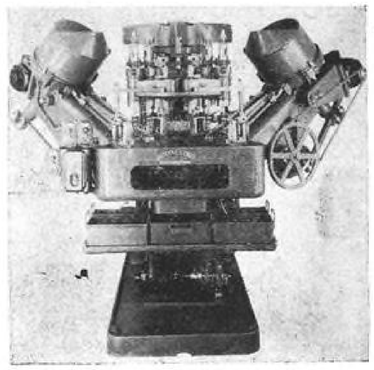
"Compars" is name given new plastic derived from compounded polyvinyl alcohol resin by **Resistoflex Corp.**, Belleville, N. J. Available in transparent, flexible, and solution forms, it is termed more wear-resistant than rubber and specially solvent proof. Described as highly inert, it is being used in hose car-



rying high octane aviation fuels. Other varieties of product have been found flexible in temperature range of −70 deg. F. to +300.—AVIATION, *Dec.*, '43.

Nut Tapper.....103

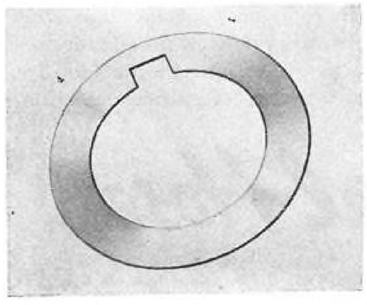
Two hopper feeders having two adjustable chutes each are reported to enable automatic tapping of four nuts simultaneously at four stations on machine manufactured by **The Bodine Corp.**, Bridgeport, Conn. Two sizes of nuts can be tapped at the same time and, after each stroke, each of four produced is discharged into a separate collecting box. Two sizes of machine are available for nuts including ¼ in.—28 and ½ in. —20. Spindle is driven by gears. Addition of automatic indexing dial per-



mits countersinking, drilling, and counterboring. Larger model occupies floor space 80 in. sq. and smaller, which, for example, can tap 160 10/32 in. nuts per minute, takes 80x55 in.—AVIATION, *Dec.*, '43.

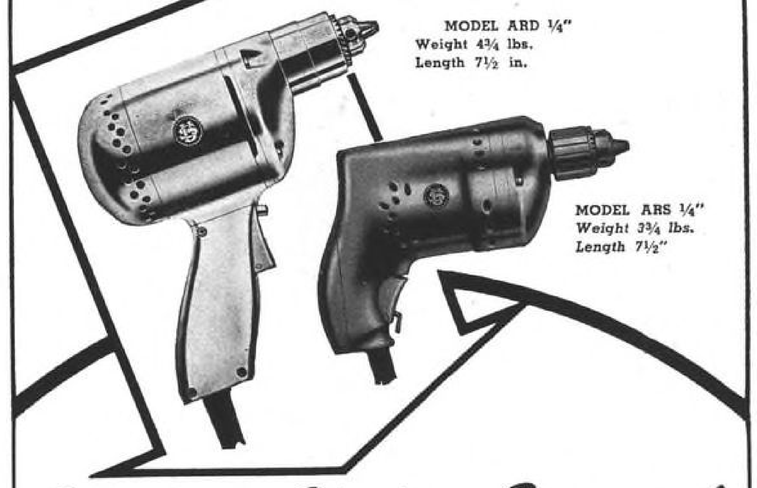
Arbor Spacer.....104

Added to line of arbor spacers is new .0015-in. metal type to permit setting of



"THE GOOD MECHANIC'S CHOICE"

A couple of "Cuties" with tremendous power



United States Special Streamlined Aviation Drills

for use in cramped quarters

Don't let their "daintiness" fool you. They're no "powder puffs" . . . but surprisingly strong in proportion to their size and designed to give plenty of leverage and power where cramped quarters require "pint size" and "featherweight."

Speeds from 550 to 5,000 r.p.m. Equipped with 3-jaw screw-back chuck; 7 ft. 3-wire rubber covered cable, indestructible rubber attachment plug.

U. S. Also Makes:

DRILLS • DRILL STANDS • VALVE SEAT GRINDERS
VALVE REFINISHING MACHINES AND SHOPS
PORTABLE SURFACERS • PORTABLE SANDERS
FLEXIBLE SHAFT MACHINES • LATHES GRINDERS
GRINDERS • BUFFERS • POLISHERS

THE UNITED STATES ELECTRICAL TOOL CO.
CINCINNATI, OHIO, U.S.A.

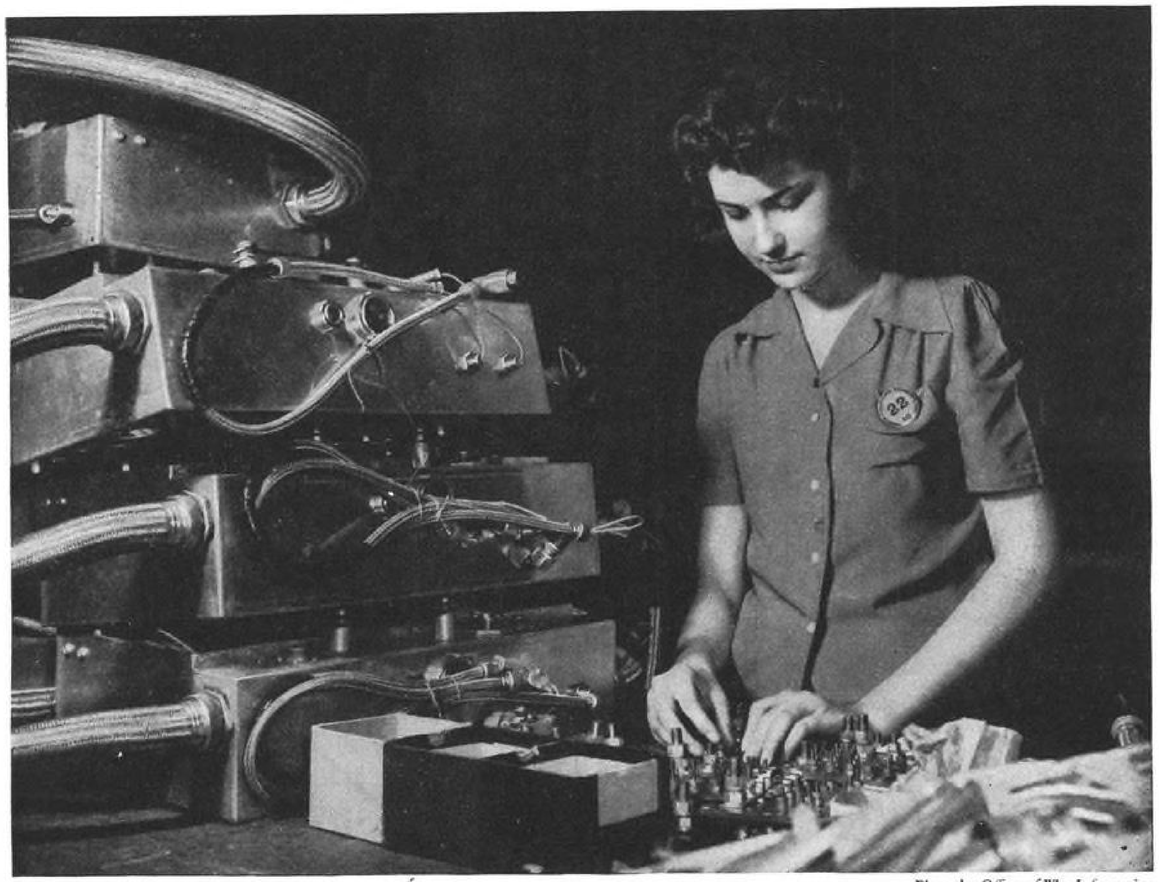


Photo by Office of War Information

PROTECTING THE "Nerve Center" OF A B-25 BOMBER



The young lady is attaching terminals to the panel of an electrical junction box, shortly to become the "nerve center" for a big B-25 bomber. To protect against static interference, incoming and outgoing wiring is encased in Flexible Low-Tension Shielded Conduit made by American Metal Hose.

Wherever planes fly, this battle-tested conduit is playing its part in supporting brilliant performance... enabling radio signals and directions to come in clear and undistorted. It is one of the important "tremendous trifles" that are helping American wartime aviation set so many outstanding records.

American Metal Hose makes a complete line of fittings and accessories for American Flexible Low-Tension Shielded Conduit. Both fittings and conduit conform to A-N, A-C and NAF specifications. We are also prepared to make complete assembly of conduit and fittings to meet individual specifications, thus conserving valuable time on the production line for aviation plants. Inquiries will receive prompt attention.

4318F

ANACONDA **American Metal Hose**

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Conn.
Subsidiary of Anaconda Copper Mining Company • *In Canada:* ANACONDA AMERICAN BRASS LTD., *New Toronto, Ontario*

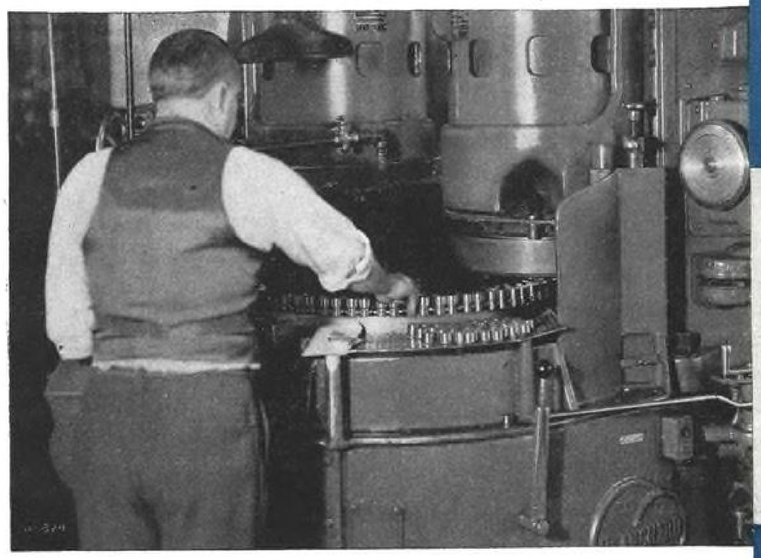
"PUT IT ON THE BLANCHARD"

These heat treated steel trunnion bearings are ground on a No. 16-A2 Blanchard Surface Grinder.

They are loaded on special 80-station fixture with magnetic studs locating from previously ground surface. The end of the bearing is then ground to very close limits. At the unloading station the work is automatically ejected and demagnetized.

.005" to .015" of stock is removed, to limits of ± .0005". 18,500 pieces are produced per 8 hour shift.

Grinding Trunnion Bearings on No. 16-A2 Blanchard Surface Grinder.



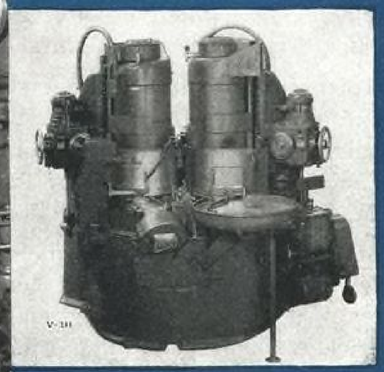
The **BLANCHARD MACHINE COMPANY**
64 STATE STREET, CAMBRIDGE, MASS.



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.

CHECK THESE ADVANTAGES OF BLANCHARD GRINDING

- ★ **Production**
- **Adaptability**
- **Fixture Saving**
- **Operation Saving**
- **Material Saving**
- ★ **Fine Finish**
- ★ **Flatness**
- ★ **Close Limits**



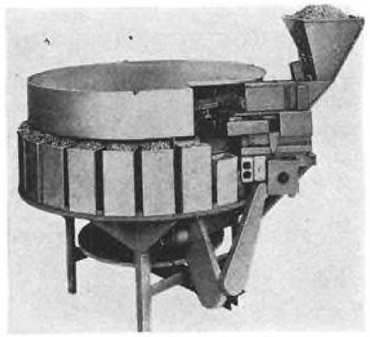
★ ..... *Especially valuable on jobs like the one illustrated.*

BLANCHARD

milling cutters to .0005 in. maker, **Detroit Stamping Co.**, Detroit, is stocking this model in all standard arbor sizes.—AVIATION, *Dec.*, '43.

Fastener Sorter 105

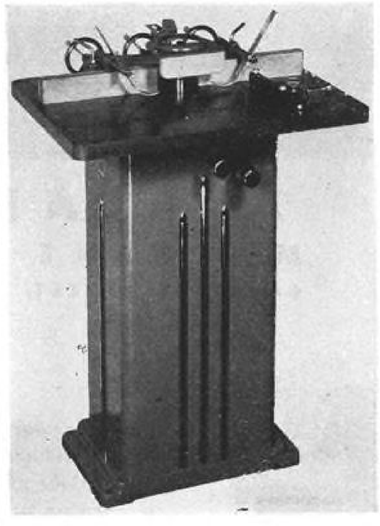
Twenty-four different length screws, bolts, and rivets can be sorted simultaneously on this machine which delivers from 80,000 to 100,000 in 8 hr. into receptacles. Frame is constructed of galvanized steel finished in gray crackle.

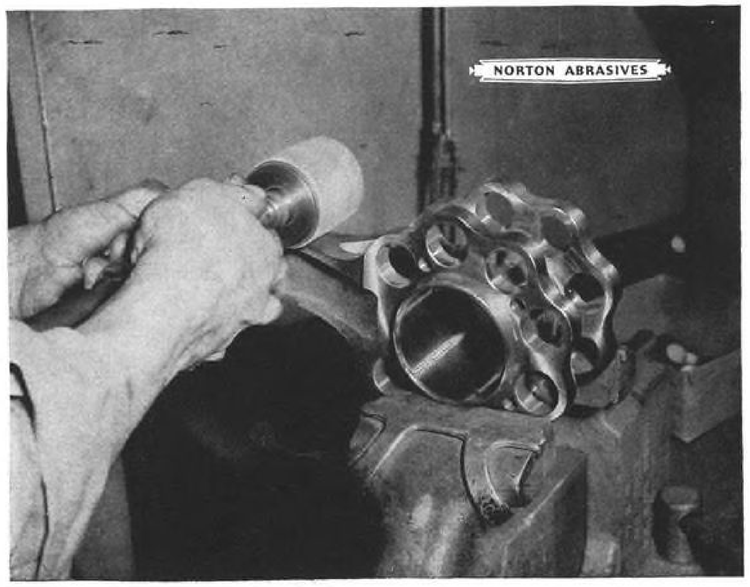


Quarter horsepower motor, for 110 V. a.c. or d.c. power, is attached to friction drive. Sorter, manufactured by **Tubin Engineering & Mfg. Co.**, Los Angeles, occupies floor space 5 ft. sq. It is 48 in. high and shipping weight is 1,200 lb.—AVIATION, *Dec.*, '43.

Spindle Shaper 106

Two different diameter cutter arbors formed on a single piece of vanadium steel are featured in spindle shaper offered by **Boice-Crane Co.**, Toledo. Change from one arbor to other is made by inverting quill. Cutters, which run below work thus permitting material of any thickness to be finished, can be accommodated up to 6¼-in. dia. Diameter





Not a BUMP *in a BOX FULL*

THAT SPIRABAND of Metalite Cloth sanding off burrs on an airplane engine master rod, is doing it many times as fast as could be done by hand—does endless other jobs equally well.

Of spirally wound abrasive cloth with plain cloth liner, it is made *without a joint;* hence NO BUMP as it quickly smoothes rough surfaces or raw edges.

Other ready-to-use "Gadgets"—Spirapoints, Pencils and Edge-slotted Discs—on your portable tools will finish difficult places inaccessible to other means; do them in seconds instead of the minutes required by hand or other old-time methods.

Make all your high-speed tools *better* tools with these reliable, ready-to-use, fast cutting, smooth finishing, resilient abrasive cloth specialties. Available in hundreds of shapes, sizes and grits.

Ask your friendly distributor's salesman for Metalite Cloth Gadgets or write us at Troy or our nearest branch for the services of one of our field engineers. He'll even demonstrate them *on your own work.*

Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, New York, Philadelphia, St. Louis, San Francisco, Tacoma

BEHR-MANNING · TROY, N.Y.
(DIVISION OF NORTON COMPANY)
RELIABLE COATED ABRASIVES SINCE 1872



Cessna Bobcat, Twin-engined Trainer



PESCO engine-driven fuel pump, standard on many planes.

ARMY E NAVY

World's largest educational institution today is the AAF Training Command. In centers throughout the country, hundreds of thousands of the world's finest pilots, ground and air combat crew technicians are trained for action. A tribute to the efficiency of the Training Command, and to the craftsmanship of the workers who build the training planes, is the safety record of the AAF, unequalled in point of flying hours. PESCO Products Co., 11610 Euclid Avenue, Cleveland 6, Ohio. (Division Borg-Warner)

In Aircraft Hydraulics, Fuel Pumps, Air Pumps, Related Accessories...

PERFORMANCE POINTS TO Pesco FIRST



The laziest bird on earth!

ONE UNSPEAKABLE MEMBER of the bird family is too lazy to dig for his own food! He rides on the backs of cows, and waits for them to move through the grass. As they do, they stir up insects for him.

But that's not why cowbirds are hated so. They're too lazy to raise their own young! Mother cowbird just drops her eggs in another bird's nest. Since the young cowbird usually pushes out all the other young, every cowbird is reared at the expense of the lives of at least two other birds!

Only one bird has ever outsmarted the cowbird. That bird is the Yellow Warbler. She just builds a new bottom for her nest—right above the egg of the cowbird!

Americans should have a feeling of kinship for the Yellow Warbler, because this ability to get things done by outsmarting the enemy, by bold, sweeping measures, has made American industry famous. It's the same reason so many of our war plants today are using Cone Multiple Spindle Automatic Lathes to get things done. For example, on one job, an 1¼" Six Spindle Conomatic in 10 seconds per piece completes 11 operations, one of which comprises simultaneous threading and tapping in the same spindle position.

A host of new industrial uses is being developed for Cone Multiple Spindle Automatic Lathes as a result of wartime demands. And after victory is won, these new uses for Cone Automatics will contribute in building the kind of world we've all been dreaming about.

CONE Automatic Machine Company, Inc., Windsor, Vermont

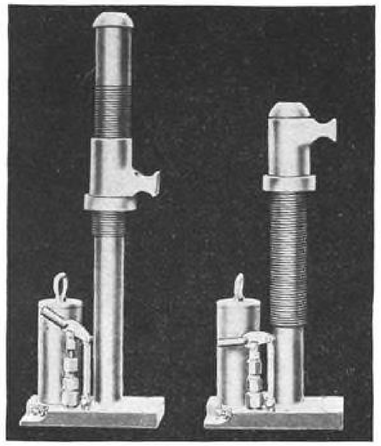
of gap around cutter can be adjusted at 6½, 3½, and 2 in.—AVIATION, *Dec.*, '43.

Shipping Paper 107

Developed to meet specifications for grease-proof, non-corrosive paper for overseas shipment of parts, wrapping material offered by **Criterion Paper & Twine Co.**, New York City, is known as KD8-C-17. Stocked in various sizes, it can be heat-sealed into bags.—AVIATION, *Dec.*, '43.

Hydraulic Jack 108

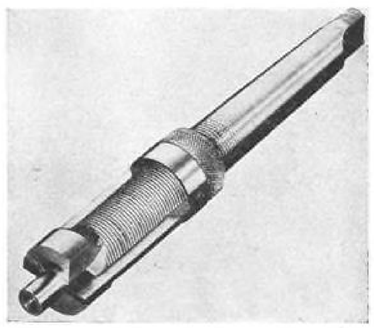
Photo shows hydraulic jack in two positions. Left: Maximum height with threaded axle unit allowing nut to adjust toe at desired level. Right: Axle toe inverted at maximum height of 13½ in. Not shown is minimum height when toe is at 5½-in. level and tail unit at 21¼ in.



While jack has capacity of 5 tons, toe will take 7½ tons on lift of not over 7 in., according to manufacturer, **Malabar Machine Co.**, Los Angeles.—AVIATION, *Dec.*, '43.

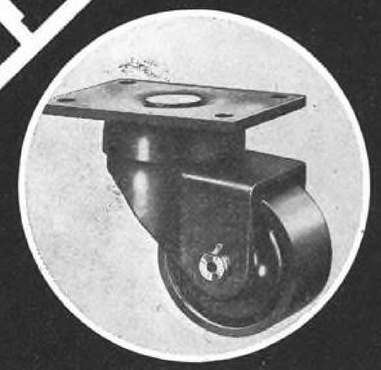
Facer, Counterborer 109

Cutter that quickly can be removed for re-sharpening is feature of new spot facer and counterboring tool. When cutter is replaced it is automatically centered, since body web locates cutter fingers. **J. M. Nash Co.**, Milwaukee.—AVIATION, *Dec.*, '43.



A SAVING AT EVERY TURN

DARNELL



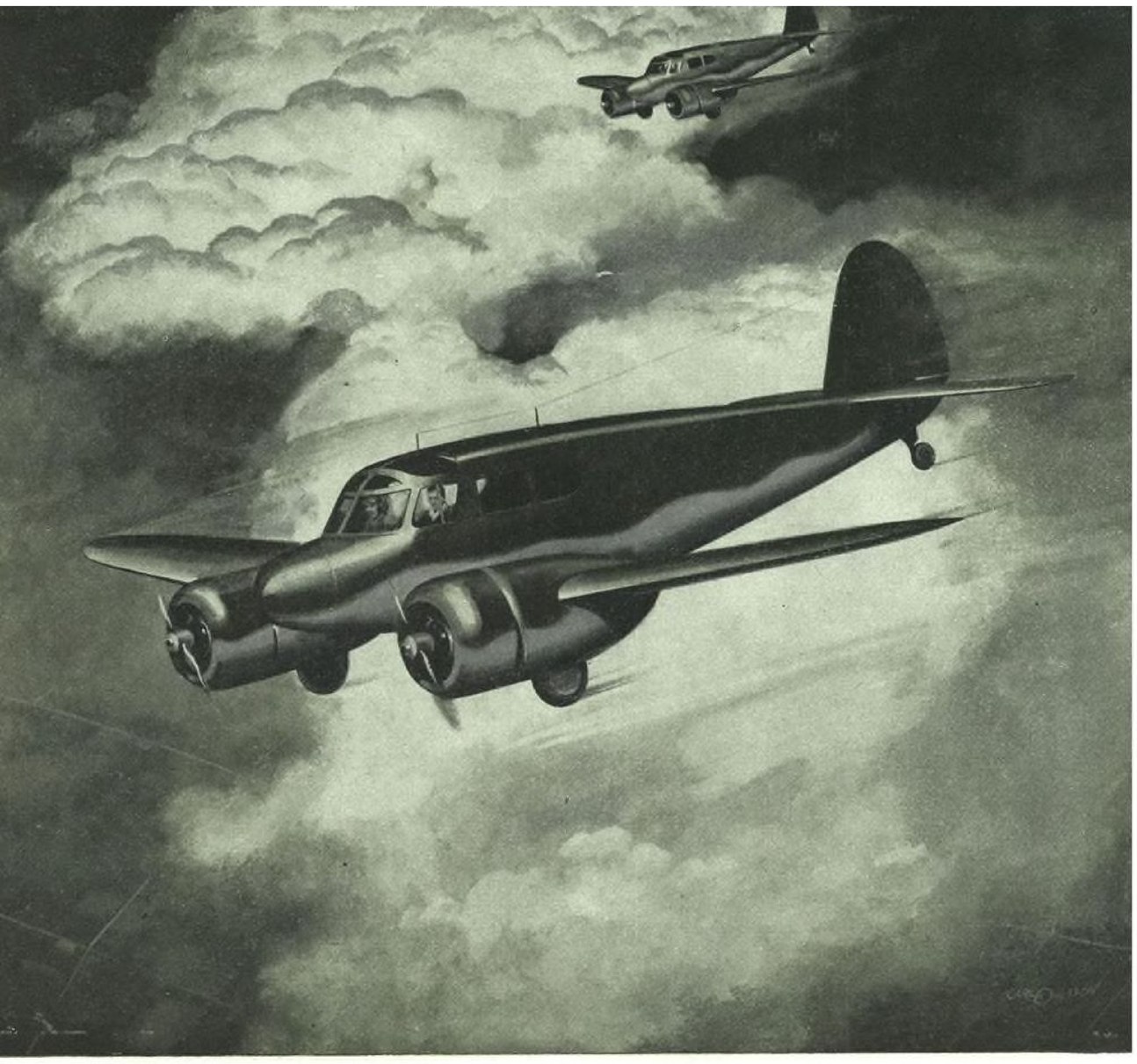
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CASTERS

FREE Manual



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BERRYLOID

AIRCRAFT FINISHES

THERE'VE BEEN some good overload stories lately, but here's a stopper. A 65 hp. *Aeronca*—a job weighing 809 lb. empty—not only got off the ground with a gross weight of 2,375 lb. but it also got to a respectable altitude. The useful load was equal to nine—count 'em—nine 174 lb. passengers.

• A new mid-west plant delivered its first plane the other day, a big cargo job. The craft went immediately to the West Coast where it stayed two days. Just three days later it showed up in Australia. So happy to see you very soon, Tojo.

• Two pilots sent back to this country after serving their tour of duty with a heavy bomber squadron were given a look-see at some of the new armament that will soon be in action. Both men were left slightly goggle-eyed, and one was moved to say, "Boy, I'm glad I'm out of this war before the really heavy shooting starts!"

• Ran across a manufacturer's service representative who gets around a lot and who's got a good idea. He's constantly visiting about a dozen different installations, each of which requires its own identification badge with, of course, rogue's gallery photo. Anyhow, this "rep" says he's going to have them all mounted on one board which he'll just hang on his coat, walk up to any guard and say, "Take your pick, bud."

• A young American was looking at a captured Italian Macchi 202 which had painted on its fin two crude silhouettes of American fighters. Lad studied them a while, then walked away asking, "Are those supposed to be two ships he shot down, two he shot up on the ground, or two he got away from?"

• A manufacturer building one of our newer and more complicated fighters got quite a jolt as he finished taking some reporters—including one completely non-technical gent—through his plant. Starting with the smallest subassembly, he gave them the works, finally ending up in the flight hangar where the normal heavy complement of .50 cal. guns was visible. Chirped the non-technical gent, "Sure go to a hell of a lot of work just to lug a few little guns around, don't you."

• The charming ladies who've taken on so many airline jobs have done a swell job, but occasionally they come very, very close to driving their supervisors completely wacky One of the lovelies, for instance, recently missed a most important traffic meeting. Next morning her harassed supervisor asked how come. "Had a date," was her calm reply. "And with men as scarce as they are, a gal who wants to get married finds any date a lot more important than a dull old meeting."

• Like new taxation schemes, postwar plans come from the strangest places. Take, for example, the one sent in to Carl Friedlander, president of Aeronca Aircraft Corp. It came from Lt. George Haller, waiting out the war in a German prison camp, who wrote that "arrangements have been completed for the handling of *Aeronca* sales in South Africa after the war." Detailing his plans, Lt. Haller asked Friedlander to "kindly write to me confirming the extension of our agreement, covering *Aeronca* sales for a minimum period of twelve months from the cessation of hostilities. We would like you also to arrange for our company to get two of the first *Aeroncas* available for export after the war, as the first company in South Africa to receive new demonstrators will have a big advantage." Unlike new tax schemes, though, you simply can't whip a guy like that.



• Every time we hear these visionary forecasts of at least one helicopter in every back yard, we shudder to think what the third dimension traffic will look like. How'd you like to be in the same sky with a lot of people now allowed to drive automobiles? Called to mind is the remark attributed to Casey Jones who, when asked if the airplane could ever be made safe, replied: "The engineers can make 'em foolproof, but they can never make 'em damfool proof."



"Mr. Maguire is figuring that this may be the last Christmas he'll be sending presents to Hitler!"



The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB POWELL, New York

Allied Superiority Increases in All Theatres; 15th Air Force Activated in Mediterranean

RAF and AAF are now putting up more than 1,000 planes each in concerted attacks. Thus Germany is being hit by more than 2,000 on some occasions. This force will increase rapidly. American fighter strength will be doubled numerically by the new year and its range will permit escort of bombers deeper into enemy land.

In reply, the Nazis are building fighter strength, multiplying anti-aircraft defenses, and burning night oil trying to develop miracle weapons like the rocket bomb, the fire disk, and the electronically guided glider bomb.

Allied shuttle operations between England and Mediterranean bases are giving missions two chances of finding weather suitable for landing instead of one. Italian and African weather will enhance all-winter attack, and the northward advance in Italy brings more enemy objectives within the short range that makes heavy bomb loads possible.

Lt. Gen. Carl A. Spaatz was placed in command of American Mediterranean flyers as the new Fifteenth Air Force was activated to carry the attack from the South. Spaatz immediately sent the 15th on a long-range blow at a Messerschmitt works in Austria. AAF, however, has still to confirm his appointment as an official command.

Some responsible officers still say they cannot detect any curtailment of German power as a result of Allied bombing; others say the Reich is being badly hurt, and that the benefit accrues mostly to the Russians, contributing greatly to their successes.

The Allies have complete command of the air over Italy, but over strong points in Germany the *Luftwaffe* has equality and takes heavy toll. However, average Allied losses are 5 percent, which Britain and the United States can well afford. Except for sporadic raids, Germany seems to have been knocked practically out of the air over England; Hitler is taking 106 tons of explosives for each one he lays on the British.

Goering has replied to RAF *Mosquito* torment with a Messerschmitt 410 two-engine fighter-attack plane. British AA gunners bagged one recently. RAF men looked it over and think they can meet it all right.

In the Pacific, American and British sea and air power has driven the Jap Navy partially to cover. Combined U. S. and British carrier forces are approaching such formidability that they must be considered one of the major "bases" from which the Jap empire can be hit. Great store is set by the new B-29 for this purpose, too, though it is too big to operate from any carrier yet contemplated. But some sources say the Allies have land bases now from which it can operate. If not, they say our sea forces can take the bases when the B-29's are ready.

The Japs are following Germany's strategy. They have cut back on bombers and are concentrating on fighters, a tell-tale defensive move. Their numerical aircraft production rate is thus increased, probably to over 1,000 per month.

The Navy's *Hellcats* and *Corsairs* are reported better than anything the Japs have or can build. Fire power on Navy fighters is five times what it was in 1940. Armor, range, and the ammunition charges have been increased while the planes have surpassed the Jap's in rate of climb and in ability to turn. Incidentally, there are a hundred times as many aerial shooting irons on war ships as there were three years ago.

"Air Superiority . . . First Requirement"

Washington (AVIATION Bureau)—Without publicity and attracting little attention, the Army has issued field regulations which appear to take the AAF another step toward the independence long sought by many of its partisans.

The regulation, printed last July and not yet fully disclosed, says "land power and air power are coequal and interdependent forces; neither is an auxiliary of the other." Secretary of War Stimson caused the regulation to be issued, and it was signed by Gen. George C. Marshall, chief of staff.

"The gaining of air superiority is the first requirement for success of any major land operation," the order says. ". . . Air forces must be employed primarily against the enemy's air forces until air superiority is obtained. In this way only can destructive and demoralizing air attacks against land forces be minimized and the inherent mobility of modern land and air forces be exploited to the fullest."

Theater commanders are instructed to exercise command equally through air force commanders and through ground force commanders. Gen. Dwight D. Eisenhower's command, for example, is handled in this manner.



"CUB" CARRIES CLARK

Lt. Gen. Mark W. Clark (seated behind pilot) hops around Italy directing his 5th Army in Piper Cub dubbed "Eleanor II." Here he is taxied along a Naples street. On another occasion, he landed on a ball field—and got in the soldiers' game. (Acme photo.)

40th Anniversary

As Dec. 17th again approached, Gov. J. Melville Broughton of North Carolina issued a proclamation calling upon the Army, Navy, government agencies, and the industry to send representatives to Kitty Hawk for an observance of the 40th anniversary of heavier-than-air flight and as a tribute to the memory of Wilbur Wright and to his brother Orville, just turned 72.

Medical Agency Urged

Dr. W. R. Stovall, medical director of CAA, thinks that a central agency should be established to make wider practical use of theoretical knowledge of pilot qualifications gathered by military and private aviation.

Since 1926 we have depended solely upon CAA medical examiners and general medical knowledge in determining whether an applicant with certain physical or medical deficiencies should be allowed to fly. The only concern of CAA is whether a pilot can fly with safety to himself and others, in contrast to the military selection of the best flyers available. Despite this difference, civil aviation medicine has been patterned along the lines of the military.

Baruch Appointed Surplus Administrator; Congress Debates Disposal Policy

Washington (AVIATION Bureau)—While Congress debates methods of disposing of surplus government war equipment—which may reach a total value of 75 billion dollars—the administration has made its first definite move to resolve the conversion - termination problem with the appointment of Bernard M. Baruch, chairman of the last world conflict's War Industries Board, to tackle the job.

Baruch will direct a new unit within James F. Byrnes' Office of War Mobilization, which announced that his duties would be "to deal with war and postwar adjustment problems and to develop unified programs and policies to be pursued by the various government agencies concerned." He will also be concerned with adjustments necessitated by "the changing requirements of our war strategy."

In aviation alone, the magnitude of Baruch's new task is staggering. While warplanes generally have no commercial value and the peacetime usefulness of military cargo and troop planes is still being debated, there are vast quantities of engines, propellers—300,000 to 500,000 will have been delivered if the war lasts another year—instruments, and other parts suitable for civilian modification which could glut the postwar market unless some systematic scheme is evolved for disposing of them.

Both Army and Navy are terminating many contracts now—the total is approaching 10,000, but Comptroller General Lindsay C. Warren, who heads the General Accounting Office, says that no one except it has authority to settle claims against the government. Indications at this writing were that final settlements, negotiated by Army and Navy will have to be approved by GAO under law which Congress is now drafting.

Sen. James E. Murray and Rep. Wright Patman have introduced a bill (HR 3580) to have all war surpluses liquidated by a custodian under the direction of a special Senate-House Committee. After hearings, the House Small Business Committee has concluded that one central agency should be created rather than multiple ones for various industries.

No matter what the eventual agency is, it will probably be instructed to operate under policies decided by Congress or the President. It is not yet clear whether the legislators or the executive will wield the control.

There is considerable opposition to Rep. Clarence Lea's bill providing for CAB to dispose of warplanes. The board's chairman, L. Welch Pogue, and vice-chairman, Edward P. Warner, have both expressed the opinion that CAB should not be asked to take sole responsibility for such liquidation. Pogue recommended a new corporation, on whose board of directors would sit representatives of Army and Navy and the State, Treasury, and Commerce Departments and CAB. The aircraft and air transport industries both would approve of an agency to handle aircraft alone rather than be lumped in with a non-exclusive surplus agency.

Many industries want legislation which will require—not merely permit—federal contracting agencies to make immediate cash settlement for costs and losses on canceled contracts. The aircraft industry wants 90 percent of amounts producers certify are due them, with negotiations to come later. Claims against the government hung fire for 15 and 20 years after the first war. Now everybody wants to get in the clear and started on new war production, or on peace work. Both these courses depend upon clear cut action on contracts.

Navy Carrier Force Bigger, More Coming

Washington (AVIATION Bureau)—Navy now has an aircraft carrier force capable of launching a major air invasion of the Jap empire. During 1944-45-46, that force will be heavily augmented.

We now have almost as many carriers as battleships, plus nearly three-score auxiliary (escort) carriers. Next year, delivery of regular carriers will be almost double. (Few people realize that this country is capable of building from one to two of these vessels per month.) In 1944, scores of auxiliaries will be produced by the Navy and Henry J. Kaiser under the Maritime Commission program. In 1945, two new 45,000-ton carriers will be delivered and a third in 1946.

Fleet carriers base 60, 70, or 80 planes each; auxiliaries 5 to 15. The new super-flat-tops will base two-engine bombers, some larger than the B-25's and will be able to take them back.

Probably they will be able to launch four-engine heavies not to be taken back.

The battleships *Iowa* and *New Jersey* displace 45,000 tons, but the same-weight carriers will have greater dimensions, more speed, more guns, and some armor. (Ordinarily carriers are thin-skinned large merchant ships and destroyers.) They will come nearer to the adequacy of land bases than carriers ever have before.

Many authorities believe the carrier is a one-war weapon and that land-based planes, before many years, will have sufficient range to reach all objectives.



SINGLE-PLACE, DOUBLE-ROTOR 'COPTER

Fred Landgraf, aircraft factory engineer and spark of Landgraf Helicopter Co., Los Angeles, inspects experimental helicopter on which he's been working two years. Made of plywood, it has enclosed 90 hp. engine driving rotor through clutch disks and tension rods. Other features: small ailerons on blade tips and retractible tricyle landing gear. (INP.)

West Coast Manpower Utilization Improves, But Materials Still Exceed Personnel

Washington (AVIATION Bureau)—There probably will never be enough manpower to chew up the materials now available. But the situation has improved, resulting in an upsurge in aircraft production which is approaching a rate of 9,000 per month about now.

WPB Chairman Donald Nelson said the increase was due to fewer design changes and to improved utilization of manpower. A controversy has developed over whether manpower was being efficiently used. West Coast plants found from a study that output had increased 4,260 percent since 1940 while personnel went up only 933 percent. But people in several aircraft producing communities feared that the urgent need for warplanes would cause WPB and the Army to cancel too many contracts in non-aircraft lines, disrupting business—and the unions which controlled labor. Congressmen and war supply officials were given many reports of wasteful use of time.

It was hard to tell who was right, and ground was taken and given by both sides. Selective Service deferred irreplaceable workers for a period of six months, with provision for renewal of deferment. This was done at the instigation of Office of War Mobilization Director James F. Byrnes, who said authority of draft boards was not abrogated. It was a program of planned replacement, he said.

On the other hand, C. E. Wilson, chairman of the Aircraft Production Board of WPB, turned down a request of North American Aviation for 10,000 additional workers on the ground that the 37,000 the company had on hand would be enough if used efficiently. This action seemed to have been urged by the Truman Committee, which had received reports from workers and citizens in the Dallas area.

The Area Production Urgency Plan, effective on the West Coast Oct. 15, is said to be working. It is a broad extension of the program to integrate production needs with manpower resources. It was written by Byrnes' OWM, a branch of the White House, and handed to industry. Whether it has been effective long enough to bear upon the current increase in production is not yet determinable.

Back Copies to Spare?

Readers of this magazine, other McGraw-Hill publications, and other scientific journals who would be willing to donate their back copies to the cause of reconstructing the files of war-torn European libraries are requested to get in touch with Dorothy J. Comins, Library of Congress Annex, Study 251, Washington 25, D. C.

Branch Stores and Banks, Incentive Pay Applied to West Coast Manpower Problem

While it was reported that house-to-house canvassing and an Army-sponsored rally which attracted 40,000 Seattleans to University of Washington Stadium had brought a rush of applicants temporarily swamping Boeing employment offices, the company itself and others on the Coast are still labor-short.

Officially Boeing reported that it had recruited 2,700 workers of a required 9,000 in one recent period of about six weeks. Out-of-state hiring teams had dispatched 800 people to the Seattle area with another 950 promised, according to latest available figures.

"While Boeing's immediate labor shortage in Seattle is now eased considerably," it was said, "continued employment over a long period of time will be required for the longer-range build-up and for replacements of normal turnover." To simplify some of workers' living problems, Pacific National Bank and a Seattle department store have established branches in *Fortress* plants (see cut).

More house-to-house canvassing for employees has been sponsored by the Los Angeles County Board of Supervisors and Northrop, Douglas, Vega, Lockheed, and Consolidated Vultee. Two-thirds of 50,000 16- and 17-yr.-old school boys who spent the summer in Southern California plants are expected to continue work throughout the year under an arrangement with school authorities allowing them to work four and study four hours a day.

Meanwhile, two North American and two Northrop plants went on two ten-hour shifts instead of three eights, and set up worker incentive systems—extra pay for meeting quotas. These are guinea pig operations and are being watched by other producers and by the government. Neither labor nor management likes the incentive system, and the War Production Board has had a hard time selling it.

Boeing of Canada Retools

Vancouver, B. C., No. 2 plant of Boeing Corp. of Canada is being retooled for production of Avro *Ansons*, used as trainers for *Mosquito* pilots. The new Roe model will have considerably more power, approaching that of the de-Havilland.

Orders placed with Boeing of Canada have necessitated subcontract of wing assemblies for Martin *Catalinas* to a Portland, Ore., company and the leasing of the civic arena at Nelson, B. C., where 250 employees, 60 percent of them women, will do subassembly work.

Canadian Notes

By James Montagnes

Toronto is to have a new postwar airport, according to Munitions & Supply Minister C. D. Howe. The field, built for war purposes, is to be developed as a postwar government project to accommodate the largest air transports. Advantages of the port, which is now employed by DeHavilland, is that it is but a short distance from the city, not 17 mi. off as is the present commercial field at Malton. The latter is to become an emergency field, while the RCAF training drome on Toronto Island, will become an auxiliary field and seaplane base.

It's now rumored that the Avro *York*, transport version of the *Lancaster* bomber, will be built at the government-owned Victory Aircraft, Ltd., which now turns out *Lancasters*. The *York* seats 50 persons, is 78 ft. long, has a span of 102 ft., and mounts four *Merlin* engines.

New Montreal-Britain record is reported by TCA—11 hr. 56 min. The run was made by one of the company's converted *Lancaster* transport craft carrying passengers and mail on the new twice-weekly transatlantic war service. (Editor's note: The converted *Lancasters* now used by TCA are not to be confused with the new *York*-version planes. One of the converted bombers was incorrectly termed a *York* in our page 272 caption, Oct. AVIATION.) It is expected that TCA will employ *Yorks* in its postwar transocean runs.

The 1,000th *Cornell* elementary trainer built by Fleet Aircraft, Ltd., was recently presented as a gift to the RCAF by the employees of the plant.

Reports have it that the Canadian government is negotiating with Vancouver city officials for large scale expansion of Vancouver Airport. Civic officials have in mind a long-range development view calling for a combined land and seaplane port to serve Canada's third city.

The RCAF, which by latest official data has 32 squadrons abroad, will eventually have 38 such all-Canadian squadrons in overseas operations. In addition, more than 25 percent of the flying strength of the RAF is made up of RCAF aircrews serving, and the percentage is increasing.



While "trying a coat for size," Boeing worker inspects sweaters offered by Seattle's store's branch maintained in "Fortress" plant as shopping aid for time-short employees.

The Washington Windsock



By BLAINE STUBBLEFIELD

The Stubblefield award is reserved this month for Filene's department store in Boston—in case they obtain CAB helicopter certificate and get tangled up in somebody's revolving clothes line while delivering packages. Incidentally, a 'copter at National Airport the other day blew away all trash and dust. Another postwar use: Street cleaning.

Note on the advance of civilization: Migrating birds are detouring the Russian front where the air is full of fighting airplanes, noise, bullets, shells, fire, smoke, and radio locator waves.

You hear high officials using the same ideas and even the same phrases about postwar international aviation. Some agreement somewhere?

There is no freedom of the air or of anything else unless it is guaranteed by popular will and force if necessary. Same goes for sovereignty. A man who will strongly influence the air future said that.

Admiral Land, chairman of the Maritime Commission, recently said that he is opposed to acquisition of air auxiliary services by steamship operators. Of course the operators and the commission may disagree with him.

More about Ploesti: The B-24's used special time-fused bombs, devised by Ordnance, to escape their own explosions. Planes approached at tree-top level to avoid early detection by radio locators, rose to 200 ft. over the target to miss smokestacks. Bombs were skipped into enemy installations.

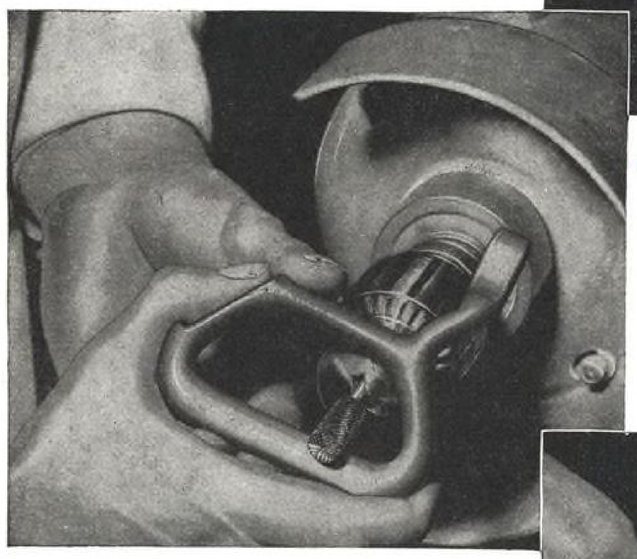
Army objected to OWI's second aircraft report (to no avail) on the ground it could serve no purpose. At least two manufacturers protested what was said about them, and at least one got corrections made.

Industrial designer came here to testify at CAB hearings on feeder lines. By mistake he got into Post Office hearings on charges against a magazine for printing snappy girl pictures. Designer was sworn in—then pulled out drawings of a 20-passenger helicopter.

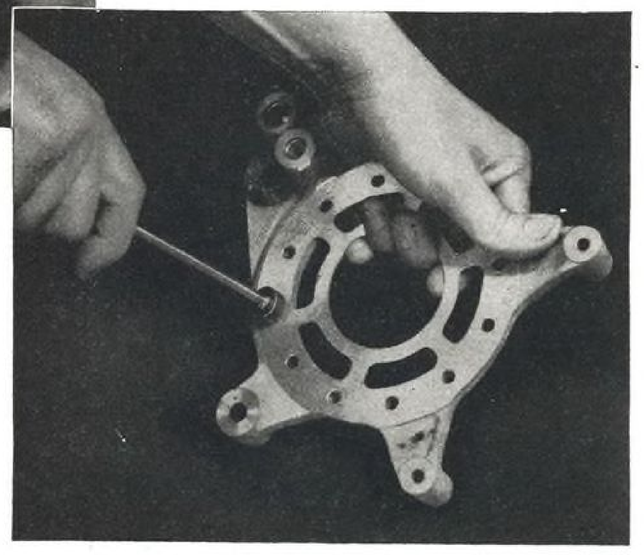
With flexible shaft, with stationary set-up, or by hand
SEVERANCE CUTTERS do the job cleaner, faster, easier

Because of their hardness, design and keen cutting edges, Severance Midget Milling Cutters speed up finishing time, easily do the job two to three times faster than any other type of rotary tool. They take deep, sharp bites and after the teeth are worn, can be successfully re-ground scores of times.





Left: A Severance Midget Milling Cutter being used in a stationary set-up, which many manufacturers of small parts have found to be a great time saver. The part is held in the hand, the tool is held in a chuck on any type of bench lathe, polishing unit or flexible shaft mounted in a vise.



Right: One of the Severance Hand Deburring tools. With a twist of the wrist this Cutter easily bites off the burr or sharp edge left by a drill or punch. Available in a wide range of sizes with radius, ball nose or angle. Write for complete facts on how Severance Midget Milling Cutters can help you speed up your cleaning and finishing operations.

Severance complete line of "Carbide" Midget Milling Cutters are now available.

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SEVERANCE TOOL INDUSTRIES INC., SAGINAW, MICHIGAN. PLANTS IN LONG ISLAND CITY, NEW YORK; DETROIT, MICHIGAN; FORT WAYNE, INDIANA; CHICAGO, ILLINOIS; LOS ANGELES, CALIFORNIA.

CALLING NAMES ★

Tyrrell Krum has been named director of public relations for Reynolds Metals Co. with headquarters in Washington.

Courtlandt S. Gross, president of Vega, was recently appointed vice-president and general manager of Lockheed; **Mort Bach,** works manager of Vega since 1941, also returns to Lockheed as works manager, relieving **John H. Sreenan** from that post in order that he may devote full time toward branch plant production problems. **F. Penn Holter** will assist Bach as asst. works manager; **Jack Cartwright** remains night asst. works manager; **Harvey C. Christen,** another Lockheed veteran, is assigned to a staff capacity representing the works manager's office; **George H. Prudden** succeeds Bach as works manager at Vega and is in turn succeeded by **W. G. Dollmeyer.** Another transfer from Vega was the recent appointment of **Harris McIntosh** as special assistant to **Pres. Robert E. Gross.**

Stewardess Helen Thorne succeeds **Laurabelle Godlove** as instructor of stewardesses for United Air Lines. Miss Godlove returns to active flight duty on UAL's Pacific coast route.

Paul R. Jordan, general manager of Harvill Corp., was elected v.-p. and gen. mgr. at a meeting of the board of directors.

H. Delaney Dilworth joins United Air Lines at Chicago as rate and tariff analyst.

Woodrow Campbell is appointed supervisor of the restaurants and food service for Western Air Lines.

William I. Selover, manager of Sperry's Los Angeles district office, is sporting a diamond studded gold pin in his lapel signalizing 30 yr. with the company. **Pres. R. E. Gillmor** presented the pin at a dinner honoring Mr. Selover.

Richard Brown, chairman of the board of Brown Instrument and v.p. of Minneapolis-Honeywell, has been named deputy director of WPB, 3rd region.

Dorothy M. J. Tracey, v.-p. of Tompkins-Johnson Co., has been appointed general manager, succeeding **Pres. A. R. Johnson** in this capacity.

J. H. Tudhope, former RCAF squadron leader, is appointed executive assistant to **Pres. H. J. Symington** and **V.-P. O. T. Larson** of Trans-Canada Air Lines, with headquarters in Montreal.

Paul Heineck is appointed midwest hydraulics representative of Bendix Aviation, Ltd.

John W. Cross is appointed general counsel of Mid-Continent Airlines.

Frank P. Tighe is appointed director of public relations and advertising for the Houdry Process Corp.

C. Bedell Monro, PCA president, will lecture on air transportation to graduates and advanced undergraduates of the American University School of Social Sciences and Public Affairs during the fall semester.

TWA announces the following promotions: **J. Reay Jones** is appointed asst. to **Traffic v.-p. Conroy; Lee Swigert,** district traffic manager in the N. Y. area, has been promoted to eastern regional traffic manager, succeeding **William F. McGrath,** recently named system traffic supt. at K. C. **A. D. "Don" Williams, Jr.,** is named new N. Y. district traffic manager; **Clyde S. Fullerton** is sales manager; **Louis P. Marechal** succeeds Fullerton as director of traffic training; **Vernon Y. Gunn** is promoted to the newly created post of asst. to the central region manager, **L. A. McDonald** succeeds him as district traffic manager at Dayton; **Ed B. Johnson** as asst. to the regional manager of the recently created mid-west div., with headquarters in K. C.; **Clancy W. Dayhoff** is appointed asst. to **Arthur Stewart,** western region mgr.; **Robert B. Riordan** becomes supervisor on the K. C. traffic training staff, and **Joseph F. O'Keefe** succeeds him; **Norvel Waldron** is asst. to the K. C. traffic training director; **Frank P. McGough** moves up to reservations supervisor, with K. C. as headquarters; **Parks E. Gilmore** becomes Chicago reservations manager; **Dale Y. Ecton** becomes K. C. guide dept. manager, and **George Brown, Jr.,** moves up to post of market research project representative.

Edward J. Eidson is appointed assistant to the general traffic manager of American Airlines.

Wm. Martin Grampp, formerly director of purchases for Brewster Aeronautical, joins Black Bear Co. as general manager.

Jerry Bacon, RFC Ace in World War I, is flight instructor for Southwest Airways teaching RAF and USAAF cadets.

H. Hauflaire is appointed to the recently created position of director of industrial relations; **Charles Young** succeeds him as personnel director, and **Charles Crowther** is the new plant supt. of Aerco Corp.

J. H. Spade is named asst. treasurer at Sikorsky Aircraft. Gardenville Airport near Buffalo offers a free course in flying to the finder of **"Duke"** their unofficial guard. Duke was the custodian of the hangars and the self-appointed guardian of the planes.

Henry S. Jones assumes duties as factory manager of Fairchild's Burlington plant, succeeding **Clayton Merry.**

Luther H. Atkinson is appointed v.-p. in charge of sales of Elastic Stop Nut Corp.

Mrs. Mary Jackson, organizer of women's counseling service at Consolidated Vultee's San Diego plant, is named asst. to the director of industrial relations and will extend the service to other Convair plants. **Miss Thelma Swank,** newly appointed chief counselor, will assist Mrs. Jackson in the organization of a counselor training course.

Alan G. Day is new representative of Hamilton Standard Propellers at Wright Field.

William V. Brown is appointed asst. director of postwar planning for Northeast Airlines. **John T. Griffin** is named operations manager for both Atlantic and commercial divisions; **Howard D. Ingalls** is named v.-p. in charge of engineering and maintenance, and **John A. Reece** is named director of pilot training division.

Walter W. Fowler, operations supt. of Trans-Canada Air Lines, is named asst. operations manager at Winnipeg, and **Frank I. Young,** at present Toronto chief pilot, succeeds him at Moncton. **William J. Lawson,** former Texas secretary of state, is appointed special representative for Braniff Airways.

★ ★ ★

BELL AIRCRAFT TESTED LOXIT SKIN FASTENERS



PHOTOGRAPH COURTESY BELL AIRCRAFT CORP.—SHOWING ACTUAL APPLICATION

FOUND THEM SAFER, FASTER, EASIER TO USE...



Test it . . . as Bell did . . . you too will find it worthwhile

THE LOXIT SKIN FASTENER . . . was recently tested by laboratory technicians at Bell Aircraft, makers of fast P-39 Airacobras, and *found to fulfill all our claims.*

SAFER . . . A higher safety factor, specially appreciated by women workers, is assured by special design and rugged construction. Hardened steel body shell and heat-treated plunger reinforced by tubular sleeve, mean long life and economy as well.

FASTER . . . LOXIT Skin Fasteners need to be compressed only at moment of application. Motion studies show that the resulting 75% saving in worker-fatigue speeds skin fastening by 10%.

EASIER TO USE . . . Simply line up skin holes, using fastener's tip as guide. Compress the fastener, and — snap! — it's in. Being smaller, LOXIT Skin Fasteners are also easier to handle at close quarters, especially near right angle bends.

FREE SAMPLES

A request on your business letterhead will bring you LOXIT Skin Fasteners for your testing. You'll find it fits any standard type pliers or gun. Write today.
Scovill Manufacturing Company, 20 Mill Street, Waterbury, Connecticut

LOXIT SKIN FASTENERS SPEED THE JOB
... A SCOVILL PRODUCT

Hush on B-29 Partially Lifted

"We now have a third superbomber . . ." said Gen. H. H. Arnold, chief of the Army Air Forces, for the first time publicly mentioning the B-29. The plane, he revealed, was "developed by the Boeing Aircraft Co. in close cooperation with the AAF and its Materiel Command and evolved in secrecy during the past several years.

"The engineering of the B-29 design was accomplished by the large Boeing staff at Seattle, which originated and developed the B-17 *Flying Fortress*. First experimental models were built at Seattle.

"Engineering and production information has been turned over to other major aircraft manufacturers who also will produce the plane through final assembly and to other industrial concerns which will handle subassembly or parts production."

This War Department statement, quoting Gen. Arnold, gave no more specific information, but it is known that initially two Boeing plants, one bomber plant, and another built specially for this plane, will turn out B-29's. Concerns making subassemblies include at least one leading automotive producer.

Gen Arnold said that the B-29 is as far ahead of the B-17 and the B-24 as they are out in front of prewar bombers. He emphasized, however, that production of the B-17 and the B-24 is being steadily increased.

Performance of the new bomber cannot be discussed before it enters combat (sometime in the spring, according to the OWI). The AAF chief said that it has a range "substantially greater" than the maximum effective range of today's longest-range heavy bombers, and it will carry quite a sizeable bomb load for that distance. "When it enters combat," he said, "today's long range will become medium range and today's heavy bombers will consequently become light heavies."

Competent sources said the B-29 is wanted in the attack on Germany to carry heavy loads of bombs to munitions works in eastern Germany and those that have been moved into Austria, Czechoslovakia, and Poland.

Gen. Arnold previously had said the new heavy bomber would be able to attack Europe from U. S. shores. He did not say with what percentage of load. The model now in production is not the same as the original design.

When there are enough B-29's, they will doubtless attack Japan from points now in Allied hands or which can be taken with rapidly increasing Naval, Army, and air strength.



MISSION FROM CHILE

Chile has more pilots than planes, so extra craft from this country would help augment her participation in hemisphere defense, according to Lt. Gen. Manuel Tovarias Arroyo. Arriving in this country by PAA "Clipper" for a tour of U. S. and Canadian bases and plants, he is greeted by Lt. Col. E. J. Hall. In background (left) are Alfred Canel, office of Coordinator of Inter-American Affairs, and Capt. Javier Undurraga Vergara, the general's aide. At a press conference, general revealed that Chile is watching Strait of Magellan for Jap blockade runners. (International News photo.)

★ SPOT CHECKING ★

The National Clinic of Domestic Aviation Planning was convening in Oklahoma City at press time. Scheduled speakers: Col. E. S. Gorrell, Casey Jones, Igor Sikorsky, Eddie Rickenbacker and Mayor LaGuardia.

Aeronautical Chamber of Commerce has approved "in principle" recommendations submitted by its Economic Development Committee following the latter's recent Colorado Springs meeting. Twenty-nine specific suggestions were prepared on contract termination, contract renegotiation, export, and use and disposition of surplus government-owned aircraft and defense plants and equipment (p. 118 and 262, Nov. Aviation).

Nation's first successful helicopter, Sikorsky's VS-300, has been presented to Henry Ford's Edison Institute, Dearborn, Mich.

Production of 100 octane gasoline, now four times that of early 1942, will be doubled again in the next few months, OWI discloses. Units, employing new or improved cracking processes have recently been put in operation by Gulf and Socony-Vacuum. Atlantic is building two more large units.

Roy A. Watkins, executive vice-president of Howard Aircraft Corp., believes the work of women in aircraft so satisfactory that they will hold their jobs after the war despite expected pressure to fill their places with men.

Low pressures at altitudes above 30,000 ft. can disturb brain gray matter and produce blindness on one side of a pilot's vision, it has been reported to Aero Medical Assn. The symptom disappears on landing.

Opening in Alabama of new bauxite (aluminum ore) mines is reported by the Bureau of Mines. Coincident, however, was a WPB announcement of cutbacks in the bauxite production program in order to save labor.

Reported is award of a subcontract to Hayes Mfg. Corp. for Bell plane wing and tail subassemblies.

The Cub Flier's Club, sponsored by Piper to teach its employees to fly, now has 107 women in its total membership of 276. Twenty-two of the 200 stars in the Club's service flag are for former girl workers now in the WASP.

★ MILITARY MEMOS ★

The Mediterranean campaign was a year old early last month, and when Allied air forces assessed damage inflicted they counted 6,000 enemy planes destroyed, half of them on the ground.

Over the past four months, RAF has dropped an average of 16,000 tons of bombs a month on Nazi territory, the U. S. 8th 5,000 tons.

Remington Arms Co. announces development of new incendiary .50 cal. ammunition called "hot enough to ignite self-sealing gas tanks."

Seventy percent of crews shot into the sea in one theater have been picked up by AAF's new Emergency Rescue Branch.

Wounded are being evacuated on litters designed to fit in bomb bays of *Fortresses* and *Liberators*.

Lt. Gen. Ira C. Eaker, commander of the 8th, has been made a Knight of the British Empire by King George. Like all U. S. citizens he is forbidden to accept the accolade of knighthood and the title "Sir" by the U. S Constitution.

Maj. Gen. Clayton L. Bissell is new assistant chief of air staff for intelligence, succeeding Brig. Gen. E. P. Sorenson. Gen. Bissell is former commander of 10th Air Force (India).

While Jap air power in the northern Solomons seems to have been liquidated, Maj. Gen. George V. Strong, chief of intelligence, general staff, warns, "The Japanese are in a strong position today and their power in many respects is steadily increasing."

Navy's prewar flying personnel of 1,200 has grown to 29,000 and will be more than double that figure in the next year, says Under Secretary Forrestal.

Locations and Commanders of Army Air Forces

1st —Mitchell Field, N. Y.; Brig. Gen. Frank O'D. Hunter
2nd—Colorado Springs; Maj. Gen. S. T. Clair Streett
3rd —Tampa, Fla.; Brig. Gen. Westside T. Larson
4th —San Francisco; Maj. Gen. Wm. E. Lynd
5th —Australia; Lt. Gen. George C. Kenney
6th —Canal Zone; Maj. Gen. Hubert R. Harmon
7th —Hawaii; Maj. Gen. Willis H. Hale
8th —England; Lt. Gen. Ira C. Eaker
9th —Middle East; Maj. Gen. Ralph Royce
10th —India; Brig. Gen. Howard C. Davidson
11th —Alaska; Maj. Gen. Davenport Johnson
12th —(Disbanded)
13th —South Pacific; Maj. Gen. Nathan F. Twining
14th —China; Maj. Gen. Claire L. Chennault
15th —Mediterranean (Commander not yet announced)
China-Burma-India Air Force, India; Maj. Gen. Geo. E. Stratemeyer

OBITUARY

Graham Bethune Grosvenor, 59, member of the executive committee and board of directors and special assistant to the president of Pan American Airways; former president of Aviation Corp. and Fairchild Airplane Mfg. Corp. and former vice-president of Fairchild Aviation Corp. and Otis Elevator Co. of Texas.

David Beecroft, 68, onetime assistant secretary and director of Bendix Aviation Corp., which he joined in 1928 when it was known as Bendix Corp.; treasurer and past president of SAE.

Caleb S. Bragg, 56, test pilot and altitude flyer during last war and shortly thereafter, in 1916 co-organizer of Wright-Martin Co., later inventor (with V. W. Kliesrath) of booster vacuum brake bearing their names, subsequently president of Langley Aviation Corp. and vice-president and consulting engineer to C. M. Keys Aircraft Service, a position he resigned last spring.

Record 8,362 Planes Made in October Includes New High in Heavy Bombers

After months of striving against obstacles, chiefly the manpower shortage and design changes, the industry made a 10 percent production gain of 764 planes in October. The total for the month was 8,362.

Donald Nelson, WPB chairman, just returned from a trip to war fronts, made the announcement and expressed the satisfaction of military and civilian leaders.

The new production record included a new high in heavy bombers for any month. October slightly exceeds a rate of 100,000 planes a year and represents the best month-to-month gain since an increase of 10 percent was recorded last May.

Nelson said the rise was due chiefly to increased labor productivity and to a reduction in the number of design changes on some models which have gone "over the hump" in that regard. The average monthly airframe weight output per employee now is about 60 lb. compared with 28 in Jan., 1941.

"We are going to produce more and more *Fortresses* and *Liberators*," Nelson said, "as well as large numbers of super-bombers," i.e., the B-29.

An unknown number of B-29's was included in the October count. Increasing emphasis on the now "light-heavy" B-17's and B-24's and on the heavy B-29's will cause numerical output to mean even less in estimating effective air power than in the past. Nevertheless, the President's suggestion that for accuracy aircraft production be reported in pounds is still not followed. A production official recently revealed that the average weight of warplanes has increased 50 percent during the past three years and will increase another 50 percent in a shorter time.

October numerical production compares with 7,598 in September, 7,612 in August, 7,373 in July, 7,094 in June, and 7,087 in May. Some authorities believe the rate can reach 10,000 per month by the new year, but many disagree.

There is no official mention of the Byrnes manpower directive which was made effective on the West Coast Oct. 15. It is believed that it could not have had much influence on production at the time of this writing.

Navy announces that its recent production emphasis has also been on bombers. Torpedo plane production in the first half of 1943, it is said, "was larger than during the preceding 30 months of the defense program combined. Production of dive and patrol bombers in the first six months of this year approximates total production in the preceding two-and-one-half years."

Distributors Plan Clinic

Plans for a service clinic to be held in collaboration with the National Aviation Training Assn. were discussed at a recent New York gathering of the Aviation Distributors and Manufacturers Assn. The latter is holding its first annual meeting at the Hotel Jefferson, St. Louis, Dec. 1st, 2nd, and 3rd simultaneously with the NATA convention in the same city.

In the preliminary New York gathering, some 35 manufacturers and distributors also considered tentative drafts for their proposed St. Louis program. Accomplishments, future plans, and relations with NATA were also discussed.

Officers of ADMA are Ray Snyder, president; W. F. Scott, Jr., vice-president; and George A. Fernley, secretary.

Brewster In Recoup; Contracts Changed

After weeks of disturbing headlines and a House Naval Affairs Committee investigation of its management and labor and the Navy, to which its three plants are assigned, Brewster Aeronautical Corp. has settled down to an attempt to recoup its production, which had slumped badly, according to several official charges.

Henry J. Kaiser, noted shipbuilder, recently assumed the Brewster presidency, succeeding Frederick Riebel Jr., who last spring succeeded C. A. Van Dusen. Riebel had made a good record as trouble shooter for the Navy and has gone back to that work. Company has a new contract with the CIO automobile workers union; it has been entered on the records of the Naval Affairs Committee. Differences between management and labor seem to have been patched up.

The company's SB2A shipboard dive-bomber (and its British *Bermuda* version) are to be tapered off to cancellation as of the first of the year to devote full capacity to the Vought-designed F3A *Corsair*. Twelve of them were delivered, Kaiser announces, between the first and sixth of November. "We have only just begun," he says, promising "real production" by the first of the year.

During October, he reports, his Vancouver shipyards built four aircraft carriers.

'Copter Laboratory Asked

A laboratory to develop the aerodynamics of the helicopter will be constructed at Langley Field, Va., by the NACA if funds requested are authorized by Congress.

The first supplementary appropriations bill for fiscal 1944 contains an item of $1,161,500 for an NACA lab for work on wing flutter, vibration, compressibility, and helicopters.

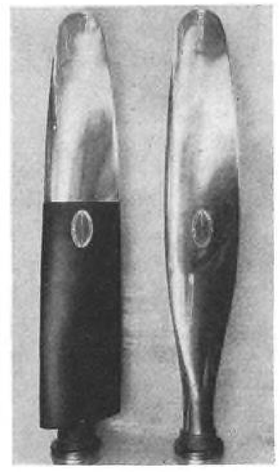
NACA, in its testimony, stated that the helicopter is being successfully flown without complete knowledge of rotor operation. More information will have to be gathered before large helicopters can be perfected, officials say.

Phenomena of flutter and compressibility at speeds above 400 mph. will be studied in the proposed lab at the urgent request of the armed forces.

Prop Fairing for P-51

Propeller blades, faired with a cuff "molded of a very light synthetic hard rubber sponge covered with a layer of erosion resistant material," Hamilton Standard Propellers announces, are now in production for North American P-51 *Mustangs*.

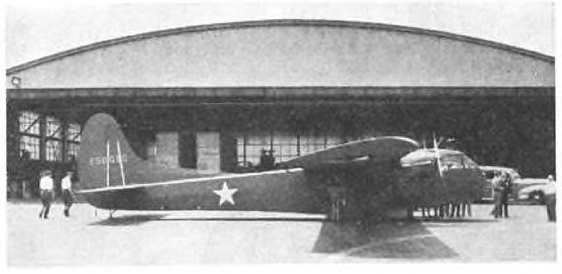
Attached to the shank, or inboard portion, of the blade, the cuff produces "some improvement in the over-all efficiency of the propeller and a resulting increase in top speed of the plane due to an improved fineness ratio at the shank of the blade," the company reports. The installation weighs from 4 to 6 lb. per blade.



Changed shape imparted by synthetic rubber sponge is shown in new blade (left) manufactured by Hamilton Standard. Aim is better cooling, efficiency, and airspeed.

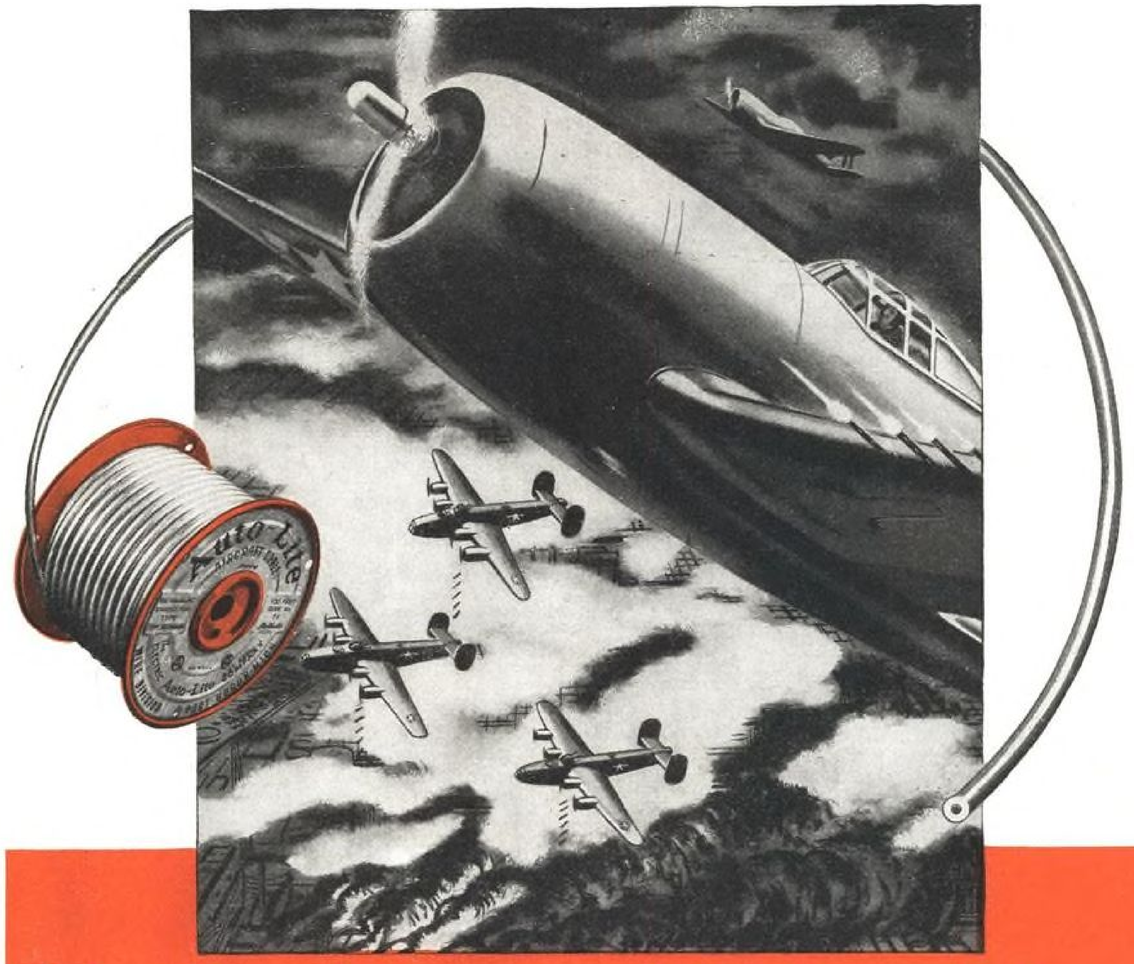
While fairings are being used on the liquid-cooled P-51, their principal purpose is to improve cooling of air-cooled engines during warm-up and in flight. (For details of manufacturing procedure, see p. 167 October AVIATION.)

Hamilton also announces that its production of warplane propellers has multiplied more than 24 times since Sept., 1939. Including output of licensees, it will be 60 times at the beginning of the year. The company has just opened a new plant at Pawtucket, R. I.



POWER GLIDER TESTED

Power glider of CG-4A type recently given test flight at Newark Air Base. It was built by Ridgefield Mfg. Corp., Ridgefield, N. J., as an AAF experimental project. Its two wing engines are demountable. First CG-4A with power was devised by engineers of Northwestern Aeronautical Corp. who installed two 130 hp. engines built by Aircooled Motors Corp.



Bomber Crew and Fighter Pilot

Our airmen know the importance of planes that set new and superlative records of performance. Machines as well as men can outmatch the enemy.

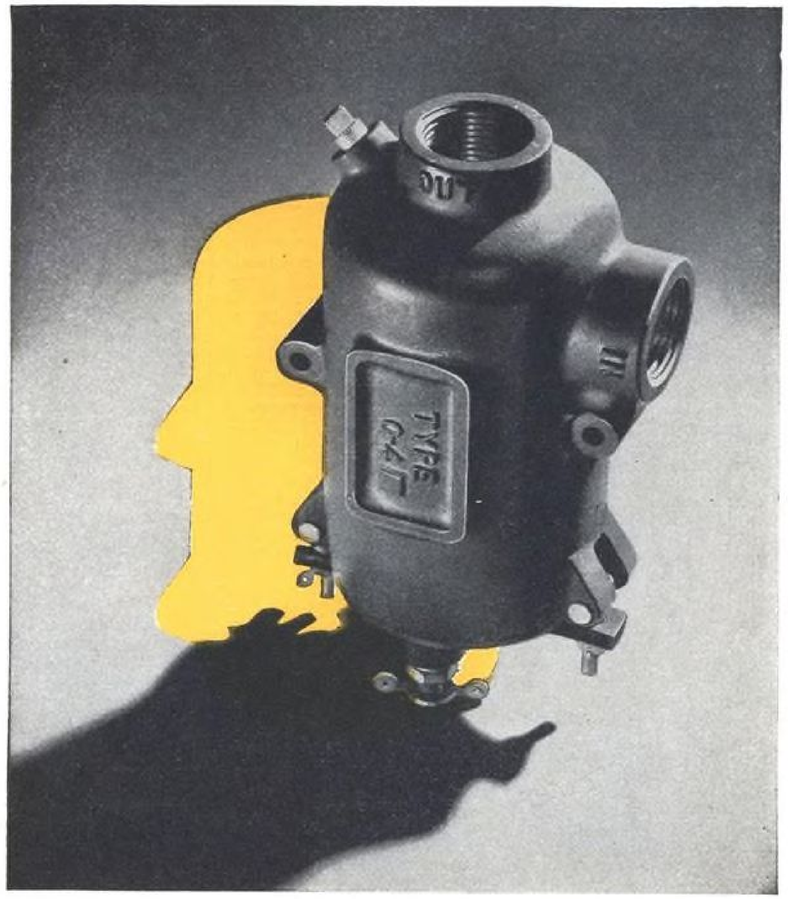
Wire plays its part—it forms a giant nervous system in excess of 10 miles in length in the Axis-smashing Super Bombers. This complicated system which controls ignition, power, lighting and instrument installations can be—and *has been*—completely precision engineered.

For the high tension system, Auto-Lite supplies Steelductor, now the choice of engineers for the majority of bombers and fighting planes. Details are given in Form No. C-503. Details of wire and cable for low tension systems are given in Form No. 838. We'd appreciate your making sure these valuable bulletins are in your file. They will be mailed promptly on request.

SARNIA, ONTARIO — THE ELECTRIC AUTO-LITE COMPANY, *Wire Division* — PORT HURON, MICH.

AUTO-LITE AIRCRAFT WIRE and CABLE

IN ITS 26 GREAT MANUFACTURING DIVISIONS, AUTO-LITE IS PRODUCING A LONG LIST OF ITEMS FOR AMERICA'S ARMED FORCES ON LAND, SEA AND IN THE AIR



FUEL STRAINERS — AIR CORPS TYPES

Air Associates has the complete range of Aircraft Fuel Strainers in full production. Included are types C-1A, C-2A, C-3, C-3A, C-4, C-4A, C-5, C-5A and various special modifications of these standard types . . . *All are manufactured in accordance with latest revisions of Army and Navy Drawings and to latest manufacturing specifications* . . . Body design permits right or left hand mounting. Drain cocks are provided in the base. Screens, of monel metal, are easily removable for inspection or cleaning . . . Present production schedules permit the acceptance of additional orders for early delivery . . . Inquiries invited.

AIR ASSOCIATES, INC.

TETERBORO, N. J. . . . *BRANCHES:* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927

Plans for More C-46's, 25,000th Buick P & W Among the Month's Production Highlights

Plans for increased production of C-46 *Commandos* and the delivery by Buick of the 25,000th *Liberator* engine are among last month's production notes released by manufacturers.

Curtiss-Wright and Higgins Aircraft, in cooperation with AAF, says B. S. Wright, director of C-W's Airplane Div., will produce C-46's on the largest scale ever contemplated in the manufacture of transports. No figures have been released, but work will be carried on in Curtiss plants in Buffalo, where the planes are already being produced, in St. Louis and Louisville and in a Higgins factory near New Orleans. Both companies will build complete planes. Under separate license, Higgins will make outer wing panels for Curtiss Buffalo plants, and the Louisville C-W factory will produce the same parts for St. Louis. Members of an executive committee, named to coordinate the activities of the various plants, are Col. Orval R. Cook, Production Div., Materiel Command, Wright Field; John J. Lee, manufacturing developments manager for C-W Airplane Div., with R. G. Miller, *Commando* coordinator, as alternate; and George A. Allward, chief Higgins aeronautical engineer. His alternate will be F. O. Higgins, production vice-president.

The Higgins factory, dedicated only a few weeks ago, was built on the site of the company's shipyard abandoned when the Maritime Commission cancelled a contract for 200 Liberty vessels some time ago. The plant cost $27,000,000 and was originally scheduled to build C-W C-76 *Caravans*, which were recently discontinued in favor of *Commandos*.

At least 60 percent of its Newark, N. J., personnel, Brewster announces, is working on C-46 wing ribs, spars, and engine nacelles under subcontract.

In announcing completion, in less than 21 months, of the 25,000th Pratt & Whitney R-1830-43 1,200 hp. radial for Consolidated Vultee *Liberators*, Harlow H. Curtice, director of General Motors' Buick division, said he believed the record had been achieved with the lowest man-hour–horsepower ratio on record. All engines manufactured to date, he said, have been accepted by AAF.

Another General Motors subsidiary, AC Spark Plug, reports that in building many thousand British-designed bomb sights for RAF and lend-lease planes in the last 15 months, production time has been cut one-third. Manufacture and assembly of some 4,200 parts was broken down into assemblies to be produced by subcontractors.

Because its North Michigan plant is going into production of Rolls Royce *Merlin* engines, Continental Aviation & Engineering is shifting work on a radial power plant previously built there to a factory at Garland, Texas. Both plants are scheduled for full capacity work.

Construction, scheduled to be completed by next April, has been begun on a $1,225,000 addition to an experimental building at Consolidated Vultee's Fort Worth plant. Spanning 300x300 with 60-ft. doors opening full width, the building will contain load testing scales of 150-tons capacity, five times the weight of a *Liberator*. . . . New test hangar has been completed for Curtiss-Wright's Propeller Div. at Caldwell-Wright (N. J.) Airport.

Practically the entire facilities of Lockheed are being devoted to production of *Lightnings*. . . . On a tour of Grumman plants, Rear Adm. D. C. Ramsay, chief of Naval Bureau of Aeronautics, recently called the *Hellcat* fighter "one of the best in the world. We consider the Grumman plane will play a successful part in the prosecution of the war against the entire Axis," he added. Whether this statement included Germany, he did not say.

Also in the visiting party was Representative Harry K. Sheppard, chairman of the House Naval Appropriations Committee, who gave it as his opinion that Grumman's was probably a "model plant not only in production but in lack of absenteeism."

Full-scale production of bomber wings has begun in the new South Scranton, Pa., plant of Murray Corp. of America. . . . Defense Plant Corp. has advanced $900,000 to American Propeller Corp., subsidiary of The Aviation Corp., for new equipment.

"Mars" to Navy

Glenn L. Martin Co. has delivered its 70-ton flying boat *Mars* to the Navy for further tests looking to its use in Naval Air Transport Service.

Designed for patrol work, the plane has been altered for transport service. On a recent endurance test flight, which lasted 32 hr. 17 min. over 4,600 mi., she took off with total weight of 141,000 lb. which included 22 passengers and fuel tanks not quite full. In another pre-delivery test, the plane, with a wingspread of 200 ft. and hull 117 ft. long, power dived from 13,000 ft., pulling out at more than 3G. Four Wright *Cyclone* 18's develop more than 8,000 hp., cargo load is put at 15 American tons.

Bendix Announces New Type Compass

A new type compass, known as the gyro flux gate compass, which gives accurate readings without lag through maneuvers up to 65 deg. from horizontal has been revealed by Bendix Aviation Corp. The new device, described as a significant advance in the field, is in volume production and has been used on American bombers for more than the past year and a half.

The flux gate unit utilizes a new principle in which the conventional swinging needle is replaced by a fixed coil system using energy generated by the earth's magnetic field. With power supplied from the aircraft's electric system, this energy is amplified to operate the reading device. It is, in effect, a combination of two units: The flux gate itself, mounted on a gyroscope to keep it in a constant position relative to the earth's field, and the receiving unit, or reading dial.

The compass is reported to give accurate readings without tending to "overshoot" or "hunt." It can be used to within less than 5 deg. of the magnetic pole, compared to approximately 20 deg. with the conventional magnetic compass.

The flux gate can be located anywhere in the aircraft. It can thus be removed from sources of interference, a fact which might simplify airframe design problems. As many as six remote reading dials, connected with the master unit, can be operated simultaneously. Corrections can be made for both variation and deviation, with the remote control units always giving the same readings as the master unit.

Conversion Plans

A program for postwar manufacture of hydraulic valves and companion equipment for buses, trucks, and trailers has been announced by Aircraft Accessories Corp., which is now producing aircraft hydraulic apparatus in Burbank, Calif., and radio equipment in Kansas City, Kan., and Slater, Mo. An automotive valve now being tested in the company's laboratory is said to weigh only one-fourth as much as those being used now.

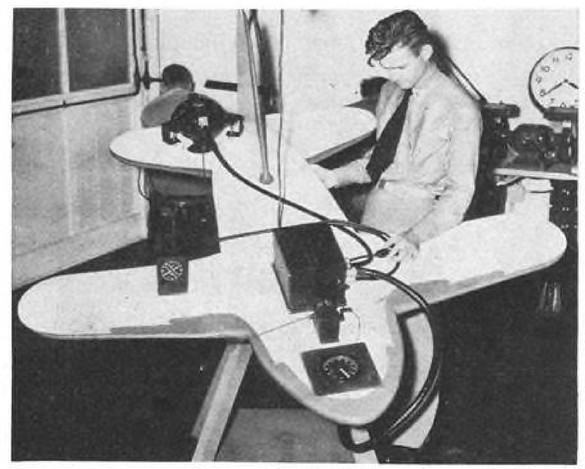
Westinghouse has a planning committee surveying conversion, postwar markets, and the consequent needs for materials and personnel.

Martin-Nebraska Gets New Contract

In connection with new and important production assignments by the Army to the Glenn L. Martin Co., Joseph T. Hartson, formerly executive vice-president of the firm, has been elected president of Glenn L. Martin-Nebraska Co. at Omaha, succeeding Mr. Martin in that office.

The Nebraska plant is tapering off output of B-26 medium bombers and a new heavy bomber will be made there in its place. Production of the B-26 will continue at Baltimore, Martin says, adding, "Our over-all responsibilities at Baltimore will be increased."

It is believed that Martin has been assigned the production of a new aircraft for the Navy. A group of high Naval officers, headed by two admirals, recently met with the management at Baltimore to "announce their new requirements and to urge intensified efforts."



At Philadelphia division of Bendix Aviation where new gyro flux gate compass is being produced for Army and Navy, Lt. (jg) T. A. Johnston shows parts of new device which can be located in most convenient part of plane. In September, this Bendix factory produced 175,000 instruments, and more are being shipped in six hours, it is reported, than the industry produced in a month before 1940.



JOSEPH T. HARTSON

New Martin-Nebraska president. He joined Martin organization in 1935, previously was an officer of Boeing, with which he started in '17.

Management Organization For Three Coast Producers

New organizational set-up of three aviation concerns is announced by Earl Herring, president and general manager of Airplane Mfg. & Supply Corp., the company managing the group.

The managing concern, under the name Amsco, will direct three producing companies: Pacific Airmotive, engaged in airplane and engine overhaul work since 1927; the Manufacturing Div. of Airplane Mfg. & Supply, maker of tools and testing equipment; and Airplane Parts & Supplies, for the past ten years distributor of new and reconditioned parts.

Executive offices are at 409 N. Brand Blvd., Glendale, Calif.

PRODUCTION-BATTLE CITATIONS

★ **Four Stars** ★
WESTINGHOUSE (Jersey City, N. J.)

★ **Three Stars** ★
LODGE & SHIPLEY

★ **Two Stars** ★
FARREL-BIRMINGHAM CO.
BULLARD CO.
GREENFIELD TAP & DIE CORP.
WESTINGHOUSE (Eight Plants)

★ **One Star** ★
CLAROSTAT MFG. CO.
WESTERN GEAR WORKS
Army-Navy "E"
AMERICAN VISCOSE CORP. (Royal Front, Va.)
AVEY DRILLING MACHERY CO.
BAKEWELL AIRCRAFT PRODUCTS
BINKS MFG. CO.
BLACKHAWK MFG. CO.
CHELSEA CLOCK CO.
COOK ELECTRIC CO.
CRESCENT PANEL CO.
DAYTON TOOL & ENGRAVING CO.
E. I. DU PONT DE NEMOURS (Plastics Dept., Arlington, N. J.)
ERIE RESISTOR CORP.
GENERAL MOTORS (Warren, Ohio)
B. F. GOODRICH (Oaks, Pa.)
LINK-BELT (Caldwell Plant, Chicago)
MILWAUKEE FLUSH VALVE CO.
HERMAN NELSON CORP.
NEW YORK RUBBER CO.
WILLSON PRODUCTS
UNITED AIRCRAFT (Chance Vought Div.)

★ FOR THE RECORD ★

Swedlow Aeroplastic Corp., Marco Chemicals, and Continental Can are pooling their facilities for making parts of MR synthetic resins. Marco resin liners are now used in many fuel tanks.

Link-Belt Co. has purchased the plant and inventory of Link Belt Supply Co., Minneapolis. Ray S. Wood has been made manager. No other personnel changes are contemplated.

Speedwall Co., Seattle, plywood panel manufacturing company now doing aircraft parts work, has been purchased by Timber Structures, Inc.

Detroit Tap and Tool Co. announces opening of factory branch office in Toledo.

Hockaday Aircraft Corp., Burbank, Calif., has purchased Hockaday-Newby Aircraft, Inc. Noel R. Hockaday, former president of the latter, will be president and general manager of the new company.

P & W Airways, Inc., has been formed in Buffalo by George King, Jr., president; Edward I. Zolte, vice-president and secretary; and Daniel Magee, treasurer, to provide flight instruction in the Niagara frontier area.

John R. Cassell Co., New York City, has added industrial photographic materials to its regular line of drafting and reproducing supplies.

Hub Industries, Inc., has established a development division in Stamford, Conn., to explore general postwar applications of hydraulic apparatus, its present product.

Carbide Alloy Corp., New York City, recently acquired by Allegheny Ludlum Steel Corp., will be operated as Allegheny's Carbide Div.

AERO SCREW COMPANY

SEE "AEROSCREW" FOR...



STEEL DRILLED HEAD AIRCRAFT BOLTS

Generally known as "Engine Bolts" and widely used in aircraft construction where bolts with heads drilled to accommodate lock wire are required. Holes drilled through all faces to meet center hole in top of hexagon head. Made of heat-treated nickel steel to conform with Army-Navy specifications, in types AN73 through AN81 and sizes up to 6" length. Also in coarse thread (NC3) or fine thread (NF3) styles. Carefully inspected and tested for quality, accuracy, and uniformity. Cadmium plating conforms to AN-QQ-P-421. Identified by "X" on head.

DRILLED FILLISTER HEAD MACHINE SCREWS

Used in many assembly operations and hence available in several types and a wide range of sizes. Low-carbon screws, for ordinary uses where high strength and close tolerances are not required, made to Air Force drawings AC500A and AC501A. Heat-treated nickel steel screws, for more particular applications where screws are appreciably stressed, conform to Army-Navy drawings AN502 and AC503. For close positions, where double cross-drilling is desirable, nickel steel screws conform to Navy drawing NAF-1164. Plating is bright and uniform. Nickel steel items identified by "X" on head.

We are Specialists . . .

in the manufacture of selected items of aircraft hardware. In addition to the above, we can furnish high-quality Hexagon Head Bolts, Clevis Bolts and Pins, Washer Head Screws, and Threaded Taper Pins.

Write for Catalog and Engineering Data

AERO SCREW COMPANY

19th Ave. at 12th St., Rockford, Illinois



In this sea-air war . . .

HYDRODYNAMIC EFFICIENCY

in a seaplane float is vital

On every sea-air front, seaplane take-offs and landings are smoother, swifter and surer because of Edo's advancements in the design and engineering of float gear.

Note the fluted bottom of an Edo float —an original and patented Edo development. As speed in the water is gained and the float rises on the step, the water is thrown off *at the first flute.* This reduces the wetted area to a minimum and enables the seaplane to break loose readily from the water. Precious seconds are saved in take-off. This action is illustrated in photos Nos. 1 and 2 taken during the tow basin tests of a scale model.

Exhaustive tests of this nature in which the action of wing lift and other actual flight conditions are simulated, accurately disclose the *hydro*dynamic characteristics of a new float model—pitching moment, angle of trim, lift, drag, etc. In wind tunnel tests, *aero*dynamic characteristics are checked with the same scientific thoroughness—see photo No. 3.

In developing new float designs for the high-performance airplanes of our Armed Forces, Edo does not rest on its unmatched experience of past years. Much of the credit for the fine war record of Edo military floats in meeting the exacting requirements of tropics-to-arctic service is due to scientific research carried on unremittingly.

EDO AIRCRAFT CORPORATION, 402 SECOND STREET, COLLEGE POINT, L. I., N. Y.

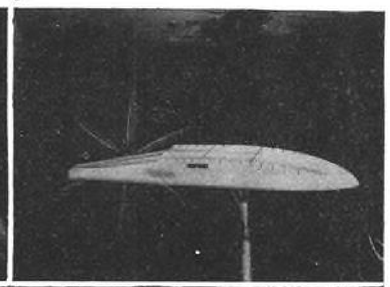
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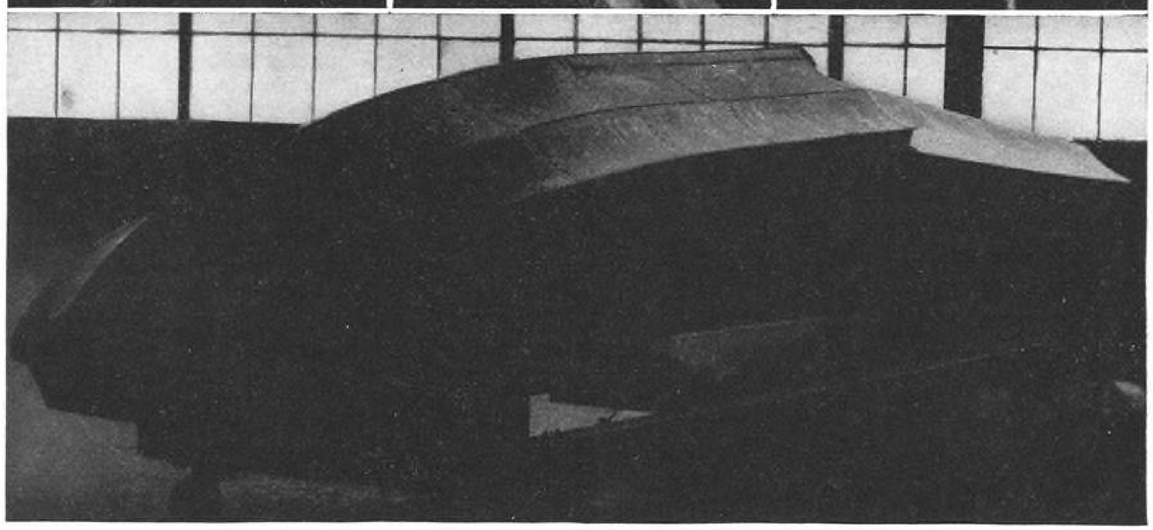


2



3





* EDO FLOAT GEAR *

SERVES THE UNITED NATIONS



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NOT HERE, Hirohito!

● **So sorry, son of heaven, but the answer is "NO! You can't land here!"** . . . Not with these gallant little sluggers, the PT boats, on the job. They're tough. They're fast. They never sleep. And whatever the occasion demands, they've got what it takes.

As a concentrated package of poison for the Axis, the PT boats are an outstanding example of the way American engineers, workers and management are teaming together to produce the deadliest weapons the world has ever known. And naturally, we're proud that *E·L* equipment is giving a good account of itself on PT boats.

The widespread use of *E·L* Vibrator Power Supplies as standard equipment—on land, sea and air—for radio, lighting, communications, etc.—wherever electric current must be changed in voltage, frequency or type—is evidence of the efficiency and rugged dependability of *E·L* products.

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E·L ELECTRICAL PRODUCTS — Vibrator Power Supplies for Communications . . . Lighting . . . Electric Motor Operation . . . Electric, Electronic and other Equipment . . . on Land, Sea or in the Air.

E·L Timer for Operating Tail-lights and Wing Lights on Aircraft— *E·L* Model S-1372 causes tail-lights to blink alternately, 1½ seconds each. No rotating equipment is involved in the action of this device. Power capacity is optional. Operates on 28 V DC. Dimensions: 5¼″ x 2¼″ x 5″. Wgt.: 1½ pounds.





CAB Searches for Policy as Lea Bill Is Reported and Applications Reach 500

Washington (AVIATION Bureau)—Seeking the basis of a policy to handle multitudinous applications for postwar feeder air routes, Civil Aeronautics Board recently held general hearings at which it listened to the opinions of airline operators, railroad and bus men, inventors, engineers, statisticians, and other interested persons.

Just as the hearings concluded the number of applications reached the 500 mark.

Officials of the Board said that the testimony gave them valuable information, but that until it was coordinated and analyzed they still could not set up a formula which would dispose justly of the applications. Although the country admittedly will be spider-webbed with mail-express pickup services and short feeder lines, still, most of the proposed operations will have to be turned down. A great many of them are duplications, and many others cannot be proved necessary.

A majority of the applications are for operations by new companies; a lesser number are for route extensions by amendment to existing certificates. When the total stood at 500, 282 could readily be classed as new operations, 112 as amendments. Airline operators feel that they could handle all of the necessary expansion. Fixed-base people, air schools, and would-be airmen feel that the feeder system ought to be awarded to local operators. This is a difficult decision which the Board will have to make. Indeed, no general conclusion may be possible; many cases may have to be decided on their own merits. All in the aviation group agree on one point: That the bus and rail people should be kept out.

The Board is now acting on only those applications that will directly facilitate the war—there are very few of them—though many claims are made to that effect. The board has also invited applications for routes from the U. S. to the Caribbean.

Any action CAB might take on proposals of surface cerriers to enter air transport would not be conclusive because of the pending Lea legislation, which is highly controversial and may not be settled for a long time. Furthermore, there would be no equipment available even if new routes were authorized by the Board.

The Lea bill, which would revise the Civil Aeronautics Act, was reported favorably to the House, but the controversial amendments of Section 408, covering participation of surface carriers in air transport, were first removed and put into a separate bill, HR 3421. Hearings had not been scheduled on the latter at this writing. A third bill, introduced by Rep. B. Carroll Reece, (Rep., Tenn.) supports "states rights," control of the Board by the Commerce Department, and upholds the claims of surface transportation—which the Lea bill does not do.

Postwar Prospects

Opinion differs concerning the immediate postwar prospects of air transport. W. A. Patterson, president of United, recently stated that average passenger rates of 5.1c. cannot be reduced enough for 10 or 15 yr. to compete against cheaper transportation. C. Bedell Monro, Penn-Central president, predicts that the airlines' prewar total of 350 planes will be nearly tripled to 1,000 within three years after the war.

Opinion indicates that it will be three or more years after the war before new transport plane designs are available. Meanwhile, the Air Transport Assn. and Air Cargo, Inc., are drawing up performance specifications, for the benefit of manufacturers, of planes wanted in the future. They are also urging the government to make provision for supply of parts for military cargo planes to be converted to airline use during the immediate postwar period. Available planes listed by Mr. Monro are the DC-3 (Army C-47), Curtiss *Commando* (Army C-46), DC-4 (Army C-54), and Lockheed *Constellation*. Doubtless different authorities would suggest others.

Applications

Meanwhile, Missouri Pacific Lines and Texas & Pacific Railway presented CAB with their proposed solution of the surface-air controversy: Eagle Airlines, a subsidiary company interconnecting with rail lines on 16 routes over 6,000 mi. Stops would be made at 108 cities, with through service contemplated to the Eastern Seaboard, Pacific Coast, and Mexico.

In New York, the 30th National Foreign Trade convention adopted a resolution declaring that "participation, ownership, or operation by American shipping companies in overseas aviation should not be prohibited by law or by administrative regulation when found to be in the public interest."

Recent route applications submitted to Civil Aeronautics Board included:

Braniff: Transcontinental service from Los Angeles to Washington, New York, and Boston, with stops at Albuquerque, Amarillo, Oklahoma City, Tulsa, St. Louis, Cincinnati, Baltimore, Philadelphia, Pittsburgh, and Columbus.

Chicago & Southern: New Orleans to Rio de Janeiro and Buenos Aires.

Colonial: Washington, D. C. to Portland, Me.

Continental: Memphis to Kansas City and Tulsa. Route extensions from Denver to Los Angeles.

Delta: Kansas City to New Orleans; Birmingham to Dallas and Fort Worth.

Northwest: Seattle to Honolulu.

Parks Air College: Feeder service in area bounded roughly by Minneapolis and Detroit and Dallas and Albuquerque involving 35 routes of about 500 mi. each.

Southair, Inc.: 17 routes to 110 cities in the South and Southwest.

TWA: Amended application for route to Cairo via the Azores. In U.S., Emporia, Kan., as transcontinental stop.

Wm. Filene's Sons Co., Boston department store: Helicopter service on six routes to 45 New England communities.

At least a score of applications have been filed for lines from the U. S. southward by most of the companies operating in the east and south of the border. Three foreign applications have been received for entry into this country from the south. A good many of them were placed in response to a request by the President. A pre-hearing conference on the group has been held by the board.



HEMISPHERE NEIGHBORS DINE

At a luncheon given at the Wings Club, New York, by Pan American and Pan American-Grace Airways for visiting South American Naval officers were (top row, left to right): John P. Lee, Office of Coordinator of Inter-American Affairs; Ens. Gambetta Banchero, Peru; Cadet Caio Amorin Pontual, Brazil; Ens. Jose Barandiaran Movoa, Peru; Ens. Javier de Cossio Tudels, Peru; Ens. Guillermo de la Flor Valle, Peru; Lt. Robert Parrangu, Chile; and Lt. J. P. Irish, USN. Middle row: Charles Ogle, Office of Coordinator of Inter-American Affairs; Lt. Leonard Janofsky, USN; Cadet Frederico Clark Nunes, Brazil; F. B. Foulke, Panagra; Lt. Hernan Lopez Angulo, Chile; Howard Aller, Jr., and J. H. Torrens, Panagra; J. L. Moloney, PAA; Ens. Pio Davila Romero, Peru; Lt. Alfredo Gomez-Lobo Guevers, Chile; Ens. Enrique Shroth Carlin, Peru; Cadet Luis Ignaci Luderitz, Brazil. Seated: F. S. Adams, PAA; Lt. Rolando Honorato Chapparre, Chile; Ens. Luis Barandiaran Pagador, Peru; Oscar Balz, Panagra; Ens. Juan Salaverry Ramos, Peru; Cadet Jose Durvalde Souza e Silva, Brazil; Capt. Ernesto Romaro, Chile; Erwin Balluder, PAA; and Ens. Omar Chioino Carranza, Peru.

British Want Some International Authority, But Nature of Air Control Is Still Undefined

Washington (AVIATION Bureau)—Working toward an Allied world air program, a British air transport committee has concluded a preliminary conference at which it unanimously agreed to recommend an international air transport authority of some sort (also see p. 291). Meanwhile, in the United States, the President's Interdepartmental Committee on Postwar Aviation has placed its recommendation on the desk of State Secretary Cordell Hull, but a strong minority report went with it. Russia appears not to have reached any conclusions. Other countries will not come into the picture till later.

A meeting of U. S. and British officials on postwar aviation was being planned for Washington at this writing. Very little agreement was expected to come from it. The British are split, despite their unanimous committee agreement, on the issue of private or public ownership; they lean toward the latter. We disagree on whether a single or multiple foreign service is desirable. That question has divided the President's interdepartmental committee, with Chairman Adolf Berle (Assistant Secretary of State) on the multiple service side.

The State Department itself is in disagreement. One faction sides with the Pan American-United Air Lines group which wants to pool facilities under a single management, the other faction with the 16 domestic airlines who want competitive foreign flying. State Department and CAB recently issued a joint statement setting definite lines between their realms of authority and declaring in effect that PAA itself can no longer negotiate with foreign countries for air rights—which shows that the pro-competition State faction is in the saddle.

International aviation is now assuming the role so long played by domestic aviation: It will become a buffer on political fronts. The aviation cards are all aces and faces, and they will be held by top men and played when they will count for the most chips.

There is no reason to expect anything but uncertainty and change in international air transport for years to come.

But some principles will take shape. Leaders in this country expect freedom of the air will evolve into the right to fly non-stop over any country without special permission. Emergency landings, of course, must be accepted. If this right of innocent passage is agreed upon, the question of bases will be unimportant: All will use them.

It seems probable that Germany and Japan will be allowed only intra-border transport operations and no aircraft industry whatever.

"Community Company" Recommended by Trippe

Need for the government to establish an international air policy and the participation of this country in overseas flying through a company jointly owned by various American interests, were urged by Juan T. Trippe, president of Pan American Airways, before the recent 30th Annual National Foreign Trade Convention in New York at which he received the Capt. Robert Dollar Award for "for his distinguished contribution to the advancement of American foreign trade."

Mr. Trippe, whose company (along with United and American Export) was not among the recent 16 signatories to a recommendation for competition abroad, stated PAA's position in the form of a question. While foreign nations support air transport monopolies, shouldn't we, he asked, have "one strong international airline—a community company—owned and controlled not by any one aviation interest but by all American transportation interests able to contribute under an organization plan approved by the government?"

Court Studies Tax

The transport industry is awaiting with interest the ruling of the U. S. Supreme Court on the appeal of Northwest Airlines from a decision of the Minnesota Supreme Court holding it liable to a 100 percent *ad valorem* state property tax on all its planes.

This will be the first high court action in the complex matter of airline taxation, and should furnish a precedent for all future local legislation. It should also clarify the multiple taxation threat to interstate air commerce and give state authorities their first pattern for assessment. Historically the court has ruled against local taxation assessed against property owned by a corporation in several states.

8c. Airmail?

Seeking ways to touch the citizen for more revenue without mashing incomes to a further pulp, House Ways and Means Committee advises a new airmail rate of 8c. per oz. after rejecting a 10c. rate.

While tax bills generally pass the House without substantial changes, they are often extensively rewritten in the Senate. No comment on the proposed mail increase has been made by any legislators.



CARGO ACCOMMODATIONS

Plywood floors and sidings, steel-screened windows, and bins—large versions of the nets that hold your shoes in an upper berth—have replaced chairs and other luxuries in this United DC-3 converted to cargo service and now making one daily roundtrip between New York and San Francisco. Loads have run as high as 6,500 lb. compared to "Mainliner's" average of 1,400 lb. of cargo. TWA has also inaugurated cargo service between Kansas City and Los Angeles.

Transport Conversions Called too Expensive

Chicago (Special to AVIATION)—Efficiency advantages of new air transport planes will make conversion of Army transports uneconomical, Edward Wells, Boeing chief engineer, told an air cargo meeting of the Society of Automotive Engineers in session here. Even if military transports were turned over to airlines gratis, he said, new cargo designs could compete favorably with them on a cost basis; conversion of *Fortresses* and *Liberators* into transports would be still more costly and would not be worth their resulting limited utility.

Wells described three designs for peace service: 1. A four-engine, 5,600 hp. plane with payload of 26,000 lb. and range of 1,200 mi. with performance between that of the C-47 and the C-54; 2. A smaller four-engine plane; and 3. A twin-engine transport. The latter two would have the same payload as the C-54—10,000 lb. of passengers and cargo. The big plane could carry a 30,000 lb. payload with operating cost of 6 to 7c. a ton-mile and passenger cost 2¼ to 2½c. a passenger-mile.

Carlos Wood, chief of preliminary design, Douglas Aircraft, predicted an "enormous increase" in air cargo as soon as rates were reduced as a result of improved planes and operating practices. Eventually, he predicted, domestic cargo planes will have high-wings and floors close to the ground; transoceanic types will be low-winged because of better emergency water-landing characteristics. He described plans for a convertible cargo-passenger cabin with moveable bulkheads and seats which would allow from 80 to 90 percent of payload to be carried either in cargo or passengers.

Limitations on size of single-rotor helicopters because of tip speed, load capacity, and experiments with two-rotor helicopters, still in an early stage, were discussed by Waldo Waterman, chief of design, Stout Research Laboratories. His company's design has not yet been flown, he said. He described various helicopter developments, citing the P-V Engineering Forum's model (p. 229 Nov., AVIATION) as one of the most successful. He also mentioned a Bell Aircraft model, now being flight-tested, and the Platt-Le Page dual-rotor 'copter, and he expressed the opinion that counter-rotating blades are not as suitable as single ones. Icing on rotor blades creates a serious problem, he said.

Col. Harold R. Harris, of the Air Transport Command, objected to pessimism among aviation people on postwar conditions.

On the other hand, William A. M. Burden, special aviation assistant to the secretary of commerce, warned that there will be a sharp decline in air transport tonnage when peace comes, but declared that the size and length of the decline would depend on imagination and perseverance.

Expect U. N. Conference To Clarify Air Policies

Though at this writing Britain's Empire Air Conference is history, there is still confusion, as far as the public is concerned, as to the precise approach decided on at the meeting for effecting an equitable postwar international air transport policy.

Publication of all points discussed is very likely to be held up for some time to come—that is, pending an international air transport meeting with Russia, England, and the U. S. participating, which is expected to take place in the near future.

The conference ended with the mere official statement that the decisions upon which the British, Indian, and Dominion representatives agreed still required approval by the respective governments. But the fact that Conference Chairman Lord Beaverbrook and Minister of War Transport Lord Leathers later were reported planning to come to Washington indicated that such approval had been obtained.

Still, the only inkling of the conference decisions was Lord Beaverbrook's expression that it was agreed that some kind of international air transport authority should be responsible to a United Nations security organization, which might be established.

During the conference, public discussions, sometimes violent, revolved about proposals for U. S.-British parity and "American dominance over British airlines." General scares about U. S. postwar plans were accented by reports in America by traveling senators and speeches by persons generally highly regarded in London.

Meanwhile, the N. Y. Chamber of Commerce stated that, as regards the lend-lease airports abroad, a treaty ought to establish the right of transit for commercial craft, plus rights to land, refuel, and stop overnight. Under usual conditions, such a proposal would hardly have aroused more than casual comment, but just at this time the State Department said it would use diplomatic influence to help U. S. airlines obtain foreign rights—and so there was some new mistrust of intentions.

Main solution to the situation seems to lie in an early convening of the United Nations conference considering international air commerce—a meeting where all problems can be aired and at least a basic agreement reached.

New Competition for PAA

First major competition with PAA by an airline under U. S. control loomed large on the South American horizon last month when a group of American investors, including TWA and Time, Inc., purchased a 51 percent controlling interest in Inter American Airways, holding company for a group of airlines started and developed by Lowell Yerex.

Main segments of Inter American are TACA., Central American airline; Britain's BWIA., which holds a permit for a Miami route; and a small line in Brazil, Aerovias Brasil.

Lowell Yerex becomes president for the next ten years of the new company.

BOAC Targeted

Lately, it is becoming apparent that BOAC may not be the only "chosen instrument" for British air commerce. For it is notable that the company's continuous changes in management, together with rather unimaginative statements by Lord Knollys, the new managing director, have disappointed more than a few people.

C. G. Grey, for one, has put the finger on Lord Knollys' statement that Capetown might in the future be reached in as little as two days. Pointing out that the *Mosquito*, which BOAC is even now using, can cruise at 350 mph. in a commercial version, Grey says that South Africa can readily be brought within 20 hr. and Australia within 36.



BRITAIN COMES UP WITH NEW AIRLINER

Tri-tailed Avro "York," new 50-passenger transport version of "Lancaster" bomber, lands in Canada after maiden Atlantic flight. Span of craft is same 102 ft. as that of bomber, but length is 78 ft. compared with military job's 69 ft. 2 in. New craft mounts four 1,240 hp. "Merlins." Among passengers on initial ocean trip was Avro Designer Roy Chadwick. Incidentally, "York" is not to be confused with converted "Lancaster" transports, such as currently employed by TCA. (International News photo.)

On Schedule . . . by "Vista"

Coincident with the recent Empire Air Conference at London, British shipping lines have displayed new interest in postwar air transport. Several of the larger companies have held stockholders' meetings at which directors were voted powers to establish such services.

Primarily, the plans have concerned transatlantic routes, over which certain British sources expect traffic approaching 4,000 passengers per day within 10 yr. after the war. Of course, the urge of such companies as Cunard, Furness, and Manchester Liners to lay hands on at least a slice of such business is understandable—for there are those who say that come peace the prime utilities of surface liners will be haulage of tourist passengers and heavy freight.

It is noted that the Bristol Aeroplane Co. is developing a 130-ton "Queen Mary" of the skyways as a "spare time diversion," and a completely new type of passenger and freight air traffic is envisioned by the proponents of the project.

But not all the interest is restricted to the North Atlantic. Two British groups are cogitating on the waters to the south. One combination, consisting of five shipping lines whose names are little known here, has opened negotiations for an England-Brazil airline. Another similar South American plan is reported involving BOAC. And since discontinuance of the Italian services is considered an inconvenience (even if the "Eyeties" did play "spy ball" for the Germans) early action may be expected establishing direct connections between Britain and South America's largest republic.

In the Caribbean, only two of the five airlines which obtained emergency permits for passenger, mail, and freight service into the United States are now operating, namely Expreso Aero Inter-Americano and KLM. Since these permits are now coming up for renewal, it is considered somewhat doubtful that the other lines (TACA, BWIA, and Cuba's CNCA) will obtain renewal of their papers—unless they definitely can start service within a minimum of time.

★INTERNATIONAL BRIEFS★

New British warplane protection is a trigger-operated, cartridge-driven "chisel" installed in the leading edge of the wing to cut barrage balloon cables before they can harm the plane hitting them.

The new Jap fighter reported giving our bombers a bit of trouble over China may be the Nakajima Army S-01. It's armed with only two 12.7 m.g.'s, but it has a 390-mi. top speed.

A French military airline now connects Damascus and Moscow. It carries mail and cargo for French airmen fighting with the Red Army.

Russia recently applied for permission to set up a direction finder at Cairo. This is probably the initial Russian participation in the London-Moscow aerial link.

Payne Field, one of the largest airports in the world, was recently opened in Egypt after being under construction for only 58 days. It's main use will be accommodation of the increasing ATC traffic.

Loss of a second Swedish DC-3, operated by ABA between Stockholm and Scotland, has brought new Swedish-German tension, since this plane was shot down over Swedish water by a German fighter, reported to have been gunning for Moscow-bound Anthony Eden. Service was discontinued "until further notice."

Ala Roma, new name for the Italian line Ala Littoria, has now been changed again to Ala Italina.

Progress Report:

Automatic Exit Flap Control



Before Pearl Harbor

Memo to AiResearch Engineers:

Can exit flap control be made automatic? It would give greater freedom to pilots...and cut open-flap time considerably. Thus you can help reduce cooling drag and increase airplane speed.

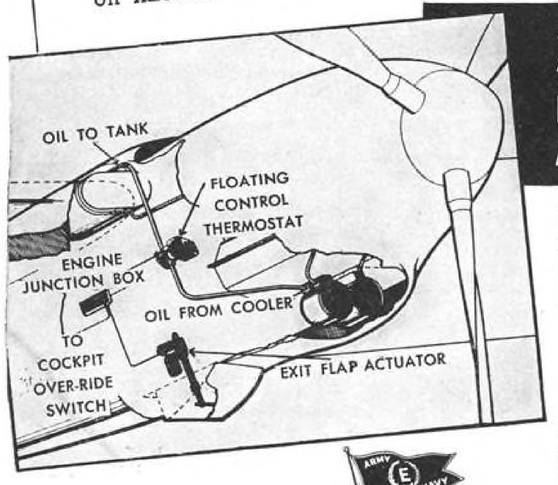
1941

Many systems being designed and tested in our laboratories. Some problems now licked. New techniques of electrical operation being developed that look like the answer.

War Comes

AiResearch has the first system of Automatic Exit Flap Control tested and proven! Lightweight, simple in design, made of standard aircraft parts, it provides a 25° F. modulation range between flap open and flap closed. Powered by a new type of electrical circuit for high altitude operation, the system goes into service on America's fighting aircraft!





Still AiResearch engineers keep striving to make the best even better...

Now AiResearch Announces Another Advancement: "FLOATING CONTROL"

The improved AiResearch Automatic Exit Flap Control System is based on a new principle of proportionate rate control whereby the thermostat moves the actuator *directly* . . . at a rate in exact proportion to each change in temperature!

With temperature control constant, it further reduces open-flap time and cooling drag. And provides these additional advantages:

A 3°F. modulation range between flap open and closed.
Elimination of all relays and follow-up.
No vibration-sensitive contacts.
Weight-savings up to 20%.
Simplified wiring

Now fully flight-tested and ready for volume production, the new system is available for 24 volt D.C. or 400 cycle A.C. supply on exit flaps for oil coolers, intercoolers and Prestone radiators.

ARMY E NAVY

CONSTANTLY, AiResearch engineers are developing better ways to control air, temperature and pressure in high altitudes. If you have such a problem—for today's military aircraft, or tomorrow's commercial airliner—AiResearch offers you engineering assistance.

AiResearch
MANUFACTURING COMPANY
LOS ANGELES • PHOENIX
DIVISION OF THE GARRETT CORPORATION

"Where Controlled Air Does the Job" • Engine Oil Cooling Systems • Engine Air Intercooling Systems Automatic Exit Flap Control Systems • Supercharger Aftercooling Systems • Engine Coolant Systems

Curtiss-Wright Corp. will stick to the aircraft business after the war and not branch out into other fields, Pres. Guy Vaughan told stockholders at the annual meeting. Except for research facilities, he added, Curtiss would be better off financially if the war had not come along.

Sperry Corp. is negotiating a $125,000,000 regulation VT-loan, according to Wall Street bankers. The Bankers Trust Co. and the Guaranty Trust Co. are scheduled to head the lending group. No announcement has been made by Sperry, but if the deal goes through it will be one of the largest wartime industrial loans.

Thompson Products is planning the sale of 45,000 new preferred shares to finance peacetime business and to retire the present convertible preferred stock, according to Pres. F. C. Crawford. The new stock is expected to carry a dividend rate of not more than 5 percent. There are 25,660 shares of the convertible perferred outstanding. Sales for the first six months of 1944 were $39,442,000 compared with $60,920,000 in all of 1942.

Dividends: Boeing Airplane Co. declared a $1 dividend payable Nov. 17 compared with $1 on Apr. 21 and a 1942 payment of $1 on July 23. Beech Aircraft Corp. also declared a $1 dividend on its common payable Oct. 28. An initial payment of a similar amount was made in Oct. 1942. Ryan Aeronautical Co. paid a 35c. dividend Nov. 26, bringing payments for the fiscal year ended Oct. 31 to 45c. a share. Consolidated Vultee paid a common stock dividend of 50c. on Nov. 1 as well as a preferred dividend of 34¼c. on Dec. 1. Bell Aircraft Corp. declared a 10 percent stock dividend (one share for every ten held) payable Dec. 2. Bell paid a $1 dividend on June 25.

Republic Aviation Corp. retired 100,000 shares of its second preferred stock on Oct. 1, leaving 50,000 shares still outstanding, according to Pres. W. Wallace Kellett. The preferred was called at $10 a share.

Northrop Aircraft showed sales of $69,791,844 for its fiscal year ended July 31, a gain of 112 percent over the $32,983,762 for the preceding year, Chairman LaMotte T. Cohu reveals. Net profit, however, declined to $1,249,535 or $3.12 a share from $3,044,741 or $7.93 a share. Backlog of unfilled orders totaled $133,065,747 and the report showed the company was using $14,500,000 of the $17,000,000 V-loan credit advanced by a banking syndicate.

Lockheed Aircraft Corp. has taken steps to absorb its wholly-owned subsidiary, Vega Aircraft Corp. Pres. Robert E. Gross reported the move was "simply a continuation of the trend towards closer integration in operations of both companies."

Fairchild Aircraft, Ltd. reports for the year ended June 30, net income of $38,386 or 30c. a share against $98,541 or 77c. a share in 1942.

TACA, central American airline holding company, plans a public stock offering totaling around $3,000,000, according to a Wall Street report. TWA is understood to have a 22 percent interest in the company, while Time, Inc., Adams Express Co., and Air Investors are said to have somewhat smaller holdings.

F. L. Jacobs Co. earned approximately $2,500,000 for the fiscal year ended July 31, according to Pres. R. C. Jacobs, who reports that dividend consideration has been postponed due to restrictions of the company's V-loan, greatly increased business with war agencies, and postwar business prospects.

Hayes Industries, Inc., reports for the year ended July 31, net profit of $648,016, equal to $1.95 per share, after estimated income and excess profits taxes of $2,125,000, less postwar refund of excess profits tax of $195,000. Net profit compares with $917,984, or $2.75 per share for the preceding fiscal year. Net sales for the fiscal year were $22,517,389, compared with net sales of $12,586,176 for the preceding period.

Panair do Brazil, Pan American Airways subsidiary, will offer for sale around $1,600,000 of stock to increase capitalization to $4,000,000, according to Pres. Paulo Sampaio. Up to 40 percent of the new stock will be sold to Brazilians and will not be transferable to foreigners or citizens born outside federal territory.

Continental Motors Corp. net profits for nine months ended July 31 amounted to $4,375,626, after all charges including income and excess profits taxes, depreciation, and reserves for charge-offs.

Stewart-Warner Corp.'s Pres. James S. Knowlton recently wrote stockholders advising that "a statement of earnings for the six months ended June 30, 1942 will not be issued now because we cannot fairly estimate the amount of earnings which may be refundable to the government in the renegotiation of our business as prime contractor, subcontractor, and supplier. Our 1942 earnings are still in the process of renegotiation. Shipments of vital war materials from our factories during the first six months of 1943 exceeded shipments in the same period of 1942 by approximately 59 percent."

Thompson Products reports net earnings of $1,408,152 or $4.53 a share for the six months to June 30 against $1,179,918 or $3.76 a share a year ago. Sales were $64,064,616 compared with $34,974,642 in the like 1942 period, with the aircraft subsidiary sales standing at $24,887,444 against $8,704,653 a year ago.

Aero Supply Co. had unfilled orders at the end of June totalling $16,508,000, while sales for the first half of 1943 were $10,178,635 against $7,885,130 in the first half of 1942.

Aeronautical Products reports net profits of $305,562 or $2.04 a share in the year to May 31 against $127,836 or $1.02 a share in the previous year.

Ex-Cell-O Corp. reports profits for the six months ended June 30 were $1,055,113 or $2.65 a share compared with $2,059,528 or $5.16 a share in 1942.

Aircraft Accessories Corp. has acquired a controlling interest in the **Phonette Co.** of America, Los Angeles, maker of radio components.

By RAYMOND L. HOADLEY

About Those "Airline Mergers" . . . Railways Form "Handy" Airline . . . Investors and Legislation . . . Manufacturers and the Excess Profits Tax . . . Why Not Sell the Workers On the Industry's Needs?

RUMORS OF MERGERS among the nation's domestic airlines are a "dime a dozen" these days, although few facts of these persistent reports can be nailed down. But this much is definite: Western Air Express has acquired approximately an 83 percent ownership of Inland Air Lines subject to CAB approval, while Northeast Airlines has purchased Mayflower Airlines.

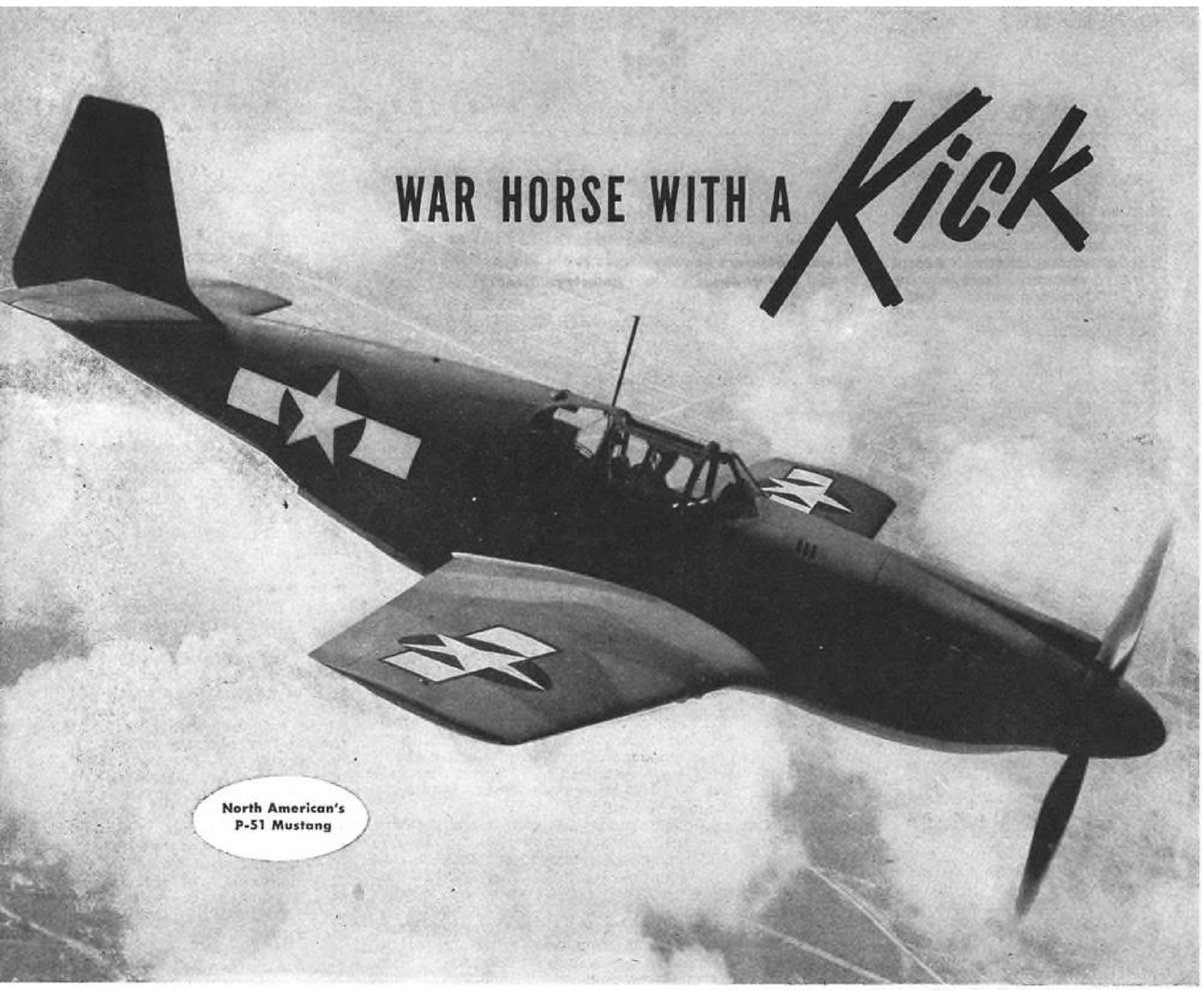
Moreover, Wall Street had it that a fifth big air transport system, made up of Chicago & Southern, Delta, and National Airlines, has been discussed. But Pres. Carlton Putnam of Chicago & Southern said that no mergers were being considered by his company. So then Delta and National were promptly linked up with Continental.

W. A. Patterson of United predicted more than six months ago that the airlines were nearing the merger stage. And where there is so much smoke there undoubtedly is fire. Meanwhile, airline officials note with lifted eyebrows that the Missouri Pacific and Texas & Pacific railroads have formed Eagle Airlines—just to have handy in case the railroads are permitted by Congress to go into the air transport business.

Considering now the status of the aircraft investor: He will receive little or no benefit from any of the legislation Congress will complete before the Chrismas holidays. And as for the aircraft concerns: Further restrictions on the invested capital base for excess profits tax exemption won't bother them, since few, if any, have had enough invested capital to make it advisable to use the invested capital tax base. But if corporate taxes are raised from 90 to 95 percent of excess profits, the plane makers will suffer accordingly.

Unfinished Congressional business at the year-end probably will include action on the contract termination muddle, the Lea aviation bill, and renegotiation amendments to the tax laws. However, if the industry continues to plug for a fair deal on their tax problems, some relief may be forthcoming from Congress in 1944.

Congress is expected to begin work early next year on a new tax bill and 1944 is a general election year. The industry has done a good job of presenting its case to Congress. Very likely it now can cinch it—by doing a similar selling job to the nearly 2,000,000 aircraft workers who, it's pertinent to point out, are nearly all voters.



Photo, courtesy North American Aviation, Inc.

It's the "wild west" of Europe now, since North American's P-51 flying "Mustangs" stampeded the range! Those rip-snorting, high-octane hay-burners bite hunks out of Heinkels, make messes out of Messerschmitts and junk out of Junkers so often that the rodeo is getting one-sided. Yes, siree, podner! – things are picking up in Fortress Europe – mostly Germans picking up the pieces!

Exactly to the liking of hell-for-leather Allied pilots is this wild-horsepower – engineer-tamed just sufficiently to out-chase, out-maneuver and out-fight anything the Axis has to offer. And although the Air Command keeps close to its vest the figures on the "Mustang's" super-qualities, you can bet that a major part of its high maneuverability is due to Fafnir Ball Bearings on the controls!

There could be no finer example of American engineering collaboration. Aircraft engineers expertly design each bearing point for maximum controllability. Fafnir engineers meet these requirements with the exact Fafnir Bearing necessary to give rigidity and friction-free performance. Victory is built on teamwork like this! The Fafnir Bearing Company, Aircraft Division, New Britain, Connecticut.

Send for copies Fafnir Aircraft Service Manual, you will find it an invaluable service guide.

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Ball Bearings
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PAUL A. SCHERER, director of research of AiResearch Mfg. Co., has been granted an indefinite leave of absence to become chief of the Engineering & Transition Office of the National Defense Research Committee headed by Pres. J. B. Conant of Harvard University.



FRANK H. HARRISON, former manager of manufacturing for the International Harvester Co., and E. J. HARRINGTON (right) ex-coordinator of planning, production, and material problems for the Lockheed Aircraft Corp., have been elected vice-presidents of Curtiss-Wright Corp. Harrison, for the present, will make his headquarters at the Columbus plant and will be in complete charge of operations for the corporation at that point. Harrington, who will be located at the N. Y. offices as a member of the executive mfg. staff, is temporarily assigned to the Columbus factory.



CLINTON B. F. MACAULEY joined the public relations staff of Fairchild Engine & Airplane Corp. As asst. to Joseph E. Lowes, Jr., director of public relations he assumes editorship of The Pegasus, succeeding W. M. Kimball, who joins Cecil & Presbrey.



MORGAN C. MONROE was appointed director of industrial relations of the Farmingdale div. of Republic Aviation Corp. He will have direct supervision of the personnel, training, employment, job classification, medical, industrial safety, employee publication depts.



MAJ. REUBEN H. FLEET has been elected president of the Institute of the Aeronautical Sciences for the year 1944, succeeding Dr. Hugh L. Dryden. Although Maj. Fleet sold his interest in Consolidated Aircraft in 1941, he remains as consultant to the new management of Consolidated Vultee Aircraft.



W. KENT WHEELER, formerly of the Martin and Solar and Lockheed Aircraft companies, has been appointed Dayton liaison representative of the manifold manufacturing division of Ryan Aeronautical Co. In the aircraft business for the past 16 yrs, he was assistant supervisor of production for Glenn L. Martin.



JAMES E. WEBB, who has been secretary and treasurer of Sperry Gyroscope Co., has been elected vice-president of the company. He will continue to serve as secretary, but is succeeded as treasurer by F. W. Kilduff, asst. treasurer, who is also director of government claims under terminated contracts.



JOHN M. DEMAREST, consulting and plant engineer for the past 25 yr. and recently associated with WPB in charge of aircraft plant expansions, was named plant manager of Wright Aeronautical plants in the N. J. area. Before joining Wright as asst. to the general supt. he was I.B.M. plant engineer.



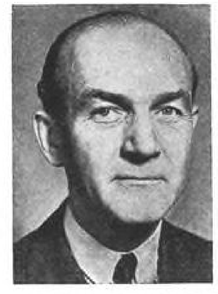
FRANK A. RUDOLPH who has been in charge of Aircraft Accessories Corp. New York offices, has been named Eastern regional manager. Through an error in the makeup, our October issue report of this change carried a photograph of ATA's Johnny Groves rather than the picture of Mr. Rudolph.



DR. EDWARD E. MINOR, JR., who has been elected a vice-president of All American Aviation, will head a newly created manufacturing and developmental division of the company. Before joining All American, Dr. Minor was development and design engineer with Glenn L. Martin.



WILLIAM L. WILSON, formerly director of industrial relations for Republic Aviation Corp., returns to Kellett Aircraft Corp. as assistant to the president. He will be assigned duties in several administrative fields, including supervision of the company's industrial relations and other programs.



ARTHUR READ CHRISTIE, with United Aircraft since 1939, has been named Washington representative of Pratt & Whitney and will direct liaison with government agencies. An extensive and colorful Army aviation career which began in 1914 preceded Mr. Christie's entry into business.

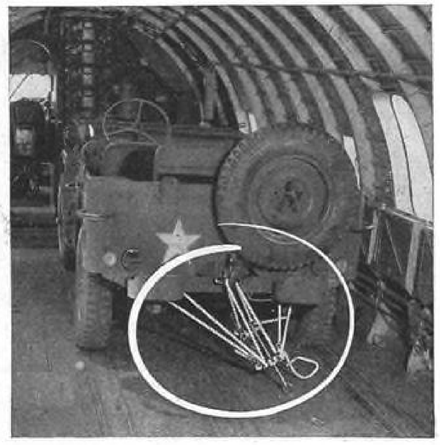




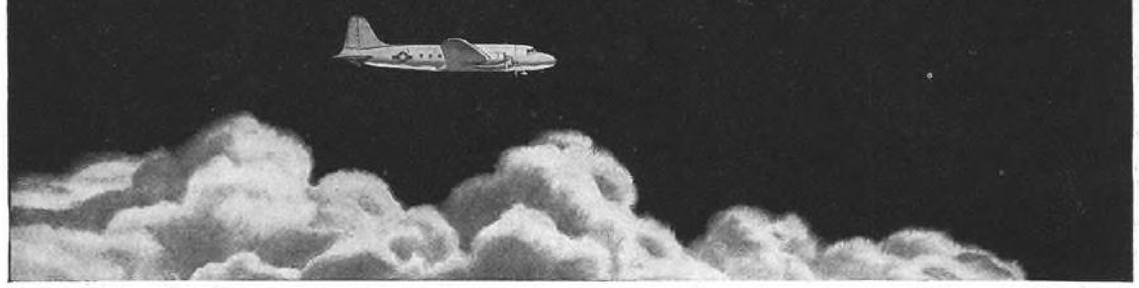
COL. ARNOLD RICH, USA Ret., has been appointed director and general manager of the technical division, Embry-Riddle School of Aviation. Rated a command pilot and combat and technical observer, he has logged approximately 3,000 flying hours. After being detailed to the Air Service in 1921, he served 7 yr. with the Air Corps Technical School, 7 with the Tactical School, and 3 with the Flying Schools. He retired from the Army in 1942. **CARL R. ANDERSON** (right) rejoined the organization as assistant vice-president, and will coordinate the work of the various promotion departments. (Ebbets photo.)



Evans Skyloader tie-down rods and beams lock heavy castings, barrels and odd-sized cargo securely in flight, while Evans rope hooks and tighteners tie down mixed cargo.



A combination of Evans Skyloader rope hooks and rods ties a jeep tightly to the deck of a cargo ship. On- and off-loading is made fast; weight of lashings is held to a minimum.



up in the cargo lanes

When giant cargo ships get "upstairs", run into the stresses and strains of flight through rough air, serious damage can befall plane, cargo and crew, unless the cargo is really made fast. For example, a sharp downdraft can lift an entire cargo off the deck of an airplane, with a resultant upward strain as much as 2.4 times greater than the cargo's weight! Evans Skyloader equipment will hold cargo firm against such a strain.

Evans Skyloader method is the most simple, effective system of tying down air cargo and *removing all slack!* Skyloader rope hooks and tighteners, as well as metal tie-down rods and beams, make it possible to handle all types and shapes of cargo, with a new security and safety that is proving its value to both military and commercial shippers.

Evans Skyloader equipment is designed to offset and solve all freight tie-down problems up in the cargo lanes, as well as to save priceless on and off loading time.

Our engineers will gladly study your special air cargo problems.

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Recent Books

• *THE OUTLOOK FOR DOMESTIC AIR TRANSPORT, by Ernest W. Williams, Jr. National Planning Assn., Washington. Paper bound. 30 pages,* 25c.

After briefly reviewing the effects of war on the airlines, Williams, economic analyst to the War Production Board, scans prospects for the initial postwar decades and concludes:

1. Because speed is its chief selling point, "air transport is likely to be complementary and supplementary rather than actively competitive with the greater part of the ground transport system. . . . There is every reason to suppose that air transport will create much of its own business. . . The most important and most immediate field for growth is in the passenger side of the business."

2. "Air express and air cargo have been substantially neglected. . . Because of the relatively high costs, air cargo transportation in the near future will probably not be able to make any impression upon the freight traffic of surface carriers. In order to attract even some of the high class less-than-carload and perishable business, it would be necessary to get rates down to 5c. or less per ton-mile. The heavy expense of collection and delivery service would make this impractical. . . . It appears, therefor, that the immediate future of air cargo is in the high class trades which can afford to pay relatively heavy charges, but even this will create a tremendous increase in volume and stimulate a rapid growth of cargo service."

3. "In the not too distant future, wise national policy will quite probably shift the first class mail to the airlines and abolish the surcharge except for expedited special delivery."

4. Possible developments: Northrop Flying Wing—"the design shows from 33 to 50 percent less drag, thus the same speed can be secured with approximately half the horsepower"; The glider—its utility "may be limited to special services such as those in which it is to be dropped off in flight to effect deliveries at one or several intermediate points"; Helicopters—"present designs are so successful as to promise great usefulness after the war, though much additional work is needed to make them ideal for private and commercial use"; Cargo haulage—research on packaging indicates possible weight savings of 33 percent; Engines—"octane ratings of 110 to 115, delivering half again as much power, will very likely be developed, making all existing engines obsolescent."

Among tasks to be tackled, says Williams, are airport planning and feeder systems.

• *FLYING POWER, by C. J. Hylander. The MacMillan Co., New York. 164 pages,* $2.

Rudiments of airplane engines—principle, design, ignition, fuel, and lubrication systems—described in simple language and with pertinent drawings by the author.

• *JOE FOSS, FLYING MARINE, as told to Walter Simmons. E. P. Dutton, New York. 160 pages, illustrations,* $2.50.

"Old Foss" (27 yr. of age) outlines his aerial career with minute accounts of his 63 days in the Southwest Pacific (mostly Guadaleanal) during which he was credited with knocking down 26 planes. Malaria got him before the Japs.

• *AIRCRAFT PRODUCTION STANDARDS, by Stuart Leavell and Stanley Bungay. McGraw-Hill Book Co., New York. 264 pages, illustrations, index,* $2.

Worker's handbook of information considered essential for successful performance of his job. Explained in drawings, specifications, and short passages of text are blueprint reading, materials, inspection, assembly and installation, standard parts, design, and manufacturers' standards.

• *MAKERS OF MODERN STRATEGY, edited by Edward Mead Earle. Princeton University Press, Princeton. 553 pages, index,* $3.75.

For students of military theory, this is a goldmine of thought (from Machiavelli to Hitler). There is one essay on air power by Edward P. Warner, CAB vice-chairman and former editor of this magazine.

"The fundamental doctrine" of the air power advocates, Douhet, Mitchell, and Seversky, Warner points out, "is that the airplane possesses such ubiquity and such advantages of speed and elevation, as to possess the power of destroying all surface installations and instruments, ashore or afloat, while itself remaining comparatively safe from any effective reprisal from the ground." Such a situation has not yet arisen in this war, he demonstrates, for two reasons: Air power advocates did not fully appreciate mechanical problems and they underestimated human endurance to bombing.

But the day of air power draws nearer: "Sooner or later, if the process of recurrent trial by world war continues, the development of the implements of aerial warfare and the technique of using them is altogether likely to catch up with the prophets. . . . The pioneer advocates of airpower, and especially Douhet, can be read to greater advantage now than when their books were first published."

• *AERO MECHANIC'S QUESTIONNAIRE, by Ralph P. Rice. Paxon Publications, St. Paul. 128 pages,* $3.

Some 2,000 multiple-choice review questions on: The use and maintenance of sheet metal and welding, hydraulics, wood, fabrics and finishes, rigging, aerodynamics, and assembly, CAA regulations, propellers, electrical systems, lubricants, fuels, and power plants.

• *MAXIMUM UTILIZATION OF EMPLOYED MANPOWER. Industrial Relations Section, Princeton University. 46 pages,* $1.

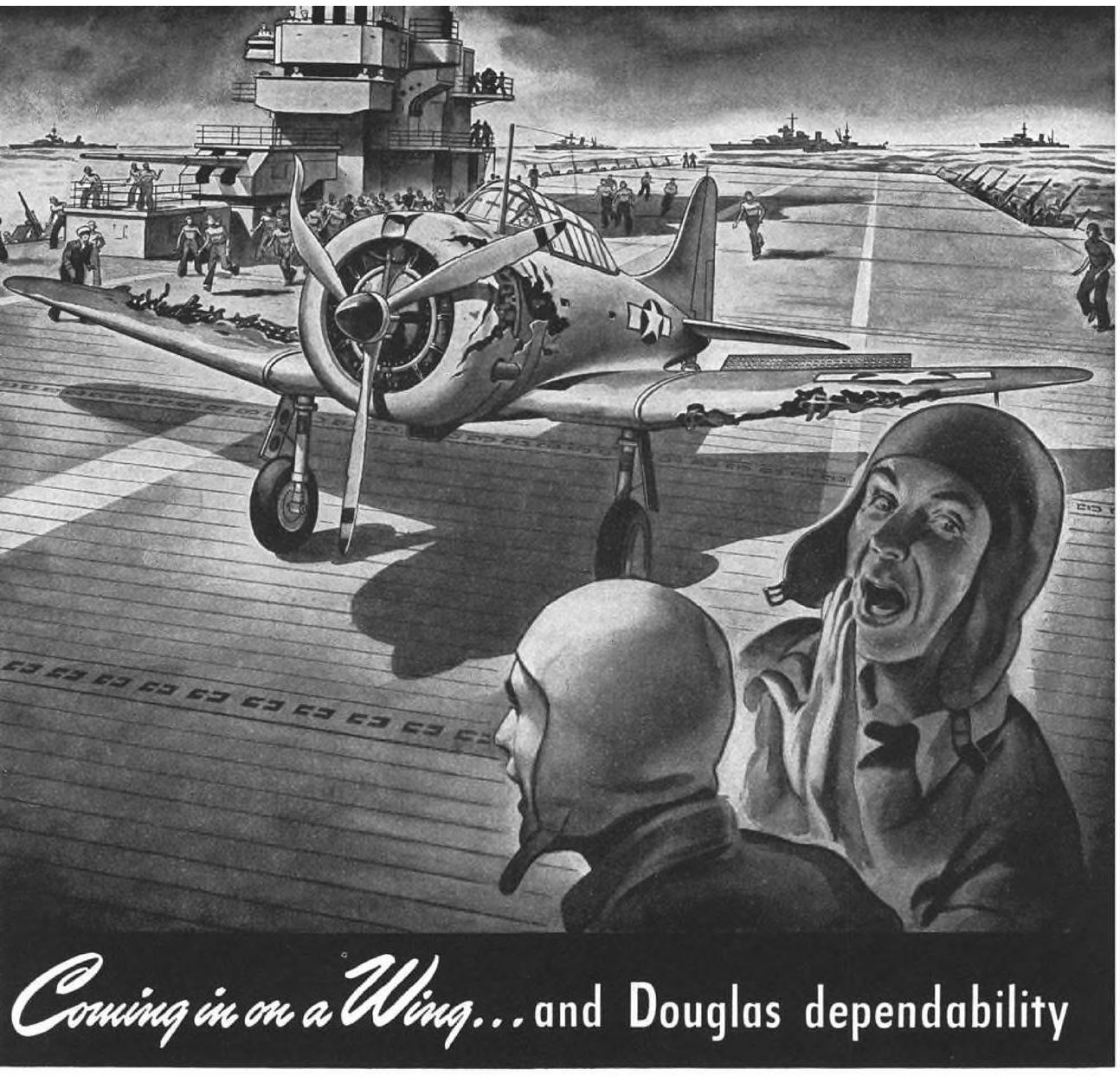
Possibly more than five million man-years in labor potential are going to waste in American factories, "not in the services of new, green labor, but of men and women who are already a part of the experienced personnel of industry," this pamphlet estimates. To aid in uncovering this waste, it outlines various inefficient practices which may be attributed to poor management, instability of work force, ineffective labor management, and situations and conditions which may reduce the workers productiveness.

• *THE HOUSE OF GOODYEAR, by Hugh Allen. Corday & Gross, Cleveland. 417 pages, index, illustrations,* $2.

Lauding free enterprise, this book offers a history of the airminded rubber company. The early balloon and dirigible days are particularly well covered. Stressed are management tenets and developments.

• *MANUAL OF AIRCRAFT PRODUCTION, by Bernard H. de Selm. McGraw-Hill Book Co., New York. 144 pages, glossary, index,* $1.25.

Descriptions of manufacturing processes to aid workers who want to progress to "the top" where, states the author, "there is a lot of room."



Coming in on a Wing... and Douglas dependability

Operating from a U. S. Aircraft Carrier during the invasion of North Africa, an SBD Dauntless Dive Bomber Pilot flew into a tree while strafing an enemy tank. He damaged the propeller, tore the cowling from one side, ripped the leading edge of the left wing at the root and slashed away the outboard end of the right horizontal stabilizer. In spite of this major damage, the plane returned to the carrier and made a perfect landing. Even as that pilot came in on a wing and Douglas dependability, so United Nations flyers throughout the world are safer while doing greater damage to the enemy because of the ruggedness Douglas men and women build into their planes.

PROGRESS REPORT... The 5,000th SBD Dauntless Dive Bomber will have been produced by the Douglas El Segundo Plant in November. On each of two successive recent months production was 45% ahead of schedule!

Douglas

AIRCRAFT COMPANY

Santa Monica, Calif.

Long Beach El Segundo, and Daggett, Calif., Tulsa, Oklahoma, Oklahoma City, Chicago

Member, Aircraft War Production Council, Inc.

Fixed Base Operator

(*Continued from page* 227)

for sale, the company is securing franchises for distribution of two well known light plane engines, to become effective immediately after the war. Thus, as soon as manufacturers are able to start deliveries, the company will be in the sales and service field covering the complete horsepower range of aircraft engines.

It is significant that Borton and his two associates were originally identified with Thompson Aeronautical Corp. in pioneering mid-western mail and passenger routes and later were with the operations division of American Airlines. From the beginning, nearly ten years ago, the company has concentrated on providing service and maintenance of "airline standards" for the private aircraft owner.

One of General Airmotive's first service contracts was a big one—the job of handling all Cleveland servicing for Central Air Lines, one of the predecessor lines of the present Penn-Central system. This was not the firm's only source of income, however, for it also did both airframe and engine overhauling for individually owned craft. It was during this early period, though, that another of the firm's continued policies was well established. That is, to get the best and most modern equipment possible to be able to do any job that came along. Airmotive had, for example, the first Magnaflux machine in the Cleveland territory. It was largely due to this policy that "Jim Borton's hangar" acquired the reputation of being the National Air Race contestants' service and repair headquarters. The racers knew Borton could do any kind of job—and thoroughly—in time to meet the starter's flag.

This ability to do all manner of work has literally made the firm a subcontractor at various times since the war started; for other general-work operators soon were sending the more difficult and highly specialized tasks to GAC, such as installation of master rod bearings, cam bearings, valve seats, valve guides, spark plug bushings, and other special operations requiring skilled machinists.

Not all the work, however, has been confined to the specialized field, since a conscious effort has always been made to get a fair share of the general maintenance and overhaul work in the area. During the past two years much of this work has come from CPT operators whose equipment has taken the terrific beating that goes with accelerated student training. Even though CPT operators maintain engines, it has been their policy to have accessories serviced at GAC.

In this connection it should be noted that General Airmotive has never put all its eggs in the flight training basket. In fact, flight training has been only incidental to the other phases of its work. Ground student training, though, has played an important part in its career. GAC's aircraft and engine mechanic school was opened in 1939 with four students. Maximum number ever taken at one time has been 100, for it was early determined that this was the top number that could be handled efficiently. Today the company holds Government certificate No. 92 for its aircraft and engine mechanics' school and is credited with having more than 500 of its graduates and former students in the armed forces, serving in every theater of war.

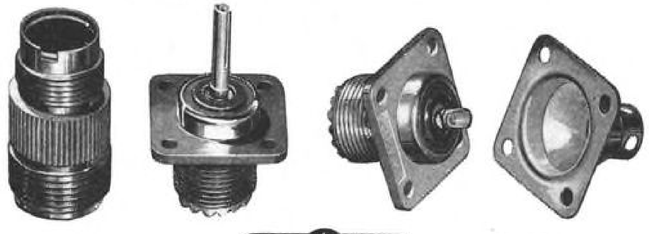
Some apparently strange—but entirely successful—policies have been maintained in the school. It has never, for example, used solicitors or salesmen to secure students but even so the registrar has from time to time found himself with applicants who couldn't be taken. The only advertising ever utilized has been a small display ad in Sunday editions of one Cleveland paper.

Nor does GAC hesitate to flunk students. Each one gets a daily rating in his log book in addition to periodic examinations. If it becomes apparent that he lacks the aptitude necessary to make a mechanic he is called in for con-



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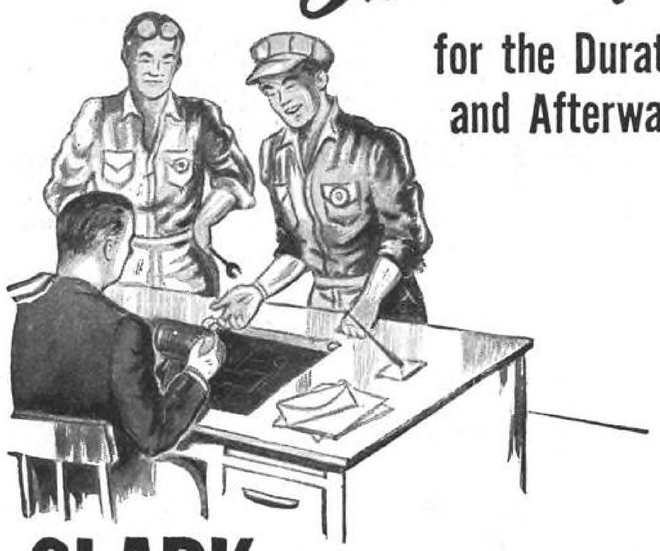
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CLARK drills and grinders

Heavy production schedules for the duration and for post-war manufacturing call for drills and grinders that will give maximum service at minimum up-keep and expense. To meet these requirements, Clark has constructed their drills and grinders so, that by actual tests under continuous service, their record of achievement has proved outstanding. In your future plans, include Clark drills and grinders and assure yourself of long service at low cost operations. If you have a problem concerning the use of drills and grinders, call on Clark. Their engineers will be glad to help you solve it.





Buy WAR BONDS

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JAS. CLARK, JR. ELECTRIC CO.

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sultation and given the facts. In the case of a minor, the student's parents are either interviewed or written that it is useless for the boy to continue. One result of this policy has been that 98 per cent of Airmotive's graduates have passed the CAA examinations required for licenses.

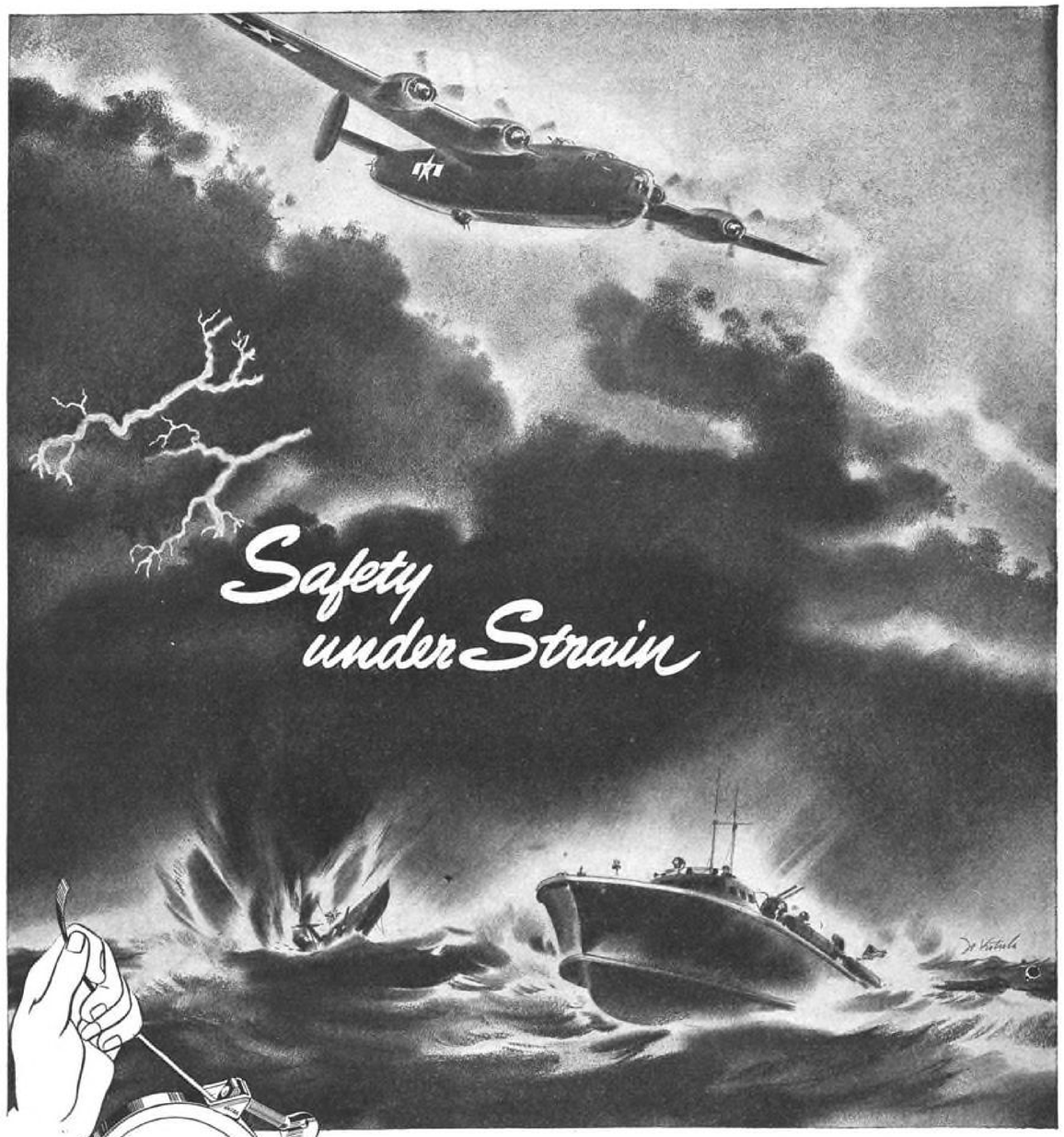
The school—even though it is the sole survivor in the territory—is living proof that such an operation can be profitably conducted despite competition of governmental training courses, paid training for nearby war industries and, of course, the AAF. Oddly enough, many of today's students are men who want to secure their A & E licenses before going into the Army. Four are men, who having seen service and received medical discharges, have returned to complete their courses.

About 20 per cent of the curriculum is devoted to classroom study, while the other 80 per cent consists of practical work on air and liquid cooled engines ranging from 40 to 1,000 hp., and on wood and metal aircraft types in current use. In every case students do work under very close supervision on company-owned planes, engines, and propellers. In one case, the firm purchased a second-hand plane that represented too good a bargain to miss. During the winter months it was thoroughly reconditioned and modified for photographic work. Then it went out on a rental basis in the spring, was gone all summer, and returned late in the fall for complete overhaul during the dull winter flying months. "It was," Borton says, "nice business while it lasted." The craft was in the size group taken over by the government early in the war.

Two rigid rules, both paying rich dividends, have been in force since the organization's inception: First, complete records are required on every job, no matter how small—a common sense business practice that is too often overlooked. Recently, for instance, a case arose in which a propeller threw part of a blade, and the owner remembered having had it straightened some two years ago. Airmotive's records showed exactly what had been done to the blade—so it was possible to complete the case history of the unit in quick order.

Second rule—also a common-sense practice—is to pay cash and take the usual 2 per cent discount on every transaction. "That 2 per cent mounts up over a period of years," Borton told AVIATION's correspondent. "But what's more important, when you pay cash nobody's going to come in and walk out with any of your stock or equipment."

Having successfully weathered the country's worst depression plus two years of wartime operation, General Airmotive's owners look to the postwar era with complete equanimity. They firmly believe there will be a key peacetime

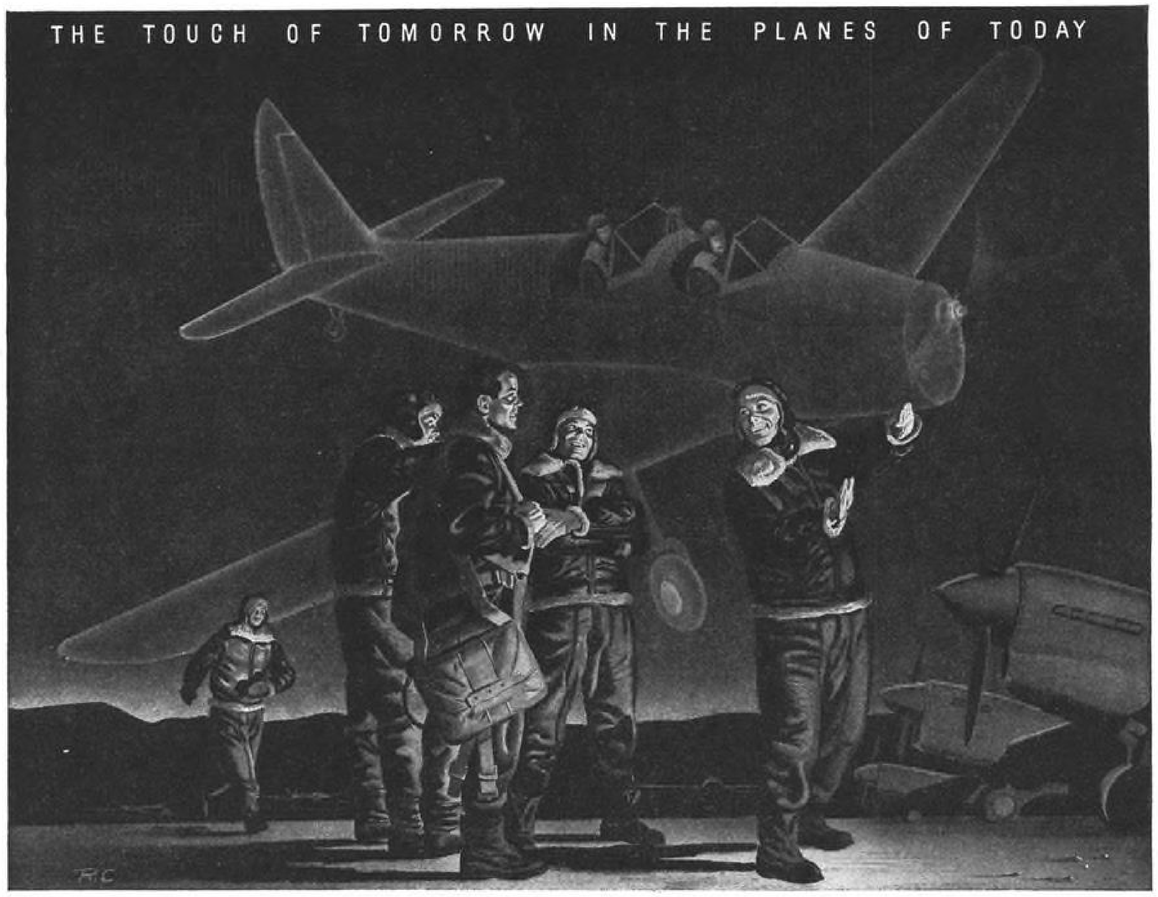


Battle action against the enemy in all weather is the proving ground for ACTUS HOSE CLAMPS. On this small device so much depends. The lives of both battle vehicles and those who man them are secured by the safe "seal-ability" of these clamps. For vital life lines they assure absolute *safety under strain.*

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America's Most Efficient "Strip" Hose Clamp
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Reunion on the Field of Battle

These are Fairchild alumni—fighting men from Norway, Canada, the U. S. A.

Though they come from different parts of the world, these skillful warriors of the United Nations Air Forces have much in common.

Typical of thousands of fliers on every fighting front, each was given an intensive course in a Fairchild Primary Trainer as one important step on the road to winning his wings. Their meeting upon some distant airfield is virtually a reunion of "old grads" of the same Alma Mater.

It is easy to understand why the Air Forces choose Fairchilds for primary training.

There is the element of added safety. For example: quick take-offs and steep climbs can be performed by novices in a Fairchild Trainer without danger of stalling, which caused so many fatalities in the last war. The trainee, behind a 175 or a 200 horsepower Ranger engine, just "pours on the coal" and he's quickly in the air with a lot of runway to spare.

And when it comes to acrobatics, which give a trainee an intimate feel of the controls and teach him instinctive flying, a Fairchild is the answer to an instructor's prayer. No need to crush the student's confidence by telling him not to dive at high speeds. Just teach him all the tricks in the bag, with the full knowledge that safety has been built into every inch of every Fairchild Trainer.

Maneuverability with great safety, and rugged landing characteristics—for which *all* Fairchild trainers are famous—provide the foundation stone of Fairchild's "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*

place for alert fixed base operators, and to this end they are planning some expansion. In addition to taking on two new engines for distribution, the parts and accessories line is to be enlarged, both as to the number of items carried and the stocks to be maintained. Thus the jobber's function will be fulfilled for smaller operators.

Although the school will be retained, emphasis will once more be on sales and service. The school will be continued because it is believed that, although CAA requirements will be changed, skills and licenses will be essential. Expansion of the service end of the business can, and well may, include complete service for feeder lines.

"We expect plenty of competition again after the war," Borton reports, "but we've always been able thus far to get our share of the business. Our policies of being adaptable, getting the best equipment possible, keeping adequate stocks, and doing quality work have kept us well out of the red so far, and we believe these policies will do just as well for us after the war."

Thrust Meter Testing

(*Continued from page* 183)

speed is attained by diving quite sharply, flattening out to an angle only sufficient to maintain the desired speed.

Use of shaft thrust measurements in routine flight testing in order to check calculated airplane performance does not appear very practicable. Additional data whereby corrections can be made are obtained, however, as well as much useful data on propellers, which should lead to improvements in airplane performance. An instrument of this type can also be used to determine relative efficiencies of various propellers more especially in outboard plan form, thickness ratio, pitch distribution, airfoil section, and tip shape.

Another possible use is to determine L/D characteristics of the airplane when gliding at or near zero thrust. Because this type of thrust meter is not adapted to reverse thrust measurements, it would be desirable to make tests with a small, but known, positive thrust. Other uses for an accurate thrust meter will undoubtedly be developed. Therefore it is believed that this rather specialized type of instrument will eventually find a useful place in flight test procedure.

Flexible Cable Control

(*Continued from page* 191)

respect they may be compared favorably to rigid rods in many applications. This result has been achieved by producing a conduit and cable (or other moving

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IN PRODUCTION *by* UNIONAIR

Made Strictly in Accordance with ARMY-NAVY Aeronautical Standards

You can expect the same high standards we have always followed in our production of CONDUIT FITTINGS, 100% inspection by our own skilled staff and always the kind of service that has made so many friends for us among Aircraft Manufacturers.

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element) to such close tolerances that "trading" and "snaking" have been substantially eliminated.

Friction remains as a substantial problem and adversely affects the theoretical efficiency. But the friction does not produce unsatisfactory operation in the majority of applications. Flexibility in these controls is almost unlimited, therefore they absorb vibration and relative movement without involuntary operation of the control. They are very light in weight, easy to install, and require little designing on the part of the aircraft manufacturer. Some of these controls do, however, present a problem in field repair and maintenance. They are without exception economical by comparison with the rigid rod and cable types of control.

There is an interesting type of flexible control now being manufactured in this country for the first time. Used extensively by the RAF since the outbreak of war, it consists of a cable of novel design operating in a dural tube. This cable, consisting of several layers of wire wound about a core, has an outside layer of comparatively large diameter wire wound in the form of an open helix so that the cable is, in fact, a flexible rack. The helix wire is rounded to form a good bearing surface in contact with the tube through which it moves, thus reducing friction.

The cable itself may be engaged with the teeth of a helical gear, and in this type of application the angular movement is unlimited. The dural tube and the cable are both produced to close tolerances to produce a close fit so that backlash is negligible. Actually, even in lengths of 40 ft. or more, the lost motion is measured in thousandths of an inch. Because of its rugged construction the control is absolutely positive in action under all loads for which it is used, and it is sufficiently flexible to absorb all vibration and relative movement which is encountered in aircraft. It does not operate involuntarily, nor does it require support, except at the control and remote ends. Therefore it transmits no stress to the airframe, except at these two points.

The cable and the tube, which are the dominant parts of the control, may be obtained in bulk, and the control may be formed and installed without any special tools. This simplifies the problems of repair and maintenance of spare parts. Since the cable is not set up under tension, the control requires no attention after installation, except infrequent lubrication. Further, it is very light and because of its small size can readily be installed in any aircraft without special design consideration.

Perhaps the most convincing proof of the satisfactory performance of this control is the fact that it is to be found on the exacting propeller pitch controls of such well known RAF aircraft as the *Mosquito, Lancaster, Typhoon,* and *Spitfire.*

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How Gunners Learn

(*Continued from page* 225)

That efficiency is evidenced by the fact that Eglin's last class qualified 36 percent of its number as experts (30 percent or more hits); 37 percent as sharpshooters (20 to 30 percent hits); and 16 percent marksmen (15 to 20 percent hits). Only 10 percent failed to qualify. The over-all average of hits for the entire class was 29.1 percent.

In addition to its course for cadets, Eglin conducts a regular school for gunnery instructors. Pilots selected from advanced flying schools take a 15-day course preparing them as gunnery instructors at their original fields, to which they return to direct pre-Eglin gunnery instruction, including "dry runs" with the gunsight aiming point camera and with 10 or 12 hr. in the theory of sighting and aiming.

Principle of the gunsight aiming point camera, developed at Eglin, is simple. The pilot goes through the same motions he employs on a loaded gun. But here trigger-pressure activates a camera. When developed and projected on a screen, the film shows the student his errors in aim. Another aid conceived at Eglin is the Hale trainer, developed by Maj. J. E. Hale, now assistant A-3 to Eglin's proving ground command. Here, the student first learns to coordinate the activities of both pilot and gunner. "Flying" a Link trainer on which a BB-loaded machine gun is mounted, he lines up his sight on a moving target and pulls the trigger to release a stream of lead pellets at miniature planes in front of him. The Hale trainer, like the aiming camera, today is standard AAF gunnery training equipment.

Flexible Gunnery

The enlisted man who would put the sting in a combat bomber must be a nerveless, healthy fighter who can thrive on the ceaseless noise of battle and the endless tension of lightning-fast action. The plan of flexible gunnery training at Tyndall Field, Fla., is a rigorous one in which the "feel" of actual combat is simulated in numerous ways. The student is placed on edge the day he reports for training. He stuffs cotton in his ears on the gun ranges. The introduction to the deafening roar of powder-explosions temporarily confuses him and mars his aim.

To be accepted for training the applicant must be no more than 5 ft. 10 in. in height and no more than 170 lb. in weight. Excellent vision is requisite.

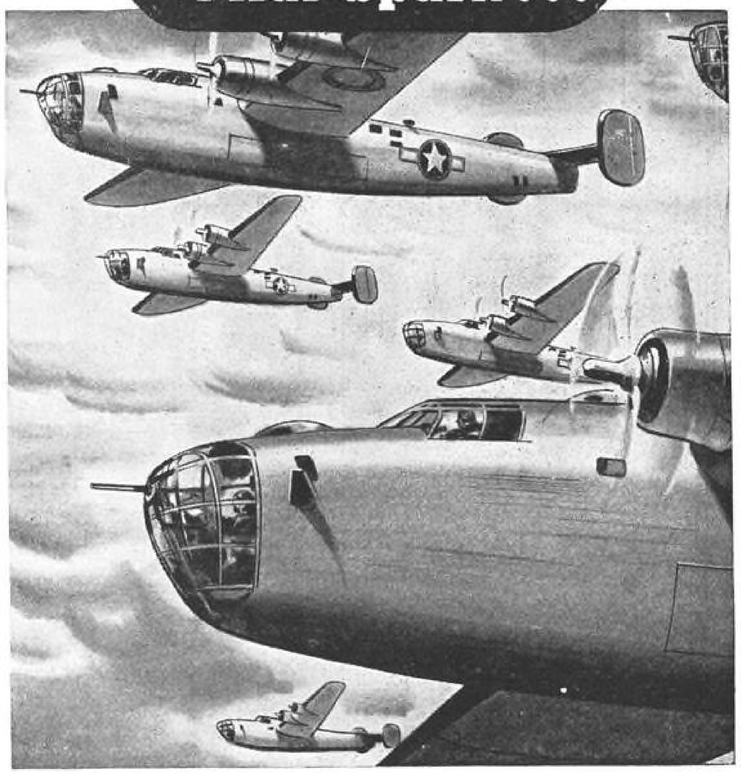
His first contact with AAF principles of shooting is made on a ground range where he fires .22 cal. bullets at a still target. Instructors tell him how to squeeze the trigger—"just like a lemon"—and how to hold his breath to steady his aim. Later, the embryo gunner uses the same bantam rifle to hurl lead at moving plane models. Thus he learns the knack of leading the target, a fundamental that must become second nature.

Students get the first thrill of automatic fire when they meet the air-powered BB-throwing machine gun on Tyndall's miniature range. The sight and the principles involved in its correct use are identical with those of real-battle guns. Targets are thin metal plane fuselages which move about a continuous track at 400 ft. per min. These targets are scaled to simulate ranges of 200, 400, and 600 yd.

Under the tutelage of nationally famed clay pigeon blasters, gunners-to-be advance from the miniature range to skeet ranges where they get more learning in sighting and leading and are trained for physical and mechanical coordination.

On the moving-base range at Tyndall the gunner first readjusts his technique

Guardian of a Vital Spark . . .



Packard Aircraft Electric Cable

Up where the air is thin and cold, the problem of safeguarding the surge of electricity that "sparks" engine performance is intensified many times. It has been one of Packard Electric's assignments to develop ignition cable for high-altitude operation, and this Packard cable is now serving in bombers and fighters of America's air forces. Close cooperation with the air forces, aircraft manufacturers and airlines has enabled Packard Electric to apply the full measure of its experience to meeting the requirements of the aircraft industry. Many types of Packard aircraft electric cable are performing varied functions on airborne equipment.

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to the demands of apparent motion. From a platform on the back of an Army truck, he shoots at clay pigeons with a .12 gage shotgun while moving 20 mph. around the course of a 1¼ mi. track. Targets are thrown from 25 trap houses along as many different trajectories. Some skin straight up in the air, while a split second later on the other side of the road another will fly out toward the truck. Others head dead-away from the gunner.

The moving base range and many others at Tyndall are supervised by short, sun-tanned Capt. Graydon D. Hubbard, who formerly held four national professional skeet titles—.410, .28, .12, and "high-over-all." Entering the AAF, he completed the six weeks' course at Tyndall and graduated with "expert" honors in every phase.

Students, no longer novices at the art of shotgun-destruction, now progress to the .30 and .50 cal. ground machine gun ranges. Already they are familiar with the innards of the guns, as every off-the-firing-line moment has been spent in tearing down weapons on the tops of tables placed conveniently on each range by Capt. Hubbard.

The target on the machine gun ranges is a white, mesh rectangle 11x3 ft. mounted above one of the Army's familiar work horses, the Jeep. The midget target-bearer, concealed from the view of those on the firing line by a protecting earthen embankment, moves at 30 mph. around a continuous single-track. Each student loads his own gun with ammunition tipped with a distinctive color. Thus scores may be totaled by a count of hits of any one color.

Turret Practice

When they progress to Tyndall's shotgun-turrets, students are likely to meet another famous marksman, Capt. Henry B. Joy, lanky skeet range officer who was national amateur all gage skeet champion in 1938 and, in '35, .20 gage title holder and "high-over all" champion for the country. His present skeet gun is a shotgun mounted in a power-operated turret on the back of a stationary truck. Inside the turret, the student sights, triggers, and fires just as he would on a machine gun. The targets are clay pigeons thrown across his field of vision. He learns that turret-shooting permits no personal freedoms in sight alignment. Instead of pointing his body and his gun by physical movement he learns to point a mechanically moved glass-house.

In other classes, students harmonize the line of the bore with that of the sight in order that trajectories of the two will converge at the desired point. On the estimation range, they endeavor to judge the range of planes which fly into their sights at low altitudes and from varying angles of attack.

WE'RE COMING OVER



One Corner of the Bell Aircraft Plant

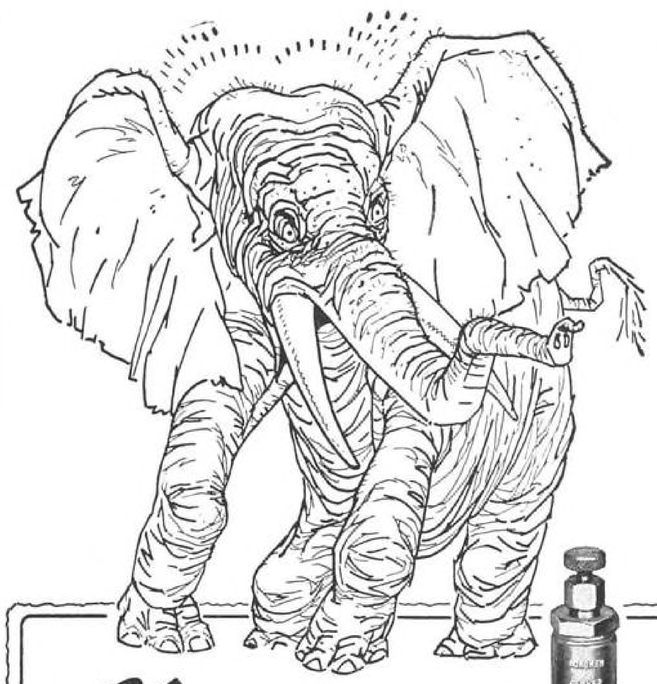


One of the best answers to the prayers of the invaded people of Europe is America's Super Bombers . . raids in which 1000 Super Bombers take part. Raids that increase with ferocity until the very earth rocks beneath Hitler's feet!

To make more certain that those Super Bombers do well the task assigned . . . Bell fighter planes will help give the proper protection.

Thus it is, with pardonable pride, we point to the fact that the Jacoel Cable Splicer . . . newest modern splicing tool . . . is helping in manufacturing Bell Aircraft Control Cables.

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It packs a wallop! It insures maximum man-hour production . . . with minimum operator fatigue.

With NORGREN LUBRICATION you can *keep* air tool power at new tool peak permanently! Norgren Lubricators are automatic. They start and stop with the air tool. *They never forget!*



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Norgren

The No. 1 event in the student's career comes when he is okayed by his instructor for his first plane trip on a gunnery mission. He fires flexible guns mounted in the rear cockpits of North American AT-6 advanced trainers, also other weapons which chatter through the sides, tail, tops, and noses of twin-engine and four-engine bombers. The *"Zero"* at which he shoots is a mesh target towed out over the Gulf. Ideas of horizontal lead employed in shooting at clay pigeons must be coupled with the principles of vertical lead necessary to hit a target that may be moving in a downward path beneath him. To sharpen his practical knowledge of ballistics, the student has hours in the classroom. As a further aid in practice, charts showing the vertical lead variables at different ranges are pasted in the gun turrets.

But all of the realistic experiences in school are not found in planes. The developing gunner also encounters the sights and sounds of actual combat in practice rounds in the "Jam Handy" trainer in ground school. In a darkened room, he sits behind a photo-electric-eye machine gun and draws a bead on enemy planes that streak toward him on a motion picture screen. In another trainer, the Waller, he shoots electrical-impulses into a man-made three-dimensional sky that seems to be filled with planes roaring down from every angle.

He studies aircraft identification in class, and when he goes to his barracks he sees plane models suspended from the ceiling over his head and silhouettes tacked on the wall all around him. He eats beneath more models. And in the post exchange they swing from the rafters.

Despite the size of Tyndall's flexible gunnery program, it employs the flight system in which only ten students (a group) are assigned an instructor who works with them throughout their course. With this sufficiency of supervision and equipment (there is one machine gun at Tyndall to each student), unsurpassed efficiency has been developed.

Heading the gunnery school at Tyndall Field is Col. Leland S. Stranatham. Lt. Col. Jack L. Randolph is director of training.

"Sighted Wreck . . ."

(*Continued from page* 127)

6. Reconnaissance cars for transporting men from job to job.

7. Truck with 420-gal. water tank for drinking and cooking.

In addition a travelling crane is always available if required (such as in this case when the plane needed lifting to repair its landing gear, bomb doors, and lower ball turret).

Veteran George Krouskop, LOC civilian in charge of the unit and a man with a nine year background with Boeing and Lockheed, quickly had Tough S—— lifted off her belly so the inspectors could complete their under-fuselage examination. While soldiers and LOC engineers went about their routine jobs, Krouskop discussed the damage inventory with visiting control board officers, and his expert knowledge supplemented the military viewpoint, providing a "fix" for immediate procurement of the urgently needed parts.

The units are so well equipped and so comprehensively stocked that delays due to insufficient tooling and ill-kept stores are rare. Meanwhile, an accurate initial assessment of parts and material needed allows time for them to be rushed to the site while technicians are still stripping damaged parts.

The mobile stores trailer carries its own stock records, and both parts and tools have to be requisitioned in duplicate so that main supply records are kept up to the minute on withdrawals and also so that the service unit, when it returns to its base, can replenish depleted stocks without resorting to a numerical check.

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"MX" Wheels are ideal for breaking corners, removing burrs and polishing grooves and slots. Surrounding surfaces are kept free of abrasive marks. Tolerances are maintained in polishing because of the light stock removal.

Write to Dept. *A*, The Carborundum Company, Niagara Falls, N. Y. for literature describing "MX" Wheels and their many uses.

Every hour this war is shortened will save $12,000,000. The lives it will save are priceless. Let's get it over with—quickly!

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A couple of days after the repair unit got started on Tough S——, officers of the Corps of Engineers arrived and surveyed the site for construction of a temporary runway so that the plane could take the air again as soon as LOC and AAF technicians had completed their job. Following the engineers report, an AAF Engineering Battalion reported to clear the field. It hewed down hedges, leveled the ground, and laid the steel mesh runway—all with mechanical precision.

In no way is the work done by mobile service units makeshift. It is as carefully and accurately carried out as if the plane were being repaired at a main base. Inspection is rigid and frequently cross-checked. Workmanship and ingenuity in making awkward repairs is excellent, meeting a completely professional standard. This shows the wisdom of infiltrating LOC experts among soldier mechanics, many of whom never saw an airplane before entering the armed forces.

After only a very short time, Tough S—— was again in the pink. It was hauled to the temporary runway, where engines were revved up and instruments and flying controls were tested and found okay. Finally all unnecessary equipment was removed (because of the short runway) and Tough S—— took off for her home field where, on arrival, she would be checked over again and test flown before tackling further missions.

Servicing of modern aircraft, with their complex equipment, presents difficult problems even when the operations are in the country of origin. When the planes are transported 4,000 mi. across an ocean and thence disperse over a scattered area for operational purposes, servicing problems become almost impossible if speed, so necessary in this war, is reckoned.

This, then, was Service Command's big problem—a problem which was quickly solved by the mobile service unit, which is now proving so successful that it is being adopted by the RAF. No doubt its use will be extended to other theaters as fast as possible.

The mobile service unit is a young, streamlined idea, both ingenious and practical. It lives up to the highest standards of the AAF for freshness of thought, determination, enthusiasm, and progressiveness.

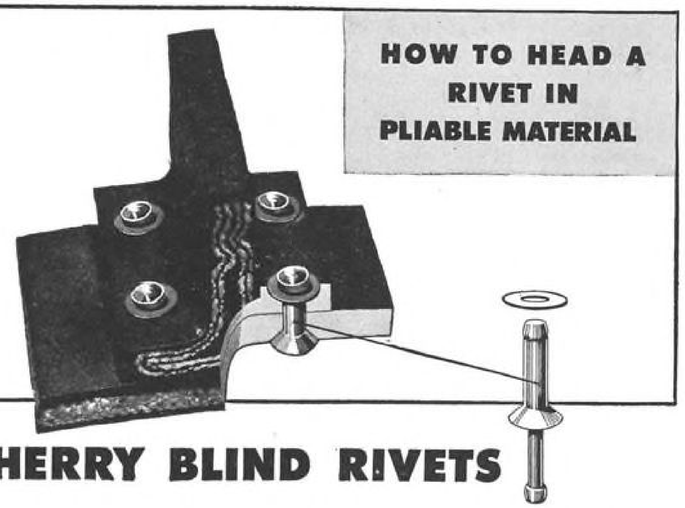
Crew Competition

(*Continued from page* 150)

This system places responsibility right down to the basic crew, and it instills a spirit of competition since no crew wants to have its work found wrong by other crews, flying personnel, or other non-commissioned officers. Stiff penalties, mainly affecting seniority and promotion, are on the books for errors made by crewmen.

New men are placed on trial for a few months. During this time they are putting into practice the theoretical work of the training school. To aid them and also the older maintenance men, sectional parts of all aircraft equipment have been set up in a classroom. This sectional equipment is made at each station from parts of unserviceable aircraft and engines—parts which come from crashes or which have already given all the service required. Engines, for instance, are cut away to show how each part functions, with colored lines drawn to show how the electrical circuits operate and the feed lines function. During off periods, mechanics have their problems solved on this sectionalized equipment.

In addition new men can attend night classes on specialized subjects several times each week. Here they may ask questions and have problems explained. That many mechanics are taking advantage of these methods of learning more about their jobs is noted from the

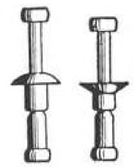


CHERRY BLIND RIVETS

CHERRY BLIND RIVETS of the hollow type are shown above holding a rubber cleat to a rubber conveyor belt. Both hollow and self-plugging types of Cherry Rivets make ideal fasteners for pliable material because they are headed by means of a pulling force. There is no hammering on rivet heads—no bucking bar needed.

Application is faster than with conventional rivets and may be done with inexperienced labor.

There are undoubtedly many places where you too can use Cherry Rivets to save time, reduce costs and get a better job. Ideal for speeding up work on war jobs. Get the complete story on Cherry Rivets now.



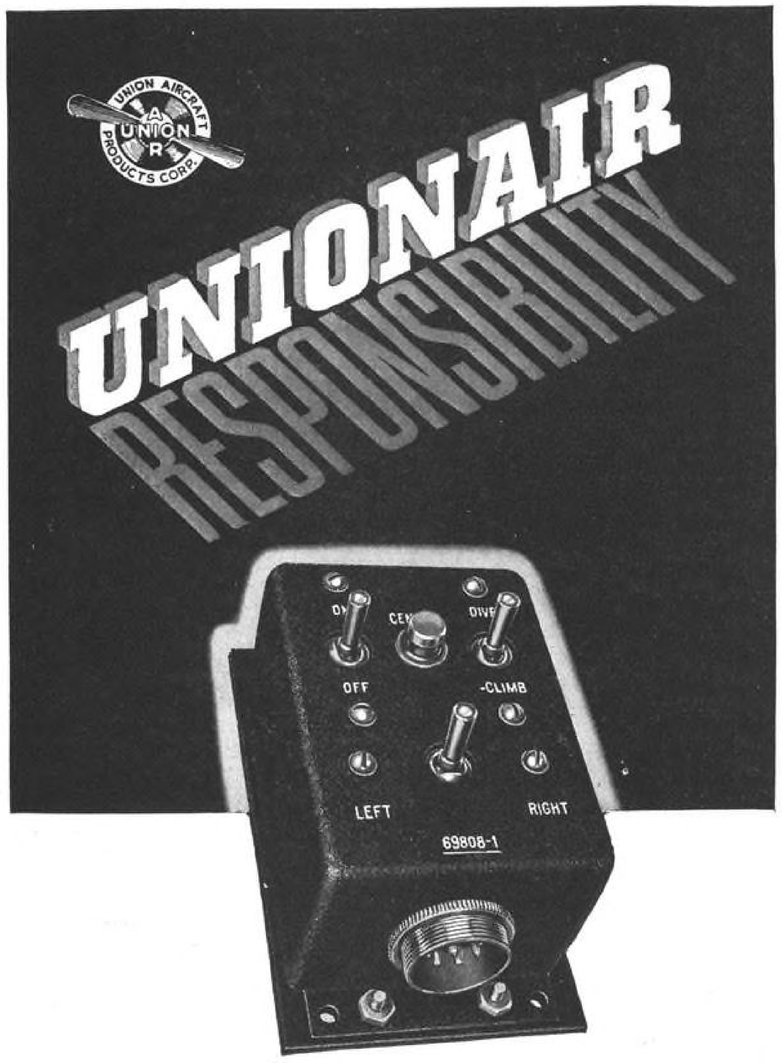
Self-plugging type with brazier and countersunk heads. Mandrel is pulled through rivet and permanently plugs it.

WRITE FOR HANDBOOK telling how to use Cherry Rivets. Address Department A-110, Cherry Rivet Company, 231 Winston St., Los Angeles 13, Calif.

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UNION AIRCRAFT PRODUCTS CORP., NEW YORK

number passing trade tests (which bring more pay) and also from the increased number of serviceable aircraft.

After a mechanic has been on the maintenance staff for a few months and shows promise, he is given a red star on his name card on the board in the control room. If he reaches average ability, the red star is replaced with a blue star. Above average brings a silver star and the chance for a promotion. This is but another feature of the incentive system put into practice at these depots.

The control boards in the hangar control room show not only the work that must be done on each aircraft, when it came in, how long it should be in the hangar, and other standard information, but it also indicates where each man on the maintenance staff is located at any moment. The name cards move with each man's work—from hangar to hangar and job to job. This gives a close check on the full utilization of manpower.

Each station sends in weekly reports on the serviceability of its aircraft and disposal of its strength. From these reports charts are prepared and kept up-to-date showing the state of serviceability of all aircraft. The graphs record the number of aircraft at each station in brown crayon, those potentially serviceable within 48 hr. in blue, and those immediately serviceable in red. If the red and blue lines become too widely divorced at any station, a technical inspector goes to the station, checks up on the reasons for the drop in serviceability percentage, and shows how the system can be improved, according to practical applications developed at other stations.

To aid in keeping aircraft in airworthy condition, a number of practical gadgets have been perfected at RCAF stations. Thus, to save wear and tear on aircraft wings in fueling, a metal step-ladder has been built on gasoline-truck front fenders. By standing on the ladder, the mechanic can fill the training aircraft without stepping on the wing walk.

Carrying a fire extinguisher at a run to a burning aircraft is a difficult job. So the RCAF has devised a wooden-wheeled carrier for the fire extinguisher. It can be trundled to the aircraft at top speed.

The job of spraying paint and dope used to mean a lot of traveling back and forth to refill the can. Now a box on the portable spraying machine carries two extra five-gallon cans of paint or dope, saving many trips to the store room.

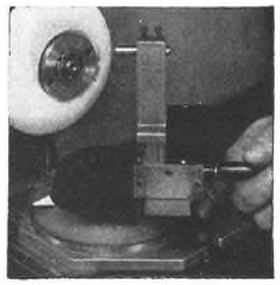
It used to take two men to roll a gasoline can under an aircraft that had to be emptied before overhaul. The same men would also have to carry the can away. Now one man does it on a specially constructed wood and metal truck



Since the VINCO B-1 DRESSER (angle tangent to radius) was designed and its manufacture started, the boss of the Dresser Department, Jimmy Allen, has made it his personal business to see that each and every Dresser was built with VINCO precision throughout.

The demand for this sturdy little Dresser has been increasing—and VINCO has increased manufacturing facilities accordingly. Production has gradually gained until now an adequate stock of Dressers is on hand. This will mean much to those wishing immediate delivery.

But in spite of the increased production, the quality of the Dresser still remains VINCO quality—precision built into every part.



The VINCO B-1 Dresser has almost universal applications; and with the care generally given precision tools, its service, under ordinary production conditions should be long and economical.

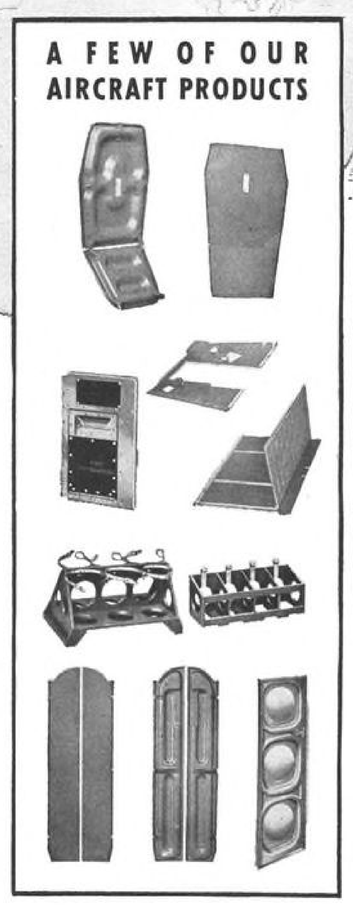
Write for the B-1 Folder which contains full details.

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with caster wheels, on which he can easily place the empty drum. A funnel is inserted to catch the gasoline. A metal grounding chain is fastened beneath the low-slung truck.

These are but a few of the "twists" which have been devised by the RCAF to speed up aircraft maintenance and thus keep as high a percentage as possible of serviceable ships at each RCAF station.

"Bush" Maintenance

(*Continued from page* 155)

It must be remembered that at few bases out of which aircraft operate in this area are there suitable hangar facilities to do overhaul or inspection work. In winter most of these bases only have nose hangars for the jobs to be done. Hangars for thorough overhauls are located at Winnipeg and a few other points.

The daily pre-flight inspection is usually completed at these bases at least 15 min. before the aircraft's departure. Engine inspection includes cleaning and check of gas strainers, ignition inspection, removal of side cowlings and inspection for oil leaks, check of exhaust tail pipe, of support brackets, and of batteries. The daily aircraft inspection includes a check on fuel and oil levels, draining fuel tanks at sediment cocks, inspection of propeller hub and blades, cowlings, floats, skis or wheel undercarriage, checking life preservers and belts, and similar details.

This daily inspection covers any aircraft and engine. Similarly the other inspections, as outlined at this division, apply to all makes of aireraft used there, while engine inspections are based on the *Wasp* model. The 25-hr. engine check calls for the daily inspection, plus the removal of all engine cowlings, inspection of engine installation, exhaust manifolds, inter-cylinder baffles, oil radiator control, oil strainer cleaning, carburetor air scoop and control, and thermo-couple connections. The 50-hr. check adds to these the changing of spark plugs, carburetor flushing, inspection of induction manifold for tightness, and checking of all primer lines and connections.

On the 200-hr. engine inspection all the foregoing must be done, and also a thorough check of valve springs and rocker arms, magnetos, checking cylinder base nuts for tightness, draining oil sump, testing electric wiring, checking booster magneto, checking engine controls, removal and inspection of propeller, and washing down entire engine installation.

At these bush bases, aircraft procedure on the 25-hr. check includes a thorough inspection of the entire air-

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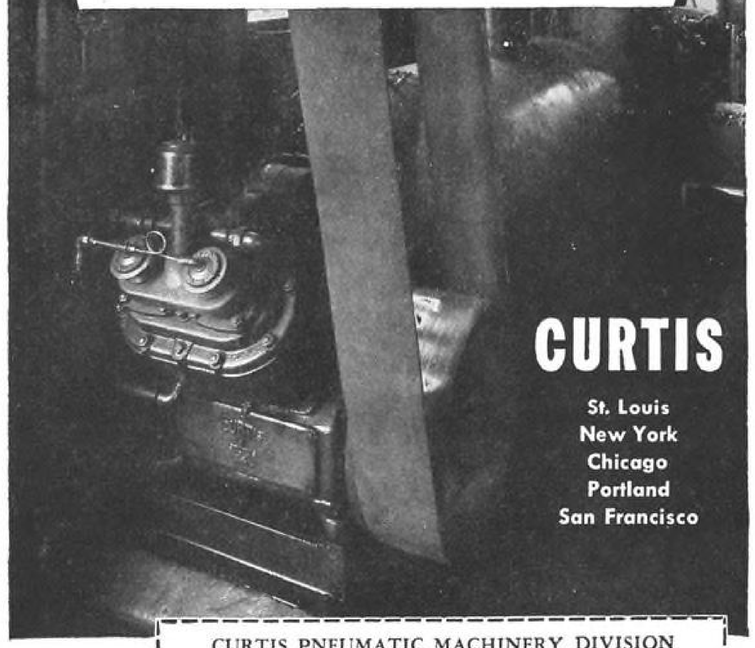
Because of the completely satisfactory performance of their first Curtis Model "C" Air Compressor over a period of six years, the Stewart Company installed the second one to handle their increased demand for air.

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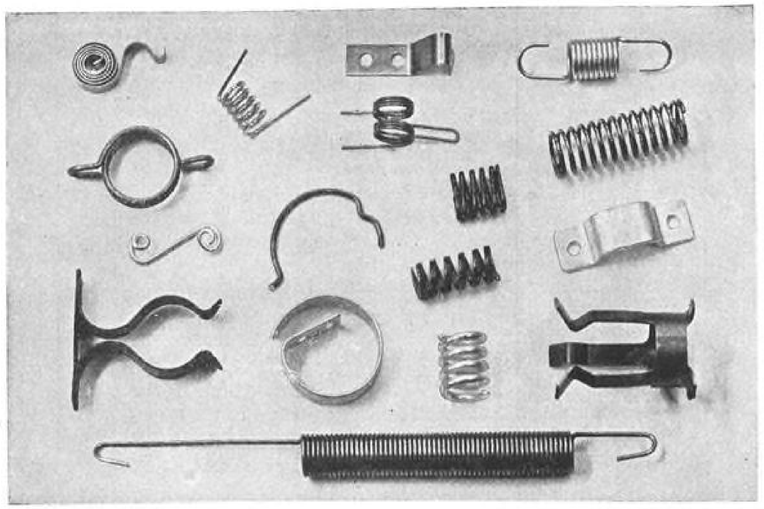




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frame, wings, empennage, emergency exit, controls for excessive play, control column for looseness, and engine ring cowling. On the 50-hr. check, in addition to the above items, all controls must be inspected, including cables and pulleys. The 200-hr. check requires the removal of all inspection plates and a thorough look-over, and repair when needed, of fairings, cabin heaters, tab, flap, stabilizer, and all controls. There is refurbishing of the cabin where necessary.

Loads carried by these bush aircraft include not only mail and passengers but also live cattle, often explosives for mining operations, drilling equipment, engines for mining camps, furniture, fresh food, indeed all types of freight. Wear and tear on cabins of these ships is thus heavier than on commercial passenger lines. And so refurbishing of cabins on the bush lines is an important item, often requiring replacing windows kicked out by live stock.

While this system of north-south air routes has not yet completed two years as a consolidated venture, big strides have been made in developing a standardized maintenance set-up. Manpower troubles due to the war have handicapped the line's maintenance staff. But through another development, CPA sees eventual answer to this shortage—that is, through its current operation of five RCAF overhaul and repair shops. In these five shops, aircraft and engines are overhauled and repaired, largely with a staff which has had to be trained for the work since the start of the war.

Accordingly, CPA expects, in the postwar period, that many of these mechanics, both men and women, will become available for its various operational bases throughout the northland. Further, the shops which have been built as a wartime necessity may then be used for major overhauls.

Metal Show Forecasts

(*Continued from page* 194)

in die castings for ground equipment. In few of these is light weight a factor, but the zinc alloys are applied with high economy. This is not in the realm of new departures, but it is not without significance that the portion of the aircraft industry concerned with ground equipment has rapidly availed itself of the economies of zinc alloy die castings.

Silver continues to expand in aircraft production, though its uses are largely in established forms, chiefly in engine bearings, electrical contacts, and brazing alloys. Indium is still being employed as an electrolytic coating on silver or lead plated silver bearings, but it has found a new use over zinc as applied to steel surfaces, chiefly on hollow steel propellers. The amount



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of indium applied over the zinc is small, being only 1½ percent of the zinc coating, but the two are heated to fuse them and form the eutectic zinc-indium alloy. This fusion is said to close all pores in the plated coating and to give it an unusually high resistance to salt-spray and other corrosion

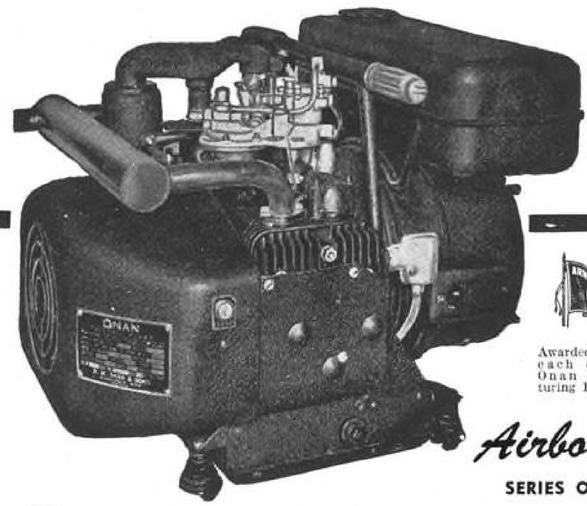
Beryllium appears to be confined largely to use in bronze springs, where its utility is well established There are claims for equal performance for certain nickel alloys without beryllium, but the nickel stringency has forced those particular alloys into the background, perhaps for the duration, though subsequently they may find some aircraft applications.

Among ferrous alloys, however, nickel has been used and presumably will continue in use to the full extent of its availability. Reports indicate that the National Emergency steels have found wide use in aircraft for engine mounts and landing gear parts. For this purpose NE 8630 has replaced SAE-X4130 for tubes and other components commonly used in welded structures. Up to the present, very few engine parts have been made of NE steels. Where relatively large sections are involved, it has been found that NE 8740 has proved an inadequate substitute for SAE 4140 because it lacks hardenability. For the same reason, no adequate NE substitute has been designated for SAE 4340.

In the field of carburizing steels, none of the NE grades offers core properties comparable with the SAE grades regularly employed. Because of the presence of nickel, chrome, and molybdenum in the scrap piles, however, there is a growing tendency toward adoption of nickel-chrome-molybdenum steels in order to regulate and control hardenability.

Some references were heard at the meeting to so-called "liquid forgings," actually castings having properties more or less duplicating those of forgings of the same or similar composition Some such forgings are centrifugally cast (see Ford's Centrifugal Cast Cylinders, page 134, June AVIATION) and are produced under exacting control. To what extent such castings can be substituted for forgings in aircraft work is uncertain as yet, but there are possibilities even for crankshafts for engines for moderate power, possibly in SAE 4330 steel. In days when even unalloyed gray iron castings having a tensile strength of 80,000 psi. or higher are produced, it is hard to say what may be accomplished with alloy iron or steel castings.

Nickel iron castings produced in sand are already being used for aircraft engine cylinders. Some receive a screwed-on aluminum head, but others are employed as inserts in making alu-



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minum castings, the aluminum forming the cylinder head and the fins along the barrel or liner. An actual bond is said to be formed between the nickel alloy iron and the aluminum and, despite some difference in expansion between the two metals, satisfactory heat transfer from the cylinder liner to the aluminum is said to be realized.

It is possible that still better results may be secured if conditions should permit the use of an alloy iron, such as Ni-Resist (containing 15-17 percent nickel, 5-7 percent copper, and 2-3 percent chromium) which has nearly the same coefficient of expansion as aluminum.

Stainless steels continue to find considerable use, especially where high strength, light weight, and high corrosion resistance are required. According to some authorities, however, types low in nickel content have proved equally satisfactory (in exhaust line parts) as the 18-8 type formerly favored. In certain cases, welded tube is now used where only seamless was permitted before. Some of this tubing is drawn to size after welding. This works the weld, improving its structure or causing it to split if a weak weld has been made. One tubing manufacturer reports, however, that welded tubing is not gaining the acceptance some had anticipated as a substitute for the seamless type.

Although some structural parts are made from stainless steel, the types high in nickel are not favored because of the nickel scarcity. But, as stainless steel is now produced in large quantities and very thin gages which are likely to be continued after the war, there is a revival of talk concerning possible postwar uses for skin and other structural applications made from such metals, especially as the proposed assemblies probably can be successfully spotwelded. This presupposes a satisfactory structure and one at least as light and as low in cost as an equivalent aluminum structure.

On the other side of the picture is the increased availability of aluminum, presumably to be at the "lowest prices ever" in the postwar economy, and the improved technique for spot-welding aluminum alloys, including the newer and stronger types. Should such structures prove to be producible in adequate strength and reliability and perhaps be stiffer for equal weight and strength than the stainless steel type, the latter might lose whatever advantage its sponsors anticipate. One aircraft manufacturer is reported using the 17-7 type of stainless steel effectively. This steel is capable of developing 200,000 psi. tensile strength with relatively high ductility.

At least one company is understood to have developed an 18-8 type of stainless steel capable of precipitation hardening. This type, according to one metallurgist, can be hardened after fabrication to a tensile strength of about 200,000 psi. This is urged as a point favoring use in aircraft structures. If the claim is valid, its effect and that of other factors will probably be difficult to establish until applied to a specific construction problem.

There were, of course, numerous other developments mentioned or displayed during the Chicago meeting which may prove significant to the aircraft industry. The developments described here, though merely typical, suggest that new horizons are appearing in the metals field and that the postwar aircraft industry will not be lacking for new materials well adapted to its need.

Sub Killers

(*Continued from page* 135)

and a huge net, 220 ft. long and 200 ft. wide, is spread over the inflated bag.

With the net secured, the car is then detached from the bag and wheeled away in a giant cradle. Sand bags, previously hung around the edges of the net, are gradually raised, diamond by diamond, on the net to force the bag down to the deck. The deflation lines are hooked up to the ship, and the helium is removed to storage in huge Horton spheres.

As the ship is deflated, the 550 sandbags are moved up the net, holding the partially deflated bag down. Finally, after several hours, the ship is completely deflated. The envelope must then be partially inflated with air so that riggers can go inside and remove valves.

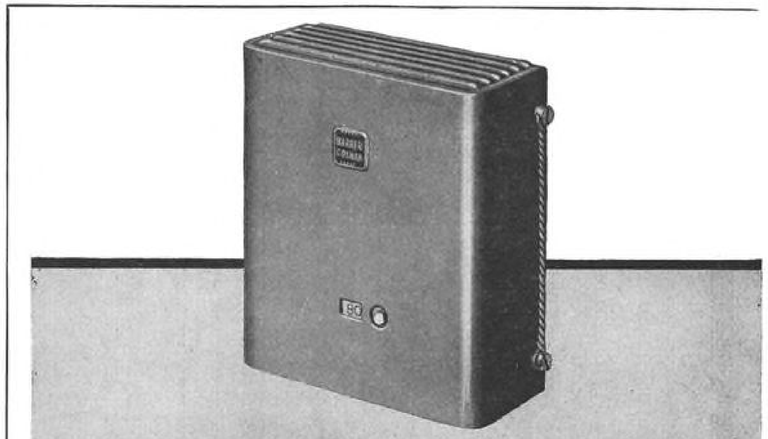
The helium plant necessary to handle erection, deflation, and purging of K-type airships consists of four stage compressors, operating at 2,400 lb. per square inch and a purification column at —192 deg. C. The purification rate of the plant is 12,000 cu.ft.-hr. Storage of helium is in two banks of cylinders, each consisting of 85 units of 2 ft.-dia. and 80 ft. long. Pressure in this stowage is 750 lb. per square inch, with a total capacity of 2,000,000 cu. ft.

Supply of helium is received at the station either by special railroad cars or high speed tractor trailers, and it is immediately placed in medium pressure storage. An underground piping system is connected to all three hangars, and by use of Worthington compressors, ships are deflated at the rate of 48,000 cu.ft.hr. This impure helium is then transferred to one of two Horton spheres with a capacity of 480,000 cu.ft. at 60 lb. pressure. When these spheres are filled, the plant is started, and the accumulated gas is then purified and transferred to storage.

As the helium in the ships loses purity, it becomes necessary either to add pure helium or to purge the ships in order to attain maximum lift. This is accomplished by drawing the impure helium out of the low part of the envelope and replacing it at the same rate so that proper pressure is maintained. The impure helium is accumulated in the spheres and purified when capacity is reached.

For advanced bases, a portable purification unit has been developed by du Pont, using a continuous circulation and charcoal purification. The rate of 4,000 cu.ft.-hr. is relatively slow, but if it is augmented by stowage, a sufficient supply can be built up to keep proper purities.

Once the car is secured the real work begins. The 24 slender wood nose battens are relaced on the nose and the nose spindle is installed. Electricians re-install all leads for running and avigational lights and electrical instruments, and radio men install the two receivers and two transmitters and intercommunication equipment. Instrument men connect all the flight instruments, while mechanics install new engines and accessories. Other riggers are busy installing the horizontal and



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vertical tail surfaces and adjusting the many fin brace wires to their proper tensions.

At last the ship, completely reassembled and ready for 3,000 hr. more of flying, is in line for dock trials and test flight.

Behind the schedule of these routine overhauls is a story of teamwork and industry. Sailors and civilians working side by side have made rigorous schedules routine. No less than 20 shops have handled this part of the overhaul, and all have had a heretofore impossible schedule to meet. Working together are these shops: Battery, cable, engine change, fabric, instrument, machine, metal, special equipment, dope, paint, sand blast, plating, propeller, electric, Lawrance, CO_2, and riggers, together with the parachute loft, and the helium plant, manned by over 200 enlisted men and 100 civilians.

Besides these shops, various offices—planning and estimating, engineering, overhaul, production, inspection, safety, and personnel—have all contributed their efforts and skill to the completed ship.

Moreover, the workers in the drafting and blueprint section have added their efforts to effect changes and improvements, and a Goodyear field engineer has assisted with his knowledge and manufacturing experience in K-ships.

The work that shops, offices, and departments have accomplished in a major overhaul is divided into routine renovation, adjustment and replacement, and service changes. The latter are technical improvements or refinements in present equipment for more efficient operation and occasionally for removal of equipment not considered necessary when the weight involved is too great. These service changes, approved by the Bureau of Aeronautics, are serially numbered. Bureau changes usually are the result of RUDM's (Report of Unsatisfactory or Defective Material) which are submitted by squadrons, hedrons, or air stations.

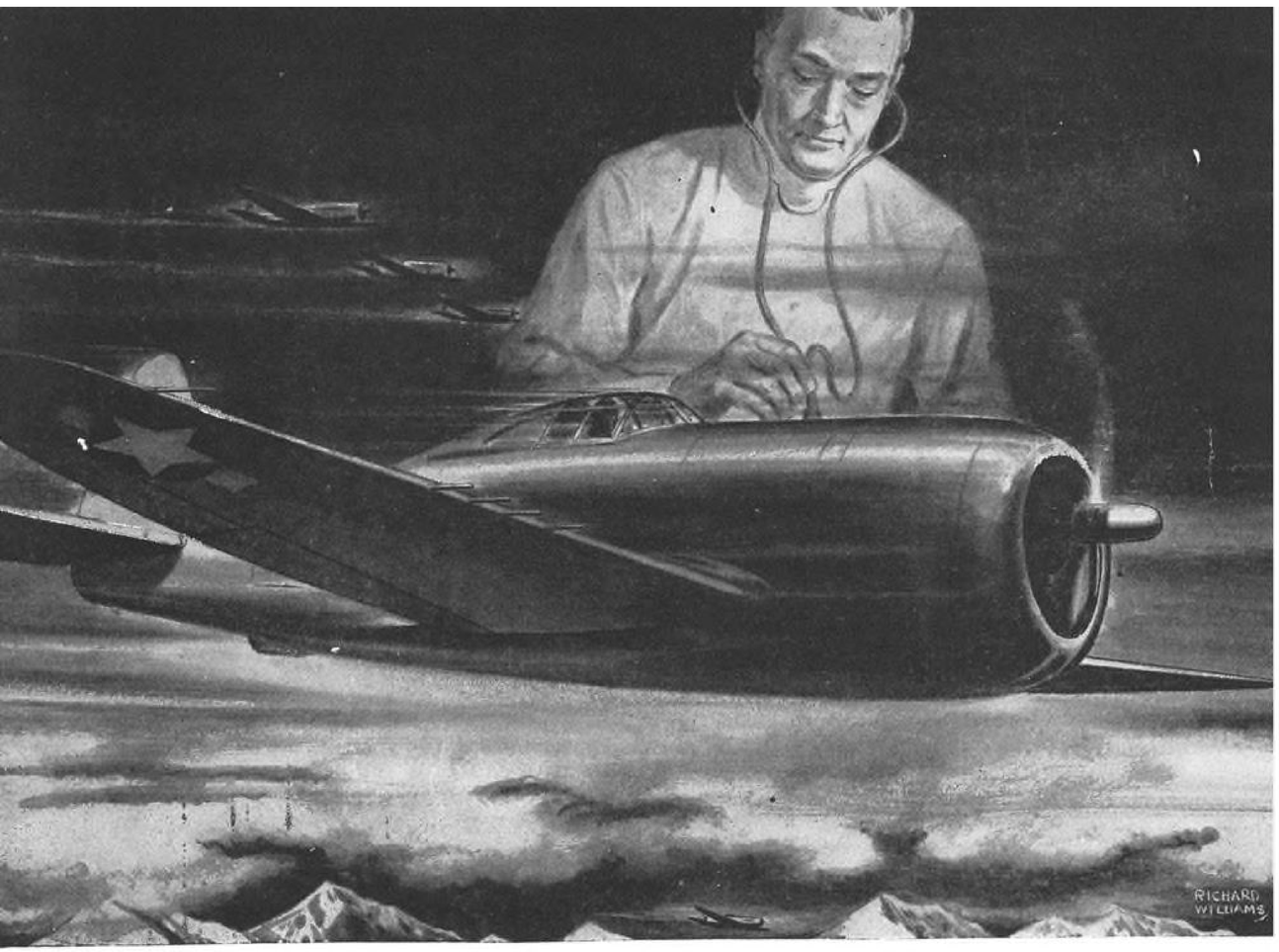
Air stations are permitted to make local changes. These changes are circulated with descriptions and blue print to all L.T.A. activities, and adoption of them is optional. If the local changes are accepted as service changes, they become mandatory and A & R accomplishes them the next time the ship has hangar availability.

Manufacturing, which accounts for about 30 percent of A & R's work load, is a varied and specialized process. With shop equipment still far from complete and most material to be used requiring high priority, the mechanical processes are only half the battle Job orders for one day often include manufacturing canvas bags for sand ballast, plating canteens for Marine landing forces, making homing loops for R.D.F. sets, special clips for auxiliary brace wires, fittings for masts, an improvised bomb sight, and other widely varied items.

An improvised plating process using batteries as a source of current and two blow torches for heat has made cadmium and chrome plating and anodizing possible.

When proper ladders for work on the sides of the ships and the lower fins could not be purchased, the carpenter shop undertook the task of manufacturing 20 55-ft. ladders for new bases. While carpenters made the actual ladders, the bases were shaped by metalsmiths, and salvage automobile wheels were mounted to give the necessary mobility. The units were completed for 50 percent of the expected cost and much quicker than they would have been available had they been purchased outside.

Richmond's organization is headed by an A & R officer, with an assistant in charge of administrative affairs. A production superintendent heads up all work, with sub-divisions under him handled by an overhaul superintendent and an assistant, a shop superintendent,



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Yet on the far-flung battlefields of the world, and in our own air lanes and waters, Military Pyrotechnics by International are playing star roles in protecting our planes and ships . . . lighting the way to an earlier victory.

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and a helium officer in charge of the helium plant. The finances and budgeting, as well as the necessary purchasing and planning, are under a planning and estimating officer. A maintenance officer and his assistant have charge of maintenance of the hangar, together with all of the shop equipment. Both civilian and enlisted personnel matters are managed by a personnel officer. Safety measures for all processes and personnel are administered by a safety officer.

Personnel at present numbers about 300. Of these, 200 are sailors and 100 civilians. Women are used extensively due to the manpower shortage. They have been found exceptionally capable in fabric and cable work. Almost all office work is handled by Civil Service women personnel.

The thirteen months just passed have seen a tremendous growth and a great deal of work done under trying conditions.

True, the next year will not be easy, but with equipment and material becoming available—plus the "can do" spirit—A & R can be depended upon to "keep 'em flying".

Cruise Control

(*Continued from page* 217)

To obtain zone times when using this type of chart, the true airspeed must be calculated, using a computer or a cruising power chart in order to determine true airspeed from instrument airspeed. The effective wind is then added or subtracted, as the case may be, to obtain ground speed. The procedure for using the maximum range chart is explained by the example on the chart.

Several types of computers of time, speed, and fuel consumption are in use. Generally, they are basically of the circular slide rule type, and to be used directly in flight planning they must be supplemented by speed-power charts for the particular airplane.

Since the weight available for payload depends upon the fuel carried, other factors constant, it is imperative that the operation of pre-determining fuel required be very accurately carried out in order that the flight may be completed safely, still leaving the maximum weight available for payload.

During the descent, it is customary to have the same cruising power on the engines, allowing the airspeed to increase during the descent. Thus the time to reach the airport is decreased. On the other hand, it is usually necessary to do some air maneuvering—circling the field to get lined up on the landing runway, which requires some extra time.

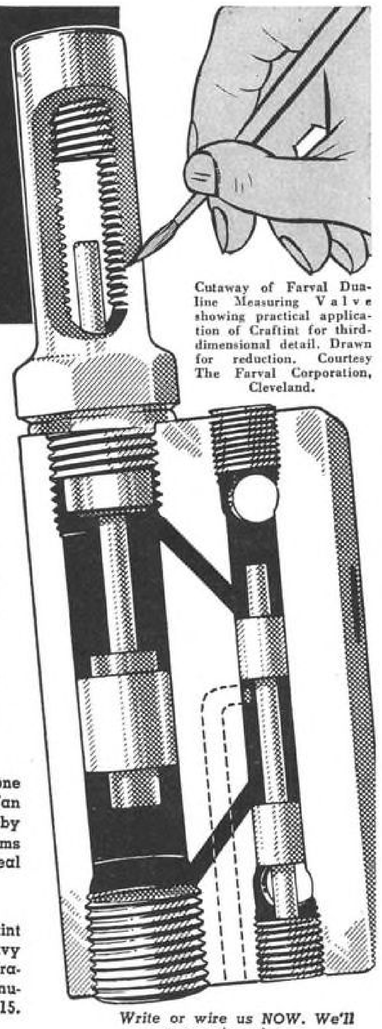
As a general rule, the extra time required in airport maneuvering is offset by the time gained through faster airspeed in the descent. Since mixtures are richened during the last part of the descent, preparing for the landing, fuel consumption in gallons per hour stays very nearly constant, even when power is reduced during the last part of the airport maneuvers.

Thus fuel and time are computed as if the cruising altitude were held right to the airport, then an instantaneous landing made, there being no allowance for the descent.

The subject of fuel reserve is a complete study in itself, and will be but briefly treated: First requirement in computing a fuel reserve is to determine the fuel and time requirements to reach some alternate airport at which the weather will undoubtedly be good for landing, should the original destination be closed in because of bad weather.

The fuel required to reach the alternate is computed from the usual cruising chart as if it were one leg or zone of the flight. In addition to reaching the alternate airport, it may be necessary to spend some time at the alternate with an air traffic delay and making an instrument approach. Usually

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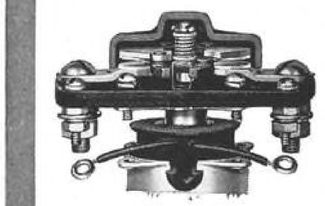
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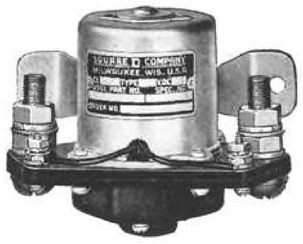


200 ampere, double pole, non-reversing contactor, Class 9350, Type K-3.

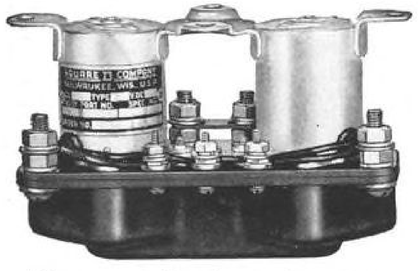
100 ampere, double pole, reversing contactor, Class 9360, Type C-2.



25 ampere, single pole contactor, Class 9350, Type B-2A.



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some flat period of time is allowed for this, depending on the airport. One hour is often an adequate time allowance.

On long over-water flights, where weather conditions and winds are not too well known and where avigational facilities such as frequent radio fixes are missing, there is sometimes added a constant fuel allowance per 1,000 mi. This might be 45 min. of cruising power per 1,000 mi. This makes allowances for getting blown off course while on instruments with no means of checking, more unfavorable winds than forecast, etc.

The last allowance usually made is for the minimum amount of fuel in the tanks with which all four engines will continue to run. When a tank is run completely dry, the engines run erratically for the last few gallons especially in rough air. Thus there is a minimum amount of fuel in the tanks with which all engines will run smoothly in very rough air. A flight plan should include the minimum fuel as a constant requirement.

To summarize: In computing the time and fuel for any trip, requirements must be determined for warm-up, run-up, taxiing, another run-up, takeoff, climb, cruising to destination, descent, extra fuel allowances for unpredictable winds and weather, cruising to an alternate airport, and spending time getting into that airport with enough fuel in the bottom of the tanks to keep all engines running until the airplane is finally on the ground.

Not all of the above factors are required for all flights. Those which apply should be allowed for. Determining an adequate, but not excessive, fuel load is one of the most important duties of a pilot or avigator. Too much care in this matter is impossible.

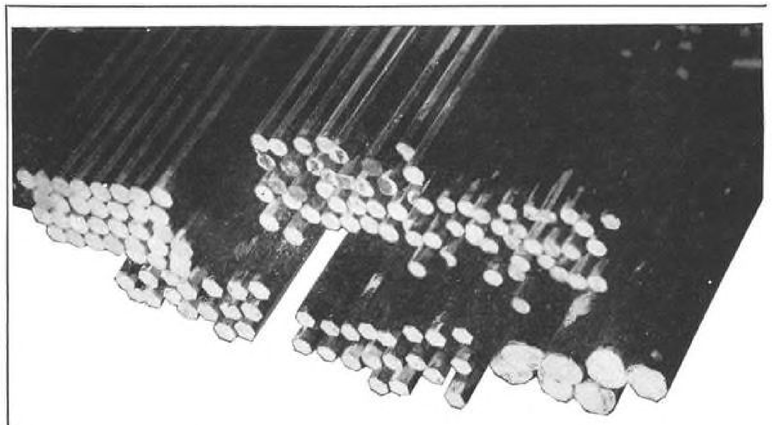
Mfg. & Mt. Join Hands

(*Continued from page* 123)

experienced some difficulty with our equipment, a man was dispatched from the home plant to assist in overcoming the trouble. However the picture has considerably changed since that time, and due in part to the increasing number and types of airplanes, coupled with the fact that training of maintenance personnel by the armed forces has thus far been unable to meet their requirements, it is an inescapable fact that the burden of keeping airplanes in service must depend to a great extent upon the manufacturer's ability to furnish trained field service men to assist operating organizations wherever the need arises.

To provide this assistance when it is needed most, we have divided the country into various zones, each composed of several states in which are located the greatest centers of operational activity. To each zone is assigned a supervising representative who coordinates the activities of a number of field representatives and who knows at all times the exact location of each one of them. Each supervising representative is in constant touch with his home plant so that upon receipt of an urgent request from Army, Navy, or commercial operators for assistance anywhere in his particular zone, it is only necessary to get in touch with the senior representative, who in turn dispatches the nearest specialist to the scene of the trouble. In this manner, we have been able to provide material assistance in the field on a 24-hr. basis.

To these field service men must go much of credit not only for the assistance they provide operators in the field but also for the service and maintenance data which they have acquired, under actual operating conditions, for incorporation in the maintenance and repair publications mentioned previously. For example, the light bomber repair manual would hardly have been possible were it not for the reports received from our



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men in the combat areas regarding the conditions under which our airplanes were being operated and the reports on types of damage most frequently encountered.

From the ice-covered landing fields of the Aleutians to the hot and sandy deserts of Libya, our field service men have been in the vanguard of those units arriving in combat areas equipped with Douglas airplanes. In recent weeks we have received the first reports from these men who accompanied the Allied Air Forces from Sicily to the invasion bridgeheads of Italy and who are now lending invaluable assistance in the maintenance and operation of our airplanes from the landing strips so recently taken from the enemy.

Although separate service departments are maintained in each of our plants to handle the problems arising in connection with the operation and maintenance of the particular type airplane manufactured there, these divisional service departments are all coordinated through the service manager at the Santa Monica plant. Similarly, the field service representatives for all plants are handled through our Santa Monica branch. In this way, it is felt that the greatest degree of coordination between all branches and groups may be attained, and that service to the customer will thereby be greatly enhanced.

One of the projects administered by our service personnel serves to emphasize the new scientific approach to service problems, and it will also prove of real aid in decreased maintenance and operating costs. This project involves compilation of overhaul and maintenance data received from operators—a compilation to assist these operators in obtaining overhaul and inspection extension periods for all the component parts of the airplane in accordance with Article 3 of CAA Safety Regulation Release No. 135.

As a concrete example of this service, we recently approved extension of overhaul periods on various component parts of the DC-3 type plane from 100 hr. up to 1,000 hr. per unit. Outer wings which were formerly removed every 4,000 hr. have received approval to remain in service 5,000 hr. before being removed. This one example, multiplied by the large number of airplanes now being operated and the large number of units on which overhaul extensions could be obtained, points the way towards decreased maintenance costs and greater operating efficiency.

In conclusion, we believe that present day service organizations, having already proved their essential character to the industry, must, if the goals and problems of postwar aviation are to be successfully met and overcome in the future, continually search after more scientific methods of approach to the varied problems coincident with the vastly increased number of aircraft in service.

Helicopter's Future

(*Continued from page* 117)

ess of development and construction are but "symbols" of what the public really wants or should have.

Yes, a great deal of ballyhoo surrounding the helicopter publicity is wishful thinking. It is important that the public is not oversold on this form of flying, since this might retard the ground work of the industry just as public enthusiasm for the autogyro hurt that development some years ago.

Too many of the engineering factors essential to making a commercial product are being glossed over or not too purely considered. To make a helicopter "fly" is as simple as assembling an engine on four wheels with a gear drive to simulate an automobile. But, it must be more than a machine that rises off the ground if it is to meet with the dream of the public as a safe family machine.

We who have lived with the problems



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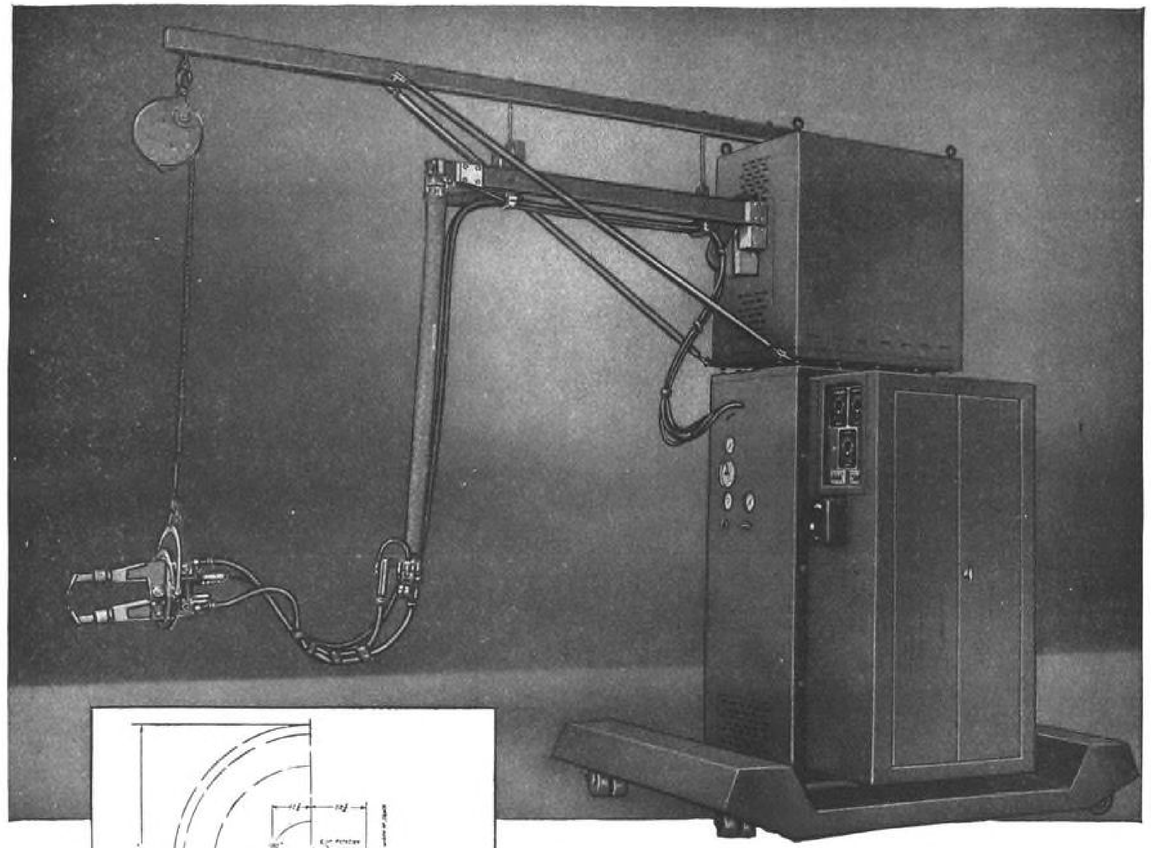
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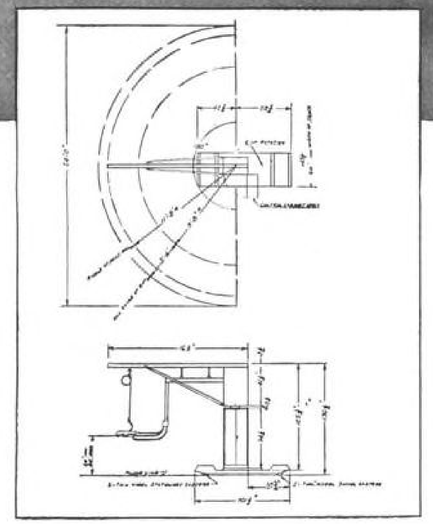
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of the autogyro and the helicopter for many years, would like to take this opportunity of sounding both a word of caution and encouragement.

The engineering possibilities of successful development of a helicopter are definitely assured. In our opinion there is no engineering requirement, in producing practical, commercial helicopters, that is beyond solution. It is our belief also that solutions will become available within a relatively short time.

A ship that will meet the safety requirements of a commercial helicopter and enable the average automobile driver to handle it with ease, must have built into it the following qualities:

1. Inherent dynamic stability
2. Hands-off controllability
3. Freedom from rotor resonance
4. Maximum lift per horsepower
5. Maximum forward flight speed
6. Economy of construction
7. Simplicity of arrangement for passengers and for freight compartments.

From an engineering point of view, there are still many problems that must be solved. With the interest of many aircraft and automotive manufacturers in this field, it appears that many able minds will be applied in the very near future to solutions of the essential problems.

The helicopter, aside from its military application, will be used as shuttle craft for large transports, as a flying machine for the busy executive, for transportation of perishable goods (especially for short distances), for mail pick-up in rural communities, for patrolling of forests and other public and utility property, and for spraying crops, Coast Guard patrol, ship-to-shore landing of passengers, advertising purposes, etc.

In our opinion, the helicopter of tomorrow will have to be designed with at least nine vital factors always in mind. These are:

1. The single rotor, for sustentation, has been clearly indicated as a correct form, compared with the many multi-rotor designs such as those of Breguet (co-axial), or Focke-Wulf (bi-axial).
2. A relatively large sustaining rotor, such as the autogyro advanced so admirably, will continue to have marked advantages.
3. Some simple form of anti-torque correction, such as the small, vertical plane propeller used by Sikorsky, will prevail for some time to come. Owing to the dimensional limitation of that form, several variants will be offered.
4. Improved mechanical design of the power plant, the transmission of power to the rotor, and the rotor hub itself are essential now, in view of the present available art.
5. Inherent stability of the self-flying ("hands-off" control type) is wholly lacking in the helicopters flying today.

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This marks a need for major improvement. The "hands-off" stability of the autogyro is attainable in the helicopter, and in light of extensive experience should be applied.

6. A high degree of control is achieved in most of the helicopters flying today, as was the case in the Focke helicopter flown in Germany before the war. Much of this control stems from the successful development of direct control of the autogyro here and abroad. In fact, the mechanism of the helicopter controls, in some cases, is not so advanced, requiring further refinement.

7. Vibration characteristics of the rotor continue to remain the most complicated, single problem in advancement of the art of all forms of rotative wing aircraft. Current helicopter successes are marred by repetition of resonant vibratory phenomena, which must ultimately be solved for public use of these vehicles.

8. The actual utility of rotary wing aircraft has been studied assiduously and carried out into engineering reality in many of the later designs of autogyros and helicopters.

9. The long, unbroken record of the autogyro testifies to the practical realization of safety as achieved and attainable. This inherent safety of the autogyro must be equaled by any helicopter if it is to continue to enjoy the present public acceptance. This fact dictates a relatively large sustaining rotor for light unit loading in order that the craft may settle and land slowly enough to avoid catastrophy.

Satisfactory solution of the above important fundamental principles will be through an evolution that may be as painful to the engineer and investor as the development history of the automobile, but the rewards will be equally gratifying.

The automotive industry will, undoubtedly, contribute a flood of new ideas that may simplify the craft and reduce the cost. The helicopter is a type of aircraft which lends itself to automotive practice, manufacture, and assembly.

Manufacturers of various accessories, such as engines, instruments, shock struts, propellers, transmissions, etc., should, and undoubtedly will, develop their products to be specifically applicable to the needs of helicopters.

Military experience with those ships now being built will contribute towards the elimination of many weaknesses that we now know exist in helicopter design.

We are certain that the public will have been granted its long-felt wish for an aircraft that can be flown in safety —granted it's within a reasonably short time after the war is over. But to retain the public's enthusiasm and the

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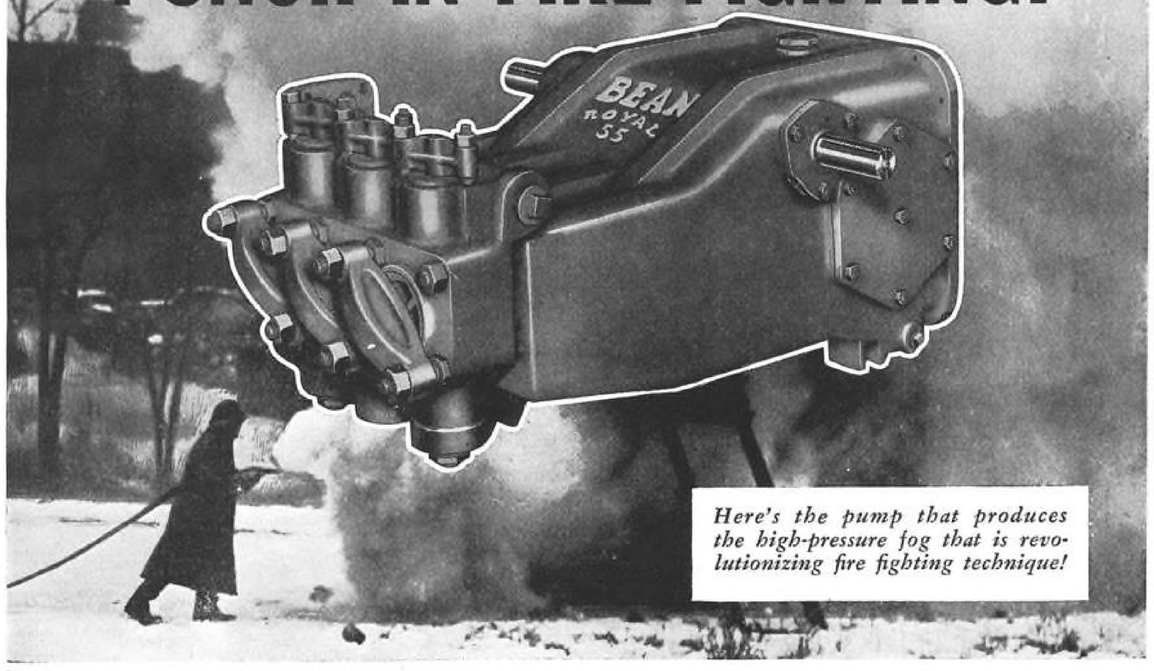
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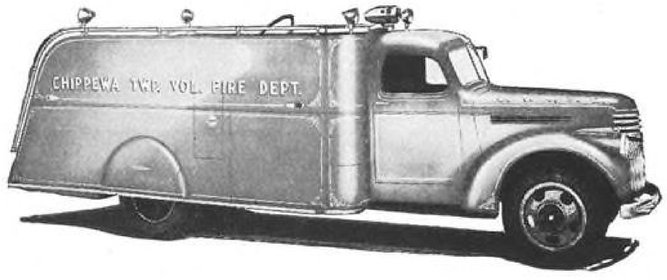


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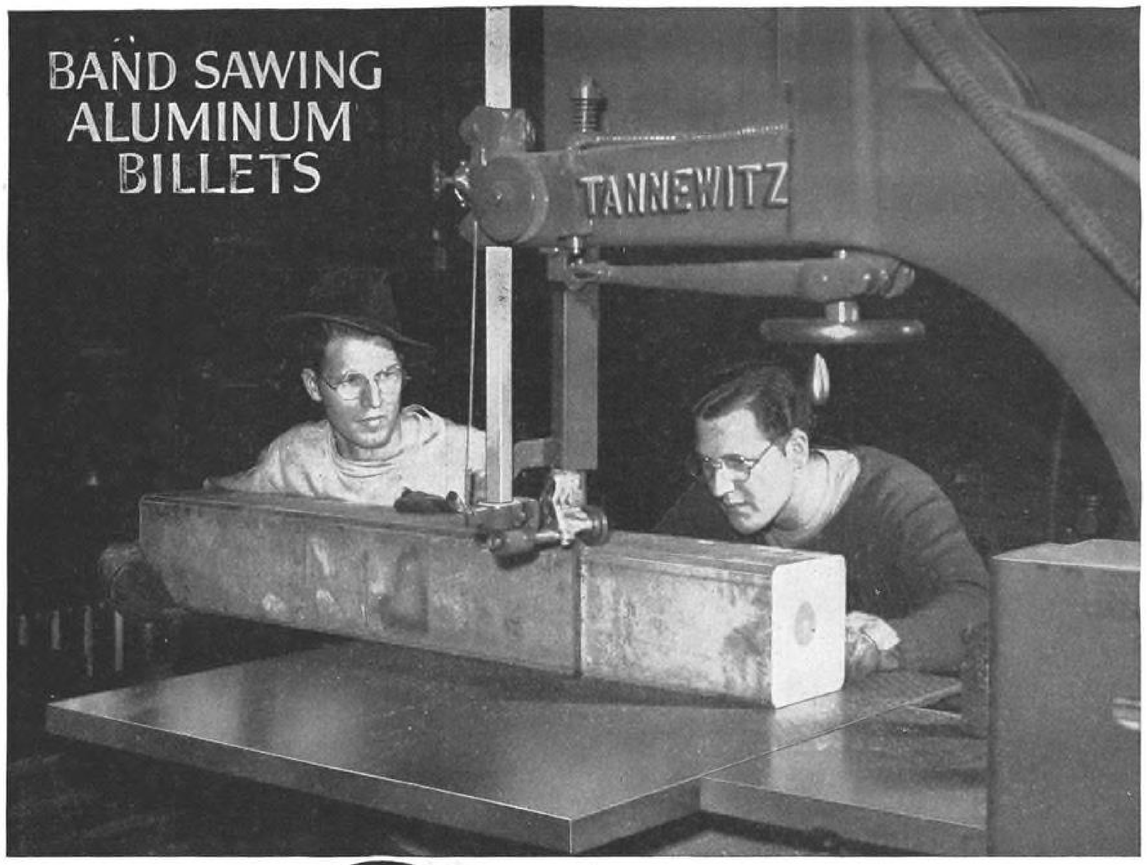
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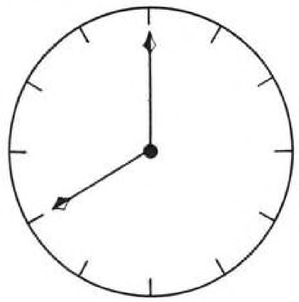
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market that would be thus available, it is important that the public should not be disappointed by unwise and premature propaganda. It is our suggestion that those in the rotary wing aircraft field who have dedicated their lives and in many cases their fortunes towards the successful attainment of a new industry coordinate their plans and their publicity towards a reasonable control of the public's enthusiasm. It is our opinion that in this way, and in this way alone, will the commercial progress of the helicopter development and manufacture be assured.

Investors Confused

(*Continued from page* 197)

of the most complete surveys made. The results are shown in Table I.

The striking fact remains that many of the country's largest trust funds are completely devoid of aviation commitments. In the three month period ended Sept. 30, 1943, only one trust added to its investments in this group, when the Wellington Fund acquired 1,000 shares each in Bendix and Sperry. It is interesting that both of these companies are equipment producers and are not strictly wedded to aircraft manufacture.

Bendix, in the past, has looked to the automotive field for its sustenance and may well return to that industry if future conditions make it desirable. While Sperry is popularly identified with aviation, actually the company's major activity lies elsewhere. Navy installations and various non-aviation industrial products have long accounted for the bulk of the company's billings.

Among the trust holdings, airline equities continue to be more popular than the aircrafts. However, this is a highly relative measure, since air transport issues are hardly in demand with trust funds at the present time.

Pan American remains the leading air carrier investment, with a total of twelve trusts owning an aggregate of 122,800 shares. The importance of investment trusts in the financial affairs of a company is clearly evident when it is realized that this summary shows about 16 percent of Pan American's total stock is owned by these funds.

Liquidation of Pan American, however, has definitely set in, with a number of sales reported during the third quarter. During this period, General American Investors sold 6,000 shares, National Bond & Share 1,000 shares, and Lehman Corp. 3,700 shares. Incidentally, PAA officers, including Pres. Juan Trippe, have been heavy sellers of their stock in recent months, as has been reported in the summaries released by the SEC.

It is also notable that Lehman Corp. sold other airline issues during the third

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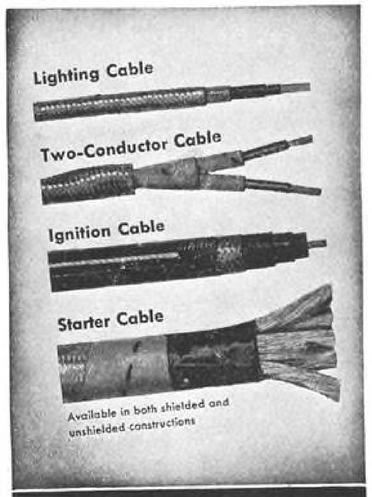


There *was* a time that Wiry Joe was merely the largest independent manufacturer of replacement wiring for the automotive industry.

Now, Wiry Joe is also known as an important source of supply for every type of electrical wire and cable for aircraft. The complete line includes starter cable, high-tension cable, primary cable, both original and replacement. Wiry Joe also makes power and welding cable.

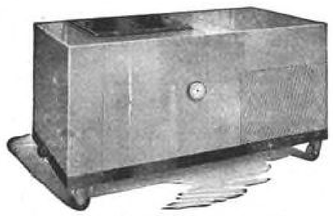
And just as Wiry Joe automotive cable won a name for quality, so, too, has Wiry Joe aviation cable. Every item in the line is built to meet rigid Army and Navy specifications, and is produced under the Dostam method of manufacture for uniformity, dependability, high efficiency and long life.

Inquiries regarding wire and cable for any type of service will be answered promptly.

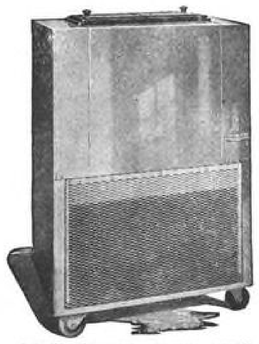


Wiry Joe
AVIATION CABLE
manufactured by
THE CRESCENT COMPANY
Pawtucket, Rhode Island

"One-Two-Three-Four-Testing!"



5.4 Cu. Ft. 32" x 34⅞" x 63½"



2.0 Cu. Ft. 48" x 24⅛" x 34⅛"

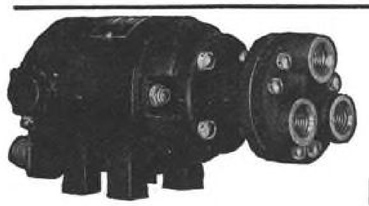
The chant of the Army or Navy radio operator preparing for action, is definitely allied with Kold-Hold thoroughness and accuracy in developing testing equipment for radio and airplane parts.

Kold-Hold Sub-Zero units provide accurate temperature control conveniently located for the operator at one spot.

The applications of Sub-Zero machines include the testing of airplane instruments, radio receivers and transmitters, conductor wire, crystals, insulators, plastics, glass, lubricating oils, paints, chemicals and others too numerous to list. What are your requirements?

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442 N. Grand Avenue LANSING, MICHIGAN



WELDON
Aircraft
FLUID METERING
PUMPS

ANTI-ICING PROTECTION
for Propellers, Carburetors, Windshields and other Vital Parts

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DUAL OUTLET
UNIFORM DELIVERY
at UNEQUAL PRESSURES

● A quarter century of experience in the manufacture of high quality precision cutting tools eminently qualifies WELDON to produce this Aircraft Fluid Metering Pump which has won complete acceptance because of its unfailing performance under the most exacting operating conditions. Rigid tests through extremes of altitude and temperature have demonstrated its dependability.

For Engineering Data Sheets Write:

THE WELDON TOOL CO. Cleveland 4, Ohio

PUMP DIVISION 2046 EAST 71st STREET CLEVELAND, OHIO

quarter. Sales comprised 4,400 shares of United Air Lines and 500 of American. This trust still owns 40,775 shares of Aviation Corp. which it acquired a number of years ago. Present indications point to further sales of airline shares by Lehman Corp.—at least recent moves are in that direction. This trust, as of Sept. 30, held the following air transport shares: American 1,600, PAA 16,300, and United 22,600. It no longer owns any aircraft manufacturing issues other than The Aviation Corp.

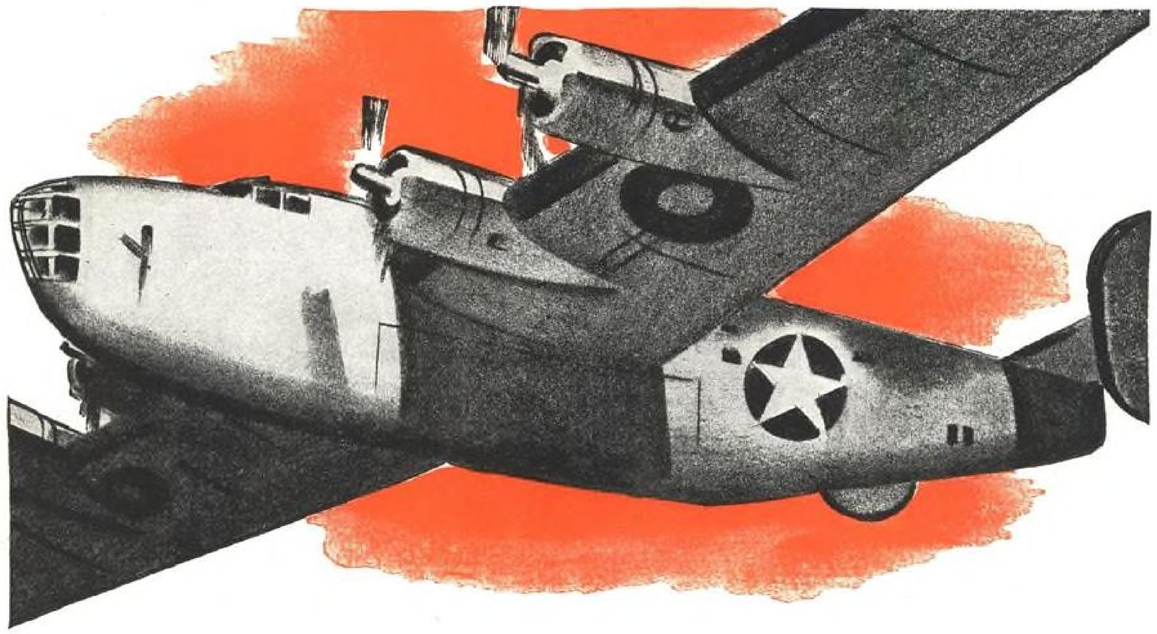
Unchanged in their airline holdings during the third quarter were a number of the country's largest trusts. These funds are Incorporated Investors, Massachusetts Investors Trust, Tri-Continental, and Selected Industries. Large blocks of American, Eastern, Pan American, and United are owned by these trusts. The 16,000 shares of Northwest, shown in Table I, are held by Incorporated Investors.

A curious sidelight was revealed in the examination of the trust portfolios. Greyhound Corp. is a highly popular issue and was very much in evidence among the trust funds. If nothing else, this may be construed as a tribute to the surface carrier's position and recognition of its management ability. In view of the bus company's announced intention to attempt entry into the air transportation field, it may be well for the air carriers to note how well Greyhound is regarded and how serious its aspirations can become.

Greyhound Corp. is a holding company and owns or controls 15 operating motor carriers. In the aggregate, these companies provide the most extensive motor bus service in the United States, operating 830,000 mi. daily. The holding company last reported total resources of about $36,500,000 compared with almost $29,000,000 for American Airlines and about $27,000,00 for United Air Lines.

More light on how aviation shares are now regarded by the investment trusts is given by the action of National Aviation Corp.—a fund established to deal exclusively in aviation securities. This has all been changed, however, and aviation equities are being constantly liquidated.

How far the trust has moved in this direction is indicated in Table II. The aviation portfolios as of Dec. 31, 1942 and Sept. 30, 1943 are presented, and they show the evidences of extensive liquidation. The tabulation speaks for itself, and no added comment appears necessary other than to note that commitments have been increased in only two issues. This is the purchase of an added 900 shares of Douglas and 500 shares more of United Aircraft preferred. These acquisitions are, by com-



THERE FLIES 15 TONS OF HEAT TREATED AL-MG ALLOYS

Why Metallurgists Choose Despatch Furnaces For Such Jobs

A bomber like this is built for trouble—from nose to tail. And most of her 15 tons of tough, light aluminum and magnesium alloys owe their strength to exacting *heat treatment* in specially designed furnaces.

To provide such furnaces has been the role of Despatch engineers for years. So today a very large percentage of *all* non-ferrous alloys used in our military and naval aircraft are "Despatch-processed". Why? Because they are convinced by *proved* performance that Despatch furnaces provide exactly the kind of heat treatment required—swiftly, surely, economically.

PROVIDE BETTER CORROSION-RESISTANCE

Take the bugaboo of corrosion. To get real resistance means most accurate heat treatment and almost split-second quenching. No easy job!

But Despatch engineers developed an electronically controlled dual-zoned type conveyor furnace (shown below) which does the entire job *automatically!* Such high corrosion-resistance was developed that a second furnace was ordered at once for another plant.

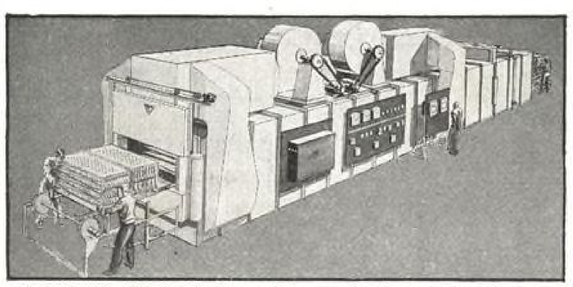
DESPATCH SYSTEM GIVES HIGHEST METAL FACTORS

This is but one example. There are scores of others involving other types of Despatch furnaces for castings, shapes, billets, preforms and rivets.

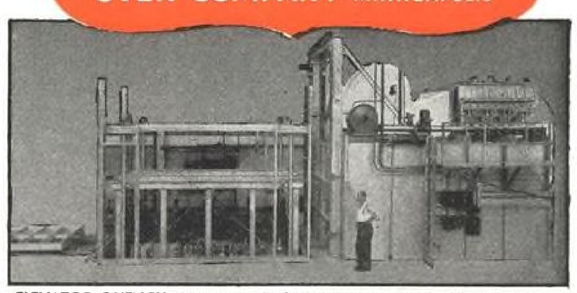
In all types, however, the unique forced convection system is so powerfully efficient that *maximum* physical factors in tensile and elongation are developed. You get just what you want. And electronic controls, robot conveyors, extra-fast quench systems and other new features help make the job easier and *better*.

WE CAN HELP YOU *with your non-ferrous heat treating problems promptly and efficiently, and also assist you in planning* your *future in the light metals industry.* ASK FOR DETAILS TODAY!

DESPATCH
OVEN COMPANY MINNEAPOLIS



COMPLETELY AUTOMATIC Despatch furnace for heat treating Al. sheets, 400 lbs. per hour. Time-cycle controlled conveyor, doors, quench. Uniformity ± 5° F. Eliminates all labor, except for loading.



ELEVATOR QUENCH system on platform-loaded Despatch furnace allows removal and quench of 8000 lbs. of castings in 20 seconds! Electric or gas-fired (radiant tubes). Very efficient.



Many spectacular savings in time, money and manpower have been accomplished by Mahon engineers in adapting Mahon Industrial Equipment to the war production program. Outstanding among these achievements was the development of the spray painting and ventilating system, pictured above, for the camouflage painting of completely assembled bombers. This gigantic, 3-level ventilating equipment—a multiple assembly of Mahon Hydro-Filter Units, combined with a mammoth Mahon Filtered Air Supply System—performs a double function. It clears the enclosure of dangerous overspray and fumes and continuously floods the entire space with tempered, washed and filtered air, maintaining an equalized air flow throughout the 150′ wide, 200′ long, 35′ high enclosure. *Four* of these immense systems already are in operation. The *fifth* soon will be in service.

If your production necessitates equipment for CLEANING . . . . RUST PROOFING . . . . SPRAY PAINTING . . . . DRYING . . . . BAKING . . . . or DUST CONTROL . . . . Mahon engineers will cooperate in working out a solution to whatever problem confronts you.



Many other installations of MAHON *built-for-the-job* EQUIPMENT are proving their value in ECONOMIZING and EXPEDITING the production of war essentials. Here are typical examples . . . .

System for Cleaning and Treating Aluminum Airplane Engine Pistons

Shrink Oven Installation for Pre-Assembly Heating of Airplane Engine Cylinder Heads

Finishing System for Shell Cases

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Impregnating System for Airplane Engine Castings

System for Painting and Baking Core Moulds for Aluminum Airplane Engine Castings

Dust Control System for Airplane Propellers

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For Victory! . . . Excel-So is helping guard the Fuel Lines on American Home & Foreign Fronts

WATER-FREE GASOLINE *Firsts* IN AVIATION

THE LEWIS EXCEL-SO WATER SEPARATOR

Men who know fuels from the ground up designed and built Today's outstanding fueling unit for American and Foreign airports, portable pipelines, truck loading racks and refueling trucks . . . ***the Excel-So Water Separator that means so much to pilots, for water-free gasoline insures safe take-offs and worry-free water problems while in the air.***

Excel-So was first to deliver gasoline containing not more than 1/100 of 1% of undissolved water, where abnormally high percentages of water, free or emulsified, were involved.

Excel-So is the only separator to guarantee delivering gasoline containing not more than 1/500 of 1% of water, free or emulsified.

Excel-So is the only separator that delivers gasoline 99.999% water-free, proven by tests in collaboration with Government testing engineers.

Excel-So is first to introduce the dual principle of coalescing and settling of emulsified water in gasoline. Most separators rely solely on the settling chamber.

Such high efficiency of water removal by Excel-So cannot be approached by any other type unit!

Simple in design . . . employing no moving parts . . . dependable automatic features and equipped with a scientifically designed coalescing and filtering media . . . Excel-So Separators are not only establishing new records in delivering water-free gasoline, but new standards in gasoline free of silt, rust, muck, etc., to planes, refueling trucks, pipe lines, mobile equipment, tankers, carriers, tenders and other craft and motorized equipment.

Built in sizes from 25 to 1000 gpm at new low pressure differentials, Excel-So Separators can be used on all existing fueling systems.

Excel-So Separators are also designed and built ***to handle Diesel fuels and kerosene.***

All features in Excel-So Separators—design, operating and processes of degumming filter media—are covered by patent applications.

When writing for special requirements covering your water separation problems, please give actual operating pressure, maximum and minimum rates of gasoline flow, approximate amount of water to be removed and current characteristics of pump motors and available current for electronic control.

WARNER LEWIS COMPANY

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Telephone: Metropolitan 5051

parison, inconsequential and hardly offset the many sales made in other issues.

By its moves, National Aviation Corp. merely confirms the uncertainty and doubt prevailing throughout the investment fraternity in respect to the future of both branches of the aviation industry. When in doubt, the policy appears to be to sell and step aside—to wait for events to tell their own tale.

Investment advisory services also mirror the confusion pertaining to the outlook for aviation equities. Eliminating all the qualifications found necessary in issuing opinions of this type, most of the investment services seem to favor giving the aircrafts a wide berth, but they are not adverse to selective nibbling at the airlines.

In speaking of the aircrafts, one service says, "We believe this group of stocks lacks attraction. . . . Later on these stocks will, no doubt, acquire real promise. But we do not believe they are in that position now." Another organization, in reviewing the airline picture, has this to say: ". . . Summing up, one may correctly say that air transport is today the most promising and interesting growth industry with large speculative profit possibilities commensurate with the risks involved."

Shades of opinion differ, but confusion prevails as to the ultimate pattern to be followed by aviation securities.

America at War

(*Continued from page* 113)

the total take of enemy planes was 350.

Incidentally, the 8th Air Force recently completed its 100th mission, hitting important non-ferrous metal plants at Duren. Incidentally again, AAF officers abroad frown on the common habit of calling a bombing attack a "raid." That word, they say, connotes a hit-and-run tactic as old as war. Strategic bombardment is an aerial invasion by the major weapon of modern war.

Complete air supremacy has been established by Allied forces in Italy. Some military men are surprised that the enemy can put up such strong ground resistance with such weak air support. But we do not have command of the air over Germany by any means. We can go in at will, but we always pay a price. Anti-aircraft fire comes up from guns planted as thick as the hair on a dog. The power and the accuracy of these A-A guns is constantly improving, and apparently little can be done about it.

Then again, the resistance of German fighters is determined, skillful, and heavy in numbers. As these Communi-



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Almost any desired combination of qualities . . . durability is only one . . . are obtainable through the *controlled* manufacture of Booth "prescription" felts and precision die-cutting into mechanical parts. Read Booth's "Technique of Felt Making."

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PRECISION CUT FELT PARTS



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oil separator

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Improved methods and quantity production have put us in a position to deliver these vital parts promptly in any quantity needed.

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MERCURY know-how, developed over 23 years devoted exclusively to aircraft fabrication, makes this company a dependable source of supply of aircraft parts and accessories, assuring quality unswerving and deliveries on schedule.

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AT *The Cradle of Aviation*

MERCURY AIRCRAFT INC.
HAMMONDSPORT · NEW YORK

ques have reported before, the Nazis have virtually stopped building bombers. Nearly all of their great production capacity is reported to be at work on interceptor equipment and on trick weapons developed in rapid succession in a vain hope to win by a stroke of genius or luck.

Yet the force of German fighters does not seem great, compared with our potential fighter strength. Fairly reliable reports give them 3,000, two-thirds in action against the British and Americans and the other third against the Russians. The 2,000 against the Allies in the West are supposed to be divided about half and half between night and day work. It doesn't sound like a big-league air force, but it's on the defensive and it is desperate.

U. S. Army fighter power against Germany, made up mostly of Lockheed P-38's, Republic P-47's, and North American P-51's, is now at about half its planned strength. But these types are now pouring out of our factories, and it is expected that quotas at the fronts in England and the Mediterranean will be doubled shortly after the new year. It can be said that the Army no longer has any expectation (if it ever had) of fighting the B-17's and B-24's without escort. Bomber guns and gunners have been doing a fine job, taking heavy toll of the enemy. But the cost unescorted was too great.

What will happen in this respect when the new Boeing B-29 goes into action—in whatever theater it moves first—remains to be seen. Called by Gen. Arnold a "battleship of the air armored heavily with multiple gun and power turrets" and with a "range substantially greater than the maximum effective range of today's longest-range heavy bombers," it may well go on the prowl alone.

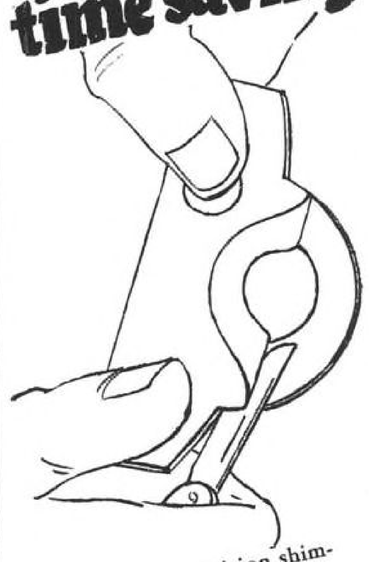
Going back to those trick weapons, the Nazis have "silver fire", phosphorescent disks, released in large numbers in the flight path of attacking planes. They set fire to ships on contact, but apparently contacts are infrequent. Other twists: Rocket throwers are being used, both in planes and on the ground, to project extremely powerful shells. Time-fused bombs are dropped in the way of attacking planes. Radio-controlled glider bombs have been used by the Germans against surface targets, but apparently not against airplanes.

These weapons can inflict damage as yet unestimated, but obviously they cannot stop Allied aerial invasions in strength.

Worth notice, among the bigger developments, is the recent acquisition by Britain of naval and air-base rights in the Azores, which belong to Portugal. Land-based aviation can range around these islands at considerable distances, thus relieving naval patrol forces for other duties.



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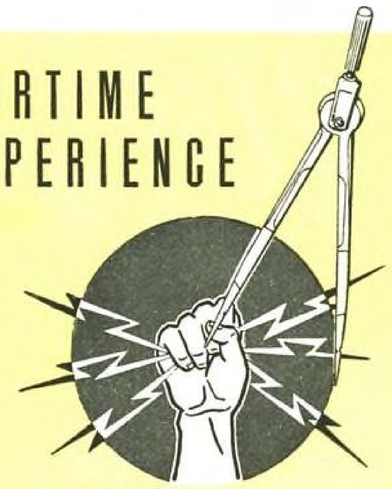
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Motor . . . . . ½ h.p.
Standardized in size and capacity . . Fabricated in quantity

SAFE—Twin roller lifting chains (either will hold)
CONVENIENT—Push button control (operated from floor or platform)
LOW MAINTENANCE—Safety valve prevents overloading

This efficient, well-designed Service Electric Hydraulic Lifter will save you time and money by helping you make more efficient use of storage space and by speeding up material handling. AVAILABLE NOW FOR IMMEDIATE SHIPMENT. Most sizes are now in stock. Wire or write for prices or Bulletin L-109.

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Toronto, Canada: United Steel Corporation, Ltd. SC&T Co. Division

·DI· SERVICE

TRUCKS, CASTERS AND SPECIALLY DESIGNED LIFTING AND HAULING UNITS

Here at home the main thing to notice is the aircraft industry's 10 percent increase in numerical production. Nearly every one is betting on a rate of 9,000 per month before the year ends, and some will even go along for the planned rate of 10,000. Donald Nelson, chairman of WPB, says the high rise from the 7,000-odd plateau that had been worrying him and a lot of other people was due to more efficient use of man-hours and to standardization of some models which had been subject to a stream of design changes.

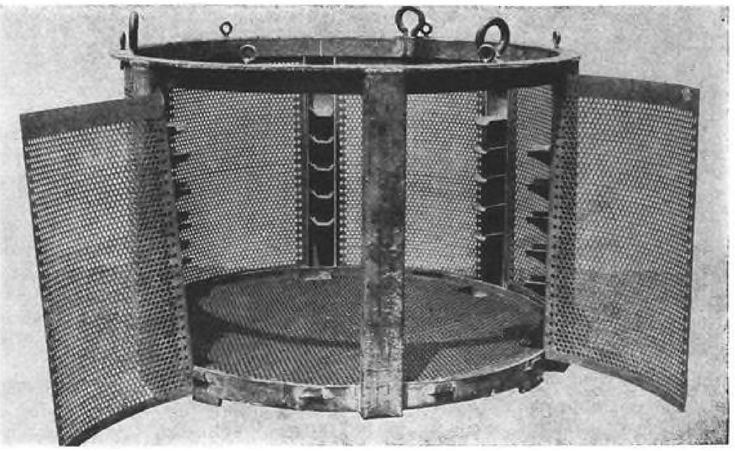
Still at home, the War Department announced that "land power and air power are co-equal and interdependent forces, neither an auxiliary of the other." But no one paid much attention. The War Department says something like that every time there is a flurry of pressure for a "separate air force," and there has just been another one. People are getting used to it.

All is fairly quiet on the civil aviation front, or was while this was being written, because a lot of different groups were off in corners cooking up various plans. Included have been at least two factions whose proponents have different ideas on postwar operations by American airlines. Also, a half dozen groups want to write the Lea legislation their own way, particularly those parts which deal with competition between surface carriers and airlines, with "federal intervention in states rights" concerning aviation, and with that old question whether CAB should be in the Department of Commerce or not.

Over in the Oriental theater you can hear hammering behind the scenes, the lights are getting dim, and it looks as if the curtain is about to go up. The Japs know—just as well as the Commander in Chief at 1600 Pennsylvania Ave. knows—that they can expect at least two plagues to come upon them. One will be an ever-increasing rain of bombs on their myriad fighting-line bases from land based craft, and the other will be the Navy's augmented carrier force, which is now big enough to throw into the Jap empire an air attack comparable in strength to many of those now coming down on Hitler. The carrier fleet is nearly as big as the battleship fleet, and you can add that up from memory or old newspapers.

The new flat-top flotilla consists of regular fleet carriers, basing 60 or 80 or more planes apiece, plus scores of auxiliaries basing 5 or 10. The number of fleet carriers can be doubled in 1944, and the auxiliaries can be tripled or better. Then in 1946, if the war goes on, the new 45,000-ton carriers will be in action.

The above is a justifiable burst of accurate enthusiasm for achievements. Don't forget what the generals told us



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Over 15 years of specialized experience in the manufacture of Carburizing and Annealing products enables The Pressed Steel Company to furnish equipment that will last long, operate economically and contribute fully to the exacting demands of aircraft production.



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Carpenter's "Quick Facts" bulletins make it easier to apply the advantages of this type of tubing to YOUR products. And you'll find them packed with helpful hints on the fabrication and use of Welded Stainless Tubing. A note on your company letterhead will start your series on its way.



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STAINLESS TUBING

when the Japs swung on us: The Nippons are so far away and so well situated militarily that we will need ten times their power, in terms of quantity and quality of weapons, to beat them.

Eng. in Airline Maint.

(*Continued from page* 137)

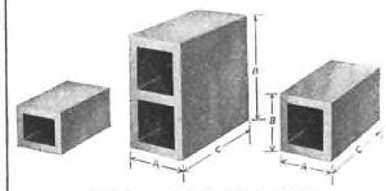
plane. This is a purely hypothetical case for purposes of illustration.

A mechanic on a specially trained winterization crew that yearly installs wing de-icer boots on DC-3 airplanes notices that by a simple revision to the procedure in attaching the inflatable rubber boots to the wing, a more durable job can be accomplished and at the same time ten man-hours per installation can be saved. He informs his foreman of his idea. His foreman, agreeing that it is a good suggestion, makes a written report of the improvement and sends it to the general foreman of airplane overhaul, who discusses it with the superintendent of overhaul. After a little time, if it is agreed that the idea has merit, a recommendation is made (with the approval of the director of maintenance) that the new method be investigated. This recommendation then takes the form of a request for engineering service, and as such it is put on the list of projects upon which maintenance wants engineering to concentrate.

At the same time that the request for engineering investigation is sent to the engineering department, it is assigned a priority by maintenance classifying it as "urgent", "rush", or "static", depending upon its importance in the eyes of maintenance. In this way, maintenance itself can specify on which of its engineering requests it wants first delivery. Knowing what the job entails, also what importance is placed upon it from a priority point of view, the chief engineer issues a job order to the proper project engineer, in this case the deicing engineer, outlining the nature of the service requested, the scope of the investigation required, and the priority assigned.

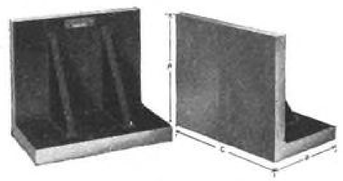
Consistent with the priority given, the project engineer starts an investigation of the proposed method of installing de-icer boots to determine if it is practical from an engineering point of view and also if any safety standards are involved. If preliminary investigation is satisfactory, he writes a letter to the manufacturer of the de-icer boots, outlining the proposed revision and asking for his comments and approval. If the change is such as to require a review of the safety factors involved, the Civil Aeronautics Authority is consulted, usually by the manufacturer, and if both the manufacturer and the CAA are agreed upon the merit of the idea, approval is then given the airline engineer to proceed.

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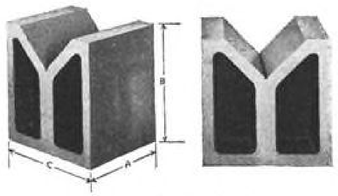
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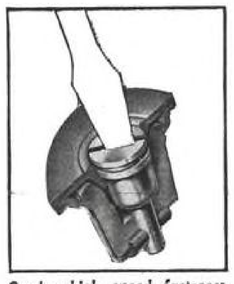
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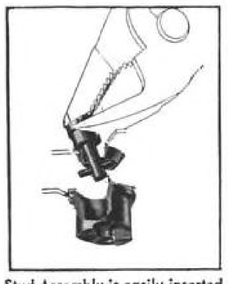
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The engineer next arranges with the manufacturer to obtain a service test set of de-icer boots incorporating the changes agreed upon, writes an engineering release including a set of specific installation drawings and instructions, and arranges with the maintenance production engineer for a special service test on one DC-3 airplane.

Briefly, this engineering release contains the following information:

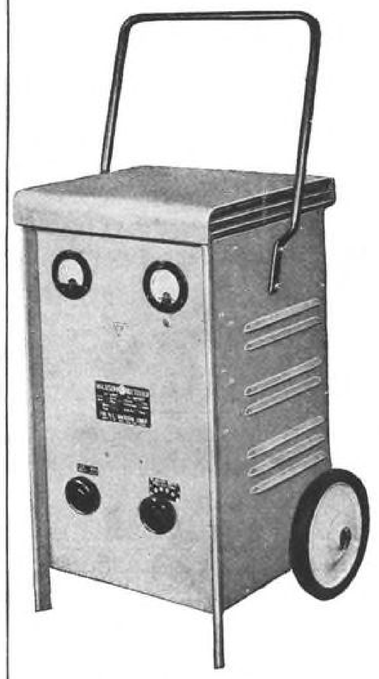
1. Code designation number
2. Scope of release
3. Priority
4. Airplane
5. List of people receiving copies
6. Classification and subclassification for filing purposes
7. Positive and complete statement describing the change and authorizing its adoption
8. Reasons for the change—explanation of what it is expected to accomplish
9. Information as to the details of delivery of the parts, purchase order number, etc.
10. Name of engineer supervising the initial installation
11. Organization requesting this change
12. Estimated weight change
13. Estimated cost or saving in cost
14. Approval of engineering department
15. Approval of maintenance department
16. CAA approval
17. Manufacturer's approval
18. List of drawings and instructions attached
19. Remarks

When signed by the chief engineer, this release indicates that the engineering department has evaluated the original suggestion and has given its answer. This answer stands and cannot be changed except by a subsequent engineering release.

The engineering change is then worked into the shop schedule by the maintenance production engineer when the service test parts arrive from the manufacturer. A service test installation is made under the supervision of the project engineer and perhaps with the assistance of a manufacturer's representative, and the airplane is test flown by the engineering test pilot. When all has been checked and approved, the airplane is released to operations with a special placard in the log book inviting pilot's comments and also calling the modification to the attention of line maintenance mechanics who may come in contact with it.

At the end of the service test period, usually 60 to 90 days, the entire performance record of the change is reviewed by engineering and maintenance in order to reach a decision as to

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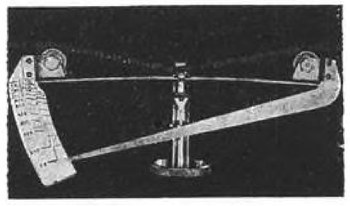
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the results of the test installation. If the idea has proven its worth in actual operation, and if the design and instructions are satisfactory, the project engineer issues a new engineering release similar to the service test installation authorizing maintenance to make a production change altering all airplanes in the fleet. Thus the new idea of a mechanic on the job becomes a standard and acceptable company practice.

A close-up view of the interweaving exchange of facts, opinions, and paper work between engineering and maintenance in even so simple an example as the case illustrated indicates that one of the main factors in making the system work is cooperation. Teamwork is the priceless ingredient in considering the engineering aspects of airline maintenance.

Ranger Service

(*Continued from page* 153)

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All field service representatives are truly technicians. It is not intended that they handle the tasks of a traveling mechanic, for it has been found that wherein the factory steps in and makes field repairs at the request of a customer, both the customer and the factory have lost an opportunity to increase their knowledge. These men demonstrate a willingness to pitch in when immediate action is necessary to get an aireraft back on flying status but, in general, their function is that of acting in an advisory capacity.

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Postwar Markets

(*Continued from page* 115)

tion of them will be diverted to commercial use so that there will be no need whatever for new commercial planes. Such pessimism, however, ranks with the vague optimism that sees the skies darkened by planes.

Looking realistically at the situation, we find the following conditions: The longer the war lasts, the greater will be the difference between military and commercial aircraft. Even today, practically the only military planes adaptable to commercial use are the cargo and transport planes. And they would need considerable modification to be converted from military to competitive commercial operations. As military models they are heavier (due to beefing up and inclusion of tactical equipment) than are straight commercial types, and therefore they are considerably less efficient in ton-mile operation cost reckoning.

Analysis of the over-all V-2 transport market shows it to be at greatest variance with prophesies of the visionaries who see practically everyone and every-



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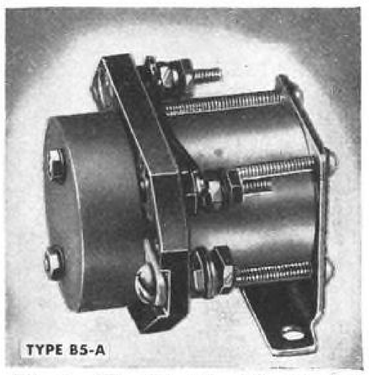
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thing moving by air. Based on experience which has yet to be disproved, and evaluating countless interviews with hard-headed airline operators, the forecast for transport craft for the two-year period following the coming armistice is set at 1,700 planes, valued with spares at $512,500,000. This market is for new planes which will probably be available within 18 mo. to 2 yr. after cessation of hostilities.

No figures are presented for the transition period, for this market will necessarily be made up of planes, best suited to airline operations, which can be obtained from the government and manufacturers—such craft as today's Douglas C-47 *Skytrain* and C-54 *Skymaster;* Curtiss C-46 *Commando;* Lockheed C-60 *Lodestar* and C-69 *Constellation;* and Consolidated Vultee C-87 *Liberator Express.* It is believed that most such craft will be purchased new directly from the manufacturers, since airline operators feel that reconversion costs on planes bought from the government would be too high in proportion to serviceability of new craft.

Moreover, it is understood that major U. S. airlines are unlikely to be willing to accept wartime transport planes for conversion to competitive commercial aviation, as has been proposed. Even though it would require more time, they would prefer to await newer, more efficient models which can be built at costs in line with those of conversions.

Already, in fact, five airlines are joining with Douglas in plans to assure the earliest possible delivery after the war of new DC-4 transports which, while smaller than the prototype, are expected to have greater capacity and better performance.

A break-down of the total 1,700-plane V-2 market shows that 1,500 planes valued at $375,000,000 can take care of the domestic passenger and cargo business which the airlines themselves believe they can build up. Here, the phrase "build up" is used advisedly, for no sensible operator believes the ticket counters and cargo docks will be flooded with travelers and merchandise. Fact is that transportation will have to be sold, just as it has had to be sold in the past. It must be understood that, based on cost, the domestic air passenger market will first have to be secured through penetration into Pullman travel field; thus the early post-war potential market will be the Pullman plus current air travel markets. Today's peak war-demand for air travel, meantime, will have to be translated into peacetime operations, which will again require selling because of the cost differential.

The air travel volume will be to some extent dependent on economic conditions of the period, since a great many of the air transport patrons have, to date, been traveling on someone else's money—on expense accounts used for business travel.

Based on past penetration records, however, commercial airline passenger traffic may be expected to approximate 33 percent of the domestic travel market for the V-2 period, increasing to 51 percent for the V-5 market.

The V-2 domestic transport market does not envision vast fleets of straight cargo planes. In fact, it is believed that not more than 10 percent of the total will be solely cargo carriers, with the remaining 90 percent being dual-purpose craft.

For American-operated transocean and international lines, the study reveals a need for not more than 100 new craft valued at $50,000,000 for the first two years after the war. This calculation is based largely on expected penetration into the waterborne transportation market. Based on Class A passenger traffic, air transport may be expected to secure 28 percent of the field for the V-2 market and up to 80 percent for the V-5 projection. This figuring is also based on the blunt fact that air travel now costs—and will continue to cost for a long time—much more than surface travel. There has been nothing to show conclusively that vast hordes of business men will have to travel to



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AVIATION SUPPLY CORP., Hapeville, Ga.
PACIFIC AIRMOTIVE, Burbank, Cal., Oakland Airport, Oakland, Cal.
AERONAUTICAL TRADING CO., 169-24 Rockaway Blvd., Jamaica, N. Y.
SUPPLY DIVISION, INC., Lambert Airport, Robertson, Mo.

all parts of the world after the war any more than they had to before.

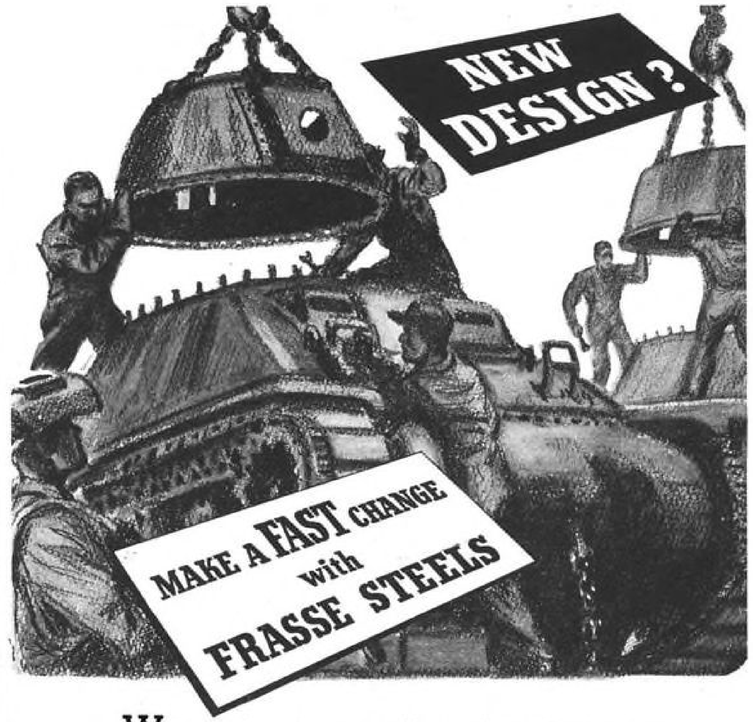
Though vastly greater numbers of pleasure travelers will want to indulge in international travel, there is also nothing to indicate that they will be more able to do so than they have to date. Income taxes alone will take any marginal money the average man might have for pleasure travel, and certainly these taxes are not going to vanish like a bad dream with the signing of the armistice. A national debt of $100,000,000,000 or more means that John Q. Public will have his excess cash, if any, taken care of for more than two or five years after the war.

In the matter of international cargo, markedly lower operating costs are imperative if air transportation is to get any respectable share of even the so-called express type of shipment. True, these costs will be steadily lowered, but they can't be expected to drop miraculously over-night—or even within two years after the Armistice—to a level where they can approach competition with surface carriers.

Here again, air transport will have to be sold, and an idea of the size of the selling job can be gleaned from a recent survey by the Foreign Credit Interchange Bureau of its 215 members. Fully 66 percent reported their products were not suited to air transport; 23 said some of their products "might" be suitable for movement by air, 12 said their products did have air transport possibilities, and 5 reported that small quantities might be moved by air. It is notable that 90 percent replied they expected no change in credit terms through use of air cargo.

As to sales of passenger and cargo planes for export, the study shows little encouragement, the figure for the V-2 market being set at 100 craft valued at $20,000,000. Why so low? Well, that question can best be answered by a counter question: Just who is going to have the money to buy American planes? Exports of new commercial craft prior to the war were never large even by prewar production standards: with most nations further impoverished by the war there is no reason to believe many outlets can be provided.

These facts, too, should be borne in mind: Much of the prewar world provided markets only for our used aircraft. Since it is believed many of our military transports will be left in the countries where they are based at the war's end, this "second hand" market will be flooded for some time, thus delaying entrance by these nations in either the used or new plane market. Even if one assumes that purchasing power will be available through continuance of lend-lease, it must be remembered that money and reasons for travel must be on hand to create a market for planes.



When design changes suddenly demand transition to new steels—you can make the changeover *faster* by filling in from Frasse warehouse stocks.

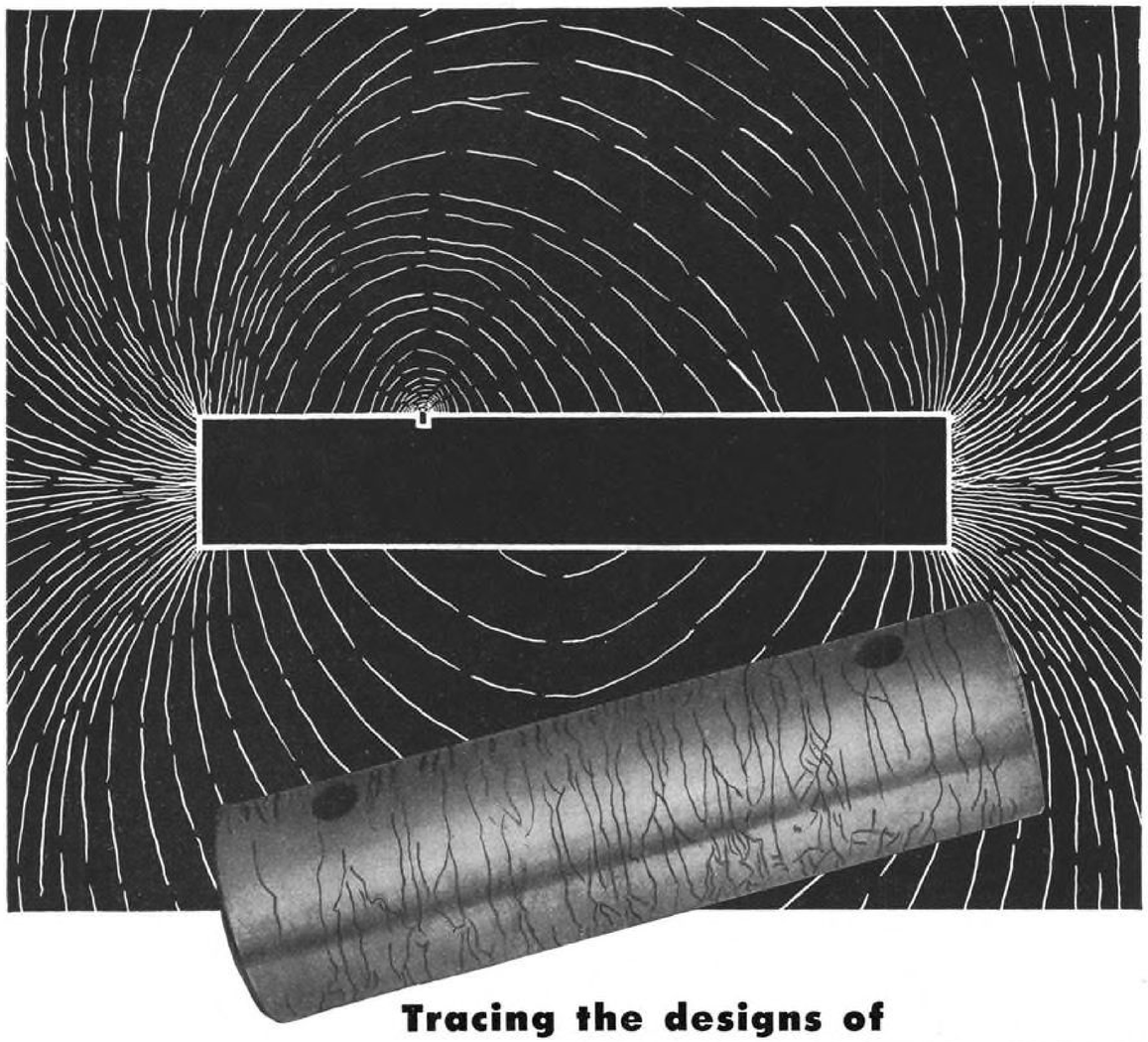
Frasse stocks—now fairly well rounded—are immediately available to carry production loads until mills can ship. Emergency quantities of Frasse cold finished bars, tubing, stainless steels, alloy and aircraft steels and tubing can be put to work while your mill order is still awaiting scheduling.

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As originators and pioneers of the Magnaflux methods, Magnaflux Corporation and its engineering staff are able to place an unequalled fund of specialized knowledge and experience at the disposal of industry. Service to Magnaflux users includes training for operators, all necessary books, regular contacts by field engineers, laboratory services, etc.

MAGNAFLUX CORPORATION

Cracks, seams and other discontinuities impossible to detect with the unaided eye are often the worst saboteurs of time, equipment and lives. These designs for "self-sabotage" in the structure of individual parts can be made to reveal themselves by visible surface patterns immediately after production.

There are three recognized non-destructive methods by which every part can be inspected at production line speeds.

Magnaflux Corporation first offered magnetic particle inspection (the basic Magnaflux* Method) for all magnetic metals.

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Finally, research extended the benefits of these methods to non-magnetic parts—aluminum, bronze, austenitic steels, plastics, ceramics, etc. This high visibility method (Zyglo*) employs a fluorescent penetrant medium to produce vivid indications under black light.

By constant engineering contacts in the field and study in the laboratory, Magnaflux research continues to add to the techniques of industrial inspection.

*Registered Trade Marks covering the methods, materials and equipment of Magnaflux Corporation.

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In Europe, Africa, Asia, or wherever, transportation must be *sold* just as it has to be in the United States.

It is in the private, or personal plane, market that the study is at greatest variance with the more ebullient forecasters. For, according to the evidence, total production of 9,500 new planes—and 25 percent spares—valued at $84,000,000 (including a highly doubtful 2,500 helicopters) will saturate the V-2 market.

These craft are broken down as follows: 5,000 two-passenger planes valued at $9,500,000; 1,500 four- and five-place craft totaling $18,000,000 in value; 500 eight- to ten-place luxury or business executive craft at $30,000,000; and the 2,500 helicopters at $12,500,000.

Since the helicopter has been the subject of a dangerous flood of publicity it deserves special mention. In the first place, the men who are actually designing and building helicopters realize full well that they have many engineering problems to whip before the sales departments can hope to get a bead on even half the astronomic number of consumers predicted as the potential market. The helicopter will not be the craft for that vague "man in the street" for some time, because the simple but inescapable fact is that (1) ease of control and (2) inherent stability must be built into any craft for the average person. Certainly, neither of these two problems are insuperable, but those in the best position to know don't anticipate the helicopter's replacing—or even greatly supplementing—the automobile for a very minimum of five years. Thus the word "doubtful" is used. Before this five year period is over, the war may end still leaving development work to be done.

Then there is the ever-present matter of cost. Experienced aircraft producers judge prospective helicopter prices approximately as follows: With production at 500 per month, the required retail sales price would be $5,000 per unit; at 1,000 per month, the retail figure can be lowered to the $3,000-$4,000 range; and output of 1,500 per month could mean setting the price tag at a $3,000 top. It is obvious that with both engineering and distribution problems to be solved, the $5,000 price is the only answer for the V-2 market.*

Assuming that 2,500 helicopters could be made and sold, there would be but 7,000 fixed-wing craft to complete the projected V-2 market, or about 1,000 less than the light plane manufacturers alone produced in their best prewar year. It must be remembered, however, that at the beginning of the war there were 6,020 pleasure, 1,606 business-owned, and 5,780 non-scheduled commercial craft registered in this country—a total of 13,406 available planes in the personal plane group.

Since many of these planes have had hard wear in the gruelling CAP coastal patrol and courier services and in war training programs, a higher-than-normal attrition of 20 percent is applied, thus leaving an assumed 10,725 used planes in the hands of private owners, charter operators, and brokers at war's end. Adding the estimated 9,500 new craft gives 21,225 personal planes to be distributed over the two years.

That figure, it could be pointed out, is just over one plane for every 200 men in our projected 2,000,000-man air force. There is considerable evidence, however, that the air force men have been greatly over-worked as plane prospects. In the first place they are not, despite flying pay, getting rich. Most plane manufacturers figure that to be a real airplane prospect, a man must have an annual income of at least $4,000, which only colonels and over get in the Army. Obviously, there is little assurance that all or even a sizable portion of the 2,000,000 air force members will

* Also see article: "What Is the Helicopter's True Commercial Future?", page 116 this issue; and "Let's Be Calm About the Helicopter," page 114 Nov. AVIATION.

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Turner Gauging members for use with Turner's PLAST-O-LOCK collet-type gauge can be obtained in steel, chrome, tungsten carbide or Nor-Bide. When sending your order specify the type you require.

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★ *Features* ★

1. Multiplies the life of the plug gauge.
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return immediately to jobs that will put them in this income bracket.

In the second place, most air force men—like others in the services—are going to be automobile prospects before they become airplane prospects. Even if the immediate postwar personal plane has much more utility than it has today, these veterans will first buy cars and spend, as they did before the war, up to 20 percent of their incomes to operate and maintain them. The remaining 80 percent of that income (after the taxes the veterans will return to shoulder) will unlikely leave enough for the majority to buy and maintain aircraft.

In the third place, a surprisingly large number of today's air force men simply don't have the interest in aviation they are assumed to have. This is a factor which has been generally overlooked, but when surveys demonstrate that up to 25 percent of the men questioned show no interest in postwar flying of any kind, it has a definite bearing on market possibilities. Many men—including pilots—chose the aviation branch because they would "rather be in a flying army than a walking army." For others the novelty of flying has worn off and they will be content to return to their old ways of life before the war.

The over-all V-5 market, while still greatly under the estimates of the more optimistic, represents a considerably expanded outlet for American aircraft, calling for 2,925 commercial passenger craft, 2,875 cargo jobs, and the annual military demand of 6,000 planes. No attempt has been made to estimate personal plane requirements for this period, largely because design and production changes are unpredictable at this early date.

Three Private Flying Hurdles

Thus far, there have been three major restrictions to private flying: Lack of utility (due in part to over-regulation), price, and fear. Utility can be greatly increased by the development of airports and flight strips—constituting a long range project—and by the design of a practical roadable airplane or development of the helicopter. In the matter of price, there is every reason to believe the personal plane can eventually be produced at a cost comparable to the automobile, for actually a small plane weighs only a quarter to a half as much as the average low price car. Pertinent design, coupled with true mass production, will have to provide the answer.

To overcome the natural fear of the air, the personal plane must be designed and built so that anyone of normal intelligence not only can fly it with ease but also with assurance. The progress being made by personal plane manufacturers leaves little doubt that these restrictions will be overcome, but too many factors are beyond their control to warrant setting time limits.

An appraisal of the V-5 transport market can be broken down into two categories: The combination passenger-mail-cargo ship and the straight cargo craft. Requirements for the former may in turn be subdivided as follows: Domestic trunk lines, 700 planes at a total value of $175,000,000; domestic feeder planes, 1,200 for a total of $60,000,000; transocean planes, 250 for a total of $125,000,000; and sales for export markets, 775 planes to total $155,000,000. This sums up to 2,925 planes which, with 20 percent for spares costing $103,000,000, gives a total market value of $618,000,000.

See "Class" Traffic on Airlines

The domestic trunk line craft are expected to be of from 60 to 100 passenger capacity, with dual provisions for cargo. It is anticipated that they will serve three classes of traffic, which may be classed as commuter, deluxe, and super deluxe, roughly comparable to today's rail coach, Pullman, and extra-fare train. With increased operating efficiency and consequent greater plane utilization, the V-5 air transport market is forecast as consisting of 80 percent of first class rail traffic and 33 percent of the railroad coach and inter-city bus traffic, a level which airline operators feel they can reach by that time.

Feeder planes are expected to be largely of from 20 to 40 passenger capacity, with cargo space. While 1,200 appears a small number in view of the visionary forecasts, it should be remembered that the CAB is not going to award certificates of convenience and necessity to every and any applicant. Even a portion of those who do receive certificates will not be able to stay in business, thus they will have used equipment to put on the market. This 1,200 figure, while conservative, is believed to be logical because the feeder line, particularly in pick-up operations, offers greater opportunity to effect increased plane utilization, thus reducing the number required to give adequate service.*

Most experienced transport operators feel that 250 transocean planes—all of which will be in the 100,000-lb.-plus weight group—will adequately serve the traffic which they will be able to develop, for they cannot overlook the fact that surface vessels will still be sailing the seven seas, sailing them at a cost much lower than any that can be reached at that date by our transport aircraft.

The V-5 export market shows up two-and-a-half times greater than that estimated for V-2 operations, based on the fact that purchasing nations will be getting on their own feet financially or, perhaps, that the United States will continue to "cover" foreign markets, perhaps in a manner similar to the former German operations in Brazil. On a purely competitive basis, American planes will no doubt continue to dominate world markets, since today they have what is generally conceded to be a five-year lead over Great Britain's, which are considered their only serious competition in the postwar era.

The dollar value of the V-5 transport market is raised by the increase to 20 percent for spares; this must be so because of the larger number of larger planes involved.

The straight cargo plane market for the V-5 period can also be subdivided, with 1,850 domestic craft costing a total of $370,000,000, 250 transoceanic craft costing $125,000,000, and 775 for export sales totaling $155,000,000. Addition of 20 percent for spares gives a total dollar value of $780,000,000.

It is believed that the domestic cargo planes of the V-5 market will be of two types, 8-10 ton craft with cruising speeds of about 175 mph., able to give service at about 8c. per ton-mile, and approximately 20-ton craft, offering 4c. per ton-mile operations.

The number of planes estimated to be needed is based on the airline executives' belief that air cargo carriers can develop business making inroads up to 40 percent of the rail express business, 80 percent of the long distance parcel business, 10 percent of the l.c.l. rail freight, and 5 percent of the l.t.l. truck business.

Process of Supplementing

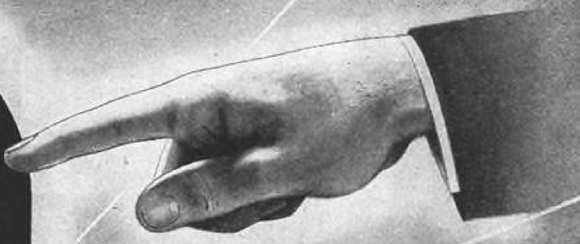
By comparison with visionary forecasts, the two- and five-year postwar markets projected by the study may at first appear overly pessimistic. In reality, however, they are felt to be realistically optimistic, for they represent increases over prewar business of as much as 500 percent. They represent, too, a sound and steady growth for an industry that will have to fight as hard for survival after the war as it did before. These markets do not envision air transportation supplanting, but rather supplementing improved and better coordinated highway, rail, and ocean transportation.

It is only in the 10-20 yr. period after the war that air transportation will make the serious inroads now dreamed of. Sound, steady growth up to that period may well make realities of such volumes of business as: more than 80 percent of the first class passengers traveling over 300 mi.—at rates reduced by 25-30 per cent; 80 percent of the first class mail going over 400 mi., with costs cut by half; and 40 percent of the railway express volume, with rates reduced 500 percent from present levels.

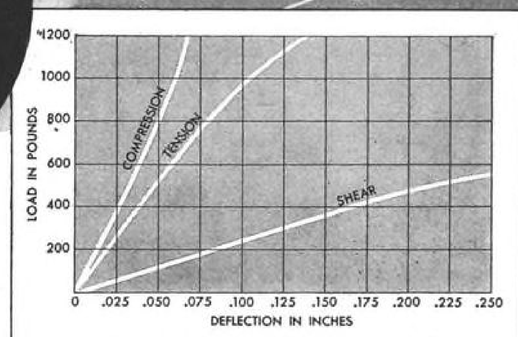
* Also see "The Feeder Airline's Place in Postwar America," page 116 Nov. AVIATION.

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Specify LORD BONDED RUBBER Shear Type MOUNTINGS

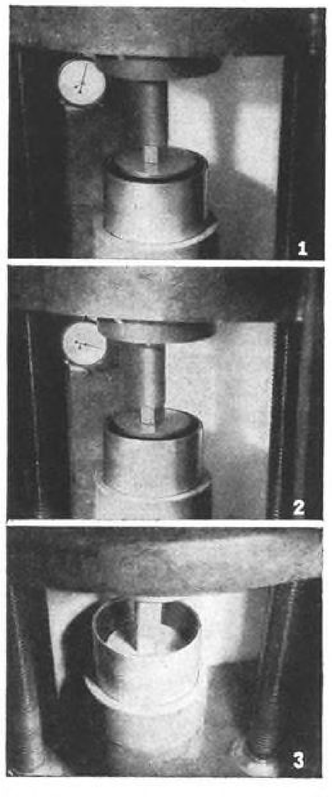






The curves in above chart indicate deflections obtained from test specimen in tension, compression, and shear, under identical loading. Note the much greater deflection of the shear stressed system, resulting in a softer suspension and consequent higher degree of vibration isolation efficiency.

Photographs proving strength of Lord Shear Type Mountings



The above tests were made using a Lord Tube Form Mounting 5½" O. D. x 4½". Figure one shows mounting under no load. Figure two shows mounting stressed in shear under its rated load of 2,200 lbs. Center sleeve is depressed 1/16". Figure three shows same mounting under 50,000 lbs. load (press capacity). Center sleeve is depressed 1-13/16" and shows no failure of rubber-to-metal bond, even with more than 2000% overload.

TO obtain the highest degree of vibration control or isolation efficiency, a flexible suspension must be employed which is soft in the direction or directions of the disturbing forces, thereby providing adequate axial deflection, and maintaining ample stability in directions normal to the major thrusts.

The only mounting design which incorporates these features is one in which the rubber is *stressed in shear*. Rubber in shear is much softer, yields more readily than in tension or compression, and consequently greater deflections can be obtained from a given size rubber element. (See chart)

Lord, by developing and perfecting a process for forming a strong and uniform bond between rubber and metal, has been able to apply this principle of shear stressed rubber to two basic designs of vibration isolation mountings, plate form and tube form, and other bonded rubber products including flexible couplings, torsion bushings, radius rod joints, turnbuckles, and diaphragms.

This process, which produces a bond as strong or stronger than the rubber:

1. Facilitates the manufacture of a simple, rugged, compact, lightweight mounting, allowing full shear freedom to the rubber element.
2. Will bond firmly and directly to various metals—Low and High Carbon Steels . . . Alloy Steels, Brass, Aluminum, and Monel Metal.
3. Produces a high ratio of bond strength to working stress providing an ample factor of safety under all loading conditions.

Lord Mountings, in plate form and tube form, with snubbing or non-snubbing features are made in various shapes and many sizes, with load ratings ranging from a few ounces to several thousand pounds. Millions of Lord Mountings and other Bonded Rubber Products are being used in almost every type of military and naval equipment, as well as in practically every field of industry, providing protection against the harmful effects of shock, vibration, and noise translation. Investigate the possibility of including them in *your* new equipment designs.

Complete information covering all Lord Mountings, as well as an engineering discussion on vibration control, is contained in Bulletins 103 and 104. Lord Vibration Engineers are available for consultation on your design problems. Write today. There is no obligation.

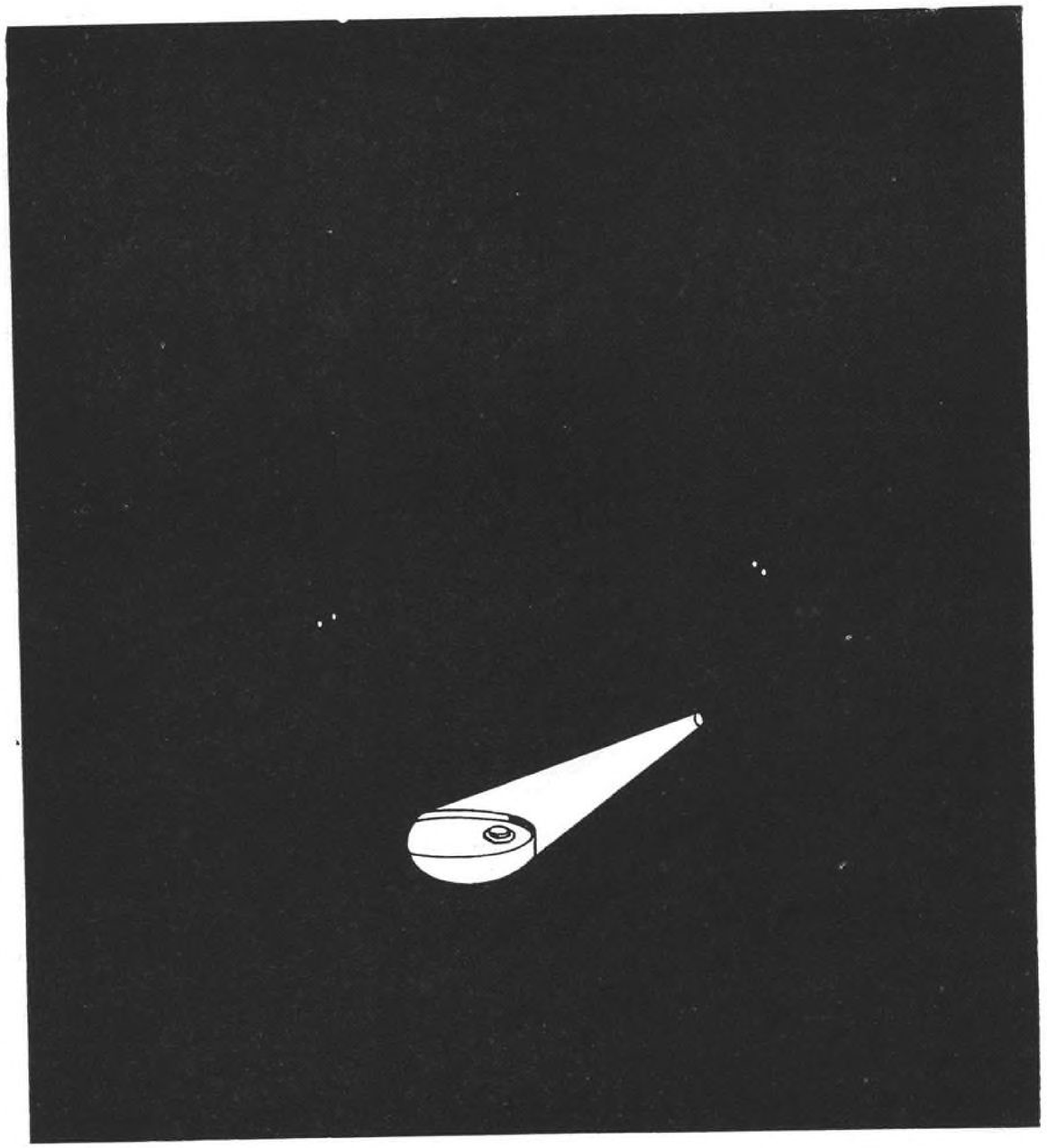
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A versatile tube stand that brings the work into range . . .

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The tube arm (with 5′ 9″ reach) moves on a ball-bearing carriage with six-foot vertical travel. Target to film distance may be anywhere from 24″ to 96 ″above the floor.

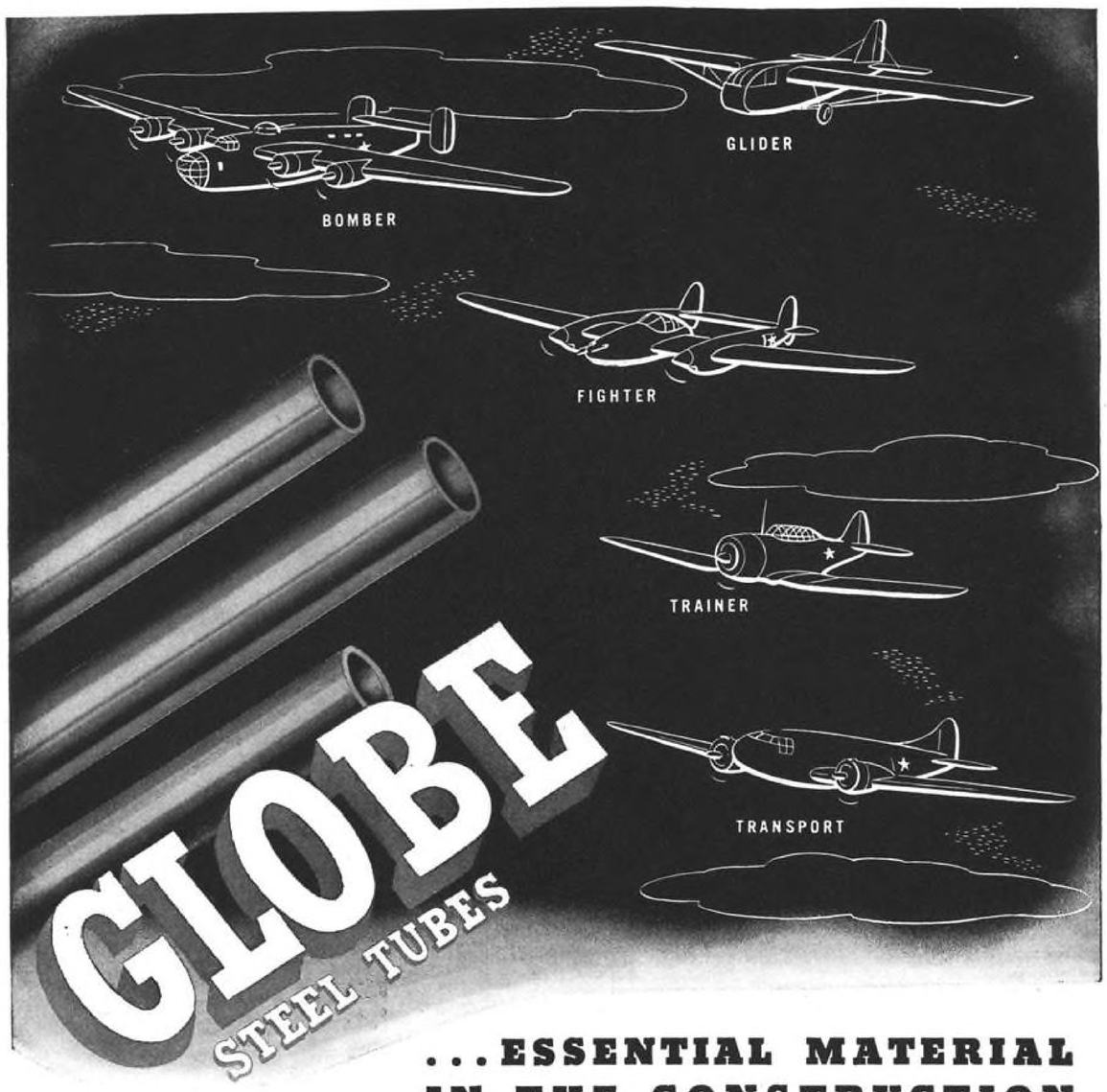
The twin columns are mounted on a ball-bearing plate on which the entire unit may be rotated a full 360 degrees around its vertical axis.

The tube itself, turning 360 degrees on its long axis and 90 degrees on its short axis, can be set at any angle within its surrounding sphere.

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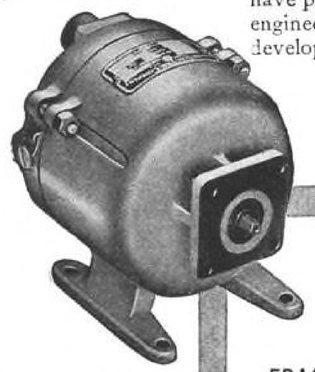
This TWA Constellation* uses lots of *SMALL ELECTRIC MOTORS*

When war was still a cloud on the horizon, TWA Airlines had Lockheed design the remarkable "Constellation," and ordered 40 of these planes, the biggest land transport plane built to date. Only recently completed, it has now become part of the Army's air transport system. When peace releases these planes for civilian use, airline passengers will gain new convenience in travel, thanks to these forward-looking engineers.

Some of the numerous small electric motors incorporated in the Army's Constellation are Bodine motors, and more and more of these motors will probably be used on the Constellation as production facilities make this possible.

When Bodine production can be again turned from military channels to applying these motors to peacetime needs, you will see more and more of them specified by manufacturers of aircraft. The wartime applications of these motors have proven their value and reliability, and through constant research, Bodine engineers keep designs up-to-date and ready for application to the newest developments in aviation.

*Now garbed in army drab, the first Constellation made its maiden flight recently. As time goes by, you'll see more and more of these big planes in the news.



Bodine motors are built to meet or exceed Air Force specifications.

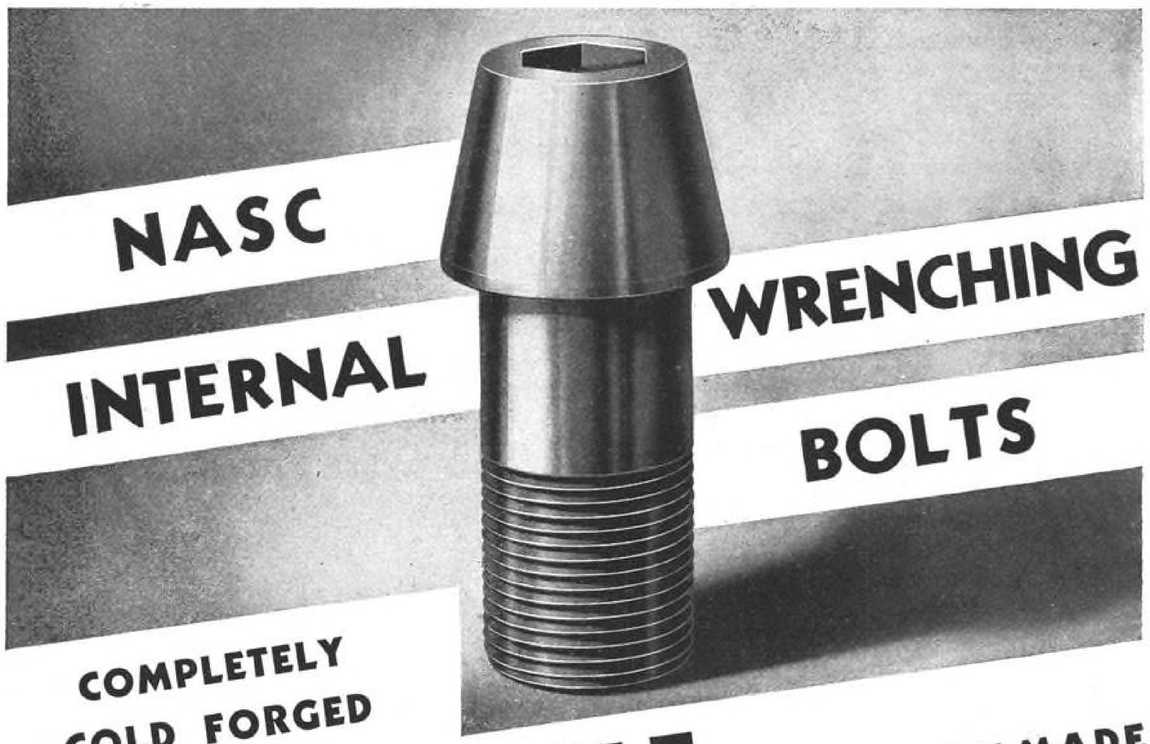
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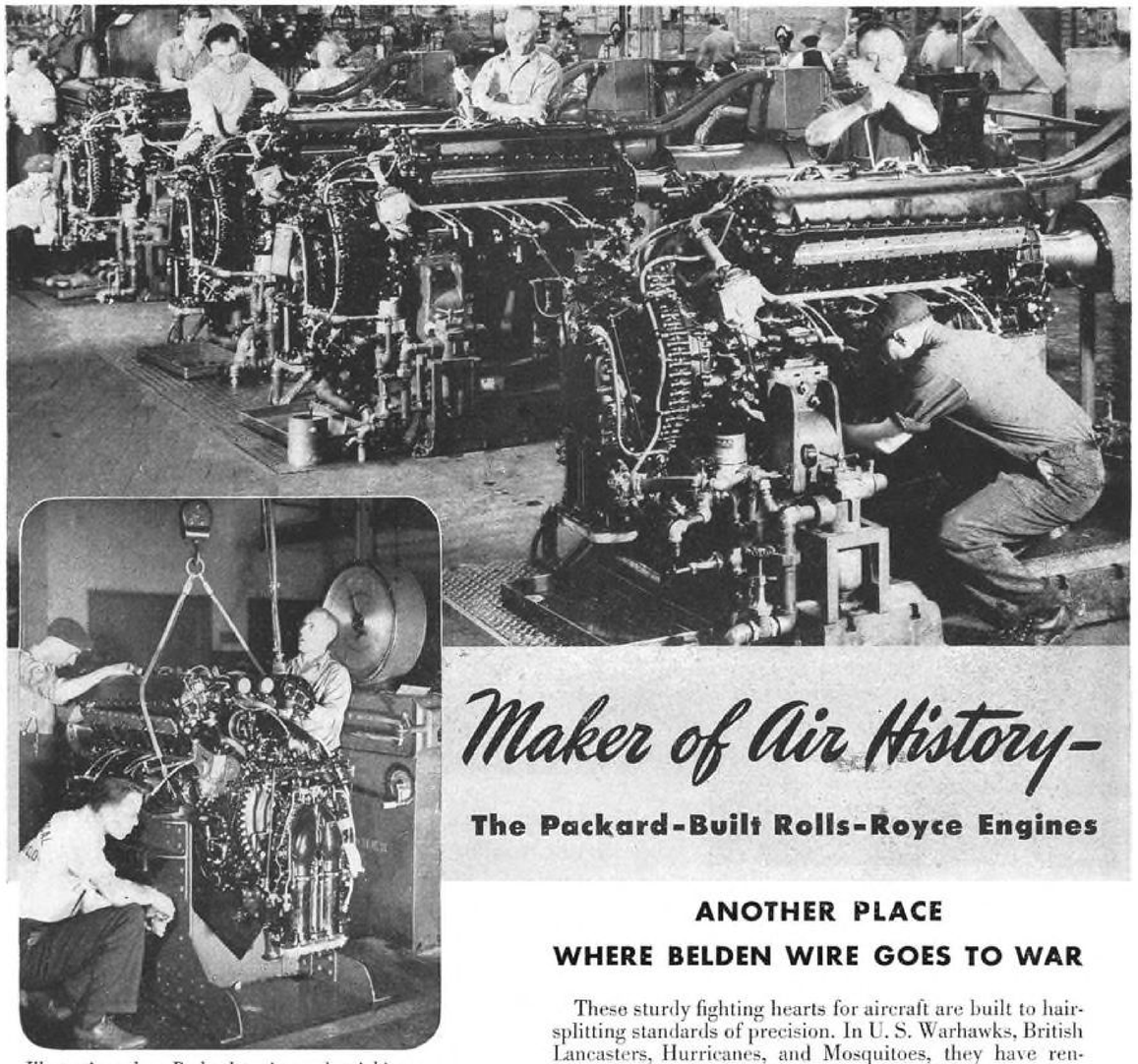
Reduce the size of assembly members and place the fastening at the desired point—saving WEIGHT . . . Clearance needed for fastening reduced to a minimum—saving SPACE . . . Manpower time reduced because of the Internal Wrenching feature with its quick and positive tightening—saving TIME . . . Holo-Krome Internal Hex Wrenching Bolts *are* the "better fastening method".

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TO SPECIAL DESIGN—

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CATALOG A4 illustrates and describes Holo-Krome Internal Wrenching Bolts plus NASC Specifications—*WRITE FOR IT.*

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WHERE BELDEN WIRE GOES TO WAR

These sturdy fighting hearts for aircraft are built to hair-splitting standards of precision. In U. S. Warhawks, British Lancasters, Hurricanes, and Mosquitoes, they have rendered amazing service in strafing and blasting across Africa and Europe—to the very doors of Berlin.

Here's another example of the way American ingenuity is defeating dictatorship. Here skilled workers are using service-tested materials in producing weapons that "stay on the job." Here's another place where Belden wire goes to war.

Back of Belden aircraft wire is a lifetime of experimenting and testing and collaboration with aircraft engineers since flying was in its infancy. This vast experience makes possible the Belden aircraft wire that meets today's needs.

Belden Manufacturing Company, 4665 W. Van Buren St.
Chicago 44, Illinois

Belden *Aircraft* WIRE

Starter, Lighting, and Instrument Cables √ √ √ SPARK PLUG WIRES

Norma-Hoffmann Precision Bearings Help Supply

"THE BREATH of LIFE" for ENGINES AT SUB-STRATOSPHERE HEIGHTS



What his oxygen supply is to the high-altitude flyer, the supercharger is to his engine. Failure of either is fatal. Together, they make possible the high-altitude fighter planes and bombers that are playing so conspicuous a part in today's warfare.

In the use of anti-friction bearings in superchargers, as in so many other aviation applications, NORMA-HOFFMANN pioneered the way. The terrific speeds of supercharger operation—often as high as 60,000 RPM—demand that ULTRA-PRECISION long characteristic of NORMA-HOFFMANN BEARINGS. And today, not only in superchargers but elsewhere at vital points throughout the plane, NORMA-HOFFMANN PRECISION BEARINGS are doing their part in winning air supremacy for the Allied Air Forces in every theatre of war.

"Where the bearings MUST NOT fail"—in engines, control mechanisms, instruments, armament, radio equipment and other aircraft accessories—they are providing that combination of speedability, load capacity and dependability so vital to the unfailing performance of the plane.

Let our engineers work with you.

"NORMA-HOFFMANN"

PRECISION BEARINGS

BALL, ROLLER AND THRUST



NORMA-HOFFMANN BEARINGS CORP'N, STAMFORD, CONN. . . . FOUNDED 1911

"Pioneer Suppliers for 20 Years of Ultra-Precision Bearings for Superchargers"

TO WIN THE WAR—*Work—Fight—Buy War Bonds!*



New, faster method of testing

PARACHUTE WEBBING

THIS PRECISION hydraulic testing machine has been designed especially for testing parachute webbing economically and accurately. High speed pulling head plus newly designed and quickly applied grips enable as many as 60 tests per hour. . . . Accuracy and reliability are assured. All breaking loads are measured by *gravity stress* acting on a pendulum. There are no metallic parts in the weighing mechanism subject to changing characteristics from metal fatigue. . . . Maximum loading capacity is 10,000 pounds. Load tests as low as 60 pounds are registered accurately. . . . *Write for details and delivery schedule.*

"It's REALLY tested . . . when it's RIEHLE tested"

RIEHLE *HYDRAULIC PENDULUM TESTING MACHINES*

Division of American Machine and Metals, Inc.

EAST MOLINE, ILLINOIS



Engine alone weighs 81 lbs. 15 oz. *The complete Andover Auxiliary Power Plant consists of a two-cylinder air-cooled 10 H. P. engine driving a 28.5-volt generator supplying a continuous power output of 5 K. W. with a peak load of 7½ K. W. Its complete weight with generator and adapter is only 116 lbs.*

● Ever stop to think just how much vital equipment a large bomber has to have to successfully bomb our enemies—how much this equipment weighs—how much space it requires—even before a bomb is loaded?

Then you will appreciate the fact that every pound saved has an unbelievably high value. The *100 pounds* saved by the Andover Auxiliary Power Unit means that more vital battle ammunition can be carried . . . more destruction can be wrought . . . greater protection for the crew.

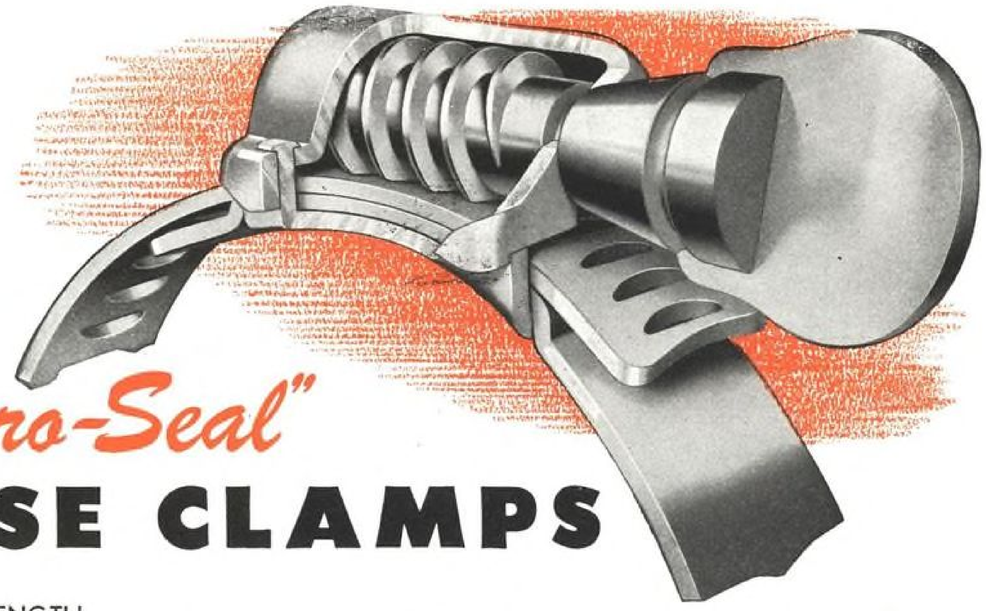
This light-weight, compact auxiliary power unit plus only one battery also means a continuous, never-failing source of electric power at the snap of the switch.

Andover

AUXILIARY POWER

ANDOVER MOTORS CORPORATION • ELMIRA, N. Y.

WHOLLY-OWNED SUBSIDIARY OF ANDOVER KENT AVIATION CORPORATION



"Aero-Seal" HOSE CLAMPS

- HIGH STRENGTH.
- UNIFORM PERIPHERAL TIGHTENING.
- NO LEAKAGE UNDER HIGH PRESSURES.
- SELF-LOCKING, NO LOCK WIRE NEEDED.
- NO LOOSE PARTS.
- CAN BE RE-USED.
- WILL NOT DISTORT OR COLLAPSE THIN-WALL TUBING.
- CAN BE PUT ON HOSE IN PLACE.
- COMPACT HOUSING DESIGN.
- 16 SIZES FOR ¼" TO 4" I.D. HOSE.
- EXTRA LONG TAKE-UP.



SHOWS M-20 CLAMP ON ⅝" AND 1" SELF-SEALING HOSE

WORM GEAR ACTION. The break-away picture above shows the AERO-SEAL action . . . a heat-treated worm which engages slots in the spring steel band, the slots corresponding to teeth of a worm gear. This gives a belt-like tightening action which assures uniform pressure (see lower picture) around the entire periphery. Hand-tightening with the thumb-screw meets maximum pressure requirements. The screw will hold tight *without lock wire* under severe vibration, as proved in authoritative tests.



RE-USABLE. AERO-SEAL Hose Clamps can be put on, and taken off, hose in place on tubing by simply backing the band out of the housing and springing it open, as shown here (except with the smallest sizes). Since no cutting or folding of the band, or disturbance of any other parts of the clamp, takes place, the AERO-SEAL clamp may be removed and replaced, or used on another hose, as many times as necessary. There are no loose pieces to fall off, screw out, or be lost.



LONG TAKE-UP. AERO-SEAL Hose Clamps have *more than double* the diametral take-up required to cover variations in hose diameter, wall thickness, and the flow of rubber under repeated tightening of clamps in service. Each size of AERO-SEAL Hose Clamp can be used on several smaller sizes of hose by simply taking up the band, thus permitting substitution of a larger size clamp when the recommended size to fit a given hose is not available. *Write for samples.*

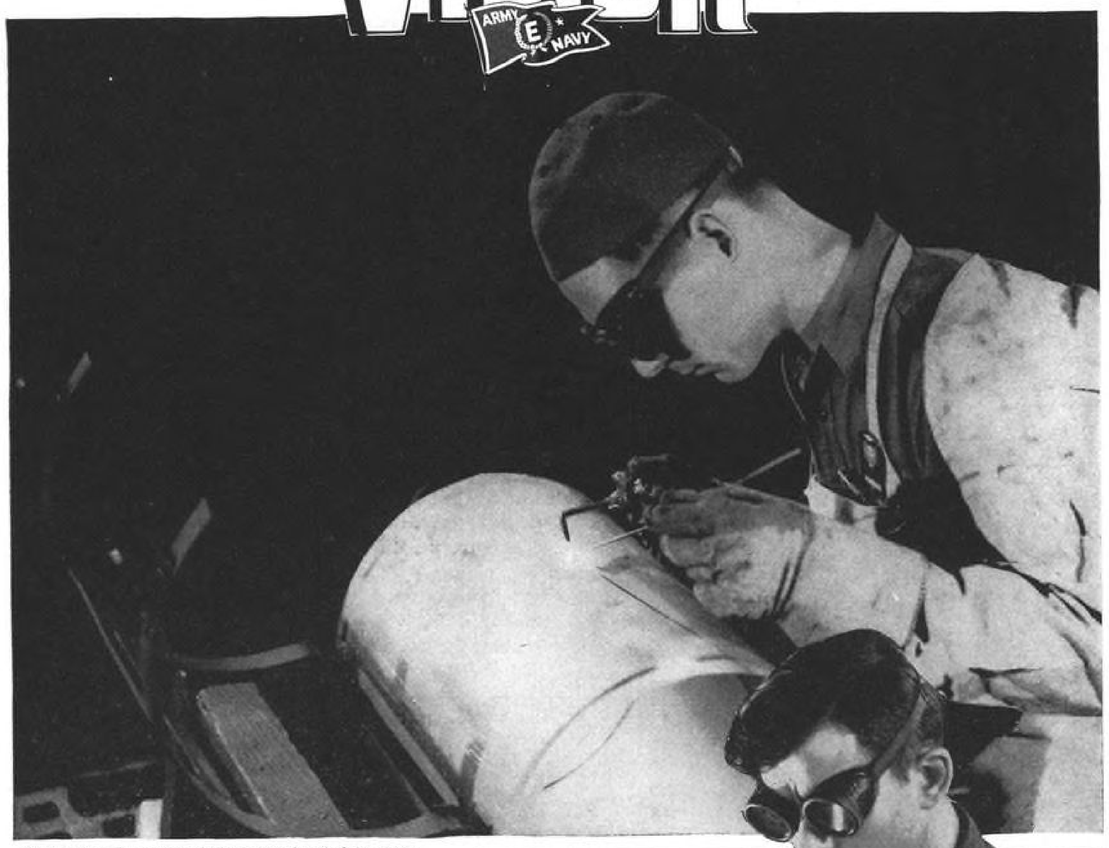
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Aircraft Standard Parts Co.

1715 Nineteenth Avenue, Rockford, Illinois

VICTOR

ARMY E NAVY



Illustrations by courtesy of The Dow Chemical Company

TO WELD MAGNESIUM

You who weld magnesium alloys will find the VICTOR Type "J" welding torches of particular advantage because they are designed specifically for the welding of the modern "light metals".

These torches are provided with a special "spiral" mixing device for better flame control and to employ with maximum efficiency oxygen and all of the suitable Hydro-carbon gases. Since proper flame control is of great importance, we recommend the VICTOR two-stage reduction regulators Models VTS-40 and 41.

You, too, will find VICTOR apparatus costs less to own and to operate.



VICTOR EQUIPMENT CO.
844 FOLSOM STREET · SAN FRANCISCO

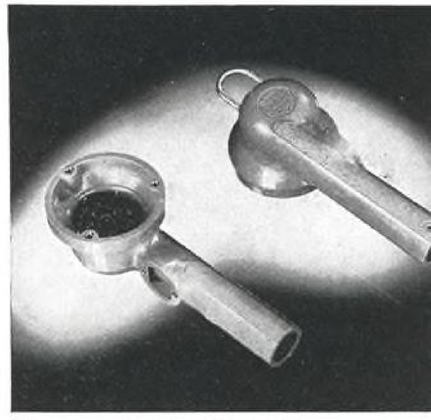
VICTOR DISTRIBUTORS FROM COAST TO COAST



It's cold up yonder. Even the mechanical devices handled by men who fly the upper airways must be made of especially selected materials to withstand the low temperatures. This mobile microphone, designed for aviation communication, is a good example of the care the Signal Corps uses in selecting the right material for a specific job.

The handle and housing of this microphone are molded from ETHOCEL, a plastic that does not become brittle or fragile when subjected to severe cold. It possesses extremely high impact strength in sub-zero temperatures, which protects it from damage if dropped.

In selecting material for this, and many other types of essential war equipment, there is always the question: Does it lend itself readily to mass production? ETHOCEL is so easy to fabricate that it actually speeds production and is an economy factor as well. Again in these microphones a Dow plastic does a more efficient job, meeting all the requirements of a difficult application.



Microphone handle molded of low temperature, impact resistant Ethocel. Six metal inserts are used in a single cavity die.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN
New York · Cleveland · Chicago · St. Louis · Houston · San Francisco · Los Angeles · Seattle

ETHOCEL

DOW PLASTICS

STYRON · SARAN

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CHEMICALS INDISPENSABLE TO INDUSTRY AND VICTORY

HOW PANELYTE*

1 ELIMINATE TIME-WASTING EXPERIMENT

2 SPEED YOUR ASSEMBLY

3 SPEED YOUR PRODUCTION

4 GIVE SPECIALIZED DESIGNING AID

CAN HELP YOU *Cut Corners* TO WIN THE WAR *FASTER!*

1 Mechanical and electrical properties of each of the 32 different grades of PANELYTE (paper, fabric, wood veneer, fibre, glass, and asbestos base) are established, as are performance records. With your specifications at hand no time is lost in costly experiment. We can tell you which grade of PANELYTE to use — and its advantages for your application.

2 For the aviation industry alone PANELYTE is now supplying over 2000 electrical and structural parts. Still more parts are shipped "ready for assembly" to every branch of our armed forces. Many of these laminated resinous parts are among the largest and most intricate yet to be molded or fabricated. Straight-line mass production, impractical if not impossible a few years ago, is now our 24 hour daily diet.

3 For 13 years PANELYTE sheets, rods and tubes, molded and fabricated parts have been stepping up production in the Automotive, Aviation, Central Station, Chemical, Communications, Electrical Equipment, Marine, Transportation, Radio, Refrigeration, Petroleum, Textile and Paper industries. Greatly enlarged facilities assure deliveries *to meet your schedules.*

4 The experience of our engineers is by no means limited to the production of structural laminated plastics. Adept in solving problems of molding and fabrication, they have designed or assisted in the design of PANELYTE parts now recognized as milestones of progress in the electrical and aeronautical fields. If you are engaged in war work their services are at your immediate disposal.

* PANELYTE DIVISION, ST. REGIS PAPER COMPANY... AMERICA'S LARGEST PRE-PEARL HARBOR PRODUCER OF THERMO-SETTING MOLDED LAMINATED PLASTICS

PANELYTE *the structural plastic*

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ST. REGIS PAPER COMPANY
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Experienced and reliable Fabricators in Industrial Centers from coast-to-coast



"Thompson" to step UP production



The number of war plants using Thompson Grinders is an indication of the value of these machines in raising production curves. In fact, the entire line of Thompson Grinders is streamlined for high speed and ultra precision. In aircraft work particularly — as illustrated by the photos on this page showing a battery of Thompson machines producing master and articulated rods for aircraft engines, and a detailed view of the setup — Thompson Grinders are helping many manufacturers to keep in step with extreme output demands, and at the same time meet today's exceptional quality-workmanship requirements. The full hydraulic action of any Thompson Grinder insures smoothness and precision, superior finishes, closer tolerances. For your sensitive, stepped-up war production, LOOK TO THOMPSON! Write for details to The Thompson Grinder Company at Springfield, Ohio.

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from the **PURR** of a kitten





LANDING GEAR



WING FLAPS



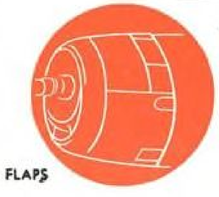
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COWL FLAPS

to the *fury* of a **HELLCAT...**

ELECTROL HYDRAULICS control her vital muscles!

Knocking out the Zero with a lethal wallop, and screaming down through shell-torn skies to unleash her devastating burden of death on the Jap destroyer . . . the Hellcat, with terrific punch is pounding out victory after victory for our Navy. Electrol Hydraulics are vital parts of the Hellcat and other Navy fighting aircraft. Our skilled engineers will gladly study your requirements to help you lick your hydraulic problems.

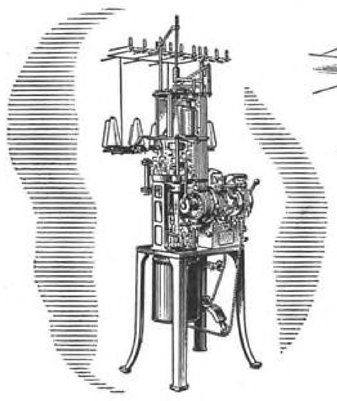
ELECTROL INCORPORATED • KINGSTON, NEW YORK

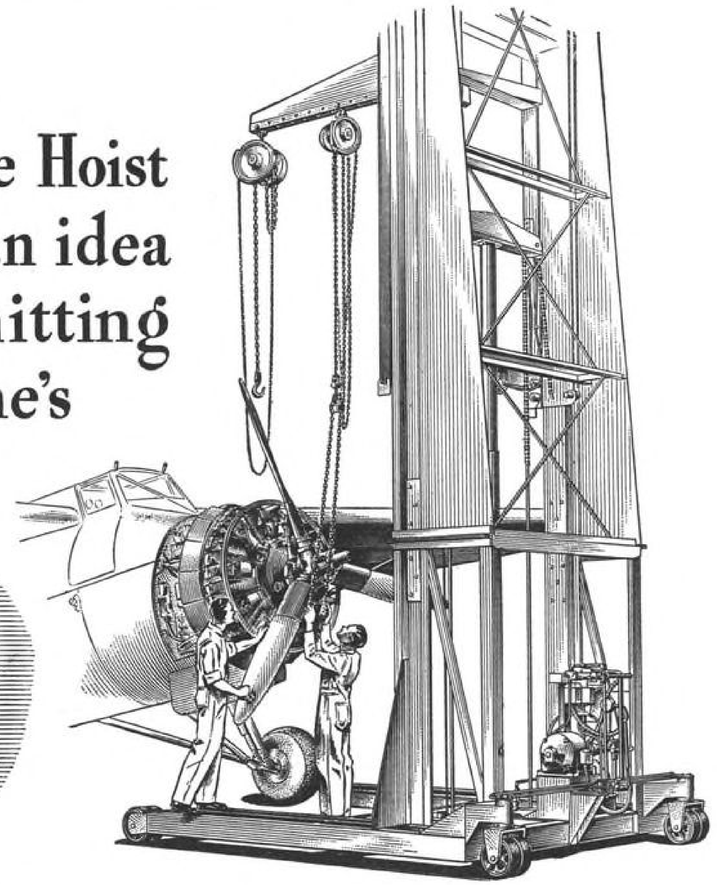


HYDRAULIC EQUIPMENT FOR AIRCRAFT

electrol
HYDRAULICS

The Engine Hoist "*Lifted*" an idea of the Knitting Machine's





PERHAPS IT SEEMS ODD—an aircraft engine hoist picking up an idea it could use—in a textile mill. Builders of knitting machinery are constantly striving for speed and more speed, greater efficiency of operation. Small wonder the knitting industry was among the first to adopt the Torrington Needle Bearing—its low coefficient of friction insured quicker response, and efficient lubrication permitted operation over long periods without *any* attention.

But the aircraft engine hoist is in no great hurry. How much overloading it could stand, and how dependable it might be—particularly at flight bases in steaming jungle, arid desert and frozen wasteland—concerned hoist designers principally. Yet *they* specified the Needle Bearing—for high load capacity and reliable performance. But in this unique anti-friction bearing's combination of features were several others that came in handy, helped equip our aircraft industry and air forces with engine hoists often surpassing specifications, and in less time, too.

For the Needle Bearing's low coefficient of friction speeded aircraft engine installation and overhauling . . . its simple, effective system of lubrication reduced maintenance time and expense . . . its long service life helped "keep 'em flying," while ready availability, for such essential applications as aircraft engine hoists, was and *is* an important factor in today's staggering plane production totals and our sustained air attacks on enemy bases.

DOES THIS SUGGEST ANYTHING TO YOU in considering your product's design for postwar? There are any number of opportunities for increasing efficiency and reducing costs through the Needle Bearing's combination of features. And you'll have a real sales story! For Tomorrow's customers will be looking for the very advantages the Needle Bearing offers in the products they buy—light weight, compact design, easy operation, efficient lubrication, minimum maintenance. Send for Catalog No. 114 covering sizes, types and ratings, as well as list of typical applications of the Needle Bearing. In working out details, Torrington engineers will gladly help you.

NEEDLE BEARINGS—ALL TYPES—ALL SIZES

NEEDLE BEARINGS TYPE DC are complete, self-contained units consisting of a full complement of rollers and a drawn, hardened outer race. They offer the advantages of small size, low cost, high capacity—and easy installation.





NEEDLE BEARINGS TYPE NCS consist of a full complement of rollers and a relatively heavy hardened outer race. They are furnished with or without inner races. Needle Bearings Type NCS are adaptable to heavier loads than Needle Bearings Type DC.

NEEDLE ROLLERS TYPE LN are produced in a range of types and sizes for assembly on the job into low-cost, high-capacity, anti-friction bearing units. Our engineering department will be glad to advise on the correct size and type for any application.



THE TORRINGTON COMPANY

Established 1866 • Torrington, Conn. • South Bend 21, Ind.

Makers of Needle Bearings and Needle Bearing Rollers

New York · Boston · Philadelphia
Detroit · Cleveland · Seattle
San Francisco · Chicago · Los Angeles
Toronto · London, England

LET'S GO! U.S. KEEP 'EM FLYING

TORRINGTON NEEDLE BEARINGS



The tramp, tramp of millions of feet . . . the clank and growl of giant tanks . . . the fearsome roar of diving planes . . . the shriek of shells . . . the whine of bullets . . .

In the background, the dogged tramp of other millions of feet . . . the clickty-click of speeding trains . . . the snort of tractors . . . the wail of whistles and sirens . . . the hum of pneumatic tools . . .

The swelling chorus has reached an ear-splitting tune and America's song of victory fills the air . . . the air that gives life to the earth and its people . . . the same air that furnishes an inexhaustible medium of power transmission for one of the chief weapons of industry, *the compressed air operated tool.*

These efficient and powerful machines, which are contributing to the miraculous surge of war production, are destined to play an even more important role in bringing to a war-torn world the new conveniences and comforts of a hard-won peace.

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TRADE MARK



Industrial Presses — Shell Loading Presses — Crank Shaft Assembly Presses . . . three of many Denison HydrOILic Presses.

AT WORK . . . *all across the country*

In war plants from coast to coast . . . and in actual warfare . . . Denison HydrOILic equipment is pressing, packing, assembling, testing. These are just a few of the many victory tasks being efficiently handled by Industry's New Right Hand . . . Oil Hydraulics!





Wartime applications of HydrOILics foreshadow the part they will play in post-war production. They will help produce more goods faster and cheaper, replace old equipment, make new products and processes possible . . . for oil-hydraulic power, *and precision control of that power,* have just begun to accomplish the many things never before possible with other mechanical methods.

Wherever smooth, exactly-controlled power is needed for pressing, pulling, clamping, positioning, or moving . . . HydrOILic equipment offers a better way. Pioneers in oil-hydraulics, Denison Engineers are fully qualified to adapt HydrOILics to your specific needs . . . Denison plants are completely equipped to build from their designs—NOW, if your priority permits! Whether it be for today's war, or tomorrow's peace, learn what HydrOILics can do for your processes . . . write today!



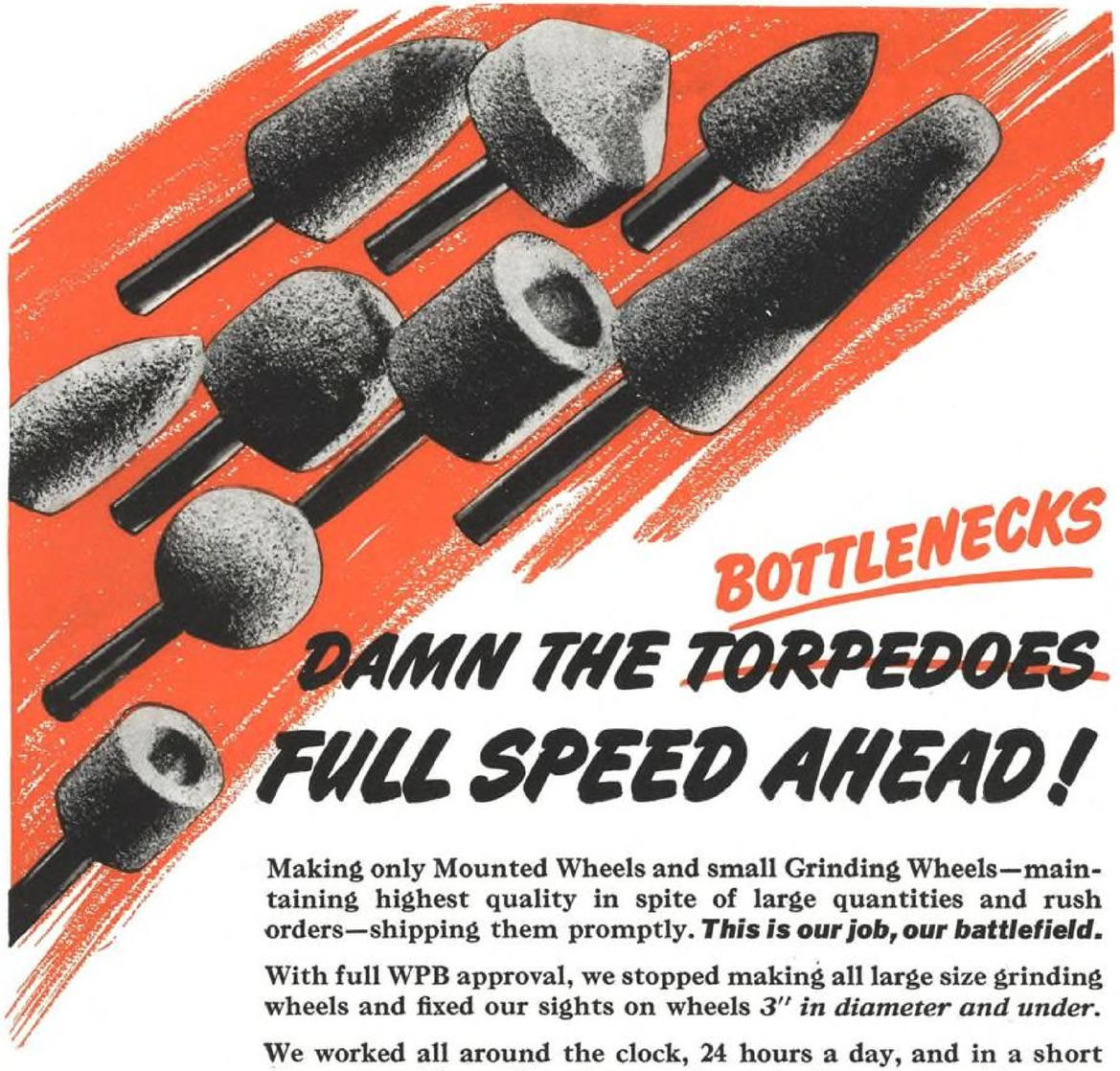
Here are three Denison HydrOILic Test Stands playing vital wartime roles . . . testing aircraft magnetos — hydraulic circuits — spark plugs.





The DENISON ENGINEERING *Company*
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COLUMBUS, OHIO





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Making only Mounted Wheels and small Grinding Wheels—maintaining highest quality in spite of large quantities and rush orders—shipping them promptly. *This is our job, our battlefield.*

With full WPB approval, we stopped making all large size grinding wheels and fixed our sights on wheels *3" in diameter and under.*

We worked all around the clock, 24 hours a day, and in a short time were able to fill orders on time—And, our central location cuts time in transit. Today, there is no waiting. With the Army-Navy E at our masthead, we are going full speed ahead.

AMERICA'S HEADQUARTERS FOR
MOUNTED WHEELS
SMALL GRINDING WHEELS

Half a century of specialization has established our reputation as the Small Wheel People of the Abrasive Industry. You can bank on us.

TEST WHEEL FREE—To get acquainted with Chicago Wheels, let us send one postpaid. Tell us size wheel and material you wish to grind.

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WILL LIGHT THE WAY TO VICTORY

GRIMES FIELD
Home Port and PROVING GROUND *of the*
Grimes Manufacturing Company
URBANA, OHIO

Today, skyfarers over the city of Urbana, Ohio, are gazing upon a new, modern airport built by the vision of men who recognize the part aviation is playing in the war and the part it will play in the future of America. Visitors to this field are calling it "The Finest Little Airport in the Country."

This small, mid-western city of Urbana can rightfully be called the birthplace of modern aircraft lighting. Here three factories of the Grimes Manufacturing Company are busily engaged in the design and manufacture of more than 120 different types of aircraft lights used on the fighting planes of the United Nations. In the skies over Urbana test pilots are continually testing and proving Grimes Lights under actual flying conditions. Thus we make sure every light will serve the specialized purpose for which it was designed.

Urbana is proud of its own municipal airport, Grimes Field; proud that it is playing an important part in the war effort. Grimes lights will continue faithfully to serve our fliers on the fighting front. When peace comes, this leadership and experience will afford new standards of lighting efficiency, safety and convenience for all air travelers.

If it's Aircraft Lighting...

ARMY E NAVY

GRIMES

Designs and Makes it!

Tonight we bomb Berlin



Safe and speedy transportation of bombs from dump to magazine area—and magazine area to plane—is a vital job in every bombing mission. It's a job being carried out today by the bomb trailers designed and built by Saginaw Products Corporation. Saginaw Bomb Trailers carry tons of treacherous T.N.T. safely—oftentimes over bumpy roads. They don't bounce at the rough spots, jack-knife when reversed or sway when speeding along at 40 miles per hour. At Allied airfields in England, Italy, Sicily, Africa, Alaska and the Pacific, Saginaw trailers are doing an efficient job, helping to speed the destruction of the enemy.

But construction of equipment for safely and speedily conveying heavy loads is no novelty to Saginaw Products Corporation. Ever since material handling became a vital phase of industrial production, Saginaw conveying equipment has been employed by many of America's largest manufacturers to keep things moving.

When you are planning the installation of mobile conveying equipment for your plant, it will pay you to consult the Saginaw Products engineers.

SAGINAW PRODUCTS CORPORATION

68 WILLIAMSON STREET • SAGINAW, MICHIGAN

(FORMERLY **SAGINAW STAMPING AND TOOL CO.**) SAGINAW, MICHIGAN



Shortening the steps from Bauxite to Bomber . . . Having built the first and only plant in the country where bauxite comes in at one end and aluminum sheet rolls out the other, Reynolds now carries the process still farther . . . making finished *aircraft parts* right at the aluminum source.

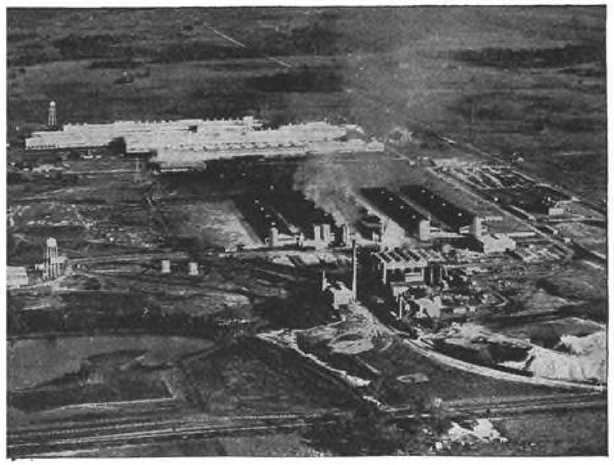
Since scrap from these parts averages 30%, Reynolds pre-fabrication saves aircraft manufacturers valuable storage space and labor . . . saves America precious shipping space and inevitable waste in handling. Reynolds turns out finished parts, quicker...and puts the scrap "back into the scrap" immediately.

For "flying aluminum," call for a Reynolds Sales Engineer . . . available throughout the United States.

REYNOLDS METALS COMPANY
PARTS DIVISION • LOUISVILLE • KENTUCKY
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38 PLANTS IN 13 STATES



Reynolds Aluminum and finished airplane parts start in this Arkansas bauxite mine. Reynolds mines more bauxite per year than had ever been mined yearly before the war in the United States.



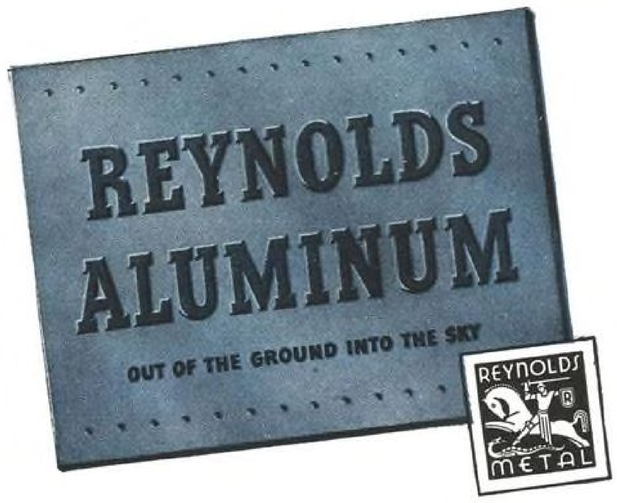
Aerial view of Reynolds plant at Listerhill, Alabama. Here bauxite is refined into alumina; the alumina is reduced into aluminum; and the aluminum is cast, alloyed and fabricated into sheet and rod.



Reynolds rolled aluminum alloy forging stock, tested and Army-Navy inspected, ready to be forged into aircraft propellers.



View of the Reynolds 300,000 sq. ft. expansion of the Parts Division in Louisville. New equipment includes giant 5,000 ton hydraulic press.



AT LAST!

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GIVES YOU **COMPLETE** TEST DATA AND ENGINEERING INFORMATION IT TOOK US MONTHS TO COMPILE.

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IN ALMOST every corner of the world today are men who got their start in aviation through Fletcher Aircraft training. They are at every front and in the factories across America. Fletcher is proud to have shared in their record.

After Victory Fletcher will again start out more men for Boston, Burma and beyond with complete lines of materials and accessories to service and supply the air commerce of the world. Years of experience in training men . . . plus wartime experience in reconditioning planes is building up this maintenance and supply organization that will be ready tomorrow.

Fletcher Aircraft
BURBANK, CALIFORNIA



Backbone of Fletcher training is the famous Standard Aircraft Workers Manual. More than 150,000 copies are now in use by all prime plane manufacturers and by many technical schools and colleges. The new 7th Edition contains all vital information on metals, AC-AN and B standard parts and tools used in aircraft production. Get your copy of this vital book. Mail the coupon today.

Fletcher Aircraft
Burbank, California

Please send postpaid the new 7th Edition of the Standard Aircraft Workers Manual for which I enclose $1.50.

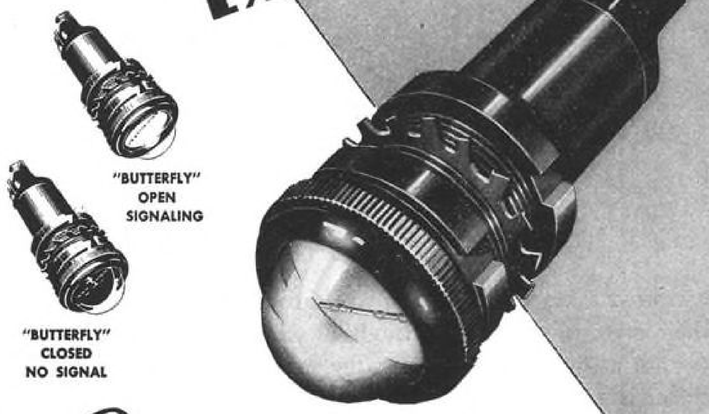
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Dependable SIGNAL INDICATION Shock Resisting! Vibration Proof!

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"BUTTERFLY" CLOSED NO SIGNAL

Littelfuse SIGNALETTE

Clear reliable indication under all conditions —rugged construction unaffected by shock or vibration—freedom from need of spares —elimination of burnouts—these are some of the factors definitely established by performance of Signalette. *Characteristics:*

Positive indication in brightest sunlight, any light, or in total darkness.

Instant adaptation to airman's eyes from cockpit to target. No blur or glare.

Dynamically balanced. Withstands vibration of 10 G. Has successfully undergone 700,000 cycles of operation.

No delicate filaments to break. Non-shatterable plastic cap.

Unaffected by extremes of temperatures from 85° F. below zero to 160° F. above.

Saves ½ current. Uses only 2.25 watts as compared with average of 4.5 watts of filament lamps. Draws only .09 ampere.

Fits the ⅝ standard lamp mounting AC42-B3593. (115 V. Signalette fits 1" lamp mounting). Solder or screw terminals.

Littelfuse Signalette is an original improvement in signal indication by light. It unfailingly indicates by reflected light—daylight or artificial—or in blackest night. Radium-active fluorescent "butterfly" vanes are electrically energized. Available in 4 voltages: 6, 12, 28 V., D.C., *and 115 V., A.C. for continuous operation.* Four signal colors: Red, green, amber, white.

SUGGESTED AIRCRAFT APPLICATIONS

LANDING GEAR
RUNNING GEAR
OXYGEN FLOW
FUEL PRESSURE
OIL PRESSURE
RADIO
"BOMBS AWAY"

WITHSTANDS SHOCK IN INDUSTRIAL USES

Signalette meets a need never before supplied in industry. It insures long-lived *dependable* indication where filament lamps are liable to fail under shock and vibration. Signalette's advantages are found in manufacturing —in railway—in simultaneous readings on test equipment—and many other applications.

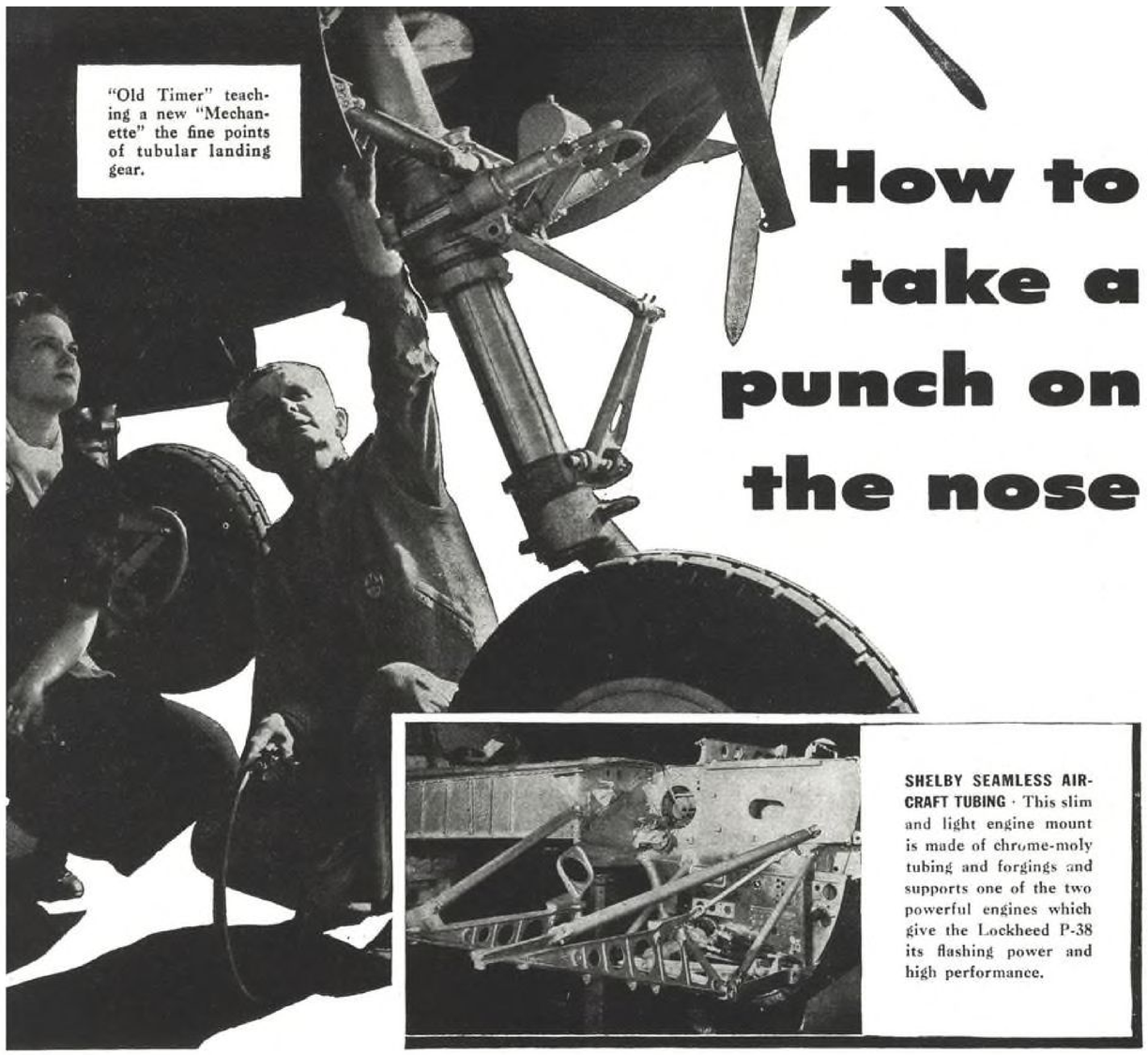
"Eye of Signalette Always Firmly on the Job!"

Send for Signalette Bulletin and engineering data. Outline needs for test samples.

WRITE OR WIRE EL MONTE OFFICE

LITTELFUSE INCORPORATED

200 ONG ST., EL MONTE, CALIFORNIA — 4757 RAVENSWOOD AVE., CHICAGO 40, ILLINOIS



"Old Timer" teaching a new "Mechanette" the fine points of tubular landing gear.

How to take a punch on the nose

SHELBY SEAMLESS AIRCRAFT TUBING · This slim and light engine mount is made of chrome-moly tubing and forgings and supports one of the two powerful engines which give the Lockheed P-38 its flashing power and high performance.

THE Lightning is a "hot" ship. It's heavier than most fighters and lands fast. Naturally, it needs a landing gear that can take any punch-on-the-nose encountered on rough front-line fields.

To get the greatest strength with the least weight, seamless alloy steel tubing is used extensively. No other form of construction has a higher strength-weight ratio.

For this type of service and in other parts of aircraft construction, SHELBY Aircraft Tubing has proved highly advantageous. First, the steel is made to exacting government specifications. Second, the seamless process of piercing a solid billet of steel assures a tube of equal integrity throughout every inch of its length. Third, a most rigid inspection of every part of every finished tube provides a double check on the final workmanship for so vital a service.

All sizes and shapes in the current range of alloys are available in SHELBY Tubing. If you do not have a copy of our book on aircraft tubing giving complete specifications, write today.

URGENT—MORE SCRAP NEEDED

Winter always cuts down the flow of scrap, but the demand for steel is greater than ever. Keep your scrap moving.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* — United States Steel Export Company, New York

USS

UNITED STATES STEEL

call it "Know How"...

There are many names for skill and experience but no substitute for the combination. Through 15 years of peacetime production, Allied Products Corporation perfected the skill of its craftsmen and the facilities of its four great plants.

Now our many skills are turned to producing the tools and dies and parts needed for war. We are proud that each of our four plants flies the Army-Navy "E" for excellence of production.

ALLIED PRODUCTS CORPORATION

Detroit and Hillsdale, Michigan

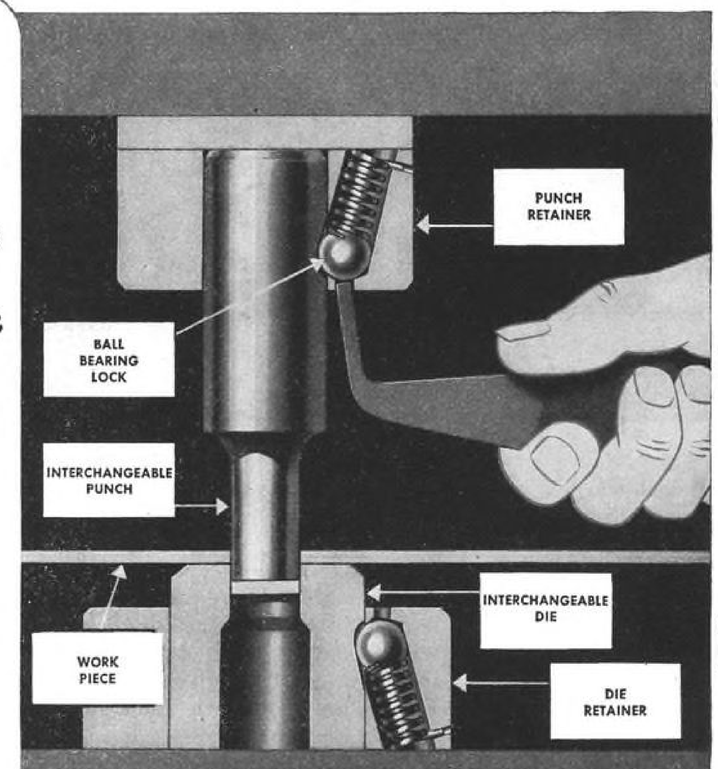
Precision Aircraft Parts . . . Plastic Molds . . . Interchangeable Punches and Dies . . . Production Parts
Sheet Metal Dies . . . Jigs and Fixtures . . . Cold Forged Parts

BUY MORE WAR BONDS

The Original Interchangeable Punch and Die

Perfected by Richard Brothers Division of Allied Products Corporation, this unit is now widely used in all metal working fields. Standard size square, round or end retainers are of case-hardened steel. The retainer is fitted with a patented ball bearing and spring lock which holds the punch or die securely but permits easy changing without removing the die from the press. Interchangeable punches are of water-hardened steel, rigidly tested and inspected. Carried in stock in a wide range of standard sizes. Special size retainer plates, punches and dies made to order. Write for the complete R-B catalog.

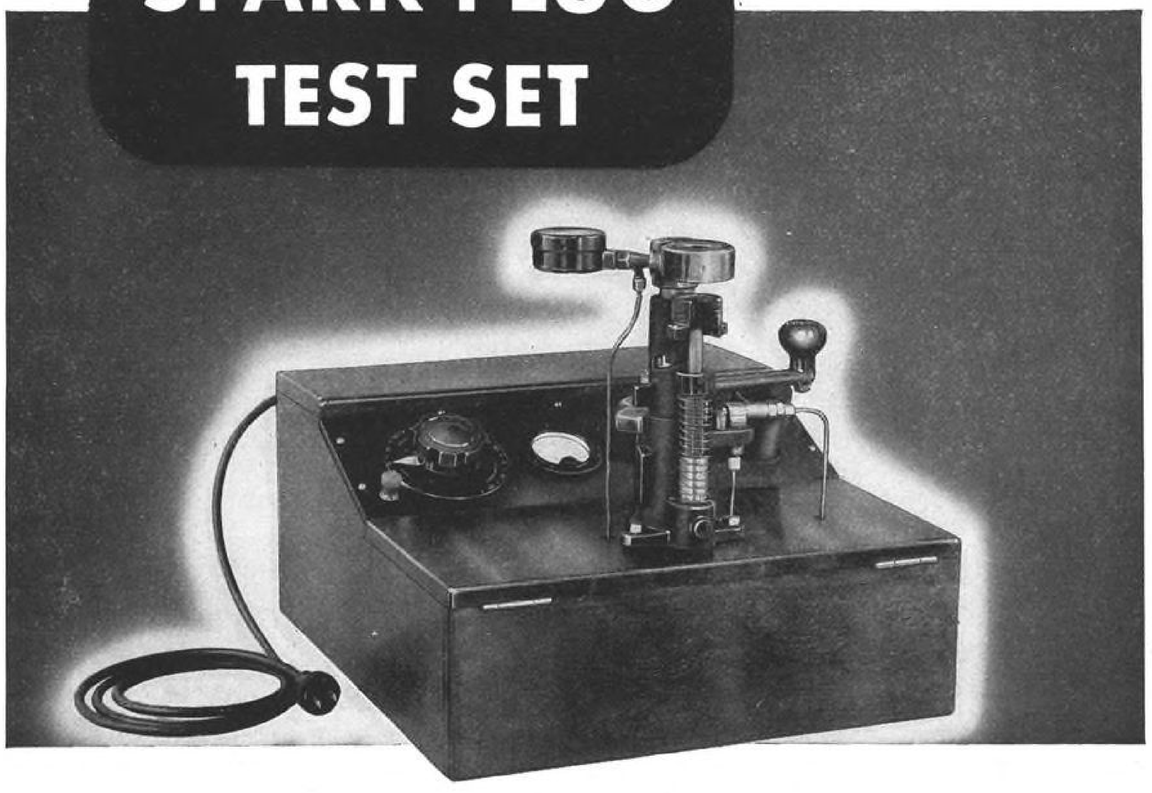
"IT'S AN ALLIED PRODUCT"



Illustrated above is a complete Richard Brothers Interchangeable Punch and Die assembly showing the method of releasing either the punch or die simply by depressing the ball bearing with the special hand tool provided.

"SERVICE WITH A PUNCH"

THE BG SPARK PLUG TEST SET



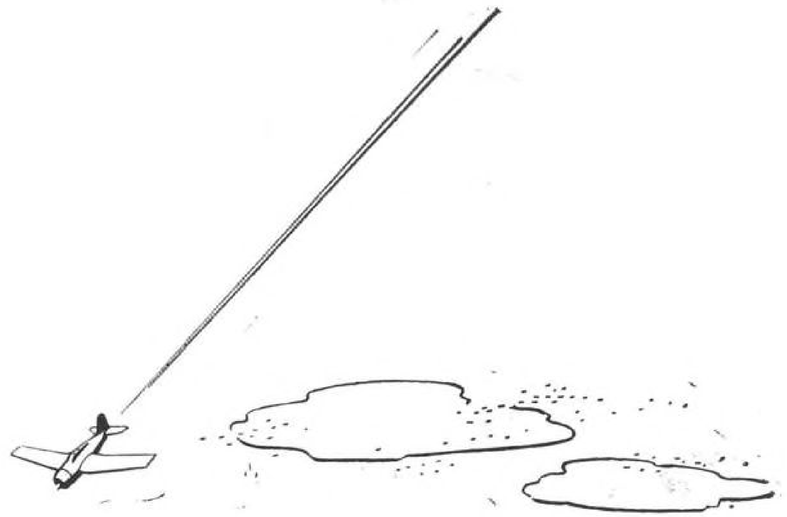
Tests The Electrical Security of Spark Plugs.
Uses High Voltage Bridge Circuit.
Operates from a 110 Volt, 60 Cycle AC Source.
Also Furnished for Operation on Other AC Voltages.
Requires Only a Supply of Dry Gas.
(Carbon Dioxide or Nitrogen)
Set Includes Pressure Regulator.

Model M-591 AC 110V-60 Cycle **Model M-600 AC 220V-60 Cycle**
Model M-601 AC 110V-25 Cycle

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







Built to Take Vibration at Its Worst!

THERE is no tougher test for any relay than the vibration set up by a power dive. Yet Automatic Electric's Class "S" Relays take the worst beating that this service can give, and come through with a safe margin to spare.

These tiny but powerful relays have been specially designed to meet the tough conditions of modern flying. Light weight and small size are only part of the story. Even more important are these features:

1. Vibration resistance is no after-thought with Class "S" Relays—it's built in. It surpasses the most rigorous tests required by the Signal Corps and the Air Forces.

2. Unique spring design provides high contact pressure within small space limits.

3. Twin contacts provide added assurance of **reliability.**

4. Newly designed pin-pivoted armature with **full-length** bearing results in exceptionally long **life, even** under the toughest conditions.

Before specifying relays for use on aircraft or for other applications where small size, light weight and dependability are important, get the facts on Class "S".

Write for circular.

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren St., Chicago, Ill.

In CANADA: Automatic Electric (Canada) Limited, Toronto

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED



Deep in the heart of the HELLCAT, precision pays off. Gears mesh sweetly, highly machined parts function easily within their close tolerances, and the power of 2,000 horses rides the blunt nose of the F6F.

Credit for the hard-hitting Hellcat belongs to the men of Grumman, of Pratt and Whitney—and to Navy pilots. We at Kenyon are proud merely to have contributed some of the vital precision parts that make the Hellcats a hard-hitting, dangerous foe . . .

Gear Boxes... Air Speed Switch... Piccolo Valve (Multiple Check and Relief Valve)... Check Valve . . . Check Relief Valve . . . Pressure-Regulating Valve . . . Timer Check Valve . . . High Pressure Relief Valve.

Precision is *our* business—always has been—and we've pledged ourselves that any manufacturer who needs Kenyon precision parts will *get* them. More than that, if *you* need any precision part or instrument and can't obtain it, we'll *make* it for you.

In other words, when you're in a jam for precision work, *think of Kenyon.*

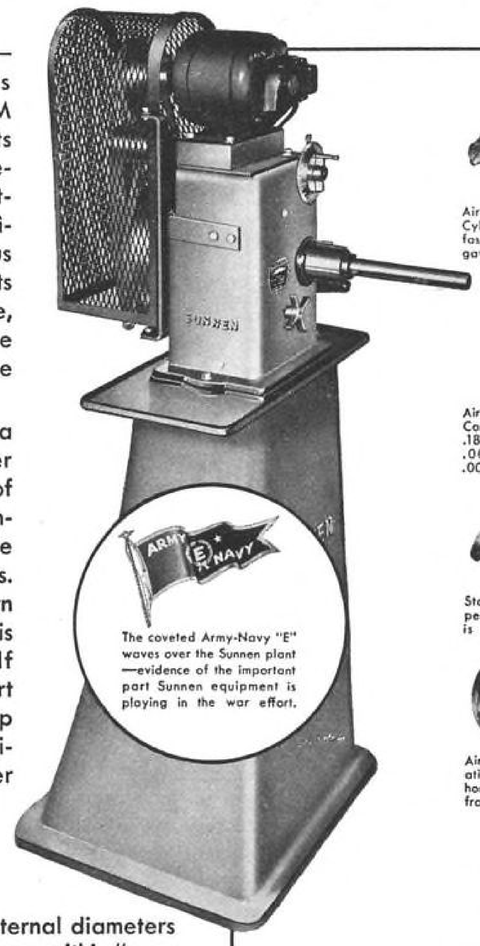
KENYON
INSTRUMENT CO., INC.
Huntington Station, L. I. • New York
If it's Kenyon-Made KENYON *It's Precision-Built*

VERY DIFFICULT INTERNAL FINISHING PROBLEM SOLVED

with the Sunnen Precision Honing Machine!

Too many scrap parts—was this manufacturer's problem. Too many 20 MM steel aircraft gun parts were being rejected because they weren't meeting the tolerance specifications. By the previous method of finishing, parts were often cut oversize, through no fault of the operator, and had to be scrapped.

A consultation with a Sunnen Service Engineer led to the installation of the Sunnen Precision Honing Machine to handle these finishing operations. In the manufacturer's own words—"This machine is going to pay for itself many times over in a short while in saving of scrap parts and time." In addition, he is getting a better surface finish.



The coveted Army-Navy "E" waves over the Sunnen plant—evidence of the important part Sunnen equipment is playing in the war effort.

Consider These Advantages

Wide range—handles internal diameters of .185" to 2.625". Accuracy within "one-tenth" guaranteed—has been held to .000025" on production jobs. Relieves big internal grinders for other jobs. Corrects errors of out-of-roundness or taper caused by previous operations. Facilitates duplication of sizes. Does not require skilled labor. Practical—inexpensive—economical to operate.

Put Sunnen Honing to work in your plant!

The coveted Army-Navy "E" waves over the Sunnen plant—evidence of the important part Sunnen Equipment is playing in the war effort.

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.

Cast Iron Valve Stem Guide. ½ to one thousandth removed—220 pieces per hour. Better finish and straighter hole.

Carbureter Idler Valve Jet. Hole is honed after reaming for smooth action.

Shell Loading Die.

Hydraulic Control Bushing. Honing gives straight round hole after rough reaming.

Aluminum Aircraft Link "produces high finish without bell-mouthing."

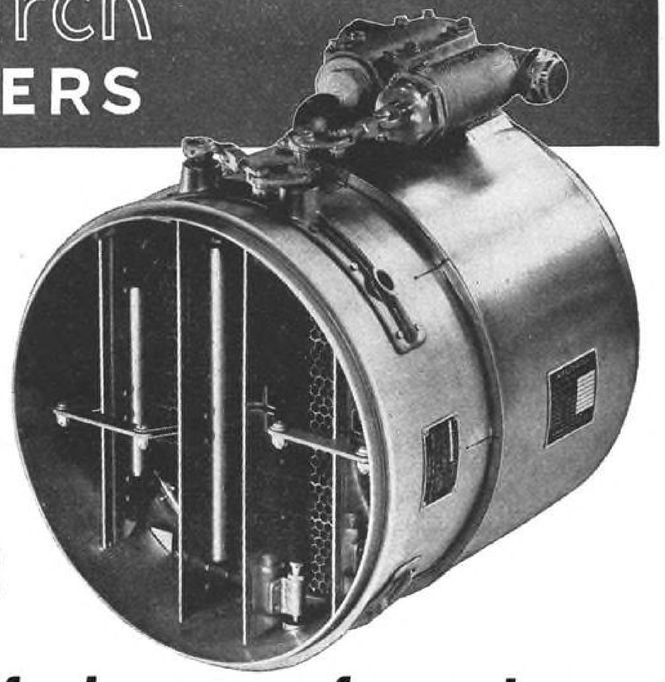
Compressor Yoke. Alignment maintained and better finish produced.

SUNNEN

SUNNEN PRODUCTS COMPANY • 7942 Manchester Avenue, St. Louis, Missouri
Canadian Factory: Chatham, Ontario

AiResearch OIL COOLERS

have



SHELLS OF BRASS,

TUBES OF COPPER

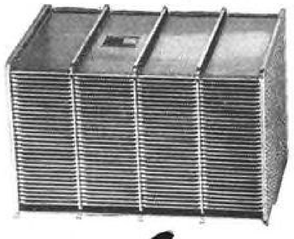
the favorite metals for heat transfer equipment

Air cooling hot motor oil to near-normal temperatures, while automatically regulating the cooling rate in whatever climate the ship must fly, is the job being done—and done well—by AiResearch's Oil Coolers. Built for all types of planes, these precision units require over 1500 individual parts—each produced of the finest material available and held to unusually close tolerances.

Copper and Brass, long known in every branch of industry for their workability, corrosion resistance and high thermal conductivity, are used extensively in these units. Washers, nuts and similar fittings are made of brass rods. Baffles, and inner and outer shells are made of sheet brass, formed and silver-brazed into cylinders. The honeycombed cores, through which the oil flows and over which the cooling air passes, are made up of 1200-odd hex-ended copper tubes, sweated to the shell and tested at 100 lb. air pressure under water at a temperature of 180°.

AiResearch's Supercharger Intercooler

Here again The American Brass Company is privileged to serve—this time through the small tube manufacturing facilities of its French Small Tube Branch—by supplying millions of aluminum alloy tubes. These tubes, partially flattened, are mechanically joined to head plates, making up the core of AiResearch's Lightweight Supercharger Intercooler which makes possible sea-level engine performance at extremely high altitudes. 43168



Well known is the fact that high altitude flying requires the use of a supercharger to compress the rarified air for efficient engine performance. Not so well known is the fact that the temperature of this compressed air is increased considerably, its density is lessened and, if fed to the carburetor without cooling, might result in engine "knock," pre-ignition, overheating and generally rough operation—hence the need for "intercoolers."

ANACONDA from mine to customer

Anaconda Copper & Brass

THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: Anaconda American Brass Ltd., *New Toronto, Ont.*



...his controls react through WHITNEY AIRCRAFT CHAINS*

These slender, responsive steel nerves translate the pilot's touch of command into power, force, or motion in many mechanisms and controls of U. S. military planes. For example, on elevator and aileron control systems, power turrets, bomb displacement gear and other sub-assemblies, Whitney Roller Chains and Sprockets have been chosen for their lightness and flexibility which give wide latitude of design to aircraft engineers. And they are chosen, too, for their strength and positive performance which give pilots the sensitive, dependable control *they have to have* over their ships.

Today, to aircraft engineers and designers, Whitney also brings the direct, personal service of the new and specialized Aviation Division . . . which focuses upon any individual problem all of Whitney's technical, engineering, and manufacturing resources. This service is at *your* service, at any time you say.

***PRODUCT OF AVIATION DIVISION of THE WHITNEY CHAIN & MFG. CO.**

HARTFORD 2, CONNECTICUT



Republic Aviation uses P-K Self-tapping Screws on several jobs to shorten assembly time

To keep the P-47's rolling down the assembly lines fast enough to meet endless demands, every fastening job must be done the quickest way consistent with security. That is why the men who designed this record-breaking fighter specified Parker-Kalon Self-tapping Screws for attaching cable clamps to the radio assembly plate and to the main structure, for attaching instruction plates, and for a number of other fastenings.

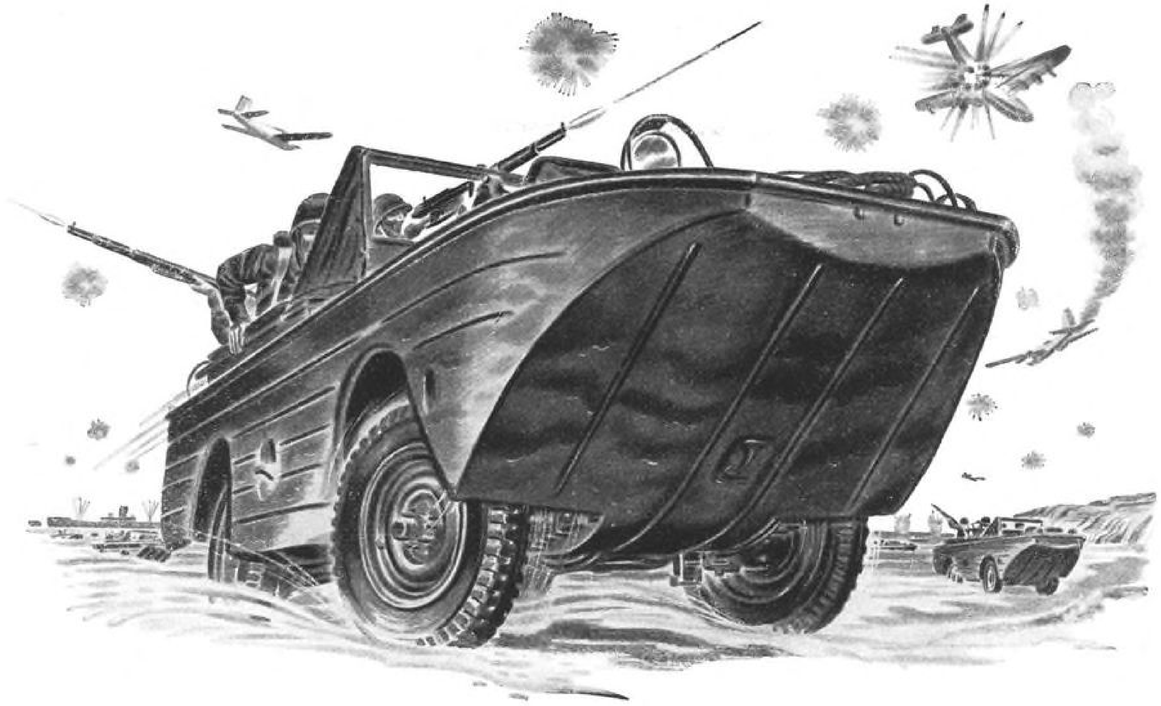
This *simplest* fastening method is used extensively by airplane manufacturers because it not only speeds up assemblies, but also provides security equal to or better than that afforded by other, more complicated fastening methods. One easy, fast operation eliminates tapping . . . ends fumbling with nuts and bolts, and placing of lock washers . . . cuts out riveting and welding in hard-to-reach places.

Question every fastening job . . . on the drafting board . . . in production. First see if it can be done the simple way – with P-K Self-tapping Screws – before putting up with slow, difficult fastening methods. Call in a P-K Assembly Engineer. He can help you with your fastening problems. And, remember, he recommends P-K Self-tapping Screws only when they will do the job better, in less time, at lower cost. If you prefer, mail a brief description of fastenings for recommendations. Parker-Kalon Corp., 192 Varick Street, New York 14, N. Y.



SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS



INDISPENSABLE ALLIES IN TIRE CONSERVATION

Schrader Valves, Cores, Caps and Gauges save rubber.

Under-inflation is the greatest single saboteur of tires! You can control it. How? 1. Use a Schrader gauge to tell proper air pressure. 2. Maintain that proper pressure by using *Schrader cores* and by seeing that *Schrader caps* are on every valve. For, it's the *CAP* that guarantees an air-tight valve. 3. Check again with the air gauge from time to time to see that proper pressure is maintained. 4. Then if extra leakage occurs, look for a tube leak.



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

ARMY E NAVY

A Brief Message from an Amphibian to . .

THE AVIATION INDUSTRY

It swims or it rides—its tire valves doubly protected by Schrader Cores and Caps. Our armed forces depend on these mighty mites, for unfailing performance for all tires from bicycles to the biggest bomber built. You can depend on them too.

DEPENDABLE

In the aviation industry Schrader valves, cores, caps and gauges are playing a vital role in tires and shock struts. Other Schrader valves used in life rafts, life vests, barrage balloons, oxygen equipment and in other important products also play their part in helping win the war! You can rely on Schrader products. You can specify them with complete confidence.

AND NOW SCHRADER AIR CONTROLS

To speed production in factories

To speed production, to increase safety and to decrease costs—compressed air is being used more than ever before for machine control, safety control and ejection methods! Write today for our catalog No. 10 showing many applications that may help your production problems.

SCHRADER PRODUCTS HELP SAVE RUBBER

Replaceable Tire Valves • Valve Cores • Air Sealing Valve Caps • Air Chucks • Valve Repair Tools • Pencil Type Gauges • Service Gauges • Airline Couplers • Vulcanizers

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

Newly Devised PRODUCTION SHORT CUTS... Provide PROMPT DELIVERY



A N 150
Turnbuckle Assembly
Fork

A N Part No.
AN150-16S
AN150-16L
AN150-32S
AN150-32L
AN150-46S
AN150-46L

A N 155
Turnbuckle
Barrel

A N Part No.
AN155-8S
AN155-16S
AN155-16L
AN155-32S
AN155-32L
AN155-46S
AN155-46L
AN155-61L
AN155-80L

A N 161
Turnbuckle Fork

U. S. ARMY AIR FORCE Part No.	A N Part No.
Air Force X43B2342-16LS	*AN161-16LS
Air Force X43B2342-16RS	**AN161-16RS
Air Force X43B2342-16LL	AN161-16LL
Air Force X43B2342-16RL	AN161-16RL
Air Force X43B2342-32LS	AN161-32LS
Air Force X43B2342-32RS	AN161-32RS
Air Force X43B2342-32LL	AN161-32LL
Air Force X43B2342-32RL	AN161-32RL
Air Force X43B2342-46LS	AN161-46LS
Air Force X43B2342-46RS	AN161-46RS
Air Force X43B2342-46LL	AN161-46LL
Air Force X43B2342-46RL	AN161-46RL

Furnished in Right and Left Hand Threads
*AN161L(S) S means Short Length — L Long Length
*AN161(L)S L means Left-Hand Thread
**AN161(R)S R means Right-Hand Thread

Reliable Effects Startling Savings in Production of "AN" Aircraft Turnbuckles

The Reliable Electric Company of Chicago, after many months of close cooperation with the Army Air Force Materials Distribution Branch, Production Engineering Department and Aircraft Laboratory, and endless experiments, have effected savings of 48% in critical material and 100% in critical machine time in the production of turnbuckle barrels, and 91% in critical material and 96% critical machine time in the production of turnbuckle forks, to provide prompt delivery of Aircraft Turnbuckles.

Value of Experiments

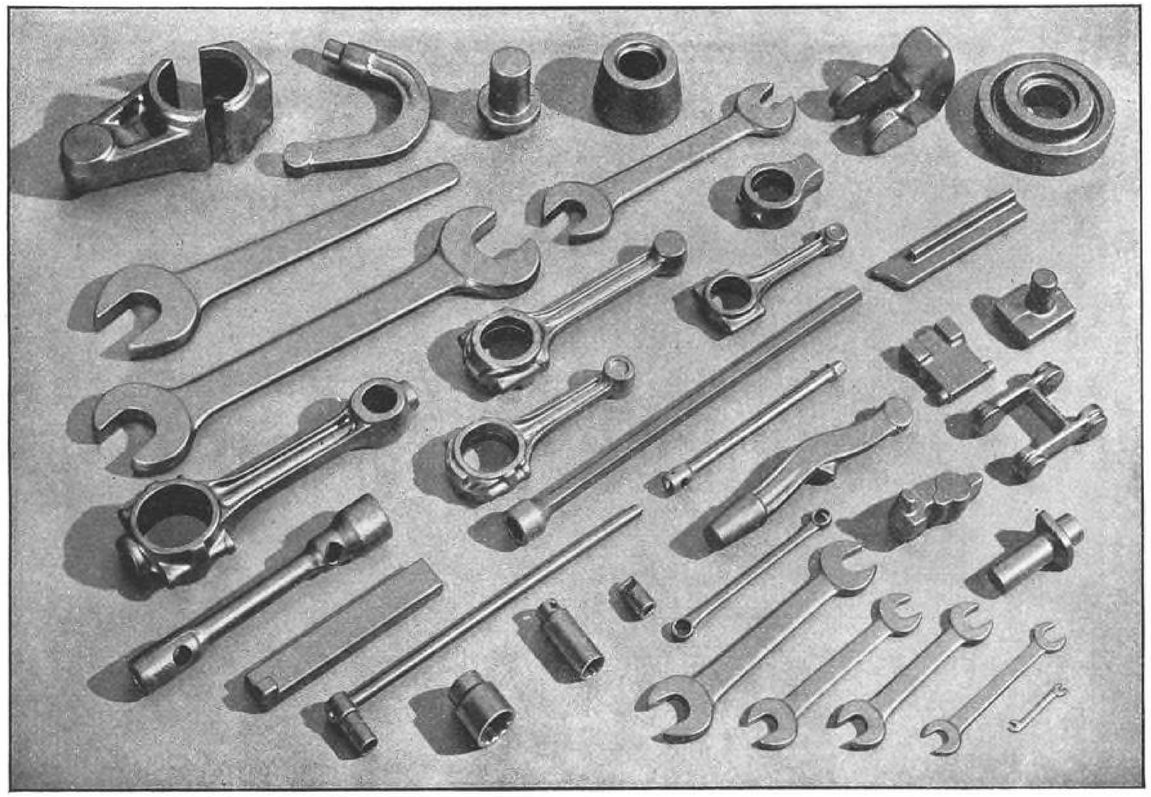
As an indication of the value of these developments, the saving on 100,000 AN150-32L Turnbuckles, which is a moderate quantity of an average size, is 60,800 lbs. of molybdenum steel and 9,100 lbs. of brass.

The bottleneck in skilled operators and critical machine tools—largely on turret lathes and multiple spindle automatic screw machines—is relieved to the extent of 22,725 hours on this quantity. This time can be devoted to the production of other critical "AN" parts by placing fork and barrel orders with Reliable.

The Reliable Electric Company normally devotes its entire capacity and laboratory to the development and manufacture of telephone and power line equipment. At present this company is applying its modern facilities in many fields with similar results to those mentioned above, from which interesting future communication and power equipment developments can be expected.

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Reliable
ELECTRIC COMPANY
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Herbrand
PRECISION FORGINGS
Upset or Drop Forged--Any Shape or Size up to 200 lbs.

You who use forgings in war production work won't have a problem of faulty forgings if the job is being done by Herbrand. Our expert hammersmiths, who have made forging their life business, maintain uniform dimensions and close tolerances producing forgings which are free from defects.

Since our organization was founded in 1881, Herbrand has never lost sight of the importance of producing quality products conforming to exacting specifications.

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



When featherweights become heavyweights

LET a nice, new, light-as-a-feather fedora soak up its share of a thundershower, and it's a featherweight no more. It seems to weigh a ton.

Exactly the same principle applies to resilient parts for aircraft. Unless the synthetic rubber used in an airplane's oil and fuel systems is inherently, completely and permanently resistant to oil-absorption, that plane eventually lugs aloft with it an impressive amount of dead-weight never included in its design.

That's why Hycar Synthetic Rubber is the preferred resilient material for oil and fuel applications in aircraft. It's light to start with (15 to 25% lighter than many other synthetics) and its superb resistance to oil-absorption keeps it light.

Check these Hycar qualities:

Oil-swell that can be controlled to insure dimensional stability.

Operating range from —65°F. to 250°F.

Abrasion-resistance 50% in excess of natural rubber.

Excellent compression-set characteristics.

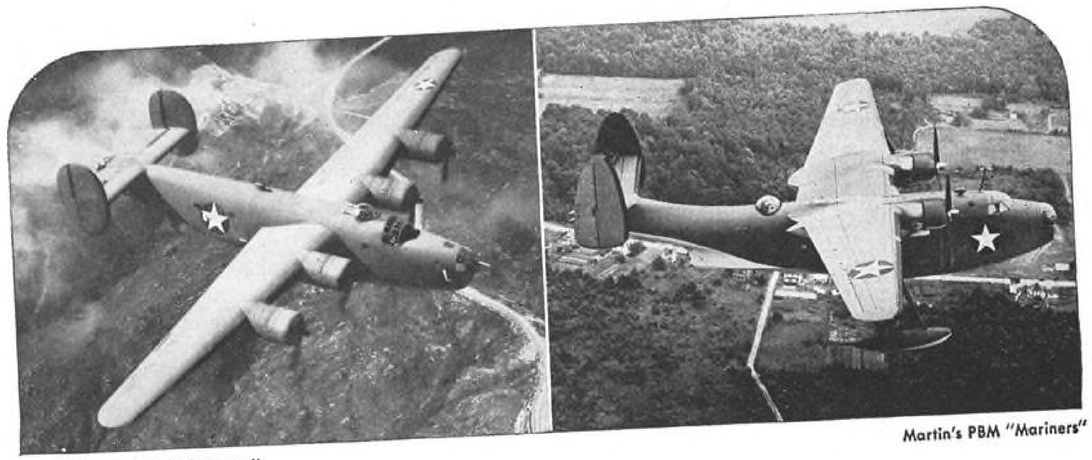
These are the qualities you want in oil and fuel hose, hydraulic systems, seals, gaskets, grommets, diaphragms and other resilient products you use. *Hycar Chemical Company, Akron 8, Ohio.*

LIMITED QUANTITIES OF HYCAR are now available to your supplier of rubber products, for experimental purposes only, without WPB allocations. This material may be used in the development and test of products for both present and future use. It enables you now to gain actual experience with Hycar in many applications which may be vitally important to your current and postwar plans. Our technical staff and laboratory are ready to help.

Hycar

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubber



Consolidated's B-24 "Liberators"

Martin's PBM "Mariners"

Clarke-Aero

Hydraulic Gun Turret Control Valves

★ Smooth, Positive Control

★ Ease of Adjustment

★ Definite Feel



THESE qualities as found in the Clarke Aero-Hydraulic Gun Turret Control Valve account for the effective fire power obtained in turrets using the Clarke Valve. The design of the valve is such that it affords maximum flexibility as to mounting position, length of column and style of grips.

This flexibility of design makes the valve adaptable to a wide variety of turret installations.





Adaptable: Fits wide variety of turrets.

CLARKE AERO-HYDRAULICS, INC.

PASADENA · CALIFORNIA

CLARKE AERO-HYDRAULICS

Ready for action!



Like a pilot's oxygen tank at 30,000 feet—the man in the cockpit depends on the filters protecting his engine against dust, to keep the heart of his ship ticking smoothly and powerfully.

AAF engine intake filters keep 'em flying on every United Nations front line air field—maintaining maximum efficiency and engine performance—and thereby saving pilots' lives.

Complete engineering and performance data is available. Please write us—there is no obligation.

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BONDS

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AMERICAN AAF AIR FILTERS **AIRPLANE ENGINE FILTERS**

KEEP UNITED NATIONS PLANES FLYING LONGER

With the proper Gulf Cutting Oil

Plant steps up production 100%

in drilling and reaming

tracer cavity in 57mm. shot

Tool life greatly increased — finish substantially improved - - -

Another war plant steps up production through improved machine tool performance—thanks to the proper Gulf Cutting Oil, as recommended by a Gulf Service Engineer.

THE PROBLEM: Drilling and reaming the tracer cavity in 57 mm. armor-piercing shot, using soluble oil. Getting over 50% rejections, tool life 200 pieces. Rejections extremely costly, since these were final machining operations.

THE SOLUTION: Proper Gulf Cutting Oil put in service. No other changes in machining practice.

RESULT: Rejections entirely eliminated, representing a 100% increase in production, tool life increased 1,000%, finish substantially improved.

It will pay you to investigate Gulf Cutting Oils—call in a Gulf Service Engineer now and ask him how they can help *you* improve finish and increase production and tool life. For your copy of the booklet on Gulf Cutting Oils—which includes a helpful 45-page machining guide—send the coupon below.

GULF OIL CORPORATION · GULF REFINING COMPANY

Tools are weapons
Treat 'em right!

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation—Gulf Refining Company A
3800 Gulf Building, Pittsburgh, Pa.

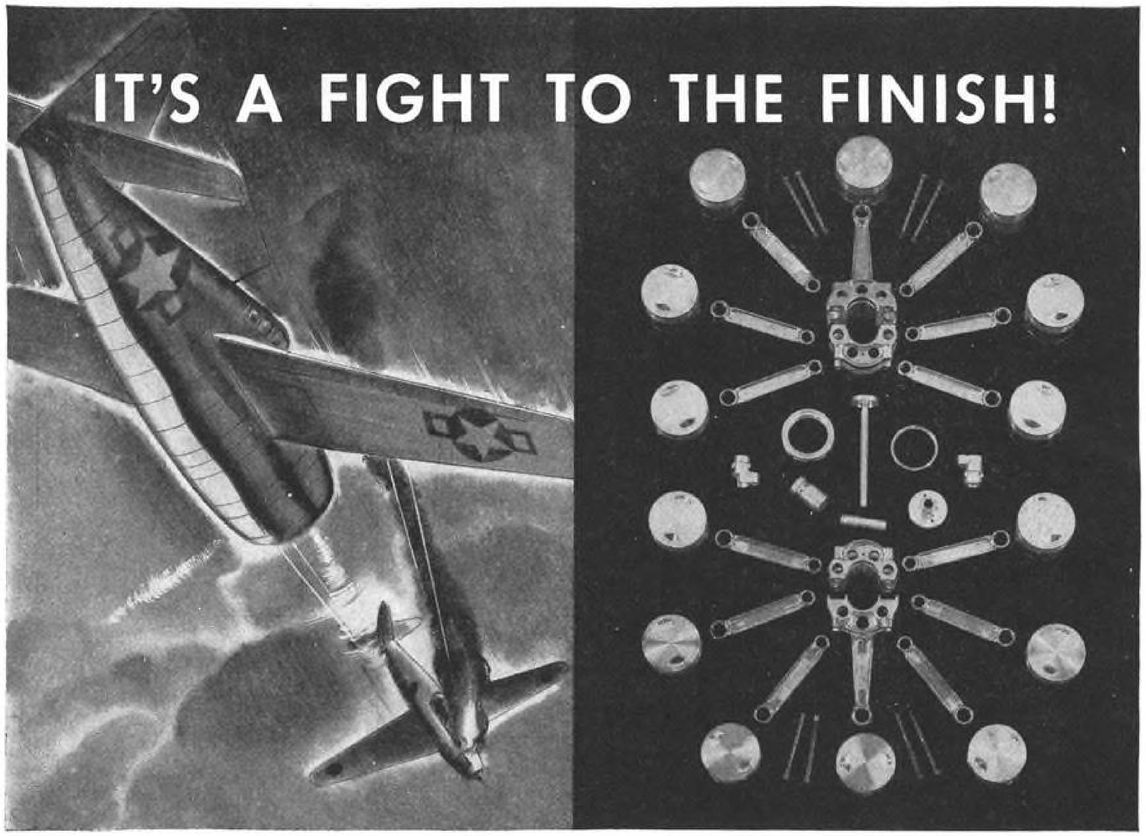
Please send me, without obligation, a copy of the new revised booklet, "Gulf Cutting Oils," which includes a helpful Machining Guide.

Name.....

Company.....

Title.....

Address.....



WHEN a Hellcat pilot eases up on the bridle of the 2000 horsepower packed into his Pratt-Whitney engine and goes tearing away to administer a dose of sudden death to some little stinking son of a Sinking Sun, a small matter like the coefficient of friction between operating parts of that engine becomes enormously important.

Not many months ago this coefficient of friction, between parts whose tolerances had to be held to within thousandths of an inch, was a limiting factor in the maximum performance of our most advanced high-output aircraft engines. It wasn't that modern finishing methods and materials couldn't produce the mirror-like finishes required—on the contrary the finishes obtained were so perfect that they had no affinity for the engine lubricant—in short, those mirror surfaces shed engine oil like water rolls off a duck's back. The inevitable result was excessive friction heat—a condition that spelled TROUBLE in capital letters.

Licking this problem was no cinch—mirror-like finishes had to be maintained but certain profilometer requirements also had to be met. This meant developing a buffing composition that not only polished but also engrained the metal surfaces with millions of microscopic channels which would retain enough lubricating oil under every operating condition, to provide a protective oil film on every vital part. A McAleer *tailored-to-the-job* greaseless type composition was the answer—a composition of such dependable uniformity and exceptionally controlled abrasive diffusion, that it met every prescribed Micron finish requirement demanded by Aircraft Specifications.

This need for perfection is nothing new to McAleer. We are well aware that this is a fight to the finish . . . even to the "finish" of a vital aircraft engine part. Because *quality-controlled* finishing materials are the products—not the sideline of McAleer, this company is qualified by years of practical experience and unusual abilities to aid you in solving your most vital finishing problems. Whether they involve metals, plastics, or both, let us *start at the finish.*



McAleer MANUFACTURING CO.

Manufacturers of Quality-Controlled Finishing Materials, Military Aircraft Sub-assemblies and Pyrotechnics . . .

ROCHESTER, MICHIGAN

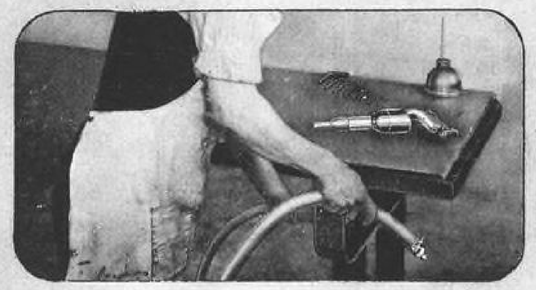
Clean, Dry Air— Regular Lubrication—



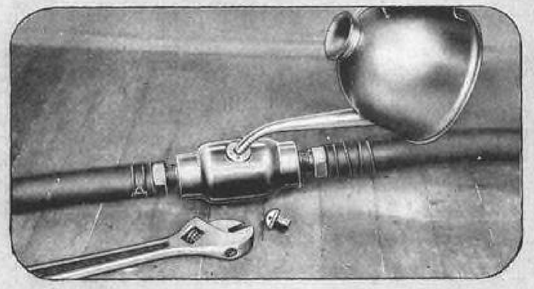
HELP TO KEEP AERO RIVETERS ON THE LINE

KEEP these simple facts in mind: air lines inevitably pick up dirt and moisture during shutdowns; regular lubrication is essential to best performance of any hand tool. Blow your air lines free of moisture before starting work . . . keep your riveters lubricated . . . give them a good general cleaning at regular intervals . . . and CP Aero Riveters will give the continuous service for which they are designed and built.

HOW TO GET MAXIMUM SERVICE FROM YOUR CP AERO RIVETERS



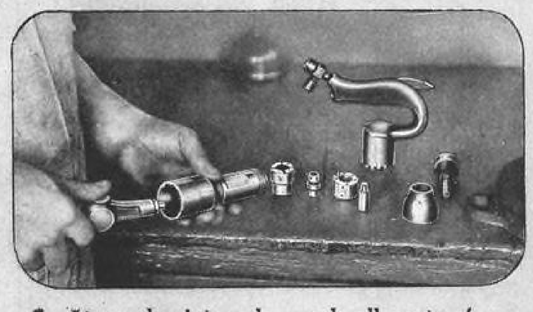
1 Before attaching hose, always blow out the air line to clear it of moisture and dirt.



2 If line oilers are used, check them at regular intervals, fill with right grade of oil.



3 If line oilers are not used, put a few drops of oil in handle of tool every two hours.



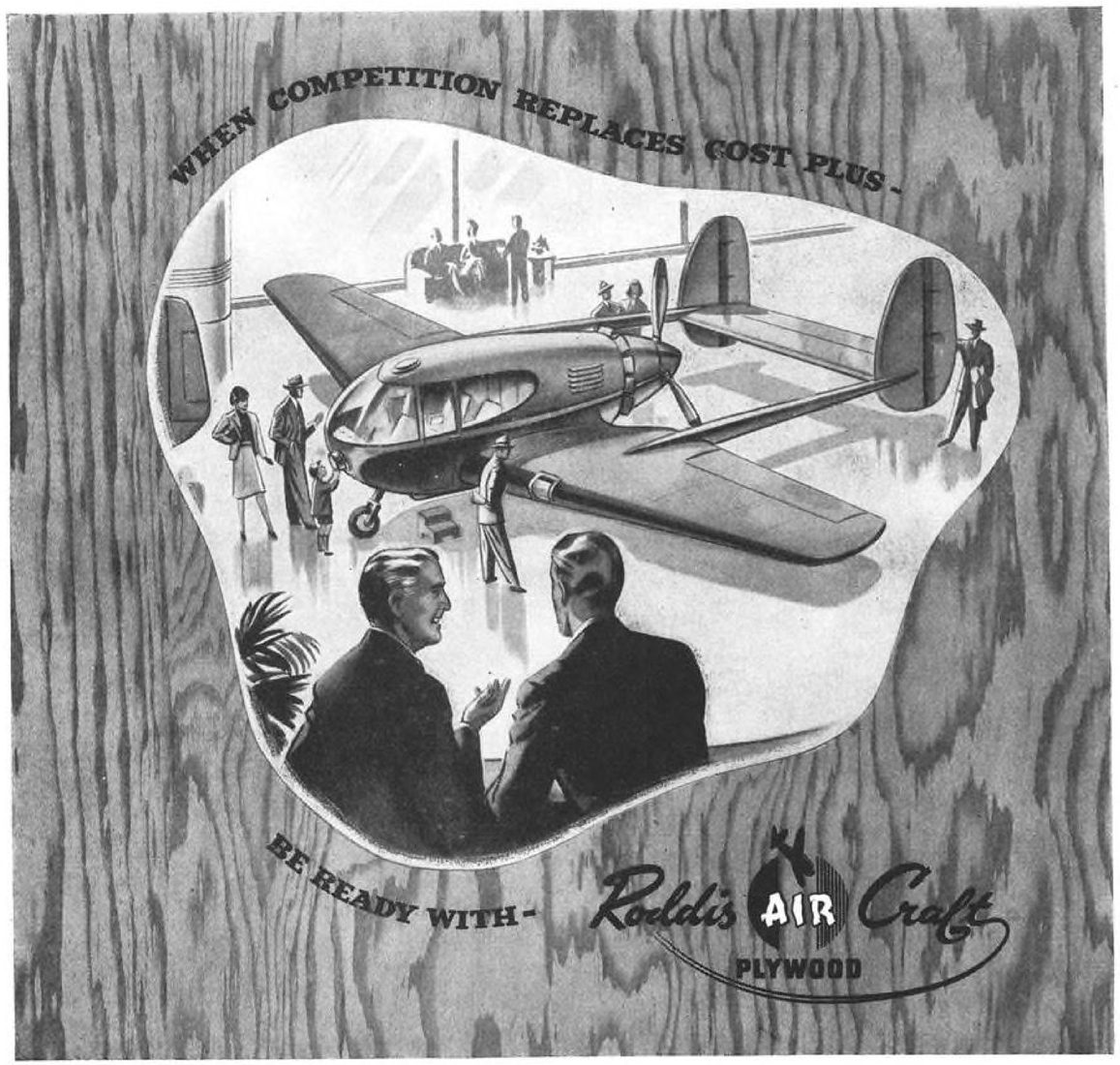
4 At regular intervals, wash all parts of riveter in kerosene, dry with air hose.

★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
(Hicycle...Universal)
ROCK DRILLS

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York, N.Y.

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AIR COMPRESSORS
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As we edge into the age of flight after Victory, civilian aircraft sales will depend on low first cost—light weight—economy of operation — safety.

That's why plywood planes are important to your postwar plans. And why you should get acquainted with Roddis Aircraft Plywood and Roddis men Now.

The testimonials to back up tomorrow's sales story are being written today by rugged combat planes and gliders made of Roddis Aircraft Plywood—slugging it out with the enemy. Yes — ask the men who fly them as well as the men who build them, how Roddis rates in the aircraft plywood industry.

Roddis men who have assisted many plane manufacturers to successfully apply Roddis aircraft plywood to combat designs are available for consultation regarding post war planes. They are stationed at our warehouses shown at the right. We suggest you get acquainted with them now.

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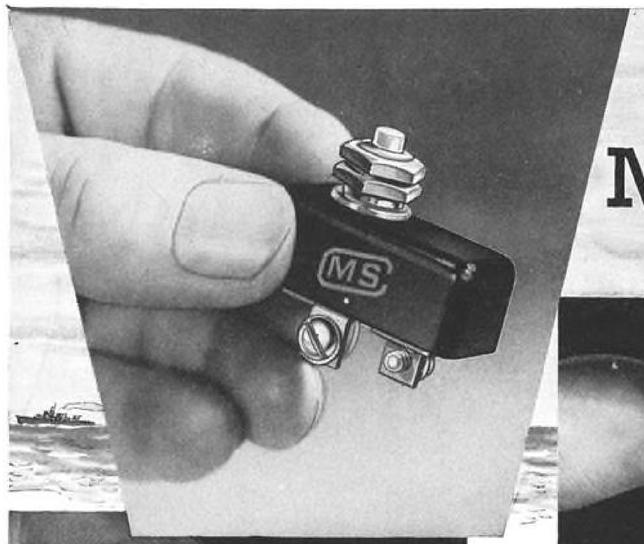
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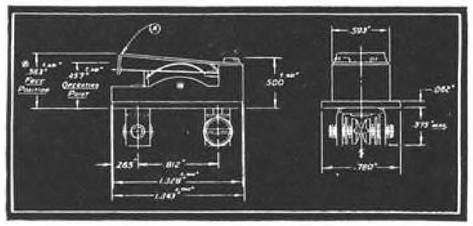
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1204 W. Ormsby Ave., Louisville, Ky.



a smaller, lighter, Micro Switch







...that is meeting high favor with Aircraft Engineers

Designed for post-war use, the Peanut Micro Switch so filled the bill for a number of military aircraft requirements that we are now making them in large scale production.

This diminutive switch is smaller than the basic Micro Switch, is very robust, highly resistant to vibration, is lighter in weight and lower in cost.

The Peanut Micro Switch is so designed that it can be used without an enclosing case, allowing the actuating movement to be applied anywhere over a large portion of the upper spring. Used with a Bakelite case, a convenient stem mounting is provided. The construction allows inherent overtravel beyond the point of operation sufficient for most uses.

The Peanut Micro Switch, encased in Bakelite housing, weighs .048 lb. This switch resists vibration and acceleration up to 300 times gravity. Operating force is 33 ounces maximum and the movement differential is 0.040" maximum.

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"Facts-in-Figures" on Production MEAN MORE BOMBERS OVER BERLIN AND TOKYO

Under the co-ordinated rhythm of Control-by-Count, plane parts flow together punctually into final assembly, from all different production departments and sub-contractors . . . where Veeder-Root Counting Devices are attached to each production machine.

For these devices help to keep production lines booming along in step . . . by publishing plain black-and-white figures that show up any tendency to fall behind, so that corrective measures can be taken immediately, before serious harm is done. And this means that delays are avoided . . . production speeded from all quarters . . . which adds up to more planes off the line and in the air over the enemy, day by day, until the war is won. *You* can get Veeder-Root Counting Devices . . . mechanically or electrically operated . . . to furnish facts-in-figures on all your production machines and processes. Whatever it is you have to count, you can count on us to count it.



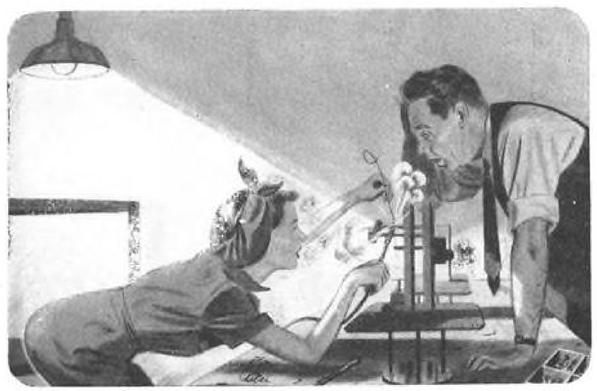
Key-Reset Revolution or Direct-Drive Counter

Veeder-Root Incorporated

HARTFORD, CONNECTICUT



1 **"Listen,"** I said, "*I* know they don't make left-handed monkey wrenches or left-handed soldering irons! They didn't make *me* left-handed either. But the way you have this light fixed, I've got to either use my left hand or work in my own shadow!"



2 **"Hmmm!"** hmms the foreman. "Maybe you got something!" He calls the superintendent, and the first thing I knew the electrician had moved a couple of light fixtures. And what a difference! Next day they were checking up on the lights all over the place. I think I deserve a medal—or something!



3 **Simple changes** like this have speeded production and improved morale in many a war plant. Changes that eliminate *glare* or *shadows*—or *gloom* from dust and grease on lighting equipment, walls and ceilings. For lighting help, call your local electric service company, your G-E lamp supplier or your nearest G-E Lamp Office.

GENERAL ELECTRIC LAMP RESEARCH is responsible for much of the good lighting that is speeding war production today. The never-ending goal of that great research organization is to make General Electric lamps *stay brighter longer.*

MADE TO STAY BRIGHTER LONGER

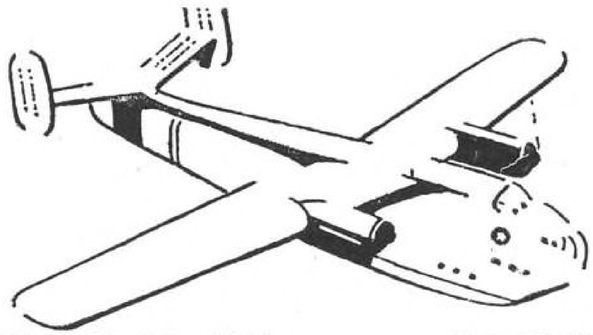


THE BEST INVESTMENT IN THE WORLD IS IN THIS COUNTRY'S FUTURE...BUY WAR BONDS

G-E MAZDA LAMPS

GENERAL ELECTRIC

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.

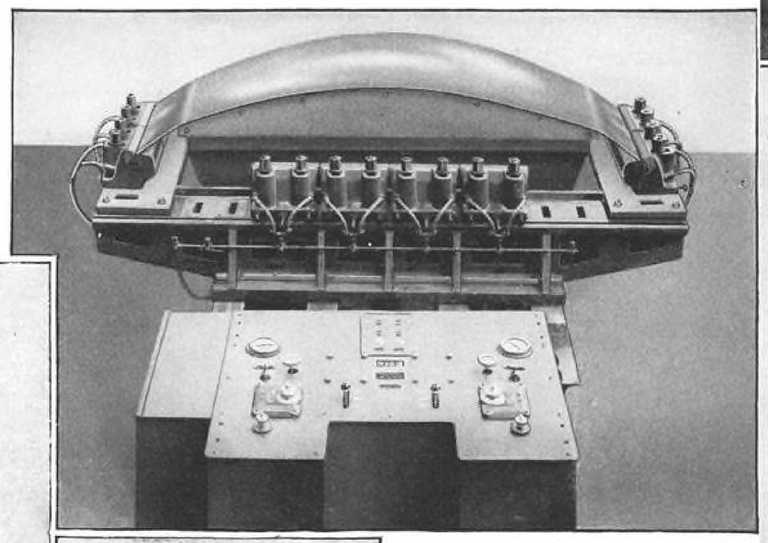


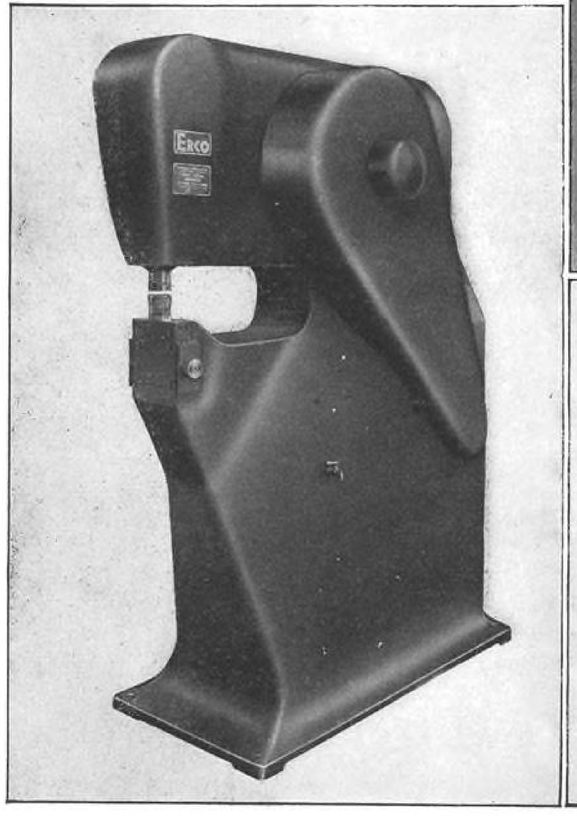
ARMY E NAVY

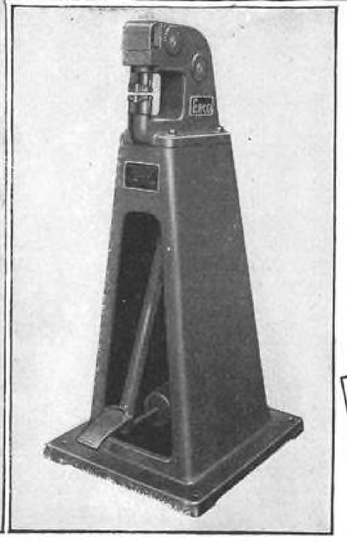
WORK...WELL DONE

When time and low cost count, performance proves that ERCO products do it better and faster.

ERCO Two-way Hydraulic Stretching Presses: (*Right*) Preferred for their stability and universal application to a large variety of forming work, either across or lengthwise of platen without changing the position of platen. Available in 75, 150 and 300 ton capacities.



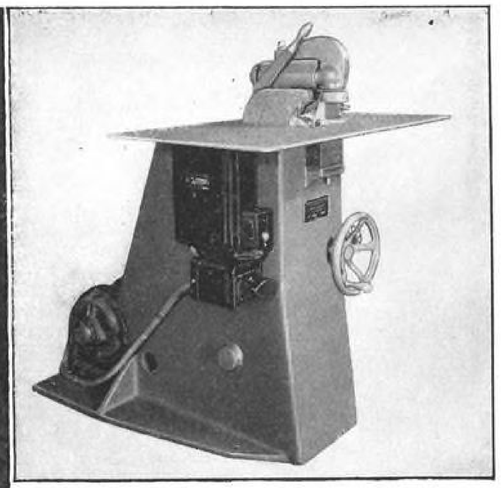




ERCO Shrinkers and Stretchers: Indispensible for removing wrinkles and forming sheet metal angles, etc. without expensive die equipment. Made in both power and foot operated models. They're pictured at the left. The foot pedal model is near left—the power model is far left.

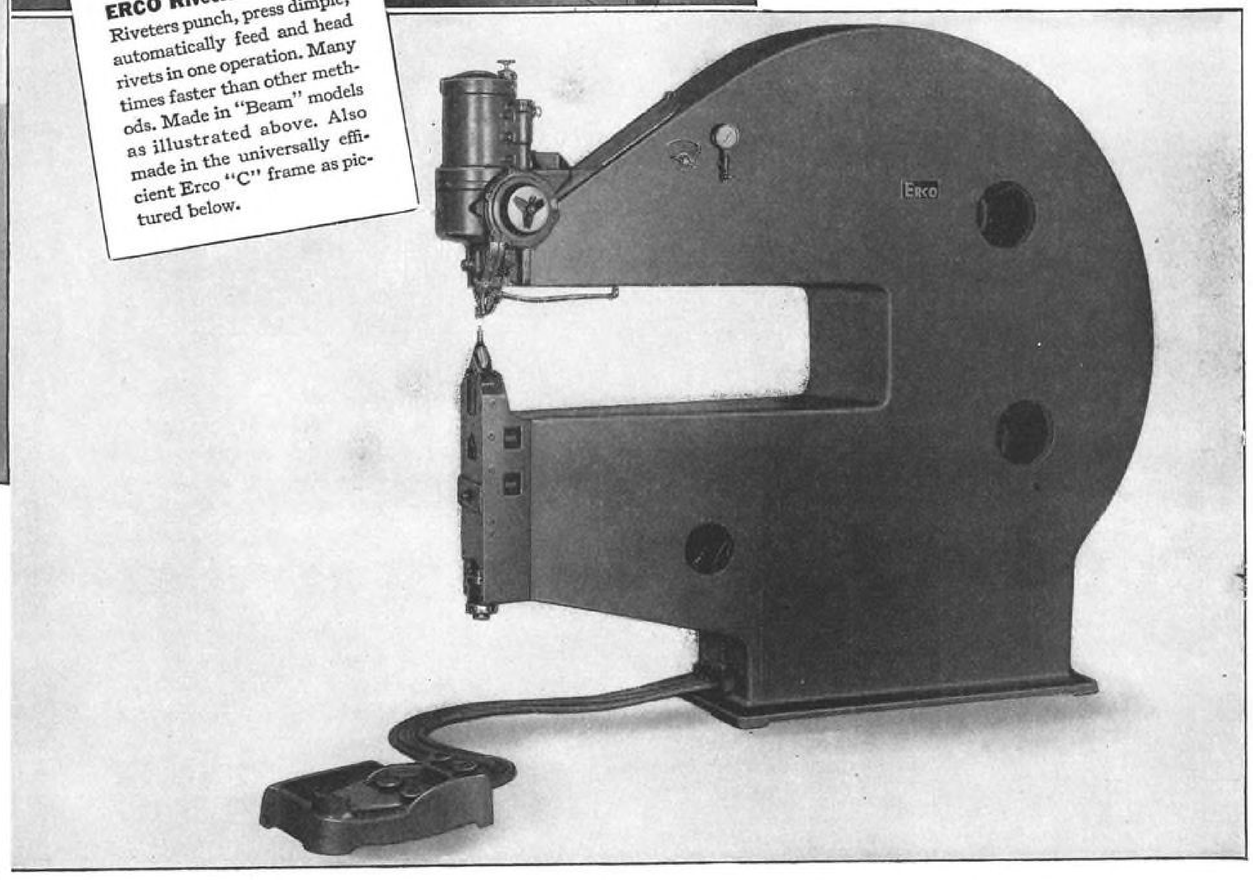
ERCO





ERCO Sheet Metal Formers: (*Above*) Internal and external flanging, return bend and wiring work on flat, curved and irregular shapes in all kinds of sheet metal.

ERCO Riveters: Only Erco Riveters punch, press dimple, automatically feed and head rivets in one operation. Many times faster than other methods. Made in "Beam" models as illustrated above. Also made in the universally efficient Erco "C" frame as pictured below.



ENGINEERING & RESEARCH CORP.

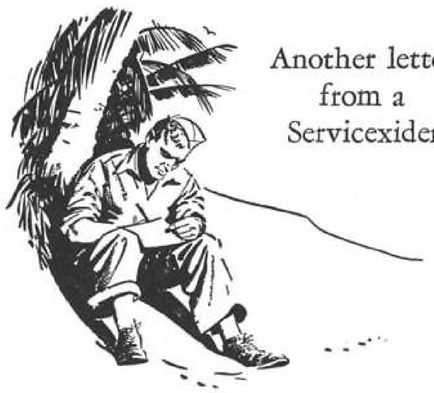
MAIN OFFICE AND PLANT
RIVERDALE, MD.

WEST COAST OFFICE
LOS ANGELES, CAL.



This photograph was taken somewhere behind the Allied lines in 1917

Exides have been flying since 1917



Another letter from a Servicexider

We get a lot of letters from the 1200 former Exide workers now serving Uncle Sam. Here's one from a boy in the South Pacific. We're proud to reprint it in part:

"They say, 'Join the Navy and see the world.' I think I've been seeing my share in the Army. The Navy dumped me off down here in the Southwest Pacific. From now on, being in the Air Force, I hope they take care of me. Am safe and sound, but it is plenty warm here, even though it is the winter season. Also getting my share of cocoanuts and native oranges. I expect to hop off of this island some time—then I suppose I will really go to work. When I move I expect to do the work which I went to school for. I suppose you are still busy around Exide; those batteries are all over this island, and I hope the boys have sense enough to 'Keep 'em Rolling' so they can get more here where they are really used to the utmost."

America's first real fighting planes, the ones that flew and fought back in 1917, were equipped with dependable Exide Batteries. Then, as now, Exides were recognized for superior performance under any and all flying conditions.

Today, rugged Exide Aircraft Batteries are found in almost every type of combat and noncombat planes. Today's Exide Aircraft Battery is even a better battery than the one which gave such excellent service in World War I. Exide's research engineers have studied every problem that faces an aviation battery and developed a product to meet demands. The men who fly America's planes will seldom see the battery itself, but the boys in the ground crews can tell them about Exides.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

ARMY E NAVY

Exide
AIRCRAFT
BATTERIES

IN THE AIR SINCE 1917

"Let's pour the work on, chum—can't let her beat us everyday!"



. . . but it's hard to beat *any* worker who drives AMERICAN PHILLIPS SCREWS

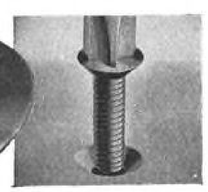
It's a fact . . . men have no easy time keeping their production ahead of women workers who have come in . . . *green* . . . and been broken into screw-driving assembly work with American Phillips Screws. For with American Phillips Screws there is no longer the forbidding differential in strength and skill between men and women . . . this modern method of screw driving is a common denominator that lifts the ability of the "weaker sex" to the productive level of the "stronger sex". And here's why:

All there is to do with American Phillips Screws is: (1) insert the Phillips driver in the Phillips Recessed Screw head. (2) Aim the driver with one hand and hold the work with the other. (3) Screw is automatically driven up straight and flush . . . without any effort to keep it straight. There's no premium on skill and strength, as with slotted screws. And the result: Production is increased as much as *twice* where American Phillips Screws are used. And there are no scarred hands, no scarred work, no broken screw heads . . . because the Phillips driver *can't slip out.*

In addition, there are other advantages to the use of American Phillips Screws which come from the name American: Full Value, guaranteed by self-checking count and individual inspection. American Engineering, that gives you expert help on special fastening problems. And American Service, that gives reasonably prompt delivery even in war time.

AMERICAN SCREW COMPANY
PROVIDENCE, RHODE ISLAND
Chicago: 589 E. Illinois Street *Detroit:* 5-267 General Motors Building





1. Fast Starting—Driver point automatically centers in the recess. fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.



2. Faster Driving—Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)



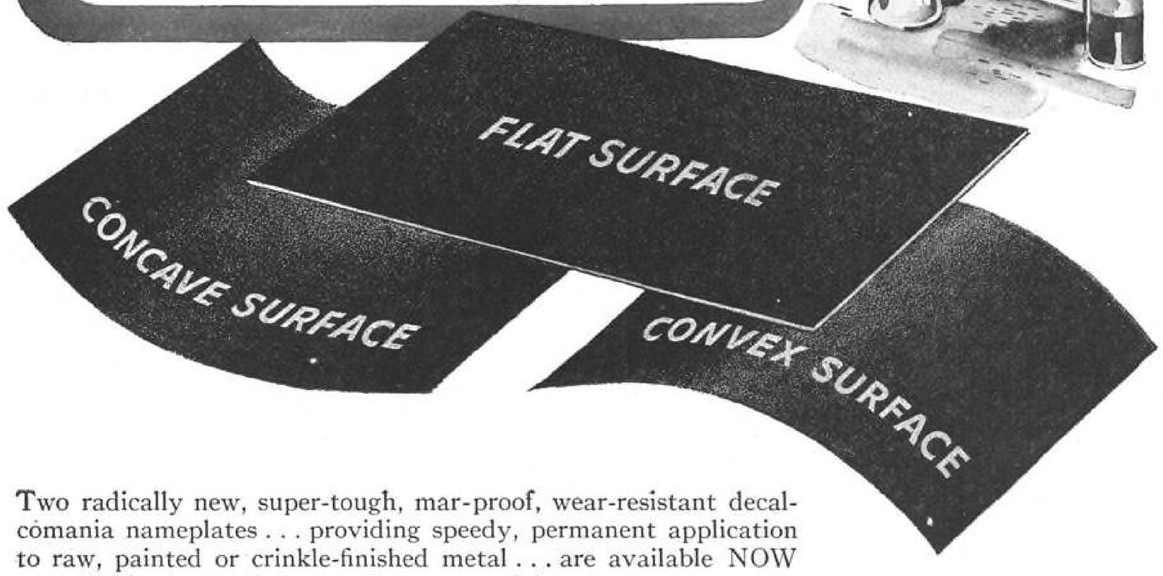
3. Better Fastenings—Screws are set up uniformly tight, without burring or breaking heads. A stronger, neater job results and there are no gouges on work-surface.

New! Durable! Different!

MEYERCORD "MAR-PROOF" DECALS

SOLVE NAMEPLATE IDENTIFICATION ON CRINKLE, PAINTED OR PLASTIC SURFACES FOR WAR USES





Two radically new, super-tough, mar-proof, wear-resistant decalcomania nameplates . . . providing speedy, permanent application to raw, painted or crinkle-finished metal . . . are available NOW to authorized manufacturers of war material.

Developed for war use in the laboratory of The Meyercord Co., the new transfers not only save time, money, weight and critical nameplate metals but eliminate rivets, bolts and screws and avoids sharp, protruding edges. Usable on flat, convex or concave surfaces. Both types have withstood rigid tests for abrasion, extremes of heat and cold, immersion, salt spray and humidity. Offered in a wide range of colors, Type C is an open letter design and Type G a background transfer design. If you have a tough identification problem — investigate "mar-proof" Meyercord Decal nameplates for efficiency at low cost. Address Department 512.

Investigate Meyercord's complete line of Decalcomania nameplates, trademarks, serial numbers, patent data, operation instructions, dial faces, panels, etc. Available in any color or size.

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50th Anniversary 1943 DECALS SAVE METAL



GOING PLACES

KLIXON AIRCRAFT CIRCUIT BREAKERS

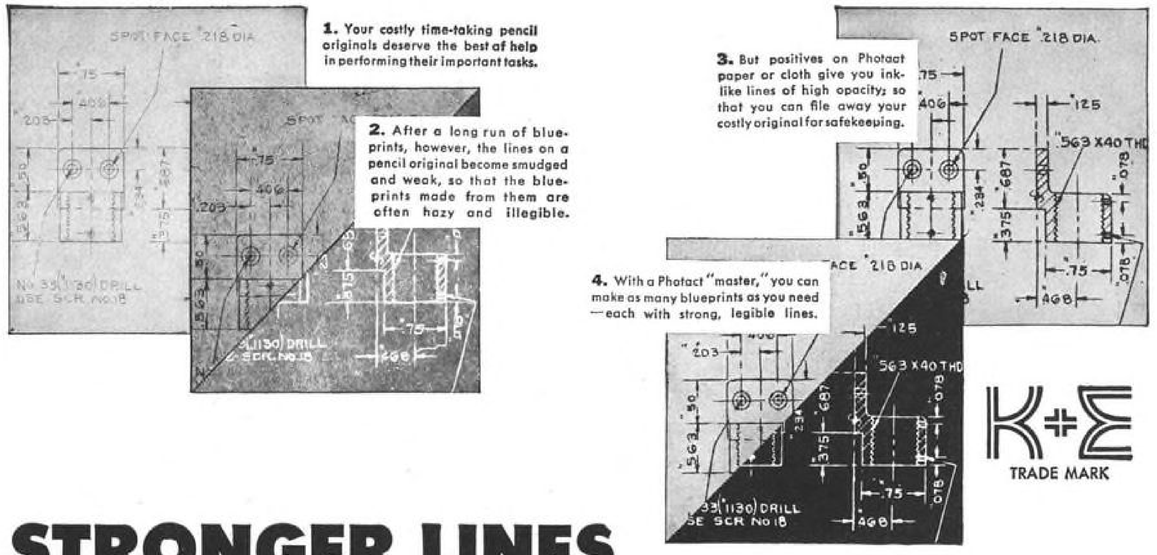
Into the deadly Brewster Dive Bombers go Klixon Circuit Breakers . . . a tough assignment. Life in a dive bomber is no push-over for any piece of equipment. Yet these Klixon Protectors are able to take it with plenty to spare. The reason . . . there's nothing delicate about these compact, light-weight Klixon Protectors. They contain no fussy parts. They're not affected by shock or vibration. And they perform accurately and efficiently in all ranges of altitude.

Yes, Klixon Aircraft Circuit Breakers, of all types . . . switch, push button, indicating, remote and others . . . are really going places. You'll find them in bombers, fighters, interceptors, trainers and transports . . . everywhere our Air Forces go.

Bulletins, containing sizes, weights and performance characteristics of Klixon Aircraft Circuit Breakers are available. Write, specifying your requirements.

KLIXON

SPENCER THERMOSTAT COMPANY
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STRONGER LINES

IN BLUEPRINTS

from pencil originals

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But pencil drawings, with all their advantages of speed and ease of correction, have a low opacity of line—and a tendency to smudge under frequent handling. As a result, blueprints from pencil originals generally do not have sufficiently strong lines for quick legibility.

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SINCE 1928 *Aviation*'s Associate Editor Jack Foster has been in aviation as pilot, mechanic, traffic agent, counsellor and journalist.



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EDITORIAL ASSISTANT is no new post for experienced journalist Barbara Frederick of *Aviation News,* one-time Editor of AWVS Bulletin.



FINANCIAL EDITOR Ray Hoadley, 17 years in reporting and interpreting the financial news and trends of aviation for leading news media.



ASSOC. EDITOR Oscar Leiding of *Air Transport,* 15 yrs. in aero-writing. As A.P. Aviation Ed., observed Europe's air preparation for war.



TECHNICAL & SCIENCE EDITOR Geo. Herrick of *Air Transport.* His work has appeared in 60 publications in 25 yrs. of technical journalism.



ASSISTANT EDITOR Jos. Riseley of *Air Transport.* Broad background as managing editor, aviation writer and aviation radio specialist.



ASSISTANT EDITOR Pauline Fortune, skilled writer, maps ever-increasing importance of women in air transport, as workers, as passengers.



Now... Burndy HYDENT CONNECTORS for Aluminum

AIRCRAFT WIRING

● Connecting aluminum to aluminum? Or aluminum to copper? Burndy licked these connector problems for the utility industry years ago . . . and now offers a complete line of HYDENT connectors for all aluminum aircraft wire and cable sizes. These HYDENT connectors are all treated by a special *Burndy process which insures minimum contact resistance and maximum resistance to corrosion. They are available, in the smaller sizes, with insulation grips for added protection.

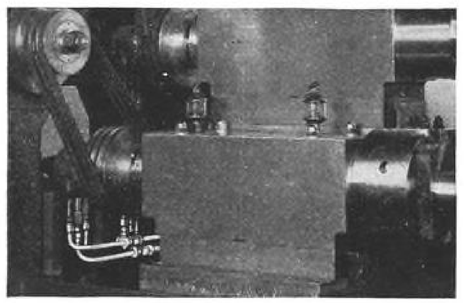
**A special contact surface treatment is essential for maximum conductivity and corrosion resistance. The Burndy treatment has been tested and thoroughly proved, throughout the years.*

Headquarters for CONNECTORS

Burndy

BURNDY ENGINEERING CO., INC.
107 EASTERN BOULEVARD, NEW YORK 54, N. Y.





–for the Production Front

Many machine tools today are equipped with hydraulic controls and hydraulic feeds. Hydraulic oil pressure drives their tables as positively as it swings battleship turrets, as precisely as it adjusts laboratory apparatus.

Seamless steel tubing provides the necessary pressure lines for an ever increasing number of these machine tools.

From Michigan Seamless Tube Company, manufacturers of machine tools can obtain recommendations based on long experience in making pressure tubing, both for peacetime needs and for the war effort.

WHAT DO YOU WANT TO KNOW ABOUT TUBING?

In addition to original development work on pressure tubing, the Laboratory of the Michigan Seamless Tube Company is constantly engaged in studies of specific tubing problems. Ask for suggestions. If necessary, the Laboratory will conduct special studies to supply the information you need.

BACK THE ATTACK ★ ★ BUY WAR BONDS

MICHIGAN TUBING

MICHIGAN SEAMLESS TUBE COMPANY
SOUTH LYON • MICHIGAN

ARMY E ★ NAVY
Awarded Feb. 12, 1943
First Star Sept. 9, 1943



DOING TODAY'S JOB, AND

Ready for Tomorrow's

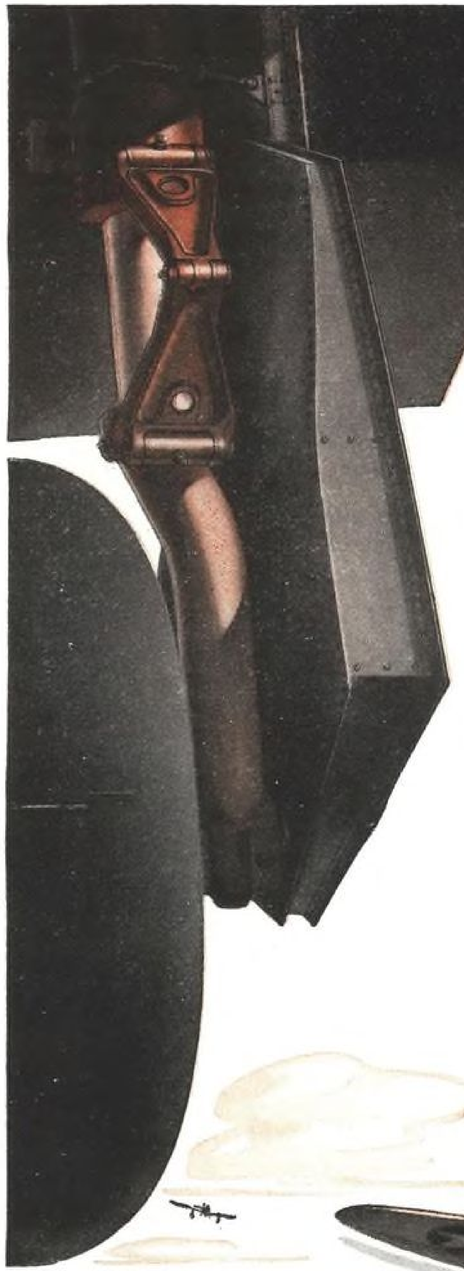
How well you know the importance—the absolute necessity—for *trained* men and women in meeting today's wartime assignments. How well you know, too, that *trained* men and women will be a vital factor in Aviation's vast program of peacetime expansion.

Here, at Embry-Riddle, we're training men and women in practically every phase of Aviation, according to their interests and adaptability. We're trying to develop the kind of people that can grow with the future—the kind that may well be an asset to you and your organization in the days ahead.

May we send you a "get acquainted" booklet which takes you behind the scenes of our School? Once you've seen it, we think you'll be a bit prejudiced in favor of the man or woman who says, "I trained at Embry-Riddle." Write us for your copy. Dept. 28

Embry Riddle
SCHOOL OF AVIATION
Miami 30, Florida

Contractors To: U.S. ARMY AIR FORCES • CIVIL AERONAUTICS ADMINISTRATION • ROYAL AIR FORCE



"Thunderbolts" land lightly on AEROLS*

Now playing a vital role in the European theater of war, Republic's P-47 "Thunderbolts" are considered the fastest high altitude fighters in the skies. Their "ground performance" is equally superb—for Aerols enable "Thunderbolts" to make swift, sure take-offs and soft, cushioned landings.

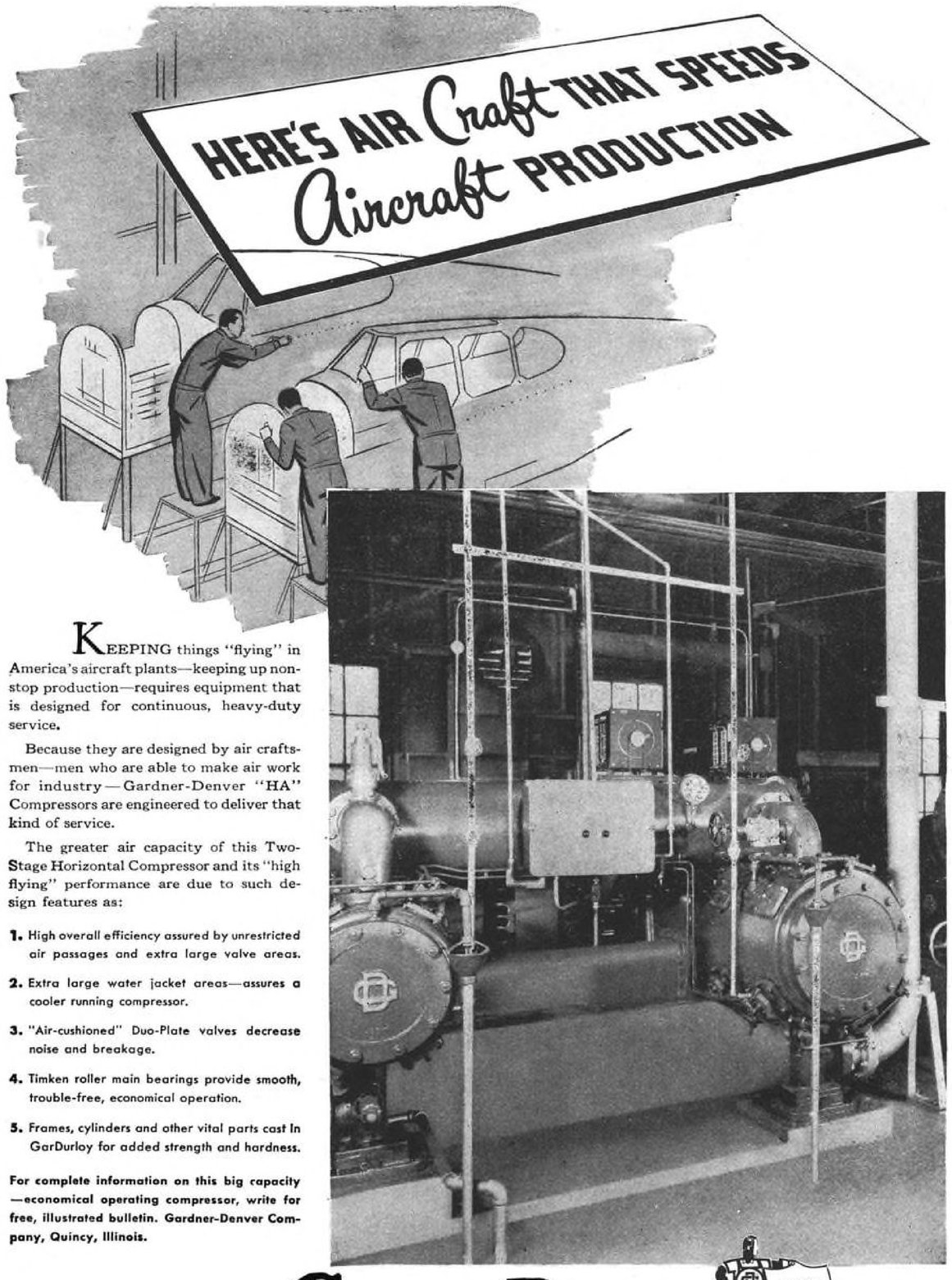
Aerols for "Thunderbolts" and many other great airplanes are now being produced on a mass production basis at our new plant, the largest in the world solely devoted to the manufacture of this important aviation product.

CLEVELAND PNEUMATIC AEROL, Inc.
Wholly owned subsidiary of The Cleveland Pneumatic Tool Company
EUCLID 17, OHIO



AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS



KEEPING things "flying" in America's aircraft plants—keeping up non-stop production—requires equipment that is designed for continuous, heavy-duty service.

Because they are designed by air craftsmen—men who are able to make air work for industry—Gardner-Denver "HA" Compressors are engineered to deliver that kind of service.

The greater air capacity of this Two-Stage Horizontal Compressor and its "high flying" performance are due to such design features as:

1. High overall efficiency assured by unrestricted air passages and extra large valve areas.
2. Extra large water jacket areas—assures a cooler running compressor.
3. "Air-cushioned" Duo-Plate valves decrease noise and breakage.
4. Timken roller main bearings provide smooth, trouble-free, economical operation.
5. Frames, cylinders and other vital parts cast In GarDurloy for added strength and hardness.

For complete information on this big capacity—economical operating compressor, write for free, illustrated bulletin. Gardner-Denver Company, Quincy, Illinois.

GARDNER-DENVER

GARDNER-DENVER PRODUCTS HELP SPEED VICTORY

Since 1859

Only metal Seal-Caps and Plugs give complete protection for fitted lines and hydraulic units!

Re-usable many times... Being of zinc plated metal, Tubing Seal-Caps and Plugs are the most efficient and the most economical available. Tubing Seal-Caps and Plugs are easily spun on or off fitted lines and hydraulic units *by hand.*

Do the protectors you use meet these Army-Navy Specifications?

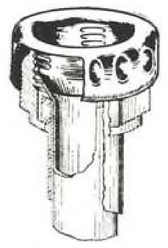
AN-C-66a: Preparation for Packaging.
"All ports shall be plugged with oil resisting material so as to protect the plug threads and bosses from damage and to prevent entrance of air and leakage of fluid from cylinder body before shipment. . . . . ."

AN-V-5a: Packaging.
"Check valves shall be packaged in suitable heavy fibre or cardboard cartons. The valve shall be sealed by suitable caps which will protect the external threads from damage in shipment and storage. . . . . ."

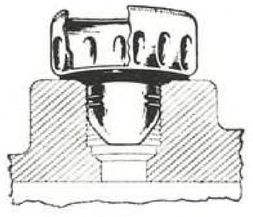
NOTE REFERENCE TO "EXTERNAL PROTECTION OF THREADS" AND "SEALING OF AIR AND FLUID." ONLY METAL CAN GIVE THIS 100% PROTECTION.



SEAL-CAPS
For threaded male fittings.



SEAL-PLUGS
For tubing with threaded fittings.



BOSS-PLUGS
For threaded flush openings

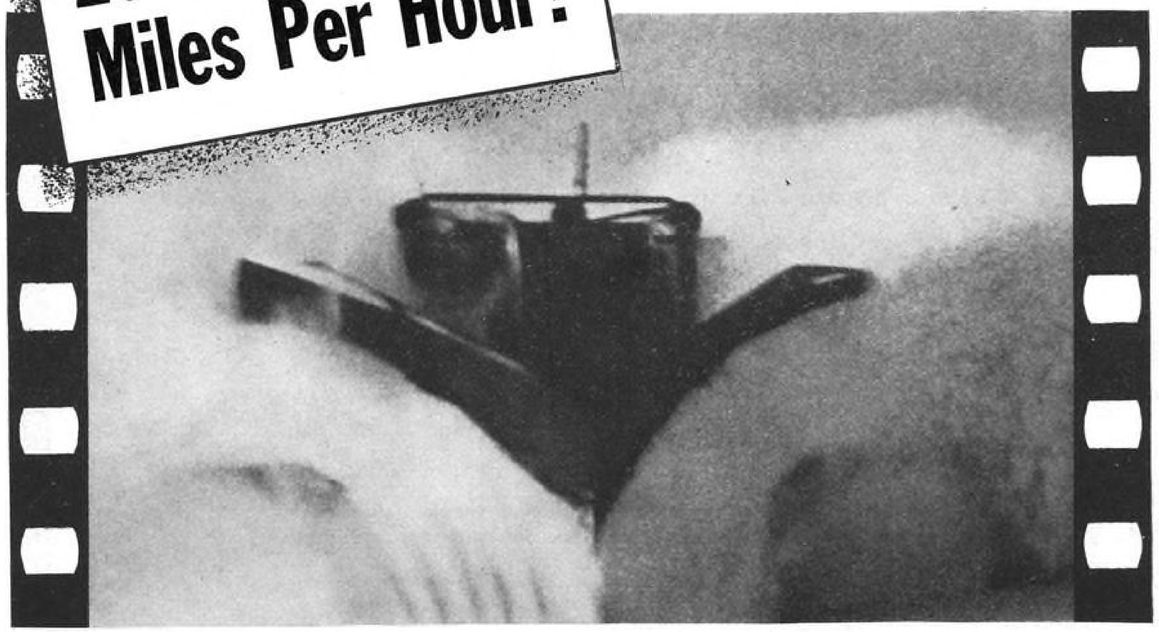
DESCRIPTION

Metal Seal-Caps, Seal-Plugs and Boss-Plugs are available for both AN and AC (Parker) fittings in all standard sizes -3 to -20. AN types are oxidized black, AC are natural zinc for easy identification, both are marked for size. -3, -4 and -5 sizes are "universal" fitting both AN and AC. Send today (on your firm letterhead please) for 32 page Aircraft Tubing Manual for valuable information on tubing installation, care and handling . . . *Tools Are Weapons—Treat 'em Right.*

TUBING SEAL-CAP, INC.
215 WEST SEVENTH STREET • LOS ANGELES 14, CALIFORNIA
EASTERN REPRESENTATIVE: 428 NEW CENTER BUILDING, DETROIT

Clearing a Path 28 ft. Wide at 30 Miles Per Hour!

• Pictured below is an unretouched enlargement from a 16 mm. movie film, showing the new 250 H.P. Walter Snow Fighter in action. It is clearing a 28 ft. width at 30 m.p.h., on an important airport runway. Because of its super power and traction, this unit is equipped with a special Speed V Front Plow and Right and Left Speed Wings which greatly increase the volume of snow removed and reduce the number of trips required to clear the runway.



If you're an airport maintenance man accustomed to working with conventional trucks, that headline at the top may seem a little unbelievable. But remember, the Walter Snow Fighter is *not* a conventional truck. There is no other truck like it — in design, in construction, in performance.

Through the exclusive Walter 4-Point Positive Drive, the great power of the 250 H.P. motor is transmitted to each of the FOUR driving wheels according to its traction at any instant. This perfect wedding of super power and traction enables Walter Snow Fighters to travel at speeds well above 20 m.p.h.—throwing the snow far to the side and preventing the formation of dangerous snow banks. There is no "wheel spinning" and "side slipping"—common failures in conventional rear-wheel and four-wheel drive trucks.

Write for complete literature describing Walter 4-Point Positive Drive and the many other specialized mechanical features of Walter Snow Fighters.



WALTER SNOW FIGHTERS

WALTER MOTOR TRUCK CO., 1001-19 IRVING AVE, RIDGEWOOD 27, QUEENS, L. I., N. Y.



TRANSOCEANIC TYPE CLIPPER OF PAN AMERICAN WORLD AIRWAYS

SUPER SERVICE with pH



THERE'S many a mile on the log when a Pan American Clipper reaches its maintenance base.

Super-service is required to achieve the "quick turn-around" which wartime schedules demand. Three-story scaffoldings are pushed up, and 185 mechanics complete a thorough inspection and servicing of the ship in 48 hours!

Highly specialized cleaning materials are essential. Many are Kelite materials manufactured for use with pH Control—the key to scientific cleaning.

pH Control

The application of pH Control to industry has revolutionized many processes—taken the guesswork out of industrial cleaning operations. The right material with the right pH will break the bond of any soil, stain or other foreign deposit—destroy its adhesive quality so that it can be easily washed or wiped away *without harm to the surface.*

Typical pH Jobs

A bath in KELITE KETREX speedily removes grease, oil, grime and light carbon from sensitive alloy parts of the Clipper's engines without affecting the metal.

★ KELITE SUPER KETREX effectively cleans the Clipper's pistons—removing the hardest deposits of carbon. ★ KELITE KEMOVER quickly strips all paint from surfaces which require a new coat.

★ Grease, grime and dirt on the motors vanish before a spray of KELITE PROTEXOL. ★ Exhaust stains meet their nemesis in KELITE KDL No. 28, which wipes them off like so much dust. ★ Interiors where ferry command pilots, generals, rulers and diplomats may ride are cleaned and freshened to perfection with KELITE No. 184. ★ And, from wind shields to wing tips, exterior surfaces are polished with KELITE KERO.

All Over the World

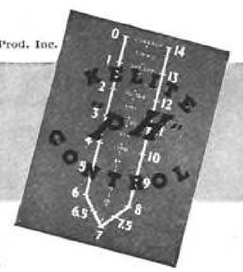
Standardized servicing is a vital part of Pan American's efficient operations; and, wherever the gleaming Clippers fly, Kelite pH controlled materials are helping to supply the super-service they require.

If you have a cleaning operation in which greater efficiency is desired, ask Kelite about the application of pH Control to your specific needs.

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KELITE

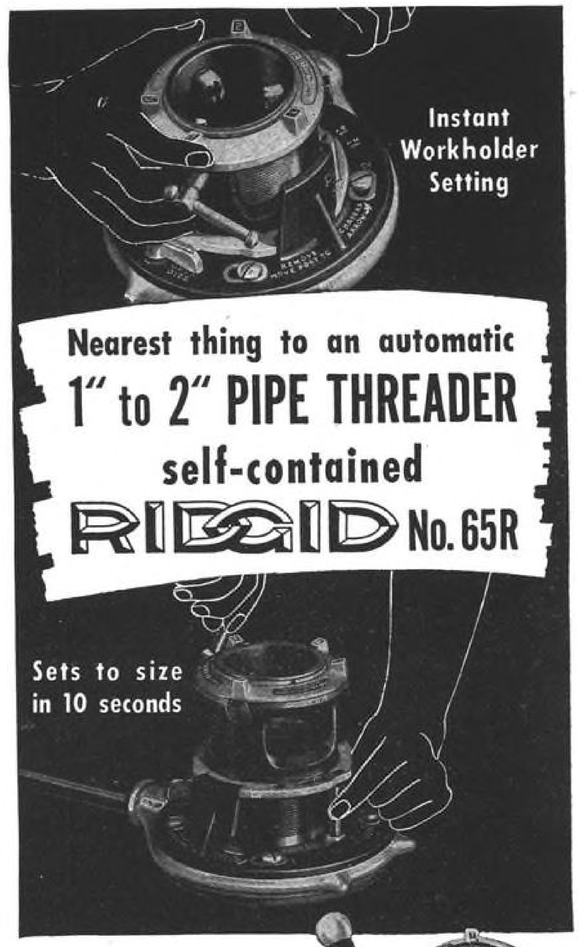
SCIENTIFIC CLEANING THROUGH pH CONTROL



MANUFACTURING PLANTS IN LOS ANGELES, PERTH AMBOY, CHICAGO, AND HOUSTON ★ OFFICES IN PRINCIPAL CITIES

KELITE PRODUCTS, INC., 909 E. 60th St., Los Angeles 1, Calif.
Send information on cleaning materials for:
Aircraft Servicing ☐, Anodizing ☐, Plating ☐, Welding ☐, Building Maintenance ☐, *Other* ☐_____
Name_____
Company_____
Address_____
City_____ State_____





WHEN you have pipe to cut in close quarters, in a trench, near a wall or other pipes it's easier with this new RIDGID Heavy-Duty Cutter. The handle is short; and you use *four* heavy-duty cutting wheels *that roll right through pipe* up to 4" with a minimum of burr. The tough malleable frame holds perfect alignment, always cuts true. Comes in two sizes — No. 42, and No. 44. For tight-spot pipe cutting . . . ask your Supply House for the *new* RIDGIDs.

Cuts pipe if there's room for a quarter turn.

YOU set it to thread 1", 1¼", 1½" or 2" pipe by a simple 10 second adjustment. You set the mistake-proof workholder to pipe size by an instant turn of the gauge ring, tighten only one screw — no bushings needed. It's almost automatic. No extra chaser dies to carry around — one high-speed steel set stays in the die stock, cuts micrometer perfect threads on all four sizes of pipe with easy ratcheted strokes. Steel and malleable durability. For smooth speedy and easy threading . . . ask your Supply House for this self-contained RIDGID No. 65R.

Buy RIDGID Pipe Tools at Supply Houses Everywhere

RIDGID
★ PIPE TOOLS ★

THE RIDGE TOOL COMPANY
ELYRIA, OHIO, U.S.A.





ACCURACY . . . *Result of*
SKILL AND EXPERIENCE

THIS applies equally well to sculpture and to castings. To produce Wellman Castings a thoroughly trained personnel works with the most modern facilities. The result —smooth, clean, precise castings with that fine degree of accuracy which saves time, costs and speeds assembly. ★ Castings in brass, bronze, heat treated aluminum and magnesium. Patterns of all kinds, sizes and designs.

THE WELLMAN BRONZE & ALUMINUM COMPANY
General Offices: 2533 East 93rd Street • Cleveland, Ohio

WELLMAN *means* WELL-CAST

WELLMAN
CASTINGS X-RAY INSPECTED

ON NOSE . . . BELLY . . . TOP AND TAIL

You'll find Plexiglas TURRETS

HARD-HITTING power turrets bristle from American heavy and medium bombers. From nose, belly, top or tail, their guns command surrounding skies . . . ready to fight off attack from any angle.

These strategic battle stations are enclosed in PLEXIGLAS—Aviation's Standard Transparent Plastic.

The crystal-clarity of PLEXIGLAS enables the gunner to aim and fire accurately. Its strength protects him from wind, weather and freezing slipstreams. Its light weight saves precious pounds for bigger bomb loads and larger fuel supplies.

In addition to these inherent advantages, every piece of PLEXIGLAS carries with it the cooperation of the Rohm & Haas technical service staff—physicists to calculate the best optical contours for sighting, engineers to discuss details of mechanical design, production men and facilities to fabricate experimental parts.

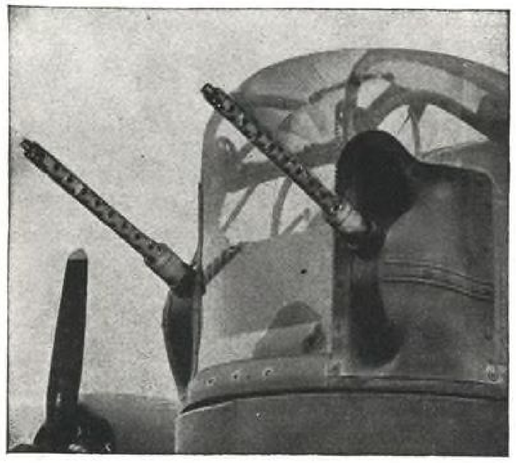
To obtain the benefits of this active assistance in your plastics development work, call our nearest office—Philadelphia, Los Angeles, Detroit, Chicago, Cleveland, New York.

Only Rohm & Haas makes PLEXIGLAS.

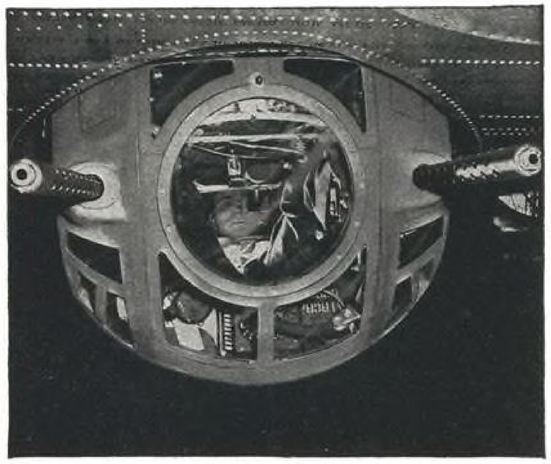


3 awards to Rohm & Haas Company and its associated firms, The Resinous Products & Chemical Company and Charles Lennig & Company.

PLEXIGLAS *is the trade-mark, Reg., U. S. Pat. Off., for the acrylic resin thermoplastic sheets manufactured by the Rohm & Haas Company.*

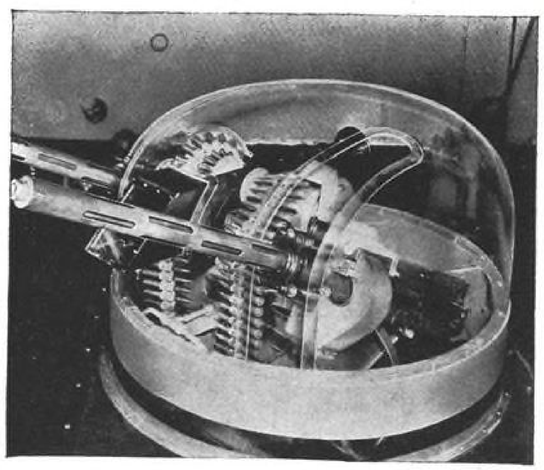


ON THE CONSOLIDATED B-24 the new Emerson-designed, Emerson-built nose turret of PLEXIGLAS adds a fourth power-operated death sting to the other three PLEXIGLAS turrets—Martin top, Sperry retractable belly, Consolidated tail.



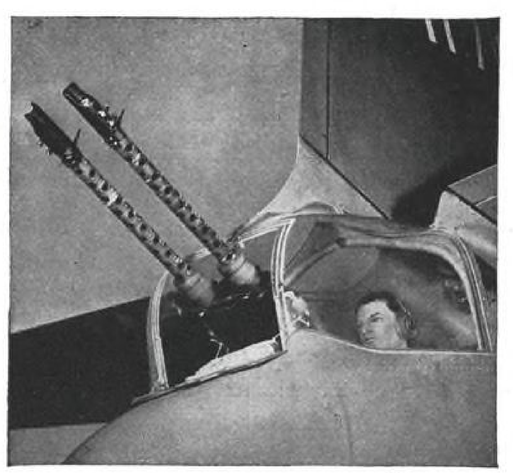


ON THE BOEING B-17 G—latest version of the Flying Fortress—both the Sperry-designed top turret, built by Emerson and Steel Products, and the Sperry-designed belly turret, built by Briggs and Emerson, incorporate PLEXIGLAS advantages.





ON THE NORTH AMERICAN B-25—the famous Mitchell medium bomber—the top turret is designed and built by Bendix. Like so many other power turrets on America's best-known bombers, this turret is constructed of crystal-clear PLEXIGLAS.



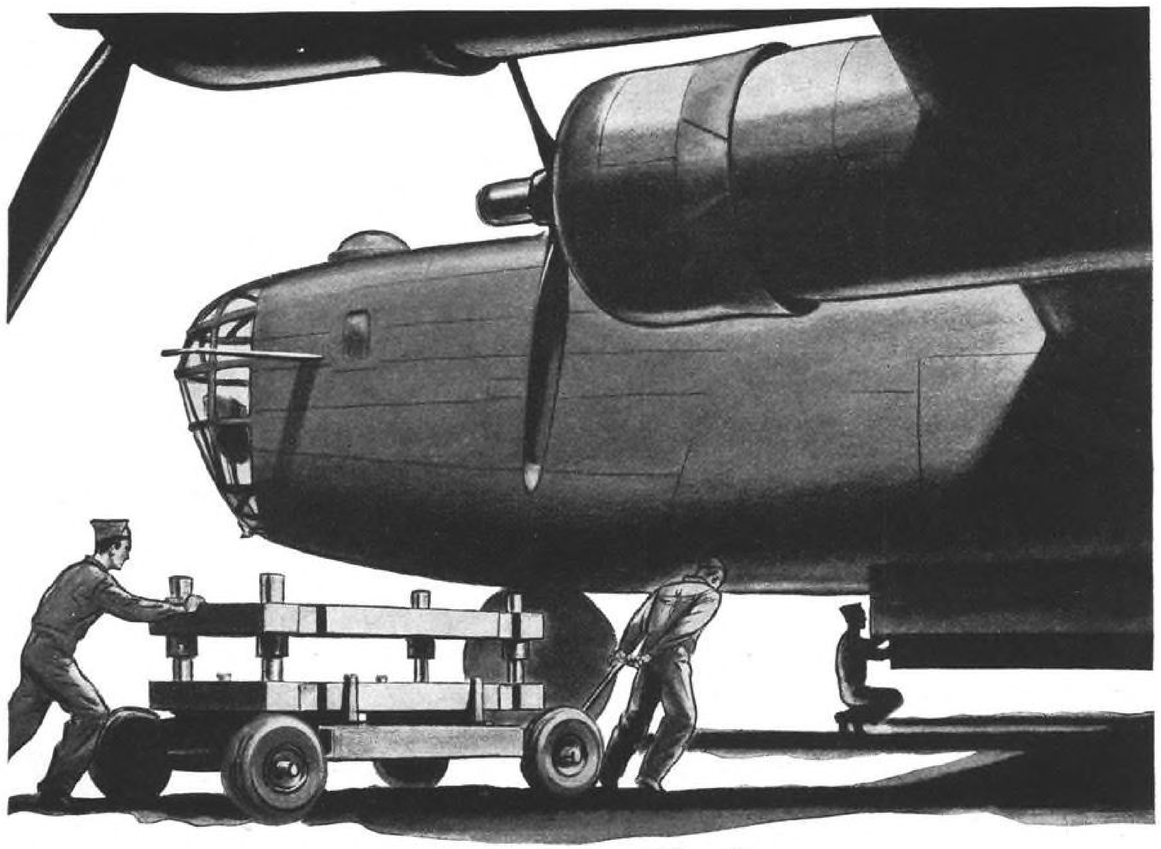


ON THE MARTIN B-26 both the tail turret and the adaptable top turret—which fights not only on this plane but also on the Consolidated B-24—are made of PLEXIGLAS, to give clear, unobstructed vision to the gunners.

ROHM & HAAS COMPANY

WASHINGTON SQUARE
PHILADELPHIA, PA.

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides
Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries



They don't load Die Sets in BOMB BAYS

Die sets are work-a-day products that stay at home, holding and guiding the dies that stamp out and form plane parts by the millions. We can safely and proudly say that Danly Die Sets have speeded America's air program.

Danly facilities and service have been steadily increased since 1940. One of the major objectives was to be ready for the mass production of planes—that was sure to come—that came—planes that are blasting the way to winning the war.

If you need die sets in any phase of your production call Danly.

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2100 South 52nd Avenue • Chicago, Illinois

Call Danly:

CHICAGO ..... *Lawndale 7440*
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Los Angeles . . . *Kimball 0181*



DANLY DIE SETS

Welded Steel Fabrication

Helping to Keep the "line" Open!

The numerous spark plugs in war service engines release a barrage of miniature (but very noisy) thunder claps. Unless well by-passed, these crashes would block the operator's phones.

Scientifically designed Bolton Shielded Ignition Assemblies are used on war plane, tank and boat engines to "drain" off a maximum of this interference and keep the "line" open. To insure long, uninterrupted service amid the impact of modern combat, these Assemblies are of extremely rugged construction.



BOLTON SHIELDED IGNITION ASSEMBLIES

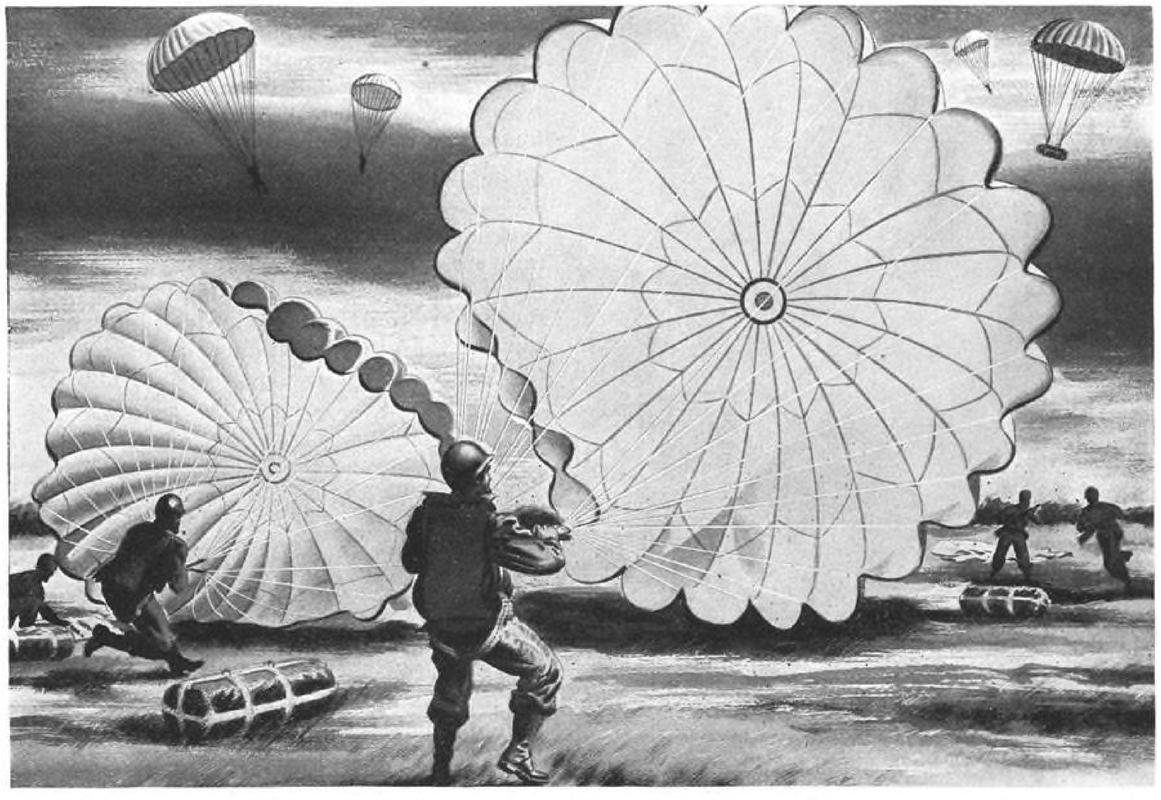
BOLTON MANUFACTURING CORPORATION

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Today...Tomorrow the Big Name in

modern nylon PARACHUTES



On the fighting and training front Reliance parachutes are demonstrating their complete reliability and safety. These modern 'chutes are made of finest nylon—ounce for ounce much stronger than silk. And when peacetime comes, these famous 'chutes will serve industry in many time-saving new ways.

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'CHUTES 50 FEET TO 3 FEET

Reliance makes all types and sizes of 'chutes for men and matériel. Back, seat and quick detachable types. Cargo and emergency kit delivery types. And several others which are military secrets.

Reliance PARACHUTES



The things

Burgess-Norton are doing today will Someday soon be Available to all Manufacturers...

in PISTON PINS including aircraft

in Hydrogen Copper Brazing

In Precision—Screw Machine—Heat Treated and Ground Products

in Ball Bearings—Non-Precision Types

A Part is never made right unless it is satisfactory to our customers.

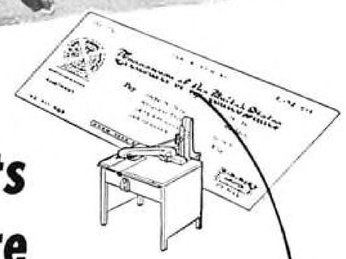
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Burgess Norton

MANUFACTURING COMPANY

40 years in GENEVA, ILLINOIS





The machine that knows the ports where sailors' sweethearts are

The Navy never forgets.

Most sailors want part of their pay sent each month to wife or mother. The Navy uses Addressograph* machines to make sure the money goes out promptly — and correctly. The name and address of the one to get the money is handled on Addressograph machines like the ones you use in your office and factory.

Every month these machines take a supply of blank checks, write the checks with amount, name and address always exact. This is only one of many ways the Navy and Army use Addressograph.

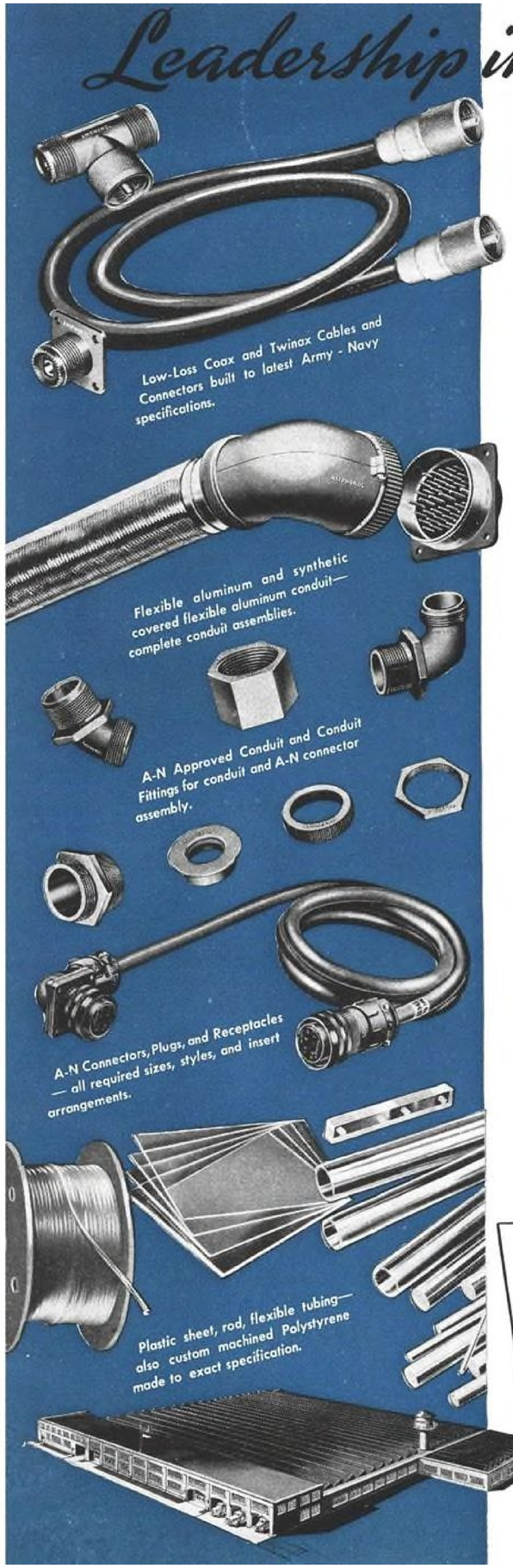
Broaden your picture of Addressograph to include check writing, tool crib control in factories, production control systems, payroll writing, record keeping of many kinds, and hundreds of other office and factory methods that save time, assure accuracy, release needed manpower, and save money. Addressograph (and Multigraph* and Multilith* machines, made by the same company) are the modern way to simplify and save by systems and methods. Trained men near you can show you how to get more value from these machines you already have. Addressograph-Multigraph Corporation—Cleveland and all principal cities of the world.

*T. M. Reg. U. S. Pat. Off.

Addressograph

TRADE-MARK REG. U.S. PAT. OFF.

SIMPLIFIED BUSINESS METHODS



Leadership in the Production of
CONNECTORS·· CABLES and PLASTICS for ELECTRONICS

Wide experience in the field . . . close collaboration with the industry's leading engineers . . . adequate production facilities . . . explain Amphenol's leadership in the manufacture of Army-Navy Type Connectors, Conduit, and Conduit Fittings, Low-Loss Cable and Connectors, and Plastics for electronic applications. Amphenol A-N products are precision engineered to give lasting dependable operation. The greatly increased production facilities at the Amphenol plant expedite the handling of orders quickly and efficiently. Depend upon Amphenol quality, workmanship, and service!

The Leadership Catalog of the Industry

With complete specifications of all Amphenol Products, technical data, charts, and helpful information— a guide book of electrical equipment used in aircraft, radio, shipbuilding industries. Send your request on company letterhead.



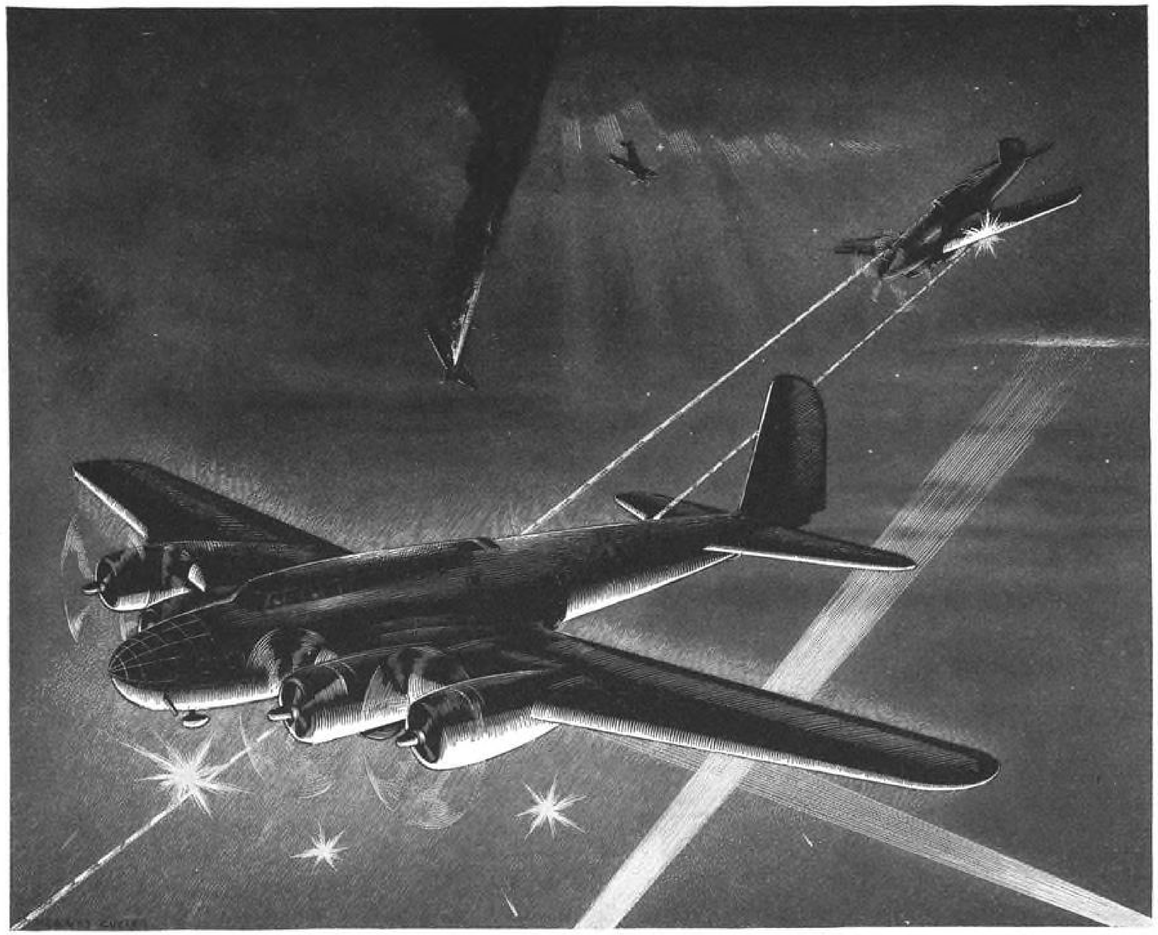
AMERICAN PHENOLIC CORPORATION

CHICAGO (50) ILLINOIS

IN CANADA

AMPHENOL LIMITED • TORONTO

Depend upon AMPHENOL Quality



Bullet wounds that **heal themselves**

EVEN before that fatal day of December 7, 1941, Shell's great research laboratories were supplying manufacturers with *butadiene*—the key to a synthetic rubber that will do things natural rubber *can't do!*

Today this synthetic rubber made with butadiene is performing one of the miracles of modern warfare! It is used to line airplane gasoline tanks . . . make "bullet-riddled" tanks self-healing. When enemy bullets pierce the tanks, the spongy rubber fills the holes, keeps the plane flying.

It is research such as this that first produced 100-octane fuel in commercial quantities . . . one of the reasons the majority of the country's leading plane and engine manufacturers prefer Shell Aviation Fuels. Shell Aviation Products are also preferred by many airlines, aviation training schools, and airports.

Farsighted airport operators will find Shell's wartime popularity a profitable peacetime asset.

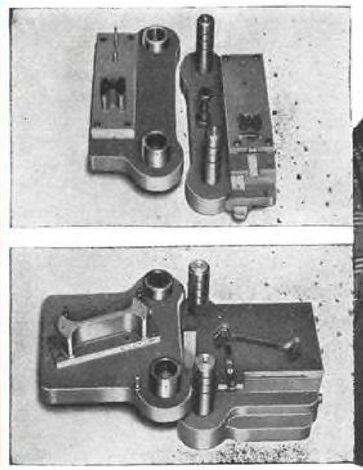
SHELL

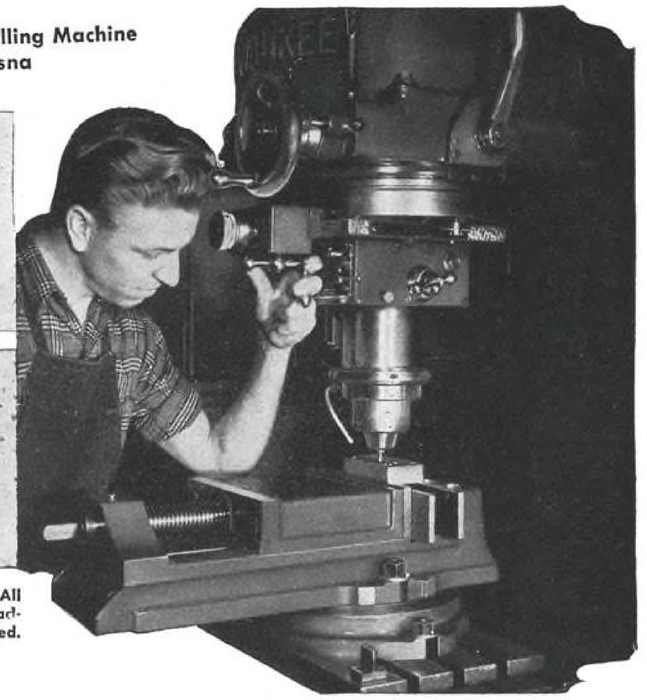
AVIATION FUELS AEROSHELL OILS

"One of the most Outstanding Machines I've ever seen"

JOHN W. RIX, *Mfg. Engineer*
Cessna Aircraft Co.

The Milwaukee Rotary Head Milling Machine "Under Fire" At Cessna





On tools like these no layout was required. All machining was done by working to "dial" graduations. Direct measurements were eliminated.

Proof That This Machine *"Has what it takes"*

Is Found In Mr. Rix's Statement:

"I consider the Milwaukee Rotary Head Milling Machine to be one of the most outstanding machines I've ever seen for tool room work. It paid for itself in the first few months of operation. We have repeatedly accomplished feats which I would not have believed possible if I had not seen them myself."

(signed) JOHN W. RIX

Since purchasing their first Milwaukee Rotary Head Milling Machine, Cessna Aircraft has milled hundreds of complicated blanking dies of geometrical form. Furthermore, they milled the punches to fit these dies with .001" clearance in between without resorting to hand fitting of any kind.

This meant that the punches and dies were heat-treated at the same time. Then, after surface grinding, they were ready for mounting on the die set.

The Milwaukee Rotary Head Milling Machine is without equal in the high speed, accurate, economical production of dies, molds, hobs, as well as the precision machining of many parts. In a single set-up, it performs layout, milling, drilling precision boring and slotting operations—mills circular and angular cuts in both vertical and horizontal planes.

The "Machine of Tomorrow" — here today!

As a leader in your field you should have the complete story on the Milwaukee Rotary Head Milling Machine and its remarkable, low-cost performance. Write for Bulletin 1002A.

Rotary Head Milling Machine
•
Autometric Jig Borers
•
Center Scope

Kearney & Trecker *Products*
CORPORATION
Milwaukee, Wisconsin
Subsidiary of Kearney & Trecker Corporation

Milwaukee Face Mill Grinder
•
Milwaukee Midgetmill
•
Milwaukee Speedmill

THE ROSÁN LOCKING SYSTEM

INSERT LOCKING PROBLEMS SOLVED



Material has been drilled and tapped. Insert, minus locking ring, has been partly screwed into place.



Insert in place. Top flush with surface of material. Note the counter-bored channel for the locking ring.



Insert locked in place. Inner serrations engaged with teeth of collar. Outer serrations broached permanently into material.

For Soft Metals, Plastics, Wood

The problem of fastening permanently in metals, plastics and wood has been solved by the Rosán Locking System.

Rosán Threaded Inserts and the Rosán Locked-in Studs are made an integral part of the parent material by the Locking System illustrated at the left.

Rosán Inserts and Studs cannot turn or loosen under vibration or torsion. Any Rosán fastening unit can be installed or replaced without injury to the parent material. Standard screw threads used on all types of units. No distortion of material. Easy to install.

There are types of Rosán Locked-in Inserts and Studs for every industry. Manufacturers are invited to submit their fastening problems to our Engineering Department. No obligation.

A Product of

BARDWELL & McALISTER, INC.

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ARMY (E) NAVY

BARDWELL & McALISTER, Inc.,
Dept. 2113, 7636 Santa Monica Blvd., Hollywood, Calif.

Please send free literature and full information on the Rosán Locking System to . . .

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Dept._____ **Firm**_____

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light TO DRIVE BY *light* TO FLY BY

Incandescent Lamps for Aviation use must possess rugged dependability. This all important characteristic has been a feature of TUNG-SOL Lamps since they were first produced for the automotive industry when electricity replaced oil for automotive lighting. TUNG-SOL Lamps are now used in planes, cars, tanks and trucks both as initial equipment and replacements. When you specify TUNG-SOL, you specify top quality in Lamps.



TUNG-SOL AIRCRAFT LAMPS

TUNG-SOL LAMP WORKS INC., NEWARK, N. J., Sales Offices: ATLANTA CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK, PHILADELPHIA. ALSO MANUFACTURERS OF ELECTRONIC TUBES AND CURRENT INTERMITTORS

This is the fifth of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME.



"Air freighters will develop Latin America."

says Glenn L. Martin, President of Glenn L. Martin Company

"WHEN YOU CONSIDER *what outmoded airplanes have been doing for several years in Latin America—delivering mining machinery, transporting tractors and supplies, taking out rich resources from roadless and rail-less regions—you begin to appreciate what vast possibilities lie in the field of freight-by-air. In fact air freighters should play a most prominent role in increasing the exchange of goods between the United States and Latin America.*

"But there is much spade work to be done, for terminal and airport facilities in Central and South America still have barely 'scratched the surface' and can be developed only at the expense of time and great quantities of money. I think that time and money will be spent, and I look for the building of airports in all sections of the continent, and the operation of lines owned by both the United States and Latin American interests.

"I believe we will set up a mutually profitable trade. Our Government is doing everything possible to prepare the ground for future trade relations, and businessmen both North and South of the Rio Grande realize what great potentialities lie in Latin America."

And so a leading aircraft manufacturer looks to a new sector of pioneering in the air world of the future. Just what that future will be, no man can tell. But every air-man knows this:—

—that no new idea in aviation can be successful without a waiting "test-pilot-market" of people who are habitually first to accept any new way of living or commercial venture that improves on what has gone before.

These are the kind of people who read TIME—the great group of aviation's silent partners:—the men and women on whom aviation will focus much of its post-war advertising—people with the income, the influence, the foresight that will help the airplane industry fly into the bright tomorrow the whole world expects of it.

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



BOEING FLYING FORTRESS

The Fort's Forte

This is *not* just another Flying Fortress.

Instead, we like to think of it as a symbol for all Fortresses . . . for the one that limped home, almost sawed in half by a wild, mad Messerschmitt . . . for the one that pulled out of a dive at almost 450 m.p.h.! Or perhaps it's the forerunner for future Forts that will blast hallelujah out of Hitler and Hirohito.

You'll note the same theme running through each success story—performance with *dependability*. That's the Fort's Forte and that's where we come in. Triplett & Barton performs X-Ray inspection on all vital stress castings for every Flying Fortress. That gives positive assurance against structural failure and saves valuable machine time otherwise wasted on defective parts.

Your metal problems are welcomed by Triplett & Barton specialized technicians. Call or write for information on how these services can help you: X-Ray and Gamma Ray inspection–Physical and Electrical testing –X-Ray Diffraction–Chemical and Spectrographic analysis–Metallography–Heat Treatment and Foundry Sand Testing–Hi-Speed and Microphotography and others.

X-RAY

TRIPLETT & BARTON INC.

METALLURGICAL DIAGNOSIS

WICHITA, KAN. **BURBANK, CALIF.** SEATTLE, WASH.

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"...contains the most complete information we have ever seen"

An executive of a major air line, after reading our aircraft piston ring manual, made the comment quoted above. The specimen pages shown here illustrate the manner in which our manual presents its facts and figures. Send for your free copy today. It is available to all who are interested in servicing aircraft. In requesting your copy we ask only that you inform us as to your position or activity which prompts your interest.



BACK THE ATTACK—WITH WAR BONDS

MUSKEGON PISTON RING CO.

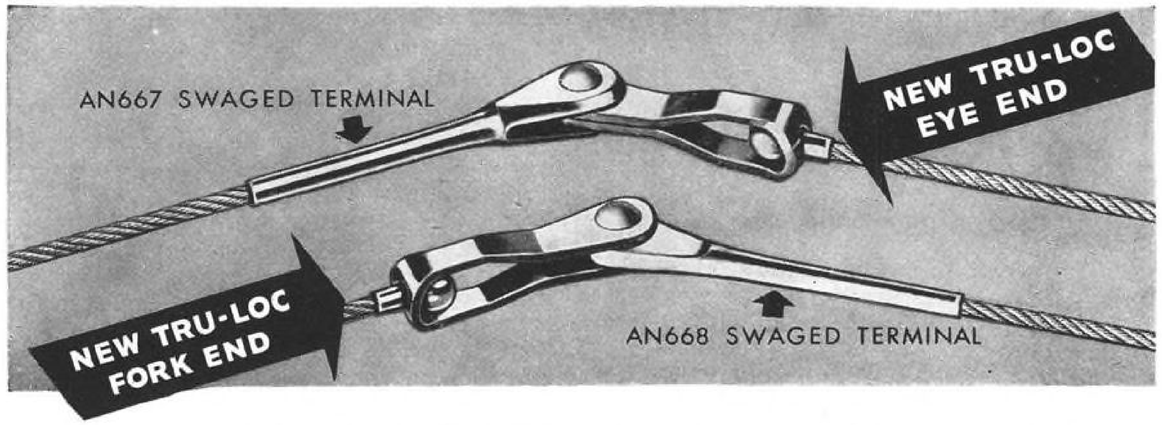
MUSKEGON, MICHIGAN

PLANTS AT MUSKEGON AND SPARTA



MUSKEGON Piston Rings

WRITE FOR YOUR COPY TODAY



NEW TRU-LOC TERMINALS THAT ARE EXACTLY

Interchangeable WITH AN667 AND AN668

You can use the many advantages of this new development in Aircraft Terminals without any change in control engineering. Strength characteristics, operating qualities and dimensions are so equalized with AN667 and AN668 that it is perfectly sound to replace completely with the new TRU-LOC Terminals. It makes absolutely no difference, either whether service replacement parts are AN667 and AN668, or the new TRU-LOC Terminals.

IMPORTANT TO PRODUCTION SCHEDULES—THEY ARE

Obtainable NOW, REDUCING DELAYS

Equipment is available for producing Strap Type End Fittings in unlimited quantities. Time and material needed to produce the Ball Type Swaged Fittings are notably less than required for AN667 and AN668. These are important war-time considerations.

LOWERS REPLACEMENT PARTS INVENTORY BECAUSE

Re-Usable

When cable assemblies must be renewed, it is only necessary to replace the small ball-type swaged fitting which is much more easily swaged than AN667 or AN668. The strap fitting is re-usable.

Exact data, including complete dimensional tables are given in this 6-page, 8 ½" x 11" folder, "AIRCRAFT TERMINALS DATA." *Write for a copy.*



ACCO *In Business for Your Safety*

AMERICAN CHAIN & CABLE COMPANY, INC. • BRIDGEPORT, CONNECTICUT

AUTOMOTIVE AND AIRCRAFT DIVISION

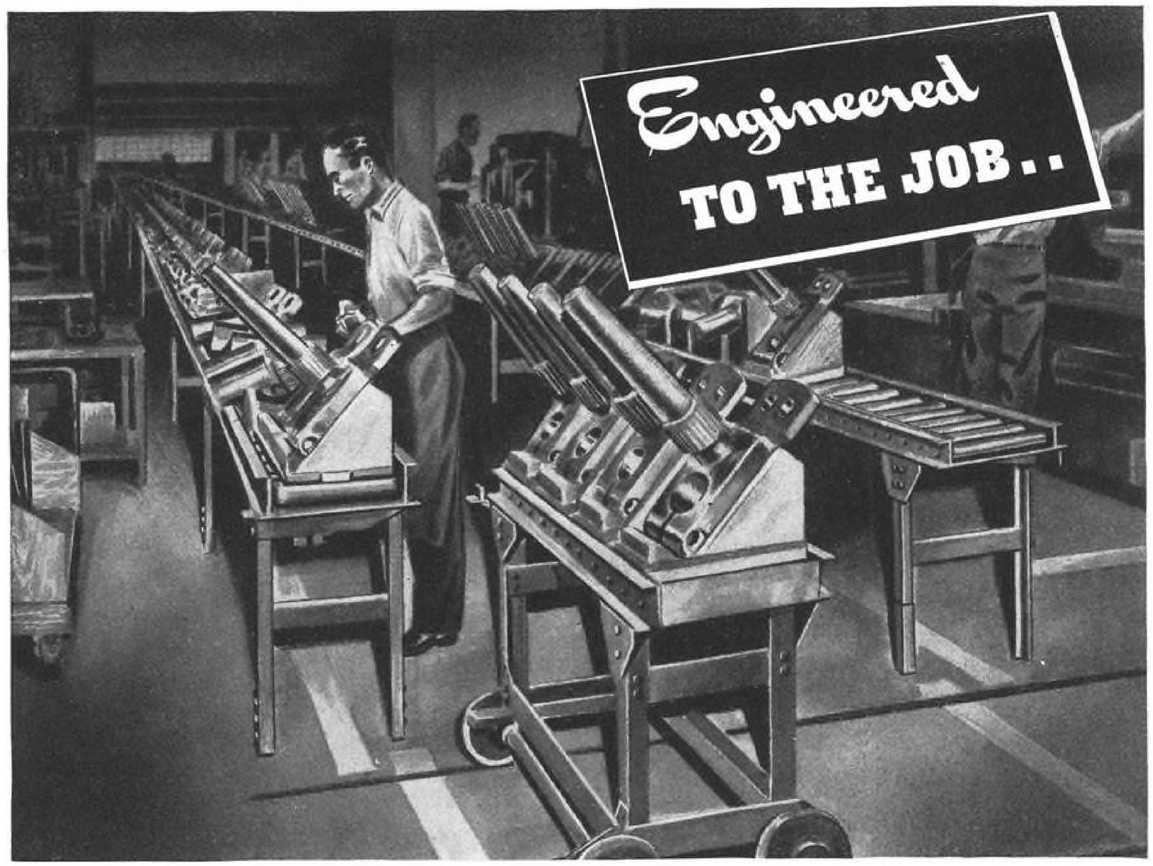
6-235 GENERAL MOTORS BUILDING DETROIT 2, MICHIGAN



TO THE ATTACK . . .

"Something that will go upstairs faster . . . " the pilots told us. "Raise the ceiling . . . " said the plane builders. Our answer . . . the Bush Intercooler . . . is today providing planes of the United Nations with the advantages of superior critical altitude. Our experience . . . specialized in the heat-transfer field and applied to the hundreds of commercial and industrial applications which will become available when the war is won . . . will one day help many a sales curve to "go upstairs faster" . . . "raise the ceiling" on many a profit. BUY WAR BONDS.

BUSH MANUFACTURING CO. HARTFORD CONNECTICUT



Standard Conveyors Synchronize Production All "Along the Line"

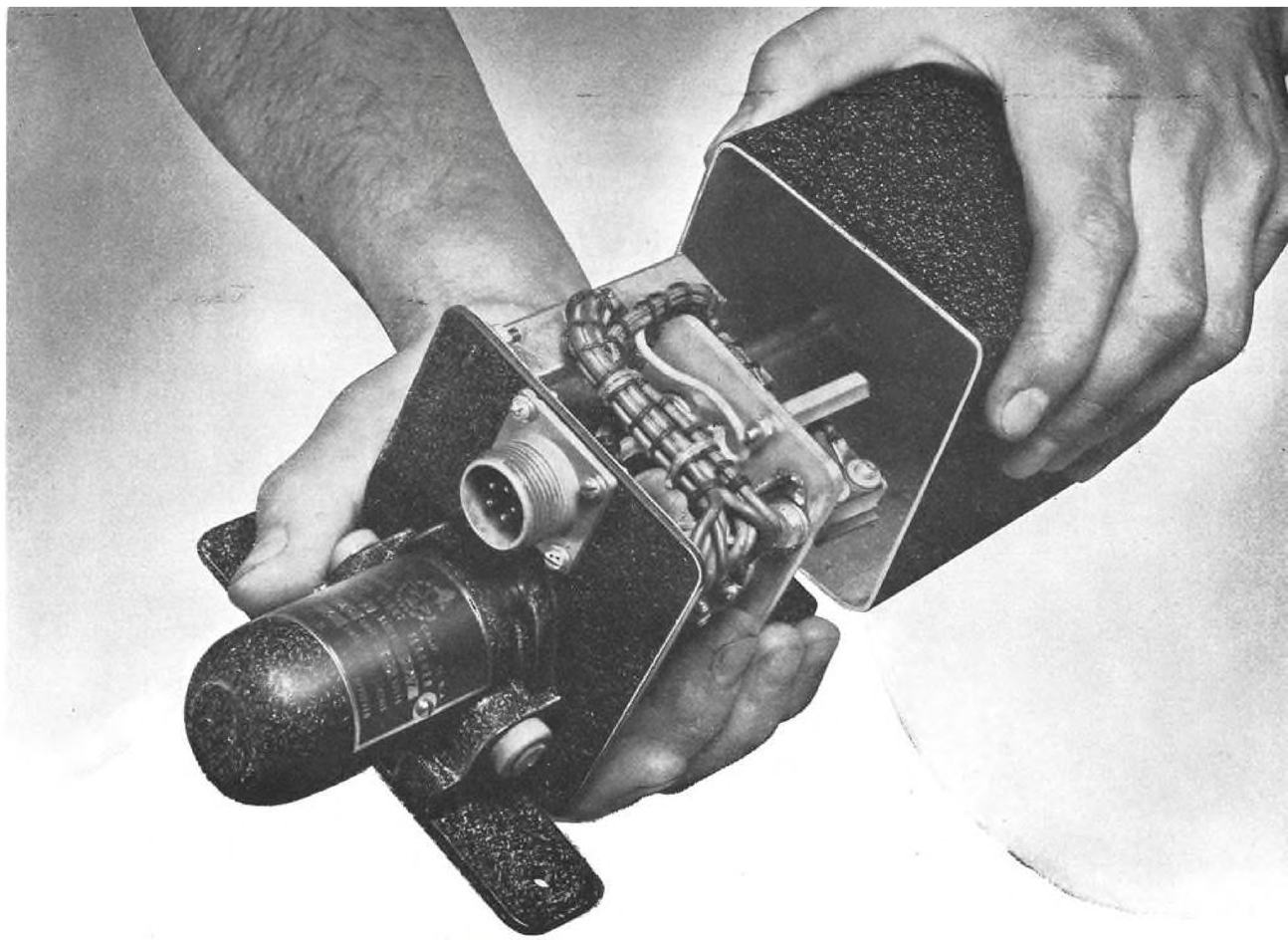
WORK in process is quickly shunted from one machine line to the next in this effective Standard Conveyor installation. The transfer table in the foreground consisting of a section of roller conveyor mounted on wheels, provides quick easy means of shifting the work-pieces from one line of roller conveyor to another. Two machine lines are thus continuously fed with work — without halt or interruption and with a minimum of manual handling.

Knowing how to apply power and gravity conveyors to best advantage is equally as important as building them well. An experience record of more than 35 years, serving all classes of industry and business, qualifies Standard Conveyor to be of service to you — on any conveyor requirement, large or small — including roller, belt, chain, slat, push bar conveyors, straight and spiral chutes, vertical lifts, portable piling and tiering machines, and pneumatic tube systems. Write for valuable reference book — "Conveyors by Standard" — Catalog No. A-12.

STANDARD CONVEYOR COMPANY
General Offices: NORTH ST. PAUL, MINN.
Sales and Service In All Principal Cities



★ ENGINEERED FOR FASTER PRODUCTION ★



Lightweight Position Light Flasher!

Built specifically to withstand both the vibration and temperature range of aircraft operation, and designed to operate in any position – mounted top, side or bottom – the Bendix Position Light Flasher offers new simplicity and reliability and is C.A.A. approved.

This Flasher, which is available for 12 or 24 volt operation, weighs only 2.1 pounds. It will operate from −65° F. to +160° F. in accordance with latest military winterization requirements. For safety, constant white light operation is provided in case of power failure. Simplicity of service and a minimum number of working parts are important features of the Flasher. Write for complete specifications and data. Bendix Aviation, Ltd., North Hollywood, California. Sales Engineering Offices in St. Louis, Dayton and New York.



The Bendix Aviation, Ltd., Flasher produces an accurate cycle forty times a minute of 150° of white light, 10° of no light, 150° of red light and 50° of no light.

Bendix Aviation, Ltd.
NORTH HOLLYWOOD, CALIF.
Subsidiary Bendix Aviation Corp.

Bendix Aviation Corporation — DESIGNERS AND MANUFACTURERS OF RADIO AND HYDRAULIC EQUIPMENT — OUR PART OF THE INVISIBLE CREW

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IRVIN Air Chute
The Life Preserver of the Air

SYMBOL OF SAFETY



The name "IRVIN" on the harness means the chute is produced in an Irvin Factory with over 20 years' experience and skill in chute-making.

Literature can be had by school or training executives for the asking. Address Main Office, Buffalo, N. Y.

IRVING AIR CHUTE CO., Inc. 1670 Jefferson Ave., Buffalo 8, N. Y.

Factories at other points in the United States, Canada and England



The CATERPILLAR CLUB

Founded in 1920. There is only one qualification for a life membership: in an emergency men and women who have saved their lives with Irvin Air Chutes.

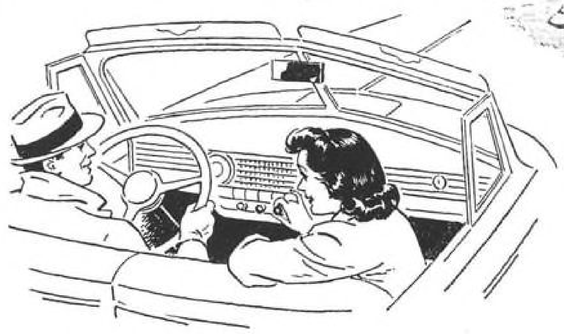
Many of the personnel of the flying services engaged in all phases of war have successfully used their Irvin Air Chutes in extreme emergency.

The word CATERPILLAR and the representation of a caterpillar are registered trade-mark features of Irving Air Chute Co. Inc. We are anxious that the records of the Club be kept as complete as possible in the Club Register and members, upon enrollment, will receive a caterpillar token with the name inscribed thereon. Communicate with Main office

IRVIN Air Chutes

SERVING THE UNITED NATIONS' AIR FORCES





From "Music on the Road" ...a Clearer Voice for War

Few entertainment mediums operate under such unfavorable conditions as the automobile radio. It sings its arias on a "stage" that bounces and jolts. It cracks its jokes while trolley-wire "lightning" snipes at its sensitive nervous system. It reads its news reports under the savage attack of high-tension current from the automobile ignition system. Even temperature and humidity get in their licks. Talk about a "dog's life"! Rover, move over.

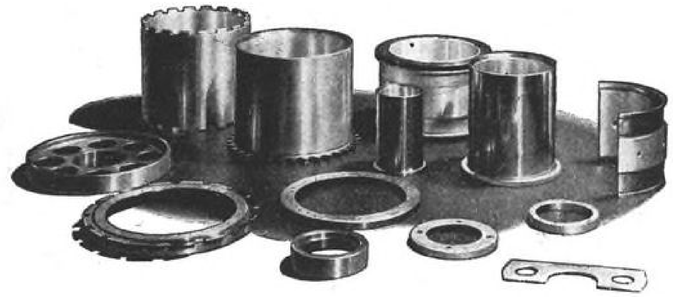
For years, Delco Radio technicians have applied themselves to overcoming the many problems of vehicular radio. One by one, vibration—electrical interference—humidity and temperature—and other trouble-makers fell before their relentless quest. Automobile radio lost its stutters and gained a calm, clear voice.

But more than better entertainment came with this conquest. In their eternal search for "a better way," Delco technicians were finding the answers—*years in advance*—to similar problems of war-vehicle radio communication. When war struck, they already had a sound working knowledge of the chief deterrents to practical radio communication in bombers, tanks, tank destroyers and other mobile units. The quest for better entertainment had yielded an invaluable by-product—a clearer voice for war.

Delco Radio
DIVISION OF
GENERAL MOTORS

★ ★ ★ ★ BACK OUR BOYS . . . BY BUYING BONDS ★ ★ ★ ★





MALLORY Bearings Point the Way—

The road to better bearing performance for high-speed engines has been clear since Mallory perfected the Mallosil Process of bonding rare metals to base metal backings.

Mallory Bearings meet the demand for reliability and precision in these days of close tolerances; when aircraft engines must withstand the brutal punishment of high altitude combat action at incredible speeds. Silver-surfaced with amazing precision by the Mallosil Process, Mallory Bearings withstand the crushing pressure, terrific temperatures and fatigue stresses set up in aviation engines.

Their performance in action tells the story. You can depend on the reliability of master connecting rod bearings, rocker bushings, pinion races, counter weight bushings, gear races, spacers and other engine parts made by Mallory.



This special checking fixture—Mallory designed and built—measures tolerances on Mallory Bearings in split-thousandths. It enables the operator to inspect several dimensions simultaneously and to determine the relationship of one with another. In the photo, the concentricity of the outside diameter is checked with inside diameter and taper.

Present Mallory Bearing production facilities are devoted entirely to War needs. But Mallory engineers are gaining a wealth of experience in applications of the Mallosil Process which will be of tremendous post-war value to manufacturers, not only for high-speed engine parts, but for a host of other products. We shall be glad to discuss the possibilities of the Mallosil Process with you.

ARMY E NAVY

P.R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA

Cable Address—PELMALLO

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P.R. MALLORY & CO. Inc.

MALLORY

SERVES THE AVIATION, THE AVIATION-INSTRUMENT AND THE AVIATION-COMMUNICATION FIELD WITH WELDING TIPS, THE MALLOSIL PROCESS—BEARINGS, SPECIAL ALLOYS, ELECTRICAL CONTACTS, VIBRATORS, VIBRAPACKS, CONDENSERS, ROTARY AND PUSH BUTTON SWITCHES, ELECTRONIC EQUIPMENT, COMMUNICATIONS HARDWARE, RECTOSTARTERS



THE HANDWRITING IS IN THE SKY!

OUR enemies' calendar of conquest has turned backward. Under the ceaseless hammering of Allied air-power, their armies are on the defensive, their industry disrupted. Soon, that air-power will support the irresistible invasions that are yet to come—the prelude to final victory.

As this pattern of air-power develops, the importance of Houdry's part in it becomes clear. Consider this fact: during nearly two years of a war whose destinies have been largely determined in the air, a score of Houdry Process plants have produced 90% of *all* catalytically cracked aviation gas for the United Nations.

Today 22 out of the 26 catalytic cracking plants in operation are Houdry-licensed units, running dependably around the clock and smoothly across the months. Thanks largely to them, our fliers have had the finest fighting fuel in the world—plenty of it and on time. Thirty-seven additional Houdry and Thermofor Catalytic Cracking units are now being built under Houdry licenses.

Houdry Catalytic Processes and the Thermofor Catalytic Cracking Process are available to all American refiners, under license arrangements, subject to approval by the United States Government.

HOUDRY CATALYTIC PROCESSES
... FOR VICTORY IN WAR
... FOR PROGRESS IN PEACE

HOUDRY PROCESS CORPORATION, WILMINGTON, DELAWARE

Licensing Agents:—

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ACIPCO STEEL — CENTRIFUGALLY CAST RADIAL ENGINE CYLINDER BARRELS



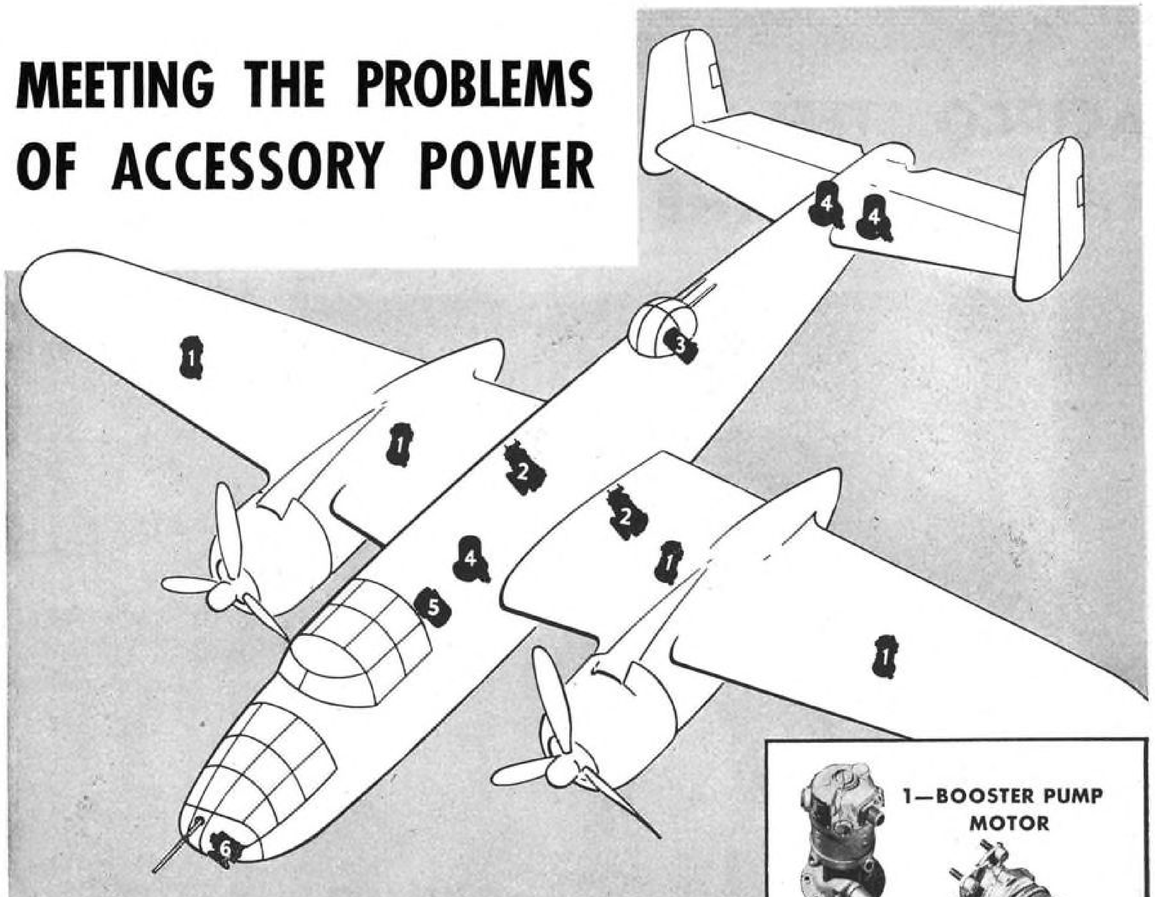
CHROMIUM-MOLYBDENUM ALLOY STEEL CYLINDER BARRELS

This is just one of many centrifugally cast steel products being produced from electric furnace steel under rigid chemical and physical specifications. Acipco Steel, centrifugally cast, is also furnished in nominal 16-foot length tubes for ship shafting and the production of parts.

Write for Catalog

AMERICAN CAST IRON PIPE COMPANY
BIRMINGHAM 2, ALABAMA

MEETING THE PROBLEMS OF ACCESSORY POWER





1—BOOSTER PUMP MOTOR

2—TRANSFER PUMP MOTOR

3—TURRET GUN MOTOR

4—SERVO MOTOR

5—AIR PUMP MOTOR

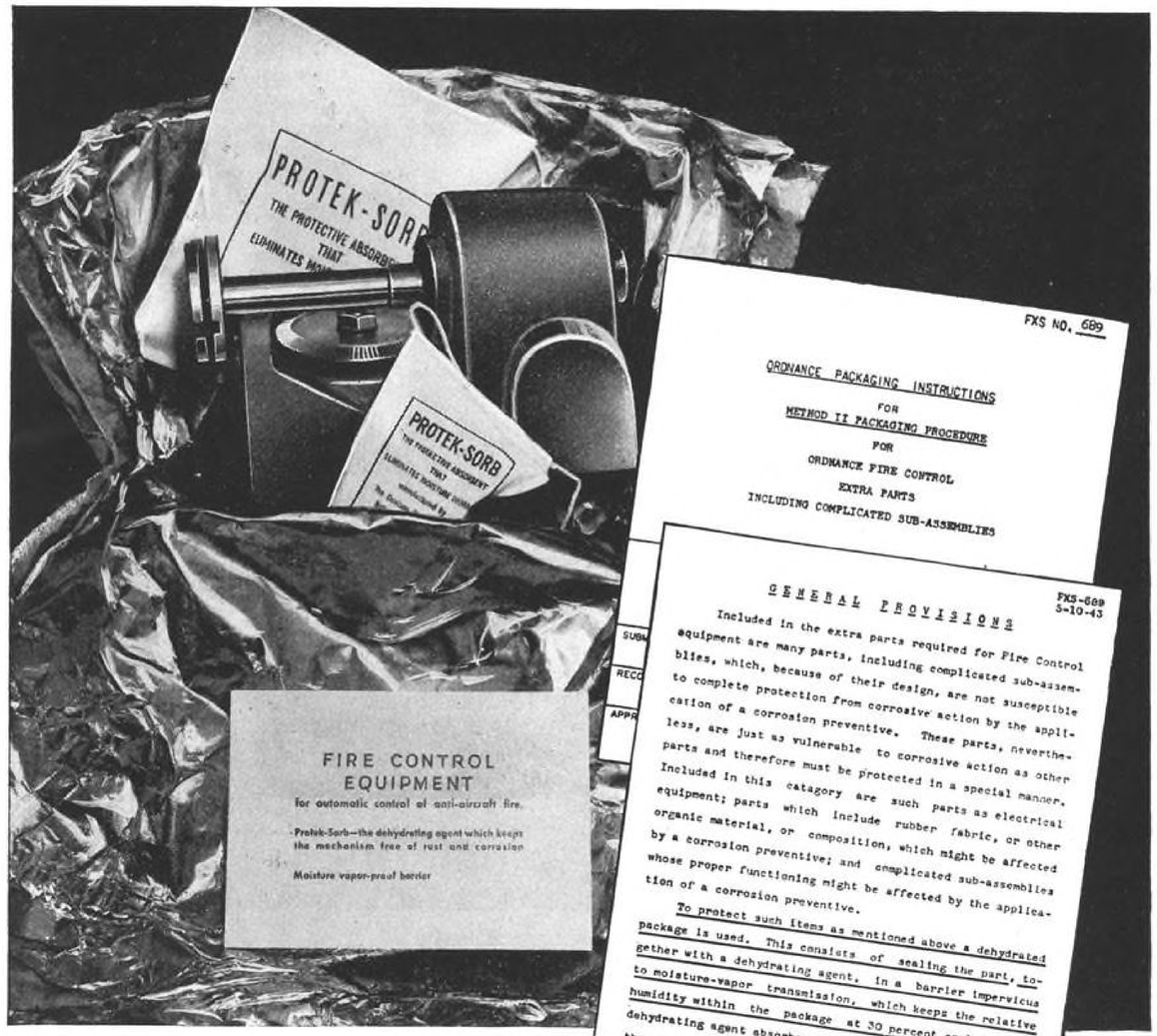
6—WINDSHIELD WIPER MOTOR

Whether the application is a fuel pump or a gun mount, an instrument or a windshield wiper, Delco aircraft electric motors represent an efficient solution to the power problem. Each is designed with special consideration for space and weight limitations—each is built to the high standard of precision which airborne operation demands. Delco Products' engineering and manufacturing experience has been applied in full measure to the satisfying of the accessory motor requirements of the aircraft industry. Delco Products Division, General Motors Corporation, Dayton, Ohio.

EVERY WAR BOND PURCHASE BRINGS VICTORY CLOSER

DELCO MOTORS

DELCO PRODUCTS *DIVISION OF* GENERAL MOTORS



PROTEK-SORB

Ready for Immediate Use—Rust Free and Slush Free—that is what Method II Packaging Procedure assures when Davison Protek-Sorb Silica Gel is used—not only for complicated assemblies but for items from airplane engines to the smallest spring.

Rust and corrosion are not simple actions. Research has found that rust may be likened to a sore. Slushing may cover the sore and aggravate it. Davison Protek-Sorb Silica Gel removes the very cause of rust and corrosion—moisture vapor.

THE DAVISON CHEMICAL CORPORATION

BALTIMORE 3, MARYLAND

Progress through Chemistry



NICKEL AIDS THE CONSTRUCTION INDUSTRY

to KEEP 'EM WORKING!

Engineers who design construction equipment can take pride in the construction industry's greatest achievement...its part in building America's "Arsenal of Democracy."

For they contributed to that amazing success, even long before the war started. They designed the tools with which the job was done...found ways to make equipment durable, and thus prevented many a breakdown of machinery at this critical time when nothing must interfere with the drive toward Victory.

Familiar to them, as a means of giving longer life to construction equipment, is the widespread use of Nickel Alloys. Those engineers have learned from long experience that Nickel imparts toughness, strength, and corrosion resistance to ferrous and non-ferrous metals, and thus assures improved performance under the most severe conditions.

Among them, as with men in many other industries, the saying is that "a little Nickel goes a long way" toward increasing dependability of machine parts—from gears to scraper blades, from dipper teeth to crusher rolls.

The experience of contractors, engineers, and machine operators in the field supports this conviction of the designing engineers...proves that the products of leading manufacturers stand up longer under the stress of exacting service.

It has been the privilege of INCO engineers and metallurgists to cooperate with the construction industry for many years. To men in all industries who desire assistance in the selection, abrication, and heat treatment of ferrous and non-ferrous alloys, the International Nickel Company cordially extends an offer of counsel and data.

New Catalog Index

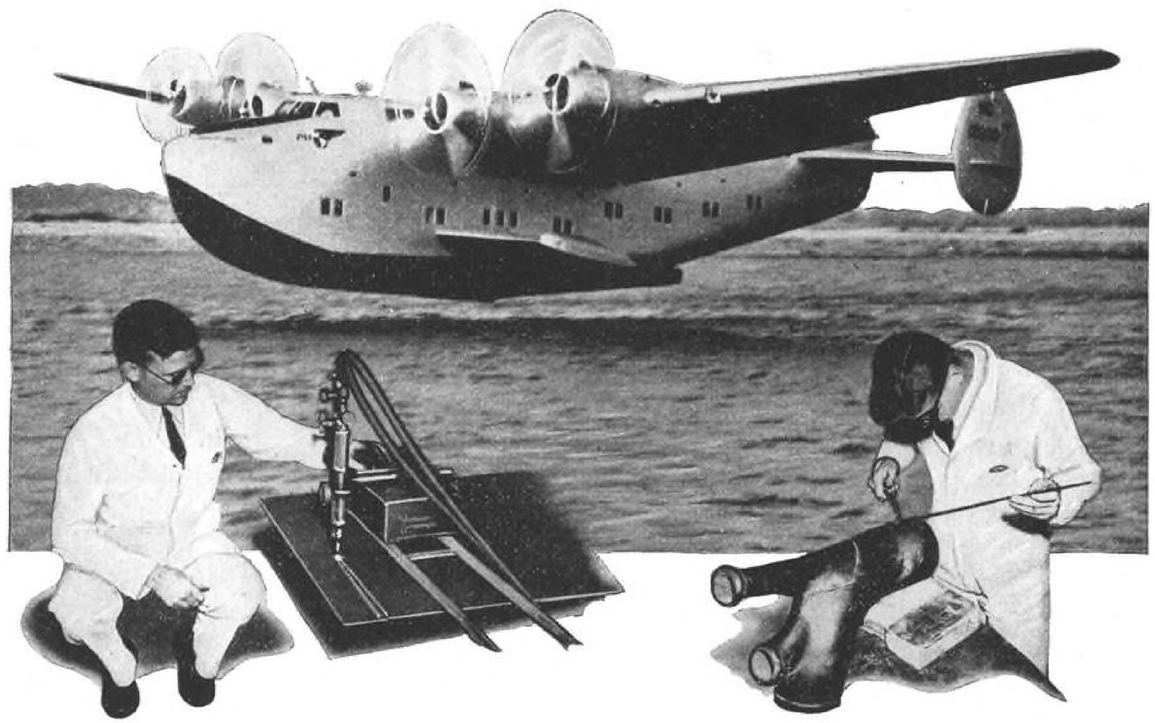
New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects—from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?



* Nickel *

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York 5, N. Y.*

Landing IN HAWAII ON SCHEDULE...



HELPED BY MODERN MAINTENANCE TOOLS

Gliding down to safe landings at many distant ports, the big flying Clippers of Pan American Airways swiftly deliver cargoes and passengers vital to the United Nations' cause. Long distance journeys are routine flights, and skillful maintenance keeps the Clippers superbly conditioned for their gruelling job.

Though wear and tear are unavoidable, costly delays in Pan American's schedules are held to a minimum. Repairs that require precision and speed are completed quickly—and Airco oxy-acetylene cutting machines and welding torches play an important part.

This use of Airco welding and cutting apparatus for maintenance is just one of many ways in which Air Reduction is serving the aviation industry. For instance, Airco oxygen regulators aid stratosphere flying . . . Airco regulators control air or gas pressures in landing gear and in hydraulic systems . . . Airco and Wilson electric welding equipment speed construction of sturdy jigs and fixtures in airplane plants . . . and Airco gas welding and cutting torches play a leading part in the manufacture of numerous aircraft parts.

Through these products and through its Research and Field Engineering Service, Air Reduction is helping to facilitate aircraft operation, maintenance, and production. For additional information, or for technical aid on any use of Airco products, write your nearest Air Reduction office.

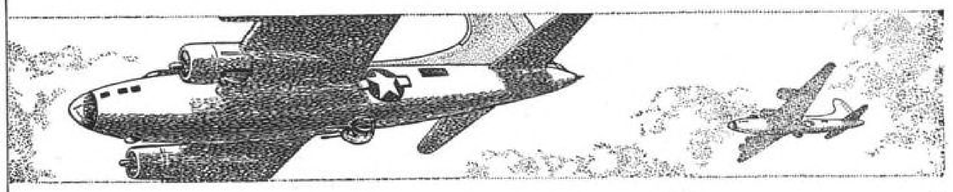
BUY U. S.
WAR BONDS

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WILSON WELDER & METALS CO., INC.

AIRCO **AIR REDUCTION**
60 EAST 42nd STREET NEW YORK 17, N. Y.

OXYGEN, ACETYLENE AND OTHER ATMOSPHERIC GASES • GAS WELDING AND CUTTING APPARATUS • CALCIUM CARBIDE
ARC WELDING MACHINES AND SUPPLIES • CARBON DIOXIDE • "DRY ICE" • ANAESTHETIC AND THERAPEUTIC GASES AND APPARATUS

WORTHINGTON
AIRFIELD
"GRASS BLITZER"



keeps today's huge airfields in "fighting trim"



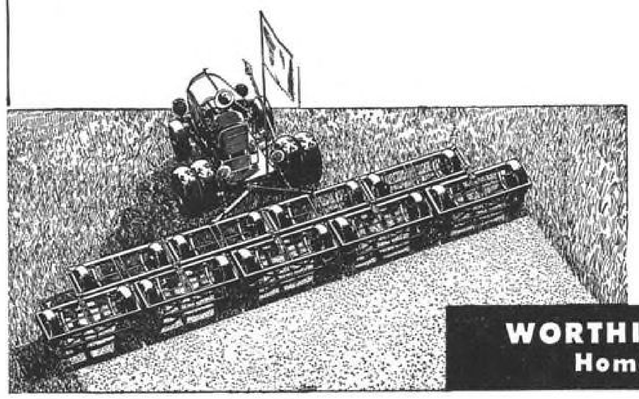
Airfields, like fighters and bombers, must be kept in "fighting trim." The turf must be cut regularly — experts advise 10 to 15 times a season depending on the climate — to assure the best and safest take-off and landing conditions. And just as speed in flying fighters and bombers is all-important today . . . so is speed a vital necessity in mowing airfields.

Speed and efficiency . . . the reasons the Worthington Airfield "Grass Blitzer" is the only gang mower being purchased today for use on the airfields of the armed forces. Look at these figures . . . they speak for themselves:

The "Grass Blitzer", developed by experts in mowing to meet exacting airfield requirements, cuts an average of 300 acres per 8-hour day, more than three times the cutting capacity of any other combination tractor and gang mower now available. It's a revolutionary type of mower, a 9-gang unit that cuts a wide 21.1 foot swath.

And especially important, the "Grass Blitzer" can be operated successfully with any make of tractor or military vehicle available at any airfield . . . yes, even a Jeep!

You can count on the Worthington "Grass Blitzer" to solve your mowing and maintenance problems. 30 years' experience have given our organization the background and knowledge to produce mowing equipment for keeping today's huge airfields in condition, to "keep 'em flying" . . . and attacking.

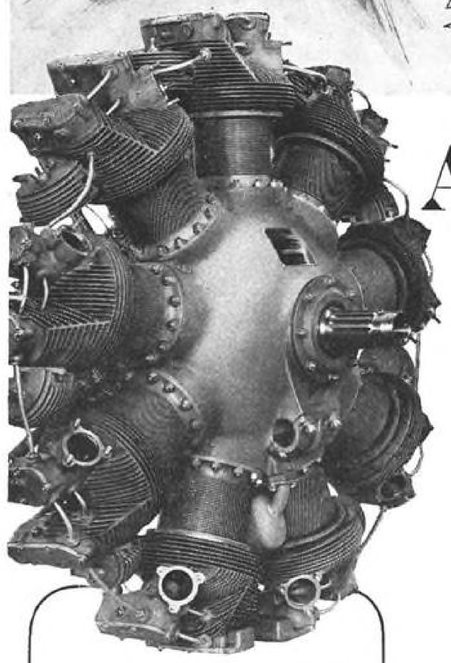




Since July 26th the Army-Navy "E" pennant has been flying over our plant . . . a tribute from the armed forces to our employees, to our suppliers and to our customers without whose wholehearted cooperation our full-out wartime production would not be possible.

WORTHINGTON MOWER COMPANY
Home Office: Stroudsburg, Pa.





All Safe - - - - - - - -

And happy words they are when hard luck and nature combine and a plane and its precious cargo makes a forced landing. The complete elimination of all power plant and fuel fire hazard will save precious lives and equipment. With the Guiberson radial air-cooled diesel engine, using fuel that will not burn even when exposed to open flame, there can be no fire hazard from broken fuel lines or by fumes ignited by hot metal or spark. Family flying must be *safe* flying, and *safe* flying must be *fire-safe*. Guiberson engineers are ready to fit America's radial air-cooled diesel engine to the power plant needs of private and commercial aviation of tomorrow.

FIRE-SAFE
POWER IN THE AIR!

- No Fire Hazard
- Lower Fuel Consumption
- Increased Cruising Range
- Greater Stamina
- Dependable Operation
- Instant Response to the Throttle
- No Ignition System
- Lower Cost of Fuel
- Constant Torque at all Speeds
- No Radio Interference

AMERICA'S ONLY RADIAL AIR-COOLED DIESEL ENGINE

SAFE THAN SORRY — GUIBERSON — BETTER BE

ESTABLISHED 1919

Guiberson U.S.A.
THE GUIBERSON CORPORATION
GUIBERSON DIESEL ENGINE COMPANY
DALLAS, TEXAS



Pittsburgh's Broad Experience Helps Solve Vital Aircraft Finishing Problems

THE inspection of planes that have seen action on the fighting fronts has emphasized the importance of aircraft finishes. Their job is to provide *dependable protection* under the most difficult service conditions.

In solving the many finishing problems that have arisen, Pittsburgh's wide experience—accumulated during years of painstaking research—has been of unestimable assistance to airplane manufacturers. Thanks to our technical staff's specialized knowledge of aircraft finishes, it has been possible in many instances to improve previous standards of quality and performance.

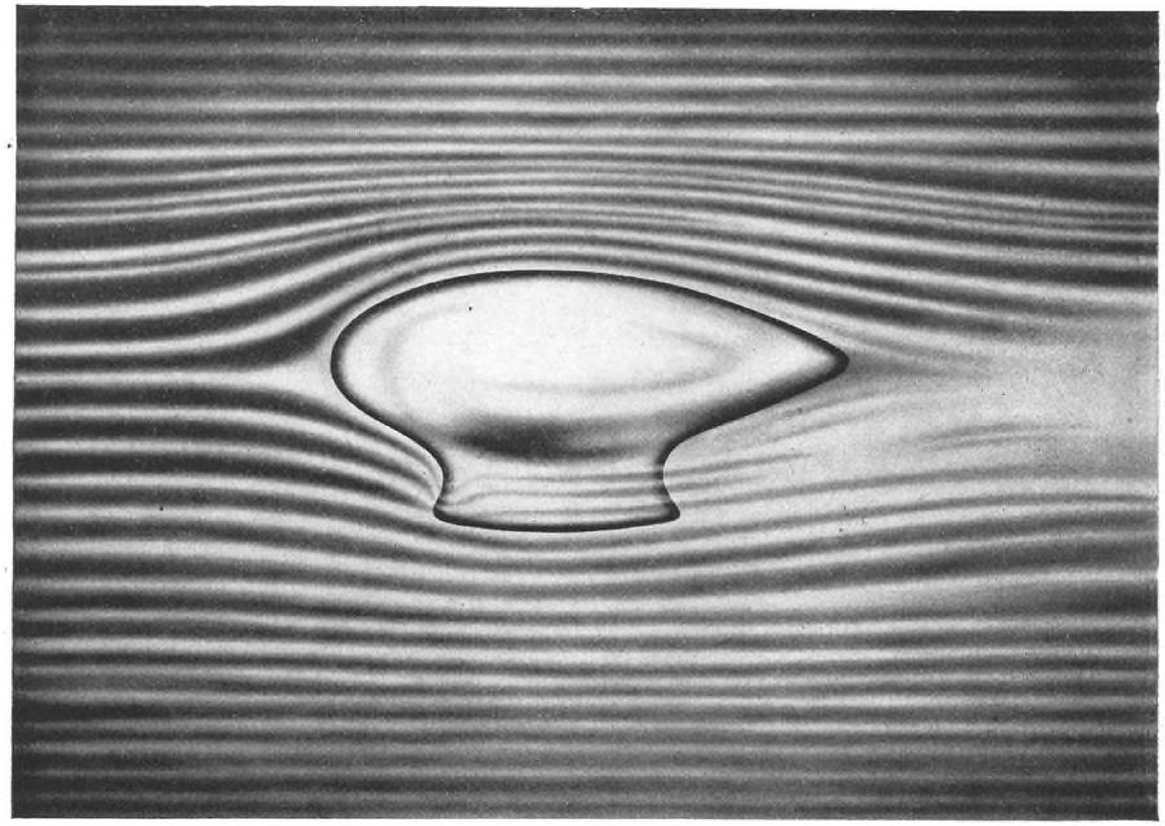
Today, a vast gallonage of Pittsburgh aircraft finishes is being supplied to the airplane industry. In every one of these formulas we endeavor to put *plus* over minimum requirements.

FREE ADVISORY SERVICE: Pittsburgh maintains a force whose specialty is solving aircraft finishing problems. Whenever you need help, get in touch with us. One of our technical men is available for consultation. Phone or write to your nearest office.

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PITTSBURGH *Industrial* **FINISHES**

PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS



Streamlined!

THE principles of streamlining are clearly evident in every speedy bird and fish. Yet thousands of years passed before man perceived these principles and applied them to boats and vehicles. With the high-speed airplane, streamlining came into its own. Exposed surfaces began to be scientifically shaped and finished so that the air-stream would flow around them with least resistance, less drag. Less drag, of course, means higher efficiency, more speed. In a combat ship it may mean the difference between life and death.

Smoke tunnel tests, as illustrated above, guide the engineers in the development of streamlining to reduce drag and turbulence. When loop antennas were first used on aircraft, flying speeds were low—the relatively high drag of an open annular (doughnut) loop was unimportant. As speeds increased, this drag became a serious handicap. Realizing the gravity of this problem, RCA engineers early in 1935 began tests on a streamlined housing with an internal loop. Today, wind-tunnel tests show that at very high speeds, an RCA streamlined loop has an extremely small drag. The loop can be turned freely without affecting the aerodynamics of the plane. Accurate bearings can be taken; remote control is simplified.

RCA Aviation Radio Equipment is the net result of engineering initiative, ingenuity, and exhaustive research at every stage of theory, design, and manufacture.

BUY WAR BONDS

RCA

RCA AVIATION RADIO

Radio Corporation of America, Camden, N. J.



Photograph taken at Sperry Gyro-Compass School

The United Nations go to school

THE OWNERS of those hats are learning about the Sperry Gyro-Compass the practical way. These representatives of the United Nations are seeing it in action in the Sperry Gyro-Compass School.

Many of the men who own those hats will be on convoy duty soon. They already know the risks of submarine warfare and surface contact. They know that lighthouses are dark these perilous nights, that radio beacons are silent, lightships are gone, weather reports no longer available, and even the use of radio communications rigidly limited.

And they know they may sail in prefabricated hulls built under conditions involving immense variation in residual magnetism. Their cargoes may be highly magnetic and their ships almost certain to be equipped with degaussing apparatus to render ineffective the sensitive magnetic mines that lurk in their path.

These factors spell the need of attaining absolute precision in navigation and call for navigation equipment that is impervious to profound and diverse magnetic influences.

That is why these sea-going men are learning about the Sperry Gyro-Compass and why it is more essential than ever in war time. In the course of their study, they learn too that the substitution of electronic circuits* for roller contacts in the follow-up system of the new compass assures even greater reliability with less care and maintenance than before.

When these men pick up their hats for the last time in the Sperry Gyro-Compass School and board their ships, it will be with full knowledge of and confidence in the Sperry Gyro-Compass.

* The Sperry electronic Gyro-Compass is sometimes called the Sperry *Gyrotronic* (registered trade-mark) Compass.

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GYROSCOPE COMPANY, INC.
Brooklyn, New York
Division of the Sperry Corporation



IRC TYPE MP RESISTORS

Keeping America's newest broadcasting F M and television transmitters operating with a minimum of interruption or distortion is a challenging job. There's no room for chance with thousands of dollars of air-time and talent services at stake. To make certain that transmitters and control instruments will function perfectly under their full power loads—often running to 50 kilowatts—daily tune-up tests at off-time periods have become standard practice. But to throw this unbridled wattage out over the regular antenna could conceivably cause air-signal havoc . . . squeals . . . crashes . . . shot noises.

So, one of the early F M and television problems faced by broadcast engineers was the development of a dummy antenna simulating the high frequency characteristics of the regular antenna, in order to obtain informative and accurate check-readings.

ANOTHER IRC APPLICATION

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Tests indicate that water-cooling at tap pressure increases their rating by as much as 90 times.

If resistances will play a part in your post-war products, consult I R C. You'll obtain unbiased engineering counsel, for I R C makes more types of resistors in more shapes for more applications than any other manufacturer in the world.

ARMY E NAVY

Proudly we fly the Army-Navy E flag with *two* white stars . . . symbol of maintained excellence in production of war materiel.

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Dept. C · 401 N. Broad Street · Philadelphia 8, Pa.

PREFERRED FOR PERFORMANCE · IRC · FIXED & VARIABLE RESISTORS



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we are proud to say, have helped to beat the enemy SAND. Special types of Vokes Air, Oil and Fuel Oil Filters were demanded, produced and did their job. In countries where sand is a menace to all machinery Vokes Filters prove invaluable in all industries.

Appalling Conditions ! VOKES tackled this problem . . .

On the right is shown the actual filter element of a Vokes Air Filter for Aircraft. It traps dust particles down to 0.00004 in. dia., upholding the Vokes standard for their filters, 99.9% filtration efficiency.

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THE ARTHUR S. LEITCH CO. LTD., 1123 BAY STREET, TORONTO, CANADA
E. CANTIN, 101 PARK AVE., NEW YORK



Thinking Homeward

Christmas 1943

In steaming tropical jungles, on beaches hallowed by American lives, in snow-covered dugouts, in submarines, on battleships, in cloud-banked skies tenanted by lurking enemy planes, men will be thinking of home.

During this Christmas season, we too will be remembering—and our thoughts will meet yours across the miles. Before another Christmas, we hope the grim battle will be won . . . so that you who are sacrificing so much for your country may return to your homes and families . . . to the professions and jobs you left.

With victory will come new responsibilities for us all—rebuilding shattered lands, raising new cities from the ashes of the old, constructing new homes and manufacturing new products for millions of people at home and abroad. There will be work for *you* and for *us* in the post-war period. Your productive capacity and leadership will be needed in the reconstruction of a battle-weary world.

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If you have a problem in remote control or power transmission, get in touch with us. We have the answers to a lot of questions in our files.

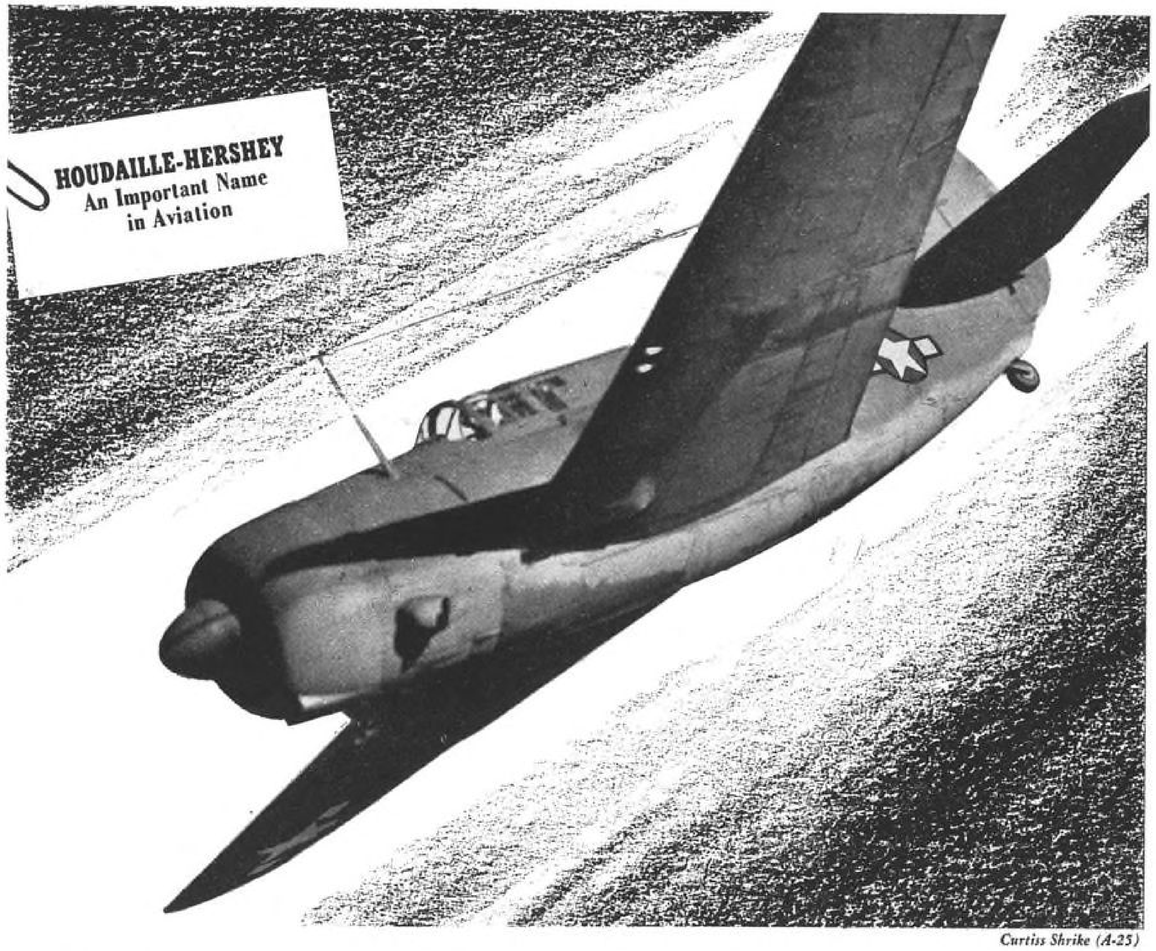
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FLEXIBLE SHAFTING

FOR REMOTE CONTROL AND POWER TRANSMISSION



Curtiss Shrike (A-25)

Where is Houdaille in this picture?

Where? Out of sight—as it should be. For Houdaille's contribution to this newest Army dive-bomber—the swift, deadly Curtiss Shrike—is the all-important retractable landing gear and tail wheel.

It takes engineering and manufacturing "know-how" of highest order to produce these rugged hydraulic mechanisms. Not only must they survive the strains of high-speed landings and take-offs but they must function infallibly when wheels are raised or lowered.

Behind Houdaille products is more than a quarter century of experience which today is producing equipment *in quantity* for many types of war planes.

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When the going gets TOUGH

● Quality in Sleeve Type Bearings is never determined by appearance. It's the long hours of satisfactory operation . . . the ability to withstand overloads . . . to keep on performing under all conditions that indicates real merit. Johnson Bronze Sleeve Type Bearings give you this type of service—and more.

There's a mighty good reason for this quality. For more than thirty-five years we have specialized on the manufacture of ALL types of Sleeve Bearings. During this time we have assisted thousands of concerns making all types of products to select the *correct* bearings for each application. This wide experience . . . this accumulated knowledge has enabled us to produce Aircraft Bearings that deliver a full measure of power efficiently.

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REG. U. S. PAT. OFF.

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"Unbrako" Internal Wrenching Bolts are being manufactured by our largest and best equipped department, where only the most highly skilled workers experienced in making precision aircraft engine parts are employed. The bolts are extremely accurate, being made to unusually close tolerances. They are now being used by some of the largest aircraft manufacturers.

Backed by the "Unbrako" name and reputation, our Internal Wrenching Bolts can be bought and used with all the confidence inspired by actual performance of the vital aircraft engine parts produced by us.

SAVE SPACE WEIGHT MATERIAL

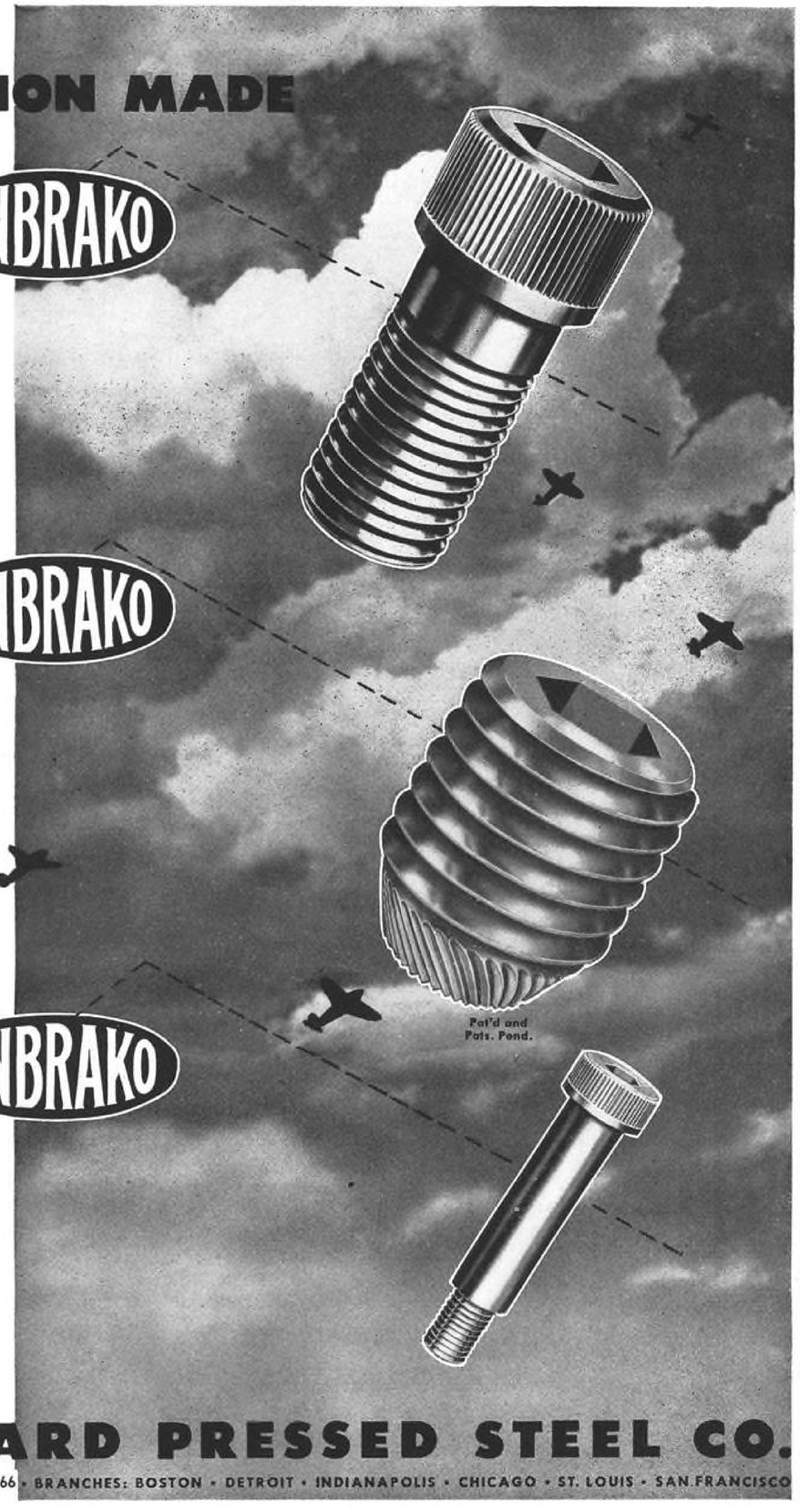
Because the "Unbrako" Wrenching Bolt is applied with an *internal* wrench, it can be jammed right into tight places as could never be done with the ordinary hex head bolts requiring a bulky external wrench to apply. The "Unbrako", therefore, saves space, material and weight — greatly facilitates compact designs.

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PRECISION MADE



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KNURLED SOCKET HEAD CAP SCREWS

The knurled heads prevent time-wasting finger slip and lost motion—help speed production. Knurling also permits locking after countersinking. Sizes: No. 4 to 1½" diameter.

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Maintenance, time and money savers. When tightened as usual, the knurls dig in and lock the screws in place so they positively won't work loose under vibration. Sizes: No. 4 to 1½" diameter.

UNBRAKO

SOCKET HEAD STRIPPER BOLTS

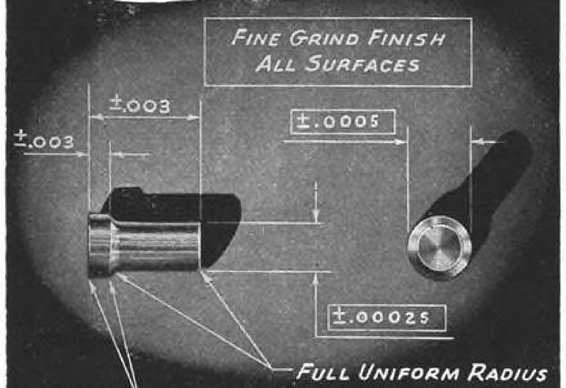
with accurately ground bodies. Available with knurled heads, as shown. Great variety of sizes immediately available from stock.

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IT'S a critical small life-and-death part. Tolerances are extremely close, perfect accuracy is demanded for free motion without binding. It's stainless steel, so smoothly finished gases can't corrode it. By an unusual set-up a corner, two radii and two diameters are precision ground *in one operation*. Continuous inspection, twice by Comparator, makes sure of flawless meeting of specifications. When you need ingenious engineering to produce difficult small parts on a quantity basis, ask Western. Complete facilities for screw machine work, heat-treating and secondary operations. We're busy but we might be able to help — write us today.



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SAVE VITAL MAN-POWER

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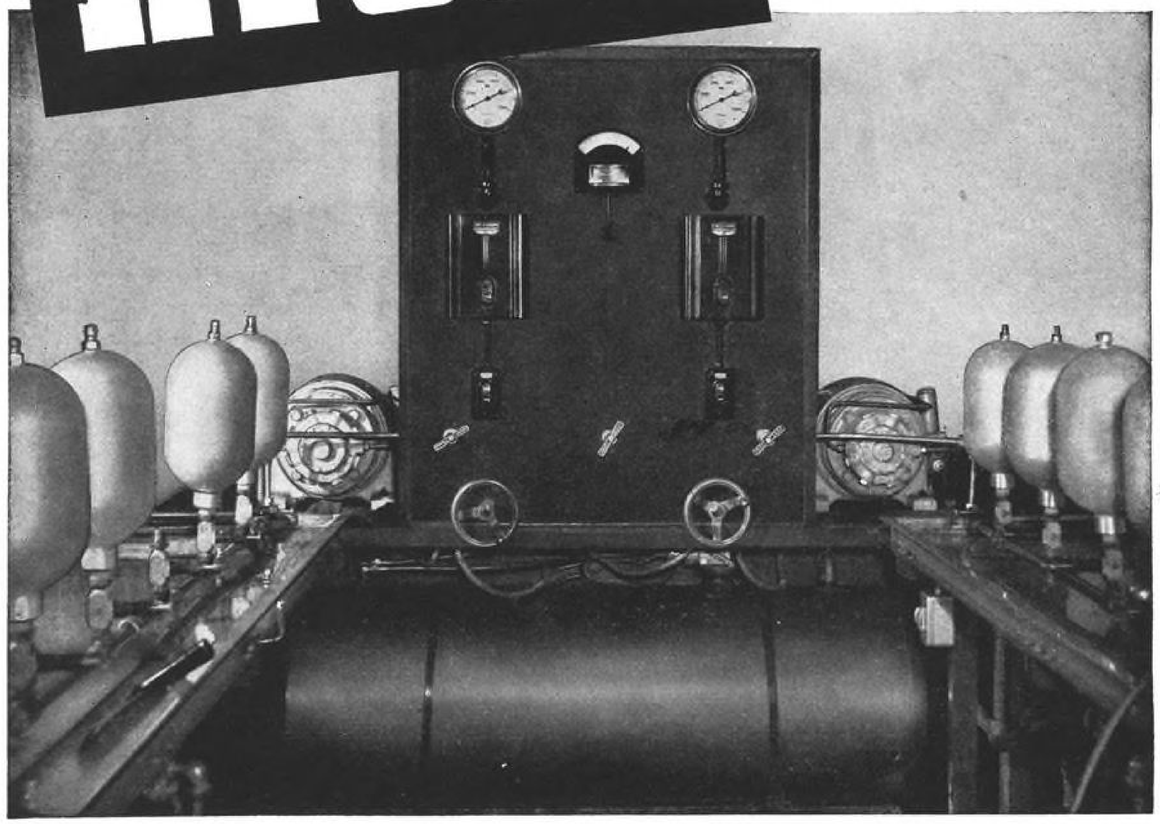
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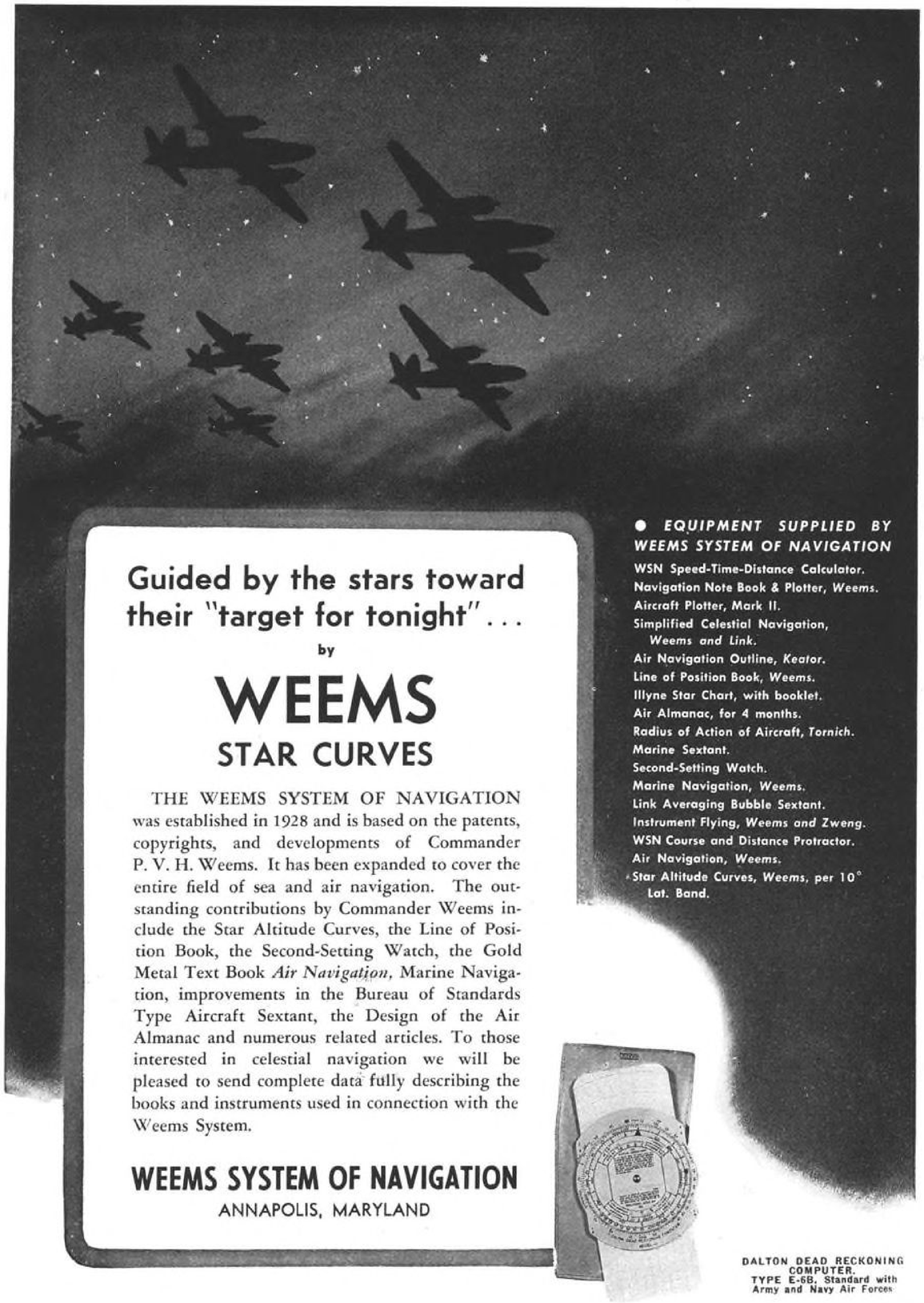
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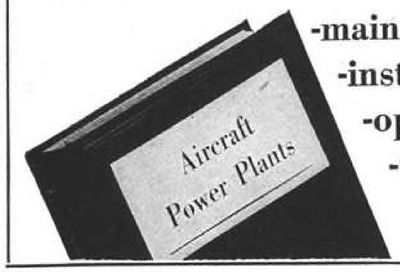
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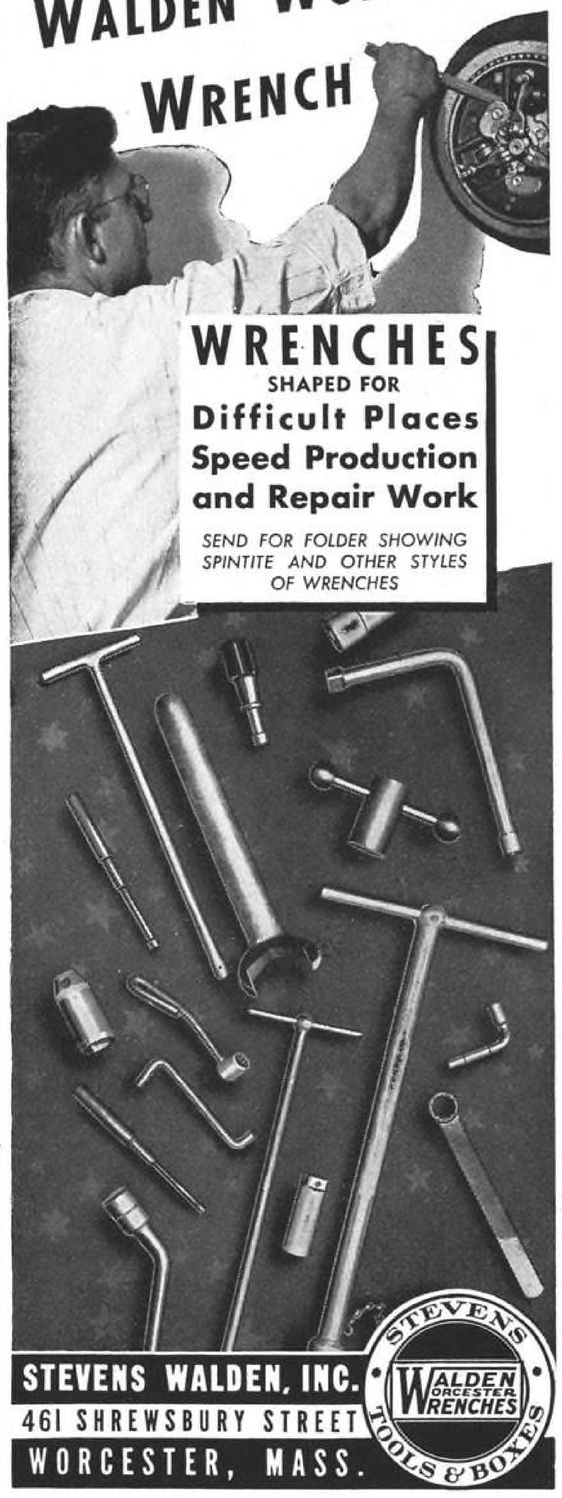
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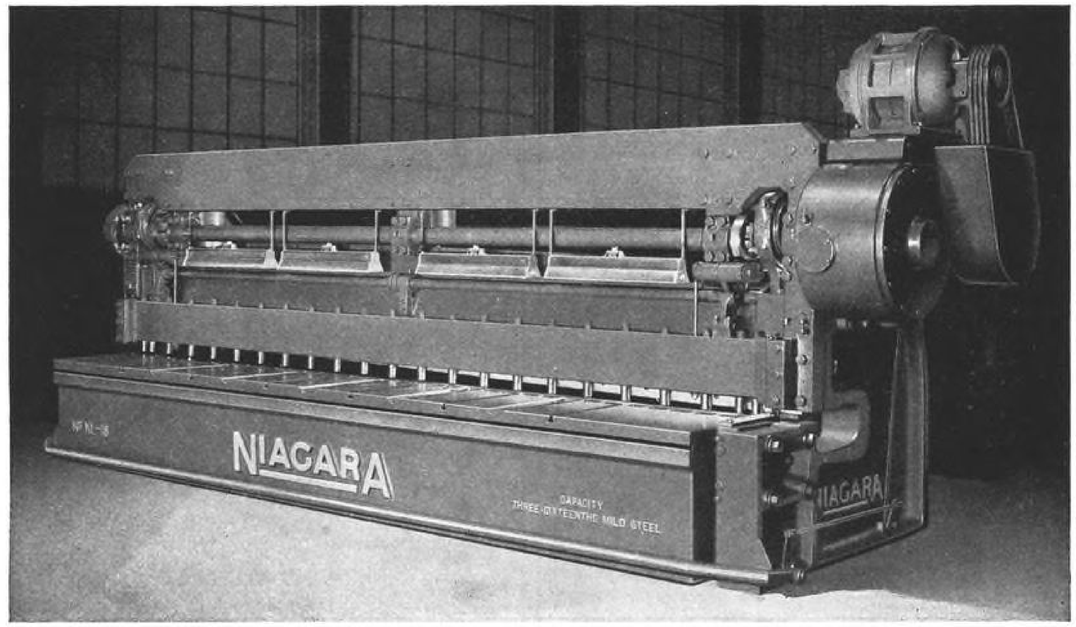
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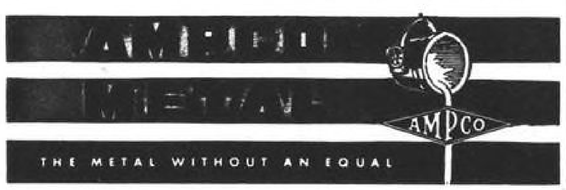
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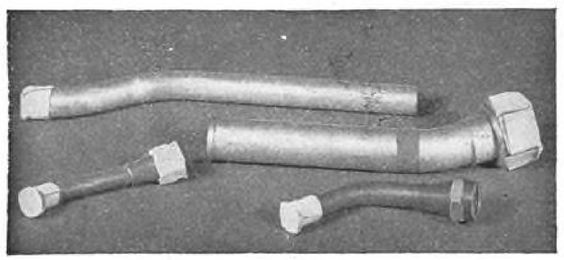
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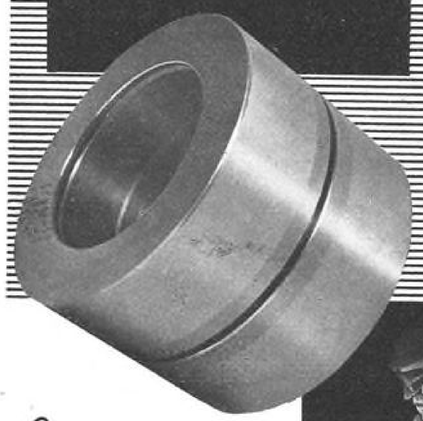
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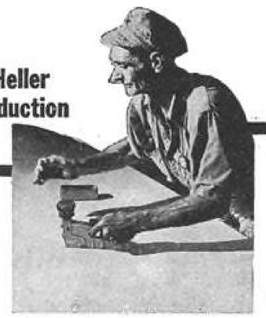
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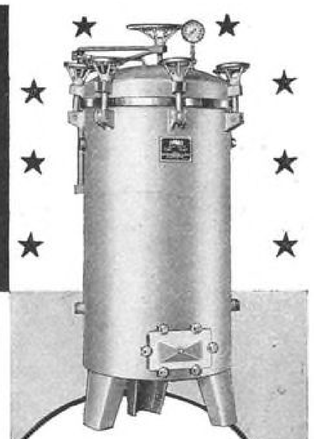


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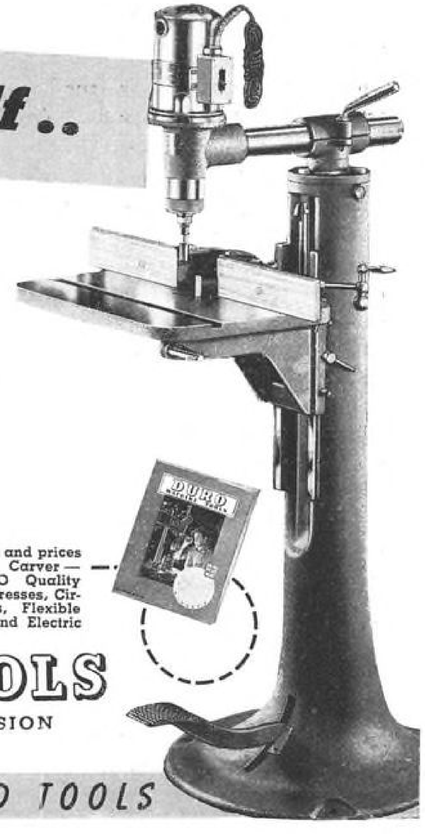
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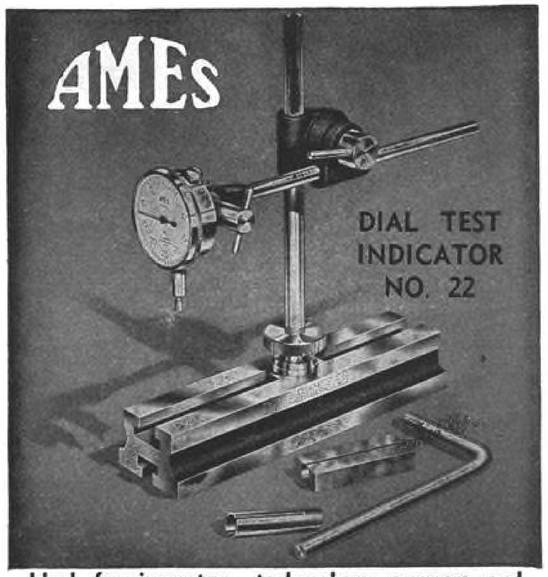
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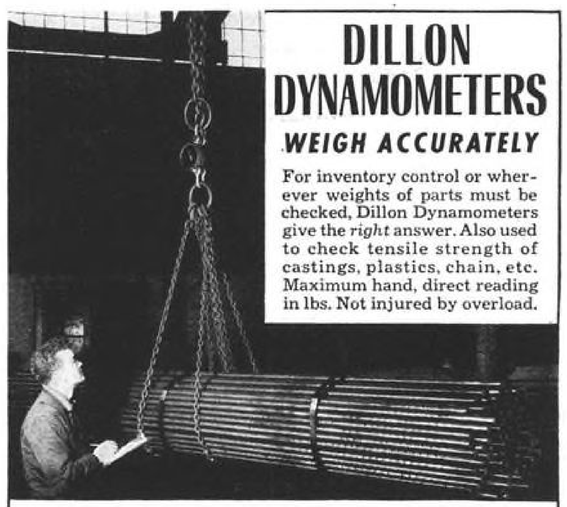
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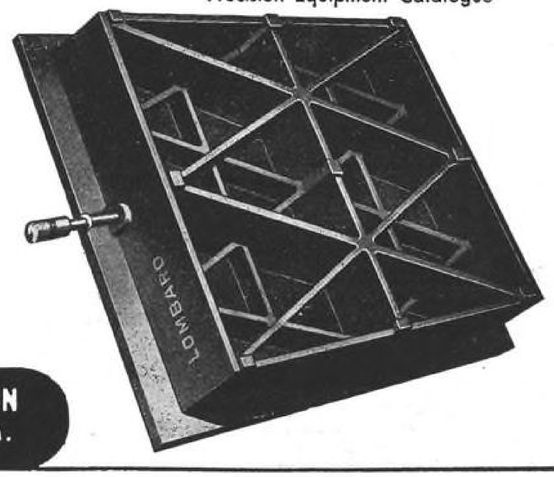
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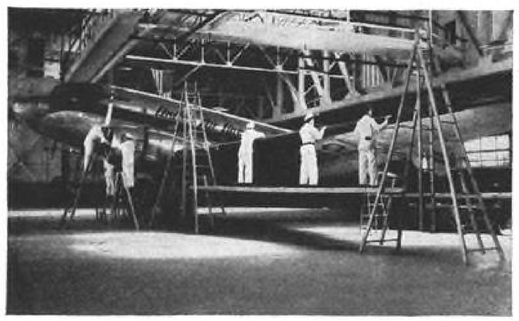
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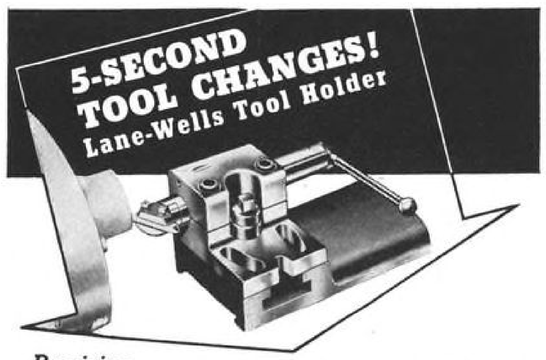
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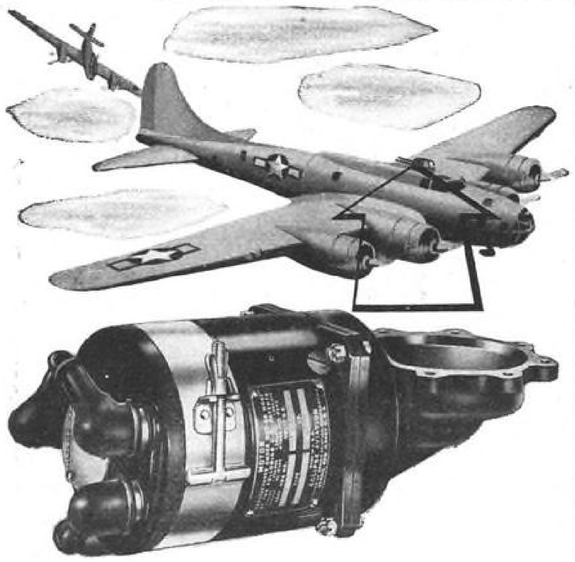
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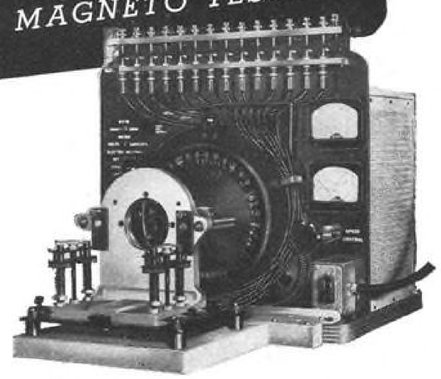
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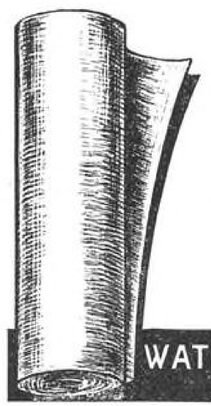
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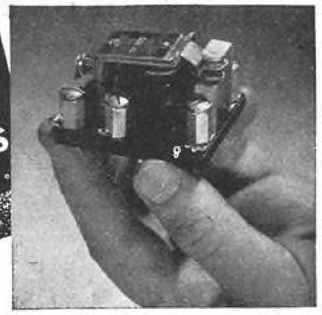
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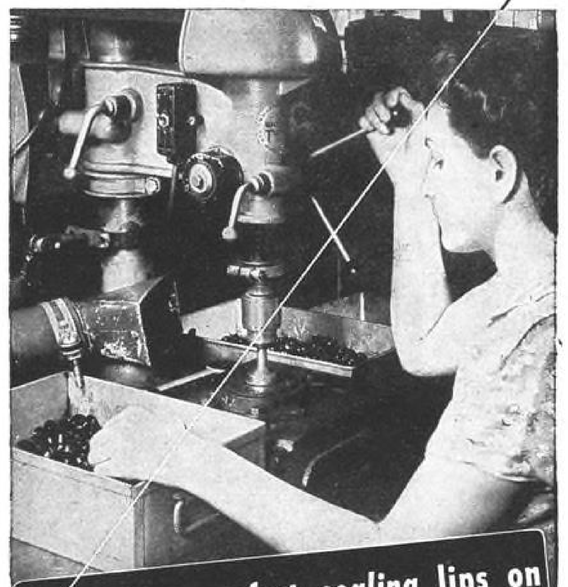
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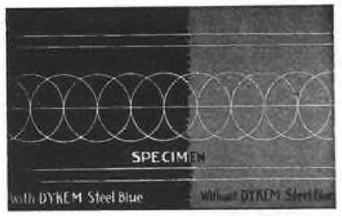
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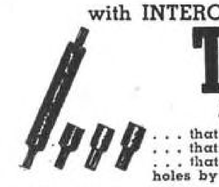
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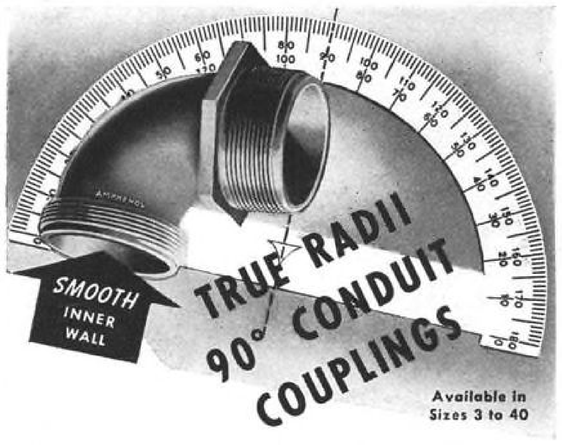
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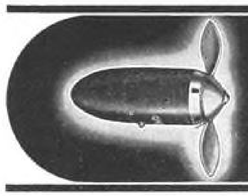


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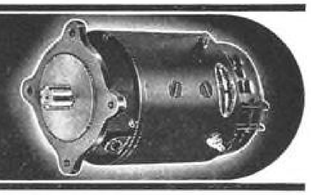
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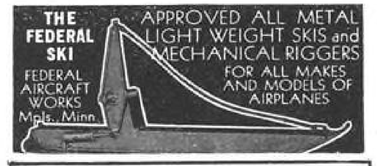
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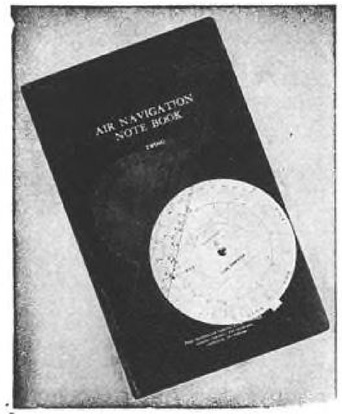
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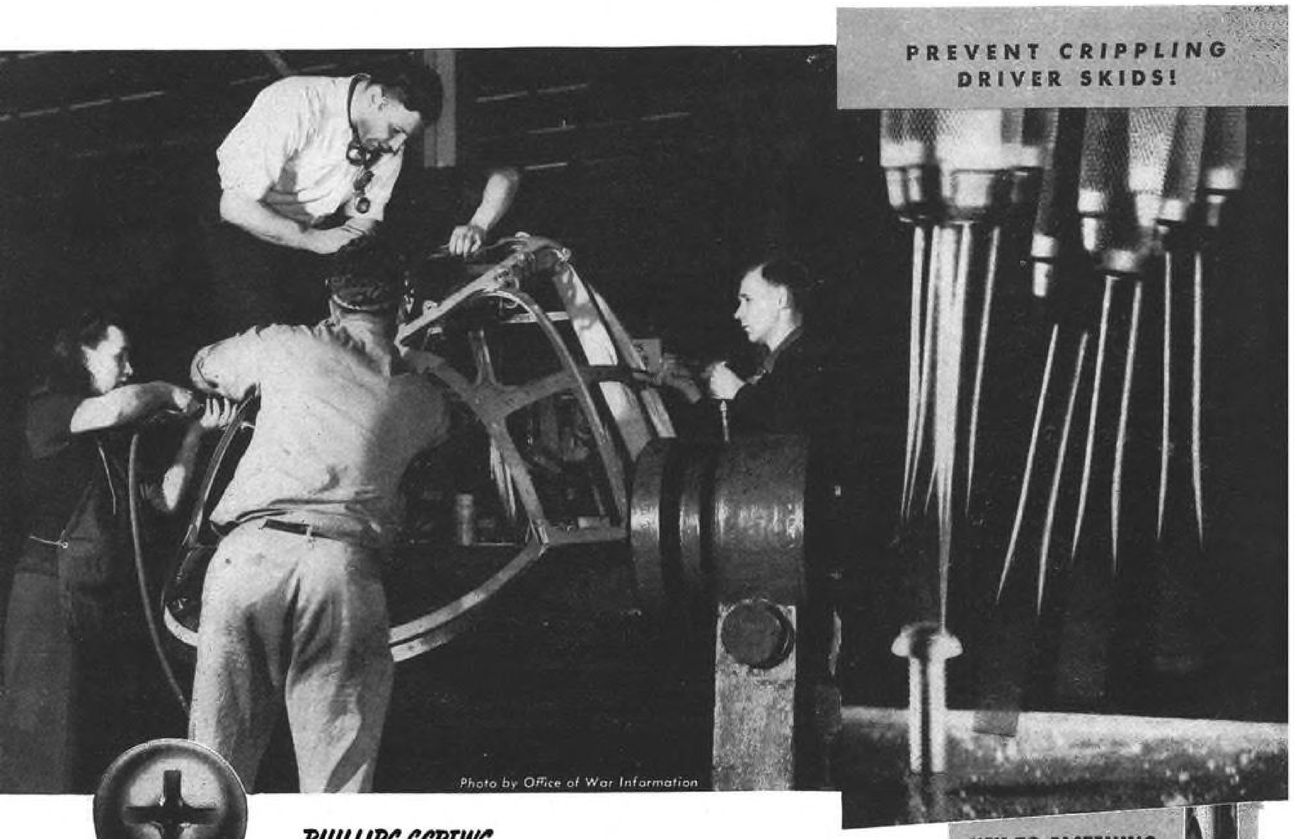
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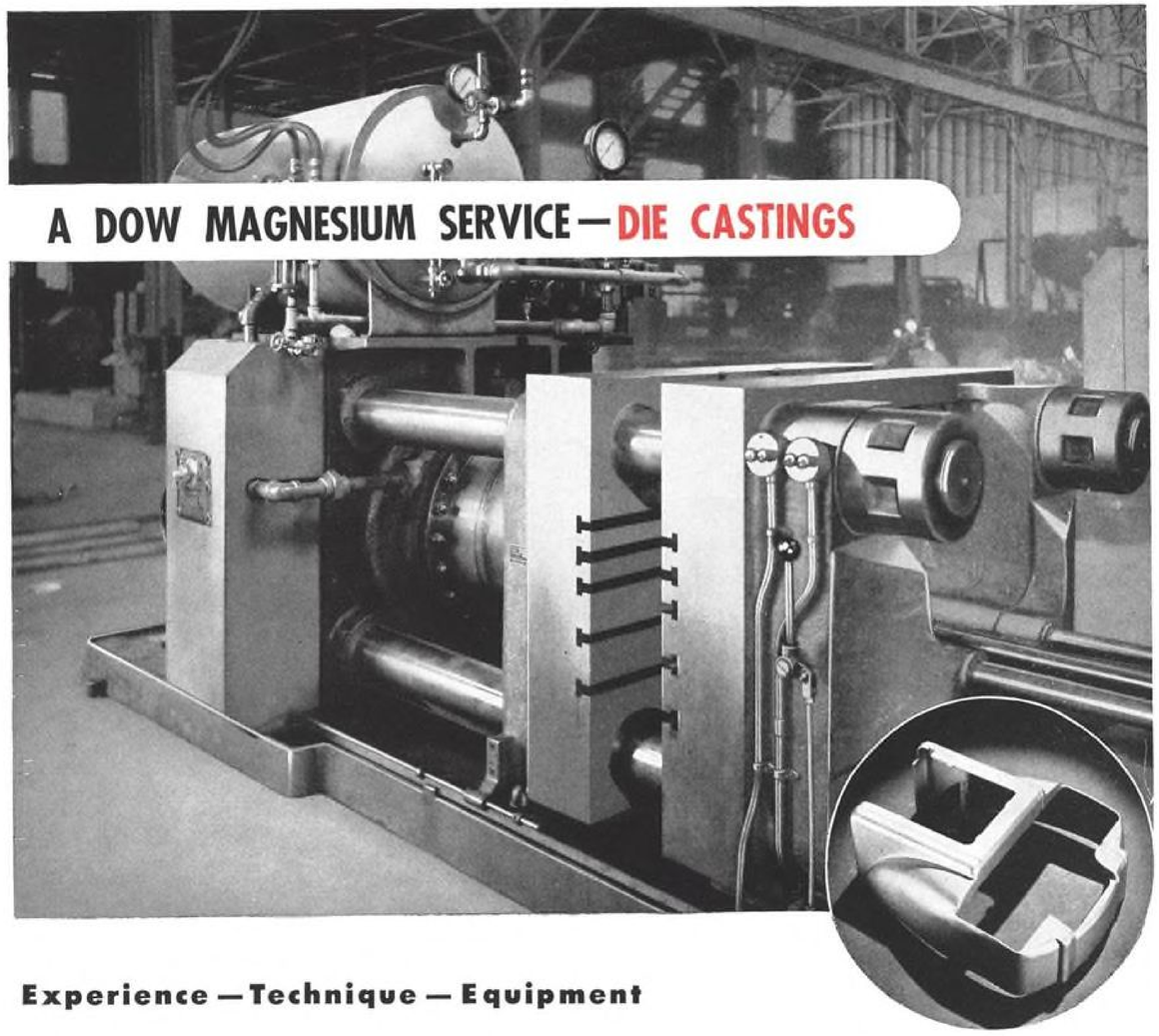
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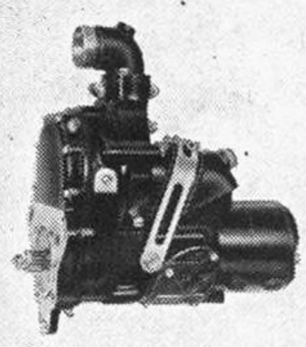


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